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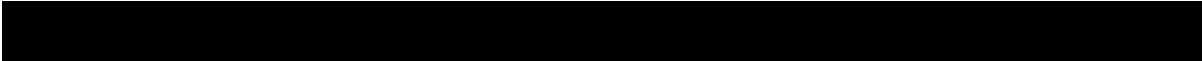
MHL (Mobile High-definition Link) Specification Version 2.0
Agilent Method of Implementation (MOI) for MHL Cables Compliance Tests
Using Agilent E5071C ENA Option TDR

Table of Contents

1. Revision History

Revision	Comments	Issue Date
1.00	Initial Revision.	Feb. 15, 2013

2. Purpose

This test procedure was written to explain how to use the Agilent ENA Option TDR to make the cable measurements required per MHL (Mobile High-definition Link) Specification Version 2.0.

3. References

➢ MHL (Mobile High-definition Link) Specification Version 2.0 (Feb. 2012)

➢ MHL (Mobile High-definition Link) Compliance Test Specification Revision 2.0 (Sep. 2012)

4. Required Equipments

1. E5071C ENA Series Network Analyzer

   ➢ Option 480 or 485 (8.5 GHz) / 4D5 (14 GHz) / 4K5 (20 GHz)

   ➢ Option TDR (Enhanced time domain analysis)

2. Test Fixture

   ➢ Wilder Technologies MHL-TPA-R-WOC (Source)

   ➢ Wilder Technologies MHL-TPA-R-WOSI (Sink)

3. 4-port ECal Module

   ➢ N4431B (for E5071C-480 or 485)

   ➢ N4433A (for E5071C-4D5 or 4K5)

4. Coaxial RF cables

5. 50 Ohm terminators (ex. Agilent 909D-301)

5. Test Procedure

5.1. Outline of Test Procedure

1. **Instrument Setup**

    ➢ Automatic setup by recalling a state file or manual setup.

2. **Calibration**

    ➢ ECal Calibration and Fixture Compensation (Time-domain measurements)

    ➢ ECal Calibration and De-embedding (Frequency-domain measurements)

3. **Measurements**

    4-1. Time-domain Measurements

    - Differential Intra Pair Skew

    - Common-mode Intra Pair Skew

    - Differential Characteristic Impedance

    - Common-mode Characteristic Impedance

    - CBUS Cable Delay

    4-2. Frequency-domain Measurements

    - Differential Insertion Loss

    - Common-mode Insertion Loss

    - Differential to Common-mode Conversion

    - CBUS Insertion Loss

    - CBUS Line Capacitance

    - Far-end Crosstalk

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 MHL cable compliance test. The state file can be downloaded at:

www.agilent.com/find/ena-tdr_mhl-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.
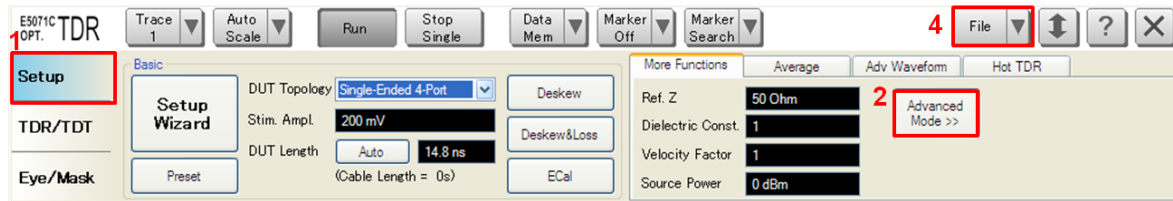
3.   A dialog box appears requesting for confirmation. Then click **Yes**. (Uncheck "Use Advanced Calibration Methods")
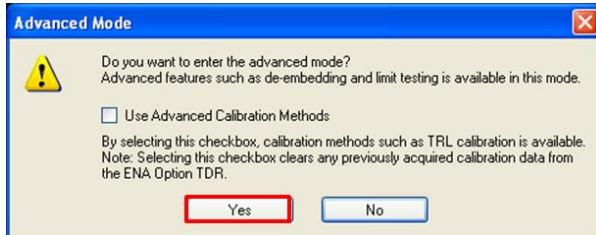
4.   Click **File** and select **Recall State** to open the Recall State dialog box.

5.   Specify a folder and a file name, and click **Open**.

The E5071C's channel 1 is used for time-domain measurements by using the TDR software at the bottom of the E5071C's screen. The channel 2 is used for frequency-domain

measurements by using the soft key on the right side of the screen or hard key on the front panel.
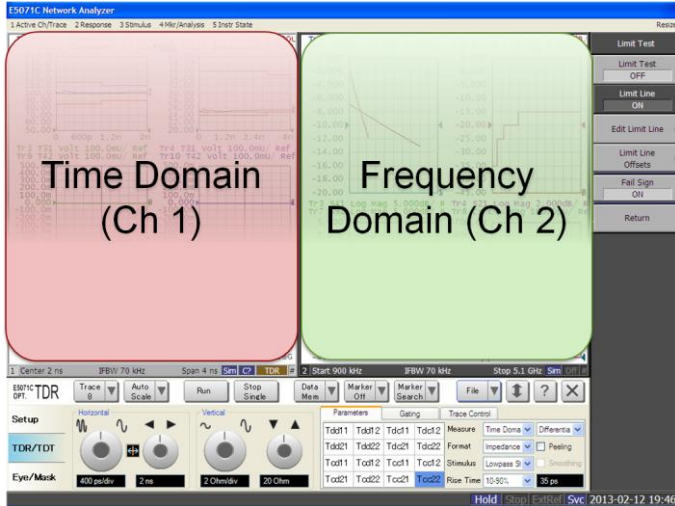
5.2.2. Saving a State File

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

5.3. Calibration

5.3.1. Time Domain Calibration

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 ENA option TDR software. Full calibration is performed by using the 4-port ECal Module at the end of RF cables connected to the ENA test ports. After connecting the test fixture to the cables, the effect of the fixture is removed by the fixture compensation function of the TDR software. This calibration is applied for time-domain measurements in Channel 1.

