Revision 1.00

Apr-21, 2014

10GBASE-KR/40GBASE-KR4
Agilent Method of Implementation (MOI) for 10GBASE-KR/40GBASE-KR4 Backplane Ethernet Interconnect Using Agilent E5071C ENA Option TDR

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1. Revision History

Revision	Comments	Issue Date
1.00	Initial Revision.	Apr-21, 2014

2. Purpose

This test procedure was written to explain how to use the Agilent ENA Option TDR to make the 10GBASE-KR/40GBASE-KR4 Backplane Ethernet interconnect measurements.

3. References

- IEEE 802.3-2012 Section 5 (Jun. 2013)

4. Required Equipment

1. E5071C ENA Series Network Analyzer
   - Option 4K5 (20 GHz)
   - Option TDR (Enhanced time domain analysis)
2. Test Fixture
   - n/a
3. 4-port ECal Module
   - N4433A (for E5071C-4K5)
4. Coaxial RF cables
5. 50 Ohm terminators (if required)

5. Test Procedure

5.1. Outline of Test Procedure

1. **Instrument Setup**
   - Automatic setup by recalling a state file or manual setup.
   - Post processing (calculation) by loading a VBA project file using user menu function.
2. **Calibration**
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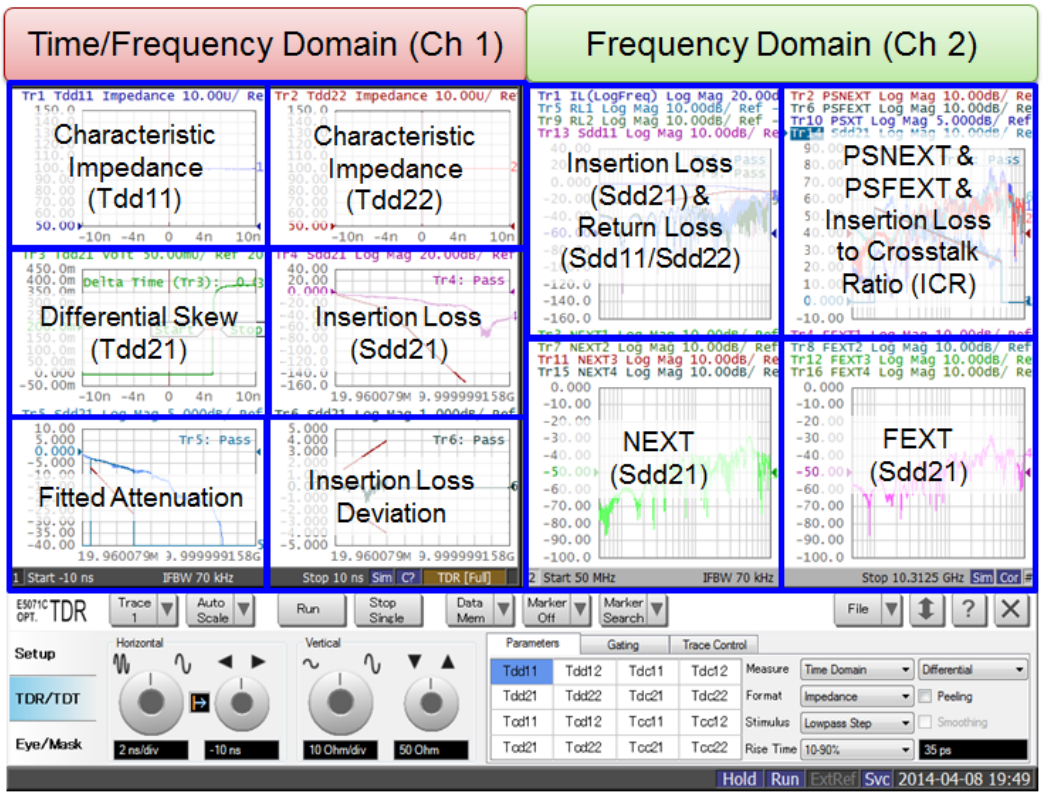
- Power Sum Differential Crosstalk (PSXT)
- Insertion Loss to Crosstalk Ratio (ICR)



Note: Hard Keys (Keys on the E5071C's front panel) are displayed in Blue color and **Bold**. (Example: **Avg**, **Analysis**)

Note: Soft keys (Keys on the E5071C's screen) are displayed in **Bold**. (Example: **S11**, **Real**, **Transform**)

Note: Buttons of the TDR software are displayed in Green color and **Bold**. (Example: **Trace**, **Rise Time**)

Note: Tabs of the TDR software are displayed in Brown color and **Bold**. (Example: **Setup**, **Trace Control**)

5.2. Instrument Setup

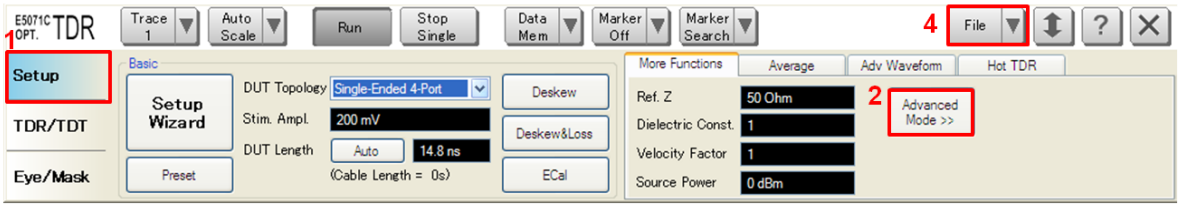
5.2.1. Recalling a State File

This section describes how to recall a state file of the E5071C that includes all the measurement settings for 10GBASE-KR/40GBASE-KR4 backplane Ethernet interconnect tests. The state file can be downloaded at: www.agilent.com/find/ena-tdr_ethernet-cabcon

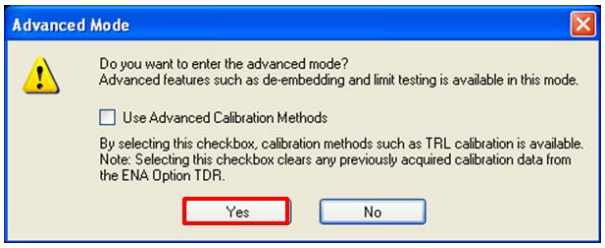
Copy the state file into the E5071C's directory via USB mass storage device and recall the state file using the TDR software. Necessary parameters for testing are automatically set up in the E5071C. Refer to Appendix for the details about manual setup.

