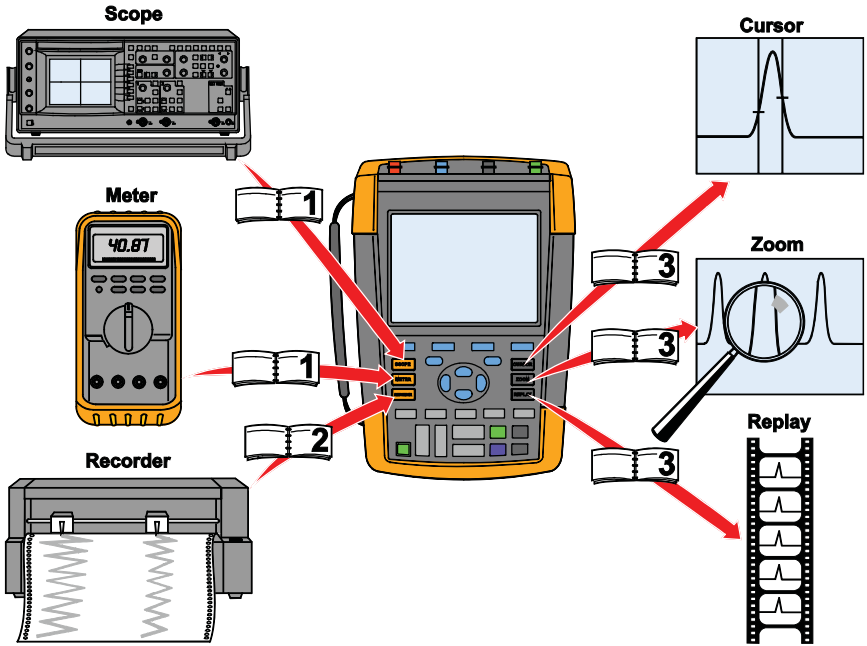
ScopeMeter® Test Tool 190 Series II

Fluke 190-062, -102, -104, -202, -204, -502, -504

Users Manual

May 2011, Rev.2, 1/14



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Introduction

⚠ Warning

Read "Safety Information" before using this instrument.

The descriptions and instructions in this manual apply to all ScopeMeter® Test Tool 190 Series II versions (hereafter referred to as the instrument or as the test tool). The versions are listed below. The version 190-x04 appears in most illustrations.

Input C and Input D, and the Input C and Input D selection keys (C and D) are only present on the versions 190-x04.

Version	Description
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).
190-504	Four 500 MHz Scope Inputs (BNC).

Unpacking the Test Tool Kit

The items in Figure 1 are included in your test tool kit:

Note

When new, the rechargeable Li-ion battery is not fully charged. See Chapter 7.

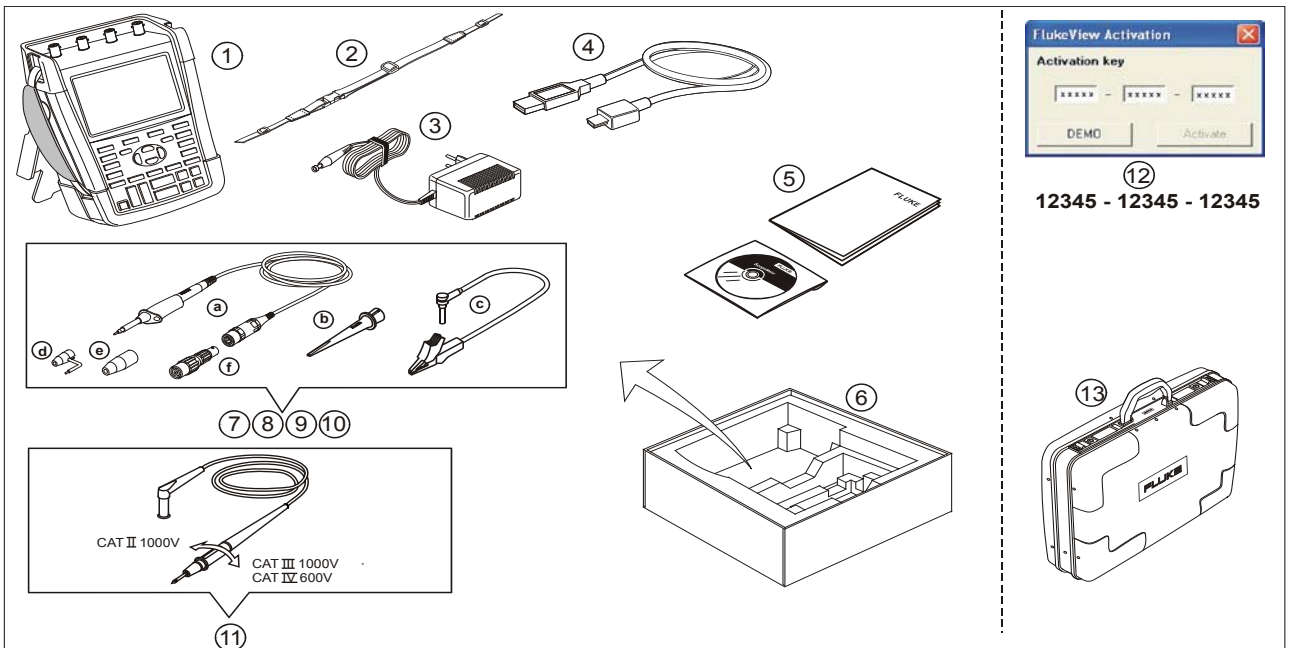


Figure 1. Test Tool Kit

All Fluke 190 Series II versions include the following items:

#	Description
1	Test Tool including – side strap – battery pack BP290 (models 190-xx2) or BP291 (models 190-xx4 and 190-5xx)
2	Hang Strap (see Chapter 6 for mounting instructions)
3	Power Adapter (country dependent, may vary from what is shown in Figure 1)
4	USB interface cable for PC connection (USB-A to mini-USB-B)
5	Safety Information sheet + CD ROM with Users Manual (multi-language) and FlukeView® ScopeMeter® Software for Windows demo package (with restricted functionality)
6	Shipment box (basic version only)
7	Voltage Probe Set (red)
8	Voltage Probe Set (blue)
9	Voltage Probe Set (gray), *not for 190-xx2*
10	Voltage Probe Set (green), *not for 190-xx2* *Each set includes:* a) **Fluke 190-50x:** 10:1 Voltage Probe, 500 MHz (red or blue or gray or green) **Other models:** 10:1 Voltage Probe, 300 MHz (red or blue or gray or green) b) Hook Clip for Probe Tip (black) c) Ground Lead with Mini Alligator Clip (black) d) Ground Spring for Probe Tip (black) e) Insulation Sleeve (black) f) **Fluke 190-50x:** 50 Ohm (1 W) Terminator
11	Test Leads with test pins (one red, one black), for models 190-xx2 only.

Fluke 190-xxx /S versions include also the following items (SCC290 kit):

#	Description
12	FlukeView® ScopeMeter® Software for Windows activation key (converts FlukeView® DEMO status into full operational status).
13	Hard Shell Carrying Case

Safety Information: Read First

Read all safety information before you use the product.

Specific warning and caution statements, where they apply, appear throughout the manual.

A "Warning" identifies conditions and actions that pose hazard(s) to the user.

A "Caution" identifies conditions and actions that may damage the product.

The following international symbols are used on the product and in this manual.

⚠	Risk of Danger. Important information. See Manual.
⧈	Double Insulated
C SP US	Conforms to relevant North American Safety Standards.
N10140	Conforms to relevant Australian standards.
	Conforms to relevant South Korean EMC Standards.
MH25777	Battery Safety Approval
⏚	Earth Ground
Li-ion	Recycling information.
CE	Conforms to European Union directives
⎓	DC (Direct Current)
≂	AC or DC (Alternating or Direct Current)
	This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 "Monitoring and Control Instrumentation" product. Do not dispose of this product as unsorted municipal waste. Go to Fluke's website for recycling information.
CAT III	Measurement Category III is applicable to test and measuring circuits connected to the distribution part of the building's low-voltage MAINS installation.
CAT IV	Measurement Category IV is applicable to test and measuring circuits connected at the source of the building's low-voltage MAINS installation.

⚠ Warning

To avoid electrical shock or fire:

- **Use only the Fluke power supply, Model BC190 (Power Adapter).**
- **Before use, check that the selected/indicated range on the BC190 matches the local line power voltage and frequency.**
- **For the BC190/808 and BC190/820 universal Power Adapters only use line cords that comply with the local safety regulations.**

Note:

To accommodate connection to various line power sockets, the BC190/808 and BC190/820 universal Power Adapters are equipped with a male plug that must be connected to a line cord appropriate for local use. Since the adapter is isolated, the line cord does not need to be equipped with a terminal for connection to protective ground. Since line cords with a protective grounding terminal are more commonly available you might consider using these anyhow.

⚠ Warning

To avoid electrical shock or fire if a product input is connected to more than 42 V peak (30 Vrms) or 60 V dc:

- **Use only insulated voltage probes, test leads and adapters supplied with the product, or indicated by Fluke as suitable for the Fluke 190 Series II ScopeMeter® Test Tool series.**
- **Before use, inspect voltage probes, test leads and accessories for mechanical damage and replace when damaged.**
- **Remove all probes, test leads and accessories that are not in use.**
- **Always connect the power adapter first to the ac outlet before connecting it to the product.**
- **Do not touch voltages >30 V ac rms, 42 V ac peak, or 60 V dc.**
- **Do not connect the ground spring (figure 1, item d) to voltages higher than 42 V peak (30 Vrms) from earth ground.**
- **When using the ground reference lead with any of the probes, make sure that the black isolation sleeve (Figure 1, item. 10e) is over the probe tip.**

- **Do not apply more than the rated voltage, between the terminals or between each terminal and earth ground.**
- **Do not apply input voltages above the rating of the instrument. Use caution when using 1:1 test leads because the probe tip voltage will be directly transmitted to the product.**
- **Do not use exposed metal BNC or banana plug connectors. Fluke offers cables with plastic, safety designed BNC connectors suitable for the ScopeMeter® Test Tool product, see Chapter 7 'Optional accessories'.**
- **Do not insert metal objects into connectors.**
- **Use the product only as specified, or the protection supplied by the product can be compromised.**
- **Carefully read all instructions.**
- **Do not use the product if it operates incorrectly.**
- **Do not use the product or its accessories in case of any damage.**
- **Disable the product or its accessories in case of any damage.**
- **Keep fingers behind the finger guards on the probes.**
- **Use only correct measurement category (CAT), voltage, and current rated probes, test leads, and adapters for the measurement.**
- **Do not exceed the Measurement Category (CAT) rating of the lowest rated individual component of a product, probe, or accessory.**
- **Do not use the product around explosive gas, vapor, or in damp or wet environments.**
- **Measure a known voltage first to make sure that the product operates correctly.**
- **Examine the case before you use the product. Look for cracks or missing plastic. Carefully look at the insulation around the terminals.**
- **Do not work alone.**
- **Comply with local and national safety codes. Use personal protective equipment (approved rubber gloves, face protection, and flame resistant clothes) to prevent shock and arc blast injury where hazardous live conductors are exposed.**
- **The battery door must be closed and locked before you operate the product.**

- **Do not operate the product with covers removed or the case open. Hazardous voltage exposure is possible.**
- **Remove the input signals before you clean the product.**
- **Use only specified replacement parts.**

Voltage ratings that are mentioned in the warnings are given as limits for “working voltage”. They represent V ac rms (50-60 Hz) for ac sinewave applications and as V dc for dc applications.

Measurement Category IV refers to the overhead or underground utility service of an installation.
Measurement Category III refers to distribution level and fixed installation circuits inside a building.
Measurement Category II refers to local level, which is applicable for appliances and portable equipment.

The terms ‘Isolated’ or ‘Electrically floating’ are used in this manual to indicate a measurement in which the product input BNC is connected to a voltage different from earth ground.

The isolated input connectors have no exposed metal and are fully insulated to protect against electrical shock.

The BNC jacks can independently be connected to a voltage above earth ground for isolated (electrically floating) measurements and are rated up to 1000 Vrms CAT III and 600 Vrms CAT IV above earth ground.

If Safety Features are Impaired

Use of the product in a manner not specified may impair the protection provided by the equipment.

Do not use test leads if they are damaged. Examine the test leads for damaged insulation, exposed metal, or if the wear indicator shows.

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

Safe Use of Li-ion battery pack

The battery pack Fluke model BP290 (26 Wh)/BP291 (52 Wh) has been tested in accordance with the UN Manual of Tests and Criteria Part III Subsection 38.3 (ST/SG/AC.10/11/Rev.3) – more commonly known as the UN T1..T8 – tests, and have been found to comply with the stated criteria. The battery pack has been tested acc.

to EN/IEC62133. As a result they can be shipped unrestricted internationally by any means.

Recommendations to safe storage of battery pack.

- Do not store battery packs near heat or fire. Do not store in sunlight.
- Do not remove a battery pack from its original packaging until required for use.
- When possible, remove the battery pack from the equipment when not in use.
- Fully charge the battery pack before storing it for an extended period to avoid a defect.
- After extended periods of storage, it may be necessary to charge and discharge the battery packs several times to obtain maximum performance.
- Keep the battery pack out of the reach of children and animals.
- Seek medical advise if a battery or part of it has been swallowed.

Recommendations to safe use of the battery pack.

- The battery pack needs to be charged before use. Use only Fluke approved power adapters to charge the battery pack. Refer to Fluke's safety instructions and Users Manual for proper charging instructions.
- Do not leave a battery on prolonged charge when not in use.
- The battery pack gives the best performance when operated at normal room temperature 20 °C ± 5 °C (68 °F ± 9 °F).
- Do not put battery packs near heat or fire. Do not put in sunlight.
- Do not subject battery packs to severe impacts such as mechanical shock.
- Keep the battery pack clean and dry. Clean dirty connectors with a dry, clean cloth
- Do not use any charger other than that specifically provided for use with this equipment.
- Do not use any battery which is not designed or recommended by Fluke for use with the Product.
- Take careful notice of correct placement of the battery in the product or the External Battery Charger.
- Do not short-circuit a battery pack. Do not keep battery packs in a place where the terminals can be shorted by metal objects (e.g. coins, paperclips, pens or other).
- Never use a battery pack or charger showing visible damage.
- Batteries contain hazardous chemicals that can cause burns or explode. If exposure to chemicals occurs, clean with water and get medical aid. Repair the product before use if the battery leaks.

- Alteration of battery pack: there shall be no attempt to open, modify, reform or repair a battery pack, which appears to be malfunctioning, or which has been physically damaged.
- Do not disassemble or crush battery packs
- Use the battery only in the application for which it is intended.
- Retain the original product information for future reference.

Recommendations to safe transport of battery packs

- The battery pack must adequately be protected against short-circuit or damage during transport.
- Always consult the IATA guidelines describing safe air transport of Li-ion batteries. Refer also to the section in the beginning of this paragraph on safe use of the battery pack.
- Check-in luggage: battery packs are only allowed when installed in the Product.
- Hand carried luggage: a number of battery packs as required for normal and individual use is allowed.
- Always consult national/local guidelines that are applicable for shipment by mail or other transporters.
- A maximum of 3 battery packs may be shipped by mail. The package must be marked as follows:

  PACKAGE CONTAINS LITHIUM-ION BATTERIES (NO LITHIUM METAL).

Recommendations to safe disposal of a battery pack.

- A failed battery pack shall be properly disposed of in accordance with local regulations.
- Dispose of properly: do not dispose of the battery as unsorted municipal waste. Go to Fluke's website for recycling information.
- Dispose in discharged condition and cover the battery terminals with isolation tape.

Chapter 1
Using the Scope and Meter

About this Chapter

This chapter provides a step-by-step introduction to the scope and meter functions of the test tool. The introduction does not cover all of the capabilities of the functions but gives basic examples to show how to use the menus and perform basic operations.

Powering the Test Tool

Follow the procedure (steps 1 through 3) in Figure 2 to power the test tool from a standard ac outlet.
See Chapter 6 for instructions on using battery power.

Turn the test tool on with the on/off key.

The test tool powers up in its last setup configuration.

The menus to adjust date, time and information language are switched on automatically when the test tool is powered on for the first time. See Figure 2.

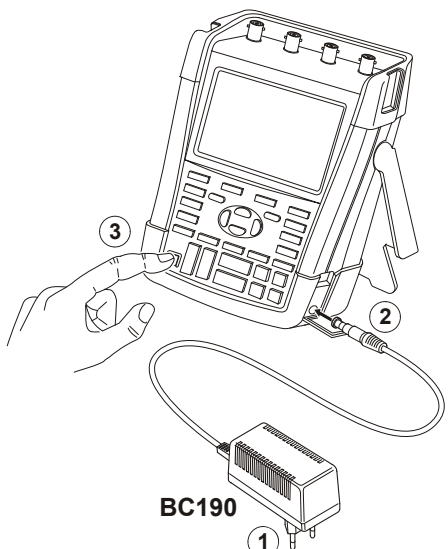


Figure 2. Powering the Test Tool

Resetting the Test Tool

If you want to reset the test tool to the factory settings, do the following:

1		Turn the test tool off.
2		Press and hold the **USER** key.
3		Press and release.

The test tool turns on, and you should hear a double beep, indicating the reset was successful.

4		Release the **USER** key.

Now look at the display; you will see a screen that looks like Figure 3.

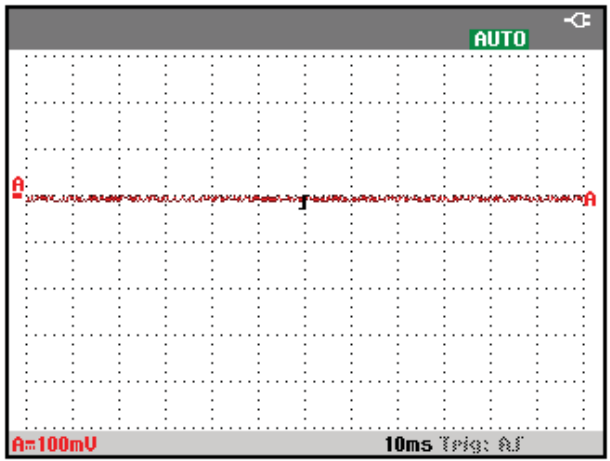


Figure 3. The Screen After Reset

Navigating a Menu

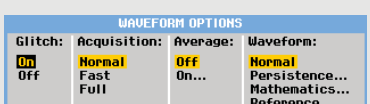
The following example shows how to use the test tool's menus to select a function. Sequently follow steps 1 through 3 to open the scope menu and to choose an item.

1 SCOPE

Press the **SCOPE** key to display the labels that define the present use for the four blue function keys at the bottom of the screen.

2 F4

Open the Waveform Options menu. This menu is displayed at the bottom of the screen. Actual settings are shown on a yellow background. The setting on a black background can be changed upon operation of the blue arrow keys and confirmed with the ENTER key. See Figure 4.



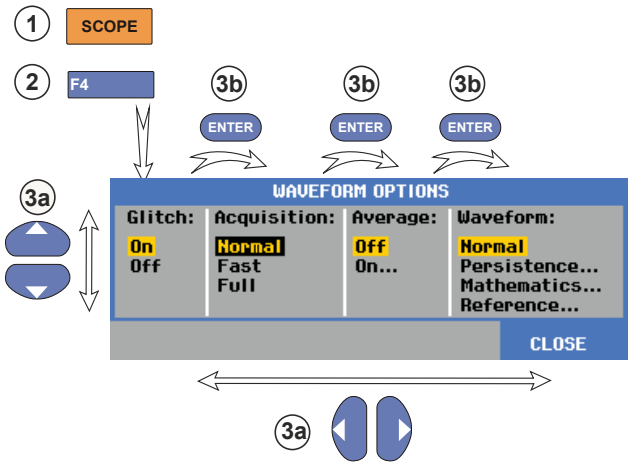


Figure 4. Basic Navigation

3a ENTER

Use the blue arrow keys to highlight the item.

3b

Press the blue **ENTER** key to accept the selection. The next option will be selected. After the last option the menu will be closed.

Note

To exit the menu at any moment press F4 *(CLOSE).*

Hiding Key Labels and Menus

You can close a menu or hide key label at any time:

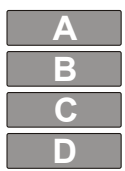
CLEAR	Hide any key label, press again to display the key label again (toggle function). A displayed menu will be closed.

To display menus or key labels, press one of the yellow menu keys, e.g. the **SCOPE** key.

You can close most menus using the F4 soft key CLOSE.

Key Illumination

Some keys are provided with an illumination LED. For an explanation of the LED function see the table below.

	**On:** The display is off, test tool is running. See Chapter 6 'Tips' section 'Setting the Display AUTO-Off timer '. **Off:** in all other situations
	**On:** Measurements are stopped, the screen is frozen. (HOLD) **Off:** Measurements are running. (RUN)
	**On:** The range key, the move up/down key, and the F1…F4 key labels, apply to the illuminated channel key(s). **Off:** -
	**On:** Manual operating mode. **Off:** Automatic operating mode, optimizes the waveform position, range, time base and triggering (Connect-and-View™)
	**On:** Signal is triggered **Off:** Signal is not triggered **Flashing:** waiting for a trigger at 'Single Shot' or 'On Trigger' waveform update.

Input Connections

Look at the top of the test tool. The test tool has four safety BNC jack signal inputs (models 190–xx4), or two safety BNC jack inputs and two safety 4-mm banana jack inputs (models 190-xx2). See Figure 5.

Isolated input architecture allows independent floating measurements with each input.

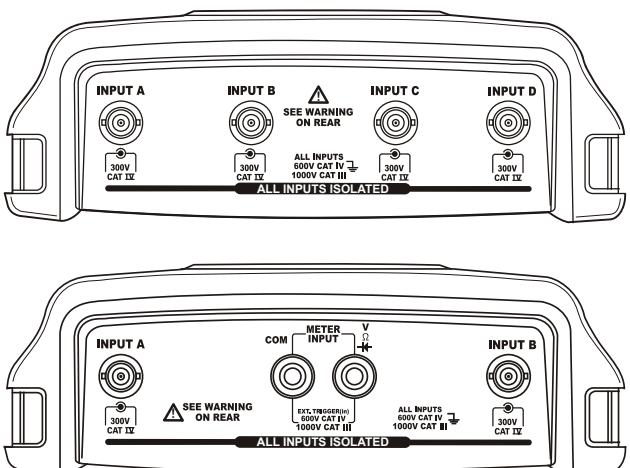


Figure 5. Measurement Connections

Making Input Connections

To make scope measurements connect the red voltage probe to input A, the blue voltage probe to input B, the grey voltage probe to input C and the green voltage probe to input D. Connect the short ground leads of **each** voltage probe to its **own** reference potential (See Figure 6).

For Meter measurements refer to the applicable section in this chapter.

⚠ Warning

To avoid electrical shock use the insulation sleeve (Figure 1 item e)) if you use the probes without the hook clip or the ground spring.

Notes

- *To maximally benefit from having independently isolated floating inputs and to avoid problems caused by improper use, read Chapter 6: "Tips".*
- *For an accurate indication of the measured signal, it is necessary to match the probe to the test tool's input channel. See section 'Calibrating the voltage Probes' in Chapter 7.*

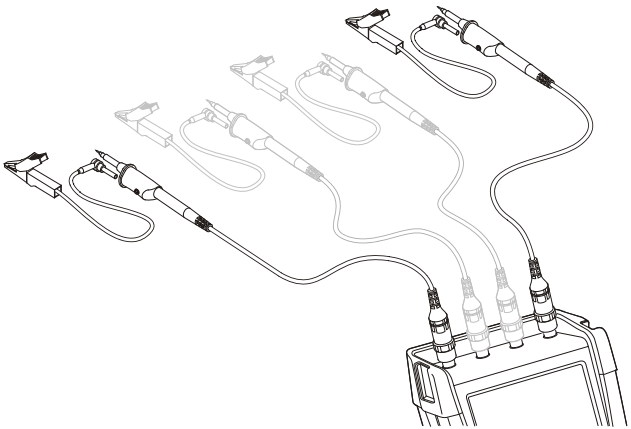


Figure 6. Scope Connections

Adjusting the Probe Type Settings

To obtain correct measurement results the test tool probe type settings must correspond to the connected probe types. To select the input A probe setting do the following:

1 

Display the **INPUT A** key labels.

2 

Open the **PROBE ON A** menu.

3 

Select the probe type **Voltage**, **Current**, or **Temp.**

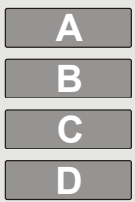
4 

Voltage: select the voltage probe attenuation factor.

Current and **Temp**: select the current probe or temperature probe sensitivity.

Selecting an Input Channel

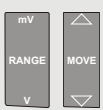
To select an input channel, do the following:



Press the required channel key (A…D):

- the channel is turned on
- labels for the F1…F4 keys are shown. Press the channel key again to turn the labels off/on (toggle).

- the channel key illumination is turned on.



If the channel key is illuminated, the RANGE and MOVE UP/DOWN keys are now assigned to the indicated channel.

Tip

To set multiple channels to the same range (V/div) as, for example, input A, do the following:

- *Select the input A measurement function, probe setting and input options for all involved channels*
- *press and hold* A
- *press* B *and/or* C *and/or* D
- *release* A

Notice that all pressed keys are illuminated now. The MOVE UP/DOWN key and the RANGE mV/V key applies to all involved input channels.

Displaying an Unknown Signal with Connect-and-View™

The Connect-and-View feature lets the test tool display complex, unknown signals automatically. This function optimizes the position, range, time base, and triggering and assures a stable display of virtually any waveform. If the signal changes, the setup is automatically adjusted to maintain the best display result. This feature is especially useful for quickly checking several signals.

To enable the Connect-and-View feature when the test tool is in MANUAL mode, do the following:

1 MANUAL AUTO Perform an Auto Set. **AUTO** appears at the top right of the screen, the key illumination is off.

The bottom line shows the range, the time base, and the trigger information.

The waveform identifier (**A**) is visible on the right side of the screen, as shown in Figure 7. The input A zero icon ▬ at the left side of the screen identifies the ground level of the waveform.

2 MANUAL AUTO Press a second time to select the manual range again. **MANUAL** appears at the top right of the screen, the key illumination is on.

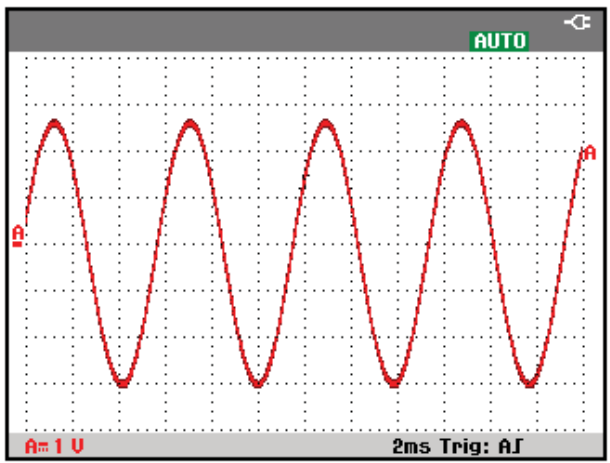


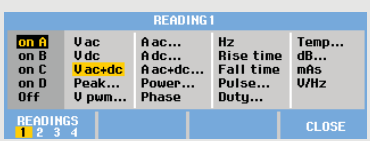
Figure 7. The Screen After an Auto Set

Use the light-gray **RANGE**, **TIME** and **MOVE** keys at the bottom of the keypad to change the view of the waveform manually.

Making Automatic Scope Measurements

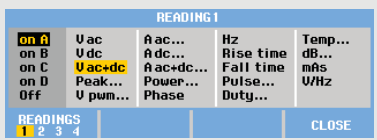
The test tool offers a wide range of automatic scope measurements. In addition to the waveforms you can display four numeric readings: **READING 1 … 4**. These readings are selectable independently, and the measurements can be done on the input A, input B, input C or input D waveform.

To choose a frequency measurement for input A, do the following:

1	SCOPE	Display the **SCOPE** key labels. 
2	F2	Open the **READING ..** menu. 
3	F1	Select the reading number to be displayed, for example **READING 1**.
4	ENTER	Select **on A**. Observe that the highlight jumps to the present measurement.
5	ENTER	Select the **Hz** measurement.

Observe that the top left of the screen displays the Hz measurement. (See Figure 8.)

To choose also a **Peak-Peak** measurement for Input B as second reading, do the following:

1	SCOPE	Display the **SCOPE** key labels. 
2	F2	Open the **READING ..** menu. 
3	F1	Select the reading number to be displayed, for example **READING 2**
4	ENTER	Select **on B**. The highlight jumps to the measurements field.

5	ENTER	Open the **PEAK** menu.
6	ENTER	Select the **Peak-Peak** measurement.

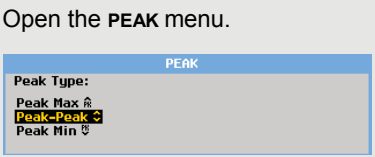


Figure 8 shows an example of the screen with two readings. The character size will be reduced when more than two readings are on.

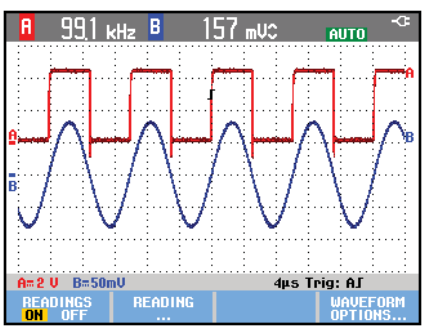


Figure 8. Hz and V peak-peak as Scope Readings

Freezing the Screen

You can freeze the screen (all readings and waveforms) at any time.

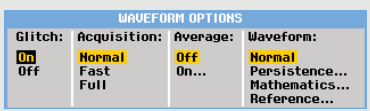
1	HOLD RUN	Freeze the screen. **HOLD** appears at the right of the reading area. The key illumination is on.
2	HOLD RUN	Resume your measurement. The key illumination is off.

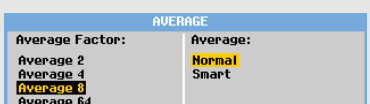
Using Average, Persistence and Glitch Capture

Using Average for Smoothing Waveforms

To smooth the waveform, do the following:

1	SCOPE	Display the **SCOPE** key labels.
2	F4	Open the **WAVEFORM OPTIONS** menu.
3		Jump to **Average:**
4	ENTER	Select **On...** to open the **AVERAGE** menu.





5	ENTER	Select **Average factor: Average 64**. This averages the outcomes of 64 acquisitions.
6	ENTER	Select **Average: Normal** (normal average) or **Smart** (smart average, see below).

You can use the average functions to suppress random or uncorrelated noise in the waveform without loss of bandwidth. Waveform samples with and without smoothing are shown in Figure 9.

Smart average

In the normal average mode occasional deviations in a waveform just distort the averaged wave shape, and do not show up on screen clearly. When a signal really changes, for instance when you probe around, it takes quite some time before the new wave shape is stable. With smart averaging you can quickly probe around, and incidental waveform changes like a line flyback in video show up on screen instantly.

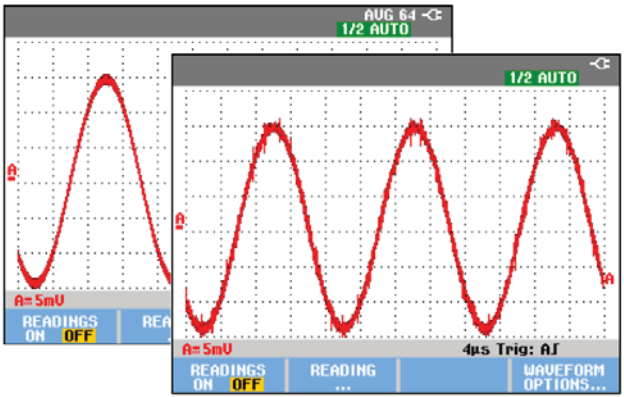


Figure 9. Smoothing a Waveform

Using Persistence, Envelope and Dot-Join to Display Waveforms

You can use Persistence to observe dynamic signals. See Figure 10.

1 SCOPE — Display the **SCOPE** key labels.

2 F4 — Open the **WAVEFORM OPTIONS** menu.

WAVEFORM OPTIONS			
Glitch:	Acquisition:	Average:	Waveform:
On	Normal	Off	Normal
Off	Fast	On...	Persistence...
	Full		Mathematics...
			Reference...

3 ENTER — Jump to **Waveform:** and open the **Persistence...** menu.

PERSISTENCE		
Digital Persistence:		Display:
Off	Infinite	Normal
Short		Envelope
Medium		Dot-join OFF
Long		

4 ENTER — Select **Digital Persistence: Short, Medium, Long** or **Infinite** to observe dynamic waveforms like on an analog oscilloscope.

Select **Digital Persistence: Off**, **Display: Envelope** to see the upper and lower boundaries of dynamic waveforms (envelope mode).

Select **Display: Dot-join: Off** to display measured samples only. Dot join off may be useful when measuring for example modulated signals or video signals.

Select **Display: Normal** to turn the envelope mode off and the dot-join function on.

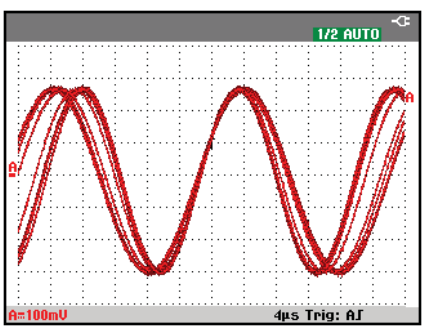
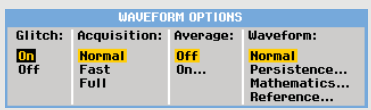


Figure 10. Using Persistence to Observe Dynamic Signals

Displaying Glitches

To capture glitches on a waveform, do the following:

1	SCOPE	Display the **SCOPE** key labels.
2	F4	Open the **WAVEFORM OPTIONS** menu.
3	ENTER	Select **Glitch: On**.
4	F4	Exit the menu.

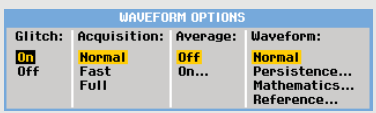


You can use this function to display events (glitches or other asynchronous waveforms) of 8 ns (8 nanoseconds, due to ADC's with 125 MS/s sampling speed) or wider, or you can display HF modulated waveforms.

When you select the 2 mV/div range Glitch Detect will automatically be turned Off. In the 2 mV/div range you can set Glitch Detect On manually.

Suppressing High Frequency Noise

Switching the glitch detection off (**Glitch**: **Off)** will suppress the high frequency noise on a waveform. Averaging will suppress the noise even more.

1	SCOPE	Display the **SCOPE** key labels.
2	F4	Open the **WAVEFORM OPTIONS** menu. 
3	ENTER	Select **Glitch: Off**, then select **Average: On…** o open the **AVERAGE** menu.
4	ENTER	Select **Average 8**.

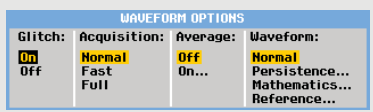
See also Using Average for Smoothing Waveforms on page 21.

Glitch capture and average do not affect bandwidth. Further noise suppression is possible with bandwidth limiting filters. See Working with Noisy Waveforms on page 27.

Acquiring Waveforms

Setting the Acquisition Speed and Waveform Memory Depth

To set the acquisition speed, do the following:

1	SCOPE	Display the **SCOPE** key labels.
2	F4	Open the **WAVEFORM OPTIONS** menu. 
3	ENTER	Select **Acquisition:** **Fast –** for fast waveform update rate; shortest record length, decreased zoom rate, no readings possible. **Full –** maximum waveform detail; 10,000 samples per waveform record length, maximum zoom rate, lower waveform update rate.

		Normal – optimal waveform update rate and zoom range combination
4	F4	Exit the menu.

See also Table 2 in Chapter 8.

Selecting AC-Coupling

After a reset, the test tool is dc-coupled so that ac and dc voltages appear on the screen.

Use ac-coupling when you wish to observe a small ac signal that rides on a dc signal. To select ac-coupling, do the following:

1	A	Display the **INPUT A** key labels. 
2	F2	Highlight **AC**.

Observe that the bottom left of the screen displays the ac-coupling icon: .

You can define how Auto Set affects this setting, see Chapter 6 ‘Changing the Auto Set Options’.

Reversing the Polarity of the Displayed Waveform

To invert, for example the input A waveform, do the following:

1	A	Display the **INPUT A** key labels. 
2	F4	Open the **INPUT A** menu. 
3	ENTER	Select **Inverted** and accept inverted waveform display.
4	F4	Exit the menu.

For example, a negative-going waveform is displayed as positive-going waveform which may provide a more meaningful view. An inverted display is identified by an inversed waveform identifier ( ) at the right of the waveform, and in the status line below the waveform.

Variable Input Sensitivity

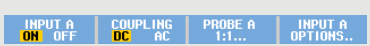
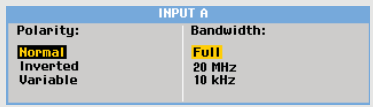
The variable input sensitivity allows you to adjust any input sensitivity continuously, for example to set the amplitude of a reference signal to exactly 6 divisions.

The input sensitivity of a range can be increased up to 2.5 times, for example between 10 mV/div and 4 mV/div in the 10 mV/div range.

To use the variable input sensitivity on for example input A, do the following:

1		Apply the input signal.
2	MANUAL AUTO	Perform an Auto Set (AUTO must appear at the top of the screen).

An Auto Set will turn off the variable input sensitivity. You can now select the required input range. Keep in mind that the sensitivity will increase when you start adjusting the variable sensitivity (the displayed waveform amplitude will increase).

3	A	Display the **INPUT A** key labels. 
4	F4	Open the **INPUT A** menu. 
5	ENTER	Select and accept **Variable**.
6	F4	Exit the menu.

At the bottom left of the screen the text A Var is displayed.

Selecting Variable will turn off cursors and automatic input ranging.

7	mV RANGE V	Press mV to increase the sensitivity, press V to decrease the sensitivity.

Note

Variable input sensitivity is not available in the Mathematics functions (+ - x and Spectrum).

Working with Noisy Waveforms

To suppress high frequency noise on waveforms, you can limit the working bandwidth to 10 kHz or 20 MHz. This function smoothes the displayed waveform. For the same reason, it improves triggering on the waveform.

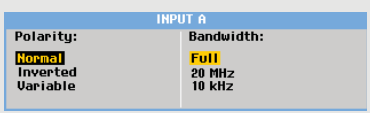
To choose the 10 kHz bandwidth on for example input A, do the following:

1 

Display the **INPUT A** key labels.

2 

Open the **INPUT A** menu.



3 

Jump to **Bandwidth:** and select **10kHz** to accept the bandwidth limitation.

Tip

*To suppress noise without loss of bandwidth, use the average function or turn off **Display Glitches**.*

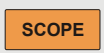
Using Mathematics Functions +, -, x, XY-mode

You can add (+), subtract (-), or multiply (x) two waveforms. The test tool will display the mathematical result waveform and the source waveforms.

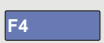
The XY-mode provides a plot with one input on the vertical axis and the second input on the horizontal axis.

The Mathematics functions perform a point-to-point operation on the involved waveforms.

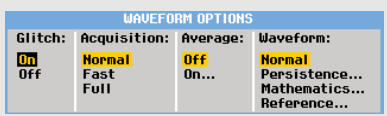
To use a Mathematics function, do the following:

1 

Display the **SCOPE** key labels.

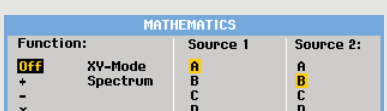
2 

Open the **WAVEFORM OPTIONS** menu.



3 

Jump to **Waveform:** and Select **Mathematics...** to open the **Mathematics** menu.



4	ENTER	Select Function: **+**, **-**, **x** or **XY-mode**.
5	ENTER	Select the first waveform: **Source 1: A**, **B**, **C** or **D**
6	ENTER	Select the second waveform: **Source 2: A**, **B**, **C** or **D** The mathematical function key labels will be displayed now: 
7	F2	Press ↑↓ to select a scale factor to fit the result waveform onto the display.
	F3	Press ↑↓ to move the result waveform up or down.
	F4	Switch the result waveform on/off (toggle).

The sensitivity range of the mathematical result is equal to the sensitivity range of the least sensitive input divided by the scale factor.

Using Mathematics Function Spectrum (FFT)

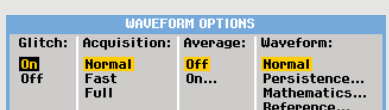
The Spectrum function shows the spectral content of the input A, B, C or D waveform in the input waveform color. It performs an FFT (Fast Fourier Transform) to transform the amplitude waveform from the time domain into the frequency domain.

To reduce the effect of side-lobes (leakage) it is recommended to use Auto windowing. This will automatically adapt the part of the waveform that is analyzed to a complete number of cycles

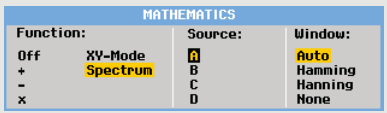
Selecting Hanning, Hamming or no windowing results in a faster update, but also in more leakage.

Ensure that the entire waveform amplitude remains on the screen.

To use the Spectrum function, do the following:

1	SCOPE	Display the **SCOPE** key labels.
2	F4	Open the **Waveform Options** menu. 

3		Jump to **Waveform:** and select **Mathematics...** to open the **Mathematics** menu.
4		Select **Function: Spectrum**.
5		Select the source waveform for the spectrum: **Source : A**, **B**, **C** or **D**
6		Select **Window: Auto** (automatic windowing)**, Hanning**, **Hamming**, or **None** (no windowing).



You will see a screen that looks like Figure 11.

Observe that the top right of the screen displays SPECTRUM.

If it displays LOW AMPL a spectrum measurement cannot be done as the waveform amplitude is too low.

If it displays WRONG TB the time base setting does not enable the test tool to display an FFT result. It is either too slow, which can result in aliasing, or too fast, which results in less than one signal period on the screen.

7	F1	Perform a spectrum analysis on waveform A, B, C or D.
8	F2	Set the horizontal amplitude scale to linear or logarithmic.
9	F3	Set the vertical amplitude scale to linear or logarithmic.
10	F4	Turn the spectrum function off/on (toggle function).

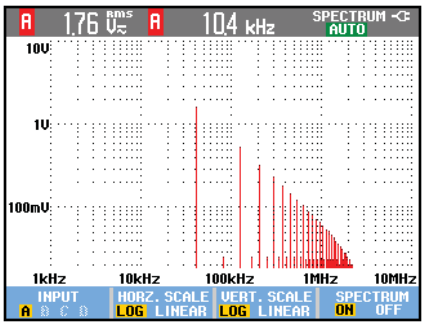


Figure 11. Spectrum Measurement

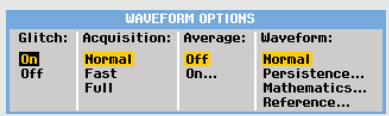
Comparing Waveforms

You can display a fixed reference waveform with the actual waveform for comparison.

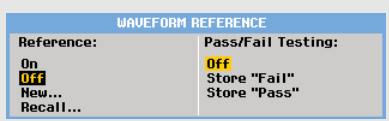
To create a reference waveform and to display it with the actual waveform, do the following:

1 SCOPE — Display the **SCOPE** key labels.

2 F4 — Open the **Waveform Options** menu.



3 ENTER — Jump to the **Waveform** field and select **Reference…** to open the **WAVEFORM REFERENCE** menu.

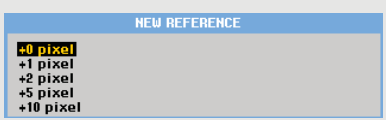


4 

Select **On** to display the reference waveform. This can be:
- the last used reference waveform (if not available no reference waveform will be shown).
- the envelope waveform if the persistence function Envelope is on.

Select **Recall…** to recall a saved waveform (or waveform envelope) from memory and use it as a reference waveform.

Select **New…** to open the **NEW REFERENCE** menu.



If you selected **New…** continue at step 5, else go to step 6.

5 

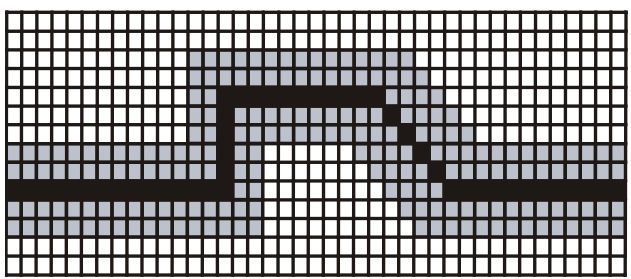
Select the width of an additional envelope to be added to the momentary waveform.

6 

Store the momentary waveform and display it permanently for reference. The display also shows the actual waveform.

To recall a saved waveform from memory and use it as a reference waveform, refer also to Chapter 5 Recalling Screens with Associated Setups.

Example of reference waveform with an additional envelope of ±2 pixels:



black pixels: basic waveform
gray pixels: ± 2 pixels envelope

1 vertical pixel on the display is 0.04 x range/div
1 horizontal pixel on the display is 0.0333 x range/div.

