FLUKE®

190 Series III

ScopeMeter® Test Tool

Models 190-xxx-III/190M-x-III/MDA-550-III

Service Manual

BC
3/2022 (English)

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Table of Contents

Title	Page
Introduction	1
Contact Fluke	1
Safety Information	1
Static Awareness	2
Specifications	3
Performance Verification	3
Equipment Requirements for Verification	4
General Operation Instructions	4
Reset the Test Tool	4
Menu Navigation	5
Standard Test Tool Setup	5
Scope Input A, B, C, D Tests	7
Input A, B, C, D Vertical Accuracy Test	7
Input A, B, C, D DC Voltage Accuracy Test	10
Input A, B, C, D AC Voltage Accuracy Test (LF)	12
Input A, B, C, D AC-Coupled Lower Frequency Test	15
Input A, B, C, D Peak Measurements Test	16
Input A, B, C, D Frequency Measurement Accuracy Test	17
Input A&B / C&D Phase Measurements Test	18
Time Base Test	19
Input A, B, C, D Trigger Sensitivity Test	20
Input A AC Voltage Accuracy (HF) and Bandwidth Test	24
Input B AC Voltage Accuracy (HF) and Bandwidth Test	25
Input C AC Voltage Accuracy (HF) and Bandwidth Test	26
Input D AC Voltage Accuracy (HF) and Bandwidth Test	27
External Trigger Level Test	28
Meter Tests	29
Meter DC Voltage Accuracy Test	29
Meter AC Voltage Accuracy and Frequency Response Test	30
Continuity Function Test	31
Diode Test Function Test	31
Ohms Measurements Test	31
Probe Calibration Generator Test	33

Calibration Adjustment 34
Calibration Number and Date 34
General Instructions 34
Equipment Required For Calibration 35
Calibration Procedure Steps 35
How to Start the Calibration 36
Display Messages and Key Functions 37
Warming-Up and Pre-Calibration 38
Error Messages 39
Final Calibration 39
Warming-Up 2, Warm-Up Final, and ADC Timing 40
Input A LF-HF Gain 41
Input B LF-HF Gain 41
Input C LF-HF Gain 42
Input D LF-HF Gain 43
Input AB Position (All Models) 44
Input AB LF-HF Gain and Position 45
Input Pos ABCD (AB) Calibration 45
Input ABCD (AB) Noise F FBW Calibration 45
Input AB Volt Gain 46
DMM Calibration 47
Multimeter Meter Zero 47
Multimeter Volt Gain 47
Multimeter Ohm Gain 48
Save Calibration Data and Exit 49
Error messages 54
Probe Calibration 54
Disassembly and Reassembly Procedures 55
Required Tools 55
Remove the Tilt Stand, Hang Strap, and Side Strap 55
Open the Test Tool, Remove the Battery Pack 56
How to Access the Top Side of PCA 57
How to Access the Bottom Side of PCA 57
Access to LCD, Keypad Foil, and Keypad 58
Disassembly Steps 59
Parts List 62
How to Obtain Parts 62
Final Assembly Parts 63
Accessory List 65

Introduction

The ScopeMeter®190 Series III Test Tool (the Product or Test Tool) is a high performance handheld oscilloscope for troubleshooting industrial electrical or electronic systems. The series includes 60, 100, 200, or 500 MHz bandwidth models. The descriptions and instructions in this manual apply to all 190 Series III versions.

Contact Fluke

Fluke Corporation operates worldwide. For local contact information, go to our website: www.fluke.com.

To register your product, or to view, print, or download the latest manual or manual supplement, go to our website.

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Safety Information

General safety information is in the printed *Safety Information* document that ships with the Product and at www.fluke.com. More specific safety information is listed where applicable.

Static Awareness

Semiconductors and integrated circuits can be damaged by electrostatic discharge during handling. This notice explains how to minimize damage to these components.

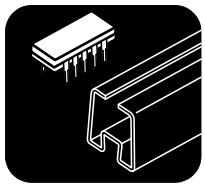
1. Understand the problem.
2. Learn the guidelines for proper handling.
3. Use the proper procedures, packaging, and bench techniques.

Follow these practices to minimize damage to static sensitive parts.

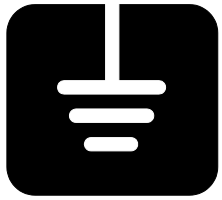
⚠⚠ Warning

To prevent electric shock or personal injury. De-energize the product and all active circuits before opening a product enclosure, touching or handling any PCBs or components.

- Minimize handling.
- Handle static-sensitive parts by non-conductive edges.
- Do not slide static-sensitive components over any surface.
- When removing plug-in assemblies, handle only by non-conductive edges.
- Never touch open-edge connectors except at a static-free work station.



- Keep parts in the original containers until ready for use.
- Use static shielding containers for handling and transport.
- Avoid plastic, vinyl, and polystyrene foam in the work area.



- Handle static-sensitive parts only at a static-free work station.
- Put shorting strips on the edge of the connector to help protect installed static-sensitive parts.
- Use anti-static type solder extraction tools only.
- Use grounded-tip soldering irons only.

Specifications

Complete specifications are at www.fluke.com. See the *190 Series III Product Specifications*.

Performance Verification

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, do not service the Test Tool unless you are qualified to do so. Service described in this manual is to be done only by qualified service personnel.

Table 1 is a list of the available models for the Test Tool.

Table 1. Model Descriptions

Model	Features
190-062-III	Two 60 MHz Scope Inputs (BNC), one Meter Input (banana jack)
190-102-III	Two 100 MHz Scope Inputs (BNC), one Meter Input (banana jack)
190-104-III	Four 100 MHz Scope Inputs (BNC)
190-202-III/190M-2-III	Two 200 MHz Scope Inputs (BNC), one Meter Input (banana jack)
190-204-III/190M-4-III	Four 200 MHz Scope Inputs (BNC)
190-502-III	Two 500 MHz Scope Inputs (BNC), one Meter Input (banana jack)
190-504-III	Four 500 MHz Scope Inputs (BNC)
MDA-550-III	Four 500 MHz Scope Inputs (BNC)

These performance tests are provided to ensure that the Test Tool is in proper operating condition. If the Test Tool fails any of the performance tests, calibration adjustment (see *Calibration Adjustment*) and/or repair is necessary.

The Performance Verification Procedure is based on the specification (see *Specifications*). The values given here are valid for ambient temperatures between 18 °C and 28 °C.

The Performance Verification Procedure is a quick check of all main specifications for the Test Tool. Accuracy of Test Tool specifications not tested is linked to those tested in this verification procedure and is embedded in the Test Tool software. This link is tested extensively for each new software release.

Equipment Requirements for Verification

The primary source instrument used in the verification procedures is the Fluke 5502A. If a 5502A is not available, you can substitute another calibrator as long as it meets the minimum test requirements.

Requirements:

- Fluke 5502A Multi-Product Calibrator, including SC600 Oscilloscope Calibration Option.
- Stackable test leads (4x) as supplied with the 5502A.
- 50 Ω Coax Cables (2x): use Fluke PM9091 (1.5 m, 3/set) and PM9092 (0.5m, 3/set).
- Male BNC to Dual Female BNC adapter (1x), Fluke PM9093/001.
- 50 Ω feed-through termination, always use Fluke TRM50 for Fluke 190-502, 190-504, and MDA-550-III. The TRM50 is included with the purchase of the 190-50x models as a standard.
- Dual Banana Plug to Female BNC Adapter (1x), Fluke PM9081/001.
- Dual Banana Jack to Male BNC Adapter (1x), Fluke PM9082/001.
- 10:1 or 100:1 Voltage Probes as supplied with Test Tool.

General Operation Instructions

Use these general instructions for all tests:

1. Power the Test Tool with the BC190 power adapter. The battery pack must be installed.
2. Allow the specified warm-up period for the 5502A.
3. For each test point, wait for the 5502A to settle.
4. Allow the Test Tool a minimum of 30 minutes to warm up.

One division on the LCD consists of 25 pixels (1 pixel = 0.04 division).

This procedure is set up for all models of the Test Tool. These have either two oscilloscope channels A and B with BNC inputs and a multimeter channel with banana inputs, or four oscilloscope channels. The figures that show the connection between calibrator and Test Tool are universal and also show the connection between the calibrator and a Test Tool with four oscilloscope channels (for example, model 190-204 and 190M-4).

Reset the Test Tool

To reset the Test Tool:

1. Press ⏻ to turn off the Test Tool.
2. Press and hold USER.
3. Press and release ⏻ to turn on the Test Tool.
4. Wait until the Test Tool beeps twice and then release USER.

   Two beeps indicate a successful reset.

Menu Navigation

During verification you must open menus and choose items from the menu.

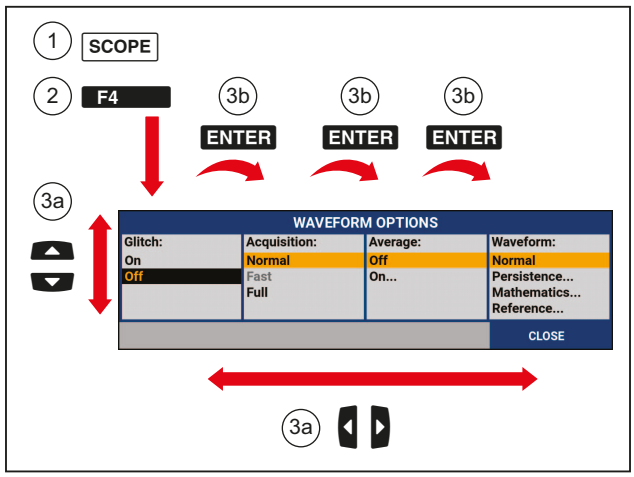
To make choices in a menu:

1. Reset the Test Tool.
2. Open a menu, for example, press SCOPE and press F2 (READING ...).

   The menu shown in Figure 1 opens. A yellow background or yellow characters mark the active functions. If more than one menu group is available, they are separated by a vertical line.
3. Use the cursor keys to highlight the function.
4. Press ENTER to confirm the selection.

   The active function in the next menu group is highlighted. If the confirmation is made in the last (most right) menu group, the menu will close.

Figure 1. Menu Item Selection



Standard Test Tool Setup

Before you start the verification procedure you must define a standard Test Tool setup, for example, SCOPE 1. During verification you will be asked to recall this setup. This defines the initial Test Tool setup for each verification.

Press ENTER to confirm each setting.

Note

The setup steps for channel C and D are only for the 4-channel models.

To create a setup (for example, SCOPE 1):

1. Reset the Test Tool. Input A is ON and other inputs are OFF.
2. Press [B]: INPUT B ON.

   The black text with yellow background indicates the actual settings.
3. Press **F3** to change the PROBE B setting.
4. Select Probe Type: **Voltage | Attenuation: 1:1**.
5. Press [C]: INPUT C ON.
6. Press **F3** to change the PROBE C setting.
7. Select Probe Type: **Voltage | Attenuation: 1:1**.
8. Press [D]: INPUT D ON.
9. Press **F3** to change the PROBE D setting.
10. Select Probe Type: **Voltage | Attenuation: 1:1**.
11. Press [A].

    The inverse text indicates the actual settings.
12. Press **F3** to change the PROBE A setting.
13. Select Probe Type: **Voltage | Attenuation: 1:1**.
14. Press [SCOPE].
15. Press **F1** – READINGS ON.
16. Press **F2** – READING … and select with **F1** – READINGS and use ▲▼ to select:
    a. Reading 1, on A, V dc
    b. Reading 2, on B, V dc
    c. Reading 3, on C, V dc
    d. Reading 4, on D, V dc
17. Press **F4** WAVEFORM OPTIONS and select **Glitch: Off | Acquisition: Normal | Average: Off | Waveform: Normal**.
18. Press **AUTO** to select MANUAL ranging (MANUAL in upper right of display).
19. Press [A]. Use MOVE ▲ and MOVE ▼ to move the Input A ground level (indicated by the zero icon in the left margin) to the center grid line. Do this for all channels.
20. Press **SAVE**.

21. Press F1 SAVE... .
22. Use ▲▼ to select SCREEN+SETUP.
23. Press ENTER.
24. Use ▲▼ to select OK SAVE.

    Remember the name under which the settings are saved (for example, SCOPE 1).
25. Press ENTER to save the settings.
26. Press HOLD RUN to leave the Hold mode.

Scope Input A, B, C, D Tests

Input A, B, C, D Vertical Accuracy Test

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, make sure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool. Dangerous voltages are present on the calibration source and connection cables during these steps.

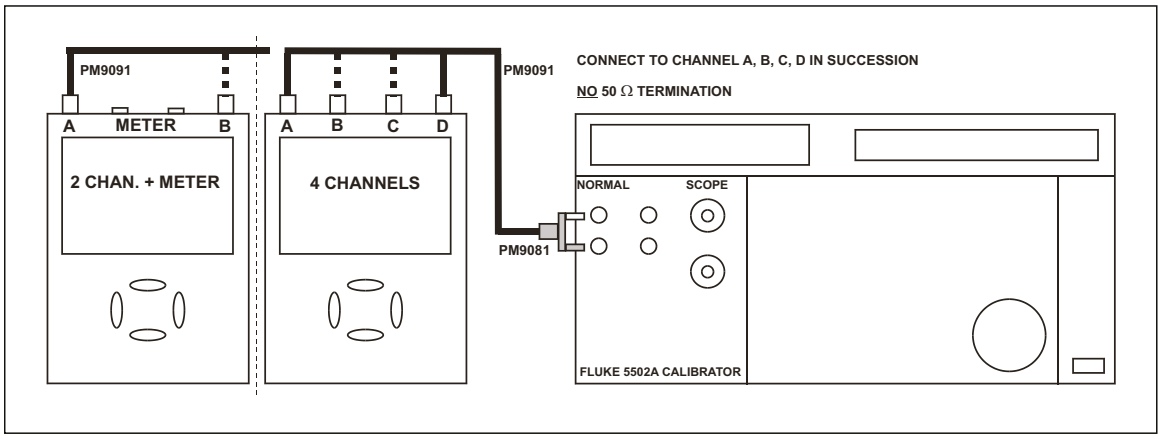
Note

The test steps for channels C and D are only for the 4-channel models.

To test:

1. Connect the Test Tool to the 5502A as shown in Figure 2. The vertical channels A, B, C, and D are checked in succession and one waveform is on the display at a time to facilitate amplitude adjustment.

Figure 2. Test Tool Inputs to 5502A Normal Output



2. Select the Test Tool setup:
   a. Recall the created setup (see *Standard Test Tool Setup*).
   b. Press SAVE, F2 (RECALL) and select **SETUP**.
   c. Press ENTER, select the setup name, and press ENTER to recall the setup.
   d. Press A, press F4 (INPUT A OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the Test Tool.
   e. Press B, press F4 (INPUT B OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the Test Tool.
   f. Press C, press F4 (INPUT C OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the Test Tool.
   g. Press D, press F4 (INPUT D OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the Test Tool.
   h. Press BACK to clear the softkey menu and see the full display.

   Note

   The 10 kHz bandwidth limiter rejects calibrator noise. It does not affect the gain accuracy at a 50 Hz input signal.

3. Press A and use mV RANGE and RANGE V to set the Input A sensitivity range to the first test point in Table 2.
4. Set the 5502A to source the appropriate initial ac voltage.
5. Adjust the 5502A output voltage until the displayed Input A trace amplitude is 6 divisions.
6. Observe the 5502A output voltage and check to see if it is within the range shown under the appropriate column.
7. Continue through the test points.
8. Check channel B, C, and D in succession. Connect channel B, C, or D to 5502A when appropriate.
9. Press TRIGGER and select B as trigger source with F1.
10. Press B, C, or D to assign vertical range to channel B, C, or D.
11. Observe the 5502A output voltage and check to see if it is within range.
12. When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 2. Vertical Accuracy Verification Points

Range	Initial 5502A Setting V ac, sine, 50 Hz	Allowable 5502A Output for Trace Amplitude of 6 Divisions
2 mV/div	4.243 mV	3.960 to 4.526
5 mV/div	10.606 mV	10.183 to 11.028
10 mV/div	21.213 mV	20.368 to 22.058
20 mV/div	42.426 mV	40.735 to 44.117
50 mV/div	106.06 mV	101.83 to 110.29
100 mV/div	212.13 mV	203.67 to 220.58
200 mV/div	424.26 mV	407.35 to 441.17
500 mV/div	1.0607 V	1.0184 to 1.1030
1 V/div	2.1213 V	2.0367 to 2.2058
2 V/div	4.2426 V	4.0735 to 4.4117
5 V/div	10.606 V	10.183 to 11.029
10 V/div	21.213 V	20.368 to 22.058
20 V/div	42.426 V	40.735 to 44.117
50 V/div	106.06 V	101.83 to 110.29
100 V/div	212.13 V	203.67 to 220.58

The vertical accuracy test can be done with dc voltage. This method is advised for automatic verification that uses the *Fluke Met/Cal Metrology Software*.

