**Procedures Guide** 

Tektronix

# **HDMI Sink Instruments**

# **Differential Impedance Measurement**

Rev. 1.1: October 13, 2010

# **Measurement Procedures**

# **Equipment Required**

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

Item	Qty.	Recommended equipment
Sampling oscilloscope	1 ea.	Tektronix TDS8200 (or DSA8200/TDS8000B/CSA8200)
TDR sampling module	1 ea.	Tektronix 80E04
$50\Omega$ SMA terminator (male)	6 ea.	Tektronix part number 015-1022-01
$50\Omega$ SMA terminator (female)	2 ea.	Tektronix part number 015-1021-00
$50\Omega$ SMA cable	2 ea.	HUBER+SUHNER SUCOFLEX 104PE, 1 meter length (typical)
TPA (test fixture)	1 ea.	Efficere Technologies EFF-HDMI-TPA-P, or Wilder Technologies TF-HDMI-TPA-P as an "Equivalent successor"

Table	1.	Eo	mi	nment	rea	mired	
1 auto	1.	LY	uı	pmont	100	uncu	

**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  $\Omega$  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  $\Omega$  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  $\Omega$  SMA terminators (male) to terminate the unused connectors on the test fixture (see Figure 2).



Figure 2 Initial equipment connections for the differential impedance measurement

# **Instrument Calibration**

### **Instrument Compensation**

- 1. Power on the instrument and wait 20 minutes for the warm-up period.
- 2. Select Compensation....



Figure 3 Utilities menu

3. Click the **Execute** button on the Compensation window.

laini	frame	021101	0 10 10			
	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
CH	Model	Serial #	Bate / Time	Status	ATEMP	C Compensate
1						Compensate
2						and Save
3						
•						<u> </u>
.owe	er Modules					All 🗾
CH	Model	Serial #	Bate / Time	Status	ATEMP	C14
1	80E04	B011	02 Mar 10 12:22	Pass	-1.8°C	
2	80E04	B011	02 Mar 10 12:22	Pass	-1.8°⊂	Storage
3						Jionage
4						<ul> <li>User</li> </ul>
5						C Factory
6						
7	80E03	B010	02 Mar 10 12:22	Pass	+0.0°⊂	
8	80E03	B010200	02 Mar 10 12:22	Pass	-0.1°C	Execute

Figure 4 Compensation window

#### **Skew 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 TDR tab on Setups window.
  - d. Click the C1-C2 Diff button on the TDR tab, and then set the ACQ On Units to  $\Omega$ .
  - e. On the Vert tab, select C1 from the Waveform field, and then set the SetupScale to  $10.00 \Omega$ /div and Position to -5.000 div.
  - f. On the Vert tab, select C2 from the Waveform field, and then set the Setup Scale to  $10.00 \Omega/div$  and Position to -5.000 div.
  - g. Click Horz tab on Setups window.
  - h. Set Timebase Record Length to 4000.
- 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 5).
  - 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 5).



Figure 5 Magnifying the TDR step pulses and the waveforms at the open ends of the test fixture

- **3.** If the **Setups** window is not displayed, press the **HORIZONTAL MENU** button.
- 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  $\Omega$ .
  - I. 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  $\Omega$ .
- 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 C2 in the Step Deskew drop-down list

box.

- File Edit View Setup Utilities Application: Help Triggered Tektronix \_ X Setups ? × Stop Acq Mode Average 💌 Trig Internal Clock ▼ 200kHz 🗟 🛠 f= 🔥 📜 🖉 -App 💦 Wfm Database | Hist | Cursor | Meas Vert Horz Acq Tria Pulse TAmplitude TAN AN AN AN AN AN F St M = v 🛄 🔺 🗵 Phase Ref | Mask TDR Disp TDR Step ACQ Preset C1 10.00Ω/div On Polarity On Units ν Ω • C2 10.00Ω/div C1 -Diff <u>61</u> C2 ☑ Ω -2.000r C1Q人, 11.34866ps  $\sim$ TDIy nn nò C1Q八 -11.85421ps Г Г 2 DIy 7 0 Г -Г Г -50.00ps/d E Г ίο ος Г Г 7 Г V Step Deske Turn Off All Steps 🔹 (3.00¢% 🗐 🕂 C2 TDR Autoset Properties... Help C2 ▲ 10.0CΩ/di 📑 🕂 🛛 0.0Ω ■ Main 🔍 🍳 50.0000ps 🖷 44.510n 🖷 🕂 🕼 C 6:25 PM 1/17/2006
- **b.** Adjust the readings of ① and ② in Figure 6 are about the same value by changing the **Step Deskew** value (see ③ in Figure 6).

