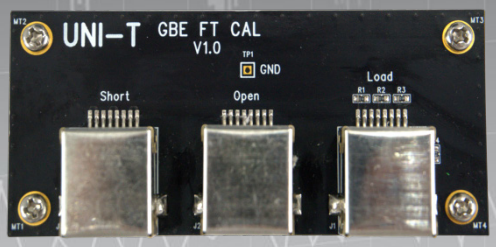
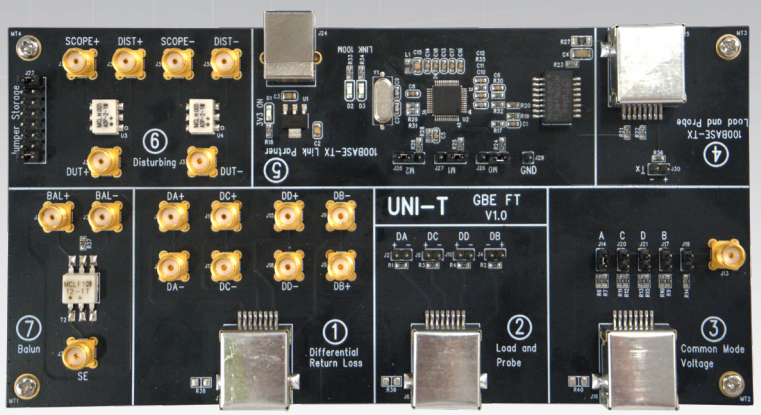
UT-GBE-FT 100/1000M Ethernet Compliance Test Fixture





User Manual V1.0

June 2025

Document Overview

This document provides an overview of the layout and application scenarios of test fixtures used in Ethernet compliance testing.

Fixture

- Ethernet Test Main Fixture
- Return Loss Calibration Fixture

Application Scenarios

- 100Base-Tx Compliance Testing
- 1000Base-Tx Compliance Testing

Fixture Layout

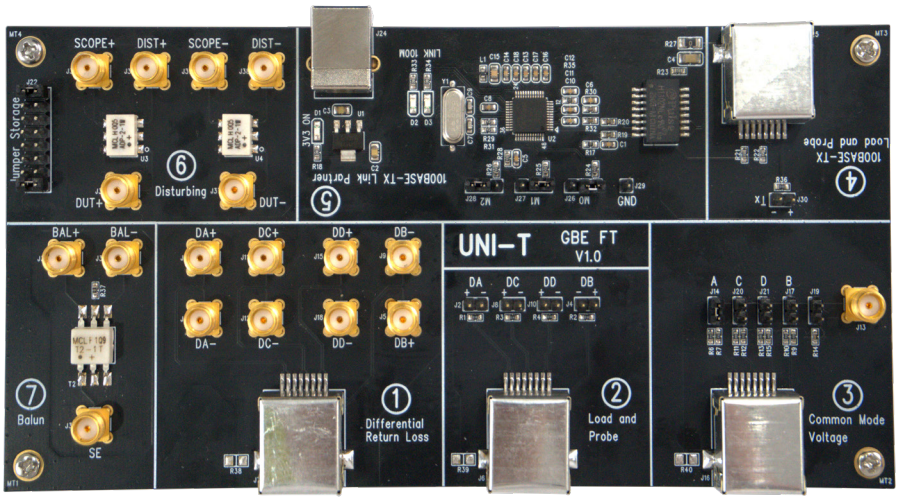


Figure 1-1 Ethernet Test Main Fixture

Each functional area of the fixture is described as follows:

Zone ①: SMA Connection Area

Used for return loss test, equipped with balun and calibration board.

Zone ②: 2.54 mm Pin Area

Used to connect differential probes for waveform testing.

Zone ③: Common-Mode Signal Testing Area

Before testing, adjust the jumper cap to the desired test channel.

Zone ④: 100M Testing Area

Before testing, connect the Device Under Test (DUT) and power the fixture via a USB cable.

Begin testing when both D1 and D2 indicators are illuminated.

Zone ⑤: On-Board 100M Link Partner Area

Functions as a built-in link partner for 100M Ethernet testing.

Zone ⑥: Disturber Signal Loading Area

Designed with two sets of power dividers to introduce disturbance signals for noise margin testing.

Zone ⑦: Balun Area

Contains a balun for return loss calibration during test setup.

Figure 1-2 Return Loss Calibration Fixture

Return loss calibration area: Used for open-circuit, short-circuit, and load calibrations of a network analyzer during return loss testing.

Accessory List

This section outlines the components included in the UT-GBE-FT kit along with standard accessories. All listed items can be ordered through UNI-T or its authorized distributors.

Accessory	Quantity	Standard/Option
Main test fixture	×1	Standard
Calibration test fixture	×1	Standard
15 cm network cable	×1	Standard
SMA load	×6	Standard
USB power supply cable	×1	Standard

Ethernet Compliance Test

Test Item	Test Sub-item	Reference Standard
Peak differential voltage test	UTP +Vout Differential voltage (Pos)	IEEE802.3-2018, Clause 25 ANSI X3.263-1995, Section 9.1.2.2
	UTP -Vout Differential voltage (Neg)	
	Signal amplitude symmetry	
Overshoot Test	Overshoot (Positive pulse width)	IEEE802.3-2018, Clause 25 ANSI X3.263-1995, Section 9.1.3
	Overshoot (Negative pulse width)	
AOI Template Test	UTP AOI template	IEEE 802.3-2018, Clause 25 ANSI X3.263-1995, Appendix J
AOI Rise/Fall Time Test	AOI +V_{out} rise time	IEEE 802.3-2018, Clause 25 ANSI X3.263-1995, Section 9.1.6
	AOI +V_{out} fall time	
	AOI +V_{out} rise/fall time symmetry	
	AOI -V_{out} rise time	
	AOI -V_{out} fall time	
	AOI -V_{out} rise/fall time symmetry	
	AOI Overall rise/ fall time symmetry	

DCD/Jitter Test	Transmitter jitter	IEEE 802.3-2018, Clause 25 ANSI X3.263-1995, Section 9.1.9
	Duty cycle distortion	IEEE 802.3-2018, Clause 25 ANSI X3.263-1995, Section 9.1.8
Return Loss Test	Transmitter return loss	to be continued
	Receiver return loss	to be continued
	MDI (Media Dependent Interface) return loss	to be continued

Test Preparation

Before testing, please prepare the following equipment:

- Oscilloscope that supports Ethernet compliance testing
- Device under test (DUT)
- Other test tools: Test fixture, differential probe, SMA cable, USB power cable, Ethernet cable

Oscilloscope Requirements

According to the 1000Base-T specifications outlined in the Ethernet conformance testing standard (IEEE 802.3), the oscilloscope must meet the minimum requirements: bandwidth: ≥ 1GHz; sample rate: ≥ 5GSa/s.

