FLUKE

ScopeMeter 190 Series II

Fluke 190-062, -102, -104, -202, - 204

Service Manual

PN 4822 872 05405
July 2011, Rev. 4, March 2013

PLACING ORDERS AND GETTING ASSISTANCE

To locate an authorized service center, visit us on the World Wide Web:

http://www.fluke.com

or call Fluke using any of the phone numbers listed below:

+1-888-993-5853 in U.S.A. and Canada

+31-40-2675200 in Europe

+1-425-446-5500 from other countries

Table of Contents

Chapter 1
Safety Instructions

Title **Page**

1.1 Introduction

Read these pages carefully before beginning to install and use the Test Tool.

The following paragraphs contain information, cautions and warnings which must be followed to ensure safe operation and to keep the Test Tool in a safe condition.

Warning

Servicing described in this manual is to be done only by qualified service personnel. To avoid electrical shock, do not service the Test Tool unless you are qualified to do so.

1.2 Safety Precautions

For the correct and safe use of this Test Tool it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual. Specific warning and caution statements, where they apply, will be found throughout the manual. Where necessary, the warning and caution statements and/or symbols are marked on the Test Tool.

1.3 Caution and Warning Statements

Caution

Used to indicate correct operating or maintenance procedures to prevent damage to or destruction of the equipment or other property.

Warning

Calls attention to a potential danger that requires correct procedures or practices to prevent personal injury.

1.4 Symbols

The following symbols are used on the Test Tool, in the Users Manual, in this Service Manual, or on spare parts for this Test Tool.

	See explanation in Users Manual		DOUBLE INSULATION (Protection Class)
	Live voltage		Earth Ground
	Static sensitive components (black/yellow).	 Li-Ion	Recycling information
	Disposal information		Conformité Européenne

Table cont'd on next page:

	Battery Safety Approval		Safety Approval
	Conforms to relevant Australian standards		RoHS China

1.5 Impaired Safety

Whenever it is likely that safety has been impaired, the Test Tool must be turned off and disconnected from line power. The matter should then be referred to qualified technicians. Safety is likely to be impaired if, for example, the Test Tool fails to perform the intended measurements or shows visible damage.

1.6 General Safety Information

Warning

Removing the Test Tool covers or removing parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can be dangerous to life.

The Test Tool shall be disconnected from all voltage sources before it is opened.

Capacitors inside the Test Tool can hold their charge even if the Test Tool has been separated from all voltage sources.

When servicing the Test Tool, use only specified replacement parts.

1.7 Safe Handling and Use of Li-ion battery pack

The Test Tool uses a rechargeable Li-ion battery pack model BP290 (26 Wh) or BP291 (52 Wh).

For instructions how to safely handle and use this battery pack refer to Paragraph “Safety Information” in the Users Manual of Fluke 190-062, 190-102, 190-104, 190-202, 190-204, 190-502 (ScopeMeter 190 Series II).

The Users Manual can be downloaded from Fluke’s website.

Chapter 2
Characteristics

For the specifications refer to the “Specifications” Chapter 8 in the Fluke 190-062, 190-102, 190-104, 190-202, 190-204, 190-502 (ScopeMeter 190 Series II) Users Manual.

The Users Manual can be downloaded from Fluke’s website.

Chapter 3
List of Replaceable Parts

Title **Page**

3.1 Introduction

This chapter contains an illustrated list of replaceable parts for the models Fluke 190 Series II ScopeMeter test tools. Parts are listed by assembly; alphabetized by item number or reference designator. Each assembly is accompanied by an illustration showing the location of each part and its item number or reference designator. The parts list gives the following information:

- Item number or reference designator (for example, “R1201”)
- Description
- Ordering code

Caution

Electrical components and in particular active components such as IC’s, transistors and diodes may be damaged by static discharge.
Handling and servicing static sensitive components and assemblies should be done only at a static free workstation by qualified personnel.

3.2 How to Obtain Parts

To locate an authorized service center refer to the second page of this manual (back of the title page).

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 Fluke-190-104), 12 digit instrument code (9444 ... .), and serial number (15500001). The items are printed on the type plate on the bottom cover.
- Ordering code
- Item number - Reference designator
- Description
- Quantity

3.3 Final Assembly Parts

See Table 3-1 and Figure 3-1, 3-2 and 3-3 for the Final Assembly parts.

Table 3-1. Final Assembly Parts and Kits

Part or Kit	Ordering Code	Consists of Following Parts	Figure/Item nr
Case Set **4** channel	3981815	Front case (Excl. lens/decal) 4 channel	3-3 / 5
		Dustseal long (2x)	3-3 / 3
		Dustseal short (2x)	3-3 / 4
		Case seal	3-3 / 13
		Bottom case assy	3-1 / 3
		Battery door	3-1 / 14
		Quarter turn screw (2x)	3-1 / 15
		Adhesive foam (for battery door)	--
		Standup bracket	3-1 / 14
Case Set **2** channel	4035349	Front case (Excl. lens/decal) 2 channel	3-3 / 5
		Dustseal long (2x)	3-3 / 3
		Dustseal short (2x)	3-3 / 4
		Case seal	3-3 / 13
		Bottom case assy	3-1 / 3
		Battery door	3-1 / 14
		Quarter turn screw (2x)	3-1 / 15
		Adhesive foam (for battery door)	--
		Standup bracket	3-1 / 14
Quarter turn screw	948609	For battery door (1x)	3-1 / 15
Li-ion Battery Pack	BP290	26 Wh, 10.8 V	---
Li-ion Battery Pack	BP291	52 Wh, 10.8 V	---
Lens/decal 190-062	4035360	---	3-3
Lens/decal 190-102	4035372	---	3-3
Lens/decal 190-104	3981826	---	3-3
Lens/decal 190-202	4035324	---	3-3
Lens/decal 190-204	3981832	---	3-3
Lens/decal 190-502	4035385	---	3-3
LCD assy Flk-190-II	3981844	LCD module LCD fixation foam Flat cable	3-3 / 1 3-3 / 2 3-3 / 7
Topholster (Input Cover 2 ch. + meter)	4035397	---	3-1 / 1
Topholster (Input Cover 4 channels)	3945328	---	3-1 / 1
Sealing strip (flexible) around inputs	3945319	---	3-1 / 11
Mounting Material Set	3981859	Selftapping Screw 10 mm (2x, to fix input cover)	3-1 / 2
		Dowel (6x, to fix straps)	3-1 / 4
		Steel Plate for Lock	3-1 / 5
		Selftapping Screw 16.5 mm (4x, to fix Rear Case)	3-1 / 6
		Screw M3x6 (2x, to fix bottom	3-1 / 8

Part or Kit	Ordering Code	Consists of Following Parts	Figure/Item nr
		holster)	
		Selftapping Screw (6x, 10.5 mm to fix Main PCA Module to Front Case)	3-3 / 12
Side Strap	3945370	Can be fixed on Left or Right side	---
Hang Strap	946769	Can be fixed op Top Side of Instrument	---
Bottom Holster Set	3981867	Bottomholster assy	3-1 / 7
		Cover for USB	3-1 / 9
		Cover for DC adapter power	3-1 / 10
Connector Set	3981871	Probe signal pin (J8010)	
		Probe ground pin (J8011)	
		USB-A connector (J8007)	
		USB-B mini connector (J8003)	
		Faston pin battery (5x, X9104-9108)	
		Cushion (Fits around Faston pin)	
		Sealing piece USB/Probe (black)	3-3 / 10
		Sealing piece DC power (black)	3-3 / 11
Keypad 4 channels	3942805	---	3-3/ 6
Keypad 2 ch. + meter	4035336	---	3-3/ 6
Keypad Foil (all models)	3942810	(Incl. Flat Cable)	3-3 / 9
USB cable	3945381	USB-A to mini-USB-B (for PC connection)	---
BNC Connector Red	3945031	X1100	---
BNC Connector Blue	3945046	X1300	---
BNC Connector Gray	3945054	X1400	---
BNC Connector Green	3945068	X1200	---
Banana Jack Black	4035403	X 1501	---
Banana Jack Red	4035415	X 1500	---
DC Power Input Socket	215785	X9100	---

Figure 3-1

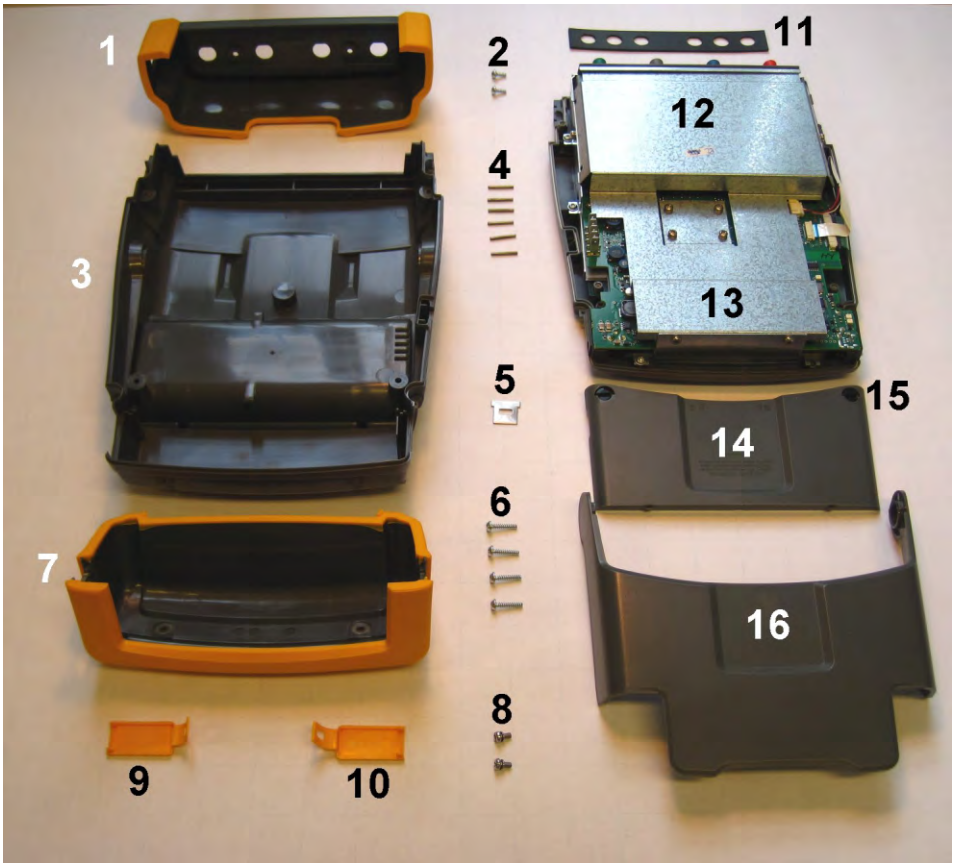


Figure 3-2

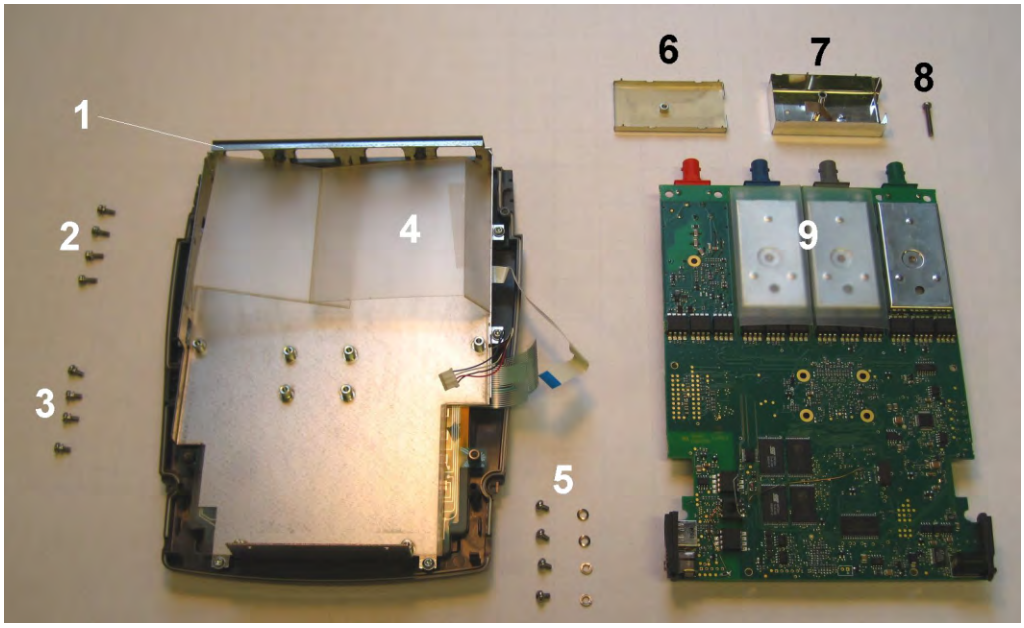
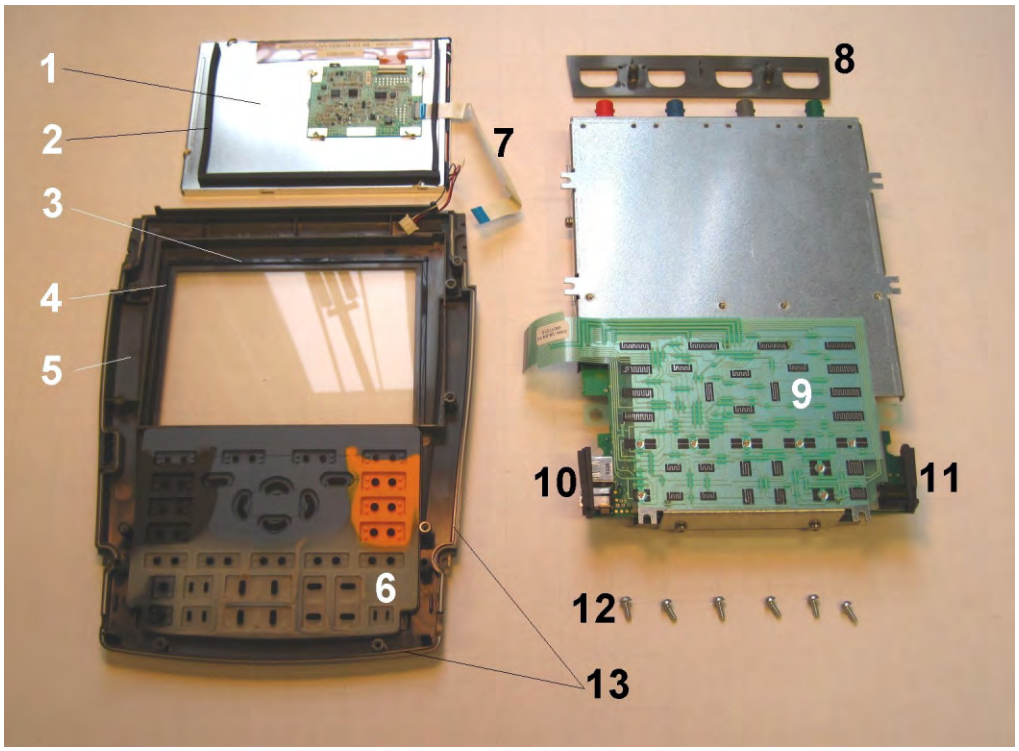


Figure 3-3



Note

Li-ion

The test tool contains a Li-ion battery. Do not mix with the solid wastestream. Spent batteries should be disposed of by a qualified recycler or hazardous materials handler.

3.5 Accessories

For a list with accessories refer to the “Maintaining the Test Tool” Chapter in the Fluke ScopeMeter 190 Series II Users Manual.

The Users Manual can be downloaded from Fluke’s website.

Chapter 4
Performance Verification

Title **Page**

4.1 Introduction

Warning

Procedures in this chapter should be performed by qualified service personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

The Fluke 190 Series II ScopeMeter Test Tools family consists of following models:

Model	Description of main features
190-062	Two 60 MHz Scope Inputs (BNC), one Meter Input (banana jacks).
190-102	Two 100 MHz Scope Inputs (BNC), one Meter Input (banana jacks).
190-104	Four 100 MHz Scope Inputs (BNC)
190-202	Two 200 MHz Scope Inputs (BNC), one Meter Input (banana jacks).
190-204	Four 200 MHz Scope Inputs (BNC).
190-502	Two 500 MHz Scope Inputs (BNC), one Meter Input (banana jacks). This model has a separate Service Manual.

The Fluke 190 Series II ScopeMeter® Test Tool (referred to as Test Tool) should be calibrated and in operating condition when you receive it.

The following performance tests are provided to ensure that the Test Tool is in a proper operating condition. If the Test Tool fails any of the performance tests, calibration adjustment (see Chapter 5) and/or repair (see Chapter 7) is necessary.

The Performance Verification Procedure is based on the specifications, listed in Chapter 2 of this Service Manual. The values given here are valid for ambient temperatures between 18 °C and 28 °C.

The Performance Verification Procedure is a quick way to check most of the Test Tool's specifications. Because of the highly integrated design of the Test Tool, it is not always necessary to check all features separately.

4.2 Equipment Required For Verification

The primary source instrument used in the verification procedures is the Fluke 5500A. If a 5500A is not available, you can substitute another calibrator as long as it meets the minimum test requirements.

- Fluke 5500A Multi Product Calibrator, including SC300 or SC600 Oscilloscope Calibration Option.
- Stackable test leads (4x) as supplied with the 5500A (required for Test Tools with a meter section with banana jacks and 2 BNC oscilloscope inputs: 190-062, 190-102, 190-202).
- 50Ω Coax Cables (4x): use Fluke PM9091 (1.5m, 3 pcs.) and PM9092 (0.5m, 3 pcs.).
  For Test Tools with with meter section with banana jacks and 2 BNC oscilloscope inputs (190-062, 190-102, 190-202) 2 Coax Cables are sufficient.
- Male BNC to Dual Female BNC adapter (3x), Fluke PM9093/001.
  For Test Tools with with meter section with banana jacks 1 adapter is sufficient.
- 50Ω feed through termination, use for example Fluke PM9585 or Fluke TRM50.

- Dual Banana Plug to Female BNC Adapter (1x), Fluke PM9081/001.
- Dual Banana Jack to Male BNC Adapter (1x), Fluke PM9082/001.
- TV Signal Generator, Philips PM5418, NOT required if SC600 Oscilloscope Calibration Option is used.
- 75Ω Coax cable (1x), Fluke PM9075.
- 75Ω Feed through termination (1x), ITT-Pomona model 4119-75.
- 10:1 Attenuator Probes as supplied with Test Tool.

4.3 General Instructions

Follow these general instructions for all tests:

- For all tests, power the Test Tool with the BC190 power adapter. The battery pack must be installed.
- Allow the 5500A to satisfy its specified warm-up period.
- For each test point, wait for the 5500A to settle.
- 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 setup for all models. Test steps that are not applicable to the Test Tool to be verified can be skipped: e.g. the verification 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 show the situation for 2 Scope Inputs + Meter Input and for 4 Scope Inputs.

4.4 Operating Instructions

4.4.1 Resetting the Test Tool

Proceed as follows to reset the Test Tool:

- Press ⏻ to turn the Test Tool off.
- Press and hold USER.
- Press and release ⏻ to turn the Test Tool on.
- Wait until the Test Tool has **beeped twice**, and then release USER. When the Test Tool has beeped twice, the RESET was successful.

4.4.2 Navigating through menu's

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

Proceed as follows to make choices in a menu:

- Reset the Test Tool
- Open a menu, for example press SCOPE, then press F2 (**READING ...**).
  A menu as showed in Figure 4-1 will be opened.
  Active functions are marked by a yellow background or yellow characters.
  If more than one menu groups are available, they will be separated by a vertical line.
  The menu you opened indicates that **READING 1** (that is the upper left reading) shows the result of a V rms measurement (**V ac+dc**) on Input A (**on A**).
- Press ◀▶ or ▲▼ to highlight the function to be selected.

- Press ENTER to confirm the selection.
  The active function in the next menu group will be highlighted now. If the confirmation was made in the last (most right) menu group, the menu will be closed.

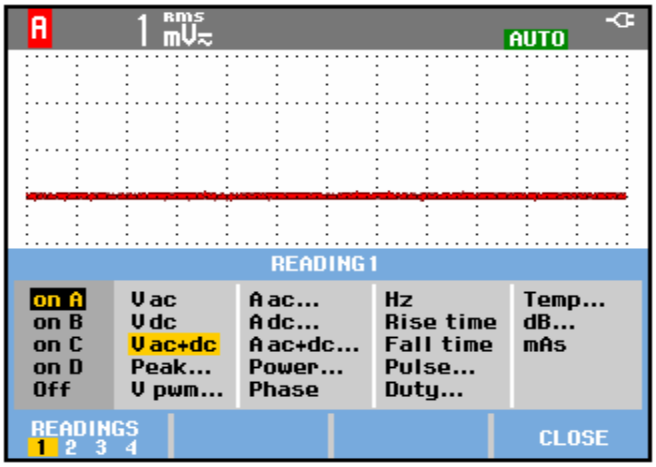


Figure 4-1. Menu item selection

4.4.3 Creating a StandardTest Tool Setup, e.g. SCOPE1

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

Note: the setup steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows to create a setup (for instance SCOPE1):

1. Reset the Test Tool. Input A is ON, other inputs are OFF now.
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 with the arrow keys:
    Reading 1, on A, V dc,
    Reading 2, on B, V dc,
    Reading 3, on C, V dc,
    Reading 4, on D, V dc.
17. Press F4 **WAVEFORM OPTIONS** and select
    Glitch: Off | Acquisition: Normal | Average: Off | Waveform: Normal .
18. Press MANUAL AUTO to select MANUAL ranging (**MANUAL** in upper right of screen) .
19. Press A : Using MOVE and MOVE 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. Using ▲ ▼ select **SCREEN+SETUP**.
23. Press ENTER.
24. Using ▲ ▼ select **OK SAVE**. Remember the name under which the settings are saved (for instance SCOPE 1).
25. Press ENTER to save the settings.
26. Press HOLD RUN to leave the Hold mode.

