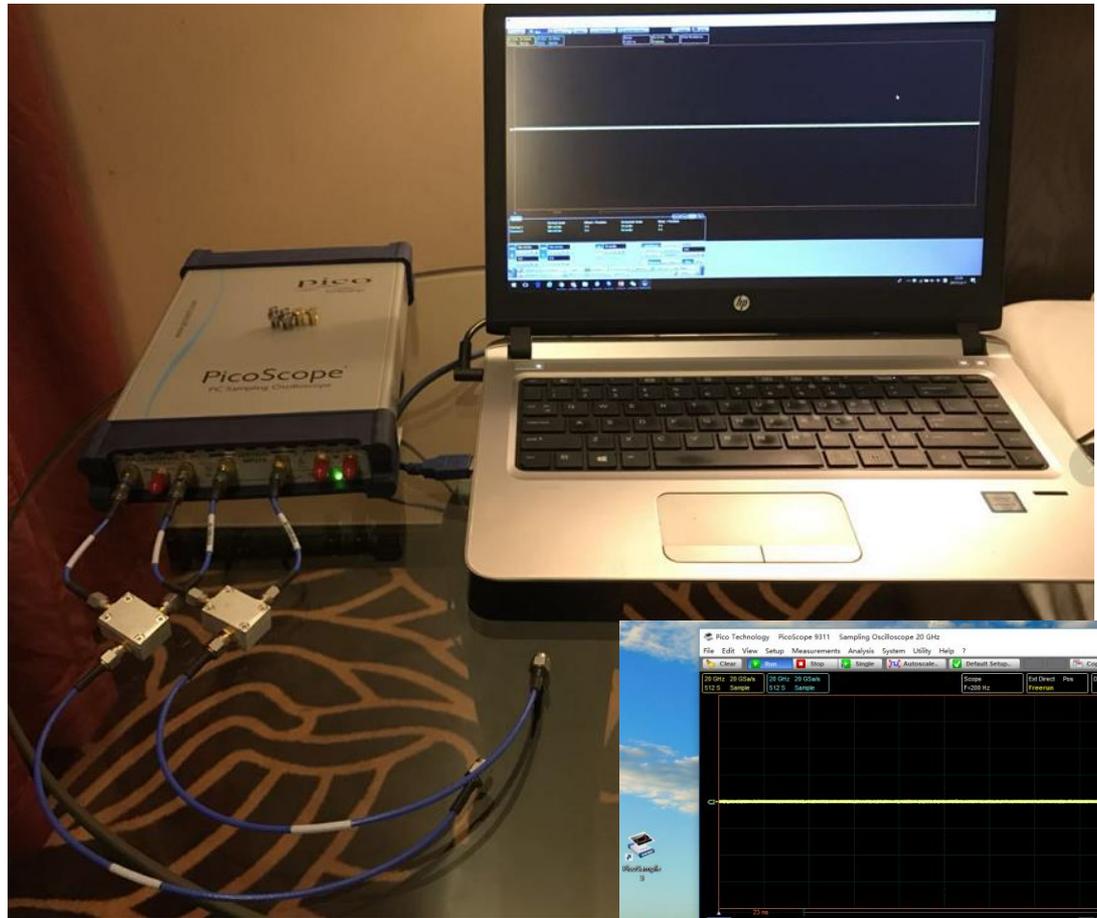


Differential TDR Test-Step by Step

Pico Technology; Based on PicoScope 9311

Step 1: Instruments Setup



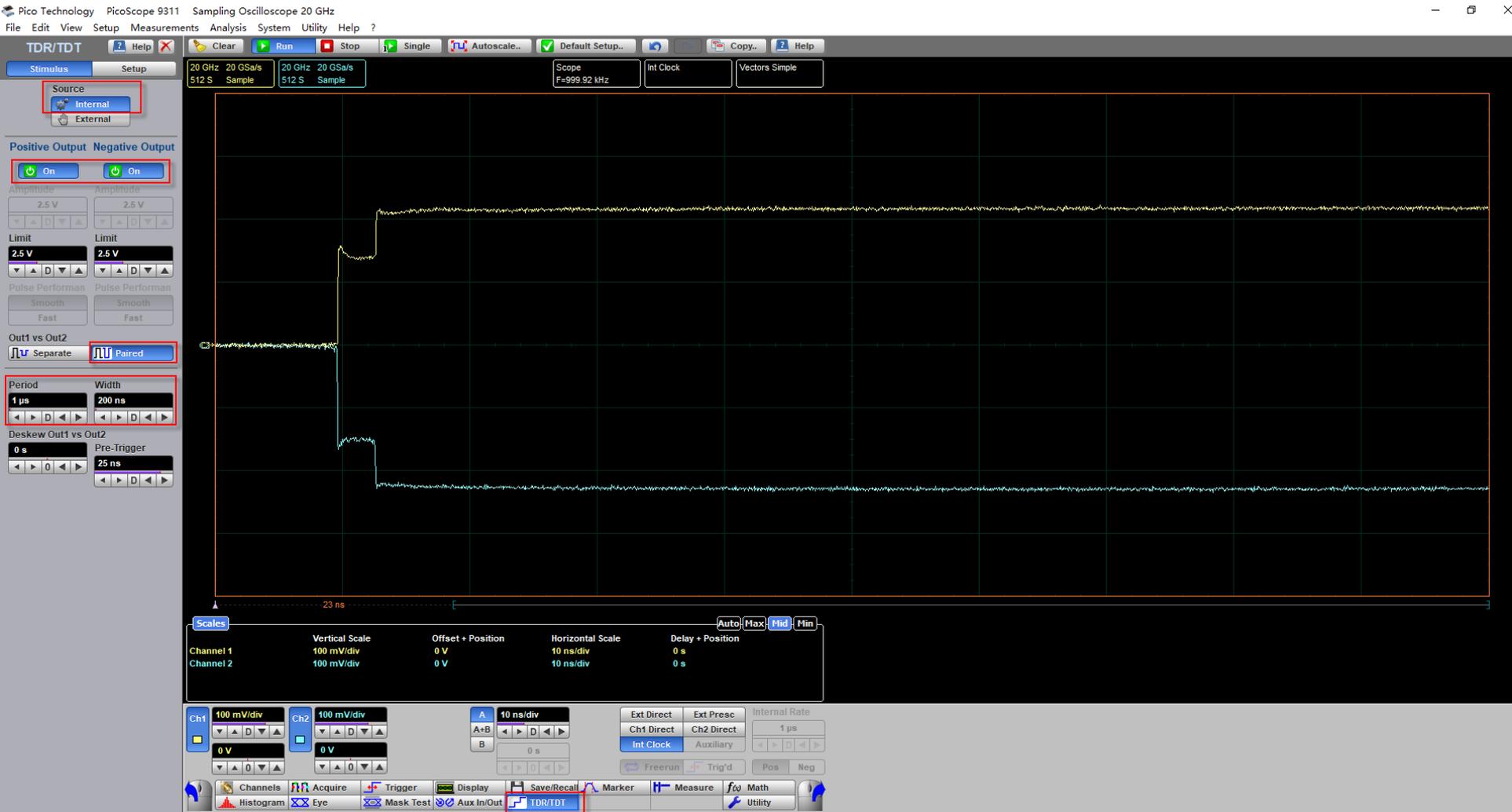
Download software and manuals for oscilloscopes and data loggers

From this page you can download the latest version PicoScope oscilloscope software, Protosc data logging software, software development kits (SDK), brochures and manuals. If you do not own a Pico product you can download the software for the product you are interested in and run a demo mode.

Product series	PicoScope 9000 Series	PicoScope 9321	Software
PicoScope 2000 Series	PicoScope 9201A	Software	Release type
PicoScope 3000 Series	PicoScope 9211A	Manuals & brochures	Info
PicoScope 4000 Series	PicoScope 9231A		Released
PicoScope 5000 Series	PicoScope 9301		
PicoScope 6000 Series	PicoScope 9302		
PicoScope 9000 Series	PicoScope 9311		
PicoScope 9000 Series	PicoScope 9312		
Protosc Data Loggers	PicoScope 9321		
PicoSource	PicoScope 9321		
Discontinued products	PicoScope 9341		

PicoSample3 Software Download
<https://www.picotech.com/downloads>

Step 2: Open TDR Stimulus Source



The screenshot displays the PicoScope 9311 TDR/TDT interface. The top menu bar includes File, Edit, View, Setup, Measurements, Analysis, System, Utility, and Help. The main window is titled "TDR/TDT" and shows a stimulus source configuration panel on the left and a waveform display on the right.