For each sensitivity range:

1. Apply a +3 division voltage, and adjust the voltage until the trace is at +3 divisions. Write down the applied voltage V1.
2. Apply a -3 division voltage, and adjust the voltage until the trace is at -3 divisions. Write down the applied voltage V2.
3. Verify that V1-V2 = 6 x range ±(2.1 % + 0.04 x range)

   Example: for range 10 mV/div. (range/div figure doubles because 2 measurements V1 and V2 are done for one accuracy check) the allowed:

   V1 - V2 = 60 mV ±(0.021 x 60 + 0.08 x 10) = 60 mV ±(1.26 + 0.8) = 60 mV ±2.06 mV.

   Exception: 2 mV/div, where accuracy is ±(2.9 % + 0.08 range/div.)

Input A, B, C, D DC Voltage Accuracy Test

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, ensure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool. Dangerous voltages are present on the calibration source and connection cables during these steps.

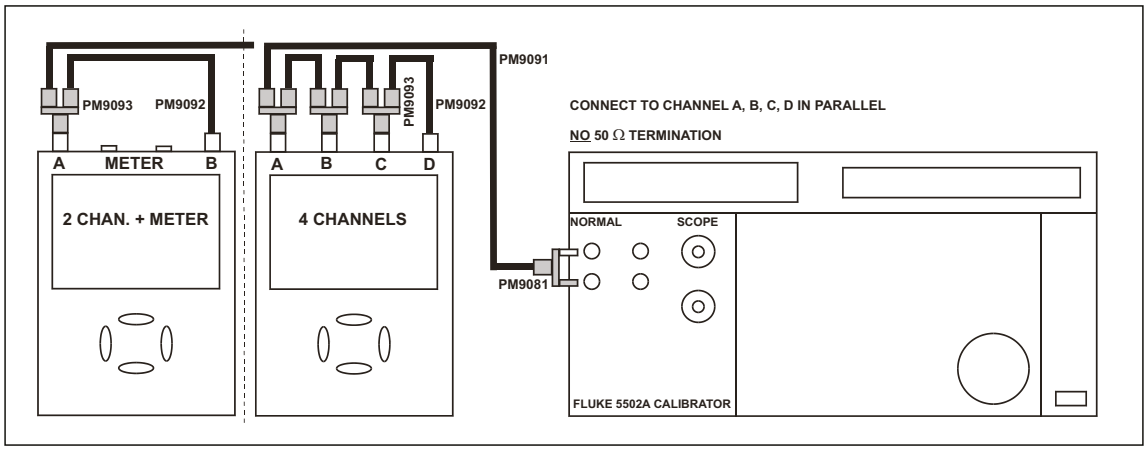
Note

The test steps for channel C and D are only for the 4-channel models.

To verify the automatic dc voltage scope measurement:

1. Connect the Test Tool to the 5502A as shown in see Figure 3.

Figure 3. Test Tool Inputs A, B, C, D to 5502A Normal Output



2. Select the Test Tool setup:

   a. Recall the setup (see *Standard Test Tool Setup*). Press **SAVE**, **F2** (RECALL) and select **SETUP**.

   b. Press **ENTER**, select the setup name, and press **ENTER** to recall the setup.

   c. Press **A**, press **F4** (INPUT A OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the ScopeMeter.

   d. Press **B**, press **F4** (INPUT B OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the ScopeMeter.

   e. Press **C**, press **F4** (INPUT C OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the ScopeMeter.

   f. Press **D**, press **F4** (INPUT D OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the ScopeMeter.

   g. Press **BACK** to clear the softkey menu and the full 8-divisions display.

3. Press [A] and use mV RANGE and RANGE V to set the Input A sensitivity range to the first test point in Table 3. Do this also for channel B, C, and D.
4. Set the 5502A to source the appropriate dc voltage.

   Observe readings A, B, C, and D and check they are within the range shown under the appropriate column.

   Due to calibrator noise, occasionally OL (overload) can be shown.
5. Continue through the test points.
6. When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 3. Volts DC Measurement Verification Points

Range	5502A Output V DC	Reading
2 mV/div	+6.0 mV	+4.9 to +7.1
	-6.0 mV	-7.1 to -4.9
5 mV/div	+15.0 mV	+14.2 to +15.8
	-15.0 mV	-15.8 to -14.2
10 mV/div	+30.0 mV	+28.9 to +31.1
	-30.0 mV	-31.1 to -28.9
20 mV/div	+60.0 mV	+58.5 to +61.5
	-60.0 mV	-61.5 to -58.5
50 mV/div	+150 mV	+142 to +158
	-150 mV	-158 to -142
100 mV/div	+300 mV	+289 to +311
	-300 mV	-311 to -289
200 mV/div	+600 mV	+585 to +615
	-600 mV	-615 to -585
500 mV/div	+1.50 V	+1.42 to +1.58
	-1.50 V	-1.58 to -1.42
1 V/div	+3.00 V	+2.89 to +3.11
	-3.00 V	-3.11 to -2.89
2 V/div	+6.00 V	+5.85 to +6.15
	-6.00 V	-6.15 to -5.85
5 V/div	+15.0 V	+14.2 to +15.8
	-15.0 V	-15.8 to -14.2
10 V/div	+30.0 V	+28.9 to +31.1
	-30.0 V	-31.1 to -28.9

Table 3. Volts DC Measurement Verification Points (cont.)

Range	5502A Output V DC	Reading
20 V/div	+60.0 V	+58.5 to +61.5
	-60.0 V	-61.5 to -58.5
50 V/div	+150 V	+142 to +158
	-150 V	-158 to -142
100 V/div	+300 V	+289 to +311
	-300 V	-311 to -289

Input A, B, C, D AC Voltage Accuracy Test (LF)

Note

The test steps for channel C and D are only for the 4-channel models.

This procedure tests the Volts ac accuracy with dc-coupled inputs up to 50 kHz. The high frequencies are tested in sections, Input A AC Voltage Accuracy (HF) & Bandwidth Test and Input B AC Voltage Accuracy (HF) & Bandwidth Test.

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, make sure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool. Dangerous voltages are present on the calibration source and connection cables during these steps.

To test the Input A, B, C, and D automatic scope ac Voltage measurement accuracy:

1. Connect the Test Tool to the 5502A. See Figure 3.
2. Select the Test Tool setup:
   a. Recall the created setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b. Press A, then press F4 (INPUT A OPTIONS ...).
   c. Select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the ScopeMeter (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).
   d. Press B, then press F4 (INPUT B OPTIONS ...).
   e. Select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the ScopeMeter (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).
   f. Press C, then press F4 (INPUT C OPTIONS ...).
   g. Select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the ScopeMeter (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).

h. Press D, then press F4 (INPUT D OPTIONS ...).

i. Select **Attenuator: Normal | Bandwidth: 10 kHz** for the available setting in the ScopeMeter (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).

j. Press BACK to clear the softkey menu and see the full 8-divisions display.

3. Press SCOPE.

4. Press F2 (– READING ...) and select with F1 (– READINGS) and the ▲ ▼:

   Reading 1, on A, V ac

   Reading 2, on B, V ac

   Reading 3, on C, V ac

   Reading 4, on D, V ac

5. Use s TIME ns to change the time base and lock on 20 µs/div for the 20 kHz signal and on 10 ms/div for the 60 Hz signal.

6. Use mV RANGE and RANGE V to select the manual vertical ranging. Set the input A and B sensitivity range to the first test point in Table 4.

   The sensitivity ranges are indicated in the lower display edge.

7. Set the 5502A to source the appropriate ac voltage.

   Observe readings **A**, **B**, **C**, and **D** and check to see if they are within the range shown under the appropriate column.

8. Continue through the test points.

When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 4. Volts AC Measurement Verification Points

Range	5502A Output V DC		Reading
	V ac	**Frequency**	
2 mV/div **(Select 10 ms/div)**	4 mV	**60 Hz**	2.9 mV to 5.1 mV
Note *Set input channel Bandwidth 10 kHz to prevent OL due to calibrator noise, see step 2.*			
5 mV/div	10 mV	**60 Hz**	8.8 mV to 11.2 mV
10 mV/div **(Select 20 µs/div)**	20 mV	20 kHz	18.0 mV to 22.0 mV
Note *Set channel Bandwidth 20 MHz.*			
20 mV/div	40 mV	20 kHz	37.5 mV to 42.5 mV
50 mV/div	100 mV	20 kHz	96.0 mV to 104.0 mV
100 mV/div	200 mV	20 kHz	180 mV to 220 mV
200 mV/div	400 mV	20 kHz	375 mV to 425 mV
500 mV/div **(Select 10 ms/div)**	900 mV	**60 Hz**	876 mV to 924 mV
500 mV/div **(Select 20 µs/div)**	900 mV	20 kHz	862 mV to 938 mV
1 V/div	2 V	20 kHz	1.80 V to 2.20 V
2 V/div	4 V	20 kHz	3.75 V to 4.25 V
5 V/div	9 V	20 kHz	8.62 V to 9.38 V
10 V/div	20 V	20 kHz	18.0 V to 22.0 V
20 V/div	40 V	20 kHz	37.5 V to 42.5 V
50 V/div	90 V	20 kHz	86.2 V to 93.8 V
100 V/div	200 V	20 kHz	180 V to 220 V

Input A, B, C, D AC-Coupled Lower Frequency Test

Note

The test steps for channel C and D are only for the 4-channel models.

To test the ac-coupled input low-frequency accuracy:

1. Connect the Test Tool to the 5502A as for the previous test. See Figure 3.
2. Select the Test Tool setup:
   a. Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b. Press SCOPE.
   c. Press F2 (– READING …) and select with F1 (– READINGS) and ▲ ▼:
      Reading 1, on A, V ac
      Reading 2, on B, V ac
      Reading 3, on C, V ac
      Reading 4, on D, V ac
   d. Press A and use F2 to select COUPLING AC.
   e. Press B and use F2 to select COUPLING AC.
   f. Press C and use F2 to select COUPLING AC.
   g. Press D and use F2 to select COUPLING AC.
   h. Press BACK to clear the softkey menu and see the full display.
3. Use s TIME ns to change and lock the time base on 40 ms/div.
4. Use mV RANGE and RANGE V to set the Input A, B, C and D sensitivity range to 500 mV.
5. Set the 5502A to source the appropriate ac voltage and frequency in Table 5.
6. Observe the reading **A**, **B**, **C**, and **D** and check that they are within the range shown under the appropriate column.
7. Continue through the test points.

When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 5. Input A, B AC Input Coupling Verification Points

5502A Output, V rms	5502A Frequency	Reading
900 mV	60 Hz	873 mV to 920 mV
900 mV	5 Hz	>630 mV

Input A, B, C, D Peak Measurements Test

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, make sure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool. Dangerous voltages are present on the calibration source and connection cables during these steps.

Note

The test steps for channel C and D are only for the 4-channel models.

To test the peak measurement accuracy:

1. Connect the Test Tool to the 5502A. See Figure 3.
2. Select the Test Tool setup:
   a. Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b. Press SCOPE.
   c. Press F2 (– READING …) and select with F1 (– READINGS) and ▲ ▼:

      Reading 1, on A, Peak … and next Peak-Peak

      Reading 2, on B, Peak … and next Peak-Peak

      Reading 3, on C, Peak … and next Peak-Peak

      Reading 4, on D, Peak … and next Peak-Peak
   d. Press BACK to clear the softkey menu and see the full display.
3. Use s TIME ns to change the time base and lock the time base on 1 ms/div.
4. Use mV RANGE and RANGE V to set the Input A, B, C, and D sensitivity ranges to 100 mV.
5. Set the 5502A to source the appropriate ac voltage and frequency as listed in Table 6.
6. Observe readings A, B, C, and D and check that they are within the range shown under the appropriate column.

When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 6. Volts Peak Measurement Verification Points

5502A Output, V rms	5502A Frequency	Reading
212.13 mV (0.6 V pp)	1 kHz	0.56 to 0.64

Input A, B, C, D Frequency Measurement Accuracy Test

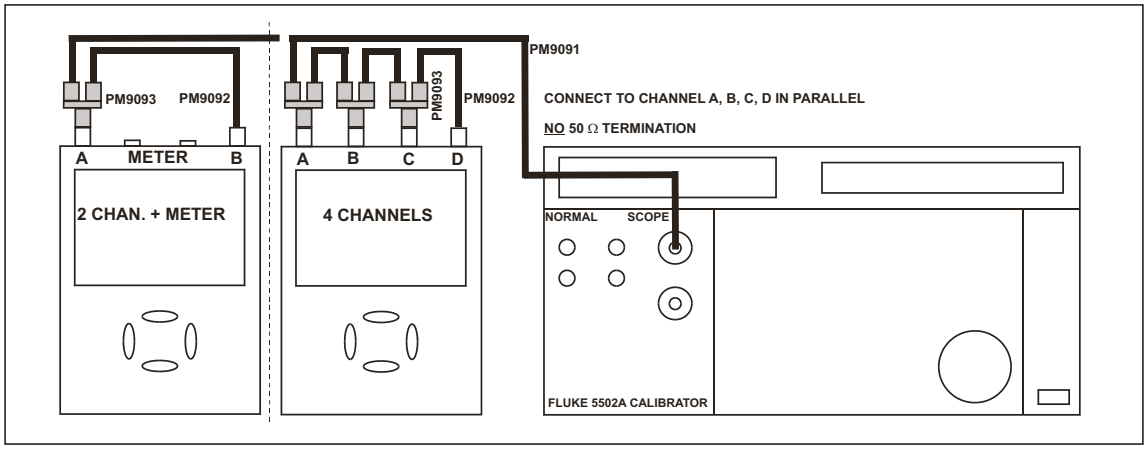
Note

The test steps for channel C and D are only for the 4-channel models.

To test the frequency measurement accuracy:

1. Connect the Test Tool to the 5502A. See Figure 4. Do not use 50 Ω terminations.

Figure 4. 5502A Scope Output to Test Tool Input A, B, C, D



2. Select the following Test Tool setup:

   a. Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.

   b. Press SCOPE.

   c. Press F2 (– READING …) and select with F1 (– READINGS) and ▲ ▼:

   Reading 1, on A, Hz

   Reading 2, on B, Hz

   Reading 3, on C, Hz

   Reading 4, on D, Hz

3. Use mV RANGE and RANGE V to select range 100 mV/div for A, B, C and D.

4. Use s TIME ns to select the required time base setting.

5. Set the 5502A to source a sine wave according to the first test point in Table 7.

   Because the 50 Ω termination is not applied, the 5502A leveled sine wave output amplitude can vary.

6. Observe reading A, B, C, and D and check that it is within the range shown under the appropriate column.

7. Continue through the test points.

When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 7. Input A, B, C, D Frequency Measurement Accuracy Test

Model	Time base	5502A-SC... MODE	Voltage	Frequency	Input Reading
All	20 ms/div	wavegen, sine	600 mVpp	16 Hz	15.90 to 16.10
190-062	20 ns/div	levsine	600 mVpp	60 MHz	59.68 to 60.32
190-104	20 ns/div	levsine	600 mVpp	100 MHz	99.3 to 100.7
190-102					
190-204/190M-4	20 ns/div	levsine	600 mVpp	200 MHz	198.8 to 201.2
190-202/190M-2					
190-502	20 ns/div	levsine	600 mVpp	500 MHz	497.3 to 502.7
190-504					

Note

Because Duty Cycle and Pulse Width measurements are based on the same principles as Frequency measurements, these measurement functions are not verified separately.

Input A&B / C&D Phase Measurements Test

Note

The test steps for channel C and D are only for the 4-channel models.

