HEACT 6 Cable Assembly Tests

Procedures Guide

Revision 1.1
Tektronix
October 13, 2010

Equipment Required

Table 1 lists the equipment required to perform the HEAC Cable Assembly Test measurement.

Table 1: Equipment required

Item	Qty.	Recommended equipment
Sampling oscilloscope	1 ea.	Tektronix DSA8200 (or TDS8000 / TDS8000B / CSA8000 / CSA8000B)
TDR sampling module	1 ea.	Tektronix 80E04
TDT sampling module	1 ea.	Tektronix 80E03
IConnect S-parameter Software	1 ea.	Tektronix 80SSPAR
50Ω SMA matched pair cable	2 ea,	Tektronix P/N:174-4866-00
50Ω SMA female-female connector	2 ea.	Tektronix P/N:015-1012-00
50Ω SMA terminator (male)	2 ea.	Tektronix P/N:015-1022-01
HEAC TDR-R adapter	2 ea.	Tektronix TF-HEAC-TDR-AR (Type A connector) TF-HEAC-TDR-CR (Type C connector)

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

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

This procedure is written assuming that the TDR module is inserted to CH1, CH2 and the TDT module is inserted CH7, CH8. If the module is inserted to other channel, replace the channel number in this procedure.

Calibration

Compensation

Allow the sampling oscilloscope to warm up 20 minutes before compensation process.

(1) Click the **Utilities** on top menu, and then select the **Compensation**.

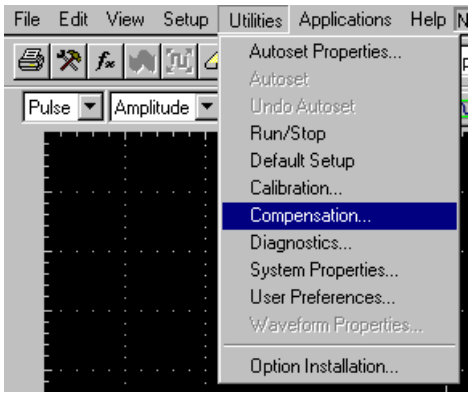

Figure 1: Utilities menu

(2) Click the **Execute** button on Compensation window.

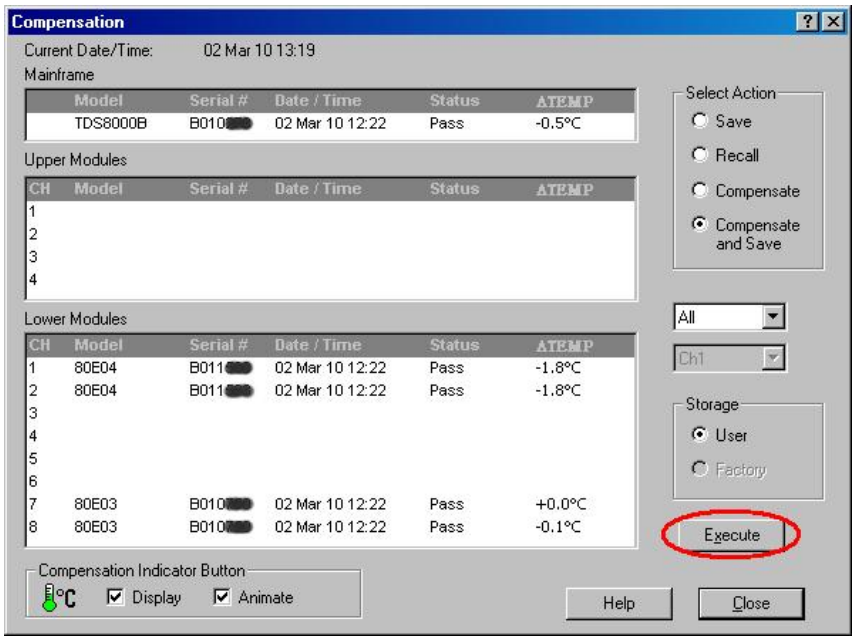

Figure 2: Compensation window.

(3) Start the test after thermometer is **green**. 

De-skew

(1) Use the 50Ω SMA matched pair cable to connect the TDR modules (CH1 and CH2).

(2) Use the 50Ω SMA matched pair cable to connect the TDT modules (CH7 and CH8).

(3) Use the 50Ω SMA female-female connector to connect each output (see Figure 3).

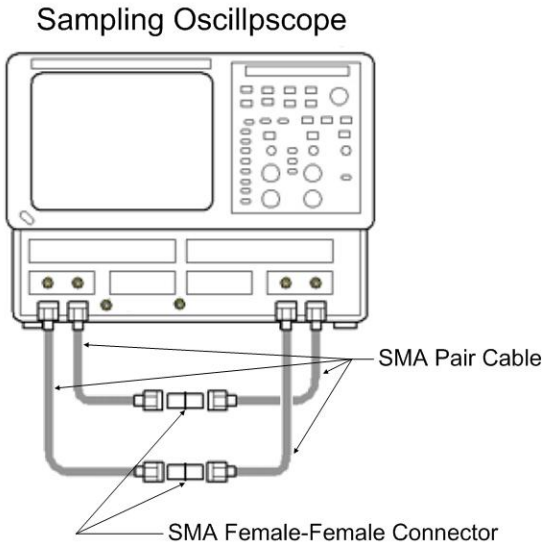

Figure 3: De-skew setup

(4) Press the **DEFAULT SETUP** button on the oscilloscope front-panel, and then click the **Yes** button.

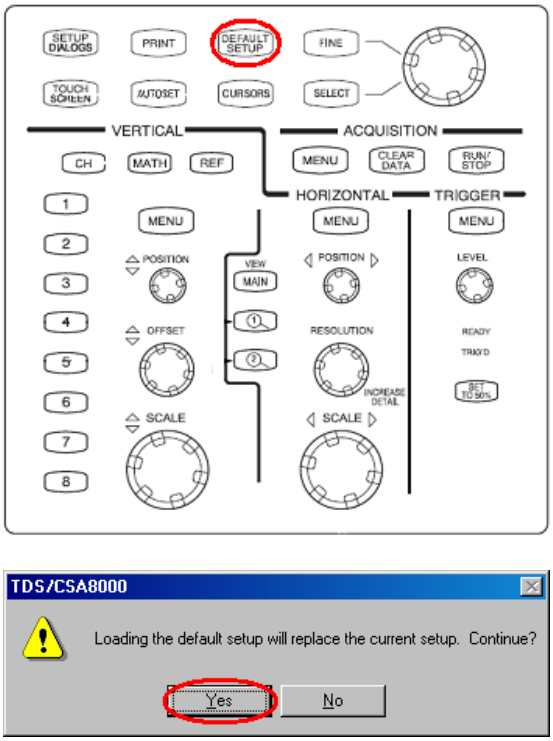

Figure 4: Front-panel button and default setup window

(5) Click Setups icon. 

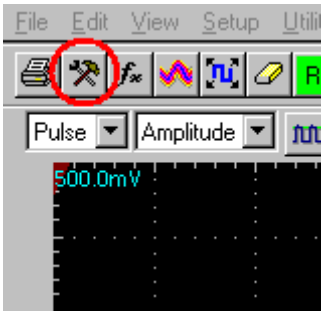

Figure 5: Setup icon

(6) Click the **TDR** tab on **Setups** window.

(7) Click the **C1-C2 Diff** button on **TDR** tab.

(8) Select the **V** in **C1** and **C2 ACQ Units** drop-down list box.

(9) Set the **C7** and **C8 ACQ On** check box to ON.

(10) Click the **Horz** tab on **Setups** window.

(11) Set the **Timebase Record Length** to 4000 on **Horz** tab.

(12) Set the **Timebase Horizontal Reference** to 30.0% on **Horz** tab.

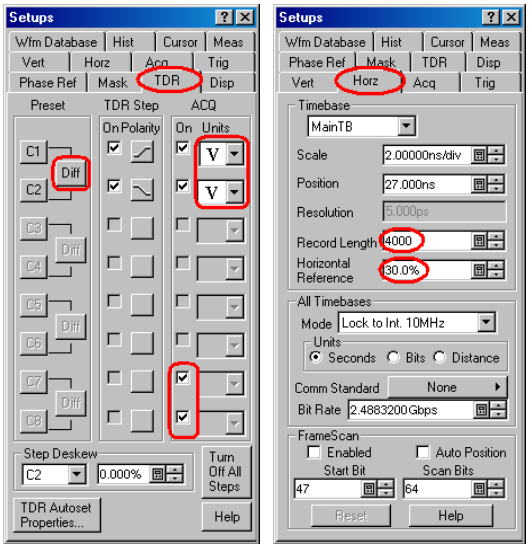

Figure 6: Setups window

(13) Adjust the **HORIZONTAL POSITION** knob so that the edge of **C7** and **C8** waveform is displayed at 3 major divisions from the left edge of the screen (see Figure 7).

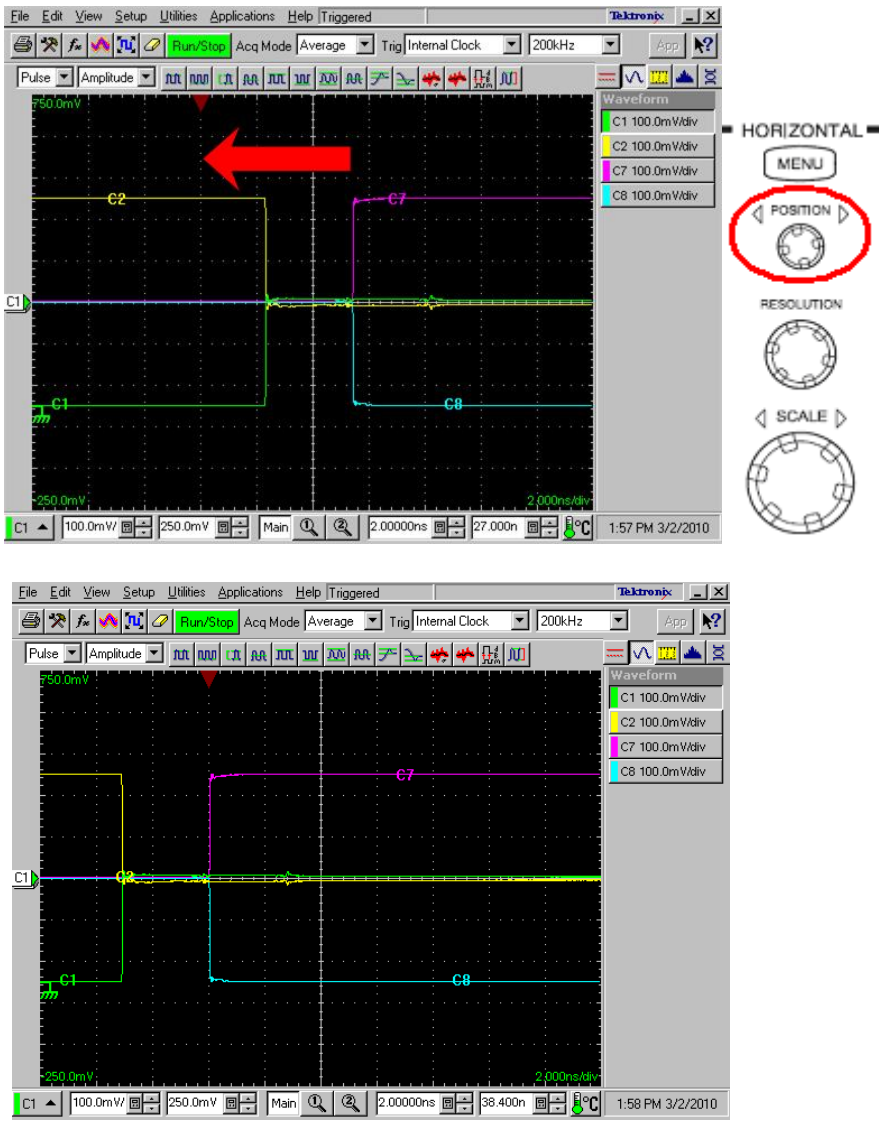

Figure 7: Setting Horizontal Position

(14) Adjust the **HORIZONTAL SCALE** knob so that the **Horizontal Main Scale** to100 ps.

Figure 8: Setting Horizontal Scale

(15) Click the **Meas** tab on **Setups** window.

(16) Select the **Meas1** in drop-dawn list box on **Meas** tub.

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

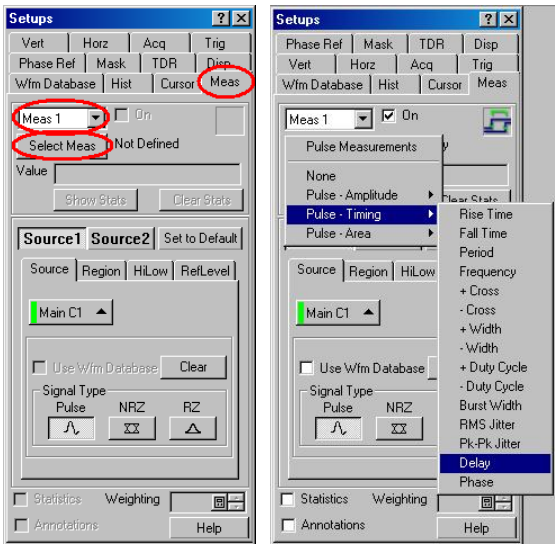

Figure 9: Measurement setups window

(18) Click the **Source1** button on **Meas** tab.

(19) Click the **Source** tab on **Meas** tab.

(20) Select the **Main C7** on **Source** tab.

(21) Click the **Region** tab on **Meas** tab.

(22) Click the **+** in **Edges Slope** radio button.

(23) Click the **RefLevel** tab on **Meas** tab.

(24) Click the **Absolute** radio button in **Reference Level Calc Method**.

(25) Set the **Reference Mid** to 125m on **RefLevel** tab.