UNI-T's high-bandwidth oscilloscope series, such as the MSO7000X and MSO8000HD, fully satisfy these requirements, offering:

- Bandwidth range: 1GHz to 8GHz
- Maximum sample rate: 20GSa/s
- 12-bit ADC (MSO8000HD series): Delivers high-resolution, high-accuracy measurement results

The MSO8000HD series excels in signal integrity, featuring:

- Low noise floor: <800μV at 50mV/div vertical scale
- High ENOB: >7bits across the full bandwidth
- Low intrinsic jitter: 150fs RMS

These characteristics ensure the authenticity and reliability of measurement data during Ethernet conformance testing.

Pre-Test Preparation for Oscilloscope

Before performing any tests, ensure the following operations are performed on the oscilloscope:

- Allow the oscilloscope to warm up for at least 30 minutes before use.
- Perform self-calibration if the ambient temperature changes by 5°C or more.
- Perform Function Check and Probe Calibration procedures.

Note: The test procedures and connections described in this manual use the MSO7000X series oscilloscope as an example. For detailed instructions on self-calibration, function checks, and probe calibration, please refer to the *MSO7000X Series Mixed Signal Oscilloscopes-User Manual* and the *UT-PD1500 Active Differential Probe-User Manual*.

Probe Requirements

A differential probe is required for testing high-speed signals. The probe should have a bandwidth of at least 1GHz. Recommended models: UT-PD1500, UT-PD2500, UT-PD4000 Active Differential Probe.

Fixture Application

Test Connection

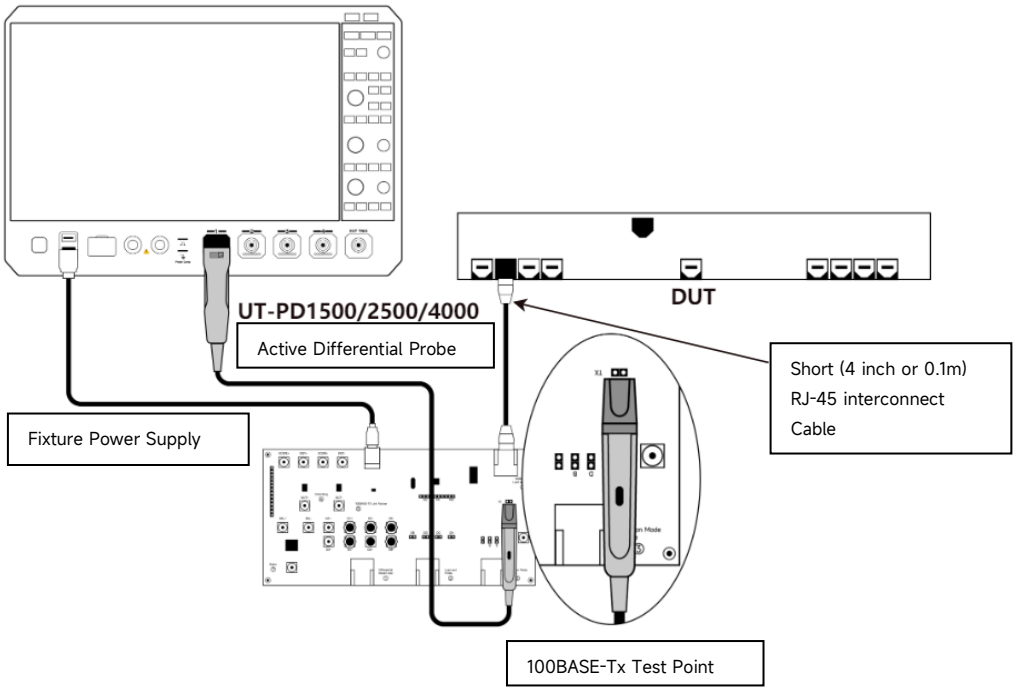


Figure 1-3 Probe Connection for 100BASE-Tx Compliance Test

100Base-Tx Test Environment Setup

Differential amplitude, symmetry, overshoot, template, rise/fall time, jitter, and duty cycle tests

Set up the test environment as shown in Figure 2-1. Use the provided 15 cm network cable to connect the DUT to the J25 interface in Zone ④ of the fixture. Insert the oscilloscope's differential probe into the two pins of J30, also in Zone ④. Then, connect any USB port on the oscilloscope to the USB Type-B port in Zone ⑤ of the fixture using the supplied USB cable to power the fixture.

Note: Ensure correct polarity when connecting the differential probe.

Once connected, the D1 (3.3V power) and D2 (100M mode) LEDs in Zone ⑤ should illuminate. The oscilloscope should then display a waveform pattern similar to Figure 2-2. Launch the oscilloscope's Ethernet compliance test software to begin testing.

