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.

ltem	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
50 Ω SMA matched pair cable	2 ea,	Tektronix P/N:174-4866-00
50 Ω SMA female-female connector	2 ea.	Tektronix P/N:015-1012-00
50 Ω 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.

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Curre Main	nt Date/Time: frame	02 Mar 1	0 13:19			
	Model	Serial #	Date / Time	Status	ATEMP	Select Action
	TDS8000B	B010	02 Mar 10 12:22	Pass	-0.5°C	C Save
Јрре	er Modules					C Recall
СН	Model	Serial #	Date / Time	Status	ATEMP	C Compensate
1						Compensate
2						and Save
3						
4						
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CH	Model	Serial #	Date / Time	Status	ATEMP	014
1	80E04	B011	02 Mar 10 12:22	Pass	-1.8°C	
2	80E04	B011	02 Mar 10 12:22	Pass	-1.8°C	- Chorago
						atulate
3						-
3 4						 User
3 4 5						User O Factory
3 4 5 6						C Factory
3 4 5 6 7	80E03	B010	02 Mar 10 12:22	Pass	+0.0°C	 User Factory

Figure 2: Compensation window.

(3) Start the test after thermometer is green.

<mark>₿°C</mark>

De-skew

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

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- (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 to 100 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.

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Meas 1 💌 🔽 On Select Meas C7 C8 Delay Value 1999	5	Meas 1 I On Select Meas C7 C8 D	elay	Meas 1	- 🔽 On C7 C8 Dela	, 5
Show Stats Clear S	Stats	Show Stats	Clear Stats	Show	Stats	Clear Stats
Source Source Set to D Source Region HiLow RefL Main C8 Use W/m Database Clear Signal Type Pulse NRZ RZ A XX A	efault evel	Source1 Source2 Source Region HiLo Gales G1 0.00% @☆ G2 100.00% @☆ On Edges Slope C +/- C Direction C →>	Set to Default w RefLevel 38 13ns 39 13ns + C <	Source 1 Source Re Reference C Relative C Hi Delta Reference Hi Mid (-125.0 Low	Source2 Se gion HLow Level Calc Met Absolute Cow Delta Dim Dim	t to Default RefLevel thod C AOP
Statistics Weighting Annotations Heighting		Statistics Weighting	Help	Statistics	Weighting s	E -

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 (\pm 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. f_{*}



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.

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Math Wave	eform	Math E	xpression									
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Exp(Log(Sigrt(Ln(C5	C6	C7	C8		6	7	8	9
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				R5	R6	R7	R8		1	Û		Eex
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Clear	Filter	Mode C	entered 💌	Me	as5	Me	as6	Me	as7	Mea	is8	
	OK		pply	Cance	1		He	lp				

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.

Define Mat	h											? ×
Math Wave	eform	xpression										
(M2)		C7-C8)									
- Functions -				1 - Sou	rces							
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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.)

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UT Name DUT001	TopMost
Stimulus (Reference)	Frequency
MATH1 TRead Clear	Max Freq 200 💌 MHz
📀 Open 🔿 Thru	Delta Freq 4.0 💌 MHz
Refresh MATH	🔽 Plot with limi

Figure 27: Differential attenuation calculation software

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

HEAC Cable Attenuation (IConnect) - 1	1.0.3
Work'g Folder C:\Documents and S	ettings\Administrator\My Do
DUT Name DUT001	TopMost
Stimulus (Reference) MATHI Read Clear © Open C Thru	Frequency Max Freq 200 Y MHz Delta Freq 4.0 Y MHz
Refresh MATH Response (TDT)	Plot with limit
Refreshed MATH selection.	CALC PLOT EXIT

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)**.

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UT Name	DUTOOL	🗆 🗆 То	pMost
Stimulus (Re	ference)	Frequency	
MATH1 -	Read Clear	Max Freq	200 💌 MHz
• Open (Thru	Delta Freq	4.0 • MHz
Refresh MATH			Plot with limit
	TT L		

Figure 31: Reading Stimulus (Reference) waveform data

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

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UT Name DUT001	TopMost
Stimulus (Reference)	Frequency
MATHL Read C.	lear Max Freq 200 💌 MHz
C Open C Thru	Delta Freq 4.0 MHz
Refresh NATH	V Blot with limi
Response (TDT)	
MATH2 - Read C.	lear CALC DIGT FYTT

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

 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. f_{x}
- (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.

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Math Waveform Math Expression												
- Functions -				_ Sou	ces-							
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Versus	Avg(Min(Max(R1	R2	R3	R4		2	3	4	5
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	OK		pply	Cance	1		Hel	P				

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.

Define Math	ı												?	X
Math Waveform Math Expression														
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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.

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- (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.

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(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.

Define Math	ı											? >	<
Math Wave	eform	Math E	xpression 1+C2)								_		
- Functions -				Sou	rces-								
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	OK		.pply	Canc	el		He	lp					

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.

Define Math	ı											? ×
Math Wave		Math E	xpression									
- Functions -				Sou	rces							
Intg(Diff(Vmag(Filter(C1	C2	C3	C4		+	•	×	1
Exp(Log(Sigrt(Ln(C5	C6	C7	C8		6	7	8	3
Versus	Avg(Min(Max(B1	R2	R3	B4		2	3	4	5
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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 $\,\Omega$ /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.

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- (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).



Sampling Oscillpscope



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

Setups	?×	Setups ? 🗙
Wfm Database Hist Cur	sor Meas	Wfm Database Hist Cursor Meas
Vert Horz Aca	Trig	Phase Ref Mask TDR Disp
Phase Ref Mask (TDR	Disp	Vert Horz Acq Trig
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On Polarity C)n Unite	(M1 🗾 🗹 On Define
	V -	Filter(C1+C2)
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	- <u>-</u>	
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	~	O dB
- Step Deskew	Turn	Linear
C2 -4.000% 🛛 🗧	Off All	
	Steps	
TDH Autoset Properties	Help	Optical >> Help

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.

 f_{π}

(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.

Define Mat	h											? ×
Math Wave	xpression (1+C2)/4)											
- Functions -				1 – Sou	rces-							
intg(Diff(Vmag(Filter(C1	C2	С3	C4		+		×	1
Exp(Log(Sigit(Ln(C5	C6	C7	C8		6	7	8	3
Versus	Avg(Min(Max(B1	R2	R3	B4		2	3	4	5
				R5	R6	R7	R8		1	0		Eex
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Clear Filter Mode Centered					Measo Measo Measo Measo Measo							
	OK		.pply	Cance	el		He	lp				

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.

Define Math	1												? ×
Math Wave	eform	Math E	Math Expression										
	0 0 D	([C1+C2	(C1+C2)/4										
- Functions -					Sour	ces							
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Exp(Log(Sigit(Ln(C5	C6	C7	C8		6	7	8	9
Versus	Avg(Min(Max(R1	R2	R3	R4		2	3	4	5
		_		-	R5	R6	B7	R8		1	0		Eex
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Backspace Filter Risetime 1.000ns						Meas2 M			as3	Meas4			
Filter Mode Centered M						Meas5 Meas6 Meas7 Meas8							
6	ОК	A			Cance	- 1		Не	lo	1			
							-						

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 $33 \sim 36$.

- (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.



Sampling Oscillpscope

Figure 67: Swap near-end and far-end