

Differential TDR Test-Step by Step

Pico Technology; Based on PicoScope 9311



Step 1: Instruments Setup







Step 2: Open TDR Stimulus Source



Setup	Measurements Analysis	System Utility Help ?								
2	Help 🗙 🔥 Clear 🚺	🕨 Run 🚺 Stop 👔 Sing	gle 🚺 Autoscale 🔽 🛙	efault Setup		Copy 🔁 Help				
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Step 3: Setup the display mode



Help 🔀 🜔	Clear 🚺 🚺 R	un 🚺 Stop 🔂 S	ingle 📜 Autoscale	Default Setup		🖻 Copy 🚺 Help			
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Step 4: Setup the TDR to Differential Mode



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Step 5: Do Rho/Ohm Calibration



Pico Technolog	gy PicoScope 9311	Sampling Oscilloscope	20 GHz Utility Help 2								- 0
TDR/TDT	Help X	Clear Run	Stop Stop	ngle 🔃 Autoscale	Default Set	up 🚺 🕥	📬 Copy 🚺 Help				
Stimulus	Setup	[]			Scope	Int Clock	Vectors Simple				
Mode	DUT				F=1.0003 MHz						
Off TDR	Single ended		~~~~					<u> </u>			
🖌 TDT	Common										
Channel	Stimulus										
Ch1 Ch2	Internal		N J								
Polarity	Internal Stimulus				Confirm				×		
Neg	Generator 2				comm						
					?	The PicoScope 93X Establish your TDR	X is ready to perform differe connections using two powe	ntial or common TDR Rho/Oh r dividers as shown in vour He	m calibration. elp.		
Vertical Scale	Horizontal Scale					Get Started or User	r Manual.	,			
p Rho	m Meter					Leave your reference	ce plane open (disconnected)	at this point.			
12 Onm	in Inch					Click OK.					
	Prop Velocity	F1+	/								
Dielectric Const							OK G	ancel			
	Ref Amplitude							-			
Rho/Ohm Calibr	100 mV										
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Correction	Corrected Time										
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							Mode DUT	lingle ander			
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		Scales					Auto Max Polarity	al Stimulus seculor 1			
		Differential TDR (F1)	Vertical Scale 100 mV/div	0 V	Horizontal Sci 10 ns/div	ale Delay+ 0 s	Vertical Scale Horizo	ntal Scale			
							P Rho Q Ohm A I	leter oot			
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		Channels A	🕺 Acquire 🕂 Trigge	r 📴 Display 🂾 S	Save/Recall 🕂 M	larker 🎁 Measu	ure f & Math			OK Cancel	
		Histogram 🛛	🗙 Eye 🛛 🔀 Mask	Test 🛛 🖉 Aux In/Out	IDR/TDT		Utility				
								Grates Vertical Scale Differential TDR (F1) 440 microly	Offset - Position Horizontal Scale	Auto Hax Tell Fin	
(Company co	onfidential ©	2017 Pico Teo	hnology					A Snowline Ext Director	et Cat Press t Cat Direct A Austilary	
	1 1 1	-		07				TAOTA TAOTA		run 🕂 Trig'd Pos Neg	

Step 6: Choose Ohm menu to show Impedance Curve

R/TDT	🖪 Help 🗙	🏷 Clear 📘	Run 🗖 S	top 👔 Single	Autoscale	Default Setup		🖆 Copy 🚺 Help			
mulus	Setup		Ч			Scope	Int Clock	Vectors Simple	_		_
	DUT					F=1.0003 MH2				 	
_	Single ended										
т	Common										
	Stimulue										
Ch2	Internal										
	Internal Stimulus										
s	Generator 1										
	Generator 2										
Scalo	Horizontal Scalo										
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		A Scales	23 NS		L			Auto Max Mid Min			
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		Differential TDR (F	F1) 50 Ω/div		100 Ω	10 ns/div	0 s				
		Ch1 50 Ohm/div	Ch2 50 Ohr	n/div	A 10 ns/d	liv	Ext Direct Ex	t Presc Internal Rate			
					A+B A P I		Int Clock Au	2 Direct			
		100 Ohm	100 Oh				Freerun	Tria'd Page Nor			
		▼ ▲ D ▼						rus rus neg			