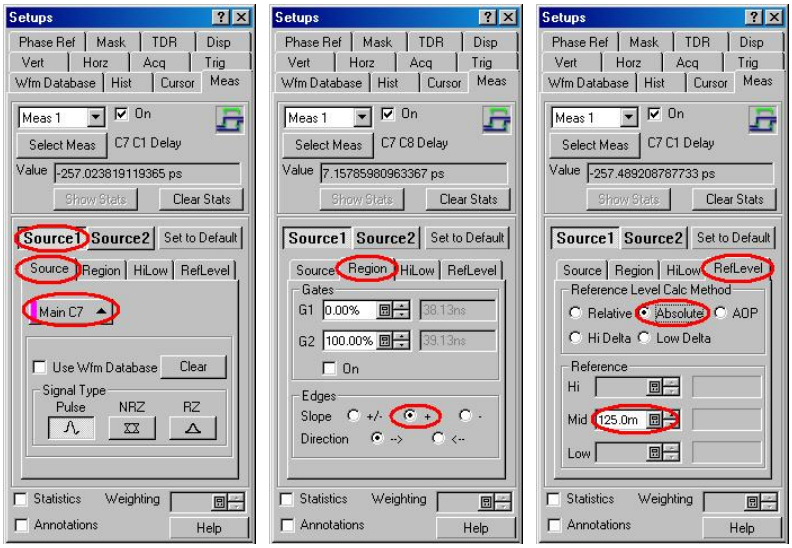

Figure 10: Measurement source1 setups window

(26) Click the **Source2** button on **Meas** tab.

(27) Click the **Source** tab on **Meas** tab

(28) Select the **Main C8** on **Source** tab.

(29) Click the **Region** tab on **Meas** tab.

(30) Click the **-** in **Edges Slope** radio button.

(31) Click the **RefLevel** tab on **Meas** tab.

(32) Click the **Absolute** radio button in **Reference Level Calc Method**.

(33) Set the **Reference Mid** to -125m on **RefLevel** tab.

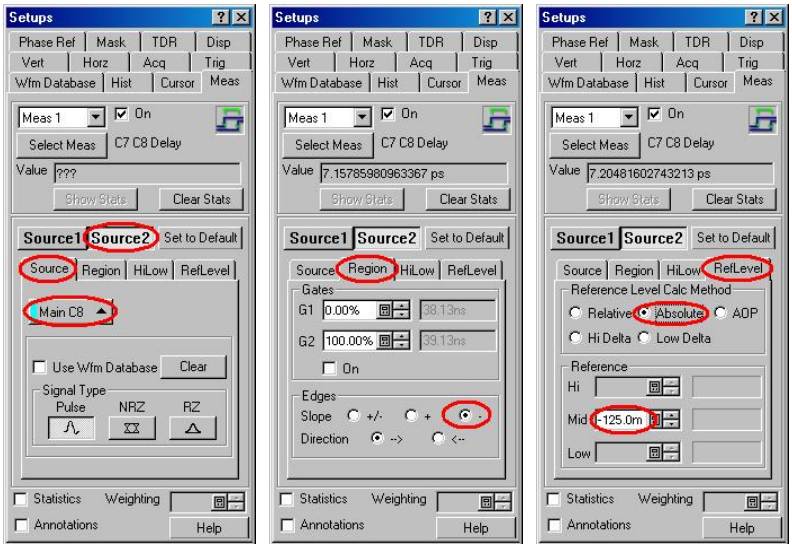

Figure 11: Measurement source2 setups window

(34) Click the **TDR** tab on **Setups** window

(35) Select the **C2** in **Step Deskew** drop-down list box.

(36) Adjust the **Step Deskew** so that measurement value of **Delay C7** is equal to 0 (±1 ps).

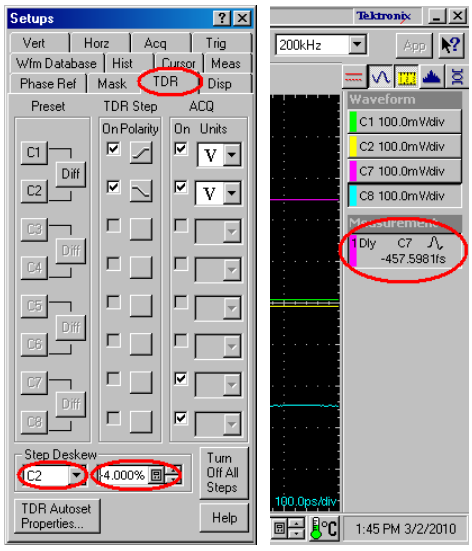

Figure 12: Setting step deskew

Test ID HEACT 6-1: Intra Pair Skew Test

(1) Connect the TDR module output CH1 to HEAC+ SMA connector and CH2 to HEAC- SMA connector on the first HEAC-TDR-R adapter.

(2) Connect the TDT module input CH7 to HEAC+ SMA connector and CH8 to HEAC- SMA connector on the second HEAC-TDR-R adapter.

(3) Connect the HEAC-TDR-R adapters and the cable under test(see Figure 13).

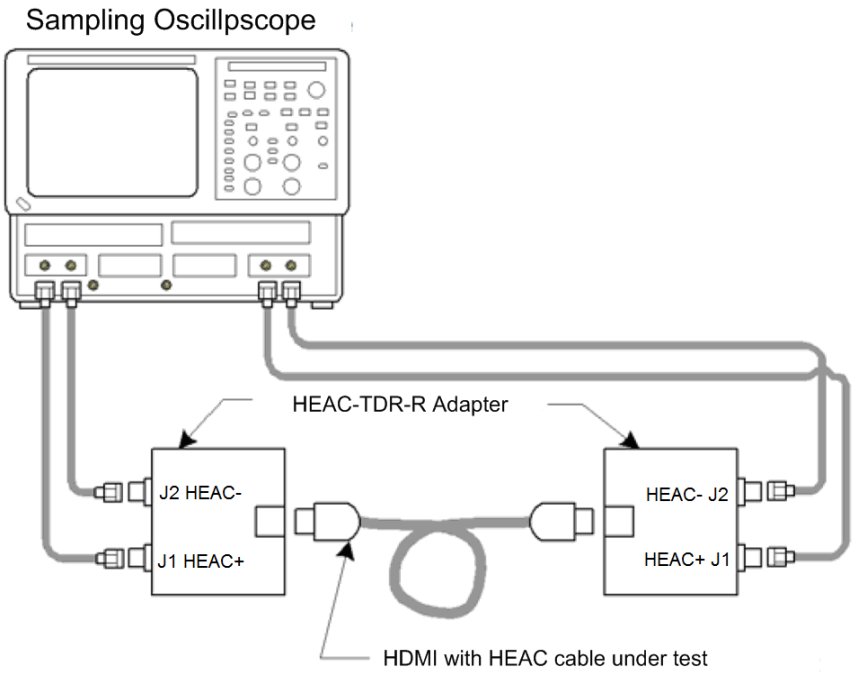

Figure 13: Intra pair skew test setup

(4) Adjust the **HORIZONTAL SCALE** knob so that the waveform edges of **C7** and **C8** are displayed on screen as shown in Figure 14..

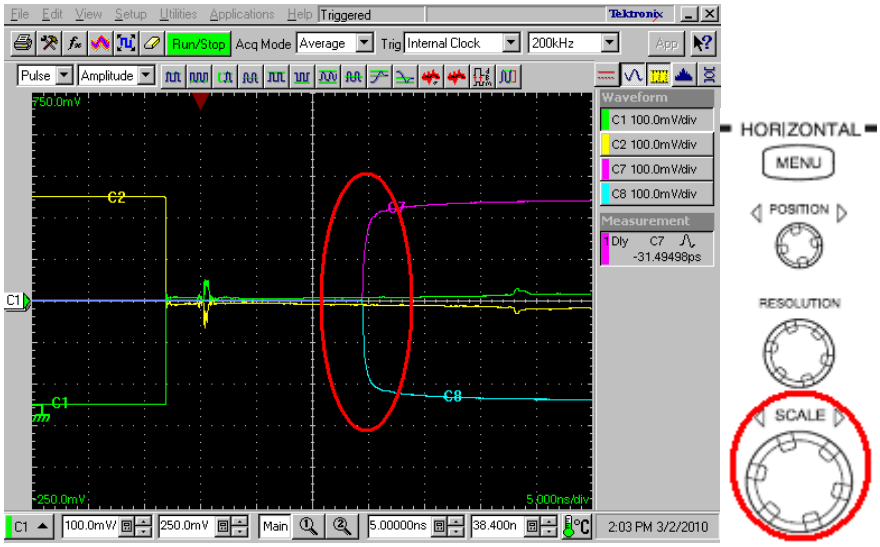

Figure 14: Setting Horizontal Scale

(5) Adjust the **HORIZONTAL POSITION** knob so that the edges of **C7** and **C8** waveforms are displayed at 3 major divisions from the left edge of the screen (see Figure 15).

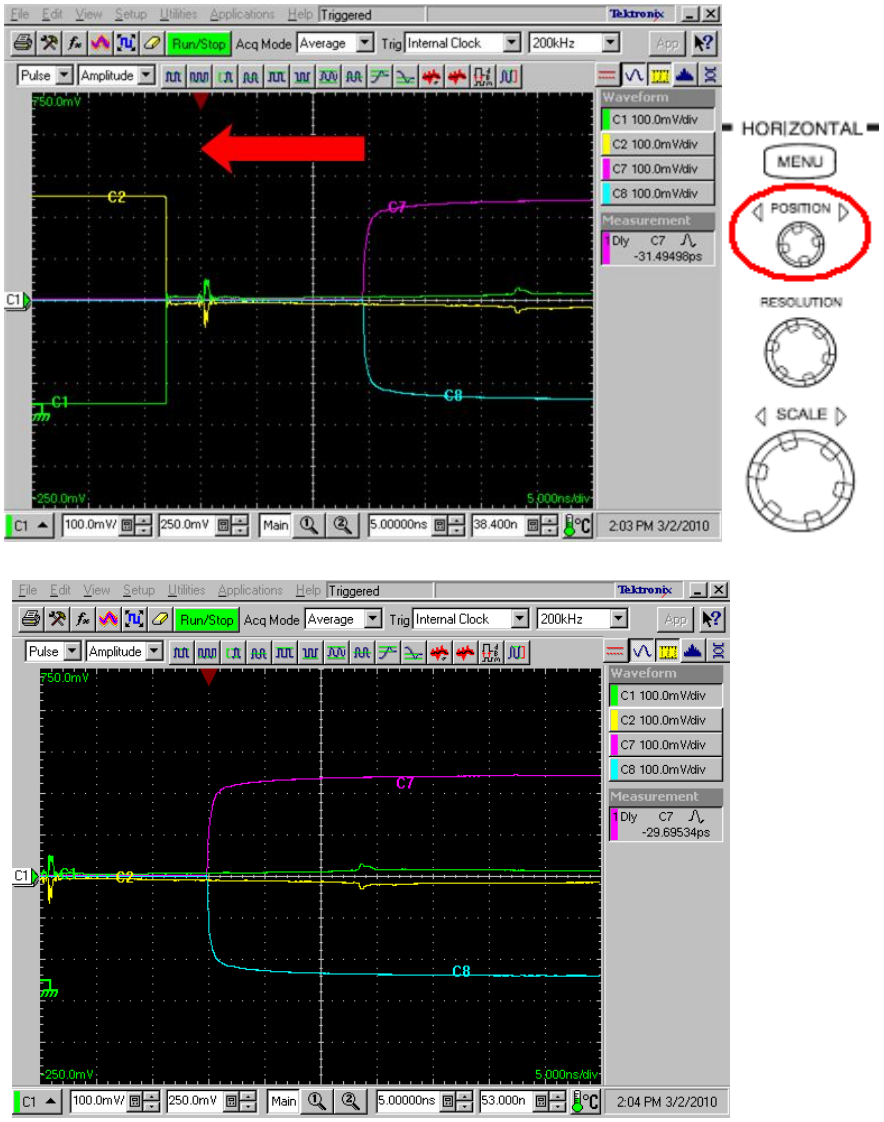

Figure 15: Setting Horizontal Position

(6) Adjust the **HORIZONTAL SCALE** knob so that the **Horizontal Main Scale** to 100 ps.

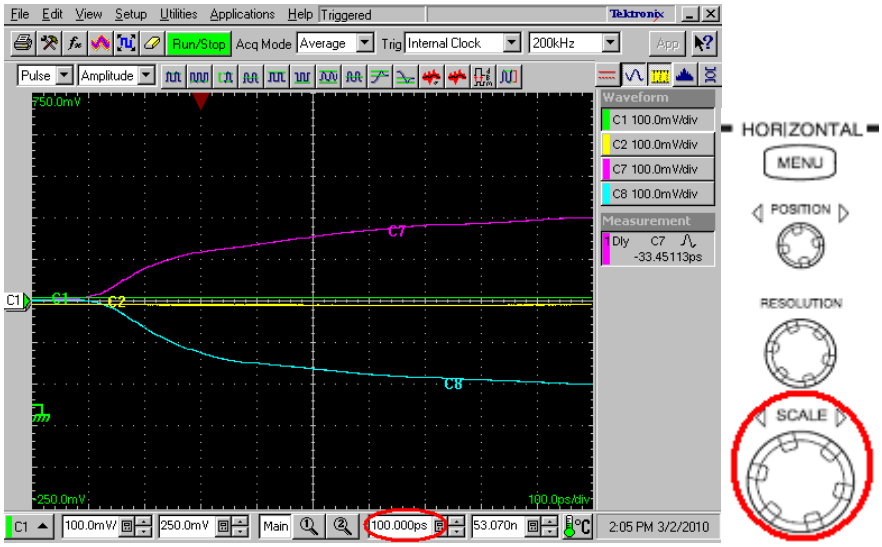

Figure 16: Setting Horizontal Scale

(7) Intra-Pair Skew is displayed as "**Dly C7**" on screen.

(8) If Intra-Pair Skew ("**Dly C7**") is more than 111 ps or less than -111 ps, then fail.

Figure 17: Result of Intra pair skew

Test ID HEACT 6-2: Differential Attenuation Test

(1) Connect the TDR module output CH1 to HEAC+ SMA connector and CH2 to HEAC- SMA connector on the first HEAC-TDR-R adapter (see Figure 18).

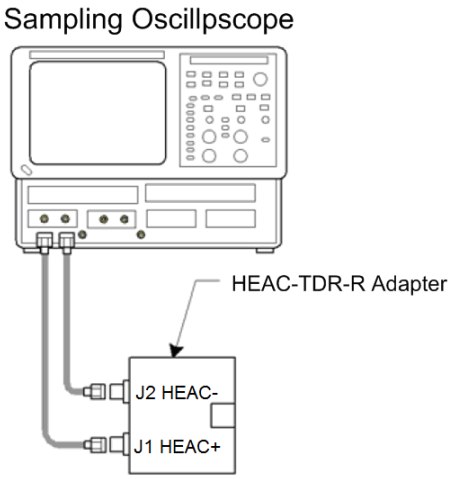

Figure 18: Differential attenuation test open setup

(2) Click the MATH icon. 