Pass - Fail Testing

You can use a reference waveform as a test template for the actual waveform. If at least one sample of a waveform is outside the test template, the failed or passed scope screen will be stored. Up to 100 screens can be stored. If the memory is full, the first screen will be deleted in favor of the new screen to be stored.

The most appropriate reference waveform for the Pass-Fail test is a waveform envelope.

To use the Pass - Fail function using a waveform envelope, do the following:

1		Display a reference waveform as described in the previous section “Comparing Waveforms”
2		From the **Pass Fail Testing:** menu select **Store “Fail”** : each scope screen with samples outside the reference will be stored **Store “Pass”** : each scope screen with no samples outside the reference will be stored

Each time a scope screen is stored you will hear a beep. Chapter 3 provides information on how to analyze the stored screens.

Analyzing Waveforms

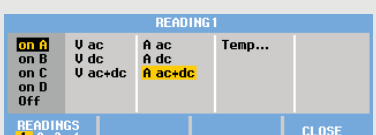
You can use the analysis functions **CURSOR**, **ZOOM** and **REPLAY** to perform detailed waveform analysis. These functions are described in Chapter 3: “*Using Cursors, Zoom and Replay*”.

Making Automatic Meter Measurements (for models 190-xx4)

The test tool offers a wide range of automatic meter measurements. You can display four large numeric readings: **READING 1 … 4**. These readings are selectable independently, and the measurements can be done on the input A, B, C or input D waveform. In METER mode the waveforms are not displayed. The 10 kHz HF rejection filter (see Working with Noisy Waveforms on page 27) is always on in the METER mode.

Selecting a Meter Measurement

To choose a current measurement for input A, do the following:

1	METER	Display the **METER** key labels. 
2	F1	Open the **Reading ..** menu. 
3	F1	Select the reading number to be displayed, for example **READING 1**
4	ENTER	Select **on A**. Observe that the highlight jumps to the present measurement.
5	ENTER	Select the **A dc…** measurement.
6	ENTER	Select a current probe sensitivity that matches the connected current probe (see Adjusting the Probe Type Settings on page 16.)

You will see a screen like in Figure 12.

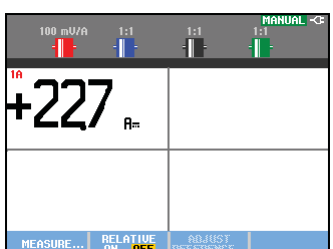


Figure 12. Meter Screen

Making Relative Meter Measurements

A relative measurement displays the present measurement result relative to a defined reference value.

The following example shows how to perform a relative voltage measurement. First obtain a reference value:

1	METER	Display the **METER** key labels. MEASURE... | RELATIVE ON OFF | ADJUST REFERENCE...
2		Measure a voltage to be used as reference value.
3	F2	Set **RELATIVE** to **ON**. (**ON** is highlighted.) This stores the reference value as reference for subsequent measurements. Observe the **ADJUST REFERENCE** soft key (F3) that enables you to adjust the reference value (see step 5 below).
4		Measure the voltage to be compared to the reference.

Now the large reading is the actual input value minus the stored reference value. The actual input value is displayed below the large reading (ACTUAL: xxxx), see Figure 13.

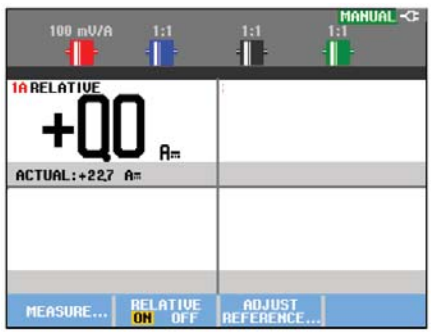


Figure 13. Making a Relative Measurement

You can use this feature when, for example, you need to monitor input activity (voltage, temperature) in relation to a known good value.

Adjusting the reference value

To adjust the reference value, do the following:

5	F3	Display the Adjust Reference menu.
6	F1	Select the applicable relative measurement reading.
7	◀ ▶	Select the digit you want to adjust.
8	▲ ▼	Adjust the digit. Repeat step 7 and step 8 until finished.
9	ENTER	Enter the new reference value.

Making Multimeter Measurements (for models 190-xx2)

The screen displays the numeric readings of the measurements on the meter input.

Making Meter Connections

Use the two 4-mm safety red (VΩ⊣) and black (**COM**) banana jack inputs for the Meter functions.
(See Figure 14.)

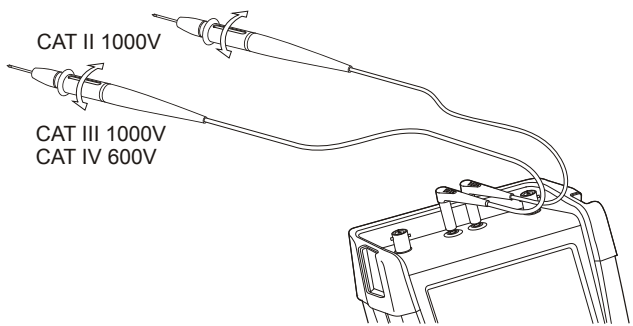
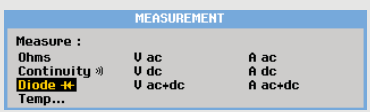


Figure 14. Meter Connections

Measuring Resistance Values

To measure a resistance, do the following:

1		Connect the red and black test leads from the 4-mm banana jack inputs to the resistor.
2	METER	Display the **METER** key labels. 
3	F1	Open the **MEASUREMENT** menu. 
4		Highlight **Ohms**.
5	ENTER	Select Ohms measurement.

The resistor value is displayed in ohms. Observe also that the bargraph is displayed. (See 15.)

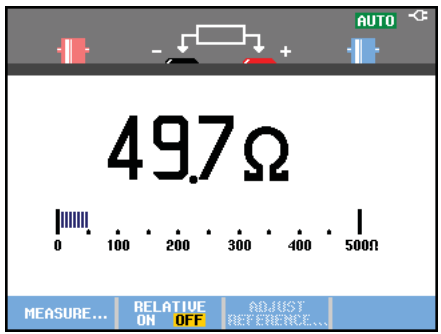


Figure 15. Resistor Value Readings

Making a Current Measurement

You can measure current in both Scope mode and Meter mode. Scope mode has the advantage of waveforms being displayed while you perform measurements. Meter mode has the advantage of high measurement resolution.

The next example explains a typical current measurement in Meter mode.

Warning

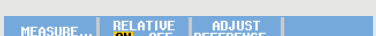
Carefully read the instructions about the current probe you are using.

To set up the test tool, do the following:

1 Connect a current probe (e.g. Fluke i410, optional) between the 4-mm banana jack inputs and the conductor to be measured.

Ensure that the red and black connectors correspond to the red and black banana jack inputs. (See Figure 16.)

2 METER Display the **METER** key labels.



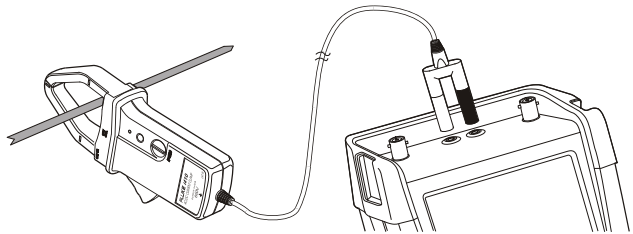
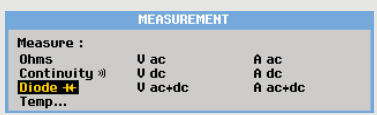


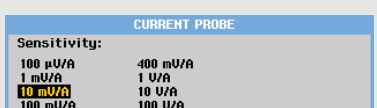
Figure 16. Measurement Setup

3 F1 Open the **MEASUREMENT** menu.



4 Highlight **A ac**.

5 ENTER Open the **CURRENT PROBE** submenu.



6		Observe the sensitivity of the current probe. Highlight the corresponding sensitivity in the menu, e.g. **1 mV/A**.
7		Accept the current measurement.

Now, you will see a screen like in Figure 17.

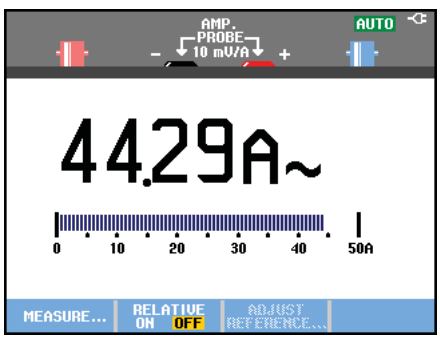


Figure 17. Ampere Measurement Readings

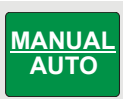
Selecting Auto/Manual Ranges

To activate manual ranging, do the following during any Meter measurement:

1		Activate manual ranging.
2		Increase (V) or decrease (mV) the range.

Observe how the bargraph sensitivity changes.

Use manual ranging to set a fixed bargraph sensitivity and decimal point.

3		Choose auto ranging again.

When in auto ranging, the bargraph sensitivity and decimal point are automatically adjusted while checking different signals.

Making Relative Meter Measurements

A relative measurement displays the present measurement result relative to a defined reference value.

The following example shows how to perform a relative voltage measurement. First obtain a reference value:

1	METER	Display the **METER** key labels. MEASURE... | RELATIVE ON OFF | ADJUST REFERENCE...
2		Measure a voltage to be used as reference value.
3	F2	Set **RELATIVE** to **ON**. (**ON** is highlighted.) This stores the reference value as reference for subsequent measurements. Observe the **ADJUST REFERENCE** soft key (F3) that enables you to adjust the reference value (see step 5 below).
4		Measure the voltage to be compared to the reference.

Now the large reading is the actual input value minus the stored reference value. The bargraph indicates the actual input value. The actual input value and the reference value are displayed below the large reading (ACTUAL: xxxx REFERENCE: xxx), see Figure 18.

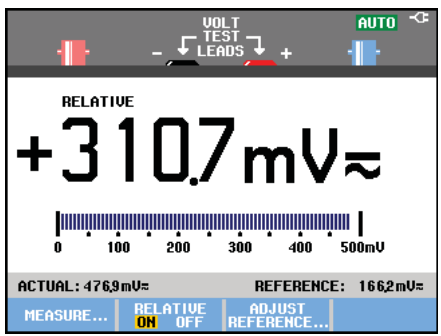


Figure 18. Making a Relative Measurement

You can use this feature when, for example, you need to monitor input activity (voltage, temperature) in relation to a known good value.

Adjusting the reference value

To adjust the reference value, do the following:

5		Display the Adjust Reference menu.
6		Select the digit you want to adjust.
7		Adjust the digit. Repeat step 6 and step 7 until finished.
8		Enter the new reference value.

Chapter 2
Using The Recorder Functions

About this Chapter

This chapter provides a step-by-step introduction to the recorder functions of the test tool. The introduction gives examples to show how to use the menus and perform basic operations.

Opening the Recorder Main Menu

First choose a measurement in scope or meter mode. Now you can choose the recorder functions from the recorder main menu. To open the main menu, do the following:

1	RECORDER	Open the recorder main menu. (See Figure 19).

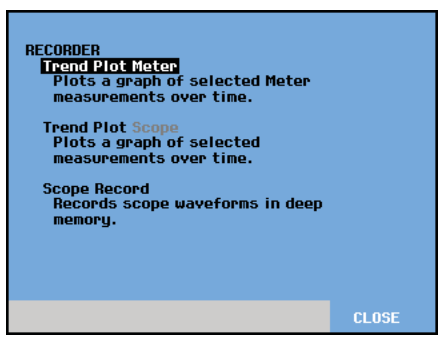


Figure 19. Recorder Main Menu

Trendplot Meter is only present in models 190-xx2.

Plotting Measurements Over Time (TrendPlot™)

Use the TrendPlot function to plot a graph of Scope or Meter measurements (readings) as function of time.

Note

Because the navigations for the TrendPlot Scope and the TrendPlot Meter are identical, only Scope TrendPlot is explained in the next sections.

Starting a TrendPlot Function

To start a TrendPlot, do the following:

1		Make automatic Scope or Meter measurements, see Chapter 1. The readings will be plotted!
2		Open the **RECORDER** main menu.
3		Highlight **Trend Plot**.
4		Start the TrendPlot recording.

The test tool continuously records the digital readings of the measurements and displays these as a graph. The TrendPlot graph rolls from right to left like a paper chart recorder.

Observe that the recorded time from start appears at the bottom of the screen. The present reading appears on top of the screen. (See Figure 20.)

Note

When simultaneously TrendPlotting two readings, the screen area is split into two sections of four divisions each. When simultaneously TrendPlotting three or four readings, the screen area is split into three or four sections of two divisions each.

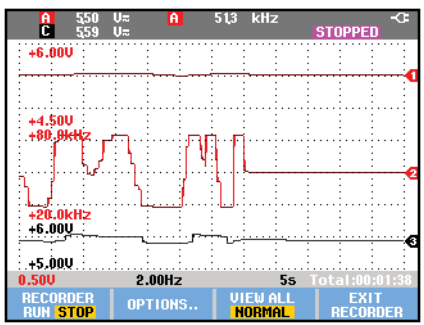


Figure 20. TrendPlot Reading

When the test tool is in automatic mode, automatic vertical scaling is used to fit the TrendPlot graph on the screen.

5	F1	Set **RECORDER** to **STOP** to freeze the recorder function.
6	F1	Set **RECORDER** to **RUN** to restart.

Note

Scope TrendPlot is not possible on cursor related measurements. As an alternative you may use the PC software FlukeView® ScopeMeter®.

Displaying Recorded Data

When in normal view (**NORMAL**), only the twelve most recently recorded divisions are displayed on screen. All previous recordings are stored in memory.

VIEW ALL shows **all** data in memory:

7	F3	Display an overview of the full waveform.

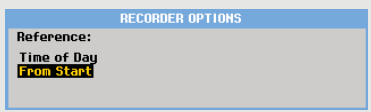
Press F3 repeatedly to toggle between normal view (NORMAL) and overview (VIEW ALL).

When the recorder memory is full, an automatic compression algorithm is used to compress all samples into half of the memory without loss of transients. The other half of the recorder memory is free again to continue recording.

Changing the Recorder Options

At the lower right of the display, the status line indicates a time. You can choose this time to represent either the start time of the recording ('Time of Day') or the time elapsed since the start of the recording ('From Start').

To change the time reference, proceed from step 6 as follows:

7	F2	Open the **RECORDER OPTIONS** menu. 
8		Select **Time of Day** or **From Start**.

Turning Off the TrendPlot Display

9	F4	Exit the recorder function.

Recording Scope Waveforms In Deep Memory (Scope Record)

The **SCOPE RECORD** function is a roll mode that logs a long waveform of each active input. This function can be used to monitor waveforms like motion control signals or the power-on event of an Uninterruptable Power Supply (UPS). During recording, fast transients are captured. Because of the deep memory, recording can be done for more than one day. This function is similar to the roll mode in many DSO's but has deeper memory and better functionality.

Starting a Scope Record Function

To record for example the input A and input B waveform, do the following:

1	Apply a signal to input A and input B.	
2	RECORDER	Open the **RECORDER** main menu.
3	ENTER	From the Recorder main menu, highlight **Scope Record** and Start the recording.

The waveform moves across the screen from right to left like on a normal chart recorder. (See Figure 21).

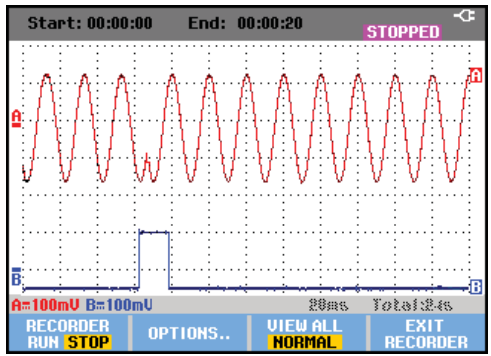


Figure 21. Recording Waveforms

Observe that the screen displays the following:

- Time from start at the top of the screen.
- The status at the bottom of the screen which includes the time/div setting as well as the total timespan that fits the memory.

Note

For accurate recordings it is advised to let the instrument first warm up for five minutes.

Displaying Recorded Data

In Normal view, the samples that roll off the screen are stored in deep memory. When the memory is full, recording continues by shifting the data in memory and deleting the first samples out of memory.

In View All mode, the complete memory contents are displayed on the screen.

4	F3	Press to toggle between **VIEW ALL** (overview of all recorded samples) and **NORMAL** view.

You can analyze the recorded waveforms using the Cursors and Zoom functions. See Chapter 3: "*Using Replay, Zoom and Cursors*".

Using Scope Record in Single Sweep Mode

Use the recorder **Single Sweep** function to automatically stop recording when the deep memory is full.

Continue from step 3 of the previous section:

4	F1	Stop recording to unlock the **OPTIONS…** softkey.
5	F2	Open the **RECORDER OPTIONS** menu. 
6	ENTER	Jump to the **Mode** field, select **Single Sweep** and accept the recorder options.
7	F1	Start recording.

Using Triggering to Start or Stop Scope Record

To record an electrical event that causes a fault, it might be useful to start or stop recording on a trigger signal:
Start on trigger to start recording; recording stops when the deep memory is full
Stop on trigger to stop recording.
Stop when untriggered to continue recording as long as a next trigger comes within 1 division in view all mode.

For the models 190-xx4 the signal on the BNC input that has been selected as trigger source must cause the trigger.

For the models 190-xx2 the signal applied to the banana jack inputs (**EXT TRIGGER (in)**). signal must cause the trigger. The trigger source is automatically set to **Ext.** (external).

To set up the test tool, continue from step 3 of the previous section:

4 Apply the signal to be recorded to the BNC input(s).

5 F1 Stop recording to unlock the **OPTIONS…** softkey.

6 F2 Open the **RECORDER OPTIONS** menu.

7 ENTER Jump to the **Mode:** field, select **on Trigger…** (models 190-xx4) or **on Ext.** (models 190-xx2) to open the **START SINGLE SWEEP ON TRIGGERING** or the **START SINGLE SWEEP ON EXT.** menu.

8 ENTER Select one of the **Conditions:** and accept the selection.

For external triggering (190-xx2) continue at step 9.

9		Select the desired trigger slope (**Slope:)** and jump to **Level:**.
10		Select the 0.12V or 1.2V trigger level and accept all recorder options.
11	Apply a trigger signal to the red and black ext. trigger banana inputs.	

During recording samples are continuously saved in deep memory. The last twelve recorded divisions are displayed on the screen. See Figure 22. Use View All to display the full memory contents.

Note

To learn more about the Single Shot trigger function, see Chapter 4 "Triggering on Waveforms".

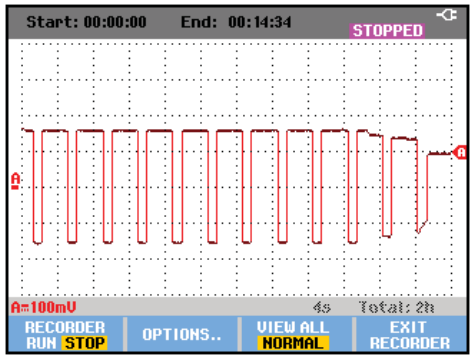


Figure 22. Triggered Single Sweep Recording

Analyzing a TrendPlot or Scope Record

From a TrendPlot or Scope Record you can use the analysis functions CURSORS and ZOOM to perform detailed waveform analysis. These functions are described in Chapter 3: "*Using Replay, Zoom and Cursors*".

Chapter 3
Using Replay, Zoom and Cursors

About this Chapter

This chapter covers the capabilities of the analysis functions **Cursor**, **Zoom**, and **Replay**. These functions can be used with one or more of the primary functions Scope, TrendPlot or Scope Record.

It is possible to combine two or three analysis functions. A typical application using these functions follows:

- First **replay** the last screens to find the screen of special interest.
- Then **zoom** in on the signal event.
- Finally, make measurements using the **cursors**.

Replaying the 100 Most Recent Scope Screens

When you are in scope mode, the test tool automatically stores the 100 most recent screens. When you press the **HOLD** key or the **REPLAY** key, the memory contents are frozen. Use the functions in the **REPLAY** menu to “go back in time” by stepping through the stored screens to find the screen of your interest. This feature lets you capture and view signals even if you did not press **HOLD**.

Replaying Step-by-Step

To step through the last scope screens, do the following:

1	REPLAY	From scope mode, open the **REPLAY** menu.  Observe that the waveform is frozen and that **REPLAY** appears at the top of the screen (see Figure 23).
2	F1	Step through the previous screens.
3	F2	Step through the next screens.

Observe that the bottom of the waveform area displays the replay bar with a screen number and related time stamp:

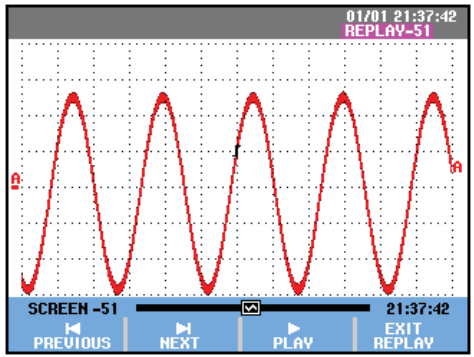


Figure 23. Replaying a Waveform

The replay bar represents all 100 stored screens in memory. The icon represents the picture being displayed on the screen (in this example: SCREEN -51). If the bar is partly white, the memory is not completely filled with 100 screens.

From this point you can use the zoom and cursor functions to study the signal in more detail.

Replaying Continuously

You can also replay the stored screens continuously, like playing a video tape.

To replay continuously, do the following:

1	REPLAY	From Scope mode, open the **REPLAY** menu.  Observe that the waveform is frozen and **REPLAY** appears at the top of the screen.
2	F3	Continuously replay the stored screens in ascending order.

Wait until the screen with the signal event of interest appears.

3	F3	Stop the continuous replay.

Turning Off the Replay Function

4	F4	Turn off **REPLAY**.

Capturing 100 Intermittents Automatically

When you use the test tool in triggered mode, 100 *triggered* screens are captured.

By combining the trigger possibilities with the capability of capturing 100 screens for later replay, you can leave the test tool unattended to capture intermittent signal anomalies. This way you could use Pulse Triggering to trigger and capture 100 intermittent glitches or you could capture 100 UPS startups.

For triggering, see Chapter 4: "*Triggering on Waveforms*".

Zooming in on a Waveform

To obtain a more detailed view of a waveform, you can zoom in on a waveform using the **ZOOM** function.

To zoom in on a waveform, do the following:

1	ZOOM	Display the **ZOOM** key labels.  **ZOOM** appears at the top of the screen, and the waveform is magnified.
2		Enlarge (decrease the time/div) or shrink (increase the time/div) the waveform.
3		Scroll. A position bar displays the position of the zoomed part in relation to the total waveform.

Tip

Even when the key labels are not displayed at the bottom of the screen, you can still use the arrow keys to zoom in and out. You can also use the **s TIME ns** *key to zoom in and out.*

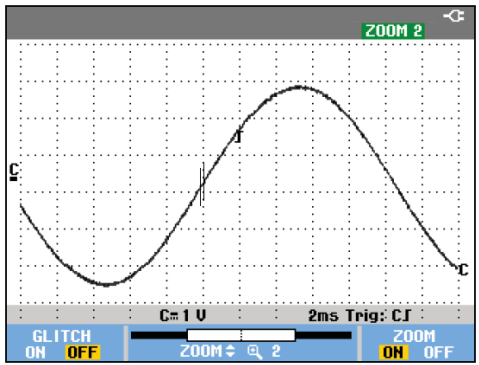


Figure 24. Zooming in a Waveform

Observe that the bottom of the waveform area displays the zoom ratio, position bar, and time/div (see Figure 24). The zoom range depends on the amount of data samples stored in memory.

Turning Off the Zoom Function

4	F4	Turn off the **ZOOM** function.

Making Cursor Measurements

Cursors allow you to make precise digital measurements on waveforms. This can be done on live waveforms, recorded waveforms, and on saved waveforms.

Using Horizontal Cursors on a Waveform

To use the cursors for a voltage measurement, do the following:

1	CURSOR	From scope mode, display the cursor key labels. 
2	F1	Press to highlight ☰
3	F2	Highlight the upper cursor.
4	▲ ▼	Move the upper cursor to the desired position on the screen.
5	F2	Highlight the lower cursor.
6	▲ ▼	Move the lower cursor to the desired position on the screen.

Note

Even when the key labels are not displayed at the bottom of the screen, you still can use the arrow keys. This allows full control of both cursors while having full screen view.

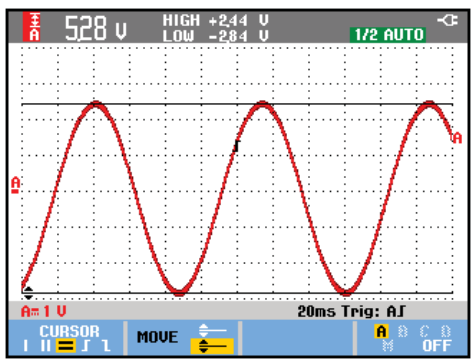


Figure 25. Voltage Measurement with Cursors

The screen shows the voltage difference between the two cursors and the voltage at the cursors. (See Figure 25.)

Use horizontal cursors to measure the amplitude, high or low value, or overshoot of a waveform.

Using Vertical Cursors on a Waveform

To use the cursors for a time measurement (T, 1/T), for a mVs-mAs-mWs measurement, or for an RMS measurement of the waveform section between the cursors, do the following:

1	CURSOR	From scope mode, display the cursor key labels. 
2	F1	Press to highlight II
3	F3	Choose, for example, time measurement: **T**.
4	F4	Choose the waveform that you want the markers to be placed on: **A**, **B**, **C**, **D** or **M** (Mathematics).
5	F2	Highlight the left cursor.
6	◀ ▶	Move the left cursor to the desired position on the waveform.
7	F2	Highlight the right cursor.

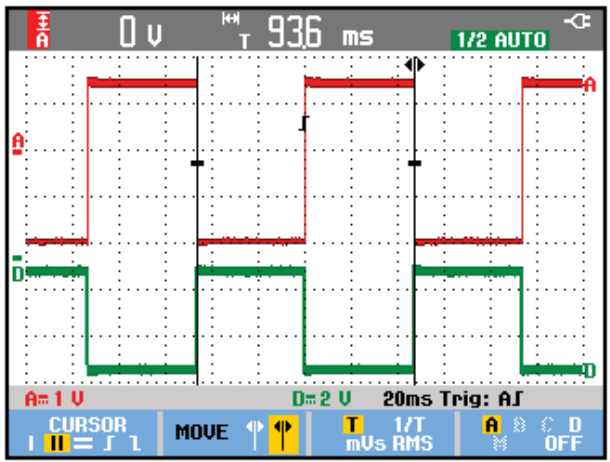


Figure 26. Time Measurement with Cursors

8	◀ ▶	Move the right cursor to the desired position on the waveform.

The screen shows the time difference between the cursors and the voltage difference between the two markers. (See Figure 26.)

9	F4	Select **OFF** to turn off the cursors.

Notes

- *For mVs select probe type ‘Voltage’.*
- *For mAs select probe type ‘Current’.*
- *For mWs select mathematical function x, and probe type ‘Voltage’ for one channel and ‘Current’ for the other channel.*

Using Cursors on a Mathematical Result (+ - x) Waveform

Cursor measurements on, for examle, a AxB waveform give a reading in Watts if input A measures (milli)Volts and input B measures (milli)Amperes.

For other cursor measurements on, for example, a A+B, A-B or AxB waveform no reading will be available if the input A and input B measurement unit are different.

Using Cursors on Spectrum Measurements

To do a cursor measurent on a spectrum, do the following:

1	CURSOR	From Spectrum measurement display the cursor key label. 
2		Move the cursor and observe the readings at the top of the screen.

Making Rise Time Measurements

To measure rise time, do the following:

1	CURSOR	From scope mode, display the cursor key labels. 
2	F1	Press to highlight ⎍
3	F4	For multiple waveforms select the required waveform A, B, C, D or M (if a math function is active).
4	F3	Select MANUAL or AUTO (this automatically does steps 5 to 7).
5	▲▼	Move the upper cursor to 100% of the waveform height. A marker is shown at 90%.
6	F2	Highlight the other cursor.
7	▲▼	Move the lower cursor to 0% of the waveform height. A marker is shown at 10%.

The reading shows the risetime from 10%-90% of the waveform amplitude.

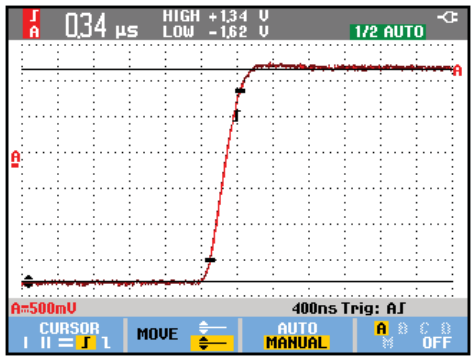


Figure 27. Risetime Measurement

Note

Direct access to Rise time or Fall time with cursors on is possible via the key sequence SCOPE, F2 – READING, and then selection of Rise or Fall time.

Chapter 4
Triggering on Waveforms

About this Chapter

This chapter provides an introduction to the trigger functions of the test tool. Triggering tells the test tool when to begin displaying the waveform. You can use fully automatic triggering, take control of one or more main trigger functions (semi-automatic triggering), or you can use dedicated trigger functions to capture special waveforms.

Following are some typical trigger applications:

- Use the Connect-and-View™ function to have full automatic triggering and instant display of virtually any waveform.
- If the signal is unstable or has a very low frequency, you can control the trigger level, slope, and trigger delay for a better view of the signal. (See next section.)
- For dedicated applications, use one of the four manual trigger functions:
  - Edge triggering
  - Video triggering
  - Pulse Width triggering
  - External Triggering (models 190-xx2 only)

Setting Trigger Level and Slope

The Connect-and-View™ function enables hands-off triggering to display complex unknown signals.

When your test tool is in manual range, do the following:

	MANUAL AUTO	Perform an auto set. **AUTO** appears at the top right of the screen.

Automatic triggering assures a stable display of virtually any signal.

From this point, you can take over the basic trigger controls such as level, slope and delay. To optimize trigger level and slope manually, do the following:

1	TRIGGER	Display the **TRIGGER** key labels. AUTO TRIG A B C D | SLOPE ⎍ ⎍ X | AUTO LEVEL MANUAL ⇕ | TRIGGER OPTIONS..
2	F2	Trigger on either positive slope or negative slope of the chosen waveform. In Dual Slope Triggering (X) the test tool triggers on both positive slope and negative slope.
3	F3	Enable the arrow keys for manual trigger level adjustment.

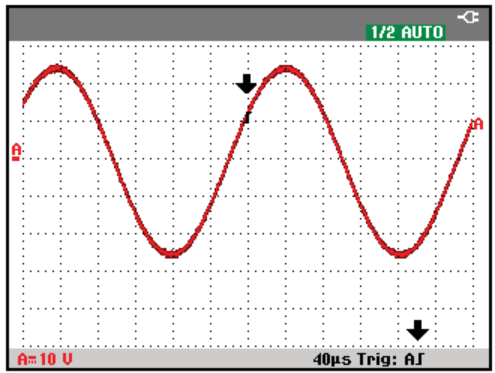


Figure 28. Screen with all Trigger Information

4	▲ ▼	Adjust the trigger level.

Observe the trigger icon ⎍ that indicates the trigger position, trigger level, and slope.

At the bottom of the screen the trigger parameters are displayed (See Figure 28). For example, **Trig : A⎍** means that input A is used as the trigger source with a positive slope.

When a valid trigger signal is found, the trigger key will be lit and the trigger parameters appear in black.

When no trigger is found, the trigger parameters appear in gray, ands the key light will be off.

Using Trigger Delay or Pre-trigger

You can begin to display the waveform some time before or after the trigger point has been detected. Initially, you have a half screen (6 divisions) of pre-trigger view (negative delay).

To set the trigger delay, do the following:

5	MOVE	Hold down to adjust the trigger delay.

Observe that the trigger icon on the screen moves to show the new trigger position. When the trigger position moves left off of the screen, the trigger icon changes into to indicate that you have selected a trigger delay. Moving the trigger icon to the right on the display gives you a pre-trigger view. This allows you to see what happened before the trigger event, or what caused the trigger.

In case of a trigger delay, the status at the bottom of the screen will change. For example:

A ⎍ →|500.0ms

This means that input A is used as the trigger source with a positive slope. The 500.0 ms indicates the (positive) delay between trigger point and waveform display.

When a valid trigger signal is found, the trigger key will be lit and the trigger parameters appear in black.

When no trigger is found, the trigger parameters appear in gray, ands the key light will be off.

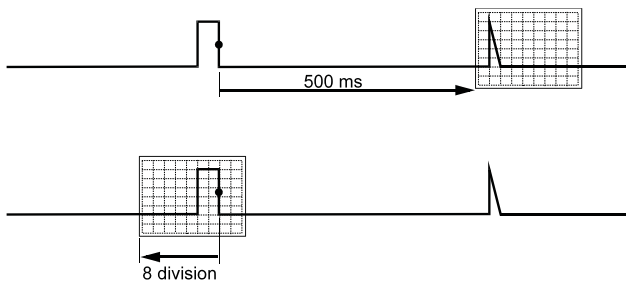


Figure 29. Trigger Delay or Pre-trigger View

Figure 29 shows an example of a trigger delay of 500 ms (top) and an example of pre-trigger view of 8 divisions (bottom).

Automatic Trigger Options

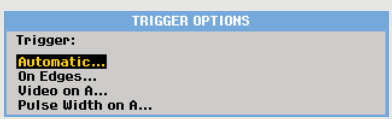
In the trigger menu, settings for automatic triggering can be changed as follows. (See also Chapter 1: *"Displaying an Unknown Signal with Connect-and-View"*)

1 TRIGGER — Display the **TRIGGER** key labels.

Note

*The **TRIGGER** key labels can differ depending on the latest trigger function used.*

2 F4 — Open the **TRIGGER OPTIONS** menu.



3 ENTER — Open the **AUTOMATIC TRIGGER** menu.

If the frequency range of the automatic triggering is set to > 15 Hz, the Connect-and-View™ function responds more quickly. The response is quicker because the test tool is instructed not to analyze low frequency signal components. However, when you measure frequencies lower than 15 Hz, the test tool must be instructed to analyze low frequency components for automatic triggering:

4 ENTER — Select **> 1 Hz** and return to the measurement screen.

Triggering on Edges

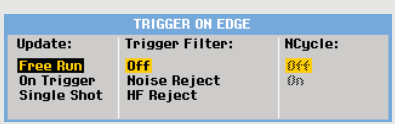
If the signal is unstable or has a very low frequency, use edge triggering to obtain full manual trigger control.

To trigger on rising edges of the input A waveform, do the following:

1 TRIGGER — Display the **TRIGGER** key labels.

2 F4 — Open the **TRIGGER OPTIONS** menu.

3 ENTER — Open the **TRIGGER ON EDGE** menu.



When **Free Run** is selected, the test tool updates the screen even if there are no triggers. A waveform always appears on the screen.

When **On Trigger** is selected, the test tool needs a trigger to display a waveform. Use this mode if you want to update the screen *only* when valid triggers occur.

When **Single Shot** is selected, the test tool waits for a trigger. After receiving a trigger, the waveform is displayed and the instrument is set to HOLD.

In most cases it is advised to use the Free Run mode:

4 ENTER — Select **Free Run**, jump to **Trigger Filter**.

5 ENTER — Set **Trigger Filter** to **Off**.

Observe that the key labels at the bottom of the screen have adapted to allow further selection of specific edge trigger settings:

Triggering on Noisy Waveforms

To reduce jitter on the screen when triggering on noisy waveforms, you can use a trigger filter. Continue from step 3 of the previous example as follows:

4		Select **On Trigger**, jump to **Trigger Filter**.
5		Set **Noise Reject** or **HF Reject** to **On**. This is indicated by a taller trigger icon ⌐.

When **Noise Reject** is on, an increased trigger gap will be applied.

When **HF Reject** is on, HF noise on the (internal) trigger signal will be suppressed.

Making a Single Acquisition

To catch single events, you can perform a **single shot** acquisition (one-time screen update). To set up the test tool for a single shot of the input A waveform, continue from step 3 (page 61) again:

4		Select **Single Shot**.

The word **MANUAL** appears at the top of the screen indicating that the test tool is waiting for a trigger. As soon as the test tool receives a trigger, the waveform is displayed and the instrument is set to hold. This is indicated by the word **HOLD** at top of the screen.

The test tool will now have a screen like Figure 30.

5		Arm the test tool for a new single shot.

Tip

The test tool stores all single shots in the replay memory. Use the Replay function to look at all the stored single shots (see Chapter 3).

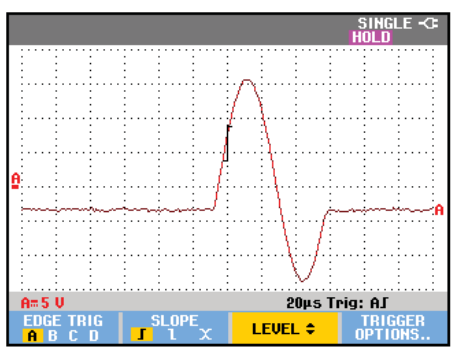


Figure 30. Making a Single Shot Measurement

N-Cycle Triggering

N-Cycle triggering enables you to create a stable picture of for example n-cycle burst waveforms.

Each next trigger is generated after the waveform has crossed the trigger level N times in the direction that complies with the selected trigger slope.

To select N-Cycle triggering, continue from step 3 (page 61) again:

4		Select **On Trigger** or **Single Shot**, jump to **Trigger Filter**.
5		Select a **Trigger Filter** or set it **Off**.
6		Set **NCycle** to **On**.

Observe that the key labels at the bottom of the screen have been changed to allow further selection of specific N-Cycle trigger settings:

7		Set the number of cycles N
8		Adjust the trigger level

Waveforms with N-Cycle triggering (N=2) and without N-Cycle triggering are shown in Figure 31.

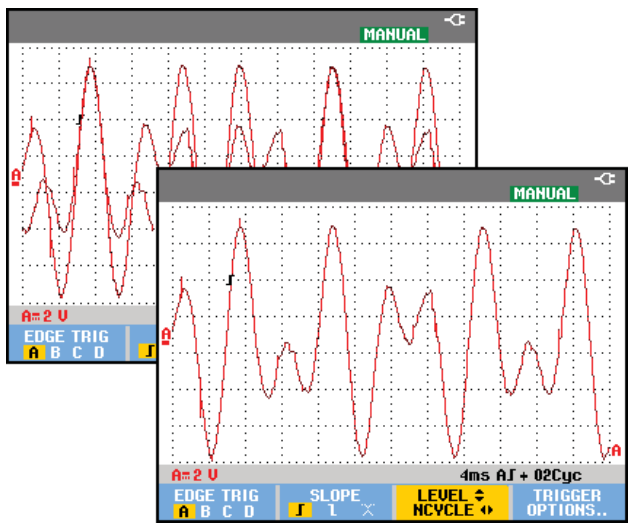


Figure 31. N-Cycle triggering

Triggering on External Waveforms (models 190-xx2)

Use external triggering when you want to display waveforms on inputs A and B while triggering on a third signal. You can choose external triggering with automatic triggering or with edge triggering.

1 Supply a signal to the red and black 4-mm banana jack inputs.

In this example you continue from the Trigger on Edges example. To choose the external signal as trigger source, continue as follows:

2 TRIGGER — Display the **TRIGGER** (On Edges) key labels.

3 F1 — Select **Ext** (external) edge trigger.

Observe that the key labels at the bottom of the screen have been adapted to allow selection of two different external trigger levels: 0.12 V and 1.2 V:

4 F3 — Select **1.2V** under the **Ext LEVEL** label.

From this point the trigger level is fixed and is compatible with logic signals.

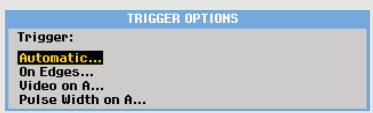
Triggering on Video Signals

To trigger on a video signal, first select the standard of the video signal you are going to measure:

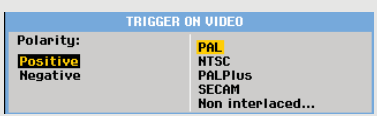
1 Apply a video signal to the red input A.

2 TRIGGER — Display the **TRIGGER** key labels.

3 F4 — Open the **Trigger Options** menu.



4 ENTER — Select **Video on A** … to open the **TRIGGER ON VIDEO** menu.



5 ENTER — Select positive signal polarity for video signals with negative going sync pulses.

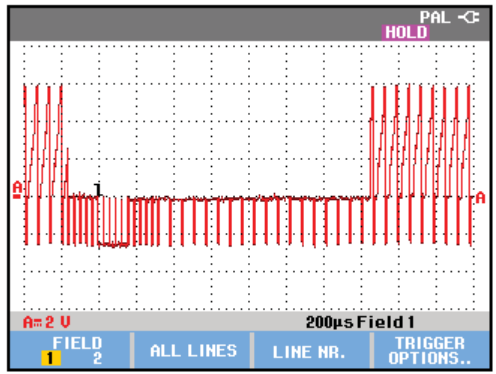


Figure 32. Measuring Interlaced Video Signals

6 ENTER — Select a video standard or **Non interlaced…** and return.

If you select Non interlaced a scan rate selection menu will open.

Trigger level and slope are now fixed.

Observe that the key labels at the bottom of the screen have been changed to allow further selection of specific video trigger settings.

Triggering on Video Frames

Use **FIELD 1** or **FIELD 2** to trigger either on the first half of the frame (odd) or on the second half of the frame (even).To trigger on the second half of the frame, do the following:

7	F1	Choose **FIELD 2**.

The signal part of the even field is displayed on the screen.

Triggering on Video Lines

Use **ALL LINES** to trigger on all line synchronization pulses (horizontal synchronization).

7	F2	Choose **ALL LINES.**

The signal of one line is displayed on the screen. The screen is updated with the signal of the next line immediately after the test tool triggers on the horizontal synchronization pulse.

To view a specific video line in more detail, you can select the line number. For example, to measure on video line 123, continue from step 6 as follows:

7	F3	Enable video line selection.
8		Select number 123.

The signal of line 123 is displayed on the screen. Observe that the status line now also shows the selected line number. The screen is continuously updated with the signal of line 123.

Triggering on Pulses

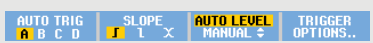
Use pulse width triggering to isolate and display specific pulses that you can qualify by time, such as glitches, missing pulses, bursts or signal dropouts.

Detecting Narrow Pulses

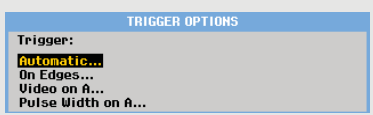
To set the test tool to trigger on narrow positive pulses shorter than 5 ms, do the following:

1 Apply a video signal to the red input A.

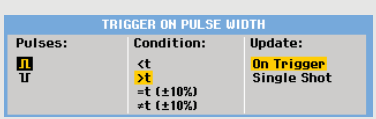
2 TRIGGER — Display the **TRIGGER** key labels.



3 F4 — Open the **TRIGGER OPTIONS** menu.



4 ENTER — Select Pulse Width on A... to open the trigger on pulse width menu.



5 ENTER — Select the positive pulse icon, then jump to **Condition**.

6 ENTER — Select **<t**, then jump to **Update**.

7 ENTER — Select **On Trigger**.

The test tool is now prepared to trigger on narrow pulses only. Observe that the trigger key labels at the bottom of the screen have been adapted to set the pulse conditions:

To set the pulse width to 5 ms, do the following:

8 F1 — Enable the arrow keys to adjust the pulse width.

9 — Select 5 ms.

All narrow positive pulses shorter than 5 ms are now displayed on the screen. (See Figure 33).

Tip

The test tool stores all triggered screens in the replay memory. For example, if you setup your triggering for glitches, you can capture 100 glitches with time stamps. Use the ***REPLAY*** *key to look at all the stored glitches.*

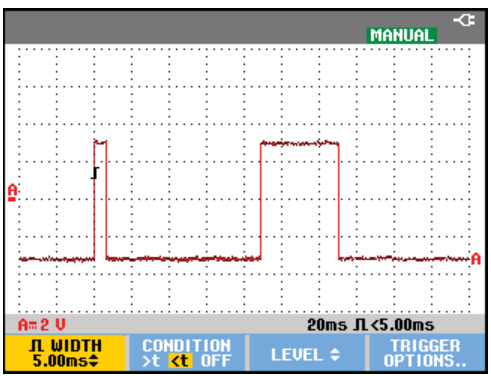


Figure 33. Triggering on Narrow Glitches

Finding Missing Pulses

The next example covers finding missing pulses in a train of positive pulses. In this example it is assumed that the pulses have a 100 ms distance between the rising edges. If the time accidently increases to 200 ms, a pulse is missing. To set the test tool to trigger on such missing pulses, let it trigger on gaps bigger than about 110 ms.

