Procedures Guide

Tektronix

HDMI Sink Instruments
Differential Impedance Measurement

Measurement Procedures

Equipment Required

Table 1 lists the equipment required to perform the differential impedance measurement.

Table 1: Equipment required

Item	Qty.	Recommended equipment
Sampling oscilloscope	1 ea.	Tektronix TDS8200 (or DSA8200/TDS8000B)
TDR sampling module	1 ea.	Tektronix 80E04
50 Ω SMA terminator	6 ea.	Tektronix part number 015-1022-01
50 Ω SMA cable	2 ea.	HUBER+SUHNER SUCOFLEX 104PEA
TPA (test fixture)	1 ea.	Efficere Technologies EFF-HDMI-TPA-P

NOTE. *To protect the sampling module from damage due to electro-overstress (EOS) and electrostatic discharge (ESD), power off a device under test (DUT) to discharge the static voltage completely from it before performing the procedures.*

While performing the following procedures, be sure to wear a grounded antistatic wrist strap to discharge the static voltage from your body.

Front-Panel Buttons   Figure 1 shows the front-panel buttons on the TDS8200 used in the procedures.
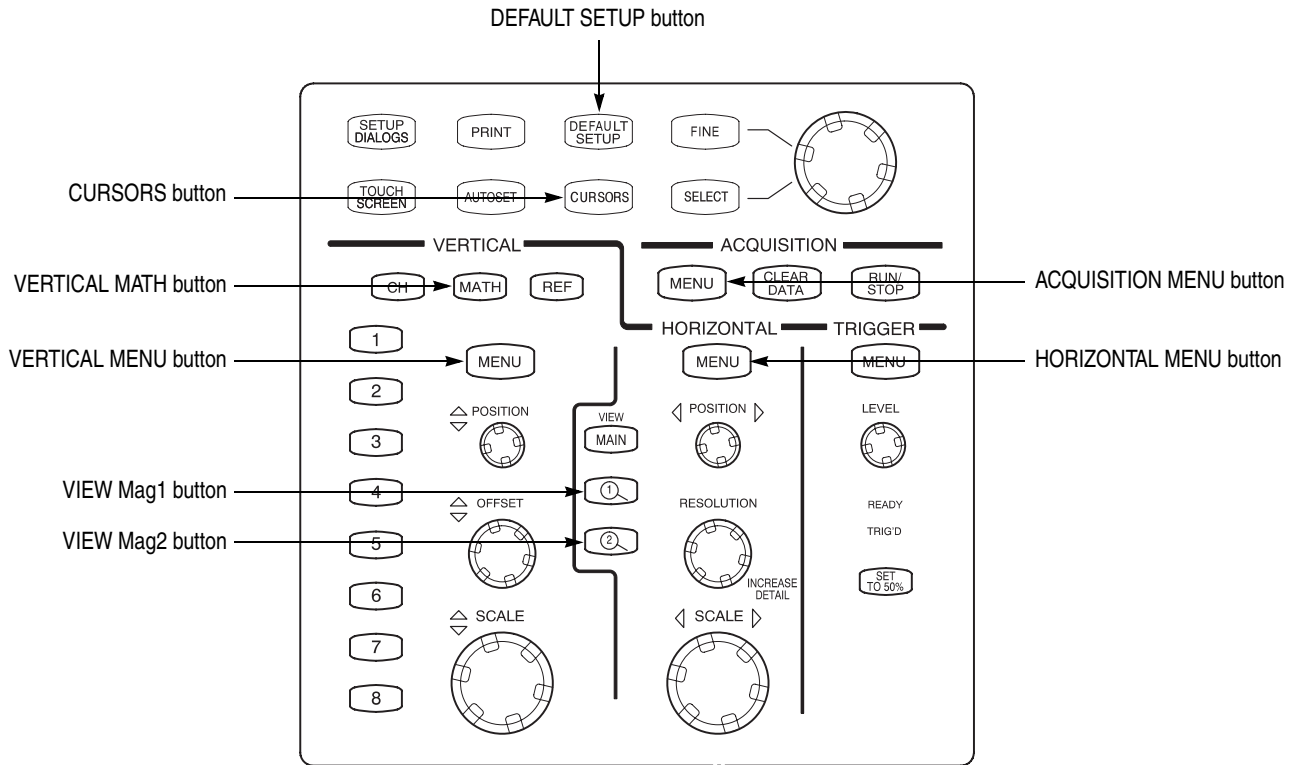

Figure 1: Front-panel buttons on the TDS8200

Equipment Connections

1. Use the 50 Ω SMA cable to connect the CH1 connector on the sampling module and the DATA0_P connector on the test fixture (see Figure 2).