If TDR setup wizard is shown, click **Close** button in the TDR setup wizard main window.

1. Open **Setup** tab.
2. Click **Advanced Mode** to show the dialog box.



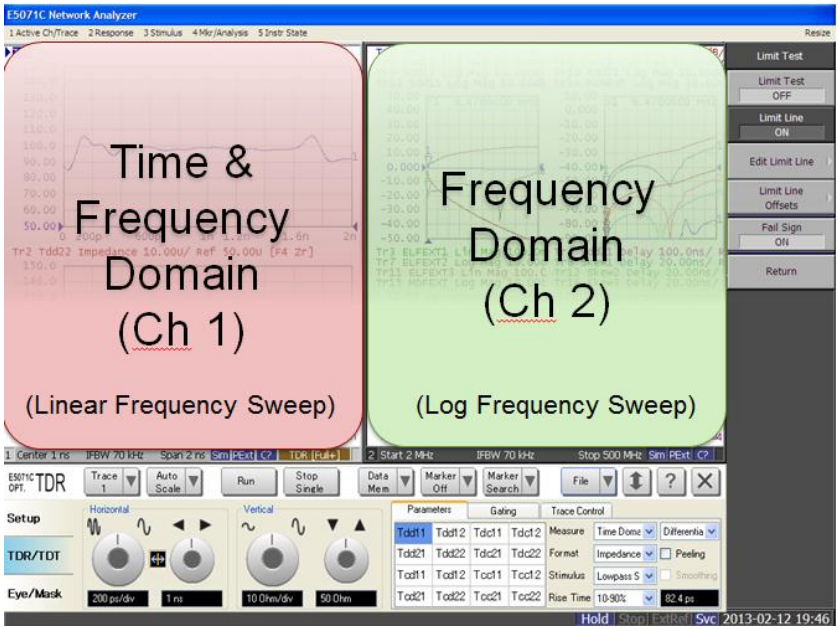
3. A dialog box appears requesting for confirmation. Then click **Yes**. (Uncheck "Use Advanced Calibration Methods")



4. Click **File** and select **Recall State** to open the Recall State dialog box.
5. Specify a folder and a file name, and click **Open**.

The E5071C's channel 1 is used for both time & frequency domain measurements with linear frequency sweep by using the TDR software at the bottom of the E5071C's screen.

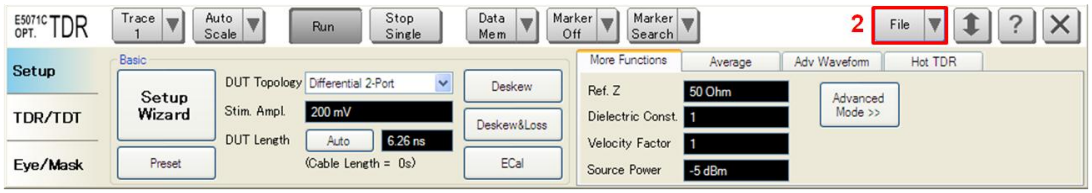
The channel 2 is used for frequency-domain measurements with log frequency sweep by using the soft key on the right side of the screen or hard key on the front panel.



5.2.2. Saving a State File

All the measurement settings including calibration information can be saved in a state file (*.tdr). After performing calibration, all necessary calibration coefficients are saved in a state file and can be recalled for the next measurements.

1. Press **Save/Recall** > **Save Type** and select **State & Cal** as a state file type.
2. Click **File** of the TDR software.



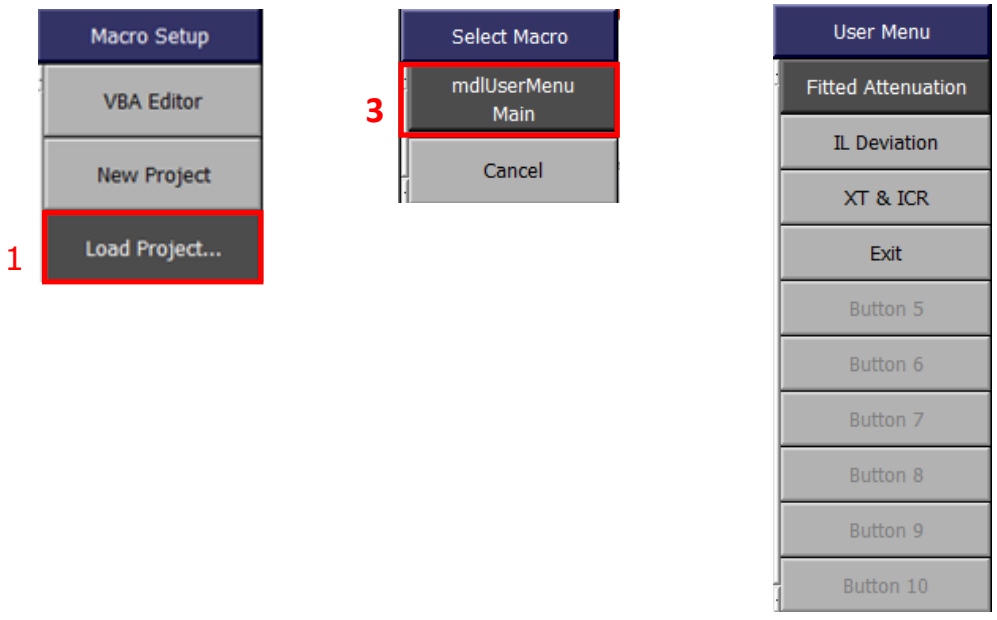
3. Select “Save State”.
4. Enter file name and save the state file with calibration information

5.2.3. Loading a VBA Project File

The user menu function, which lets the users perform procedures assigned to specific soft keys, is useful to perform the post processing. This section describes how to load a VBA project file of the E5071C that perform the calculation for 10GBASE-KR/40GBASE-KR4 backplane Ethernet interconnect tests. The VBA project file can be downloaded at: www.agilent.com/find/ena-tdr_ethernet-cabcon

Copy the VBA project file into the E5071C's directory via USB mass storage device and recall the VBA project file.