5.3.1.1. ECal Calibration & Fixture Compensation

Calibration for time-domain measurements (except CBUS Line Capacitance) is performed by the TDR software. The 4-port ECal Module (i.e. N4431B) connected to 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>**.
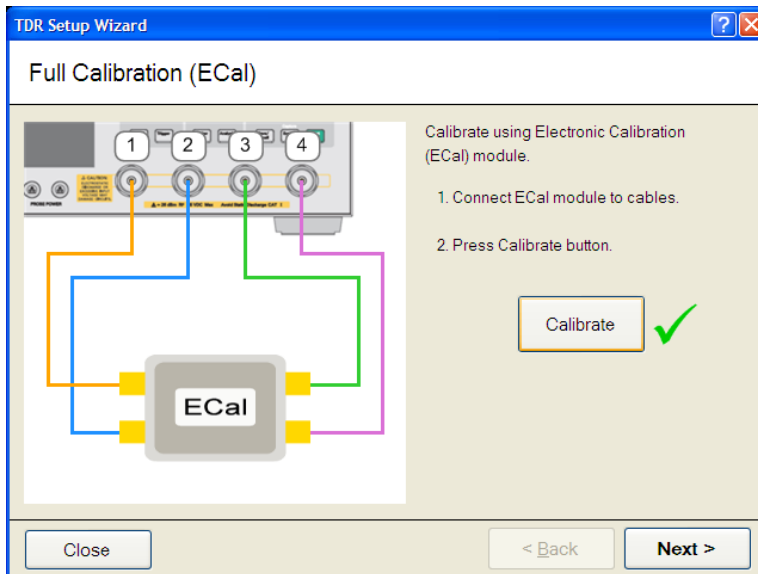
5. Disconnect the ECal Module and connect the test fixtures to the RF cables. Click **Fixture Comp** to perform fixture compensation. Once green check mark appears, click **Finish** to complete the compensation.
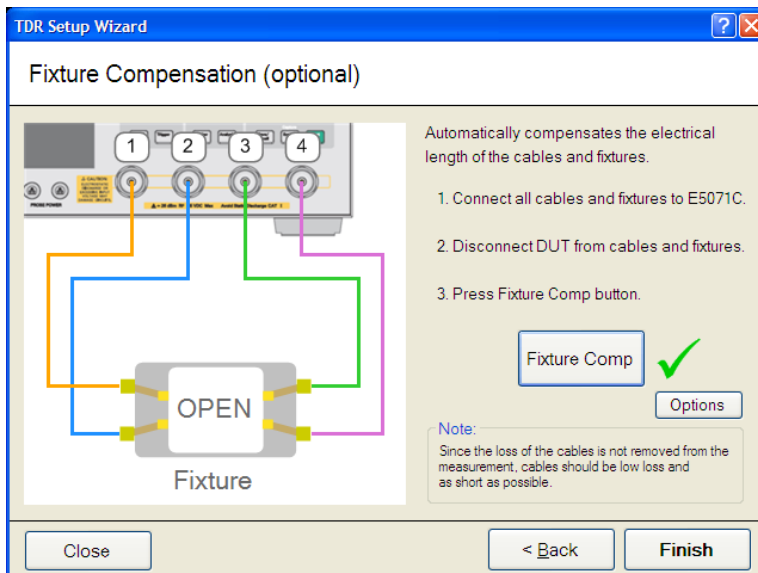
6. Connect DUT to the test fixtures.

7. Open **Setup** tab.

8. Click **Auto** to launch the diagram.
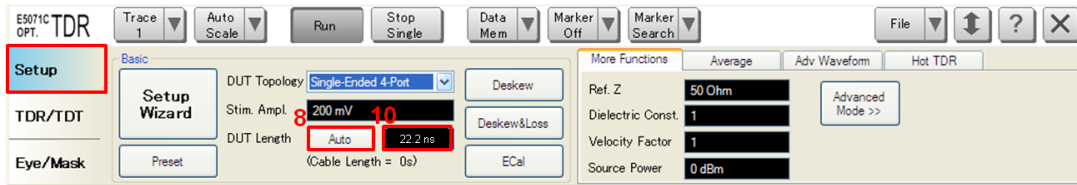
9. Click **Measure** to specify DUT's electrical length in the dialog box. Once green check mark appears, click **Finish**.
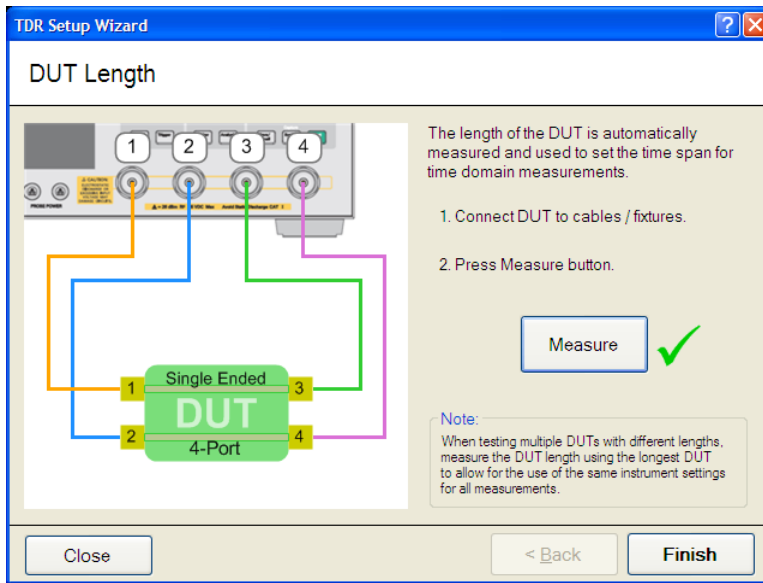
10. Read DUT Length and confirm it is over 18 ns. Otherwise input 18 ns in the field.

5.3.1.2.   Adjustment of Effective Rise Time

The effective rise time is adjusted for the specification of characteristic impedance measurements. DUT is disconnected during the adjustment procedure.

1. Open **TDR/TDT** tab.

2. Click **Trace x**.

   ➢ Trace 1 & Trace 7 for Differential Characteristic Impedance.

   ➢ Trace 2 & Trace 8 for Common-Mode Characteristic Impedance.

