

ML4025-TDR User Operation Manual

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Connection
Installation
Calibration
Measurement
Troubleshooting

User Manual Revision 1.0
Windows GUI Version v.1.0.r6380
API Version 1.0
Firmware Version 3.2

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General Safety Precautions

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the General Safety Summary in other system manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Use Proper Power Cord. Only use the power cord specified for this product and certified for the country of use.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal that exceeds the maximum rating of that terminal.

Do Not Operate Without Covers.

Do not operate this product with covers or panels removed.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate with Suspected Failures.

If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

⚠ CAUTION: *Caution statements identify conditions or practices that could result in damage to this product or other property.*

⚠ CAUTION: *Provide adequate cooling. Provide adequate cooling to the board to avoid damaging any part of it specifically for the ATE version of the board. Refer to the power section to know the power dissipation values*

Preface

This is the user operation manual for the **ML4025-TDR**. It covers the following information:

- Describes the capabilities of the instrument: How to install it and its software.
- Explains how to operate the instrument as a time domain reflectometer, time domain transmitter and sampling scope to measure: Impedance Profile, Insertion Loss, Return Loss, Near-End Crosstalk, Far-End Crosstalk, Integrated Crosstalk Noise.
- Lists the instrument's specifications

Contact MultiLane SAL

MultiLaneSAL is an engineering services company and an OEM supplier of specialty test and communication equipment for the semiconductor and optical transport industries. Multilane delivers ultra-compact test instruments of the highest value and performance for high speed communication and signal integrity applications. The Company has a large engineering team and a fully equipped lab with state of the art equipment, having recently moved to a 6000sq foot facility in **Houmal Technology Park (HTP)**.

Multilane SAL customers can leverage great flexibility and capability in product customization thanks to our team's in-depth expertise in high speed I/O, Signal Integrity, and access to advanced development and test tools. MultiLane has the resources and know-how to meet customers' product development and design requirements. Our R&D has a proven track record in delivering leading edge products and development tool kits to the Automated Test market while applying the production processes to deliver high quality products on schedule and within budget.

Multilane Sal's team is composed of experienced and disciplined engineers offering products and turnkey solutions of modules and systems for high speed IO, Signal Integrity, SOC development and optical communication from verbal requirements (Architecture, PRD, HW/FW/SW design implementation and characterization).

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Product Description

This section describes your instrument, operating under Windows.

Model and Package Content

This manual supports the instrument **ML4025-TDR (cPCI)**

Hardware Packages

ML4025-TDR (cPCI): 4 differential ports operating as TDR/TDT/Sampling Scope lanes, 4 single-ended ports (**Optional**), reference clock input, external reference clock output (**Optional**)

User Guide Manual

Manual containing user operation guide, software installation and start up procedure.

Software package and documentations:

- Main **ML4025-TDR** GUI.
- USB driver. The Ethernet interface is controlled through the API version 2.0 that includes the Ethernet package.

Overview

ML4025-TDR is a state of the art Digital Sampling Oscilloscope with CDR, Time Domain Reflectometry, and Time Domain Transmission. The DSO automatically performs accurate eye diagram analysis at 35 GHz to characterize the quality of transmitters and receivers, implementing a statistical under-sampling technique with comprehensive software libraries used for eye measurements, jitter analysis and processing of NRZ/PAM4 data. The true differential TDR/TDT is used to determine the performance of different features in many applications including Time Domain Reflectometry/Transmission, impedance testing, propagation and time delay while testing up to 4X35 GHz true-differential channels. It is designed for characterization as well as manufacturing.

MultiLane offers the **ML4025-TDR** instrument in a cPCI card format that fits into the **ML4000** MultiLane Signal Integrity Analyzer 6U cPCI Chassis.

Key Features

- High Resolution TDR/TDT measurements
- Determination of the magnitude and polarity of any back reflected signal
- 4 ports per module expandable up to 32 and more
- Low power dissipation
- Sample aperture jitter below 60 fs
- Return Loss
- Insertion Loss
- Near-End Crosstalk
- Far-End Crosstalk
- Integrated Crosstalk Noise
- Low cost quadruple 35 GHz Digital Sampling Scope optimized for high speed data analysis
- High Fidelity Signal Capture
- CDR up to 30 Gbps
- Low intrinsic Jitter
- cPCI friendly interface, allows control of multiple modules through either Fast Ethernet or USB
- User friendly GUI, high throughput APIs and libraries.
- Supports external API calls from other software e.g. LabView
- Repeatable performance and traceable to standards
- Single ended and differential electrical inputs for each of the four channels
- Color graded persistence in eye and pattern capture modes
- Ability to analyze and load captured data into the simulator
- Capability to save statistical measurement and data files for multiple DSOs
- Full eye measurements can be attained in the tens of milliseconds

Target Applications

- Time Domain Reflectometry
- Localization of the position of discontinuity
- Impedance Profile
- Propagation/Time delay
- Copper board-trace, connector, and cable evaluation
- Communication Systems/Backplane Test
- DAC testing
- Electro-optical Transceiver Testing
- Multi-port system testing or Line Cards
- In-Situ testing of high port count systems
- Telecom Equipment Test for Installation and Maintenance.

Product Software

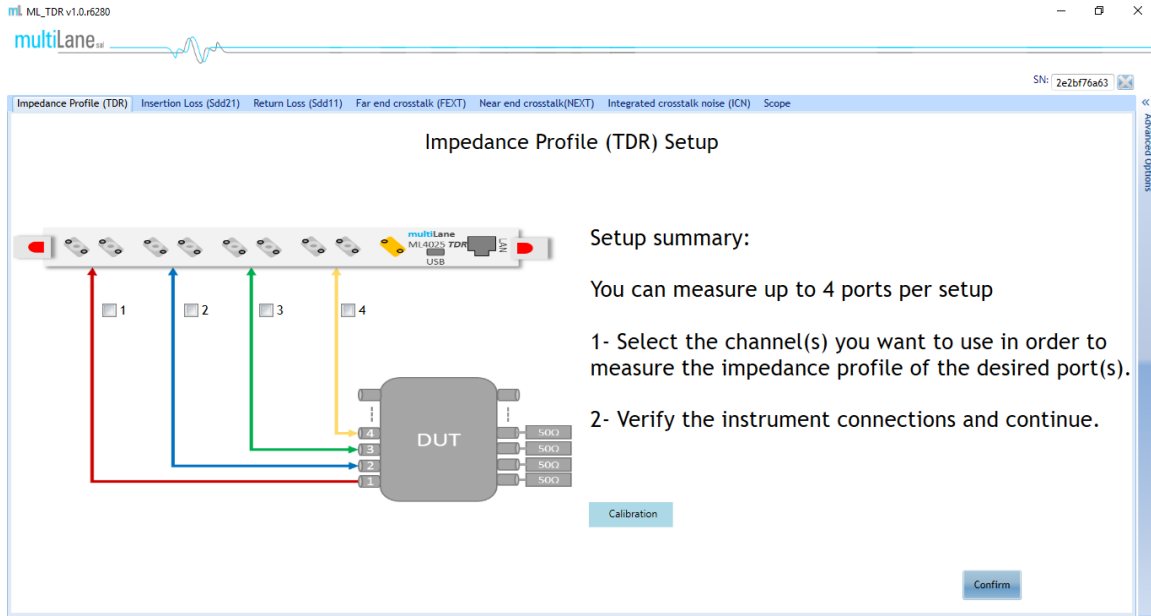


Figure 1: ML4025-TDR GUI

The instrument includes the following software:

- **ML4025-TDR GUI.**
- **MultiLane ML4025-TDR USB driver.**
- **ML4025-TDR ETH Configuration Software.**

Instrument GUI runs on Windows XP (32/64 bit), Windows 7,8 and 10.

NOTE. These applications require the Microsoft .NET Framework 3.5.

If the Microsoft.NET Framework 3.5 is needed, it can be downloaded through this link:

<http://download.microsoft.com/download/2/0/e/20e90413-712f-438c-988e-fdaa79a8ac3d/dotnetfx35.exe>.

For more products updates, check the following webpage:

www.multilaneinc.com/products.html

Minimum PC Requirements

The Windows PC properties for the **ML4025-TDR** software should meet the following specifications:

- Windows XP SP3 or greater
- Minimum 1 GB RAM
- 1 Ethernet card to establish connection with the device
- USB Connector
- Pentium 4 processor 2.0 GHz or greater
- .NET Framework 3.5 sp1

Instrument Ports

The ML4025-TDR has 4 differential ports. Each of the ports can either be configured as a TDR port to measure reflections, as a pattern generator only, or as a sampling scope (receiver) only. Transmission measurements require one differential port to act as pattern generator while another will be the receiver.



Figure 2: ML4025-TDR cPCI Front Panel

	Port Name	Description
1	Clk In	This is the trigger input for the sampling scope (DSO). It is used in DSO mode only. Note that the DSO can also work in clock recovery mode where it does not need an external trigger.
2	CH1 - CH4	The positive legs of the differential ports. Each port can be configured either as TX or as RX
3	$\overline{\text{CH1}} - \overline{\text{CH4}}$	The negative legs of the differential ports. Each port can be configured either as TX or as RX
4	USB	Mini-B USB port for firmware updates and for changing the IP address only
5	LAN	RJ-45 port for data transfer and communication with the GUI

Table 1: ML4025-TDR cPCI Ports

How to connect this instrument

This session covers the connection options of the instrument, addressing the following topic:

- **ML4025-TDR** Fast Ethernet / USB Connections method.

NOTE. This release supports Ethernet connection for the software applications (note that the IP¹ should be in the same range of the network).

Connecting Through an Ethernet cable

To establish an Ethernet connection between the **ML4025-TDR** panel and the PC, connect an Ethernet **straight** cable between the panel and the Router or Switch, and connect your PC to the router via cable or wireless. The device can be pinged to verify that a connection has been established.

Make sure to have the instrument's correct IP address.

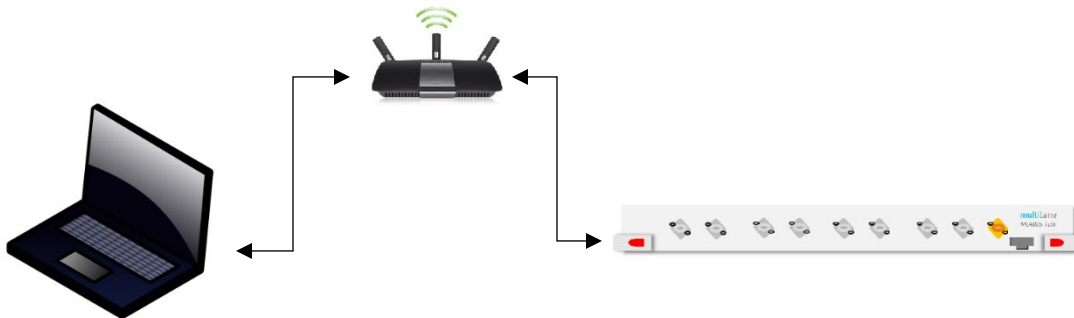


Figure 3: **ML4025-TDR** connected to PC via Ethernet

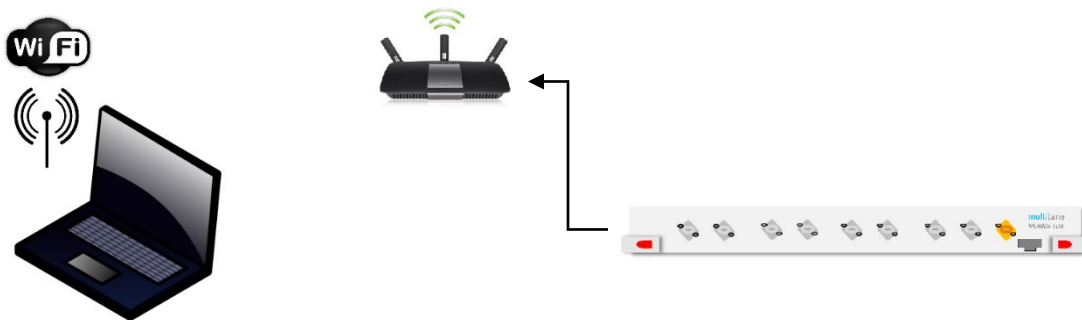


Figure 4: **ML4025-TDR** connected to PC Wirelessly

¹[http:// en.wikipedia.org/wiki/IP_address](http://en.wikipedia.org/wiki/IP_address)

Connecting Through USB cables

Connect a USB Mini-B type cable between the instrument and the PC.