Stimulus Source Configuration:

- Source:** Internal (highlighted with a red box)
- Positive Output:** On (highlighted with a red box)
- Negative Output:** On (highlighted with a red box)
- Amplitude:** 2.5 V (for both Positive and Negative)
- Limit:** 2.5 V (for both Positive and Negative)
- Pulse Perform:** Smooth (for both Positive and Negative)
- Out1 vs Out2:** Paired (highlighted with a red box)
- Period:** 1 μ s
- Width:** 200 ns
- Deskew Out1 vs Out2:** 0 s
- Pre-Trigger:** 25 ns

Waveform Display:

- The main display shows a waveform with a 23 ns scale bar.
- Scope Settings:** 20 GHz, 20 GSa/s, 512 S Sample
- Int Clock:** F=999.92 kHz
- Vectors Simple:** (highlighted with a red box)

Channel Scales:

Channel	Vertical Scale	Offset + Position	Horizontal Scale	Delay + Position
Channel 1	100 mV/div	0 V	10 ns/div	0 s
Channel 2	100 mV/div	0 V	10 ns/div	0 s

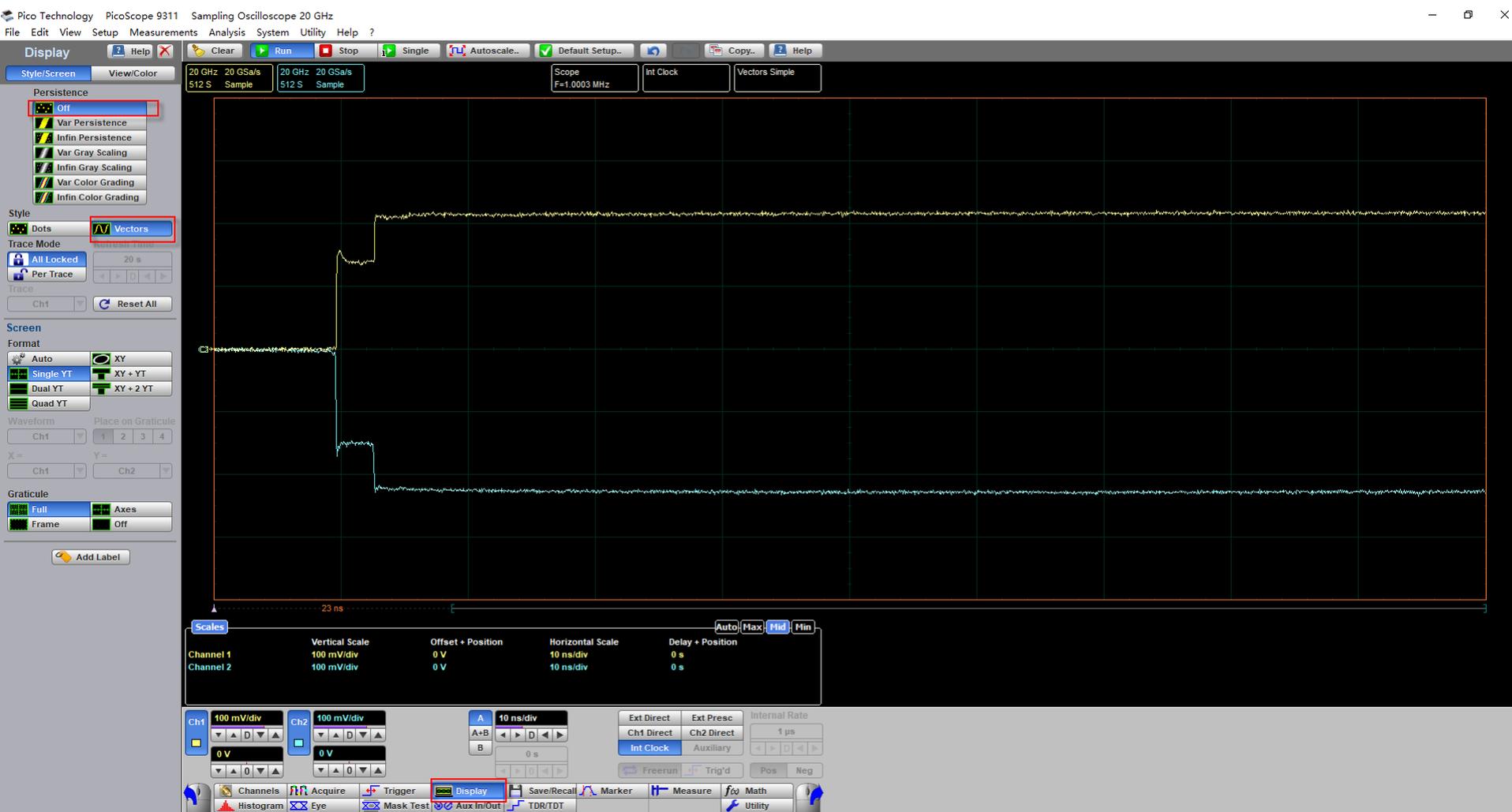
Channel Controls:

- Ch1: 100 mV/div, 0 V
- Ch2: 100 mV/div, 0 V
- Horizontal Scale: 10 ns/div
- Internal Rate: 1 μ s

Bottom Panel:

- Channels: Histogram, Eye, Mask Test, Aux In/Out, TDR/TDT (highlighted with a red box)
- Acquire: (highlighted with a red box)
- Trigger: (highlighted with a red box)
- Display: (highlighted with a red box)
- Save/Recall: (highlighted with a red box)
- Marker: (highlighted with a red box)
- Measure: (highlighted with a red box)
- Math: (highlighted with a red box)
- Utility: (highlighted with a red box)

Step 3: Setup the display mode

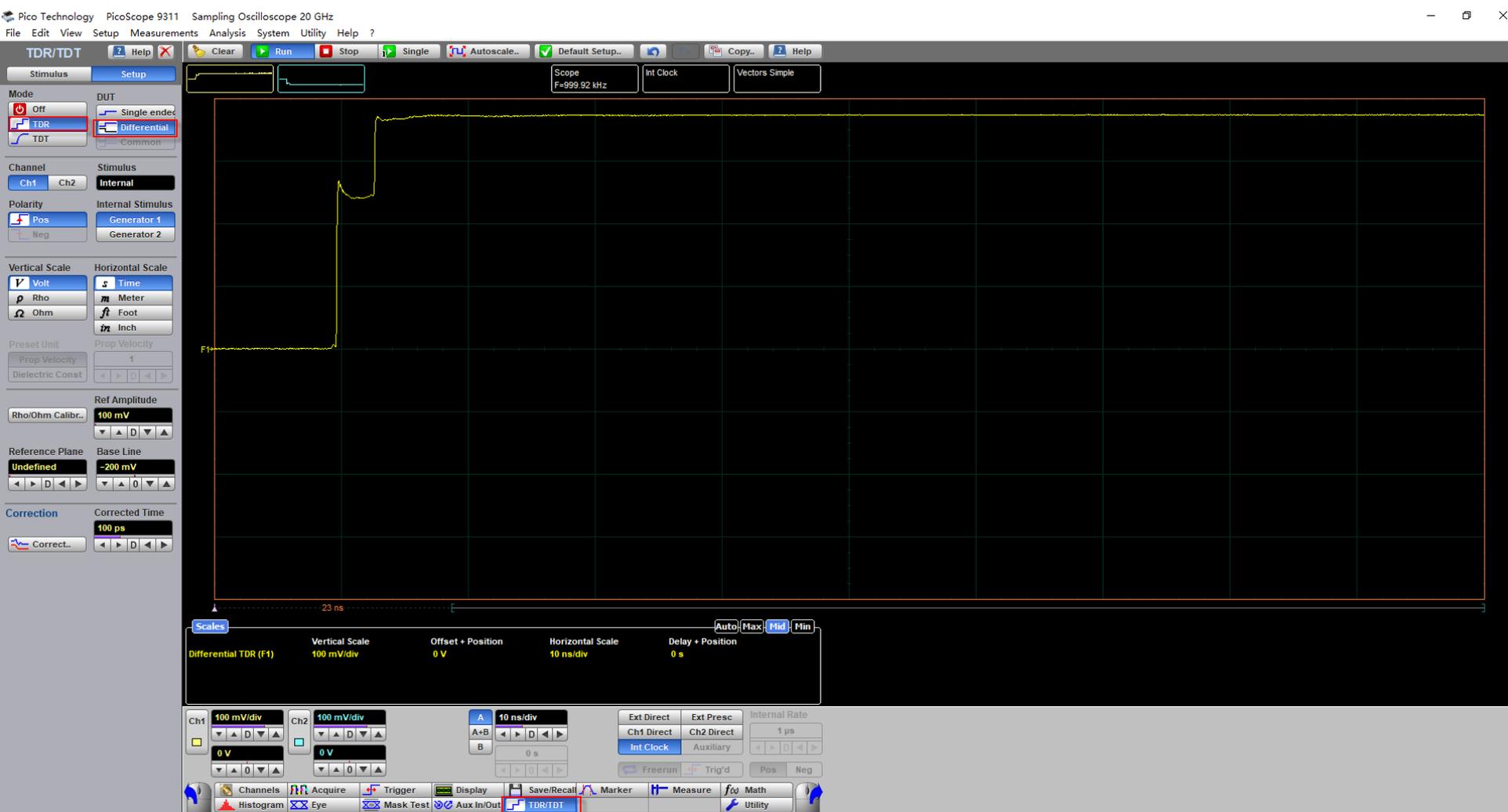


The screenshot shows the PicoScope 9311 software interface. The main display area shows a signal waveform on a grid. The left sidebar contains the 'Display' menu, which is expanded to show 'Style/Screen' and 'View/Color' options. The 'Style/Screen' section is further expanded to show 'Persistence' and 'Style' options. The 'Persistence' section has 'Off' selected. The 'Style' section has 'Vectors' selected. The 'View/Color' section has 'All Locked' selected. The 'Screen' section has 'Format' options: 'Auto', 'Single YT', 'Dual YT', and 'Quad YT'. The 'Waveform' section has 'Ch1' selected. The 'Graticule' section has 'Full' selected. The 'Scales' section at the bottom shows the following settings:

Channel	Vertical Scale	Offset + Position	Horizontal Scale	Delay + Position
Channel 1	100 mV/div	0 V	10 ns/div	0 s
Channel 2	100 mV/div	0 V	10 ns/div	0 s

The 'Display' button in the bottom toolbar is highlighted with a red box. The 'Display' button is located in the bottom toolbar, between the 'Trigger' and 'Save/Recall' buttons.