To test the phase measurement accuracy:

1. Connect the Test Tool to the 5502A. See Figure 4.
2. Select the Test Tool setup:
   a. Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b. Press SCOPE.
   c. Press F2 (– READING …) and select with F1 (– READINGS) and ▲ ▼:

      Reading 1, on A, Phase

      Reading 2, on B, Phase

      Reading 3, on C, Phase

      Reading 4, on D, Phase

3. Use mV RANGE and RANGE V to select range **100 mV/div** for A, B, C and D.
4. Use s TIME ns to select the required time base setting.
5. Set the 5502A to source a sine wave according to the first test point in Table 8.

   Because no 50 Ω termination is applied, the 5502A leveled sine wave output amplitude can vary.
6. Observe the readings A, B, C, and D and check that they are not outside the range shown under the appropriate column.
7. Continue through the test points.

When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 8. Phase Measurement Verification Points

Time base	5502A-SC... MODE	Voltage	Frequency	Input A, B, C, D Reading ... Deg
20 ms/div	wavegen, sine, 1 MΩ	10 Hz	600 mVpp	-2 to +2
200 ns/div	levsine	1 MHz	300 mVpp	-2 to +2
20 ns/div	levsine	10 MHz	300 mVpp	-3 to +3

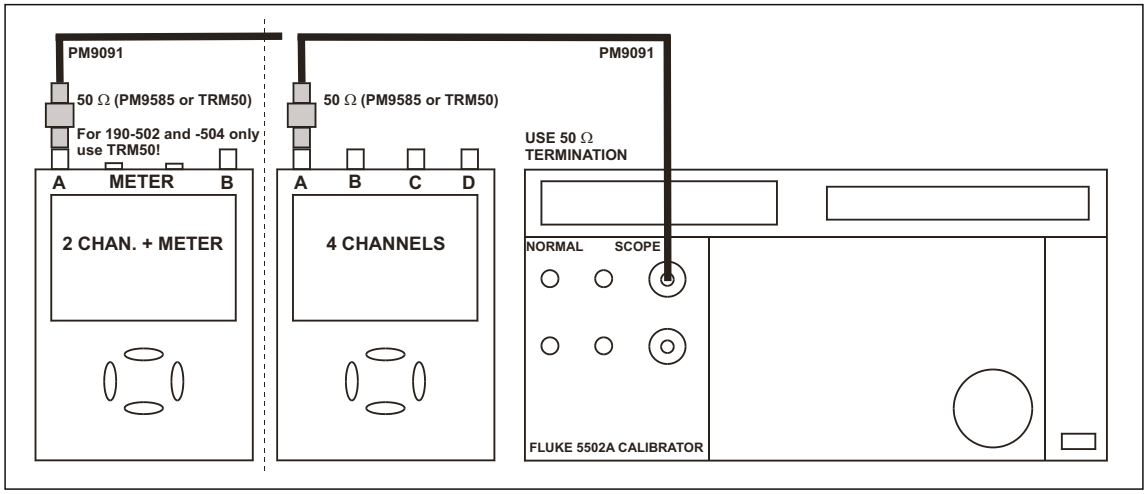
Time Base Test

To test the time base accuracy:

1. Connect the Test Tool to the 5502A as shown in Figure 5.

   For the Fluke 190-502, 190-504, and MDA-550-III you must use the Fluke TRM50 50 Ω terminator.

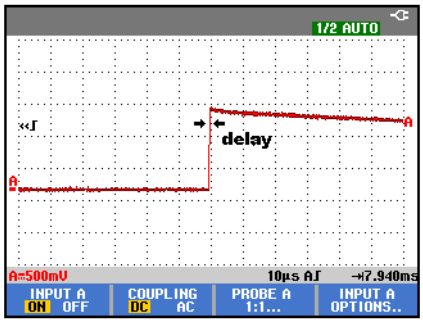
Figure 5. 5502A Scope Output to Test Tool Input A



2. Set the 5502A to source an 8 ms time marker (MODE marker).
3. Select the Test Tool setup:
   a. Reset the Test Tool.
   b. Use mV RANGE and RANGE V to select manual vertical ranging, and set the Input A sensitivity range to **5 V/div (10:1 probe)** or **500 mV/div** (probe A factor is 1:1).
   c. Use s TIME ns to change the time base to select manual time base ranging and lock the time base on 10 ms/div).
   d. Use ◁ MOVE ▷ to move the trace to the left. Once the trigger point is shifted across the left hand border of the display, going off display, the trigger delay time with respect to the first vertical grid line is indicated in the lower right of the display. See Figure 6.

      Adjust the trigger delay time to 8.000 ms (A ⎍ →| 8.00 ms).

Figure 6. Time Base Verification



   e. Use s TIME ns to set the time base on **10 µs/div**.
   f. Use ◁ MOVE ▷ to move the trace to the right until the indicated trigger delay is **7.940 ms**.
   g. Examine the rising edge of the time marker pulse at the height of the trigger level indicator top. Verify that the rising edge is at the center grid line. The allowed deviation is ±3 pixels. See Figure 6.

Input A, B, C, D Trigger Sensitivity Test

To test the Input A trigger sensitivity:

1. Connect the Test Tool to the 5502A. See Figure 5.
2. Reset the Test Tool to select the Test Tool setup.
3. Use RANGE V and mV RANGE to change the sensitivity range to select manual sensitivity ranging and lock the Input A sensitivity range on **2 V/div**.

4. Use s TIME ns to select the time base in Table 9.
5. Set the 5502A to source the leveled sine wave for the appropriate Test Tool model.
6. Adjust the 5502A output voltage until the displayed trace has the trigger amplitude indicated under the last column of Table 9.
7. Verify that the signal is well triggered.

   If not, press TRIGGER and use F3 to enable ▲ ▼ for manual Trigger Level adjustment. Adjust the trigger level and verify that the signal is triggered. The trigger icon (⊥) indicates the trigger level.
8. Continue through the test points.

When you are finished, set the 5502A to Standby.

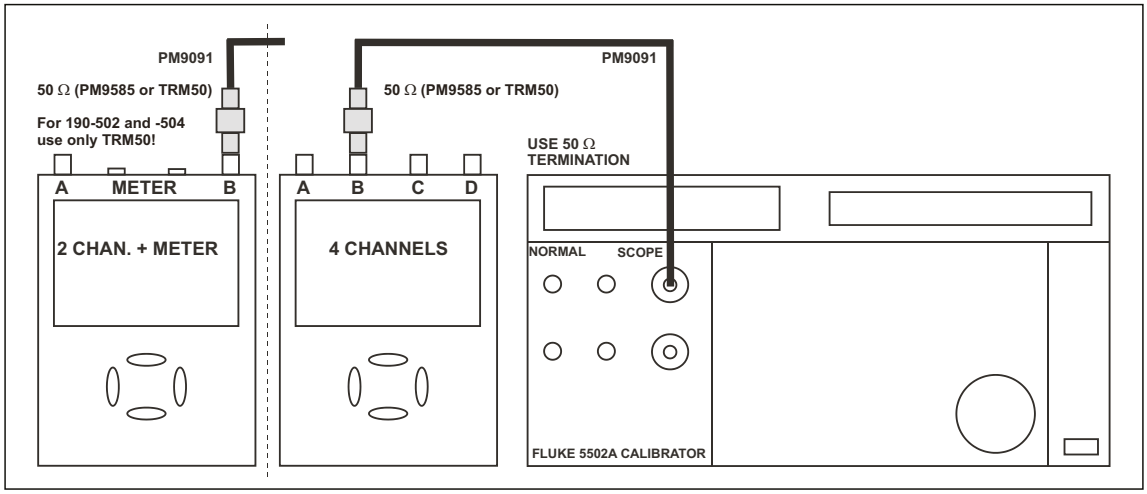
Table 9. Input Trigger Sensitivity Test Points

UUT Model	UUT Time base	5502A SC... MODE levsine		UUT Trigger Amplitude
		Initial Input Voltage	Frequency	
All	200 ns/div	100 mV pp	5 MHz	0.5 div
190-062	10 ns/div	400 mV pp	60 MHz	1 div
	10 ns/div	800 mV pp	100 MHz	2 div
190-102/190-104	10 ns/div	400 mV pp	100 MHz	1 div
	10 ns/div	800 mV pp	150 MHz	2 div
190-202/190M-2/ 190-204/190M-4	10 ns/div	400 mV pp	200 MHz	1 div
	10 ns/div	800 mV pp	250 MHz	2 div
190-502/190-504/ MDA-550-III	2 ns/div	400 mV pp	500 MHz	1 div
	2 ns/div	800 mV pp	600 MHz	2 div

To test the Input B trigger sensitivity:

1. Connect the Test Tool to the 5502A. See Figure 7.

Figure 7. 5502A Scope Output to Test Tool Input B



2. Reset the Test Tool to select the Test Tool setup.
3. Press [B] to turn Input B on.
4. Press TRIGGER and use F1 to select **Input B** as trigger source.
5. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging, and lock the Input B sensitivity range on **2 V/div**.
6. Repeat step 4 to step 8 same as for the Input A trigger test.

When you are finished, set the 5502A to Standby.

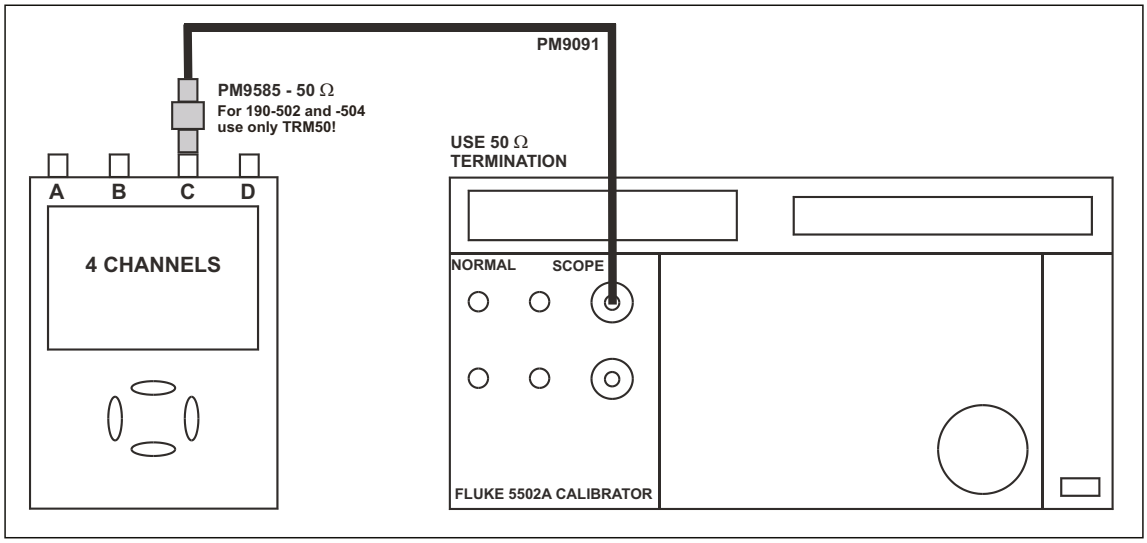
To test the Input C trigger sensitivity:

1. Connect the Test Tool to the 5502A. See Figure 8.

Note

The test steps for channel C are only for the 4-channel models.

Figure 8. 5502A Scope Output to Test Tool Input C



2. Reset the Test Tool to select the Test Tool setup.
3. Press C to turn Input C on.
4. Press C and use MOVE to move the Input C trace zero to the center grid line.
5. Press TRIGGER and use F1 to select Input C as trigger source.
6. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging and lock the Input C sensitivity range on **2 V/div**.
7. Repeat step 4 to step 8 same as for the Input A trigger test.

When you are finished, set the 5502A to Standby.

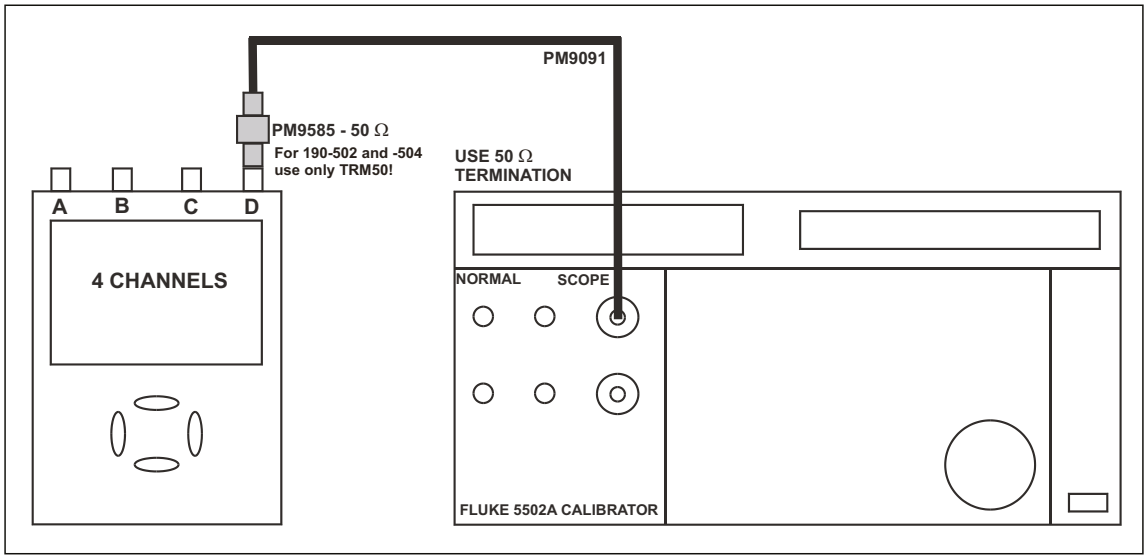
To test the Input D trigger sensitivity:

1. Connect the Test Tool to the 5502A. See Figure 9.

Note

The test steps for channel D are only for the 4-channel models.

Figure 9. 5502A Scope Output to Test Tool Input D



2. Reset the Test Tool to select the Test Tool setup.
3. Press D to turn Input D on.
4. Use MOVE to move the Input D trace zero to the center grid line.
5. Press TRIGGER and use F1 to select Input D as trigger source.
6. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging and lock the Input D sensitivity range on **2 V/div**.
7. Repeat step 4 to step 8 same as for the Input A trigger test.

When you are finished, set the 5502A to Standby.

Input A AC Voltage Accuracy (HF) and Bandwidth Test

To test the Input A high frequency automatic scope ac voltage measurement accuracy and the bandwidth:

1. Connect the Test Tool to the 5502A. See Figure 5.
2. Select the Test Tool setup:
   a. Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.

b. Press SCOPE.

c. Press F2 (– READING ...) and select with F1 (– READINGS) and F1 (READINGS) on **A | V ac**.

d. Press AUTO to select autoranging (AUTO in upper right LCD edge).

e. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging, and lock the Input A sensitivity range on **500 mV/div**. AUTO in upper right LCD edge becomes ½ AUTO.

f. Use MOVE to move the Input A trace zero to the center grid line.

3. Set the 5502A to source a sine wave and to the first test point in Table 10.
4. Observe the Input A reading and check that it is within the range shown under the appropriate column.
5. Continue through the test points.

When you are finished, set the 5502A to Standby.

Table 10. HF AC Voltage Verification Points Input A

UUT Model	5502A SC... MODE levsine		UUT Reading A
	Voltage	Frequency	
All	2.545 Vpp	1 MHz	835 mV to 965 mV
All	2.545 Vpp	25 MHz	790 mV to 1.010 V
Models 60 MHz	2.545 Vpp	60 MHz	>630 mV
Models 100 MHz	2.545 Vpp	100 MHz	>630 mV
Models 200 MHz	2.545 Vpp	200 MHz	>630 mV
Models 500 MHz	2.545 Vpp	500 MHz	>630 mV

Input B AC Voltage Accuracy (HF) and Bandwidth Test

To test the Input B high frequency automatic scope ac voltage measurement accuracy and the bandwidth:

1. Connect the Test Tool to the 5502A. See Figure 7.
2. Select the Test Tool setup:

   a. Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.

   b. Press SCOPE.

c. Press F2 (– READING …) and select with F1 (READINGS 2), and select on **B | V ac**.

d. Press AUTO to select autoranging (AUTO in upper right LCD edge).

e. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging and lock the Input B sensitivity range on **500 mV/div**.

f. Press TRIGGER and use F1 to select Input B as trigger source.

3. Set the 5502A to source a sine wave at the first test point in Table 10.
4. Observe the Input B reading and check that it is within the range shown under the appropriate column of Table 10.
5. Continue through the test points.