Figure 6 Adjusting the step deskew

- 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 6 has the minimum value by changing the Deskew value (see ④ in Figure 7).

Setups	? ×
Phase Ref 1 Wfm Database Vert Ho Waveform C1 💽	Mask   TDR   Disp   His:   Cursor   Meas rz   Acq   Trig I On   Define
Setup	
Scale	10.03Ω/div 📃 🛟
Position	-5.000div 🛛 🗧
- Channel	
Offset	20.0
Deskew	11.00ps
Delay	
Bandwidth	<b></b>
Units	
- External A	Attenuation
1.000	C dB
DC Cal	0.0v
ptical >	Help

Figure 7 Changing the Deskew value

7. Turn off the Mag View feature (see Figure 8).



Figure 8 Screen image after turning off the Mag View feature

## **Setting 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 (C1-C2)* in the Math Expression field in the Define Math window.

- b. Set Filter Mode to Centered.
- c. Select the Math Waveform On check box, and then click OK.
- d. Press the VERTICAL MENU button (if the Setups window is not displayed), and then click the Vert tab and select M1.
- e. 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.
- 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 9 is 200 ps by changing the **Filter Risetime** value (see (6) in Figure 10). If you cannot adjust the value to 200 ps exactly, set it to the nearest value below 200 ps.



Figure 9 Adjusting the rise time

M1 💌 🗹 On		Filter(C	Filter(C1-C2)								
unctions -	]			]   Sour	ces-						
Intg(	Diff(	Vmag(	Filter(	C1	C2	C3	C4	+	5.50	×	1
Exp(	Log(	Sqit(	Ln(	C5	CG	C7	C8	6	7	8	9
Versus	Avg(	Min(	Max(	B1	R2	R3	R4	2	3	4	5
				R5	R6	R7	R8	্ৰ	0	20	Ee;
()	Num	Avgs 2		- Mea	suren	nent :	Scala	rs			-
Backspac	e Filter	Risetime (19	5.0ps	Me	asī	Me	as2	Meas3	Me	as4	
Clear	Filter	Mode C	entered 💌	Me	as5	Me	as6	Meas7	Me	as8	

Figure 10 Changing the Filter Risetime value

### **Offset Calibration**

- 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  $\Omega$ .
- 4. Change the math waveform:
  - **a.** Press the **VERTICAL MATH** button to display the **Define Math** window, and then click **Clear**.
  - **b.** Change the math expression from *Filter* (C1 C2) to *Filter* (C1 + C2) in the **Math Expression** field. **Filter Risetime** value is unchanged.
- 5. Press the VERTICAL MENU button.
- 6. Click the Vert tab, and then set M1 Scale to  $10.00 \Omega$ /div and M1 Position to -10.00 div.
- 7. Set the HORIZONTAL SCALE to 100 ps/div.
- 8. Adjust the **HORIZONTAL POSITION** knob so that the rising edge of the waveform is displayed at near 1 major division from the left edge of the screen (see Figure 11).



Figure 11 TDR rising edge waveform

- 9. Click Horz tab, and then Set Horizontal reference to 10.0%.
- 10. Click the Meas tab.
- Select Meas1, and then click the Select Meas button and select Pulse-Amplitude > Mean.
- 12. Click Source1, and then select M1 in the Source tab.
- 13. Disconnect the 50  $\Omega$  SMA cables from the test fixture.
- 14. Connect the 50  $\Omega$  SMA terminators (female) or airlines to the end of the 50  $\Omega$  SMA cables.
- **15.** Measure the mean value of **M1** (see Figure 12).



Figure 12 Measuring the M1 value

- **16.** Press the **ACQUISITION MENU** button to display the **Math Expression** window.
- 17. Calculate the difference between 100  $\Omega$  and the value measured in step 15, and then enter the difference value in the **Math Expression** field. For instance, if the measured value is 97.8  $\Omega$ , enter *Filter* (C1 + C2) + 2.2 in the field.