2. Use the 50 Ω SMA cable to connect the CH2 connector on the sampling module and the DATA0_N connector on the test fixture (see Figure 2).

3. Use the 50 Ω SMA terminators to terminate the unused connectors on the test fixture (see Figure 2).
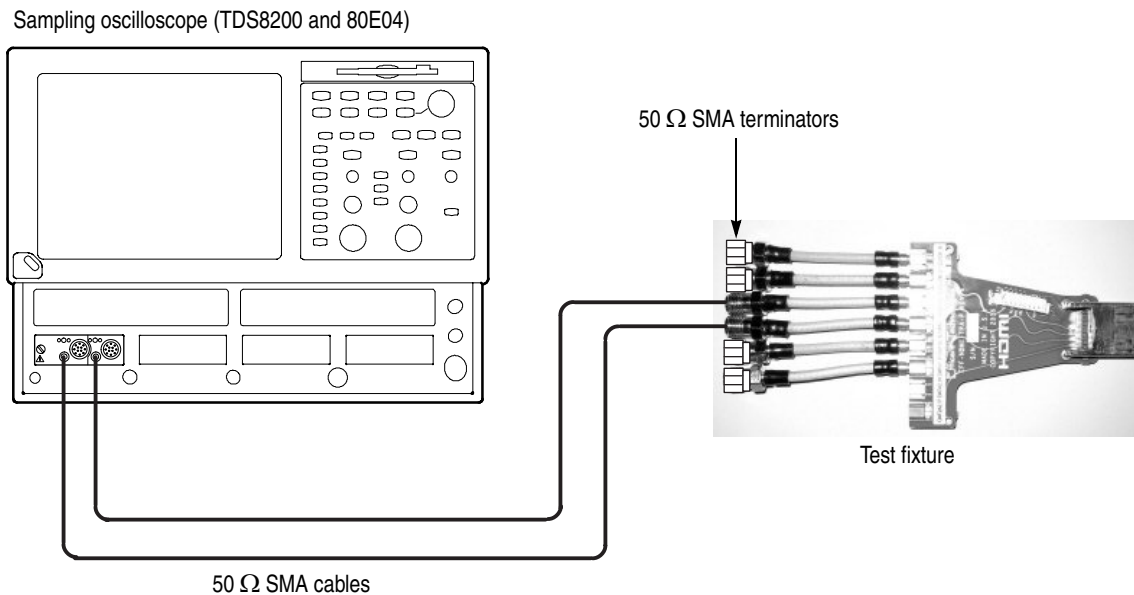
Sampling oscilloscope (TDS8200 and 80E04)

50 Ω SMA terminators

Test fixture

50 Ω SMA cables

Figure 2: Initial equipment connections for the differential impedance measurement

Calibration

1. Output TDR step pulses from the sampling oscilloscope, and then set the oscilloscope so that both the TDR step pulses and waveforms at the open ends of the test fixture are displayed on the screen:

    a. Press the **DEFAULT SETUP** button, and then click **Yes**.

    b. Press the **ACQUISITION MENU** button to display the **Setups** window.

    c. Click the **C1-C2 Diff** button on the **TDR** tab, and then set the **ACQ On Units** to Ω.

    d. On the **Vert** tab, select **C1** from the **Waveform** field, and then set the **SetupScale** to 10.00 Ω/div and **Position** to -5.000 div.

    e. On the **Vert** tab, select **C2** from the **Waveform** field, and then set the **SetupScale** to 10.00 Ω/div and **Position** to -5.000 div.