3. Click **Parameter** tab.

4. Select "Time Domain" and "Differential" for Measure.

5. Select Format to "Volt".

6. Click **Marker Search** and select "Rise Time (20 – 80%)".

7. Press **Run** to measure the rise time on the screen.

8. Enter rise time until the measure rise time is close to the specified value.

   ➢ "200 ps" for Differential Characteristic Impedance.

   ➢ "600 ps" for Common-Mode Characteristic Impedance.

9. Click **Marker Search** and select "Rise Time (20 – 80%)" to turn off the marker.

10. Select Format to "Impedance".
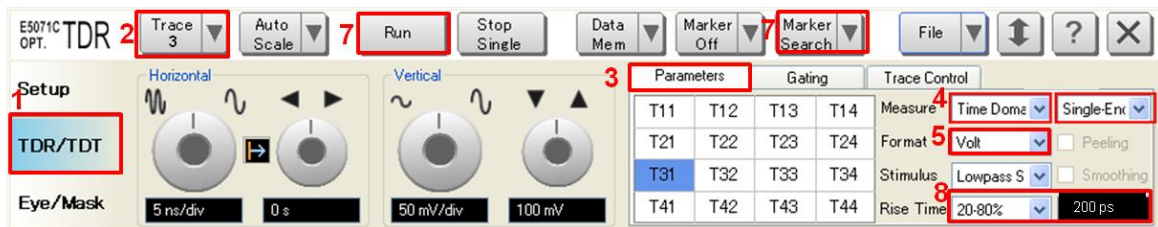
5.3.2.   Frequency Domain Calibration

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 ENA test ports. The fixture effect will be eliminated by de-embedding S-parameters (*.s4p or .s2p) of the fixture. The S-parameter data is provided by fixture vendors.

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 ENA's soft key. The 4-port ECal Module (i.e. N4431B) connected to the E5071C is necessary for the calibration procedure.

1. Press **Channel Next** key to select Channel 2.

2. Connect all test cables to the ECal Module.

3. Press **Calibrate** > **ECal** > **4-Port Cal.**

5.3.2.2.   De-embedding Fixture

The effect of the test fixtures are removed by a de-embedding function of the E5071C's firmware. 4-port Touchstone files (*.s4p) are used to compensate differential transmission lines of the fixtures, while 2-port Touchstone files (*.s2p) are used for compensation of the single-ended lines.

The following 4-port fixture compensation is applied to 4-port measurements such as Differential Insertion Loss, Common-Mode Insertion Loss, Differential and Common-Mode conversion, and Far-End Crosstalk measurements.

1. Press **Trace Next** to select trace.

2. Press **Analysis** > **Fixture Simulator** and turn it **ON.**

3. Press **Analysis** > **Fixture Simulator** > **De-Embedding SnP > Topology > Select Topology** to select topology **C.**

4. Press **Analysis** > **Fixture Simulator** > **De-Embedding SnP > Topology > Ports >** to select **1-2-3-4.**

5. Press **Analysis** > **Fixture Simulator** > **De-Embedding SnP > Topology > User File (nwk1)** and specify a 4-port de-embedding file (*.s4p) for the Source fixture.

6. Press **Analysis** > **Fixture Simulator** > **De-Embedding SnP > Topology > Type (nwk1)** and select **De-embed**.

7. Press **Analysis** > **Fixture Simulator** > **De-Embedding SnP > Topology > User File (nwk2)** and specify a de-embedding file (*.s4p) for the Sink fixture.

8. Press **Analysis** > **Fixture Simulator** > **De-Embedding SnP > Topology > Type (nwk2)** and select **De-embed**.

9. Press **Analysis** > **Fixture Simulator** > **De-Embedding SnP > De-Embedding SnP** and turn it **ON.**

The following 2-port fixture compensation is applied to CBUS Insertion Loss measurement.

1. Press **Analysis** > **Fixture Simulator** and turn it **ON.**

2. Press **Analysis** > **Fixture Simulator** > **De-Embedding > Select Port > 1.**

3. Press **Analysis** > **Fixture Simulator** > **De-Embedding > User File** and specify a 2-port de-embedding file (*.s2p) for the Source fixture.

4. Press **Analysis** > **Fixture Simulator** > **De-Embedding > Select Type** to set to **User.**

5. Press **Analysis** > **Fixture Simulator** > **De-Embedding > Select Port > 2.**

6. Press **Analysis** > **Fixture Simulator** > **De-Embedding > User File** and specify a 2-port de-embedding file (*.s2p) for the Sink fixture.

7. Press **Analysis** > **Fixture Simulator** > **De-Embedding > Select Type** to set to **User.**

Note that the fixture compensation is not performed for CBUS Line Capacitance measurement.

5.4.   Measurement

5.4.1.   Differential Intra-Pair Skew

1. Connect DUT (Figure 5-1).
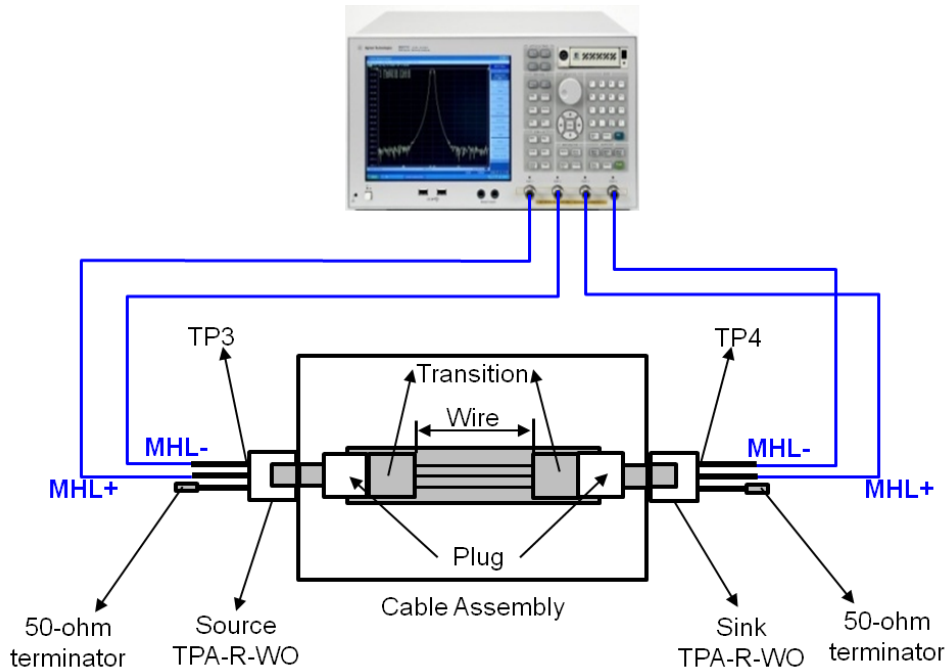
Figure 5-1. Differential Intra-Pair Skew Test Setup

Note: Unused fixture pots should be terminated with 50 ohm terminators.