M1 💌	🔽 On	Filter(C	Filter(C1+C2)+2.2									
Functions -				- Sour	ces							
Intg(	Diff(	Vmag(	Filter(	C1	C2	С3	C4		:+:	(1 <b>2</b> 3)	×	1
Exp(	Log(	Sqrt(	Ln(	C5	CG	C7	CS		6	7	8	9
Versus	Avg(	Min(	Max(	B1	R2	R3	R4		2	3	4	5
	2			R5	R6	R7	FI8		1	0		Eex
() Backspac	Num e Filter	Avgs 2 Risetime 1	95.0ps 🖪 ≑	Mea	suren asi	n <b>ent</b> ! Me	Scala as2	rs Mea	\$3	Mea	ns4	
Clear	Filter	Filter Mode Centered 💌		Me	as5	Me	as6	Mea	s7	Mea	188	

Figure 13 Entering the difference value

### **Defining Reference Waveform**

Unfiltered impedance waveform needs to be defined in order to determine the horizontal reference position precisely during measuring differential impedance. This will reduce the impact of uncertainty on horizontal positioning caused by using the filtered impedance waveform.

1. Select Math Waveform to M2, and enter C1+C2+<value of Offset compensation > in the Math Expression field. (The offset compensation value corresponds to the measured value at step 15 in the Offset Calibration.)

M2 VII Un		C1+C2	C1+C2+2.2								
Functions -				1 – Sour	ces			1			
Intg(	Diff[	∀mag(	Filter(	C1	C2	C3	C4	+		×	1
Exp(	Log(	Sqrt(	Ln(	C5	CG	C7	C8	6	7	8	9
Versus	Avg(	Min(	Max(	B1	R2	R3	R4	2	3	4	5
	77			R5	R6	R7	R8	1	0	4	Eex
() Backspac	Num	Avgs 2 Risetime 1,	000ns 🛛 🕂	Mea	suren	nent : Me	Scala	I L	Ne		1
Clear	Filter	Mode C	entered 💌	Me	as5	Me	as6	Meas7	Mea	as8	

Figure 14 M2 Define Math

- 2. Press the VERTICAL MENU button (if the Setups window is not displayed), and click the Vert tab.
- 3. Set the M1 Scale to  $10 \Omega/div$  and M1 Position to -10 div.
- 4. Select M1 in the Waveform drop-down list box on the Vert tab.
- 5. Set the **Waveform On** check box for **M1** to OFF in order to hide the filtered differential impedance waveform.
- 6. Set the M2 Scale to  $10 \Omega/div$  and M2 Position to -10 div.
- 7. Select M2 in the Waveform drop-down list box on the Vert tab.
  - 8. Set the **Waveform On** check box for **M2** to ON in order to show the unfiltered differential impedance waveform.

Setups	? ×	Setups	? ×
Phase Ref Mask TDR Wim Database Hist Cursor Vert Horz Acq Waveform M1 ▼ On Defin Filter(C1+C2)+2.2 Setup Scale 10.00Ω/div ■	Disp   Meas Trig e	Phase Ref     Mask     TDf       Wfm Database     Hist     Ct       Vet     Horz     Acq       Waveform     M2     Imode       C1+C2+2.2     Setup     Scale	R Disp Irsor Meas Trig Define
Position -10.00div @ Channel Offset 0.00 @ Deskew 0.0s @ Delay @ Bandwidth		Position -10.00div Channel Offset 0.00 Deskew 0.0s Delay Bandwidth	
Units External Attenuation	a	Units External Attenuation	dB Linear

Figure 15 Setting filtered M1 to OFF, unfiltered M2 to ON

## **Setting Horizontal Position and Scale**

### If "Sink\_Term\_Distance" of the CDF is defined

- I. If "Sink\_Term\_Distance" <= 150 ps (else go to step II in page 17)
  - 1. Press the HORZONTAL MENU button.
  - 2. Select the MainTB in Timebase field.
  - **3.** Set the **Scale** to 50.0 ps/div.
  - 4. Set the Horizontal Reference to 30.0%.