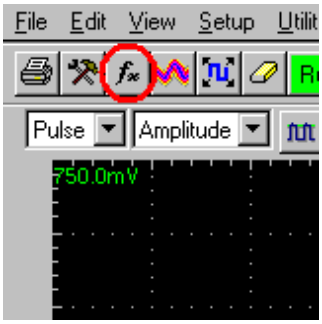

Figure 19: Math icon

(3) Select the **M1** in **Math Waveform** drop-down list box on **Define Math** window.

(4) Enter "*C1-C2*" in the **Math Expression** filed on **Define Math** window.

(5) Set the **Math Waveform ON** check box to ON.

(6) Click the **Apply** button on **Define Math** window.

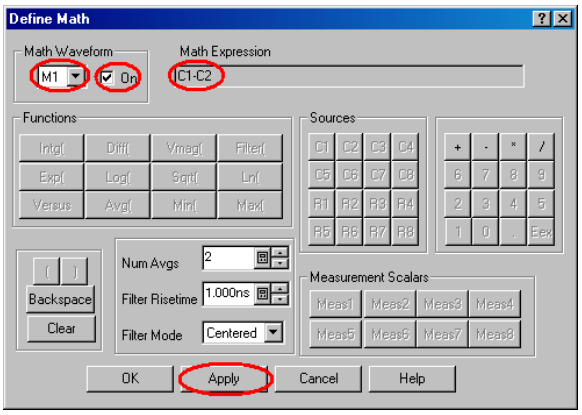

Figure: 20 Defining Math1

(7) Select the **M2** in **Math Waveform** drop-down list box on **Define Math** window.

(8) Enter "*C7-C8*" in the **Math Expression** filed on **Define Math** window.

(9) Set the **Math Waveform ON** check box to ON.

(10) Click the **OK** button on **Define Math** window.

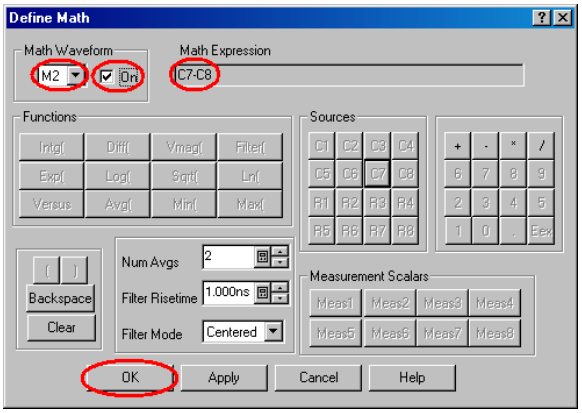

Figure: 21 Defining Math2

(11) Click the Setups icon. 

(12) Click the **Vert** tab on **Setups** window.

(13) Select the **M1** in **Waveform** drop-down list box on **Vert** tab.

(14) Set the **Setup Scale** to 100 mV/div and the Setup **Position** to -7.000 div.

(15) Select the **M2** in **Waveform** drop-down list box on **Vert** Tab.

(16) Set the **Setup Scale** to 100 mV/div and the Setup **Position** to -2.000 div.

(17) Click the **Horz** tab.

(18) Set the **Timebase Horizontal Reference** to 10% on **Horz** tab.

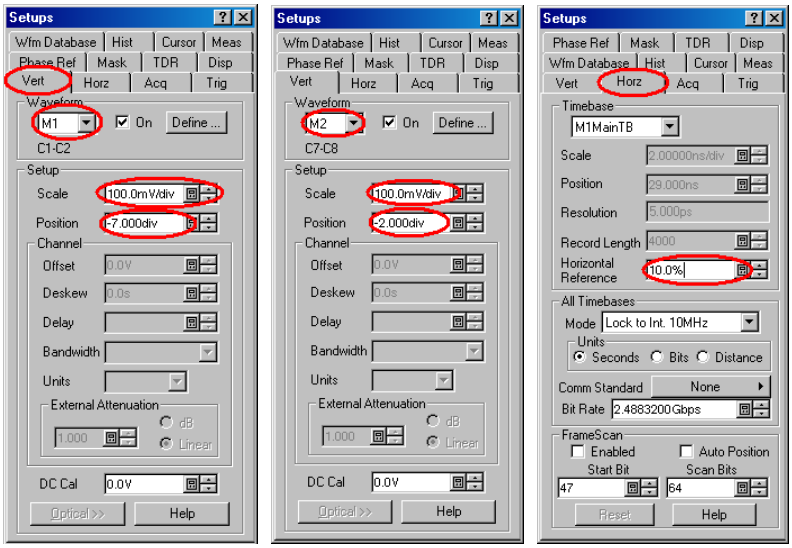

Figure 22: Setups window

(19) Adjust the **HORIZONTAL SCALE** knob so that the edge of **M1** waveform is displayed on screen.

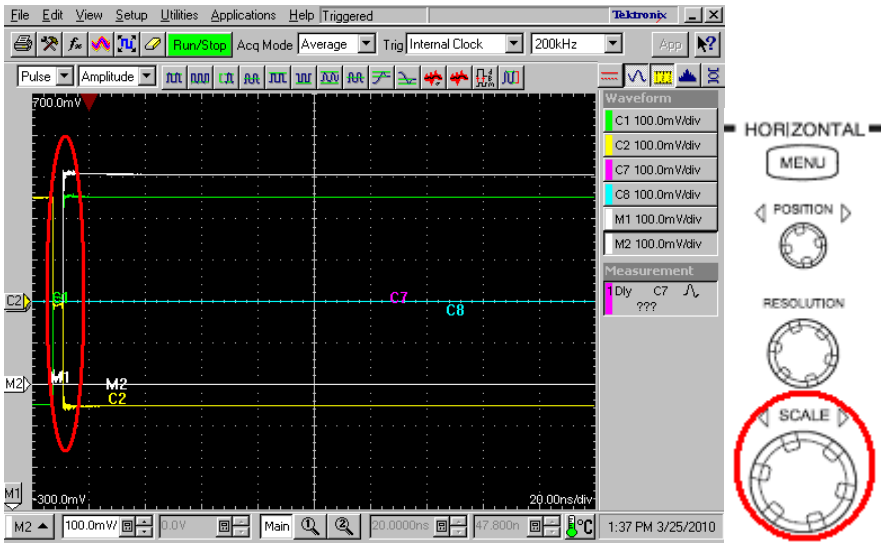

Figure 23: Setting Horizontal Scale

(20) Adjust the **HORIZONTAL POSITION** knob so that the edge of **M1** waveform is displayed at 1 major division from the left edge of the screen (see Figure 24).

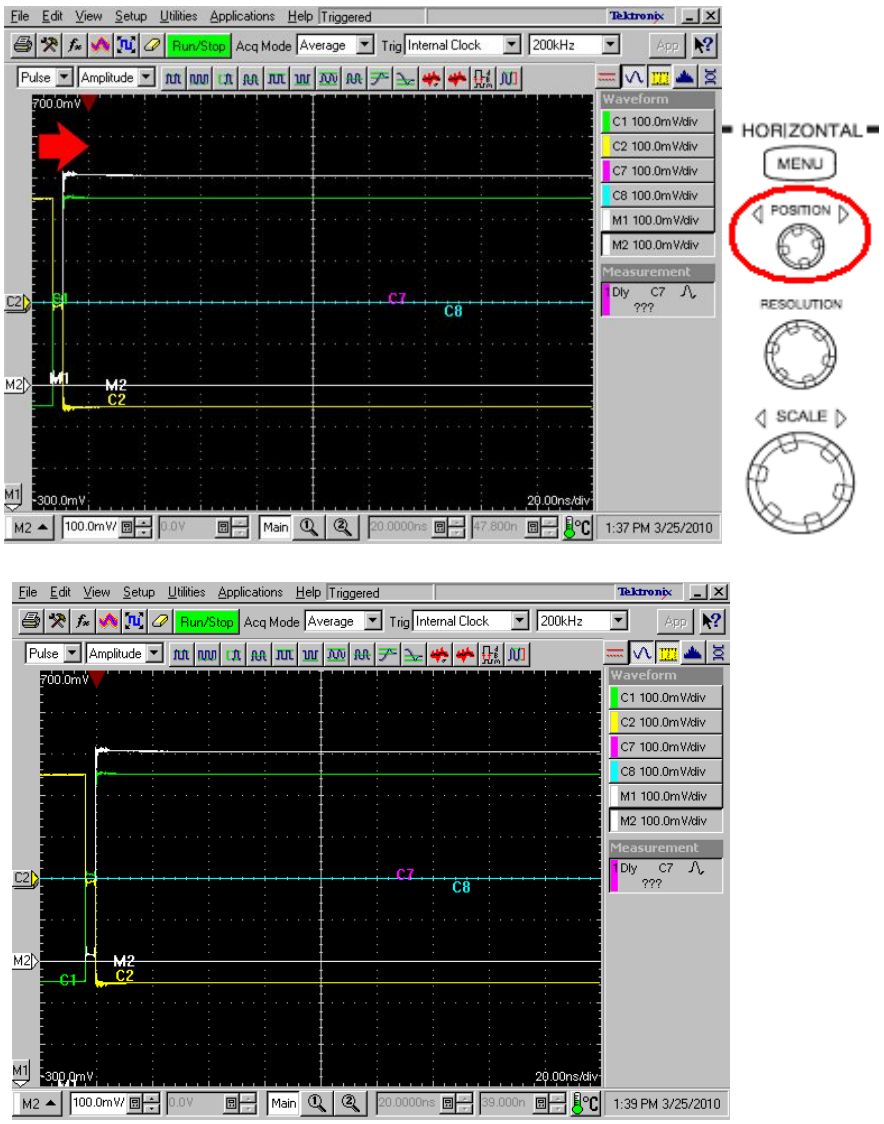

Figure 24: Setting Horizontal Position

(21) Connect the TDT module input CH7 to HEAC+ SMA connector and CH8 to HEAC- SMA connector on the second HEAC-TDR-R adapter.

(22) Connect the HEAC-TDR-R adapters and the cable under test (see Figure 25).

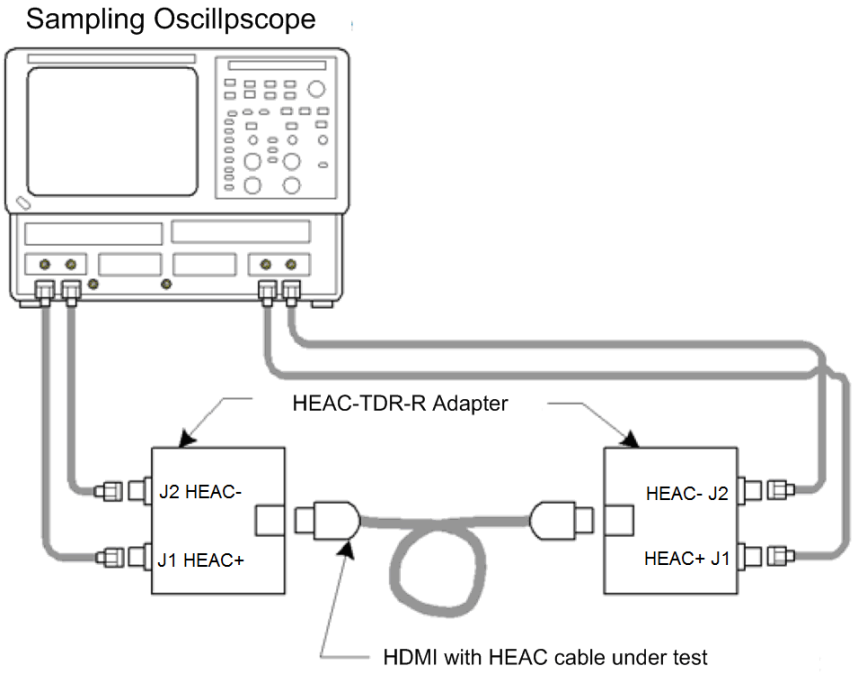

Figure 25: Differential attenuation test setup

(23) Adjust the **HORIZONTAL SCALE** knob so that the **M2** edge is displayed in the right half side of screen (see Figure 26). (Do not change **HORIZONTAL POSITION**).

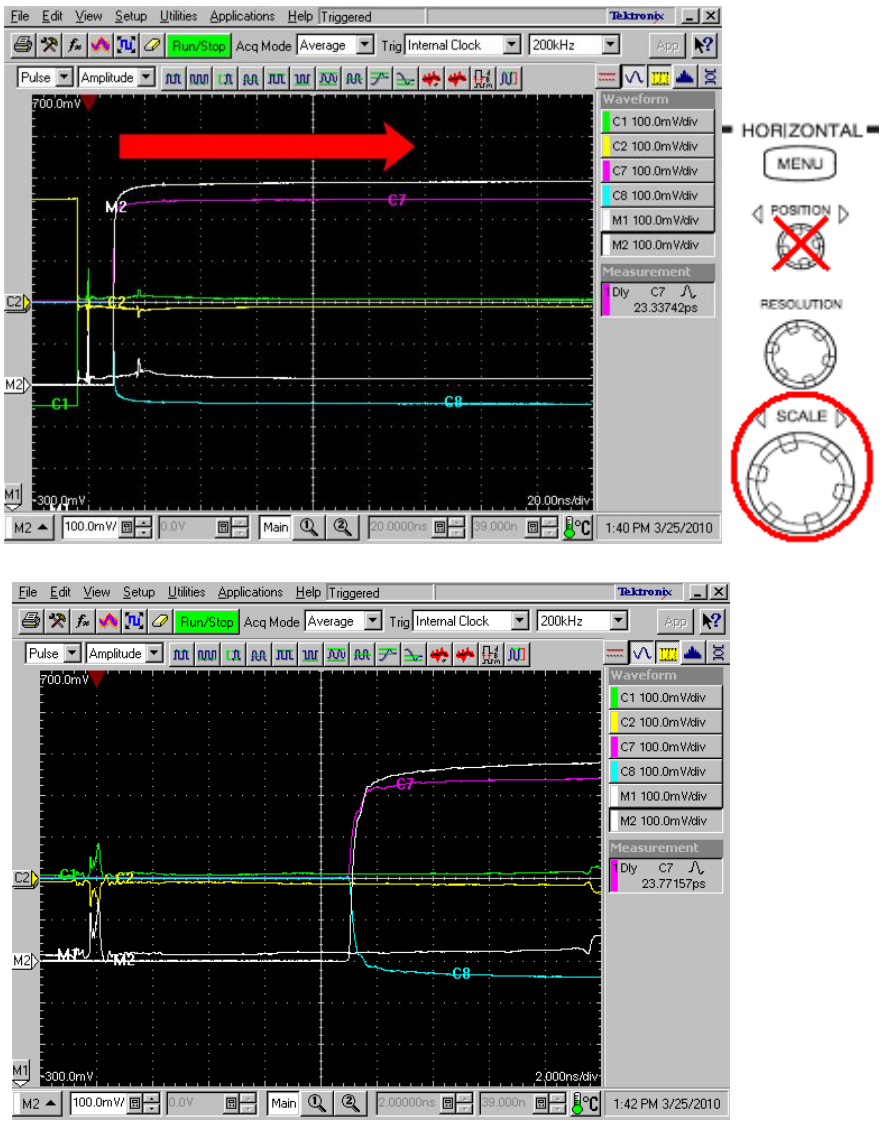

Figure 26: Setting Horizontal Scale

(24) Start the **Differential Attenuation Calculation** software.