2. Use the sampling oscilloscope Mag View feature to magnify the TDR step pulses and waveforms at the open ends of the test fixture in other windows:

    a. Press the **VIEW Mag1** button, and then use the **HORIZONTAL POSITION** knob and **HORIZONTAL SCALE** knob to display the TDR step pulses properly (see Figure 3 on page 4).

   b. Press the **VIEW Mag2** button, and then use the **HORIZONTAL POSITION** knob and **HORIZONTAL SCALE** knob to display the waveforms at the open ends of the test fixture properly (see Figure 3).
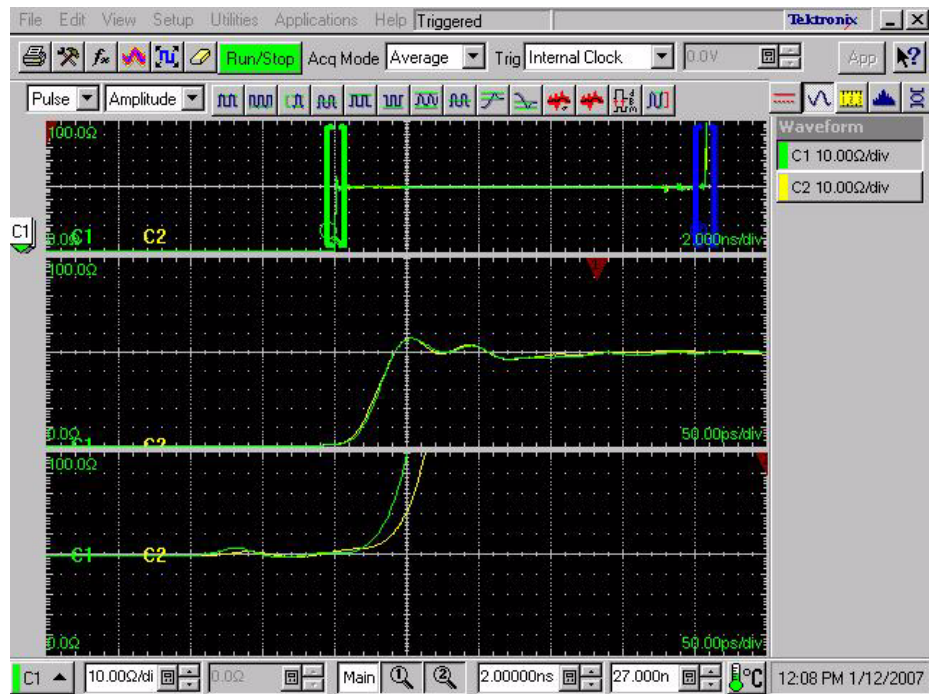
3. Press the **HORIZONTAL MENU** button.

Figure 3: Magnifying the TDR step pulses and the waveforms at the open ends of the test fixture

4. Set the sampling oscilloscope so that the delay between the CH1 and CH2 can be measured in the magnified window:

   a. Press the **VIEW Mag1** button, and then click the **Meas** tab.

   b. Click the **Select Meas** button, and then select **Pulse-Timing** > **Delay**.

   c. Click **Source1**, and then select **Mag1 C1** on the **Source** tab.

   d. Click the **Region** tab, and then set **Edge Slope** to + and **Direction** to -->.

   e. Click **Source2**, and then select **Mag1 C2** on the **Source** tab.

   f. Click the **Region** tab, and then set **Edge Slope** to + and **Direction** to -->.

   g. Press the **VIEW Mag2** button, and then click the **Meas** tab.

   h. Select **Meas2**, and then click the **Select Meas** button and select **Pulse-Timing** > **Delay**.

      i.   Click **Source1**, and then select **Mag2 C1** on the **Source** tab.

      j.   Click the **Region** tab, and then set **Edge Slope** to + and **Direction** to -->.

      k.   Click the **RefLevel** tab, and then select **Absolute**. Set **Mid** to **75** Ω.

      l.   Click **Source2**, and then select **Mag2 C2** on the **Source** tab.

      m.   Click the **Region** tab, and then set **Edge Slope** to + and **Direction** to -->.

      n.   Click the **RefLevel** tab, and then select **Absolute**. Set **Mid** to **75** Ω.