4.5 Display and Backlight Test

Proceed as follows to test the display and the backlight:

1. Press ⏻ to turn the Test Tool on.
2. Remove the BC190 power adapter, and verify that the backlight is dimmed.
3. Apply the BC190 power adapter and verify that the backlight brightness increases.
4. Press and hold USER (USER), then press and release CLEAR (CLEAR MENU) .

   The Test Tool shows the calibration menu in the bottom of the display.

   - Do not press F3 now! If you did, turn the Test Tool off and on, and start at 4.
   - Pressing CLEAR will toggle the menu on-off.
5. Press F1 **PREVIOUS** three times.
   The Test Tool shows **Contrast (CL 0100):**
6. Press F3 **CALIBRATE** .The Test Tool shows a dark display; the test pattern as shown in Figure 4-2 may be not visible or hardly visible.

Observe the display closely, and verify that the display shows no abnormalities, as for example very light pixels or lines.

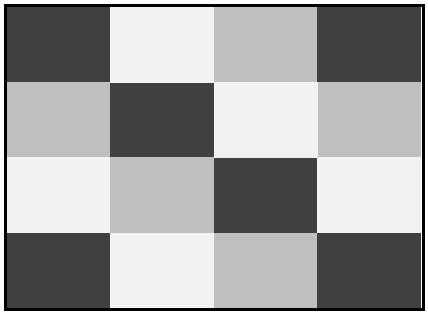


Figure 4-2. Display Test Pattern

7. Press F2 .
   The test pattern is removed; the Test Tool shows **Contrast (CL 0100):**
8. Press F2 again to do the next step **Contrast (CL 0110):**
9. Press F3 **CALIBRATE**
   The Test Tool shows the display test pattern shown in Figure 4-2, at default contrast.
   Observe the display closely, and verify that the display shows no abnormalities.
   Also verify that the contrast of the upper left and upper right square of the test pattern is equal.
10. Press F2 .
    The test pattern is removed; the Test Tool shows **Contrast (CL 0110):**
11. Press F2 again to do the next step **Contrast (CL 0120):**
12. Press F3 **CALIBRATE**
    The Test Tool shows a light display; the test pattern as shown in Figure 4-2 may not be visible or hardly visible.
    Observe the display closely, and verify that the display shows no abnormalities.
13. Turn the Test Tool OFF and ON to exit the calibration menu and to return to the normal operating mode.

If the maximum, minimum, or default display contrast is not OK, then you can adjust these items without performing a complete calibration adjustment; refer to Section 5 for detailed information.

4.6 Scope Input A, B, C, D Tests

4.6.1 Input A, B, C, D Vertical Accuracy Test

WARNING

Dangerous voltages will be present on the calibration source and connecting cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool.

Note: the test steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows:

1. Connect the Test Tool to the 5500A as shown in Figure 4-3. The vertical channels A, B, C and D (A and B) are checked in succession so that there is one waveform on the screen at a time to facilitate amplitude adjustment.

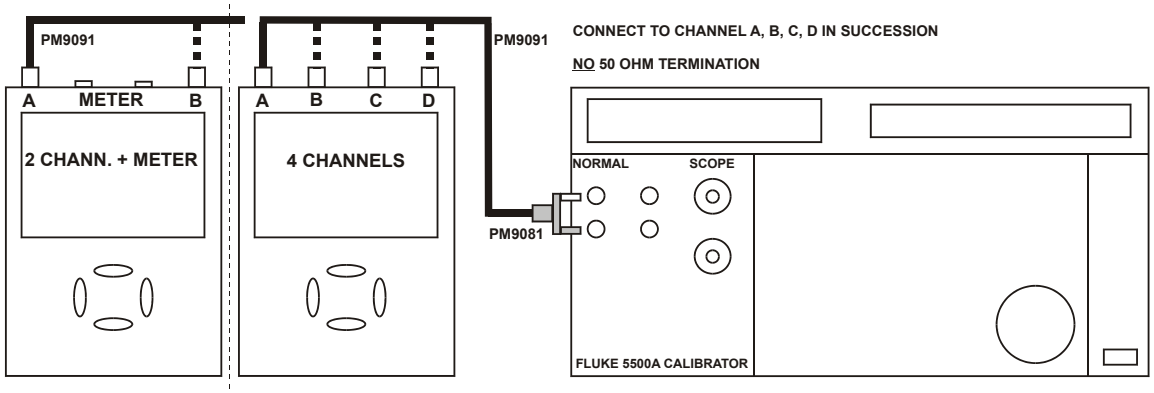


Figure 4-3. Test Tool Inputs A, B, C, D (A, B) to 5500A Normal Output

2. Select the following Test Tool setup:

   - Recall the created setup (e.g. SCOPE 1, see section 4.4.3): press SAVE , F2 **RECALL** , select **SETUP**, press ENTER, select SCOPE 1 and press ENTER to recall the setup.
   - Press A , press F4 **INPUT A OPTIONS...** , and select **Attenuator: Normal | Bandwidth: 20 kHz**
   - Press B , press F4 **INPUT B OPTIONS...** , and select **Attenuator: Normal | Bandwidth: 20 kHz**
   - Press C , press F4 **INPUT C OPTIONS...** , and select **Attenuator: Normal | Bandwidth: 20 kHz**
   - Press D , press F4 **INPUT D OPTIONS...** , and select **Attenuator: Normal | Bandwidth: 20 kHz**
   - Press CLEAR to clear the softkey menu, and to see the full screen.

   Note:

   The 20 kHz bandwidth limiter rejects calibrator noise. It does not affect the gain accuracy at a 50 Hz input signal

3. Press A and using mV RANGE and RANGE V set the Input A sensitivity range to the first test point in Table 4-1.
4. Set the 5500A to source the appropriate initial ac voltage.
5. Adjust the 5500A output voltage until the displayed Input A trace amplitude is 6 divisions.
6. Observe the 5500A output voltage and check to see if it is within the range shown under the appropriate column.
7. Continue through the test points.
8. Next check channel B, C or D in succession:
   Connect channel B, C or D input to 5500A,

Press TRIGGER and select B, C or D as trigger source with F1,
Press B, C or D to assign vertical range to channel B, C or D,
Observe the 5500A output voltage and check to see if it is within range.

9. When you are finished, set the 5500A to 0 (zero) Volt, and to Standby.

Table 4-1. Vertical Accuracy Verification Points

Range	Initial 5500A Setting, V ac, sine, 50 Hz	Allowable 5500A output for trace amplitude of 6 divisions
2 mV/div	4.243 mV	3.951 to 4.517
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 110.28
100 mV/div	212.13 mV	203.67 to 220.58
200 mV/div	424.26 mV	407.35 to 441.16
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 11.028
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

Note

The vertical accuracy test can also be done with dc voltage. This method is advised for automatic verification using the Fluke Met/Cal Metrology Software. For each sensitivity range you must proceed as follows:

1. *Apply a +3 divisions voltage, and adjust the voltage until the trace is at +3 divisions. Write down the applied voltage V1*
2. *Apply a -3 divisions 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

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

WARNING

Dangerous voltages will be present on the calibration source and connecting cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool.

Note: the test steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows to verify the automatic dc voltage scope measurement:

Connect the Test Tool to the 5500A as shown in see Figure 4-4.

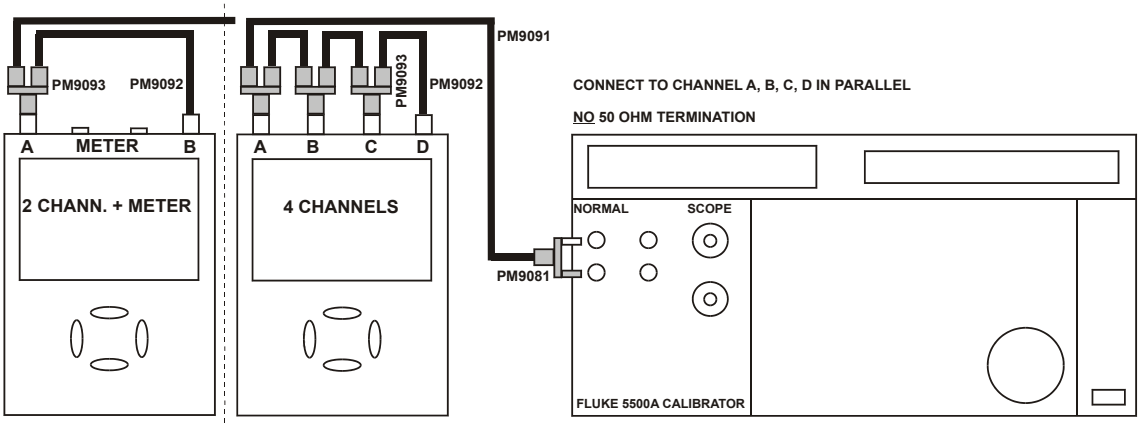


Figure 4-4. Test Tool Inputs A, B, C, D (A, B) to 5500A Normal Output

1. Select the following Test Tool setup:
   - Recall the created setup (e.g. SCOPE 1, see section 4.4.3): press SAVE , F2 **RECALL** , select **SETUP**, press ENTER, select SCOPE 1 and press ENTER to recall the setup .
   - Press A , then press F4 **INPUT A OPTIONS ...**
   - Select **Attenuator: Normal | Bandwidth: 20 kHz.**
   - Press B , then press F4 **INPUT B OPTIONS ...**
   - Select **Attenuator: Normal | Bandwidth: 20 kHz.**
   - Press C , then press F4 **INPUT C OPTIONS ...**
   - Select **Attenuator: Normal | Bandwidth: 20 kHz.**
   - Press D , then press F4 **INPUT D OPTIONS ...**
   - Select **Attenuator: Normal | Bandwidth: 20 kHz.**
   - Press CLEAR to clear the softkey menu, and to see the full 8 divisions screen.
2. Press A and using mV RANGE and RANGE V set the Input A sensitivity range to the first test point in Table 4-2. Do this also for channels B, C and D
3. Set the 5500A to source the appropriate dc voltage.
4. Observe readings **A, B**, **C** and **D** and check to see if 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 5500A to 0 (zero) Volt, and to Standby.

Table 4-2. Volts DC Measurement Verification Points

Range	5500A output V dc	Input A, B, C, D (A, B) Reading
2 mV/div	+6.0 mV	+4.9 to +7.1
	-6.0 mV	-4.9 to -7.1
5 mV/div	+15.0 mV	+14.3 to +15.7
	-15.0 mV	-14.3 to -15.7
10 mV/div	+30.0 mV	+29.0 to +31.0
	-30.0 mV	-29.0 to -31.0
20 mV/div	+60.0 mV	+58.5 to +61.5
	-60.0 mV	-58.5 to -61.5
50 mV/div	+150 mV	+143 to +157
	-150 mV	-143 to -157
100 mV/div	+300 mV	+290 to +310
	-300 mV	-290 to -310
200 mV/div	+600 mV	+586 to +614
	-600 mV	-586 to -614
500 mV/div	+1.50 V	+1.43 to +1.57
	-1.50 V	-1.43 to -1.57
1 V/div	+3.00 V	+2.90 to +3.10
	-3.00 V	-2.90 to -3.10
2 V/div	+6.00 V	+5.86 to +6.14
	-6.00 V	-5.86 to -6.14
5 V/div	+15.0 V	+14.3 to +15.7
	-15.0 V	-14.3 to -15.7
10 V/div	+30.0 V	+29.0 to +31.0
	-30.0 V	-29.0 to -31.0
20 V/div	+60.0 V	+58.6 to +61.4
	-60.0 V	-58.6 to -61.4
50 V/div	+150 V	+143 to +157
	-150 V	-143 to -157
100 V/div	+300 V	+290 to +310
	-300 V	-290 to -310

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

This procedure tests the Volts ac accuracy with dc coupled inputs up to 50 kHz. The high frequencies are tested in sections 4.6.10, 4.6.12, 4.6.14 and 4.6.16.

Note: the test steps for channel C and D are only for the models 190-104, 190-204.

Warning

Dangerous voltages will be present on the calibration source and connecting cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool.

Proceed as follows to test the Input A, B, C and D automatic scope ac Voltage measurement accuracy:

1. Connect the Test Tool to the 5500A as for the previous test (see Figure 4-4)
2. Select the following Test Tool setup.
   - Recall the created setup (e.g. SCOPE 1, see section 4.4.3): press SAVE , F2 **RECALL** , select **SETUP**, press ENTER, select SCOPE 1 and press ENTER to recall the setup .
   - Press A , then press F4 **INPUT A OPTIONS ...**
   - Select **Attenuator: Normal | Bandwidth: 20 kHz** (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).
   - Press B , then press F4 **INPUT B OPTIONS ...**
   - Select **Attenuator: Normal | Bandwidth: 20 kHz** (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).
   - Press C , then press F4 **INPUT C OPTIONS ...**
   - Select **Attenuator: Normal | Bandwidth: 20 kHz** (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).
   - Press D , then press F4 **INPUT D OPTIONS ...**
   - Select **Attenuator: Normal | Bandwidth: 20 kHz** (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).
   - Press CLEAR to clear the softkey menu, and to see the full 8 divisions screen.
3. Press SCOPE,
4. Press F2 – **READING ...** and select with F1 – **READINGS** and with the arrow keys:
   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. Using s TIME ns change the time base to lock the time base on 20 µs/div for the 20 kHz signals, and on 10 ms/div for the 60 Hz signal.
6. Using mV RANGE and RANGE V select manual vertical ranging, and set the input A, B, C and D sensitivity range to the first test point in Table 4-3.
   The sensitivity ranges is indicated in the lower display edge.

7. Set the 5500A to source the appropriate ac voltage.
8. Observe readings **A**, **B, C** and **D** and check to see if they are within the range shown under the appropriate column.
9. Continue through the test points.
10. When you are finished, set the 5500A to 0 (zero) Volt, and to Standby.

Table 4-3. Volts AC Measurement Verification Points

Range	5500A output		Input A, B, C, D Reading
	V ac	Frequency	
2 mV/div **(Select 10 ms/div)** **Set input A, B, C, D Bandwidth 20 kHz to prevent OL due to calibrator noise: see step 2.**	4 mV	**60 Hz**	3.0 mV to 5.0 mV
5 mV/div	10 mV	**60 Hz**	8.9 mV to 11.1 mV
10 mV/div **(Select 20 μs/div)**. **Set input A, B, C, D Bandwidth to 20 MHz**	20 mV	20 kHz	18.0 mV to 22.0 mV
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**	877 mV to 923 mV
500 mV/div **(Select 20 μs/div)**	900 mV	20 kHz	863 mV to 937 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	8.63 V to 9.37 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	86.3 V to 93.7 V
100 V/div	200 V	20 kHz	180 V to 220 V

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

Note: the test steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows to test the ac coupled input low frequency accuracy:

1. Connect the Test Tool to the 5500A as for the previous test (see Figure 4-4).
2. Select the following Test Tool setup:

- Recall the created setup (e.g. SETUP 1, see section 4.4.3): press SAVE , F2 **RECALL** , select **SETUP** press ENTER, select SCOPE 1 and press ENTER to recall the setup.
- Press SCOPE
- Press F2 – **READING ...** and select with F1 – **READINGS** and with the arrow keys:
  Reading 1, on A, V ac,
  Reading 2, on B, V ac,
  Reading 3, on C, V ac,
  Reading 4, on D, V ac.
- Press A , then using F2 select **COUPLING AC.**
- Press B , then using F2 select **COUPLING AC.**
- Press C , then using F2 select **COUPLING AC.**
- Press D , then using F2 select **COUPLING AC.**
- Press CLEAR to clear the softkey menu, and to see the full screen.

3. Using s TIME ns change the time base to lock the time base on 40 ms/div.
4. Using mV RANGE and RANGE V set the Input A, B, C and D sensitivity range to 500 mV.
5. Set the 5500A to source the appropriate ac voltage and frequency, according to Table 4-4.
6. Observe the reading **A, B, C** and **D** and check to see if they are within the range shown under the appropriate column.
7. Continue through the test points.
8. When you are finished, set the 5500A to 0 (zero) Volt, and to Standby.

Table 4-4. Input A, B, C, D AC Input Coupling Verification Points

5500A output, V rms	5500A Frequency	Reading A, B, C, D (A, B)
900 mV	60 Hz	873 mV to 927 mV
900 mV	5 Hz	>630 mV

4.6.5 Input A, B, C, D Peak Measurements Test

WARNING

Dangerous voltages will be present on the calibration source and connecting cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool.

Note: the test steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows to test the Peak measurement accuracy:

1. Connect the Test Tool to the 5500A as for the previous test (see Figure 4-4).
2. Select the following Test Tool setup:

- Recall the created setup (e.g. SETUP 1, see section 4.4.3): press SAVE, F2 **RECALL**, select **SETUP** press ENTER, select SCOPE 1 and press ENTER to recall the setup.
- Press SCOPE
- Press F2 – **READING ...** and select with F1 – **READINGS** and with the arrow keys:
  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**.
- Press CLEAR to clear the softkey menu, and to see the full screen.

3. Using s TIME ns change the time base and lock the time base on 1 ms/div.
4. Using mV RANGE and RANGE V set the Input A, B, C and D sensitivity ranges to 100 mV.
5. Set the 5500A to source the appropriate ac voltage and frequency, according to Table 4-5.
6. Observe readings **A, B, C** and **D** and check to see if they are within the range shown under the appropriate column.
7. When you are finished, set the 5500A to 0 (zero) Volt, and to Standby.

Table 4-5. Volts Peak Measurement Verification Points

5500A output, Vrms (sine)	5500A Frequency	Reading A, B, C, D
212.13 mV (0.6 V pp)	1 kHz	0.56 to 0.64

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

Note: the test steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows to test the frequency measurement accuracy:

1. Connect the Test Tool to the 5500A as shown in Figure 4-5. Do NOT use 50 Ω terminations!

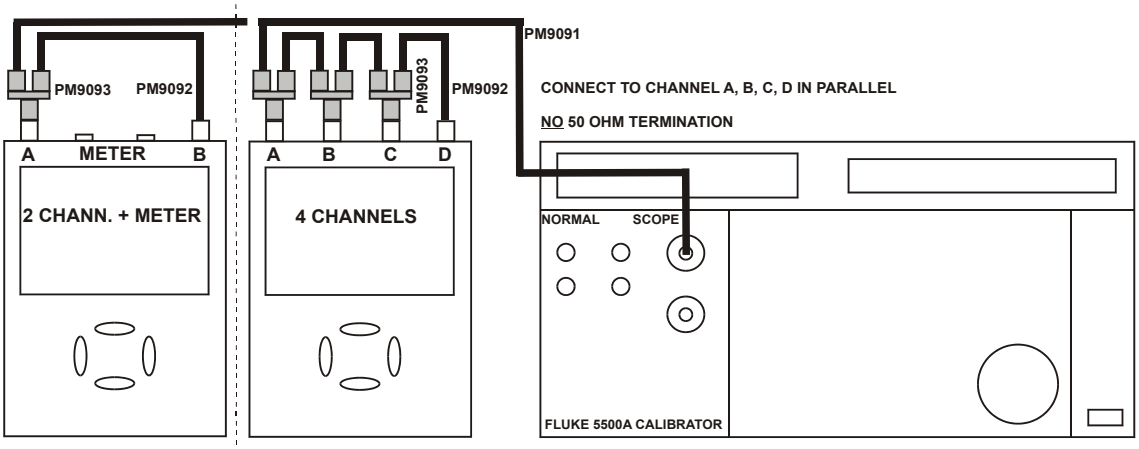


Figure 4-5. 5500A Scope Output to Test Tool Input A, B, C, D (A, B)

2. Select the following Test Tool setup:
   - Recall the created setup (e.g. SETUP 1, see section 4.4.3): press SAVE , F2 **RECALL** , select **SETUP** press ENTER, select SCOPE 1 and press ENTER to recall the setup.
   - Press SCOPE
   - Press F2 – **READING ...** and select with F1 – **READINGS** and with the arrow keys:
     Reading 1, on A, Hz,
     Reading 2, on B, Hz,
     Reading 3, on C, Hz,
     Reading 4, on D, Hz.
3. Using mV RANGE and RANGE V select range 100 mV/div for A, B, C and D.
4. Using s TIME ns select the required time base setting.
5. Set the 5500A to source a sine wave according to the first test point in Table 4-6. As no 50Ω termination is applied, the 5500 leveled sine wave output amplitude will be twice the set value.
6. Observe reading **A, B, C** and **D** and check to see if it is within the range shown under the appropriate column.
7. Continue through the test points.
8. When you are finished, set the 5500A to 0 (zero) Volt, and to Standby.

Table 4-6. Input A, B, C, D Frequency Measurement Accuracy Test

Model	Time base	5500A-SC... MODE	Voltage	Frequency	Input A, B, C, D 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
190-104 190-102	20 ns/div	levsine	600 mVpp	100 MHz	99.3 to 100.7
190-204 190-202	20 ns/div	levsine	600 mVpp	200 MHz	198.8 to 201.2

Note

Duty Cycle and Pulse Width measurements are based on the same principles as Frequency measurements. Therefore the Duty Cycle and Pulse Width measurement function will not be verified separately.

4.6.7 Input A&B / C&D Phase Measurements Test

Note: the test steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows to test the phase measurement accuracy:

1. Connect the Test Tool to the 5500A as for the previous test (see Figure 4-5).
2. Select the following Test Tool setup:
   - Recall the created setup (e.g. SETUP 1, see section 4.4.3): press SAVE, F2 **RECALL**, select **SETUP** press ENTER, select SCOPE 1 and press ENTER to recall the setup.
   - Press SCOPE
   - Press F2 – **READING ...** and select with F1 – **READINGS** and with the arrow keys:
     Reading 1, on A, Phase
     Reading 2, on B, Phase
     Reading 3, on C, Phase
     Reading 4, on D, Phase
3. Using mV RANGE and RANGE V select range 100 mV/div for A, B, C and D.
4. Using s TIME ns select the required time base setting.
5. Set the 5500A to source a sine wave according to the first test point in Table 4-7. As no 50Ω termination is applied, the 5500 leveled sine wave output amplitude will be twice the set value.
6. Observe the readings **A, B, C** and **D** and check to see if they are not outside the range shown under the appropriate column.
7. Continue through the test points.
8. When you are finished, set the 5500A to 0 (zero) Volt, and to Standby.

