Test ID 5-15 Utility Line Impedance Test Procedures Guide

Revision 1.1 Tektronix October 13, 2010

Equipment Required

Table 1 lists the equipment required to perform the Utility Line Impedance 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
50 Ω SMA matched pair cable	1 ea,	Tektronix P/N:174-4866-00
50 Ω SMA terminator (male)	3 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. 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.

Curre Mainf	nt Date/Time: irame	02 Mar 1	0 13:19			
	Model TDS8000B	Serial # B010	Date / Time 02 Mar 10 12:22	Status Pass	АТЕМР -0.5°С	C Save
Jppe	r Modules					C Recall
ĊН	Model	Serial #	Date / Time	Status	атемр	C Compensate
1 2						Compensate
3						and Save
4						
.owe	r Modules					All
CH	Model	Serial #	Date / Time	Status	ATEMP	
1	80E04	B011	02 Mar 10 12:22	Pass	-1.8°⊂	
2	80E04	B011	02 Mar 10 12:22	Pass	-1.8°C	- Storage
3						C Use
4 5						ve User
0						C Factory
n –	80E03	B010	02 Mar 10 12:22	Pass	+0.0°⊂	
7			02 14 40 42:22	Pass	-0.1°C	

Figure 2: Compensation window.

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



Test ID 5-15: Utility Line Impedance

Adjustment TDR Rise Time

- (1) Connect the TDR module output CH1 to HEAC+ (J1) SMA connector on the input of the HEAC-TRD-R adapter with SMA cable, either channel of the matched pair SMA cable.
- (2) Connect 50 Ω terminator to HEAC- (J2) SMA connector (see Figure 3).





(3) 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

 \mathbf{x}

(4) Click Setups icon.



Figure 5: Setup icon

- (5) Click the **TDR** tab on **Setups** window.
- (6) Click the **Preset C1** button on **TDR** tab
- (7) Select the **V** in **C1 ACQ Units** drop-down list box.
- (8) Click the Horz tab on Setups window.
- (9) Set the **Timebase Record Length** to **4000** on **Horz** tab.
- (10) Set the **Timebase Horizontal Reference** to **50.0%** on **Horz** tab.



Figure 6: Setups windows

(11) Adjust the **HORIZONTAL POSITION** knob so that the edge of **C1** waveform is displayed at 5 major divisions from the left edge of the screen (see Figure 7).



Figure 7: Setting Horizontal Position



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

Figure 8: Setting Horizontal Scale

- (13) Click the Vert tab on Setups window.
- (14) Set the Setup Scale to 30 mV/div and the Setup Position to -4.000 div.

Setups	? ×
Wfm Database Hist Cursor M	teas]
Phase Ref Mask TDR D	isp 🚶
Vert Horz Acq Tr	ig
Waveform	
C1 V Un Define	-
Setup	
Scale 30.00mV/div 🗐 🛨	
Position -4.000div 🛛 🕀	
Channel	
Offset 250.0mV	
Deskew 0.0s	
Delay 📃 🗧	
Bandwidth 📃 💌	
Units 🔽	
External Attenuation	
C dB	
Linear	
Dullar 0.0V	
Optical >> Help	

Figure 9: Vertical setups window

(15) Close Setups Window.

- (16) Click the MATH icon. f_{\ast}
- (17) Select the **M1** in **Math Waveform** drop-down list box on **Define Math** window.
- (18) Enter "*Filter (C1)*" in the **Math Expression** filed on **Define Math** window.
- (19) Select the Centered in Filter Mode drop-down list box on Define Math window.
- (20) Set the **Math Waveform ON** check box for **M1** to ON in order to show the filtered single impedance waveform.
- (21) Click the **OK** button on **Define Math** window.

Define Matl	h											?	×
Math Waveform Math Expression													
- Functions -				Sour	ces								
intg(Diff(Vmag(Filter(C1	C2	C3	C4		+	•	×	1	
Exp(Log(Sqrt(Ln(C5	C6	C7	C8		6	7	8	9	
Versus	Avg(Min(Max(B1	R2	R3	R4		2	3	4	5	
				R5	R6	B7	R8		1	0		Eex	
() Backspac	Num	Avgs 2 Bisetime 1	.000ns 🖩 🔹	Mea	suren	nent S	icala	irs—	- 2.	14	- 1		
Clear	Me	as I as 5	Mea Mea	152 156	Mea	18.0 187	Mea	194 198					
0	OK		opply	Cance	I		Hel	P					

Figure 10: Defining filtered waveform



Figure 11: Rising edges of Filtered M1 and unfiltered C1

- (22) Click the Setups icon.
- (23) Click the **Meas** tab on **Setups** window.
- (24) Select the **Meas1** in drop-down list box on **Meas** tab.
- (25) Click the Select Meas button, and then select Pulse Timing > Rise Time.
- (26) Click the **Source** tab on **Meas** tab
- (27) Select the Main M1 on Source tab.
- (28) Set the **Meas1 ON** check box to on.



Figure 12: Measurement Setups window

(29) Close Setups Window.