Step 4: Setup the TDR to Differential Mode



The screenshot displays the PicoScope 9311 software interface for a Sampling Oscilloscope at 20 GHz. The main window shows a TDR waveform in differential mode. The left-hand menu is configured as follows:

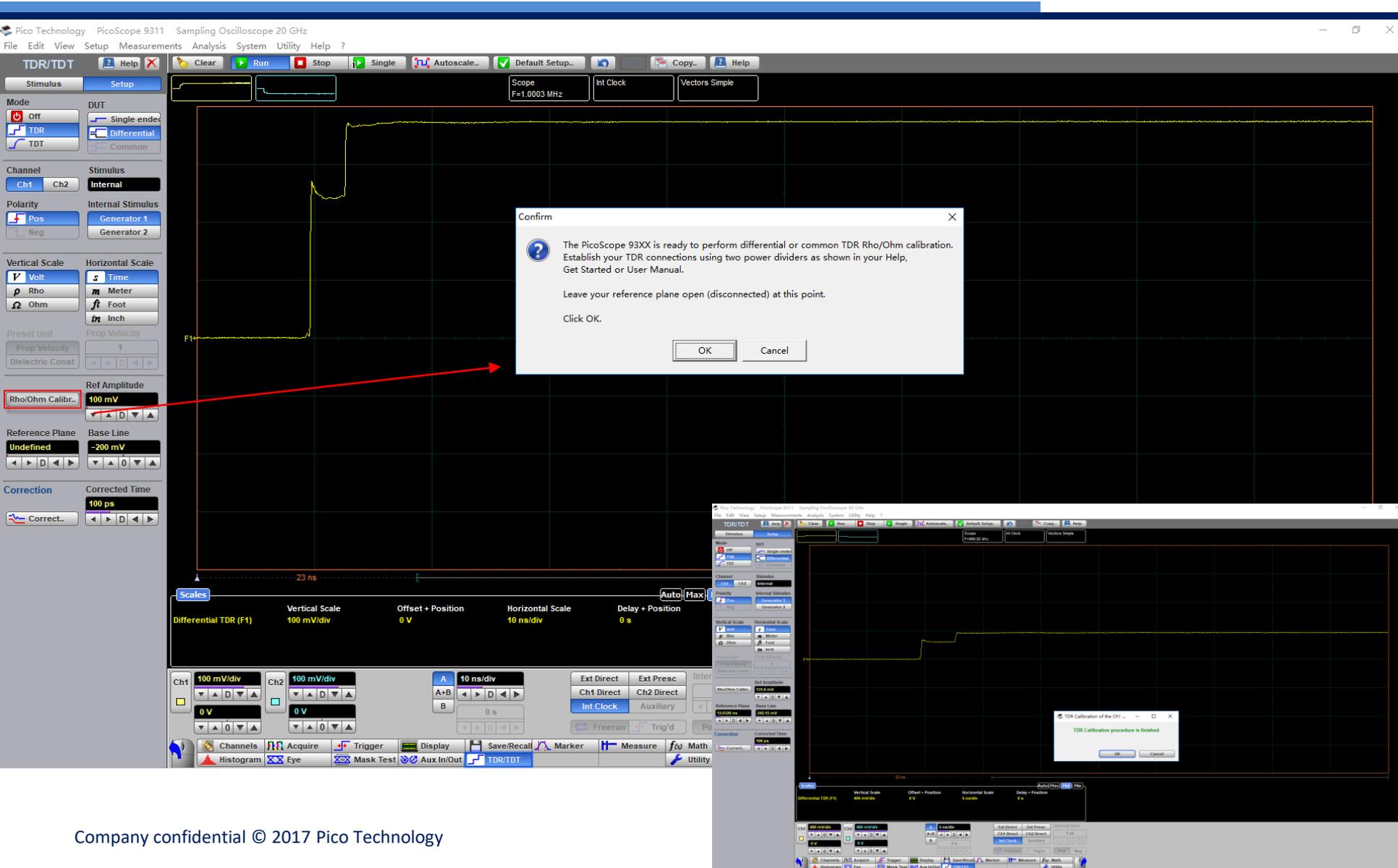
- TDR/TDT**: Stimulus Setup, Mode: Off, DUT: Single ended, TDR: **Differential**, TDT: Common.
- Channel**: Ch1, Ch2, Stimulus: Internal.
- Polarity**: Pos, Internal Stimulus: Generator 1, Generator 2.
- Vertical Scale**: Volt, Rho, Ohm.
- Horizontal Scale**: Time, Meter, Foot, Inch.
- Preset Unit**: Prop Velocity: 1, Dielectric Const.
- Rho/Ohm Calibr...**: 100 mV.
- Reference Plane**: Undefined, Base Line: -200 mV.
- Correction**: Corrected Time: 100 ps.

The main display area shows a yellow waveform on a grid. A vertical scale bar on the left indicates 100 mV/div. A horizontal scale bar at the bottom indicates 10 ns/div. A 'Scales' window is open, showing the following settings:

Vertical Scale	Offset + Position	Horizontal Scale	Delay + Position
Differential TDR (F1)	0 V	10 ns/div	0 s

The bottom control bar includes buttons for Channels, Acquire, Trigger, Display, Save/Recall, Marker, Measure, Math, Histogram, Eye, Mask Test, Aux In/Out, **TDR/TDT**, and Utility. The TDR/TDT button is highlighted with a red box.

Step 5: Do Rho/Ohm Calibration



The screenshot displays the PicoScope 9311 interface during a Rho/Ohm calibration. The main window shows a signal trace with a 23 ns scale bar. A dialog box is open, asking for confirmation to perform differential or common TDR Rho/Ohm calibration. The dialog text reads: "The PicoScope 93XX is ready to perform differential or common TDR Rho/Ohm calibration. Establish your TDR connections using two power dividers as shown in your Help, Get Started or User Manual. Leave your reference plane open (disconnected) at this point. Click OK." A red arrow points from the "Rho/Ohm Calibr.." button in the left-hand menu to the dialog box. Below the main window, a smaller inset shows the same interface with a "TDR Calibration of the CH1 ... TDR Calibration procedure is finished" message box.

Vertical Scale
Differential TDR (F1)
100 mV/div

Horizontal Scale
10 ns/div

Reference Plane
Undefined

Correction
Corrected Time: 100 ps

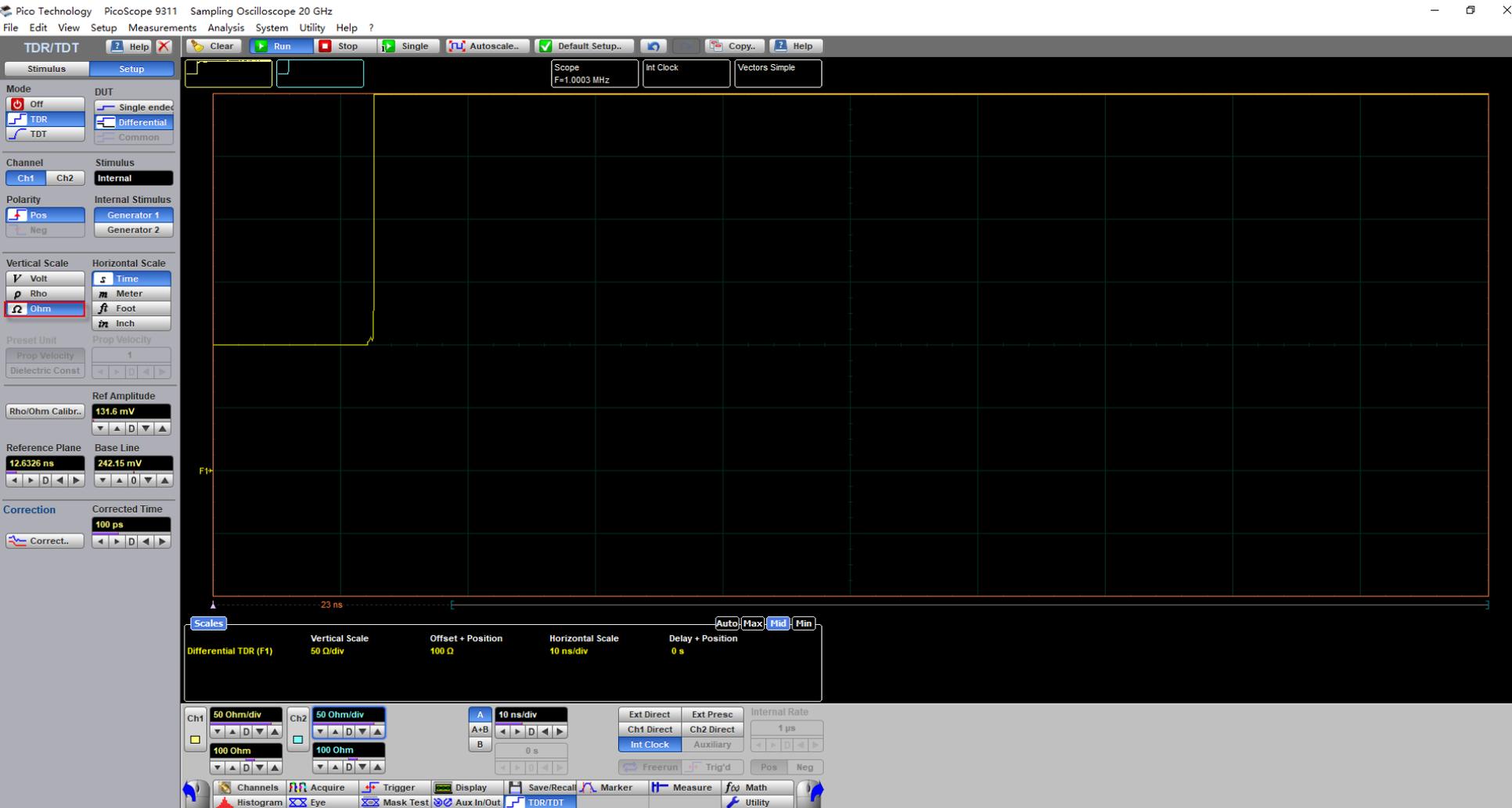
Channels
Ch1: 100 mV/div, 0 V
Ch2: 100 mV/div, 0 V