(25) Click . button, and then select the **Work Folder**. (The measurement result is saved to this folder)

(26) Input the **DUT Name**. (The file name of the measurement result.)

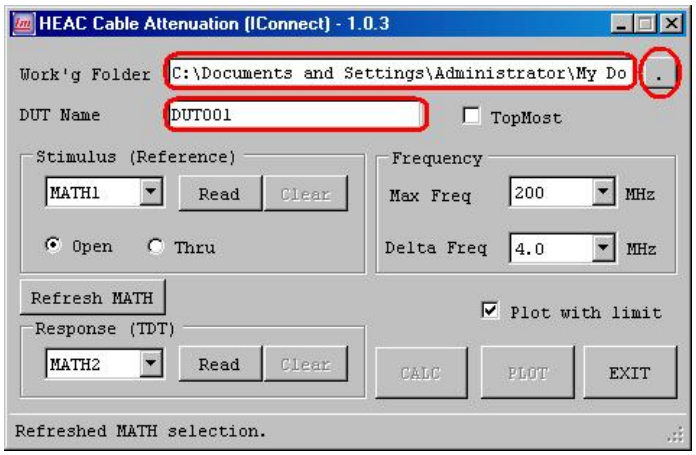

Figure 27: Differential attenuation calculation software

(27) Click the **Read** button in **Response (TDT)**.

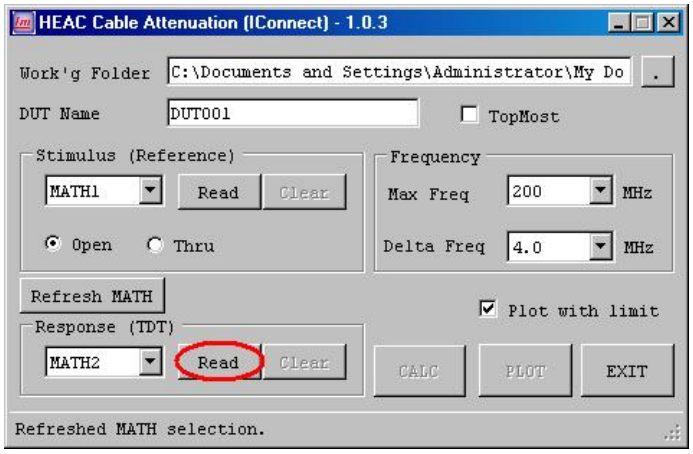

Figure 28: Reading response (TDT) waveform data

(28) Remove the cable under test from HEAC-TDR-R adapters (see Figure 29).

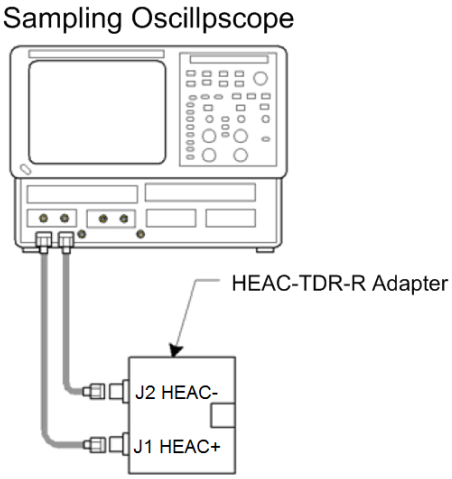

Figure 29: Remove the cable

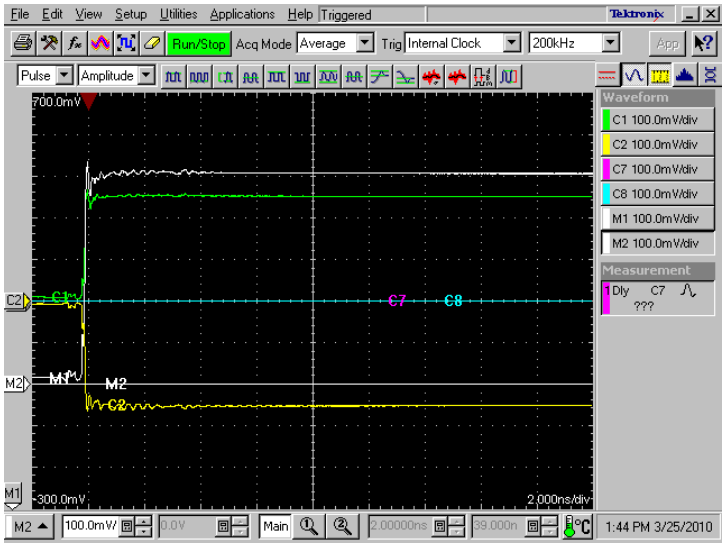

Figure 30: Reference waveform

(29) Click the **Read** button in **Stimulus (Reference)**.

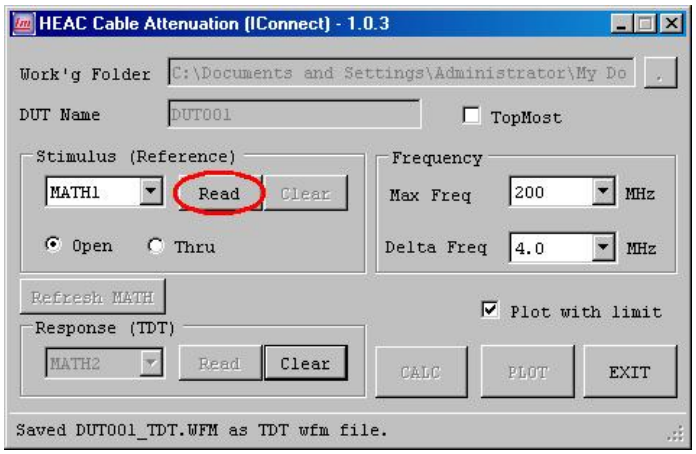

Figure 31: Reading Stimulus (Reference) waveform data

(30) Click the **CALC** button on **Differential Attenuation Calculation** window.

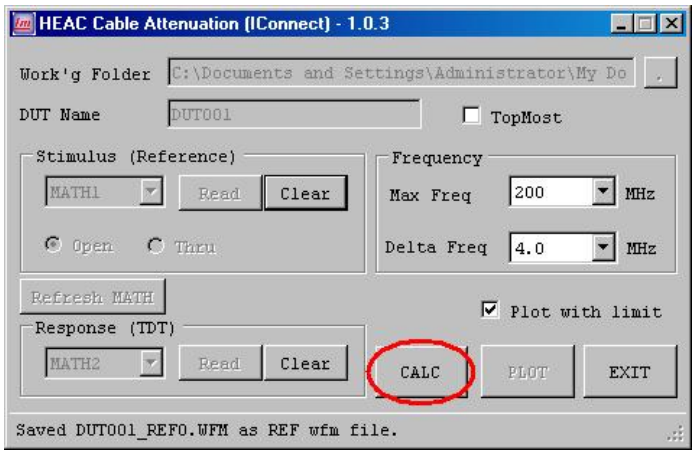

Figure 32: Calculation

(31) Differential Attenuation is displayed to the plot window.

(32) If the plot (blue line) is under than the limit (red line), then fail.

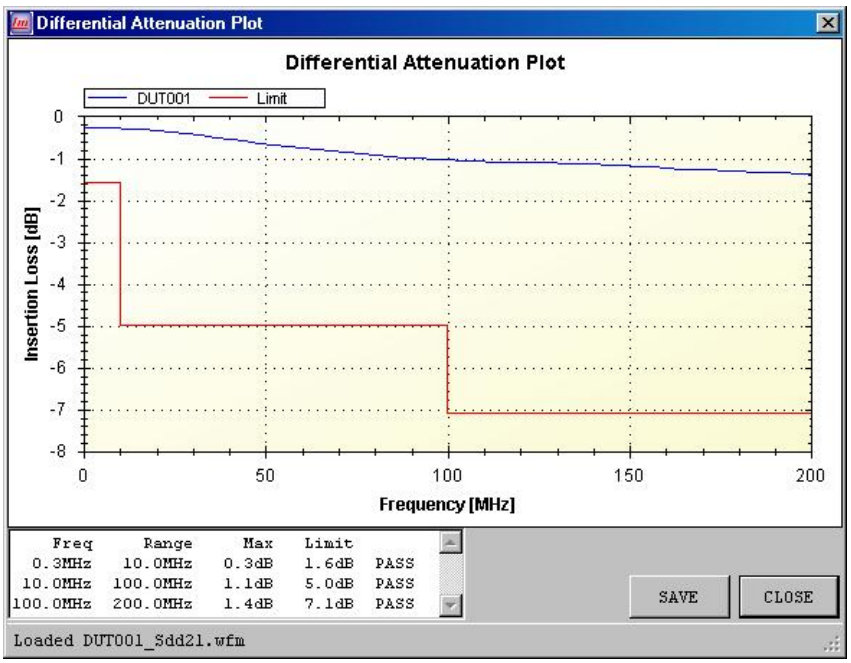

Figure 33: Differential attenuation plot

Test ID HEACT 6-3: Differential/Common Mode Impedance Test

In the impedance measurement procedure, the unfiltered impedance waveform needs to be defined and used in order to define the horizontal reference position precisely during measuring impedance. This will reduce the impact of uncertainty on horizontal positioning caused by using the filtered impedance waveform.

Differential Impedance Test

Setting Rise Time

(1) Connect the TDR module output CH1 to HEAC+ SMA connector and CH2 to HEAC- SMA connector on the first HEAC-TDR-R adapter.

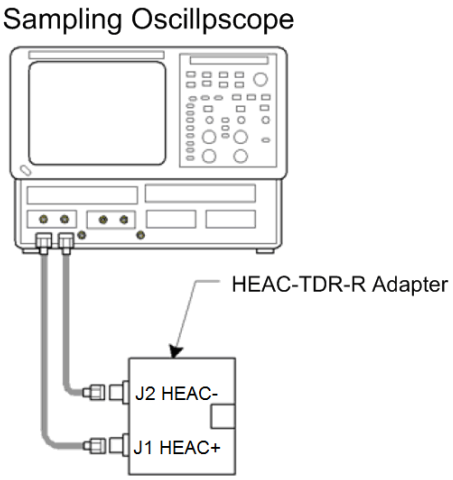

Figure 34: Initial equipments connection

(2) Click the MATH icon. 

(3) Select the **M1** in **Math Waveform** drop-sown list box on **Define Math** window.

(4) Enter "*Filter(C1-C2)*" in the **Math Expression** filed on **Define Math** window.

(5) Select the **Centered** in **Filter Mode** drop-down list box on **Define Math** window.

(6) Click the **Apply** button on **Define Math** window.

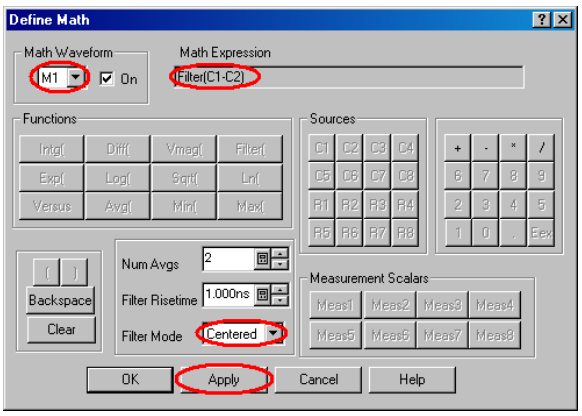

Figure: 35 Defining filtered waveform

(7) Select the **M2** in **Math Waveform** drop-sown list box on **Define Math** window.

(8) Set the **Math Waveform ON** check box to OFF.

(9) Click the **OK** button on **Define Math** window.

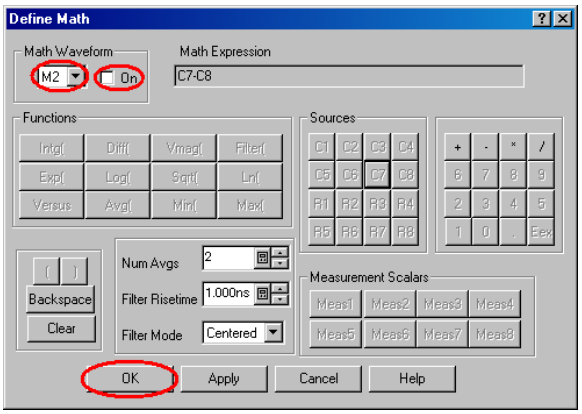

Figure: 36 Defining unfiltered waveform

(10) Click the Setups icon. 

(11) Click the **TDR** tab on **Setups** window.

(12) Set the **C1,C2,C7** and **C8 ACQ On** check box to OFF.

(13) Click the **Vert** tab on **Setups** window.

(14) Select **M1** in **Waveform** drop-down list box on **Vert** tab.

(15) Set the **Setup Scale** to 100.0 mv/div and the **Setup Position** to -7.000 div.