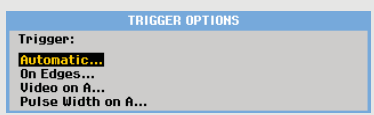
Do the following:

1 TRIGGER

Display the **TRIGGER** key labels.

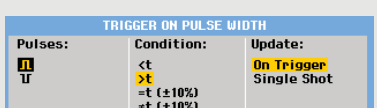
2 F4

Open the **TRIGGER OPTIONS** menu.



3 ENTER

Select **Pulse Width on A...** to open the **TRIGGER ON PULSE WIDTH** menu.



4		Select the positive pulse icon to trigger on a positive pulse, then jump to **Condition:** .
5		Select **>t**, then jump to **Update:** .
6		Select **On Trigger** and exit the menu.

The test tool is now prepared to trigger on pulses that are more than a selectable time in duration. Observe that the trigger menu at the bottom of the screen has been adapted to set the pulse condition:

To set the pulse width to 110 ms, continue as follows:

7		Enable the arrow keys to adjust the pulse width.
8		Select 110 ms.

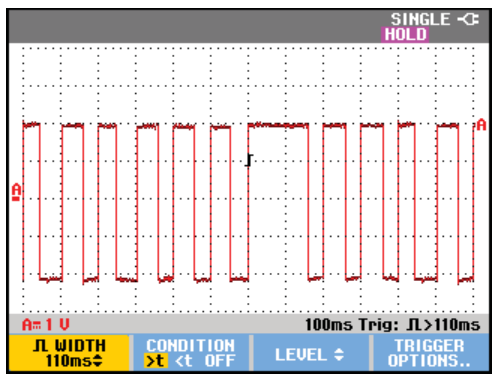


Figure 34. Triggering on Missing Pulses

Using Memory and PC

About this Chapter

This chapter provides a step-by-step introduction to the general functions of the test tool that can be used in the three main modes: Scope, Meter, or Recorder. You will find information on computer communication at the end of this chapter.

Using the USB Ports

The test tool is provided with two USB ports:

- a USB-host port to connect an external flash memory drive (‘USB-stick’) for data storage.
- a mini-USB-B port which allows you to connect the test tool to a PC for remote control and data transfer under PC-control, see Using FlukeView® on page 79.

The ports are fully isolated from the input channels and are covered with dust covers when not in use.

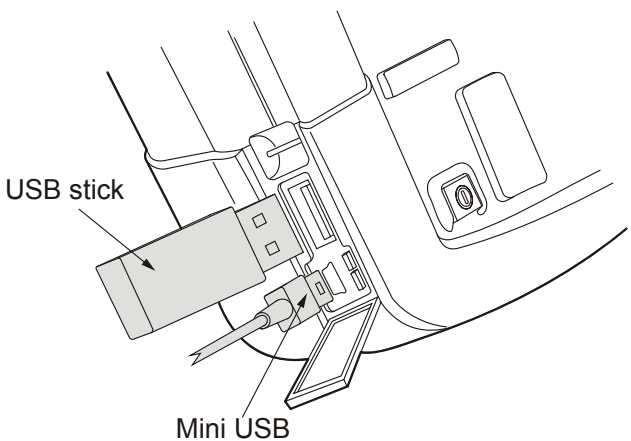


Figure 35. Test Tool USB Connections

Saving and Recalling

You can:

- Save screens and setups to internal memory, and recall them again from memory. The test tool has 30 ‘screen and setup’ memories, 10 ‘record and setup’ memories, and 9 screen image memories. See also
-
- Table 1.
- Save up to 256 screens and setups to a USB memory device, and recall them again from memory.
- Name saved screens and setups according to your own preferences.
- Recall screens and recordings to analyze the screen image at a later date.
- Recall a setup to continue a measurement with the recalled operating configuration.

Notes

Saved data is stored in non-volatile Flash memory.

Not saved instrument data is stored in RAM memory and will be kept at least 30 seconds when the battery is removed when no power is supplied via the BC190 power adapter.

Table 1. Test Tool Internal Memory

Mode	Memory locations		
	30x	10x	9x
METER	Setup + 1 screen	-	Screen image
SCOPE	Setup + 1 screen	Setup + 100 replay screens	Screen image
SCOPE REC	-	Setup + record data	Screen image
TRENDPLOT	-	Setup + trendplot data	Screen image

Notes:

- *In persistence mode, the most recent waveform will be saved, not all waveforms that build the persistence display.*

- *In the displayed file list of stored data the following symbols are used:*


setup + 1 screen


setup + replay screens/record data


setup + trendplot data


screen image (imagexxx.bmp

- *a screen image can be copied to a USB stick connected to the test tool. The USB stick connected to a PC allows you to insert the image for instance into a text document. The copying function is available under SAVE and F4 – File OPTIONS. A screen image can not be recalled on to the screen.*

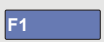
Saving Screens with Associated Setups

To save for example a screen+setup in Scope mode, do the following:

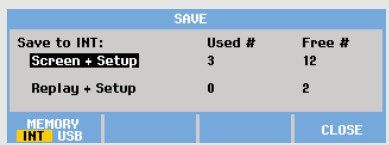
1 

Display the **SAVE** key labels.

From this point the screen is frozen.

2 

Open the **SAVE** menu.



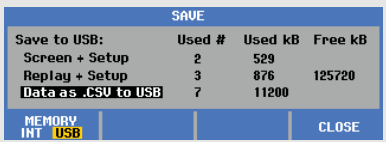
Observe the number of available and used memory locations.

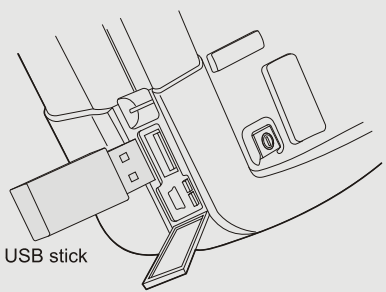
In METER mode the **SAVE AS** menu will be shown now as only a setup+screen can be saved, see step 4.

3 F1

Select the target memory INT (internal memory) or USB (USB device).

Observe the new **SAVE** menu if you select USB.

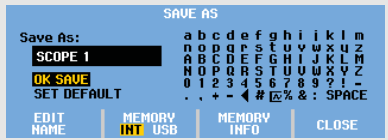



USB stick

You can save data in .csv format to a USB stick. The saved .csv file can be used to analyze the data in e.g. FlukeView® ScopeMeter® or in Excel.

4 ENTER

Select **Screen+Setup** and open the **SAVE AS** menu.



Below Save As: the default name + serial number and OK SAVE are already selected.

To modify the name for this particular Screen+Setup or to modify the default name see below '***Editing Names***'.

5 ENTER

Save the Screen+setup.

To resume your measurements press HOLD RUN.

All memories in use

If no free memory locations are available a message pops up that proposes to you to overwrite the oldest data set. Do one of the following:

If you don't want to overwrite the oldest data set,

- press F3, the delete one or more memory locations, and save again.

If you want to overwrite the oldest data set,

- press F4.

Editing names

To name the screen+setup according to your own preferences, continue from step 4 as follows:

5	F1	Open the **EDIT NAME** menu.
6	F2	Skip to a new character position.
7		Select another character and press ENTER to accept your choice. Repeat 6 and 7 until done.
8	F1	Accept the name and return to the **SAVE AS** menu.
9		Highlight OK SAVE to save the actual screen using the edited name.

To modify the default name generated by the test tool, continue from step 8 as follows:

9		Highlight SET DEFAULT to save the new default name.
10		Highlight OK SAVE to save the actual screen using the new default name.

Notes

The 'record+setup' memory locations store more than just what is visible on the screen. In TrendPlot or Scope Record mode the full recording is saved. In scope mode you can save all 100 replay screens in a single record+setup memory location. The table below shows what you can store for the various test tool modes.

To save a TrendPlot press STOP first.

Saving Screens in .bmp Format (Print Screen)

To save a screen in bitmap (.bmp) format, do the following:

1	SAVE	Display the **SAVE** key labels. 
2	F3	Save the screen to: - Internal memory (INT) if no USB device is connected. - a USB device if connected.

The file is saved using a fixed name (IMAGE) and a serial number, for example IMAGE004.bmp.

If no free memory locations are available a message pops up that proposes to you to overwrite the oldest data set. Do one of the following:

If you don't want to overwrite the oldest data set,

- press F3, then delete one or more memory locations, and save again.
- If you want to overwrite the oldest data set,
- press F4.

Deleting Screens with Associated Setups

To delete a screen and associated setup, do the following:

1	SAVE	Display the **SAVE** key labels. 
2	F4	Open the **FILE OPTIONS** menu.
3	F1	Select the source, internal memory (INT) or a USB device.
4	▲ ▼	Highlight **DELETE** ,
5	ENTER	Accept your choice and jump to the filename field
6	▲ ▼	Select the file to be deleted, Or
	F2	Select all files for deletion.
7	ENTER	Delete the selected files.

Recalling Screens with Associated Setups

To recall a screen+setup, do the following:

1	SAVE	Display the **SAVE** key labels. 
2	F2	Open the **RECALL** menu.
3	F1	Select the source, internal memory (INT) or a USB device.
4	▲▼	Highlight **DATA** .
5	ENTER	Accept your choice and jump to the filename field
6	▲▼	Select the file to be recalled.
7	ENTER	Recall the selected screen+setup.

Observe that the recalled waveform is displayed and that **HOLD** appears on the screen. From this point you can use cursors and zoom for analysis or you can print the recalled screen.

To recall a screen as a reference waveform to compare it to an actually measured waveform, see Chapter 1 ‘Comparing Waveforms’.

Recalling a Setup Configuration

To recall a setup configuration, do the following:

1	SAVE	Display the **SAVE** key labels. 
2	F2	Open the **RECALL** menu.
3	F1	Select the source, internal memory (INT) or a USB device.
4	▲▼	Highlight **setup** .
5	ENTER	Accept your choice and jump to the filename field.
6	▲▼	Select the file to be recalled,
7	ENTER	Recall the selected setup.

From this point you continue in the new operating configuration.

Viewing Stored Screens

To scroll through the memories while looking at the stored screens, do the following:

1	SAVE	Display the **SAVE** key labels. 
2	F2	Open the **RECALL** menu.
3	F1	Select the source, internal memory (INT) or a USB device.
4	ENTER	Jump to the filename field.
5	▲▼	Highlight a file.
6	F2	View the screen, and open the viewer. 
7	▲▼	Scroll through all stored screens.
8	F3	Save the screen to USB device (if connected) or internal memory.
9	F4	Exit the View mode.

Note:

In the VIEW mode the replay screens of a saved 'record+setup' cannot be viewed! Only the screen at the instant of saving can be reviewed in this way. To see all replay screens recall them from memory using the RECALL option.

Renaming Stored Screens and Setup Files

To modify the name of stored files, do the following:

1	SAVE	Display the **SAVE** key labels. 
2	F4	Open the **FILE OPTIONS** menu.
3	F1	Select the source, internal memory (INT) or a USB device.
4	▲▼	Highlight **RENAME**.
5	ENTER	Accept your choice and jump to the filename field.
6	▲▼	Highlight the file to be renamed.

7	ENTER	Open the **RENAME** menu.
8	F2	Skip to a new character position.
9		Select another character. Repeat 8 and 9 until done.
10	F1	Accept the name and return to the **RENAME** menu.

Copying-Moving Stored Screens and Setup Files

You can copy or move a file from internal memory to a USB device or from a USB device to internal memory.

To copy or to move a file, do the following:

1	SAVE	Display the **SAVE** key labels. 
2	F4	Open the **FILE OPTIONS** menu.
3	F1	Select the source, internal memory (INT) or a USB device. The other memory will become the destination.
4		Highlight **COPY** to copy or **MOVE** to move (copy and delete source) a file.
5	ENTER	Accept your choice and jump to the filename field.
6	 F2	Select the file to be copied or moved, Or Select all files
7	ENTER	Copy or delete the selected files.

Using FlukeView®

With the FlukeView® software you can upload waveform data and screen bitmaps to your PC or notebook computer for further processing.

USB drivers for the test tool and a FlukeView® Demo version with restricted functionality are available on the CD-ROM included in the shipment.

Connecting to a Computer

To connect the test tool to a PC or notebook computer and use the FlukeView software for Windows® (SW90W), do the following:

- Use a USB-A to mini-USB-B interface cable to connect a computer to the mini USB PORT of the test tool (See Figure 36).
- Install the test tool USB drivers, see Appendix A.
- Install the FlukeView® Demo version. For information about installing and using the FlukeView®. ScopeMeter® software see the FlukeView® Users Manual on the CD ROM.

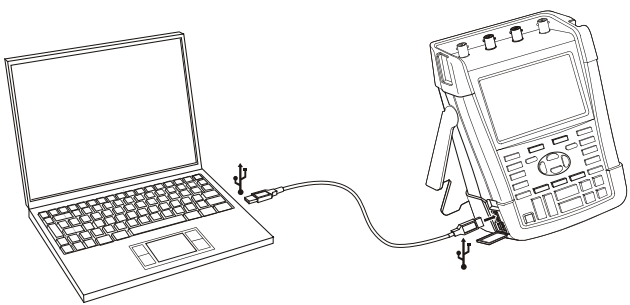


Figure 36. Connecting a Computer

Notes

- *The optional kit SCC290 contains an activation code to convert the FlukeView® Demo version into a fully operational version.*
- *A complete FlukeView® version can be ordered using ordering code SW90W. For use with the Fluke Series II ScopeMeter®test tools FlukeView®ScopeMeter®release V5.1 or higher is required.*
- *The test tool input channels are electrically isolated from the USB port.*
- *Remote control and data transfer via mini-USB is not possible while saving or recalling data to or from the USB-stick.*

Chapter 6
Tips

About this Chapter

This chapter gives you information and tips on how you can make the best use of the test tool.

Using the Standard Accessories

The following illustrations show the use of the standard accessories such as voltage probes, test leads, and the various clips.

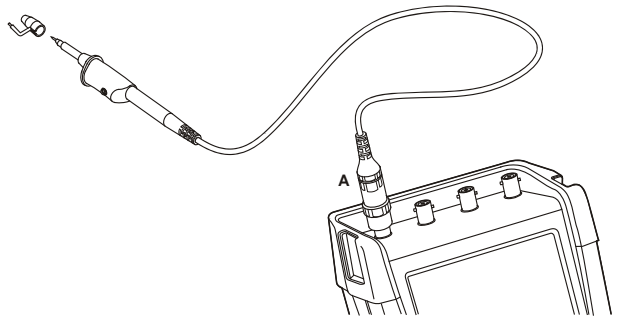


Figure 37. HF Voltage Probe Connection Using Ground Spring

Warning

To avoid electrical shock or fire, do not connect the ground spring to voltages higher than 30 Vrms from earth ground.

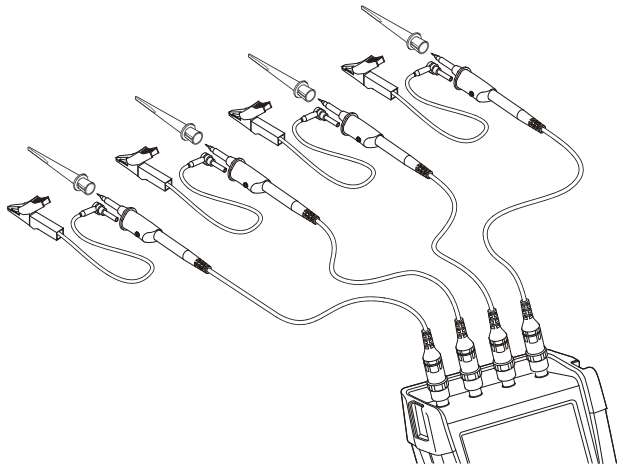


Figure 38. Electronic Connections for Measurements Using Hook Clips and Alligator Clip Grounding

⚠⚠ Warning

To avoid electrical shock, re-apply the insulation sleeve (Figure 1, item e) over the probe tip when the hook clip is not used. This also avoids the risk of accidently interconnecting the reference contact of multiple probes when groundleads are connected or avoids short-circuiting any circuitry via the bare ground ring of the probe..

Using the Independently Floating Isolated Inputs

You can use the independently floating isolated inputs to measure signals that are independently floating from each other.

Independently floating isolated inputs offer additional safety and measurement capabilities compared to inputs with common references or grounds.

Measuring Using Independently Floating Isolated Inputs

The test tool has independently floating isolated inputs. Each input section (A, B, C, D – A, B, METER INPUT) has its own signal input and its own reference input. The reference input of each input section is electrically isolated from the reference inputs of the other input sections. The isolated input architecture makes the test tool about as versatile as having four independent instruments. The advantages of having independently floating isolated inputs are:

- It allows simultaneous measurement of independently floating signals.
- Additional safety. Since the commons are not directly connected, the chance of causing short circuit when measuring multiple signals is greatly reduced.
- Additional safety. When measuring in systems with multiple grounds, the ground currents induced are kept to a minimum.

Because the references are not connected together inside the test tool, each reference of the used inputs must be connected to a reference voltage.

Independently floating isolated inputs are still coupled by parasitic capacitance. This can occur between the input references and the environment, and between the input references mutually (see Figure 39). For this reason, you should connect the references to a system ground or another stable voltage. If the reference of an input is connected to a high speed and / or high voltage signal, you should be aware of parasitic capacitance. (See Figure 39, Figure 41, Figure 42 and Figure 43.)

Note

The input channels are electrically isolated from the USB port and from the power adapter input.

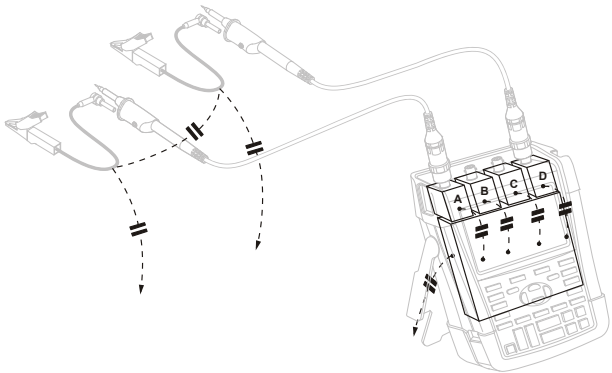


Figure 39. Parasitic capacitance between probes, instrument and environment

Note:

Parasitic capacitances such as shown in Figure 39, 41 and 43 can cause ringing on the signal. Ringing can be limited by adding a ferrite bead around the probe cable.

Warning

To avoid electrical shock, always use the insulation sleeve (Figure 1, item e) or the hook clip when using the probe reference (ground) lead. The voltage applied to the reference lead is also present on the ground ring near the probe tip as shown in Figure 40. The isolation sleeve avoids the risk of accidently interconnecting the reference contact of multiple probes when groundleads are connected or short-circuiting any circuitry via the bare ground ring..

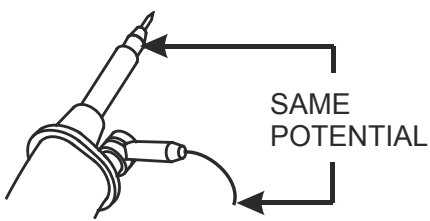


Figure 40. Probe Tip

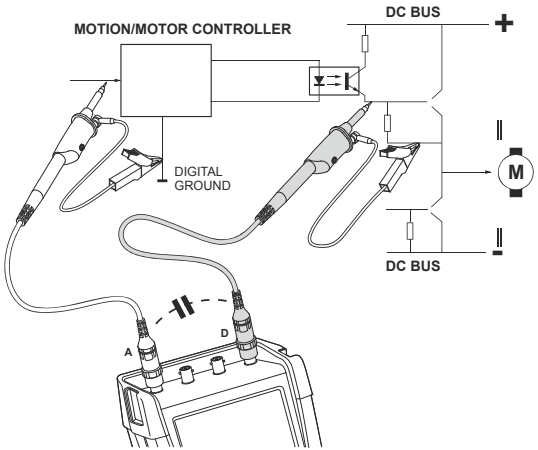


Figure 41. Parasitic capacitance between analog and digital reference

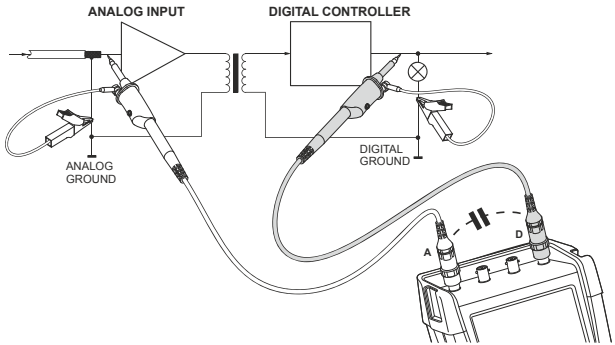


Figure 42. Correct connection of reference leads

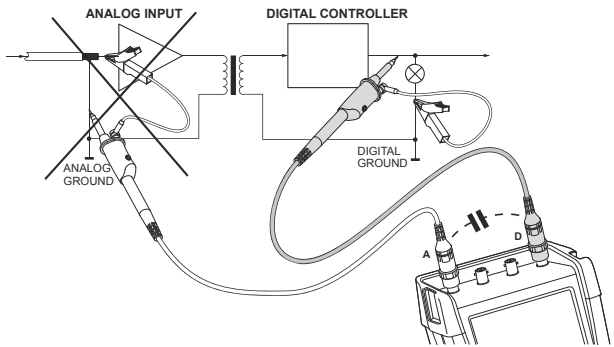


Figure 43. Wrong connection of reference leads

Noise that is picked up by reference lead D can be transmitted by parasitic capacitance to the analog input amplifier.

Using the Tilt Stand

The test tool is equipped with a tilt stand, allowing viewing from an angle while placed on a table. The typical position is shown in Figure 44.

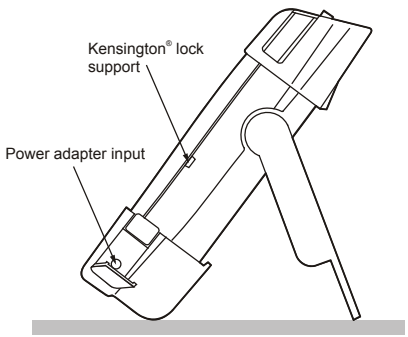


Figure 44. Using the Tilt Stand

Note

An optional Hanging Hook, ordering code HH290, can be attached to the rear of the test tool. The hook enables you to hang the test tool at a convenient viewing position, for example a cabinet door or a separation wall.

Kensington®-lock

The test tool is provided with a security slot compatible with a Kensington® lock, see Figure 44.

The Kensington Security Slot along with a locking cable provides physical security against thefts of opportunity. Locking cables can be obtained from, for example, laptop computer accessory dealers.

Fixing the Hangstrap

A hang strap is supplied with the test tool. The figure below shows how to attach the strap correctly to the test tool.

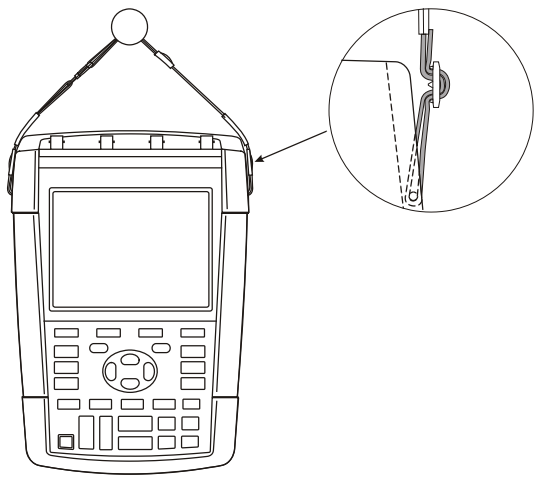


Figure 45. Fixing the Hangstrap

Resetting the Test Tool

If you want to reset the test tool to the factory settings, without clearing the memories, do the following:

1		Turn the test tool off.
2		Press and hold.
3		Press and release.

The test tool turns on, and you should hear a double beep, indicating the reset was successful.

4		Release.

Suppressing Key Labels and Menu's

You can close a menu or hide key label at any time:

	Hide any key label, press again to display the key label again (toggle function). A displayed menu will be closed.

To display menus or key labels, press one of the yellow menu keys, e.g. the **SCOPE** key.

You can also close a menu using the  softkey CLOSE.

Changing the Information Language

During operation of the test tool, messages may appear at the bottom of the screen. You can select the language in which these messages are displayed. In this example you can select English or French. To change the language from English to French, do the following:

1	USER	Display the **USER** key labels. 
2	F2	Open the **LANGUAGE SELECT** menu. 
3		Highlight **FRENCH**.
4	ENTER	Accept French as the language.

Note

The languages available in your test tool may differ from this example.

Adjusting the Contrast and Brightness

To adjust the contrast and backlight brightness, do the following:

1	USER	Display the **USER** key labels. 
2	F4	Enable the arrow keys for manual contrast and backlight adjustment.
3		Adjust the contrast of the screen.
4		Change the backlight.

Note

The new contrast and brightness are stored until a new adjustment is made.

To save battery power, the test tool is in economic brightness mode when operated on the battery. The high brightness intensity increases when you connect the power adapter.

Note

Using dimmed light lengthens battery power operating time. See Chapter 8 'Specifications', section 'Miscellaneous'.

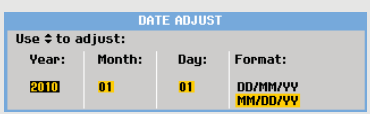
Changing Date and Time

The test tool has a date and time clock. For example, to change the date to 19 April, 2013, do the following:

1 USER — Display the **USER** key labels.

2 F1 — Open the **USER OPTIONS** menu.

3 ENTER — Open the **DATE ADJUST** menu.



4 ENTER — Choose 2013, jump to **Month:** .

5 ENTER — Choose 04, jump to **Day:** .

6 ENTER — Choose 19, jump to **Format:** .

7 ENTER — Choose **DD/MM/YY**, accept the new date.

You can change the time in a similar way by opening the **Time Adjust…** menu (steps 2 and 3.)

Saving Battery Life

When operated on the battery, the test tool conserves power by shutting itself down. If you have not pressed a key for at least 30 minutes, the test tool turns itself off automatically.

Automatic power shutdown will not occur if TrendPlot or Scope Record is on, but the backlight will dim. Recording will continue even if the battery is low, and retention of memories is not jeopardized.

To save battery life without automatic power shutdown you can use the display AUTO-off option. The display will be turned off after the selected time (30 seconds or 5 minutes).

Note

If the power adapter is connected, there is no automatic power shutdown, and the display AUTO-off function is inactive.

Setting the Power Down Timer

Initially the power shutdown time is 30 minutes. You can set the power shutdown time to 5 minutes as following:

1 

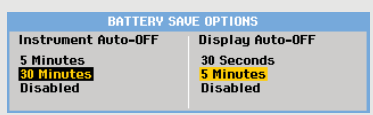
Display the **USER** key labels.

2 

Open the **USER OPTIONS** menu.

3 

Open the **BATTERY SAVE OPTIONS** menu.

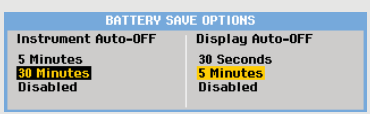


4 

Select **Instrument Auto-OFF 5 Minutes**.

Setting the Display AUTO-off Timer

Initially the display AUTO-off timer is disabled (no automatic display turn off). You can set the display AUTO-off timer to 30 seconds or to 5 minutes as following:

1		Display the **USER** key labels. 
2		Open the **USER OPTIONS** menu. 
3		Open the **BATTERY SAVE OPTIONS** menu. 
4		Select **Display Auto-OFF 30 Seconds** or **5 Minutes**.

The display will be turned off after the selected time is elapsed.

To turn on the display again do one of the following:

- Press any key. The Display will be visible again and the Display Auto-Off timer starts again. The display will be turned off again when the time has elapsed.
- Connect the power adapter; the Auto-Off timer is inactive now.

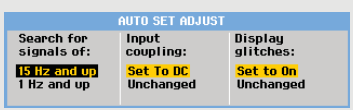
Changing the Auto Set Options

With the next procedure you can choose how auto set behaves when you press the **AUTO-MANUAL** (auto set) key.

1 USER — Display the **USER** key labels.

2 F1 — Open the **USER OPTIONS** menu.

3 ENTER — Open the **AUTO SET ADJUST** menu.



If the frequency range is set to > 15 Hz, the Connect-and-View function responds more quickly. The response is quicker because the test tool is instructed not to analyze low frequency signal components. However, when you measure frequencies lower than 15 Hz, the test tool must be instructed to analyze low frequency components for automatic triggering:

4 ENTER — Select **1 Hz and up**, then jump to **Input Coupling:**

When you press the **AUTO-MANUAL** (auto set) key, the input coupling can either be set to dc or left unchanged:

5 ENTER — Select **Unchanged**.

When you press the **AUTO-MANUAL** (auto set) key glitch capture can either be set to On or left unchanged:

6 ENTER — Select **Unchanged**.

Note

The auto set option for the signal frequency is similar to the automatic trigger option for the signal frequency. (See Chapter 4: "Automatic Trigger Options"). However, the auto set option determines the behavior of the auto set function and shows only effect when you press the auto set key.

Chapter 7
Maintaining the Test Tool

About this Chapter

This chapter covers basic maintenance procedures that can be performed by the user. For complete service, disassembly, repair, and calibration information, see the Service Manual. (www.fluke.com)

Warning

- **Have an approved technician repair the product.**
- **Use only specified replacement parts.**
- **Before carrying out any maintenance, carefully read the safety information at the beginning of this manual.**

Cleaning the Test Tool

Warning

Remove the input signals before you clean the test tool.

Clean the test tool with a damp cloth and a mild soap. Do not use abrasives, solvents, or alcohol. These may damage the text on the test tool.

Storing the Test Tool

If you are storing the test tool for an extended period of time, charge the Li-ion (Lithium-ion) batteries before storing.

Charging the Batteries

At delivery, the Li-ion batteries may be empty and must be charged for 5 hours (with the test tool turned off) to reach full charge.

When battery power is used, the battery indicator at the top of the screen informs you about the condition of the batteries. The battery symbols are: ■ ◧ ◧ ▭ ⊠. The symbol ⊠ indicates that there are typically five minutes of operating time left. See also Displaying Battery Information on page 101.

To charge the batteries and power the instrument, connect the power adapter as shown in Figure 46. To charge the batteries more quickly, turn off the test tool.

Caution

To avoid overheating of the batteries during charging, do not exceed the allowable ambient temperature given in the specifications.

Note

No damage will occur if the power adapter is connected for long periods, e.g., during the weekend. The instrument then automatically switches to trickle charging.

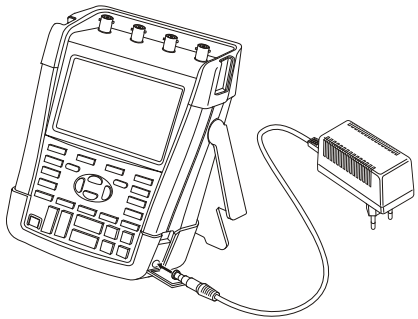


Figure 46. Charging the Batteries

Alternatively, you may choose to exchange the battery (Fluke accessory BP290 or BP291) with a fully charged one, and use the external battery charger EBC290 (optional Fluke accessory).

Replacing the Battery Pack

Warning

Use only the Fluke BP290 (not recommended for 190-xx4) or BP291 for replacement!

When no adapter power is supplied, data not yet saved in the test tool memory is maintained if the battery is replaced within 30 seconds. To avoid loss of data, do one of the following actions before removing the battery:

- Store the data in the test tool's non volatile flash memory, on a computer or a USB stick.
- Connect the power adapter.

To replace the battery pack, proceed as follows:

1. Remove all probes and/or test leads
2. Remove the standup or fold it to the test tool
3. Unlock the battery cover (Figure 47)
4. Lift the battery cover and remove it, (Figure 48)
5. Lift one side of the battery and remove it (Figure 49)
6. Install a battery and close the battery cover.

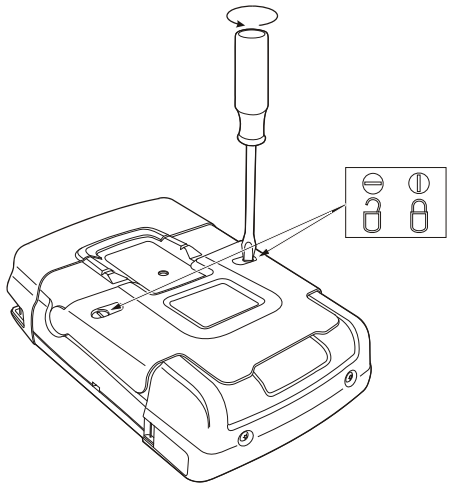


Figure 47. Unlocking the Battery Cover

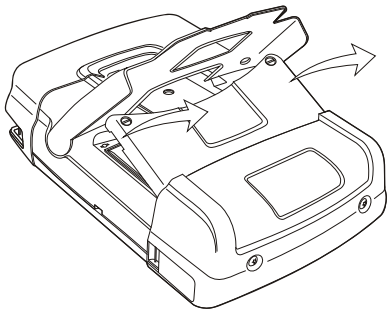


Figure 48. Removing the Battery Cover

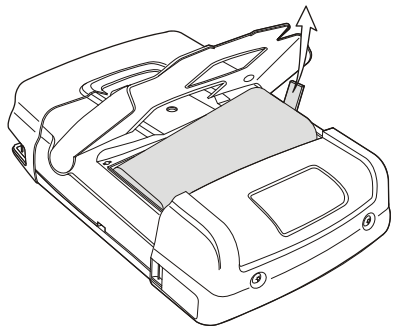
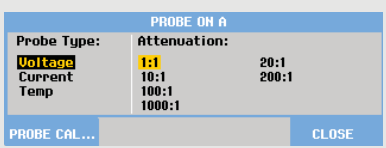


Figure 49. Removing the Battery

Calibrating the Voltage Probes

To fully meet user specifications, you need to adjust the voltage probes for optimal response. The calibration consists of a high frequency adjustment and a dc calibration for 10:1 probes and 100:1 probes. The probe calibration matches the probe to the input channel.

This example shows how to calibrate the 10:1 voltage probes:

1	A	Display the input A key labels. 
2	F3	Open the **PROBE ON A** menu.  If the correct probe type is already selected (yellow shaded) you can continue at step 5.
3	ENTER	Select **Probe Type: Voltage**, and **Attenuation: 10:1**.
4	F3	Open the **PROBE ON A** menu again.
5	F1	Select PROBE CAL…

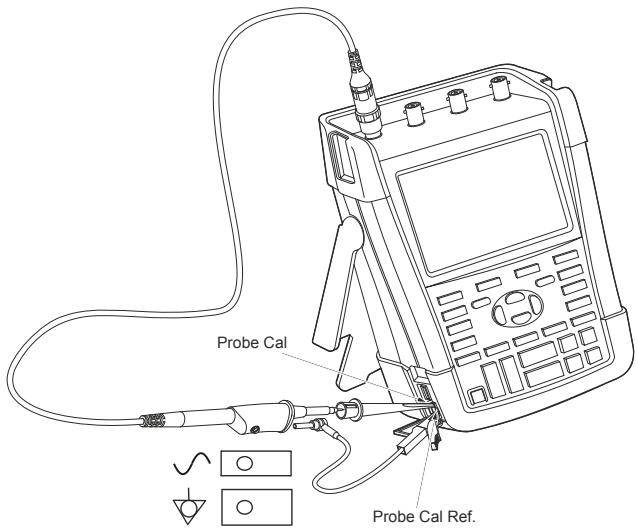


Figure 50. Adjusting Voltage Probes

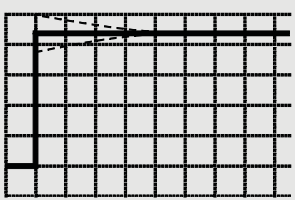
Note

it is necessary to connect both the hook clip and the zero reference contact.

A message appears asking you whether to start the 10:1 probe calibration.

6	F4	Start the probe calibration.

A message appears telling you how to connect the probe. Connect the red 10:1 voltage probe to input A and to the probe calibration reference signal as shown in Figure 50.

7		Adjust the trimmer screw in the probe housing until a pure square wave is displayed. For instructions to access the trimmer screw in the probe housing see the probe instruction sheet. 
8	F4	Continue with DC calibration. Automatic DC calibration is only possible for 10:1 voltage probes.

The test tool automatically calibrates itself to the probe. During calibration you should not touch the probe. A message indicates when the DC calibration has completed successfully.

9	F4	Return.

Repeat the procedure for the blue 10:1 voltage probe on input B, the gray 10:1 voltage probe on input C and the green 10:1 voltage probe on input D.

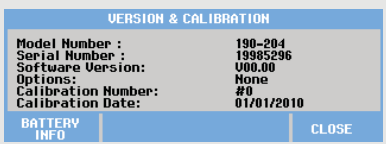
Note

When using 100:1 voltage probes, choose 100:1 attenuation to perform an adjustment.

Displaying Version and Calibration Information

You can display version number and calibration date:

1	USER	Display the **USER** key labels.
2	F3	Open the **VERSION & CALIBRATION** screen.
3	F4	Close the screen.



The screen gives you information about the model number with software version, the serial number, the calibration number with latest calibration date, and installed (software) options.

The test tool specifications (see Chapter 8) are based on a 1 year calibration cycle.

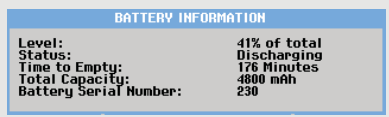
Recalibration must be carried out by qualified personnel. Contact your local Fluke representative for recalibration.

Displaying Battery Information

The battery information screen provides information about the batterystatus and battery serial number.

To display the screen proceed from step 2 in the previous section as follows:

3	F1	Open the **BATTERY INFORMATION** menu.
4	F4	Return to the previous screen.



'Level' indicates the available battery capacity as a percentage of the present maximum battery capacity.

'Time to Empty' indicates a calculated estimate for the remaining operating time.

Parts and Accessories

The following tables list the user-replaceable parts and specific optional accessories for the various test tool models.

To order replacement parts or additional accessories, contact your Fluke representative.

Replacement Parts

Item	Ordering Code
Power Adapter available models:	
Universal Europe 230 V, 50 and 60 Hz	BC190/801
North America 120 V, 50 and 60 Hz	BC190/813
United Kingdom 240 V, 50 and 60 Hz	BC190/804
Japan 100 V, 50 and 60 Hz	BC190/806
Australia 240 V, 50 and 60 Hz	BC190/807
Universal 115 V/230 V, 50 and 60 Hz *	BC190/808
	BC190/820
** UL listing applies to BC190/808 and BC190/820 with UL listed line plug adapter for North America. The 230 V rating of the BC190/808 and BC190/820 are not for use in North America. For other countries, a line plug adapter complying with the applicable National Requirements must be used.*	
Test Leads with test pins (one red, one black)	TL175

Replacement Parts (continued)

Voltage Probe Set (Red or Blue or Gray or Green) The set includes the following items (not available separately): • 10:1 Voltage Probe, 500 MHz (red or blue) • Hook Clip for Probe Tip (black) • Ground Lead with Mini Alligator Clip (black) • Ground Spring for Probe Tip (black) • Insulation Sleeve (black) *See Figure 1 on page 2 for item reference.* *See the VPS410-II instruction sheet for voltage/CAT ratings.*	VPS410-II-R (red) VPS410-II-B (blue) VPS410-II-G (gray) VPS410-II-V (green)

Replacement Parts (continued)

Replacement Set for Voltage Probe VPS410 and VPS410-II The set includes the following items (not available separately): • 1x Hook Clip for Probe Tip (black) • 1x Ground Lead with Mini Alligator Clip (black) • 2x Ground Spring for Probe Tip (black) • 2x Insulation Sleeve for Probe Tip (black) *See Figure 1 on page 2 for item reference.* *See the VPS410 instruction sheet for voltage/CAT ratings.*	RS400
BNC Feedthrough 50 Ohm (1 Watt) terminator (set of two pieces, black)	TRM50
Li-ion battery (26 Wh, not recommended for models 190-xx4)	BP290
Li-ion battery (52 Wh)	BP291
Hangstrap	946769

Optional Accessories

Item	Ordering Code
Voltage Probe Set, designed for use with the Fluke 190-50x test tool.  The set includes the following items (not available separately): • 10:1 Voltage Probe, 500 MHz (red or blue or gray or green) • Hook Clip for Probe Tip (black) • Ground Lead with Mini Alligator Clip (black) • Ground Spring for Probe Tip (black) • Insulation Sleeve (black) • Probe Tip to BNC Adapter	VPS510-R (red) VPS510-B (blue) VPS510-G (gray) VPS510-V (green)
Replacement Set for Voltage Probe VPS510  The set includes the following items (not available separately): • 1x Hook Clip for Probe Tip (black) • 1x Ground Lead with Mini Alligator Clip (black) • 2x Ground Spring for Probe Tip (black) • 2x Insulation Sleeve for Probe Tip (black) • 2x Probe Tip to BNC Adapter	RS500

Optional accessories (continued)

Probe Accessory Extension Set – VPS410, VPS410-II The set includes the following items (not available separately): • 1x Industrial Alligator for Probe Tip (black) • 1x 2-mm Test Probe for Probe Tip (black) • 1x 4-mm Test Probe for Probe Tip (black) • 1x Industrial Alligator for 4 mm Banana Jack (black) • 1x Ground Lead with 4-mm Banana Jack (black)	AS400
Software & Carrying Case Kit. Set contains the following parts: • FlukeView Software activation key, to convert the FlukeView demo version into an operational version. • Hard Shell Carrying Case C290	SCC290
FlukeView® ScopeMeter® Software for Windows® (full version)	SW90W
Hard Shell Carrying Case	C290
External Battery Charger, charges BP290/BP291 externally using BC190	EBC290
High Working Voltage Ruggedized Probe, 100:1, (available in 4 colors), 150 MHz, category rating 1000V CAT III / 600V CAT IV, working voltage (between probe tip and reference lead) 2000V in a CAT III environment/ 1200V in a CAT IV environment.	VPS420-R (red) VPS420-B (blue) VPS420-G (gray) VPS420-V (green)

Optional accessories (continued)

Hanging Hook; allows the test tool to be hung on a cabinet door or separation wall.	HH290
50 Ohm Coaxial Cable Set; includes 3 cables (1 red, 1 gray, 1 black), 1.5 m length with safety designed insulated BNC connectors.	PM9091
50 Ohm Coaxial Cable Set; includes 3 cables (1 red, 1 gray, 1 black), 0.5 m length with safety designed insulated BNC connectors.	PM9092
Safety designed BNC T-piece, Male BNC to dual female BNC (fully isolated).	PM9093
BNC Feedthrough 50 Ohm (1 W) terminator (set of two pieces, black)	TRM50
10:1 200 MHz voltage probe, 2.5 m.	VPS212-R (red), VPS212-G (gray)
1:1 30 MHz voltage probe, 1.2 m.	VPS101
Dual Banana Plug male to female BNC	PM9081
Dual Banana Jack female to male BNC	PM9082
Automotive Troubleshooting Kit	SCC298
Service Kit Meter and Drive Applications	SKMD001

Troubleshooting

The Test Tool Shuts Down After a Short Time

- The batteries may be empty. Check the battery symbol at the top right of the screen. A symbol indicates that the batteries are empty and must be charged. Connect the BC190 power adapter.
- The test tool is still on but the 'display auto off' timer is active, see Chapter 6 'Setting the Display AUTO-off Timer'. To turn the display on press any key (restarts the 'display AUTO-off' timer), or connect the BC190 power adapter.
- The power down timer is active, see Chapter 6 'Setting the Power Down timer'.
  Press to turn the test tool on.

The Screen Remains Black

- Make sure that the test tool is on (press)
- You might have a problem with the screen contrast. Press USER, then press F4. Now you can use the arrow keys to adjust the contrast.
- The display 'auto off' timer is active, see Chapter 6 'Setting the Display AUTO-off Timer'. To turn the display on press any key (restarts the 'display AUTO - off' timer), or connect the BC190 power adapter.

The Test Tool Cannot Be Turned Off

If the test tool cannot be turned off due to a software hangup, do the following:

- Keep the ON/OFF key pressed for at least 5 seconds.

FlukeView® Does Not Recognize The Test Tool

- Make sure that the test tool is turned on.
- Make sure that the interface cable is properly connected between the test tool and the PC. Use only the test tool mini USB port for communication with a computer!
- Make sure that no SAVE/RECAL/COPY/MOVE action from or to a USB-stick is being performed.
- Make sure that the USB drivers have been correctly installed, see Appendix A.

Battery Operated Fluke Accessories Do Not Function

- When using battery operated Fluke accessories, always first check the battery condition of the accessory with a Fluke multimeter or follow the procedure given for that particular accessory.

Chapter 8
Specifications

Introduction

Performance Characteristics

FLUKE guarantees the properties expressed in numerical values with the stated tolerance. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical ScopeMeter® test tools.

The Test Tool meets the specified accuracy 30 minutes and two complete acquisitions after power on. Specifications are based on a 1-year calibration cycle.

Environmental Data

The environmental data mentioned in this manual are based on the results of the manufacturer's verification procedures.

Safety Characteristics

The test tool has been designed and tested in accordance with Standards EN/IEC 61010-1, EN/IEC 61010-2-030, EN/IEC 61010-31, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use.