When you are finished, set the 5502A to Standby.

Input C AC Voltage Accuracy (HF) and Bandwidth Test

Note

The test steps for channel C are only for the 4-channel models.

To test the Input C high frequency automatic scope ac voltage measurement accuracy and bandwidth:

1. Connect the Test Tool to the 5502A. See Figure 8.
2. Select the Test Tool setup:

   a. Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.

   b. Press SCOPE, then press F2 (READING…) and select **READINGS 3 on C | V ac**.

   c. Press AUTO to select autoranging (**AUTO** in upper right LCD edge).

   d. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging and lock the Input C sensitivity range on **500 mV/div**.

   e. Use MOVE to move the Input C trace zero to the center grid line.

   f. Press TRIGGER and use F1 to select Input C as trigger source.

3. Set the 5502A to source a sine wave and to the first test point in Table 10.
4. Observe the Input C reading and check that it is within the range shown under the appropriate column of Table 10.
5. Continue through the test points.

When you are finished, set the 5502A to Standby.

Input D AC Voltage Accuracy (HF) and Bandwidth Test

Note

The test steps for channel C are only for the 4-channel models.

To test the Input D high frequency automatic scope ac voltage measurement accuracy and the bandwidth:

1. Connect the Test Tool to the 5502A. See Figure 9
2. Select the Test Tool setup:
   a. Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b. Press SCOPE, then press F2 (READING...) and select **READINGS 4 on D | V ac**.
   c. Press AUTO to select autoranging (**AUTO** in upper right LCD edge).
   d. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging and lock the Input C sensitivity range on **500 mV/div**.
   e. Use MOVE to move the Input D trace zero to the center grid line.
   f. Press TRIGGER and use F1 to select Input C as trigger source.
3. Set the 5502A to source a sine wave and to the first test point in Table 10.
4. Observe the Input D reading and check that it is within the range shown under the appropriate column of Table 10.

When you are finished, set the 5502A to Standby.

External Trigger Level Test

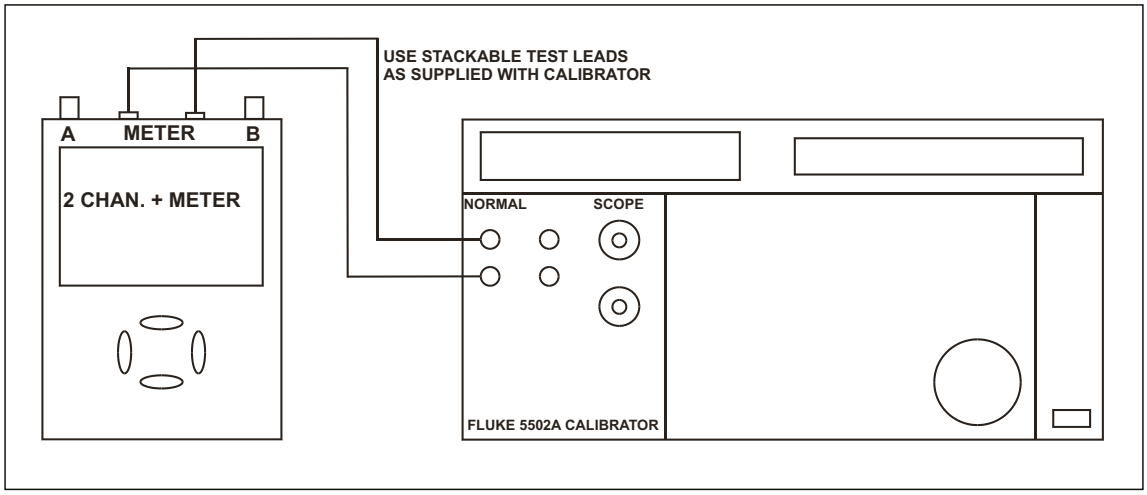
Note

The external trigger level test is for the models 190-062, 190-102, 190-202, 190M-2, and 190-502.

To test the external trigger level:

1. Connect the Test Tool to the 5502A. See Figure 10.

Figure 10. Test Tool Meter/Ext Input to 5502A Normal Output



2. Reset the Test Tool to select the Test Tool setup.
3. Press TRIGGER.
4. Use F4 to select the **TRIGGER OPTIONS...** menu.
5. Select **On Edges...** from the TRIGGER OPTIONS menu.
6. Press ENTER.
7. Select **Update: Single Shot** ENTER, **Trigger Filter: Noise Reject** ENTER, **NCycle: Off** ENTER.
8. Use F1 (EDGE TRIG) to select Ext.
9. Use F2 (SLOPE) to select positive slope triggering (⌐).
10. Use 3 (Ext LEVEL) to select **1.2 V**.
11. Set the 5502A to source **0.4 V dc**.
12. Verify that no trace is shown on the Test Tool display and that the status line at the display top shows **SINGLE MANUAL** or **SINGLE WAITING**.

    If the display shows the trace and status as **SINGLE HOLD**, press HOLD RUN to re-arm the Test Tool for a trigger.
13. Set the 5502A to source **1.7 V**.
14. To verify that the Test Tool is triggered, check that the trace becomes visible. To repeat the test, start at step 3.

Set the 5502A to Standby.

Meter Tests

Note

The following tests are for the models 190-062, 190-102, 190-202, 190M-2, and 190-502.

Meter DC Voltage Accuracy Test

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, make sure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool. Dangerous voltages are present on the calibration source and connection cables during these steps.

To test the meter dc voltage measurement accuracy:

1. Connect the Test Tool to the 5502A. See Figure 10.
2. Select the Test Tool setup.
3. Press METER.
4. Press F1 to open the Measurement menu and select V dc.
5. Press ENTER.
6. Press AUTO to select MANUAL ranging. Use mV RANGE and RANGE V to select the ranges.
7. Set the range to the first test point in Table 11.
8. Set the 5502A to source the appropriate dc voltage. Observe the reading and check to see if it is within the range shown under the appropriate column.
9. Continue through the test points.

When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 11. Meter Volts dc Measurement Verification Points

Range	5502A Output V DC	Meter Reading
500.0 mV	+500 mV	497.0 to 503.0
	-500.0 mV	-497.0 to -503.0
	0 mV	-0.5 to +0.5
5.000 V	+5.000 V	4.970 to 5.030
	-5.000 V	-4.970 to -5.030
50.00 V	+50.00 V	49.70 to 50.30
	-50.00 V	-49.70 to -50.30
500.0 V	+500.0 V	497.0 to 503.0
	-500.0 V	-497.0 to -503.0
1100 V	+1000 V	0.990 to 1.010
	-1000 V	-0.990 to -1.010

Meter AC Voltage Accuracy and Frequency Response Test

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, ensure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool. Dangerous voltages are present on the calibration source and connection cables during these steps.

To test the ac voltage measurement accuracy:

1. Connect the Test Tool to the 5502A. See Figure 10.
2. Select the Test Tool setup.
3. Press METER.
4. Press F1 to open the Measurement menu and select V ac.
5. Press ENTER.
6. Press AUTO to select MANUAL ranging. Use mV RANGE and RANGE V to select the ranges.
7. Set the range to the first test point in Table 12.
8. Set the 5502A to source the appropriate ac voltage.
9. Observe the reading and check that it is within the range shown under the appropriate column.
10. Continue through the test points.

When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 12. Meter Volts AC Measurement Verification Points

Range	5502A Output V AC	Frequency	Meter Reading
500.0 mV	500.0 mV	60 Hz	494.0 to 506.0
		1 kHz	486.0 to 514.0
		3 kHz	>350.0
5.000 V	5.000 V	60 Hz	4.940 to 5.060
		1 kHz	4.860 to 5.140
		3 kHz	>3.500
50.00 V	50.00 V	60 Hz	49.40 to 50.60
		1 kHz	48.60 to 51.40
		3 kHz	>35.00
500.0 V	500.0 V	60 Hz	494.0 to 506.0
		1 kHz	486.0 to 514.0
		3 kHz	>350.0
1100 V (1.1 kV)	1000 V	60 Hz	0.980 to 1.020
		1 kHz	0.960 to 1.040
		3 kHz	> 0.700

Continuity Function Test

To test the continuity function:

1. Press METER.
2. Press F1 to open the Measurement menu and select **Continuity**.
3. Connect the Test Tool to the 5502A. See Figure 10.
4. Set the 5502A to 20 Ω. Use the 5502A "COMP OFF" mode.
5. Listen to hear that the beeper is on.
6. Set the 5502A to **80** Ω.
7. Listen to hear that the beeper is off.

When you are finished, set the 5502A to Standby.

Diode Test Function Test

To test the diode function:

1. Select the Test Tool setup.
2. Press METER.
3. Press F1 to open the Measurement menu and select **Diode**.
4. Connect the Test Tool to the 5502A. See Figure 10.
5. Set the 5502A to **1 kΩ**. Use the 5502A "COMP OFF" mode.
6. Observe the main reading and check that it is within **0.4 V** and **0.6 V**.
7. Set the 5502A to **1 V dc**.
8. Observe the main reading and check that it is within **0.975 V** and **1.025 V**.

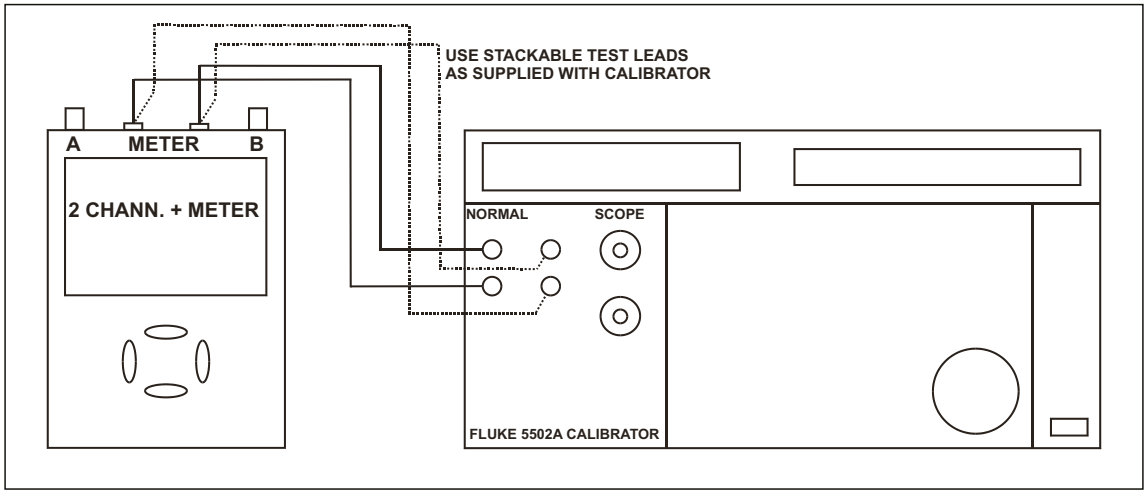
When you are finished, set the 5502A to Standby.

Ohms Measurements Test

To test the Ohms measurement accuracy:

1. Connect the Test Tool to the 5502A. See Figure 11.

Figure 11. Test Meter Tool Input to 5502A Normal Output 4-Wire



2. Select the Test Tool setup.
3. Press METER.
4. Press F1 to open the Measurement menu and select **Ohms**.
5. Press AUTO to select AUTO ranging.
6. Set the 5502A to source the appropriate resistance value for the first test point in Table 13.
7. Use the 5502A "COMP 2 wire" mode for the verifications up to and including 50 kΩ. For the higher values, the 5502A will turn off the "COMP 2 wire" mode.
8. Observe the reading and check that it is within the range shown under the appropriate column.
9. Continue through the test points.

When you are finished, set the 5502A to Standby.

Table 13. Resistance Measurement Verification Points

5502A Output	Meter Reading (Comp 2-Wire)
0 Ω	0.0 to 0.5 (COMP 2 wire)
400 Ω	397.1 to 402.9 (COMP 2 wire)
4 kΩ	3.971 to 4.029 (COMP 2 wire)
40 kΩ	39.71 to 40.29 (COMP 2 wire)
400 kΩ	397.1 to 402.9 (off)
4 MΩ	3.971 to 4.029 (off)
30 MΩ	29.77 to 30.23 (off)

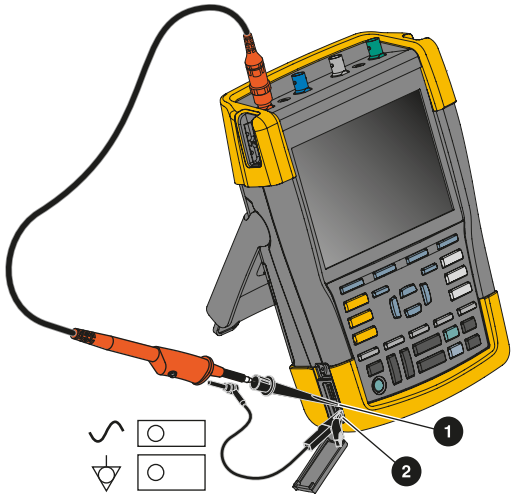
Probe Calibration Generator Test

To calibrate, connect a 10:1 or 100:1 probe as supplied with the Test Tool to input A (red probe). Connect the probe tip and the probe ground lead with the probe cal terminals on the lower left side of the Test Tool. See Figure 12 (the figure is universal and shows a Test Tool with four oscilloscope channels such as the model 190-204 or 190M-4).

1. Reset the Test Tool.
2. Press [A] to show the input A key labels.
3. Press ENTER to select the 10:1 or 100:1 voltage probe for the calibration.
4. Press ENTER to confirm and F1 to reopen the probe menu.
5. Press F3 (-PROBE A 10:1 ….).
6. Press F1 (- PROBE CAL…) and follow the instructions on the display.
7. Press F4 to start the probe calibration. The first step is to manually adjust the square wave response to a pure square wave (pulse top must be straight). The trimmer is located in the probe housing near the BNC and can be reached by rotating the center part of the housing. For further information refer to the probe instruction sheet.
8. When done, press F4 to start the DC calibration automatically. The Probe Calibration is OK if all instructions shown on the display are finished successfully.

   Close the hole of the trimmer by rotating the center part of the housing. This is important for safe use of the probe at high input voltages.
9. Repeat the procedure for channel B (blue probe). For the 4-channel test tools, repeat the procedure for channel C (gray probe) and channel D (green probe).

Figure 12. Probe Calibration Connection



1 Probe Cal

2 Probe Cal Reference

Note

VPS421 does not need adjustment.

This is the end of the Performance Verification Procedure.

Calibration Adjustment

This section provides the complete Calibration Adjustment procedure for the Test Tool.

The Test Tool allows closed-case calibration with known reference sources. It measures the reference signals, calculates the correction factors, and stores the correction factors in RAM. When the calibration is complete, the correction factors can be stored in FlashROM.

The Test Tool should be calibrated after repair or if it fails the Performance Verification. The Test Tool has a normal calibration cycle of one year.

Calibration Number and Date

When storing valid calibration data in FlashROM after the calibration adjustment procedure is complete, the calibration date is set to the actual Test Tool date, and the calibration number increments by one.

To show the calibration date and number:

1. Press USER, then press F3 to see the version and calibration data.
2. Press F4 to close the version and calibration menu.

Note

The calibration date and calibration number do not change if you do only the Probe Calibration.

General Instructions

Follow these general instructions for all calibration steps:

- Allow the specified warm-up period for the 5502A. For each calibration point, wait for the 5502A to settle.
- The required warm-up period for the Test Tool is included in the *Warming-Up and Pre-Calibration* step.
- Ensure that the Test Tool battery is sufficiently charged.
- Power the Test Tool with the BC190 Power Adapter.
- This procedure is for all models. Test steps that are not applicable to the Test Tool to be adjusted can be skipped. For example, the adjustment of the meter with banana jacks can be skipped in instruments with four scope (BNC) inputs.
- The figures that show how to interconnect Signal Source and Test Tool are for 2 Scope Inputs + Meter Input and for 4 Scope Inputs.