5.   Adjust step deskew so that the delay between the TDR step pulses is equal to the delay between waveforms at the open ends of the test fixture:

      a.   Click the **TDR** tab, and then select **C1_C2** in the **Step Deskew** drop-down list box.

      b.   Adjust the readings of ① and ② in Figure 4 are about the same value by changing the **Step Deskew** value (see ③ Figure 5 on page 6).
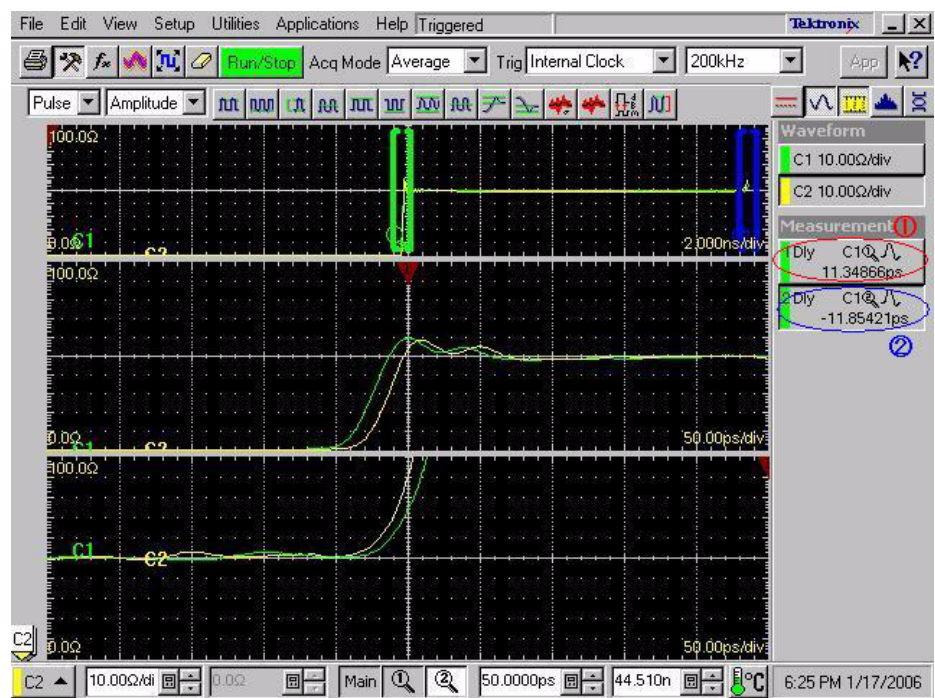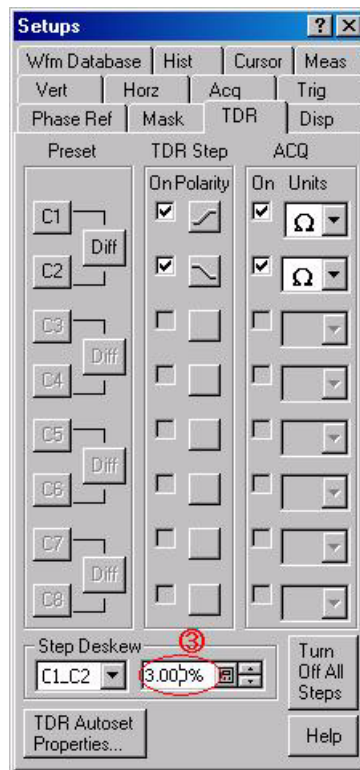

Figure 4: Adjusting the step deskew

Figure 5: Changing the Step Deskew value

6. Adjust deskew so that the delay between the waveforms at the open ends of the test fixture has the minimum value:

   a. Click the **Vert** tab, and then select **Deskew**.