This manual contains information and warnings that must be followed by the user to ensure safe operation and to keep the instrument in a safe condition. Use of this equipment in a manner not specified by the manufacturer may impair protection provided by the equipment.

Oscilloscope

Isolated Inputs A,B, C and D (Vertical)

Number of Channels
- Fluke 190-xx2 ..... 2 (A, B)
- Fluke 190-xx4 ..... 4 (A,B,C,D)

Bandwidth, DC Coupled
- FLUKE 190-50x ..... 500 MHz (-3 dB)
- FLUKE 190-2xx..... 200 MHz (-3 dB)
- FLUKE 190-1xx..... 100 MHz (-3 dB)
- FLUKE 190-062 ..... 60 MHz (-3 dB)

Lower Frequency Limit, AC Coupled
- with 10:1 probe ..... <2 Hz (-3 dB)
- direct (1:1)..... <5 Hz (-3 dB)

Rise Time
- FLUKE 190-50x ..... 0.7 ns
- FLUKE 190-2xx..... 1.7 ns
- FLUKE 190-1xx..... 3.5 ns
- FLUKE 190-062 ..... 5.8 ns

Analog Bandwidth Limiters ..... 20 MHz and 10 kHz

Input Coupling..... AC, DC

Polarity..... Normal, Inverted

Sensitivity Ranges
- with 10:1 probe ..... 20 mV to 1000 V/div
- direct (1:1)..... 2 mV to 100 V/div

Dynamic Range..... > ±8 div (< 10 MHz)
..... > ±4 div (> 10 MHz)

Waveform Positioning Range..... ±4 divisions

Input Impedance on BNC, DC Coupled
- 4-channel models..... 1 MΩ (±1 %)//14 pF (±2.25 pF)
- 2-channel models..... 1 MΩ (±1 %)//15 pF (±2.25 pF)

⚠ Max. Input Voltage
For detailed specifications, see “Safety” on page 126

Vertical Accuracy .....±(2.1 % + 0.04 range/div)
2 mV/div: ....±(2.9 % + 0.08 range/div)
For voltage measurements with 10:1 probe, add probe accuracy, see section ‘10:1 Probe’ on page 129

Digitizer Resolution ..... 8 bits, separate digitizer for each input

Horizontal

Minimum Time Base Speed (Scope Record) ..... 2 min/div

Real Time Sampling Rate

FLUKE 190-50x
- 5 ns to 4 µs /div (3 or 4 channels) ..... up to 1.25 GS/s
- 2 ns to 4 µs /div (2 channels)..... up to 2.5 GS/s
- 1 ns to 4 µs /div (1 channel) ..... up to 5 GS/s
- 10 µs to 120 s/div ..... 125 MS/s

FLUKE190-202,-204:
- 2 ns to 4 µs /div (1 or 2 channels) ..... up to 2.5 GS/s
- 5 ns to 4 µs /div (3 or 4 channels) ..... up to 1.25 GS/s
- 10 µs to 120 s/div ..... 125 MS/s

FLUKE 190-102, -104:
5 ns to 4 μs /div (all channels).....up to 1.25 GS/s
10 μs to 120 s/div.....125 MS/s
FLUKE 190-062:
10 ns to 4 μs /div (all channels).....up to 625 MS/s
10 μs to 120 s/div.....125 MS/s

Glitch Detection
4 μs to 120 s/div .....displays glitches as fast as 8 ns

Waveform Display .....A, B, C, D,
Math (+, -, x, X-Y mode, spectrum)
Normal, Average, Persistence, Reference

Time Base Accuracy .....±(100 ppm + 0.04 div)

Record Length (all models): see table below.

Table 2. Record Length (all models, Samples/points per input)

Mode	Glitch Detect On	Glitch Detect Off	Max. Samplerate
Scope - Normal	300 min/max pairs	3k true samples compressed into 1 screen (300 samples per screen)	190-062: 625 MS/s 190-102/104: 1.25 GS/s 190-202/204: 2.5 GS/s (1 or 2 channels on) 190-204: 1.25 GS/s (3 or 4 channels on) 190-50x: 5 GS/s (1 channel on) 190-50x: 2.5 GS/s (2 channels on) 190-504: 1.25 GS/s (3 or 4 channels on)
Scope - Fast	300 min/max pairs	-	
Scope - Full	300 min/max pairs	10k true samples, compressed into 1 screen. Use Zoom and Scroll to see waveform details	
Scope Record Roll		30k samples	4x 125 MS/s
Trend Plot		> 18k min/max/ average values per measurement	Up to 5 measurements per second

Trigger and Delay

Trigger Modes.....Automatic, Edge, Video, Pulse Width, N-Cycle, External (190-xx2)

Trigger Delay ..... up to +1200 divisions

Pre Trigger View..... one full screen length

Delay .....-12 div to +1200 div

Max. Delay.....48 s at 4 s/div

Automatic Connect-and-View Trigger

Source .....A, B, C, D EXT (190-xx2)

Slope ..... Positive, Negative, Dual

Edge Trigger

Screen Update .....Free Run, On Trigger, Single Shot

Source.....A, B, C, D, EXT (190-xx2)

Slope.....Positive, Negative, Dual

Trigger Level Control Range .....±4 divisions

Trigger Sensitivity

DC to 5 MHz at >5 mV/div	0.5 divisions
DC to 5 MHz at 2 mV/div and 5 mV/div	1 division
500 MHz (FLUKE 190-50x)	1 division
600 MHz (FLUKE 190-50x)	2 divisions
200 MHz (FLUKE 190-2xx)	1 division
250 MHz (FLUKE 190-2xx)	2 divisions
100 MHz (FLUKE 190-1xx)	1 division
150 MHz (FLUKE 190-1xx)	2 divisions
60 MHz (FLUKE 190-062)	1 division
100 MHz (FLUKE 190-062)	2 divisions

Isolated External Trigger (190-xx2)

Bandwidth .....10 kHz

Modes ..... Automatic, Edge

Trigger Levels (DC to 10 kHz)..... 120 mV, 1.2 V

Video Trigger

Standards ....PAL, PAL+, NTSC, SECAM, Non-interlaced

Modes ..... Lines, Line Select, Field 1 or Field 2

Source ..... A

Polarity ..... Positive, Negative

Sensitivity ..... 0.7 division sync level

Pulse Width Trigger

Screen Update .....On Trigger, Single Shot

Trigger Conditions.....<T, >T, =T (±10 %), ≠T(±10 %)

Source ..... A

Polarity ..... Positive or negative pulse

Pulse Time Adjustment Range.....0.01 div. to 655 div. with a minimum of 300 ns (<T, >T) or 500 ns (=T, ≠T), a maximum of 10 s, and a resolution of 0.01 div. with a minimum of 50 ns

Continuous Auto Set

Autoranging attenuators and time base, automatic Connect-and-View™ triggering with automatic source selection.

Modes
- Normal ..... 15 Hz to max. bandwidth
- Low Frequency ..... 1 Hz to max. bandwidth

Minimum Amplitude A, B, C, D
- DC to 1 MHz ..... 10 mV
- 1 MHz to max. bandwidth ..... 20 mV

Automatic Capturing Scope Screens

Capacity ..... 100 Scope Screens

For viewing screens, see Replay function.

Automatic Scope Measurements

The accuracy of all readings is within ± (% of reading + number of counts) from 18 °C to 28 °C. Add 0.1x (specific accuracy) for each °C below 18 °C or above 28 °C. For voltage measurements with 10:1 probe, add probe accuracy, see section '10:1 Probe' on page 129. At least 1.5 waveform period must be visible on the screen.

General

Inputs ..... A, B, C and D

DC Common Mode Rejection (CMRR) ..... >100 dB
AC Common Mode Rejection at 50, 60, or 400 Hz ..... >60 dB

DC Voltage (VDC)

Maximum Voltage
- with 10:1 probe ..... 1000 V
- direct (1:1) ..... 300 V

Maximum Resolution
- with 10:1 probe ..... 1 mV
- direct (1:1) ..... 100 µV

Full Scale Reading ..... 999 counts

Accuracy at 4 s to 10 µs/div, FLUKE 190-xx2
- 2 mV/div ..... ±(1.5 % + 10 counts)
- 5 mV/div to 100 V/div ..... ±(1.5 % + 6 counts)

Accuracy at 4 s to 10 µs/div, FLUKE 190-xx4
- 2 mV/div ..... ±(3 % + 10 counts)
- 5 mV/div to 100 V/div ..... ±(3 % + 6 counts)

Normal Mode AC Rejection at 50 or 60 Hz ..... >60 dB

AC Voltage (VAC)

Maximum Voltage
- with 10:1 probe ..... 1000 V
- direct (1:1) ..... 300 V

Maximum Resolution
- with 10:1 probe ..... 1 mV
- direct (1:1) ..... 100 µV

Full Scale Reading ..... 999 counts

Accuracy, FLUKE 190-xx2
- DC coupled:
  - DC to 60 Hz ..... ±(1.5 % +10 counts)
- AC coupled, low frequencies:
  - 50 Hz direct (1:1) ..... ±(1.5 % + 10 counts) - 0.6%
  - 60 Hz direct (1:1) ..... ±(1.5 % + 10 counts) - 0.4%
  - With the 10:1 probe the low frequency roll off point will be lowered to 2 Hz, which improves the AC accuracy for low frequencies. When possible use DC coupling for maximum accuracy.

AC or DC coupled, high frequencies:
60 Hz to 20 kHz..... ±(2.5 % + 15 counts)
20 kHz to 1 MHz..... ±(5 % + 20 counts)
1 MHz to 25 MHz ..... ±(10 % + 20 counts)
For higher frequencies the instrument's frequency roll off starts affecting accuracy.

Accuracy, FLUKE 190-xx4
DC coupled:
DC to 60 Hz..... ±(3 % +10 counts)

AC coupled, low frequencies:
50 Hz direct (1:1)..... ±(3 % + 10 counts) - 0.6%
60 Hz direct (1:1)..... ±(3 % + 10 counts) – 0.4%
With the 10:1 probe the low frequency roll off point will be lowered to 2 Hz, which improves the AC accuracy for low frequencies. When possible use DC coupling for maximum accuracy.

AC or DC coupled, high frequencies:
60 Hz to 20 kHz..... ±(4 % + 15 counts)
20 kHz to 1 MHz..... ±(6 % + 20 counts)
1 MHz to 25 MHz ..... ±(10 % + 20 counts)
For higher frequencies the instrument's frequency roll off starts affecting accuracy.

Normal Mode DC Rejection ..... >50 dB

All accuracies are valid if:
- The waveform amplitude is larger than one division
- At least 1.5 waveform period is on the screen

AC+DC Voltage (True RMS)

Maximum Voltage
with 10:1 probe ..... 1000 V
direct (1:1) ..... 300 V

Maximum Resolution
with 10:1 probe ..... 1 mV
direct (1:1) ..... 100 µV

Full Scale Reading ..... 1100 counts

Accuracy, FLUKE 190-xx2
DC to 60 Hz..... ±(1.5 % + 10 counts)
60 Hz to 20 kHz..... ±(2.5 % + 15 counts)
20 kHz to 1 MHz..... ±(5 % + 20 counts)
1 MHz to 25 MHz..... ±(10 % + 20 counts)
For higher frequencies the instrument's frequency roll off starts affecting accuracy.

Accuracy, FLUKE 190-xx4
DC to 60 Hz..... ±(3 % + 10 counts)
60 Hz to 20 kHz..... ±(4 % + 15 counts)
20 kHz to 1 MHz..... ±(6 % + 20 counts)
1 MHz to 25 MHz..... ±(10 % + 20 counts)
For higher frequencies the instrument's frequency roll off starts affecting accuracy.

Amperes (AMP)

With Optional Current Probe or Current Shunt

Ranges .....same as VDC, VAC, VAC+DC

Probe Sensitivity ..... 100 µV/A, 1 mV/A, 10 mV/A, 100 mV/A, 400 mV/A, 1 V/A, 10 V/A, and 100 V/A

Accuracy .....same as VDC, VAC, VAC+DC (add current probe or current shunt accuracy)

Peak

Modes .....Max peak, Min peak, or peak-to-peak

Maximum Voltage
- with 10:1 probe ..... 1000 V
- direct (1:1)..... 300 V

Maximum Resolution
- with 10:1 probe ..... 10 mV
- direct (1:1)..... 1 mV

Full Scale Reading..... 800 counts

Accuracy
- Max peak or Min peak.....±0.2 division
- Peak-to-peak.....±0.4 division

Frequency (Hz)

Range .....1.000 Hz to full bandwidth

Full Scale Reading..... 999 counts

Accuracy
- 1 Hz to full bandwidth ..... ±(0.5 % +2 counts) (4 s/div to 10 ns/div and 10 periods on the screen).

Duty Cycle (DUTY)

Range ..... 4.0 % to 98.0 %

Resolution .....0.1 % (when period > 2 div)

Full Scale Reading .....999 counts (3-digit display)

Accuracy (logic or pulse)..... ±(0.5 % +2 counts)

Pulse Width (PULSE)

Resolution (with **GLITCH** off) ..... 1/100 division

Full Scale Reading .....999 counts

Accuracy
- 1 Hz to full bandwidth ..... ±(0.5 % +2 counts)

Vpwm

Purpose..... to measure on pulse width modulated signals, like motor drive inverter outputs

Principle ..... readings show the effective voltage based on the average value of samples over a whole number of periods of the fundamental frequency

Accuracy ..... as Vrms for sinewave signals

V/Hz

Purpose ..... to show the measured Vpwm value (see Vpwm) divided by the fundamental frequency on Variable AC Motor Speed drives.

Accuracy ..... %Vrms + %Hz

Note

AC motors are designed for use with a rotating magnetic field of constant strength. This strength depends on the applied vottage (Vpwm) divided by the fundamental frequency of the appied voltage (Hz). The nominal Volt and Hz value are shown on the motor type plate.

Power (A and B, C and D)

Power Factor..... ratio between Watts and VA
Range ..... 0.00 to 1.00

Watt ..... RMS reading of multiplication corresponding samples of input A or C (volts) and Input B or D (amperes)
Full Scale Reading ..... 999 counts

VA ..... Vrms x Arms
Full Scale Reading ..... 999 counts

VA Reactive (VAR) ..... $\sqrt{((VA)^2-W^2)}$
Full Scale Reading ..... 999 counts

Phase (A and B, C and D)

Range..... -180 to +180 degrees

Resolution ..... 1 degree

Accuracy
0.1 Hz to 1 MHz..... ±2 degrees
1 MHz to 10 MHz..... ±3 degrees

Temperature (TEMP)

With Optional Temperature Probe (℉ not for Japan)

Ranges (°C or °F)..... -40.0 to +100.0 °
-100 to +250 °
-100 to +500 °
-100 to +1000 °
-100 to + 2500 °

Probe Sensitivity..... 1 mV/°C and 1 mV/°F

Accuracy ..... ±(1.5 % + 5 counts)

(add temperature probe accuracy for overall accuracy)

Decibel (dB)

dBV ..... dB relative to one volt

dBm..... dB relative to one mW in 50 Ω or 600 Ω

dB on..... VDC, VAC, or VAC+DC

Accuracy ..... same as VDC, VAC, VAC+DC

Meter Measurements for Fluke 190-xx4

Four of the Automatic Scope Measurements as defined above may be displayed at the same time, using larger screen area for convenient reading, suppressing the scope waveform information. For specifications see Automatic scope Measurements above.

Meter Measurements for Fluke 190-xx2

The accuracy of all measurements is within ± (% of reading + number of counts) from 18 °C to 28 °C.
Add 0.1x (specific accuracy) for each °C below 18 °C or above 28 °C.

Meter Input (Banana Jacks)

Input Coupling .....DC

Frequency Response .....DC to 10 kHz (-3 dB)

Input Impedance ..... 1 MΩ (±1 %)//14 pF (±1.5 pF)

⚠ Max. Input Voltage ..... 1000 V CAT III
600 V CAT IV
(For detailed specifications, see “Safety”)

Meter Functions

Ranging.....Auto, Manual

Modes ..... Normal, Relative

General

DC Common Mode Rejection (CMRR) .....>100 dB
AC Common Mode Rejection at 50, 60, or 400 Hz .....>60 dB

Ohms (Ω)

Ranges .....500.0 Ω, 5.000 kΩ, 50.00 kΩ, 500.0 kΩ, 5.000 MΩ, 30.00 MΩ

Full Scale Reading
500 Ω to 5 MΩ.....5000 counts
30 MΩ .....3000 counts

Accuracy .....±(0.6 % +6 counts)

Measurement Current .....0.5 mA to 50 nA, ±20 % decreases with increasing ranges

Open Circuit Voltage .....<4 V

Continuity (CONT)

Beep .....<50 Ω (±30 Ω)

Measurement Current .....0.5 mA, ±20 %

Detection of shorts of .....≥1 ms

Diode

Maximum Voltage Reading .....2.8 V

Open Circuit Voltage .....<4 V

Accuracy .....±(2 % +5 counts)

Measurement Current .....0.5 mA, ±20 %

Temperature (TEMP)

With Optional Temperature Probe

Ranges (°C or °F)..... -40.0 to +100.0 °
-100.0 to +250.0 °
-100.0 to +500.0 °
-100 to +1000 °
-100 to + 2500 °

Probe Sensitivity.....1 mV/°C and 1 mV/°F

DC Voltage (VDC)

Ranges.....500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V

Full Scale Reading .....5000 counts

Accuracy .....±(0.5 % +6 counts)

Normal Mode AC Rejection at 50 or 60 Hz ±1 %.....>60 dB

AC Voltage (VAC)

Ranges.....500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V

Full Scale Reading .....5000 counts

Accuracy
15 Hz to 60 Hz.....±(1 % +10 counts)
60 Hz to 1 kHz.....±(2.5 % +15 counts)
For higher frequencies the frequency roll off of the Meter input starts affecting accuracy.

Normal Mode DC Rejection.....>50 dB

AC+DC Voltage (True RMS)

Ranges ..... 500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V

Full Scale Reading..... 5000 counts

Accuracy
DC to 60 Hz ..... ±(1 % +10 counts)
60 Hz to 1 kHz .....±(2.5 % +15 counts)
For higher frequencies the frequency roll off of the Meter input starts affecting accuracy.

All accuracies are valid if the waveform amplitude is larger than 5 % of full scale.

Amperes (AMP)

With Optional Current Probe or Current Shunt

Ranges .....same as VDC, VAC, VAC+DC

Probe Sensitivity..... 100 µV/A, 1 mV/A, 10 mV/A, 100 mV/A, 1 V/A, 10 V/A, and 100 V/A

Accuracy.....same as VDC, VAC, VAC+DC (add current probe or current shunt accuracy)

Recorder

TrendPlot (Meter or Scope)

Chart recorder that plots a graph of min and max values of Meter or Scope measurements over time.

Measurement Speed.....>5 measurements/s

Time/Div.....5 s/div to 30 min/div

Record Size (min, max, average).....19200 points

Recorded Time Span .....64 min to 546 hours

Time Reference .....time from start, time of day

Scope Record

Records scope waveforms in deep memory while displaying the waveform in Roll mode.

Source.....Input A, B, C, D

Max. Sample Speed (4 ms/div to 1 min/div).....125 MS/s

Glitch capture (4 ms/div to 2 min/div).....8 ns

Time/Div in normal mode ..... 4 ms/div to 2 min/div

Record Size .....30k points per waveform

Recorded Time Span .....4.8 s to 40 hours

Acquisition Modes ..... Single Sweep
Continuous Roll
Start/Stop on Trigger

Time Reference ..... time from start, time of day

Zoom, Replay and Cursors

Zoom

Zoom ranges from full record overview to detailed view of individual samples

Replay

Displays a maximum of 100 captured quad input Scope screens.

Replay modes ..... Step by Step, Replay as Animation

Cursor Measurements

Cursor Modes ..... single vertical cursor
dual vertical cursors
dual horizontal cursors (Scope mode)

Markers ..... automatic markers at cross points

Measurements ..... value at cursor 1
value at cursor 2
difference between values at cursor 1 and 2
time between cursors,
RMS between cursors
Time of Day (Recorder modes)
Time from Start (Recorder modes)
Rise Time, fall time
A x s (current over time between cursors)
V x s (voltage over time between cursors)
W x s (power over time between cursors using powerwaveform AxB or CxD)

Miscellaneous

Display

View Area ..... 126.8 x 88.4 mm (4.99 x 3.48 inches)

Resolution..... 320 x 240 pixels

Backlight .....LED (Temperature compensated)

Brightness..... Power Adapter: 200 cd/m^2
Battery Power: 90 cd/ m^2

Display Auto-OFF time (battery saving).....30 seconds,
5 minutes or disabled

⚠ Power

FLUKE 190-xx4, -50x: Rechargeable Li-ion Battery (model BP291):

Operating Time ..... up to 7 hours (Low Intensity)
Charging Time ..... 5 hours
Capacity/Voltage..... 52 Wh / 10.8 V

FLUKE 190-062, -102, -202: Rechargeable Li-ion Battery (model BP290):

Operating Time ..... up to 4 hours (Low Intensity)
Charging Time ..... 2.5 hours
Capacity/Voltage..... 26 Wh / 10.8 V

Rechargeable Li-ion Battery (model BP 290 and BP291):

Life Time (> 80 % capacity).....300x charge/discharge

Allowable ambient
temperature during charging: .....0 to 40 °C (32 to 104 °F)

Auto power down
time (battery saving):.....5 min, 30 min or disabled

Power Adapter BC190:

- BC190/801 European line plug 230 V ±10 %
- BC190/813 North American line plug 120 V ±10 %
- BC190/804 United Kingdom line plug 230 V ±10 %
- BC190/806 Japanese line plug 100 V ±10 %
- BC190/807 Australian line plug 230 V ±10 %
- BC190/808 Universal switchable adapter 115 V ±10 % or 230 V ±10 %, with plug EN60320-2.2G
- BC190/820 Universal adapter 100...240 V ±10 %, with plug EN60320-2.2G

Line Frequency ..... 50 and 60 Hz

Probe Calibration

Manual pulse adjustment and automatic DC adjustment with probe check

Generator Output ..... 1.225 Vpp / 500 Hz
square wave

Internal Memory

Number of Scope Memories 30
Each memory can contain 2/4 waveforms plus corresponding setups

Number of Recorder Memories 10
Each memory can contain:
- a 2/4 channel input TrendPlot
- a 2/4 channel input Scope Record
- 100 2/4 channel input Scope screens (Replay)

Number of Screen Image memories 9
Each memory can contain one screen image

External Memory

USB stick, 2GB max

Mechanical

Size ..... 265 x 190 x 70 mm (10.5 x 7.5 x 2.8 in)

Weight

FLUKE 190-xx4 ..... 2.2 kg (4.8 lbs) including battery

FLUKE 190-5xx ..... 2.2 kg (4.8 lbs) including battery

FLUKE 190-xx2 ..... 2.1 kg (4.6 lbs) including battery

Interface Ports

Two USB ports provided. Ports are fully insulated from instrument's floating measurement circuitry.

- A USB-host port directly connects to external flash memory drive ('USB-stick', ≤ 2 GB) for storage of waveform data, measurement results, instrument settings and screen copies.
- A mini-USB-B is provided which allows for interconnection to PC for remote control and data transfer using SW90W (FlukeView® software for Windows ®).
- One port can be active at the same time, therefor remote control and data transfer via mini-USB is not possible when saving or recalling data to or from the USB-stick.

Environmental

Environmental.....MIL-PRF-28800F, Class 2

Temperature
- Operating:
  - battery installed..... 0 to 40 °C (32 to 104 °F)
  - no battery installed..... 0 to 50 °C (32 to 122 °F)
- Storage .....-20 to +60 °C (-4 to +140 °F)

Humidity (Maximum Relative)
- Operating:
  - 0 to 10 °C (32 to 50 °F).....noncondensing
  - 10 to 30 °C (50 to 86 °F)..... 95 % (± 5 %)
  - 30 to 40 °C (86 to 104 °F)..... 75 % (± 5 %)
  - 40 to 50 °C (104 to 122 °F)..... 45 % (± 5 %)
- Storage:
  - -20 to +60 °C (-4 to +140 °F).....noncondensing

Altitude
- Operating:
  - CATIII 600V, CATII 1000V..... 3 km (10 000 feet)
  - CATIV 600V, CATIII 1000V..... 2 km (6 600 feet)
- Storage ..... 12 km (40 000 feet)

Vibration (Sinusoidal)..... max. 3 g

Vibration (Random)..... 0.03 g^2/Hz

Shock..... max. 30 g

Electromagnetic Environment .....EN/IEC61326-1 (Portable Equipment)

Enclosure Protection ..... IP51, ref: IEC60529

Standards

Conforms to .....

Electromagnetic Compatibility.....Applies to use in Korea only. Class A Equipment (Industrial Broadcasting & Communication Equipment) [1]

[1] This product meets requirements for industrial (Class A) electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and is not to be used in homes.

⚠ *Safety*

Designed for 1000 V Measurement Category III, 600 V Measurement Category IV (with supplied 10:1 probes) per:

- EN/IEC 61010-1, Pollution Degree 2
- EN/IEC61010-2-030
- IEC61010-031

⚠ Max. Input Voltages

BNC Input A, B, (C, D) directly ..... 300 V CAT IV

Via VPS410 ..... 1000 V CAT III
600 V CAT IV

METER/EXT banana input ..... 1000 V CAT III
600 V CAT IV

⚠ Max. Floating Voltage

FLUKE 190-xxx (test tool or test tool + VPS410)

From any terminal to earth ground ..... 1000 V CAT III
600 V CAT IV

Between any terminal ..... 1000 V CAT III
600 V CAT IV

FLUKE 190-xxx + VPS510

From any terminal to earth ground ..... 300 V CAT III

Between any terminal ..... 300 V CAT III

Voltage ratings are given as “working voltage”. They should be read as Vac-rms (50-60 Hz) for AC sinewave applications and as Vdc for DC applications.

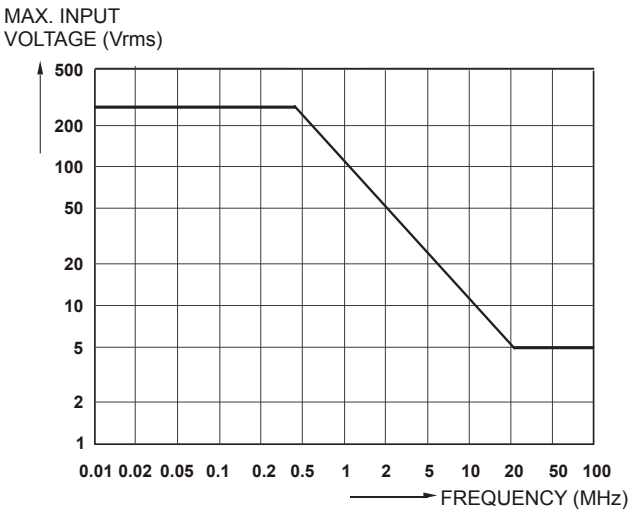


Figure 51. Max. Input Voltage vs. Frequency

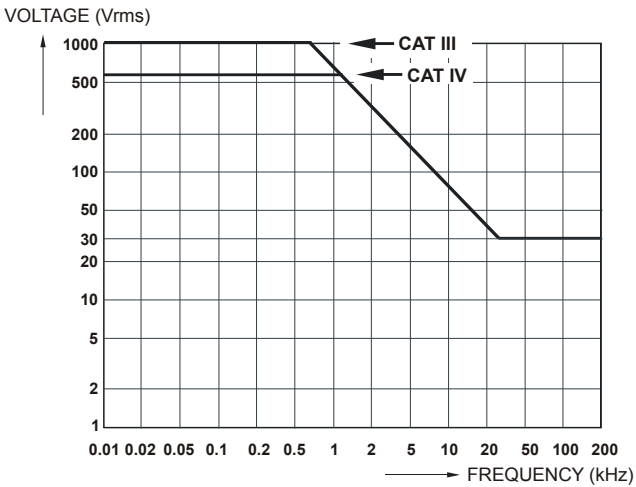


Figure 52. Safe Handling: Max. Voltage Between Scope References, and Between Scope References and earth ground.

10:1 Probe VPS410

Accuracy

Probe accuracy when adjusted on the test tool:

DC to 20 kHz.....±1 %
20 kHz to 1 MHz.....±2 %
1 MHz to 25 MHz .....±3 %

For higher frequencies the probe's roll off starts affecting the accuracy.

For further probe specifications see the instruction sheet supplied with the VPS410 probe set.

Electromagnetic Immunity

The Fluke 190 Series II test tools, including standard accessories are compliant to EN61326-1, with the addition of the following table

Scope Mode (10 ms/div: Waveform disturbance with VPS410 voltage probe shorted. (Table 3)

Table 3. (E = 3V/m)

Frequency	No Disturbance	Disturbance < 10% of full scale	Disturbance > 10% of full scale
80 MHz – 450 MHz	≥ 500 mV/d	100, 200 mV/div	2, 5, 10, 20, 50 mV/div
450 MHz – 1 GHz	All ranges		
1.4 GHz – 2 GHz	All ranges		
2 GHz – 2.7 GHz (1 V/m)	All Ranges		

Appendices

Appendix A
Installing USB Drivers

Introduction

The Fluke 190 Series II ScopeMeter® comes with a USB interface (connector: USB type “B mini”) for communication with a computer. To be able to communicate with the instrument, drivers need to be loaded onto the computer. This document describes how to install the drivers on a Windows XP computer. Installing on other Windows versions will be similar.

Drivers for Windows XP, Vista and Win 7 are available from the Windows Driver Distribution Center, and can be downloaded automatically if your computer is connected to the internet.

The drivers have passed Windows Logo Verification and are signed by Microsoft Windows Hardware Compatibility Publisher. This is required for installation on Win 7.

Note

The Fluke 190 Series II instrument requires two drivers to be loaded in sequence.

- *1st it requires installation of the Fluke 190 ScopeMeter® USB driver*
- *2nd it requires installation of the Fluke USB Serial port*

Both of these drivers need to be installed to be able to communicate with the ScopeMeter®!

Installing the USB Drivers

To install the USB drivers, do the following:

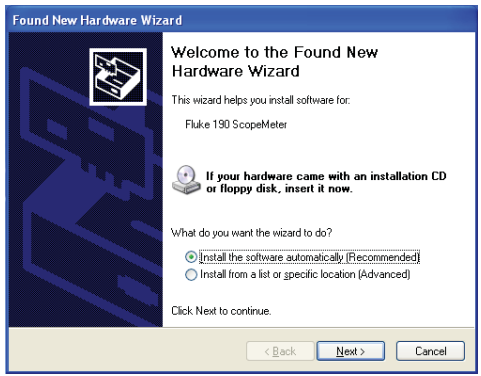
1 Connect the Fluke 190 Series II instrument to the PC. The USB cable can be plugged in and out (hot-swap) when both the computer and the instrument are on. It is not required to power off.

When there is no driver loaded for the Fluke 190 Series II instrument, Windows will show that there is New Hardware detected, and the Wizard for installing new hardware will open.

Depending on your PC settings, Windows may ask for permission to search the Windows Update Web site on the internet for the latest revision. When you have an internet connection it is advised to select “Yes” and click Next. To install drivers from the CD-ROM or from a location on the hard drive select “No, not this time”.

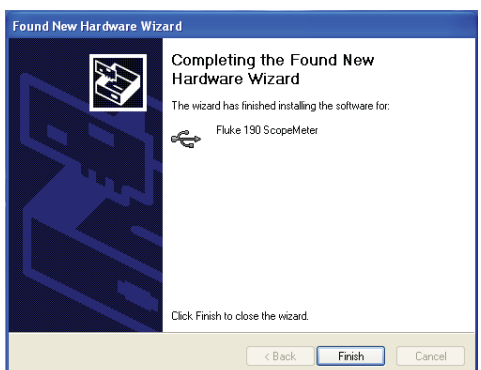
2 In the following window click ‘Next’ to install the software automatically.

Windows will download the drivers automatically from the Windows Driver Distribution Center on the internet. If there is no connection to the internet, you need to load the CD-ROM, supplied with the ScopeMeter®, which contains the drivers.



3 Follow the instructions on screen.

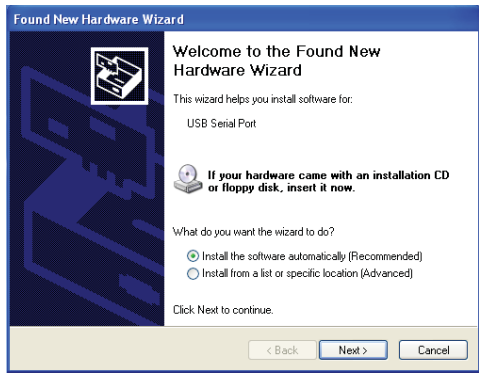
When the driver has finished installation click ‘Finish’ to complete the first step of the driver installation.



4 After completing the first step the New Hardware Wizard will start again to install the USB Serial Port Driver.

Click ‘Next’ to install the software automatically.

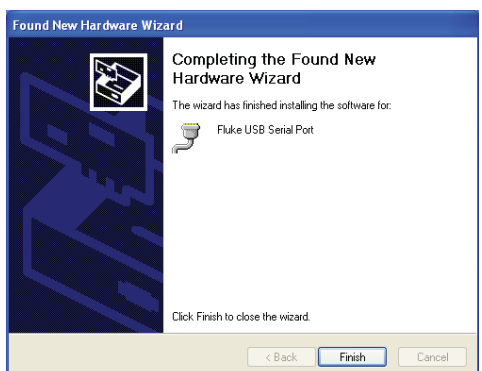
Windows will download the drivers automatically from the Windows Driver Distribution Center on the internet. If there is no connection to the internet, you need to load the CD-ROM, supplied with the ScopeMeter®, which contains the drivers.



5 Follow the instructions on screen.

When the driver finished installation click ‘Finish’ to complete the final step of the driver installation.

You are now ready to use the ScopeMeter® with FlukeView® Software SW90W from version V5.1 onwards.

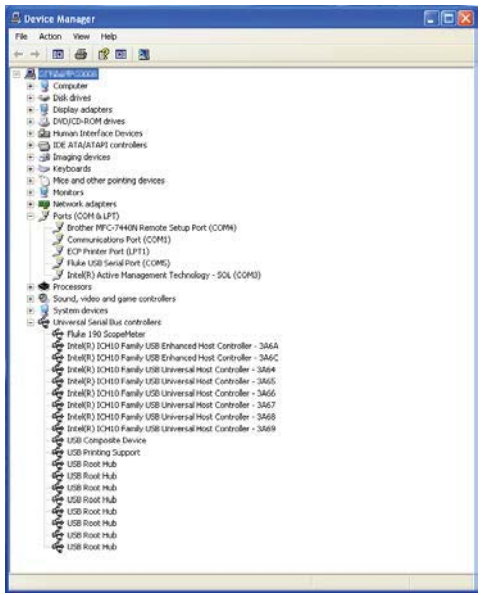


6 To check if the drivers are loaded properly, connect the ScopeMeter® 190 Series II to your computer and open the Device Manager. (See the Help file of your computer how to open the device manager for your Windows version)

From the device manager click on the + sign to Expand the 'Universal Serial Bus controllers'. The 'Fluke 190 ScopeMeter®, should be listed here.

From the device manager click on the + sign to Expand the 'Ports (COM & LPT)' Universal Serial Bus controllers. The 'Fluke USB Serial Port COM(5)' should be listed here.

Note that the COM port number may differ and is automatically assigned by Windows.



Notes

1) *Sometimes application software may require a different port number. (for example in the range Com 1..4). In this situation the COM port number can be changed manually.*
   To manually assign a different COM port number right click on 'Fluke USB Serial Port COM(5)' and select properties. From the Properties menu, select the Port Settings tab, and click 'Advanced…' to change the port number.

2) *Sometimes other applications installed on the PC automatically occupy the newly created port. On most situations it is sufficient to unplug the Fluke 190 Series II ScopeMeter® USB cable shortly and then re-connect the cable.*

Appendix B
Battery Pack MSDS

Li-ion Battery Pack

Contact Fluke for a Battery Material Safety Data Sheet (MSDS) or Compliance Information.

Table of Contents

List of Tables

List of Figures

Chapter 1
Safety Instructions

Title **Page**

Introduction

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

This section contains information, cautions, and warnings that must be followed to ensure safe operation and to keep the Test Tool in a safe condition.

⚠⚠ Warning

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

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.

Caution and Warning Statements

A **Warning** identifies hazardous conditions and procedures that are dangerous to the user. A **Caution** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

Symbols

Table 1 is a list of symbols that are used on the Test Tool, in the Users Manual, in this Service Information, or on spare parts for this Test Tool.

Table 1-1. Symbols

Symbol	Description
	Risk of Danger. Important information. See manual.
	Hazardous voltage
	Live Voltage
	Earth Ground
	DC (Direct Current)
	AC or DC (Alternating or Direct Current)
	Conforms to relevant Australian EMC standards.
	Conforms to relevant North American Safety Standards.
	Conforms to European Union directives.
	Conforms to relevant South Korean EMC Standards.
	Double Insulation
CAT III	Measurement Category III is applicable to test and measuring circuits connected to the distribution part of the building's low-voltage MAINS installation.
CAT IV	Measurement Category IV is applicable to test and measuring circuits connected at the source of the building's low-voltage MAINS installation.
 Li-ion	This product contains a Lithium-ion battery. Do not mix with the solid waste stream. Spent batteries should be disposed of by a qualified recycler or hazardous materials handler per local regulations. Contact your authorized Fluke Service Center for recycling information.
	This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 "Monitoring and Control Instrumentation" product. Do not dispose of this product as unsorted municipal waste. Go to Fluke's website for recycling information.

⚠⚠ Warning

To prevent electrical shock or fire:

- **Use only the Fluke power supply, Model BC190 (Power Adapter).**
- **Before use, check that the selected/indicated range on the BC190 matches the local line power voltage and frequency.**
- **For the BC190/808 and BC190/820 universal Power Adapters, use line cords that comply with the local safety regulations.**

Note

The BC190/808 and BC190/820 universal Power Adapters are equipped with a male plug that must be connected to a line cord appropriate for local use. The adapter is isolated so the line cord does not need to be equipped with a terminal for connection to protective ground.

⚠⚠ Warning

To prevent electrical shock or fire if a product input is connected to more than 42 V peak (30 Vrms) or 60 V dc:

- **Use only insulated voltage probes, test leads and adapters supplied with the product, or indicated by Fluke as suitable for the Fluke 190 Series II ScopeMeter® Test Tool series.**
- **Before use, inspect voltage probes, test leads, and accessories for mechanical damage and replace when damaged.**
- **Remove all probes, test leads, and accessories that are not in use.**
- **Always connect the power adapter first to the ac outlet before connecting it to the product.**
- **Do not touch voltages >30 V ac rms, 42 V ac peak, or 60 V dc.**
- **Do not connect the ground spring to voltages higher than 42 V peak (30 Vrms) from earth ground.**
- **When using the ground reference lead with any of the probes, make sure that the black isolation sleeve is over the probe tip.**
- **Do not apply more than the rated voltage, between the terminals or between each terminal and earth ground.**
- **Do not apply input voltages above the rating of the instrument. Use caution when using 1:1 test leads because the probe tip voltage will be directly transmitted to the product.**
- **Do not use exposed metal BNC or banana plug connectors. Fluke offers cables with plastic, safety designed BNC connectors suitable for the ScopeMeter® Test Tool product.**
- **Do not insert metal objects into connectors.**

- **Use the product only as specified, or the protection supplied by the product can be compromised.**
- **Carefully read all instructions.**
- **Do not use the product if it operates incorrectly.**
- **Do not use the product or its accessories in case of any damage.**
- **Disable the product or its accessories in case of any damage.**
- **Keep fingers behind the finger guards on the probes.**
- **Use only correct measurement category (CAT), voltage, and current rated probes, test leads, and adapters for the measurement.**
- **Do not exceed the Measurement Category (CAT) rating of the lowest rated individual component of a product, probe, or accessory.**
- **Do not use the product around explosive gas, vapor, or in damp or wet environments.**
- **Measure a known voltage first to make sure that the product operates correctly.**
- **Examine the case before you use the product. Look for cracks or missing plastic. Carefully look at the insulation around the terminals.**
- **Do not work alone.**
- **Comply with local and national safety codes. Use personal protective equipment (approved rubber gloves, face protection, and flame resistant clothes) to prevent shock and arc blast injury where hazardous live conductors are exposed.**
- **The battery door must be closed and locked before you operate the product.**
- **Do not operate the product with covers removed or the case open. Hazardous voltage exposure is possible.**
- **Remove the input signals before you clean the product.**
- **Use only specified replacement parts.**
- **Use of the product in a manner not specified may impair the protection provided by the equipment.**
- **Do not use test leads if they are damaged. Examine the test leads for damaged insulation, exposed metal, or if the wear indicator shows.**

Voltage ratings that are mentioned in the warnings are given as limits for “working voltage”. They represent V ac rms (50-60 Hz) for ac sinewave applications and as Vdc for dc applications.

The terms ‘Isolated’ or ‘Electrically floating’ are used in this manual to indicate a measurement in which the product input BNC is connected to a voltage different from earth ground.

The isolated input connectors have no exposed metal and are fully insulated to protect against electrical shock.

The BNC jacks can independently be connected to a voltage above earth ground for isolated (electrically floating) measurements and are rated up to 1000 Vrms CAT III and 600 Vrms CAT IV above earth ground.

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

Li-ion Battery Pack

The battery pack has been tested in accordance with the UN Manual of Tests and Criteria Part III Subsection 38.3 (ST/SG/AC.10/11/Rev.3) – more commonly known as the UN T1..T8 – tests, and have been found to comply with the stated criteria.

The battery pack has been tested to EN/IEC62133.

Safe Storage of Battery Pack

⚠⚠ Warning

To prevent electrical shock or fire:

- **Do not store battery packs near heat or fire. Do not store in sunlight.**
- **Do not remove a battery pack from its original packaging until ready to use.**
- **When possible, remove the battery pack from the equipment when not in use.**
- **Fully charge the battery pack before storing it for an extended period to avoid a defect.**
- **After extended periods of storage, it may be necessary to charge and discharge the battery packs several times to obtain maximum performance.**
- **Keep the battery pack out of the reach of children and animals.**
- **Seek medical advice if a battery or part of it has been swallowed.**

Safe Use of Battery Pack

⚠⚠ Warning

To prevent electrical shock or fire:

- **The battery pack needs to be charged before use. Use only Fluke approved power adapters to charge the battery pack. Refer to Fluke's safety instructions and Users Manual for proper charging instructions.**
- **Do not leave a battery on prolonged charge when not in use.**
- **The battery pack gives the best performance when operated at normal room temperature 20 °C ±5 °C (68 °F ±9 °F).**
- **Do not put battery packs near heat or fire. Do not put in sunlight.**
- **Do not subject battery packs to severe impacts such as mechanical shock.**
- **Keep the battery pack clean and dry. Clean dirty connectors with a dry, clean cloth.**
- **Do not use any charger other than that specifically provided for use with this equipment.**
- **Do not use any battery which is not designed or recommended by Fluke for use with the Product.**
- **Take careful notice of correct placement of the battery in the product or the External Battery Charger.**
- **Do not short-circuit a battery pack. Do not keep battery packs in a place where the terminals can be shorted by metal objects (for example, coins, paperclips, pens or other).**
- **Never use a battery pack or charger showing visible damage.**
- **Batteries contain hazardous chemicals that can cause burns or explode. If exposure to chemicals occurs, clean with water and get medical aid. Repair the product before use if the battery leaks.**
- **Do not open, modify, reform, or repair a battery pack that appears to malfunction or has been physically damaged.**
- **Do not disassemble or crush battery packs.**
- **Use the battery only as intended for the application.**
- **Retain the original product information for future reference.**

Safe Transport of Battery Pack

- The battery pack must be protected against short-circuit or damage during transport.
- Always consult the IATA guidelines describing safe air transport of Li-ion batteries. Refer also to the section in the beginning of this paragraph on safe use of the battery pack.
- Check-in luggage: battery packs are only allowed when installed in the Product.
- Hand-carry luggage: a number of battery packs as required for normal and individual use is allowed.
- Always consult national/local guidelines that are applicable for shipment by mail or other transporters.
- A maximum of three battery packs may be shipped by mail. The package must be marked as follows: PACKAGE CONTAINS LITHIUM-ION BATTERIES (NO LITHIUM METAL).

Safe Disposal of Battery Pack

- A failed battery pack shall be properly disposed of in accordance with local regulations.
- Properly dispose of the battery pack. Do not dispose of the battery as unsorted municipal waste.
- Dispose in discharged condition and cover the battery terminals with isolation tape.

Chapter 2
Specifications

Title **Page**

Introduction

Specifications are subject to change without notification.