Figure 5: ML4025-TDR with USB connection

Installation

This chapter covers installation of the instrument, addressing the following topics:

- System Start-up
- How to connect to the instrument via Ethernet

Note: For windows vista, 7, 8 and 10 users should always run the GUI as administrator.

System Start-up

To use the **ML4025-TDR GUI** under Windows XP, Windows 7,8, and 10, it is important that the correct start-up sequence is followed:

- Make sure you have Microsoft *.NET Framework 3.5* installed.
- If not installed, refer to the Note in the [Product Software](#) section.
- Install the **ML4025-TDR** software.
- After installation, run the software.
- A new window that says: “Connect to your instrument” will appear; this is the main software interface which allows you to connect to the ML4025-TDR.

Connect to the Instrument via Ethernet:

- Connect the PC to the front panel via the RJ-45 connector located on the front panel through an Ethernet cable to be able to control it.
- In order to connect via Ethernet, the IP address of the board is required.
To learn more options on how to connect the Ethernet cable go to the section [Connect through an Ethernet Cable](#).

Note that no drivers are required; the board’s IP address should simply be entered in the text box next to the **IP** label then click on the **connect** button as shown in Figure 6.

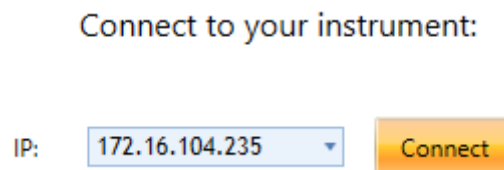


Figure 6: Connect Via Ethernet

- To make sure that you are connected, you can also ping your device.
- To change the IP address of the board, you need to install the USB drivers (refer to the section that addresses [USB Driver Installation](#)).
- Install the Ethernet configuration software that allows you to read, write the **IP** address, **Mask** and **Gateway** of the instrument.

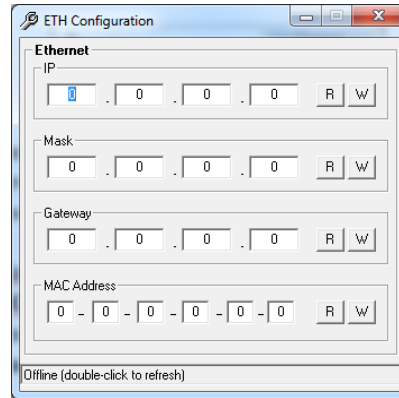


Figure 7: Ethernet Configuration

The instrument is now powered up and connected through the right IP address. Next, the TDR/TDT measurements that can be performed by the ML4025-TDR along with the needed calibrations will be addressed.

Measurements:

The ML4025-TDR can be used to test any component and has a wizard that facilitates testing of backplanes and DACs with its ability to measure the impedance profile, the return loss, insertion loss, near-end crosstalk, far-end crosstalk and integrated crosstalk noise. Even though the ML4025-TDR is a native differential TDR instrument, single-ended measurements are also possible if you terminate the unused connector with a 50 Ohm load.

Impedance Profile:

To measure a DUT's impedance profile, the ML4025-TDR's ports are used as time domain reflectometers. A pulse with 12ps rise time is transmitted and the reflections are measured by the same port to shape the DUT's impedance profile.

Calibration

Impedance profile measurement using the ML4025-TDR needs no calibration. However, aligning the TDR pulse to start at the DUT connection point is recommended. This is done as follows:

- Select the channel(s) on which the calibration will be performed.
- Click on "Calibration" followed by "Run" to start the calibration process.
- Disconnect the DUT from its connection point with the ML4025-TDR as instructed by the GUI and press "Next Setup".
- Reconnect the DUT and press "Confirm".

Impedance Profile Measurement

- After completing the calibration, keep the cables connected to one end of the DUT, while terminating the other end with a 50Ω load.
- Measurements can either be differential or single ended. For single ended measurement, "Single_Ended" mode should be selected in the "Advanced Options" tab and only one port is used for each channel while the second is terminated with a 50Ω load.
- Select the channel(s) on which the impedance profile measurement will be performed.
- Click "Confirm" to measure the impedance profile.
- Press "Play" for measuring continuously or "Play Once" for a single capture.

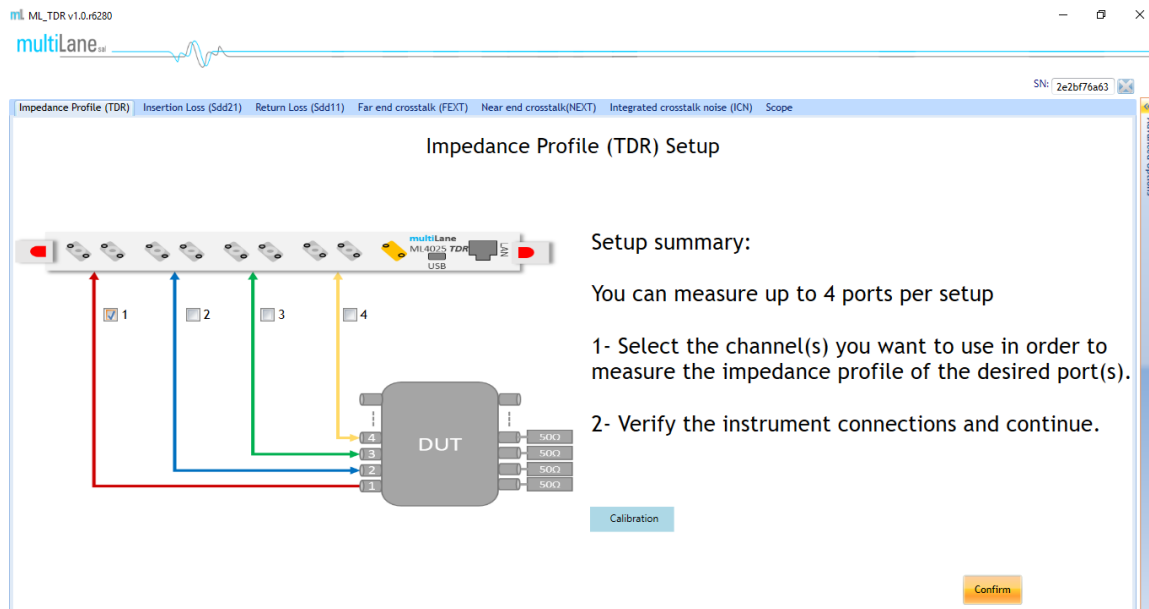


Figure 8: Measure Impedance Profile

Calibration for DAC Testing

Calibration for the impedance profile measurement of direct attach copper cables is similar to that of backplanes on the software side, but the setup differs.

- Calibration for impedance profile measurements is performed using the DAC and an MCB having a connector with the appropriate form factor.
- Disconnect the DAC from the MCB as instructed by the GUI and press “Next Setup”.
- Reconnect the DAC and press “Confirm”.

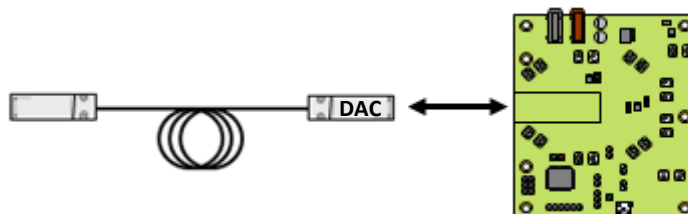


Figure 9: Calibration for DAC

Measurement for DAC

- After completing the calibration, keep the DAC connected and connect its other side to a second MCB.
- Connect one ML4025-TDR channel to the first MCB’s TX channel.
- Terminate the respective RX channel on the second MCB with a 50Ω load or connect it to another ML4025-TDR channel.

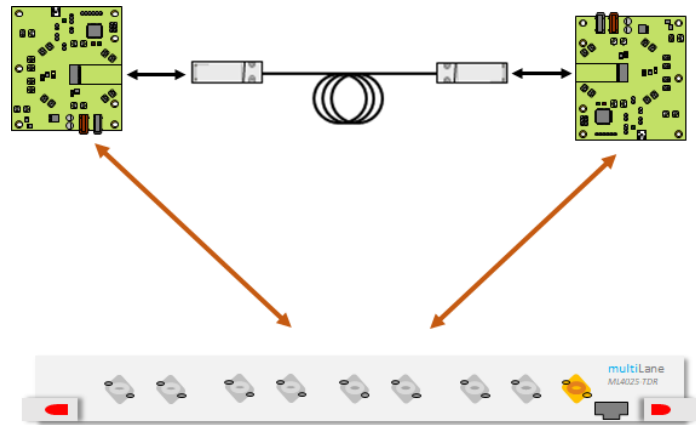


Figure 10: Setup for DAC Measurement

- Measurements can either be differential or single ended. For single ended measurement, “Single_Ended” mode should be selected in the “Advanced Options” tab and only one port is used for each channel while the second is terminated with a 50Ω load.
- Select the channel(s) on which the impedance profile measurement will be performed.
- Click “Confirm” to measure the impedance profile.
- Press “Play” for continuous measurement or “Play Once” for a single capture.



Figure 11: Impedance Profile of a DAC

Insertion Loss:

To measure a DUT's insertion loss, some of the ML4025-TDR's ports are used as time domain transmitters and others as sampling scopes. A line rate of 25Gbps is used with PRBS11 and the transmitted signal is measured by another channel configured as a scope to measure the DUT's insertion loss.

Calibration

Before performing insertion loss measurements on a DUT, the ports that will be used should be calibrated by measuring a reference circuit.

Calibration is done before the DUT's connection point.

- Select the channel(s) on which the calibration will be performed.
- Click on "Calibration" followed by "Run" to start the calibration process.
- Connect the cables coming from the selected channels together using a M-M connector and press "Confirm".

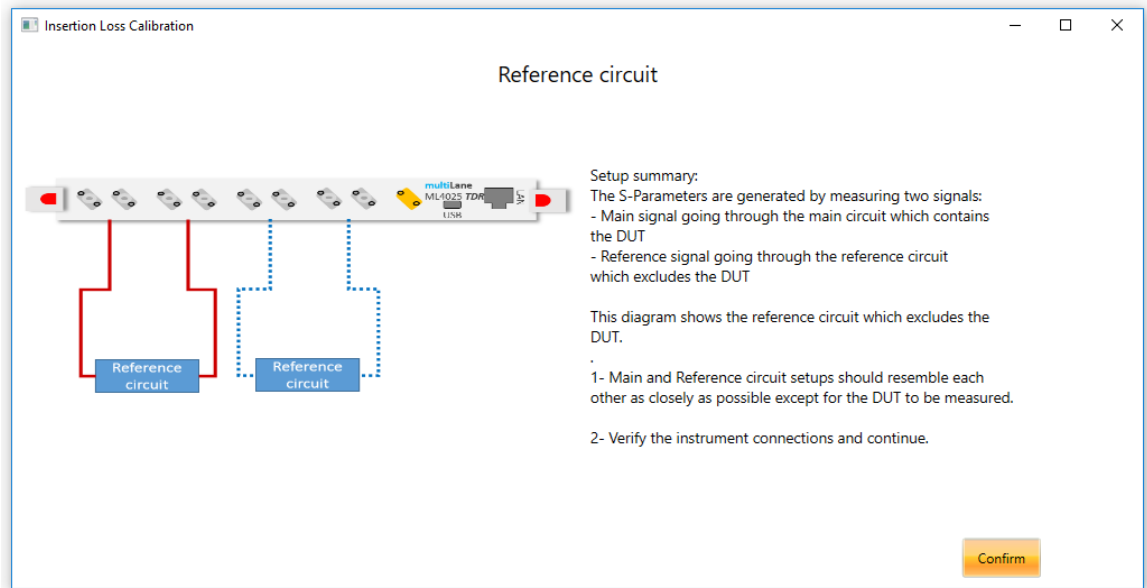


Figure 12: S21 Reference Circuit

- To make sure the calibration is correct, keep the cables connected and measure the insertion loss. It should display a horizontal line at 0dB.