   b. Adjust the deskew so that the reading of ② in Figure 4 on page 5 has the minimum value by changing the **Deskew** value (see ④ in Figure 6).
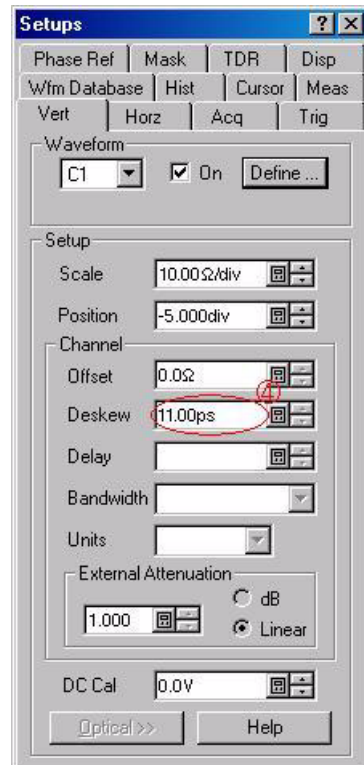
Figure 6: Changing the Deskew value

7. Turn off the Mag View feature.

Setting the Rise Time

1. Click the **TDR** tab, and then set **ACQ On Units** to **V**.

2. Define a math waveform:

   a. Press the **VERTICAL MATH** button, and then enter **Filter (CH1-CH2)** in the **Math Expression** field in the **Define Math** window.

   b. Select the **Math Waveform On** check box, and then click **OK**.

   c. Press the **VERTICAL MENU** button (if the Setups window is not displayed), and then click the **Vert** tab and select **M1**.

   d. Set **Scale** to **100.0 mV/div** and **Position** to **-5.00 div**.

3. Use the **HORIZONTAL SCALE** knob to set the horizontal scale to **200 ps/div**.

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4. Use the **HORIZONTAL POSITION** knob to display the math waveform at the center of the screen.

5. Set the sampling oscilloscope to measure the rise time of the waveform:

   a. Press the **VERTICAL MENU** button (if the Setups window is not displayed), and then click the **Meas** tab.

   b. Select **Meas3**, and then click the **Select Meas** button and select **Pulse-Timing** > **Rise Time**.

   c. Click **Source1**, and then select **Main M1** on the **Source** tab.

6. Press the **VERTICAL MATH** button to display the **Define Math** window.

7. Adjust the rise time so that the reading of ⑤ in Figure 7 is 200 ps by changing the **Filter Risetime** value (see ⑥ in Figure 8). If you cannot adjust the value to 200 ps exactly, set it to the nearest value below 200 ps.
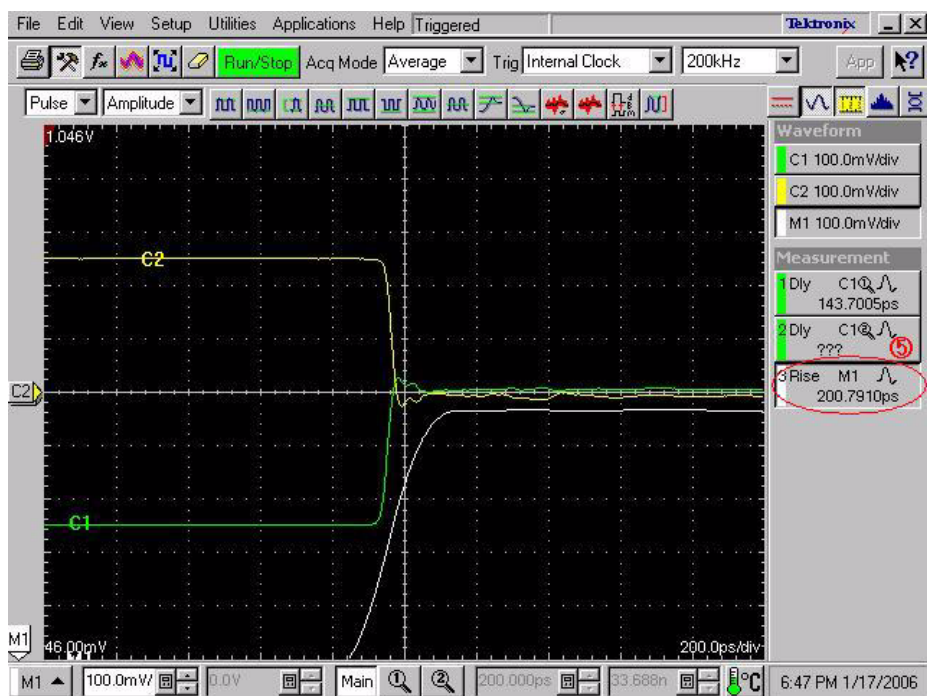