1. Press **Macro Setup** > **Load Project…** to open the dialog box.
2. Specify a folder and a file name, and click **Open**.
3. Press **Macro Setup** > **Select Macro > mdlUserMenu Main** to load the VBA project.



5.3. Calibration

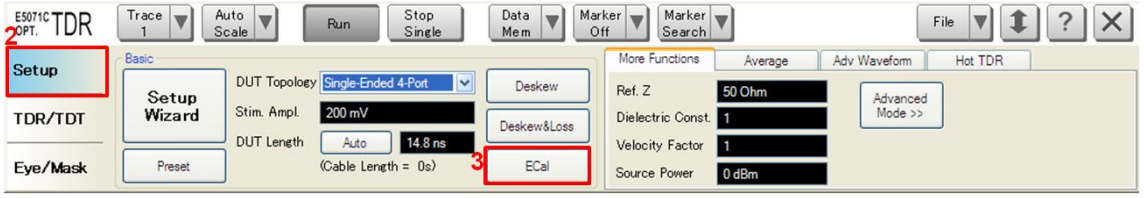
5.3.1. Time & Frequency Domain Calibration (Channel 1)

The purpose of this step is to calibrate the delay and loss of the RF cables and test fixtures by following the wizard of the E5071C TDR software. Full calibration is performed by using the 4-port ECal Module at the end of RF cables connected to the E5071C's test ports. After connecting the test fixture to the cables, the effect of the fixture can be removed by the fixture compensation function of the TDR software if required. This calibration is applied for time & frequency domain measurements in Channel 1.

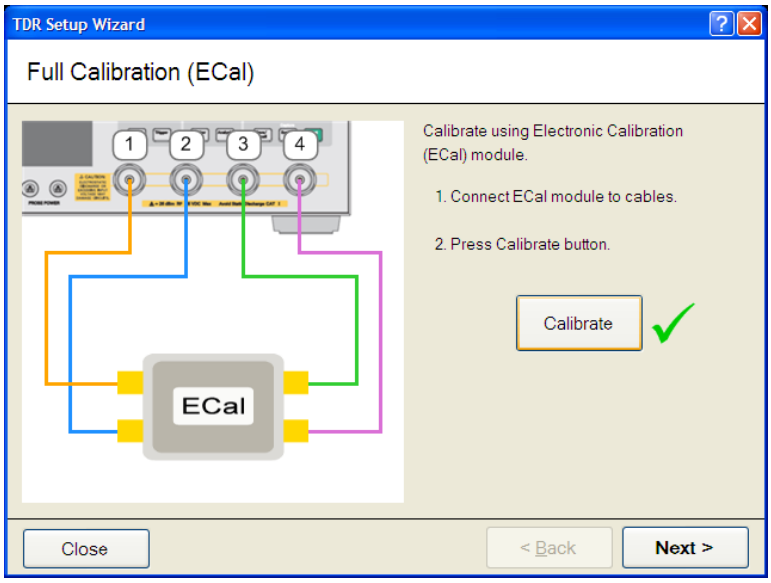
5.3.1.1. ECal Calibration & Fixture Compensation

Calibration for time & frequency domain measurements is performed by the TDR software. The 4-port ECal Module (i.e. N4433A) connected to the USB port of the E5071C is necessary for the calibration procedure.

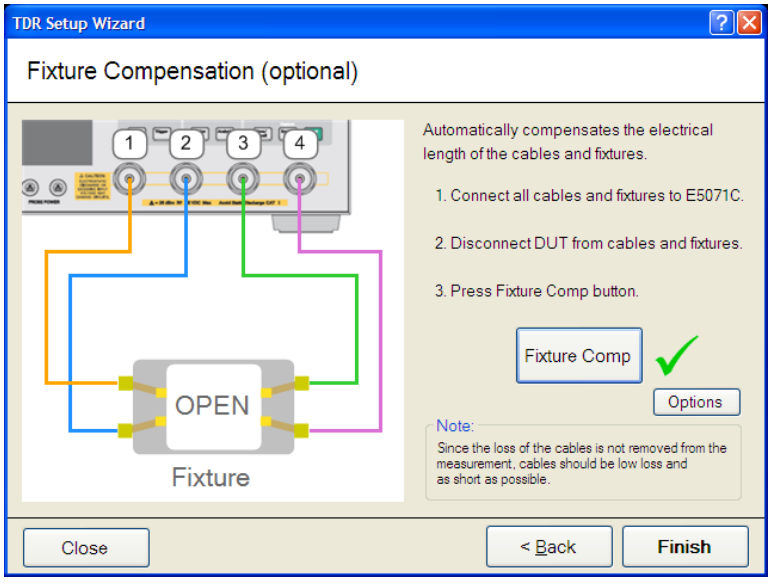
1. Press **Channel Next** to select Channel 1.
2. Open **Setup** tab of the TDR software.
3. Click **ECal** to launch calibration wizard.



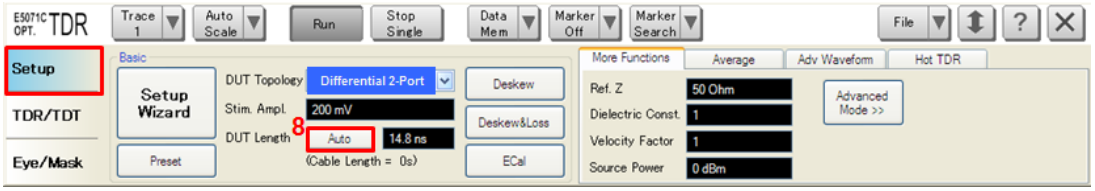
4. Connect all test cables to the ECal Module and click **Calibrate**. Once green check mark appears, click **Next>**.