Insertion Loss Measurement

- After completing the calibration, disconnect the reference circuit and connect the ML4025-TDR's transmitting channel to one end of the DUT.
- Connect the DUT's other end to the ML4025-TDR's receiving channel.
- Measurements can either be differential or single ended. For single ended measurement, "Single_Ended" mode should be selected in the "Advanced Options" tab and only one port is used for each channel while the second is terminated with a 50Ω load.
- Select the channel(s) on which the insertion loss measurement will be performed.
- Click "Confirm" to measure the DUT's insertion loss.
- Press "Play" for continuous measurement or "Play Once" for a single capture.

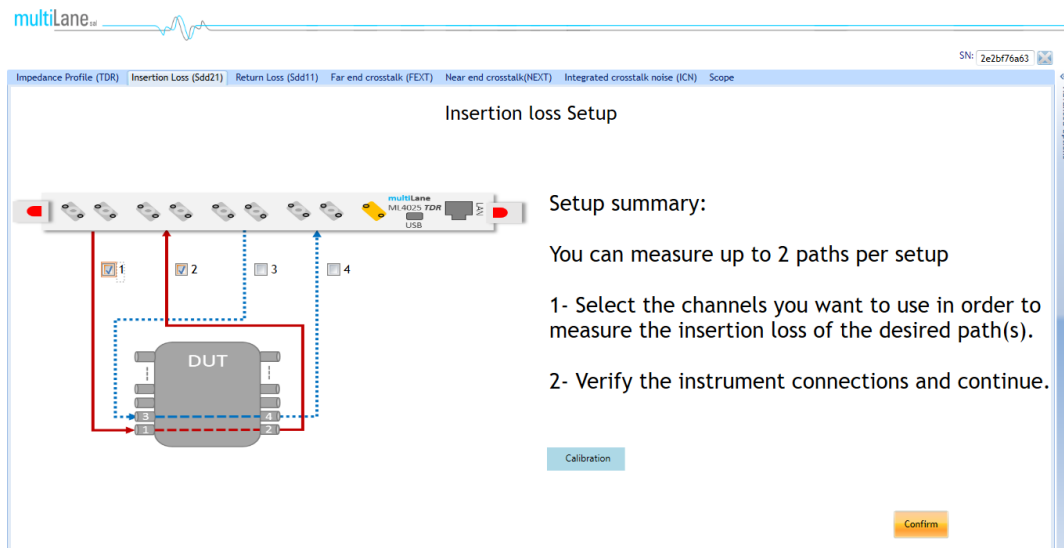


Figure 13: Insertion Loss Measurement

DAC Testing

- After completing the calibration, disconnect the reference circuit and connect the cables coming out of the ML4025-TDR's transmitting channel to an MCB's TX channel.
- Connect the ML4025-TDR's receiving channel to a second MCB's RX channel.
- Connect the two MCB's with a DAC.
- Measurements can either be differential or single ended. For single ended measurement, "Single_Ended" mode should be selected in the "Advanced Options" tab and only one port is used for each channel while the second is terminated with a 50Ω load.
- Select the channel(s) on which the insertion loss measurement will be performed.

- Click “Confirm” to measure the DAC’s insertion loss.
- Press “Play” for measuring continuously or “Play Once” for a single capture.



Figure 14: S21 Measurement for DAC

De-embedding

Effects from unwanted components can be removed from the measurements by using the software’s de-embedding feature.

- After having measured the insertion loss, choose “DeEmbedding S parameters” from the toolbar.
- Load the S2P or S4P files containing the S-parameters that need to be de-embedded.
- Press “Continue”.
- Press “Play” or “Play Once” to get the resulting measurement.

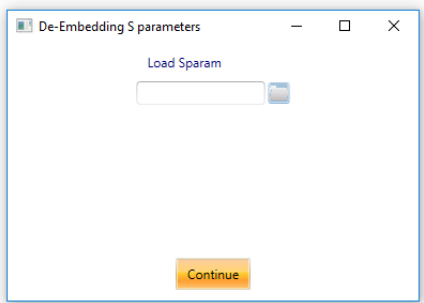


Figure 15: De-embedding S-parameters

Return Loss:

To measure return loss, the ML4025-TDR’s ports are used as time domain reflectometers configured in the same way as for impedance profile measurement.

Calibration

Before performing return loss measurements on a backplane, the ports that will be used should be calibrated using short, open and 50Ω load terminations.

Calibration is done before the DUT’s connection point. For backplane testing, the terminations are connected at the end of the cables coming out of the ML4025-TDR ports.



Figure 16: Termination for Calibration

- Select the channel(s) on which the calibration will be performed.

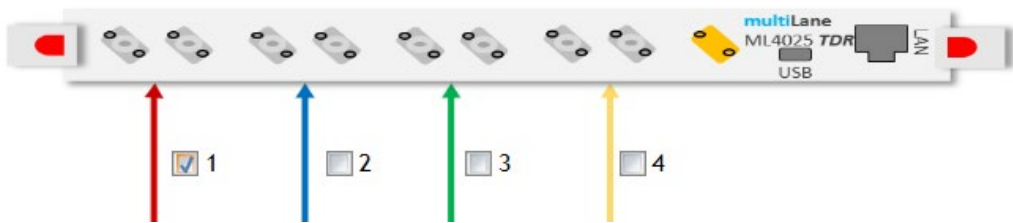


Figure 17: Channel Selection

- Click on “Calibration” followed by “Run” to start the calibration process.

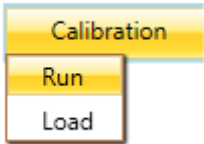


Figure 18: Run Calibration

- Terminate the cables coming out of the ML4025-TDR ports with the open, load and short terminations successively as instructed on the GUI.

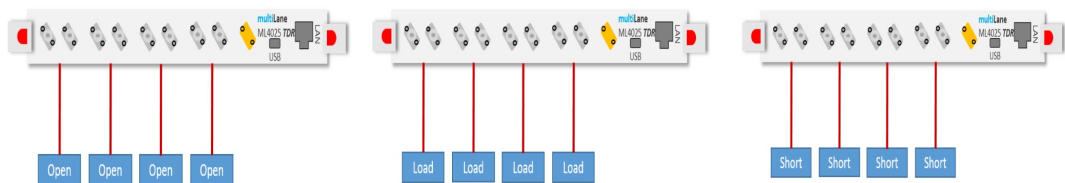


Figure 19: TDR Calibration Steps

Return Loss Measurement

- After completing the calibration, remove the terminations and connect the cables to one end of the DUT, while terminating the other end with a 50Ω load.
- Measurements can either be differential or single ended. For single ended measurement, “Single_Ended” mode should be selected in the “Advanced Options” tab and only one port is used for each channel while the second is terminated with a 50Ω load.
- Select the channel(s) on which the return loss measurement will be performed.
- Click “Confirm” to measure the impedance profile.
- If a 3rd party calibration kit was used, the VNA reference files should be loaded by pressing on the appropriate button in the toolbar and then selecting it under “VNA Files”.

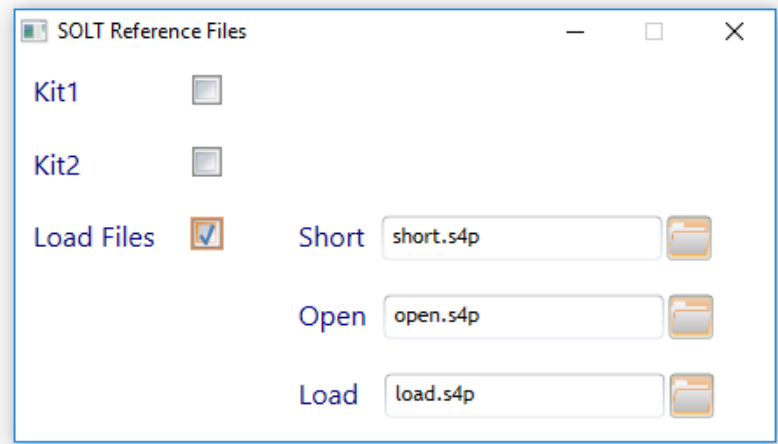


Figure 20: Load VNA Kit

- Press “Play” for measuring continuously or “Play Once” for a single capture.

Gating for DAC Testing

To measure a DAC’s return loss, two MCB’s and 50Ω load terminations are used. The gating method is performed, and therefore no calibration needs to be done.

- In order to isolate the DAC, we measure the impedance profile for 3 different setups and apply gating.
- Select the channel(s) on which the gating will be performed.
- Select “Gating” under “Calibration” in the toolbar.

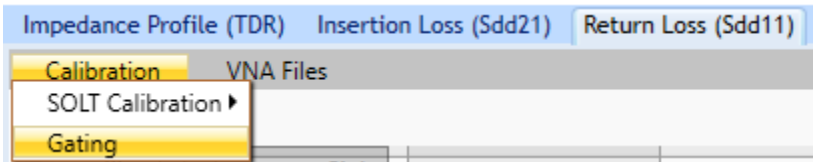


Figure 21: Gating for S11 Measurement

- Connect the first setup as instructed by the software and press “Next Setup”.
- Connect an ML4025-TDR channel to the first MCB’s TX channel.
- Terminate the second MCB’s RX channel with 50Ω loads.
- Connect the DAC to both MCB’s.
- Remove the DAC from the second MCB as instructed by the software and press “Next Setup”.
- Remove the DAC from the first MCB as instructed by the software and press “Confirm”.

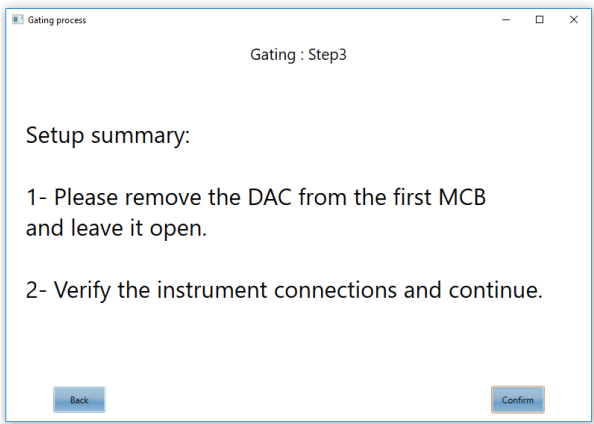


Figure 22: Gating Process

- Apply markers at the points of difference between the main setup’s impedance profile and the other two and press “Apply Gating”.

