GT-23-047

Glenair El Ochito Red

High Speed Characterization Report for Differential Applications

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Revision History

Rev	Date	Approved	Description
A	11/28/2023	L. Blackwell	Initial Release

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1. Introduction

This document contains results from testing that was performed to evaluate the high-frequency electrical performance of the Glenair El Ochito Red contact. This report outlines frequency domain performance metrics such as insertion loss (IL) and return loss (RL) as well as the time-domain performance metric of impedance.

2. Product Overview

High speed, harsh environment El Ochito® octaxial contacts save size and weight. Suitable for aircraft avionics, weapons systems, satellites, radars, communications equipment and other aerospace/defense gear, El Ochito® contacts are optimized for 40G Ethernet, SuperSpeed USB and other multi-gigabit datalink protocols including HDMI, DisplayPort and SATA. Available discrete contacts and jumper assemblies are readily incorporated into Glenair aerospace-grade circular and rectangular connectors.

3. Test Setup

This section details the test assemblies, test PCBs and equipment used to perform the high-speed characterization. All measurements were taken using a Tektronix DSA8300 Digital Serial Analyzer and a Keysight N5227B PNA network analyzer which were connected to SMA launch test fixture PCBs designed specifically for this testing.

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3.1.Test Fixtures

3.1.1. Test PCBs

PCB test fixtures utilizing edge-launch SMA connectors were designed for the high-speed tests. Each set consisted of two El Ochito to SMA boards and a calibration board. One test set used straight, Series 792, PCB-mount connectors, part numbers 792-005SA-1P1MNAC and 792-006PA-1P1MNNAC. The other set used right-angle, Series 792, PCB-mount connectors, part numbers 792-010PA-1P1MENAC and 792-009SA-1P1MNAC. Photographs of the test boards are seen in the following two figures.

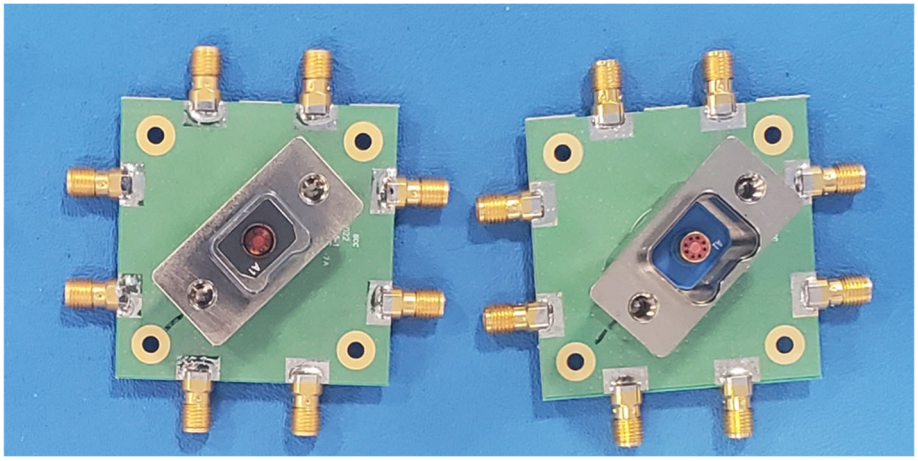

Figure 1. Straight El Ochito Test PCB Set

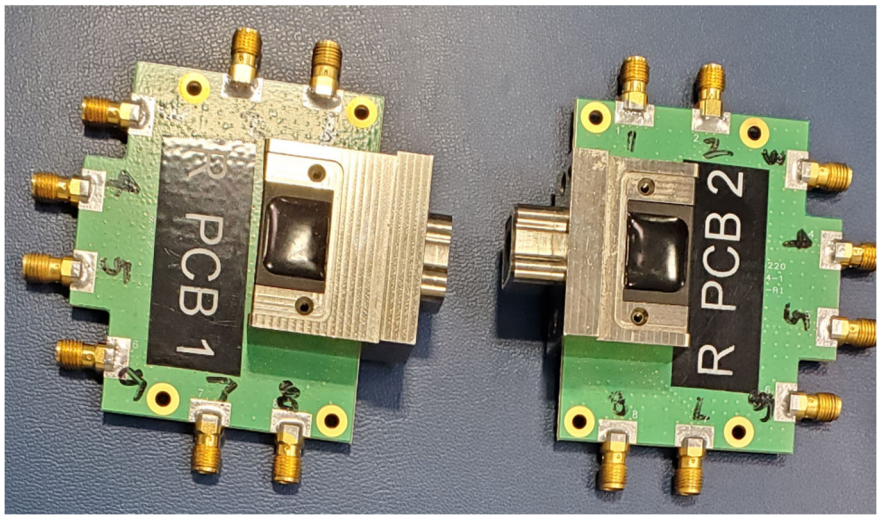

Figure 2. Right-Angle El Ochito Test PCB Set

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The board sets were manufactured as a single panel and separated into individual test boards to give consistent signal characteristics.

3.1.2. Test Cable Assemblies

The test cable assemblies consisted of a Series 792 plug connector, part number 792-001SA-1W1MN, with 858-049 contacts, and a Series 792 receptacle connector, part number 792-002PA-1W1MNN, with 858-050 contacts. The test cable assemblies are shown in Figure 3.

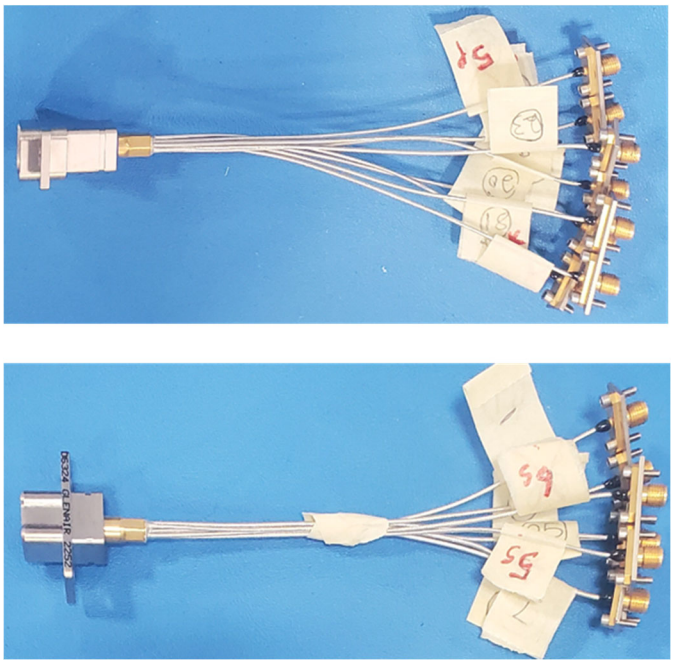

Figure 3. El Ochito Test Cable Assembly Set

3.2.Test Pairs

The encircled signal pin locations shown in the figure below denotes differential test pairs.

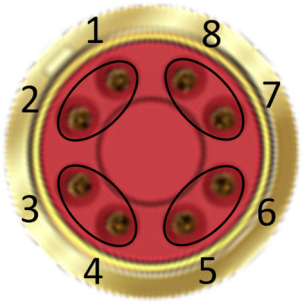

Figure 4. El Ochito Red Test Pairs

4. Straight El Ochito Red Performance

This section includes both frequency and time domain results. Test fixture PCB loss has been de-embedded to show the performance of the assembly only.

4.1.Frequency Domain Analysis

4.1.1. Insertion Loss / Return Loss

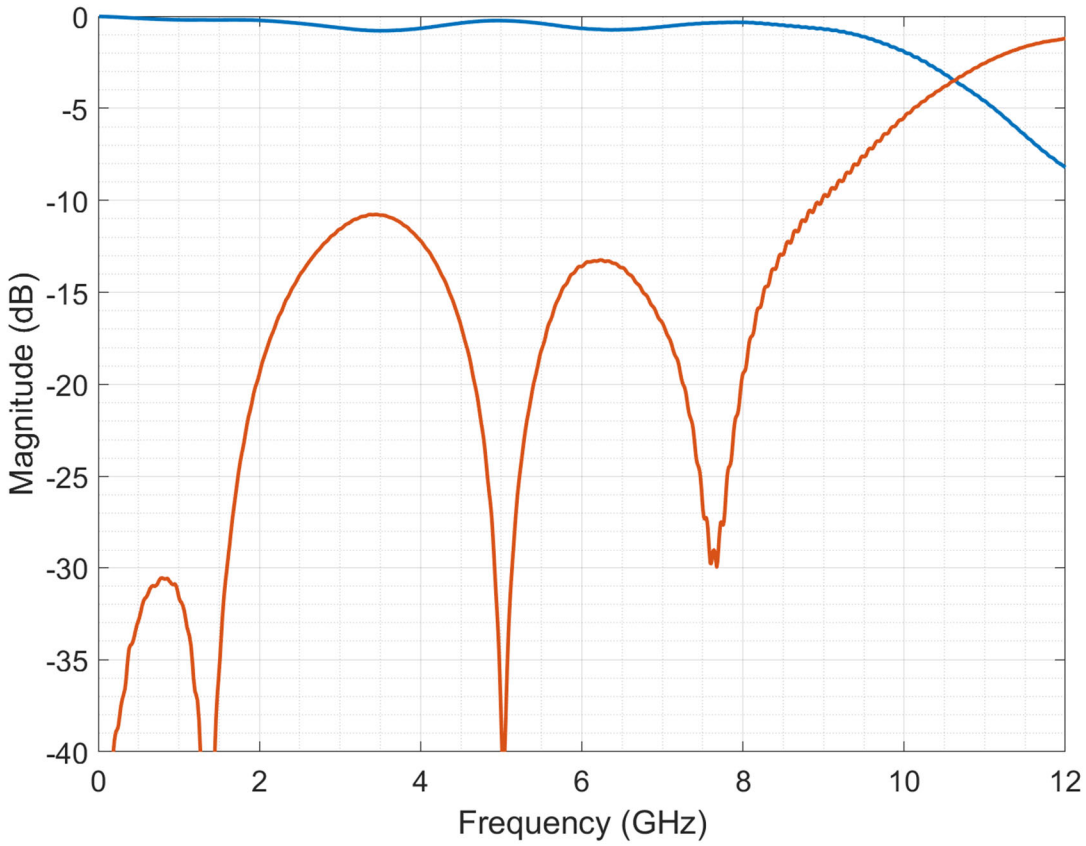

Figure 5. Straight El Ochito Red Response

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4.1.2. Straight El Ochito Red Crosstalk