Trigger
A: 10 ns/div, 0 s

Display
Auto, Max

Utility
Histogram, Eye, Mask Test, Aux In/Out, TDR/TDT

Step 6: Choose Ohm menu to show Impedance Curve



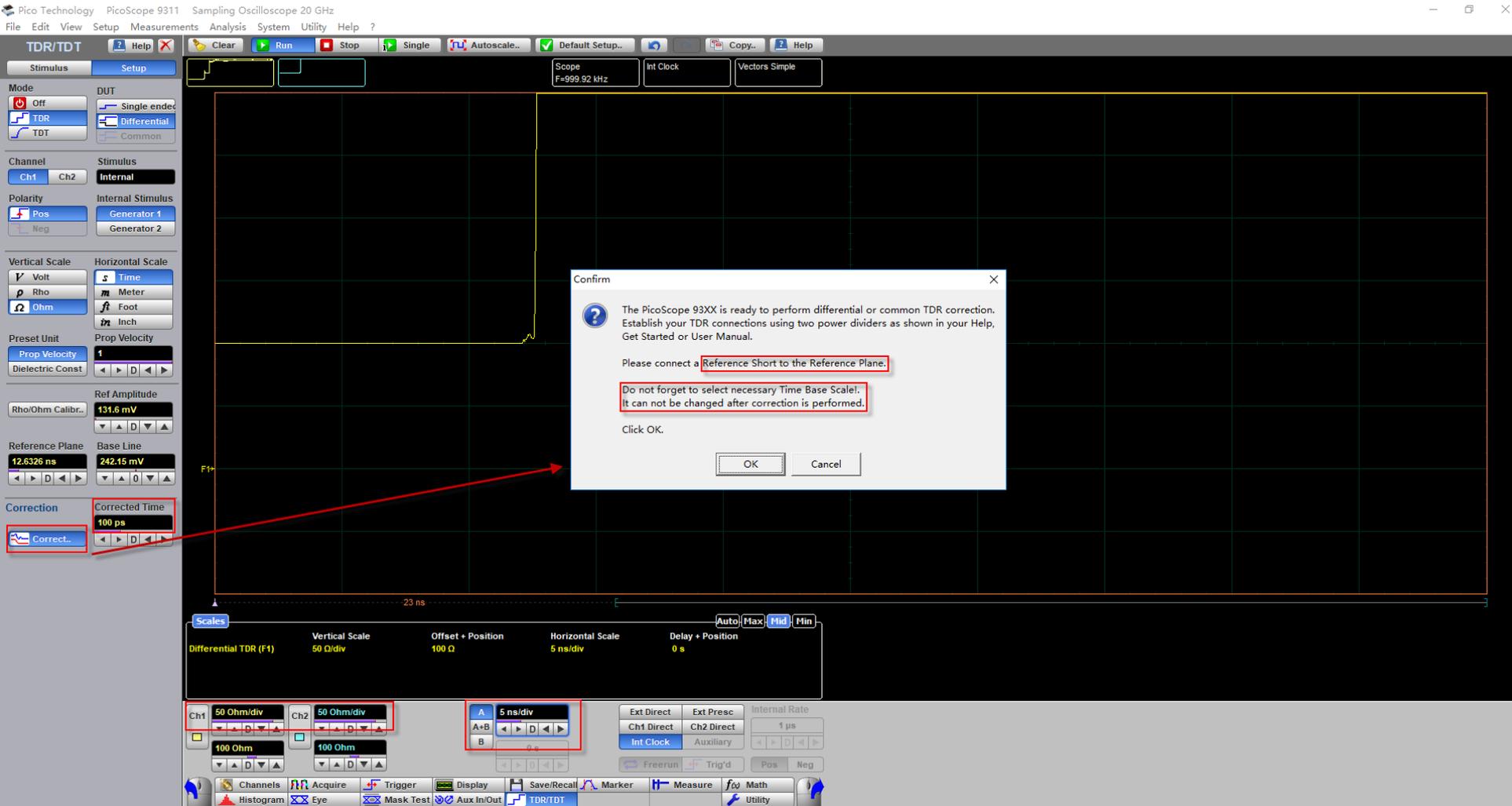
The screenshot displays the PicoScope 9311 software interface. The main window shows a grid with a yellow trace. The left-hand menu is open to the 'Setup' section, where the 'Vertical Scale' is set to 'Ohm'. The 'Horizontal Scale' is set to 'Time'. The 'Reference Plane' is set to 'Base Line'. The 'Correction' section shows a 'Corrected Time' of 100 ps. The 'Scales' panel at the bottom shows the following settings:

Vertical Scale	Offset + Position	Horizontal Scale	Delay + Position
Differential TDR (F1)	100 Ω	10 ns/div	0 s

The 'Scales' panel also shows the following settings:

Ch1	Ch2	A	B	Ext Direct	Ext Presc	Internal Rate
50 Ohm/div	50 Ohm/div	10 ns/div	0 s	Ch1 Direct	Ch2 Direct	1 ps

Step 7: Do Correction-Click Correction



The screenshot displays the PicoScope 9311 software interface. A central dialog box titled "Confirm" is open, containing the following text:

The PicoScope 93XX is ready to perform differential or common TDR correction. Establish your TDR connections using two power dividers as shown in your Help, Get Started or User Manual.

Please connect a **Reference Short to the Reference Plane.**

Do not forget to select necessary Time Base Scale. It can not be changed after correction is performed.

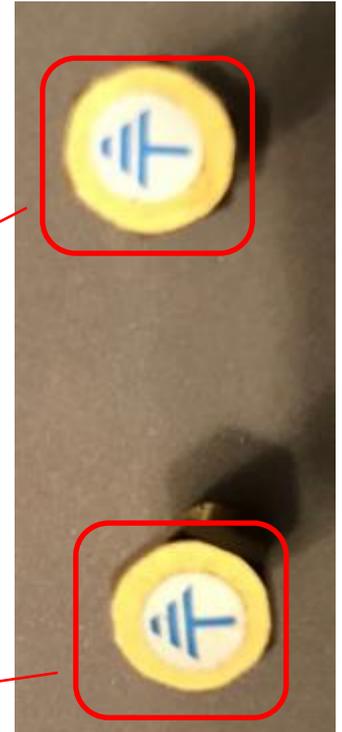
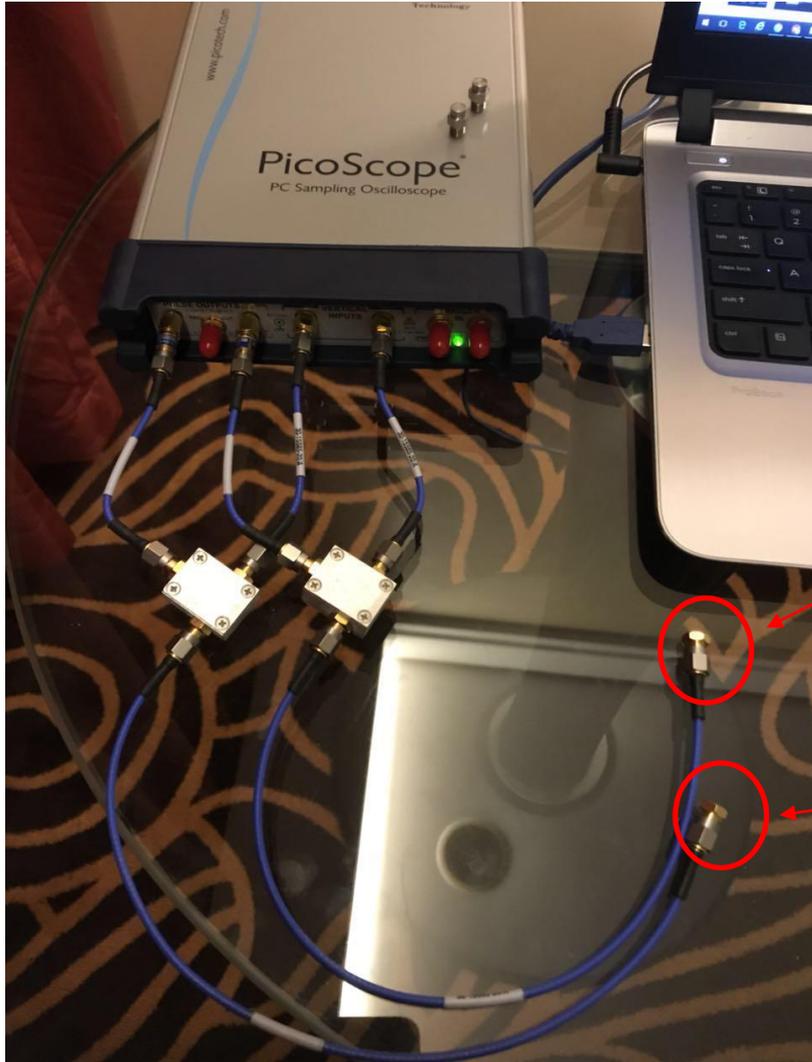
Click OK.

Buttons for "OK" and "Cancel" are at the bottom of the dialog.