Oscilloscope

Isolated Inputs A, B, C and D (Vertical)

Number of Channels
- Fluke 190-xx2 ..... 2 (A, B)
- Fluke 190-xx4 ..... 4 (A, B, C, D)

Bandwidth, DC Coupled
- Fluke 190-50x ..... 500 MHz (-3 dB)
- Fluke 190-2xx ..... 200 MHz (-3 dB)
- Fluke 190-1xx ..... 100 MHz (-3 dB)
- Fluke 190-062 ..... 60 MHz (-3 dB)

Lower Frequency Limit, AC Coupled
- with 10:1 probe ..... <2 Hz (-3 dB)
- direct (1:1) ..... <5 Hz (-3 dB)

Rise Time
- Fluke 190-50x ..... 0.7 ns
- Fluke 190-2xx ..... 1.7 ns
- Fluke 190-1xx ..... 3.5 ns
- Fluke 190-062 ..... 5.8 ns

Analog Bandwidth Limiters ..... 20 MHz, 20 kHz, and 10 kHz (varies according to version)

Input Coupling ..... AC, DC

Polarity ..... Normal, Inverted

Sensitivity Ranges
- with 10:1 probe ..... 20 mV to 1000 V/div
- direct (1:1) ..... 2 mV to 100 V/div

Dynamic Range ..... > ±8 div (<10 MHz)
> ±4 div (>10 MHz)

Waveform Positioning Range ..... ±4 divisions

Input Impedance on BNC, DC Coupled
- 4-channel models ..... 1 MΩ (±1 %)//14 pF (±2.25 pF)
- 2-channel models ..... 1 MΩ (±1 %)//15 pF (±2.25 pF)

Vertical Accuracy ..... ±(2.1 % + 0.04 range/div)
- 2 mV/div ..... ±(2.9 % + 0.08 range/div)

Digitizer Resolution ..... 8 bits, separate digitizer for each input

Horizontal

Minimum Time Base Speed
(Scope Record)..... 2 min/div
Real Time Sampling Rate
Fluke 190-50x:
5 ns to 4 µs/div (3 or 4 channels)..... up to 1.25 GS/s
2 ns to 4 µs/div (2 channels)..... up to 2.5 GS/s
1 ns to 4 µs/div (1 channel)..... up to 5 GS/s
10 µs to 120 s/div..... 125 MS/s
Fluke 190-202, -204:
2 ns to 4 µs/div (1 or 2 channels)..... up to 2.5 GS/s
5 ns to 4 µs/div (3 or 4 channels)..... up to 1.25 GS/s
10 µs to 120 s/div..... 125 MS/s
Fluke 190-102, -104:
5 ns to 4 µs/div (all channels)..... up to 1.25 GS/s
10 µs to 120 s/div..... 125 MS/s
Fluke 190-062:
10 ns to 4 µs/div (all channels)..... up to 625 MS/s
10 µs to 120 s/div..... 125 MS/s
Glitch Detection
4 µs to 120 s/div..... displays glitches as fast as 8 ns
Waveform Display..... A, B, C, D, Math (+, -, x, X-Y mode, spectrum) Normal, Average, Persistence, Reference
Time Base Accuracy..... ±(100 ppm + 0.04 div)
Record Length (all models): see table that follows.

Record Length (all models, Samples/points per input)

Mode	Glitch Detect On	Glitch Detect Off	Max. Sample Rate
Scope - Normal	300 min/max pairs	3 k true samples compressed into 1 screen (300 samples per screen)	190-062: 625 MS/s 190-102/104: 1.25 GS/s 190-202/204: 2.5 GS/s (1 or 2 channels on) 190-204: 1.25 GS/s (3 or 4 channels on) 190-50x: 5 GS/s (1 channel on) 190-50x: 2.5 GS/s (2 channels on) 190-504: 1.25 GS/s (3 or 4 channels on)
Scope - Fast	300 min/max pairs	-	
Scope - Full	300 min/max pairs	10 k true samples, compressed into 1 screen. Use Zoom and Scroll to see waveform details	
Scope Record Roll		30 k samples	4x 125 MS/s
Trend Plot		>18 k min/max/average values/measurement	Up to 5 measurements/second

Trigger and Delay

Trigger Modes..... Automatic, Edge, Video, Pulse Width, N-Cycle, External (190-xx2)
Trigger Delay..... up to +1200 divisions
Pre-Trigger View..... one full screen length
Delay..... -12 div to +1200 div
Max. Delay..... 48 s at 4 s/div

Automatic Connect-and-View Trigger

Source..... A, B, C, D
EXT (190-xx2)
Slope..... Positive, Negative, Dual

Edge Trigger

Screen Update ..... Free Run, On Trigger, Single Shot
Source ..... A, B, C, D, EXT (190-xx2)
Slope ..... Positive, Negative, Dual
Trigger Level Control Range ..... ±4 divisions
Trigger Sensitivity
- DC to 5 MHz at >5 mV/div ..... 0.5 division
- DC to 5 MHz at 2 mV/div and 5 mV/div ..... 1 division
- 500 MHz (Fluke 190-50x) ..... 1 division
- 200 MHz (Fluke 190-2xx) ..... 1 division
- 100 MHz (Fluke 190-1xx) ..... 1 division
- 60 MHz (Fluke 190-062) ..... 1 division

Isolated External Trigger (190-xx2)

Bandwidth ..... 10 kHz
Modes ..... Automatic, Edge
Trigger Levels (DC to 10 kHz) ..... 120 mV, 1.2 V

Video Trigger

Standards ..... PAL, PAL+, NTSC, SECAM, Non-interlaced
Modes ..... Lines, Line Select, Field 1 or Field 2
Source ..... A
Polarity ..... Positive, Negative
Sensitivity ..... 0.7 division sync level

Pulse Width Trigger

Screen Update ..... On Trigger, Single Shot
Trigger Conditions ..... <T, >T, =T (±10 %), ≠T(±10 %)
Source ..... A
Polarity ..... Positive or negative pulse
Pulse Time Adjustment Range ..... 0.01 div. to 655 div. with a minimum of 300 ns (<T, >T) or 500 ns (=T, ≠T), a maximum of 10 s, and a resolution of 0.01 div. with a minimum of 50 ns

Continuous Auto Set

Autoranging attenuators and time base, automatic Connect-and-View™ triggering with automatic source selection.
Modes
- Normal ..... 15 Hz to max. bandwidth
- Low Frequency ..... 1 Hz to max. bandwidth

Minimum Amplitude A, B, C, D
- DC to 1 MHz ..... 10 mV
- 1 MHz to max. bandwidth ..... 20 mV

Automatic Capturing Scope Screens

Capacity ..... 100 Scope Screens
For viewing screens, see Replay function.

Automatic Scope Measurements

The accuracy of all readings is within ± (% of reading + number of counts) from 18 °C to 28 °C. Add 0.1x (specific accuracy) for each °C below 18 °C or above 28 °C. For voltage measurements with 10:1 probe, add probe accuracy. At least 1.5 waveform period must be visible on the screen.

General

Inputs ..... A, B, C and D
DC Common Mode Rejection (CMRR) ..... >100 dB
AC Common Mode Rejection at
50, 60, or 400 Hz ..... >60 dB

DC Voltage (VDC)

Maximum Voltage
- with 10:1 probe ..... 1000 V
- direct (1:1) ..... 300 V

Maximum Resolution
- with 10:1 probe ..... 1 mV
- direct (1:1) ..... 100 µV

Full Scale Reading ..... 999 counts

Accuracy at 4 s to 10 µs/div, Fluke 190-xx2
- 2 mV/div ..... ±(1.5 % + 10 counts)
- 5 mV/div to 100 V/div ..... ±(1.5 % + 6 counts)

Accuracy at 4 s to 10 µs/div, Fluke 190-xx4
- 2 mV/div ..... ±(3 % + 10 counts)
- 5 mV/div to 100 V/div ..... ±(3 % + 6 counts)

Normal Mode AC Rejection
at 50 or 60 Hz ..... >60 dB

AC Voltage (VAC)

Maximum Voltage
- with 10:1 probe ..... 1000 V
- direct (1:1) ..... 300 V

Maximum Resolution
- with 10:1 probe ..... 1 mV
- direct (1:1) ..... 100 µV

Full Scale Reading ..... 999 counts

Accuracy, Fluke 190-xx2
- DC coupled:
  - DC to 60 Hz ..... ±(1.5 % +10 counts)
- AC coupled, low frequencies:
  - 50 Hz direct (1:1) ..... ±(1.5 % + 10 counts) –0.6 %
  - 60 Hz direct (1:1) ..... ±(1.5 % + 10 counts) –0.4 %
  - With the 10:1 probe the low frequency roll-off point will be lowered to 2 Hz, which improves the AC accuracy for low frequencies. When possible use DC coupling for maximum accuracy.
- AC or DC coupled, high frequencies:
  - 60 Hz to 20 kHz ..... ±(2.5 % + 15 counts)
  - 20 kHz to 1 MHz ..... ±(5 % + 20 counts)
  - 1 MHz to 25 MHz ..... ±(10 % + 20 counts)
  - For higher frequencies the instrument's frequency roll-off starts affecting accuracy.

Accuracy, Fluke 190-xx4

DC coupled:

DC to 60 Hz.....±(3 % +10 counts)

AC coupled, low frequencies:

50 Hz direct (1:1).....±(3 % + 10 counts) –0.6 %

60 Hz direct (1:1).....±(3 % + 10 counts) –0.4 %

With the 10:1 probe the low frequency roll-off point will be lowered to 2 Hz, which improves the AC accuracy for low frequencies. When possible use DC coupling for maximum accuracy.

AC or DC coupled, high frequencies:

60 Hz to 20 kHz.....±(4 % + 15 counts)

20 kHz to 1 MHz.....±(6 % + 20 counts)

1 MHz to 25 MHz.....±(10 % + 20 counts)

For higher frequencies the instrument's frequency roll-off starts affecting accuracy.

Normal Mode DC Rejection.....>50 dB

All accuracies are valid if:

- The waveform amplitude is larger than one division
- At least 1.5 waveform period is on the screen

AC+DC Voltage (True RMS)

Maximum Voltage

with 10:1 probe.....1000 V

direct (1:1).....300 V

Maximum Resolution

with 10:1 probe.....1 mV

direct (1:1).....100 µV

Full Scale Reading ..... 1100 counts

Accuracy, Fluke 190-xx2

DC to 60 Hz.....±(1.5 % + 10 counts)

60 Hz to 20 kHz.....±(2.5 % + 15 counts)

20 kHz to 1 MHz.....±(5 % + 20 counts)

1 MHz to 25 MHz.....±(10 % + 20 counts)

For higher frequencies the instrument's frequency roll-off starts affecting accuracy.

Accuracy, Fluke 190-xx4

DC to 60 Hz.....±(3 % + 10 counts)

60 Hz to 20 kHz.....±(4 % + 15 counts)

20 kHz to 1 MHz.....±(6 % + 20 counts)

1 MHz to 25 MHz.....±(10 % + 20 counts)

For higher frequencies the instrument's frequency roll-off starts affecting accuracy.

Amperes (AMP)

With Optional Current Probe or Current Shunt

Ranges .....same as VDC, VAC, VAC+DC

Probe Sensitivity.....100 µV/A, 1 mV/A, 10 mV/A, 100 mV/A, 400 mV/A, 1 V/A, 10 V/A, and 100 V/A

Accuracy.....same as VDC, VAC, VAC+DC (add current probe or current shunt accuracy)

Peak

Modes ..... Max peak, Min peak, or peak-to-peak
Maximum Voltage
  with 10:1 probe ..... 1000 V
  direct (1:1)..... 300 V
Maximum Resolution
  with 10:1 probe ..... 10 mV
  direct (1:1)..... 1 mV
Full Scale Reading..... 800 counts
Accuracy
  Max peak or Min peak..... ±0.2 division
  Peak-to-peak ..... ±0.4 division

Frequency (Hz)

Range ..... 1.000 Hz to full bandwidth
Full Scale Reading..... 999 counts
Accuracy
  1 Hz to full bandwidth..... ±(0.5 % +2 counts) (4 s/div to 10 ns/div and 10 periods on the screen)

Duty Cycle (DUTY)

Range ..... 4.0 % to 98.0 %
Resolution..... 0.1 % (when period >2 div)
Full Scale Reading..... 999 counts (3-digit display)
Accuracy (logic or pulse) ..... ±(0.5 % +2 counts)

Pulse Width (PULSE)

Resolution (with **GLITCH** off) ..... 1/100 division
Full Scale Reading..... 999 counts
Accuracy
  1 Hz to full bandwidth..... ±(0.5 % +2 counts)

Vpwm

Purpose: to measure on pulse width modulated signals, like motor drive inverter outputs
Principle: readings show the effective voltage based on the average value of samples over a whole number of periods of the fundamental frequency
Accuracy: as V_{rms} for sinewave signals

V/Hz

Purpose: to show the measured Vpwm value (see Vpwm) divided by the fundamental frequency on Variable AC Motor Speed drives.
Accuracy: % Vrms + % Hz

Note

AC motors are designed for use with a rotating magnetic field of constant strength. This strength depends on the applied voltage (Vpwm) divided by the fundamental frequency of the applied voltage (Hz). The nominal Volt and Hz values are shown on the motor type plate.

Power (A and B, C and D)

Power Factor ..... ratio between Watts and VA
Range ..... 0.00 to 1.00
Watt ..... RMS reading of multiplication corresponding samples of input A or C (volts) and Input B or D (amperes)
Full Scale Reading ..... 999 counts
VA ..... Vrms x Arms
Full Scale Reading ..... 999 counts
VA Reactive (VAR) ..... $\sqrt{((VA)^2-W^2)}$
Full Scale Reading ..... 999 counts

Phase (A and B, C and D)

Range ..... -180 to +180 degrees
Resolution ..... 1 degree
Accuracy
0.1 Hz to 1 MHz ..... ±2 degrees
1 MHz to 10 MHz ..... ±3 degrees

Temperature (TEMP)

With Optional Temperature Probe (°F not for Japan)

Ranges (°C or °F) ..... -40.0 to +100.0 °
-100 to +250 °
-100 to +500 °
-100 to +1000 °
-100 to +2500 °
Probe Sensitivity ..... 1 mV/°C and 1 mV/°F
Accuracy ..... ±(1.5 % + 5 counts) (add temperature probe accuracy for overall accuracy)

Decibel (dB)

dBV ..... dB relative to one volt
dBm ..... dB relative to one mW in 50 Ω or 600 Ω
dB on ..... VDC, VAC, or VAC+DC
Accuracy ..... same as VDC, VAC, VAC+DC

Meter Measurements for Fluke 190-xx4

Four of the Automatic Scope Measurements as defined above may be displayed at the same time, using larger screen area for convenient reading, suppressing the scope waveform information. For specifications see Automatic Scope Measurements above.

Meter Measurements for Fluke 190-xx2

The accuracy of all measurements is within ± (% of reading + number of counts) from 18 °C to 28 °C.

Add 0.1x (specific accuracy) for each °C below 18 °C or above 28 °C.

Meter Input (Banana Jacks)

Input Coupling	DC
Frequency Response	DC to 10 kHz (-3 dB)
Input Impedance	1 MΩ (±1 %)//14 pF (±1.5 pF)
⚠ Max. Input Voltage	1000 V CAT III 600 V CAT IV (For detailed specifications, see “Safety”)

Meter Functions

Ranging	Auto, Manual
Modes	Normal, Relative

General

DC Common Mode Rejection (CMRR)	>100 dB
AC Common Mode Rejection at 50, 60, or 400 Hz	>60 dB

Ohms (Ω)

Ranges	500.0 Ω, 5.000 kΩ, 50.00 kΩ, 500.0 kΩ, 5.000 MΩ, 30.00 MΩ
Full Scale Reading	
500 Ω to 5 MΩ	5000 counts
30 MΩ	3000 counts
Accuracy	±(0.6 % +6 counts)
Measurement Current	0.5 mA to 50 nA, ±20 % decreases with increasing ranges
Open Circuit Voltage	<4 V

Continuity (CONT)

Beep	<50 Ω (±30 Ω)
Measurement Current	0.5 mA, ±20 %
Detection of shorts of	≥1 ms

Diode

Maximum Voltage Reading	2.8 V
Open Circuit Voltage	<4 V
Accuracy	±(2 % +5 counts)
Measurement Current	0.5 mA, ±20 %

Temperature (TEMP)

With Optional Temperature Probe

Ranges (°C or °F)	-40.0 to +100.0 ° -100.0 to +250.0 ° -100.0 to +500.0 ° -100 to +1000 ° -100 to +2500 °
Probe Sensitivity	1 mV/°C and 1 mV/°F

DC Voltage (VDC)

Ranges ..... 500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V
Full Scale Reading ..... 5000 counts
Accuracy ..... ±(0.5 % +6 counts)
Normal Mode AC Rejection at
50 or 60 Hz ±1 % ..... >60 dB

AC Voltage (VAC)

Ranges ..... 500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V
Full Scale Reading ..... 5000 counts
Accuracy
- 15 Hz to 60 Hz ..... ±(1 % +10 counts)
- 60 Hz to 1 kHz ..... ±(2.5 % +15 counts)

For higher frequencies the frequency roll-off of the Meter input starts affecting accuracy.
Normal Mode DC Rejection ..... >50 dB

AC+DC Voltage (True RMS)

Ranges ..... 500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V
Full Scale Reading ..... 5000 counts
Accuracy
- DC to 60 Hz ..... ±(1 % +10 counts)
- 60 Hz to 1 kHz ..... ±(2.5 % +15 counts)
- For higher frequencies the frequency roll-off of the Meter input starts affecting accuracy.
- All accuracies are valid if the waveform amplitude is larger than 5 % of full scale.

Amperes (AMP)

With Optional Current Probe or Current Shunt
Ranges ..... same as VDC, VAC, VAC+DC
Probe Sensitivity ..... 100 µV/A, 1 mV/A, 10 mV/A, 100 mV/A, 1 V/A, 10 V/A, and 100 V/A
Accuracy ..... same as VDC, VAC, VAC+DC (add current probe or current shunt accuracy)

Recorder

TrendPlot (Meter or Scope)

Chart recorder that plots a graph of min and max values of Meter or Scope measurements over time.
Measurement Speed ..... >5 measurements/s
Time/div ..... 5 s/div to 30 min/div
Record Size (min, max, average) ..... 19200 points
Recorded Time Span ..... 64 min to 546 hours
Time Reference ..... time from start, time of day

Scope Record

Records scope waveforms in deep memory while displaying the waveform in Roll mode.

Source..... Input A, B, C, D

Max. Sample Speed
(4 ms/div to 1 min/div)..... 125 MS/s

Glitch capture (4 ms/div to 2 min/div)..... 8 ns

Time/Div in normal mode..... 4 ms/div to 2 min/div

Record Size ..... 30 k points per waveform

Recorded Time Span..... 4.8 s to 40 hours

Acquisition Modes..... Single Sweep, Continuous Roll, Start/Stop on Trigger

Time Reference ..... time from start, time of day

Zoom, Replay and Cursors

Zoom

Zoom ranges from full record overview to detailed view of individual samples

Replay

Displays a maximum of 100 captured quad input Scope screens.

Replay modes..... Step by Step, Replay as Animation

Cursor Measurements

Cursor Modes ..... single vertical cursor, dual vertical cursors, dual horizontal cursors (Scope mode)

Markers..... automatic markers at cross points

Measurements:

- value at cursor 1
- value at cursor 2
- difference between values at cursor 1 and 2
- time between cursors
- RMS between cursors
- Time of Day (Recorder modes)
- Time from Start (Recorder modes)
- Rise Time, fall time
- A x s (current over time between cursors)
- V x s (voltage over time between cursors)
- W x s (power over time between cursors using powerwaveform AxB or CxD)

Miscellaneous

Display

View Area..... 126.8 mm x 88.4 mm (4.99 in x 3.48 in)

Resolution..... 320 pixels x 240 pixels

Backlight ..... LED (Temperature compensated)

Brightness..... Power Adapter: 200 cd/m^2
Battery Power: 90 cd/ m^2

Display Auto-OFF time (battery saving)..... 30 seconds, 5 minutes or disabled

⚠ Power

Fluke 190-xx4, -50x: Rechargeable Li-ion Battery (model BP291):

Operating Time .....up to 7 hours (Low Intensity)
Charging Time.....5 hours
Capacity/Voltage .....52 Wh / 10.8 V

Fluke 190-062, -102, -202: Rechargeable Li-ion Battery (model BP290):

Operating Time.....up to 4 hours (Low Intensity)
Charging Time.....2.5 hours
Capacity/Voltage .....26 Wh / 10.8 V

Rechargeable Li-ion Battery (model BP 290 and BP291):

Life Time (>80 % capacity).....300 x charge/discharge
Allowable ambient temperature during charging..... 0 °C to 40 °C (32 °F to 104 °F)
Auto power down time (battery saving) .....5 min, 30 min or disabled

Power Adapter BC190:

- BC190/801 European line plug 230 V ±10 %
- BC190/813 North American line plug 120 V ±10 %
- BC190/804 United Kingdom line plug 230 V ±10 %
- BC190/806 Japanese line plug 100 V ±10 %
- BC190/807 Australian line plug 230 V ±10 %
- BC190/808 Universal switchable adapter 115 V ±10 % or 230 V ±10 %, with plug EN60320-2.2G
- BC190/820 Universal adapter 100...240 V ±10 %, with plug EN60320-2.2G

Line Frequency.....50 Hz and 60 Hz

Probe Calibration

Manual pulse adjustment and automatic DC adjustment with probe check

Generator Output .....1.225 Vpp / 500 Hz square wave

Internal Memory

Number of Scope Memories.....up to 30 (varies according to version)
Each memory can contain 2/4 waveforms plus corresponding setups

Number of Recorder Memories.....10

Each memory can contain:

- 2/4 channel input TrendPlot
- 2/4 channel input Scope Record
- 100 2/4 channel input Scope screens (Replay)

Number of Screen Image memories 9

Each memory can contain one screen image

External Memory

USB stick, 2GB max

Mechanical

Size .....265 mm x 190 mm x 70 mm (10.5 in x 7.5 in x 2.8 in)

Weight

Fluke 190-xx4.....2.2 kg (4.8 lb) including battery
Fluke 190-5xx.....2.2 kg (4.8 lb) including battery
Fluke 190-xx2.....2.1 kg (4.6 lb) including battery

Interface Ports

Two USB ports provided. Ports are fully insulated from instrument's floating measurement circuitry:

- A USB-host port directly connects to external flash memory drive ('USB-stick', ≤2 GB) for storage of waveform data, measurement results, instrument settings and screen copies.
- A mini-USB-B is provided which allows for interconnection to PC for remote control and data transfer using SW90W (FlukeView® software for Windows ®).
- One port can be active at the same time, so remote control and data transfer via mini-USB is not possible when saving or recalling data to or from the USB-stick.

Environmental

Environmental	MIL-PRF-28800F, Class 2
Temperature	
Operating	0 °C to 50 °C (32 °F to 122 °F)
Operating and charging	0 °C to 40 °C (32 °F to 104 °F)
Storage	-20 °C to +60 °C (-4 °F to +140 °F)
Humidity (Maximum Relative)	
Operating	
0 °C to 10 °C (32 °F to 50 °F)	noncondensing
10 °C to 30 °C (50 °F to 86 °F)	95 % (± 5 %)
30 °C to 40 °C (86 °F to 104 °F)	75 % (± 5 %)
40 °C to 50 °C (104 °F to 122 °F)	45 % (± 5 %)
Storage	
-20 °C to +60 °C (-4 °F to +140 °F)	noncondensing
Altitude	
Operating	
CATIII 600 V, CATII 1000 V	3 km (10,000 feet)
CATIV 600 V, CATIII 1000 V	2 km (6,600 feet)
Storage	12 km (40,000 feet)
Vibration (Sinusoidal)	max. 3 g
Vibration (Random)	0.03 g^2/Hz
Shock	max. 30 g
Electromagnetic Environment	EN/IEC61326-1(Portable Equipment)
Enclosure Protection	IP51, ref: IEC60529

Certifications

Conforms to ..... CE C SP US N10140

Safety

Designed for 1000 V Measurement Category III, 600 V Measurement Category IV (with supplied 10:1 probes) in accordance with:

- EN/IEC 61010-1, Pollution Degree 2
- EN/IEC 61010-2-030
- IEC 61010-031

⚠ Max. Input Voltages

BNC Input A, B, (C, D) directly	300 V CAT IV
Via VPS410	1000 V CAT III, 600 V CAT IV
METER/EXT banana input	1000 V CAT III, 600 V CAT IV

⚠ Max. Floating Voltage

Fluke 190-xxx (test tool or test tool + VPS410)

From any terminal to earth ground.....1000 V CAT III, 600 V CAT IV

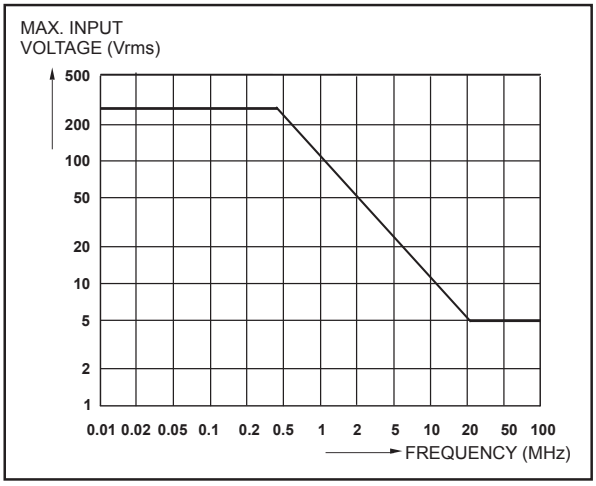
Between any terminal.....1000 V CAT III, 600 V CAT IV

Fluke 190-xxx + VPS510

From any terminal to earth ground.....300 V CAT III

Between any terminal.....300 V CAT III

Voltage ratings are given as “working voltage”. They should be read as Vac-rms (50-60 Hz) for AC sinewave applications and as Vdc for DC applications.



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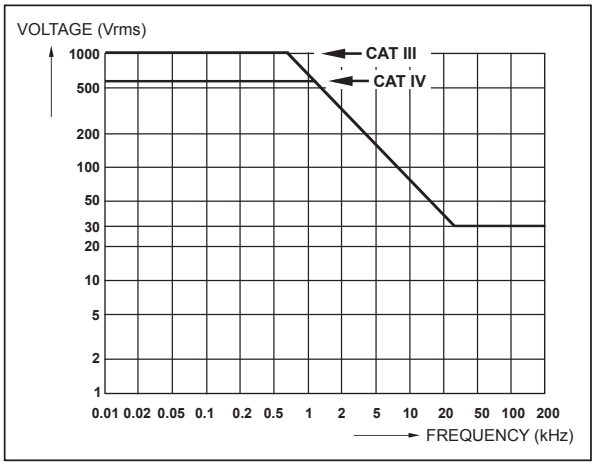
Max. Input Voltage vs. Frequency



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Safe Handling: Max. Voltage between Scope References, and between Scope References and Earth Ground

10:1 Probe VPS410

Accuracy

Probe accuracy when adjusted on the test tool:

DC to 20 kHz..... ±1 %
20 kHz to 1 MHz ..... ±2 %
1 MHz to 25 MHz ..... ±3 %

For higher frequencies the probe's roll-off starts affecting the accuracy.

For further probe specifications see the instruction sheet supplied with the VPS410 probe set.

Electromagnetic Immunity

The Fluke 190 Series II test tools, including standard accessories are compliant to EN 61326-1, with the addition of the table that follows.

Scope Mode (10 ms/div: Waveform disturbance with VPS410 voltage probe shorted (see table below).

(E = 3V/m)

Frequency	No Disturbance	Disturbance <10 % of full scale	Disturbance >10 % of full scale
80 MHz – 450 MHz	≥500 mV/d	100, 200 mV/div	2, 5, 10, 20, 50 mV/div
450 MHz – 1 GHz	All ranges		
1.4 GHz – 2 GHz	All ranges		
2 GHz – 2.7 GHz (1 V/m)	All Ranges		

Chapter 3
Parts List

Introduction

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

The parts list shows:

- Description
- Ordering code

⚠ Caution

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

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

Final Assembly Parts

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

⚠ Caution

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

Table 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 (excluding lens/decal) 4 channel	3-3 / 5
		Dust seal long (2x)	3-3 / 3
		Dust seal 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 / 16
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 / 16
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 / 14
Lens/decal 190-102	4035372	---	3-3 / 14
Lens/decal 190-104	3981826	---	3-3 / 14
Lens/decal 190-202	4035324	---	3-3 / 14
Lens/decal 190-204	3981832	---	3-3 / 14
Lens/decal 190-502	4035385		3-3 / 14
Lens/decal 190-504	4534710		3-3 / 14
LCD assy Flk-190-II	3981844	LCD module LCD fixation foam Flat cable	3-3 / 1 3-3 / 2 3-3 / 3
Top holster (Input Cover 2 channels + meter)	4035397	---	3-1 / 1
Top holster (Input Cover 4 channels)	3945328	---	3-1 / 1
Sealing strip (flexible) around inputs	3945319	Set of 2: 1 pce. for 4 channel + 1 pce. for 2 channel instruments	3-1 / 11

Table 3-1. Final Assembly Parts and Kits (cont.)

Part or Kit	Ordering Code	Consists of Following Parts	Figure/Item nr
Mounting Material Set	3981859	Self tapping 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
		Self tapping Screw 16.5 mm (4x, to fix Rear Case)	3-1 / 6
		Screw M3x6 (2x, to fix bottom holster)	3-1 / 8
		Self tapping 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 on Top Side of Instrument	---
Bottom Holster Set	3981867	Bottom holster assy	3-1 / 7
		Cover for USB	3-1 / 9
		Cover for DC adapter power	3-1 / 10
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, 500 MHz	4306959	X1100[1]	
BNC Connector Blue, 500 MHz	4306967	X1300[1]	
BNC Connector Gray, 500 MHz	4306971	X1400[1]	
BNC Connector Green, 500 MHz	4306980	X1200[1]]	
BNC Connector Black, 500 MHz	4306998		---
BNC Connector Red, 200 MHz	3945031	X1100[2]	
BNC Connector Green, 200 MHz	3945068	X1200[2]	
BNC Connector Blue, 200 MHz	3945046	X1300[2]	---
BNC Connector Gray, 200 MHz	3945054	X1400[2]	---
Banana Jack Black	4035403	X 1501	---
Banana Jack Red	4035415	X 1500	---
DC Power Input Socket	215785	X9100	---

[1] Later PCA sub code 5

[2] Early PCA sub code 2 or firmware version ≤10.

Check that the serial number is ≥25375604. If yes, use the later connectors. If <25375604, evaluate the firmware and subversion. To find the version, press in sequence, USER and F3 VERSION & CAL. If the firmware version is <V11.00, use the early connectors. If the firmware is ≥V11.10, check under subversions that the last datablock is x5xx (for instance 2516). This value determines that the higher frequency adjust point should be used.

- for x5xx: use the later connectors
- for x2xx: use the early connectors

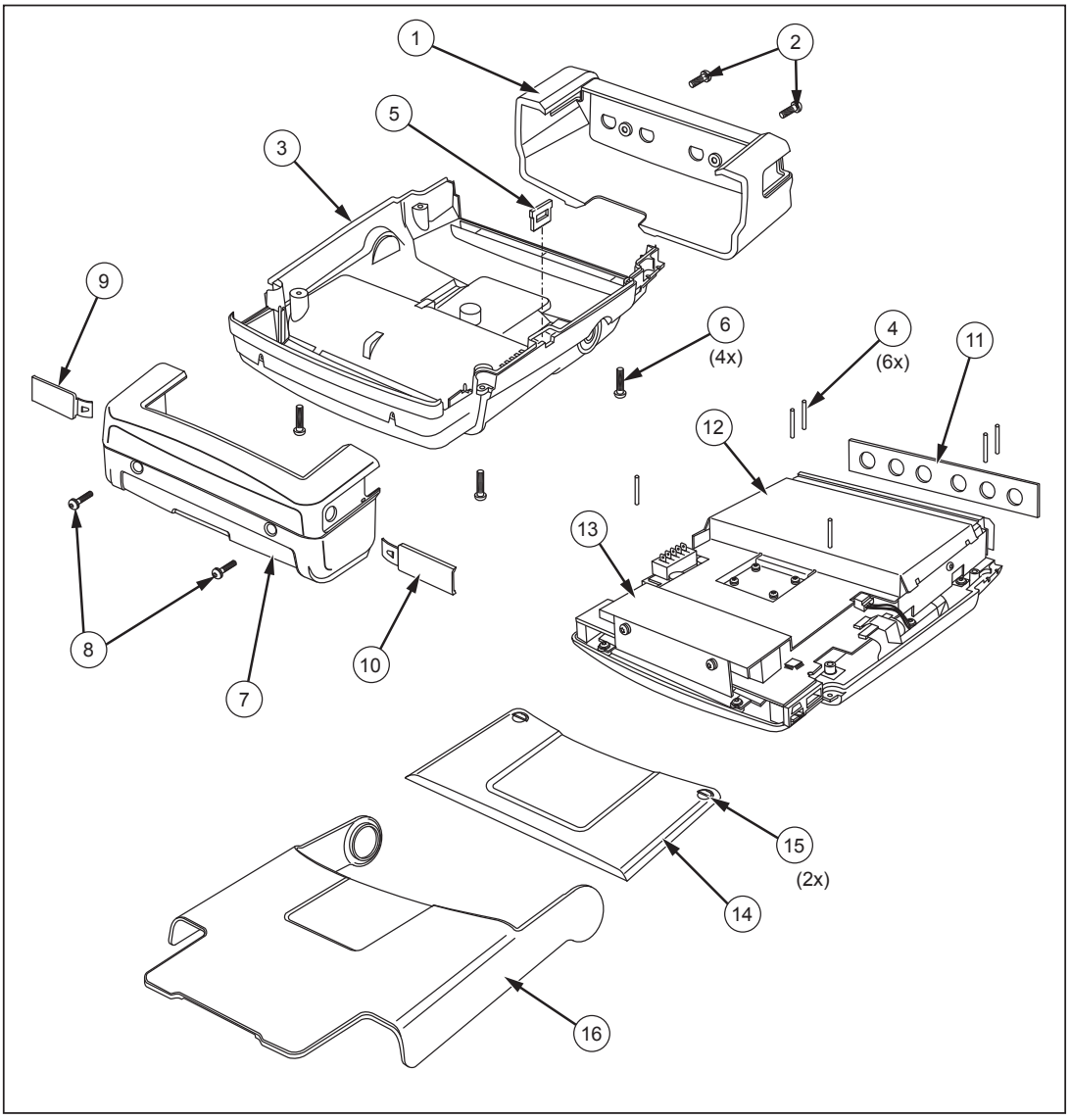

Figure 3-1. Open Case and Screws

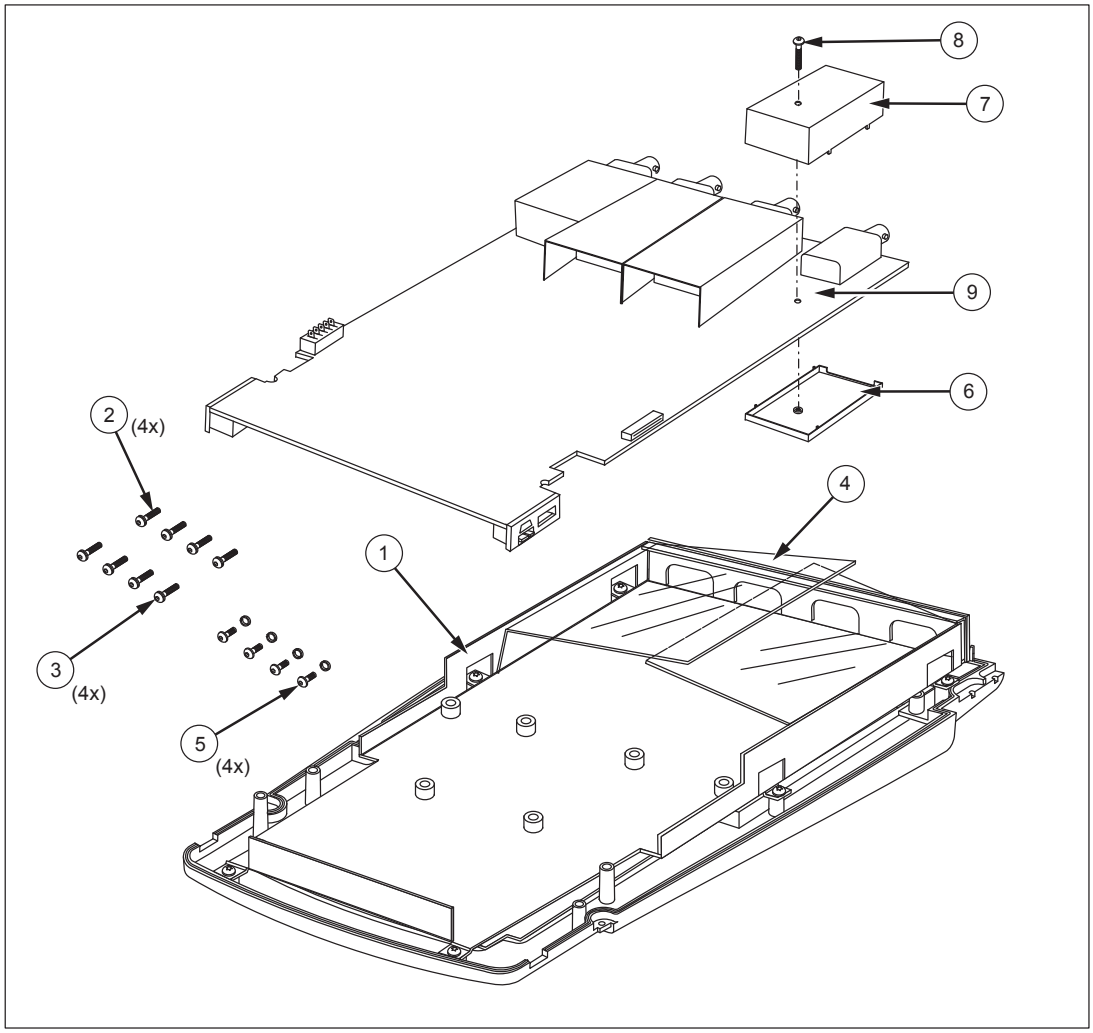

Figure 3-2. Screening Plate Removed and Screws

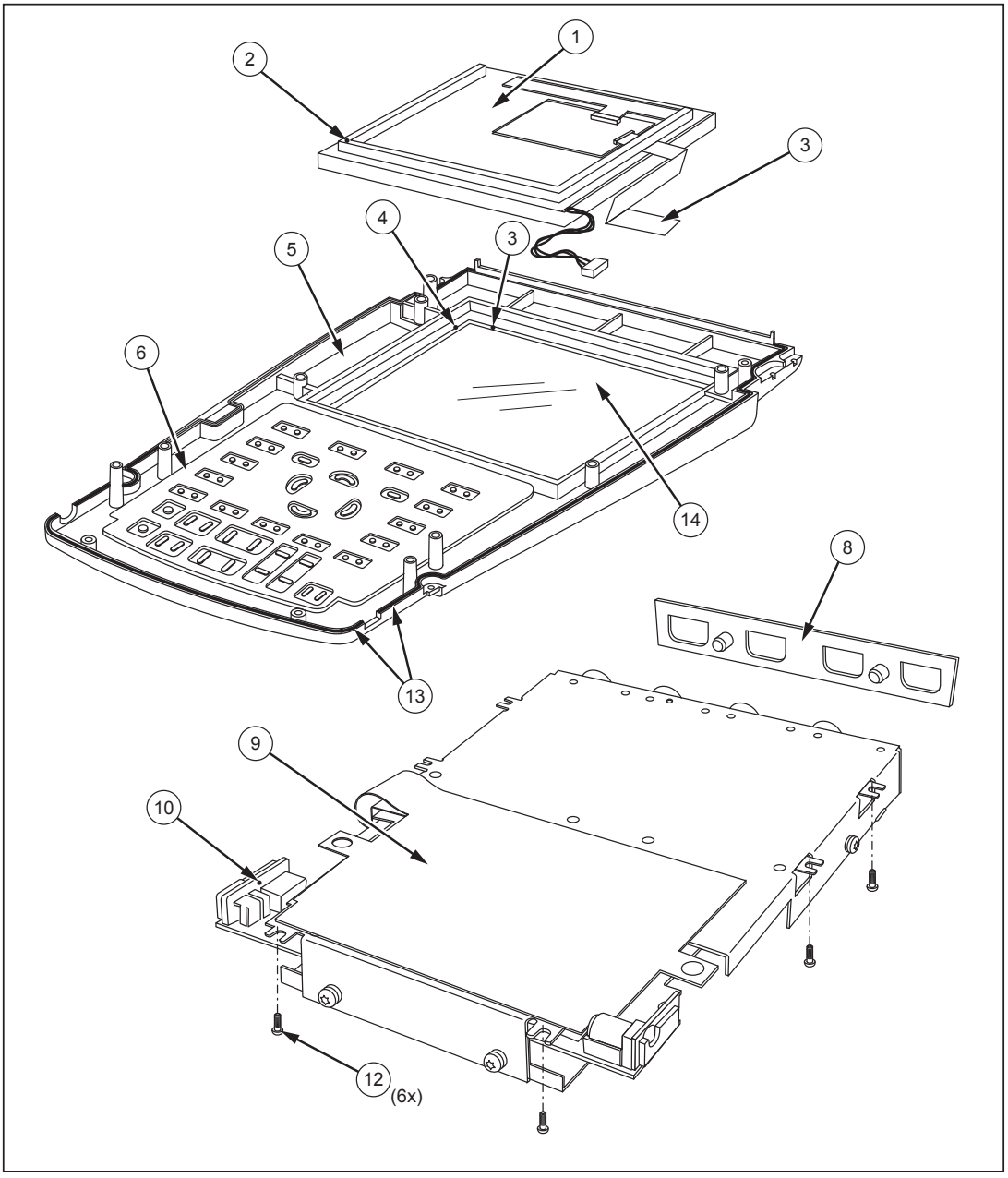

Figure 3-3. PCA Removed from Chassis, Bottom Side Visible

Accessory List

For an Accessory list, see *Maintaining the Test Tool* in the *Fluke ScopeMeter 190 Series II Users Manual*.

Chapter 4
Performance Verification

Title **Page**

Introduction

⚠⚠ Warning

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

Table 4-1 lists the available models for the Test Tools.

Table 4-1. Model Descriptions

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).
190-504	Four 500 MHz Scope Inputs (BNC).

The Test Tool should be calibrated and in operating condition on arrival.

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

The Performance Verification Procedure is based on the specification (see Chapter 2). The values given here are valid for ambient temperatures between 18 °C and 28 °C.

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

Equipment Requirements for Verification

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

- Fluke 5502A Multi-Product Calibrator, including SC600 Oscilloscope Calibration Option.
- Stackable test leads (4x) as supplied with the 5502A.
- 50 Ω Coax Cables (2x): use Fluke PM9091 (1.5 m, 3 pcs./set) and PM9092 (0.5 m, 3 pcs./set).
- Male BNC to Dual Female BNC adapter (1x), Fluke PM9093/001.
- 50 Ω feed through termination, always use Fluke **TRM50** for Fluke 190-502 and 190-504.
- 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 (part of SC600 600 MHz Oscilloscope Calibration Option).
- 10:1 Attenuator Probes as supplied with Test Tool.

General Instructions

Follow these general instructions for all tests:

- Power the Test Tool with the BC190 power adapter. The battery pack must be installed.
- Allow the 5502A to satisfy its specified warm-up period.
- For each test point, wait for the 5502A 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 set up for all models of the Test Tool. These have either two oscilloscope channels A and B with BNC inputs and a multimeter channel with banana inputs, or four oscilloscope channels.
  The figures that show the connection between calibrator and Test Tool are universal and also show the connection between calibrator and a Test Tool with four oscilloscope channels (for instance model 190-204).

Operation Instructions

Reset the Test Tool

Proceed as follows to reset the Test Tool:

1. Press ⏻ to turn off the Test Tool.
2. Press and hold USER.
3. Press and release ⏻ to turn on the Test Tool.
4. Wait until the Test Tool **beeps twice** and then release USER. Two beeps indicate a successful reset.

Menu Navigation

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

Proceed as follows to make choices in a menu:

1. Reset the Test Tool.
2. Open a menu, for example, press SCOPE and press F2 (READING …).
   The menu shown in Figure 4-1 opens.
   A yellow background or yellow characters mark the active functions. If more than one menu group is available, they are separated by a vertical line.
   The menu shown 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**).
3. Press ◀▶ or ▲▼ to highlight the function to be selected.
4. Press ENTER to confirm the selection.
   The active function in the next menu group is highlighted. If the confirmation is made in the last (most right) menu group, the menu will close.

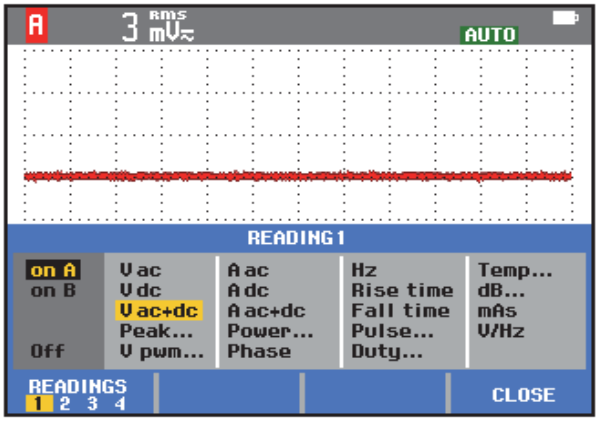

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Figure 4-1. Menu Item Selection

Standard Test Tool Setup

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

Press ENTER to confirm each setting.