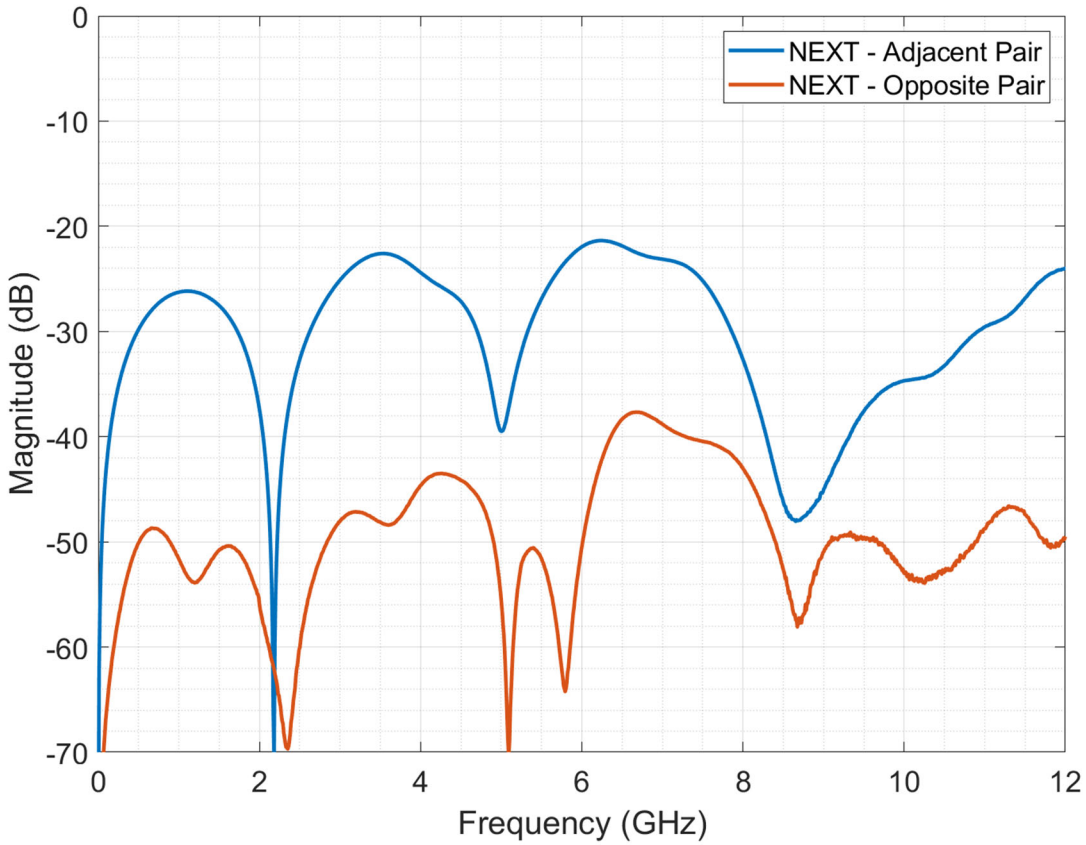

Figure 6. Straight El Ochito Red NEXT

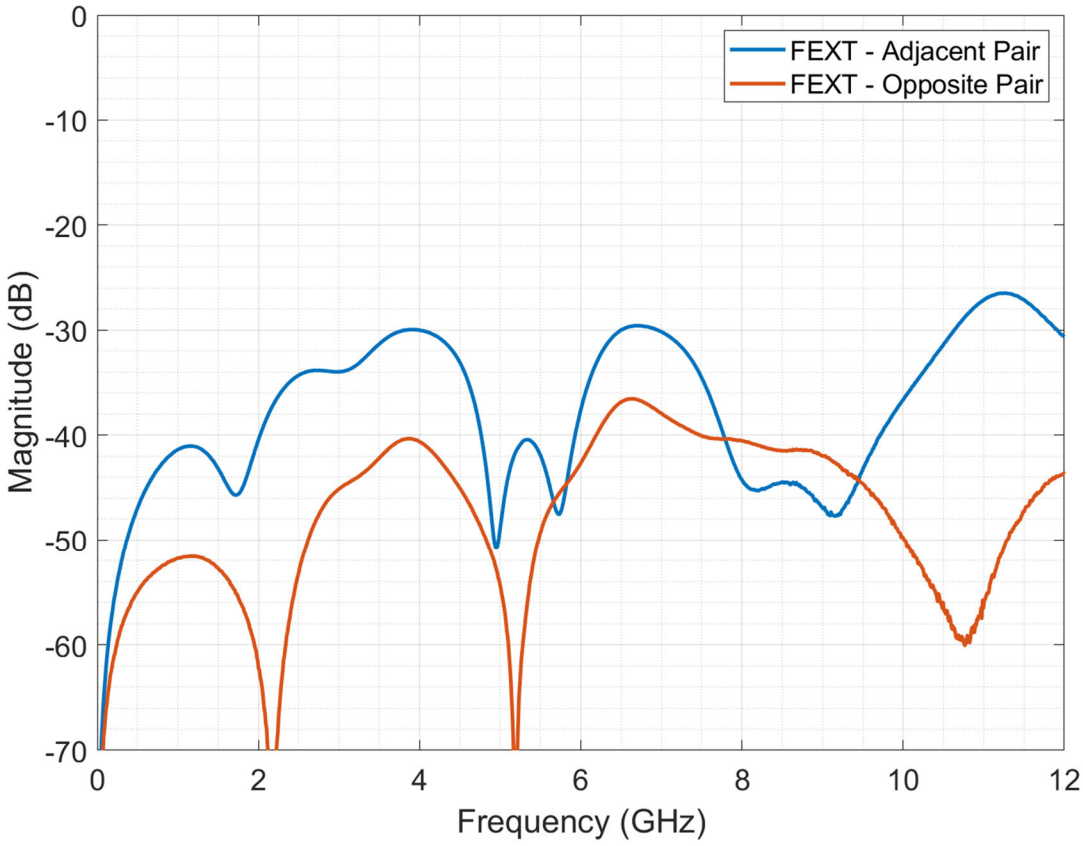

Figure 7. Straight El Ochito Red FEXT

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4.2.Straight El Ochito Red Time Domain Analysis

4.2.1. Straight El Ochito Red TDR

A graph is shown below for various rise times. Rise time is defined at 10% to 90% of the signal's rising edge. Rise times of 50ps, 100ps, and 200ps were used. The following table shows the relative bandwidth, BW, for a given TDR test step rise time, t_r.

t_r (ps)	BW (GHz)
50	7.00
100	3.50
200	1.75

Table 1. Bandwidth to Rise Time Relationship

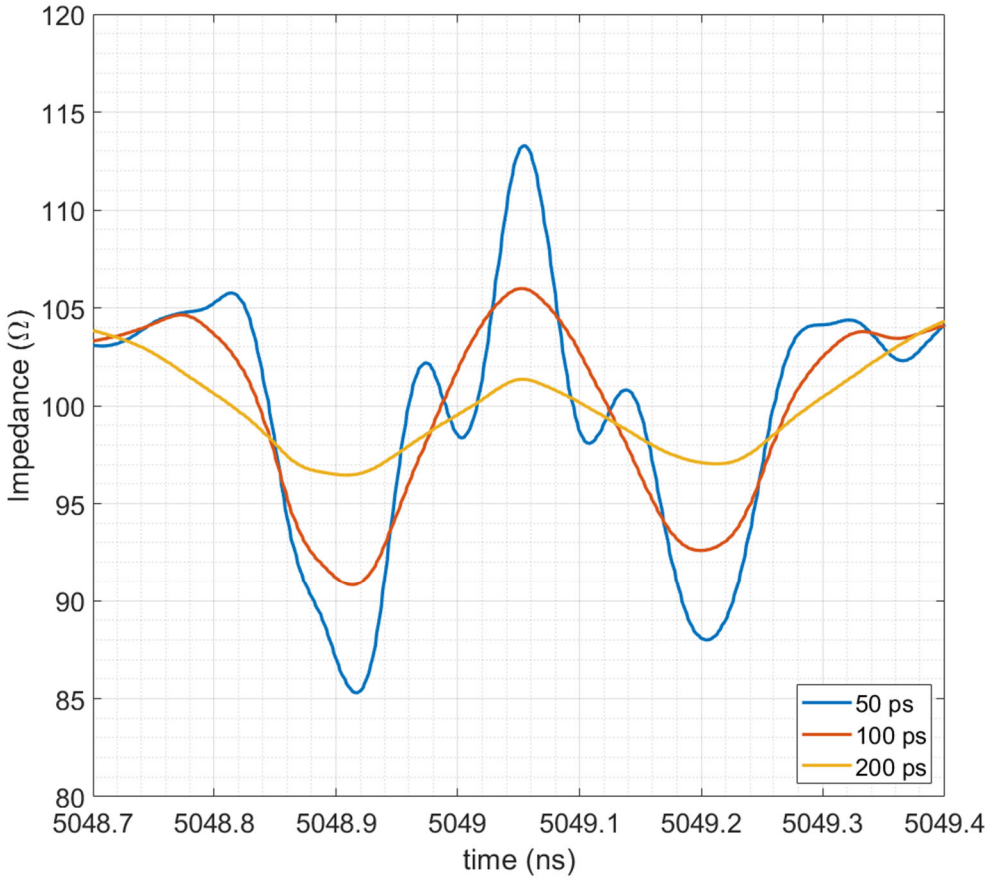

Figure 8. TDR – Straight El Ochito Red

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5. Right-Angle El Ochito Red Performance Summary

This section includes both frequency and time domain results. Test fixture PCB loss has been de-embedded to show the performance of the assembly only.

5.1.Frequency Domain Analysis

5.1.1. Insertion Loss/Return Loss

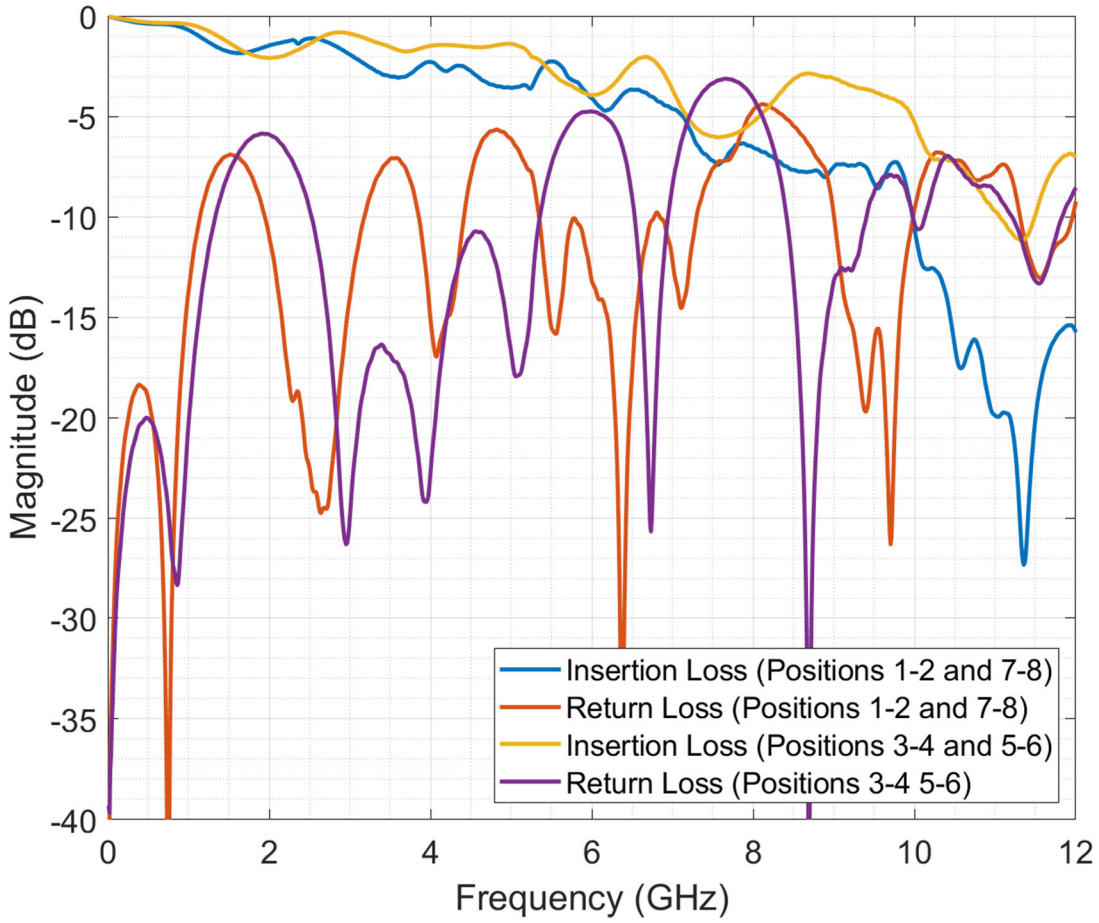

Figure 9. Right-angle El Ochito Red Response

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5.1.2. Right-Angle El Ochito Red Crosstalk