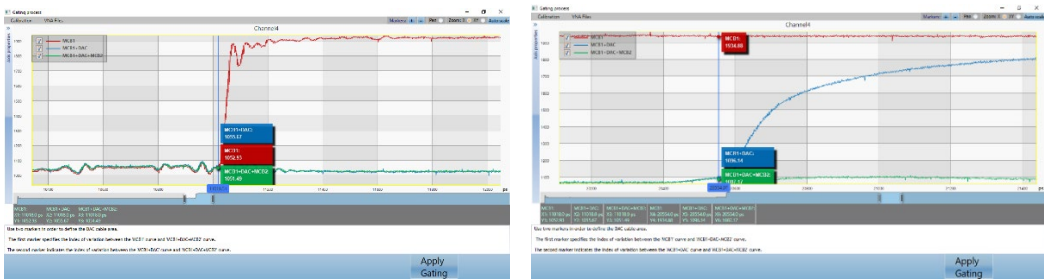


Figure 23: Applying Markers for Gating

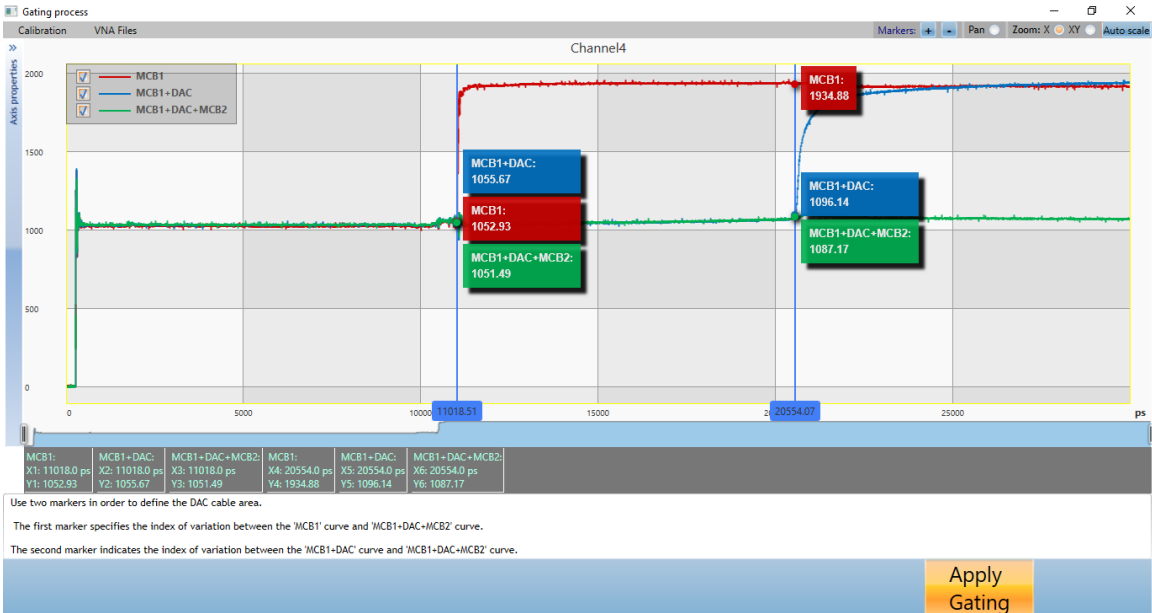


Figure 24: Apply Gating

- Press “Play” to measure continuously or “Play Once” for a single capture.

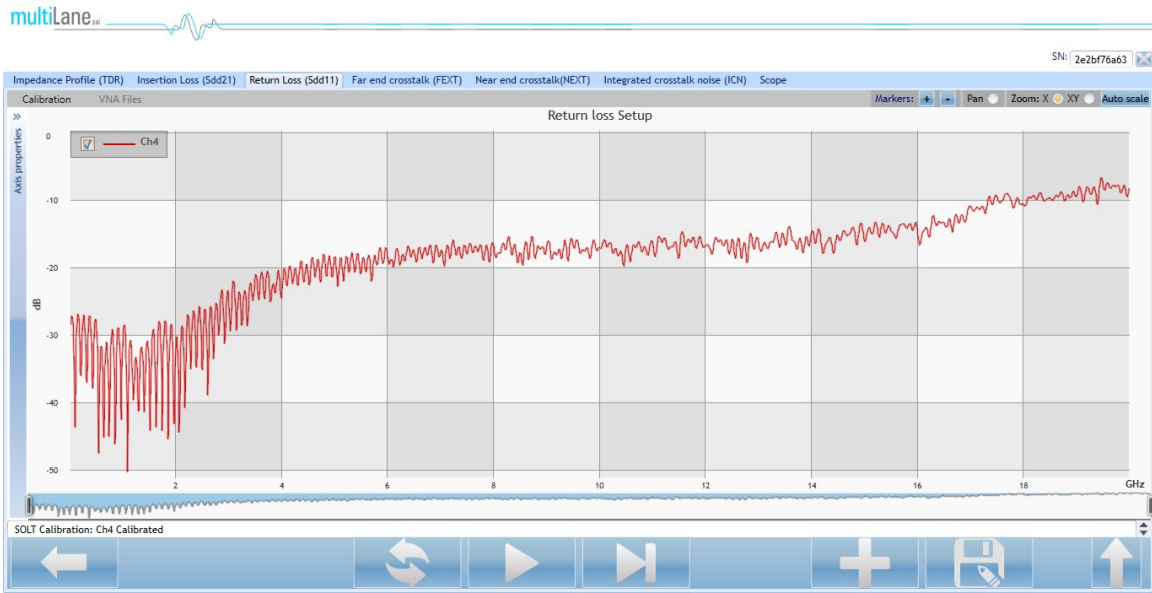


Figure 25: S11 Measurement for DAC

Near-End Crosstalk:

To measure Near-End Crosstalk (NEXT), ports 0,1 and 2 of the ML4025-TDR are used as time domain transmitters and the fourth is used as a sampling scope. A line rate of 25Gbps is used with PRBS11 in the same way as for insertion loss measurement.

Calibration

Calibration is similar to that of S21 measurements, the ports that will be used for transmission along with the fourth port should be calibrated by measuring a reference circuit.

Calibration is done before the DUT's connection point.

- Select the channel(s) on which the calibration will be performed.
- Click on "Calibration" followed by "Run" to start the calibration process.
- Connect the cables coming from the selected channel and channel 4 together using a M-M connector and press "Confirm".

NEXT Measurement

- After completing the calibration, disconnect the reference circuit and connect the ML4025-TDR's receiving channel to one of the DUT's RX ports and terminate its appropriate TX port at the far-end with a 50Ω load.
- Connect the ML4025-TDR's transmitting channel to one of the DUT's TX ports located at the near-end of the measured channel and terminate its appropriate RX port at the far-end with a 50Ω load.

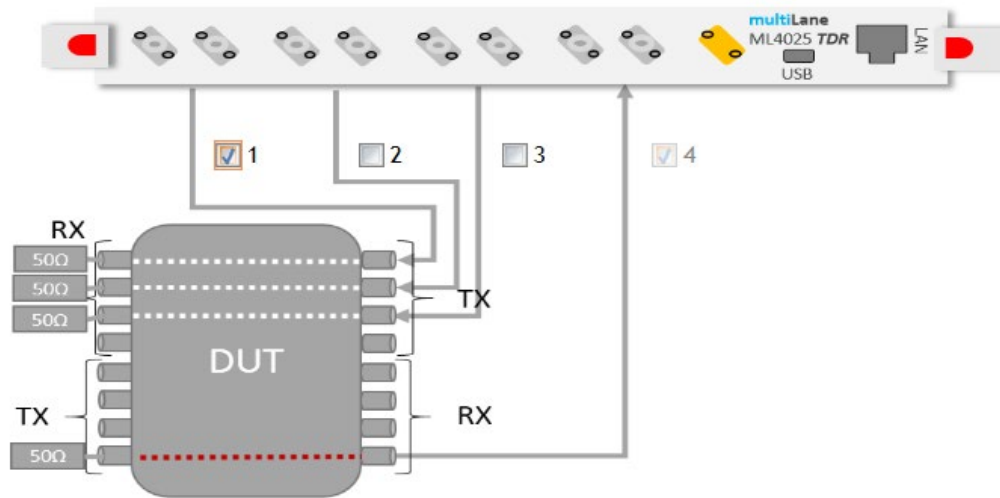


Figure 26: Setup for NEXT Measurement

- Measurements can either be differential or single ended. For single ended measurement, "Single_Ended" mode should be selected in the "Advanced Options" tab and only one port is used for each channel while the second is terminated with a 50Ω load.
- Select the channel(s) on which the NEXT measurement will be performed.
- Click "Confirm" to measure the DUT's Near-End Crosstalk.
- Press "Play" for measuring continuously or "Play Once" for a single capture.

Far-End Crosstalk:

Far-End Crosstalk (FEXT) and NEXT are similar. Ports 0,1 and 2 of the ML4025-TDR are used as time domain transmitters and the fourth is used as a sampling scope. A line rate of 25Gbps is used with PRBS11.

Calibration

Calibration is the same as that of NEXT measurement.

FEXT Measurement

- After completing the calibration, disconnect the reference circuit and connect the ML4025-TDR's receiving channel to one of the DUT's RX ports and terminate its appropriate TX port at the far-end with a 50Ω load.
- Connect the ML4025-TDR's transmitting channel to one of the DUT's TX ports located at the far-end of the measured channel and terminate its appropriate RX port at the measured channel's near-end with a 50Ω load.

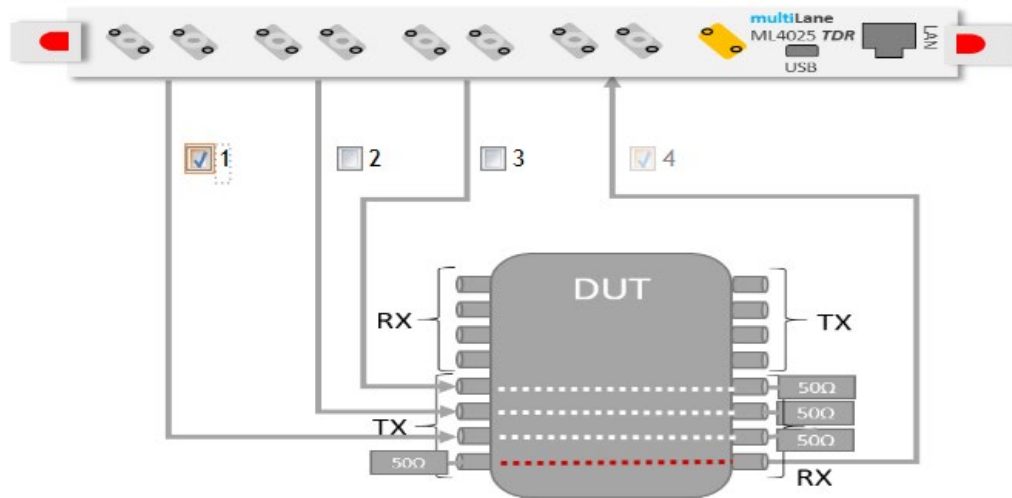


Figure 27: Setup for FEXT Measurement

- Measurements can either be differential or single ended. For single ended measurement, "Single_Ended" mode should be selected in the "Advanced Options" tab and only one port is used for each channel while the second is terminated with a 50Ω load.
- Select the channel(s) on which the FEXT measurement will be performed.
- Click "Confirm" to measure the DUT's Far-End Crosstalk.
- Press "Play" for measuring continuously or "Play Once" for a single capture.



Figure 28: FEXT Measurement

Integrated Crosstalk Noise:

Integrated Crosstalk Noise (ICN) is a mV value that is obtained by measuring and processing the total near-end and far-end crosstalk on a specific channel. For example, on a DUT with four channels, three FEXT and four NEXT measurements should be performed.

- Once on the ICN test window, press “OK” to start.

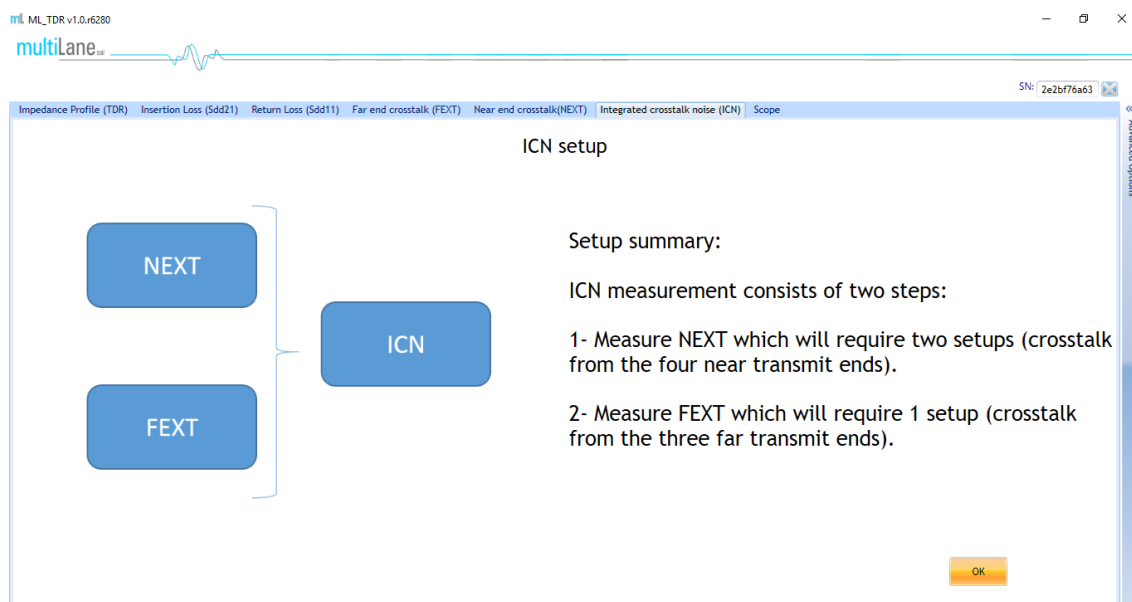


Figure 29: ICN Instructions

- Calibrate all channels successively by connecting them one by one to channel 4 using two cable pairs and M-M connectors as explained in the *Near-End Crosstalk* and *Far-End Crosstalk* sections.
- Connect channel 4 to the RX connector of the channel to be measured.
- Connect channels 1, 2 and 3 to the near-end TX connectors of the adjacent channels and perform NEXT measurement.
- Repeat the last step as needed to cover all available channels.
- Connect channels 1, 2 and 3 to the far-end TX connectors of the adjacent channels and perform FEXT measurement.
- Repeat the last step as needed to cover all available channels.