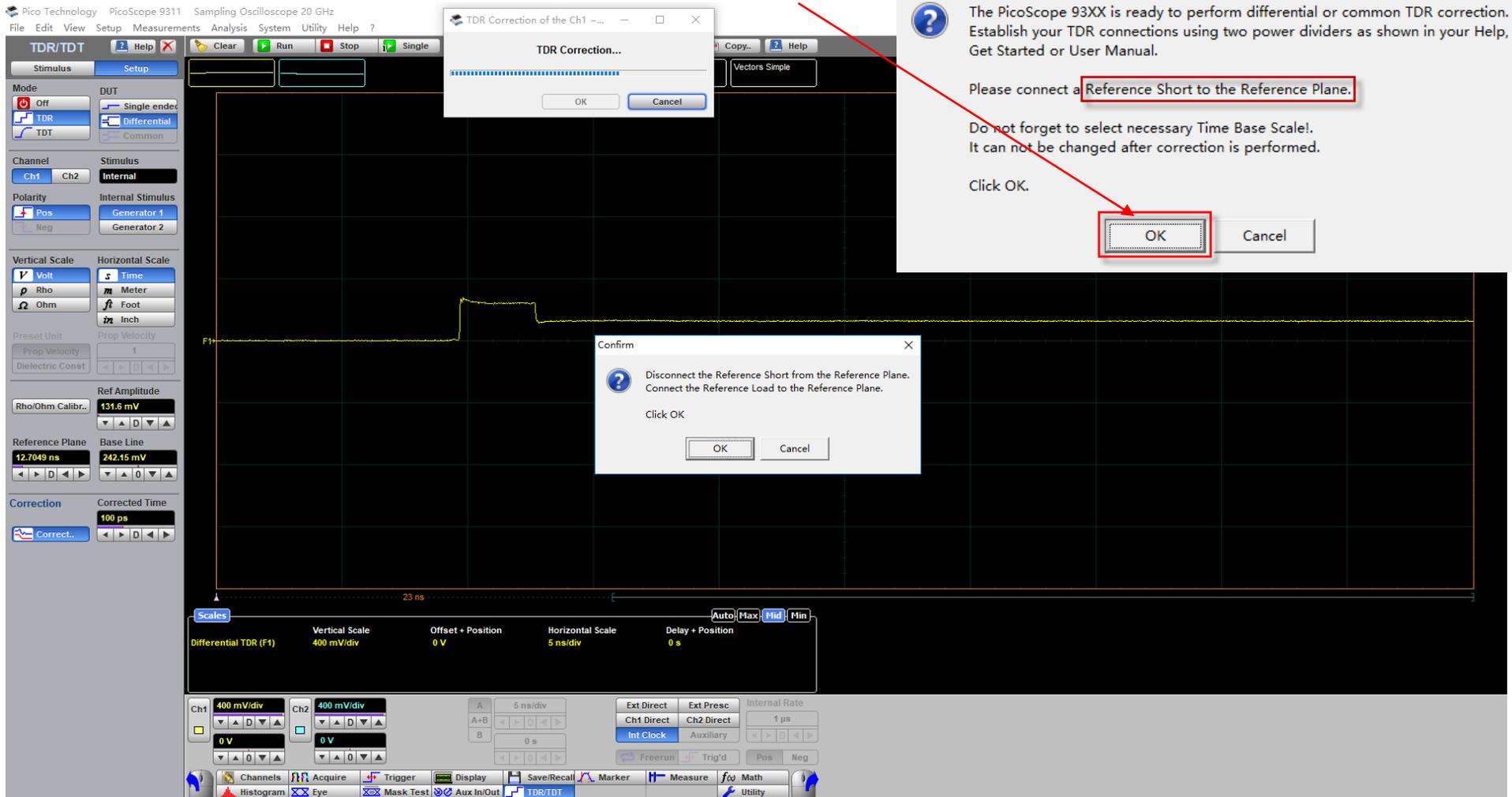
In the background, the software interface shows the following settings:

- Correction:** Corrected Time: 100 ps. A "Correct..." button is highlighted with a red box.
- Scales:** Differential TDR (F1) with Vertical Scale: 50 Ohm/div, Offset + Position: 100 Ohm, Horizontal Scale: 5 ns/div, Delay + Position: 0 s.
- Channels:** Ch1 and Ch2 are both set to 50 Ohm/div. A red box highlights the channel settings.
- Time Base:** The horizontal scale is set to 5 ns/div, highlighted with a red box.

Step 8: Do Correction-Connect the Reference Short



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



Click OK

TDR Correction...

OK Cancel

Confirm

The PicoScope 93XX is ready to perform differential or common TDR correction. Establish your TDR connections using two power dividers as shown in your Help, Get Started or User Manual.

Please connect a **Reference Short to the Reference Plane.**

Do not forget to select necessary Time Base Scale. It can not be changed after correction is performed.

Click OK.

OK Cancel

Confirm

Disconnect the Reference Short from the Reference Plane. Connect the Reference Load to the Reference Plane.

Click OK

OK Cancel

Scales

Vertical Scale	Offset + Position	Horizontal Scale	Delay + Position
Differential TDR (F1)	0 V	5 ns/div	0 s

Ch1 400 mV/div Ch2 400 mV/div

Internal Rate 1 μ s

Channels Acquire Trigger Display Save/Recall Marker Measure f₀ Math

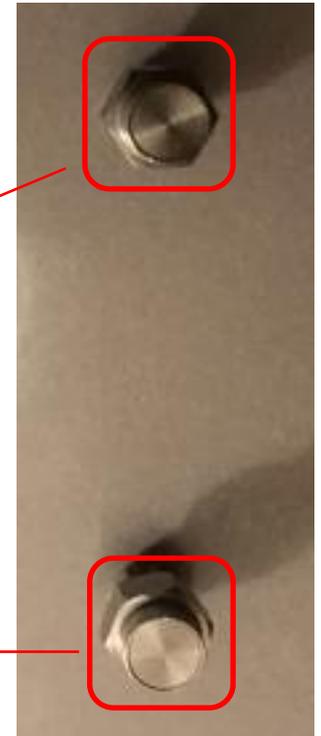
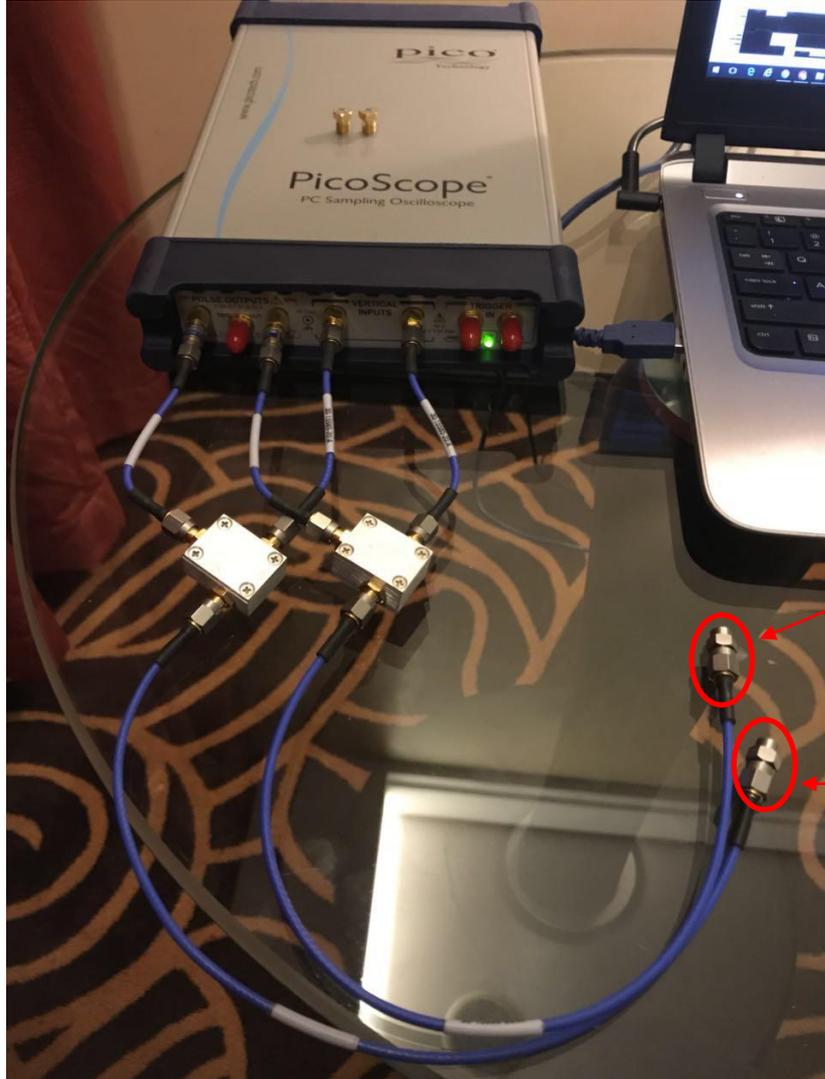
Histogram Eye Mask Test Aux In/Out TDR/TDT Utility