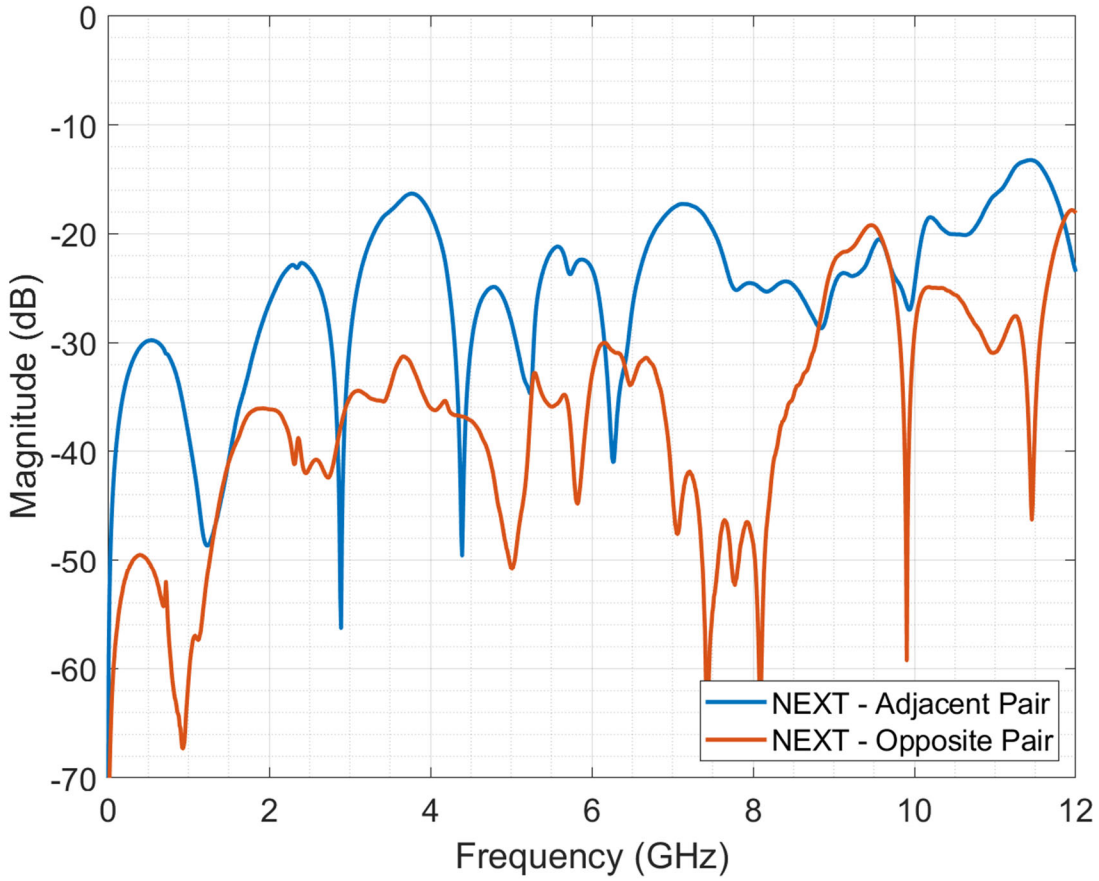

Figure 10. Right-angle El Ochito Red NEXT

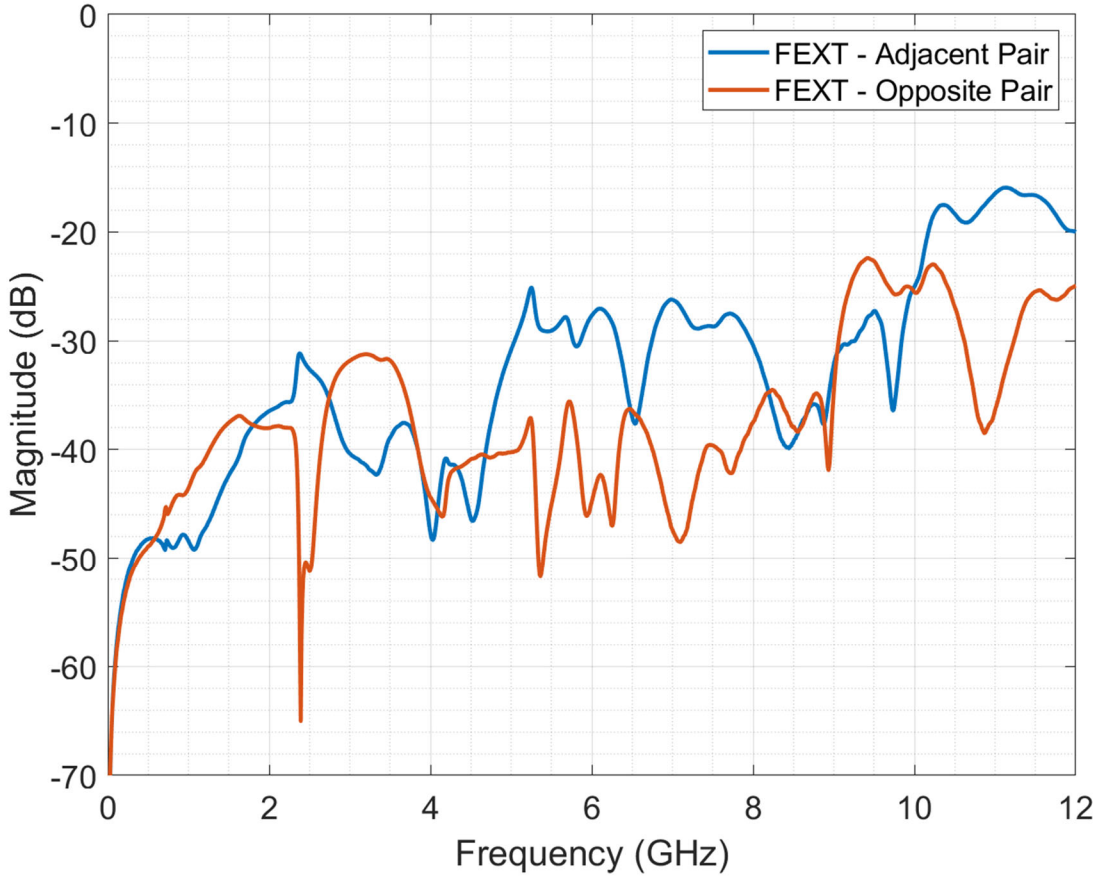

Figure 11. Right-angle El Ochito Red FEXT

5.2.Right-angle El Ochito Red Time Domain Analysis

5.2.1. Right-angle El Ochito Red TDR

A graph is shown below for various rise times. Rise time is defined at 20% to 80% of the signal's rising edge. Rise times of 50ps, 100ps, and 200ps were used. The following table shows the relative bandwidth, BW, for a given TDR test step rise time, t_r.

t_r (ps)	BW (GHz)
50	7.00
100	3.50
200	1.75

Table 2. Bandwidth to Rise Time Relationship

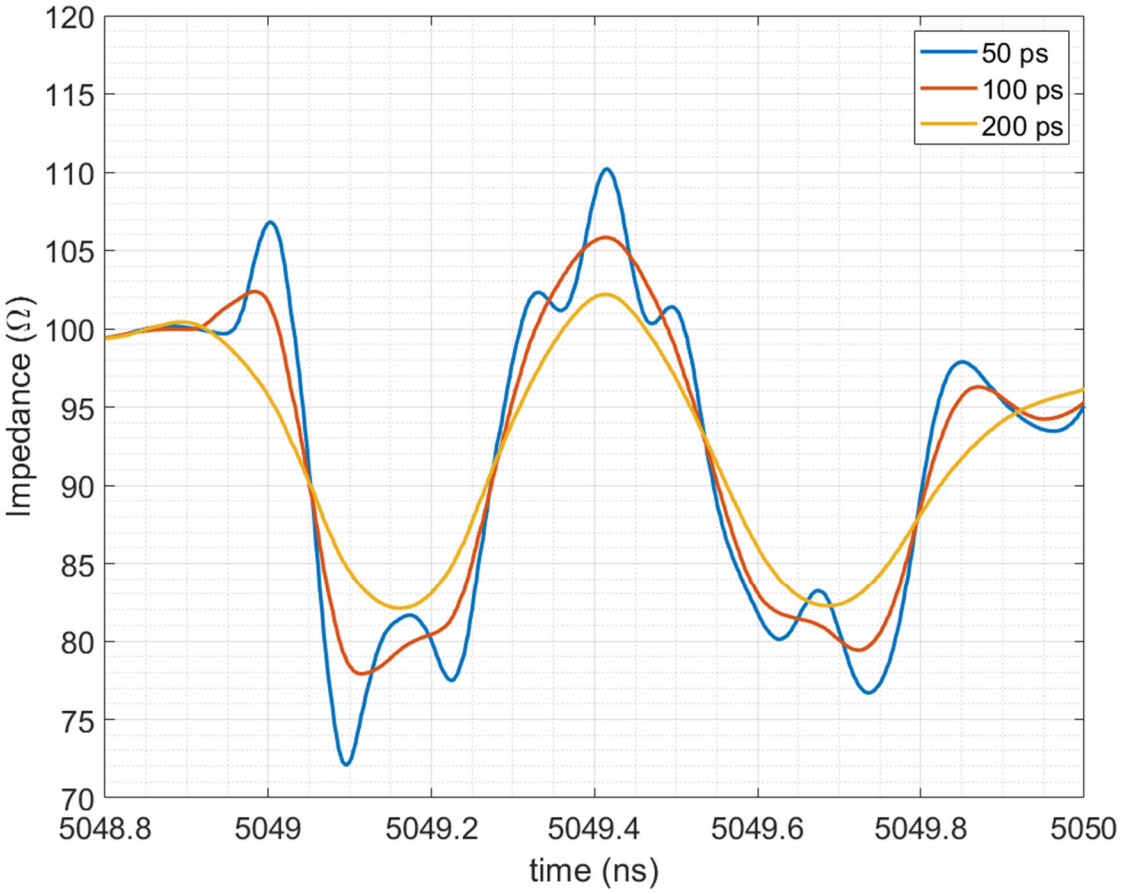

Figure 12. TDR – Right-angle El Ochito Red (Positions 3/4, 5/6)