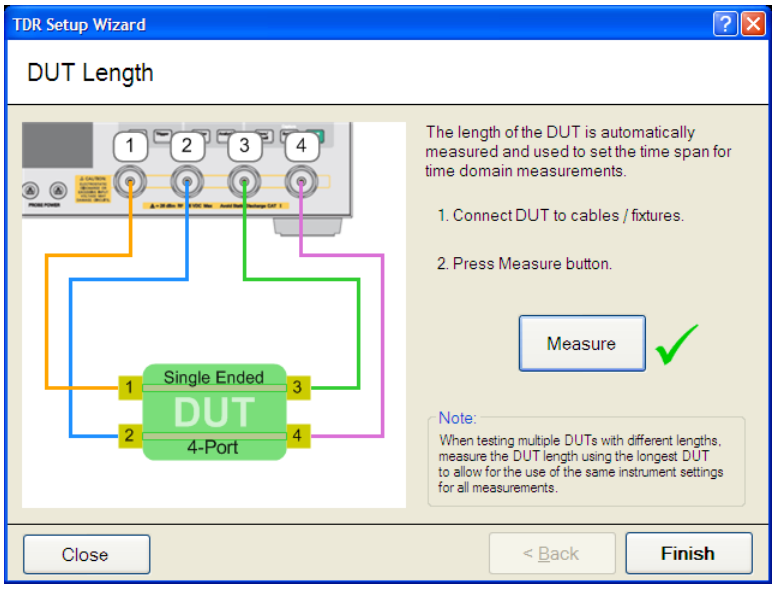
5. If it is not required to perform the fixture compensation, click **Finish**. If required to compensate the fixture effects, disconnect the ECal Module and connect the test fixtures to the RF cables. Click **Fixture Comp** to perform fixture compensation. Once green check mark appears, click **Finish** to complete the compensation.



6. Connect DUT to the test fixtures.
7. Open **Setup** tab.
8. Click **Auto** to launch the diagram.



9. Click **Measure** to specify DUT's electrical length in the dialog box. Once green check mark appears, click **Finish**.



5.3.2. Frequency Domain Calibration (Channel 2)

The purpose of this step is to calibrate out the RF effects (i.e. mismatch, loss or delay) of RF cables and test fixtures. Full calibration is performed by using the 4-port ECal Module at the end of RF cables connected to the E5071C's test ports. And if required, the test fixtures are connected to the RF test cables, and the fixture's effect will be eliminated by auto port extension function of the E5071C's firmware. The calibration is applied for frequency-domain measurements in Channel 2.

5.3.2.1. ECal Calibration

Calibration for the frequency-domain measurement is performed by selecting the E5071C's soft key. The 4-port ECal Module (i.e. N4433A) connected to the USB port of the E5071C is necessary for the calibration procedure.

1. Press **Channel Next** key to select Channel 2.
2. Connect all RF test cables to the ECal Module.
3. Press **Calibrate** > **ECal** > **4-Port Cal.**

5.3.2.2. Auto Port Extension

If required, the effect of the test fixtures (i.e. delay) can be removed by auto port extension function of the E5071C's firmware. The calibration plane (at the RF test cables by ECal calibration) is moved to the end of test fixtures by auto port extension.

1. Connect the test fixture to the RF cable. The DUT is not connected to the test fixture (the fixture end is left open).
2. Press **Cal** > **Port Extension** > **Auto Port Extension > Select Ports** and check all ports (Port 1 to Port 4).
3. Press **Cal** > **Port Extension** > **Auto Port Extension > Measure Open** and select **All** to enable auto port extension.

5.4. Measurement

The procedures for time-domain and frequency-domain measurements are introduced in this section. The physical connections depend on the manufacture's backplane configuration and the number of measurements depends on the number of lanes.

5.4.1. Characteristic Impedance

1. Connect the E5071C and the test fixture with the RF cables (Figure 5-1).

E5071C	Port 1	Port 2	Port 3	Port 4
Test Point	TP1 +	TP1 -	TP4 +	TP4 -

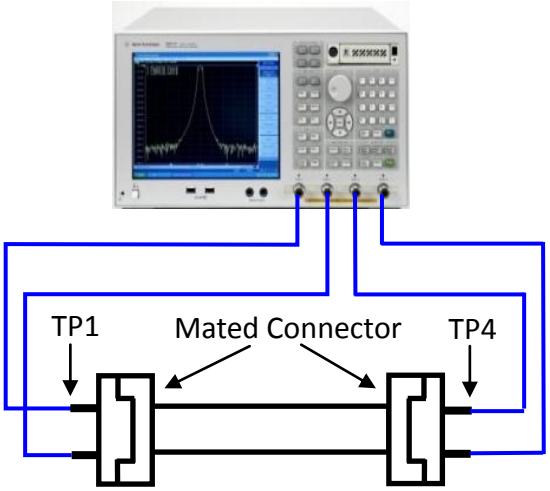


Figure 5-1 Characteristic Impedance Test Setup

Note: Unused fixture ports should be terminated with 50 ohm terminators if required.

2. Press **Channel Next** to select Channel 1 of the E5071C.
3. Select **Trace 1** (Tdd11).
4. Click **Stop Single**.
5. Confirm the differential characteristic impedance is 100 ohm ± 10 ohm.
6. Select **Trace 2** (Tdd22)
7. Confirm the differential characteristic impedance is 100 ohm ± 10 ohm.

5.4.2. Differential Skew

The skew (propagation delay) between duplex channel pair combinations of a interconnect should meet requirement.

1. Connect DUT to the test fixtures with the RF cables (Figure 5-1).

E5071C	Port 1	Port 2	Port 3	Port 4
Test Point	TP1 +	TP1 -	TP4 +	TP4 -

2. Select **Trace 3** (Tdd21).
3. Click **Stop Single**.
4. Click **Data Mem** > **Data -> Mem** to copy the trace data to memory.
5. Click **Data Mem** > **Data & Memory** to show the data & memory traces.
6. Change DUT connection to another duplex channel pair.
7. Click **Stop Single**.
8. Click **Auto Scale** and select "Y".
9. Read Delta Time (Tr3).
10. Confirm the total differential skew from TP1 to TP4 is less than the minimum transition time for port type of interest.