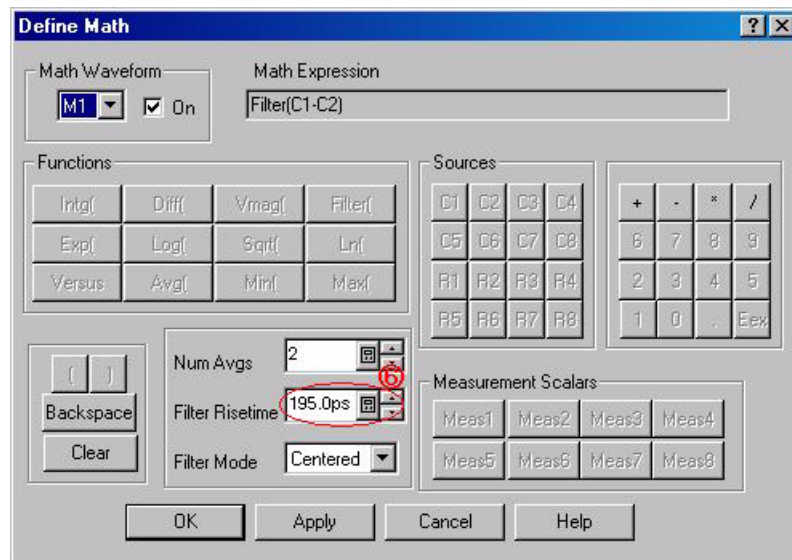**Figure 7: Adjusting the rise time**

Figure 8: Changing the Filter Risetime value

Measuring the Impedance

1. Clear the C1 and C2 waveforms.

2. Press the **ACQUISITION MENU** button, and then click the **TDR** tab.

3. Set **ACQ On Units** to Ω.

4. Change the math waveform:

    a. Press the **VERTICAL MATH** button to display the **Define Math** window, and then click **Clear**.

    b. Enter **Filter (CH1 +CH2)** in the **Math Expression** field.

5. Press the **VERTICAL MENU** button.

6. Click the **Vert** tab, and then set **M1 Scale** to **10.00 Ω/div** and **M1 Position** to **-10.00 div**.

7. Set the vertical scale to 100 ps/div.

8. Adjust the **HORIZONTAL POSITION** knob so that the rise-time waveform is displayed at near 1 major division from the left side of the screen.

9. Connect the test fixture to the HDMI connector on a device under test (DUT) (see Figure 9).
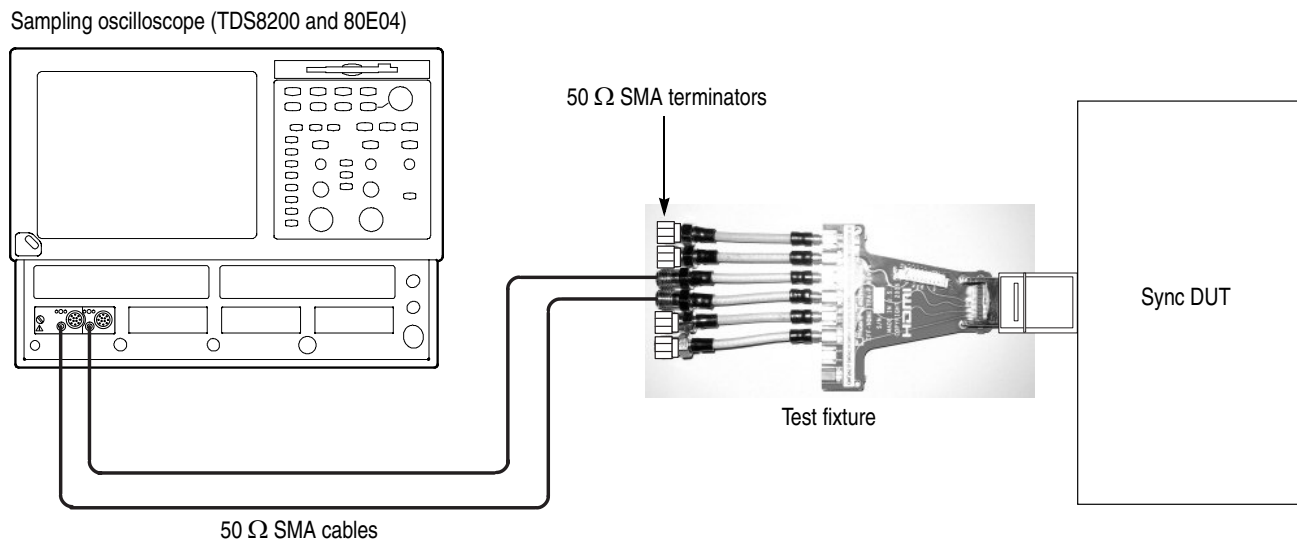
Figure 9: Connecting a sync DUT to the test fixture