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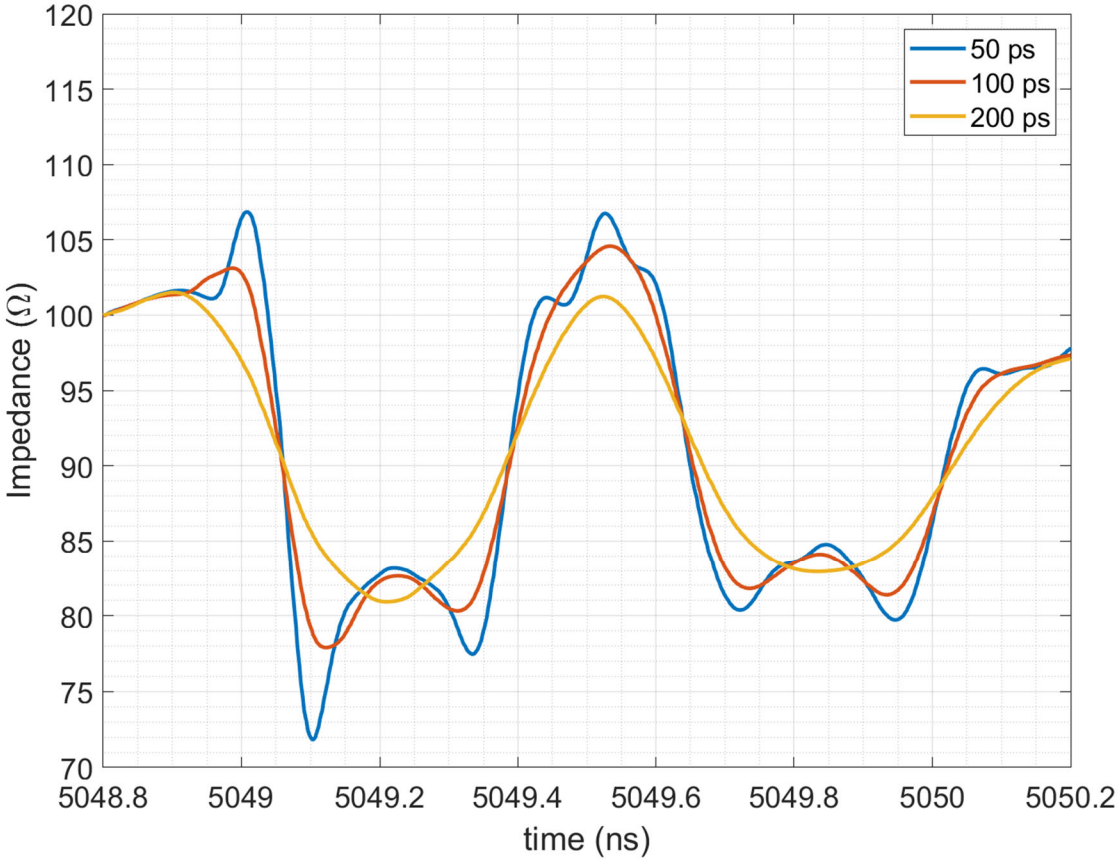

Figure 13. TDR – Right-angle El Ochito Red (Positions 1/2, 7/8)

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6. Cable Assembly El Ochito Red Performance

This section includes both frequency and time domain results. Test fixture PCB loss has been de-embedded to show the performance of the assembly only.

6.1.Frequency Domain Analysis

6.1.1. Insertion Loss / Return Loss

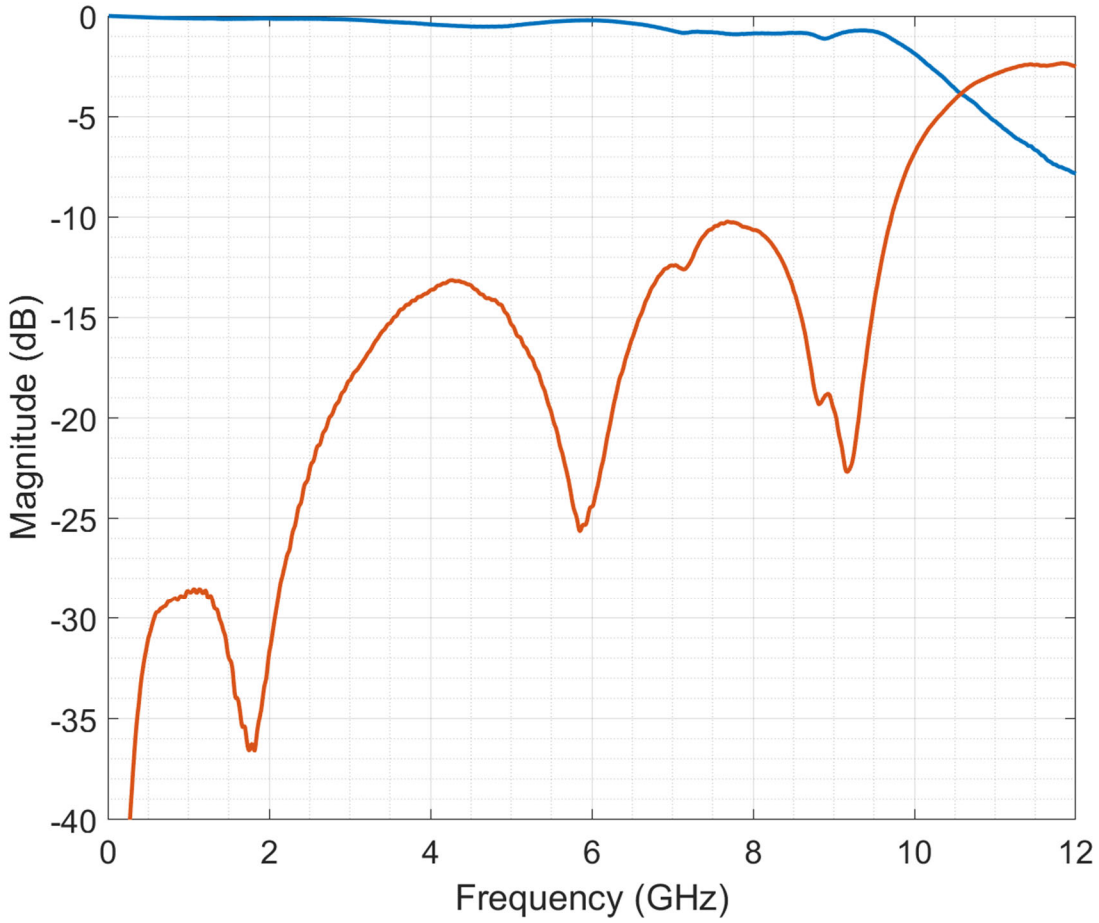

Figure 14. Cable Assembly El Ochito Red Response

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6.1.2. Cable Assembly El Ochito Red Crosstalk

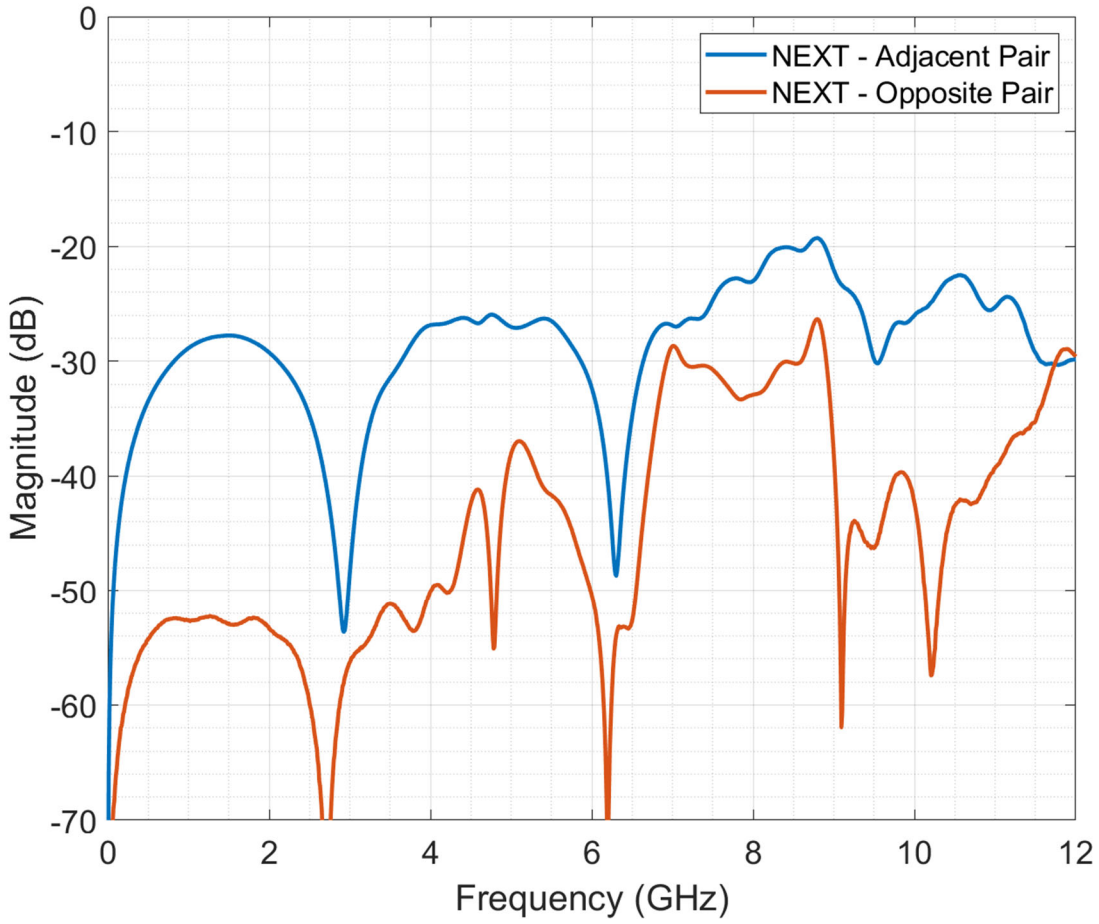

Figure 15. Cable Assembly El Ochito Red NEXT

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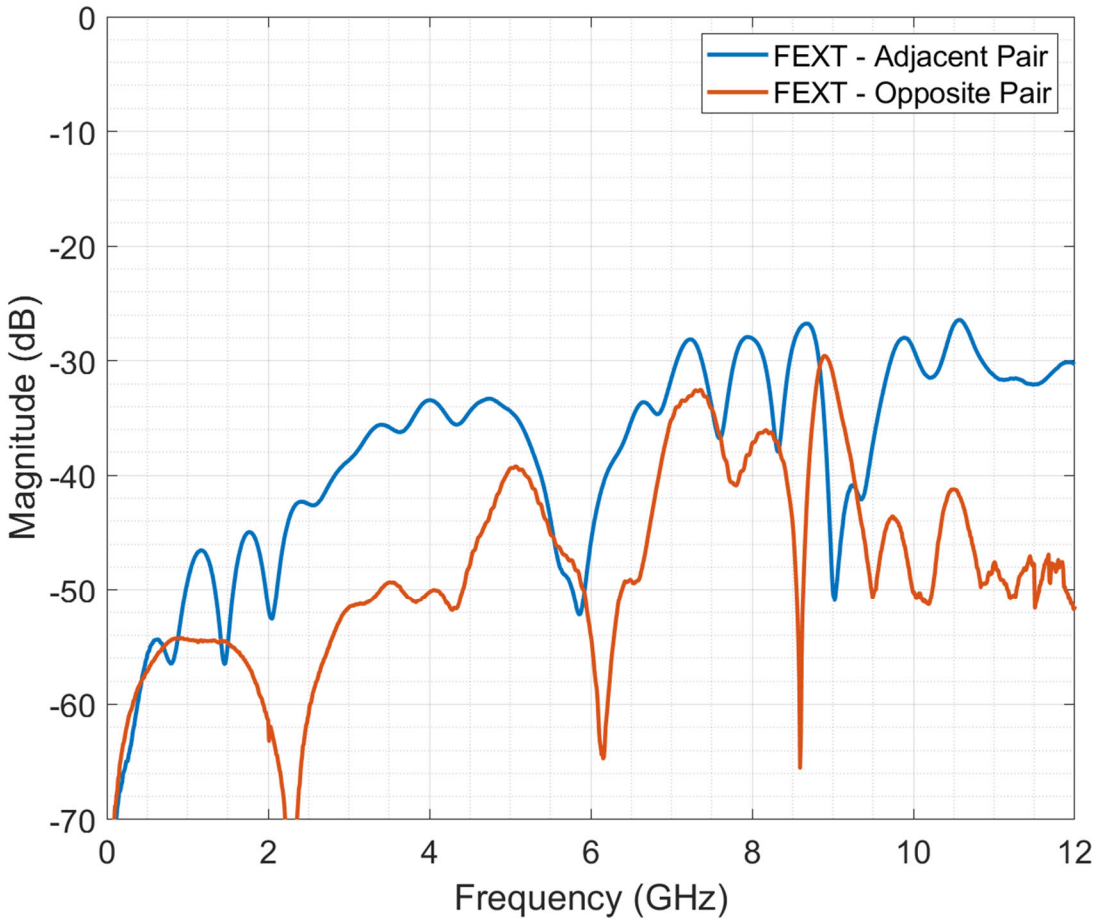