2. Select **Trace 3**.

3. Press **Stop Single**.

4. Click **Auto Scale** and select "X & Y" for auto scaling the x-axis and y-axis. Record the transition point of x-axis (in sec).

5. Click the box below the right knob under Horizontal. Set the horizontal value to the above transition point in a dialog box, so that the transition point can be centered.

6. Select **Trace 9** and repeat the same operations, step 4 to 5.

7. Select **Trace 3**.

8. Click **Marker Search** and select **Δ Time** to show the dialog box.

9. Check the **Δ Time**.

10. Select **Target (Stop)** to Trace 9 (T42).

11. Input **Position (%)** to 50.

12. Click **OK**.
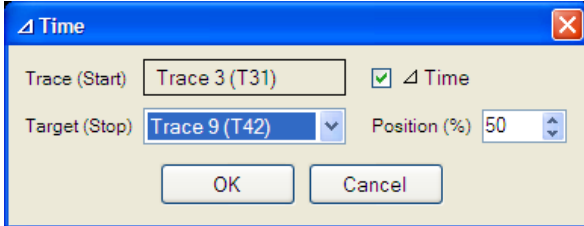
13. Confirm the measured intra-pair skew is within the limit. If common-mode intra-pair skew is less than or equal to 43 ps, then PASS. Otherwise FAIL.

5.4.2. Common-mode Intra-Pair Skew

1. Connect DUT (Figure 5-1).

2. Select **Trace 4**.

3. Press **Stop Single**.

4. Click **Auto Scale** and select "X & Y" for auto scaling the x-axis and y-axis. Record the transition point of x-axis (in sec).

5. Click the box below the right knob under Horizontal. Set the horizontal value to the above transition point in a dialog box, so that the transition point can be centered.

6. Select **Trace 10** and repeat the same operations, step 4 to 5.

7. Select **Trace 4**.

8. Click **Marker Search** and select **Δ Time** to show the dialog box.

9. Check the **Δ Time**.

10. Select **Target (Stop)** to Trace 10 (T42).

11. Input **Position (%)** to 50.

12. Click **OK**.

13. Confirm the measured intra-pair skew is within the limit. If common-mode intra-pair skew is less than or equal to 43 ps, then PASS. Otherwise FAIL.

5.4.3.   Differential Characteristic Impedance

1.   Connect DUT (Figure 5-1).

2.   Select **Trace 1**.

3.   Press **Stop Single**.

4.   Confirm the measured characteristic impedance is within the limit shown in Table 5-1.

5.   Select **Trace 7** and repeat the same operations of step 2 to 4 for the sink end of the DUT (Sdd22).

Table 5-1 Differential Characteristic Impedance Limit

	Min	Max	Unit	Note
MHL+ and MHL- Differential Impedance	85	115	Ohm	*1
	90	110	Ohm	*2

*1. Connection point and transition area, up to 1 ns distance. A single excursion is permitted out to 65-125 ohms, no wider than 250 ps.

*2. Cable area, from 1 ns to 2 ns distance.

5.4.4.   Common-mode Characteristic Impedance

1.   Connect DUT (Figure 5-1).

2.   Select **Trace 2**.

3.   Press **Stop Single**.

4.   Confirm the measured characteristic impedance is within the limit shown in Table 5-2.

5.   Select **Trace 8** and repeat the same operations of step 2 to 4 for the sink end of the DUT (Scc22).

6.   Confirm the measured characteristic impedance is within the limit shown in Table 5-2.

Table 5-2 Common-mode Characteristic Impedance Limit

	Min	Max	Unit	Note
MHL Clock Common-mode Impedance	24	36	Ohm	*1
	25	35	Ohm	*2

*1. Connection point and transition area, up to 3 ns distance. A single excursion is permitted out to 20-40 ohms, no wider than 500 ps.

*2. Cable area, from 3 ns to 4 ns distance.

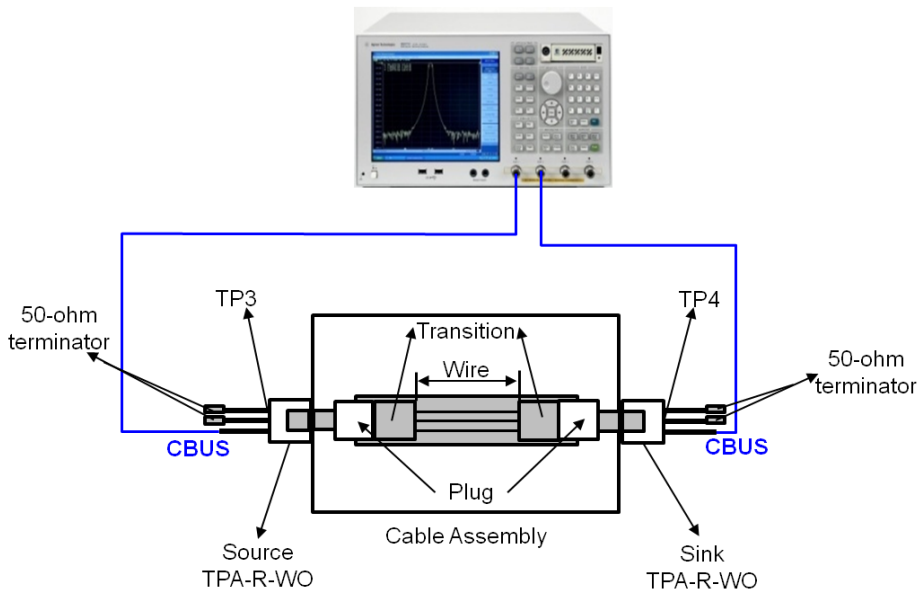### 5.4.5.   CBUS Cable Delay

1. Connect DUT (Figure 5-2).

Figure 5-2. CBUS Cable Delay Test Setup

2. Select **Trace 5**.

3. Press **Stop Single**.

4. Click **Auto Scale** and select "X" for auto scaling the x-axis.

5. Press **Marker Search** > **Target** > **Target Value** and enter "0.1".

6. Confirm the measured CBUS Cable Delay is within the limit. If the delay is less than or equal to 35 ns, then PASS. Otherwise FAIL.