Note

The setup steps for channel C and D are only for the models 190-104, 190-204, and 190-504.

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

1. Reset the Test Tool. Input A is ON and other inputs are OFF.
2. Press B : **INPUT B ON**. The black text with yellow background indicates the actual settings.

3. Press F3 to change the **PROBE B** setting.
4. Select **Probe Type: Voltage | Attenuation: 1:1**.
5. Press C : **INPUT C ON**.
6. Press F3 to change the **PROBE C** setting.
7. Select **Probe Type: Voltage | Attenuation: 1:1**.
8. Press D : **INPUT D ON**.
9. Press F3 to change the **PROBE D** setting.
10. Select **Probe Type: Voltage | Attenuation: 1:1**.
11. Press A. The inverse text indicates the actual settings.
12. Press F3 to change the **PROBE A** setting.
13. Select **Probe Type: Voltage | Attenuation: 1:1**.
14. Press SCOPE.
15. Press F1 – **READINGS ON**.
16. Press F2 – **READING** … and select with F1 – **READINGS** and with ▲▼:
    a) Reading 1, on A, V dc
    b) Reading 2, on B, V dc
    c) Reading 3, on C, V dc
    d) Reading 4, on D, V dc
17. Press F4 **WAVEFORM OPTIONS** and select **Glitch: Off | Acquisition: Normal | Average: Off | Waveform: Normal**.
18. Press MANUAL AUTO to select MANUAL ranging (**MANUAL** in upper right of display).
19. Press A. Use MOVE ▲ and MOVE ▼ to move the Input A ground level (indicated by the zero icon ▭ in the left margin) to the center grid line. Do this for all channels.
20. Press SAVE.
21. Press F1 **SAVE...**
22. Use ▲▼ to select **SCREEN+SETUP**.
23. Press ENTER.
24. Use ▲▼ to select **OK SAVE**. Remember the name under which the settings are saved (for instance SCOPE 1).
25. Press ENTER to save the settings.
26. Press HOLD RUN to leave the Hold mode.

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.
5. Do not press F3 now. If you do, turn off and turn on the Test Tool, and start at Step 4.
6. Press CLEAR to toggle on and off the menu.
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 shown in Figure 4-2 may be not visible or hardly visible.
   Observe the display closely, and verify that the display shows no abnormalities, such as very light pixels or lines.

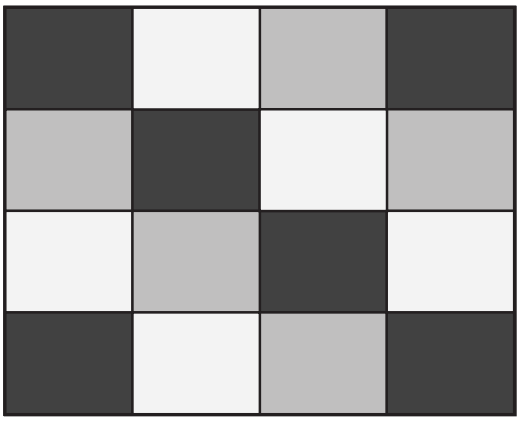

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Figure 4-2. Display Test Pattern

7. Press F2.

   The test pattern is removed and the Test Tool shows **Contrast (CL 0100):**
8. Press F2 again to do the next **Contrast (CL 0110):**
9. Press F3 (CALIBRATE).

   The Test Tool shows the display test pattern at default contrast, see Figure 4-2.

   Observe the display closely. Verify that the display shows no abnormalities and 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 and 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 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 off and turn on the Test Tool to exit the calibration menu and 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.

Scope Input A, B, C, D Tests

Input A, B, C, D Vertical Accuracy Test

⚠⚠ Warning

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

Note

The test steps for channels C and D are only for the models 190-104, 190-204, or 190-504.

Proceed as follows:

1. Connect the Test Tool to the 5502A as shown in Figure 4-3. The vertical channels A, B, C, and D are checked in succession so that there is one waveform on the display at a time to facilitate amplitude adjustment.

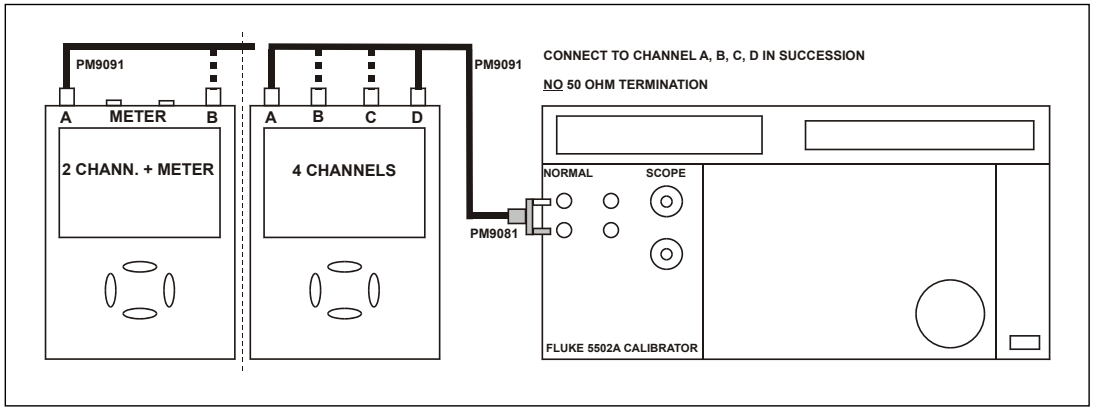


Figure 4-3. Test Tool Inputs A, B to 5502A Normal Output

2. Select the following Test Tool setup:

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

   b) Press A, press F4 (INPUT A OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the Test Tool.

   c) Press B, press F4 (INPUT B OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the Test Tool.

   d) Press C, press F4 (INPUT C OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the Test Tool.

   e) Press D, press F4 (INPUT D OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the Test Tool.

   f) Press CLEAR to clear the softkey menu and see the full display.

Note

The 10 kHz or 20 kHz bandwidth limiter rejects calibrator noise. It does not affect the gain accuracy at a 50 Hz input signal.

3. Press A and use mV RANGE and RANGE V to set the Input A sensitivity range to the first test point in Table 4-2.
4. Set the 5502A to source the appropriate initial ac voltage.
5. Adjust the 5502A output voltage until the displayed Input A trace amplitude is 6 divisions.
6. Observe the 5502A output voltage and check to see if it is within the range shown under the appropriate column.
7. Continue through the test points.

8. Check channel B, C, and D in succession. Connect channel B, C, or D to 5502A when appropriate.
9. Press TRIGGER and select B as trigger source with F1.
10. Press B, C, or D to assign vertical range to channel B, C, or D.
11. Observe the 5502A output voltage and check to see if it is within range.
12. When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 4-2. Vertical Accuracy Verification Points

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

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

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

   Example: for range 10 mV/div. (range/div figure doubles because 2 measurements V1 and V2 are done for one accuracy check) the allowed V1 - V2 = 60 mV ±(0.021 x 60 + 0.08 x 10) = 60 mV ±(1.26 + 0.8) = 60 mV ±2.06 mV.

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

⚠⚠ Warning

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

Note

The test steps for channel C and D are only for the models 190-104, 190-204, and 190-504.

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

1. Connect the Test Tool to the 5502A as shown in see Figure 4-4.

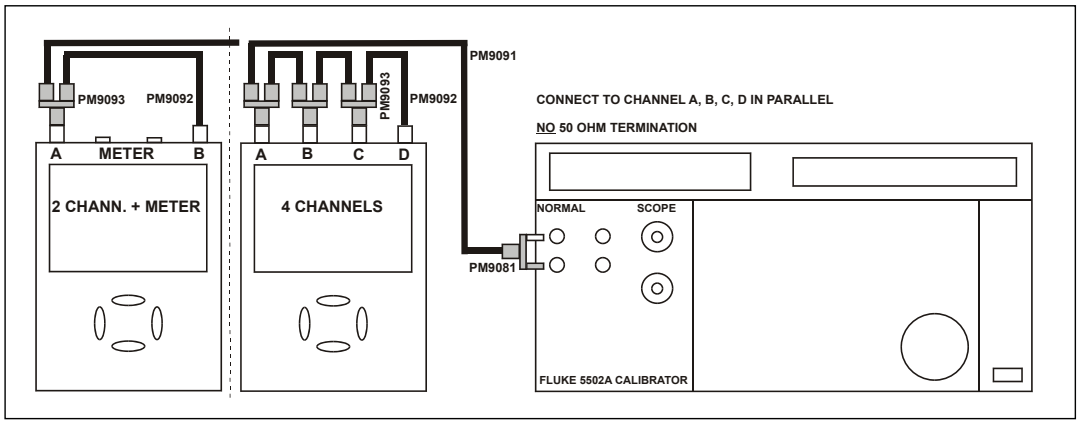


Figure 4-4. Test Tool Inputs A, B, C, D to 5502A Normal Output

2. Select the Test Tool setup:
   a) Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**. Press ENTER, select the setup name, and press ENTER to recall the setup.
   b) Press A, press F4 (INPUT A OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the ScopeMeter.
   c) Press B, press F4 (INPUT B OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the ScopeMeter.
   d) Press C, press F4 (INPUT C OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the ScopeMeter.
   e) Press D, press F4 (INPUT D OPTIONS...), and select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for available setting in the ScopeMeter.
   f) Press CLEAR to clear the softkey menu and the full 8-divisions display.
3. Press A and use mV RANGE and RANGE V to set the Input A sensitivity range to the first test point in Table 4-3. Do this also for channel B, C, and D.
4. Set the 5502A to source the appropriate dc voltage.
5. Observe readings **A, B, C,** and **D** and check they are within the range shown under the appropriate column.

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

Table 4-3. Volts DC Measurement Verification Points

Range	5502A Output V dc	2 Channel Input Reading	4 Channel Input Reading
2 mV/div	+6.0 mV	+4.9 to +7.1	+4.8 to +7.2
	-6.0 mV	-7.1 to -4.9	-7.2 to -4.8
5 mV/div	+15.0 mV	+14.2 to +15.8	+13.9 to +16.1
	-15.0 mV	-15.8 to -14.2	-16.1 to -13.9
10 mV/div	+30.0 mV	+28.9 to +31.1	+28.5 to +31.5
	-30.0 mV	-31.1 to -28.9	-31.5 to –28.5
20 mV/div	+60.0 mV	+58.5 to +61.5	57.6 to 62.4
	-60.0 mV	-61.5 to -58.5	-62.4 to -57.6
50 mV/div	+150 mV	+142 to +158	+139 to +161
	-150 mV	-158 to -142	-161 to -139
100 mV/div	+300 mV	+289 to +311	+285 to +315
	-300 mV	-311 to -289	-315 to -285
200 mV/div	+600 mV	+585 to +615	+576 to +624
	-600 mV	-615 to -585	-624 to -576
500 mV/div	+1.50 V	+1.42 to +1.58	+1.39 to +1.61
	-1.50 V	-1.58 to -1.42	-1.61 to -1.39
1 V/div	+3.00 V	+2.89 to +3.11	+2.85 to +3.15
	-3.00 V	-3.11 to -2.89	-3.15 to -2.85
2 V/div	+6.00 V	+5.85 to +6.15	+5.76 to +6.24
	-6.00 V	-6.15 to -5.85	-6.24 to -5.76
5 V/div	+15.0 V	+14.2 to +15.8	+13.9 to +16.1
	-15.0 V	-15.8 to -14.2	-16.1 to -13.9
10 V/div	+30.0 V	+28.9 to +31.1	+28.5 to +31.5
	-30.0 V	-31.1 to -28.9	-31.5 to –28.5
20 V/div	+60.0 V	+58.5 to +61.5	57.6 to 62.4
	-60.0 V	-61.5 to -58.5	-62.4 to -57.6
50 V/div	+150 V	+142 to +158	+139 to +161
	-150 V	-158 to -142	-161 to -139
100 V/div	+300 V	+289 to +311	+285 to +315
	-300 V	-311 to -289	-315 to -285

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

Note

The test steps for channel C and D are only for the models 190-104, 190-204, and 190-504.

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

⚠⚠ Warning

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

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 5502A as shown in Figure 4-4.
2. Select the Test Tool setup:
   a) Recall the created setup (*Creating a Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b) Press A, then press F4 (INPUT A OPTIONS …).
   c) Select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the ScopeMeter (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).
   d) Press B, then press F4 (INPUT B OPTIONS …).
   e) Select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the ScopeMeter (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).
   f) Press C, and then press F4 (INPUT C OPTIONS …).
   g) Select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the ScopeMeter (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).
   h) Press D, then press F4 (INPUT D OPTIONS …).
   i) Select **Attenuator: Normal | Bandwidth: 10 kHz** or **20 kHz** for the available setting in the ScopeMeter (2 mV/d and 5 mV/d) or **| Bandwidth: 20 MHz** (other ranges).
   j) Press CLEAR to clear the softkey menu and see the full 8-divisions display.
3. Press SCOPE.
4. Press F2 (– READING …) and select with F1 (– READINGS) and the ▲▼:
   Reading 1, on A, V ac
   Reading 2, on B, V ac
   Reading 3, on C, V ac
   Reading 4, on D, V ac

5. Use s TIME ns to change the time base and lock on 20 µs/div for the 20 kHz signal and on 10 ms/div for the 60 Hz signal.
6. Use mV RANGE and RANGE V to select the manual vertical ranging. Set the input A and B sensitivity range to the first test point in Table 4-4.

   The sensitivity ranges are indicated in the lower display edge.
7. Set the 5502A 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 5502A to 0 (zero) Volt and Standby.

Table 4-4. Volts AC Measurement Verification Points

Range	5502A output		2 Ch Input Reading	4 Ch Input Reading
	V ac	Frequency		
2 mV/div **(Select 10 ms/div)**	4 mV	**60 Hz**	2.9 mV to 5.1 mV	2.9 mV to 5.1 mV
Note *Set input A, B, Bandwidth 10 kHz or 20 kHz to prevent OL due to calibrator noise, see step 2.*				
5 mV/div	10 mV	**60 Hz**	8.8 mV to 11.2 mV	8.7 mV to 11.3 mV
10 mV/div **(Select 20 µs/div)**.	20 mV	20 kHz	18.0 mV to 22.0 mV	17.7 mV to 22.3 mV
Note *Set input A, B Bandwidth 20 MHz.*				
20 mV/div	40 mV	20 kHz	37.5 mV to 42.5 mV	36.9 mV to 43.1 mV
50 mV/div	100 mV	20 kHz	96.0 mV to 104.0 mV	94.5 mV to 105.5 mV
100 mV/div	200 mV	20 kHz	180 mV to 220 mV	177 mV to 223 mV
200 mV/div	400 mV	20 kHz	375 mV to 425 mV	369 mV to 431 mV
500 mV/div **(Select 10 ms/div)**	900 mV	**60 Hz**	876 mV to 924 mV	863 mV to 937 mV
500 mV/div **(Select 20 µs/div)**	900 mV	20 kHz	862 mV to 938 mV	849 mV to 951 mV
1 V/div	2 V	20 kHz	1.80 V to 2.20 V	1.77 V to 2.23 V
2 V/div	4 V	20 kHz	3.75 V to 4.25 V	3.69 V to 4.31 V
5 V/div	9 V	20 kHz	8.62 V to 9.38 V	8.49 V to 9.51 V
10 V/div	20 V	20 kHz	18.0 V to 22.0 V	17.7 V to 22.3 V
20 V/div	40 V	20 kHz	37.5 V to 42.5 V	36.9 V to 43.1 V
50 V/div	90 V	20 kHz	86.2 V to 93.8 V	84.9 V to 95.1 V
100 V/div	200 V	20 kHz	180 V to 220 V	177 V to 223 V

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, and 504.

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

1. Connect the Test Tool to the 5502A as for the previous test (see Figure 4-4).
2. Select the Test Tool setup:
   a) Recall the setup (*Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b) Press SCOPE.
   c) Press F2 (– READING …) and select with F1 (– READINGS) and ▲▼:
      Reading 1, on A, V ac
      Reading 2, on B, V ac
      Reading 3, on C, V ac
      Reading 4, on D, V ac
   d) Press A and use F2 to select **COUPLING AC.**
   e) Press B and use F2 to select **COUPLING AC.**
   f) Press C and use F2 to select **COUPLING AC.**
   g) Press D and use F2 to select **COUPLING AC.**
   h) Press CLEAR to clear the softkey menu and see the full display.
3. Use s TIME ns to change the time base to lock the time base on 40 ms/div.
4. Use mV RANGE and RANGE V to set the Input A, B, C and D sensitivity range to 500 mV.
5. Set the 5502A to source the appropriate ac voltage and frequency listed in Table 4-5.
6. Observe the reading **A, B, C,** and **D** and check that they are within the range shown under the appropriate column.
7. Continue through the test points.
8. When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 4-5. Input A, B AC Input Coupling Verification Points

5502A output, V rms	5502A Frequency	2 Ch Reading	4 Ch Reading
900 mV	60 Hz	873 mV to 920 mV	859 mV to 933 mV
900 mV	5 Hz	>630 mV	>630 mV

Input A, B, C, D Peak Measurements Test

⚠⚠ Warning

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

Note

The test steps for channel C and D are only for the models 190-104, 190-204, and 190-504.

To test the peak measurement accuracy:

1. Connect the Test Tool to the 5502A as shown Figure 4-4.
2. Select the Test Tool setup:
   a) Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b) Press SCOPE.
   c) Press F2 (– READING …) and select with F1 (– READINGS) and with ▲▼:
   Reading 1, on A, Peak … and next **Peak-Peak**
   Reading 2, on B, Peak … and next **Peak-Peak**
   Reading 3, on C, Peak … and next **Peak-Peak**
   Reading 4, on D, Peak … and next **Peak-Peak**
   d) Press CLEAR to clear the softkey menu, and to see the full display.
3. Use s TIME ns to change the time base and lock the time base on 1 ms/div.
4. Use mV RANGE and RANGE V to set the Input A, B, C, and D sensitivity ranges to 100 mV.
5. Set the 5502A to source the appropriate ac voltage and frequency as listed in Table 4-6.
6. Observe readings **A, B, C,** and **D** and check that they are within the range shown under the appropriate column.
7. When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 4-6. Volts Peak Measurement Verification Points

5502A output, Vrms (sine)	5502A Frequency	Reading A, B
212.13 mV (0.6 V pp)	1 kHz	0.56 to 0.64

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

Note

The test steps for channel C and D are only for the models 190-104, 190-204, and 190-504.

Proceed as follows to test the frequency measurement accuracy:

1. Connect the Test Tool to the 5502A as shown in Figure 4-5. Do not use 50 Ω terminations.

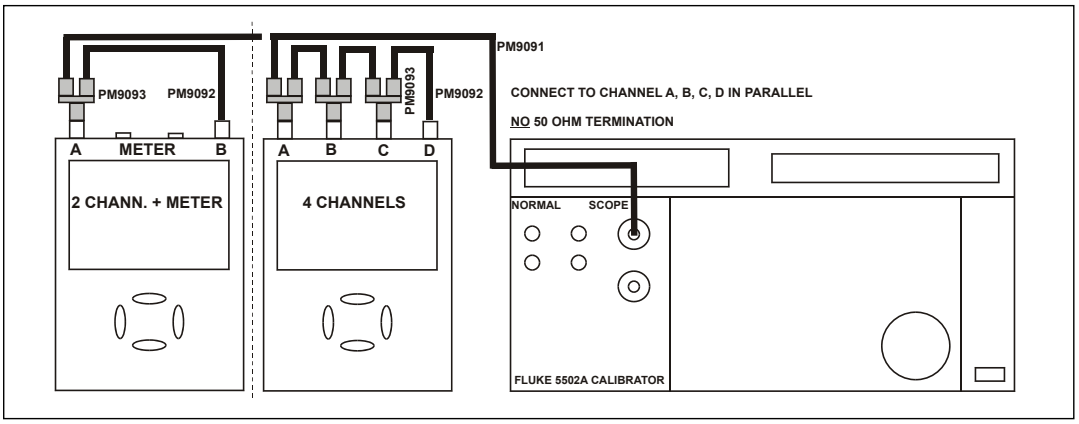


Figure 4-5. 5502A Scope Output to Test Tool Input A, B, C, D

2. Select the following Test Tool setup:

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

   b) Press SCOPE.

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

   Reading 1, on A, Hz

   Reading 2, on B, Hz

   Reading 3, on C, Hz

   Reading 4, on D, Hz

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

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

5. Set the 5502A to source a sine wave according to the first test point in Table 4-7.

   Because no 50 Ω termination is applied, the 5502A leveled sine wave output amplitude is twice the set value.

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

7. Continue through the test points.
8. When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 4-7. Input A, B, C, D Frequency Measurement Accuracy Test

Model	Time base	5502A-SC... MODE	Voltage	Frequency	Input A, B 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
190-502 190-504	20 ns/div	levsine	600 mVpp	500 MHz	497.3 to 502.7

Note

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

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, and 190-504.

Proceed as follows to test the phase measurement accuracy:

1. Connect the Test Tool to the 5502A as shown in Figure 4-5.
2. Select the Test Tool setup:

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

   e) Press SCOPE.

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

   Reading 1, on A, Phase
   Reading 2, on B, Phase
   Reading 3, on C, Phase
   Reading 4, on D, Phase

3. Use mV RANGE and RANGE V to select range 100 mV/div for A, B, C and D.
4. Use s TIME ns to select the required time base setting.

5. Set the 5502A to source a sine wave according to the first test point in Table 4-8.

   Because no 50 Ω termination is applied, the 5502A leveled sine wave output amplitude will be twice the set value.

6. Observe the readings **A, B, C,** and **D** and check that they are not outside the range shown under the appropriate column.
7. Continue through the test points.
8. When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 4-8. Phase Measurement Verification Points

Time base	5502A-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

Time Base Test

Proceed as follows to test the time base accuracy:

1. Connect the Test Tool to the 5502A as shown in Figure 4-6.

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

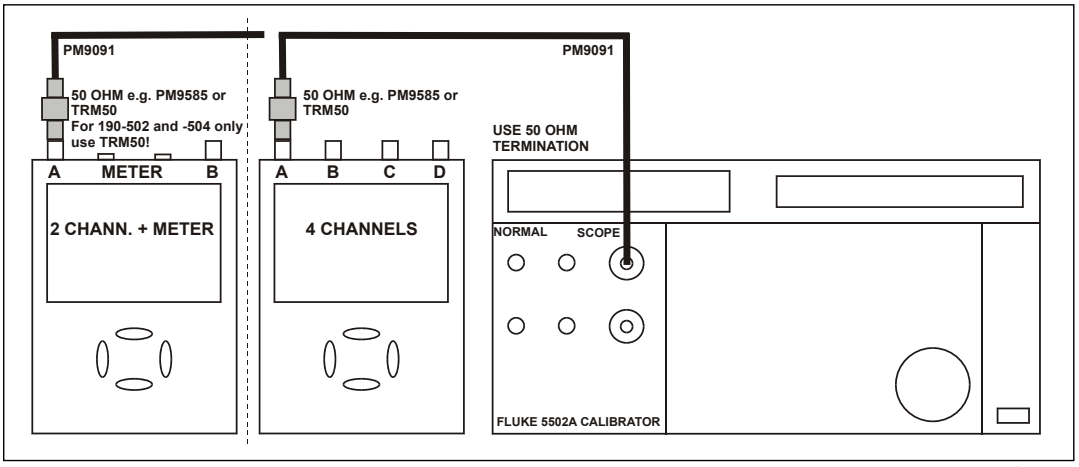
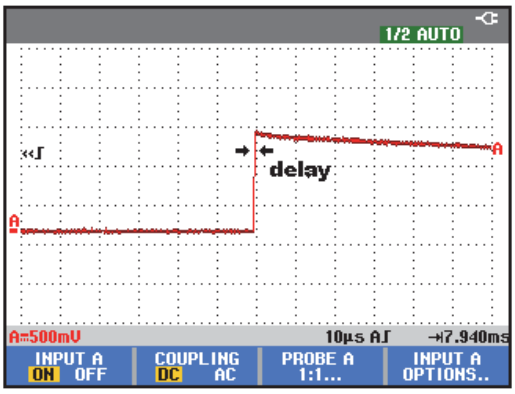


Figure 4-6. 5502A Scope Output to Test Tool Input A

2. Set the 5502A to source an 8 ms time marker (MODE marker).

3. Select the Test Tool setup:
   a) Reset the Test Tool.
   b) Use mV RANGE and RANGE V to select manual vertical ranging, and set the Input A sensitivity range to 5 V/div (10:1 probe) or 500 mV/div (probe A factor is 1:1).
   c) Use s TIME ns to change the time base to select manual time base ranging and lock the time base on 10 ms/div).
   d) Use MOVE to move the trace to the left. Once the trigger point is shifted across the left hand border of the display, going off display, the trigger delay time with respect to the first vertical grid line will be indicated in the lower right of the display, see Figure 4-7.

      Adjust the trigger delay time to 8.000 ms (**A ∫ →| 8.00 ms**).
   e) Use s TIME ns to set the time base on 10 µs/div.
4. Use MOVE to 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

Input A Trigger Sensitivity Test

Proceed as follows to test the Input A trigger sensitivity:

1. Connect the Test Tool to the 5502A as shown in Figure 4-6.
2. Reset the Test Tool to select the Test Tool setup.
3. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging, and lock the Input A sensitivity range on 2 V/div.
4. Use s TIME ns to select the time base indicated under the second column of Table 4-9.

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

   If not, press TRIGGER and use F3 to enable ▲▼ for manual Trigger Level adjustment. Adjust the trigger level and verify that the signal is triggered. The trigger icon (∫) indicates the trigger level.
8. Continue through the test points.
9. When you are finished, set the 5502A to Standby.

Table 4-9. Input A Trigger Sensitivity Test Points

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

Input A AC Voltage Accuracy (HF) and 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 5502A as shown in Figure 4-6.
2. Select the Test Tool setup:
   a) Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b) Press SCOPE, then press F2 (- READING…) and select F1 (READINGS) **on A | V ac**.
   c) Press MANUAL AUTO to select autoranging (**AUTO** in upper right LCD edge).
   d) Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging, and lock the Input A sensitivity range on 500 mV/div. **AUTO** in upper right LCD edge becomes ½ **AUTO**.
   e) Use MOVE to move the Input A trace zero to the center grid line.
3. Set the 5502A to source a sine wave and to the first test point in Table 4-10.
4. Observe the Input A reading and check that it is within the range shown under the appropriate column.
5. Continue through the test points.
6. When you are finished, set the 5502A to Standby.

Table 4-10. HF AC Voltage Verification Points

UUT Model	5502A SC... MODE levsine		UUT Reading A
	Voltage	Frequency	
All	2.545 Vpp	1 MHz	835 mV to 965 mV
All	2.545 Vpp	25 MHz	790 mV to 1.010 V
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
190-502; -504	2.545 Vpp	500 MHz	>630 mV

Input B Trigger Sensitivity Test

Proceed as follows to test the Input B trigger sensitivity:

1. Connect the Test Tool to the 5502A as shown in Figure 4-8.

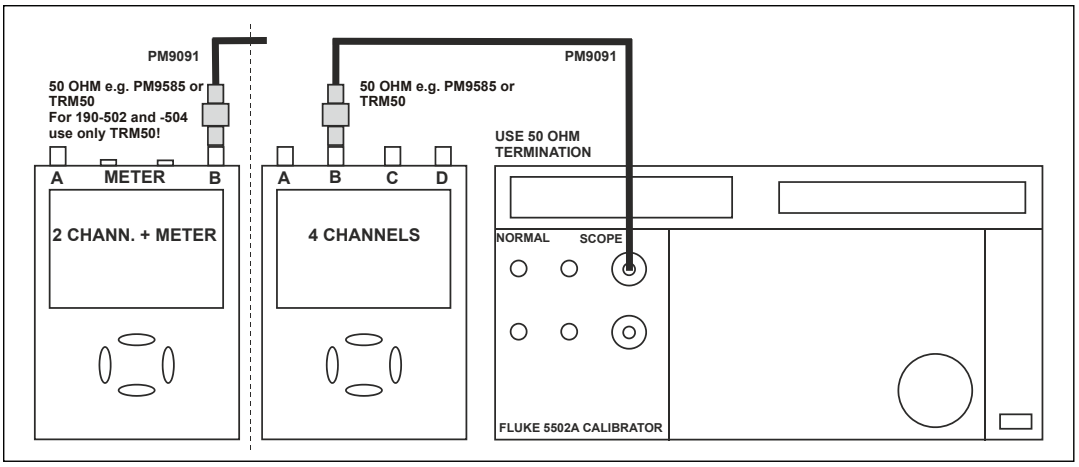


Figure 4-8. 5502A Scope Output to Test Tool Input B

2. Reset the Test Tool to select the Test Tool setup:
3. Press B to turn Input B on.
4. Press TRIGGER and use F1 to select Input B as trigger source.
5. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging, and lock the Input B sensitivity range on 2 V/div.
6. Use s TIME ns to select the time base listed in Table 4-11.
7. Set the 5502A to source the leveled sine wave given in the first row of Table 4-10.
8. Adjust the 5502A output voltage until the displayed trace has the amplitude indicated under the appropriate column of Table 4-11.
9. Verify that the signal is well triggered.

   If not, press TRIGGER and use F3 to enable ▲▼ for manual Trigger Level adjustment. Adjust the trigger level and verify that the signal will be triggered now. The trigger icon (∫) indicates the trigger level.
10. Continue through the test points.
11. When you are finished, set the 5502A to Standby.

Table 4-11. Input B Trigger Sensitivity Test Points

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

Input B AC Voltage Accuracy (HF) and 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 5502A as shown in Figure 4-8.
2. Select the Test Tool setup:
   a) Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b) Press SCOPE, then press F2 (READING…), select F1 (READINGS 2), and select **on B | V ac**.
   c) Press MANUAL AUTO to select autoranging (**AUTO** in upper right LCD edge).
   d) Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging and lock the Input B sensitivity range on 500 mV/div.
   e) Press TRIGGER and use F1 to select Input B as trigger source.
3. Set the 5502A to source a sine wave at the first test point in Table 4-12.
4. Observe the Input B reading and check that it is within the range shown under the appropriate column of Table 4-12.
5. Continue through the test points.

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

Table 4-12. HF AC Voltage Verification Points

UUT Model	5502A SC... MODE levsine Voltage	Frequency	UUT Reading B
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
190-502; -504	2.545 Vpp	500 MHz	>630 mV

Input C Trigger Sensitivity Test

Note

The test steps for channel C are only for the models 190-104, 190-204, and 190-504.

Proceed as follows to test the Input C trigger sensitivity:

1. Connect the Test Tool to the 5502A as shown in Figure 4-9.

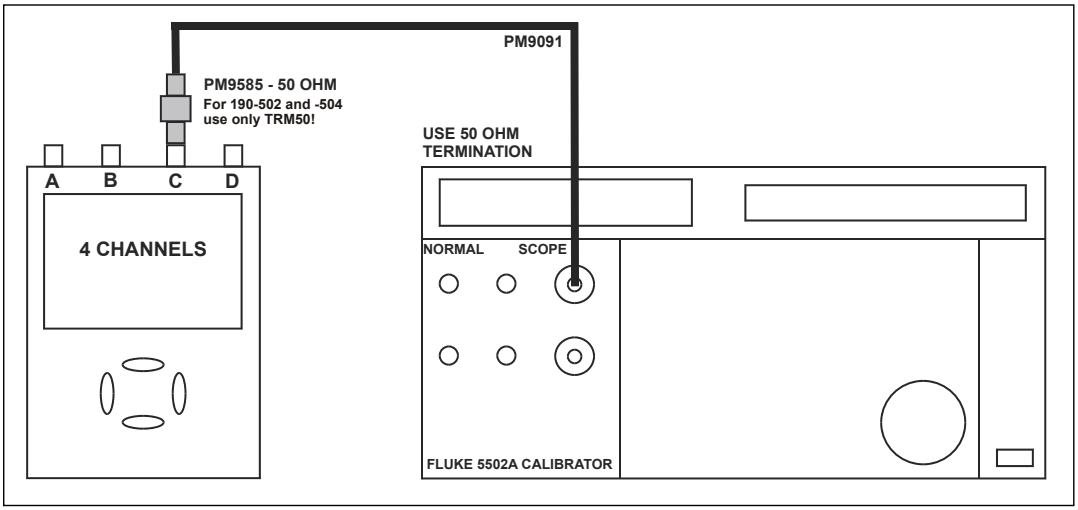


Figure 4-9. 5502A Scope Output to Test Tool Input C

2. Reset the Test Tool to select the Test Tool setup.
3. Press C to turn Input C on.
4. Press C and use MOVE to move the Input C trace zero to the center grid line.
5. Press TRIGGER and use F1 to select Input C as trigger source.
6. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging and lock the Input C sensitivity range on 2 V/div.
7. Use s TIME ns to select the time base in Table 4-13.
8. Set the 5502A to source the leveled sine wave given in the first row of Table 4-13.
9. Adjust the 5502A output voltage until the displayed trace has the amplitude indicated under the appropriate column of Table 4-13.
10. Verify that the signal is well triggered.

    If not, press TRIGGER and use F3 to enable the ▲▼ for manual Trigger Level adjustment. Adjust the trigger level and verify that the signal is triggered. The trigger icon (∫) indicates the trigger level.
11. Continue through the test points.
12. When you are finished, set the 5502A to Standby.

Table 4-13. Input C Trigger Sensitivity Test Points

UUT Model	UUT Time base	5500A SC... Initial Input Voltage	MODE levsin Frequency	UUT Trigger Amplitude
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
190-504	2 ns/div	400 mV pp	500 MHz	1 div
	2 ns/div	800 mV pp	600 MHz	2 div

Input C AC Voltage Accuracy (HF) and Bandwidth Test

Note

The test steps for channel C are only for the models 190-104, 190-204, and 190-504.

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

1. Connect the Test Tool to the 5502A as shown in Figure 4-9.

2. Select the Test Tool setup:
   a) Recall the setup (see *Standard Test Tool Setup*). Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
   b) Press SCOPE, then press F2 (READING…) and select **READINGS 3 on C | V ac**.
   c) Press MANUAL AUTO to select autoranging (**AUTO** in upper right LCD edge).
   d) Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging and lock the Input C sensitivity range on 500 mV/div.
   e) Use MOVE to move the Input C trace zero to the center grid line.
   f) Press TRIGGER and use F1 to select Input C as trigger source.
3. Set the 5502A to source a sine wave and to the first test point in Table 4-14.
4. Observe the Input C reading and check that it is within the range shown under the appropriate column of Table 4-14.
5. Continue through the test points.
6. When you are finished, set the 5502A to Standby.

Table 4-14. HF AC Voltage Verification Points

UUT Model	5500A SC... MODE levsine		UUT Reading A
	Voltage	Frequency	
all	2.545 Vpp	1 MHz	835 mV to 965 mV
all	2.545 Vpp	25 MHz	790 mV to 1.010 V
190-104	2.545 Vpp	100 MHz	>630 mV
190-204	2.545 Vpp	200 MHz	>630 mV
190-504	2.545 Vpp	500 MHz	>630 mV

Input D Trigger Sensitivity Test

Note

The test steps for channel D are only for the models 190-104, 190-204, and 190-504.

Proceed as follows to test the Input D trigger sensitivity:

1. Connect the Test Tool to the 5502A as shown in Figure 4-10.

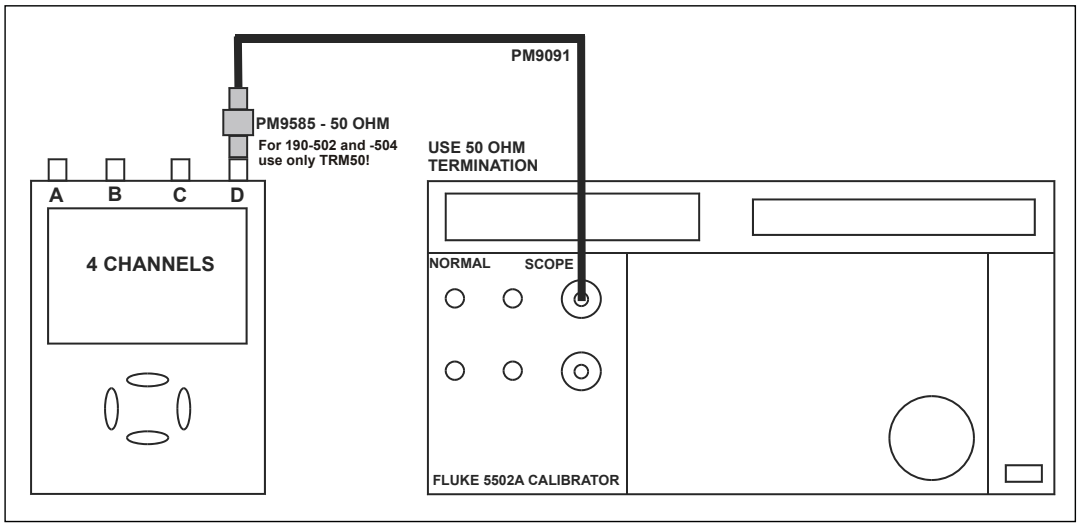


Figure 4-10. 5502A Scope Output to Test Tool Input D

2. Reset the Test Tool to select the Test Tool setup.
3. Press D to turn Input D on.
4. Use MOVE to move the Input D trace zero to the center grid line.
5. Press TRIGGER and use F1 to select Input D as trigger source.
6. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging and lock the Input D sensitivity range on 2 V/div.
7. Use s TIME ns to select the time base indicated in Table 4-15.
8. Set the 5502A to source the leveled sine wave given in the first row of Table 4-14.
9. Adjust the 5502A output voltage until the displayed trace has the amplitude indicated under the appropriate column of Table 4-15.
10. Verify that the signal is well triggered.

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

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

Table 4-15. 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
190-504	2 ns/div	400 mV pp	500 MHz	1 div
	2 ns/div	800 mV pp	600 MHz	2 div

Input D AC Voltage Accuracy (HF) and Bandwidth Test

Note

The test steps for channel C are only for the models 190-104, 190-204, and 190-504.

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 5502A as shown in Figure 4-10.
2. Recall the setup (see *Standard Test Tool Setup*) to select the Test Tool setup.
3. Press SAVE, F2 (RECALL) and select **SETUP**, press ENTER, select the setup name, and press ENTER to recall the setup.
4. Press SCOPE, then press F2 (READING…), and select **READINGS 4 on D | V ac**.
5. Press MANUAL AUTO to select autoranging (**AUTO** in upper right LCD edge).
6. Use mV RANGE and RANGE V to change the sensitivity range to select manual sensitivity ranging and lock the Input D sensitivity range on 500 mV/div.
7. Use MOVE to move the Input D trace zero to the center grid line.
8. Press TRIGGER and use F1 to select Input D as trigger source.
9. Set the 5502A to source a sine wave and to the first test point in Table 4-16.
10. Observe the Input D reading and check that it is within the range shown under the appropriate column of Table 4-16.
11. Continue through the test points.
12. When you are finished, set the 5502A to Standby.

Table 4-16. HF AC Voltage Verification Points

UUT Model	5500A SC...MODE levsine		UUT Reading A
	Voltage	Frequency	
all	2.545 Vpp	1 MHz	835 mV to 965 mV
all	2.545 Vpp	25 MHz	790 mV to 1.010 V
190-104	2.545 Vpp	100 MHz	>630 mV
190-204	2.545 Vpp	200 MHz	>630 mV
190-504	2.545 Vpp	500 MHz	>630 mV

Video Test with SC600 Scope Calibration Option

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

To verify:

1. Connect the Test Tool to the calibrator as shown in Figure 4-11.

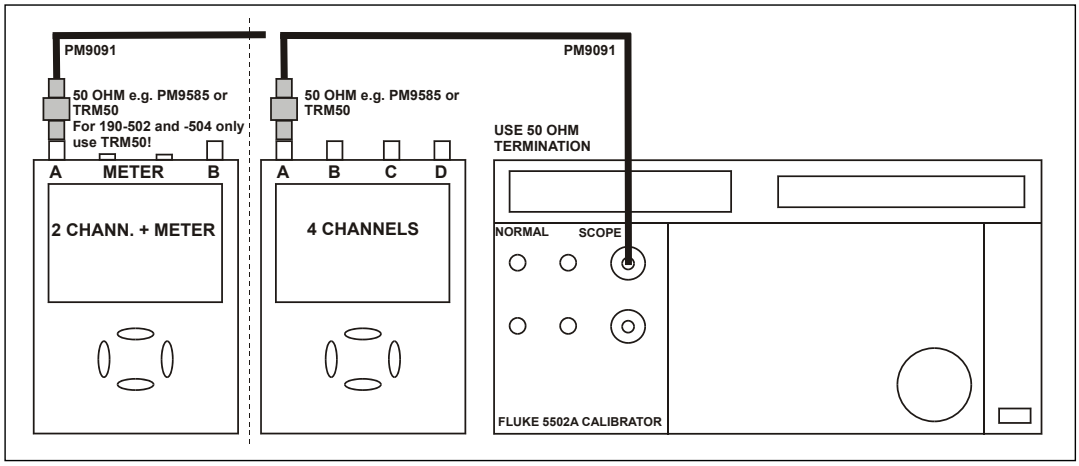


Figure 4-11. Test Tool Input A to TV Signal Generator

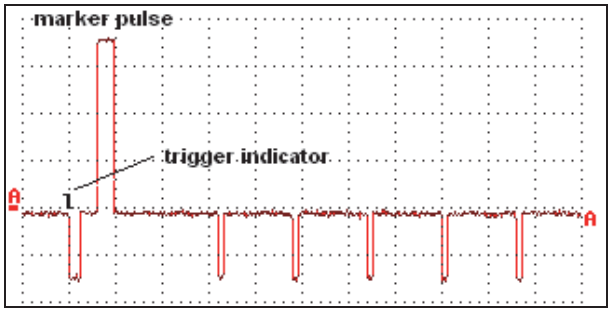
2. Reset the Test Tool to select the Test Tool setup.
3. Press TRIGGER and then press F4 to open the Trigger Options menu.
4. Choose **VIDEO on A...** and choose from the shown menu:

   Polarity: POSITIVE | PAL (or **NTSC** or **PALplus** or **SECAM**)
5. Press F2 to select **ALL LINES**.
6. Press F3 to enable ▲▼ to select the video line number.
7. Use ▲▼ to select line number:
   - 622 for PAL, PALplus, or SECAM
   - 525 for NTSC
8. Use MOVE to move the Input A trace zero to the center grid line.

9. Use mV RANGE and RANGE V to set the Input A sensitivity to 2 V/div (the actual probe setting is 10:1).
10. Use s TIME ns to select the time base to 20 µs/div.
11. Set the calibrator to video mode 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
12. Observe the trace and check if the Test Tool triggers on the negative pulse before the marker pulse (see Figure 4-12).
13. Use ▲▼ to select Test Tool line number:
    - 310 for PAL, PALplus, or SECAM
    - 262 for NTSC
14. 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

15. Observe the trace and check if the Test Tool triggers on the negative pulse before the marker.
16. Select the Test Tool setup and press F4 to open the Trigger Options menu.
17. Choose **VIDEO on A...** and from the opened menu choose:

    Polarity: NEGATIVE | PAL (or **NTSC** or **PALplus** or **SECAM**)
18. Set the calibrator video trigger output signal to -100 %
19. Use ▲▼ to select line number 310 (PAL, PALplus, or SECAM) or 262 (NTSC).
20. 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
21. Observe the trace and check if the Test Tool triggers on the positive pulse before the marker.



video-sc600.bmp

Figure 4-12. SC600 Marker Pulse

External Trigger Level Test

Note

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

To test the external trigger level:

1. Connect the Test Tool to the 5502A as shown in Figure 4-13.

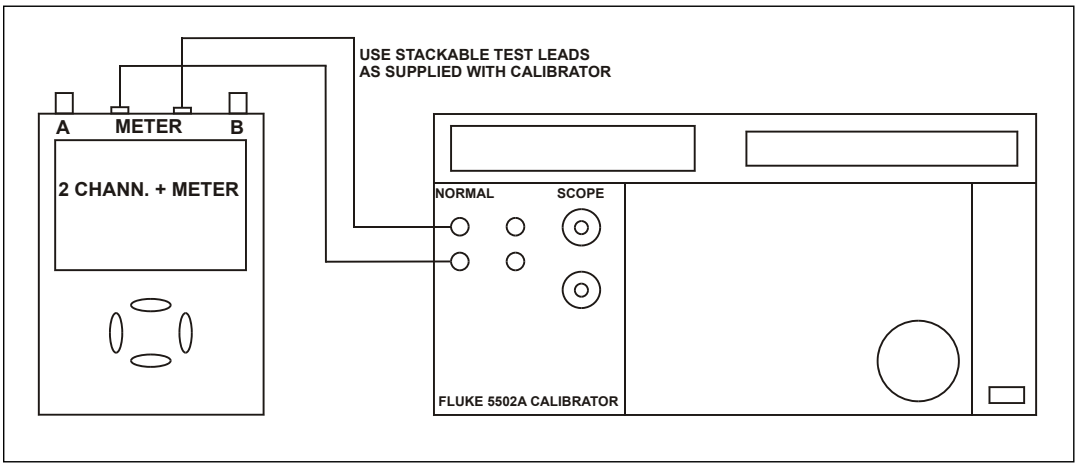


Figure 4-13. Test Tool Meter/Ext Input to 5502A Normal Output

2. Reset the Test Tool to select the Test Tool setup.
3. Press TRIGGER.
4. Use F4 to select the **TRIGGER OPTIONS...** menu.
5. Select **On Edges...** from the **TRIGGER OPTIONS** menu.
6. Press ENTER.
7. Select **Update: Single Shot** ENTER, **Trigger Filter: Noise Reject** ENTER, **NCycle: Off** ENTER.
8. Use F1 (EDGE TRIG) to select **Ext**.
9. Use F2 (SLOPE) to select positive slope triggering (trigger icon ⎍).
10. Use F3 (Ext LEVEL) to select **1.2 V**.
11. Set the 5502A to source 0.4 V dc.
12. Verify that no trace is shown on the Test Tool display and that the status line at the display top shows **SINGLE MANUAL** or **SINGLE WAITING**.