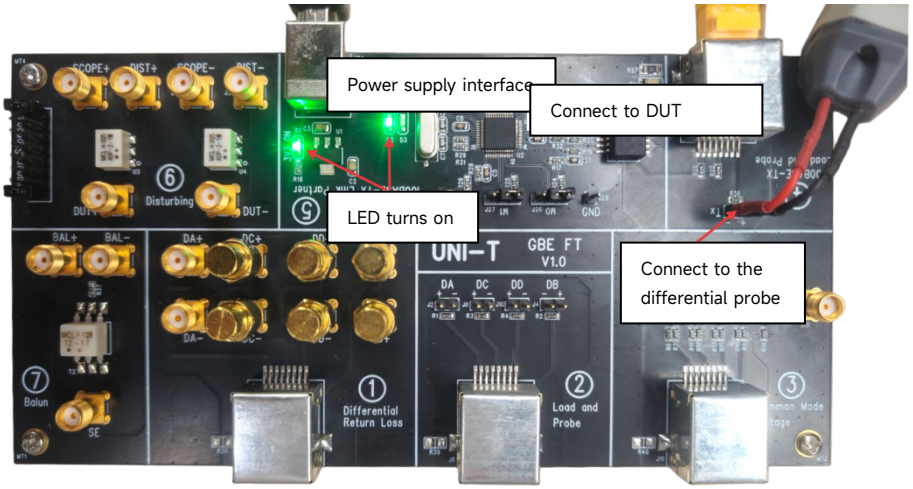


Figure 2-1 100Base-Tx Test Environment Setup

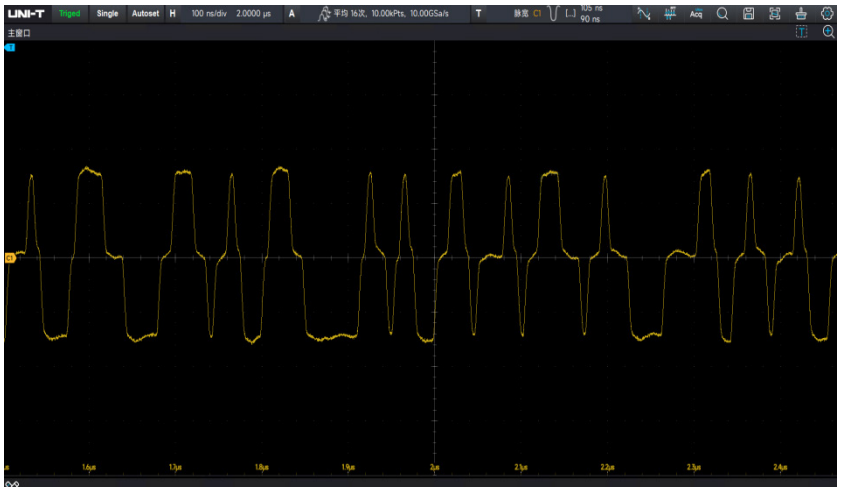


Figure 2-2 100M Idle Pattern

Transmitter Return Loss Test

Before testing, perform a calibration of the vector network analyzer (VNA). Use an SMA cable to connect Group A signal lines to the balun—specifically, connect DA+ to BAL+ and DA− to BAL−. Then, connect the SE (single-ended) output of the balun to Port 1 of the VNA, as shown in Figure 2-3. During the calibration, follow the on-screen instructions of the VNA. Insert the 15 cm network cable into the Open, Short, and Load interfaces on the calibration fixture one by one.

After calibration is complete, remove the calibration board, insert the 15 cm network cable into the DUT, and power on the DUT, then complete the transmitter return loss test using VNA.

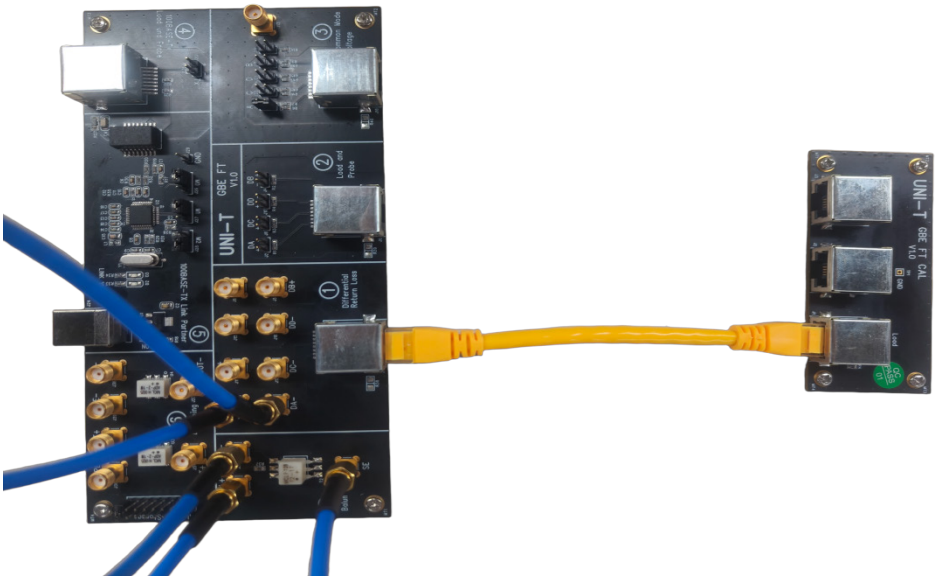


Figure 2-3 Transmitter Return Loss Calibration and Test Connection

Receiver Return Loss Test

Before testing, perform a calibration of the vector network analyzer (VNA). Use an SMA cable to connect Group B signal lines to the balun—specifically, connect DB+ to BAL+ and DB− to BAL−. Then, connect the SE (single-ended) output of the balun to Port 1 of the VNA, as shown in Figure 2-4. During the calibration, follow the on-screen instructions of the VNA. Insert the 15 cm network cable into the Open, Short, and Load interfaces on the calibration fixture one by one.

After calibration is complete, remove the calibration board, insert the 15 cm network cable into the DUT, and power on the DUT, then complete the receiver return loss test using the VNA.