5.4.6.   Differential Insertion Loss

1. Connect DUT (Figure 5-1).

2. Press **Channel Next** to select Channel 2.

3. Press **Trace Next** to select Trace 1 (Sdd21).

4. Press **Start** > and set start frequency to **1 MHz.**

5. Press **Stop** > and set stop frequency to **5.1 GHz.**

6. Press **Trigger** > **Single**.

7. Confirm the measured differential insertion loss is lower than the limit shown in Table 5-3.

Table 5-3 Differential Insertion Loss Limit

Frequency (MHz)	Attenuation (dB)
0	2.25
825	5.5
2475	12.0
4125	18.0
5100	21.5

5.4.7.   Common-mode Insertion Loss

1. Connect DUT (Figure 5-1)

2. Press **Trace Next** to select Trace 4 (Scc21).

3. Press **Start** > and set start frequency to **1 MHz.**

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4. Press **Stop >** and set stop frequency to **1.125 GHz.**

5. Press **Trigger > Single**.

6. Confirm the measured common-mode insertion loss is lower than the limit shown in Table 5-4.

Table 5-4 Common-Mode Insertion Loss Limit

Frequency (MHz)	Attenuation (dB)
0	0.5
25	1.5
125	3.0
375	5.5
1125	12.0

5.4.8.   Differential to Common-mode Conversion

1. Connect DUT (Figure 5-1).

2. Press **Trace Next** to select Trace 2 (Sdc21).

3. Press **Start >** and set start frequency to **1 MHz.**

4. Press **Stop >** and set stop frequency to **5.1 GHz.**

5. Press **Trigger > Single**.

6. Confirm the measured differential to common-mode conversion is lower than the limit shown in Table 5-5.

Table 5-5 CBUS Line Capacitance Limit

Frequency (MHz)	Attenuation (dB)
0 to 300	-35
>300 to 675	-25
>675 to 1500	-20
>1500 to 5100	-15

7. Press **Trace Next** to select Trace 6 (Scd21).

8. Confirm the measured trace is lower than the limit in Table 5-5.

5.4.9. CBUS Insertion Loss

1. Connect DUT (Figure 5-2.)

2. Press **Trace Next** to select Trace 4 (S21).

3. Press **Start >** and set start frequency to **1 MHz.**

4. Press **Stop >** and set stop frequency to **300 MHz.**

5. Press **Trigger > Single**.

6. Confirm the measured insertion loss is higher than the limit shown in Table 5-6.

Table 5-6 CBUS Insertion Loss Limit

Frequency (MHz)	Attenuation (dB)
0	0.5
1	0.5
10	0.8
100	2.8
300	7.0

5.4.10. CBUS Line Capacitance

1. Press **Trace Next** to select Trace 8 (S11).

2. Press **Start >** and set start frequency to **900 kHz.**

3. Press **Stop >** and set stop frequency to **1.1 MHz.**

4. Connect the test cables to the test fixture. (The DUT is not connected in this step.)

5. Press **Trigger > Single**.

6. Press **Marker >** and enter "1 MHz" for Marker 1. Record the marker value ($C_{FIXTURE}$).

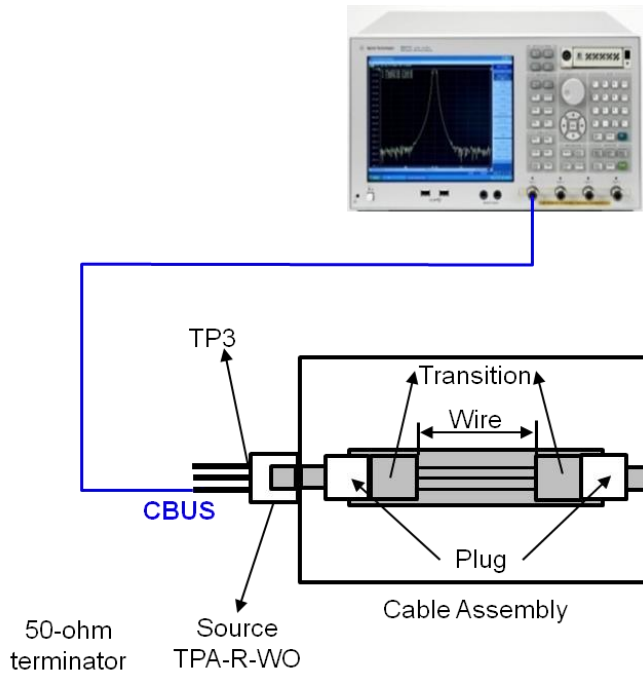7. Connect the DUT to the test fixture. (Figure 5-3).

Figure 5-3   CBUS Line Capacitance Test Setup

8. Press **Trigger > Single**.

9. Press **Marker** > and enter "1 MHz" for Marker 1. Record the marker value (C_{TOTAL}).

10. Confirm the capacitance ($C_{CBUS} = C_{TOTAL} - C_{FIXTURE}$) is within the limit shown in Table 5-7.

Table 5-7 CBUS Line Capacitance Limit

	Min	Max	Unit	Note
CBUS Line Capacitance	30	350	pF	*1

*1. Minimum capacitance on CBUS is required to limit rise and fall times when connecting with minimum load, as from a Source to Dongle with minimum cable length.