Step 7: Do Correction-Click Correction



TDT_	🔝 Help 🗙	🏷 Clear	🕨 Run	🚺 Stop	1 Single	e 🚺 Auto	oscale	V Default Setup		🖷 Copy 🔝 Help				
Ilus	Setup							Scope F=999.92 kHz	Int Clock	Vectors Simple				
	DUT													
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	Prop Velocity						^/\		Get Started or U	Jser Manual.				
Const									Please connect	a Reference Short to the Refere	nce Plane.			
	Def Amerikanda							6	Do not forget to	select necessary Time Base S	ale!.			
Calibr	131.6 mV								t can not be ch	anged after correction is perfo	med.			
	▼ ▲ D ▼ ▲								Click OK.					
e Plane	Base Line									······	-1			
	242.15 mV	F1 >								OK Cance				
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		Differential	TDR (F1)	Vertical Scale 50 Ω/div	•	Offset + Posit 100 Ω	tion	Horizontal Scale 5 ns/div	Delay 0 s	+ Position				
		Ch1 50 Oh	m/div Ch2	50 Ohm/div		A	5 ns/div		Ext Direct	xt Presc Internal Rate				
				▼		A+B	< > D		Ch1 Direct C	th2 Direct 1 µs				
		100 0		100 Ohm		L B	0.		The Clock					
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				Acquire	g, ingger	Usplay	1 5	averkecan 1 🔨 Mark	u Mea	sure for main				





Step 9: Do Correction-Click Ok to start the Reference Short Correction





Step 10: Do Correction-Disconnect the Reference Short from the Reference Plane



S Pico Technolog	gy PicoScope 9311	Sampling Oscillo	scope 20 GHz	. [TDR Correction of the Ch1	– 🗆 X	1			- 0	×
File Edit View	Setup Measurem	ents Analysis Sys	stem Utility Help Run Stop	? Single	TDP Corror	stion	Copy				
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Mode	DUT			J	01						
	Single ender				OK	Cancel					
TDT	Common										
Channel	Stimulus										
Ch1 Ch2	Internal										
Polarity Pos	Generator 1										
Yeg	Generator 2										
Vertical Scale	Horizontal Scale										
Volt P Rho	s Time m Meter										
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	Prop Velocity	F1)				Garferr			 	 	
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Rho/Ohm Calibr	131.6 mV					Click OK					
Reference Plane	Rase Line										
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Correction	Corrected Time										
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		- Scales		23 ns		····-E	Auto Max Mid Min				
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		Ch1 400 mV/div	Ch2 400 mV/di	v <u> </u>	A 5 ns/div	Ext Direct Ext Pr	internal Rate				
						Int Clock Auxil	iary				
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		Channe	els	Trigger	Display 🂾 Save/Recall 🎢	Marker H- Measure	f& Math				