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

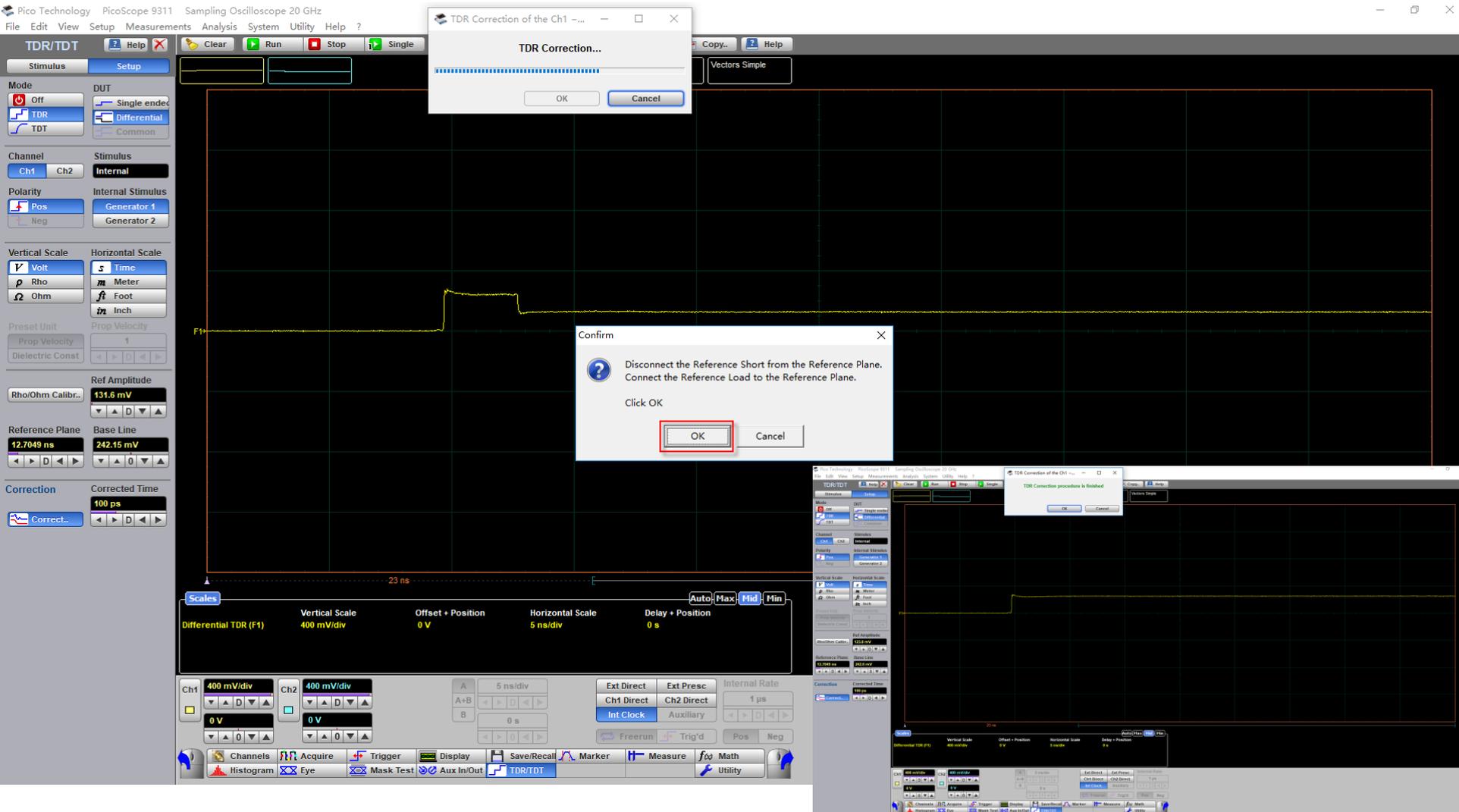


The screenshot shows the PicoScope 9311 interface with a TDR correction dialog box open. The dialog box is titled "TDR Correction of the Ch1 - ..." and contains a progress bar and "OK" and "Cancel" buttons. A second dialog box, titled "Confirm", is also open, displaying the message: "Disconnect the Reference Short from the Reference Plane. Connect the Reference Load to the Reference Plane." The "OK" button in this dialog is highlighted with a red box. The background shows a waveform on a grid with a yellow trace. The interface includes various control panels for stimulus, channel, vertical/horizontal scale, and correction.

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



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



The screenshot displays the PicoScope 9311 interface during a TDR correction procedure. The main window shows a differential TDR waveform with a 23 ns scale bar. A 'TDR Correction of the Ch1' dialog box is open, and a 'Confirm' dialog box is also open, asking to disconnect the reference short and connect the reference load. The 'Confirm' dialog box has the 'OK' button highlighted with a red box.

TDR Correction of the Ch1

TDR Correction...

OK Cancel

Confirm

Disconnect the Reference Short from the Reference Plane.
Connect the Reference Load to the Reference Plane.

Click OK

OK Cancel

Scales

Vertical Scale	Offset + Position	Horizontal Scale	Delay + Position
Differential TDR (F1)	0 V	5 ns/div	0 s