5.4.11. Far-End Crosstalk
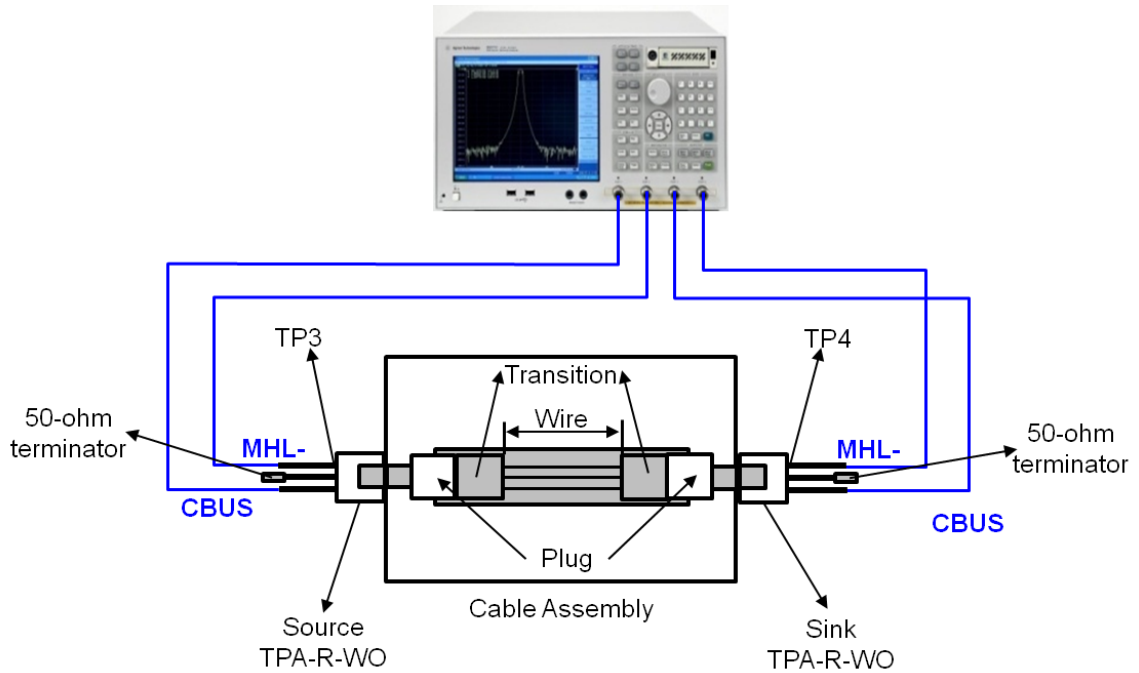
5.4.11.1. Connections

Figure 5-4   Far-End Crosstalk Test Setup (MHL- & CBUS)

The 4-port S-parameter measurements for Far-End Crosstalk are performed for the following combinations (Table 5-7). The test ports of the E5071C (Port 1 to 4) are connected to the ports of test fixtures.

Table 5-8 Test Port Connections for Far-End Crosstalk Measurements

Lines / Ports	Port 1	Port 2	Port 3	Port 4
MHL- & CBUS	Source MHL-	Source CBUS	Sink MHL-	Sink CBUS
MHL+ & VBUS	Source MHL+	Source VBUS	Sink MHL+	Sink VBUS
MHL- & CBUS	Source MHL-	Source CBUS	Sink MHL-	Sink CBUS
CBUS & VBUS	Source CBUS	Source VBUS	Sink CBUS	Sink VBUS

5.4.11.2. Measurement and Data Analysis

1. Connect DUT (Figure 5-4).

2. Press **Trace Next** to select Trace 3 (S41).

3. Press **Start >** and set start frequency to **1 MHz.**

4. Press **Stop >** and set stop frequency to **5.1 GHz.**

5. Press **Trigger > Single**.

6. Confirm the measured far-end crosstalk is lower than the limit shown in Table 5-9.

7. Press **Trace Next** to select Trace 7 (S32).

8. Confirm the measured far-end crosstalk is lower than the limit shown in Table 5-9.

Table 5-9 Far-End Crosstalk Limit between MHL and CBUS or VBUS

Frequency	Attenuation (dB)
0 to 30 MHz	-30
>30 M to 300 MHz	-20
>300 M to 5.1 GHz	-15 (*)

(*) Excursions are permitted to -11.5 dB for the frequency range of 825 to 5100 MHz if the differential insertion loss of the cable meets the below:

Table 5-10 Differential Insertion Loss Limit for Far-End Crosstalk Excursion

Frequency (MHz)	Attenuation (dB)
0	2.0
825	2.0
2475	8.0
4125	14.5
5100	18.0

9. Repeat the same measurements for all the connections in Table 5-8. When measuring crosstalk between CBUS and VBUS lanes, confirm the measured crosstalk is lower

than the limit shown in Table 5-11.

Table 5-11 Far-End Crosstalk Limit between CBUS and VBUS

| Frequency	Attenuation (dB)
0 to 75 MHz	-25
>75 M to 225 MHz	-20
>225 M to 375 MHz	-15
>375 M to 1.125 GHz	-10

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_mhl-cabcon

6.1. Channel & Trace Setup

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 "Single-Ended 4-Port". Click **OK** in a dialog box.
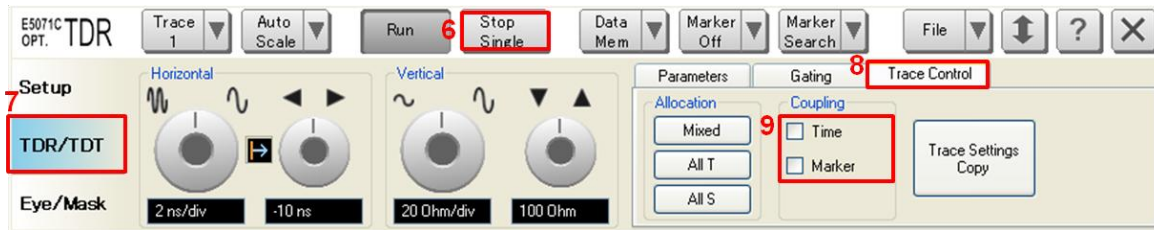
4. Click **Advanced Mode>>**.
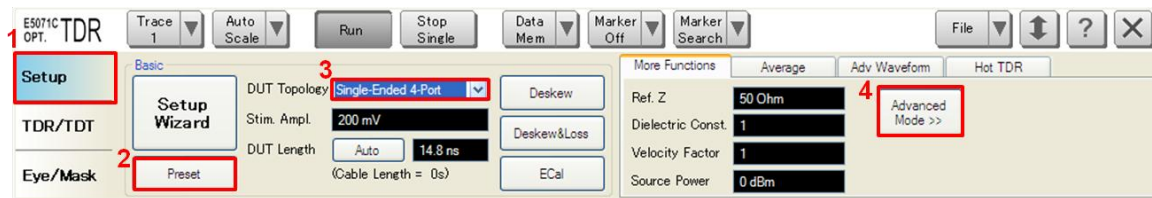
5. A dialog box appears requesting for confirmation. Then click **Yes**. (Clear the check box for "Use Advanced Calibration Methods")
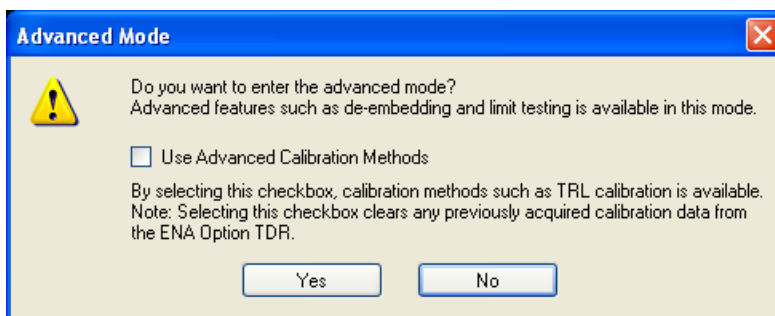
6. Click **Stop Single**.