Table 4-7. Phase Measurement Verification Points

Time base	5500A-SC... MODE	Frequency	Voltage	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

4.6.8 Time Base Test

Proceed as follows to test the time base accuracy:

1. Connect the Test Tool to the 5500A as shown in Figure 4-6.

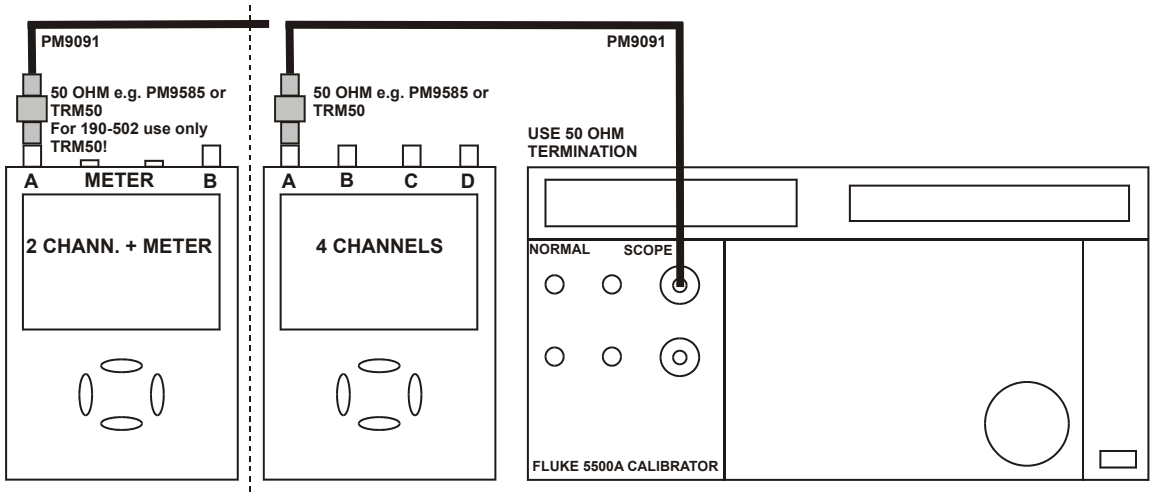
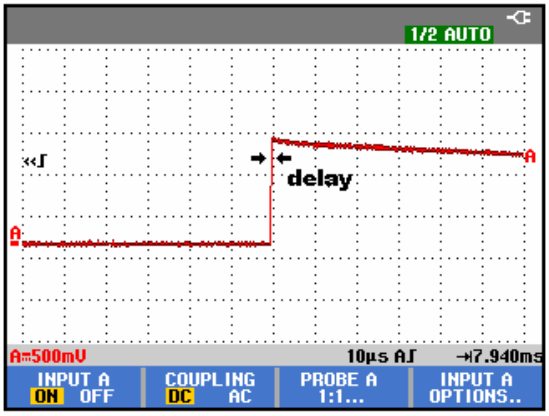


Figure 4-6. 5500A Scope Output to Test Tool Input A

2. Set the 5500A to source a 8 ms time marker (MODE marker).
3. Select the following Test Tool setup:
   - Reset the Test Tool
   - Using mV RANGE and RANGE V 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)
   - Using s TIME ns change the time base to select manual time base ranging, and lock the time base on 10 ms/div).
   - Using MOVE move the trace to the left. Once the trigger point is shifted across the left hand border of the screen, going off screen, the trigger delay time with respect to the first vertical grid line will be indicated in the lower right of the display, as can be seen in the left-hand screen in figure 4-7.
     Adjust the trigger delay time to 8.000 ms (**A ⌠ →| 8.00 ms**).
   - Using s TIME ns set the time base on 10 µs/div.

4. Using MOVE move the trace to the right until the indicated trigger delay is 7.940 ms.
5. 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 4-7.



190c-tb3.bmp

Figure 4-7. Time Base Verification.

4.6.9 Input A Trigger Sensitivity Test

Proceed as follows to test the Input A trigger sensitivity:

1. Connect the Test Tool to the 5500A as for the previous test (see Figure 4-6).
2. Select the following Test Tool setup:
   - Reset the Test Tool
   - Using mV RANGE and RANGE V change the sensitivity range to select manual sensitivity ranging, and lock the Input A sensitivity range on 2 V/div.
3. Using s TIME ns select the time base indicated under the second column of Table 4-8.
4. Set the 5500A to source the leveled sine wave for the appropriate Test Tool model.
5. Adjust the 5500A output voltage until the displayed trace has the trigger amplitude indicated under the last column of Table 4-8.
6. Verify that the signal is well triggered.
   If it is not, press TRIGGER , then using F3 enable the up/down arrow keys for manual Trigger Level adjustment. Adjust the trigger level and verify that the signal will be triggered now. The trigger level is indicated by the trigger icon (Γ).
7. Continue through the test points.
8. When you are finished, set the 5500A to Standby.

Table 4-8. Input A Trigger Sensitivity Test Points

UUT	UUT	5500A SC... MODE levsin		UUT
Model	Time base	Initial Input Voltage	Frequency	Trigger Amplitude
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
190-104, -102	10 ns/div	400 mV pp	100 MHz	1 div
	10 ns/div	800 mV pp	150 MHz	2 div
190-204, -202	10 ns/div	400 mV pp	200 MHz	1 div
	10 ns/div	800 mV pp	250 MHz	2 div

4.6.10 Input A AC Voltage Accuracy (HF) & Bandwidth Test

Proceed as follows to test the Input A high frequency automatic scope ac voltage measurement accuracy, and the bandwidth:

1. Connect the Test Tool to the 5500A as for the previous test (see Figure 4-6).
2. Select the following Test Tool setup:
   - Recall the created setup (e.g. SETUP 1, see section 4.4.3): press SAVE, F2 **RECALL** , select **SETUP** press ENTER, select SCOPE 1 and press ENTER to recall the setup.
   - Press SCOPE , then press F2 **- READING**…, and select **READINGS 1** (F1) **on A | V ac**.
   - Press MANUAL AUTO to select autoranging (**AUTO** in upper right LCD edge)
   - Using mV RANGE and RANGE V 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**)
   - Using MOVE move the Input A trace zero to the center grid line
3. Set the 5500A to source a sine wave, to the first test point in Table 4-9.
4. Observe the Input A reading and check to see if it is within the range shown under the appropriate column.
5. Continue through the test points.
6. When you are finished, set the 5500A to Standby.

Table 4-9. HF AC Voltage Verification Points

UUT	5500A SC... MODE levsine		UUT
Model	Voltage	Frequency	Reading A
all	2.545 Vpp	1 MHz	835 mV to 965 mV
all	2.545 Vpp	25 MHz	790 mV to 1.010 V
190-062	2.545 Vpp	60 MHz	>630 mV
190-104, -102	2.545 Vpp	100 MHz	>630 mV
190-204, -202	2.545 Vpp	200 MHz	>630 mV

4.6.11 Input B Trigger Sensitivity Test

Proceed as follows to test the Input B trigger sensitivity:

1. Connect the Test Tool to the 5500A as shown in Figure 4-8.

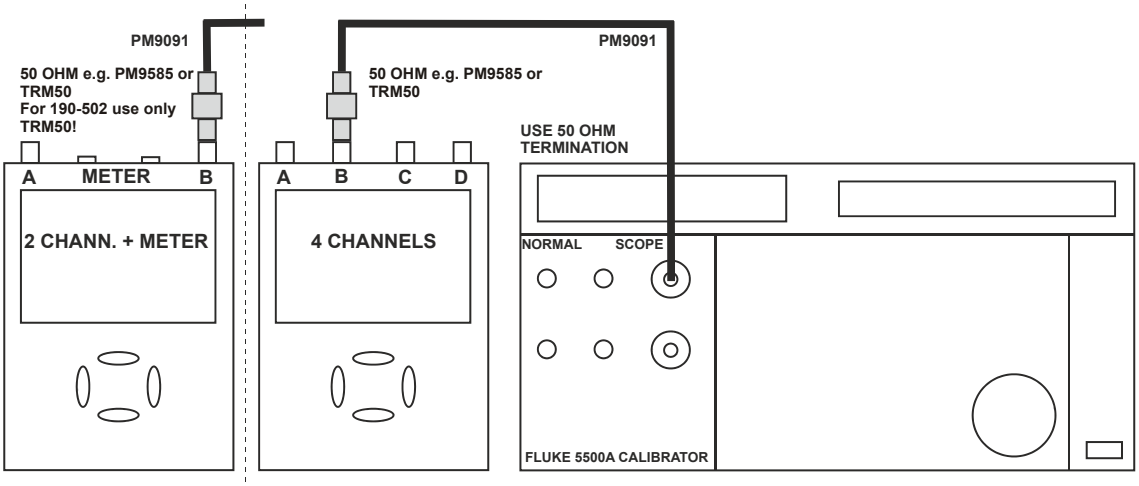


Figure 4-8. 5500A Scope Output to Test Tool Input B

2. Select the following Test Tool setup:
   - Reset the test tool
   - Press B to turn Input B on.
   - Press TRIGGER and use F1 to select Input B as trigger source.
   - Using mV RANGE and RANGE V change the sensitivity range to select manual sensitivity ranging, and lock the Input B sensitivity range on 2 V/div.
3. Using s TIME ns select the time base indicated under the first column of Table 4-10.
4. Set the 5500A to source the leveled sine wave given in the first row of Table 4-10.
5. Adjust the 5500A output voltage until the displayed trace has the amplitude indicated under the appropriate column of Table 4-10.
6. Verify that the signal is well triggered.
   If it is not, press TRIGGER , then using F3 enable the up/down arrow keys for manual Trigger Level adjustment. Adjust the trigger level and verify that the signal will be triggered now. The trigger level is indicated by the trigger icon (Γ).
7. Continue through the test points.
8. When you are finished, set the 5500A to Standby.

Table 4-10. Input B Trigger Sensitivity Test Points

UUT Model	UUT Time base	5500A SC... MODE levsin		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
190-104, -102	10 ns/div	400 mV pp	100 MHz	1 div
	10 ns/div	800 mV pp	150 MHz	2 div
190-204, -202	10 ns/div	400 mV pp	200 MHz	1 div
	10 ns/div	800 mV pp	250 MHz	2 div

4.6.12 Input B AC Voltage Accuracy (HF) & Bandwidth Test

Proceed as follows to test the Input B high frequency automatic scope ac voltage measurement accuracy, and the bandwidth:

1. Connect the Test Tool to the 5500A as for the previous test (see Figure 4-8).
2. Select the following Test Tool setup:
   - Recall the created setup (e.g. SETUP 1, see section 4.4.3): press SAVE, F2 **RECALL** , select **SETUP** press ENTER, select SCOPE 1 and press ENTER to recall the setup.
   - Press SCOPE , then press F2 **READING…** , select **READINGS 2** (F1) and select **on B | V ac**.
   - Press MANUAL AUTO to select autoranging (**AUTO** in upper right LCD edge)
   - Using mV RANGE and RANGE V change the sensitivity range to select manual sensitivity ranging, and lock the Input B sensitivity range on 500 mV/div.
   - Press TRIGGER and use F1 to select Input B as trigger source.
3. Set the 5500A to source a sine wave, to the first test point in Table 4-11.
4. Observe the Input B reading and check to see if it is within the range shown under the appropriate column of table 4-11.
5. Continue through the test points.
6. When you are finished, set the 5500A to Standby.

Table 4-11. HF AC Voltage Verification Points

UUT	5500A SC... MODE levsine		UUT
Model	Voltage	Frequency	Reading A
all	2.545 Vpp	1 MHz	835 mV to 965 mV
all	2.545 Vpp	25 MHz	790 mV to 1.010 V
190-062	2.545 Vpp	60 MHz	>630 mV
190-104, -102	2.545 Vpp	100 MHz	>630 mV
190-204, -202	2.545 Vpp	200 MHz	>630 mV

4.6.13 Input C Trigger Sensitivity Test

Note: the test steps for channel C are only for the models 190-104, 190-204.

Proceed as follows to test the Input C trigger sensitivity:

1. Connect the Test Tool to the 5500A as shown in Figure 4-9.

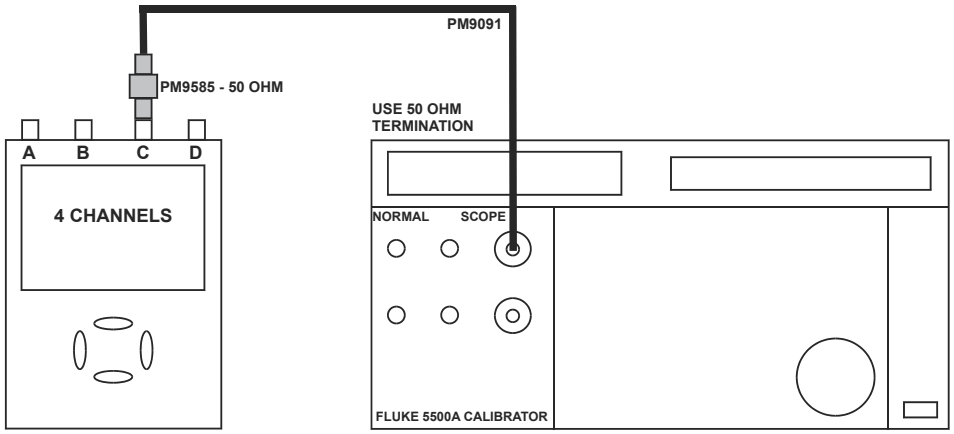


Figure 4-9. 5500A Scope Output to Test Tool Input C

2. Select the following Test Tool setup:
   - Reset the test tool.
   - Press C to turn Input C on.
   - Press C : using MOVE move the Input C trace zero to the center grid line.
   - Press TRIGGER and use F1 to select Input C as trigger source.
   - Using mV RANGE and RANGE V change the sensitivity range to select manual sensitivity ranging, and lock the Input C sensitivity range on 2 V/div.
3. Using s TIME ns select the time base indicated under the first column of Table 4-12.
4. Set the 5500A to source the leveled sine wave given in the first row of Table 4-12.
5. Adjust the 5500A output voltage until the displayed trace has the amplitude indicated under the appropriate column of Table 4-12.

6. Verify that the signal is well triggered.
   If it is not, press TRIGGER , then using F3 enable the up/down arrow keys for manual Trigger Level adjustment. Adjust the trigger level and verify that the signal will be triggered now. The trigger level is indicated by the trigger icon (⎍).
7. Continue through the test points.
8. When you are finished, set the 5500A to Standby.

Table 4-12. Input C Trigger Sensitivity Test Points

UUT Model	UUT Time base	5500A SC... MODE levsin		UUT Trigger Amplitude
		Initial Input Voltage	Frequency	
ALL	200 ns/div	100 mV pp	5 MHz	0.5 div
190-104	10 ns/div	400 mV pp	100 MHz	1 div
	10 ns/div	800 mV pp	150 MHz	2 div
190-204	10 ns/div	400 mV pp	200 MHz	1 div
	10 ns/div	800 mV pp	250 MHz	2 div

4.6.14 Input C AC Voltage Accuracy (HF) & Bandwidth Test

Note: the test steps for channel C are only for the models 190-104, 190-204.

Proceed as follows to test the Input C high frequency automatic scope ac voltage measurement accuracy, and the bandwidth:

1. Connect the Test Tool to the 5500A as for the previous test (see Figure 4-9).
2. Select the following Test Tool setup:
   - Recall the created setup (e.g. SETUP 1, see section 4.4.3): press SAVE , F2 **RECALL** , select **SETUP** press ENTER, select SCOPE 1 and press ENTER to recall the setup.
   - Press SCOPE , then press F2 **READING…** , and select **READINGS 3 on C | V ac**.
   - Press MANUAL AUTO to select autoranging (**AUTO** in upper right LCD edge)
   - Using mV RANGE and RANGE V change the sensitivity range to select manual sensitivity ranging, and lock the Input C sensitivity range on 500 mV/div.
   - using MOVE move the Input C trace zero to the center grid line
   - Press TRIGGER and use F1 to select Input C as trigger source.
3. Set the 5500A to source a sine wave, to the first test point in Table 4-13.
4. Observe the Input C reading and check to see if it is within the range shown under the appropriate column of table 4-13.
5. Continue through the test points.
6. When you are finished, set the 5500A to Standby.

Table 4-13. HF AC Voltage Verification Points

UUT	5500A SC... MODE levsine		UUT
Model	Voltage	Frequency	Reading A
all	2.545 Vpp	1 MHz	835 mV to 965 mV
all	2.545 Vpp	25 MHz	790 mV to 1.010 V
190-104	2.545 Vpp	100 MHz	>630 mV
190-204	2.545 Vpp	200 MHz	>630 mV

4.6.15 Input D Trigger Sensitivity Test

Note: the test steps for channel D are only for the models 190-104, 190-204.

Proceed as follows to test the Input D trigger sensitivity:

1. Connect the Test Tool to the 5500A as shown in Figure 4-10.

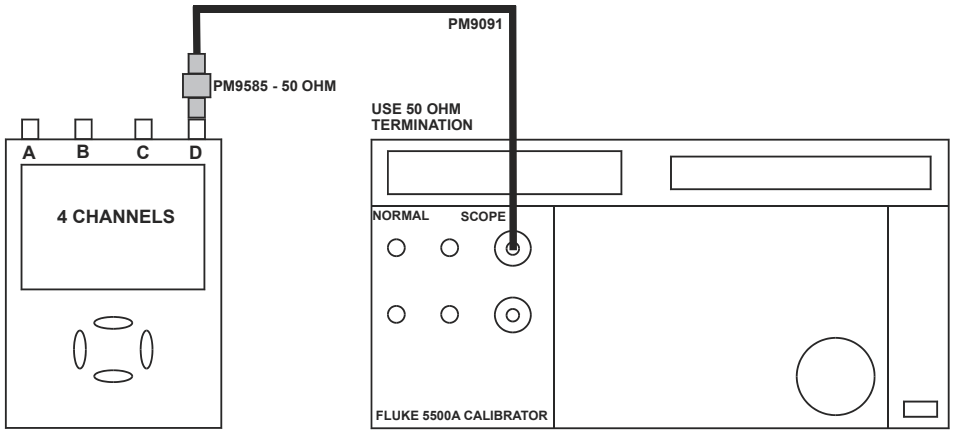


Figure 4-10. 5500A Scope Output to Test Tool Input D

2. Select the following Test Tool setup:
   - Reset the test tool
   - Press D to turn Input D on.
   - Using MOVE move the Input D trace zero to the center grid line.
   - Press TRIGGER and use F1 to select Input D as trigger source.
   - Using mV RANGE and RANGE V change the sensitivity range to select manual sensitivity ranging, and lock the Input D sensitivity range on 2 V/div.
3. Using s TIME ns select the time base indicated under the first column of Table 4-14.
4. Set the 5500A to source the leveled sine wave given in the first row of Table 4-14.
5. Adjust the 5500A output voltage until the displayed trace has the amplitude indicated under the appropriate column of Table 4-14.

6. Verify that the signal is well triggered.
   If it is not, press TRIGGER , then using F3 enable the up/down arrow keys for manual Trigger Level adjustment. Adjust the trigger level and verify that the signal will be triggered now. The trigger level is indicated by the trigger icon (⎍).
7. Continue through the test points.
8. When you are finished, set the 5500A to Standby.

Table 4-14. Input D Trigger Sensitivity Test Points

UUT Model	UUT Time base	5500A SC... MODE levsin		UUT Trigger Amplitude
		Initial Input Voltage	Frequency	
ALL	200 ns/div	100 mV pp	5 MHz	0.5 div
190-104	10 ns/div	400 mV pp	100 MHz	1 div
	10 ns/div	800 mV pp	150 MHz	2 div
190-204	10 ns/div	400 mV pp	200 MHz	1 div
	10 ns/div	800 mV pp	250 MHz	2 div

4.6.16 Input D AC Voltage Accuracy (HF) & Bandwidth Test

Note: the test steps for channel C are only for the models 190-104, 190-204.

Proceed as follows to test the Input D high frequency automatic scope ac voltage measurement accuracy, and the bandwidth:

1. Connect the Test Tool to the 5500A as for the previous test (see Figure 4-10).
2. Select the following Test Tool setup:
   - Recall the created setup (e.g. SETUP 1, see section 4.4.3): press SAVE , F2 **RECALL** , select **SETUP** press ENTER, select SCOPE 1 and press ENTER to recall the setup.
   - Press SCOPE , then press F2 **READING…** , and select **READINGS 4 on D | V ac**.
   - Press MANUAL AUTO to select autoranging (**AUTO** in upper right LCD edge)
   - Using mV RANGE and RANGE V change the sensitivity range to select manual sensitivity ranging, and lock the Input D sensitivity range on 500 mV/div.
   - using MOVE move the Input D trace zero to the center grid line
   - Press TRIGGER and use F1 to select Input D as trigger source
3. Set the 5500A to source a sine wave, to the first test point in Table 4-15.
4. Observe the Input D reading and check to see if it is within the range shown under the appropriate column of table 4-15.
5. Continue through the test points.
6. When you are finished, set the 5500A to Standby.