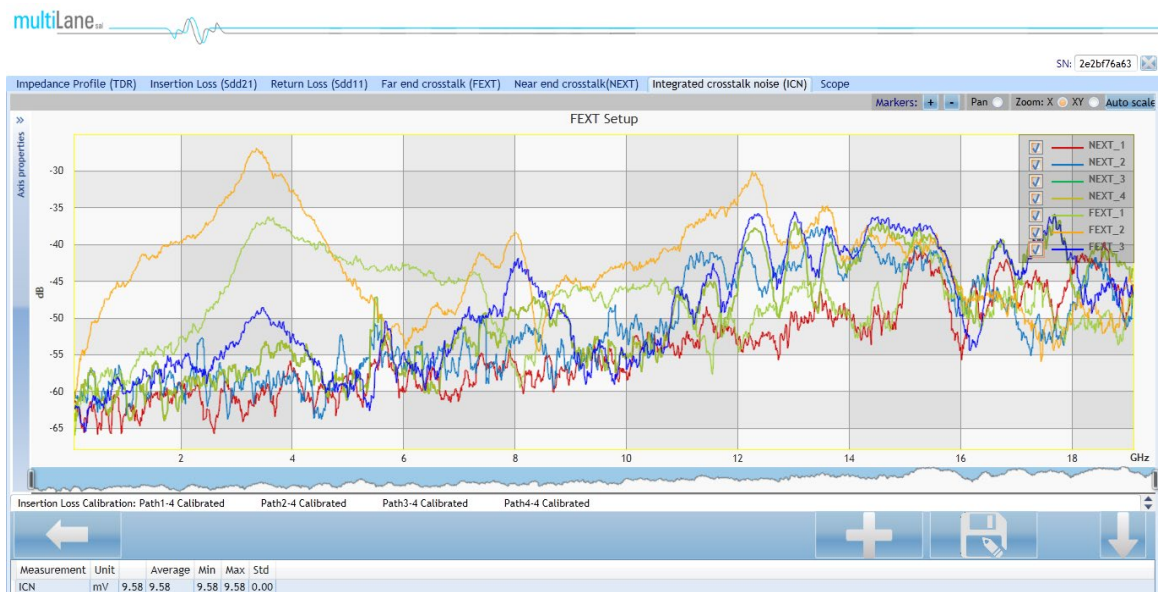


Figure 30: ICN Measurement

Correlation with IEEE mask & Loss at Nyquist:

The insertion loss and return loss plots obtained during DAC testing can be compared to the IEEE masks for 10G & 25G DACs.

The masks can be added by pressing on the “Measurement” button on the bottom right.

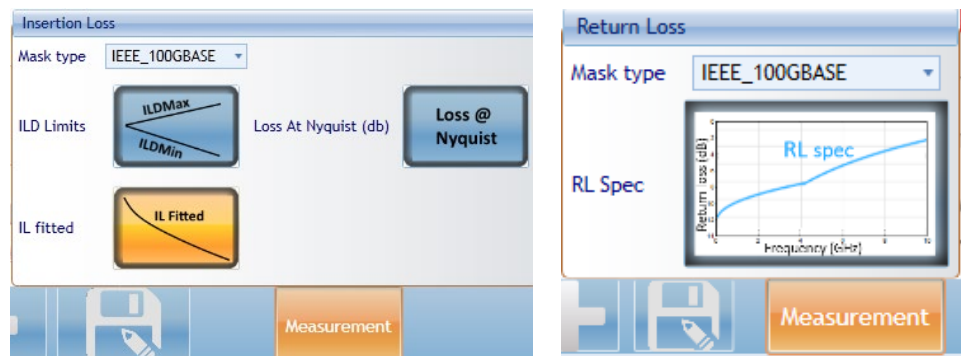


Figure 31: Measurement Button

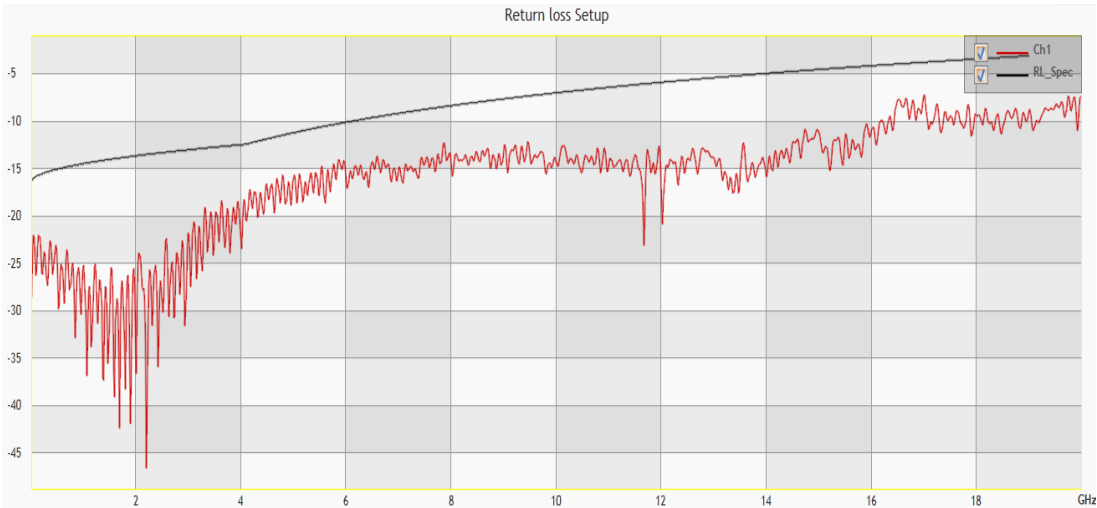


Figure 32: RL IEEE Mask

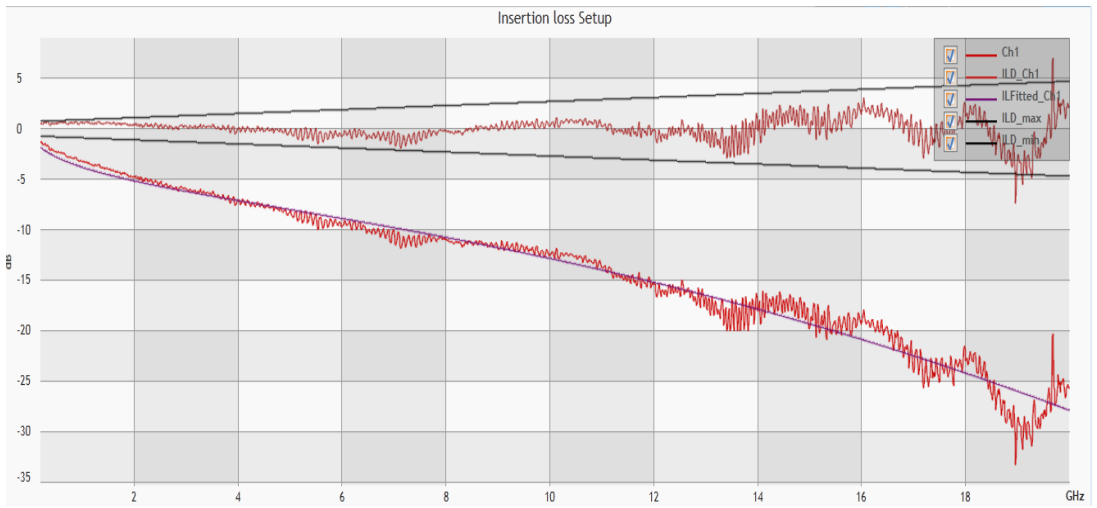


Figure 33: IL IEEE Mask

The loss at Nyquist can also be measured by pressing on “Loss at Nyquist” at the bottom right as shown in

Correlation with other measurements:

The software allows measurements made using the ML4025-TDR to be correlated to ones obtained using 3rd party instruments such as a VNA. This can be achieved by loading S2P or S4P files in the GUI and superimposing both plots.

- Press the “+” sign on the bottom right of the GUI.



Figure 34: Load S2P/S4P Files

- Load the S2P or S4P file, and choose the port order to be 1,2 – 3,4 or 1,3 – 2,4 depending on how the measurement was taken on the 3rd party instrument.

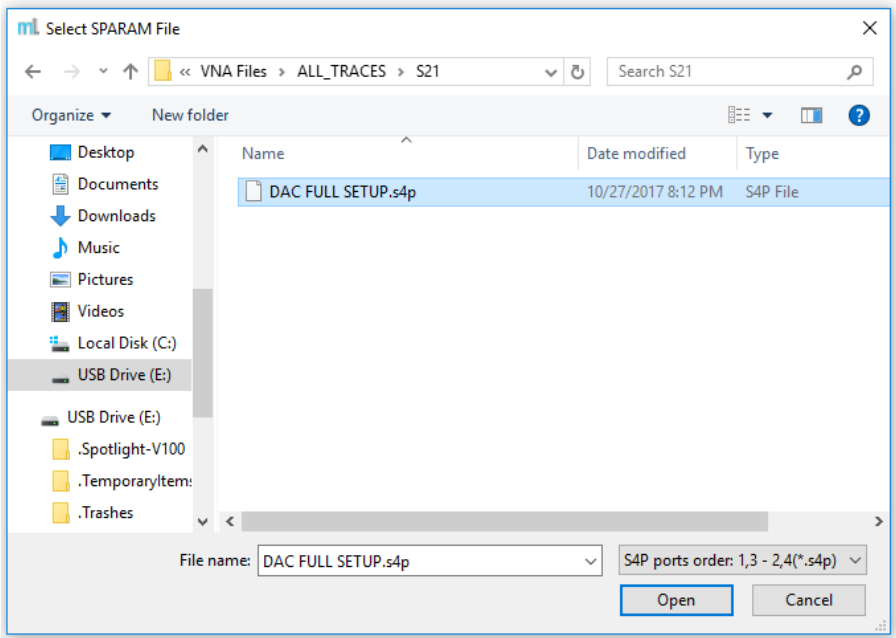


Figure 35: Load S2P/S4P Files

- Markers can be added to compare the amplitude of the different measurements at a specific time.



Figure 36: S21 Correlation with VNA

Saving Data:

Measurements and calibrations made using the ML4025-TDR can be saved and loaded in the GUI.

While performing a calibration, the calibration file can be saved by pressing “Save” before “Done” as shown in Figure 37.