Equipment Required For Calibration

The primary source instrument used in the calibration procedures is the Fluke 5502A. If a 5502A is not available, you can substitute another calibrator that meets the minimum test requirements:

- Fluke 5502A Multi-Product Calibrator, including SC600 Oscilloscope Calibration Option.
- Stackable test leads (4x) as supplied with the 5502A (required for Test Tools with banana jacks and 2 BNC oscilloscope inputs).
- 50 Ω Coax Cables (4x): use Fluke PM9091 (1.5 m, 3/set) and PM9092 (0.5 m, 3/set). For Test Tools with banana jacks and 2 BNC oscilloscope inputs 2 Coax Cables are sufficient.
- 50 Ω feed through termination, Fluke TRM50 (4x for Test Tools with 4 BNC oscilloscope inputs; 2x for Test Tools with banana jacks and 2 BNC oscilloscope inputs).
- Male BNC to Dual Female BNC adapter (3x), Fluke PM9093/001.
- Dual Banana Plug to Female BNC Adapter (1x), Fluke PM9081/001.

Calibration Procedure Steps

For a complete calibration adjustment you must do all steps:

1. Select the Calibration Mode.
2. Do the *Warming-Up and Pre-Calibration* section.
3. Do the *Final Calibration* section.
4. Do the *DMM Calibration* section if the instrument is a 2-channel + DMM model.
5. Save the calibration data and exit the calibration mode.
6. Do the *Probe Calibration* section.

A partial probe calibration is allowed. The probe calibration matches the probe to the input channel in use.

How to Start the Calibration

To start the calibration:

1. Power the Test Tool with the power adapter input and the BC190 power adapter.
2. Check the actual Test Tool date and adjust the date if necessary (the calibration date will become the Test Tool date when saving the calibration data):
   a. Press USER (toggles the menu bar on and off).
   b. Press F1 to open the OPTIONS menu.
   c. Use ▲ ▼ to select the **DATE ADJUST...** option.
   d. Press ENTER to open the DATE ADJUST menu.
   e. If necessary, adjust the date with ▲ ▼. Press ENTER to activate all selections and leave the menu.
3. Select the calibration mode.

   The Calibration Adjustment Procedure uses built-in calibration setups that can be accessed in the calibration mode.

   To enter the calibration mode proceed as follows:

   a. Press and hold USER.
   b. Press and release F1, and release USER.

   The display shows the CAL MODE (Calibration Adjustment) screen.

   The display shows the calibration step **WarmingUp (CL 0200)**, the calibration status, and the softkey menu.

Continue as indicated in the *Calibration Procedure Steps* section on previous page.

Note

You can exit the calibration mode at any time without changing the calibration data by turning the Test Tool off.

Display Messages and Key Functions

When the Test Tool is in the calibration mode, only the **F1** to **F4** softkeys, the ⏻ key, and the **BACK** key are active, unless otherwise stated.

The calibration adjustment menu shows the actual calibration step (name and number) and its status: **Cal Name (CL nnnn) %:Status (...)**

Cal Name	Name of the selected calibration step, for example, WarmingUp
(CL nnnn)	Number of the calibration step
%	Progress %
Status (...) can be:	
IDLE (valid)	After (re)entering this step, the calibration process is not started. The calibration data of this step are valid. This means that the last time this step was done, the calibration was successful. It does not necessarily mean that the unit meets the specifications related to this step.
IDLE (invalid)	After (re)entering this step, the calibration process is not started. The calibration data are invalid. This means that the last time this step was done, the calibration was not successful. Most probably the unit will not meet the specifications if the actual calibration data are saved.
BUSY aaa% bbb%	Calibration adjustment step in progress; progress % for Input A and Input B. During Warming-Up, the elapsed time is shown.
READY	Calibration adjustment step finished.
Error :xxxx	Calibration adjustment failed, due to wrong input signal(s) or because the Test Tool is defective. If the error code is <5000 you can repeat the failed step. If the error code is ≥5000 you must repeat the complete final calibration (start at *Warming-Up 2, Warm-Up Final, and ADC Timing*).

The functions of the keys are:

F1	**PREVIOUS**	select the previous step (if applicable)
F2	**NEXT**	select the next step (if applicable)
F3	**CALIBRATE**	start the calibration adjustment of the actual step
F4	**EXIT**	leave the calibration mode (turn off and turn on the tool to make sure that the tool operation is normal)

Note

F1 *and* **F2** *are disabled whenever they can harm the process.*

Warming-Up and Pre-Calibration

The Warming-Up and Pre-Calibration state is the start of the calibration mode. The display shows **WarmingUp (CL 0200):xx %**.

Note

*You must always start the calibration adjustment at the **WarmingUp (CL 0200)** step. The calibration will be invalid if you start at any other step.*

The Warming-Up and Pre-Calibration consists of a 30-minute warm-up period, followed by several internal calibration adjustment steps that do not require input signals. The total process takes about 75 minutes.

To do the Warming-Up and Pre-Calibration:

1. Remove all input connections from the Test Tool.
2. Press **F3** (CALIBRATE) to start the Warming-Up and Pre-Calibration.

   The display shows the calibration step in progress and status.

   The first step is:

   WarmingUp (CL 0200) %:BUSY 00:29:59

   or

   WarmingUp1 (CL 0200) :BUSY 00:09:59.

   The warming-up period is counted down to 00:00:00. Then the remaining pre-calibration steps are performed automatically. The entire procedure takes about 60 minutes.
3. Wait until the display shows **End Precal: READY**.

   The PreCal data have now been stored in FlashROM.

   If you turn off the Test Tool now by accident, turn it on again immediately and select the calibration mode. Continue with step 5 below.
4. Press **F2** (NEXT) several times, see *Final Calibration*. If you turn off the Test Tool now, and you do not turn on immediately, the Test Tool has cooled down, and you must repeat the Warming-Up and Pre-Calibration (select the calibration mode and start at CL 0200).
5. Press **F2** (NEXT) and continue at the Final Calibration section.

Error Messages

If error message 1000 is displayed during Warming-Up or Pre-Calibration step CL 0215, the Main PCA hardware version is not suitable for the installed software version. Other error messages during Warming-Up or Pre-Calibration indicate that the Test Tool is defective, and should be repaired.

If you did the *Warming-Up and Pre-Calibration* section successfully and you want to store the Pre-Calibration data before continuing with the Final Calibration:

1. Press **F4** (YES).

   When you turn off and turn on the Test Tool again, it will show the message:

   The instrument needs calibration.

   Please contact your service center.

   The calibration date and number do not update. You must continue with the Final Calibration.

To return to the Maintenance mode and repeat the complete calibration:

1. Press **F3** (NO).
2. Press **F1** until the display shows:

   WarmingUp (CL 0200):IDLE

3. Calibrate the Test Tool, starting at *Warming-Up and Pre-Calibration*.

If you want to exit and maintain the old calibration data:

1. Turn off the Test Tool.

Final Calibration

Before you start the final calibration, do the *Warming-Up and Pre-Calibration* section.

The final calibration requires input conditions that are described in each step. After a step starts, steps that require the same input conditions are done automatically. For example, if you start calibration step CL 0850, the calibration can include step CL 0869 and at the end the display shows CL 0799: READY.

Note

*You must always start the calibration adjustment at the **WarmingUp (CL 0200)** step. The calibration will be invalid if you start at any other step. See the Warming-Up 2, Warm-Up Final, and ADC Timing section.*

If you do calibration step N (for example, step CL 0581), then return to a previous step (for example, step CL 0580), and then calibrate this step, the complete final calibration becomes invalid; then you must repeat the calibration starting at the *Warming-Up 2, Warm-Up Final, and ADC Timing* section.

You can repeat a step that shows the status **:READY** by pressing **F3** again.

Refer to Table 14 for all calibration steps for each function.

Warming-Up 2, Warm-Up Final, and ADC Timing

Do the Warming-Up 2 step (**CL 0500**) with open inputs:

1. Press **F3** to start the calibration.

   Wait until the display shows calibration status **End Precal:READY**.

2. Press **F2** to select the next calibration step (**CL 0201, WarmUpFinal**).
3. Press **F3** to start the calibration.

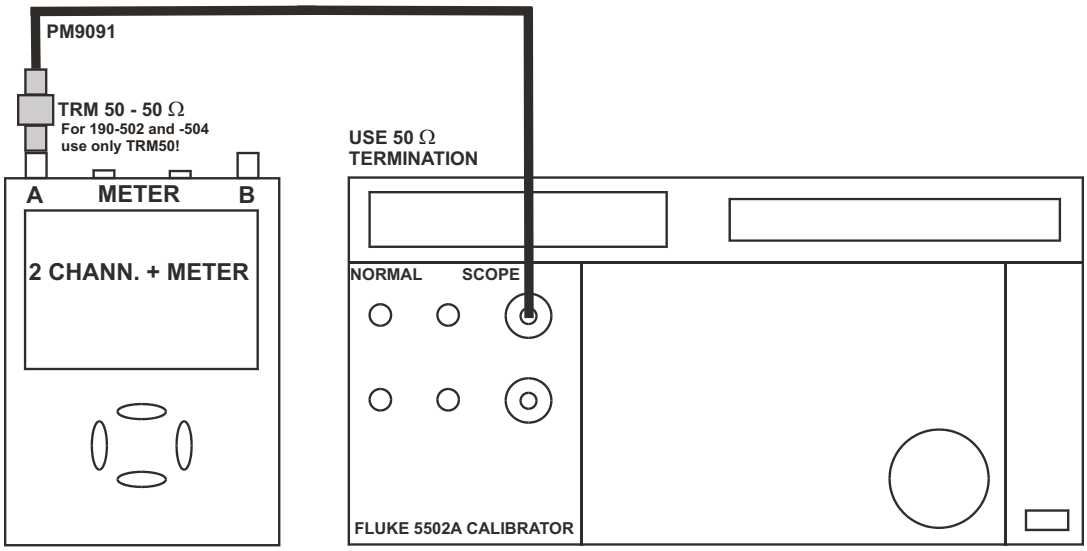
   Wait until the display shows calibration ready.

4. Press **F2** to select the next calibration step (**CL 0570, ADC Timing**).
5. Connect Ch. A of the Test Tool to the 5502A SCOPE output. See Figure 13. Use a 50 Ω termination.
6. Set the 5502A to generate a sine wave 50.25 MHz / 0.5 V pp (mode LEVSINE) at the SCOPE output.
7. Set the 5502A in operate (OPR).
8. Press **F3** to start the calibration.

   Wait until the display shows calibration status **:READY**.

9. Set the 5502A in standby (STBY).
10. Continue at the *Input A LF-HF Gain* section.

Figure 13. 5502A Scope Output to Test Tool Input A



Input A LF-HF Gain

To do the Input A LF-HF Gain calibration:

1. Connect Ch. A of the Test Tool to the 5502A. See Figure 13.
2. Press **F2** to select the first calibration step in Table 14, *Input A LF-HF Gain*.

   The display must show step **CL 0654** (Pos A Fast).
3. Set the 5502A SCOPE output to source the signal required for the first calibration point.
4. Set the 5502A in operate (OPR) or standby (STBY) as indicated.
5. Press **F3** to start the calibration.

   Wait until the display shows calibration status **CL 509: READY**.
6. Press **F2** to select the next calibration step, set the 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points for *Input A LF-HF Gain*.
7. Wait until the display shows calibration status **CL 0461: READY**.

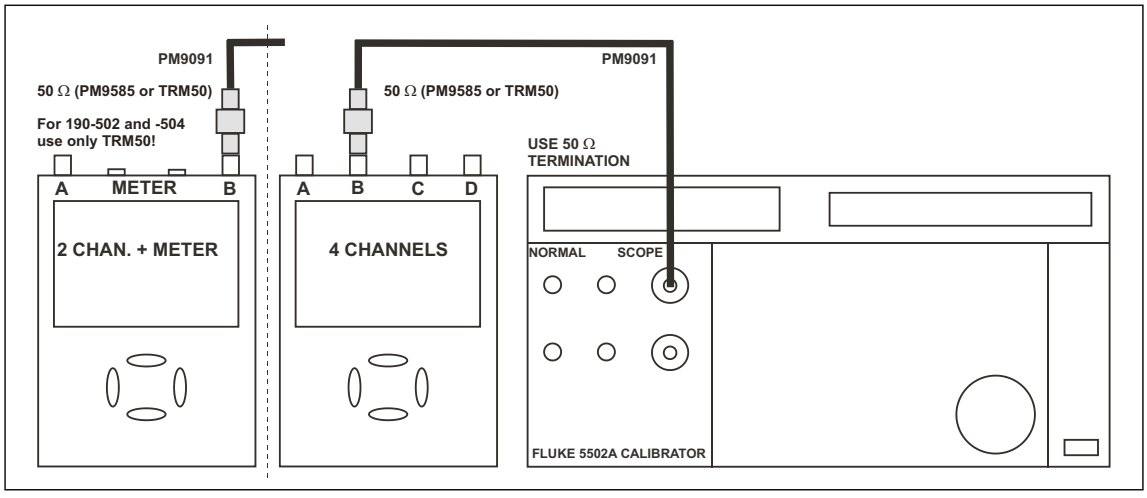
When you are finished, set the 5502A to Standby. Continue at the Input B LF-HF Gain section.

Input B LF-HF Gain

To do the Input B LF-HF Gain calibration:

1. Press **F2** to select the first calibration step in Table 14, *Input B LF-HF Gain*.
2. Connect Ch. B of the Test Tool to the 5502A. See Figure 14.

Figure 14. 5502A Scope Output to Test Tool Input B



3. Set the 5502A SCOPE output to source the signal required for the first calibration point for *Input B LF-HF Gain* (CL 0674, Pos B Fast).

4. Set the 5502A to operate (OPR) or standby (STBY) as indicated.
5. Press **F3** to start the calibration.

   Wait until the display shows calibration status **CL 0529: READY**.
6. Press **F2** to select the next calibration step, set the 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points for *Input B LF-HF Gain and* wait until the display shows calibration status **CL 463: READY**.
7. When you are finished, set the 5502A to Standby.
8. Continue at the *Input C LF-HF Gain* section.

Input C LF-HF Gain

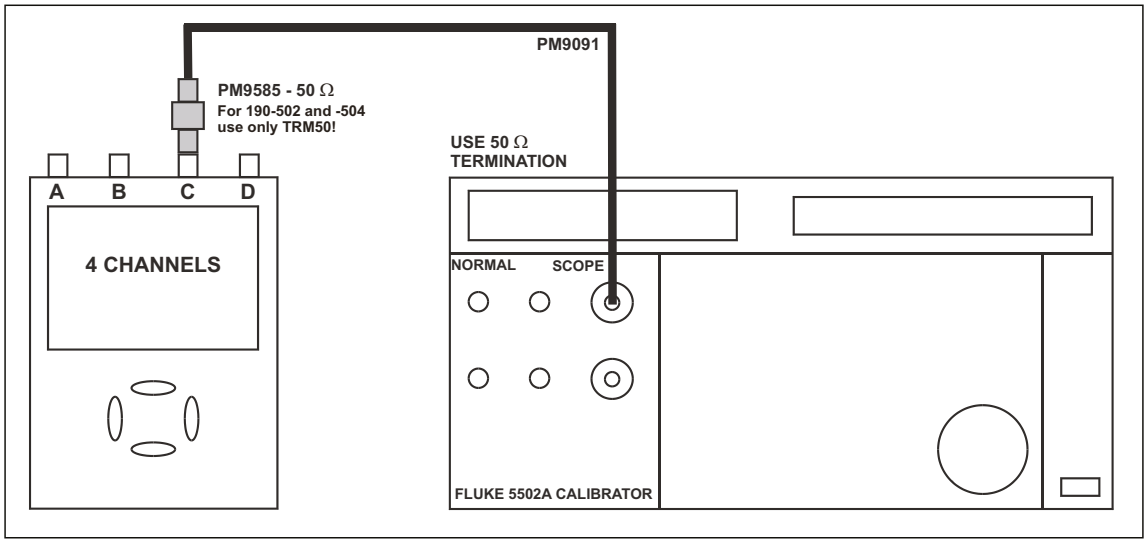
Sections *Input C LF-HF Gain* and *Input D LF-HF Gain* are for 4-channel ScopeMeters (190-104, 190-204, 190M-4, 190-504, and MDA-550-III models). For 2-channel models, see *Input AB Position (All Models)*.

To do the Input C LF-HF Gain calibration:

1. Connect Ch. C of the Test Tool to the 5502A. See Figure 15.

   The display must show step **CL 0694** (Pos C Fast). If it does not, then press **F1** or **F2** to select the first calibration step in Table 14, *Input C LF-HF Gain*.