Step 11: Do Correction-Connect the Reference Load to the Reference Plane





Step 12: Do Correction-Click Ok to start the Reference Load Calibration



File Edit View	Setup Measurem	nents Analysis System	n Utility Help ?	S IDR Correction of	of the Ch1 1							
TDR/TDT	🖪 Help 🗙	🏷 Clear 📘 📘 Ru	n 🚺 Stop 🔂 S	ingle T	DR Correction	P Copy Help						
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Mode	DUT		· · · · · · · · · · · · · · · · · · ·		ОК	Cancel						
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TDT	Common											
Channel	Stimulus											
Ch1 Ch2	Internal											
Polarity	Internal Stimulus											
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Vertical Scale	Horizontal Scale											
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Dielectric Const					Di	sconnect the Reference Short from t	the Reference Plane.					
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Rho/Ohm Calibr	131.6 mV				Cli	ick OK						
Reference Plane	Base Line					[/·····]	1					
12.7049 ns	242.15 mV					OK Cancel						
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Correct							Channel Slimulas					
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				2			Neg Generator 2					
		Scales	2	3 115	L	Auto Max Mid Min	V Volt 2 Trace					
			Vertical Scale	Offset + Position	Horizontal Scale	Delay + Position	Preset List Prep Melocity					
		Differential TDR (F1)	400 mV/div	0 V	5 ns/div	0 s	Berlectric Const. < > D < >					
							Reference Plane Base Line					
						Internal Pate						
				A 5 ns/di	Ext Dire Ch1 Dir	rect Ch2 Direct 1 µs						
				BOS		ck Auxiliary						
		V A 0 V A			<► Free	erun 🕂 Trig'd 🛛 Pos 🛛 Neg	(6086)	Vertical Scale Offset	t + PosiSon Horizontal Scale Delay -	Auto Han Ma		
		Channels	Acquire 🕂 Trigge	er 🚾 Display 🂾 Sav	e/Recall 🔨 Marker 🕴	- Measure f Math						
		Histogram	XX Lye XX Mask			/ Utility			A Sasily ExtBreet E A+8	Elizeral Rate		
										Trig'd Pos Neg		

Step 13: F2 is the impedance waveform with Corrected risetime



Edit View	Setup Measurem	ents Analysis Syster	m Utility Help ?							
DR/TDT	🔝 Help 🔀	🏷 Clear 🚺 🖪	un 🔲 Stop 🚺 S	ingle 🚺 🔁 Autoscale	🖌 Default Setup		🛚 Copy 🚺 Help			
imulus	Setup				Scope	Int Clock	Vectors Simple			
	DUT				F=999.92 kHz		-			
ff	Single ended									
DR										
iel	Stimulus									
Cnz	Internal									
ty	Internal Stimulus									
Neg	Generator 2									
al Scale	Horizontal Scale									
Volt Rho	s Time									
Ohm	ft Foot									
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	Def Amplitude									
Ohm Calibr	123.8 mV									
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049 ns	242.6 mV	F2+								
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ection	Corrected Time	-								
	100 ps									
Correct										
		<u> </u>	2	3 ns	EE					
		Scales		077			Auto Max Mid Min			
		Differential TDR (F1)	50 Ω/div	100 Ω	5 ns/div	0 s	luon			
		Corrected TDR (F2)	50 Ω/div	100 Ω	5 ns/div	0 s				
		50 Ohm/div	Gba 50 Ohm/div	A 5 ns/c	liv	Ext Direct Ext Pr	esc Internal Rate			
				A+B 🔺 🕨 D		Ch1 Direct Ch2 Di	rect 1 µs			
		100 Ohm	100 Ohm	B 0 s		Int Clock Auxili	ary A D A D			
		V A D V A	V A D V A			🗈 Freerun 👉 Tri	g'd Pos Neg			
		Channels	R Acquire	er 🚾 Display 💾 Sa	ve/Recall	r H- Measure	for Math			

Step 14: F2 is the impedance waveform with Corrected risetime(Disconnect the load)



Pico Technolog	y PicoScope 9311	Sampling Oscillo	scope 20 GHz								- 0
	Betup Measurem	ents Analysis Sys	Rup Sto	p ?		Default Setup		Conv R Help			
Stimulus	Setup				Autoscale	Scope F=999 92 kHz	Int Clock	Vectors Simple			
Mode Off TDR TDT	DUT Single ender Differential Common					1-500.02 M12					
Channel Ch1 Ch2 Polarity Pos Neg	Stimulus Internal Internal Stimulus Generator 1 Generator 2										
Vertical Scale V Volt P Rho Q Ohm	Horizontal Scale <u>s Time</u> <u>m Meter</u> <u>f Foot</u>										
Preset Unit Prop Velocity Dielectric Const	inch Prop Velocity 1 < > D Ref Amplitude			·····							
Rho/Ohm Calibr Reference Plane 12.7049 ns	123.8 mV ▼ ▲ D ▼ ▲ Base Line 242.6 mV ▼ ▲ 0 ▼ ▲	#3+									
Correction	Corrected Time										
				23 ns			&	uto Max Mid Min -			
		Differential TDR (F1 Corrected TDR (F2)	Vertical So 50 Ω/div 50 Ω/div	cale Off 100 100	set + Position Ω Ω	Horizontal Scale 5 ns/div 5 ns/div	Delay + Posi 0 s 0 s	tion			
		Ch1 50 Ohm/div	Ch2 50 Ohm/		A 5 ns/dit A+B Image: Second		xt Direct Ext Pre h1 Direct Ch2 Dir nt Clock Auxilia Freerun Trig	Internal Rate			
		Channe	els NR Acquire ram XX Eye	Trigger Mask Test	🖬 Display 🛛 💾 Sav Z Aux In/Out 🖵 TDR	re/Recall <mark>/ 1 Marker</mark> R/TDT	Measure	f∞ Math			