5.4.3. Insertion Loss

1. Connect DUT to the test fixtures with the RF cables (Figure 5-1).
2. Select **Trace 4** (Sdd21).
3. Click **Stop Single**.
4. Confirm the measured differential insertion loss meets the limit shown below.

$$IL(f) \le IL_{max}(f) = A_{max}(f) + 0.8 + 2.0\times10^{-10} f$$

for $f_{min} \le f \le f_2$

$$IL(f) \le IL_{max}(f) = A_{max}(f) + 0.8 + 2.0\times10^{-10} f_2 + 1\times10^{-8}(f - f_2)$$

for $f_2 < f \le f_{max}$

f_{min}	0.05			GHz
f_{max}	15.00			GHz
f_2	1.250	3.125	6.000	GHz

5. Press **Channel Next** to select Channel 2 of the E5071C.
6. Press **Trace Next** to select Trace 1 (Sdd21).
7. Press **Trigger** > **Single**.
8. Press **Display** > **Data -> Mem** to copy the trace data to memory.
9. Press **Display** > **Display** then select **Mem** to show the memory trace. The measured differential insertion loss with log frequency sweep will be used for calculation of insertion loss to cross-talk ratio (ICR) in 5.4.10.

5.4.4. Fitted Attenuation

The fitted attenuation is defined to be the least mean squares line fit to the insertion loss computed over the frequency range 1 GHz to 6 GHz. The maximum fitted attenuation due to trace skin effect and dielectric properties is defined.

1. Press **Channel Next** to select Channel 1 of the E5071C.
2. Select **Trace 5**.
3. Press **Macro Setup** > **User Menu** to show the programs.
4. Press **Fitted Attenuation** to perform the least mean squares line fit to the insertion loss measured in 5.4.3. The fitted attenuation result is stored in the data trace while the insertion loss result (Channel 1/Trace 4) in 5.4.3 is stored in the memory trace.
5. Confirm the calculated fitted attenuation meets the limit shown below.

$$A(f) \le A_{max}(f) = 20\log_{10}(e) \times (b_1\sqrt{f} + b_2 f + b_3 f^2 + b_4 f^3)$$

b_1	2.00×10^{-5}
b_2	1.10×10^{-10}
b_3	3.20×10^{-20}
b_4	-1.20×10^{-30}

5.4.5. Insertion Loss Deviation

Insertion loss deviation is the difference between the insertion loss and the fitted attenuation.

1. Select **Trace 6**.
2. Press **Macro Setup** > **User Menu** to show the programs.
3. Press **IL Deviation** to calculate the difference between the insertion loss in 5.4.3 and the fitted attenuation in 5.4.4.
4. Confirm the calculated insertion loss deviation meets the limit shown below.

$$ILD(f) \geq ILD_{min}(f) = -1.0 - 0.5\times10^{-9}f$$

$$ILD(f) \leq ILD_{max}(f) = 1.0 + 0.5\times10^{-9}f$$

for $f_1 \leq f \leq f_2$.

f_1	0.125	0.312	1.000	GHz
f_2	1.250	3.125	6.000	GHz

5.4.6. Return Loss

1. Connect the E5071C and the test fixtures with the RF cables (Figure 5-1).
2. Press **Channel Next** to select Channel 2 of the E5071C.
3. Press **Trace Next** to select Trace 5 (Sdd11).
4. Press **Trigger** > **Single**.
5. Confirm the measured return loss meets the limit shown below.

$$RL(f) \geq RL_{min}(f) = 12$$

for 50 MHz $\leq f <$ 275 MHz and

$$RL(f) \geq RL_{\min}(f) = 12 - 6.75\log_{10}\left(\frac{f}{275\ \text{MHz}}\right)$$

for 275 MHz $\leq f <$ 3000 MHz and

$$RL(f) \geq RL_{\min}(f) = 5$$

for 3000 MHz $\leq f \leq$ 10312.5 MHz.

5. Press **Trace Next** to select Trace 9 (Sdd22).
6. Confirm the measured return loss meets the limit of Step 5.

5.4.7. Power Sum Differential Near-end Crosstalk (PSNEXT)

The differential near-end crosstalk at TP4 is calculated as the power sum of the individual NEXT aggressors (PSNEXT). PSNEXT is computed as equation, where $NEXT_n$ is the crosstalk loss (dB) of aggressor n. For the case of a single aggressor, PSNEXT will be the crosstalk loss for that single aggressor.

$$PSNEXT(f) = -10\log\left(\sum_{n} 10^{-NEXT_n(f)/10}\right)$$

The following procedure guides how to make measurements of the NEXT of a duplex channel followed by a different NEXT. Up to 4 NEXT measurements can be made for the PSNEXT.

1. Connect the E5071C and the test fixture with the RF cables (Figure 5-1). The physical connections for the NEXT measurements depend on the manufacture's backplane configuration.
2. Press **Trace Next** to select Trace 3 (Sdd21).
3. Press **Trigger** > **Single**.
4. Press **Display** > **Data -> Mem** to copy the trace data to memory.
5. Press **Display** > **Display** then select **Mem** to show the memory trace.
6. Press **Scale** > **Auto Scale**.
7. Change the connection to make the 2nd NEXT measurement if required.

8. Press **Trace Next** to select Trace 7 (Sdd21).
9. Repeat the same measurement as Step 3 to Step 6.
10. Change the connection to make the 3rd NEXT measurement if required.
11. Press **Trace Next** to select Trace 11 (Sdd21).
12. Repeat the same measurement as Step 3 to Step 6.
13. Change the connection to make the 4th NEXT measurement if required.
14. Press **Trace Next** to select Trace 15 (Sdd21).
15. Repeat the same measurement as Step 3 to Step 6.

Up to 4 NEXT measurements can be performed by following Step 1 to Step 15. The measured NEXT results will be used for calculation of power sum differential near-end crosstalk (PSNEXT). The calculation will be implemented in 5.4.10 insertion loss to crosstalk ratio (ICR).