Figure 15. 5520A Scope Output to Test Tool Input C



2. Set the 5502A SCOPE output to source the signal required for the first calibration point in *Input C LF-HF Gain*.
3. Set the 5502A to operate (OPR) or standby (STBY) as indicated.
4. Press **F3** to start the calibration.

Wait until the display shows calibration status **CL 0549: READY**.

5. Press **F2** to select the next calibration step, set the 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points of *Input C LF-HF Gain*.

6. Wait until the display shows calibration status **CL 0465: READY**.
7. When you are finished, set the 5502A to Standby.
8. Continue at the *Input D LF-HF Gain* section.

Input D LF-HF Gain

To do the Input D LF-HF Gain calibration:

1. Press **F2** to select the first calibration step in Table 14, *Input D LF-HF Gain*.
2. Connect Ch. D of the Test Tool to the 5502A. See Figure 16.
3. Set the 5502A SCOPE output to source the signal required for the first calibration point in *Input D LF-HF Gain* (CL 0675, Pos D Fast).
4. Set the 5502A to operate (OPR) or standby (STBY) as indicated.
5. Press **F3** to start the calibration.

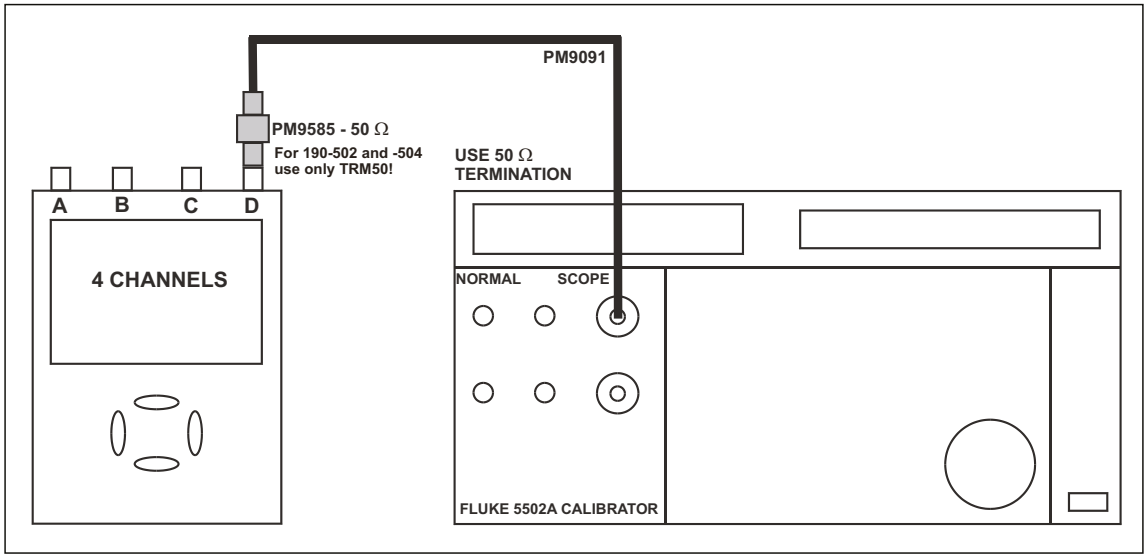
   Wait until the display shows calibration status **CL 0569: READY**.

6. Press **F2** to select the next calibration step, set the 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points of *Input D LF-HF Gain*.

7. Wait until the display shows calibration status **CL 0467: READY**.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Input AB Position (All Models)* section.

Figure 16. 5502A SCOPE Output to Test Tool Input D



Input AB Position (All Models)

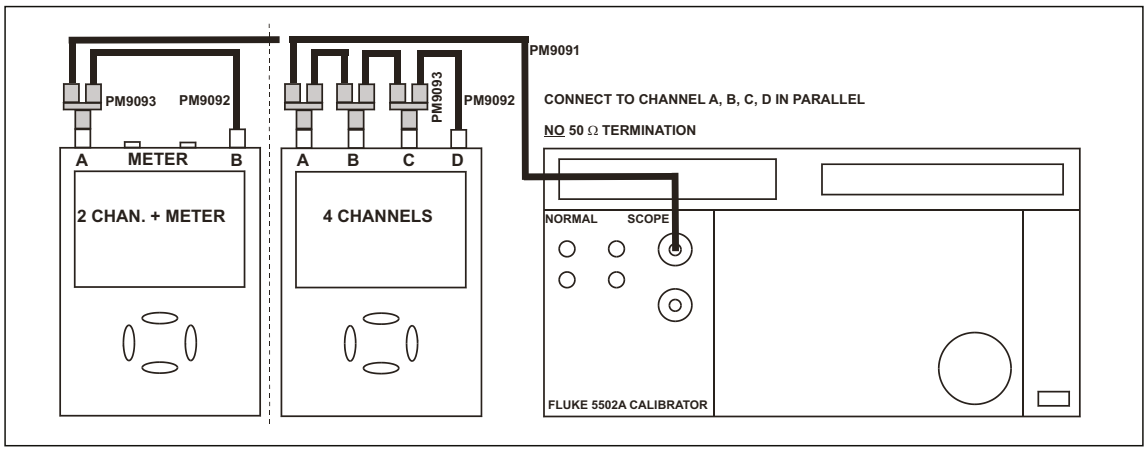
To do the Input AB Position calibration:

1. Press **F2** to select calibration adjustment step **CL 0637** (Pos AB).
2. Set up the test shown in Figure 17 with the 5502A set to supply 1 kHz square wave (SCOPE, MODE volt, SCOPE Z 1 MΩ), of 500 mV to channel A and B.
3. Press **F3** to start the calibration.

   Wait until the display shows calibration status **CL 0637: READY**.

Continue at the *Input AB LF-HF Gain and Position* section.

Figure 17. Test Tool Input ABCD to 5502A Scope Output



Input AB LF-HF Gain and Position

To do the Input AB LF-HF Gain calibration:

1. Press **F2** to select the first calibration step in Table 14, *Input AB Gain and Position*.

   ⚠⚠ Warning

   To prevent possible electrical shock, fire, or personal injury, make sure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool. Dangerous voltages are present on the calibration source and connection cables during these steps.

2. Set the 5502A to operate (OPR).
3. Press **F3** to start the calibration.

   Wait until the display shows calibration status **:READY**.

4. Press **F2** to select the next calibration step, set the 5502A to the next calibration point, and start the calibration. Continue through all calibration points of *Input AB Gain and Position*.

Set the 5502A to Standby, and continue at the *Input Pos ABCD (AB) Calibration* section.

Input Pos ABCD (AB) Calibration

To do the Input Pos AB calibration:

1. Press **F2** to select calibration adjustment step **CL 0619** in Table 14, *Input ABCD (AB)*.
2. Remove all Input A, B connections (Calibrator STBY).
3. Press **F3** to start the calibration.
4. Wait until the display shows calibration status as **CL 0633: READY**.

Continue at the *Input ABCD (AB) Noise F FBW Calibration* section.

Input ABCD (AB) Noise F FBW Calibration

To do the Input AB Noise F FBW Calibration:

1. Press **F2** to select calibration adjustment step **CL 0850** in Table 14, *Input ABCD Noise F FBW*.
2. Connect 50 Ω feed through terminations to all BNC Inputs A, B, (C, and D).
3. Press **F3** to start the calibration.

   Wait until the display shows calibration status as **CL 0869: READY**.

Continue at the *Input AB Volt Gain* section.

Input AB Volt Gain

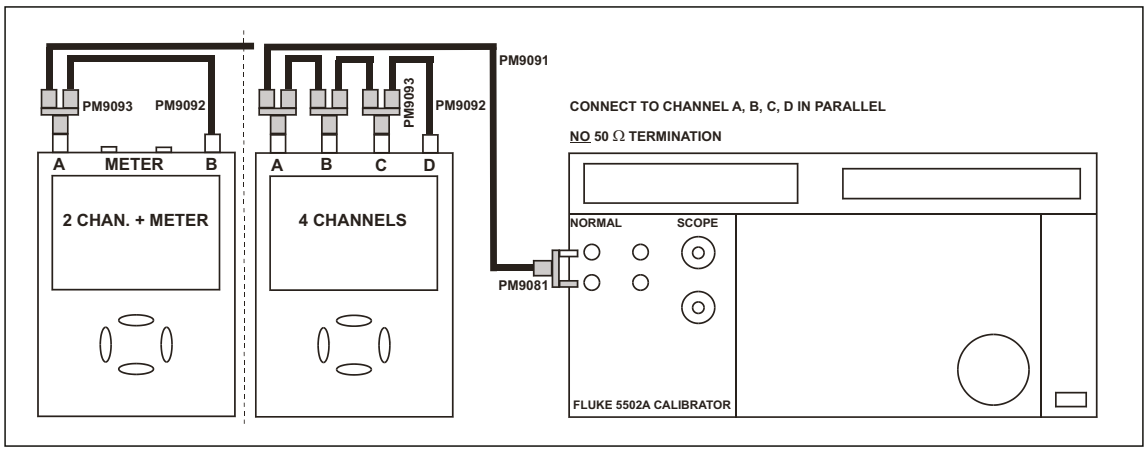
⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, make sure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool. Dangerous voltages are present on the calibration source and connection cables during these steps.

To do the Input AB Volt Gain calibration:

1. Press **F2** to select the **CL 0799** calibration step in Table 14, *Input AB Volt Gain*.
2. Connect Ch. A and B of the Test Tool to the 5502A NORMAL output. See Figure 18.

Figure 18. Test Tool Input AB to 5502A Normal Output



3. Set the 5502A to supply a 50 Hz voltage (NORMAL output), to the first calibration point in *Input AB Volt Gain*.
4. Press **F3** to start the calibration.

   Wait until the display shows calibration status **:READY**.
5. Press **F2** to select the next calibration step, set the 5502A to the next calibration point, and start the calibration. Continue through all calibration steps of *Input AB Volt Gain*.
6. When all calibration steps are done, the display shows calibration status as **CL 0813: READY**:

   a. For 4-channel tools, press **SAVE**.

   b. For 2-channel tools, see *DMM Calibration*.

Set the 5502A to Standby.

DMM Calibration

The adjustment steps for the meter section are only for the models 190-062, 190-102, and 190-202, 190M-2. For 4-channel tools, go to *Save Calibration Data and Exit*.

Multimeter Meter Zero

To do the Multimeter (DMM) Zero calibration:

1. Press **F2** to select calibration adjustment step **CL 0890**.
2. Short circuit (interconnect) the banana jack Meter inputs. Use a test lead as short as possible.
3. Press **F3** to start the zero calibration.

   Wait until the display shows the status **CL 0906: READY**.
4. Remove the input terminations.

Continue at the *Multimeter Volt Gain* section.

Multimeter Volt Gain

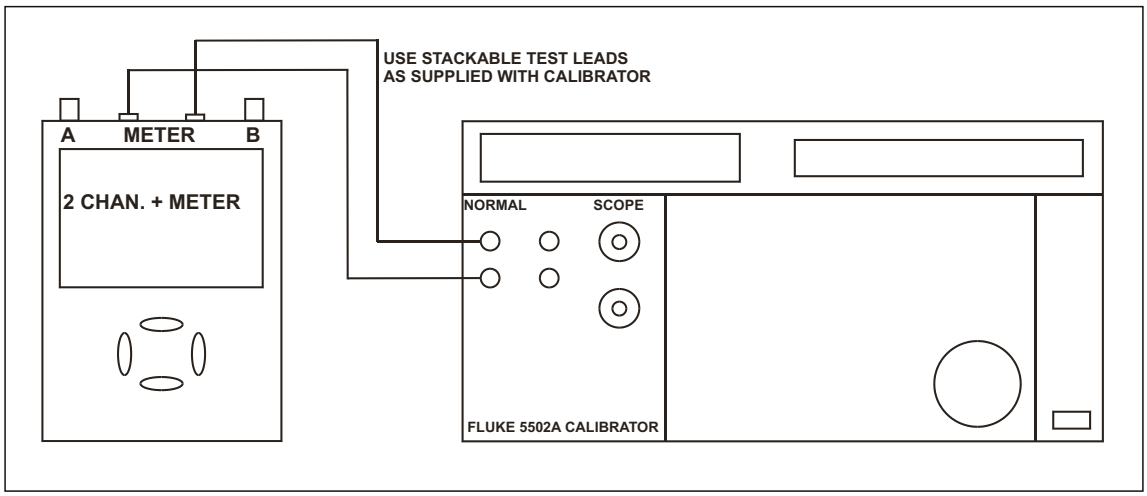
⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, make sure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool. Dangerous voltages are present on the calibration source and connection cables during these steps.

To do the DMM Volt Gain calibration:

1. Press **F2** to select the **CL 0840** calibration step in Table 14, *Multimeter Volt Gain*.
2. Connect the Test Tool to the 5502A. See Figure 19.

Figure 19. 5502A Normal Output to Test Tool Banana Input



3. Set the 5502A to supply a DC voltage to the first calibration point in *Multimeter Volt Gain*.
4. Set the 5502A to operate (OPR).
5. Press **F3** to start the calibration.

   Wait until the display shows calibration status **:READY**.
6. Press **F2** to select the next calibration step, set the 5502A to the next calibration point, and start the calibration. Continue through all calibration points of *Multimeter Volt Gain* until the display shows the status **CL 0844: READY**.

Set the 5502A to Standby, and continue at the *Multimeter Ohm Gain* section.

Multimeter Ohm Gain

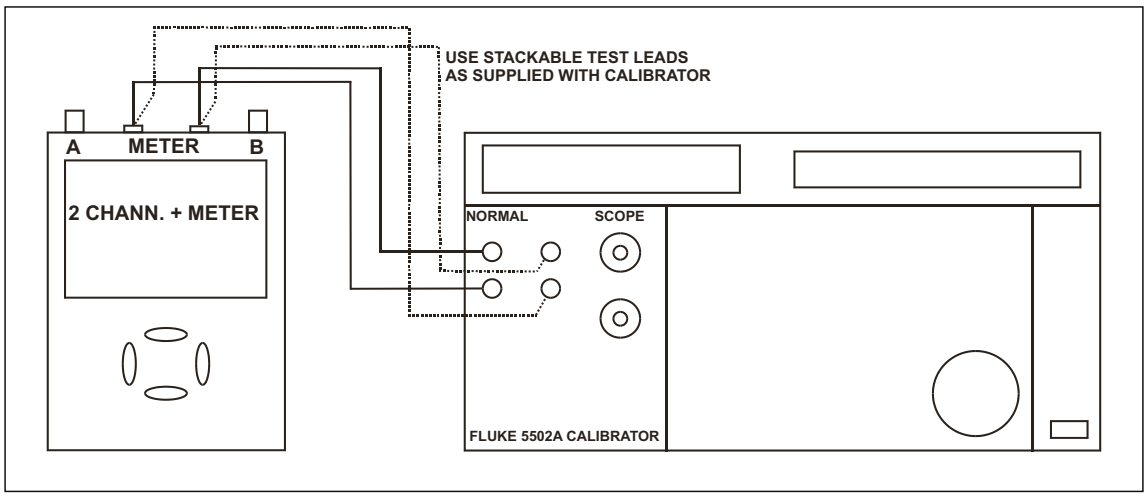
Note

The adjustment steps for the meter section are only for the models 190-062, 190-102, 190-202, 190M-2, and 190-502.

To do the DMM Ohm Gain calibration:

1. Press **F2** to select the **CL 0910** calibration adjustment step in Table 14, *Multimeter Ohm Gain*.
2. Connect the Test Tool to the 5502A. See Figure 20. Notice that the sense leads must be connected directly to the Test Tool inputs.

Figure 20. Four-Wire Ohms Calibration Connections



3. Set the 5502A to the first test point in *Multimeter Ohm Gain*. Use the 5502A "COMP 2 wire" mode for the calibration adjustments up to and including 100 kΩ. For the higher values, the 5502A will turn off the "COMP 2 wire" mode.

4. Set the 5502A to operate (OPR).
5. Press **F3** to start the calibration.

   Wait until the display shows the calibration status **:READY**.
6. Press **F2** to select the next calibration step, set the 5502A to the next calibration point, and start the calibration.
7. Continue through all calibration points for *Multimeter Ohm Gain* until the display shows the status **CL 0916: READY**.

When you are finished, set the 5502A to Standby.

Continue at the *Save Calibration Data and Exit* section.

Save Calibration Data and Exit

To save the calibration data and exit the Maintenance mode:

1. Remove all test leads from the Test Tool inputs.
2. Press **F4** (SAVE). The Test Tool shows on the display:

   Calibration data valid.