Table 4-15. HF AC Voltage Verification Points

UUT	5500A SC... MODE levsine		UUT
Model	Voltage	Frequency	Reading A
all	2.545 Vpp	1 MHz	835 mV to 965 mV
all	2.545 Vpp	25 MHz	790 mV to 1.010 V
190-104	2.545 Vpp	100 MHz	>630 mV
190-204	2.545 Vpp	200 MHz	>630 mV

4.6.17 Video test using the Video Pattern Generator

Note: you can skip this test if you do the test ***4.6.17 Video test using the SC600 Scope Calibration option***

Only one of the systems NTSC, PAL, PALplus, or SECAM has to be verified.

Proceed as follows:

1. Connect the Test Tool to the TV Signal Generator as shown in Figure 4-11.

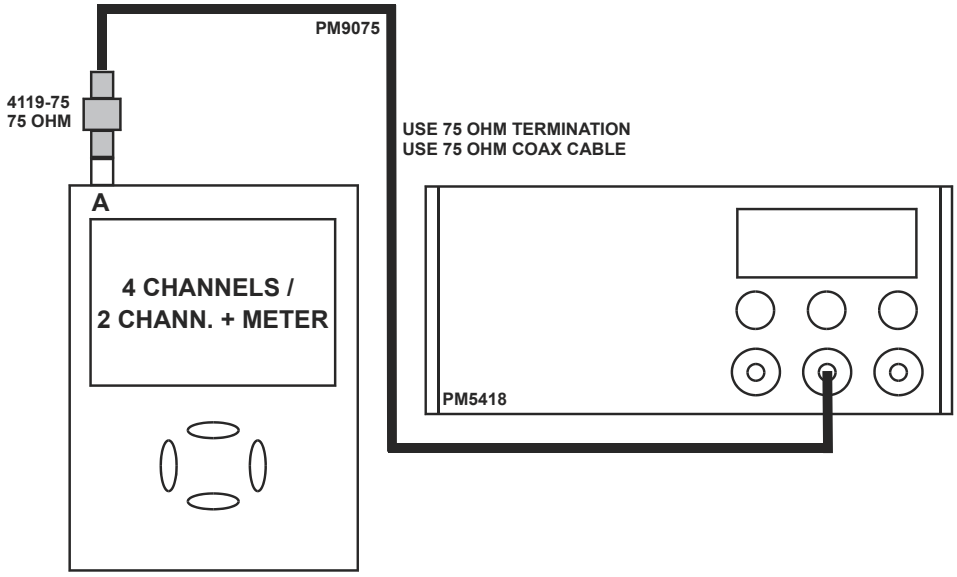


Figure 4-11. Test Tool Input A to TV Signal Generator

2. Select the following Test Tool setup:
   - Reset the Test Tool
   - Press TRIGGER , then press F4 to open the Trigger Options menu.
   - Choose **VIDEO on A...** , then from the shown opened menu choose **Polarity: POSITIVE | PAL** (or **NTSC** or **PALplus** or **SECAM**)
   - Press F2 to select **ALL LINES**
   - Press F3 to enable the arrow keys for selecting the video line number.
   - Using ▲▼ select line number:

⇒ 622 for PAL, PALplus, or SECAM

⇒ 525 for NTSC.

- Press A, then F3 and set **Attenuation:** to **1:1**
- Using MOVE move the Input A trace zero to the center grid line
- Using mV RANGE and RANGE V set the Input A sensitivity to 200 mV/div.
- Using s TIME ns select the time base to 20 µs/div.

3. Set the TV Signal Generator to source a signal with the following properties:
   - the system selected in step 2
   - gray scale
   - sync pulse amplitude > 0.7 div.
   - chroma amplitude zero.
4. Observe the trace, and check to see if the Test Tool triggers on line number:

   ⇒ 622 for PAL or SECAM, see Figure 4-12

   ⇒ 525 for NTSC, see Figure 4-13.

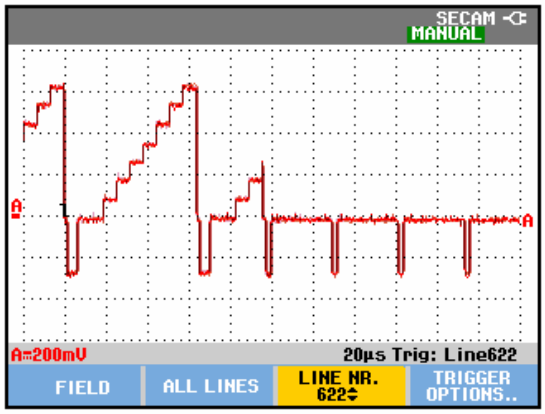


Figure 4-12. Trace for PAL/SECAM line 622

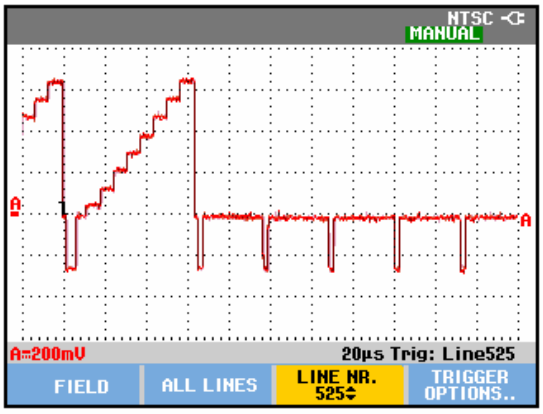


Figure 4-13. Trace for NTSC line 525

5. Using ▲▼ select line number:

   ⇒ 310 for PAL or SECAM

   ⇒ 262 for NTSC

6. Observe the trace, and check to see if the Test Tool triggers on:

   ⇒ line number 310 for PAL or SECAM, see Figure 4-14.

   ⇒ line number 262 for NTSC, see Figure 4-15.

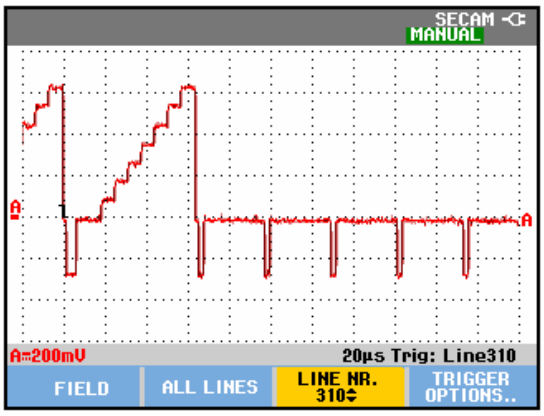


Figure 4-14. Trace for PAL/SECAM line 310

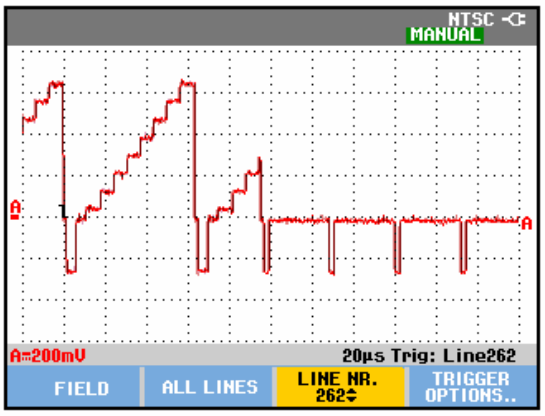


Figure 4-15. Trace for NTSC line 262

7. Apply the inverted TV Signal Generator signal to the Test Tool.
   Invert the signal by using a Banana Plug to BNC adapter (Fluke PM9081/001) and a Banana Jack to BNC adapter (Fluke PM9082/001), as shown in Figure 4-16.

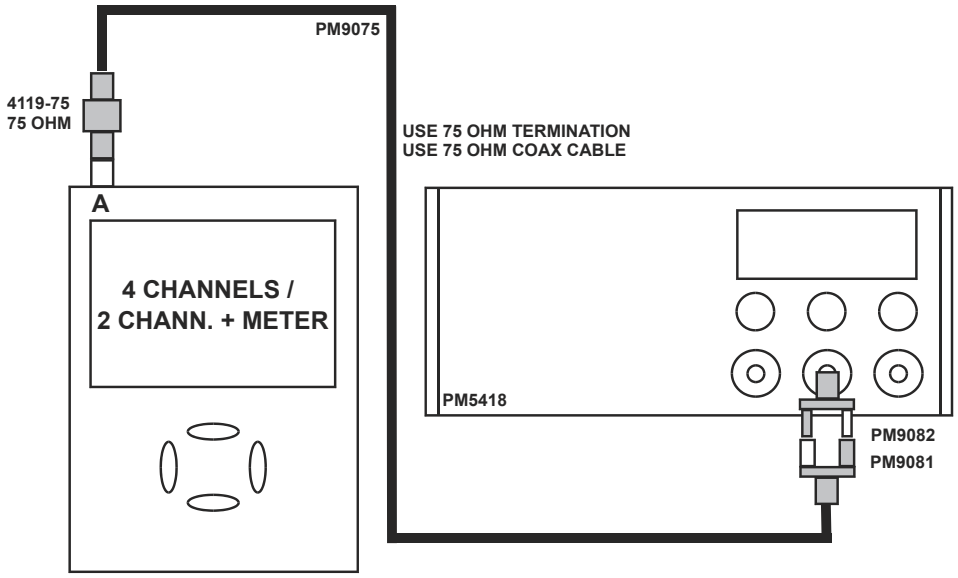


Figure 4-16. Test Tool Input A to TV Signal Generator Inverted

8. Select the following Test Tool setup:
   - Press F4 to open the Trigger Options menu.
   - Choose **VIDEO on A...** , then from the shown opened menu choose **Polarity: NEGATIVE | PAL** (or **NTSC** or **PALplus** or **SECAM**)
9. Using ▲▼ select line number 310 (PAL or SECAM) or 262 (NTSC)
10. Observe the trace, and check to see if the Test Tool triggers on line number 310 (PAL or SECAM, see Figure 4-17), or line number 262 (NTSC, see Figure 4-18).

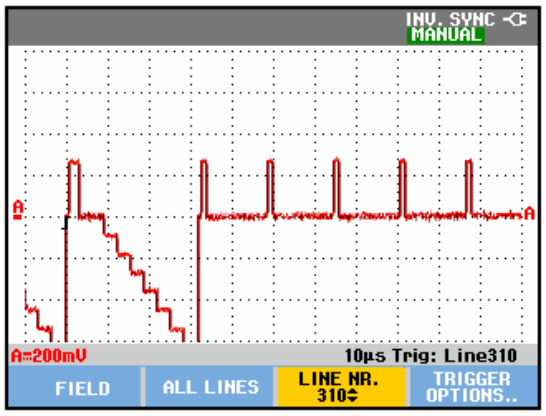


Figure 4-17. Trace for PAL/SECAM line 310 Negative Video

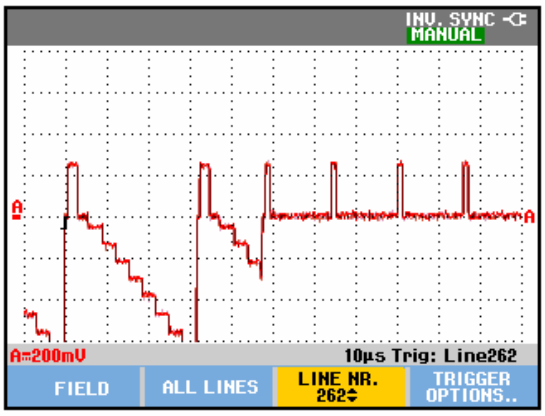


Figure 4-18. Trace for NTSC line 262 Negative Video

4.6.18 Video test using SC600 Scope Calibration Option

You can skip this test if you did test ***4.6.17 Video test using the Video Pattern Generator.***

Only one of the systems NTSC, PAL, PALplus, or SECAM has to be verified.

Proceed as follows:

1. Connect the Test Tool to the calibrator as shown in Figure 4-19.

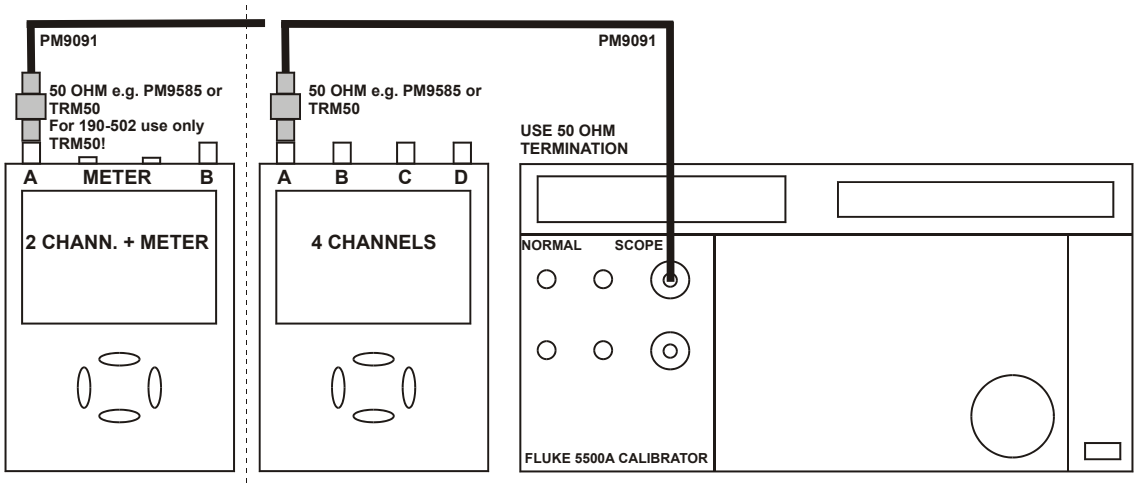


Figure 4-19. Test Tool Input A to TV Signal Generator

2. Select the following Test Tool setup:
   - Reset the Test Tool
   - Press TRIGGER , then press F4 to open the Trigger Options menu.
   - Choose **VIDEO on A...** , then from the shown opened menu choose

     Polarity: POSITIVE | PAL (or **NTSC** or **PALplus** or **SECAM**)
   - Press F2 to select **ALL LINES**
   - Press F3 to enable the arrow keys for selecting the video line number.

- Using ▲▼ select line number:
  ⇒ 622 for PAL, PALplus, or SECAM
  ⇒ 525 for NTSC.
- Using MOVE move the Input A trace zero to the center grid line
- Using mV RANGE and RANGE V set the Input A sensitivity to 2 V/div (the actual probe setting is 10:1).
- Using s TIME ns select the time base to 20 µs/div.

3. Set the calibrator to mode video with amplitude +100%. Set format and marker line number to :
   ⇒ PAL 622 (even), for PAL and PALplus
   ⇒ SECAM 622 (even), for SECAM
   ⇒ NTSC 262 even, for NTSC.
4. Observe the trace, and check to see if the Test Tool triggers on the negative pulse before the marker pulse (see Figure 4-20).
5. Using ▲▼ select Test Tool line number:
   ⇒ 310 for PAL, PALplus or SECAM
   ⇒ 262 for NTSC
6. Set the calibrator format and marker line number to :
   ⇒ PAL 310 (odd), for PAL and PALplus
   ⇒ SECAM 310 (odd), for SECAM
   ⇒ NTSC 262 odd, for NTSC.
7. Observe the trace, and check to see if the Test Tool triggers on the negative pulse before the marker.
8. Select the following Test Tool setup:
   - Press F4 to open the Trigger Options menu.
   - Choose **VIDEO on A...** , then from the shown opened menu choose **Polarity: NEGATIVE | PAL** (or **NTSC** or **PALplus** or **SECAM**)
9. Set the calibrator video trigger output signal to -100%
10. Using ▲▼ select line number 310 (PAL, PALplus or SECAM) or 262 (NTSC)
11. Set the calibrator format and marker line number to :
    ⇒ PAL 310 (odd), for PAL and PALplus
    ⇒ SECAM 310 (odd), for SECAM
    ⇒ NTSC 262 odd, for NTSC.
12. Observe the trace, and check to see if the Test Tool triggers on the positive pulse before the marker.

video-sc600.bmp

Figure 4-20. SC600 Marker Pulse

4.7 External Trigger Level Test

Note: following test is for the models 190-062, 190-102, 190-202.

Proceed as follows:

1. Connect the test tool to the 5500A as shown in Figure 4-21.

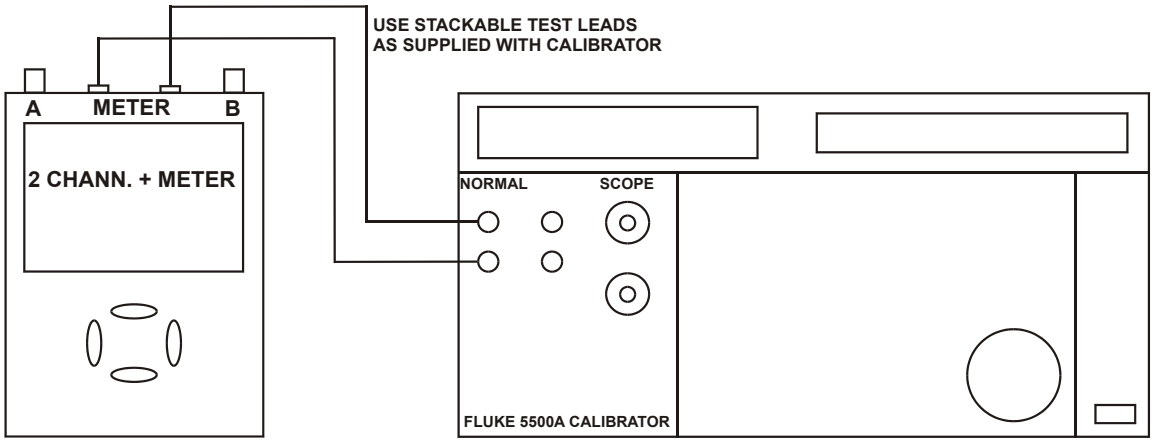


Figure 4-21. Test Tool Meter/Ext Input to 5500A Normal Output

2. Select the following test tool setup:
   - Reset the test tool
   - Press TRIGGER
   - Using F4 select the **TRIGGER OPTIONS...** menu
     ⇒ Select **On Edges...** from the **TRIGGER OPTIONS** menu
     ⇒ Press ENTER
     ⇒ Select **Update: Single Shot** ENTER, **Trigger Filter: Noise Reject** ENTER, **NCycle: Off** ENTER
   - Using F1 **EDGE TRIG** select **Ext** .
   - Using F2 **SLOPE** select positive slope triggering (trigger icon ⌐).
   - Using F3 **Ext LEVEL** select **1.2 V**
3. Set the 5500A to source 0.4V dc.
4. 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 **SINGLE HOLD** then press HOLD RUN to re-arm the test tool for a trigger.
5. Set the 5500A to source 1.7 V
6. Verify that the test tool is triggered by checking that the trace becomes visible.
   To repeat the test, start at step 3.
7. Set the 5500A to Standby.

4.8 Meter (DMM) Tests

Note: following tests are for the models 190-062, 190-102, 190-202.

4.8.1 Meter DC Voltage Accuracy Test

WARNING

Dangerous voltages will be present on the calibration source and connecting cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the test tool.

Proceed as follows to test the meter dc voltage measurement accuracy:

1. Connect the test tool to the 5500A as for the previous test (see Figure 4-21).
2. Select the following test tool setup:
   - Press METER
   - Press F1 to open the Measurement menu, and select **V dc.**
   - Press ENTER.
   - Press MANUAL AUTO to select MANUAL ranging; use mV RANGE and RANGE V to select the ranges.
3. Set the range to the first test point in Table 4-16.
4. Set the 5500A to source the appropriate dc voltage.
5. Observe the reading and check to see if it is within the range shown under the appropriate column.
6. Continue through the test points.
7. When you are finished, set the 5500A to 0 (zero) Volt, and to Standby.

Table 4-16. Meter Volts dc Measurement Verification Points

Range	5500A output V dc	Meter Reading
500.0 mV	+ 500 mV	497.0 to 503.0
	- 500 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

4.8.2 Meter AC Voltage Accuracy & Frequency Response Test

Warning

Dangerous voltages will be present on the calibration source and connecting cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the test tool.

Proceed as follows to test the ac voltage measurement accuracy:

1. Connect the test tool to the 5500A as for the previous test (see Figure 4-21).
2. Select the following test tool setup:
   - Press METER
   - Press F1 to open the Measurement menu, and select **V ac**
   - Press ENTER.
   - Press MANUAL AUTO to select MANUAL ranging; use mV RANGE and RANGE V to select the ranges.
3. Set the range to the first test point in Table 4-17.
4. Set the 5500A to source the appropriate ac voltage.
5. Observe the reading and check to see if it is within the range shown under the appropriate column.
6. Continue through the test points.
7. When you are finished, set the 5500A to 0 (zero) Volt, and to Standby.

Table 4-17. Meter Volts AC Measurement Verification Points

Range	5500A 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

4.8.3 Continuity Function Test

Proceed as follows:

1. Select the following test tool setup:
   - Press METER
   - Press F1 to open the Measurement menu, and select **Continuity**
2. Connect the test tool to the 5500A as for the previous test (see Figure 4-21).
3. Set the 5500A to 20 Ω. Use the 5500A "COMP OFF" mode.
4. Listen to hear that the beeper is on.
5. Set the 5500A to 80 Ω.
6. Listen to hear that the beeper is off.
7. When you are finished, set the 5500A to Standby.

4.8.4 Diode Test Function Test

Proceed as follows to test the Diode Test function :

1. Select the following test tool setup:
   - Press METER
   - Press F1 to open the Measurement menu, and select ■ **Diode**
2. Connect the test tool to the 5500A as for the previous test (see Figure 4-21).

3. Set the 5500A to **1 kΩ**. Use the 5500A "COMP OFF" mode.
4. Observe the main reading and check to see if it is within **0.4 V** and **0.6 V**.
5. Set the 5500A to **1 V dc.**
6. Observe the main reading and check to see if it is within **0.975 V** and **1.025 V**.
7. When you are finished, set the 5500A to Standby.

