7 Performance Verification

This procedure can be used to verify the warranted characteristics of the HFP2500 High Frequency Probe.

The recommended calibration interval for the model HFP2500 is one year. The complete performance verification procedure should be performed as the first step of annual calibration. Test results can be recorded on a photocopy of the Test Record provided in Appendix A at the end of the manual.

Performance verification can be completed without removing the probe covers or exposing the user to hazardous voltages. Adjustment should only be attempted if a parameter measured in the Performance Verification Procedure is outside the specification limits.

Note:

Adjustment should only be performed by qualified personnel.

This procedure tests the following specifications:

- Output Zero Voltage
- Offset Accuracy
- LF Attenuation Accuracy

TEST EQUIPMENT REQUIRED

Table 7-1 lists the test equipment and accessories (or their equivalents) that are required for performance verification of the HFP2500 Probe.

This procedure has been developed to minimize the number of calibrated test instruments required.

Only the parameters listed in **boldface** in the "Minimum requirements" column must be calibrated to the accuracy indicated.

Because the input and output connectors types may vary on different brands and models of test instruments, additional adapters or cables may be required.

Table 7-1. List of Required Equipment

Description	Minimum Requirements	Test Equipment Examples
Digital Oscilloscope	ProBus interface	LeCroy WavePro960 or LeCroy LT344
Digital Multimeter (DMM) with test probe leads	4.5 digit **DC: 0.1% Accuracy** **AC: 0.1% accuracy**	Agilent Technologies 34401A or Fluke 8842A-09
Function Generator	Sine Wave output amplitude adjustable to 14.14 Vp-p (5 Vrms) into 1 MΩ at 70 Hz	Agilent Technologies 33120A or Stanford Research Model DS340
Power Supply	0-12 V, settable to 10 mV	HP E3611A
BNC Coaxial Cable (2 ea.)	Male to Male, 50 Ω, 36" Cable	Pomona 2249-C-36 or Pomona 5697-36
BNC Tee Connector	Male to Dual Female	Pomona 3285
Calibration Fixture	ProBus Extender Cable	LeCroy PROBUS-CF01
Terminator, Precision, BNC	50 Ω ± 0.05%	LeCroy TERM-CF01
Banana Plug Adapter (2 ea.)	Female BNC to Dual Banana Plug	Pomona 1269
BNC to Mini-grabber	BNC Male to Mini-grabber Cable, 36"	Pomona 5187-C-36

PRELIMINARY PROCEDURE

1. Connect the HFP2500 probe to the female end of the ProBus Extension Cable. Connect the male end of the ProBus Extension Cable to channel 1 of the oscilloscope.
2. Turn the oscilloscope on and allow at least 30 minutes warm-up time for the HFP2500 and test equipment before performing the Verification Procedure.
3. Turn on the other test equipment and allow these to warm up for the time recommended by the manufacturer.
4. While the instruments are reaching operating temperature, make a photocopy of the Performance Verification Test Record (located in Appendix A), and fill in the necessary data.
5. Select the channel to which the probe is connected. Set the oscilloscope scale factor to 20 mV/div.

6. Disconnect the ProBus Extender Cable from the oscilloscope. Verify that the scale factor changes from 20 mV/div to 2 mV/div.
7. Re-connect the ProBus extender Cable to the oscilloscope.

The warranted characteristics of the HFP2500 are valid at any temperature within the Environmental Characteristics listed in the Specifications. However, some of the other test equipment used to verify the performance may have environmental limitations required to meet the accuracy needed for the procedure. Make sure that the ambient conditions meet the requirements of all the test instruments used in his procedure.

Note

*The correct operation of the HFP2500 controls requires software version 8.7.0 or higher. The software version in the test oscilloscope can be verified by pushing **SCOPE STATUS**, then selecting the **System** menu option.*

Contact your local LeCroy representative if the software in your oscilloscope requires updating.

FUNCTIONAL CHECK

The functional check will verify the basic operation of the probe functions.

It is recommended the Functional Check be performed prior to the Performance Verification Procedure.

1. Return to the factory default settings by:
    a. Pressing the oscilloscope's front panel **PANELS** button.
    b. From the Menu buttons press **FROM DEFAULT SETUP.**
2. Select Channel 1 and enter the **Coupling** menu.
3. Verify that **Probe sensed (HFP2500)** is displayed on the right hand menu.
4. If the trace colors have been reassigned or you are unsure, restore the default colors by pressing the following menus:

DISPLAY, **More Display Setup**, **Color Scheme** and in the Color Scheme menu press **1**.