(16) Click the **Horz** tab on **Setups** window.

(17) Set the **Timebase Horizontal Reference** to 50% on **Horz** tab.

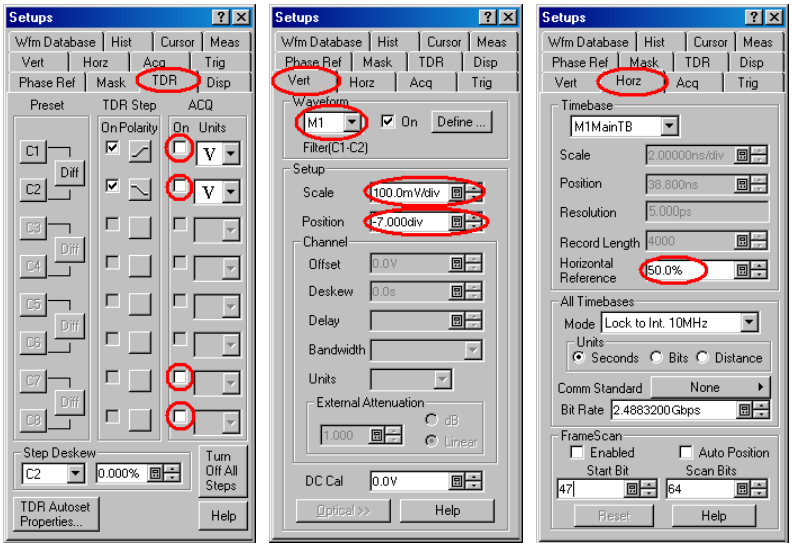

Figure 37: Setups window

(18) Adjust the **HORIZONTAL POSITION** knob so that the edge of **M1** waveform is displayed at center of the screen (see Figure 38).

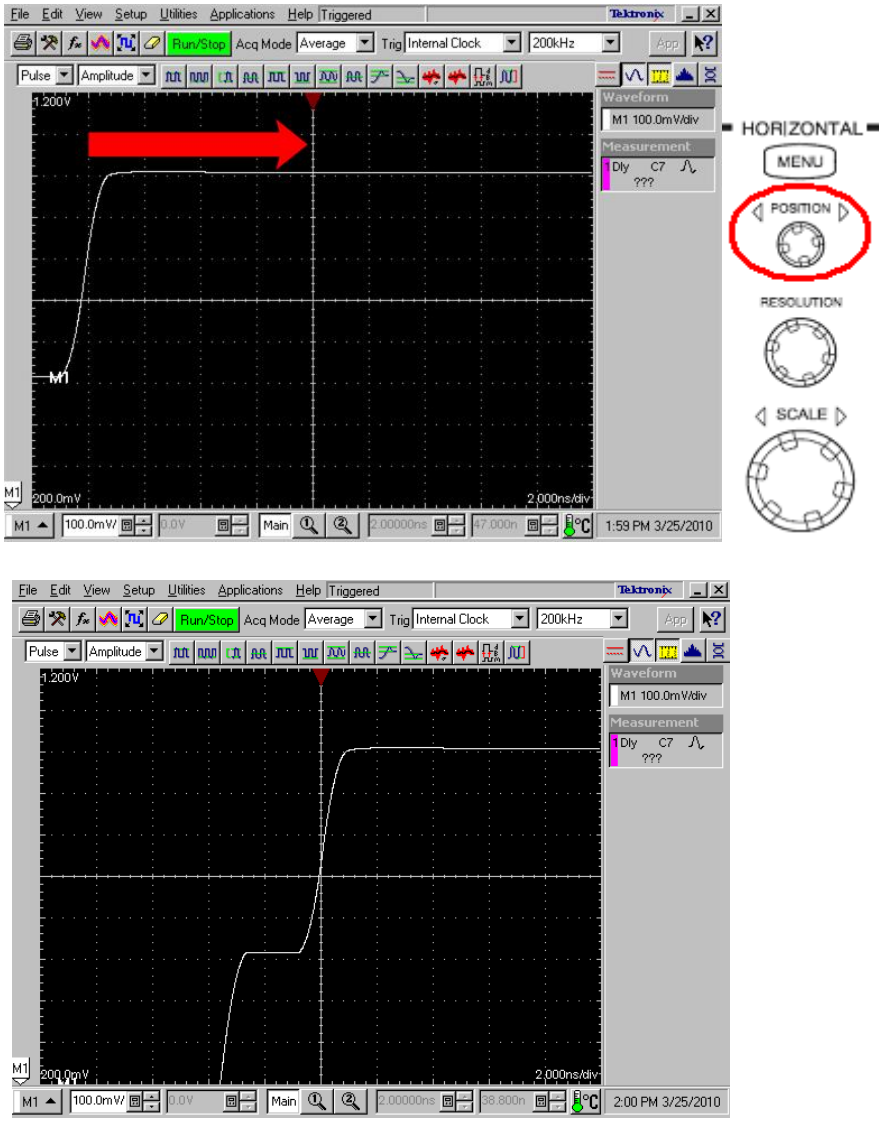

Figure 38: Setting Horizontal Position

(19) Adjust the **HORIZONTAL SCALE** knob so that the **Horizontal Main Scale** to 500 ps.

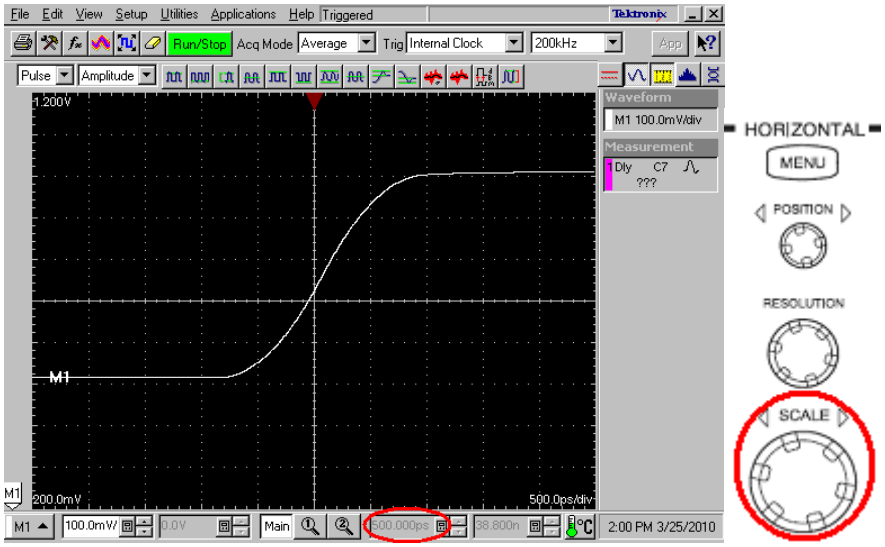

Figure 39: Setting Horizontal Scale

(20) Click the **Meas** tab on **Setups** window.

(21) Select the **Meas1** in drop-down list box on **Meas** tab.

(22) Click the **Select Meas** button, and then select **Pulse – Timing** > **Rise Time**.

(23) Click the **Source1** button on **Meas** tab.

(24) Click the **Source** tab on **Meas** tab

(25) Select the **Main M1** on **Source** tab.

(26) Click the **RefLevel** tab on **Meas** tab

(27) Click the **Relative** radio button in **Reference Level Calc Method**.

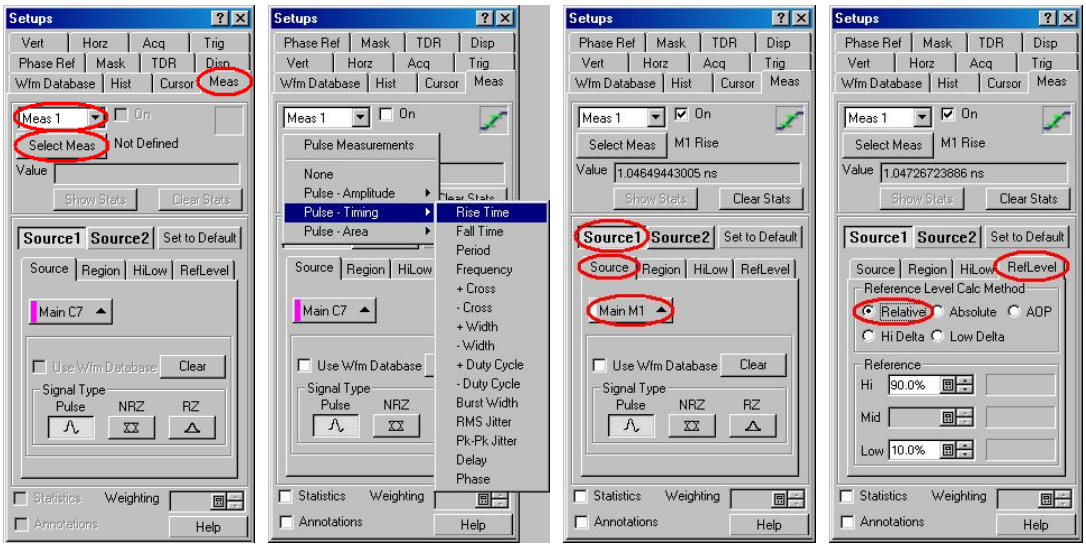

Figure 40: Measurement setups window

(28) Click the MATH icon. 

(29) Select the **M1** in **Math Waveform** drop-down list box on **Define Math** window.

(30) Adjust the **Filter Risetime** on **Define Math** window so that measurement value of **Rise M1** is equal to 1 ns. If you cannot adjust the value to 1 ns exactly, set it to the nearest value below 1 ns.

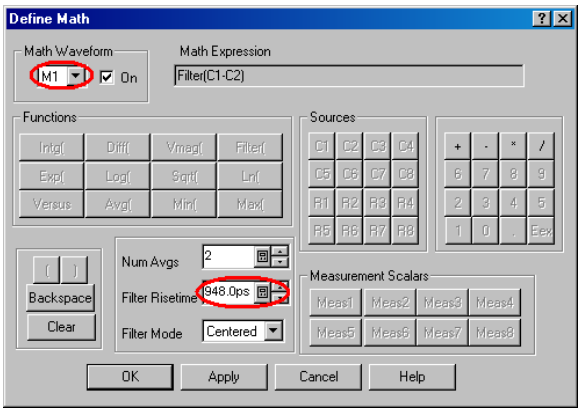

Figure 41: Setting Filter Risetime

Defining Waveforms and Connecting Equipments

(1) Make sure that the **Define Math** window is displayed and **M1** in **Math Waveform** drop-down list is selected.

(2) Click the **Clear** button, and then enter "*Filter (C1+C2)*" in the **Math Expression** filed on **Define Math** window in order to change the math expression from "*Filter (C1 – C2)*" to "*Filter (C1 +C2)*".

(3) Set the **Math Waveform On** check box for **M1** to OFF in order to hide the filtered differential impedance waveform.

(4) Click the **Apply** button on **Define Math** window.

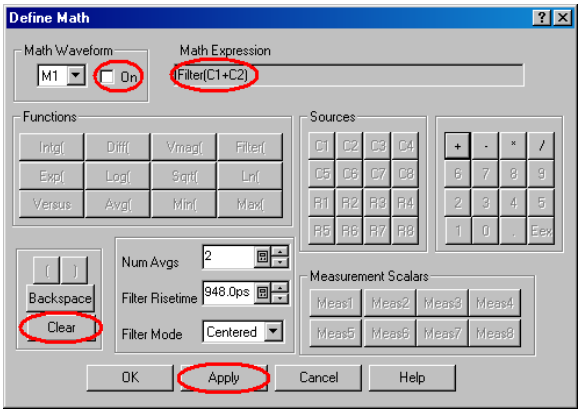

Figure 42: Changing Math Expression for M1

(5) Select the **M2** in **Math Waveform** drop-down list box on **Define Math** window.

(6) Click the **Clear** button, and then enter "*C1+C2*" in the **Math Expression** filed on **Define Math** window.

(7) Set the **Math Waveform On** check box for **M2** to ON in order to show the unfiltered differential impedance waveform..

(8) Click the **OK** button on **Define Math** window.

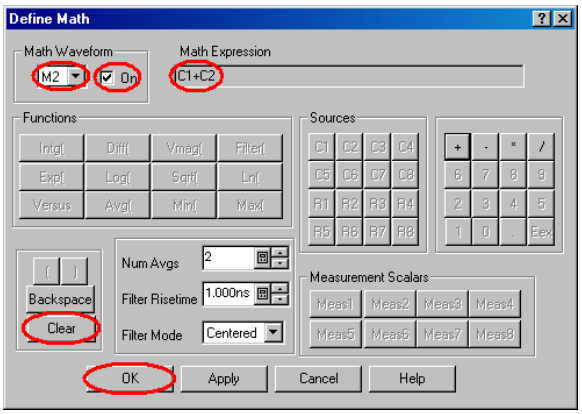

Figure 43: Defining unfiltered waveform M2

(9) Click the Setups icon. 

(10) Click the **TDR** tab on **Setups** window.

(11) Select the Ω in **C1** and **C2 ACQ Unit** drop-down list box on **TDR** tab.

(12) Click the **Vert** tab on **Setup** window

(13) Select the **M1** in **Waveform** drop-down list box on **Vert** tab.

(14) Set the **Setup Scale** to 5.000 Ω/div and the **Setup Position** to -20.00 div.

(15) Select the **M2** in **Waveform** drop-down list box on **Vert** tab.

(16) Set the **Setup Scale** to 20.00 Ω/div and the **Setup Position** to -5.000 div.

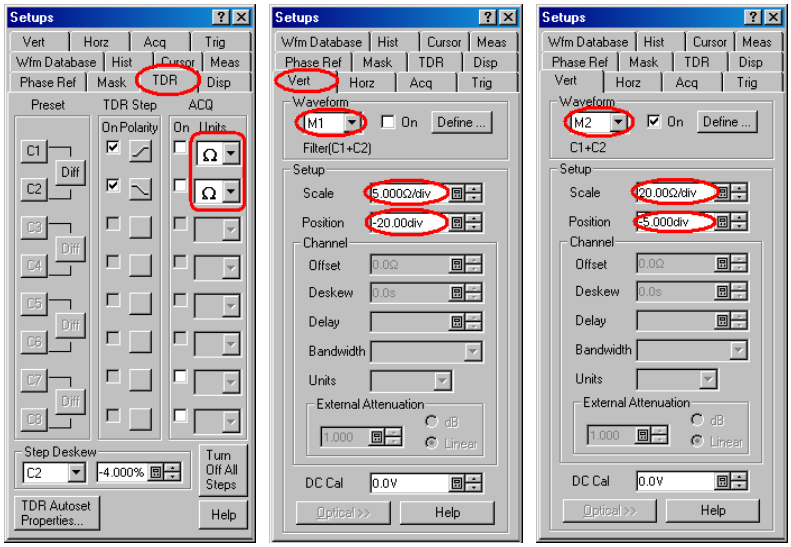

Figure 44: Setups window

(17) Connect the near end of the cable to the first HEAC-TDR-R adapter.