4.8.5 Ohms Measurements Test

Proceed as follows to test the Ohms measurement accuracy:

1. Connect the test tool to the 5500A as shown in Figure 4-22.

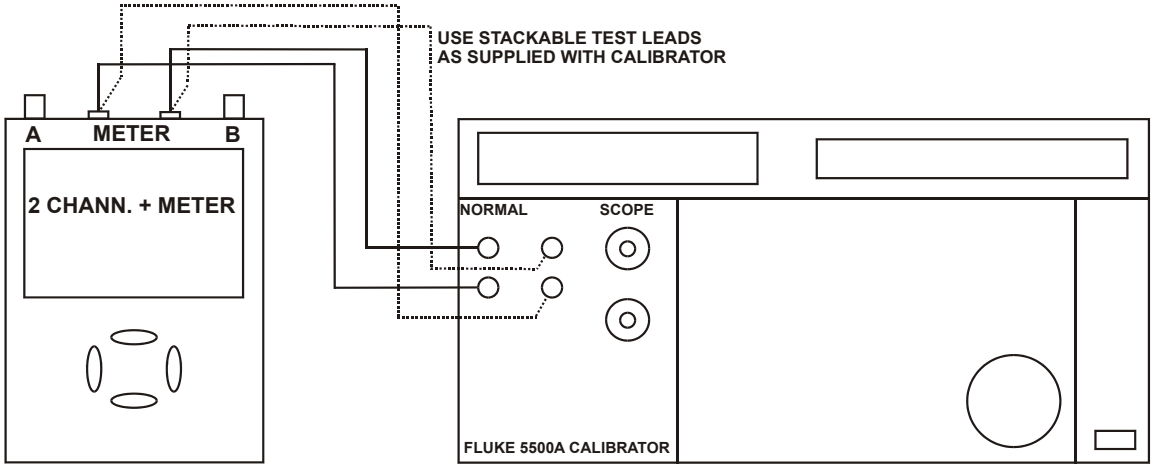


Figure 4-22. Test Meter Tool Input to 5500A Normal Output 4-Wire

2. Select the following test tool setup:
   - Press METER
   - Press F1 to open the Measurement menu, and select **Ohms**
   - Press MANUAL AUTO to select AUTO ranging.
3. Set the 5500A to source the appropriate resistance value for the first test point in Table 4-18.
   Use the 5500A "COMP 2 wire" mode for the verifications up to and including 50 kΩ. For the higher values, the 5500A will turn off the "COMP 2 wire" mode.
4. Observe the reading and check to see if it is within the range shown under the appropriate column.
5. Continue through the test points.
6. When you are finished, set the 5500A to Standby.

Table 4-18. Resistance Measurement Verification Points

5500A output	Meter Reading (COMP 2 wire)
0Ω	0.0 to 0.5 (COMP 2 wire)
400Ω	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)

4.9 Probe Calibration Generator Test

To verify Connect a 10:1 probe as supplied with the Test Tool to input A (red probe). Connect the probe tip and the probe's ground lead with the probe cal terminals on the lower left side of the Test Tool as shown in figure 4-23.

1. Reset the test tool.
2. Press A to show the input A key labels
3. Press F3 **- PROBE A 10:1 ….**
4. Press F1 **- PROBE CAL…** and follow the instructions as displayed on screen.
5. 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 to be operated is located in the probe housing and can be reached by rotating the centre part of the housing. For further information refer to the probe instruction sheet. When done, press F4 to start the DC calibration that is performed automatically. The Probe Calibration is OK if all instructions displayed on screen are finished succesfully.
   Close the hole of the trimmer by rotating the centre part of the housing: this is important for safe use of the probe at high input voltages.
6. Proceed is the same way for the channels B (blue probe) and in 4 Channel Test Tools (190-104, 190-204) C (gray probe), and D (green probe).

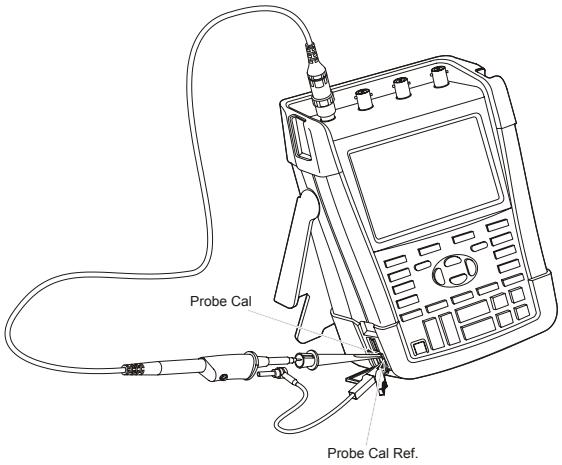


Figure 4-23. Probe calibration.

This is the end of the Performance Verification Procedure.

Chapter 5
Calibration Adjustment

Title **Page**

5.1 General

5.1.1 Introduction

The following information, provides the complete Calibration Adjustment procedure for the Fluke 190-062 (60 MHz), 190-102 (100 MHz), 190-104 (100 MHz), 190-202 (200 MHz), 190-204 (200 MHz) ScopeMeter Test Tool (referred to as Test Tool).

The Test Tool allows closed-case calibration using known reference sources. It measures the reference signals, calculates the correction factors, and stores the correction factors in RAM. After completing the calibration, 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.

5.1.2 Calibration number and date

When storing valid calibration data in FlashROM after performing the calibration adjustment procedure, the calibration date is set to the actual Test Tool date, and calibration number is raised by one. To display the calibration date and - number:

1. Press USER , then press F3 to see the Version & Calibration data (see Figure 5.1).
2. Press F4 to return to exit the Version & Calibration screen.

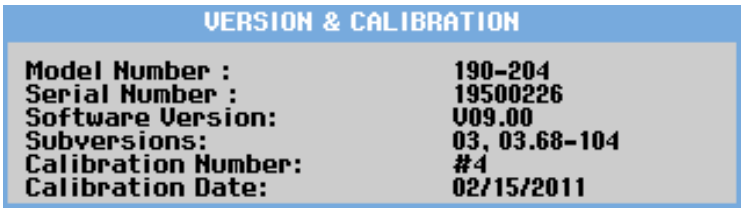


Figure 5-1. Version and Calibration Data (example)

Note:

The calibration date and calibration number will not be changed if only the Contrast Calibration Adjustment and /or the Probe Calibration is done

5.1.3 General Instructions

Follow these general instructions for all-calibration steps:

- Allow the 5500A to satisfy its specified warm-up period. For each calibration point , wait for the 5500A to settle.
- The required warm up period for the Test Tool is included in the WarmingUp & PreCal calibration step.
- Ensure that the Test Tool battery is charged sufficiently.
- Power the Test Tool via the BC190 Power Adapter.

- This procedure is setup for all models. Test steps that are not applicable to the Test Tool to be adjusted can be skipped: e.g. 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 show the situation for 2 Scope Inputs + Meter Input and for 4 Scope Inputs.

5.1.4 Equipment Required For Calibration

The primary source instrument used in the calibration procedures is the Fluke 5500A. If a 5500A is not available, you can substitute another calibrator as long as it meets the minimum test requirements.

- Fluke 5500A Multi Product Calibrator, including SC300 or SC600 Oscilloscope Calibration Option.
- Stackable test leads (4x) as supplied with the 5500A (required for Test Tools with a meter section with banana jacks and 2 BNC oscilloscope inputs).
- 50Ω Coax Cables (4x): use Fluke PM9091 (1.5m, 3 pcs.) and PM9092 (0.5m, 3 pcs.).
  For Test Tools with with meter section with banana jacks and 2 BNC oscilloscope inputs 2 Coax Cables are sufficient.
- 50Ω feed through termination, Fluke PM9585 or TRM50 (4x for Test Tools with 4 BNC oscilloscope inputs; 2x for Test Tools with a meter section 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.

5.2 Calibration Procedure Steps

To do a **complete** calibration adjustment you must do all following steps:

1. Select the Calibration Mode, section 5.3.
2. Do the Contrast Calibration Adjustment, section 5.4.
3. Do the WarmingUp & PreCalibration, section 5.5.
4. Do the Final Calibration. The Final Calibration steps depend on the software that is installed in your Test Tool. The installed Software Version is visible after the knob sequence USER, F3 – VERSION & CAL... .
   If the installed firmware is **V09.00, V10.00 or V10.4x** you must do the steps in section **5.6**.
   If the installed firmware is **V11.10** you must do the steps in section **5.7**.
5. Save the Calibration Data and Exit the calibration mode, section 5.8 (all software versions).
6. Do the probe Calibration, section 5.9 (all software versions).

The following **partial** calibrations are allowed:

- Contrast calibration, do the above-mentioned steps 1, 2, and 5.
  If during normal operation the display cannot be made dark or light enough, or if the display after a Test Tool reset is too light or too dark, you can do this calibration.
- Probe calibration, do the above-mentioned step 6.
  The probe calibration matches the probe to the used input channel.

5.3 Starting the Calibration

Follow the steps below to start the calibration:

1. Power the Test Tool via the power adapter input using 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):
   - Press USER (toggles the menu bar on-off)
   - press F1 to open the **OPTIONS** menu
   - using ▲ ▼ select **DATE ADJUST**...
   - press ENTER to open the **DATE ADJUST** menu
   - adjust the date if necessary. Press ENTER to activate all selections and to 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:

   - Press and hold USER , press and release CLEAR , release USER .

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

   The display shows the calibration step **Warming Up (CL 0200)** , the calibration status **:IDLE (valid)** or **:IDLE (invalid)** , and the softkey menu.

Continue as indicated in section 5.2.

You can leave the calibration mode without changing the calibration data by turning the Test Tool off.

Explanation of screen messages and key functions.
When the Test Tool is in the calibration Mode, only the F1 to F4 soft keys, the ⏻ key, and the CLEAR key can be operated, unless otherwise stated.

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

Cal Name	Name of the selected calibration step, e.g. **WarmingUp**
(CL nnnn)	Number of the calibration step

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 WarmingUp 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 5.6.1).

Functions of the keys F1-F4 are:

F1 **PREVIOUS** select the previous step

F2 **NEXT** select the next step

F3 **CALIBRATE** start the calibration adjustment of the actual step

F4 **EXIT** leave the calibration mode

5.4 Contrast Calibration Adjustment

After entering the calibration mode the display shows:

WarmingUp (CL 0200):IDLE (valid)

Do not press F3 now! If you did, turn the Test Tool off and on, and enter the calibration mode again.

Proceed as follows to adjust the maximum display darkness (CL 0100), the default contrast (CL 0110) , and the maximum display brightness (CL 0120).

1. Press F1 three times to select maximum darkness calibration **Contrast (CL 0100):**
2. Press F3 **CALIBRATE** . The display will show a dark test pattern, see Figure 5-2
3. Using ▲▼ adjust the display to the maximum darkness at which the test pattern is only just visible.
4. Press F3 to return to the softkey menu.
5. Press F2 to select default contrast calibration **Contrast (CL 0110):**
6. Press F3 **CALIBRATE**. The display shows the test pattern at default contrast.
7. Using ▲▼ set the display to optimal (becomes default) contrast.
8. Press F3 to return to the softkey menu.
9. Press F2 to select maximum brightness calibration **Contrast (CL 0120):**
10. Press F3 **CALIBRATE**. The display shows a bright test pattern.

11. Using  adjust the display to the maximum brightness, at which the test pattern is only just visible.
12. Press F3 to return to the softkey menu.
13. Now you can either
    - Exit, if only the Contrast had to be adjusted. Continue at Section 5.8.

    or
    - Do the complete calibration. Press F2 to select the next step (WarmingUp), and continue at Section 5.5.

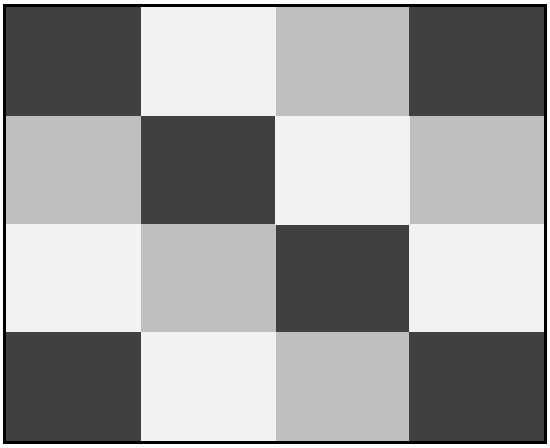


Figure 5-2. Display Test Pattern

5.5 Warming Up & Pre-Calibration

The WarmingUp & Pre-Calibration state will be entered after entering the calibration mode (section 5.3), or after selecting the next step if you have done the Contrast Calibration step CL 120 (section 5.4). The display will show **WarmingUp (CL 0200):IDLE (valid)** or **(invalid)**.

Unless you want to calibrate the display contrast only, you must always start the calibration adjustment at the **Warming Up (CL 0200)** step. Starting at another step will make the calibration invalid!

The WarmingUp & Pre-Calibration consists of a 30 minutes warming-up period, followed by several internal calibration adjustment steps that do not require input signals.

Proceed as follows to do the WarmingUp & Pre-Calibration:

1. Remove all input connections from the Test Tool.
2. Press F3 to start the Warming-Up & Pre-Calibration.
   The display shows the calibration step in progress, and its status.
   The first step is **WarmingUp (CL 0200) :BUSY 00:29:59 .** The warming-up period is counted down from 00:29:59 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; now you can select the calibration mode, and continue with step 4 below (press F2 **NEXT** several times, see 5.6 or 5.7).
   If you turn off the instrument now, and you do not turn on immediately, the Test

Tool has cooled down, and you must repeat the WarmingUp and PreCalibration (select the calibration mode and start at CL 0200).

4. Press F2 NEXT and continue at Section 5.6 or 5.7.

Error Messages

If error message **1000** is displayed during WarmingUp or PreCalibration step CL0215, the Main PCA hardware version is not suitable for the installed software version. Other error messages during WarmingUp or PreCalibration indicate that the Test Tool is defective, and should be repaired.

5.6 Final Calibration (Firmware: V09.00, V10.00 or V10.4x)

Important: the Final Calibration steps depend on the software that is installed in your Test Tool. The installed Software Version is visible after the knob sequence USER, F3 – VERSION & CAL... .
If the installed firmware is **V09.00, V10.00 or V10.4x** you must do the steps in this section **5.6**. For firmware **V11.10** you must do the steps in section **5.7**.

Before starting the final calibration you must have done the WarmingUp & PreCalibration (section 5.5)!

The final calibration requires input conditions that will be described in each step. After starting a step, several steps that require the same input conditions will be done automatically. So if you start for example calibration step CL 0852, the calibration can include also step CL 0929, and at the end the display then shows CL 0929: READY

You must always start the Final Calibration at the first step, see Section 5.6.1. Starting at another step will make the calibration invalid!

If you proceeded to calibration step N (for example step CL 0481), then return to a previous step (for example step CL 0480) , and then calibrate this step, the complete final calibration becomes invalid; then you must repeat the calibration starting at 5.6.1.

It is allowed to repeat a step that shows the status :READY by pressing F3 again.

Error messages

Proceed as follows if an error message **ERROR: nnnn** is displayed during calibration:

- if **nnnn** < 5000 then check input signal and test leads, and repeat the current step by pressing F2 again.
- if **nnnn** ≥ 5000 then check input signal and test leads, and repeat the final calibration starting at section 5.6.1.

If the error persists the Test Tool is defective.

5.6.1 Warm Up Final and ADC Timing

Proceed as follows:

1. The Warm Up Final step (CL 0201) must be done with open inputs.
2. Press F3 to start the calibration.
3. Wait until the display shows calibration status **:READY.**
4. Press F2 to select the next calibration step (CL 0570)
5. Connect the Test Tool to the 5500A SCOPE output as shown in Figure 5-3. Use 50Ω termination.
6. Set the 5500A to generate a sine wave 50 MHz / 0.5 V pp (mode LEVSINE) at the SCOPE output.
7. Set the 5500A in operate (OPR).
8. Press F3 to start the calibration.
9. Wait until the display shows calibration status **:READY.**

10. Set the 5500A in standby (STBY).
11. Continue at Section 5.6.2.

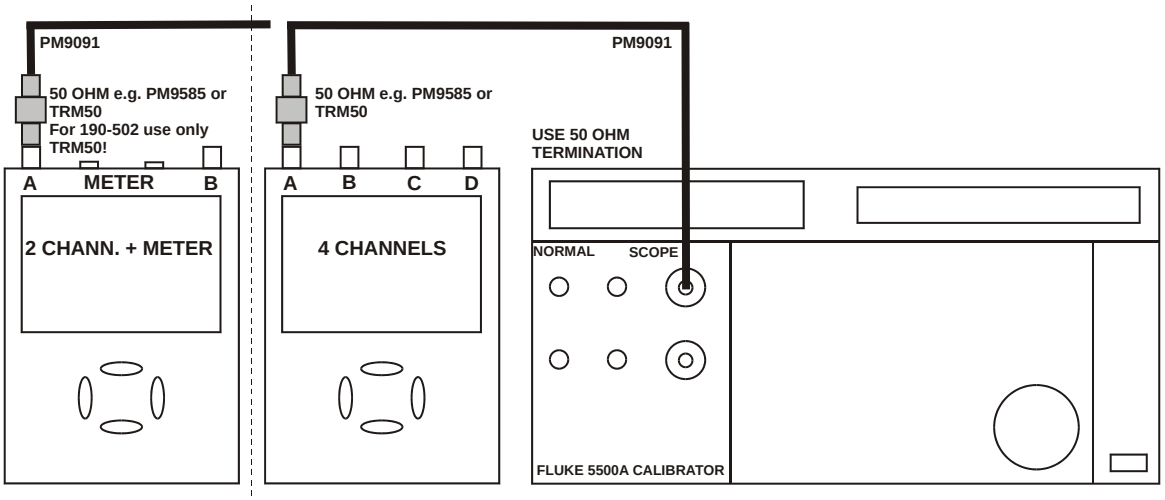


Figure 5-3. 5500A SCOPE Output to Test Tool Input A.

5.6.2 Input A LF-HF Gain

Proceed as follows to do the Input A LF-HF Gain calibration:

1. Connect the Test Tool to the 5500A as shown in Figure 5-3.
2. The display must show step CL 0654. If it does not, then press F2 or F1 to select the first calibration step in Table 5-1.
3. Set the 5500A SCOPE output to source the signal required for the first calibration point in Table 5-1.
4. Set the 5500A in operate (OPR) or standby (STBY) as indicated.
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY** .
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point signal, and start the calibration.
   Continue through all calibration points of Table 5-1 (and 5-2).
8. When you are finished, set the 5500A to Standby.
9. Continue at Section 5.6.3.

Table 5-1. Input A LF-HF Gain Calibration Points

Cal step	UUT input signal	5500A Setting
CL 0654	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0480	0.62 Vpp sine wave, 50 kHz	SCOPE levsine, 0.62 Vpp, 50 kHz
CL 0481	0.62 Vpp sine wave Fluke 190-202/204: 221 MHz Fluke 190-102: 151 MHz Fluke 190-104: 121 MHz Fluke 190-062: 81 MHz	SCOPE levsine, 0.62 Vpp, 221 MHz 151 MHz 121 MHz 81 MHz

Table 5-2. Input A LF-HF Gain Calibration Points (Extra steps for 190-104/204, V10.4x firmware **)

Cal step	UUT input signal	5500A Setting
CL 0460	124 mVpp sine wave, 50 kHz	SCOPE levsine, 124 mVpp, 50 kHz
CL 0461	124 mVpp sine wave Fluke 190-204: 221 MHz Fluke 190-104: 121 MHz	SCOPE levsine, 124 mVpp, 221 MHz 121 MHz

** Four channel instruments (190-104/204) with firware V10.4x require the extra steps CL 460 and CL 461. Installed firmware version can be checked via key sequence: USER key, F3 – VERSION & CAL, Software Version: ... .

5.6.3 Input B LF-HF Gain

Proceed as follows to do the Input B LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-3.
2. Connect the Test Tool to the 5500A as shown in Figure 5-4.
3. Set the 5500A SCOPE output to source the signal required for the first calibration point in Table 5-3.
4. Set the 5500A in operate (OPR) or standby (STBY) as indicated.
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY** .
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point signal, and start the calibration.
   Continue through all calibration points of Table 5-3 (and 5-4).
8. When you are finished, set the 5500A to Standby.
9. Continue at Section 5.6.4.

Table 5-3. Input B LF-HF Gain Calibration Points

Cal step	UUT input signal	5500A Setting
CL 0674	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0482	0.62 Vpp sine wave, 50 kHz	SCOPE levsine, 0.62 Vpp, 50 kHz
CL 0483	0.62 Vpp sine wave Fluke 190-202/204: 221 MHz Fluke 190-102: 151 MHz Fluke 190-104: 121 MHz Fluke 190-062: 81 MHz	SCOPE levsine, 0.62 Vpp, 221 MHz 151 MHz 121 MHz 81 MHz

Table 5-4. Input B LF-HF Gain Calibration Points (Extra steps for 190-104/204, V10.4x firmware **)

Cal step	UUT input signal	5500A Setting
CL 0462	124 mVpp sine wave, 50 kHz	SCOPE levsine, 124 mVpp, 50 kHz
CL 0463	124 mVpp sine wave Fluke 190-204: 221 MHz Fluke 190-104: 121 MHz	SCOPE levsine, 124 mVpp, 221 MHz 121 MHz

** Four channel instruments (190-104/204) with firware V10.4x require the extra steps CL 462 and CL 463. Installed firmware version can be checked via key sequence: USER key, F3 – VERSION & CAL, Software Version: ... .