5. Verify that the probe head LED shows basically the same color as the channel 1 trace color.
6. Disconnect the probe from channel 1 and connect respectively to channel 2, 3 and 4.
7. Verify that in each case the LED color corresponds to the trace color of the channel to which the probe is connected.

PROCEDURE

A. Output Zero Voltage

1. Connect one end of a BNC cable to the female BNC connector on the probe end of the ProBus extender cable. Connect the precision 50 Ω terminator to the other end of the BNC cable.
2. Connect the banana plugs of the Precision terminator to the input of the DMM. Make sure that the plug corresponding to the BNC shield (marked "Ground") is connected to the **LO** or **COMMON** input of the DMM. Refer to figure 7-1 for setup information.

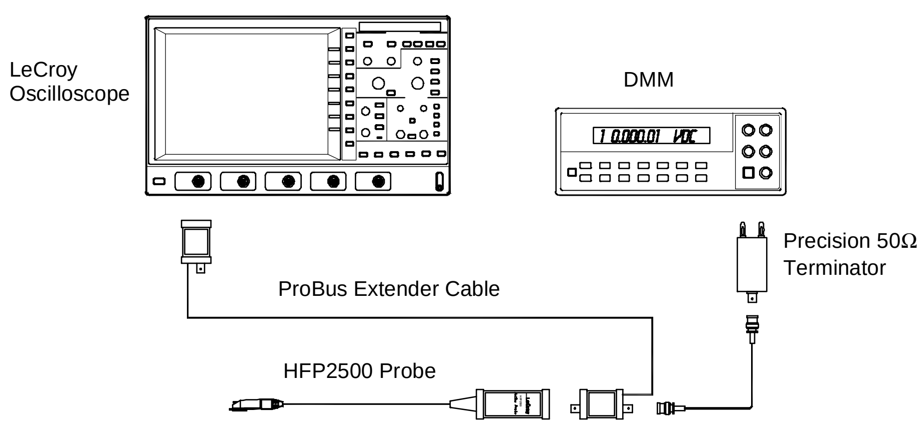

Figure 7-1. Output Zero Voltage Test Setup

3. Set the **OFFSET** on the oscilloscope to zero, as indicated by on-screen display.
4. Set the DMM to read DC Volt on the most sensitive range.
5. Record the voltage measured on the DMM to 10 µV resolution as ’Output Zero Voltage’ in the Test record.
6. Check that the voltage indicated by the DMM is between ±800 µV.
7. Disconnect the DMM from the precision 50 Ω terminator. Leave the remaining setup in place for the next step.

B. Offset Accuracy

1. Connect the BNC end of the BNC to mini-grabber cable to a female end of the BNC tee adapter and connect a female BNC to dual banana plug adapter to the male end of the BNC tee. (Refer to figure 7-2)