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** > 10.

12. Press **Display** > **Allocate Traces** > x6 (2 columns by 3 rows).

13. Press **Channel Max** to maximize the screen of channel 1.

6.2.   Differential Intra-Pair Skew

6.2.1.   Parameter Setup

1.   Select **Trace 3.**

2.   Open **Parameters** tab.

3.   Select "Time Domain" and "Single-Ended" for Measure.

4.   Select Formant to "Volt".

5.   Click **T31**.
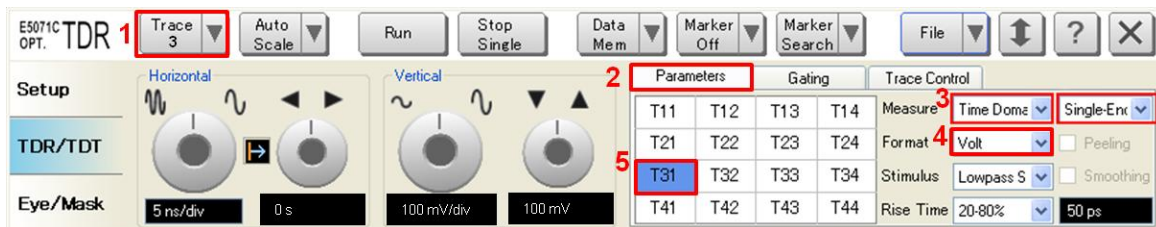
6.   Open **Trace Control** tab.

7.   Click **Trace Settings Copy** to launch trace copy dialog box.

8.   Select Trace 3 in the From list.

9. Select Trace 9 in the To list.
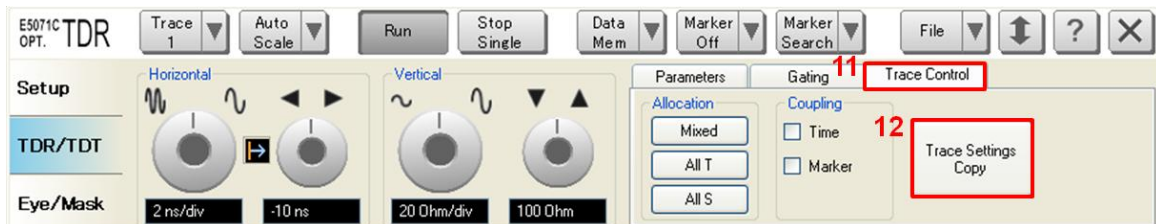
10. Click **Copy**.

11. Click **Close**.

12. Select **Trace 9.**

13. Open **Parameters** tab.

14. Click **T42**.

6.2.2.   Crosstalk Compensation

1. Select **Trace 3.**

2. Press **Display** > **Equation Editor…** > Enter an equation **"S31-S32"**.

3. Check **Enabled** to enable the equation on trace.

4. Click **Apply**.

5. Click **Close**.

6. Select **Trace 9.**

7. Press **Display** > **Equation Editor…** > Enter an equation **"-S42+S41"**.

8. Check **Enabled** to enable the equation on trace.

9. Click **Apply**.

10. Click **Close**.

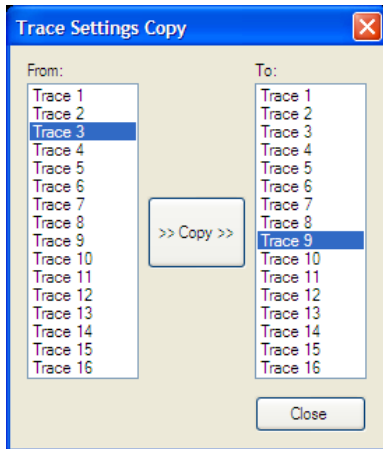## 6.3.   Common-Mode Intra-Pair Skew

6.3.1.   Parameter Setup

1. Open **Trace Control** tab.

2. Click **Trace Settings Copy** to launch trace copy dialog box.

3. Select the **Trace 3** in the From list.

4. Select the **Trace 4** in the To list.

5. Select the **Trace 10** in the To list.

6. Click **Copy**.
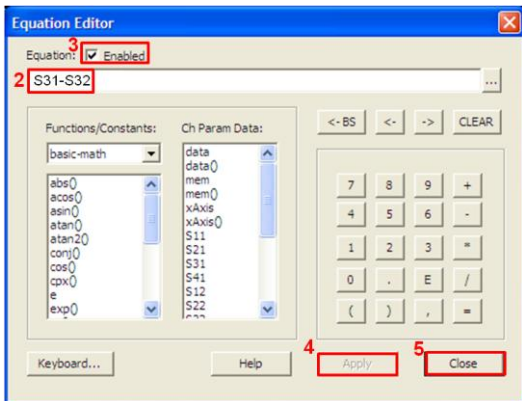
7. Click **Close**

8. Select **Trace 10**.

9. Open **Parameters** tab.

10. Click **T42**.

6.3.2. Crosstalk Compensation

1. Select **Trace 4.**

2. Press **Display** > **Equation Editor…** > Enter an equation **"S31+S32"**.

3. Check **Enabled** to enable the equation on trace.

4. Click **Apply**.

5. Click **Close**.

6. Select **Trace 10.**

7. Press **Display** > **Equation Editor…** > Enter an equation **"S42+S41"**.

8. Check **Enabled** to enable the equation on trace.

9. Click **Apply**.

10. Click **Close**.

6.4. Differential Characteristic Impedance

1. Select **Trace 1**.

2. 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 Horizontal. Set the horizontal scale to "200 ps/div" in a dialog box.