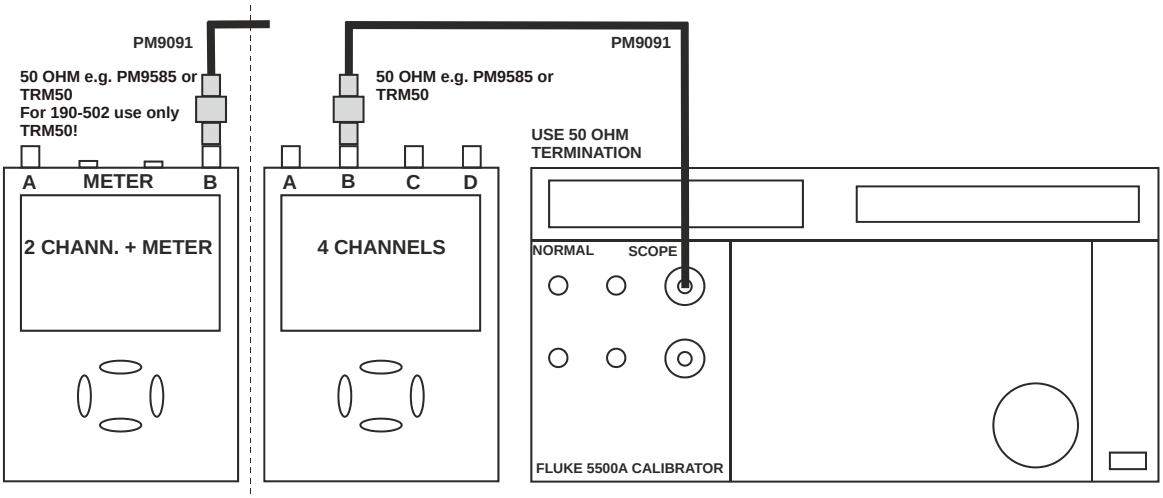


Figure 5-4. 5500A SCOPE Output to Test Tool Input B

5.6.4 Input C LF-HF Gain

Note: the adjustment steps for channel C are only for the models 190-104, 190-204.

Proceed as follows to do the Input C LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-5.
2. Connect the Test Tool to the 5500A as shown in Figure 5-5.
3. Set the 5500A SCOPE output to source the signal required for the first calibration point in Table 5-5.
4. Set the 5500A in operate (OPR) or standby (STBY) as indicated.
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY** .
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point signal, and start the calibration.
   Continue through all calibration points of Table 5-5 (and 5-6).
8. When you are finished, set the 5500A to Standby.
9. Continue at Section 5.6.5.

Table 5-5. Input C LF-HF Gain Calibration Points

Cal step	UUT input signal	5500A Setting
CL 0656	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0484	0.62 Vpp sine wave, 50 kHz	SCOPE levsine, 0.62 Vpp, 50 kHz
CL 0485	0.62 Vpp sine wave Fluke 190-204: 221 MHz Fluke 190-104: 121 MHz	SCOPE levsine, 0.62 Vpp, 221 MHz 121 MHz

Table 5-6. Input C LF-HF Gain Calibration Points (Extra steps for 190-104/204, V10.4x firmware **)

Cal step	UUT input signal	5500A Setting
CL 0464	124 mVpp sine wave, 50 kHz	SCOPE levsine, 124 mVpp, 50 kHz
CL 0465	124 mVpp sine wave Fluke 190-204: 221 MHz Fluke 190-104: 121 MHz	SCOPE levsine, 124 mVpp, 221 MHz 121 MHz

** Four channel instruments (190-104/204) with firware V10.4x require the extra steps CL 464 and CL 465. Installed firmware version can be checked via key sequence: USER key, F3 – VERSION & CAL, Software Version: ... .

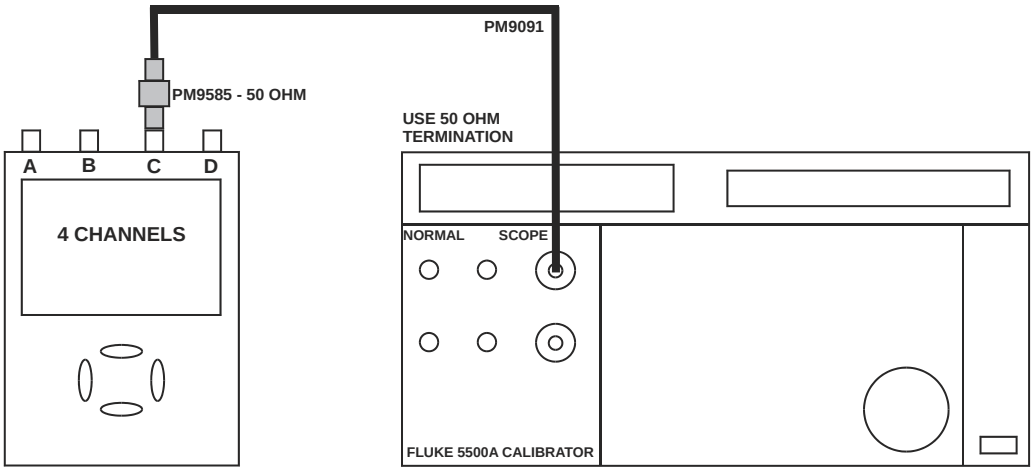


Figure 5-5. 5500A SCOPE Output to Test Tool Input C

5.6.5 Input D LF-HF Gain

Note: the adjustment steps for channel D are only for the models 190-104, 190-204.

Proceed as follows to do the Input D LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-7.

2. Connect the Test Tool to the 5500A as shown in Figure 5-6.
3. Set the 5500A SCOPE output to source the signal required for the first calibration point in Table 5-7.
4. Set the 5500A in operate (OPR) or standby (STBY) as indicated.
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY** .
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point signal, and start the calibration.
   Continue through all calibration points of Table 5-7 (and 5-8).
8. When you are finished, set the 5500A to Standby.
9. Continue at Section 5.6.6.

Table 5-7. Input D LF-HF Gain Calibration Points

Cal step	UUT input signal	5500A Setting
CL 0675	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0486	0.62 Vpp sine wave, 50 kHz	SCOPE levsine, 0.62 Vpp, 50 kHz
CL 0487	0.62 Vpp sine wave Fluke 190-204: 221 MHz Fluke 190-104: 121 MHz	SCOPE levsine, 0.62 Vpp, 221 MHz 121 MHz

Table 5-8. Input D LF-HF Gain Calibration Points (Extra steps for 190-104/204, V10.4x firmware **)

Cal step	UUT input signal	5500A Setting
CL 0466	124 mVpp sine wave, 50 kHz	SCOPE levsine, 124 mVpp, 50 kHz
CL 0467	124 mVpp sine wave Fluke 190-204: 221 MHz Fluke 190-104: 121 MHz	SCOPE levsine, 124 mVpp, 221 MHz 121 MHz

** Four channel instruments (190-104/204) with firware V10.4x require the extra steps CL 466 and CL 467. Installed firmware version can be checked via key sequence: USER key, F3 – VERSION & CAL, Software Version: ... .

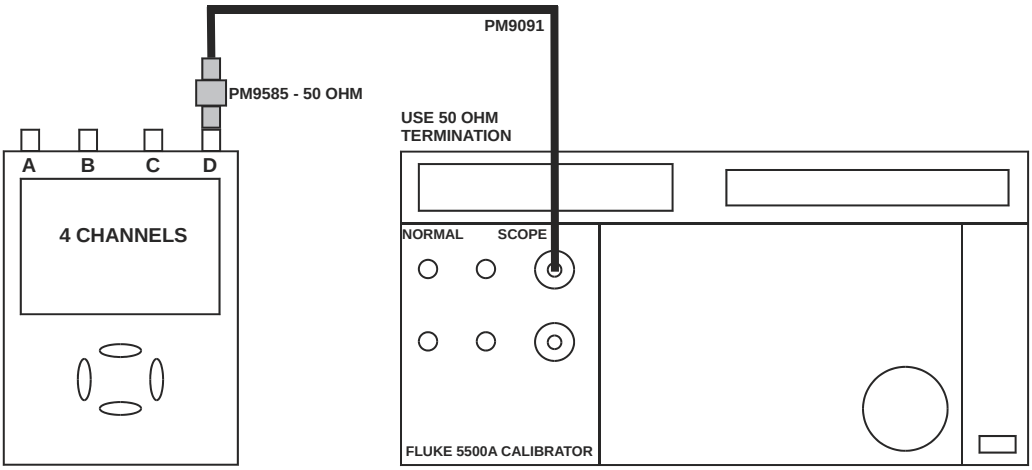


Figure 5-6. 5500A SCOPE Output to Test Tool Input D

5.6.6 Input ABCD (AB) LF-HF Gain

Note: the adjustment steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows to do the Input ABCD LF-HF Gain calibration.

1. Press F2 to select the first calibration step in Table 5-9.
2. Connect the Test Tool to the 5500A as shown in Figure 5-7.

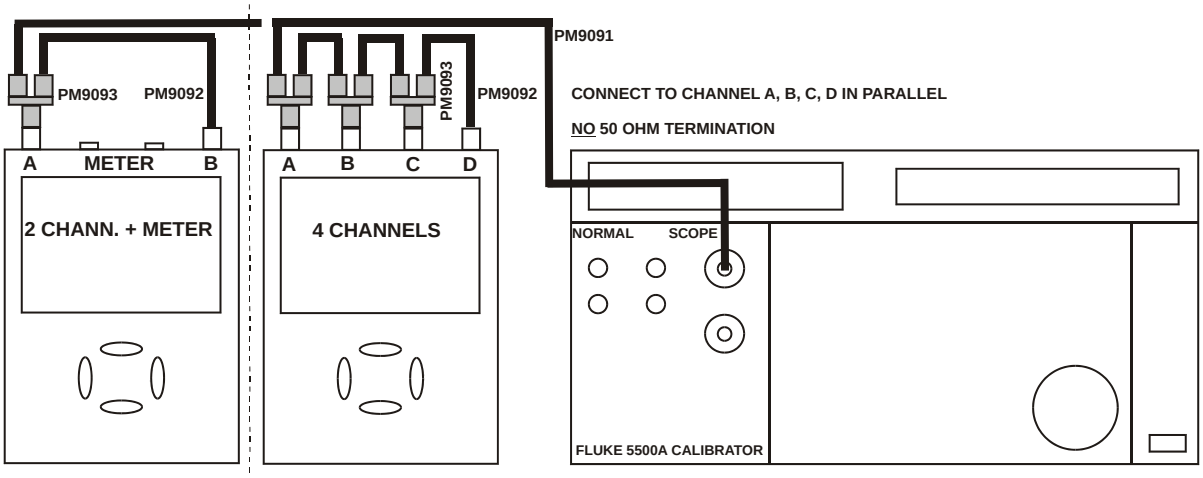


Figure 5-7. Test Tool Input ABCD to 5500A SCOPE Output

3. Set the 5500A to supply a 1 kHz square wave (SCOPE, MODE volt, SCOPE Z 1 MΩ), to the first calibration point in Table 5-9.

Warning

Dangerous voltages will be present on the calibration source and connection cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool.

4. Set the 5500A to operate (OPR).
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY**.
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-9.
8. Set the 5500A to Standby, and continue at Section 5.6.7.

Table 5-9. Input ABCD Gain Calibration Points

Cal step	UUT input value (5500A SCOPE, MODE volt, SCOPE Z 1 MΩ, 1 kHz)	
CL 0660	300 mV	
CL 0604	500 mV	
CL 0637	none	(5500 standby)
CL 0504	500 mV	
CL 0624	none	(5500 standby)
CL 0599	10 mV	
CL 0600	25 mV	
CL 0601	50 mV	
CL 0602	100 mV	
CL 0603	250 mV	
CL 0662	2 V	
CL 0605	1 V	
CL 0606	2.5 V	
CL 0607	5 V	
CL 0664	20 V	
CL 0608	10 V	
CL 0609	25 V	
CL 0610	50 V	(set 5500A to OPR!)

5.6.7 Input ABCD (AB) Position

Proceed as follows to do the Input ABCD (AB) Position calibration:

1. Press F2 to select calibration adjustment step **CL 0619**.
2. Remove all Input A, B, C, D (A, B) connections (open inputs).
3. Press F3 to start the calibration
4. Wait until the display shows calibration status **:READY**.
5. Continue at Section 5.6.8

5.6.8 Input ABCD (AB) Volt Gain

Warning

Dangerous voltages will be present on the calibration source and connection cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool.

Note: the adjustment steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows to do the Input ABCD (AB) Volt Gain calibration.

1. Press F2 to select the first calibration step in Table 5-10.
2. Connect the Test Tool to the 5500A as shown in Figure 5-8.

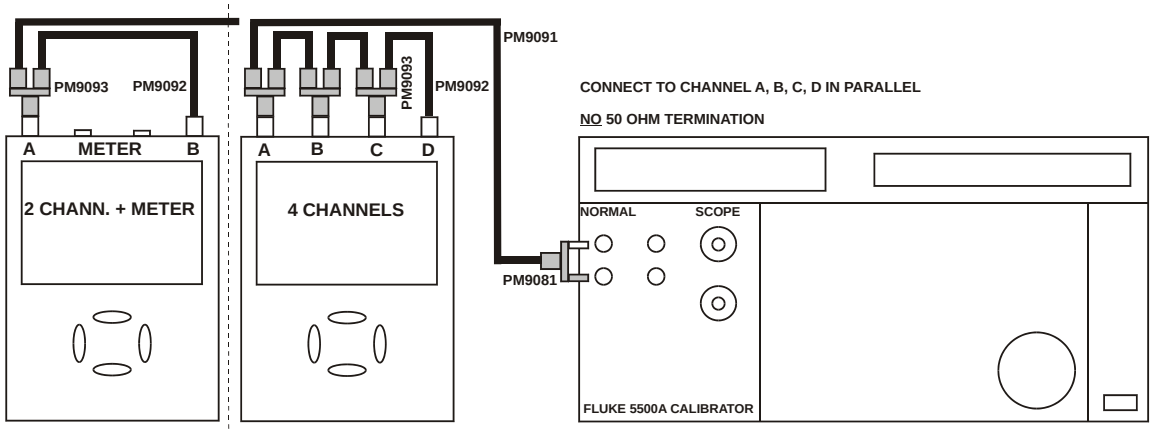


Figure 5-8. Test Tool Input ABCD to 5500A Normal Output

3. Set the 5500A to supply a DC voltage (NORMAL output), to the first calibration point in Table 5-10.
4. Set the 5500A to operate (OPR).
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY**.
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-10.
8. Set the 5500A to Standby, and continue at Section 5.6.9.

Table 5-10. Input ABCD Gain Calibration Points

Cal step	UUT input value (5500A NORMAL)
CL 0799	5 mV
CL 0800	12.5 mV
CL 0801	25 mV
CL 0802	50 mV
CL 0803	125 mV
CL 0804	250 mV
CL 0805	500 mV
CL 0806	1.25 V
CL 0807	2.5 V
CL 0808	5 V
CL 0809	12.5 V
CL 0810	25 V
CL 0811	50 V (set 5500A to OPR!)
CL 0812	125 V
CL 0813	250 V

5.6.9 Input ABCD (AB) Zero

Proceed as follows to do the Input ABCD (AB) Zero calibration:

1. Press F2 to select calibration adjustment step CL 0852
2. Short circuit Input A, B, C, D (A, B) with 50Ω feed through terminations.
3. Press F3 to start the zero calibration
4. Wait until the display shows the status **:READY**.
5. Remove the input terminations.
6. Fluke 190-062, 190-102, 190-202: continue at Section 5.6.10.
   Fluke 190-104, 190-204: continue at Section 5.8.

5.6.10 Multimeter (DMM) Volt Gain

Warning

Dangerous voltages will be present on the calibration source and connection cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the test tool.

Note: the adjustment steps for the meter section are only for the models 190-062, 190-102, 190-202.

Proceed as follows to do the DMM Volt Gain calibration.

1. Press F2 to select the first calibration step in Table 5-11.
2. Connect the test tool to the 5500A as shown in Figure 5-9.

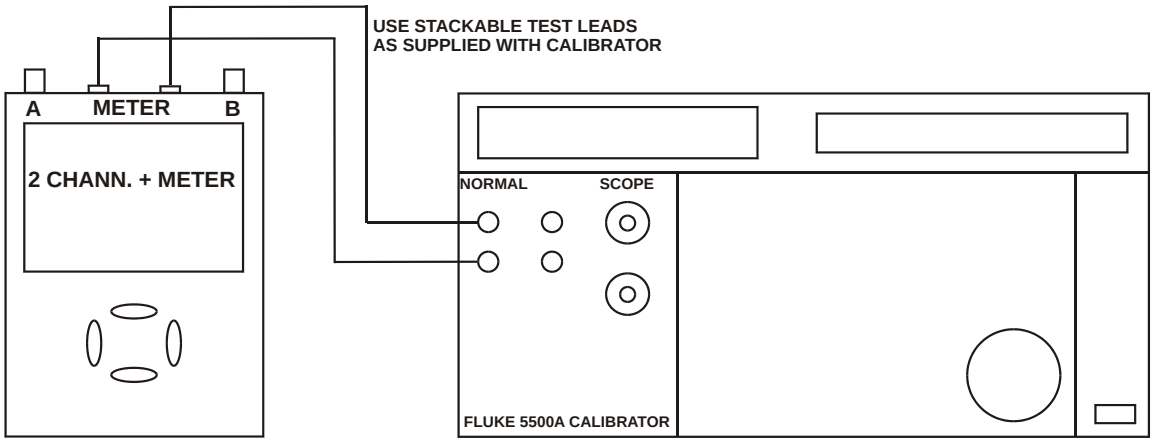


Figure 5-9. 5500A NORMAL Output to Test Tool Banana Input

3. Set the 5500A to supply a DC voltage, to the first calibration point in Table 5-11.
4. Set the 5500A to operate (OPR).
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY**.
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-11
8. Set the 5500A to Standby, and continue at Section 5.6.11.

Table 5-11. DMM Gain Calibration Points

Cal step	UUT input value (5500A NORMAL)
CL 0840	500 mV
CL 0849	2.5 V
CL 0841	5 V
CL 0842	50 V (set 5500A to OPR!)
CL 0843	500 V
CL 0844	1000 V

5.6.11 Multimeter (DMM) Numeric Zero

Note: the adjustment steps for the meter section are only for the models 190-062, 190-102, 190-202.

Proceed as follows to do the Multimeter (DMM) Zero calibration:

1. Press F2 to select calibration adjustment step CL 0890

2. Short circuit the banana jack Meter inputs properly (calibration includes Ohms zero!). Use a test lead as short as possible.
3. Press F3 to start the zero calibration
4. Wait until the display shows the status **:READY**.
5. Remove the input terminations.
6. Continue at Section 5.6.12.

5.6.12 Multimeter (DMM) Ohm Gain

Note: the adjustment steps for the meter section are only for the models 190-062, 190-102, 190-202.

Proceed as follows to do the DMM Ohm Gain calibration:

1. Press F2 to select first calibration adjustment step in Table 5-12.
2. Connect the test tool to the 5500A as shown in Figure 5-10.
   Notice that the sense leads must be connected directly to the test tool.

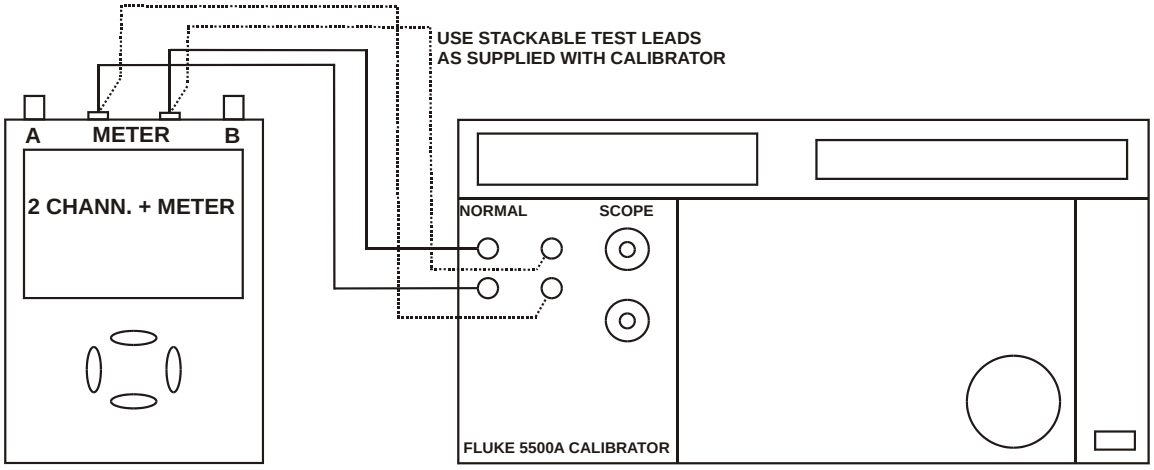


Figure 5-10. Four-wire Ohms calibration connections

3. Set the 5500A to the first test point in Table 5-12. Use the 5500A "COMP 2 wire" mode for the calibration adjustments up to and including 100 kΩ. For the higher values, the 5500A will turn off the "COMP 2 wire" mode.
4. Set the 5500A to operate (OPR).
5. Press F3 to start the calibration.
6. Wait until the display shows the calibration status **:READY**.
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point, and start the calibration. Continue through all calibration points.
8. When you are finished, set the 5500A to Standby.
9. Continue at Section 5.8.

Table 5-12. Ohm Gain Calibration Points

Cal Step	UUT input Value (5500 NORMAL)
CL 0910	100 Ω
CL 0911	1 kΩ
CL 0912	10 kΩ
CL 0913	100 kΩ
CL 0914	1 MΩ
CL 0915	10 MΩ

5.7 Final Calibration (Firmware: V11.10)

Important: the Final Calibration steps depend on the Software Version that is installed in your Test Tool. The installed software is visible after the knob sequence USER, F3 – VERSION & CAL... .
If the installed firmware is **V11.10** you must do the steps in this section **5.7**.

Before starting the final calibration you must have done the WarmingUp & PreCalibration (section 5.5)!

