10GBASE-KR/40GBASE-KR4
Agilent Method of Implementation (MOI) for
Interconnect Using Agilent E5071C ENA Option TDR
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1. **Revision History**

<table>
<thead>
<tr>
<th>Revision</th>
<th>Comments</th>
<th>Issue Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Initial Revision.</td>
<td>Apr-21, 2014</td>
</tr>
</tbody>
</table>

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**
   - ECal Calibration

3. **Measurements**

   4-1. **Time-domain Measurements**
       - Characteristic Impedance
       - Differential Skew

   4-2. **Frequency-domain Measurements**
       - Fitted Attenuation
       - Insertion Loss
       - Insertion Loss Deviation
       - Return Loss
       - Power Sum Differential Near-end Crosstalk (PSNEXT)
       - Power Sum Differential Far-end Crosstalk (PSFEXT)
       - 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.

![ECal Calibration Wizard](image)

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).

<table>
<thead>
<tr>
<th>E5071C Port</th>
<th>Port 1</th>
<th>Port 2</th>
<th>Port 3</th>
<th>Port 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Point</td>
<td>TP1 +</td>
<td>TP1 -</td>
<td>TP4 +</td>
<td>TP4 -</td>
</tr>
</tbody>
</table>

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 an interconnect should meet requirement.

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

<table>
<thead>
<tr>
<th>E5071C Port</th>
<th>Port 1</th>
<th>Port 2</th>
<th>Port 3</th>
<th>Port 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Point</td>
<td>TP1 +</td>
<td>TP1 -</td>
<td>TP4 +</td>
<td>TP4 -</td>
</tr>
</tbody>
</table>

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.

\[
IL(f) \leq IL_{\text{max}}(f) = A_{\text{max}}(f) + 0.8 + 2.0 \times 10^{-10} f \\
\text{for } f_{\text{min}} \leq f \leq f_2 \\
IL(f) \leq IL_{\text{max}}(f) = A_{\text{max}}(f) + 0.8 + 2.0 \times 10^{-10} f_2 + 1 \times 10^{-3}(f - f_2) \\
\text{for } f_2 \leq f \leq f_{\text{max}}
\]
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.

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

<table>
<thead>
<tr>
<th>( b_1 )</th>
<th>2.00 \times 10^{-5}</th>
</tr>
</thead>
<tbody>
<tr>
<td>( b_2 )</td>
<td>1.10 \times 10^{-10}</td>
</tr>
<tr>
<td>( b_3 )</td>
<td>3.20 \times 10^{-20}</td>
</tr>
<tr>
<td>( b_4 )</td>
<td>-1.20 \times 10^{-30}</td>
</tr>
</tbody>
</table>
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.

\[
ILD(f) \geq ILD_{\text{min}}(f) = -1.0 - 0.5 \times 10^{-9} f \\
ILD(f) \leq ILD_{\text{max}}(f) = 1.0 + 0.5 \times 10^{-9} f
\]

for \( f_1 \leq f \leq f_2 \):

| \( f_1 \) | 0.125 | 0.312 | 1.000 |
| \( f_2 \) | 1.250 | 3.125 | 6.000 |

\( f \) in 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).
5. Confirm the measured return loss meets the limit shown below.

\[
RL(f) \geq RL_{\text{min}}(f) = 12
\]

for 50 MHz \( \leq f < 275 \) MHz and
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 $\text{NEXT}_n$ 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.

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

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 $F_{EXT_n}$ 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.

$$PSFEXT(f) = -10 \log \left( \sum_{n} 10^{-F_{EXT_n}(f)/10} \right)$$

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.

\[
ICR_{fit}(f) \geq ICR_{min}(f) = 23.3 - 18.7 \log_{10}(\frac{f}{5 \text{ GHz}})
\]
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** > x2.
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.
7. Press Analysis > Fixture Simulator > Topology > Device > Bal-Bal
8. Press Analysis > Fixture Simulator > Topology > Port1 (bal) > 1-2
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.
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**.
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.

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.
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.