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

Meter Tests

Note

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

Meter DC Voltage Accuracy Test

⚠⚠ Warning

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

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

1. Connect the Test Tool to the 5502A as shown in Figure 4-13.
2. Select the Test Tool setup.
3. Press METER.
4. Press F1 to open the Measurement menu and select **V dc.**
5. Press ENTER.
6. Press MANUAL AUTO to select MANUAL ranging. Use mV RANGE and RANGE V to select the ranges.
7. Set the range to the first test point in Table 4-17.
8. Set the 5502A to source the appropriate dc voltage.
9. Observe the reading and check to see if it is within the range shown under the appropriate column.
10. Continue through the test points.
11. When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 4-17. Meter Volts dc Measurement Verification Points

Range	5502A 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

Meter AC Voltage Accuracy and Frequency Response Test

⚠⚠ Warning

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

Proceed as follows to test the ac voltage measurement accuracy:

1. Connect the Test Tool to the 5502A as shown in Figure 4-13.
2. Select the Test Tool setup.
3. Press METER.
4. Press F1 to open the Measurement menu and select **V ac**.
5. Press ENTER.
6. Press MANUAL AUTO to select MANUAL ranging. Use mV RANGE and RANGE V to select the ranges.
7. Set the range to the first test point in Table 4-18.
8. Set the 5502A to source the appropriate ac voltage.
9. Observe the reading and check that it is within the range shown under the appropriate column.
10. Continue through the test points.
11. When you are finished, set the 5502A to 0 (zero) Volt and Standby.

Table 4-18. Meter Volts AC Measurement Verification Points

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

Continuity Function Test

To test the continuity function:

1. Select the Test Tool setup.
2. Press METER.
3. Press F1 to open the Measurement menu and select **Continuity.**
4. Connect the Test Tool to the 5502A as shown in Figure 4-13.
5. Set the 5502A to 20 Ω. Use the 5502A “COMP OFF” mode.
6. Listen to hear that the beeper is on.
7. Set the 5502A to 80 Ω.
8. Listen to hear that the beeper is off.
9. When you are finished, set the 5502A to Standby.

Diode Test Function Test

To do the diode test function:

1. Select the Test Tool setup.
2. Press METER.
3. Press F1 to open the Measurement menu and select ■ **Diode**.
4. Connect the Test Tool to the 5502A as shown in Figure 4-13.

5. Set the 5502A to **1 kΩ**. Use the 5502A “COMP OFF” mode.
6. Observe the main reading and check that it is within **0.4 V** and **0.6 V**.
7. Set the 5502A to **1 V dc.**
8. Observe the main reading and check that it is within **0.975 V** and **1.025 V**.
9. When you are finished, set the 5502A to Standby.

Ohms Measurements Test

To test the Ohms measurement accuracy:

1. Connect the Test Tool to the 5502A as shown in Figure 4-14.

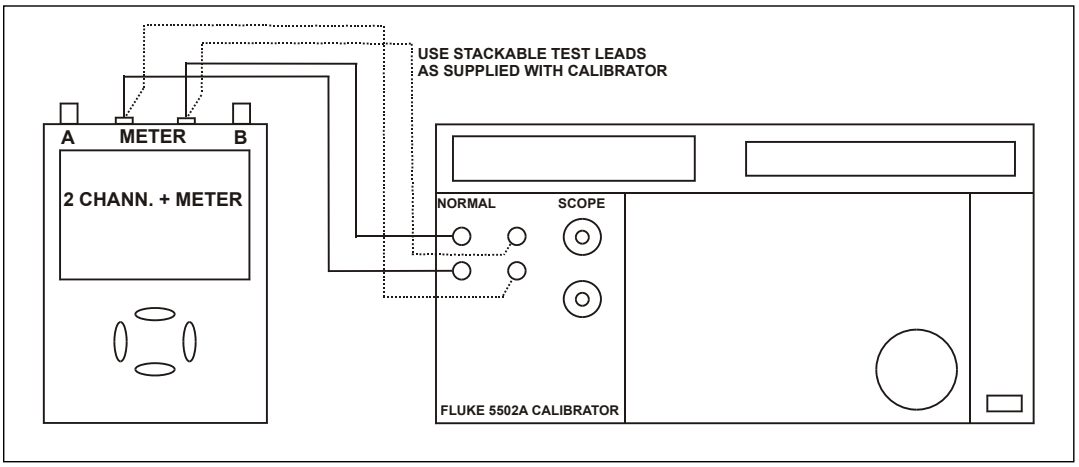


Figure 4-14. Test Meter Tool Input to 5502A Normal Output 4-Wire

2. Select the Test Tool setup.
3. Press METER.
4. Press F1 to open the Measurement menu and select **Ohms**.
5. Press MANUAL AUTO to select AUTO ranging.
6. Set the 5502A to source the appropriate resistance value for the first test point in Table 4-19.
7. Use the 5502A “COMP 2 wire” mode for the verifications up to and including 50 kΩ. For the higher values, the 5502A will turn off the “COMP 2 wire” mode.
8. Observe the reading and check that it is within the range shown under the appropriate column.
9. Continue through the test points.
10. When you are finished, set the 5502A to Standby.

Table 4-19. Resistance Measurement Verification Points

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

Probe Calibration Generator Test

To calibrate, connect a 10:1 probe as supplied with the Test Tool to input A (red probe). Connect the probe tip and the probe ground lead with the probe cal terminals on the lower left side of the Test Tool as shown in Figure 4-15 (the figure is universal and shows a Test Tool with four oscilloscope channels such as the model 190-204).

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 on the display.
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 is located in the probe housing and can be reached by rotating the center part of the housing. For further information refer to the probe instruction sheet.
6. When done, press F4 to start the DC calibration automatically. The Probe Calibration is OK if all instructions shown on the display are finished successfully.

   Close the hole of the trimmer by rotating the center part of the housing. This is important for safe use of the probe at high input voltages.
7. Repeat the procedure for channel B (blue probe). For the 4-Channel Test Tools (190-104, 190-204, 190-504), repeat the procedure for channel C (gray probe) and channel D (green probe).

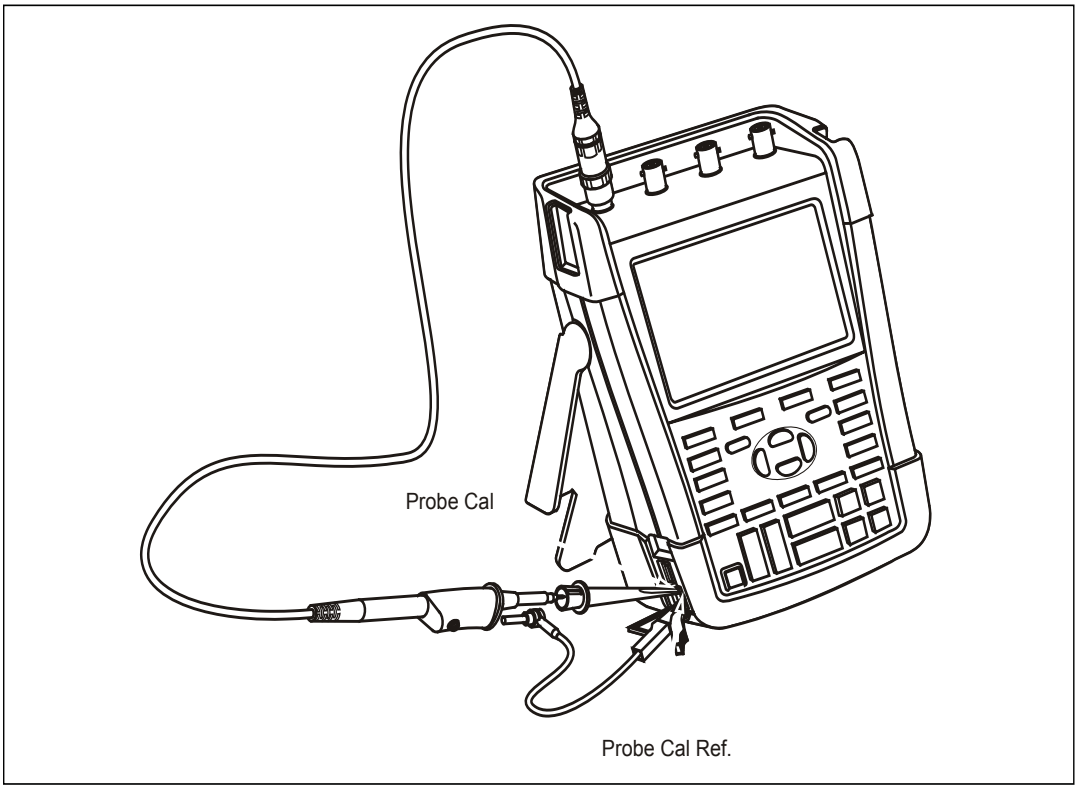


Figure 4-15. Probe Calibration

This is the end of the Performance Verification Procedure.

Chapter 5
Calibration Adjustment

Title **Page**

Introduction

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

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

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

Because the hardware and firmware has changed over the life of the Product, development of a second version of the adjust procedure has been necessary. This section has both adjust procedures.

To identify the procedure version you need:

1. Check that the serial number is 25375604 or higher. If yes, use the first procedure.
2. If no, evaluate the firmware and Subversion. Press in sequence, USER, F3 VERSION & CAL. If the firmware version is V11.00 or lower, use the second procedure.

If the firmware is V11.10 or higher:

3. In the same popup menu, check under Subversions that the last datablock is x5xx (for instance 2516). This value determines the higher frequency adjust point that should be used.

   In the tables when red or blue values are listed:

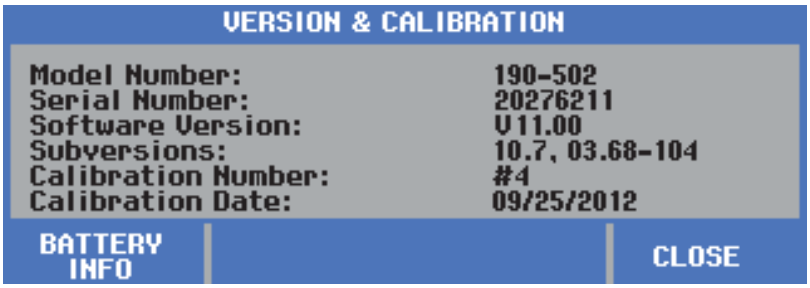
   - 5: The *Final Calibration for V11.10 and later* procedure should be done. Use the levels in Red.
   - 2: The *Final Calibration for V11.10 and later* procedure should be done. Use the levels in Blue.

General

Calibration Number and Date

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

1. Press USER, then press F3 to see the version and calibration data (Figure 5-1).
2. Press F4 to close the version and calibration menu.



version-calibration-3.bmp

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

Note

The calibration date and calibration number do not change if you do only the Contrast Calibration Adjustment and/or the Probe Calibration.

General Instructions

Follow these general instructions for all-calibration steps:

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

Equipment Required For Calibration

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

- Fluke 5502A Multi-Product Calibrator, including SC600 Oscilloscope Calibration Option.
- Stackable test leads (4x) as supplied with the 5502A (required for Test Tools with banana jacks and 2 BNC oscilloscope inputs).
- 50 Ω Coax Cables (4x): use Fluke PM9091 (1.5 m, 3 pcs.) and PM9092 (0.5 m, 3 pcs.). For Test Tools with banana jacks and 2 BNC oscilloscope inputs 2 Coax Cables are sufficient.
- 50 Ω feed through termination, Fluke TRM50 (4x for Test Tools with 4 BNC oscilloscope inputs; 2x for Test Tools with banana jacks and 2 BNC oscilloscope inputs). The use of model TRM50 is mandatory for Fluke 190-502.
- Male BNC to Dual Female BNC adapter (3x), Fluke PM9093/001.
- Dual Banana Plug to Female BNC Adapter (1x), Fluke PM9081/001.

Calibration Procedure Steps

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

1. Select the Calibration Mode.
2. Do the Contrast Calibration Adjustment.
3. Do the Warming-Up and Pre-Calibration.
4. Do the *Final Calibration for V11.10 and Later* section or *Final Calibration (Firmware: V10.9 and Lower)*. If the installed firmware is **V09.00, V10.00 or V10.4x** you must do the steps in the *Final Calibration (Firmware: V10.9 And Lower)* section.

   If the installed firmware is **V11.10** you must do the steps in the *Final Calibration For V11.10 and later* section.
5. Save the Calibration Data and Exit the calibration mode.
6. Do the probe calibration.

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.

How to Start the Calibration

To start the calibration:

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

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

   To enter the calibration mode proceed as follows:

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

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

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

Continue as indicated in the *Calibration Procedure Steps* section.

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

Explanation of Display Messages and Key Functions

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

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

Cal Name — Name of the selected calibration step, for example, **WarmingUp**

(CL nnnn) — Number of the calibration step

Status (…) can be:

IDLE (valid) — After (re)entering this step, the calibration process is not started. The calibration data of this step are valid. This means that the last time this step was done, the calibration was successful. It does not necessarily mean that the unit meets the specifications related to this step.

IDLE (invalid) — After (re)entering this step, the calibration process is not started. The calibration data are invalid. This means that the last time this step was done, the calibration was not successful. Most probably the unit will not meet the specifications if the actual calibration data are saved.

BUSY aaa% bbb% — Calibration adjustment step in progress; progress % for Input A and Input B. During Warming-Up, the elapsed time is shown.

READY — Calibration adjustment step finished.

Error :xxxx — Calibration adjustment failed, due to wrong input signal(s) or because the Test Tool is defective.

If the error code is <5000 you can repeat the failed step.

If the error code is ≥5000 you must repeat the complete final calibration (start at *Warming-Up 2, Warm-Up Final, and ADC Timing*).

The functions of the keys are:

F1	**PREVIOUS**	select the previous step
F2	**NEXT**	select the next step
F3	**CALIBRATE**	start the calibration adjustment of the actual step
F4	**EXIT**	leave the calibration mode

Contrast Calibration Adjustment

After you enter the calibration mode, the display shows:

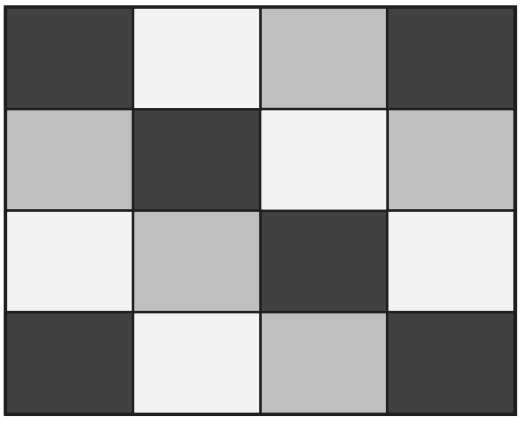
WarmingUp (CL 0200):IDLE (valid)

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

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 shows a dark test pattern, see Figure 5-2.
3. Use ▲ ▼ to adjust the display to the maximum darkness where 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 test pattern shows on the display at default contrast.
7. Use ▲ ▼ to set the display to optimal (this setting becomes the 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. Use ▲ ▼ to adjust the display to the maximum brightness where 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 the *Save Calibration Data and Exit* section.

    or
    - Do the complete calibration. Press F2 to select the next step (Warming-Up) and continue.



hpp204.eps

Figure 5-2. Display Test Pattern

Warming-Up and Pre-Calibration

The Warming-Up and Pre-Calibration state is entered after the calibration mode, or after selecting the next step if you have done the Contrast Calibration step, CL 120. 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 **WarmingUp (CL 0200)** step. Starting at another step will make the calibration invalid.

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

To do the Warming-Up and Pre-Calibration:

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

   The display shows the calibration step in progress and its status.

   The first step is **WarmingUp (CL 0200) :BUSY 00:29:59** or **WarmingUp1 (CL 0200) :BUSY 00:09:59.** The warming-up period is counted down to 00:00:00. Then the remaining pre-calibration steps are performed automatically. The entire procedure takes about 60 minutes.
3. Wait until the display shows **End Precal: READY**.

   The PreCal data have now been stored in FlashROM.

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

Error Messages

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

Final Calibration For v11.10 and later

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

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

Note

You must always start the Final Calibration at the first step. See the Warming-Up 2, Warm-Up Final, and ADC Timing *section. Starting at another step will make the calibration invalid.*

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

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** shows on the display during calibration:

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

If the error persists, the Test Tool is defective.

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

The Warming-Up 2 step (**CL 0500**) must be done with open inputs:

1. Press F3 to start the calibration.
2. Wait until the display shows calibration status **End Precal:READY**.
3. Press F2 to select the next calibration step (**CL 201, WarmUpFinal**).
4. Press F3 to start the calibration.
5. Wait until the display shows calibration ready. Press F2 to select the next calibration step (**CL 0570, ADC Timing**).
6. Connect Ch. A of the Test Tool to the 5502A SCOPE output as shown in Figure 5-3. Use a 50 Ω termination.
7. Set the 5502A to generate a sine wave 50 MHz / 0.5 V pp (mode LEVSINE) at the SCOPE output.
8. Set the 5502A in operate (OPR).
9. Press F3 to start the calibration.
10. Wait until the display shows calibration status **:READY.**
11. Set the 5502A in standby (STBY).
12. Continue at the *Input A LF-HF Gain* section.

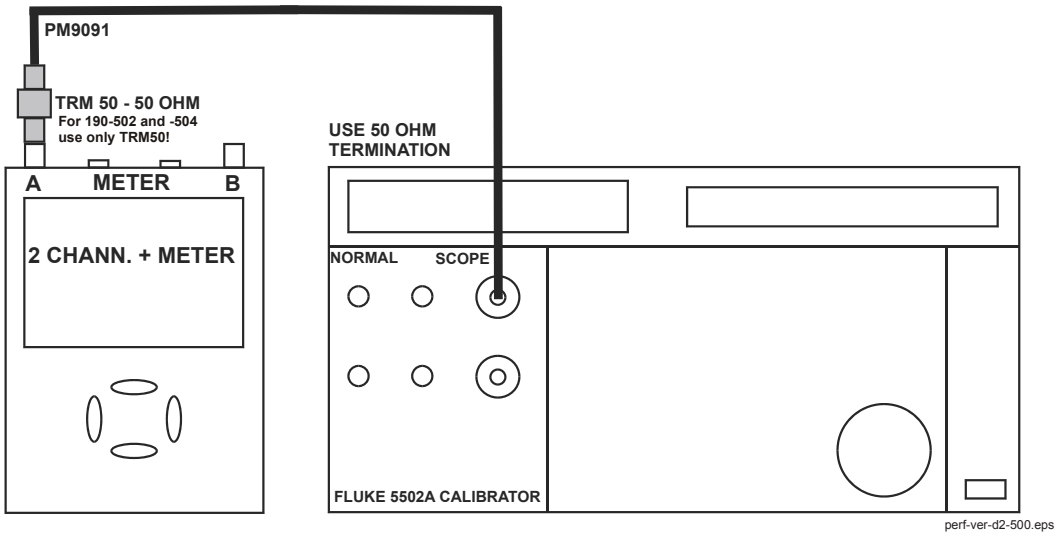


Figure 5-3. 5502A SCOPE Output to Test Tool Input A

Input A LF-HF Gain

To do the Input A LF-HF Gain calibration:

1. Connect Ch. A of the Test Tool to the 5502A as shown in Figure 5-3.
2. The display must show step CL 0654 (Pos A Fast). If it does not, then press F1 or F2 to select the first calibration step in Table 5-1.
3. Set the 5502A SCOPE output to source the signal required for the first calibration point in Table 5-1.
4. Set the 5502A 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 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points of Table 5-1.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Input B LF-HF Gain* section.

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

Cal step	UUT input signal	5502A Setting
CL 0654	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0415	100 mVpp square wave, 1 kHz	SCOPE edge, 100 mVpp, 1 kHz
CL 0510	2.5 Vpp square wave, 1 kHz	SCOPE edge, 2.5 Vpp, 1 kHz
CL 0580	2.5 Vpp sine wave, 50 kHz	SCOPE levsine, 2.5 Vpp, 50 kHz
CL 0581	2.5 Vpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 2.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0480	500 mVpp sine wave, 50 kHz	SCOPE levsine, 500 mVpp, 50 kHz
CL 0481	0.5 Vpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz Fluke 190-202/204: 221 MHz Fluke 190-102/104: 141 MHz Fluke 190-062: 91 MHz	SCOPE levsine, 0.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz 221 MHz 141 MHz 91 MHz
CL 0460	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0461	100 mVpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz Fluke 190-202/204: 221 MHz Fluke 190-102/104: 141 MHz Fluke 190-062: 91 MHz	SCOPE levsine, 100 mVpp, 501 MHz 381 MHz 151 MHz 111 MHz 221 MHz 141 MHz 91 MHz

Input B LF-HF Gain

To do the Input B LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-2.
2. Connect Ch. B of the Test Tool to the 5502A as shown in Figure 5-4.
3. Set the 5502A SCOPE output to source the signal required for the first calibration point in Table 5-2 (CL 0674, Pos B Fast).
4. Set the 5502A to 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 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points of Table 5-2.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Input C LF-HF Gain* section.

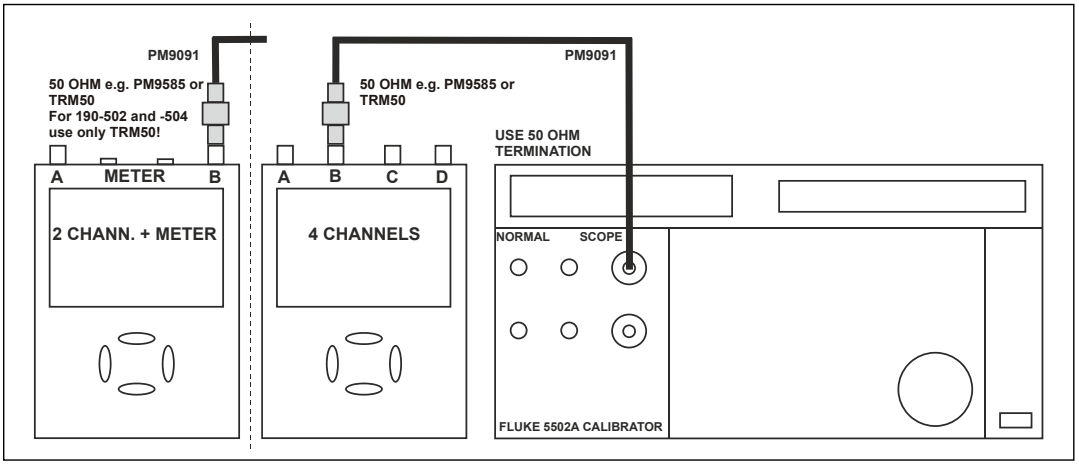


Figure 5-4. 5502A SCOPE Output to Test Tool Input B

Table 5-2. Input B LF-HF Gain Calibration Points

Cal step	UUT input signal	5502A Setting
CL 0674	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0435	100 mVpp square wave, 1 kHz	SCOPE edge, 100 mVpp, 1 kHz
CL 0530	2.5 Vpp square wave, 1 kHz	SCOPE edge, 2.5 Vpp, 1 kHz
CL 0582	2.5 Vpp sine wave, 50 kHz	SCOPE levsine, 2.5 Vpp, 50 kHz
CL 0583	2.5 Vpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 2.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0482	500 mVpp sine wave, 50 kHz	SCOPE levsine, 500 mVpp, 50 kHz
CL 0483	0.5 Vpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz Fluke 190-202/204: 221 MHz Fluke 190-102/104: 141 MHz Fluke 190-062: 91 MHz	SCOPE levsine, 0.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz 221 MHz 141 MHz 91 MHz
CL 0462	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0463	100 mVpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz Fluke 190-202/204: 221 MHz Fluke 190-102/104: 141 MHz Fluke 190-062: 91 MHz	SCOPE levsine, 100 mVpp, 501 MHz 381 MHz 151 MHz 111 MHz 221 MHz 141 MHz 91 MHz

Input C LF-HF Gain

Sections *Input C LF-HF Gain* and *Input D LF-HF Gain* are for 4-channel ScopeMeters (190-104, 190-204, and 190-504 models). For 2-channel models, proceed to the *Input AB Position* section.

To do the Input C LF-HF Gain calibration on 190-104, 190-204, and 190-504 models:

1. Connect Ch. C of the Test Tool to the 5502A as shown in Figure 5-5.
2. The display must show step CL 0694 (Pos C Fast). If it does not, then press F1 or F2 to select the first calibration step in Table 5-3.

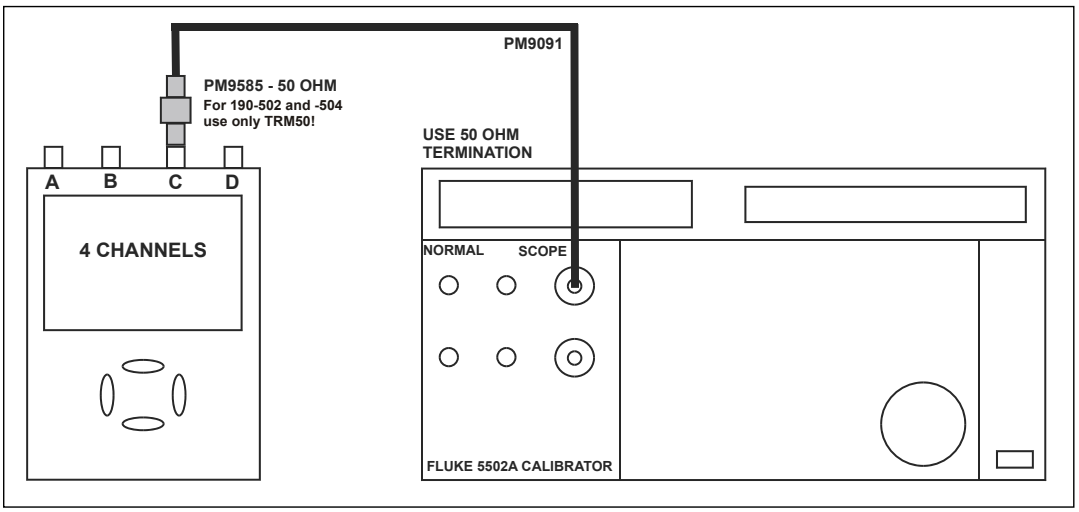


Figure 5-5. 5502A SCOPE Output to Test Tool Input C

3. Set the 5502A SCOPE output to source the signal required for the first calibration point in Table 5-3.
4. Set the 5502A to 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 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points of Table 5-3.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Input D LF-HF Gain* section.

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

Cal step	UUT input signal	5502A Setting
CL 0694	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0455	100 mVpp square wave, 1 kHz	SCOPE edge, 100 mVpp, 1 kHz
CL 0550	2.5 Vpp square wave, 1 kHz	SCOPE edge, 2.5 Vpp, 1 kHz
CL 0584	2.5 Vpp sine wave, 50 kHz	SCOPE levsine, 2.5 Vpp, 50 kHz
CL 0585	2.5 Vpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 2.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0484	500 mVpp sine wave, 50 kHz	SCOPE levsine, 500 mVpp, 50 kHz
CL 0485	0.5 Vpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz Fluke 190-202/204: 221 MHz Fluke 190-102/104: 141 MHz Fluke 190-062: 91 MHz	SCOPE levsine, 0.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz 221 MHz 141 MHz 91 MHz
CL 0464	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0465	100 mVpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz Fluke 190-202/204: 221 MHz Fluke 190-102/104: 141 MHz Fluke 190-062: 91 MHz	SCOPE levsine, 100 mVpp, 501 MHz 381 MHz 151 MHz 111 MHz 221 MHz 141 MHz 91 MHz

Input D LF-HF Gain

To do the Input D LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-4.
2. Connect Ch. D of the Test Tool to the 5502A as shown in Figure 5-6.
3. Set the 5502A SCOPE output to source the signal required for the first calibration point in Table 5-4 (CL 0675, Pos D Fast).
4. Set the 5502A to 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 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points of Table 5-4.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Input AB Position* section.

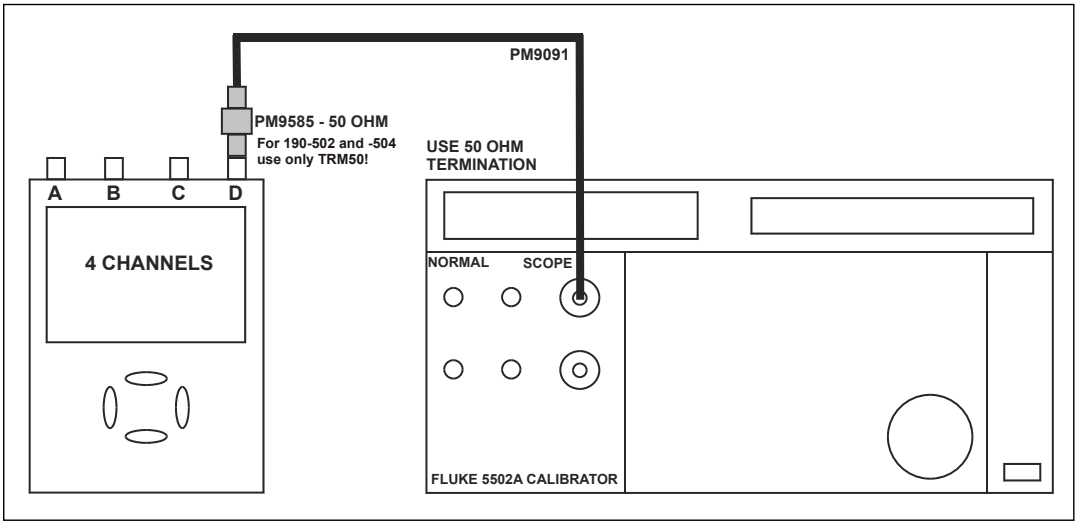


Figure 5-6. 5502A SCOPE Output to Test Tool Input D

Table 5-4. Input D LF-HF Gain Calibration Points

Cal step	UUT input signal	5502A Setting
CL 0675	0.5 Vpp square wave, 1 kHz	SCOPE edge, 0.5 Vpp, 1 kHz
CL 0475	100 mVpp square wave, 1 kHz	SCOPE edge, 100 mVpp, 1 kHz
CL 0590	2.5 Vpp square wave, 1 kHz	SCOPE edge, 2.5 Vpp, 1 kHz
CL 0586	2.5 Vpp sine wave, 50 kHz	SCOPE levsine, 2.5 Vpp, 50 kHz
CL 0587	2.5 Vpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz	SCOPE levsine, 2.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz
CL 0486	500 mVpp sine wave, 50 kHz	SCOPE levsine, 500 mVpp, 50 kHz
CL 0487	0.5 Vpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz Fluke 190-202/204: 221 MHz Fluke 190-102/104: 141 MHz Fluke 190-062: 91 MHz	SCOPE levsine, 0.5 Vpp, 501 MHz 381 MHz 151 MHz 111 MHz 221 MHz 141 MHz 91 MHz
CL 0466	100 mVpp sine wave, 50 kHz	SCOPE levsine, 100 mVpp, 50 kHz
CL 0467	100 mVpp sine wave Red subversion 5; Blue Subversion 2 Fluke 190-502/504: 501 MHz Fluke 190-202/204: 381 MHz Fluke 190-102/104: 151 MHz Fluke 190-062: 111 MHz Fluke 190-202/204: 221 MHz Fluke 190-102/104: 141 MHz Fluke 190-062: 91 MHz	SCOPE levsine, 100 mVpp, 501 MHz 381 MHz 151 MHz 111 MHz 221 MHz 141 MHz 91 MHz

Input AB Position

To do the Input AB Position calibration:

1. Press F2 to select calibration adjustment step **CL 0637** (Pos AB).
2. Remove all Input A, B connections (open inputs).
3. Press F3 to start the calibration.
4. Wait until the display shows calibration status **:READY**.
5. Continue at the *Input AB LF-HF Gain and Position* section.

Input AB LF-HF Gain and Position

To do the Input AB LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-5 for the subversion.
2. Connect Ch. A and B of the Test Tool to the 5502A as shown in Figure 5-7.

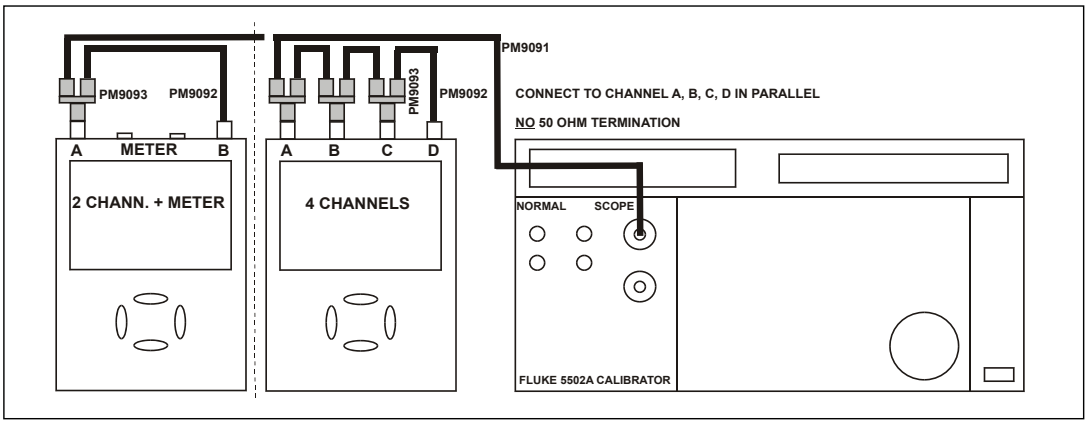


Figure 5-7. Test Tool Input ABCD to 5502A SCOPE Output

3. Set the 5502A to supply a 1 kHz square wave (SCOPE, MODE volt, SCOPE Z 1 MΩ), of 500 mV to channel A and B.

⚠⚠ Warning

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

4. Set the 5502A 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 5502A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-5.
8. Set the 5502A to Standby, and continue at the *Input Pos ABCD (AB) Calibration* section.

Table 5-5. Input AB Gain and Position Calibration Points

Cal step	UUT input value (5502A SCOPE, MODE volt, SCOPE Z 1 MΩ, 1 kHz)
CL 0504	500 mV, 1 kHz, MODE VOLT
CL 0624	Open inputs, Calibrator STBY
CL 0673	50 V, 1 kHz, MODE volt
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 5502A to OPR!)

Input Pos ABCD (AB) Calibration

To do the Input Pos AB calibration:

1. Press F2 to select calibration adjustment step CL 0619.
2. Remove all Input A, B connections (Calibrator STBY).
3. Press F3 to start the calibration.
4. Wait until the display shows calibration status **:READY**.
5. Continue at the *Input ABCD (AB) NoiseF FBW Calibration* section.

Input ABCD (AB) Noise F FBW Calibration

To do the Input AB NoiseF FBW Calibration:

1. Press F2 to select calibration adjustment step CL 0850.
2. Connect 50 Ω feed through terminations to all BNC Inputs A, B, (C, and D).
3. Press F3 to start the calibration.
4. Wait until the display shows calibration status **:READY**.
5. Continue at the *Input AB Volt Gain* section.

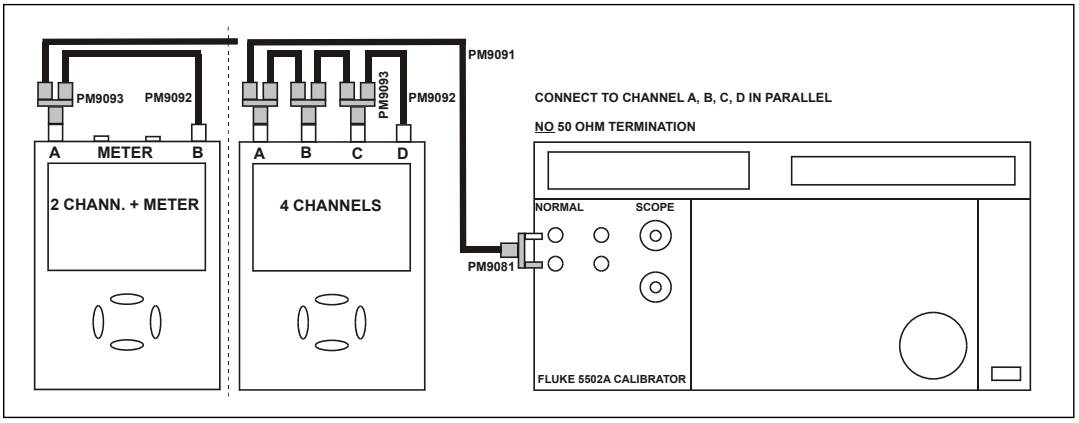
Input AB Volt Gain

⚠⚠ Warning

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

To do the Input AB Volt Gain calibration:

1. Press F2 to select the first calibration step in Table 5-6.
2. Connect Ch. A and B of the Test Tool to the 5502A NORMAL output as shown in Figure 5-8.



Perf-Ver-B2.eps

Figure 5-8. Test Tool Input AB to 5502A Normal Output

3. Set the 5502A to supply a DC voltage (NORMAL output), to the first calibration point in Table 5-6.

4. Set the 5502A 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 5502A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-6.
8. Set the 5502A to Standby, and continue at the *Multimeter (DMM) Meter Zero* section.

Table 5-6. Input ABCD Gain Calibration Points

Cal step	UUT input value (5502A NORMAL, dc output)
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 5502A to OPR!)
CL 0812	125 V
CL 0813	250 V

Multimeter Meter Zero

Note

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

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

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

Multimeter Volt Gain

⚠⚠ Warning

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

Note

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

To do the DMM Volt Gain calibration:

1. Press F2 to select the first calibration step in Table 5-7.
2. Connect the Test Tool to the 5502A as shown in Figure 5-9.

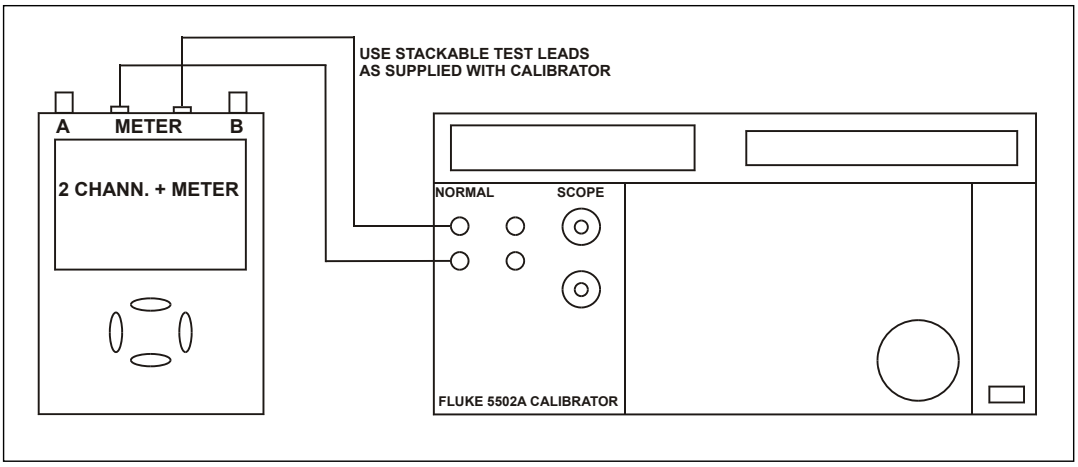


Figure 5-9. 5502A NORMAL Output to Test Tool Banana Input

3. Set the 5502A to supply a DC voltage to the first calibration point in Table 5-7.
4. Set the 5502A 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 5502A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-7.
8. Set the 5502A to Standby, and continue at the *Multimeter (DMM) Ohm Gain* section.

Table 5-7. DMM Volt Gain Calibration Points

Cal step	UUT input value (5502A NORMAL, dc output)
CL 0840	500 mV
CL 0849	2.5 V
CL 0841	5 V
CL 0842	50 V (set 5502A to OPR!)
CL 0843	500 V
CL 0844	1000 V

Multimeter Ohm Gain

Note

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

To do the DMM Ohm Gain calibration:

1. Press F2 to select the first calibration adjustment step in Table 5-8.
2. Connect the Test Tool to the 5502A as shown in Figure 5-10. Notice that the sense leads must be connected directly to the Test Tool inputs.

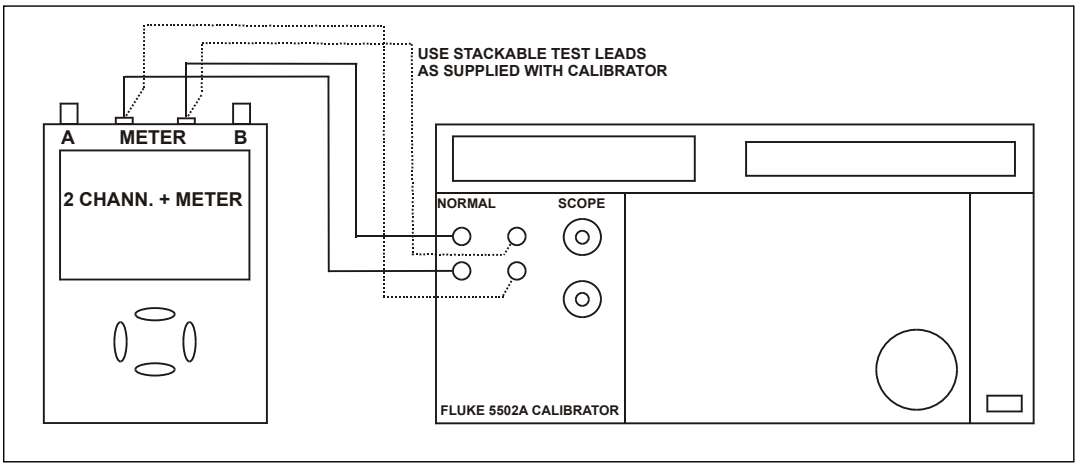


Figure 5-10. Four-wire Ohms Calibration Connections

3. Set the 5502A to the first test point in Table 5-8. Use the 5502A “COMP 2 wire” mode for the calibration adjustments up to and including 100 kΩ. For the higher values, the 5502A will turn off the “COMP 2 wire” mode.
4. Set the 5502A to operate (OPR).

5. Press F3 to start the calibration.
6. Wait until the display shows the calibration status **:READY**.
7. Press F2 to select the next calibration step, set the 5502A to the next calibration point, and start the calibration. Continue through all calibration points.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Save Calibration Data and Exit* section.

Table 5-8. 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

Final Calibration (Firmware: V10.9 and Lower)

The Final Calibration steps depend on the software that is installed in your Test Tool.

To view the software version installed on your Test Tool:

1. Press USER.
2. Press F3 and **– VERSION & CAL ….**

If the installed firmware is **V09.00, V10.00 or V10.4x**, do the steps in this *Final Calibration (Firmware: V10.9 and Lower)* section. For firmware **V11.10**, do the steps in *Final Calibration For V11.10 and later* section.

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

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 are done automatically. For example, if you start calibration step CL 0852, the calibration can include step CL 0929 and at the end the display shows CL 0929: READY.

Note

You must always start the Final Calibration at the first step. See the Warm Up Final and ADC Timing *section. Starting at any other step will make the calibration invalid.*

If you proceed 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. You must repeat the calibration starting at *Warm-Up Final and ADC Timing*.

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

If the error persists, the Test Tool is defective.

Warm-Up Final and ADC Timing

The Warm-Up Final step (CL 0201) must be done with open inputs:

1. Press F3 to start the calibration.
2. Wait until the display shows calibration status **:READY**.
3. Press F2 to select the next calibration step (CL 0570).