Figure 16. Cable Assembly El Ochito Red FEXT

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6.2.Cable Assembly El Ochito Red Time Domain Analysis

6.2.1. Cable Assembly El Ochito Red TDR

A graph is shown below for various rise times. Rise time is defined at 10% to 90% of the signal's rising edge. Rise times of 50ps, 100ps, and 200ps were used. The following table shows the relative bandwidth, BW, for a given TDR test step rise time, t_r.

t_r (ps)	BW (GHz)
50	7.00
100	3.50
200	1.75

Table 3. Bandwidth to Rise Time Relationship

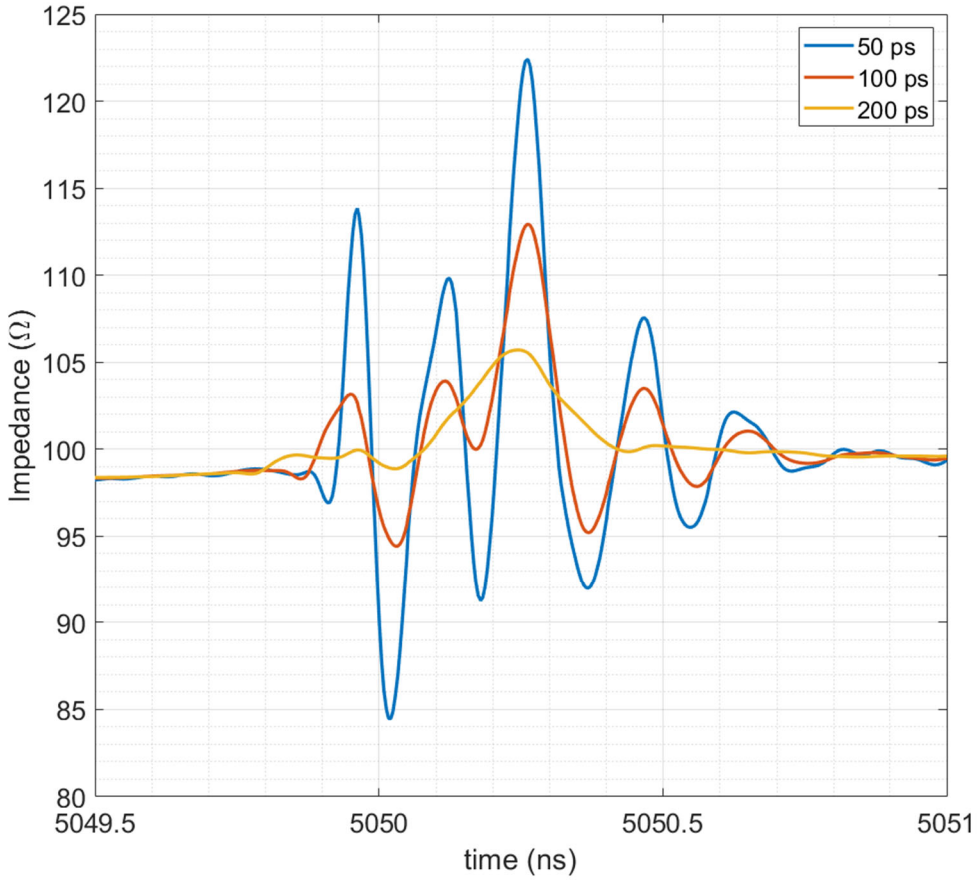

Figure 17. TDR – Cable Assembly El Ochito Red

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7. Right-Angle PCB to Straight PCB El Ochito Red Performance

This section includes both frequency and time domain results. Test fixture PCB loss has been de-embedded to show the performance of the assembly only.

7.1.Frequency Domain Analysis

7.1.1. Insertion Loss / Return Loss

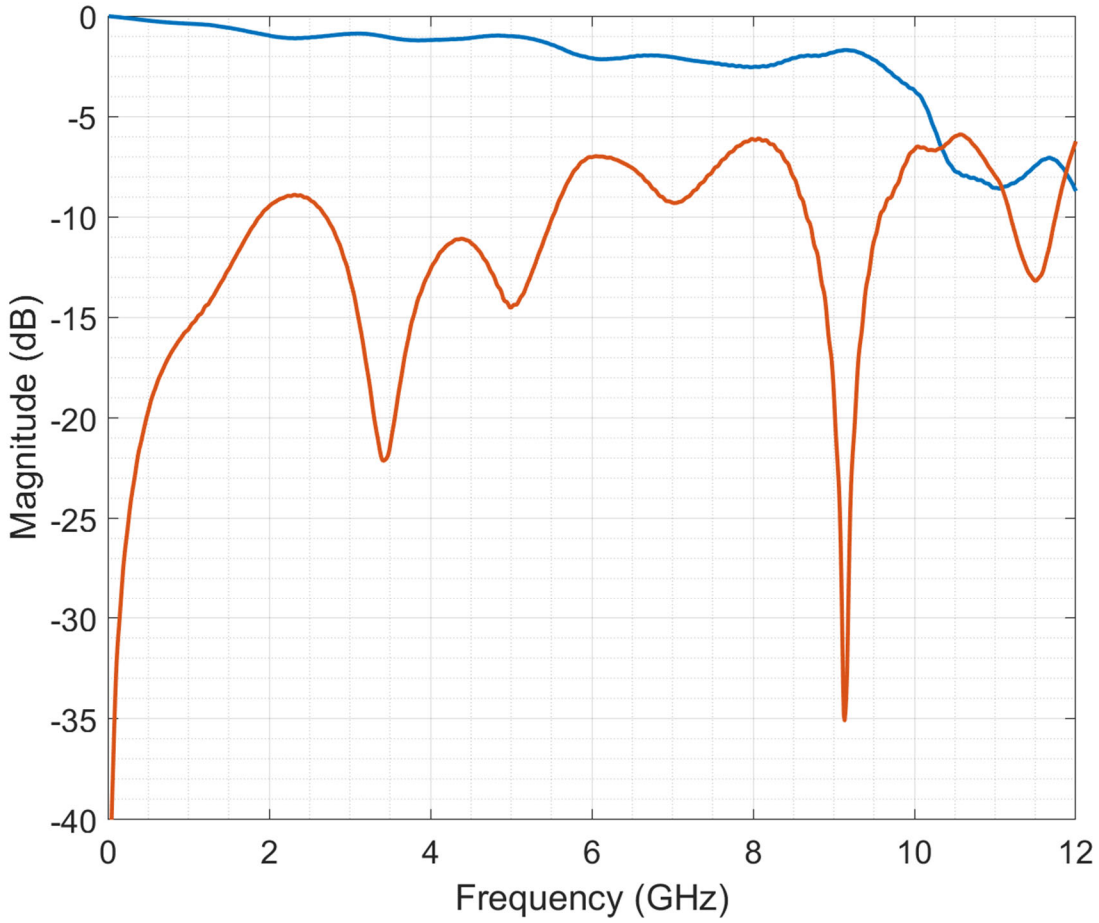

Figure 18. Right-Angle PCB to Straight PCB El Ochito Red Response

The bandwidth of the Right-Angle PCB to Straight PCB El Ochito Red can be drawn from Figure 5 by noting the frequency where the difference between the insertion loss and return loss is 3dB. In this manner, the bandwidth is found to be ~8 Ghz.

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7.1.2. Right-Angle PCB to Straight PCB El Ochito Red Crosstalk