(30) Click the MATH icon.

 f_{π}

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

<u>File E</u> dit <u>V</u> iew §	<u>S</u> etup <u>U</u> tili	ties <u>A</u> pplica	tions <u>H</u> elp	Triggered						Tektr	onix _ X
🖨 🛠 f* 🔥	juj 🥒 <mark>F</mark>	lun/Stop A	cq Mode 🗛	/erage 💌 Trig	Interna	al Clock	•	20	00kHz	•	App 💦
Pul Define Mat	h								? ×		. 🔢 📥 💆
Math Wav	eform	Math E	xpression							Wavel	form
M1 💌	🔽 On	Filter(C1	1)							M1 3	D.84mV/div
- Functions -				Sources						Meas	memont
intg(Diff(Vmag(Filter(C1 C2 C	3 C4	+	•	×	7	1Rise 9	M1 八 98.2652ps
Екр(Log(Sigrt(Ln(C5 C6 C	7 C8	6	7	8	9		
Versus	Avg(Min(Max(R1 R2 R	3 R4	2	3	4	5		
		বি		R5 R6 R	7 R8	1	Û		Eex		
()	Num	Avgs 2		Measuremer	it Scala	rs —					
Backspac	e Filter	Risetime 95	6.0ps 🖪 🕂	Measi N	leas2	Meas3	Mea	s4			
Clear	Filter	Mode Ce	entered 💌	Meas5 N	leas6	Meas7	Mea	s8			
	ОК		oolv (Cancel	Hel	• 1					
C1 M1			~ <u></u>								
M1 220.2mV			<u></u>		. i.			.5 <u></u> 90),Ops/di	v	
M1 🔺 30.84mV	0.0	V 🛛 🔶	Main 🛈	Q 500.0	00ps 🖪	39	.150n:	: 🖪	-80	14:34	2010-09-13

Figure 13: Setting Filter Risetime

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

Defining Waveforms and Connecting Equipments

- (1) Click the Setups icon. >
- (2) Click the **TDR** tab on **Setups** window.
- (3) Select the Ω in C1 ACQ Units drop-down list box.

Setups		? ×
Vert	Horz Ac	q Trig
Wfm Data	base Hist	Cursor Meas
Phase Re	f Mask 🔍 T	DR Disp
Preset	TDR Step	ACQ
	On Polarity	On Units
		ĽΩ -)
C2		<u>р т</u>
C4		
[5]		
C6		
C8		
E Step Des	kew	Turn
C2	▼ 0.000% 📃	Off All Steps
TDR Auto Propertie	oset Is	Help

Figure 14: TDR Setup window

- (4) Click the **Vert** tab on **Setups** window.
- (5) Select **C1** in **Waveform** drop-down list box on **Vert** tab. (**C1** is the unfiltered single impedance waveform.)
- (6) Set the Setup Scale to 10.00 Ω /div and the Setup Position to -5.000 div.
- (7) Select **M1** in **Waveform** drop-down list box on **Vert** tab. (**M1** is the filtered single impedance waveform.)
- (8) Set the Setup Scale to 10.00 Ω /div and the Setup Position to -5.000 div.



Figure 15: Vertical Setups window



Figure 16 :TDR Open Waveform

- (9) Connect the near end of the cable to the first HEAC-TDR-R adapter.
- (10) Connect the far end of the cable to the second HEAC-TDR-R adapter.
- (11) Connect 50 Ω terminators to HEAC+ and HEAC– connectors on the far end of the HEAC-TRD-R adapter.



Figure 17: Utility Line Impedance Open Setup

Setting Horizontal Position

The unfiltered impedance waveform needs to be used in order to determine 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.

(1) Adjust the **HORIZONTAL POSITION** knob so that **C1**, the unfiltered and single impedance waveform, change point is displayed at 2 major divisions from the left edge of the screen.



Figure 18: Setting Horizontal Position

Measuring Impedance

- (1) Click the Setups icon.
- (2) Click the **Meas** tab on **Setups** window.
- (3) Select the **Meas1** in drop-down list box on **Meas** tab.
- (4) Click the **Select Meas** button, and then select **Pulse Amplitude > Max**.
- (5) Click the **Source** tab on **Meas** tab.
- (6) Select the Main M1 on Source tab.
- (7) Set the **Meas1 ON** check box to on.
- (8) Click the **Region** tab on **Meas** tab.
- (9) Set the Gates G1 to 20.00% and the Gates G2 to 70.00% on Region tab.
- (10) Set the Gates On check box to on.



Figure 19: Measurement1 setups window

- (11) Select the **Meas2** in drop-down list box on **Meas** tab.
- (12) Click the Select Meas button, and then select Pulse Amplitude > Min.
- (13) Click the **Source** tab on **Meas** tab.
- (14) Select the Main M1 on Source tab.
- (15) Set the **Meas1 ON** check box to on.
- (16) Click the **Region** tab on **Meas** tab.
- (17) Set the Gates G1 to 20.00% and the Gates G2 to 70.00% on Region tab.
- (18) Set the Gates On check box to on.



Figure 20: Measurement2 setups window

- (19) Click the **Vert** tab on **Setups** window.
- (20) Select C1 in Waveform drop-down list box on Vert tab.
- (21) Set the **Waveform On** check box for **C1** to OFF in order to hide the unfiltered single impedance waveform.

Setups	? ×
Wfm Database	Hist Cursor Meas
Phase Bef M	lask TDR Disp
Vert Hor	z Acq Trig
	C On Define
Setup	
Scale	10.00Ω/div 📃 🗧
Position	-5.000div 🔲 🗧
- Channel	
Offset	0.0Ω
Deskew	2.0s
Delay	
Bandwidth	7
Units	V
– External A	ttenuation
1.000	OdB
DC Cal	0.0V 🔲 🗧
<pre>ptical >></pre>	Help

Figure 21: Vertical Setups window

- (22) Utility Line Impedance is displayed as "1 Max M1" and "2 Min M1" on screen.
- (23) If Utility Line Impedance max ("1 Max M1") is more than 74.25 Ω , then fail.
- (24) If Utility Line Impedance min ("2 Min M1") is less than 35.75 Ω , then fail.



Figure 22: Result of Utility Line Impedance

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



Figure 23: Swap near-end and far-end