   Save data and exit maintenance mode?

   Note

   Calibration data valid indicates that the calibration adjustment procedure is performed correctly. It does not necessarily mean that the Test Tool meets the specifications.
3. Press **F4** (YES) to save and exit.

   Note

   After saving the calibration data, the calibration number and date updates if the calibration data changes and the data are valid. The calibration number and date do not change if:

   - *the calibration mode is entered and left without doing a calibration adjustment*
   - *only the probe calibration was done*
   - *you press* **F3** *(NO), the Test Tool returns to the calibration mode*
   - *you can either calibrate the Test Tool again, or press* **F4** *(EXIT), (YES) to save and exit*

   Error messages:

   WARNING: Calibration data not valid.

   Save data and exit maintenance mode?

Table 14. Calibration Points

Cal Step	DUT Input Signal	5502A Setting
Input A LF-HF Gain Calibration Points (see Figure 13)		
CL 0654	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0415	100 mVpp square wave, 1 kHz	SCOPE edge, 100 mVpp, 1 kHz
CL 0510	2.5 Vpp square wave, 1 kHz	SCOPE edge, 2.5 Vpp, 1 kHz
CL 0580	2.5 Vpp sine wave, 50 kHz	SCOPE levsine, 2.5 Vpp, 50 kHz
CL 0581	2.5 Vpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 2.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0480	500 mVpp sine wave, 50 kHz	SCOPE levsine, 500 mVpp, 50 kHz
CL 0481	0.5 Vpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 0.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0460	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0461	100 mVpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 100 mVpp, 501 MHz 381 MHz 151 MHz 111 MHz
Input B LF-HF Gain Calibration Points (see Figure 14)		
CL 0674	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0435	100 mVpp square wave, 1 kHz	SCOPE edge, 100 mVpp, 1 kHz
CL 0530	2.5 Vpp square wave, 1 kHz	SCOPE edge, 2.5 Vpp, 1 kHz
CL 0582	2.5 Vpp sine wave, 50 kHz	SCOPE levsine, 2.5 Vpp, 50 kHz
CL 0583	2.5 Vpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 2.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0482	500 mVpp sine wave, 50 kHz	SCOPE levsine, 500 mVpp, 50 kHz

Table 14. Calibration Points (cont.)

Cal Step	DUT Input Signal	5502A Setting
CL 0483	0.5 Vpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 0.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0462	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0463	100 mVpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 100 mVpp, 501 MHz 381 MHz 151 MHz 111 MHz
Input C LF-HF Gain Calibration Points (see Figure 15) 4-channel models only		
CL 0656	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0455	100 mVpp square wave, 1 kHz	SCOPE edge, 100 mVpp, 1 kHz
CL 0550	2.5 Vpp square wave, 1 kHz	SCOPE edge, 2.5 Vpp, 1 kHz
CL 0584	2.5 Vpp sine wave, 50 kHz	SCOPE levsine, 2.5 Vpp, 50 kHz
CL 0585	2.5 Vpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 2.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0484	500 mVpp sine wave, 50 kHz	SCOPE levsine, 500 mVpp, 50 kHz
CL 0485	0.5 Vpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 0.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0464	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0465	100 mVpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 100 mVpp, 501 MHz 381 MHz 151 MHz 111 MHz

Table 14. Calibration Points (cont.)

Cal Step	DUT Input Signal	5502A Setting
Input D LF-HF Gain Calibration Points (see Figure 16) 4-channel models only		
CL 0675	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0475	100 mVpp square wave, 1 kHz	SCOPE edge, 100 mVpp, 1 kHz
CL 0590	2.5 Vpp square wave, 1 kHz	SCOPE edge, 2.5 Vpp, 1 kHz
CL 0586	2.5 Vpp sine wave, 50 kHz	SCOPE levsine, 2.5 Vpp, 50 kHz
CL 0587	2.5 Vpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 2.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0486	500 mVpp sine wave, 50 kHz	SCOPE levsine, 500 mVpp, 50 kHz
CL 0487	0.5 Vpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 500 mVpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0466	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0467	100 mVpp sine wave Fluke 190-502/504: 501 MHz Fluke 190-202/204/190M-2/4: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 100 mVpp, 501 MHz 381 MHz 151 MHz 111 MHz
Input AB Position Calibration Points (see Figure 17) all models		
CL 0637	500 mV, 1 kHz, MODE VOLT	
Input AB Gain and Position Calibration Points (see Figure 17)		
CL 0504	500 mV, 1 kHz, MODE VOLT	SCOPE volt, 500 mV, 1 kHz
CL 0624	Open inputs, Calibrator STBY	no signal
CL 0673	50 V, 1 kHz, MODE volt, (set 5502A to OPR!)	SCOPE volt, 50 V, 1 kHz (set 5502A to OPR!)
Input Pos ABCD (AB) Calibration Points		
CL 0619	no signal	
Input ABCD (AB) Noise F FBW Calibration Points		
CL 0850	no signal	

Table 14. Calibration Points (cont.)

Cal Step	DUT Input Signal	5502A Setting
Input ABCD Gain Calibration Points (see Figure 18)		
CL 0799	5 mV, 50 Hz	Normal output
CL 0800	12.5 mV, 50 Hz	
CL 0801	25 mV, 50 Hz	
CL 0802	50 mV, 50 Hz	
CL 0803	125 mV, 50 Hz	
CL 0804	250 mV, 50 Hz	
CL 0805	500 mV, 50 Hz	
CL 0806	1.25 V, 50 Hz	
CL 0807	2.5 V, 50 Hz	
CL 0808	5 V, 50 Hz	
CL 0809	12.5 V, 50 Hz	
CL 0810	25 V, 50 Hz	
CL 0811	50 V (set 5502A to OPR!), 50 Hz	
CL 0812	125 V, 50 Hz	
CL 0813	250 V, 50 Hz	
DMM Meter Zero Calibration Points (2-channel models only)		
CL 0890	no input, see *Multimeter Meter Zero*	SCOPE Off, 0 V, 0 Hz, Operate
DMM Volt Gain Calibration Points (see Figure 19)		
CL 0840	500 mV, 0 Hz	SCOPE Off, 500 mV, 0 Hz
CL 0849	2.5 V, 0 Hz	SCOPE Off, 2.5 V, 0 Hz
CL 0841	5 V, 0 Hz	SCOPE Off, 5 V, 0 Hz
CL 0842	50 V (set 5502A to OPR!), 0 Hz	SCOPE Off, 50 V, 0 Hz, Operate
CL 0843	500 V, 0 Hz	SCOPE Off, 500 V, 0 Hz
CL 0844	1000 V, 0 Hz	SCOPE Off, 1000 V, 0 Hz
Ohm Gain Calibration Points (see Figure 20)		
CL 0910	100 Ω	SCOPE Off, 100 Ω, Operate
CL 0911	1 kΩ	
CL 0912	10 kΩ	
CL 0913	100 kΩ	
CL 0914	1 MΩ	
CL 0915	10 MΩ	
CL 0916	100%: READY	

Error messages

Proceed as follows if an error message ERROR: nnnn shows on the display during calibration:

- if nnnn <5000, check input signal and test leads and press **F2** to repeat the current step.
- if nnnn ≥5000, check input signal and test leads and repeat the final calibration in the *Warming-Up 2, Warm-Up Final, and ADC Timing*.

If the error persists, the Test Tool is defective.

Probe Calibration

To adjust the VPS410-II or VPS421 100:1 probes, see the *Users Manual*.

Disassembly and Reassembly Procedures

This section provides the required disassembly procedures. The printed circuit assembly removed from the Test Tool must be adequately protected against damage.

The Test Tool contains static sensitive components. Handling and servicing these components should be done only at a static free workstation by qualified personnel.

The Test Tool contains a Li-ion battery pack. See Section 1 for instructions on how to safely handle and use this battery pack. The Users Manual is available at www.fluke.com.

The Test Tool uses self-tapping screws. For longer life, use a hand-operated screwdriver to reinsert the screws into the same screw-hole threads on the case.

See Figure 22, Figure 23, and Figure 24 for disassembly.

⚠⚠ Warning

To prevent electric shock, disconnect test leads, probes and power supply from any live source and from the Test Tool itself. Always remove the battery pack before completely disassembling the Test Tool. Only qualified personnel using customary precautions against electric shock should work on a disassembled unit with power on.

Required Tools

To access all the assemblies, you need:

- Static-free work surface and anti-static wrist wrap
- #10 Torx screwdriver
- A small screwdriver or pair of tweezers to unlock flat cables from their connector
- Cotton gloves (to avoid contaminating the lens and the PCA)

Remove the Tilt Stand, Hang Strap, and Side Strap

To separate the tilt stand from the rear case:

1. Gently bend one rotation point away from the rear case.
2. Move the stand away from the housing.

   There is no need to remove screws or other fixing devices.
3. Before opening the Test Tool, remove the hang strap and the side strap. See the Users Manual.

   The grip of the side strap consists of two halves kept together with hook-and-loop tape. The straps can be taken apart and removed from their fixing dowels in the side of the Test Tool. Before you do this, take careful notice on the correct position of the strap.
4. To install, work in reverse order.

Open the Test Tool, Remove the Battery Pack

To remove the battery:

1. Turn the plastic battery door screws one-quarter turn counterclockwise with a standard blade screwdriver.
2. Remove the battery access door.
3. Remove the battery from the instrument.

   Note

   Do not short circuit the battery contacts. Do not open or damage the battery housing.
4. If attached, remove the hang strap and the side strap (see *Remove the Tilt Stand, Hang Strap, and Side Strap*).
5. Loosen the two black self-tapping screws that fasten the grey/yellow input cover around the BNC input and banana sockets.
6. Remove the cover.

   Note

   When reinstalling the input cover do not forget to reinstall the flexible sealing strip around the input sockets. The holes in this strip have a flat side that must align with the flat side of the BNC input sockets. The strip has six holes.

   When reinstalling the input cover, reinstall the four steel pins (2x17 mm) in the left side and right side of the Test Tool. The pins are used to attach the hang strap and the side strap.
7. Remove the two screws M3x10 (total length) from the bottom holster. The screws fit into square nuts that fit into the rear case.
8. Remove the bottom holster.

   Note

   When reinstalling the holster, reinstall the two steel pins (2x17 mm) in the left side and right side of the instrument. The pins are used to attach the side strap. Take care that the yellow covers for the DC input and USB inputs are in place correctly.
9. Remove the four self-tapping screws 16 mm long (total length) that attach the rear case. Two of these screws are located in the battery compartment.
10. Remove the rear case.

    Note

    When reinstalling the rear case, do not forget to put the steel plate 16x17 mm in place again. This plate is in the cavity on the right-hand side of the Test Tool and can be used to attach a Kensington Lock.

    When reinstalling the bottom case, take care that the flat cables to the LCD and keyboard are not damaged between the case parts.

How to Access the Top Side of PCA

Most of the measurement points are located on the top side of the PCA.

For access to this side, remove the upper plate (shielding lid):

1. Remove the four screws M3x6.5 (total length) with a spring-washer (left side, right side, and bottom side).
2. Remove the four screws M3x10 (total length) that are grouped in a square around the sampling chip N2000.
3. Observe how the screening plate fits onto the lower chassis before you remove this plate to access the top side of the PCA.

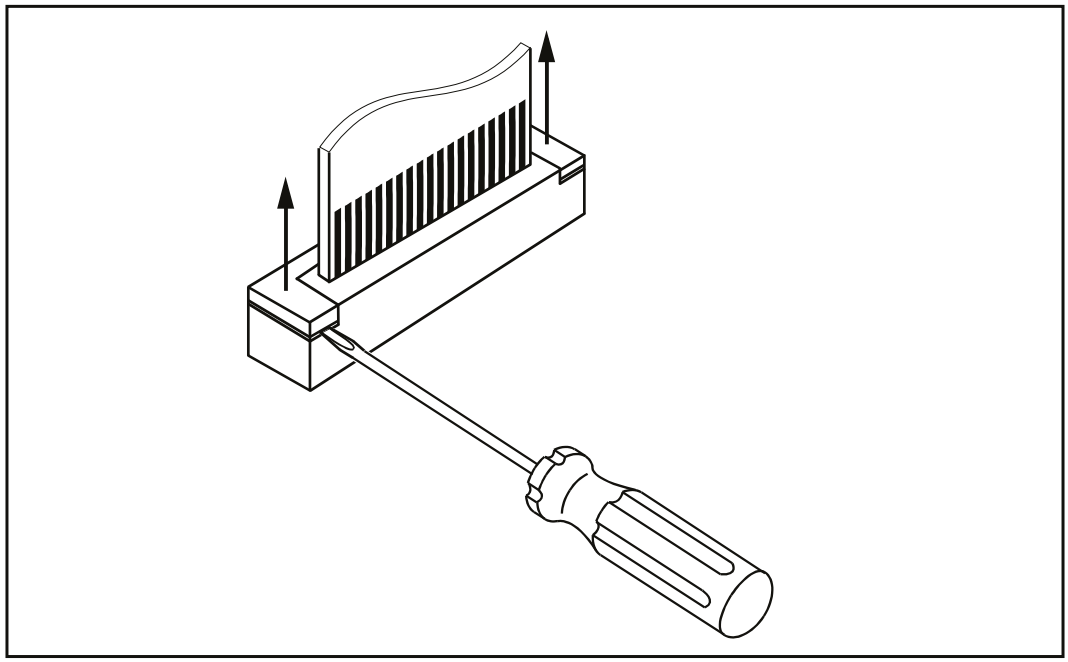
How to Access the Bottom Side of PCA

To avoid contaminating the flex cable contacts with grease from your fingers, wear cotton gloves or do not touch these contacts. Contaminated contacts might not cause immediate instrument failure. Failures typically show up when contaminated instruments are operated in humid areas.

To access:

1. Unlock both flat cables by shifting the connector latch at the left and right edge with a small screwdriver. The latch is an integral part of the connector body. See Figure 21.

Figure 21. Flat Cable Connector



2. Remove the flat cables from connector X9303 (to LCD) and J9414 (to keyboard).
3. Remove the four screws M3x10 that fix the PCA to the lower chassis (shielding assembly).

4. Carefully slide the PCA out of the holes for the BNCs and Banana Jacks (2-ch Test Tools). The A, B, and Meter input circuits are covered with an isolation foil.
5. Take careful notice on how the foil is positioned around the PCA before you remove the foil as far as required to repair a defective channel.
6. Remove a screw M3x22 that fixes the top and bottom screening of the suspected channel.
7. Reinsert the flat cables if you want to measure the bottom side of the PCA under working condition. See Figure 22, Figure 23, and Figure 24.

Note

Before you attach the PCA again to the lower chassis plate, place the isolation foils around the channels.

Access to LCD, Keypad Foil, and Keypad

To access:

1. Unlock both flat cables by shifting the connector latch at the left and right edge using a small screwdriver. The latch is an integral part of the connector body.
2. Remove the flat cables from connector X9303 (to LCD) and J9414 (to keyboard).
3. Remove 6 self-tapping screws 10 mm long (total length) that fix the Main PCA module to the top case assembly.
4. Separate the Main PCA module from the top case.

   Now you have access to LCD-module, keypad foil and keypad. They can be separated from the top case without the removal of screws or clamps.
5. To prevent contamination, wear cotton gloves or do not touch contact areas with your hands.

Note

When installing the LCD-module into the top case, take care that no dust or dirt is present between module and the window/decal.

Before reinstalling the Main PCA module on to the top case, place the grey plastic strip around the BNC inputs.

Disassembly Steps

See Figure 22, Figure 23, and Figure 24 for guidance on disassembly.

Note

Figures may be subject to minor changes without prior notice.