Step 15: Connect DUT(Cables)





Step 16: Test Results(Cables)



🔝 Help 🗡 🏷 Clear 🚺 Run 🔲 Stop 🚹 Single 📜	Autoscale Default Setup	Copy.	Help	 	
X-Marker	Scope F=999.92 kHz	Int Clock Vectors Sim	ple		
XY-Marker					
Source					
Source					
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water a second and the second provided and the second provided and the second provided and the second provided a second provided and the second provid	and the second second second second				
On					
nce					
F2*					
	E				
Marker Scales XM1 = 13.4 ns XM2 = 14.825 ns	dXM = 1.425 ns 1 / d	Auto Max Mic			
YM1 = 100.307 Ω YM2 = 102.523 Ω	dYM = 2.21556 Ω dYM / d	XM = 1.5548 kΩ / μs			
50 Ohm/dix	5 ns/div	Ext Direct Ext Press Interna	I Rate		
		Ch1 Direct Ch2 Direct 1	μs		
100 Ohm 100 Ohm	BOS	Int Clock Auxiliary			

Step 17: Connect DUT(Differential PCB Trace)





Step 18: Test result(Differential PCB Trace)



Pico Technology PicoScope 931 ile Edit View Setup Measuren	1 Sampling Oscilloscope 2 ments Analysis System U	20 GHz Utility Help ?						- 0
Mathematics 💶 Help 🕅	🔥 Clear 📘 📘 Run	Stop Single	Autoscale Default	t Setup	🚰 Copy 🔝 Help			
Function Scaling			Scope	Int Clock	Vectors Simple			
🗖 F1 🔲 F2 🔲 F3 📕 F4			F=1.0003	3 MHz				
Vertical								
Vertical Zoom Vertical Position								
50 Ω/div 0.25 div								
Horizontal								
Horizontal Zoom Horizontal Position	α					XX		
625 ps/div 6.725 ns			- him	In-	man			
						\sim		
Re Real In Imaginary								
			V					
	F2+	ł						
	F14		- E					
	Marker Scales				Auto Max Mid Min			
	XM1 = 13.4437 r YM1 = 119.284 C	ns XM2 = 13.7188 ns Ω YM2 = 120.986 Ω	dXM = 275 ps dYM = 1.70162 Ω	1 / dXM = 3.63636 GHz dYM / dXM = 6.1877 kΩ / j	μs			
	50000070000000							
	Ch1 40 Ohm/div Ch	2 50 Ohm/div	A 10 ns/div	Ext Direct E	xt Presc Internal Rate			
			A+B + D + F	Ch1 Direct Cl	Auxiliary			
		V A D V A	< > 0 4 5	To Freerun	Trig'd Pos Neg			
	Channels S	Acquire	Display	Marker H- Meas	ure f Math			
	Histogram	Fue Vay Mack Test N	Aux In/Out TOP/TOT					

Step 19: Connect DUT(PCB Trace/Single Ended)





Step 20: Test Result(PCB Trace/Single Ended)

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Step 21: Connect DUT(PCB Trace/Differential)

Step 22: Test Result(PCB Trace/Single Ended)

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