Vertical Scale: 400 mV/div

Horizontal Scale: 5 ns/div

Delay + Position: 0 s

Channels: Ch1 400 mV/div, Ch2 400 mV/div

Offset + Position: 0 V

Horizontal Scale: 5 ns/div

Delay + Position: 0 s

Internal Rate: 1 μ s

Ext Direct: Ch1 Direct, Ch2 Direct

Ext Presc: Auxiliary

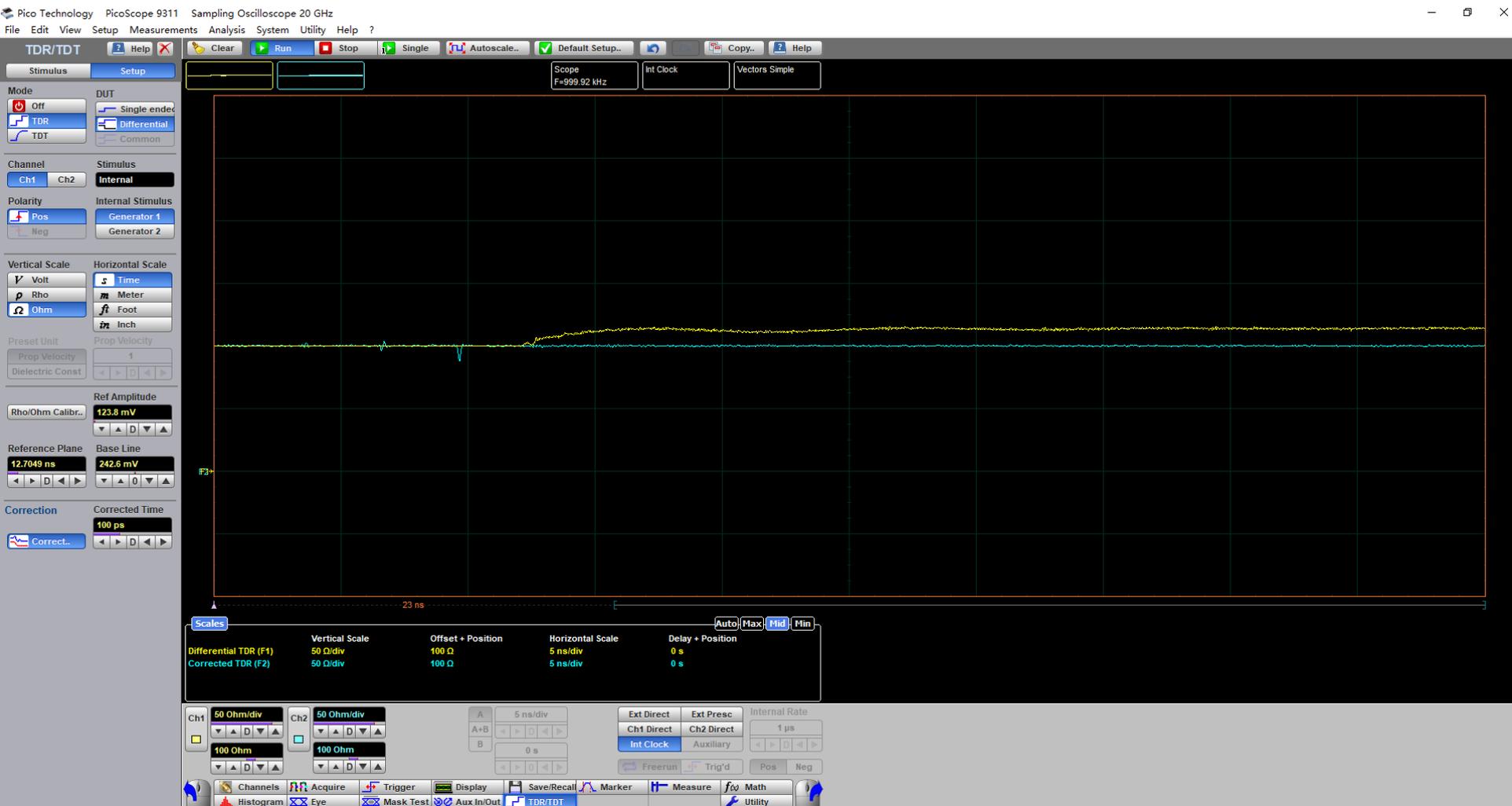
Int Clock: Freerun, Trig'd

Pos: Neg

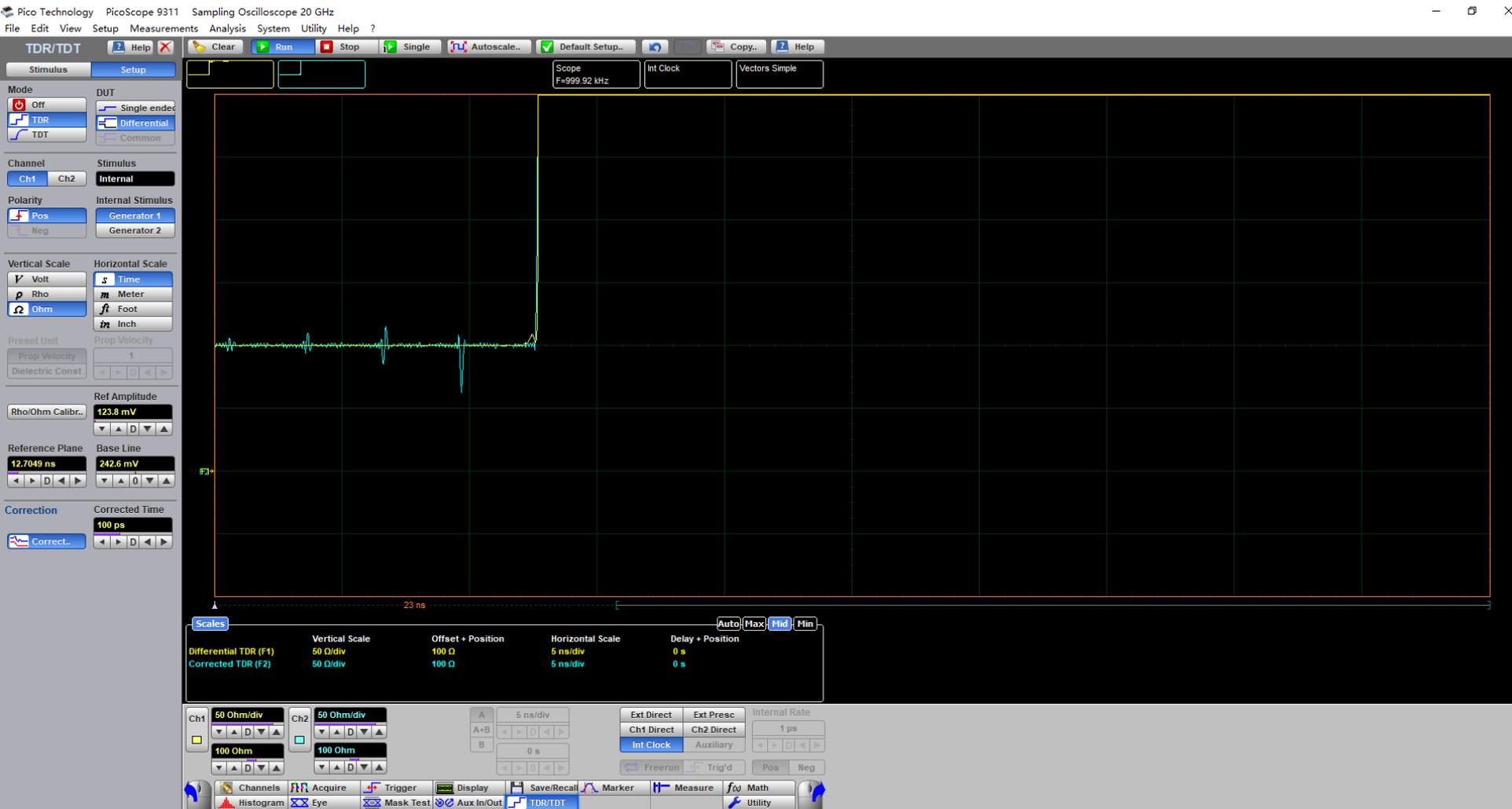
Channels: Channels, Acquire, Trigger, Display, Save/Recall, Marker, Measure, Math

Histogram, Eye, Mask Test, Aux In/Out, TDR/TDT, Utility

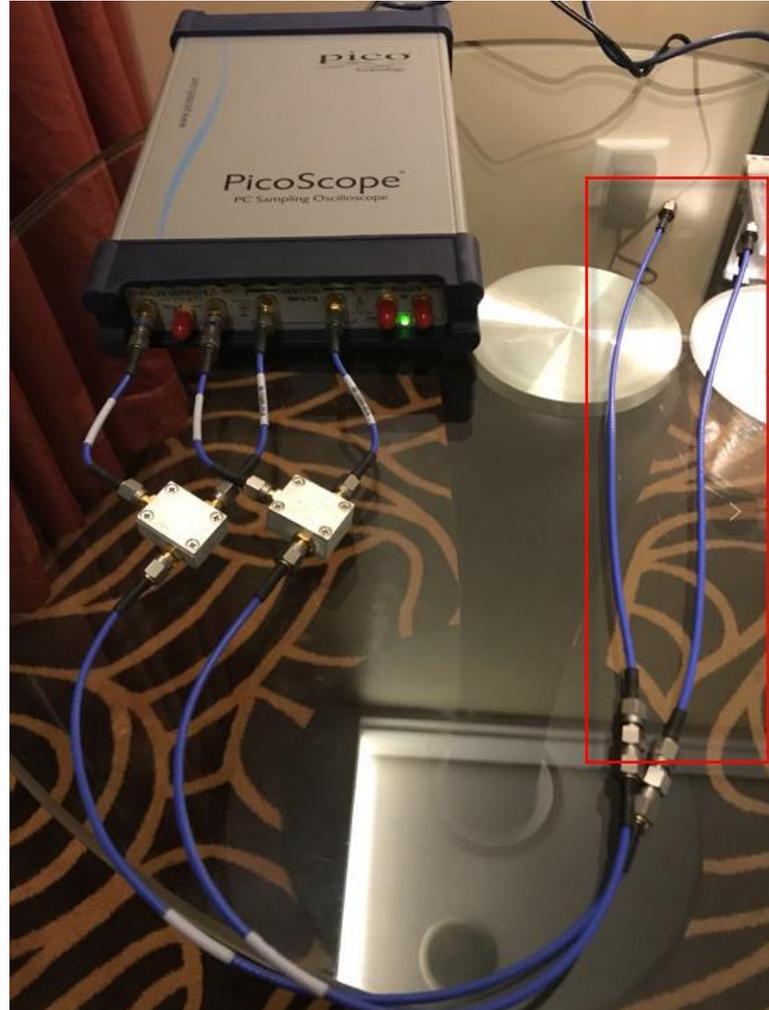
Step 13: F2 is the impedance waveform with Corrected risetime



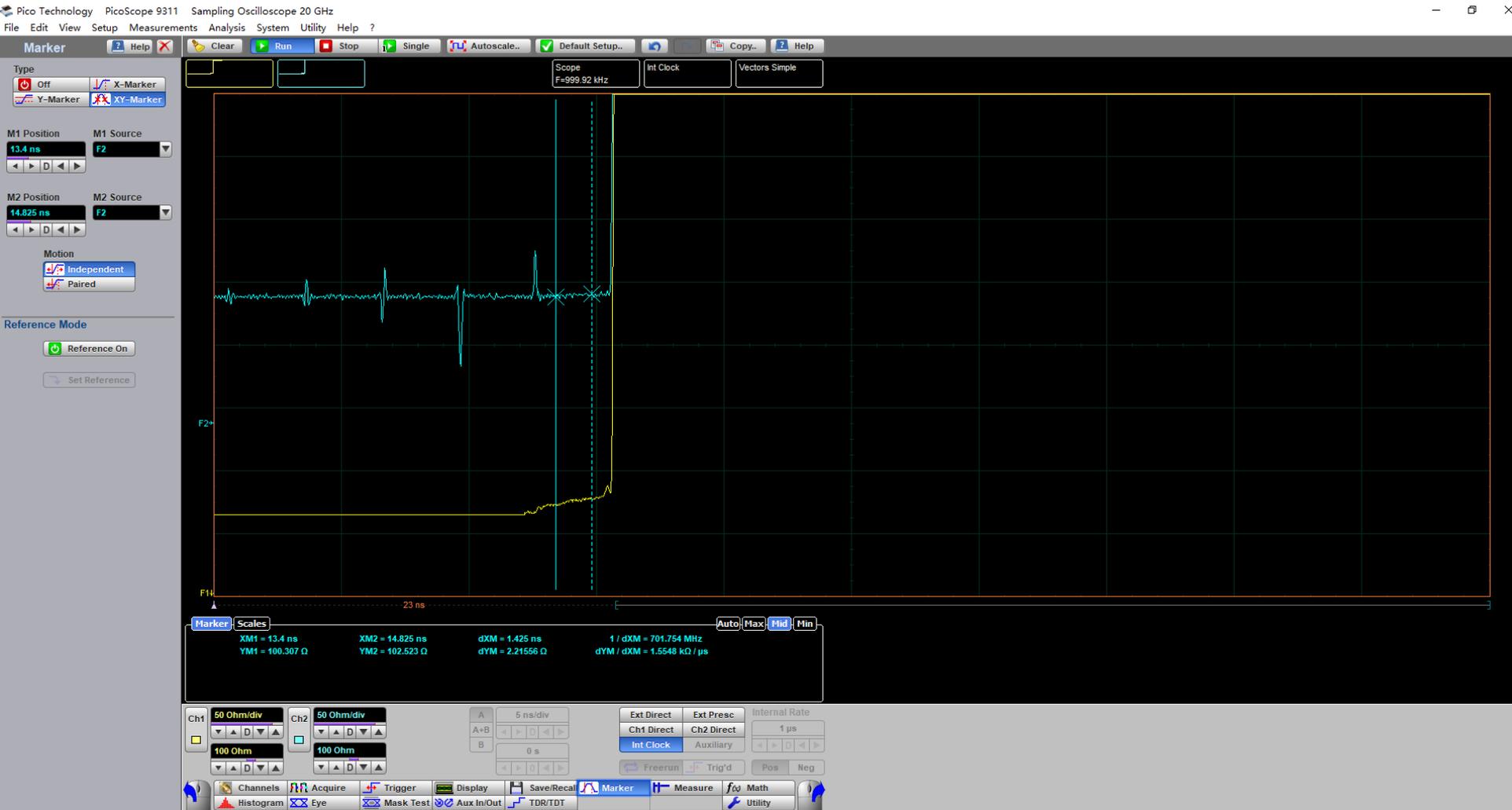
Step 14: F2 is the impedance waveform with Corrected risetime(Disconnect the load)