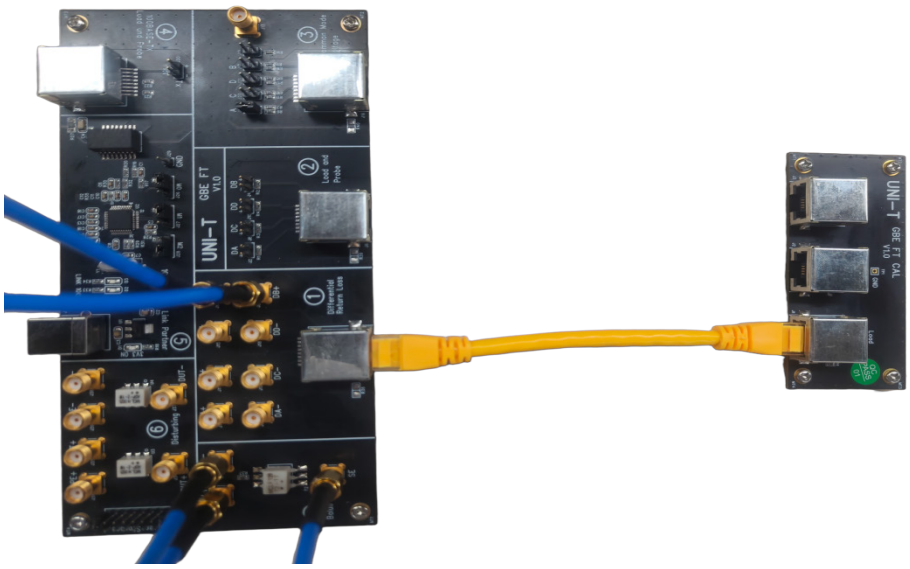


Figure 2-4 Receiver Return Loss Calibration and Test Connection

1000Base-T Test Environment Setup

Peak output voltage, differential output templates, and maximum output droop tests

There are two test environment setups: without disturbing signal and with disturbing signal.

- **Without disturbing signal:**
  Set up the test environment as shown in Figure 3-1. Connect the differential probe to the DB port in Zone ②, and connect the DUT to the J6 port.
- **With disturbing signal:**
  Set up the test environment as shown in Figure 3-2. Connect DIST+ and DIST− to the disturbing source and connect SCOPE+ and SCOPE− to the oscilloscope. Connect the Tx differential signals to the power splitter using SMA cables (DUT+ to DA+, DUT− to DA−). Then connect the DUT to the J7 port.

If calibration of the disturbing signal amplitude is required, refer to Figure 5-2 and 5-3.

After completing the setup, power on the DUT to start the test. Ensure that the test mode is configured to Mode 1 for this procedure.

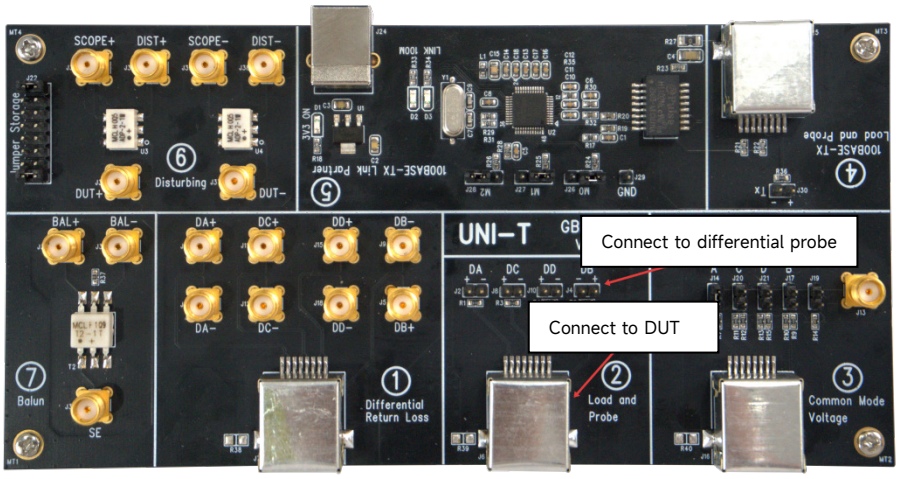


Figure 3-1 Mode 1 Test Connection Without Disturbing Signal

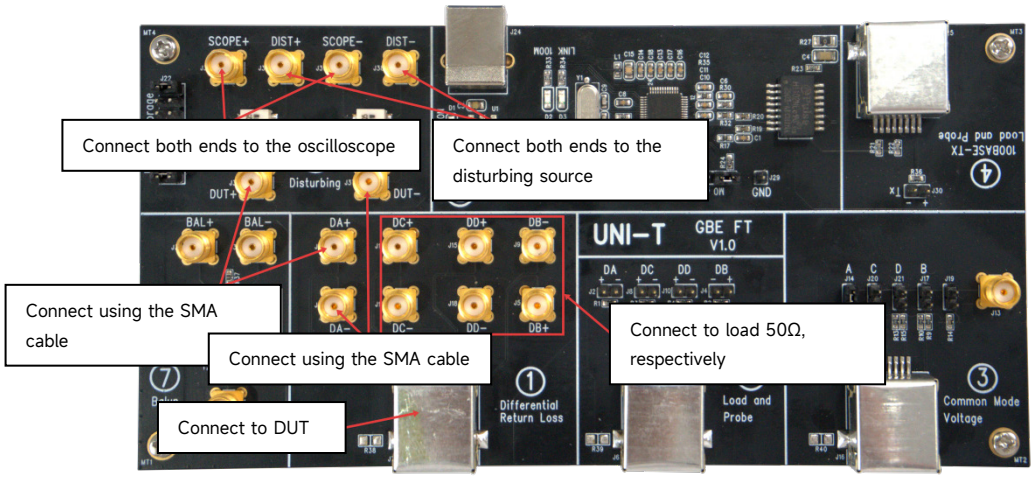


Figure3-2 Mode 1 Test Connection With Disturbing Signal

Transmitter Distortion Test

Set up the test environment as shown in Figure 3-1 or 3-2. Ensure that the oscilloscope is triggered by the Tx_TCLK signal and that the test mode is set to Mode 4 to match the test requirements.

MDI Common Output Test

Set up the test environment as shown in Figure 3-3. Use the jumper cap to select the channel under test—only one channel group can be selected at a time. Ensure that the test mode is configured to Mode 4 to meet the test requirements.