(18) Connect the far end of the cable to the second HEAC-TDR-R adapter.

(19) Connect 50 Ω terminators to HEAC+ and HEAC– connectors on the far end of the HEAC-TRD-R adapter.

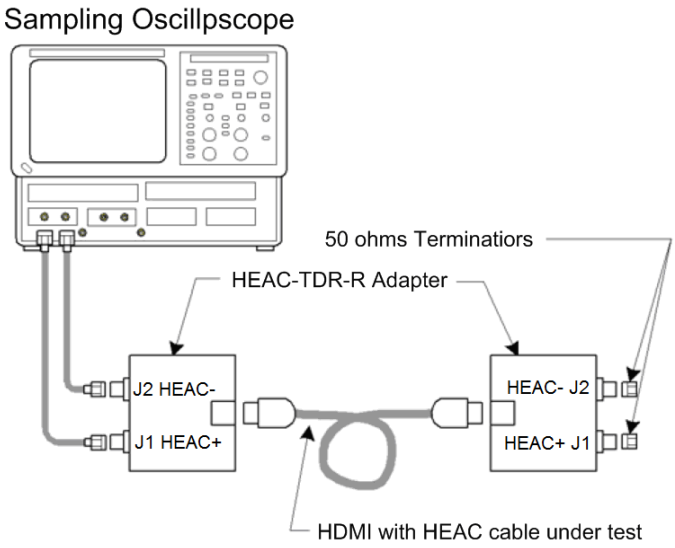

Figure 45: Differential impedance test setup

Setting Horizontal Position

(1) Make sure that the unfiltered impedance waveform, **M2**, is displayed.

(2) Adjust the **HORIZONTAL POSITION** knob so that the **M2** waveform change point is displayed at 3 major divisions from the left edge of the screen.

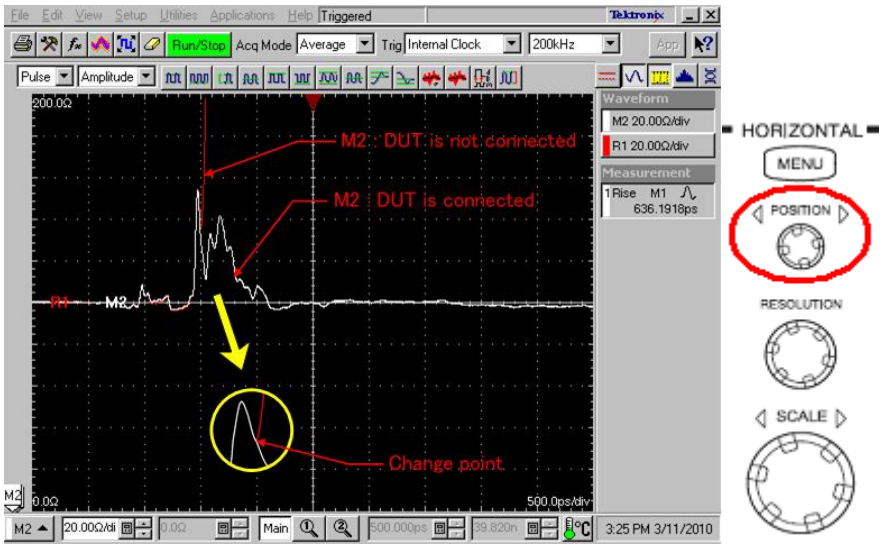

Figure 46: Setting Horizontal Position

(3) Click the Setups icon. 

(4) Click the **Vert** tab on **Setups** window.

(5) Select the **M1** in **Waveform** drop-down list box on **Vert** tab.

(6) Set the **Waveform On** check box for **M1** to ON in order to show the filtered differential impedance waveform again.

(7) Select the **M2** in **Waveform** drop-down list box on **Vert** tab.

(8) Set the **Waveform On** check box for **M2** to OFF in order to hide the unfiltered differential impedance waveform.

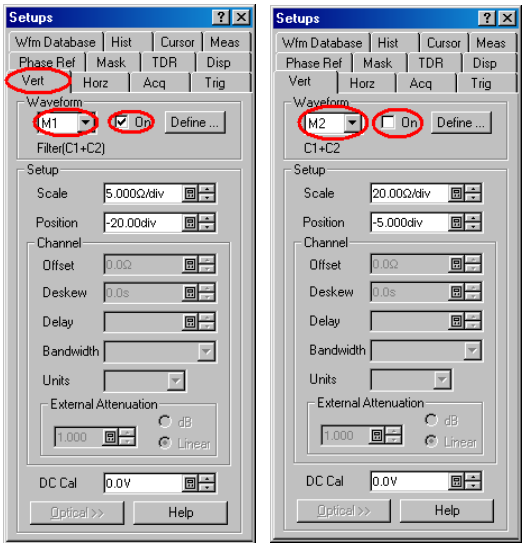

Figure 47: Setups window

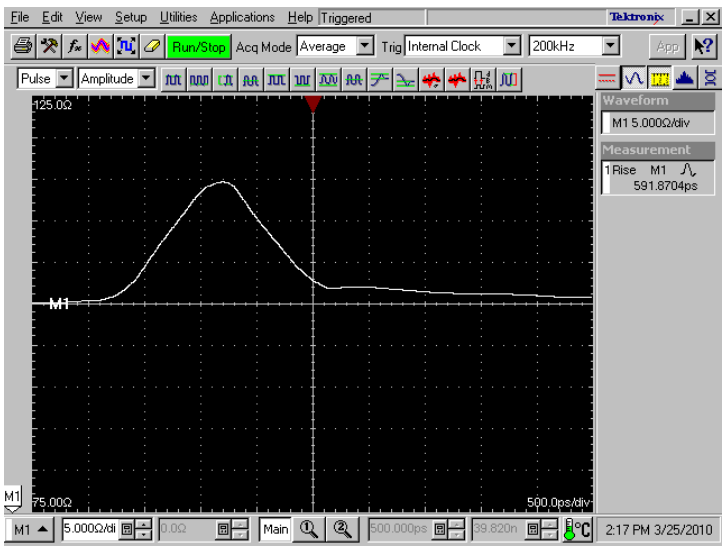

Figure 48: Filtered Differential Impedance Waveform

Measuring Impedance

(1) Click the **Meas** tab on **Setups** window.

(2) Select the **Meas2** in drop-down list box on **Meas** tab.

(3) Click the **Select Meas** button, and then select **Pulse – Amplitude** > **Max**.

(4) Click the **Source1** button on **Meas** tab.

(5) Click the **Source** tab on **Meas** tab.

(6) Select the **Main M1** on **Source** tab.

(7) Click the **Region** tab on **Meas** tab.

(8) Set the **Gates G1** to 30.00% and the **Gates G2** to 50.00% on **Region** tab.

(9) Set the **Gates On** check box to ON.

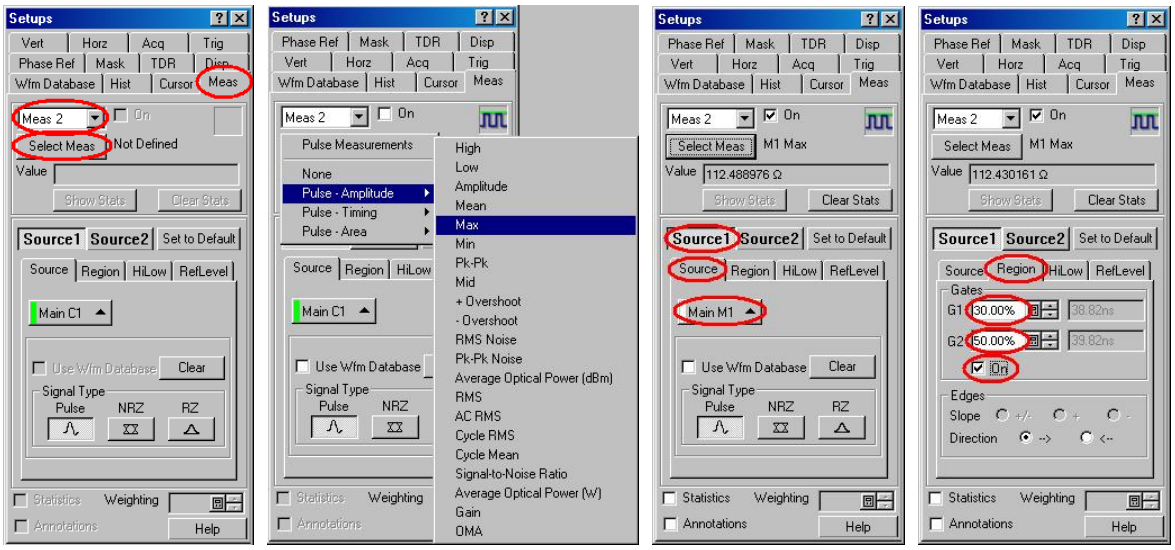

Figure 49: Measurement2 setups window

(10) Select the **Meas3** in drop-down list box on **Meas** tab.

(11) Click the **Select Meas** button, and then select **Pulse – Amplitude** > **Min**.

(12) Click the **Source1** button on **Meas** tab.

(13) Click the **Source** tab on **Meas** tab.

(14) Select the **Main M1** on **Source** tab.

(15) Click the **Region** tab on **Meas** tab.

(16) Set the **Gates G1** to 30.00% and the **Gates G2** to 50.00% on **Region** tab.

(17) Set the **Gates On** check box to ON.

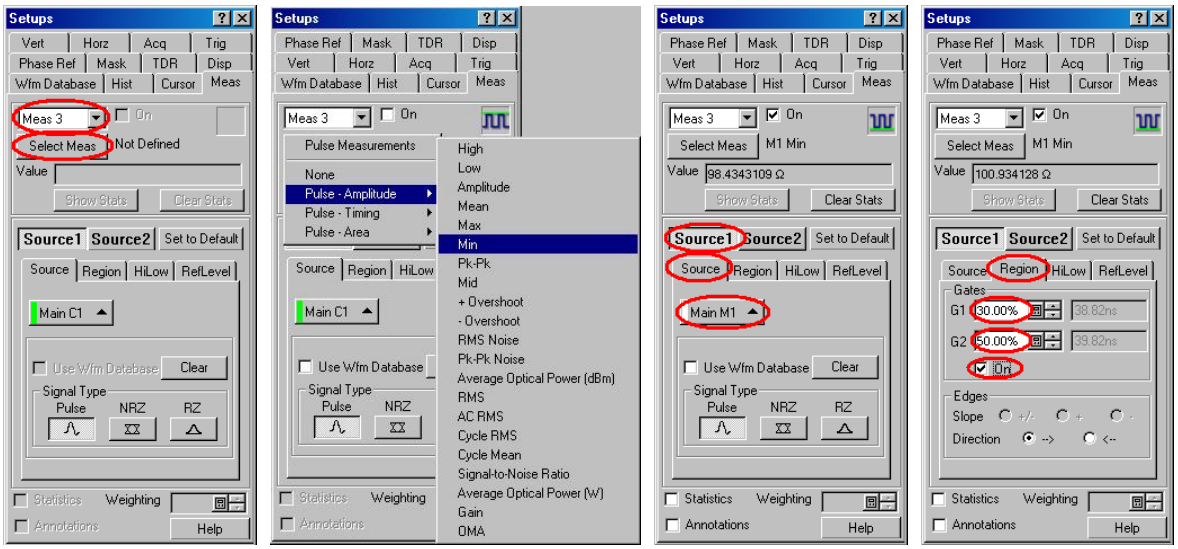

Figure 50: Measurement3 setups window

(18) Select the **Meas4** in drop-down list box on **Meas** tab.

(19) Click the **Select Meas** button, and then select **Pulse – Amplitude** > **Max**.

(20) Click the **Source1** button on **Meas** tab.

(21) Click the **Source** tab on **Meas** tab.

(22) Select the **Main M1** on **Source** tab.

(23) Click the **Region** tab on **Meas** tab.

(24) Set the **Gates G1** to 50.00% and the **Gates G2** to 80.00% on **Region** tab.

(25) Set the **Gates On** check box to ON.

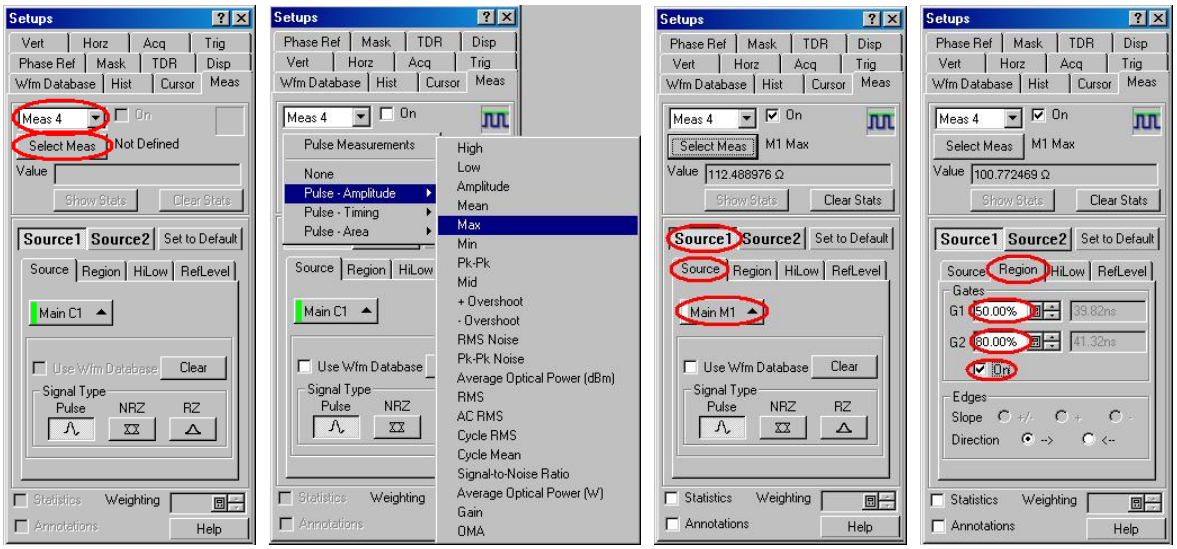

Figure 51: Measurement4 setups window

(26) Select the **Meas5** in drop-down list box on **Meas** tab.