Note: At least one NEXT measurement (Step 1 to Step 6) needs to be performed for PSNEXT calculation.

5.4.8. Power Sum Differential Far-end Crosstalk (PSFEXT)

The differential far-end crosstalk at TP4 is calculated as the power sum of the individual FEXT aggressors (PSFEXT). PSFEXT is computed as equation, where $FEXT_n$ is the crosstalk loss (dB) of aggressor n. For the case of a single aggressor, PSFEXT will be the crosstalk loss for that single aggressor.

$$PSFEXT(f) = -10\log\left(\sum_n 10^{-FEXT_n(f)/10}\right)$$

The following procedure guides how to make measurements of the FEXT of a duplex channel followed by a different FEXT. Up to 4 FEXT measurements can be made for the PSFEXT.

1. Connect the E5071C and the test fixture with the RF cables (Figure 5-1). The physical connections for the FEXT measurements depend on the manufacture's backplane configuration.
2. Press **Trace Next** to select Trace 4 (Sdd21).
3. Press **Trigger** > **Single**.
4. Press **Display** > **Data -> Mem** to copy the trace data to memory.
5. Press **Display** > **Display** then select **Mem** to show the memory trace.
6. Press **Scale** > **Auto Scale**.
7. Change the connection to make the 2nd FEXT measurement if required.
8. Press **Trace Next** to select Trace 8 (Sdd21).
9. Repeat the same measurement as Step 3 to Step 6.
10. Change the connection to make the 3rd FEXT measurement if required.
11. Press **Trace Next** to select Trace 12 (Sdd21).
12. Repeat the same measurement as Step 3 to Step 6.
13. Change the connection to make the 4th FEXT measurement if required.
14. Press **Trace Next** to select Trace 16 (Sdd21).
15. Repeat the same measurement as Step 3 to Step 6.

Up to 4 FEXT measurements can be performed by following Step 1 to Step 15. The measured FEXT results will be used for calculation of power sum differential far-end crosstalk (PSFEXT). The calculation will be implemented in 5.4.10 insertion loss to crosstalk ratio (ICR).

Note: At least one FEXT measurement (Step 1 to Step 6) needs to be performed for PSFEXT calculation.

5.4.9. Power Sum Differential Crosstalk (PSXT)

The differential crosstalk at TP4 is calculated as the power sum of the individual NEXT and FEXT aggressors (PSXT). PSXT may be computed as equation.

$$PSXT(f) = -10\log(10^{-PSNEXT(f)/10} + 10^{-PSFEXT(f)/10})$$

The measured NEXT and FEXT results in 5.4.7 and 5.4.8 will be used for calculation of power sum differential crosstalk (PSXT). The calculation will be implemented in 5.4.10 insertion loss to crosstalk ratio (ICR).

Note: Both 5.4.7 PSNEXT and 5.4.8 PXFEXT need to be performed for PSNEXT calculation.

5.4.10. Insertion Loss to Crosstalk Ratio (ICR)

Insertion loss to crosstalk ratio (ICR) is the ratio of the insertion loss, measured from TP1 to TP4, to the total crosstalk measured at TP4. ICR_{fit} is defined to be the least mean squares line fit to the ICR computed over the frequency range 100 MHz to 5.15625 GHz.

1. Press **Trace Next** to select Trace 14.
2. Press **Macro Setup** > **User Menu** to show the programs.
3. Press **XT & ICR** to calculate PSNEXT (Trace 2), PSFEXT (Trace 6), PSXT (Trace 10) and ICR (Trace 14). The ICR result is stored in the data trace while the insertion loss result in 5.4.3 (Channel 2/Trace 1) is stored in the memory trace. The calculated data for PSNEXT, PSFEXT, and PSXT is stored in the memory trace respectively.
4. Confirm the calculated insertion loss to crosstalk ratio meets the limit shown below.

$$ICR_{fit}(f) \geq ICR_{min}(f) = 23.3 - 18.7\log_{10}\left(\frac{f}{5\ \text{GHz}}\right)$$

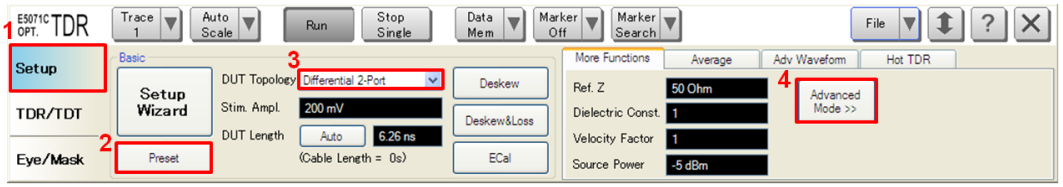
6. [Appendix] Manual Setup

The procedures of manual setup for time-domain and frequency-domain measurements are introduced in the section. All the following parameters are saved in the E5071C's state file, which is available at: www.agilent.com/find/ena-tdr_ethernet-cabcon

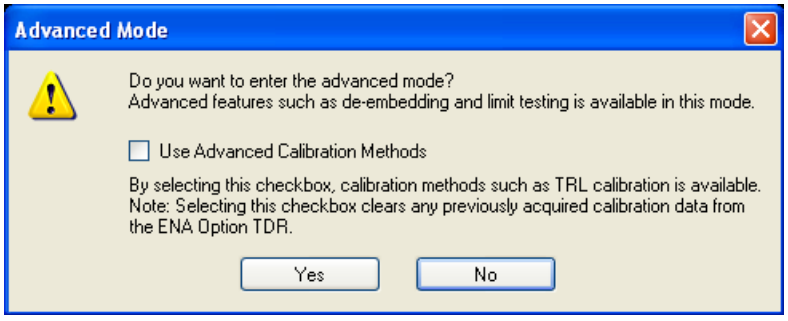
6.1. Channel & Trace Setup (Channel 1)

If TDR setup wizard is shown when launching the TDR software, click **Close** button in the TDR setup wizard main window.