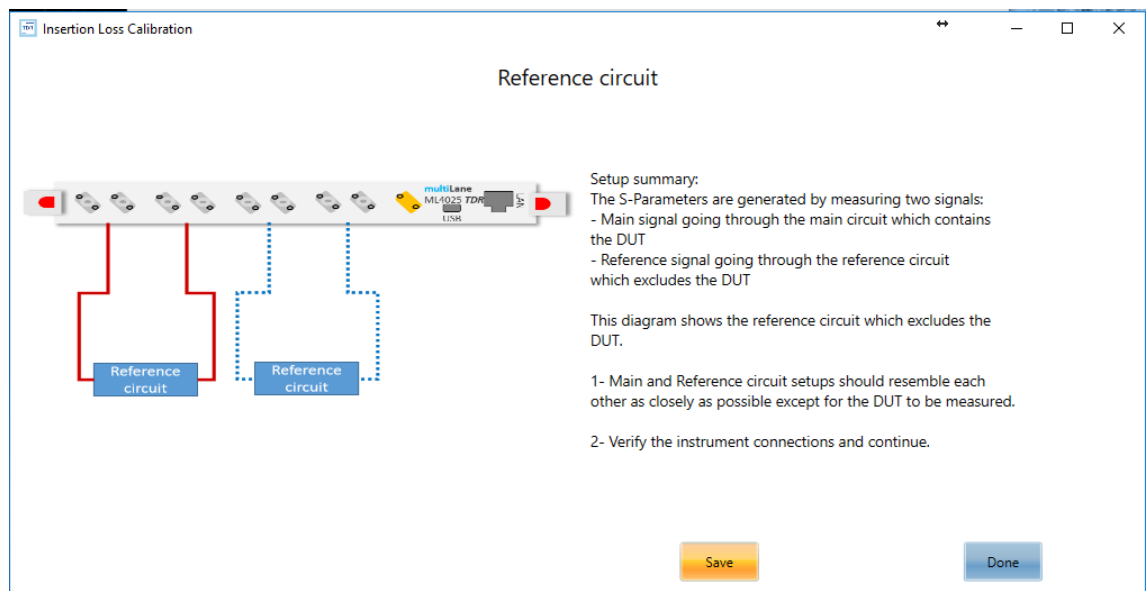


Figure 37: Save Calibration

Saved calibration files can later be loaded for the same setup to avoid having to repeat the process.

Loading a calibration file is done by choosing “Load” instead of “Run” under “Calibration” and then selecting the needed file.

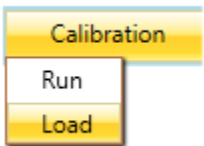


Figure 38: Load Calibration

Measurements can also be saved as S2P files by pressing on the save icon located at the bottom right of the screen.



Figure 39: Save Measurements

Measurements that can be performed using the ML4025-TDR’s TDR/TDT functionalities have been covered along with the needed calibrations. The ML4025-TDR’s operation as a scope will be discussed in the next section.

Sampling Oscilloscope:

The ML4025-TDR can also be used as a scope to measure eye diagrams and patterns from an external PPG. The connection setup can be configured inside the *Scope* window. It allows the user to choose the channel used, the line rate, pattern length, synchronization mode, number of packets and clock divider.

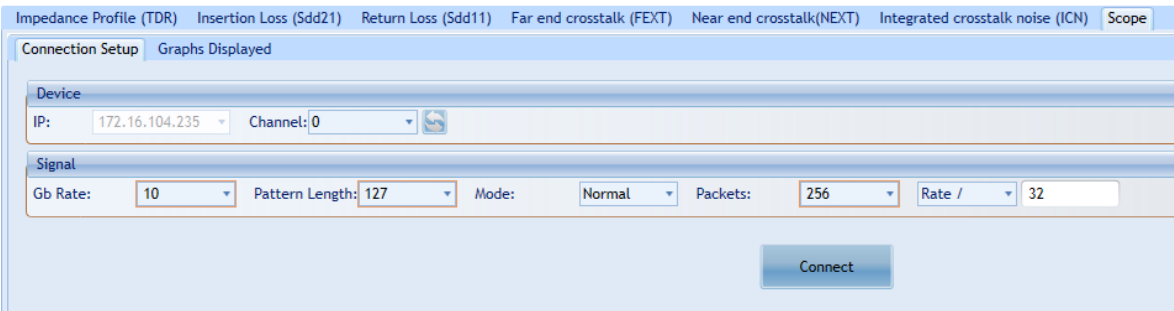


Figure 40: Connection Setup

- Select the channel(s) on which measurements are performed.
- Choose the line rate as configured on the external PPG.
- Choose the external signal’s pattern length as configured on the PPG.
- Choose the clock synchronization mode to be normal or clock data recovery.

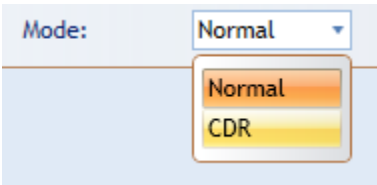


Figure 41: Clock Synchronization Mode

- Choose the preferred number of packets used.
- Choose the clock divider as configured on the external PPG.
- Press “Connect” to display the eye diagram.

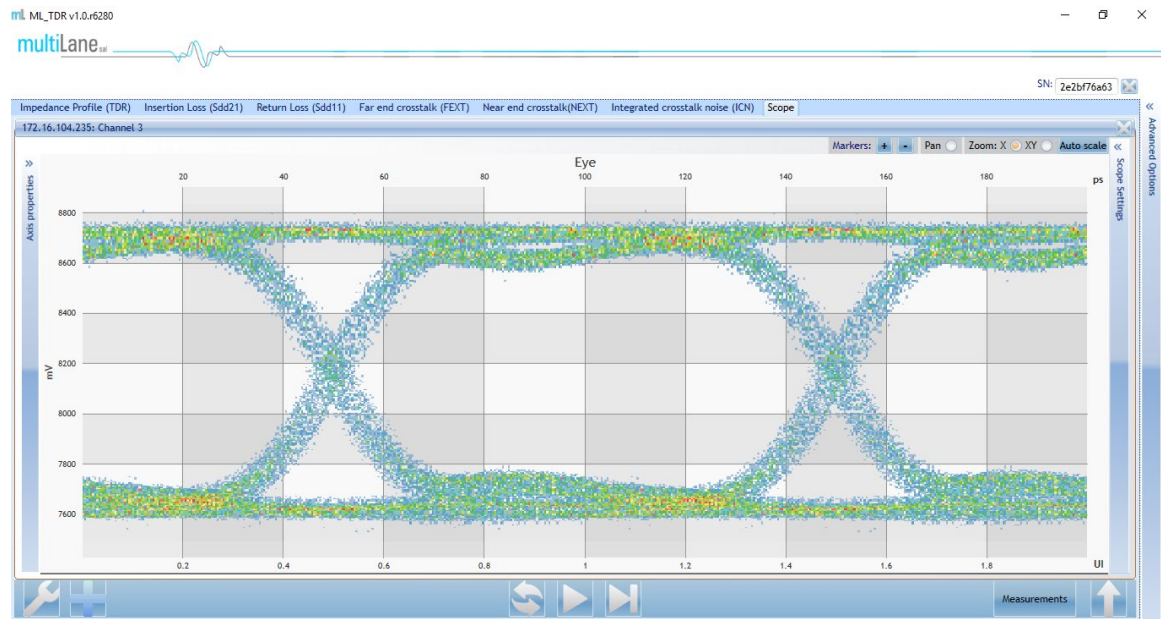


Figure 42: Eye Diagram on ML4025-TDR

The user can go back to the settings window by pressing the wrench icon on the bottom left of the screen.



Figure 43: Configure DSO

The user can change views and choose between eye diagram or pattern graph under *Graphs Displayed*.

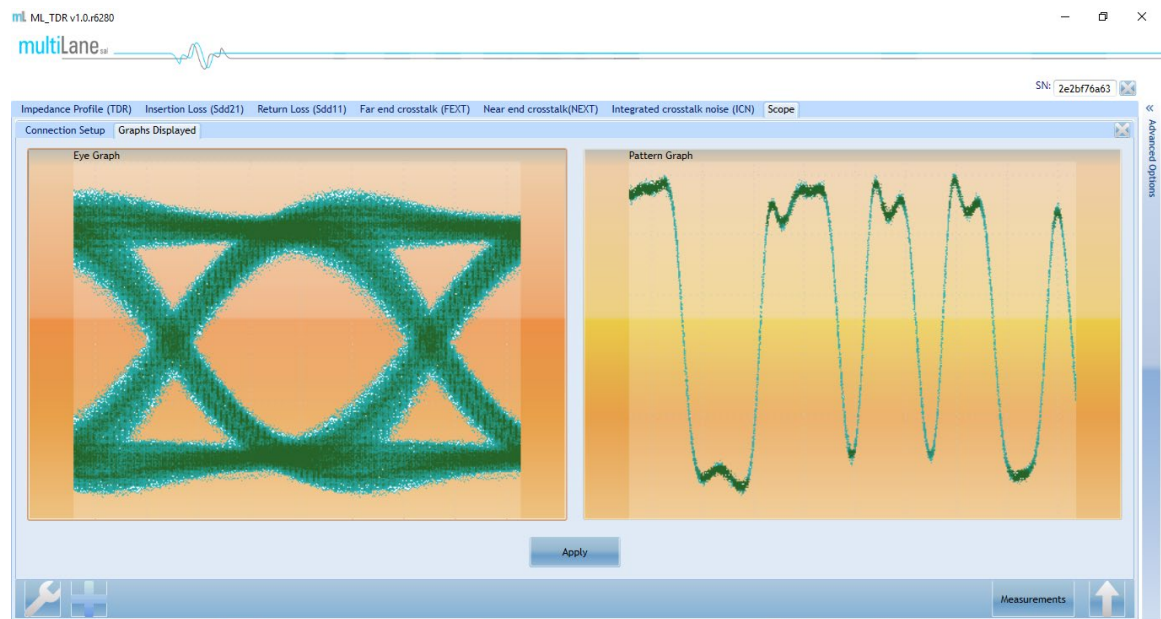


Figure 44: Graph Selection

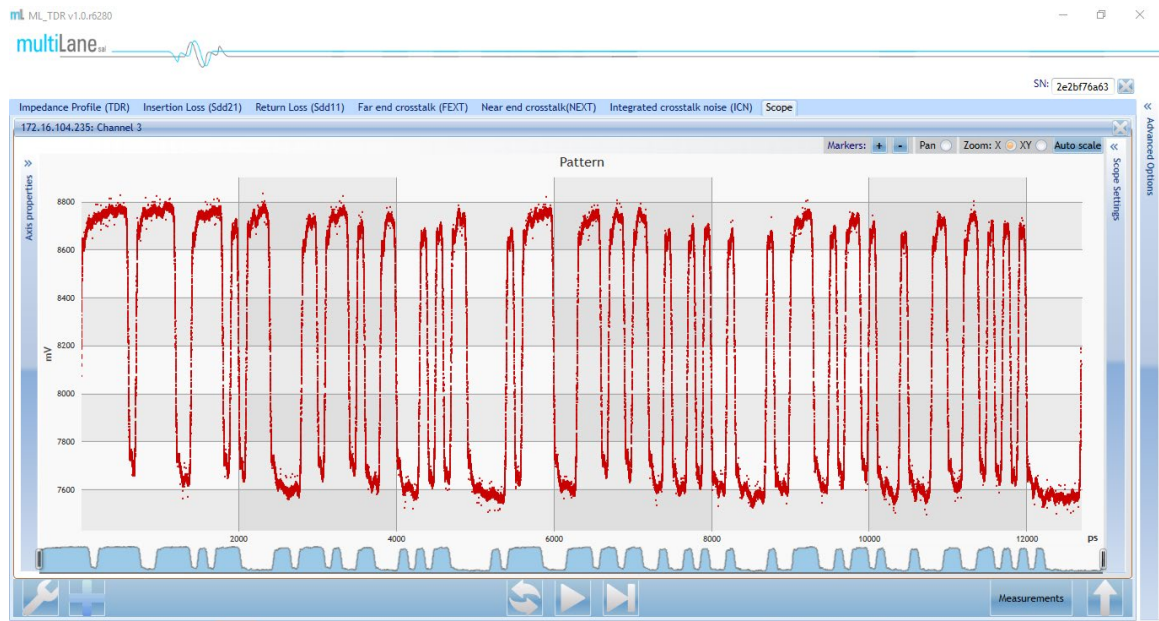


Figure 45: Pattern Graph

Additional settings such as intrinsic jitter, amplification, wander correction and filters can be manipulated by pressing *Scope Settings* on the right side of the screen.