Figure 16 Horizontal Setups Window

5. Connect the test fixture to the HDMI connector on a DUT (see Figure 17).



Figure 17 Connecting a Sink DUT to the test fixture

6. Adjust the HORIZONTAL POSITION knob so that a M2 (unfiltered impedance) waveform peak of change point becomes 3 divisions from left (see Figure 18.).



Figure 18 Adjust Horizontal Position

- 7. Press the VERTICAL MENU button.
- 8. Select M1 in the Waveform drop-down list box on the Vert tab.
- **9.** Set the **Waveform On** check box for **M1** to ON in order to show the filtered differential impedance waveform again.
- 10. Select M2 in the Waveform drop-down list box on the Vert tab.
- 11. Set the **Waveform On** check box for **M2** to OFF in order to hide the unfiltered differential impedance waveform.

Setups ? ×	Setups ? 🗙
Phase Ref   Mask   TDR   Disp	Phase Ref   Mask   TDR   Disp
Wfm Database   Hist   Curso   Meas	Wfm Database   Hist   Curso:   Meas
Vert Horz Acq Trig	Vert Horz Acq Trig
Waveform	Waveform
M1 💌 🔽 On Define	M2 💌 🗖 On Define
Filter(C1+C2)+2.2	C1+C2+2.2
Setup	Setup

Figure 19 Setting filtered M1 to ON, unfiltered M2 to OFF

12. Go to "Measuring Impedance" in page 23.

#### II. If 150 ps < "Sink\_Term\_Distance" <= 600 ps (else go to Step III in page 19)

- 1. Press the HORZONTAL MENU button.
- 2. Select the MainTB in Timebase field.
- 3. Set the Scale to 100.0 ps/div.
- 4. Set the Horizontal Reference to 20.0%.



Figure 20 Horizontal Setups Window

- 5. Connect the test fixture to the HDMI connector on a DUT (see Figure 17).
- 6. Adjust the HORIZONTAL POSITION knob so that a M2 (unfiltered impedance) waveform peak of change point becomes 2 divisions from left (see Figure 21).



Figure 21 Adjust Horizontal Position

- 7. Press the VERTICAL MENU button.
- 8. Select M1 in the Waveform drop-down list box on the Vert tab.
- **9.** Set the **Waveform On** check box for **M1** to ON in order to show the filtered differential impedance waveform again.
- 10. Select M2 in the Waveform drop-down list box on the Vert tab.

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

Setups	? ×	Setups 🛛 ? 🗙
Phase Ref   Mask   TDR	Disp	Phase Ref   Mask   TDR   Disp
Wfm Database   Hist   Cur	so: Meas	Wfm Database   Hist   Curso   Meas
Vert Horz Acq	Trig	Vert Horz Acq Trig
Waveform M1 V On D Filter(C1+C2)+2.2	efine	Waveform M2   On Define C1+C2+2.2
_ Setup		Setup



**12.** Go to "Measuring Impedance" in page 23.

#### III. If 600 ps < "Sink\_Term\_Distance"

- 1. Set the Horizontal scale and position.
  - a. Press the HORZONTAL MENU button.
  - b. Select the MainTB in Timebase field.
  - c. Set the Scale to 200.0 ps/div.
  - d. Set the Horizontal Reference to 10.0%.

Setups ? 🗙
Phase Ref         Mask         TDR         Disp           W/m Database         His:         Cursor         Meas           Vert         Horz         Acq         Trig
Timebase MainTB
Scale 200.000ps/div 📃 🗧
Position \$5.490ns
Resolution 385.0fs
Record Length 4000
Horizontal Reference
All Timebases
Mode Lock to Int 10MHz
Seconds C Bits C Distance
Comm Standard None
Bit Rate 2.4883200 Gbps
FrameScan Enabled Auto Position Start Bit Scan Bits 47 East Hep

Figure 23 Horizontal Setups Window

- e. Connect the test fixture to the HDMI connector on a device under test (DUT) (see Figure 17).
- **f.** Adjust the **HORIZONTAL POSITION** knob so that a **M2** (unfiltered impedance) waveform peak of change point becomes 1 division from left (see Figure 24).