The final calibration requires input conditions that will be described in each step. After starting a step, several steps that require the same input conditions will be done automatically. So if you start for example calibration step CL 0852, the calibration can include also step CL 0929, and at the end the display then shows CL 0929: READY

You must always start the Final Calibration at the first step, see Section 5.7.1. Starting at another step will make the calibration invalid!

If you proceeded to calibration step N (for example step CL 0481), then return to a previous step (for example step CL 0480) , and then calibrate this step, the complete final calibration becomes invalid; then you must repeat the calibration starting at 5.7.1.

It is allowed to repeat a step that shows the status :READY by pressing F3 again.

Error messages

Proceed as follows if an error message **ERROR: nnnn** is displayed during calibration:

- if **nnnn** < 5000 then check input signal and test leads, and repeat the current step by pressing F2 again.
- if **nnnn** ≥ 5000 then check input signal and test leads, and repeat the final calibration starting at section 5.7.1.

If the error persists the Test Tool is defective.

5.7.1 Warm Up Final and ADC Timing

Proceed as follows:

1. The Warm Up Final step (CL 0201) must be done with open inputs.
2. Press F3 to start the calibration.
3. Wait until the display shows calibration status **:READY.**
4. Press F2 to select the next calibration step (CL 0570)
5. Connect the Test Tool to the 5500A SCOPE output as shown in Figure 5-11. Use 50Ω termination.
6. Set the 5500A to generate a sine wave 50 MHz / 0.5 V pp (mode LEVSINE) at the SCOPE output.
7. Set the 5500A in operate (OPR).
8. Press F3 to start the calibration.
9. Wait until the display shows calibration status **:READY.**

10. Set the 5500A in standby (STBY).
11. Continue at Section 5.7.2.

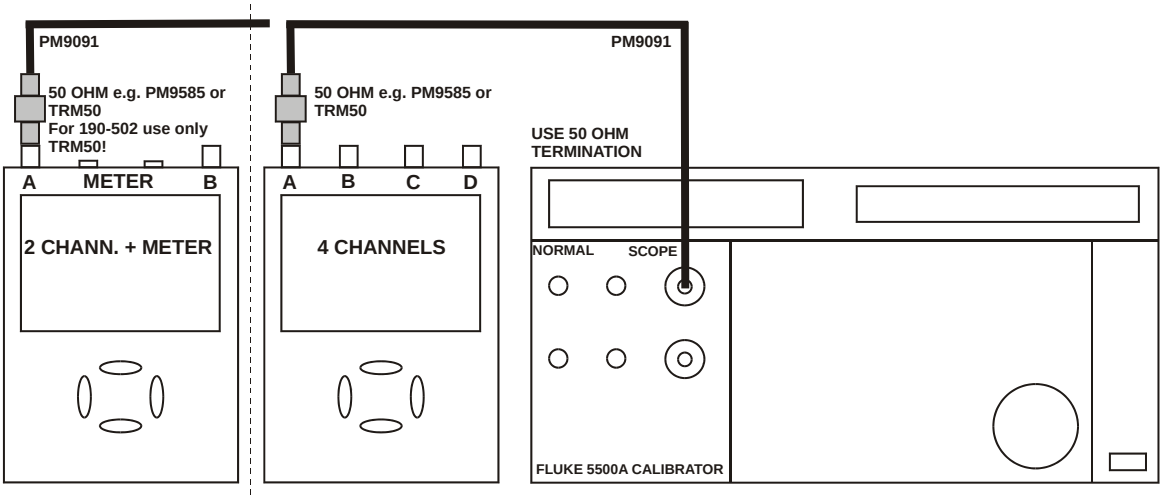


Figure 5-11. 5500A SCOPE Output to Test Tool Input A.

5.7.2 Input A LF-HF Gain

Proceed as follows to do the Input A LF-HF Gain calibration:

1. Connect the Test Tool to the 5500A as shown in Figure 5-11.
2. The display must show step CL 0654. If it does not, then press F2 or F1 to select the first calibration step in Table 5-13.
3. Set the 5500A SCOPE output to source the signal required for the first calibration point in Table 5-13.
4. Set the 5500A in operate (OPR) or standby (STBY) as indicated.
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY** .
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point signal, and start the calibration.
   Continue through all calibration points of Table 5-13.
8. When you are finished, set the 5500A to Standby.
9. Continue at Section 5.7.3.

Table 5-13. Input A LF-HF Gain Calibration Points

Cal step	UUT input signal	5500A Setting
CL 0654	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0480	0.5 Vpp sine wave, 50 kHz	SCOPE levsine, 0.5 Vpp, 50 kHz
CL 0481	0.5 Vpp sine wave Fluke 190-202/204: 221 MHz Fluke 190-102/104: 121 MHz Fluke 190-062: 81 MHz	SCOPE levsine, 0.5 Vpp, 221 MHz 121 MHz 81 MHz
CL 0460	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0461	100 mVpp sine wave Fluke 190-202/204: 221 MHz Fluke 190-102/104: 121 MHz Fluke 190-062: 81 MHz	SCOPE levsine, 100 mVpp, 221 MHz 121 MHz 81 MHz

5.7.3 Input B LF-HF Gain

Proceed as follows to do the Input B LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-14.
2. Connect the Test Tool to the 5500A as shown in Figure 5-12.
3. Set the 5500A SCOPE output to source the signal required for the first calibration point in Table 5-14.
4. Set the 5500A in operate (OPR) or standby (STBY) as indicated.
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY** .
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point signal, and start the calibration.
   Continue through all calibration points of Table 5-14.
8. When you are finished, set the 5500A to Standby.
9. Continue at Section 5.7.4. for model 190-104 and 190-204 (4 oscilloscope channels).
   Continue at Section 5.7.6. for model 190-062, 190-102 and 190-202 (2 oscilloscope channels).

Table 5-14. Input B LF-HF Gain Calibration Points

Cal step	UUT input signal	5500A Setting
CL 0674	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0482	0.5 Vpp sine wave, 50 kHz	SCOPE levsine, 0.5 Vpp, 50 kHz
CL 0483	0.5 Vpp sine wave Fluke 190-202/204: 221 MHz Fluke 190-102/104: 121 MHz Fluke 190-062: 81 MHz	SCOPE levsine, 0.5 Vpp, 221 MHz 121 MHz 81 MHz
CL 0462	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0463	100 mVpp sine wave Fluke 190-202/204: 221 MHz Fluke 190-102/104: 121 MHz Fluke 190-062: 81 MHz	SCOPE levsine, 100 mVpp, 221 MHz 121 MHz 81 MHz

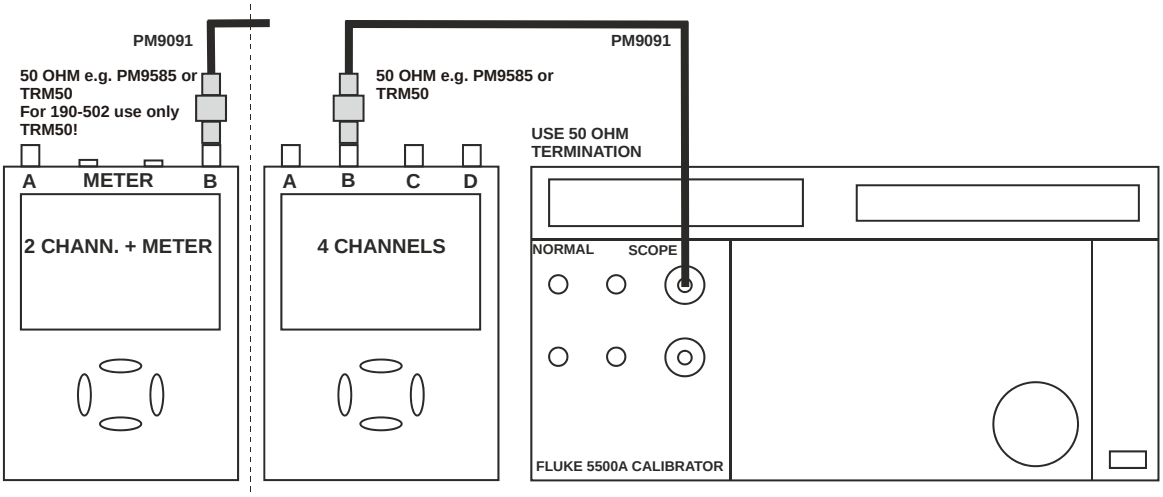


Figure 5-12. 5500A SCOPE Output to Test Tool Input B

5.7.4 Input C LF-HF Gain

Note: the adjustment steps for channel C are only for the models 190-104, 190-204.

Proceed as follows to do the Input C LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-15.
2. Connect the Test Tool to the 5500A as shown in Figure 5-13.
3. Set the 5500A SCOPE output to source the signal required for the first calibration point in Table 5-15.
4. Set the 5500A in operate (OPR) or standby (STBY) as indicated.
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY** .

7. Press F2 to select the next calibration step, set the 5500A to the next calibration point signal, and start the calibration.
   Continue through all calibration points of Table 5-15.
8. When you are finished, set the 5500A to Standby.
9. Continue at Section 5.7.5.

Table 5-15. Input C LF-HF Gain Calibration Points

Cal step	UUT input signal	5500A Setting
CL 0656	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0484	0.5 Vpp sine wave, 50 kHz	SCOPE levsine, 0.5 Vpp, 50 kHz
CL 0485	0.5 Vpp sine wave Fluke 190-204: 221 MHz Fluke 190-104: 121 MHz	SCOPE levsine, 0.5 Vpp, 221 MHz 121 MHz
CL 0464	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0465	100 mVpp sine wave Fluke 190-204: 221 MHz Fluke 190-104: 121 MHz	SCOPE levsine, 100 mVpp, 221 MHz 121 MHz

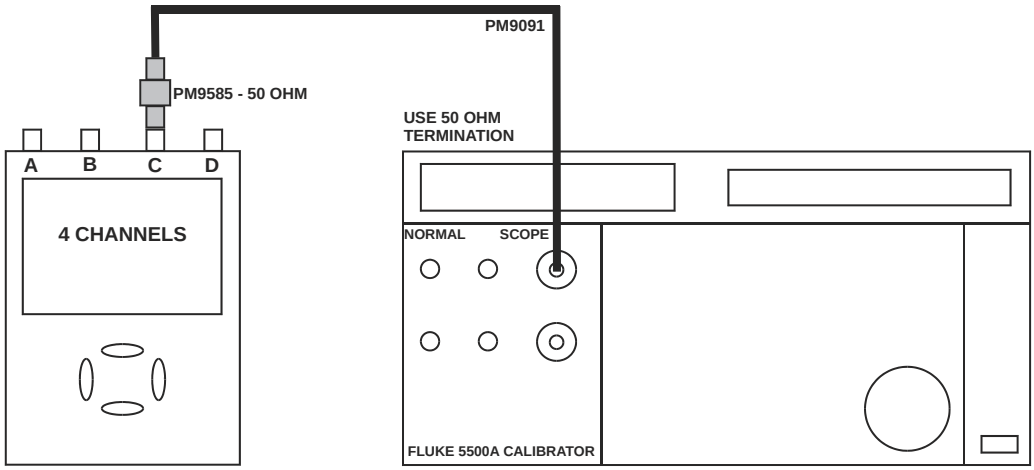


Figure 5-13. 5500A SCOPE Output to Test Tool Input C

5.7.5 Input D LF-HF Gain

Note: the adjustment steps for channel D are only for the models 190-104, 190-204.

Proceed as follows to do the Input D LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-16.
2. Connect the Test Tool to the 5500A as shown in Figure 5-14.

3. Set the 5500A SCOPE output to source the signal required for the first calibration point in Table 5-16.
4. Set the 5500A in operate (OPR) or standby (STBY) as indicated.
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY** .
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point signal, and start the calibration.
   Continue through all calibration points of Table 5-16.
8. When you are finished, set the 5500A to Standby.
9. Continue at Section 5.7.6.

Table 5-16. Input D LF-HF Gain Calibration Points

Cal step	UUT input signal	5500A Setting
CL 0675	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0486	0.5 Vpp sine wave, 50 kHz	SCOPE levsine, 0.5 Vpp, 50 kHz
CL 0487	0.5 Vpp sine wave Fluke 190-204: 221 MHz Fluke 190-104: 121 MHz	SCOPE levsine, 0.5 Vpp, 221 MHz 121 MHz
CL 0466	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0467	100 mVpp sine wave Fluke 190-204: 221 MHz Fluke 190-104: 121 MHz	SCOPE levsine, 100 mVpp, 221 MHz 121 MHz

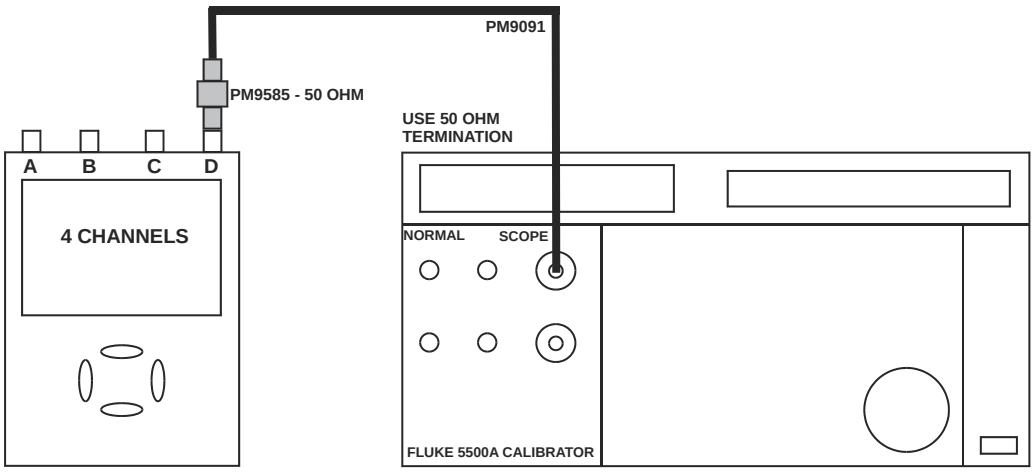


Figure 5-14. 5500A SCOPE Output to Test Tool Input D

5.7.6 Input ABCD (AB) LF-HF Gain

Note: the adjustment steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows to do the Input ABCD LF-HF Gain calibration.

1. Press F2 to select the first calibration step in Table 5-17.
2. Connect the Test Tool to the 5500A as shown in Figure 5-15.

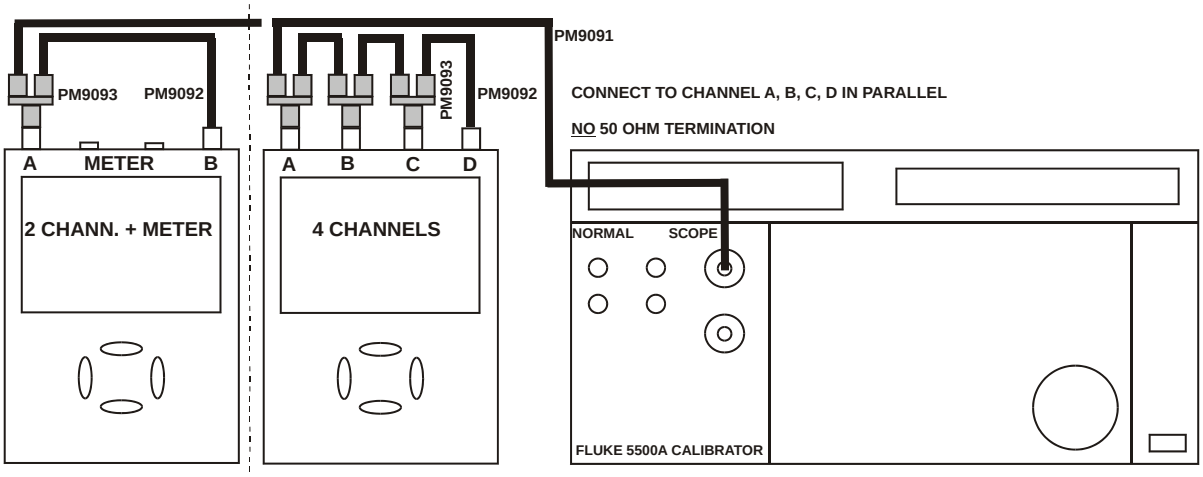


Figure 5-15. Test Tool Input ABCD to 5500A SCOPE Output

3. Set the 5500A to supply a 1 kHz square wave (SCOPE, MODE volt, SCOPE Z 1 MΩ), to the first calibration point in Table 5-17.

Warning

Dangerous voltages will be present on the calibration source and connection cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool.

4. Set the 5500A to operate (OPR).
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY**.
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-17.
8. Set the 5500A to Standby, and continue at Section 5.7.7.

Table 5-17. Input ABCD Gain Calibration Points

Cal step	UUT input value (5500A SCOPE, MODE volt, SCOPE Z 1 MΩ, 1 kHz)
CL 0660	300 mV
CL 0604	500 mV
CL 0637	none (5500 standby)
CL 0504	500 mV
CL 0624	none (5500 standby)
CL 0599	10 mV
CL 0600	25 mV
CL 0601	50 mV
CL 0602	100 mV
CL 0622	none (5500 standby)
CL 0603	250 mV
CL 0662	2 V
CL 0605	1 V
CL 0606	2.5 V
CL 0607	5 V
CL 0664	20 V
CL 0608	10 V
CL 0609	25 V
CL 0610	50 V (set 5500A to OPR!)

5.7.7 Input ABCD (AB) Position

Proceed as follows to do the Input ABCD (AB) Position calibration:

1. Press F2 to select calibration adjustment step **CL 0619**.
2. Remove all Input A, B, C, D (A, B) connections (open inputs).
3. Press F3 to start the calibration.
4. Wait until the display shows calibration status **:READY**.
5. Continue at Section 5.7.8.

5.7.8 Input ABCD (AB) Zero

Proceed as follows to do the Input ABCD (AB) Zero calibration:

1. Press F2 to select calibration adjustment step **CL 0850**.
2. Short circuit Input A, B, C, D (A, B) with 50Ω feed through terminations.
3. Press F3 to start the zero calibration

4. Wait until the display shows the status **:READY**.
5. Remove the input terminations.
6. Continue at Section 5.7.9.

5.7.9 Input ABCD (AB) Volt Gain

Warning

Dangerous voltages will be present on the calibration source and connection cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the Test Tool.

Note: the adjustment steps for channel C and D are only for the models 190-104, 190-204.

Proceed as follows to do the Input ABCD (AB) Volt Gain calibration.

1. Press F2 to select the first calibration step in Table 5-18.
2. Connect the Test Tool to the 5500A as shown in Figure 5-16.

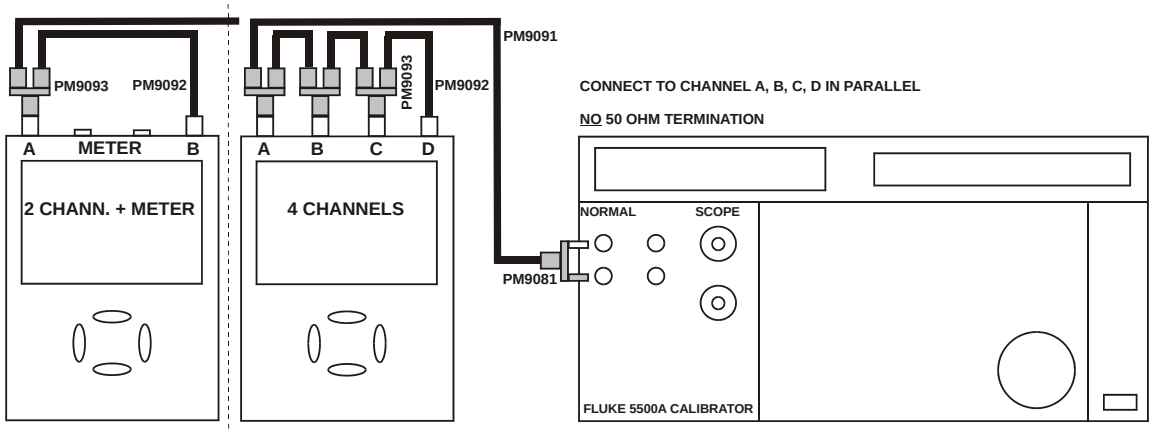


Figure 5-16. Test Tool Input ABCD to 5500A Normal Output

3. Set the 5500A to supply a DC voltage (NORMAL output), to the first calibration point in Table 5-18.
4. Set the 5500A to operate (OPR).
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY**.
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-18.
8. Set the 5500A to Standby and continue at Section:
   - 5.7.10 for model 190-062, 190-102 and 190-202 (with multimeter channel).
   - 5.8 for model 190-104, 190-204 (with 4 oscilloscope channels).

Table 5-18. Input ABCD Gain Calibration Points

Cal step	UUT input value (5500A NORMAL)
CL 0799	5 mV
CL 0800	12.5 mV
CL 0801	25 mV
CL 0802	50 mV
CL 0803	125 mV
CL 0804	250 mV
CL 0805	500 mV
CL 0806	1.25 V
CL 0807	2.5 V
CL 0808	5 V
CL 0809	12.5 V
CL 0810	25 V
CL 0811	50 V (set 5500A to OPR!)
CL 0812	125 V
CL 0813	250 V

5.7.10 Multimeter (DMM) Numeric Zero

Note: the adjustment steps for the meter section are only for the models 190-062, 190-102, 190-202.

Proceed as follows to do the Multimeter (DMM) Zero calibration:

1. Press F2 to select calibration adjustment step **CL 0890.**
2. Short circuit the banana jack Meter inputs properly (calibration includes Ohms zero!). Use a test lead as short as possible.
3. Press F3 to start the zero calibration
4. Wait until the display shows the status **:READY**.
5. Remove the input terminations.
6. Continue at Section 5.7.11.

5.7.11 Multimeter (DMM) Volt Gain

Warning

Dangerous voltages will be present on the calibration source and connection cables during the following steps. Ensure that the calibrator is in standby mode before making any connection between the calibrator and the test tool.