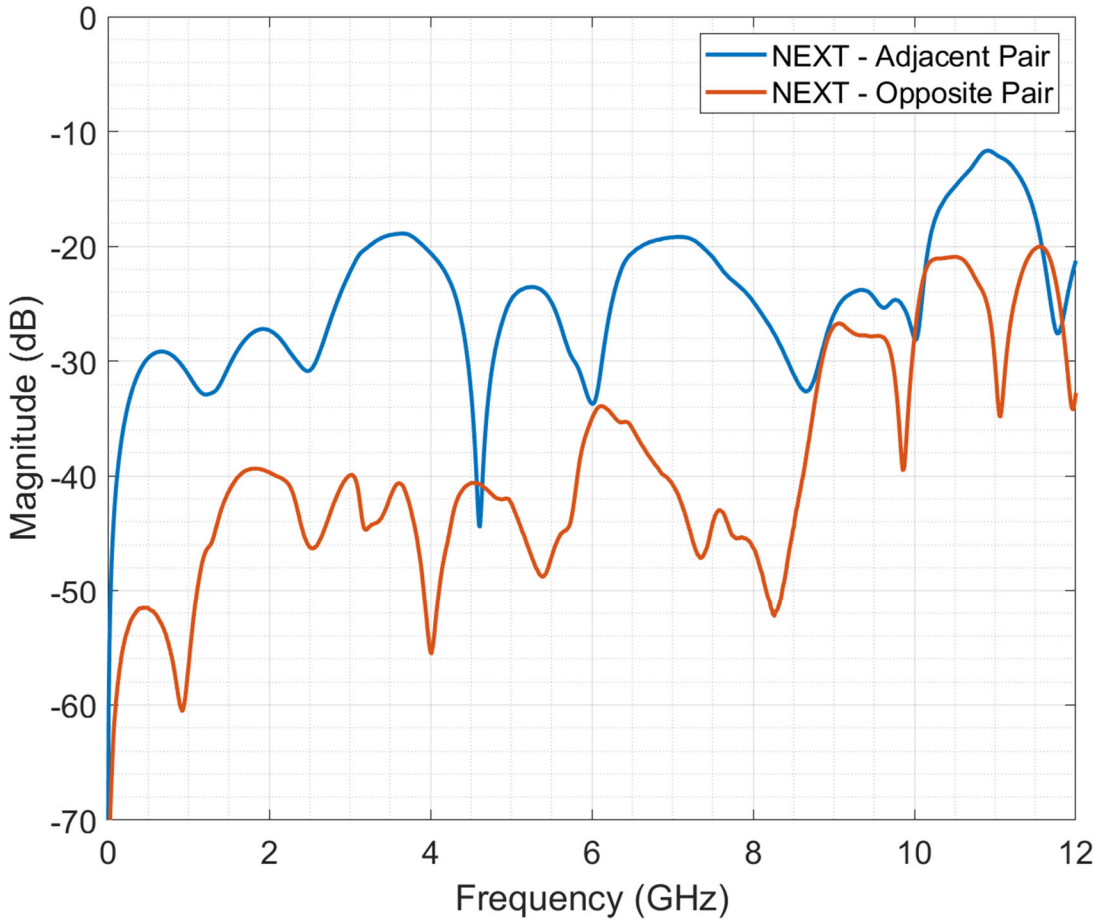

Figure 19. Right-Angle PCB to Straight PCB El Ochito Red NEXT

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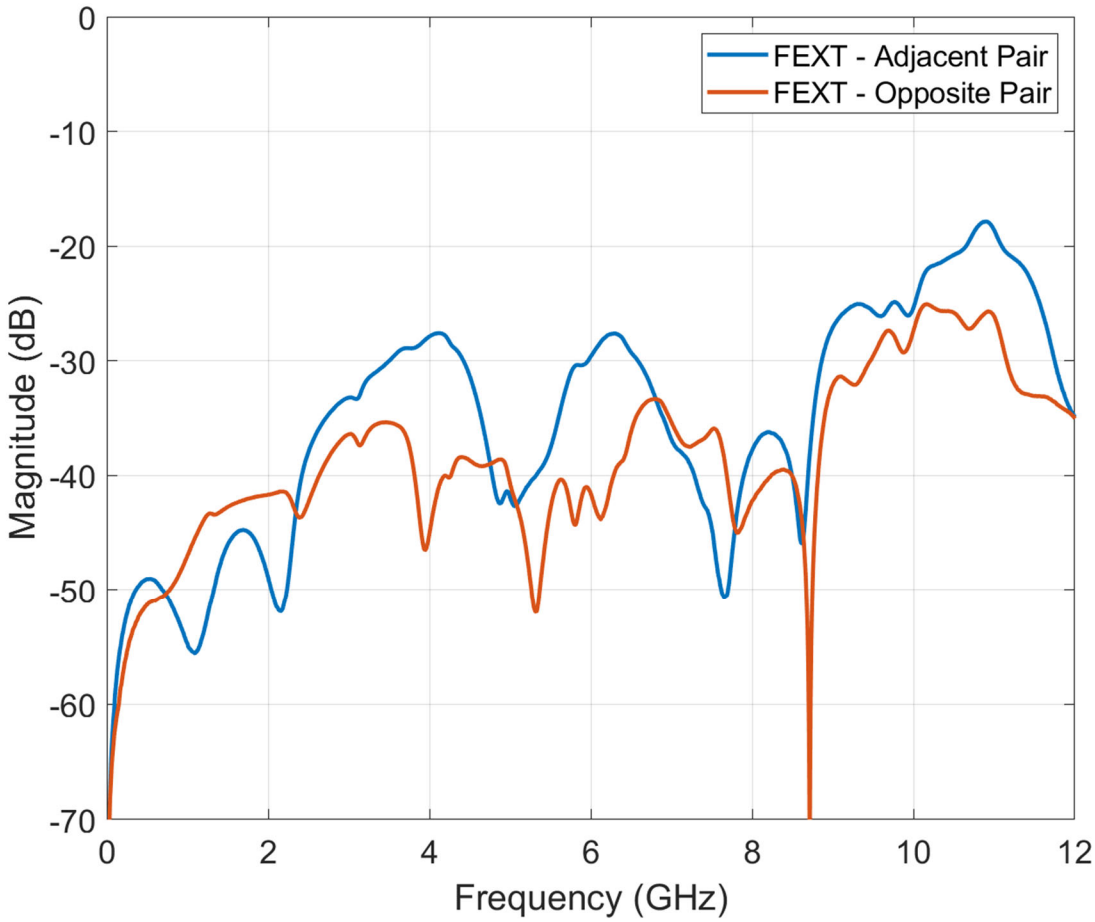

Figure 20. Right-Angle PCB to Straight PCB El Ochito Red FEXT

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7.2.Right-Angle PCB to Straight PCB El Ochito Red Time Domain Analysis

7.2.1. Right-Angle PCB to Straight PCB El Ochito Red TDR

A graph is shown below for various rise times. Rise time is defined at 10% to 90% of the signal's rising edge. Rise times of 50ps, 100ps, and 200ps were used. The following table shows the relative bandwidth, BW, for a given TDR test step rise time, t_r.

t_r (ps)	BW (GHz)
50	7.00
100	3.50
200	1.75

Table 4. Bandwidth to Rise Time Relationship

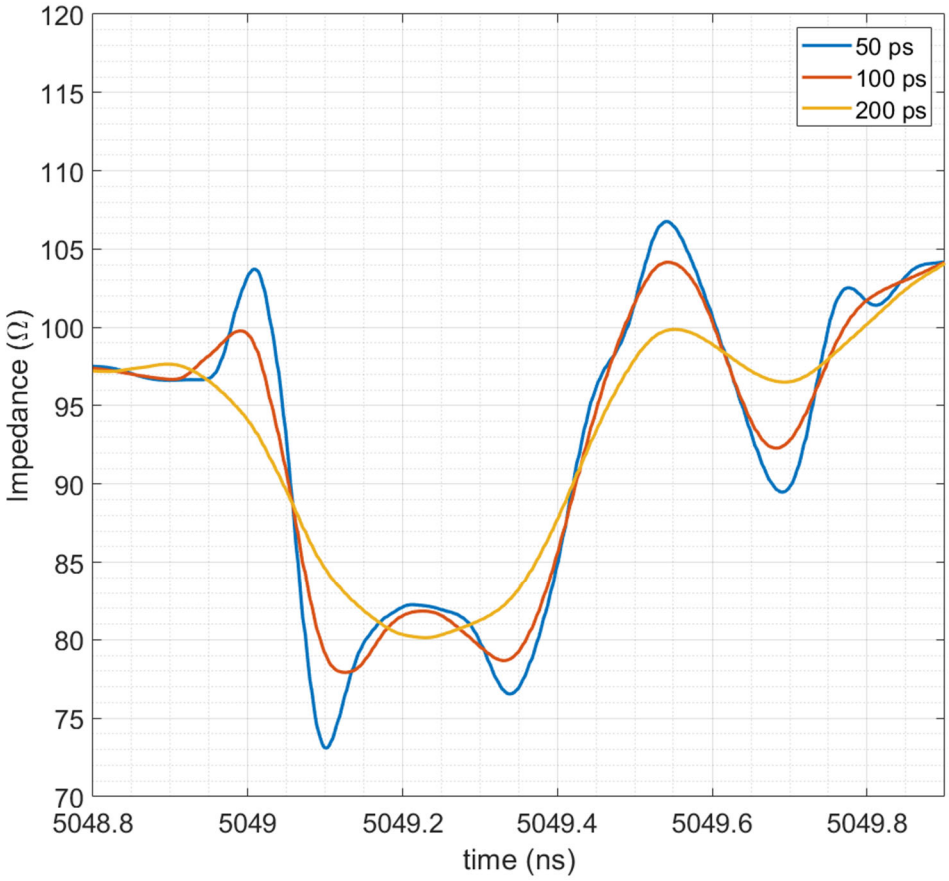

Figure 21. TDR – Right-Angle PCB to Straight PCB El Ochito Red

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8. Straight PCB to Right-angle PCB El Ochito Red Performance

This section includes both frequency and time domain results. Test fixture PCB loss has been de-embedded to show the performance of the assembly only.

8.1.Frequency Domain Analysis

8.1.1. Insertion Loss / Return Loss

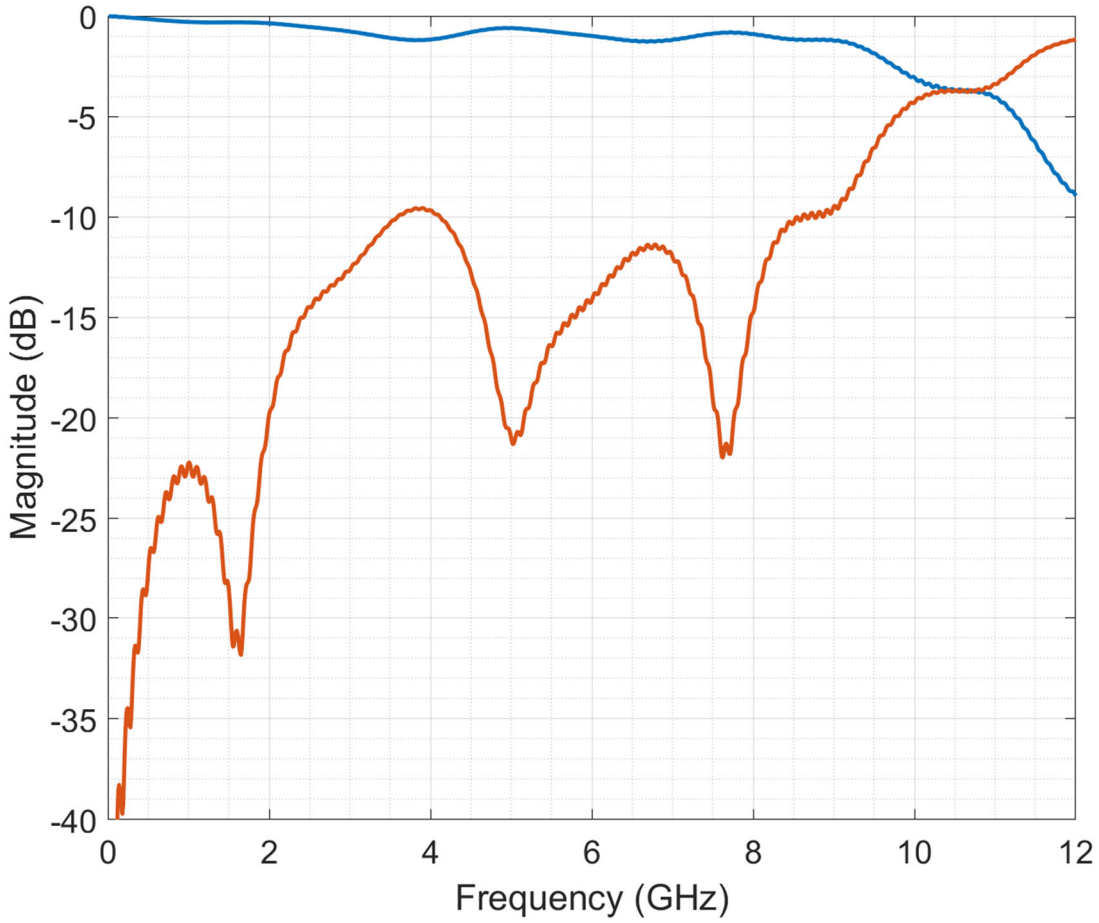

Figure 22. Straight PCB to Right Angle PCB El Ochito Red Response

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8.1.2. Straight PCB to Right Angle PCB El Ochito Red Crosstalk