Figure 24 Adjust Horizontal Position

2. If "Sink\_Term\_Distance" <= 1.6 ns (else go to step 3)

**a.** Go to step 6 in page 21.

- 3. If 1.6ns < "Sink\_Term\_Distance" <= 2.4 ns (else go to step 4)
  - a. Press the HORZONTAL MENU button.
  - b. Select the MainTB in Timebase field.
  - c. Set the Scale to 300.0 ps/div.



Figure 25 Horizontal Setups Window

**d.** Go to step 6 in page 21.

4. If 2.4 ns < "Sink\_Term\_Distance" <= 4.0 ns (else go to step 5 in page 21)

- a. Press the HORZONTAL MENU button.
- b. Select the MainTB in Timebase field.
- c. Set the Scale to 500.0 ps/div.



Figure 26 Horizontal Setups Window

**d.** Go to step 6 in page 21.

- 5. If 4.0 ns < "Sink\_Term\_Distance" <= 8.0 ns
  - a. Press the HORZONTAL MENU button.
  - b. Select the MainTB in Timebase field.
  - c. Set the Scale to 1.0 ns/div.



Figure 27 Horizontal Setups Window

- 6. Press the VERTICAL MENU button.
- 7. Select M1 in Waveform drop-down list box on the Vert tab.

- 8. Set the **Waveform On** check box for **M1**to ON in order to show the filtered differential impedance waveform again.
- 9. Select M2 in the Waveform drop-down list box on the Vert tab.
- **10.** Set the **Waveform On** check box for **M2** to OFF in order to hide the unfiltered differential impedance waveform.

Setups 🔋	Setups ? ×
Phase Ref   Mask   TDR   Disp	Phase Ref   Mask   TDR   Disp
Wfm Database   Hist   Curso   Meas	Wfm Database Hist Curso Meas
Vert Horz Acq Trig	Vert Horz Acq Trig
Waveform	Waveform
M1 💌 🗹 On Define	M2 💌 🗖 On Define
Filter(C1+C2)+2.2	C1+C2+2.2
Setup	Setup



11. Go to "Measuring Impedance" in page 23.

### If "Sink\_Term\_Distance of the CDF" is not defined

- 1. Connect the test fixture to the HDMI connector on a DUT (see Figure 17).
- 2. Set the HORIZONTAL SCALE to longer as waveform stabilizes.



Figure 29 Waveform Stabilizes

3. Set the HORIZONTAL SCALE magnified before waveform stabilizes.



Figure 30 Magnified Waveform

### **Measuring Impedance**

#### If "Sink\_Term\_Distance" of the CDF is defined

- 1. Set the Measurement tab.
  - a. Press the VERTICAL MENU button, and then click the Meas tab.
  - b. Select Meas1, and then click the Select Meas button and select Pulse-Amplitude > Max.
  - c. Click Source, and then select Main M1 on the Source tab.
  - d. Click Region, and then select Gate On check box on the Region tab.
  - e. Set Gate G1 to same value of the Horizontal Reference.
    - If "Sink\_Term\_Distance" <= 150 ps then set G1to30%.
    - If 150 ps < "Sink Term Distance" <= 600 ps then set G1 to 20%.
    - If 600 ps < "Sink Term Distance" then set G1to 10%.
  - **f.** Set **Gate G2** to the calculated value of  $Gl+("Sink\_Term\_Distance" / Horizontal Scale * 10)$

If "Sink\_Term\_Distance" = 800 ps then set G1 to 10% and G2 to 10+(800/200\*10)=50%.



Figure 31 Set Meas1 to Max

- g. Select Meas2, and then click the Select Meas button and select Pulse-Amplitude > Min.
- h. Click Source, and then select Main M1 on the Source tab.
- i. Click Region, and then select Gate On check box on the Region tab.
- j. Set Gate G1 to same value of the Horizontal Reference.
- **k.** Set **Gate G2** to the calculated value of  $G1 + ("Sink\_Term\_Distance" / Horizontal Scale * 10)$



Figure 32 Set Meas2 to Min

 Select Meas3, and then click the Select Meas button and select Pulse-Amplitude > Means.

m. Click Source, and then select Main M1 on the Source tab.