(27) Click the **Select Meas** button, and then select **Pulse – Amplitude** > **Min**.

(28) Click the **Source1** button on **Meas** tab.

(29) Click the **Source** tab on **Meas** tab.

(30) Select the **Main M1** on **Source** tab.

(31) Click the **Region** tab on **Meas** tab.

(32) Set the **Gates G1** to 50.00% and the **Gates G2** to 80.00% on **Region** tab.

(33) Set the **Gates On** check box to ON.

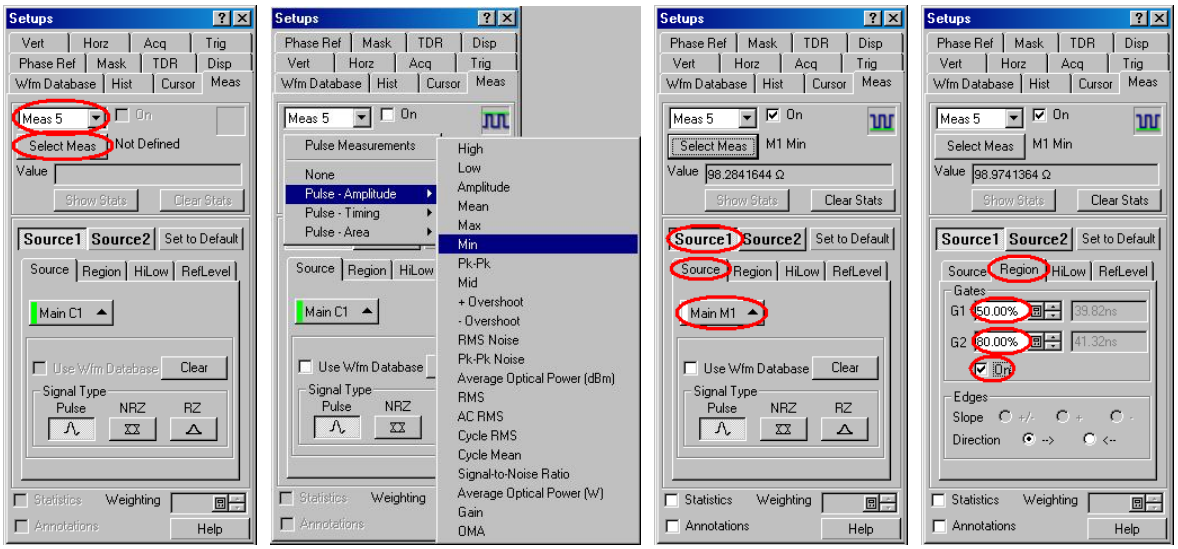

Figure 52: Measurement5 setups window

(34) Differential Impedance of connection point and transition area is displayed as "**2 Max M1**" and "**3 Min M1**" on screen.

(35) Differential Impedance of cable area is displayed as "**4 Max M1**" and **"5 Min M1**" on screen.

(36) If difference impedance max of connection point and transition area ("**2 Max M1**") is more than 115 Ω, then fail.

(37) If difference impedance min of connection point and transition area ("**3 Min M1**") is less than 85 Ω, then fail.

(38) If difference impedance max of cable area ("**4 Max M1**") is more than 110 Ω, then fail.

(39) If difference impedance min of cable area ("**5 Max M1**") is less than 90 Ω, then fail.

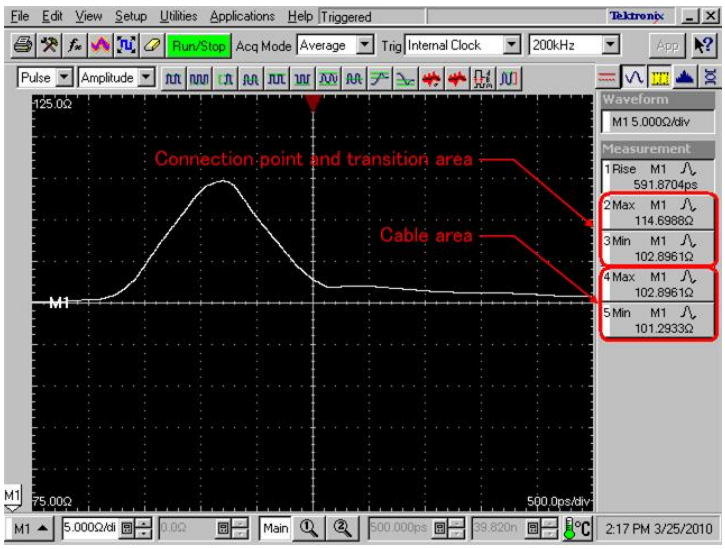

Figure 53: Result of differential impedance

(40) Swap the near-end connection and far-end connection of the cable assembly and repeat the test.

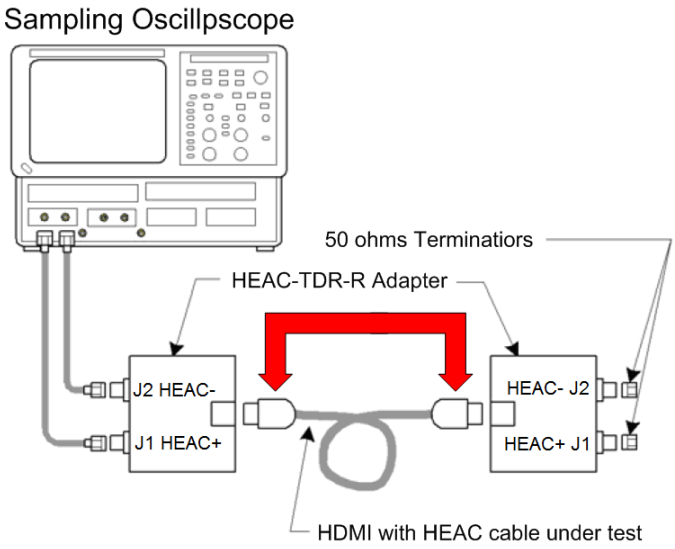

Figure 54: Swap near-end and far-end

Common Mode Impedance Test

Setting Rise Time

(1) Connect the TDR module output CH1 to HEAC+ SMA connector and CH2 to HEAC- SMA connector on the first HEAC-TDR-R adapter (see Figure 55).

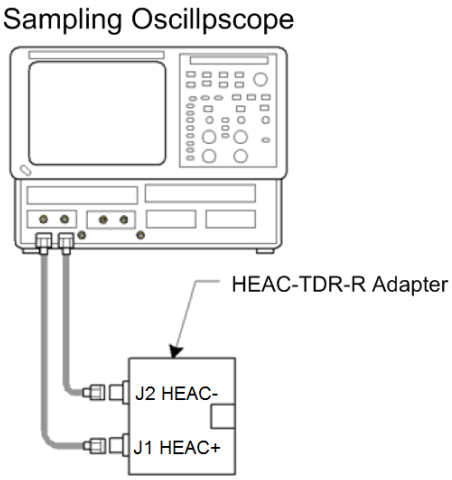

Figure 55: Common mode impedance test open setup

(2) Click the Setups icon. 

(3) Click the **TDR** tab on **Setups** window

(4) Select the **V** in **C1** and **C2 ACQ Units** drop-down list box on **TDR** tab.

(5) Click the **C2 TDR Step Polarity** button, set polarity to positive.

(6) Click the **Vert** tab on **Setups** window

(7) Select **M1** in **Waveform** on **Vert** tab.

(8) Set the **Setup Scale** to 100.0 mv/div and the **Setup Position** to -7.000 div.

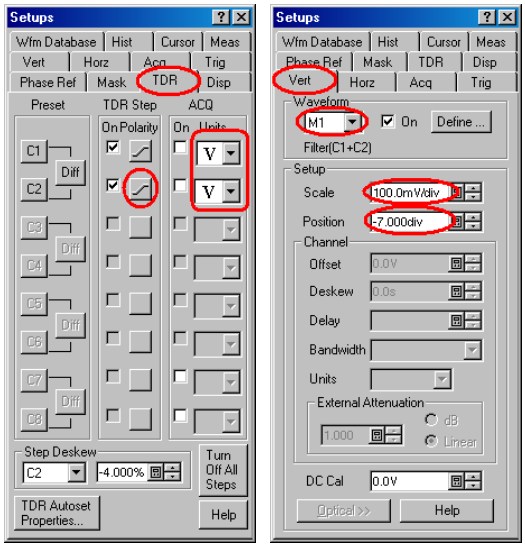

Figure 56: Setups window

(9) Adjust the **HORIZONTAL POSITION** knob so that the edge of **M1** waveform is displayed at center of the screen (see Figure 57).

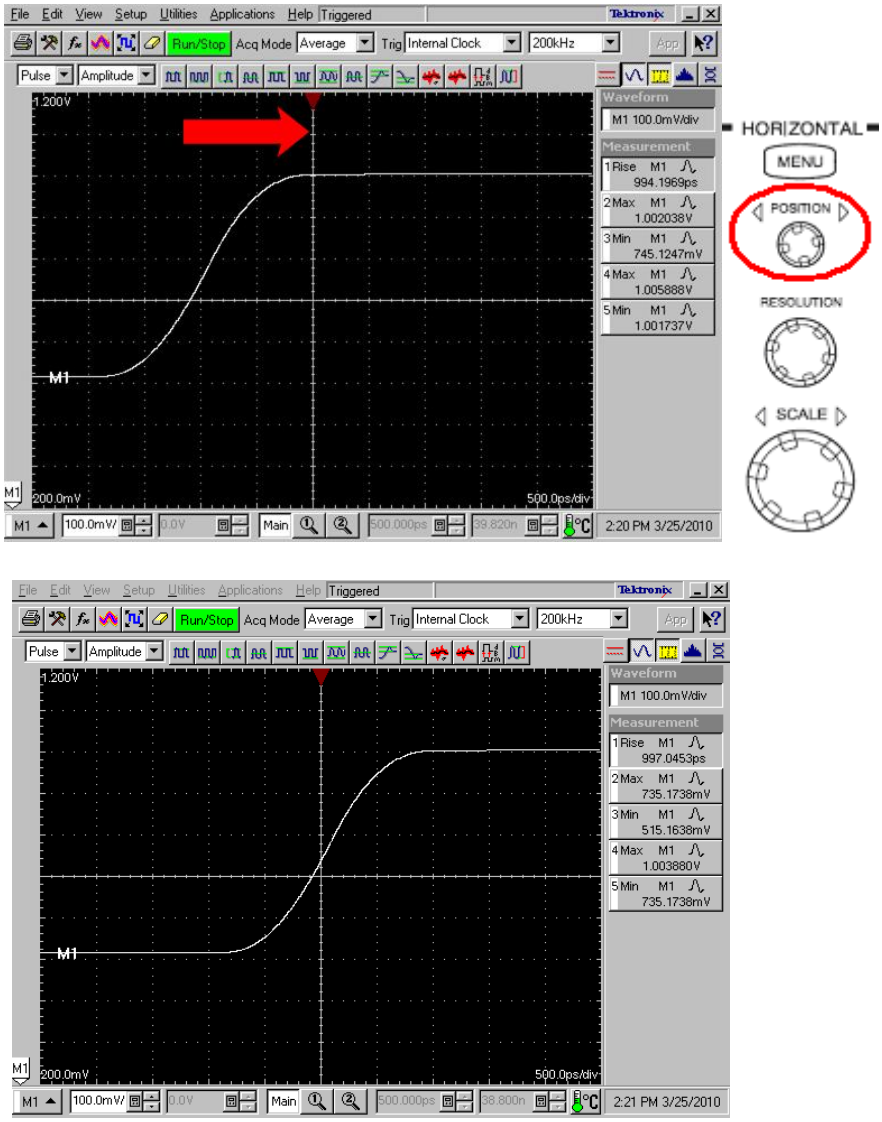

Figure 57: Setting Horizontal Position

(10) Click the MATH icon. 

(11) Select the **M1** in **Math Waveform** drop-down list box on **Define Math** window.

(12) Adjust the **Filter Risetime** on **Define Math** window so that measurement value of **Rise M1** is equal to 1 ns. If you cannot adjust the value to 1 ns exactly, set it to the nearest value below 1 ns.

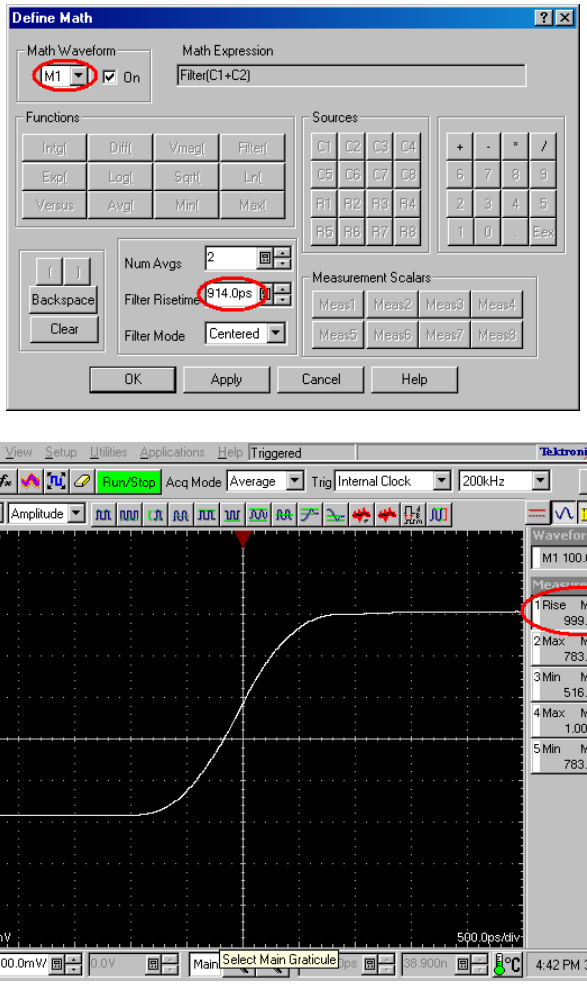

Figure 58: Setting Filter Risetime

Defining Waveforms and Connecting Equipments

(1) Make sure that the **Define Math** window is displayed and **M1** in **Math Waveform** drop-down list is selected.