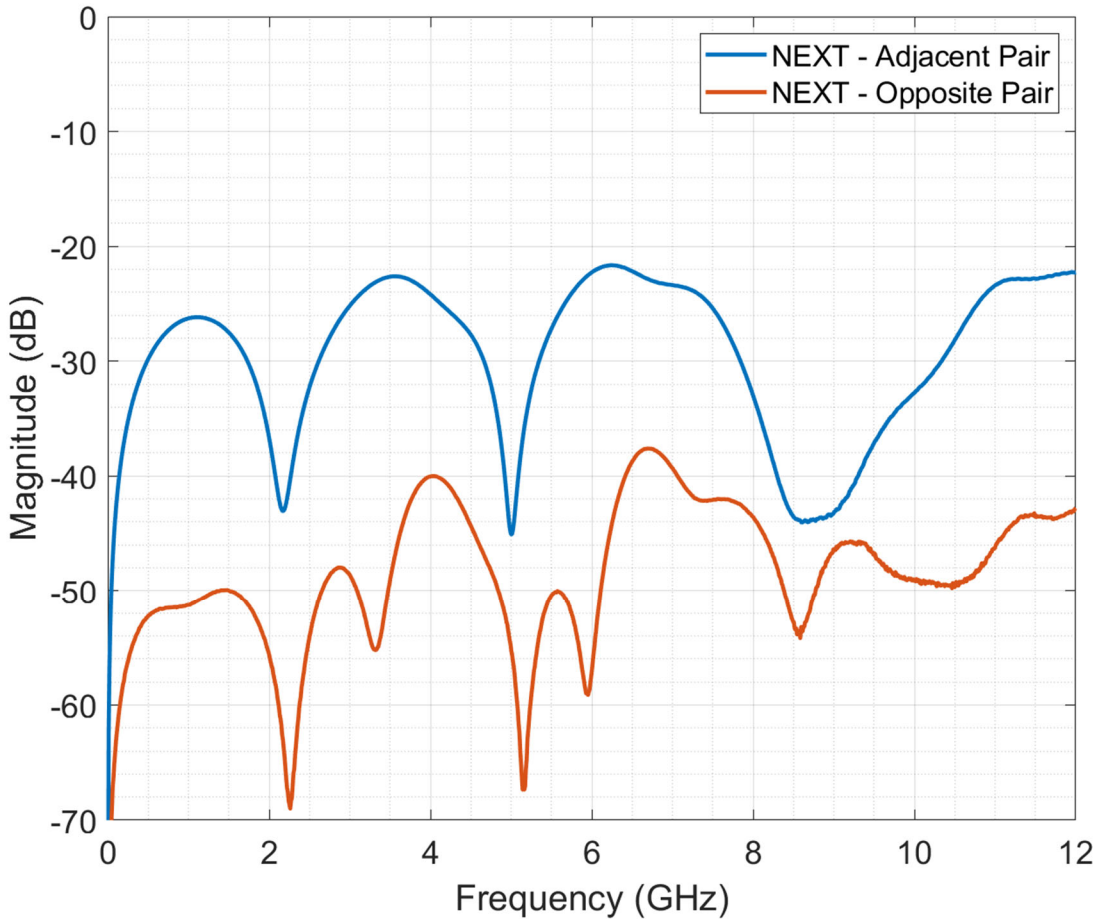

Figure 23. Straight PCB to Right Angle PCB El Ochito Red NEXT

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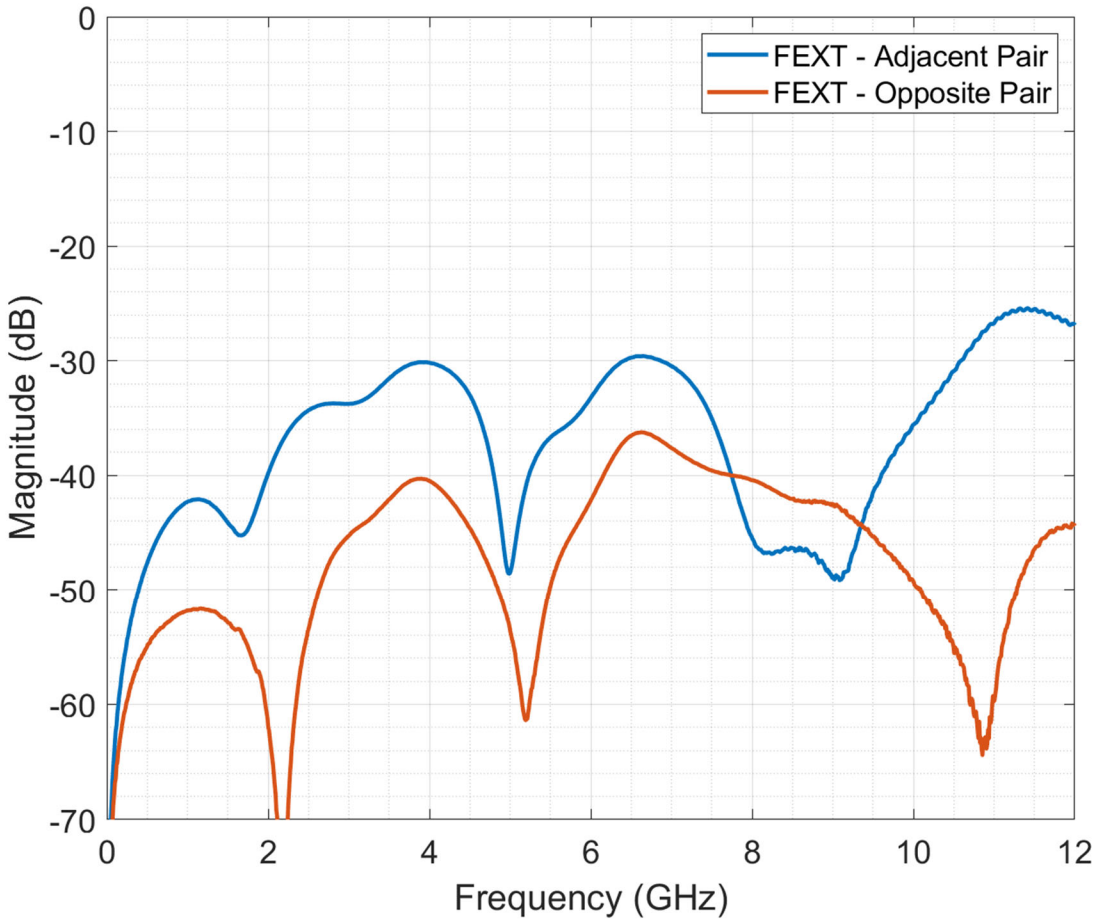

Figure 24. Straight PCB to Right Angle PCB El Ochito Red FEXT

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8.2.Straight PCB to Right Angle PCB El Ochito Red Time Domain Analysis

8.2.1. Straight PCB to Right Angle PCB El Ochito Red TDR

A graph is shown below for various rise times. Rise time is defined at 10% to 90% of the signal's rising edge. Rise times of 50ps, 100ps, and 200ps were used. The following table shows the relative bandwidth, BW, for a given TDR test step rise time, t_r.

t_r (ps)	BW (GHz)
50	7.00
100	3.50
200	1.75

Table 5. Bandwidth to Rise Time Relationship

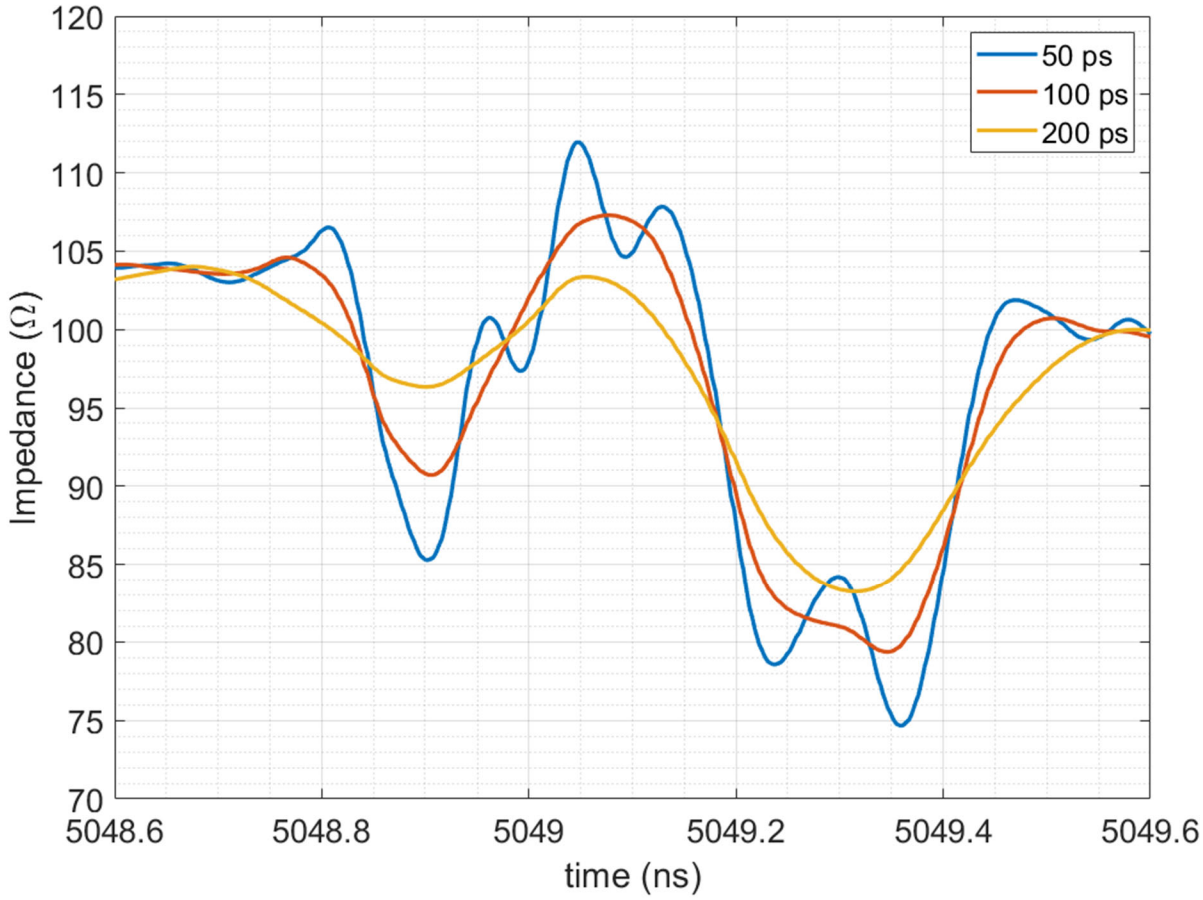

Figure 25. TDR – Straight PCB to Right Angle PCB El Ochito Red

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9. Straight PCB to Cable Assembly El Ochito Red Performance

This section includes both frequency and time domain results. Test fixture PCB loss has been de-embedded to show the performance of the assembly only.

9.1.Frequency Domain Analysis

9.1.1. Insertion Loss / Return Loss

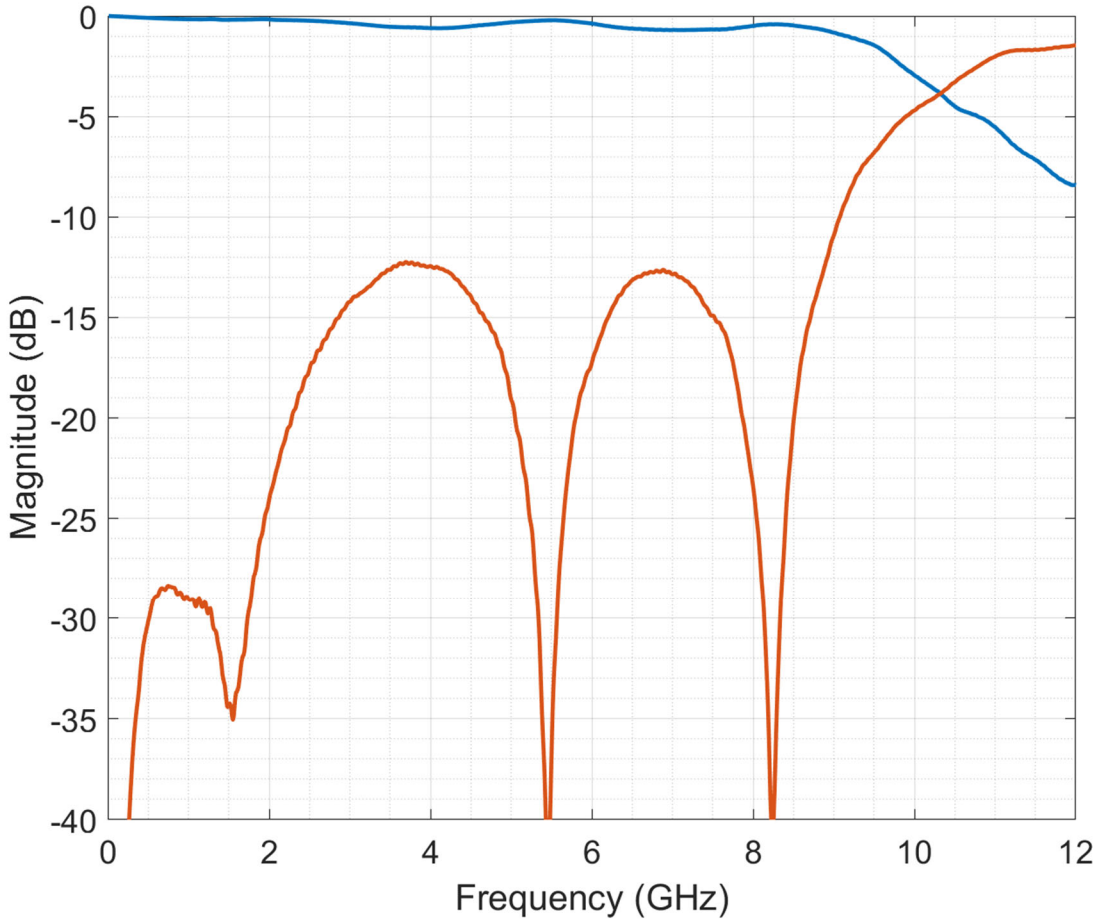

Figure 26. Straight PCB to Cable Assembly El Ochito Red Response

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9.1.2. Straight PCB to Cable Assembly El Ochito Red Crosstalk