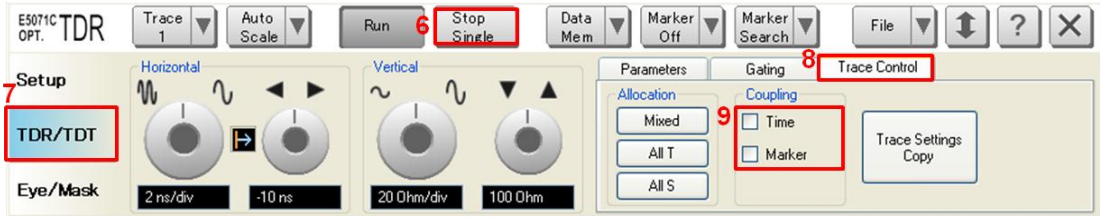
1. Open **Setup** tab in the TDR software.
2. Click **Preset** to preset the instrument. Click **OK** in a dialog box to continue.
3. Set **DUT Topology** to "Differential 2-Port". Click **OK** in a dialog box.
4. Click **Advanced Mode>>**.



5. A dialog box appears requesting for confirmation. Then click **Yes** (Clear the check box for "Use Advanced Calibration Methods").



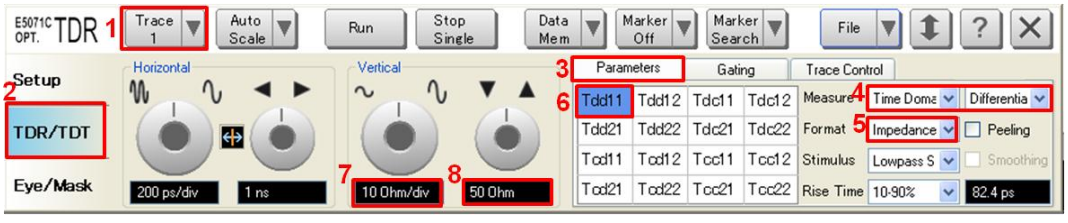
6. Click **Stop Single**.
7. Open **TDR/TDT** tab.
8. Click **Trace Control** tab.
9. Clear **Time** and **Marker** check box under Coupling.



10. Press **Display** > **Allocate Channels** >  .
11. Press **Display** > **Num of Traces** > 6.
12. Press **Display** > **Allocate Traces** > x6 (3 columns by 2 rows).
13. Press **Channel Max** to maximize the screen of Channel 1.

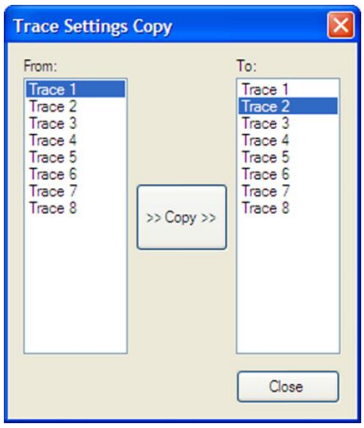
6.2. Characteristic Impedance

1. Select **Trace 1**.
2. Open **TDR/TDT** tab.
3. Open **Parameters** tab.
4. Select “Time Domain” and “Differential” for Measure.
5. Select Format to “Impedance”
6. Click **Tdd11**.
7. Click the box below the left knob under Vertical. Set the vertical scale to “10 Ohm/div” in a dialog box.
8. Click the box below the right knob under Vertical. Set the vertical position to “50 Ohm” in a dialog box.



9. Open **Trace Control** tab.
10. Click **Trace Settings Copy** to launch trace copy dialog box.
11. Select the Trace 1 in the From list.

12. Select the Trace 2 in the To list.
13. Click **Copy**.
14. Click **Close**.



15. Select **Trace 2**.
16. Open **Parameters** tab.
17. Click **Tdd22**.

6.3. Differential Skew

1. Select **Trace 3**.
2. Open **TDR/TDT** tab.
3. Open **Parameters** tab.
4. Select “Time Domain” and “Differential” for Measure.
5. Select Format to “Volt”
6. Click **Tdd21**.
7. Click **Marker Search** and select **Δ Time.**
8. Check **Δ Time.**
9. Select **Target (Stop)** to Trace 3 and click **OK.**

6.4. Insertion Loss (Liner Frequency Sweep)

10. Select **Trace 4**.
11. Open **TDR/TDT** tab.
12. Open **Parameters** tab.
13. Select “S-Parameter” and “Differential” for Measure.
14. Select Format to “Log Mag”
15. Click **Sdd21**.

6.5. Fitted Attenuation

1. Open **TDR/TDT** tab.
2. Open **Trace Control** tab.
3. Click **Trace Settings Copy** to launch trace copy dialog box.
4. Select the Trace 4 in the From list.
5. Select the Trace 5 in the To list.
6. Click **Copy**.
7. Click **Close**.

6.6. Insertion Loss Deviation

1. Open **TDR/TDT** tab.
2. Open **Trace Control** tab.
3. Click **Trace Settings Copy** to launch trace copy dialog box.
4. Select the Trace 4 in the From list.
5. Select the Trace 6 in the To list.
6. Click **Copy**.
7. Click **Close**.

6.7. Common Parameters Setup for Frequency-domain Measurements (Channel 2)

1. Press **Channel Next** to select Channel 2.
2. Press **Start** > Set start value to “50 MHz”.
3. Press **Stop** > Set stop value to “10.3125 GHz”.
4. Press **Sweep Type** > **Log Freq**
5. Press **Sweep Type** > Set **Points** to “1601”
6. Press **Analysis** > **Fixture Simulator** and turn it **ON**.
6. Press **Analysis** > **Fixture Simulator** > **Topology** > **Device** > **Bal-Bal**
7. Press **Analysis** > **Fixture Simulator** > **Topology** > **Port1 (bal) > 1-2**
8. Press **Analysis** > **Fixture Simulator** > **Topology** > **Port2 (bal) > 3-4**
9. Press **Display** > **Num of Traces** > 16.
10. Press **Analysis** > **Fixture Simulator** > **BalUn ON All Traces** to enable mixed-mode S-parameter (i.e. Sdd11) measurements on all traces.
11. Press **Display** > **Allocate Traces** > x4 (2 columns by 2 rows).