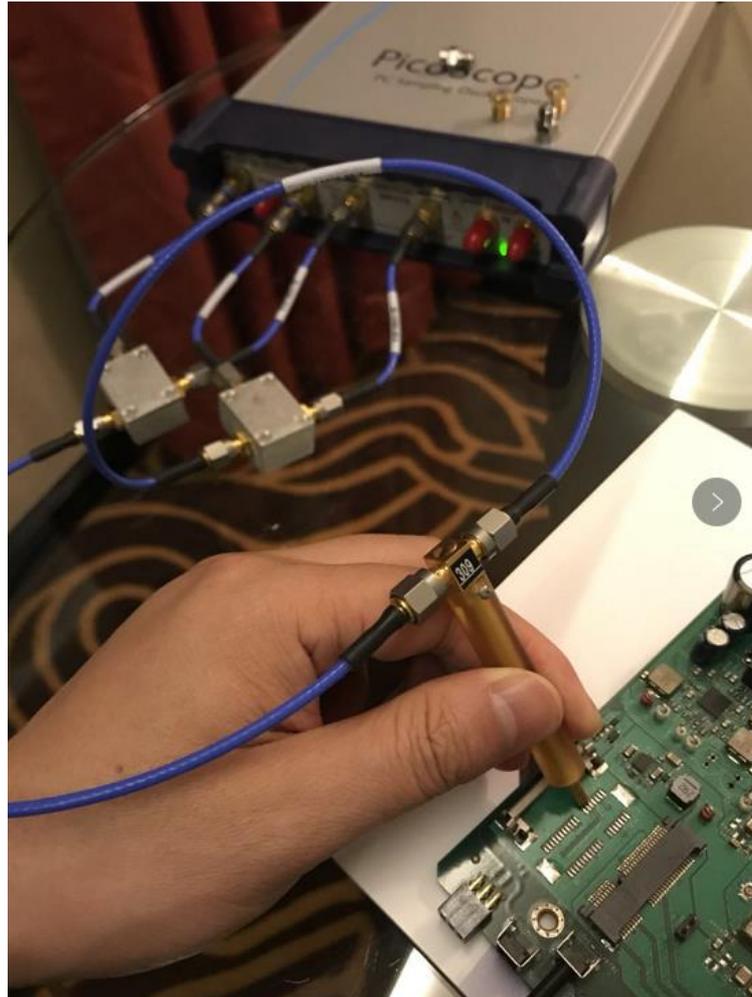
Step 15: Connect DUT(Cables)



Step 16: Test Results(Cables)



Step 17: Connect DUT(Differential PCB Trace)



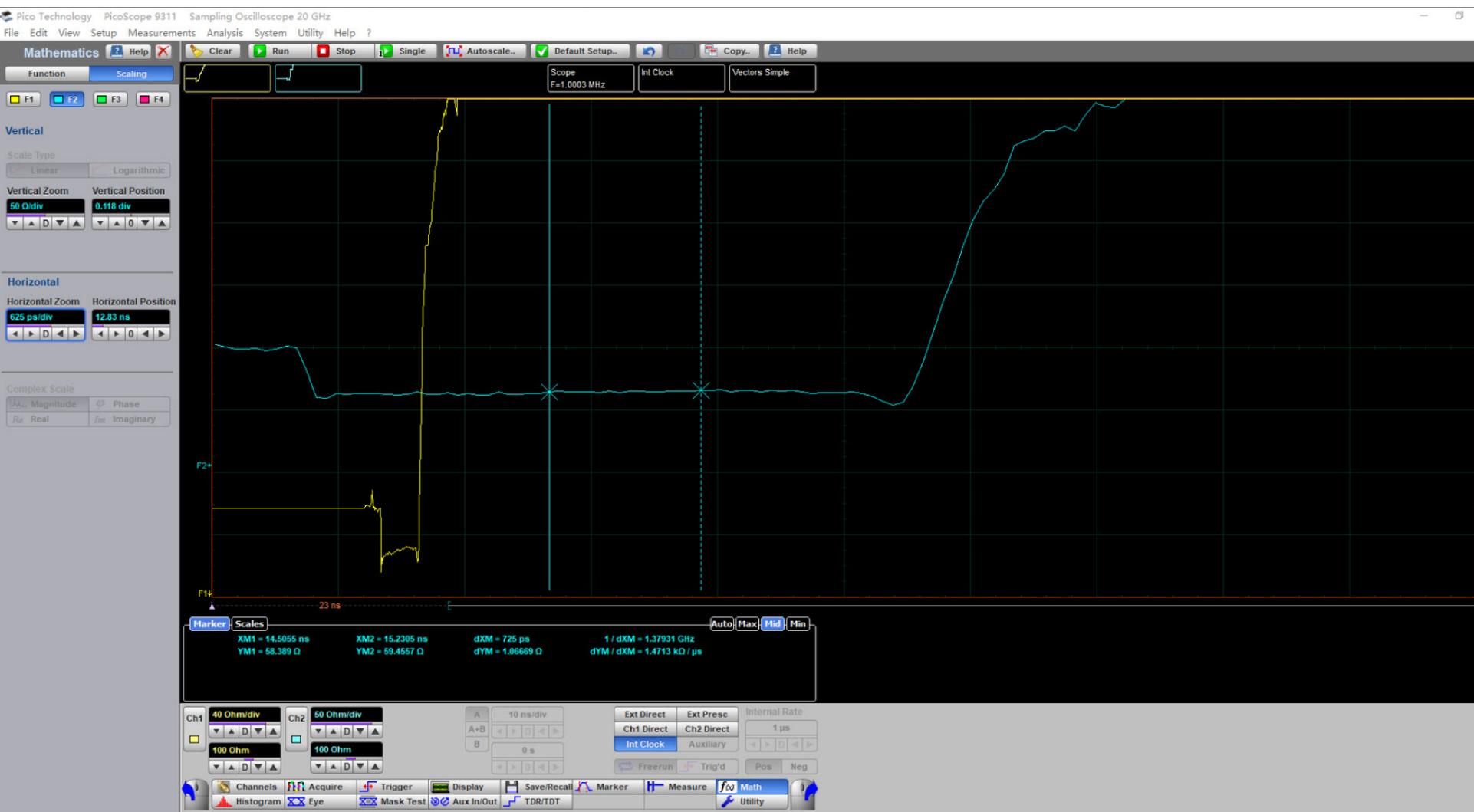
Step 18: Test result(Differential PCB Trace)



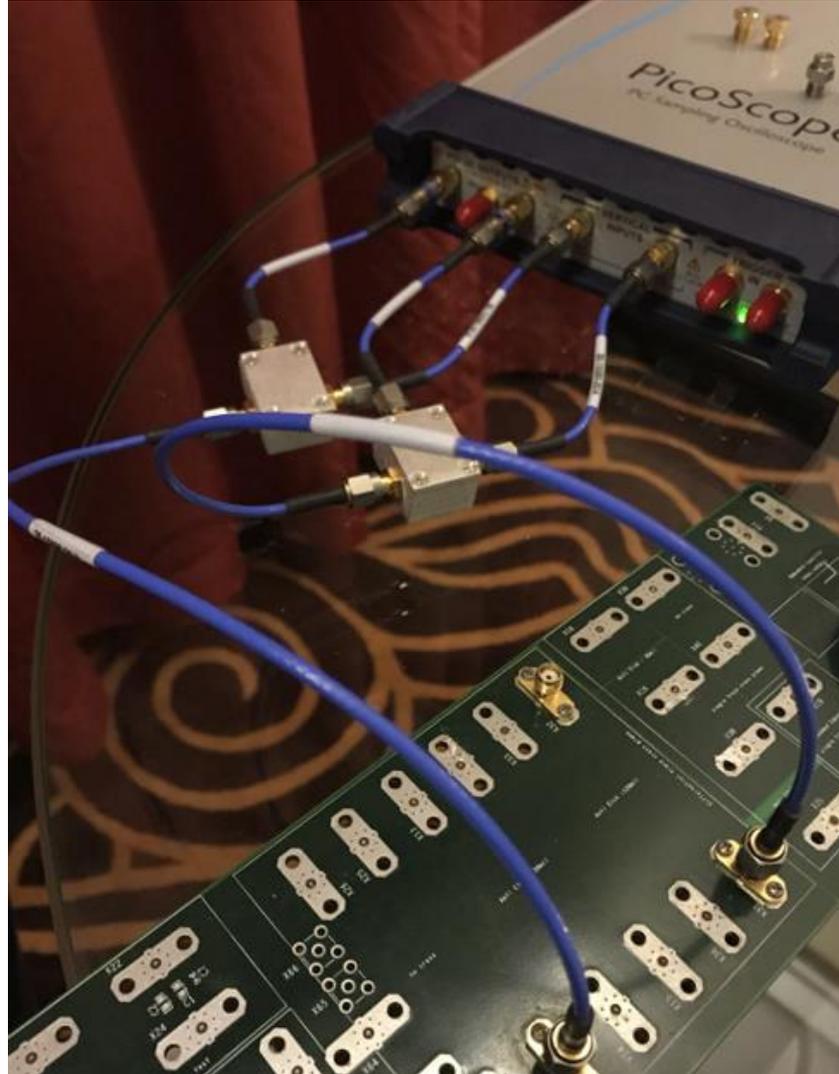
Step 19: Connect DUT(PCB Trace/Single Ended)



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



Step 21: Connect DUT(PCB Trace/Differential)



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