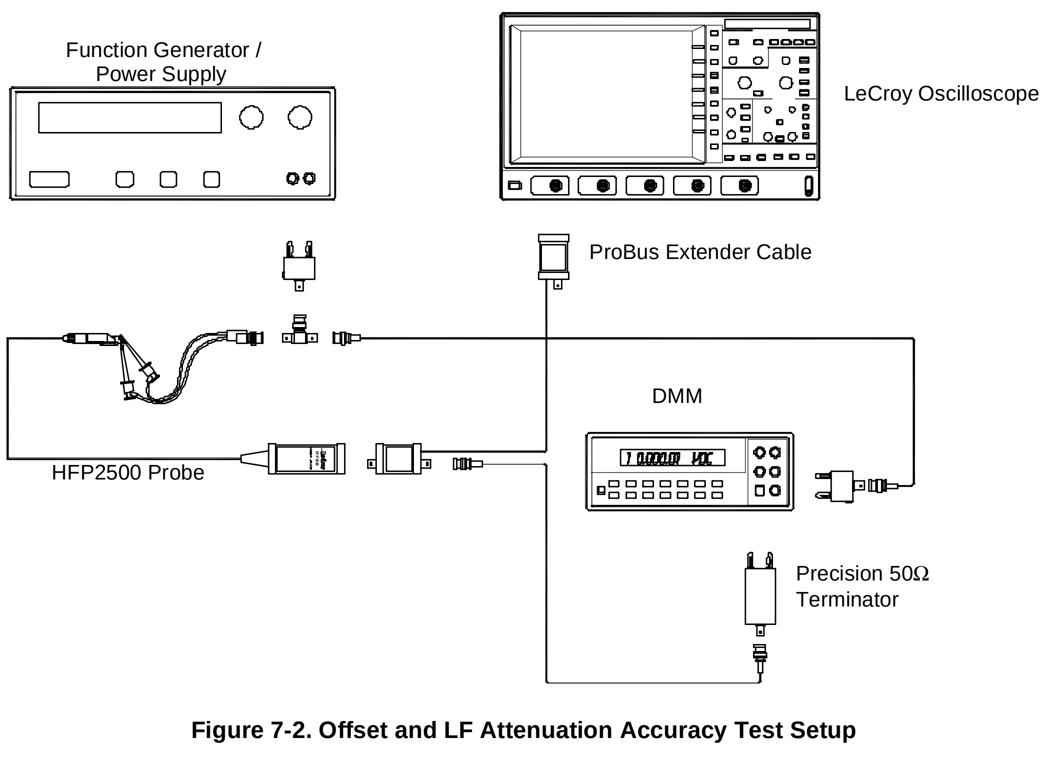

Figure 7-2. Offset and LF Attenuation Accuracy Test Setup

2. Carefully insert the Straight Tips (supplied in accessory kit) into the sockets of the probe head. Attach the red lead of the mini-grabber to the signal input and the black lead to the ground input of the probe head.
3. Set the power supply to approximately 0 Volt.
4. Plug the dual banana plug adapter with probe attached into the output terminals of the power supply with ground side of the adapter (and the ground side of the probe head) connected to the **positive** terminal of the power supply.
5. Attach a BNC cable to the unused female port of the BNC tee and a dual banana plug adapter to the other end of the cable and plug the dual banana plug adapter into the DMM input. Make sure the side of the banana plug adapter corresponding to the BNC shield (marked "GROUND") is connected to the **LOW** or **COMMON** input of the DMM.
6. Adjust the power supply to an output of 10.0 V ± 100 mV as indicated on the DMM.
7. Record the DMM reading, which should be a **negative** number, to 10 mV resolution as ’Power Supply Negative Output Voltage’ in the Test Record.
8. Add 10 (to correct for the +10 V offset as described in step B-13) to the ’PS Negative Output Voltage’ recorded in step B-7. (Do NOT adjust the power supply output amplitude).
9. Divide the resulting sum by 10.
10. Record the answer to three significant places as ’Expected Negative Ouput Voltage" in the test record.
11. Remove the banana plug adapter, connected to the power supply, from the DMM and connect the precision 50 Ω terminator to the DMM, making sure that the banana plug side marked ’GROUND" is connected to the **LOW** or **COMMON** input of the DMM.
12. Set the DMM to read DC Volt on the most sensitive range.
13. Verify that the display for channel 1 is turned ON. Turn the oscilloscope **OFFSET** knob to read +10.00 V on the oscilloscope display.
14. After the DMM has settled, record the reading to 100 µV resolution as ’Measured Negative Ouput Voltage’ in the Test

Record.

15. Subtract the measured voltage as recorded in step B-14 from the expected output voltage recorded in step B-10. Be sure to include the sign of each of the values in the calculation.
16. Record the answer to three significant places as ’Offset Error Voltage’ in the Test Record.
17. Verify that the error is between ±10.8 mV.

Note:

The error term is derived from the Offset Accuracy specification of ±1% ±8 mV. Using a 10.0 V offset setting, the maximum error would be 108 mV referred to the input, which becomes ±10.8 mV error referred to the output (taking into account the ÷10 attenuation).

18. Using the oscilloscope’s **OFFSET** knob, set the probe offset to 0 V, as indicated in the on-screen display.
19. Remove the dual banana plug adapter with the HFP2500 attached from the power supply and reconnect to the supply but now with the grounded side of the banana plug (and grounded socket of the probe head) connected to the **negative** terminal of the power supply output.
20. Disconnect the DMM from the precision 50 Ω terminator and connect the DMM to the dual banana plug adapter connected to the power supply output.
21. Record the DMM reading, which should be a **positive** number, to 10 mV resolution as ’Power Supply Positive Output Voltage’ in the Test Record.
22. Subtract 10 from the output voltage recorded in step B-21. Divide this number by 10.
23. Record the result to three significant places as ’Expected Positive Output Voltage’ in the Test Record.
24. Set the oscilloscope **OFFSET** to –10.00 V as read on the oscilloscope display.
25. Remove the banana plug adapter from the DMM and connect the precision 50 Ω terminator to the DMM, making sure that

the banana plug side marked 'GROUND" is connected to the **LOW** or **COMMON** input of the DMM.