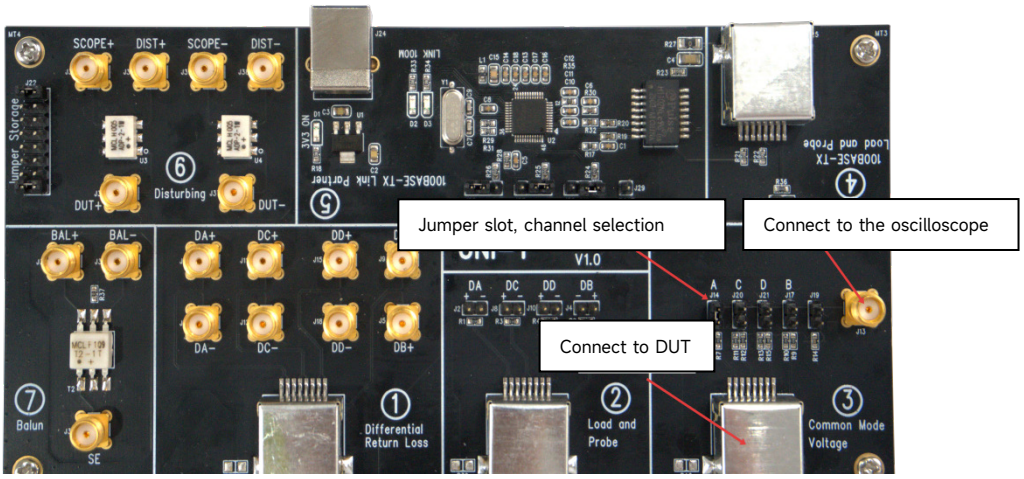


Figure 3-3 MDI Common Mode Output Test Connection

Jitter Test

This test fixture supports only Jtxout jitter testing. For the connection setup, refer to Figure 3-1. The oscilloscope must be triggered by the Tx_tclk signal, and the test mode should be set to Mode 2 or 3. Note that the test results are for reference only, as the specification does not define a limit for this parameter.

The measurement points for Tx_tclk jitter—whether filtered or unfiltered—in both Master and Slave modes are located on the Tx_tclk signal, not on the fixture itself.

Jitter testing in Slave mode requires a specialized jitter test channel (i.e., a 120-meter Cat 5 cable with segmented 100Ω and 120Ω impedance sections), which is not supported by this fixture.

Return Loss Test

The return loss test method is similar to that of 100Base-Tx, but with the following differences:

- ✓ All signal groups (A, B, C, D) must be tested.
- ✓ The test mode should be set to Mode 4.
- ✓ The return loss mask (template) is different from that used in the 100Base-Tx test.

Jumper Cap

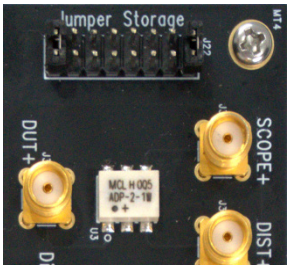


Figure 4-1 Jumper Cap Storage

Bit No.	Name	Description
J22	Jumper Storage	Used to store unused jumper caps. This area has no electrical connections.

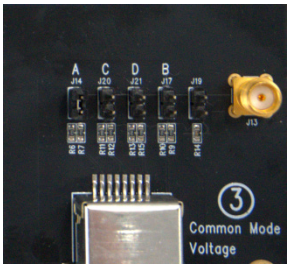


Figure 4-2 Common Mode Channel and Load Selection Jumper Cap

Bit No.	Name	Description
J14	A	Selects 1000Base-T Channel A
J20	C	Selects 1000Base-T Channel C
J21	D	Selects 1000Base-T Channel D
J17	B	Selects 1000Base-T Channel B
J19	/	Onboard 50-ohm load selection jumper cap (not installed by default)

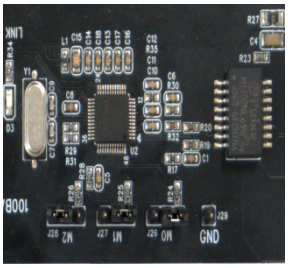


Figure 4-3 Onboard Link Partner Configured with Jumper Cap

Bit No.	Name	Description
J26	M0	Reserved, connected to high level by default
J27	M1	Reserved, connected to high level by default
J28	M2	Reserved, connected to low level by default

Appendix

1000Base-T Test Mode

For 1000Base-T test, different test items require specific test mode configurations. Refer to Figure 5-1, sourced from IEEE Standard 802.3, Section 40.6.1.1.2, for the corresponding test mode requirements.

Bit 1 (9.15)	Bit 2 (9.14)	Bit 3 (9.13)	Mode
0	0	0	Normal operation
0	0	1	Test mode 1—Transmit waveform test
0	1	0	Test mode 2—Transmit jitter test in MASTER mode
0	1	1	Test mode 3—Transmit jitter test in SLAVE mode
1	0	0	Test mode 4—Transmitter distortion test
1	0	1	Reserved, operations not identified.
1	1	0	Reserved, operations not identified.
1	1	1	Reserved, operations not identified.

Figure 5-1 1000Base-T Test Mode

1000Base-T Test Disturbing Signal Configuration

For testing scenarios involving disturbing signals, refer to Figure 5-2 for the disturbing amplitude and frequency. This figure is extracted from IEEE 802.3 standard, Section 40.6.1.1.3.

- The peak output voltage test, differential output template test, and maximum droop test use a disturbing signal of 2.8V at 31.25MHz.
- The transmitter distortion test uses a disturbing signal of 5.4V at 20.833MHz.

Characteristic	Transmit test fixture 1	Transmit test fixture 2	Transmit test fixture 3
Waveform	Sine wave		
Amplitude	2.8 volts peak-to-peak	2.8 volts peak-to-peak	5.4 volts peak-to-peak
Frequency	31.25 MHz	31.25 MHz	20.833 MHz (125/6 MHz)
Purity	All harmonics >40 dB below fundamental		

Figure 5-2 1000Base-T Disturbing Signal Configuration

1000Base-T Test Disturbing Signal Calibration

If calibration of the disturbing signal amplitude is required, refer to Figure 5-3 for the connection setup. Note that the disturbing signal is differential. When using two single-ended disturbing sources, synchronization between them must be configured according to the instrument manufacturer's guidelines.