(2) Click the **Clear** button, and then enter "*Filter((C1+C2)/4)*" in the **Math Expression** filed on **Define Math** window in order to change the math expression from "*Filter (C1 + C2)*" to "*Filter ((C1 + C2) / 4)*".

(3) Set the **Math Waveform On** check box for **M1** to OFF in order to hide the filtered common mode impedance waveform.

(4) Click the **Apply** button on **Define Math** window.

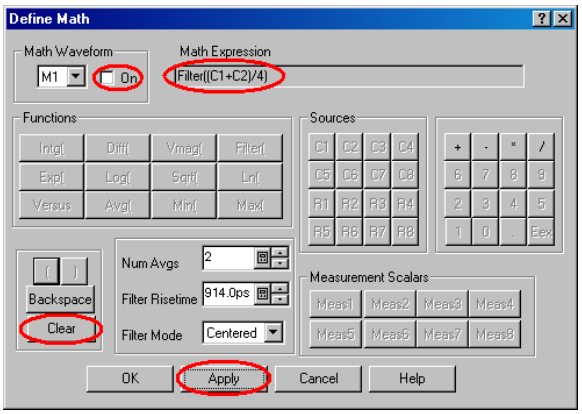

Figure 59: Changing Math Expression for M1

(5) Select the **M2** in **Math Waveform** drop-down list box on **Define Math** window.

(6) Click the **Clear** button, and then enter "*(C1+C2)/4*" in the **Math Expression** filed on **Define Math** window.

(7) Set the **Math Waveform ON** check box for **M2** to ON in order to show the unfiltered common mode impedance waveform.

(8) Click the **OK** button on **Define Math** window.

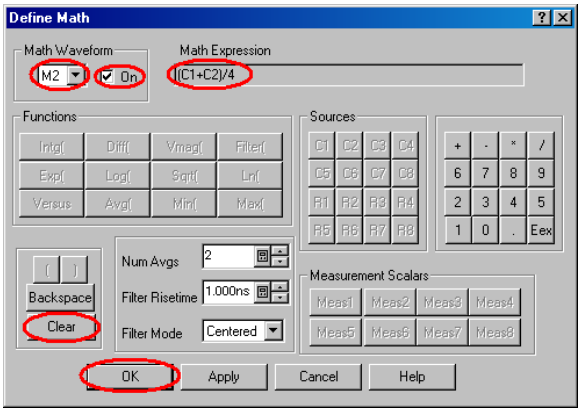

Figure 60: Defining unfiltered waveform M2

(9) Click the Setups icon. 

(10) Click the **TDR** tab on **Setups** window.

(11) Select the Ω in **C1** and **C2 ACQ Unit** drop-down list box.

(12) Click the **Vert** tab on **Setup** window.

(13) Select the **M1** in **Waveform** drop-down list box on **Vert** tab.

(14) Set the **Setup Scale** to 2.000 Ω/div and the **Setup Position** to -15.00 div.

(15) Select the **M2** in **Waveform** drop-down list box on **Vert** tab.

(16) Set the **Setup Scale** to 10.00 Ω/div, and the **Setup Position** to -5.000 div.

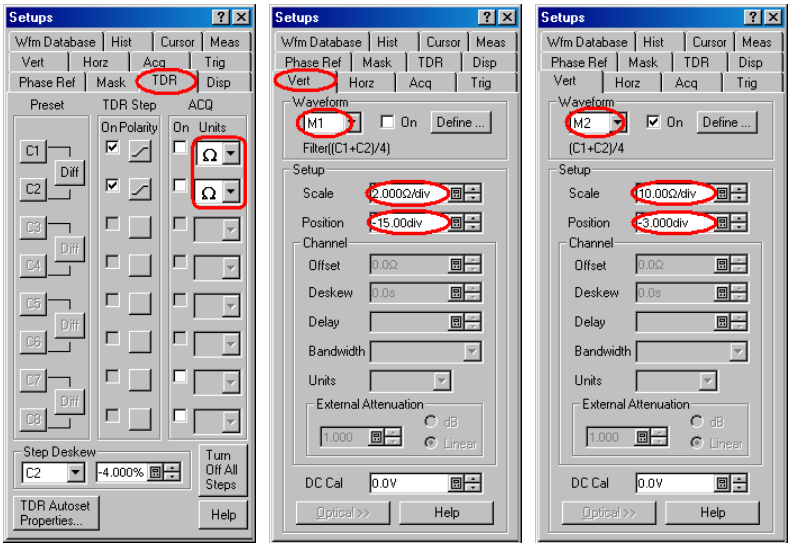

Figure 61: Setups window

(17) Connect the near end of the cable to the first HEAC-TDR-R adapter.

(18) Connect the far end of the cable to the second HEAC-TDR-R adapter.

(19) Connect 50 Ω terminators to HEAC+ and HEAC– connectors on the far end of the HEAC-TRD-R adapter.

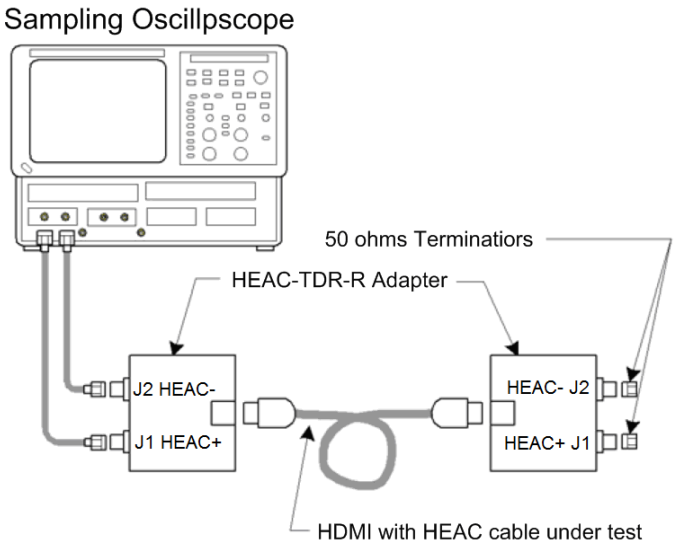

Figure 62: Common mode impedance test setup

Setting Horizontal Position

(1) Adjust the **HORIZONTAL POSITION** knob so that a **M2** waveform change point is displayed at 3 major divisions from the left edge of the screen (see Figure 62).

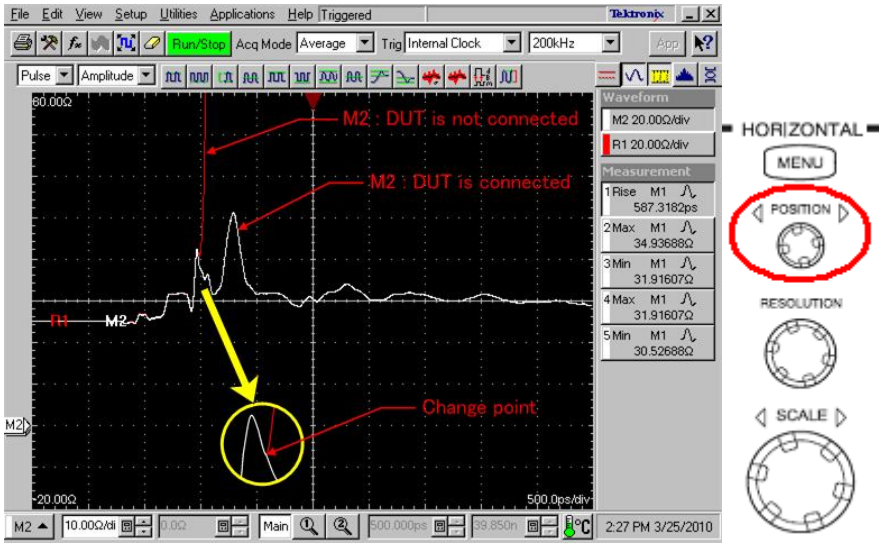

Figure 63: Adjust Horizontal Position

(2) Click the Setups icon. 

(3) Click the **Vert** tab on **Setups** window.

(4) Select the **M1** in **Waveform** drop-down list box on **Vert** tab.

(5) Set the **Waveform On** check box for **M1** to ON in order to show the filtered common mode impedance waveform again.

(6) Select the **M2** in **Waveform** drop-down list box on **Vert** tab.

(7) Set the **Waveform On** check box for **M2** to OFF in order to hide the unfiltered common mode impedance waveform.

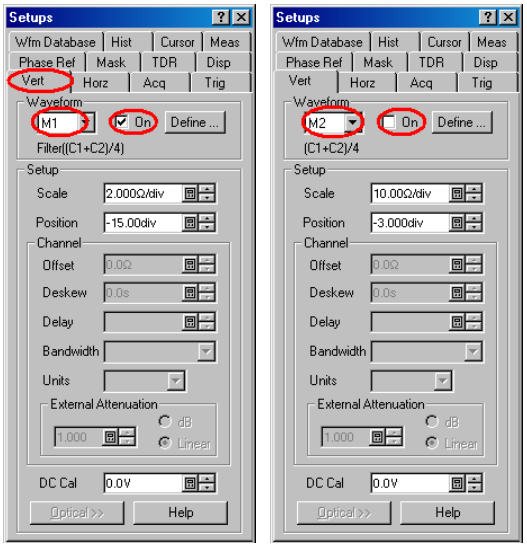

Figure 64: Setups window

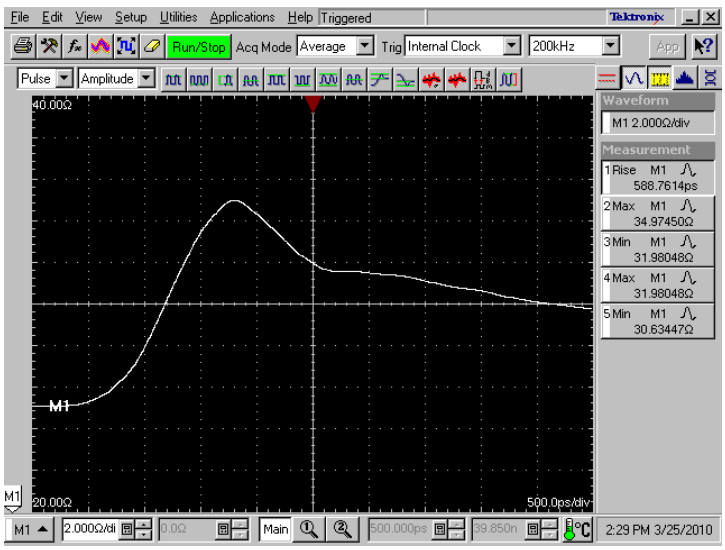

Figure 65: Filtered Common mode Impedance Waveform

Measuring Impedance

Detailed setups for the impedance measurement have been already performed in steps (1) ~ (32), page 33 ~ 36.

(1) Common Mode Impedance of cable area is displayed as "**4 Max M1**" and **"5 Min M1**" on screen.

(2) If difference impedance max of cable area ("**4 Max M1**") is more than 36 Ω, then fail.

(3) If difference impedance min of cable area ("**5 Max M1**") is less than 24 Ω, then fail.

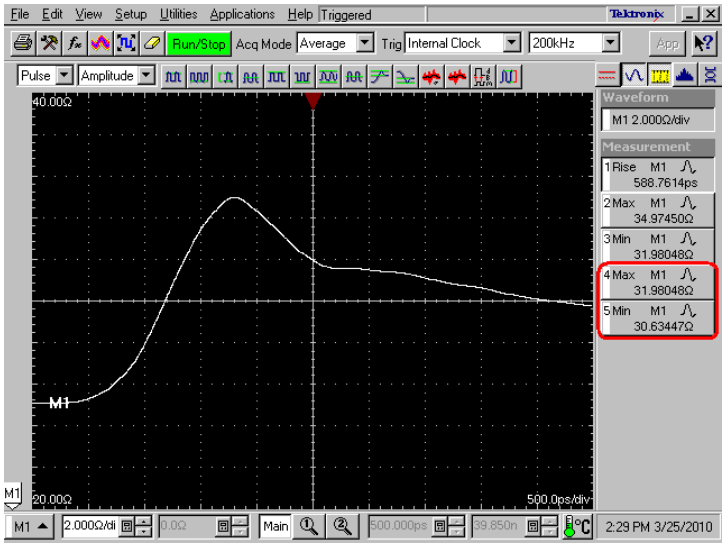

Figure 66: Result of Common mode Impedance

(4) Swap the near-end connection and far-end connection of the cable assembly and repeat the test.

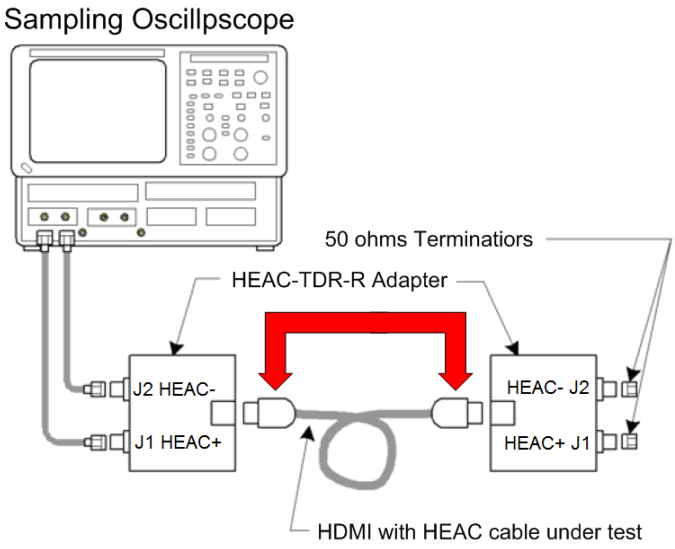

Figure 67: Swap near-end and far-end