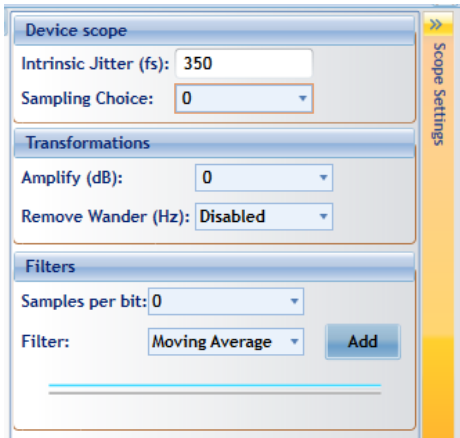


Figure 46: Scope Settings

To add filters, choose the filter that is needed, press *Add* and then proceed to select the advanced options specific to it.

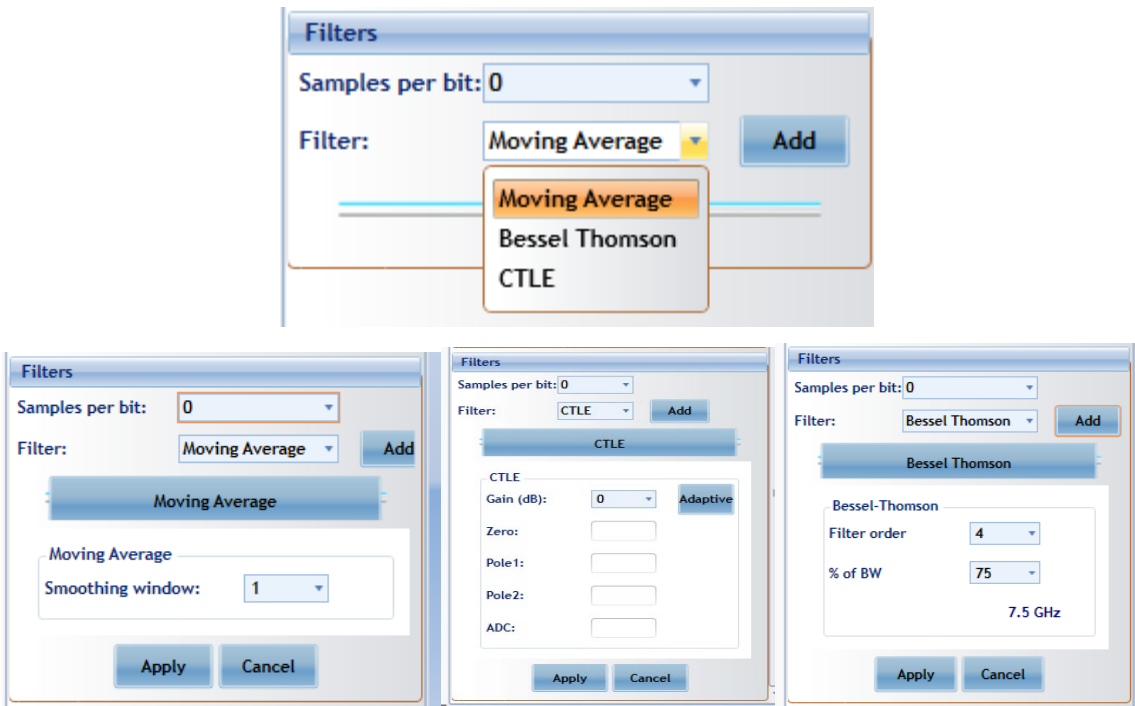


Figure 47: Filter Settings

Graph display settings can also be modified by pressing on *Axis Properties* on the left side of the screen.

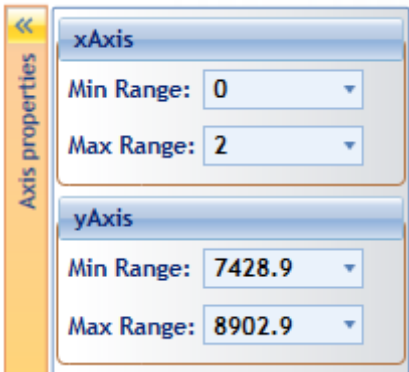


Figure 48: Axis Properties

Additional channels can be added by pressing on the “+” sign next to the wrench icon on the bottom left.

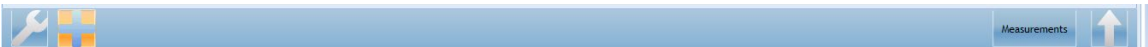


Figure 49: Adding Channels

To add measurements, press the *Measurements* button on the bottom right, select the ones needed and then press the upward arrow located on the right of the *Measurements* button to display them.

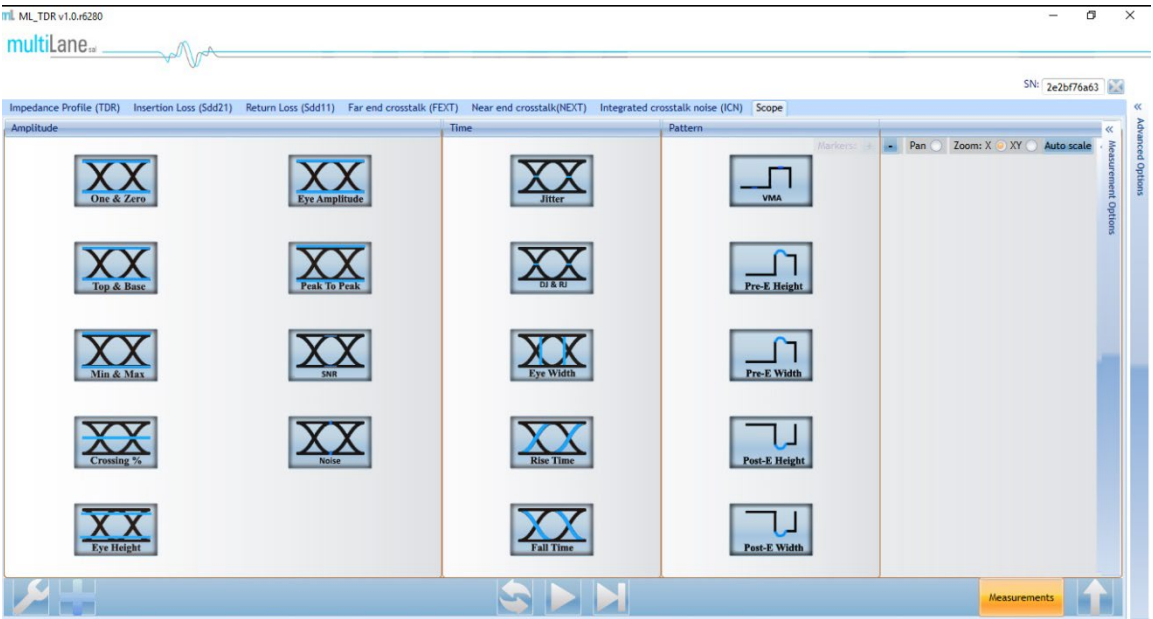


Figure 50: Choose Measurements

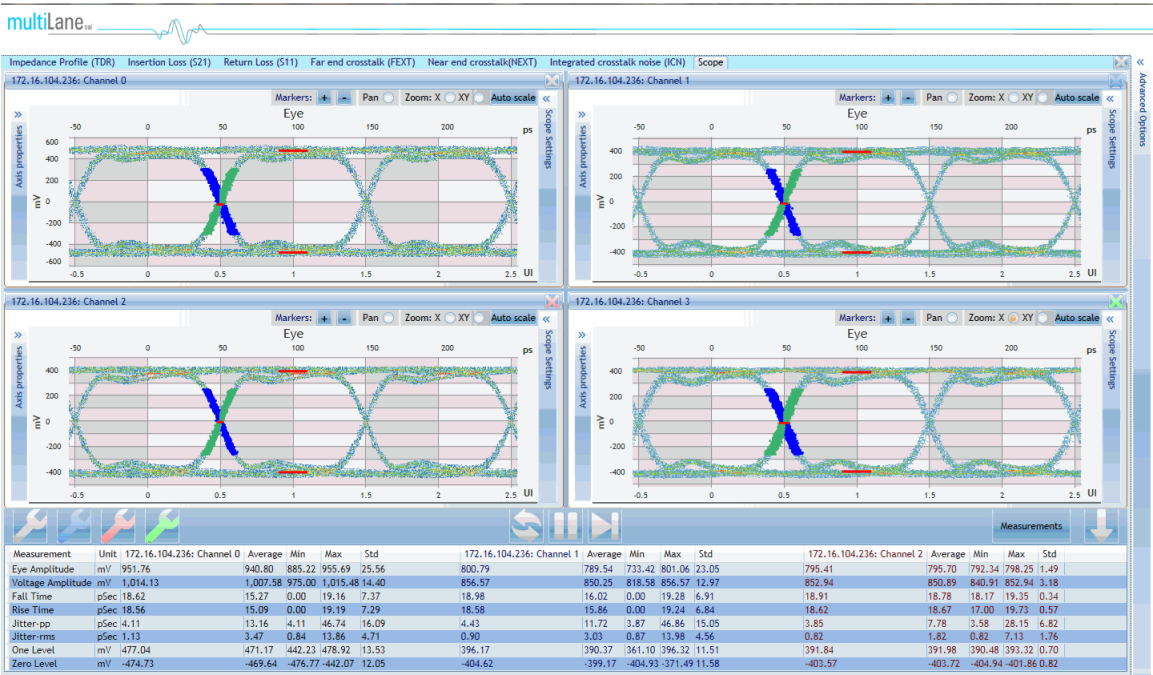


Figure 51: Eye Diagram with Measurements

USB Driver Installation

During the MultiLane software installation, the USB drivers of a specific instrument should normally be installed automatically. If for some reason this doesn't happen, or an error window like the one shown in the screenshot below appears, it is recommended to install the USB drivers manually. After doing that, press *cancel* and continue the installation process.

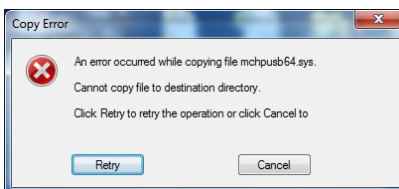


Figure 52: USB Driver Not Installed

USB software drivers' names:

- **ML4025-TDR USB driver**

The following instructions are applicable for a manual USB driver installation using Windows XP, Windows 7, 8 and 10.

- Power up the instrument.
- Plug-in the USB cable into the PC and connect it to the panel; refer to the section [Connect through USB cables](#).

USB Driver Installation on Windows XP, Windows 7 platforms

- Ignore the *“new hardware found”* or *“driver software not successfully installed”* messages by pressing **cancel** or **close**.
- Go to the device manager via a right click on **My Computer**:
 - Click on **Manage**.
 - Click on **Device Manager**.
- Right click on the top-level tab (Here multilane-PC) and select **“Scan for hardware changes”**.

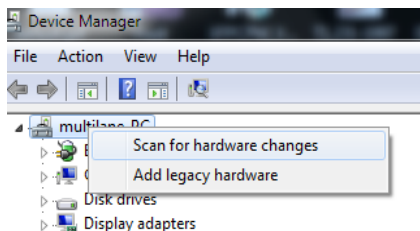


Figure 53: Scan for Hardware Changes

- A message appears stating: **“Scanning Plug and Play compliant hardware”**.

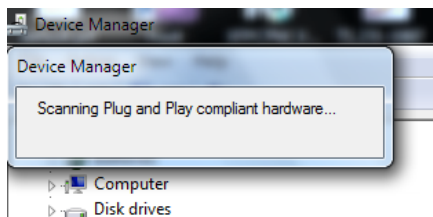


Figure 54: Scanning for Plugs

- In the **Other Devices** tab, the **ML4025-TDR USB Device** description appears.
- In the **Other Devices** tab, right-click on the **ML4025-TDR USB Device** and select **“Update Driver Software”**
- A dialog box appears asking for the method to search for the driver software. Select **“Browse my computer for driver software”**.
- A dialog box appears asking for the Driver software path. Enter the path and click **“Next”**.
- A security dialog box appears, select **“Install this driver software anyway”**.
- The PC commences Driver software installation.
 - A Windows message appears (after some time) saying that you have successfully updated your driver software.
- Press close.
- In the Device Manager, a new tab appears named **MultiLane SAL Devices**. Expanding it reveals **“MultiLane SAL ML4025-TDR USB Device”**.
- You are now connected via USB and you can control the instrument.