4. Connect the Test Tool to the 5502A SCOPE output as shown in Figure 5-11. Use the 50 Ω termination.
5. Set the 5502A to generate a sine wave 50 MHz / 0.5 V pp (mode LEVSINE) at the SCOPE output.
6. Set the 5502A to operate (OPR).
7. Press F3 to start the calibration.
8. Wait until the display shows calibration status **:READY**.
9. Set the 5502A to standby (STBY).
10. Continue at the *Input A LF-HF Gain* section.

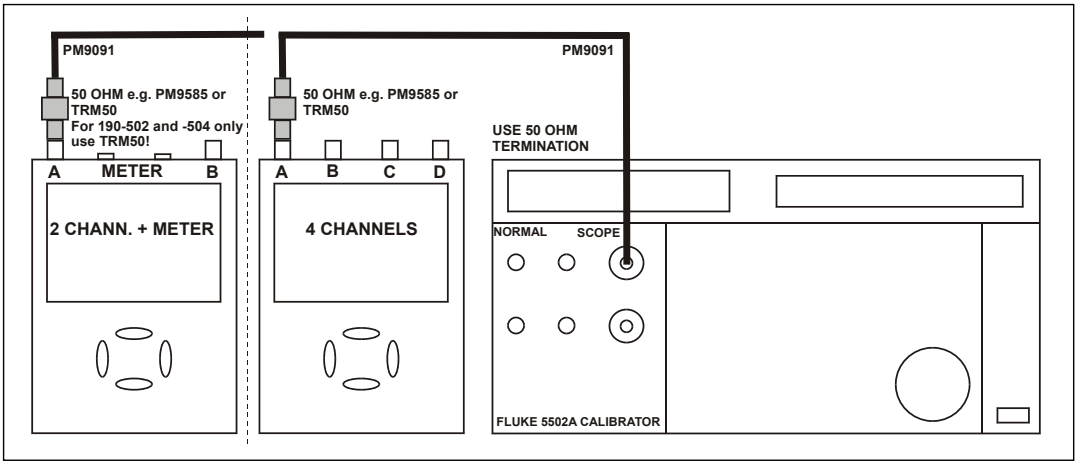


Figure 5-11. 5502A SCOPE Output to Test Tool Input A

Input A LF-HF Gain

To do the Input A LF-HF Gain calibration:

1. Connect the Test Tool to the 5502A as shown in Figure 5-11.
2. The display must show step CL 0654. If it does not, press F2 or F1 to select the first calibration step in Table 5-9.
3. Set the 5502A SCOPE output to source the signal required for the first calibration point in Table 5-9.
4. Set the 5502A to 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 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points of Table 5-9 and Table 5-10.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Input B LF-HF Gain* section.

Table 5-9. Input A LF-HF Gain Calibration Points

Cal step	UUT input signal	5502A 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 5-10. Input A LF-HF Gain Calibration Points (Extra steps for 190-104/204, V10.4x firmware *)

Cal step	UUT input signal	5502A 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 firmware 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 …*

Input B LF-HF Gain

To do the Input B LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-11.
2. Connect the Test Tool to the 5502A as shown in Figure 5-12.

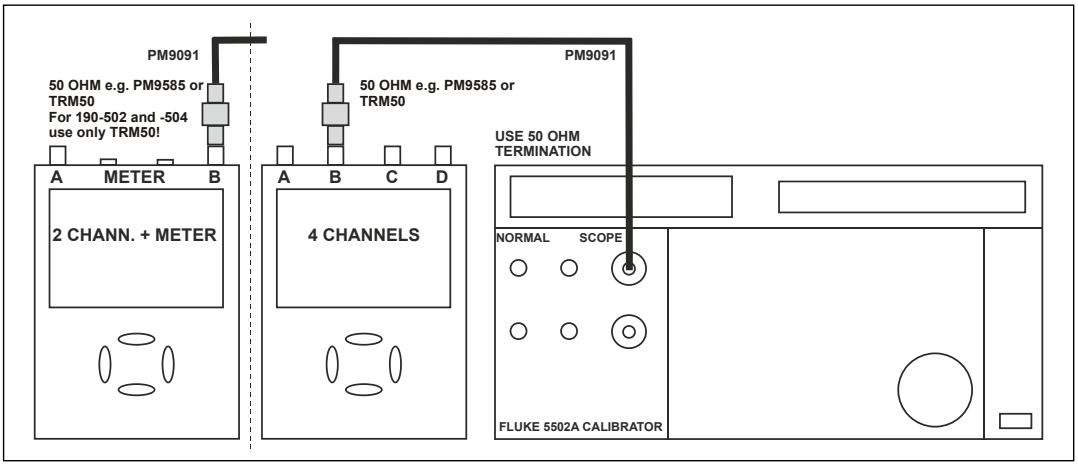


Figure 5-12. 5502A SCOPE Output to Test Tool Input B

3. Set the 5502A SCOPE output to source the signal required for the first calibration point in Table 5-11.
4. Set the 5502A to 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 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points of Table 5-11 and Table 5-12.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Input C LF-HF Gain* section.

Table 5-11. Input B LF-HF Gain Calibration Points

Cal step	UUT input signal	5502A 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 5-12. Input B LF-HF Gain Calibration Points (Extra steps for 190-104/204, V10.4x firmware *)

Cal step	UUT input signal	5502A 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 firmware 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: …*		

Input C LF-HF Gain

Note

The adjustment steps for channel C are only for the models 190-104 and 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 5-13.
2. Connect the Test Tool to the 5502A as shown in Figure 5-13.

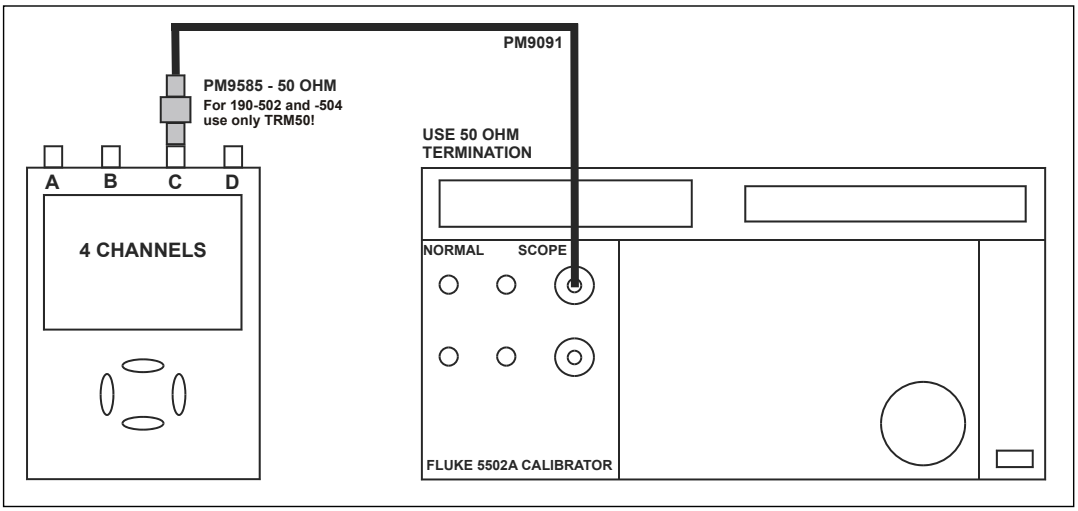


Figure 5-13. 5502A SCOPE Output to Test Tool Input C

3. Set the 5502A SCOPE output to source the signal required for the first calibration point in Table 5-13.
4. Set the 5502A 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 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points of Table 5-13 and Table 5-14.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Input D LF-HF Gain* section.

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

Cal step	UUT input signal	5502A 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 5-14. Input C LF-HF Gain Calibration Points (Extra steps for 190-104/204, V10.4x firmware *)

Cal step	UUT input signal	5502A 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 firmware 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: …*		

Input D LF-HF Gain

Note

The adjustment steps for channel D are only for the models 190-104 and 190-204.

To do the Input D LF-HF Gain calibration:

1. Press F2 to select the first calibration step in Table 5-15.
2. Connect the Test Tool to the 5502A as shown in Figure 5-14.

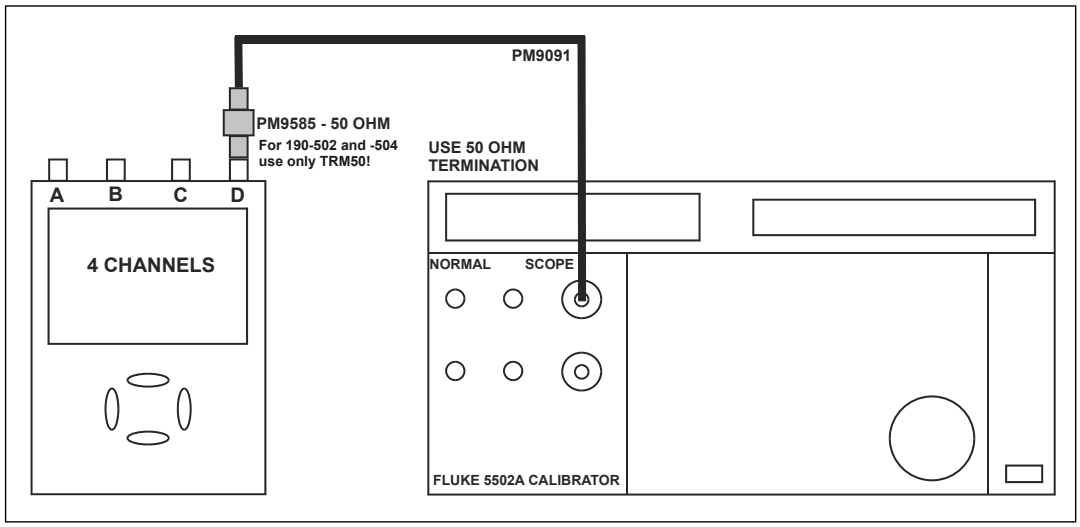


Figure 5-14. 5502A SCOPE Output to Test Tool Input D

3. Set the 5502A SCOPE output to source the signal required for the first calibration point in Table 5-15.
4. Set the 5502A 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 5502A to the next calibration point signal, and start the calibration.

   Continue through all calibration points of Table 5-15 and Table 5-16.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Input ABCD (AB) LF-HF Gain* section.

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

Cal step	UUT input signal	5502A 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 5-16. Input D LF-HF Gain Calibration Points (Extra steps for 190-104/204, V10.4x firmware *)

Cal step	UUT input signal	5502A 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 firmware 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: …*		

Input ABCD (AB) LF-HF Gain

Note

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

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 5502A as shown in Figure 5-15.

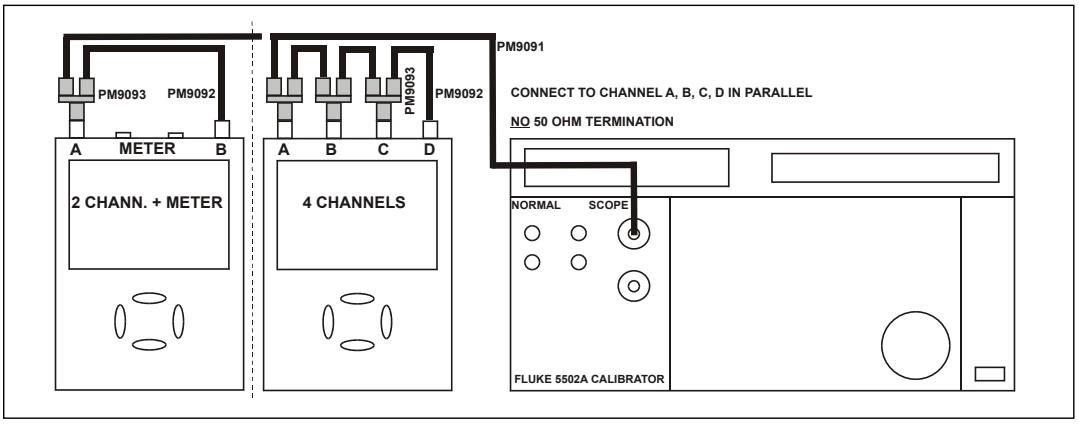


Figure 5-15. Test Tool Input ABCD to 5502A SCOPE Output

3. Set the 5502A to supply a 1 kHz square wave (SCOPE, MODE volt, SCOPE Z 1 MΩ) to the first calibration point in Table 5-17.

⚠⚠ Warning

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

4. Set the 5502A 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 5502A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-17.
8. Set the 5502A to Standby, and continue at the *Input ABCD (AB) Position* section.

Table 5-17. Input ABCD Gain Calibration Points

Cal step	UUT input value (5502A 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 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 5502A to OPR)

Input ABCD (AB) Position

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 the *Input ABCD (AB) Volt Gain* section.

Input ABCD (AB) Volt Gain

⚠⚠ Warning

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

Note

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

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 5502A as shown in Figure 5-16.

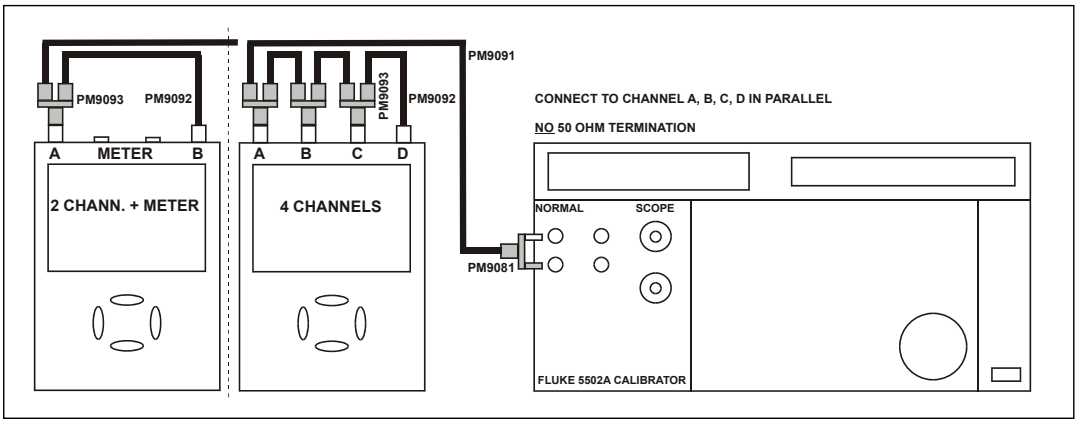


Figure 5-16. Test Tool Input ABCD to 5502A Normal Output

3. Set the 5502A to supply a DC voltage (NORMAL output) to the first calibration point in Table 5-18.
4. Set the 5502A 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 5502A to the next calibration point, and start the calibration. Continue through all calibration points of Table 5-18.
8. Set the 5502A to Standby and continue at the *Input ABCD (AB) Zero* section.

Table 5-18. Input ABCD Gain Calibration Points

Cal step	UUT input value (5502A 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 5502A to OPR!)
CL 0812	125 V
CL 0813	250 V

Input ABCD (AB) Zero

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 50 Ω 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. For Fluke 190-062, 190-102, and 190-202: continue at the *Multimeter (DMM) Volt Gain* section. For Fluke 190-104 and 190-204: continue at the *Save Calibration Data and Exit* section.

Multimeter Volt Gain

⚠⚠ Warning

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

Note

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

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 5502A as shown in Figure 5-17.

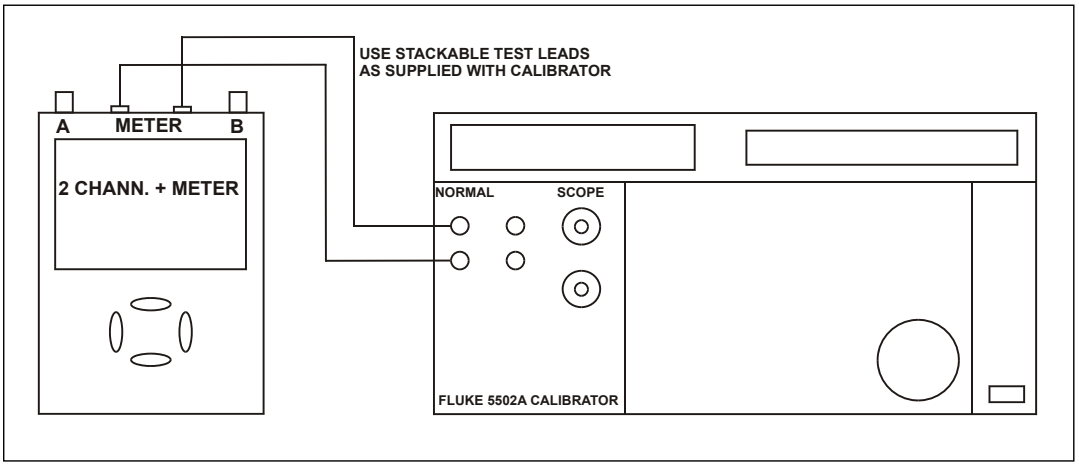


Figure 5-17. 5502A NORMAL Output to Test Tool Banana Input

3. Set the 5502A to supply a DC voltage, to the first calibration point in Table 5-19.
4. Set the 5502A 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 5502A to the next calibration point, and start the calibration. Continue through all calibration points in Table 5-19.
8. Set the 5502A to Standby and continue at the *Multimeter (DMM) Numeric Zero* section.

Table 5-19. DMM Gain Calibration Points

Cal step	UUT input value (5502A NORMAL)
CL 0840	500 mV
CL 0849	2.5 V
CL 0841	5 V
CL 0842	50 V (set 5502A to OPR!)
CL 0843	500 V
CL 0844	1000 V

Multimeter Numeric Zero

Note

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

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 the *Multimeter (DMM) Ohm Gain* section.

Multimeter Ohm Gain

Note

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

To do the DMM Ohm Gain calibration:

1. Press F2 to select the first calibration adjustment step in Table 5-20.
2. Connect the Test Tool to the 5502A as shown in Figure 5-18. Notice that the sense leads must be connected directly to the Test Tool.

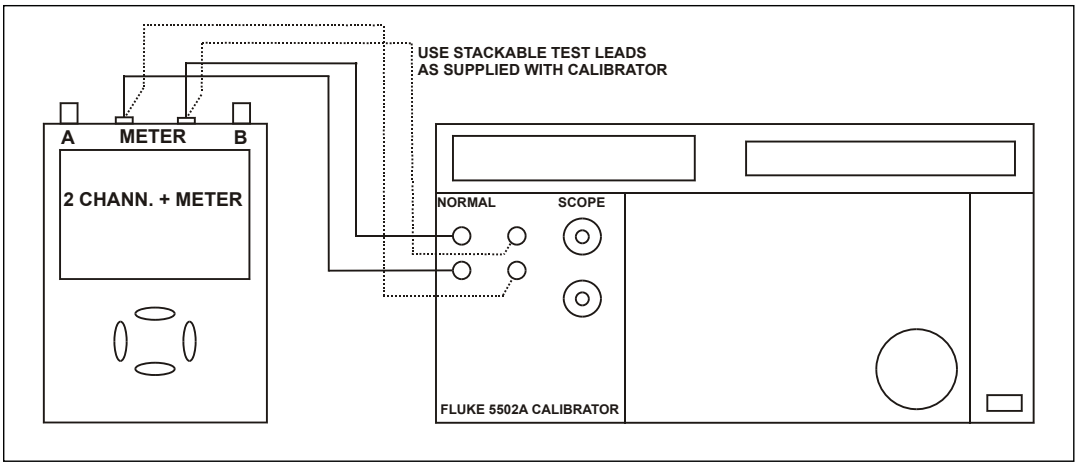


Figure 5-18. Four-wire Ohms Calibration Connections

3. Set the 5502A to the first test point in Table 5-20. Use the 5502A "COMP 2 wire" mode for the calibration adjustments up to and including 100 kΩ. For the higher values, the 5502A will turn off the "COMP 2 wire" mode.
4. Set the 5502A to operate (OPR).
5. Press F3 to start the calibration.
6. Wait until the display shows the calibration status **:READY**.
7. Press F2 to select the next calibration step, set the 5502A to the next calibration point, and start the calibration. Continue through all calibration points.
8. When you are finished, set the 5502A to Standby.
9. Continue at the *Save Calibration Data and Exit* section.

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

Save Calibration Data and Exit

To save the calibration data and exit the Maintenance mode:

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

   Calibration data valid.

   Save data and exit maintenance mode?

Note

Calibration data valid indicates that the calibration adjustment procedure is performed correctly. It does not necessarily mean that the Test Tool meets the specifications listed in Chapter 2.

3. Press F4 (YES) to save and exit.

Note

After saving the calibration data, the calibration number and date updates if the calibration data changes and the data are valid.

The calibration number and date do not change if:

- *the calibration mode is entered and left without doing a calibration adjustment.*
- *only the contrast calibration adjustment and/or the probe calibration are done.*

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.*

Error messages:

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

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

1. Press F4 (YES).

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

   The instrument needs calibration.
   Please contact your service center.

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

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

1. Press F3 (NO).
2. Press F1 until the display shows **WarmingUp (CL 0200):IDLE**, and calibrate the Test Tool, starting at *Warming-Up and Pre-Calibration*.

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

1. Turn the Test Tool off.

Probe Calibration

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

To adjust the VPS410-II probes:

1. Connect the red probe from the red Input A BNC to the banana jack. See Figure 5-19.

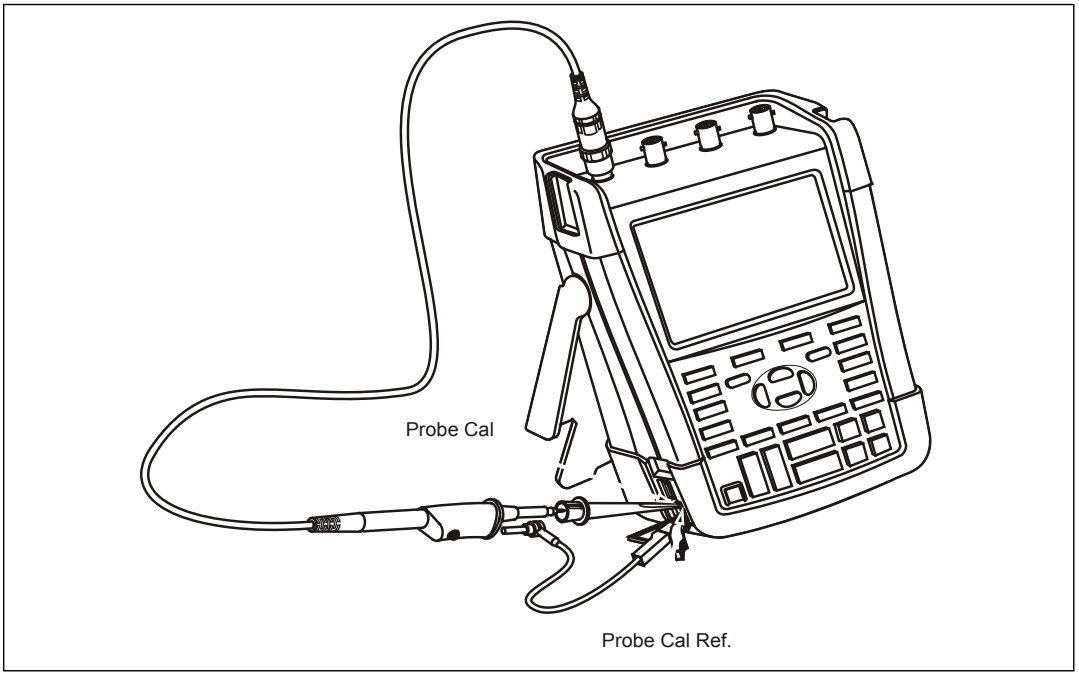


Figure 5-19. 10:1 Probe Calibration Connection

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 shown on the display.

7. Press F4 to start the probe calibration.

   The first step is to manually adjust the square wave response to a pure square wave (pulse top must be straight, see Figure 5-20). The trimmer is located in the probe housing and is reached by rotating the center part of the housing. For more information, see the instruction sheet for the probe.

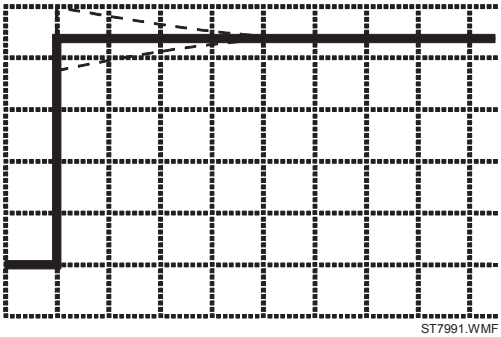


Figure 5-20. 10:1 Probe Calibration

8. When done, press F4 to start the DC calibration automatically.

   The Probe Calibration is OK if all instructions shown on the display are finished successfully.

9. Close the hole of the trimmer by rotating the center part of the housing: this is important for safe use of the probe at high input voltages.

10. Repeat the procedure for the blue VPS410-II-B probe that is connected between the blue Input B BNC and the probe calibration terminals on the left side of the instrument.

Chapter 6
Disassembly

Title **Page**

Introduction

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

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

The Test Tool contains a Li-ion battery pack. See Section 1 for instructions on how to safely handle and use this battery pack.

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

At the end of this chapter, see Figures 6-2, 6-3, and 6-4 for disassembly.

⚠⚠Warning

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

Disassembly and Reassembly Procedures

Required Tools

To access all the assemblies, you need:

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

Remove the Tilt Stand, Hang Strap, and Side Strap

To separate the tilt stand from the rear case: 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 the “Tips” Chapter. 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 you do this, take careful notice on the correct position of the strap. To install, work in reverse order.

Open the Test Tool, Remove the Battery Pack

Proceed as follows:

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

Note

Do not short circuit the battery contacts. Do not open or damage the battery housing.

4. If attached, remove the hang strap and the side strap (see the *Removing the Tilt Stand, Hang Strap, and Side Strap* section).
5. Loosen the two black self-tapping screws that fasten the grey/yellow input cover around the BNC input and banana sockets.
6. Remove the cover.

Note

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

When reinstalling the input cover, reinstall the four steel pins (2x17 mm) in the left side and right side of the Test Tool. The pins are used to attach the hang strap and the side strap.

7. Remove the two screws M3x10 (total length) from the bottom holster. The screws fit into square nuts that fit into the rear case.
8. Remove the bottom holster.

Note

When reinstalling the holster, reinstall the two steel pins (2x17 mm) in the left side and right side of the instrument. The pins are used to attach the side strap. Take care that the yellow covers for the DC input and USB inputs are in place correctly.

9. Remove the four self-tapping screws 16 mm long (total length) that attach the rear case. Two of these screws are located in the battery compartment.
10. Remove the rear case.

Note

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

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

How to Access the Top Side of PCA

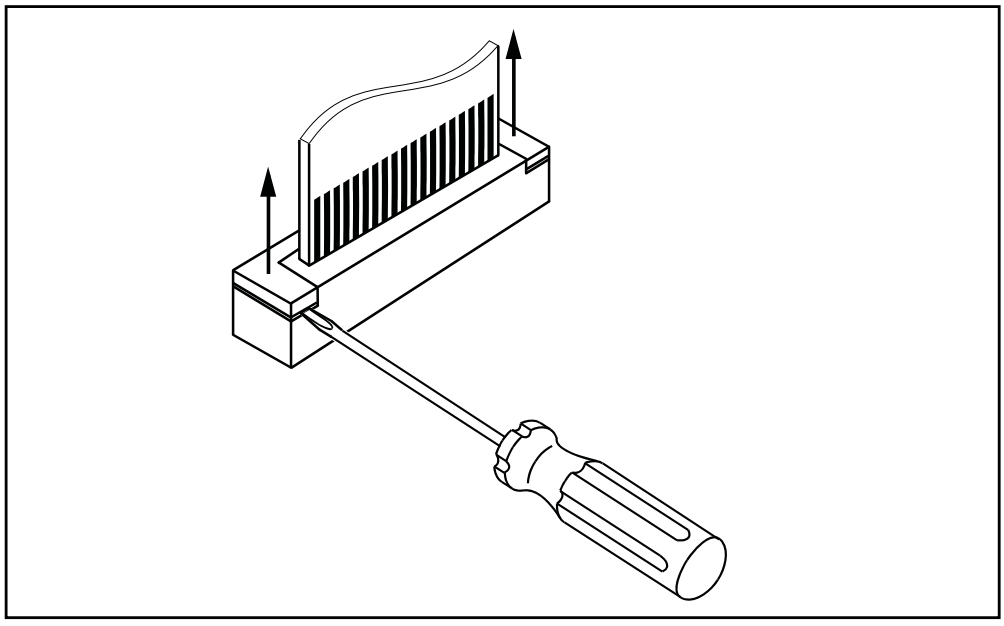
Most of the measurement points are located on the top side of the PCA. For access to this side, remove the upper plate (shielding lid):

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

How to Access the Bottom Side of PCA

To avoid contaminating the flex cable contacts with grease from your fingers, do not touch these contacts or wear cotton gloves. Contaminated contacts may not cause immediate instrument failure. Failures 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. See Figure 6-1.



st8682.eps

Figure 6-1. Flat Cable Connector

2. Remove the flat cables from connector X9303 (to LCD), J9414 (to keyboard), J9415 (to LCD backlight).
3. Remove the four screws M3x10 that fix the PCA to the lower chassis (shielding assembly).
4. Carefully slide the PCA out of the holes for the BNCs and Banana Jacks (2-ch Test Tools). The A, B, and Meter input circuits are covered with an isolation foil.
5. Take careful notice on how the foil is positioned around the PCA before you remove the foil as far as required to repair a defective channel.

6. Remove a screw M3x22 that fixes the top and bottom screening of the suspected channel.
7. Reinsert the flat cables if you want to measure the bottom side of the PCA under working condition. See Figures 6-2, 6-3, and 6-4 at the end of this chapter.

Note

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

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 self-tapping screws 10 mm long (total length) that fix the Main PCA module to the top case assembly.
4. Separate the Main PCA module from the top case.

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

Note

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

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

Disassembly Steps

See Figures 6-2, 6-3, and 6-4 for guidance on disassembly.

Note

Pictures may be subject to minor changes without prior notice.

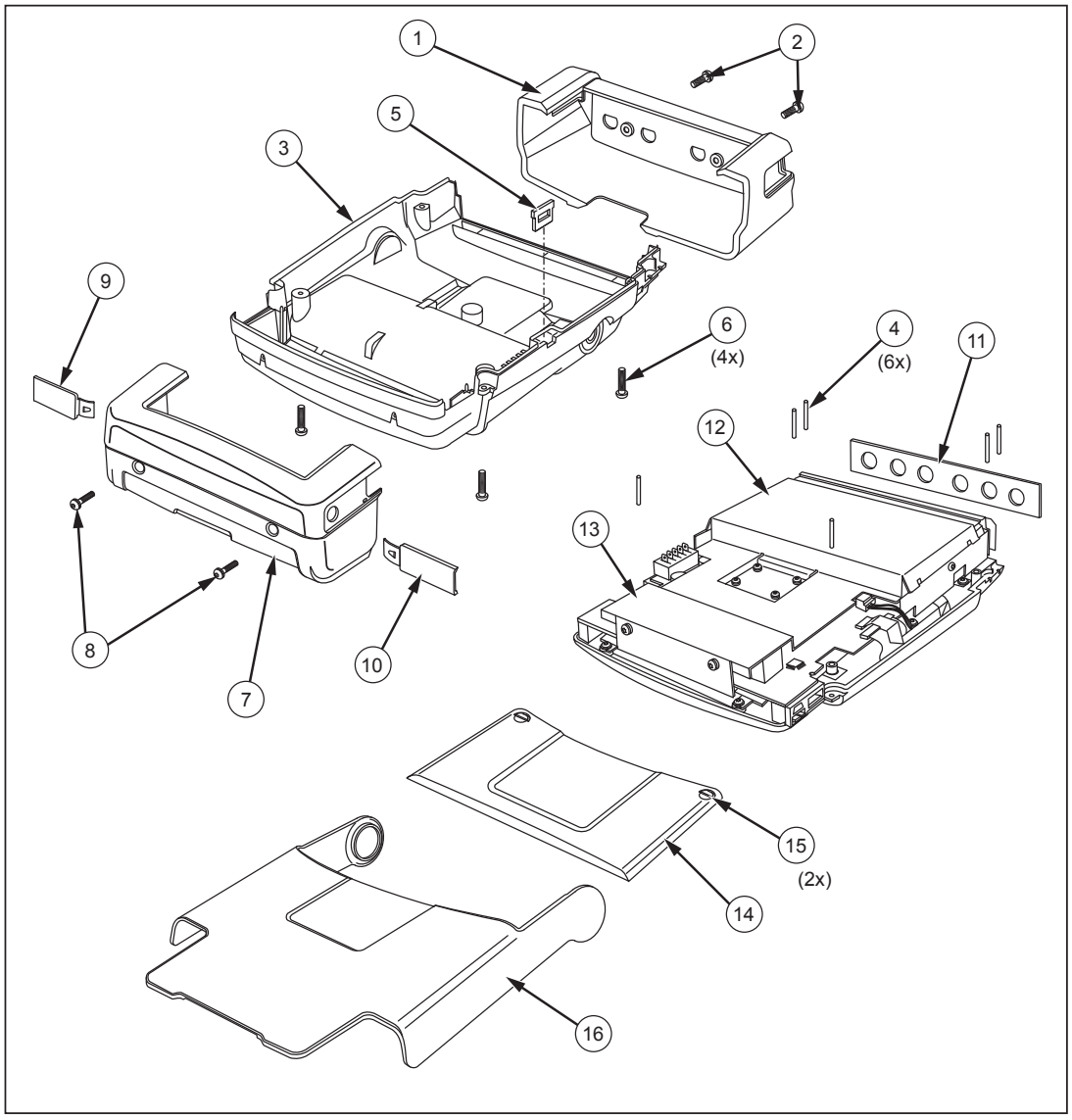


Figure 6-2. Opened Case and Screws

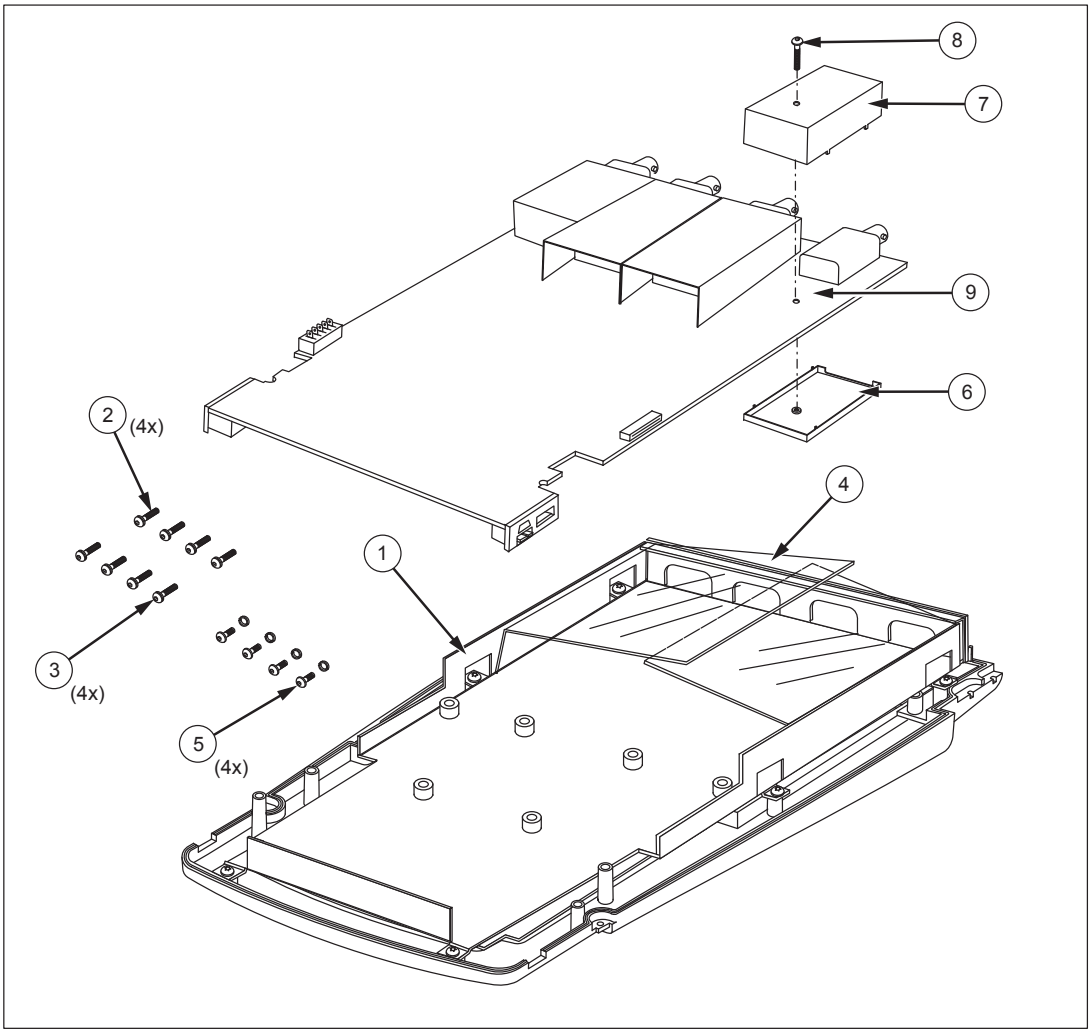


Figure 6-3. Screening Plate Removed and Screws

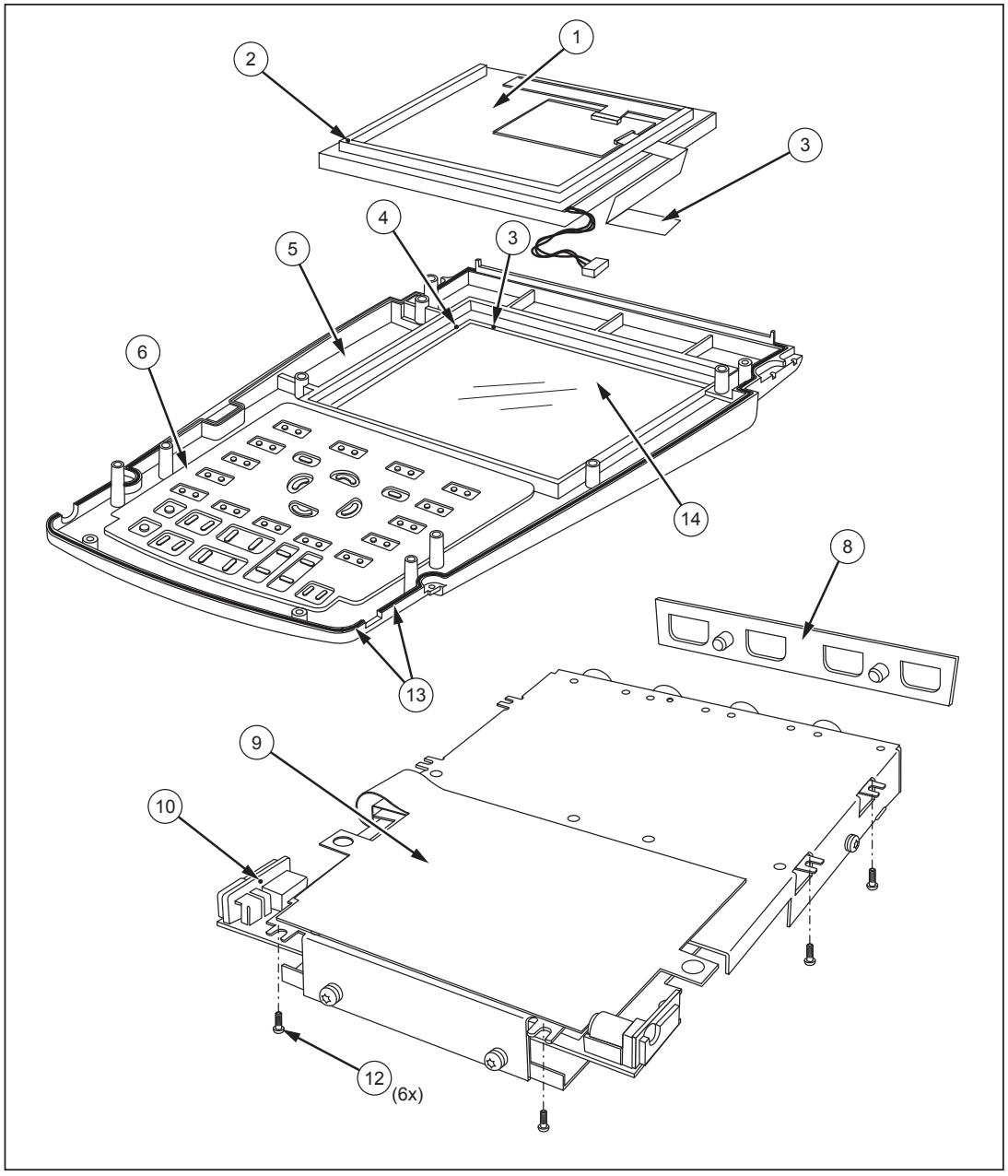


Figure 6-4. PCA Removed from Chassis, Bottom Side Visible

Manual Supplement

Manual Title:	190 Series II User	Supplement Issue:	**1**
Print Date:	May 2011	Issue Date:	3/15
Revision/Date:	2, 1/14	Page Count:	1

This supplement contains information necessary to ensure the accuracy of the above manual. This manual is distributed as an electronic manual on the following CD-ROM:

CD Title:	190 Series II
CD Rev. & Date:	2, 1/2014
CD PN:	0040 244 00774 and 0040 247 00784

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Change #1, 115

On page 9, remove the following sentence from the top of the page:

As a result they can be shipped unrestricted internationally by any means.

Manual Supplement

Manual Title:	**190 Series II Service**		
	Fluke 190-062, -102, -104, -202, -204, -502, -504		
Print Date:	February 2013	Supplement Issue:	**4**
Revision/Date:	2, 2/15	Issue Date:	12/19
		Page Count:	2

This supplement contains information necessary to ensure the accuracy of the above manual.

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Change #1, 134

On page 4-19, replace Table 4-7 with:

Table 4-7. Input A, B, C, D Frequency Measurement Accuracy Test

Model	Time base	5502A-SC... MODE	Voltage	Frequency	Input A, B 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
190-502 190-504 [1]	10 ns/div	levsine	600 mVpp	500 MHz	497.3 to 502.7

[1] Due to the decreased sampling rate with more than 2 inputs on, the 500 MHz check of a 190-504 must be done with only 2 channels on. Check with A & B on, C & D off, then with A & B off, C & D on.

Change #2, 413

On page 4-10, replace Table 4-2 with:

Table 4-2. Vertical Accuracy Verification Points Allowable 5502A

Range	Initial 5502A Setting, V ac, sine, 50 Hz	Allowable 5502A Output for trace amplitude of 6 divisions
2 mV/div	4.243 mV	4.063 to 4.423
5 mV/div	10.606 mV	10.313 to 10.899
10 mV/div	21.213 mV	20.626 to 21.800
20 mV/div	42.426 mV	41.252 to 43.600
50 mV/div	106.06 mV	103.13 to 108.99
100 mV/div	212.13 mV	206.26 to 218.00
200 mV/div	424.26 mV	412.52 to 436.00
500 mV/div	1.0607 V	1.0314 to 1.0900
1 V/div	2.1213 V	2.0626 to 2.1800
2 V/div	4.2426 V	4.1252 to 4.3600
5 V/div	10.606 V	10.313 to 10.899
10 V/div	21.213 V	20.626 to 21.800
20 V/div	42.426 V	41.252 to 43.600
50 V/div	106.06 V	103.13 to 108.99
100 V/div	212.13 V	206.26 to 218.00

Change #3, 643, 655

Remove Chapter 2: ***Specifications***

See the *ScopeMeter 190 Series II Product Specifications*.

On page 3-5, Table 3-1, add the following and replace the Note section with:

LENS MDA-510,FOR SERVICE	5035464		
LENS MDA-550,FOR SERVICE	5035473		
HANDSTRAP MDA,FOR SERVICE	5035486		
KEYPAD MDA,FOR SERVICE	5035499		

[1] Later PCA sub code 5 or 6
[2] Early PCA sub code 2 or firmware version ≤10.

Check that the serial number is ≥25375604. If yes, use the later connectors. If <25375604, evaluate the firmware and subversion. To find the version, press in sequence, USER and F3 VERSION & CAL. If the firmware version is <V11.00, use the early connectors. If the firmware is ≥V11.10, check under subversions that the last datablock is x5xx (for instance 2516). This value determines that the higher frequency adjust point should be used.

- for x5xx or x6xx: use the later connectors
- for x2xx: use the early connectors

On page 4-3, Table 4-1 add:

MDA-510	Four 500 MHz Scope Inputs (BNC), With Motor Drive Analysis
MDA-550	Four 500 MHz Scope Inputs (BNC), With Motor Drive Analysis

On page 5-3, under step 3, replace the first bullet with:

- 5 or 6: The Final Calibration for V11.10 and later procedure should be done. Use the levels in Red.

On page 5-15, Table 5-2, page 5-17, Table 5-3 and page 5-19, Table 5-4 replace the 3 occurrences in each table:

From: Red subversion 5; Blue Subversion 2
To: Red subversion 5 or 6; Blue Subversion 2

Change #4, SP12

On page 5-37, Table 5-17, insert a new row after row 10:

CL 0603	250 mV