    10. Display the horizontal cursors and align them to the 85 Ω and 115 Ω points on the impedance waveform:

        a. Press the **CURSORS** button twice to display the horizontal cursors.

        b. Use the multipurpose knob to adjust the reading value of v1 at the right side of the screen to 115 Ω

        c. Press the **SELECT** button to toggle selection between the two cursors.

        d. Use the multipurpose knob to adjust the reading value of v1 at the right side of the screen to 85 Ω

    11. Use the automatic measurement feature to measure the Max and Min values of the impedance waveform. At this time, use the gating feature to specify the measurement area.

        a. Select **Pulse** and **Amplitude** from the pull-down menus in the measurement tool bar.

        b. Click **Max** and **Min** on the tool bar to specify the measurement items.

        c. Right-click Max in the measurement area at the left side of the screen to display the Setup dialog box for setting Max.

        d. On the **Region** tab, set the **G1** (Gate1) to **0** and **G2** (Gate2) to **50**, and then select the **On** check box.

        e. Right-click Min in the measurement area at the left side of the screen to display the Setup dialog box for setting Min.

f. On the **Region** tab, set the **G1** to **0** and **G2** to **50**, and then select the **On** check box.

g. When you select Max or Min in the Measurement area at the left side of the screen, each gate position is indicated by the vertical cursor.

h. Adjust the gates so that the measurement area is between the gates using a mouse.

12. Measure the impedance of the waveform:

When the Sink_Diff_PowerOn field of the CDF is Y:

■ Measure the impedance between the HDMI connector on the DUT and the receive IC pin. The measurement period (time width) is defined in the Sink_Term_Distance field of the CDF.

■ If the measurement value is less than and equal to 75 Ω or 125 Ω, the differential lines being measured are Fail.

■ If an area that has the value less than and equal to 85 Ω or more than and equal to 115 Ω lasts for more than and equal to 250 ps, the differential lines being measured are Fail (even if an area that has the any of the above values lasts for less than and equal to 250 ps, if the area appears twice, the differential lines being measured are Fail).

■ If any of the above cases do not apply, the differential lines being measured are Pass.

When the Sink_Diff_PowerOn field of the CDF is N:

■ Measure the impedance between the HDMI connector on the DUT and the point that the impedance settles at the terminal impedance.

■ If the measurement value is less than and equal to 75 Ω or 125 Ω, the differential lines being measured are Fail.

■ If an area that has the value less than and equal to 85 Ω or more than and equal to 115 Ω lasts for more than and equal to 250 ps, the differential lines being measured are Fail (even if an area that has the any of the above values lasts for less than and equal to 250 ps, if the area appears twice, the differential lines being measured are Fail).

■ If the terminal impedance is less than and equal to 75 Ω or 125 Ω, the differential lines being measured are Fail.

■ If any of the above cases do not apply, the differential lines being measured are Pass.

13. Repeat Step 12 for all the TMDS lines.

— End of Procedures —