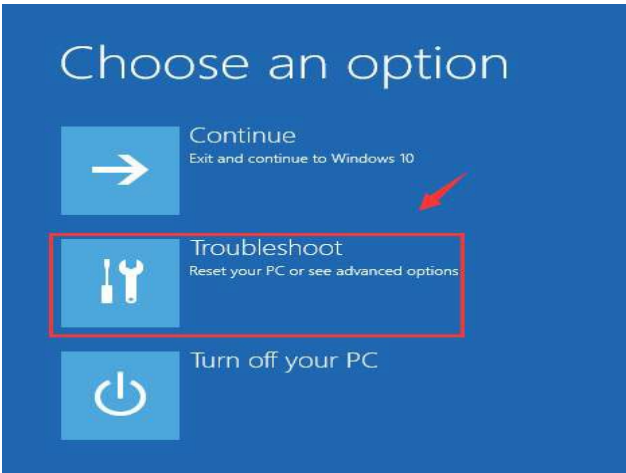
USB Driver Installation on Windows 8 platforms:

- Select “Settings” for the right-side menu, then “Change PC settings” 1.2. Under the “General” tab, scroll down to “Advanced startup” and click on “Restart now”
- Select “Troubleshoot/Advanced options/Startup settings/Restart” 1.4. Press “F7” for the “7) Disable driver signature enforcement”
- Install the MCHPUSB driver manually from MCHPUSB.inf (“Install this driver software anyway”)
- Open “Device manager” from the “Control panel”. Right click the unrecognized device and select “Update driver software”. Select “Browse my computer for driver software”. Select “Let me pick from a list of device drivers on my computer”. Select “Custom USB device”. Select the corresponding model (Microchip Custom USB Device)

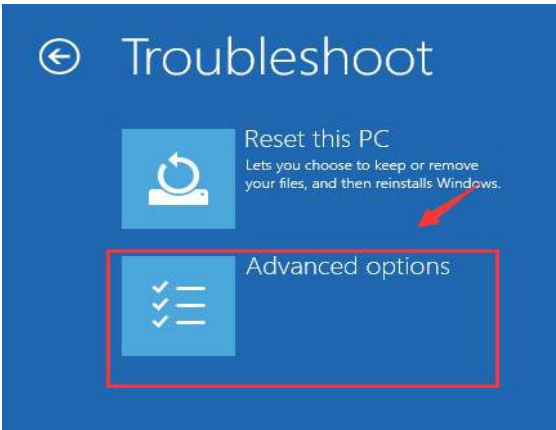
USB Driver Installation on Windows 10 platforms:

This method allows you to stop the driver signature enforcement feature for once. It is not a permanent change. Restart your computer and this feature is back on again.

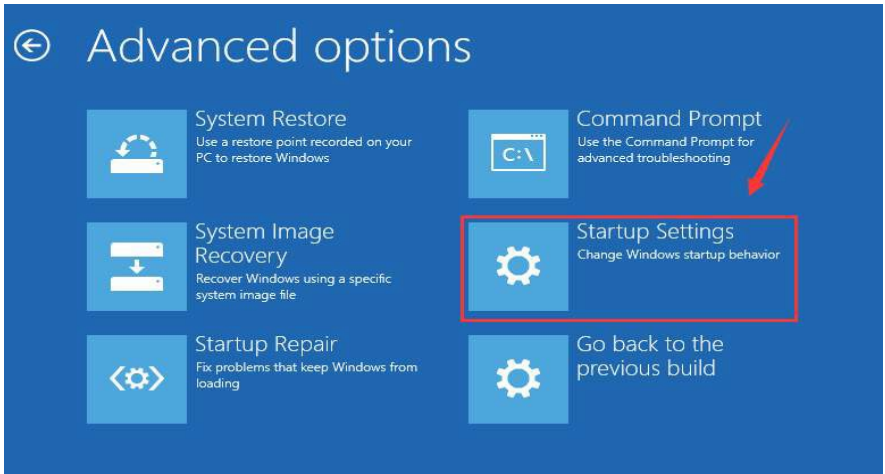
- 1) Press Start button, and then click the icon for Restart and Shut down. Now, press and hold Shift key when you choose Restart.
- 2) Choose Troubleshoot.



- 3) Choose Advanced options.



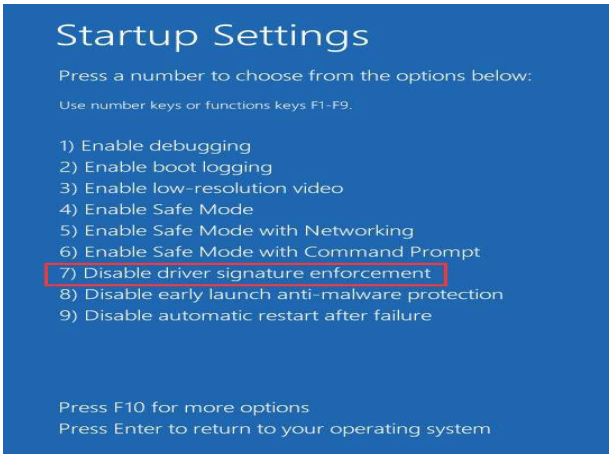
4) Now choose Startup Settings.



5) Click the Restart button.



6) Press F7 key on your keyboard to go Disable driver signature enforcement.



7) Your PC will restart now and the driver signature enforcement feature will be disabled. You are free to install unsigned drivers as you want. As mentioned above, this is not a permanent fix and it will be gone the next time you restart your computer.

Firmware Upgrade

The PIC32 Bootloader program automatically runs when the ML4025-TDR GUI detects incorrect or outdated firmware. The following software is needed to load the firmware:

- ML Configuration GUI

Instructions to upgrade the Firmware

1. When connecting to an instrument with outdated/incorrect firmware, the Bootloader Software pops up automatically (Figure 55)

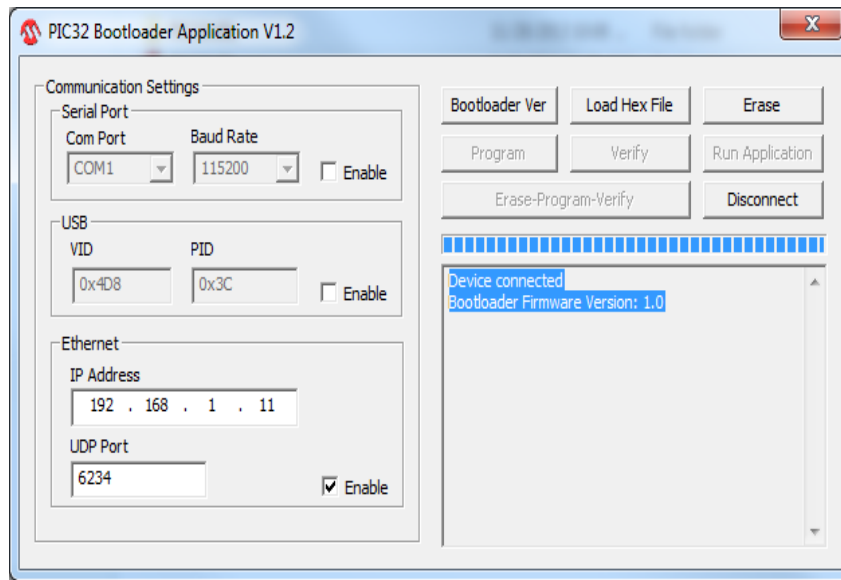


Figure 55: Bootloader Software

2. User has the option for loading the new firmware.
3. Set IP at 192.168.1.11 and UDP port at 6234, press on "Enable", check box in the Ethernet Tab and then press "Connect" button. If connection is successful, the software will display "Device connected Bootloader Firmware Version: 1.0"
4. Otherwise, attach a USB cable to the board and press "Enable" check box in the USB tab of the GUI then press on "Connect" as shown in Figure 56

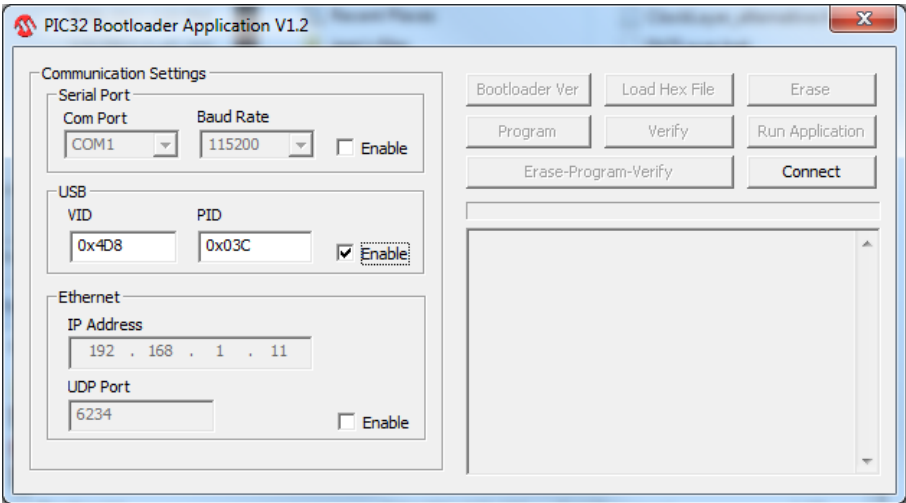


Figure 56: Connect Bootloader Software

5. Press “Load Hex File” then load the new **ML4025-TDR** firmware and press “Open”.
6. Press “Erase-Program-Verify” button. Successful loading will be indicated by the bootloader software as shown in .

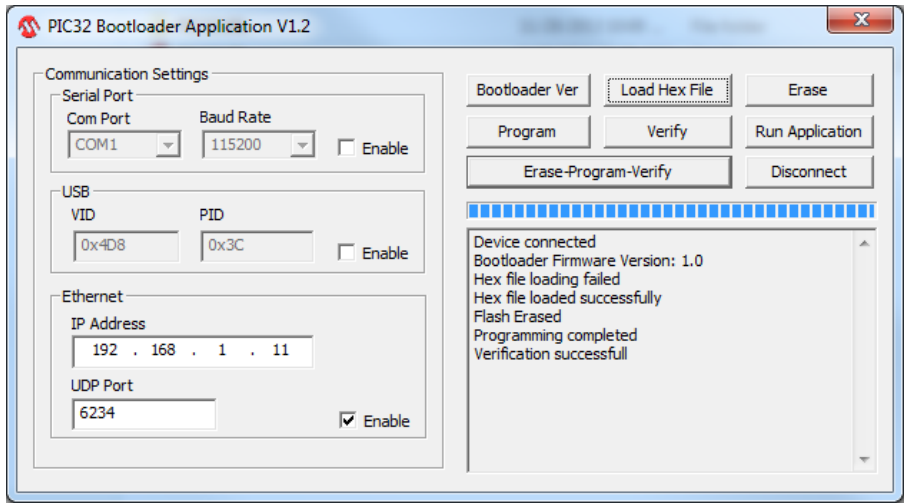


Figure 57: Erase Program Verify

7. Power cycle the **ML4025-TDR**
8. **ML4025-TDR** is now ready for normal operation

In case the user lost the old IP (when upgrading the firmware or when changing the IP) or when the IP is mistakenly erased, he can always put a jumper and power cycle the board, this will initiate the board in the default IP.

Ordering Information

Order No.	Description
ML4025-TDR	4 Channels TDR/TDT/Sampling Scope
ML4000	6U cPCI Chassis
Standard Warranty - 1 Year	
<i>For more information on this or other products, contact Multilane sales team by email at sales@multilaneinc.com</i>	

Table 2: Order Information

For more information on this or other products contact MultiLane sales team by email at sales@multilaneinc.com.

Manual Revision History

This section describes the changes that were implemented in this document. The changes are listed by revision, starting with the most current publication.

Revision 1.0: March 19th, 2018; First publication of this document, preliminary revision.