Figure 22. Opened Case and Screws

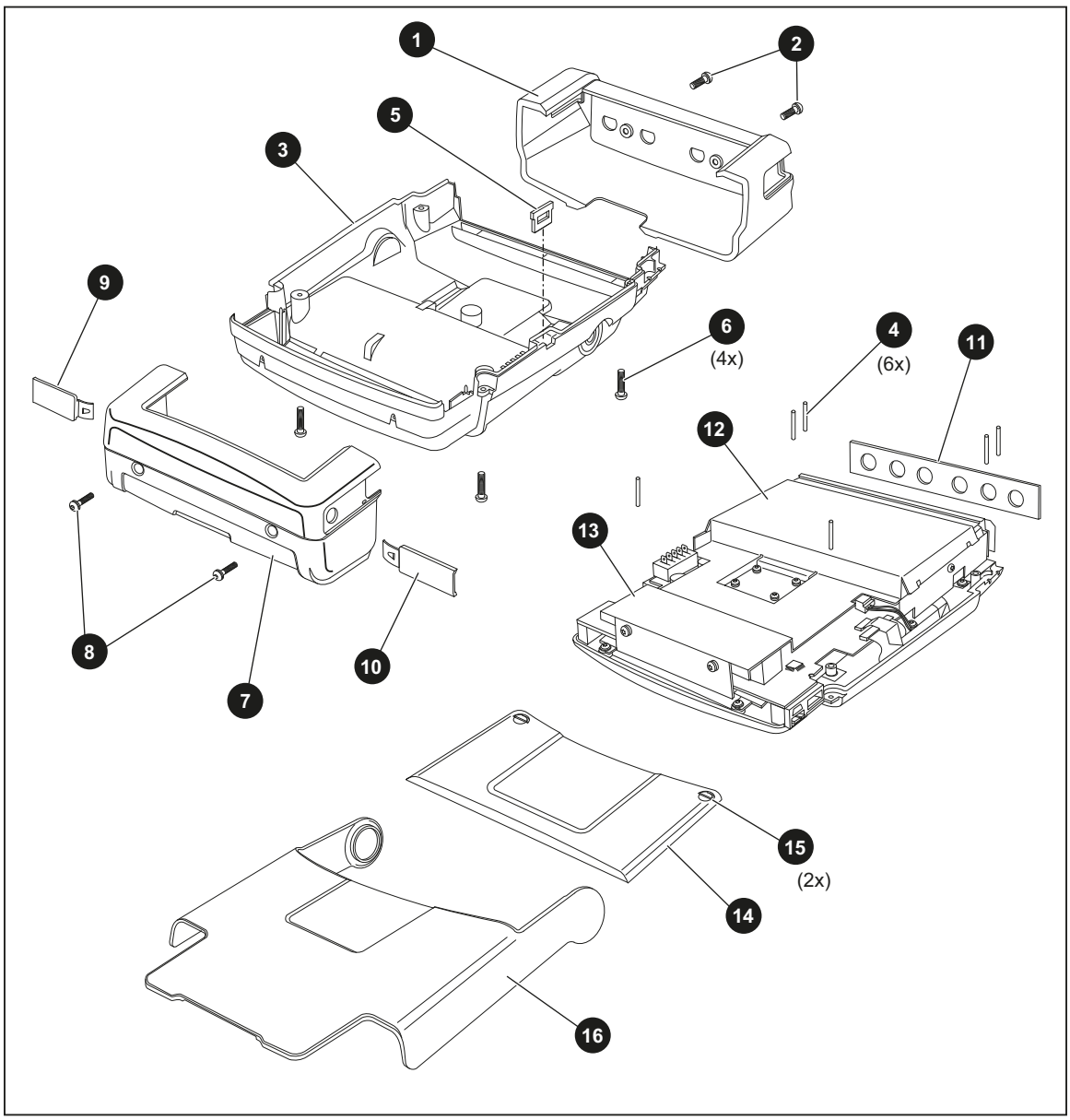


Figure 23. Screening Plate Removed and Screws

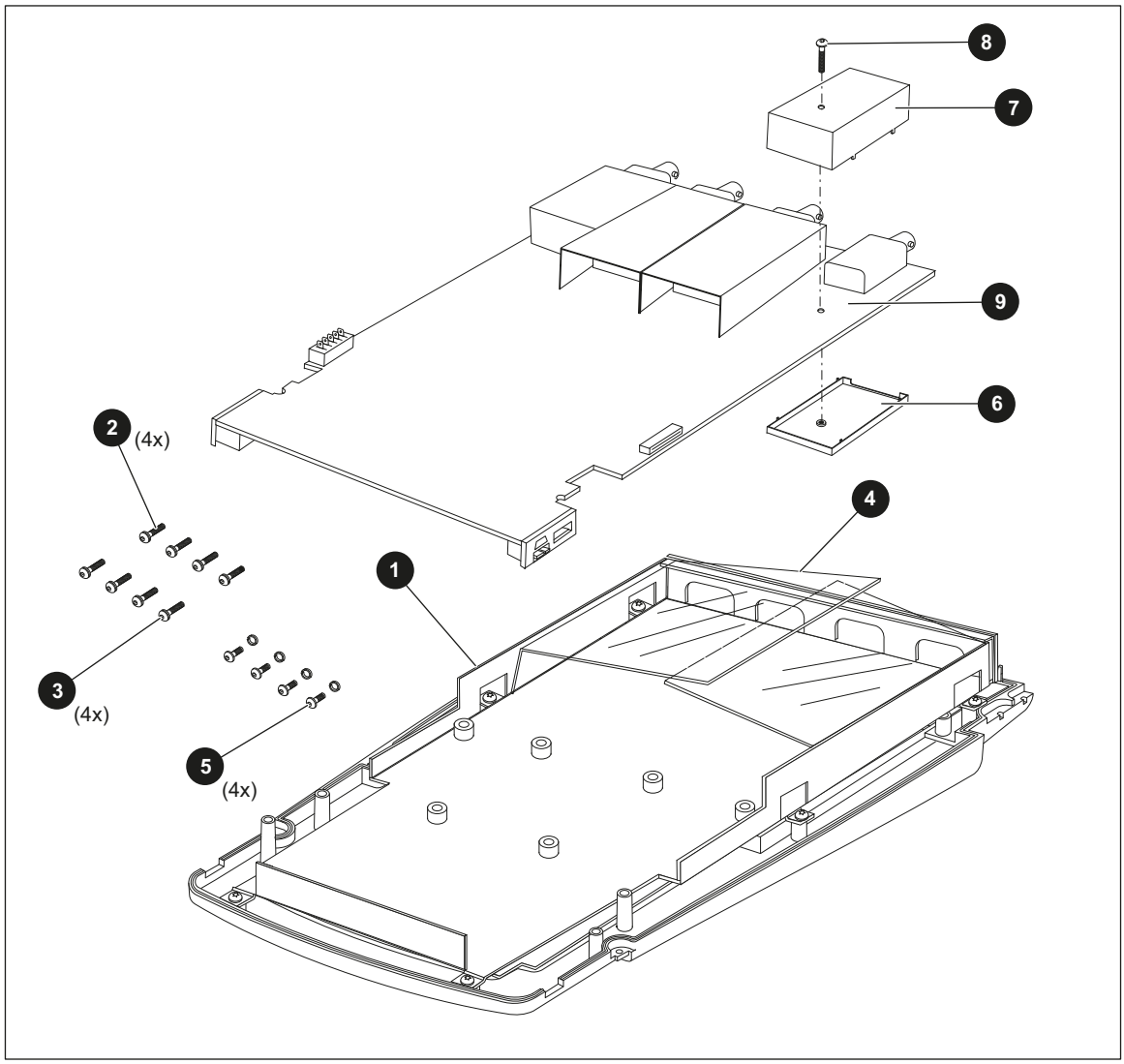
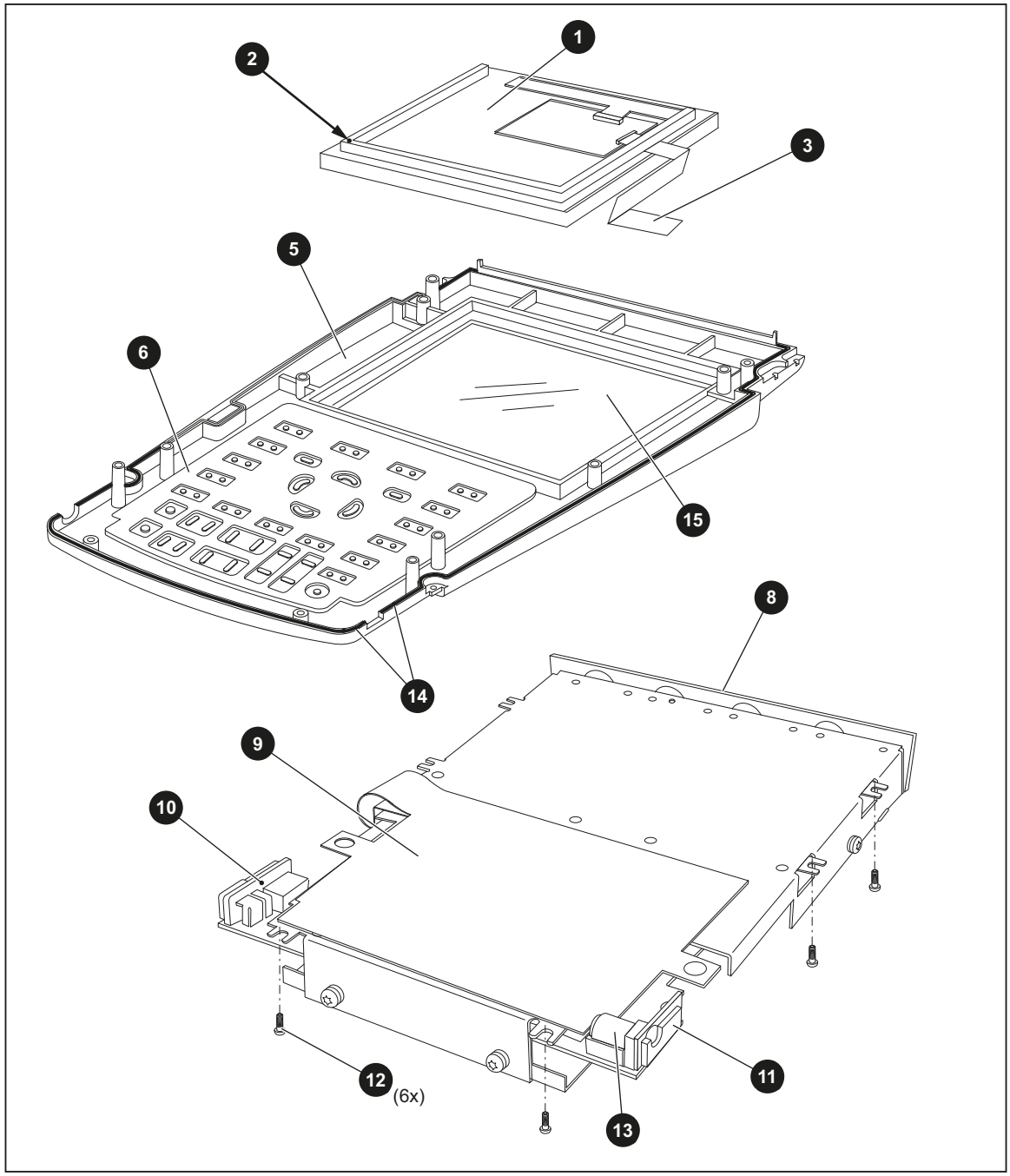


Figure 24. PCA Removed from Chassis, Bottom Side Visible



Parts List

This section contains a list of replaceable parts for all the models of the Test Tool. Parts are listed by assembly and alphabetized by item number or reference designator. The figures show the location of each part and the item number or reference designator.

The parts list shows:

- Description
- Ordering code

⚠ Caution

Electrical components, and in particular active components such as ICs, transistors, and diodes, may be damaged by static discharge.

Only qualified personnel at a static-free workstation should handle and service static-sensitive components and assemblies.

How to Obtain Parts

To locate an authorized service center, go to www.fluke.com.

In the event that the part ordered has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

To ensure prompt delivery of the correct part, include the following information when you place an order:

- Instrument model (for example, 190-502-III) and serial number (25530001) that is printed on the type plate on the bottom cover
- Ordering code
- Item number - Reference designator
- Description
- Quantity

Final Assembly Parts

See Table 15 and Figure 22, Figure 23, and Figure 24 for the Final Assembly parts.

Caution

The Test Tool contains a Li-ion battery. Do not mix with the solid waste stream. Spent batteries should be disposed of by a qualified recycler or hazardous materials handler.

Table 15. Final Assembly Parts and Kits

Part or Kit	Order Code	Includes	Figure/Item Number
Top holster (Input Cover 2 channels + meter)	4035397	--	22 / 1
Top holster (Input Cover 4 channels)	3945328	--	22 / 1
Sealing strip (flexible) around inputs	3945319	Set of 2: 1 pc for 4 channel + 1 pc for 2 channel instruments	22 / 11
Tab Mounting Material Set	3981859	Self tapping Screw 10 mm (2x, to fix input cover)	22 / 2
		Dowel (6x, to fix straps)	22 / 4
		Steel Plate for Lock	22 / 5
		Self tapping Screw 16.5 mm (4x, to fix Rear Case)	22 / 6
		Screw M3x6 (2x, to fix bottom holster)	22 / 8
		Self tapping Screw (6x, 10.5 mm to fix Main PCA Module to Front Case)	24 / 12
Side Strap (handstrap) 190 series/MDA-550-III	3945370	Can be attached to left or right side	--
Bottom Holster Set	3981867	Bottom holster assy	22 / 7
		Cover for USB	22 / 9
		Cover for DC adapter power	22 / 10
Case Set 4-channel	5325233	Front case (excludes lens/decal) 4-channel	24 / 5
		Case seal	24 / 14
		Bottom case assy (includes decal with warnings and markings)	22 / 3
		Battery door	22 / 14
		1/4-turn screw (2x)	22 / 15
		Adhesive foam (for battery door)	--
		Standup bracket	22 / 16

Table 15. Final Assembly Parts and Kits (cont.)

Part or Kit	Order Code	Includes	Figure/Item Number
Case Set 2-channel	5325240	Front case (excludes lens/decal) 2-channel	24 / ❺
		Case seal	24 / ⓮
		Bottom case assy (includes decal with warnings and markings)	22 / ❸
		Battery door	22 / ⓮
		1/4-turn screw (2x)	22 / ⓯
		Adhesive foam (for battery door)	--
		Standup bracket	22 / ⓰
Connector Set	3981871	Probe signal pin (J8010)	not shown individually
		Probe ground pin (J8011)	
		USB-A connector (J8007)	
		USB-B mini connector (J8003)	
		Faston pin battery (5x, X9104-9108)	
		Cushion (fits around Faston pins)	
		Sealing piece USB/Probe (black)	24 / ❿
		Sealing piece DC power (black)	24 / ⓫
BNC Connector, red, 500 MHz	4306959	X1100	not shown individually
BNC Connector, blue, 500 MHz	4306967	X1300	
BNC Connector, gray, 500 MHz	4306971	X1400	
BNC Connector, green, 500 MHz	4306980	X1200	
Banana Jack, black	4035403	X1501	
Banana Jack, red	4035415	X1500	
1/4-turn fastener (single piece)	948609	for battery door (requires 2)	22 / ⓯
Lens/decal 190-062-III	5325257	--	24 / ⓯
Lens/decal 190-102-III	5325269	--	24 / ⓯
Lens/decal 190-104-III	5325278	--	24 / ⓯
Lens/decal 190-202-III	5325284	--	24 / ⓯
Lens/decal 190-204-III	5325291	--	24 / ⓯

Table 15. Final Assembly Parts and Kits (cont.)

Part or Kit	Order Code	Includes	Figure/Item Number
Lens/decal 190-502-III	5325305	--	24 / 15
Lens/decal 190-504-III	5325310	--	24 / 15
Lens 190M-2-III	5325322	--	24 / 15
Lens 190M-4-III	5325331	--	24 / 15
Lens/decal MDA-550-III	5325346	--	24 / 15
LCD assy Flk-190-III	5325354	LCD module	24 / 1
		LCD fixation foam	24 / 2
		Flat cable	24 / 3
Keypad 4 channels 190-III	5325387	--	24 / 6
Keypad 2 ch. + DMM 190-III	5325393	--	24 / 6
Keypad, MDA-550-III	5325400	--	24 / 6
Keypad Foil (all models)	5325417	includes flat cable	24 / 9
DC Power Input Socket, 190-III & 430-II	1285578	X9100	24 / 13
BP290 Li-ion Battery Pack	4025762	26 Wh, 10.8 V (available as accessory)	not shown
BP291 Li-ion Battery Pack	3894688	52 Wh, 10.8 V (available as accessory)	not shown
Hang Strap	946769	attach to top of instrument	not shown

Accessory List

The up-to-date accessory list is at www.fluke.com.