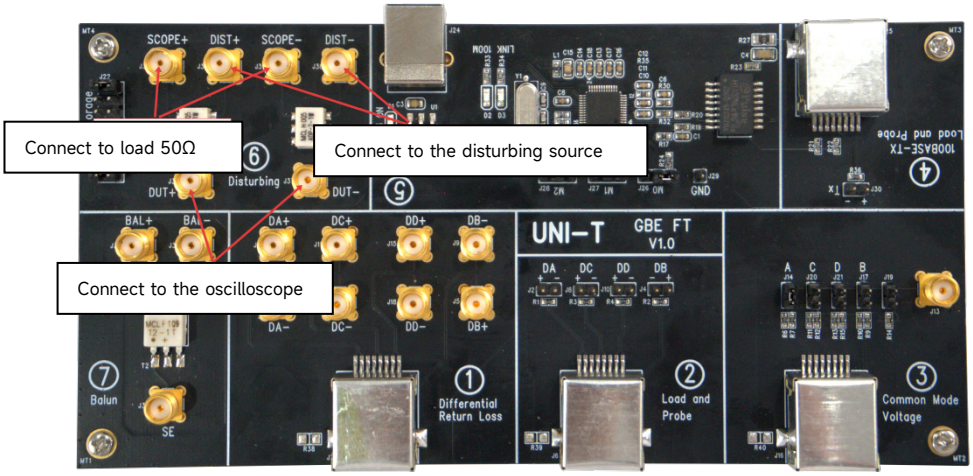


Figure 5-3 Disturbing Signal Calibration Connection

Onboard Balun Characteristic

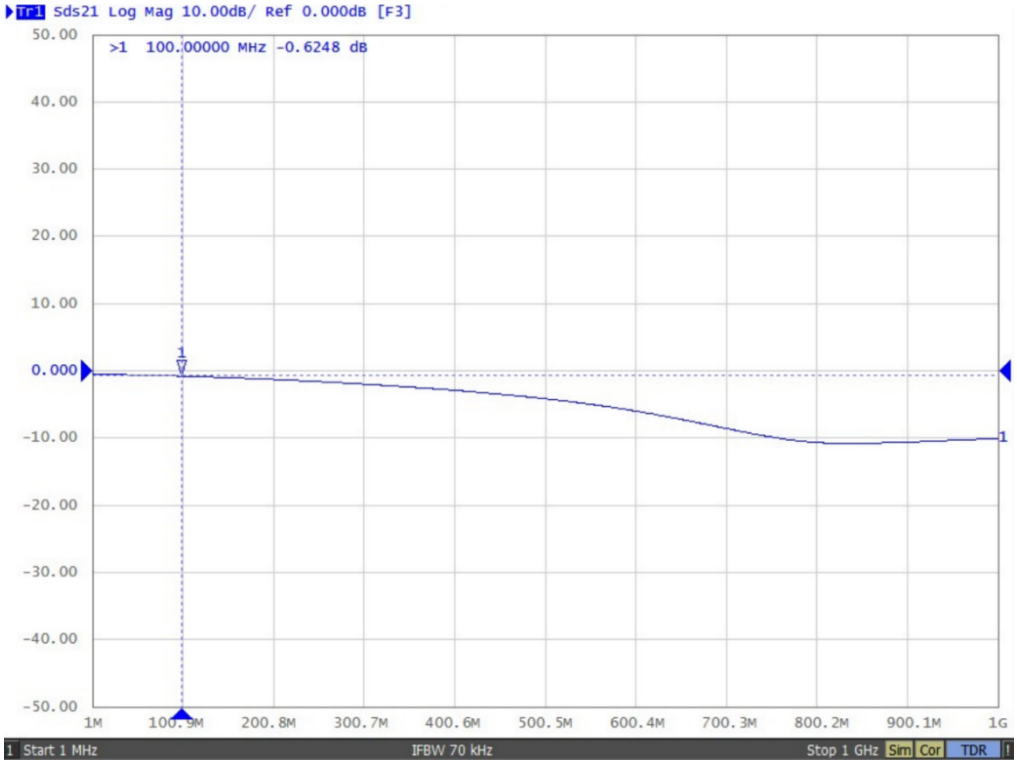


Figure 5-4 Balun Insertion Loss

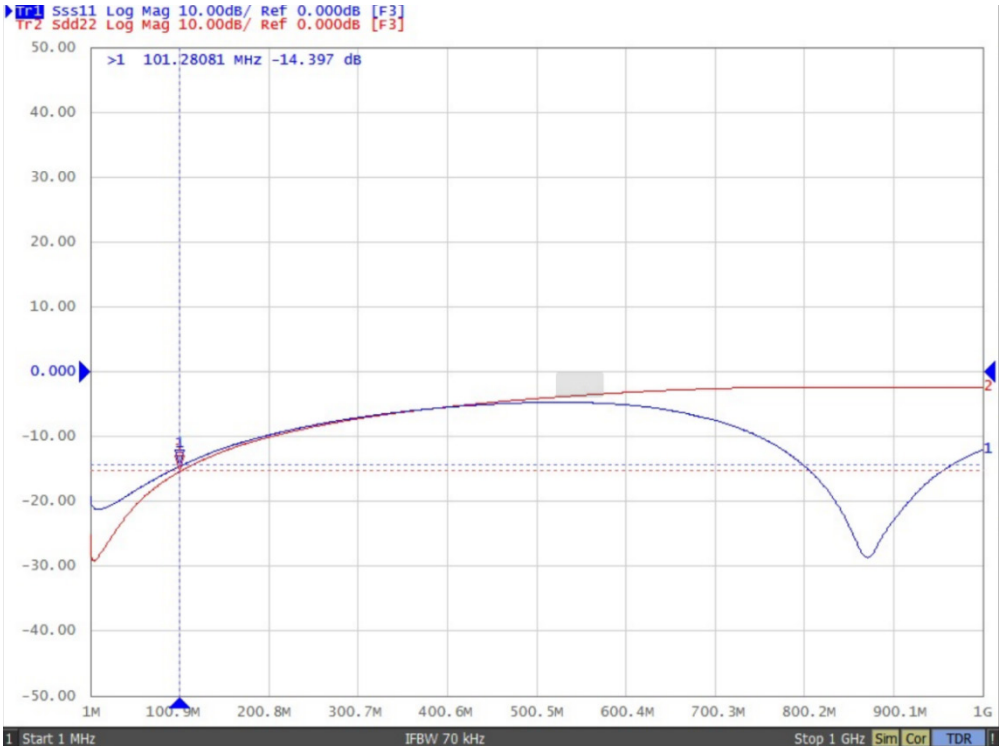


Figure 5-5 Balun Return Loss

Onboard Power Divider Characteristic

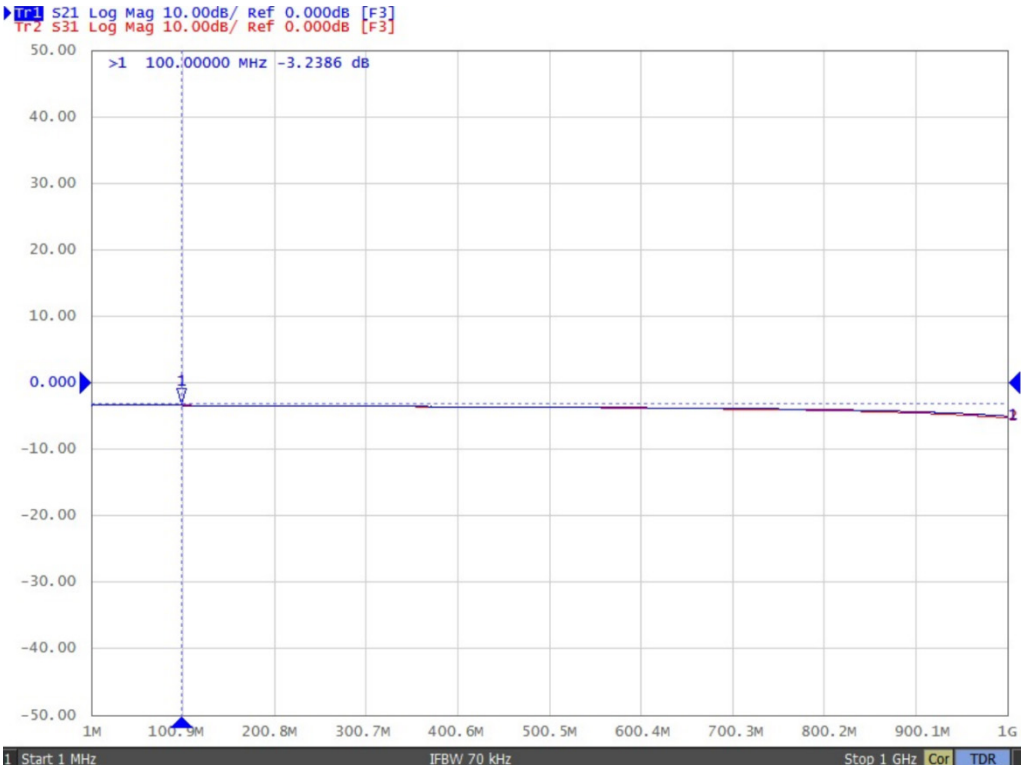


Figure 5-6 Power Divider Insertion Loss

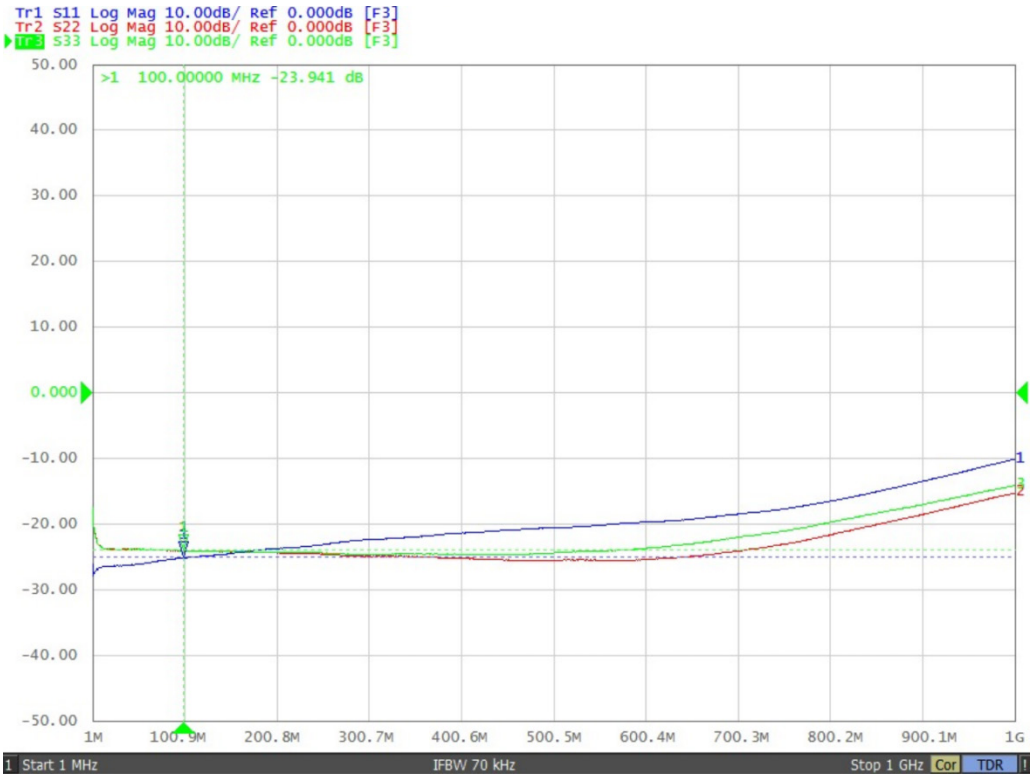


Figure 5-7 Power Divider Return Loss

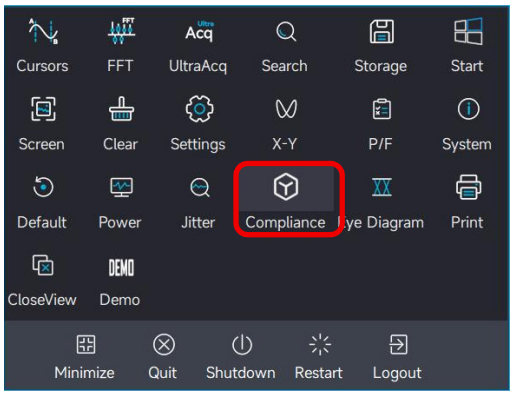
Test Example

100Base-Tx Ethernet Compliance Test

Set up the test environment as shown in Figure 2-1. Use the provided 15 cm network cable to connect the DUT to the J25 interface in Zone ④ of the fixture. Insert the oscilloscope's differential probe into the two pins of J30, also in Zone ④. Then, connect any USB port on the oscilloscope to the USB Type-B port in Zone ⑤ of the fixture using the supplied USB cable to power the fixture.

Note: Ensure correct polarity when connecting the differential probe.

Once connected, the D1 (3.3V power) and D2 (100M mode) LEDs in Zone ⑤ should illuminate. The oscilloscope should then display a waveform pattern similar to Figure 2-2. Launch the oscilloscope's Ethernet compliance test software to begin testing.



Open Compliance Analysis Test

Click Test settings to open the configuration window. Select the required test items and configure the settings based on actual testing requirements. Click Start to begin the test after completing the configuration.

Test Item and Parameter Configuration