Note: the adjustment steps for the meter section are only for the models 190-062, 190-102, 190-202.

Proceed as follows to do the DMM Volt Gain calibration.

1. Press F2 to select the first calibration step in Table 5-19.
2. Connect the test tool to the 5500A as shown in Figure 5-17.

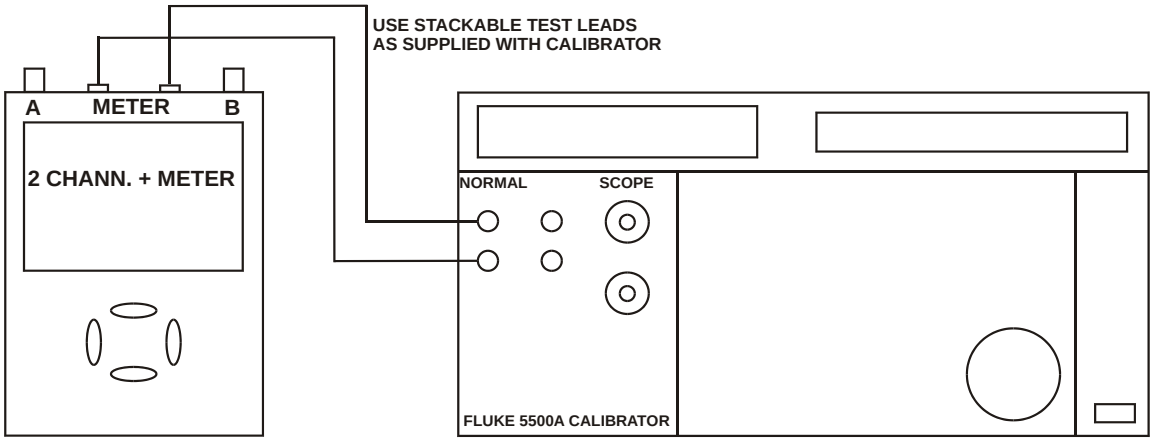


Figure 5-17. 5500A NORMAL Output to Test Tool Banana Input

3. Set the 5500A to supply a DC voltage, to the first calibration point in Table 5-19.
4. Set the 5500A to operate (OPR).
5. Press F3 to start the calibration.
6. Wait until the display shows calibration status **:READY**.
7. Press F2 to select the next calibration step, set the 5500A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-19.
8. Set the 5500A to Standby, and continue at Section 5.7.12.

Table 5-19. DMM Gain Calibration Points

Cal step	UUT input value (5500A NORMAL)
CL 0840	500 mV
CL 0849	2.5 V
CL 0841	5 V
CL 0842	50 V (set 5500A to OPR!)
CL 0843	500 V
CL 0844	1000 V

5.7.12 Multimeter (DMM) Ohm Gain

Note: the adjustment steps for the meter section are only for the models 190-062, 190-102, 190-202.

Proceed as follows to do the DMM Ohm Gain calibration:

3. Press F2 to select first calibration adjustment step in Table 5-20.
4. Connect the test tool to the 5500A as shown in Figure 5-18.
   Notice that the sense leads must be connected directly to the test tool.

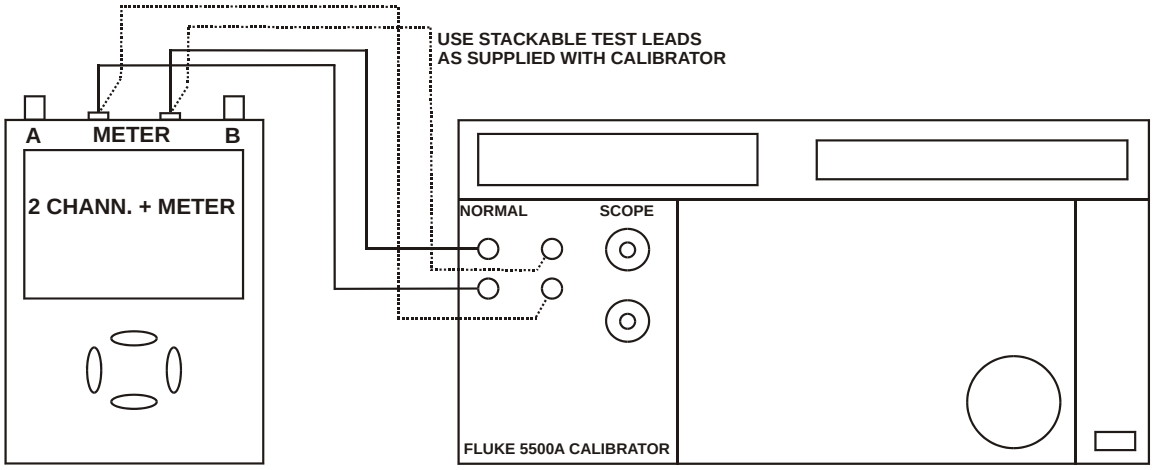


Figure 5-18. Four-wire Ohms calibration connections

10. Set the 5500A to the first test point in Table 5-20. Use the 5500A “COMP 2 wire” mode for the calibration adjustments up to and including 100 kΩ. For the higher values, the 5500A will turn off the “COMP 2 wire” mode.
11. Set the 5500A to operate (OPR).
12. Press F3 to start the calibration.
13. Wait until the display shows the calibration status **:READY**.
14. Press F2 to select the next calibration step, set the 5500A to the next calibration point, and start the calibration. Continue through all calibration points.
15. When you are finished, set the 5500A to Standby.
16. Continue at Section 5.8.

Table 5-20. Ohm Gain Calibration Points

Cal Step	UUT input Value (5500 NORMAL)
CL 0910	100 Ω
CL 0911	1 kΩ
CL 0912	10 kΩ
CL 0913	100 kΩ
CL 0914	1 MΩ
CL 0915	10 MΩ

5.8 Save Calibration Data and Exit

Proceed as follows to save the calibration data, and to exit the Maintenance mode:

1. Remove all test leads from the Test Tool inputs.
2. Press F4 **EXIT**. The Test Tool will 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 characteristics listed in Chapter 2.

3. Press F4 **YES** to save and exit.

Note 1

After saving the calibration data, the calibration number and - date will be updated if the calibration data have been changed and the data are valid. The calibration number and - date will not change if:
- the calibration mode is entered and left without doing a calibration adjustment.
- only the contrast calibration adjustment (5.4) and/or the probe calibration is done.

Note 2

If you press F3 **NO** *,the Test Tool returns to the calibration mode. You can either calibrate the Test Tool again, or press* F4 **EXIT** , F4 **YES** *to save and exit.*

Possible error messages.

The following messages can be shown on the Test Tool display:

WARNING: Calibration data not valid.
Save data and exit maintenance mode?

Proceed as follows:

- If you did the WarmingUp and Pre-Calibration successfully (section 5.5), and you want to store the Pre-Calibration data before continuing with the Final Calibration:

  ⇒ Press F4 **YES**.

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

The instrument needs calibration.
Please contact your service center.

The calibration date and number will not be updated. You must continue with the Final Calibration!

- To return to the Maintenance mode, if you want to repeat the complete calibration:

  ⇒ Press F3 **NO**.

  Now press F1 until the display shows **WarmingUp (CL 0200):IDLE**, and calibrate the Test Tool, starting at section 5.5.

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

  ⇒ Turn the Test Tool off.

5.9 Probe Calibration

To meet full user specifications, you need to adjust the supplied red (R), blue (B), gray (G) and green (V) VPS410 10:1 voltage probes for optimal response.

To adjust the VPS410 probes, do the following:

1. Connect the red probe from the red Input A BNC to the banana jacks. See figure 5-9

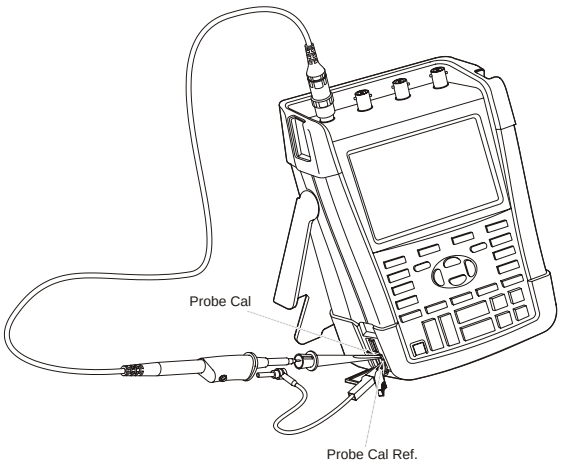


Figure 5-19. 10:1 Probe Calibration Connection

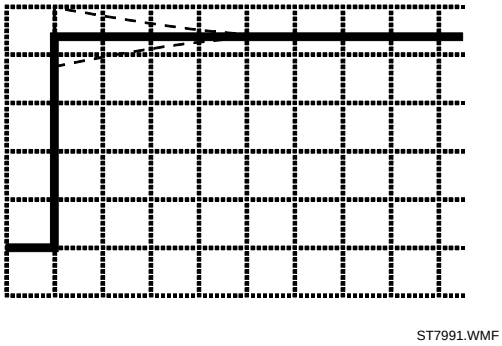


Figure 5-20. 10:1 Probe Calibration

2. Press A, and then F3 to open the **Probe on A** menu
3. Select Probe Type: ■ **Voltage | Attenuation:** ■ **10:1 .**
4. Press ENTER .
5. Press F3 **- PROBE A.**
6. **Press** F1 **- PROBE CAL** and follow the instructions as displayed on screen.
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, refer to fig. 5-10). The trimmer to be operated is located in the probe housing and can be reached by rotating the centre part of the housing. For further information refer to the probe instruction sheet. When done, press F4 to start the DC calibration that is performed automatically. The Probe Calibration is OK if all instructions displayed on screen are finished succesfully.
   Close the hole of the trimmer by rotating the centre part of the housing: this is important for safe use of the probe at high input voltages.
8. Repeat the procedure for the blue VPS410-B probe, connected between the blue Input B BNC and the probe cal terminals on the left side of the instrument.
9. Repeat the procedure for the gray VPS410-G probe, connected between the gray Input C BNC and the probe cal terminals on the left side of the instrument.
10. Repeat the procedure for the green VPS410-V probe, connected between the green Input D BNC and the probe cal terminals on the left side of the instrument.

Chapter 6
Disassembling the Test Tool

Title **Page**

6.1. Introduction

This section provides the required disassembling 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. Refer to the Fluke 190 Series II Users Manual “Safety Information” Chapter (page 4 onwards) for instructions how to safely handle and use this battery pack. The Users Manual can be downloaded from Fluke’s website..

In the Test Tool a number of selftapping screws are used. When mounting these screws again it is advised to use a hand-operated screwdriver and reisert them into the ‘tracks’ already present in the plastic. This assures a longer life.

At the end of this chapter a number of pictures shows the various stages of disassembling.

Warning

To avoid 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

6.2. Disassembly & Reassembly Procedures

6.2.1 Required Tools

To access all the assemblies, you need the following:

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

6.2.2 Removing the Tilt Stand, Hang Strap, and Side Strap

To separate the Tilt Stand from the Rear Case: gently bend one rotation point away from the Rear Case and move the stand away from the housing. There is no need to remove screws or other fixing devices.

Before opening the Test Tool, you must remove the Hang Strap and the Side Strap. How to remove and install the Hang Strap is explained in the Users Manual in Chapter ‘Tips’. The grip of the Side Strap consists of two halves kept together with Velcro tape. After having opened it, the straps can be taken apart and be removed from their fixing dowels in the side of the Test Tool. Before doing this, take careful notice on the correct position of the strap. To install work in reverse order.

6.2.3 Opening the Test Tool, Removing the Battery Pack

Proceed as follows:

1. Remove the battery access door with a standard blade screwdriver by turning the plastic battery door screws one-quarter turn counterclockwise.
2. Take the battery out of the instrument.

   Note: take care not to short circuit the battery's contacts. Do not open or damage the battery's housing.
3. When present, take off the Hang Strap and the Side Strap (refer to 6.2.2.).
4. Loosen the two black selftapping screws about 12.5 mm long (total length) that fix the grey/yellow Input Cover that is around the BNC-input (and banana) sockets.
5. Take the Cover off.

   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 a hole pattern for use on Test Tools with 4 channels and 2 channels + meter inputs.

   Note: when reinstalling the Input Cover, do not forget to reinstall 4 steel pins (2x17 mm) in the left and right side of the instrument. The pins are used to attach the Hang Strap and the Side Strap.
6. Remove 2 screws M3x10 from the Bottomholster. The screws fit into square nuts that in turn fit into the Rear Case. Take care that the nuts are not lost.
7. Take the Bottomholster off.

   Note: when reinstalling the Holster, take care to reinstall 2 steel pins (2x17 mm) in the left and right side of the instrument. The pins are used to attach the Side Strap. Take care that the yellow covers of DC-input and USB-inputs are correctly in place.
8. Remove four selftaping screws 16 mm long (total length) that attach the Rear Case. Two of these screws are located in the battery compartment.
9. Take the Rear Case off.

   Note: when reinstalling the Rear Case, do not forget to put the steel plate 16x17 mm in place again. This plate is present in the cavity on the right-hand side of the instrument and can be used to attach a Kensington Lock.

   Note: when reinstalling the bottom case, take care that flat cables to LCD and keyboard are not damaged inbetween case parts.

6.2.4 Getting access to Top Side of PCA

Most of the measuring points are located on the top side of the PCA. To get access to this side, remove the upper plate (Shielding Lid):

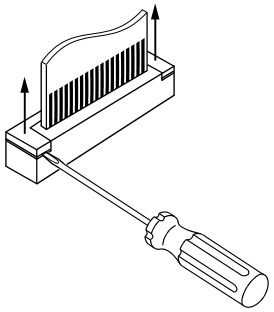
1. Remove 4 screws M3x6.5 with a spring-washer (left and right side, bottom side).
2. Remove 4 screws M3x10 that are grouped in a square around Sampling chip N2000.
3. Take the screening plate off to get access to the top side of the PCA. Before doing this observe how this plate fits on to the lower chassis.

6.2.5 Getting access to Bottom Side of PCA

Important: to avoid contaminating the flex cable contacts with grease from your fingers, do not touch these contacts (or wear cotton gloves). Contaminated contacts may not cause immediate instrument faillure. Faillures typically show up when contaminated instruments are operated in humid areas.

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. The figure below shows this.
2. Remove the flat cables from connector X9303 (to LCD), J9414 (to keyboard), J9415 (to LCD backlight).
3. Remove 4 screws M3x10 that fix the PCA to the lower chassis (Shielding Assy).
4. Carefully slide the PCA out of the holes for the BNC's and Banana Jacks (2 ch Test Tools).
5. Four channel Test Tools: the A, B, C, D input circuits are covered with 2 isolation foils (a small one around channel B and C; a larger one around all four channels). Remove the foils as far as required to repair a defective channel. Take careful notice on how the foil is positioned around the PCA and through the notches in the PCA that are inbetween the channels. Next remove a screw M3x22 that fixes the top and bottom screening of the suspected channel.
6. Two channel + Meter Test Tools: the A, B and Meter C, D input circuits are covered with 1 isolation foil. Remove the foil as far as required to repair a defective channel. Take careful notice on how the foil is positioned around the PCA. Next remove a screw M3x22 that fixes the top and bottom screening of the suspected channel.
7. Reinsert the flatcables again if you want to measure the bottom side of the PCA under working condition. See the figures at the end of this chapeter.

   Note: Before fixing the PCA again to the lower chassis plate it is advised to put the isolation foils around the channels in place.



6.2.6 Getting access to LCD, Keypad Foil and Keypad

Proceed as follows:

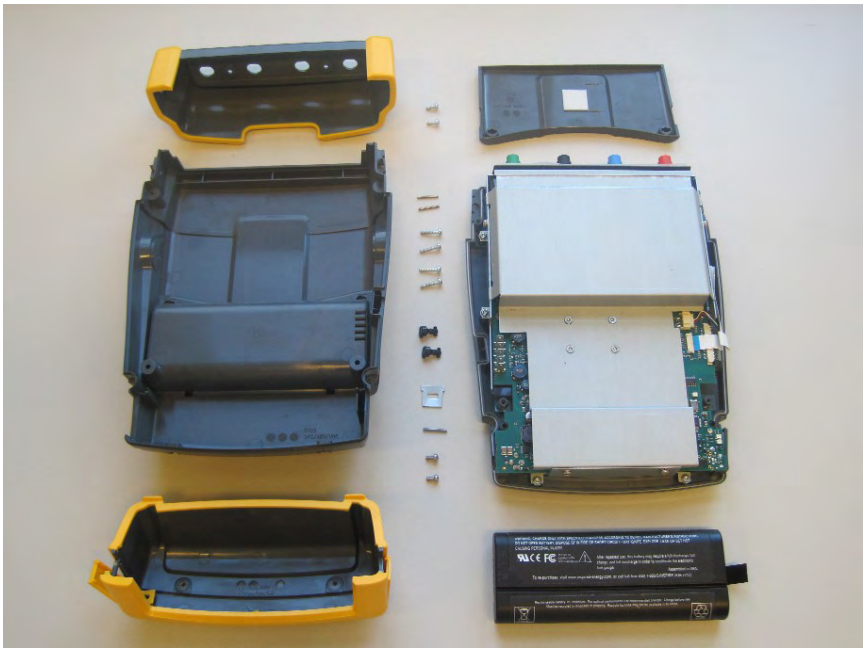
1. Unlock both flat cables by shifting the connector latch at the left and right edge using a small screwdriver. The latch is an integral part of the connector body.
2. Remove the flat cables from connector X9303 (to LCD), J9414 (to keyboard), J9415 (to LCD backlight).
3. Remove 6 selftapping screws 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.
5. Now you have access to LCD-module, keypad foil and keypad. They can be separated from top case without the removal of screws or clamps. Do not touch contact areas with your hands in order to avoid contamination (or wear cotton gloves).

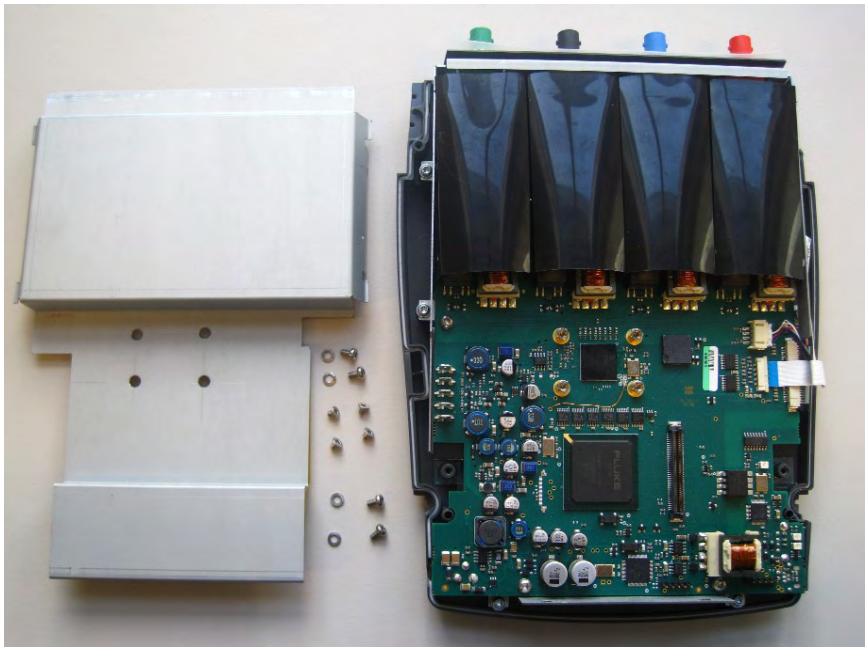
   Note 1: when installing the LCD-module into the top case, take care that no dust or dirt is present between module and the window/decal.
   Note 2: before reinstalling the Main PCA module on to the top case, put the grey plastic strip around the BNC-inputs in place.

6.2.7 Pictures Showing Disassembly Steps

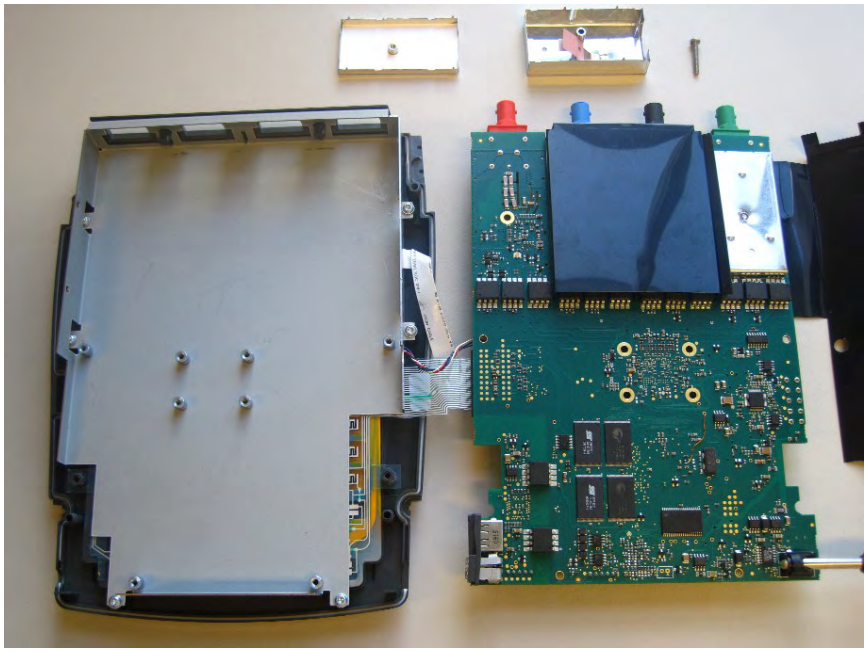
Note: pictures may be subject to minor changes without prior notice and are showing a 4 channel Test Tool.



Opened Case + Screws.



Screening Plate Removed + Screws.



PCA removed from Chassis, Bottom Side visible.