6.8. Insertion Loss (Log Frequency Sweep)

1. Press **Trace Next** to select Trace 1.
2. Press **Meas** > **Sdd21**.
3. Press **Scale** > Set **Scale/Div** to 20 dB/div.
4. Press **Scale** > Set **Reference Value** to -60 dB.
5. Press **Display** > **Equation Editor…** > Enter an equation **“IL(LogFreq)=data(1)”**.
6. Check **Enabled** to enable the equation on trace.
7. Click **Apply**.
8. Click **Close**.

Note: The equation editor is used to show the label on the display and no actual calculation is performed.

6.9. Return Loss

1. Press **Trace Next** to select Trace 5.
2. Press **Meas** > **Sdd11**.
3. Press **Scale** > Set **Scale/Div** to 10 dB/div.
4. Press **Scale** > Set **Reference Value** to -30 dB.
5. Press **Display** > **Equation Editor…** > Enter an equation **"RL1=data(5)"**.
6. Check **Enabled** to enable the equation on trace.
7. Click **Apply**.
8. Click **Close**.
9. Press **Trace Next** to select Trace 9.
10. Press **Meas** > **Sdd22**.
11. Repeat the same operations of Step 3 to step 8. For an equation, enter **"RL2=data(9)"**.

Note: The equation editor is used to show the label on the display and no actual calculation is performed.

6.10. Power Sum Differential Near-end Crosstalk (PSNEXT)

1. Press **Trace Next** to select Trace 3.
2. Press **Meas** > **Sdd21**.
3. Press **Display** > **Equation Editor…** > Enter an equation **"NEXT1=data(3)"**.
4. Check **Enabled** to enable the equation on trace.
5. Click **Apply**.
6. Click **Close**.
7. Press **Trace Next** to select Trace 7.
8. Repeat the same operations of Step 2 to step 6. For an equation, enter **"NEXT2=data(7)"**.
9. Press **Trace Next** to select Trace 11.

10. Repeat the same operations of Step 2 to step 6. For an equation, enter **"NEXT3=data(11)"**.
11. Press **Trace Next** to select Trace 15.
12. Repeat the same operations of Step 2 to step 6. For an equation, enter **"NEXT4=data(15)"**.
13. Press **Trace Next** to select Trace 2.
14. Repeat the same operations of Step 2 to step 6. For an equation, enter **"PSNEXT=data(2)"**.

Note: The equation editor is used to show the label on the display and no actual calculation is performed.

6.11. Power Sum Differential Far-end Crosstalk (PSFEXT)

1. Press **Trace Next** to select Trace 4.
2. Press **Meas** > **Sdd21**.
3. Press **Display** > **Equation Editor…** > Enter an equation **"FEXT1=data(4)"**.
4. Check **Enabled** to enable the equation on trace.
5. Click **Apply**.
6. Click **Close**.
7. Press **Trace Next** to select Trace 8.
8. Repeat the same operations of Step 2 to step 6. For an equation, enter **"FEXT2=data(8)"**.
9. Press **Trace Next** to select Trace 12.
10. Repeat the same operations of Step 2 to step 6. For an equation, enter **"FEXT3=data(12)"**.
11. Press **Trace Next** to select Trace 16.
12. Repeat the same operations of Step 2 to step 6. For an equation, enter **"FEXT4=data(16)"**.

13. Press **Trace Next** to select Trace 6.
14. Repeat the same operations of Step 2 to step 6. For an equation, enter **"PSFEXT=data(6)"**.

Note: The equation editor is used to show the label on the display and no actual calculation is performed.

6.12. Power Sum Differential Crosstalk (PSXT)

1. Press **Trace Next** to select Trace 10.
2. Press **Meas** > **Sdd21**.
3. Press **Display** > **Equation Editor…** > Enter an equation **"PSXT=data(10)"**.
4. Check **Enabled** to enable the equation on trace.
5. Click **Apply**.
6. Click **Close**.

Note: The equation editor is used to show the label on the display and no actual calculation is performed.

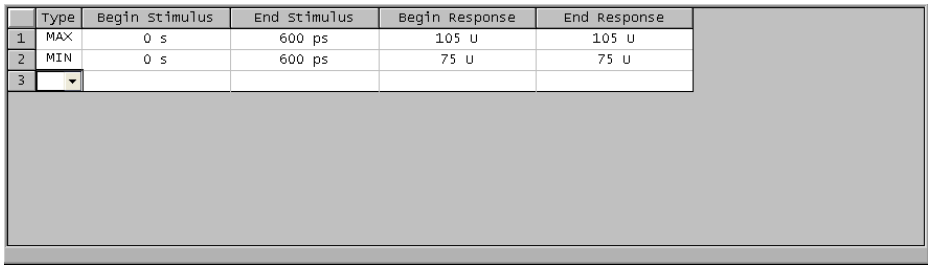
6.13. Insertion Loss to Crosstalk Ratio (ICR)

1. Press **Trace Next** to select Trace 14.
2. Press **Meas** > **Sdd21**.

Note: Do not use the equation editor for this trace.

6.14. Defining Limit Line Tables

1. Press **Trace Next** to select trace to set the limit line table.
2. Press **Analysis** > **Limit Test > Limit Line** and turn it **ON** to display limit lines.
3. Press **Analysis** > **Limit Test > Edit Limit Line** to edit the limit line table.



	Type	Begin Stimulus	End Stimulus	Begin Response	End Response
1	MAX	0 s	600 ps	105 U	105 U
2	MIN	0 s	600 ps	75 U	75 U
3					

4. Press **Analysis** > **Limit Test > Limit Test** and turn it **ON**.
5. Press **Analysis** > **Limit Test > Limit Test** > **Fail Sign** to switch the fail sign ON/OFF. When turned on, the Fail sign is displayed on the E5071C's screen, if one or more failed traces are within the channel.
6. Press **System** > **Misc Setup** > **Beeper** > **Beep Warning** to turn ON/OFF the warning beeper.