Once the test is complete, the system will automatically generate a comprehensive test report based on the configured parameters. The report clearly presents the Pass/Fail results for each test item, along with data tables and test screenshots for intuitive analysis.

UNI-T **100Base-Tx Ethernet Compliance Test Report**

Overall Information	
DUT ID	DUT_1
Overall Test Result	Fail
Start Time	2025-06-12 13:09:49.721
Excute Time	00:03:13.526
Acquisition Mode	Live

Test Result Summary	
UTP AOI Template	Fail
AOI +Vout Fall Time	Pass
AOI -Vout Fall Time	Pass
AOI +Vout Rise Time	Pass
AOI -Vout Rise Time	Pass
AOI +Vout Rise/Fall Symmetry	Pass
AOI -Vout Rise/Fall Symmetry	Pass
UTP +Vout Differential Output Voltage	Pass
UTP -Vout Differential Output Voltage	Pass
Signal Amplitude Symmetry	Pass

UTP AOI Template					Fail
Measure Value	Unit	Lower Limit	Upper Limit	Margin	Comments
130687	Hits	N.A.	0.000	High:-130687.000	HitPointNum: SEG1:175 SEG2:38020 SEG3:32823 SEG4:28753 SEG5:30095 SEG6:30 SEG7:568 SEG8:46 SEG9:177 SEG10:0

AOI +Vout Fall Time					Pass
Measure Value	Unit	Lower Limit	Upper Limit	Margin	Comments
3.788	ns	3.000	5.000	Low:0.788 High:1.212	EdgeTime: 3.788ns

AOI -Vout Fall Time					Pass
Measure Value	Unit	Lower Limit	Upper Limit	Margin	Comments
3.840	ns	3.000	5.000	Low:0.840 High:1.160	EdgeTime: 3.840ns

Pass/Fail Result, Test Data Table

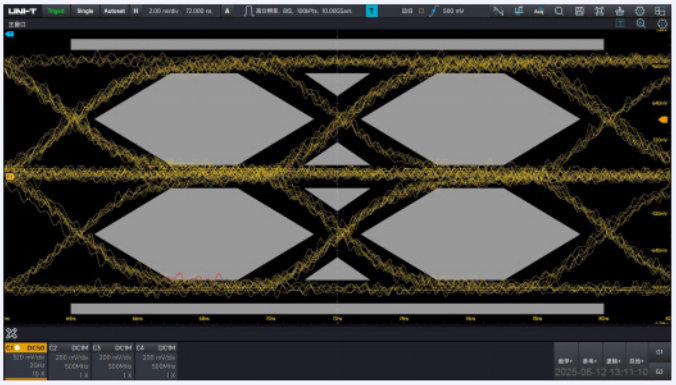
AOI -Vout Rise/Fall Symmetry					Pass
Measure Value	Unit	Lower Limit	Upper Limit	Margin	Comments
138.000	ps	N.A.	500.000	High:362.000	EdgeTime1: 3.717ns EdgeTime2: 3.856ns