8. Click the box below the right knob under Horizontal. Set the horizontal center to "1 ns" in a dialog box.

9. Click the box below the left knob under Vertical. Set the vertical scale to "10 Ohm/div" in a dialog box.

10. Click the box below the right knob under Vertical. Set the vertical center to "50 Ohm" in a dialog box.

11. Open **Trace Control** tab.

12. Click **Trace Settings Copy** to launch trace copy dialog box.

13. Select the Trace 1 in the From list.

14. Select the Trace 7 in the To list.

15. Click **Copy**.

16. Click **Close**.

17. Select **Trace 7**.

18. Open **Parameter** tab.

19. Click **Tdd22**.

6.5. Common-Mode Characteristic Impedance

1. Select **Trace 2**.

2. Open **Parameters** tab.

4. Select "Time Domain' and "Differential" for Measure.

5. Select Format to "Impedance"

6. Click **Tcc11**.

7. Click the box below the left knob under Horizontal. Set the horizontal scale to "400 ps/div" in a dialog box.

8. Click the box below the right knob under Horizontal. Set the horizontal center to "2 ns" in a dialog box.

9. Click the box below the left knob under Vertical. Set the vertical scale to "2 Ohm/div" in a dialog box.

10. Click the box below the right knob under Vertical. Set the vertical center to "20 Ohm" in a dialog box.

11. Open **Trace Control** tab.

12. Click **Trace Settings Copy** to launch trace copy dialog box.

13. Select the Trace 2 in the From list.

14. Select the Trace 8 in the To list.

15. Click **Copy**.

16. Click **Close**.

17. Select **Trace 8**.

18. Open **Parameters** tab.

19. Click **Tcc22**.

6.6. CBUS Cable Delay

1. Select **Trace 5**.

2. Open **Parameters** tab.

3. Select "Time Domain" and "Single-Ended' for Measure.

4. Select Format to "Volt"

5. Click **T21**.

6. Click the box below the left knob under Vertical. Set vertical scale to "100 mV/div" in a dialog box.

7. Click the box below the right knob under Vertical. Set vertical center to "100 mV" in a dialog box.

The following procedures are manual setup for frequency domain measurements.

6.7. Common Parameters Setup for Frequency-domain Measurements

1. Press **Channel Next** to select Channel 2.

2. Press **Sweep Setup** > **Points** and set to "1,601".

3. Press **Start** > Set start value to "900 kHz".

4. Press **Stop** > Set stop value to "5.1 GHz".

5. 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** > 8.

10. Press **Display**.> **Allocate Traces** > x4 (2 columns by 2 rows).

6.8. Differential Insertion Loss

1. Press **Trace Next** to select Trace 1.

2. Press **Analysis** > **Fixture Simulator** > **BalUn** and turn it **ON**

3. Press **Analysis** > **Fixture Simulator** > **Measurement** > **Sdd21**.

4. Set **Scale/Div** to 5 dB/div.

5. Set **Reference Value** to -10 dB.

6.9. Common-Mode Insertion Loss

1. Press **Trace Next** to select Trace 5.

2. Press **Analysis** > **Fixture Simulator** > **BalUn** and turn it **ON**

3. Press **Analysis** > **Fixture Simulator** > **Measurement** > **Scc21**.

4. Set **Scale/Div** to 2 dB/div.

5. Set **Reference Value** to -10 dB.

6.10. Differential and Common-mode Conversion

1. Press **Trace Next** to select Trace 2.

2. Press **Analysis** > **Fixture Simulator** > **BalUn** and turn it **ON**

3. Press **Analysis** > **Fixture Simulator** > **Measurement** > **Sdc21**.

4. Set **Scale/Div** to 5 dB/div.

5. Set **Reference Value** to -20 dB.

6. Press **Trace Next** to select Trace 6.

7. Press **Analysis** > **Fixture Simulator** > **BalUn** and turn it **ON**

8. Press **Analysis** > **Fixture Simulator** > **Measurement** > **Scd21**.

9. Set **Scale/Div** to 5 dB/div.

10. Set **Reference Value** to -20 dB.

6.11. CBUS Insertion Loss

1. Press **Trace Next** to select Trace 4.

2. Press **Meas** > **S21.**

3. Press **Scale** > Set **Scale/Div** to 2 dB/div.

4. Press **Scale** > Set **Reference Value** to -8 dB.

6.12. Far-End Crosstalk

1. Press **Trace Next** to select Trace 3.

2. Press **Meas** > **S41.**

3. Press **Scale** > Set **Scale/Div** to 5 dB/div.

4. Press **Scale** > Set **Reference Value** to -20 dB.

5. Press **Trace Next** to select Trace 7.

6. Press **Meas** > **S32.**

7. Press **Scale** > Set **Scale/Div** to 5 dB/div.

8. Press **Scale** > Set **Reference Value** to -20 dB.

6.13. CBUS Line Capacitance

1. Press **Trace Next** to select Trace 8.

2. Press **Meas** > **S11.**

3. Press **Format** > **Lin Mag.**

4. Press **Display** > **Equation Editor…** > Enter an equation **"Cs = -1/(2*PI*xAxis*im(50*(1+S11)/(1-S11)))"**.

5. Check **Enabled** to enable the equation on trace.

6. Click **Apply**.

7. Click **Close**.

8. Press **Scale** > Set **Scale/Div** to 100 pU/div.

9. Press **Scale** > Set **Reference Value** to -300 pU.

6.14. Defining Limit Line Tables

1. Press **Trace Next** to select trace to set the limit line table.

2. Press **Analysis** > **Limit Line** and turn it **ON** to display limit lines.

3. Press **Analysis** > **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** and turn it **ON**.

5. Press **Analysis** > **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.