26. Record the DMM reading to three significant places as 'Measured Positive Output Voltage' in the Test Record.
27. Subtract the Measured Output Voltage as recorded in step B-26 from the Expected Output Voltage recorded in step B-23. Be sure to include the sign of the values in the calculation.
28. Record the result to 100 µV resolution as 'Offset Error Voltage' in the Test Record.
29. Verify that the output error is between ±10.8 mV.
30. Return the oscilloscope offset to 0 Volt. Leave the setup connections for the next step.

C. LF Attenuation Accuracy

1. Disconnect the BNC tee at the power supply from the dual banana plug adapter. Connect the BNC tee to the output of the function generator. (Use a 50 Ω termination if the function generator requires such a load).
2. Disconnect the DMM from the precision 50 Ω terminator and connect the DMM to the dual banana plug adapter connected to the function generator output.
3. Set the DMM to read AC Volt and set the range to measure 5.0 Vrms.
4. Set the mode of the function generator to sine wave, the frequency to 70 Hz and the output amplitude to 5 Vrms ±10 mV as measured on the DMM.
5. Record the output voltage to 1 mV resolution as 'Generator Output Voltage' in the Test Record. Be careful not to alter the output amplitude after the reading is recorded.
6. Divide the reading recorded in step C-5 by 10 and record the result with 100 µV resolution as 'Expected Output Voltage, top range" in the Test Record.
7. Remove the banana plug adapter, connected to the function generator, from the DMM and connect the precision 50 Ω terminator to the DMM, making sure that the banana plug side marked 'GROUND" is connected to the **LOW** or **COMMON**

input of the DMM.

8. After the DMM reading has stabilized, record the reading to 100 µV resolution as ’Measured Output Voltage, top range’ in the Test Record.
9. Calculate the error by dividing the measured output voltage recorded in step C-8 by the expected top output voltage recorded in step C-6. Subtract 1 from this ratio and multiply by 100% to get the error in percent.

$$Error = \left(\frac{Measured\ Output\ Voltage}{Expected\ Output\ Voltage} - 1\right) \times 100\%$$

10. Record the calculated error to two decimal places (±0.xx%) as ’Gain Error, top range’ in the test record.
11. Verify that the error is less than ±1.0 %.
12. Disconnect the precision 50 Ω terminator from the DMM.
13. Connect the banana plug adapter connected via a BNC cable to the BNC tee at the function generator to the DMM. Verify that the side of the plug marked ’Ground’ is connected to the **LOW** or **COMMON** input of the DMM.
14. Adjust the sine wave generator output amplitude to approximately 2.5 Vrms as measured on the DMM.
15. Record the reading to 1 mV resolution as ’Generator Output Voltage, mid range’ in the Test Record. Be careful not to alter the output amplitude after the reading is recorded.
16. Divide the reading recorded in step C-15 by 10.
17. Record the result to 100 µV resolution as ’Expected Output Voltage, mid range’ in the test record.
18. Remove the banana plug adapter from the DMM and connect the precision 50 Ω terminator to the DMM, making sure that the banana plug side marked ’GROUND" is connected to the **LOW** or **COMMON** input of the DMM.
19. After the DMM has stabilized, record the reading to 100 µV resolution as ’Measured Output Voltage, mid range’ in the

Test record.

20. Calculate the error by dividing the measured output voltage recorded in step C-19 by the expected top output voltage recorded in step C-17. Subtract 1 from this ratio and multiply by 100% to get the error in percent.

$$Error = \left(\frac{Measured\ Output\ Voltage}{Expected\ Output\ Voltage} - 1\right) \times 100\%$$

21. Record the calculated error to two decimal places (±0.xx %) as 'Gain Error, mid range' in the Test record.
22. Verify that the mid range gain error is less than ±1.0%

This completes the Performance Verification of the HFP2500. Complete and file the Test Record, as required to support your internal calibration procedure.

Apply suitable calibration label to the HFP2500 housing as required.

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