- n. Click Region, and then select Gate On check box on the Region tab.
- o. Set Gate G1 to same value of the Horizontal Reference.
- p. Set Gate G2 to calculated value of G1 + ("Sink\_Term\_Distance" / Horizontal Scale \* 10)

Setups	? ×	Setups	? ×
Phase Ref     Mask     TDR       Vert     Horz     Acq       Wfm Database     His:     Cursor	Disp   Irig   Meas	Phase Ref   Mask   TDR Vert   Horz   Acq Wfm Database   His:   Curso	Disp Irig Meas
Meas 3 V On Select Meas M1 Mean	AA	Meas 3 V On Select Meas M1 Mean	M
Show Stats Clear S	itats	Show Stats Cle	ar Stats
Source Source Set to D Source Region HiLow RefL Main M1 Use WIm Database Clear Signal Type Pulse NRZ RZ A ZZ A	efault	Source1 Source2 Set Source Region HiLow R Gates G1 10.00% B+ 45.49 G2 50.00% B+ 46.29 V On Edges Slope C +// C + Direction C +> C <	o Default
Statistics Weighting Annotations He		Statistics Weighting Annotations	D + Help

Figure 33 Set Meas2 to Mean

- 2. Set Cursor.
  - a. Click Cursor tab.
  - **b.** Press the **HORZONTAL MENU** button.
  - c. Select the Horizontal Bars in Function field.
  - d. Set the Cursor1 Source to Main M1 and Position to  $85 \Omega$ .
  - e. Set the Cursor2 Source to Main M1 and Position to  $115 \Omega$ .

Setups	? ×
Phase Ref   M	Mask TDR Disp 12 Acq Trig
Wfm Database	His: Cursor Meas
Function	
O Off	
C Vertica	l Bars
G Horizor	otal Bare
C L L L	
<ul> <li>Wavef</li> </ul>	orm
Cursor 1	
Source	Main M1 🔺
Position	85 0Ω
Color	·
Cursor 2	
Source	Main M1 🔺
Position	115Ω
Color	·
	Help

Figure 34 Cursor Setups Window



**f.** Measure the Max and Min value. (see Figure 35).

Figure 35 Measurement Result

**3.** Repeat step for all the TMDS lines.

#### If "Sink\_Term\_Distance" of the CDF is not defined

- 1. Display the horizontal cursors and align them to the 85  $\Omega$  and 115  $\Omega$  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  $\Omega$ .
  - 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  $\Omega$ .

etups	?
Phase Ref   1 Vert   Ho Wfm Database	Mask TDR Disp rz Acq Trig His: Cursor Mea:
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C Off	
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Cursor 1	
Source	Main M1 🔺
Position	85 0Ω
Color	·
Cursor 2	
Source	Main M1 🔺
Position	115Ω
Color	<b></b>
	Help

Figure 36 Cursor Setups Window

- 2. 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.



Figure 37 Set Meas1 to Max

- 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.



Figure 38 Set Meas2 to Min

- **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.



Figure 39 Measurement Result

#### I. When "Sink\_Diff\_PowerOn" field of the CDF is "Y":

- 1. 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.
  - **a.** If the measurement value is less than or equal to 75  $\Omega$ , or more than or equal to 125  $\Omega$ , the differential lines being measured are Fail.
  - **b.** If an area that has the value less than or equal to  $85 \Omega$  or more than or equal to  $115 \Omega$  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 or equal to 250 ps, if the area appears twice, the differential lines being measured are Fail).
  - **c.** If any of the above cases do not apply, the differential lines being measured are Pass.

#### II. When "Sink\_Diff\_PowerOn" field of the CDF is "N":

- 1. Measure the impedance between the HDMI connector on the DUT and the point that the impedance settles at the terminal impedance.
  - **a.** If the measurement value is less than or equal to 75  $\Omega$ , or more than or equal to 125  $\Omega$ , the differential lines being measured are Fail.
  - **b.** If an area that has the value less than or equal to  $85 \Omega$ , or more than or equal to  $115 \Omega$ , lasts for more than or 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 or equal to 250 ps, if the area appears twice, the differential lines being measured are Fail).
  - c. If the terminal impedance is less than or equal to 75  $\Omega$ , or more than or equal

to  $125 \Omega$ , the differential lines being measured are Fail.

- **d.** If any of the above cases do not apply, the differential lines being measured are Pass.
- **2.** Repeat step for all the TMDS lines.