UTP +Vout Differential Output Voltage					Pass
Measure Value	Unit	Lower Limit	Upper Limit	Margin	Comments
0.980	V	0.950	1.050	Low:0.030 High:0.070	MeanVoltage: 1.008V BaseLineVoltage: 0.028V

UTP -Vout Differential Output Voltage					Pass
Measure Value	Unit	Lower Limit	Upper Limit	Margin	Comments
-0.981	V	-1.050	-0.950	Low:0.069 High:0.031	MeanVoltage: -0.979V BaseLineVoltage: 0.002V

Signal Amplitude Symmetry					Pass
Measure Value	Unit	Lower Limit	Upper Limit	Margin	Comments
1.001	%	0.980	1.020	Low:0.021 High:0.019	MeanVoltagePos: 1.009V BaselineVoltagePos: 0.027V MeanVoltageNeg: -0.977V BaselineVoltageNeg: 0.004V

UTP AOI Template



Test Data Table and Test Screenshot

Limited Warranty and Liability

UNI-T guarantees that the Instrument product is free from any defect in material and workmanship within three years from the purchase date. This warranty does not apply to damages caused by accident, negligence, misuse, modification, contamination, or improper handling. If you need a warranty service within the warranty period, please contact your seller directly. UNI-T will not be responsible for any special, indirect, incidental, or subsequent damage or loss caused by using this device. For the probes and accessories, the warranty period is one year. Visit instrument.uni-trend.com for full warranty information.

Learn more at: www.uni-trend.com

Register your product to confirm your ownership. You will also get product notifications, update alerts, exclusive offers and all the latest information you need to know.

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