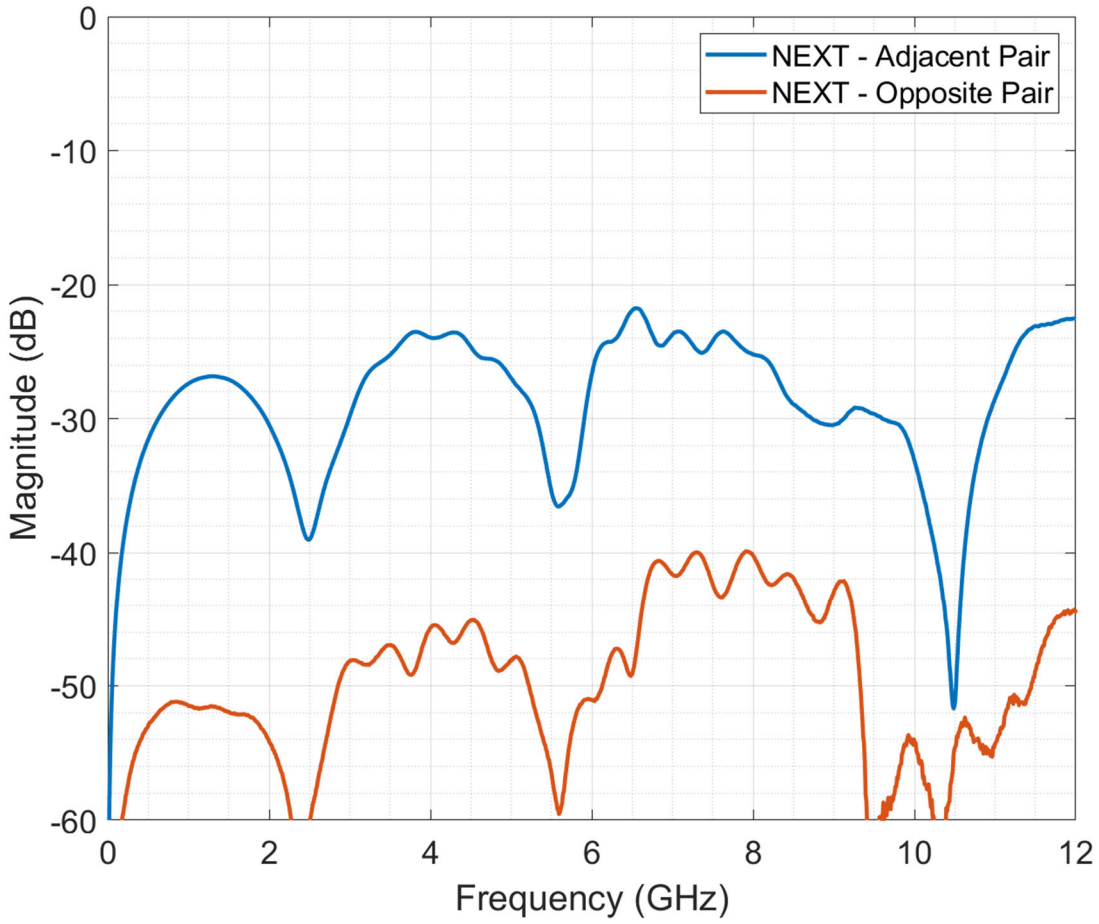

Figure 27. Straight PCB to Cable Assembly El Ochito Red NEXT

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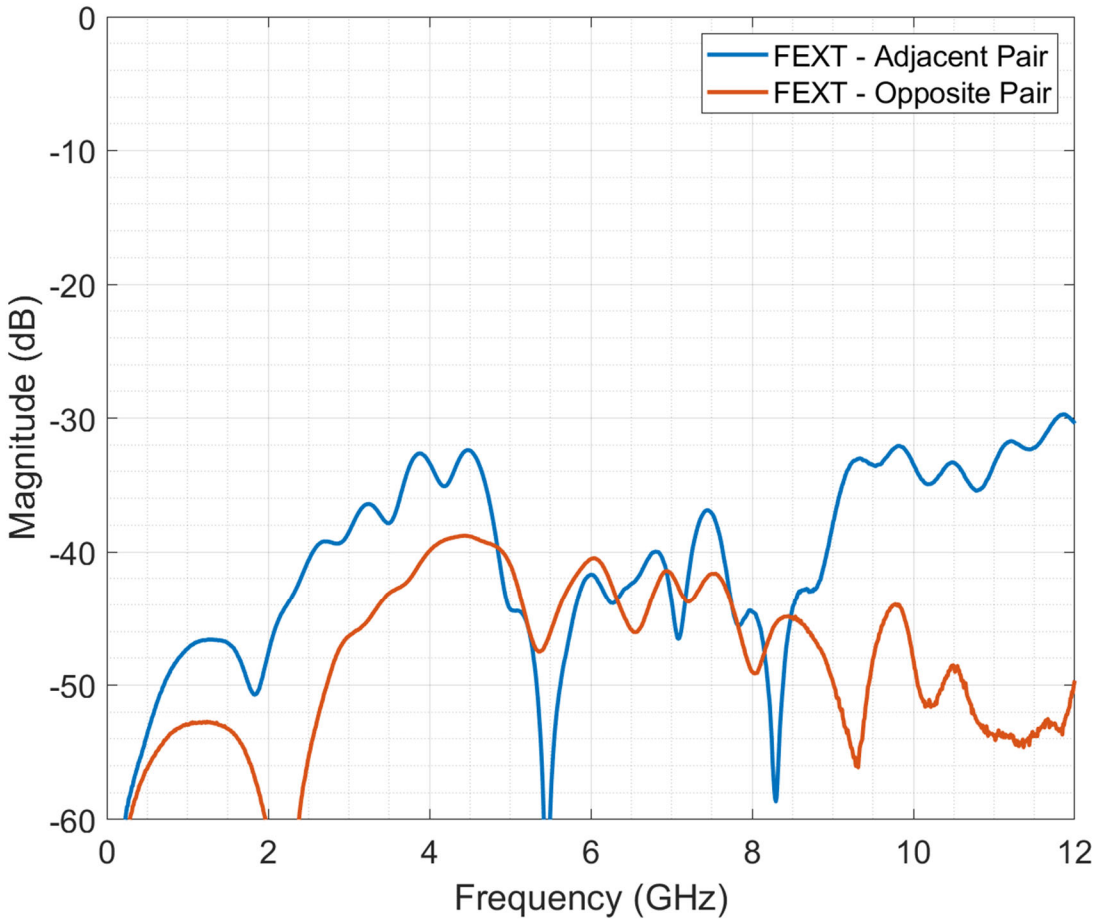

Figure 28. Straight PCB to Cable Assembly El Ochito Red FEXT

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9.2.Straight PCB to Cable Assembly El Ochito Red Time Domain Analysis

9.2.1. Straight PCB to Cable Assembly El Ochito Red TDR

A graph is shown below for various rise times. Rise time is defined at 10% to 90% of the signal's rising edge. Rise times of 50ps, 100ps, and 200ps were used. The following table shows the relative bandwidth, BW, for a given TDR test step rise time, t_r.

t_r (ps)	BW (GHz)
50	7.00
100	3.50
200	1.75

Table 6. Bandwidth to Rise Time Relationship

Figure 29. TDR – Straight PCB to Cable Assembly El Ochito Red

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10. Right-angle PCB to Cable Assembly El Ochito Red Performance

This section includes both frequency and time domain results. Test fixture PCB loss has been de-embedded to show the performance of the assembly only.

10.1. Frequency Domain Analysis

10.1.1. Insertion Loss / Return Loss

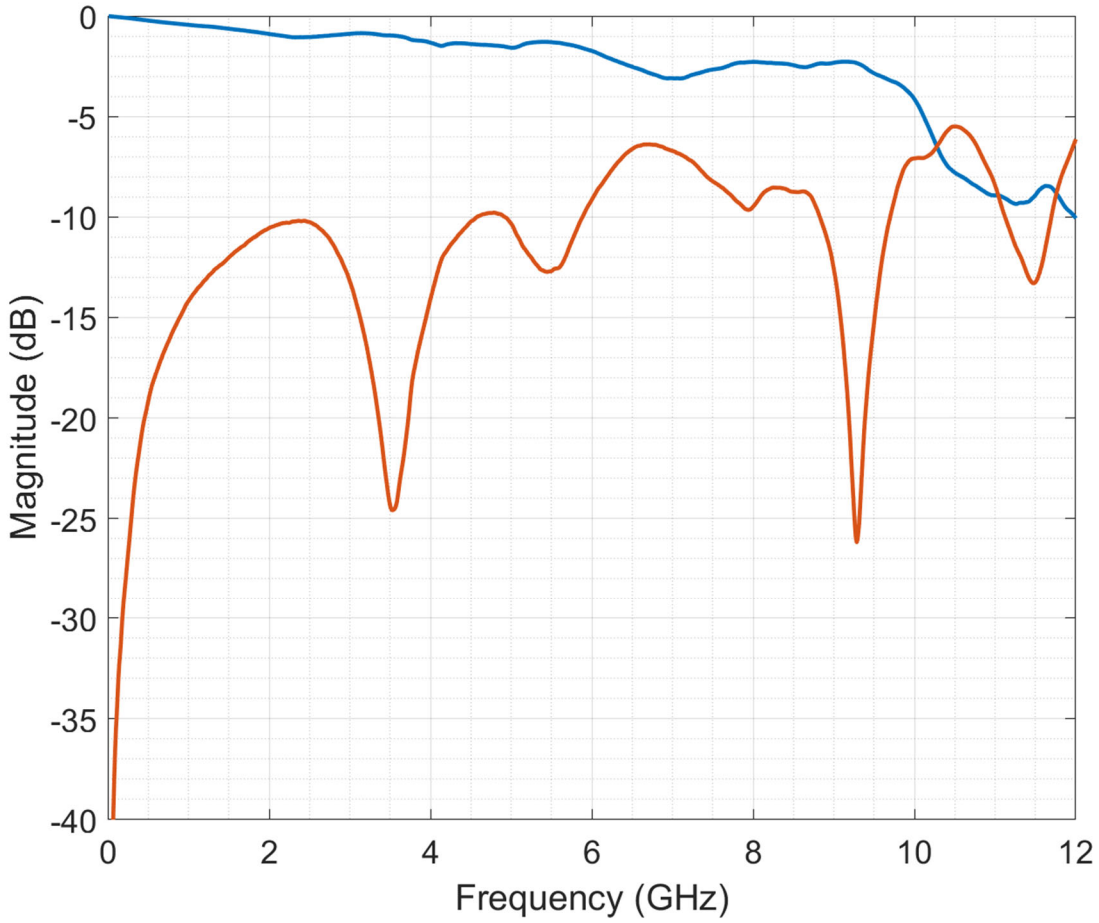

Figure 30. Right-angle PCB to Cable Assembly El Ochito Red Response

10.1.2. Right-angle PCB to Cable Assembly El Ochito Red Crosstalk

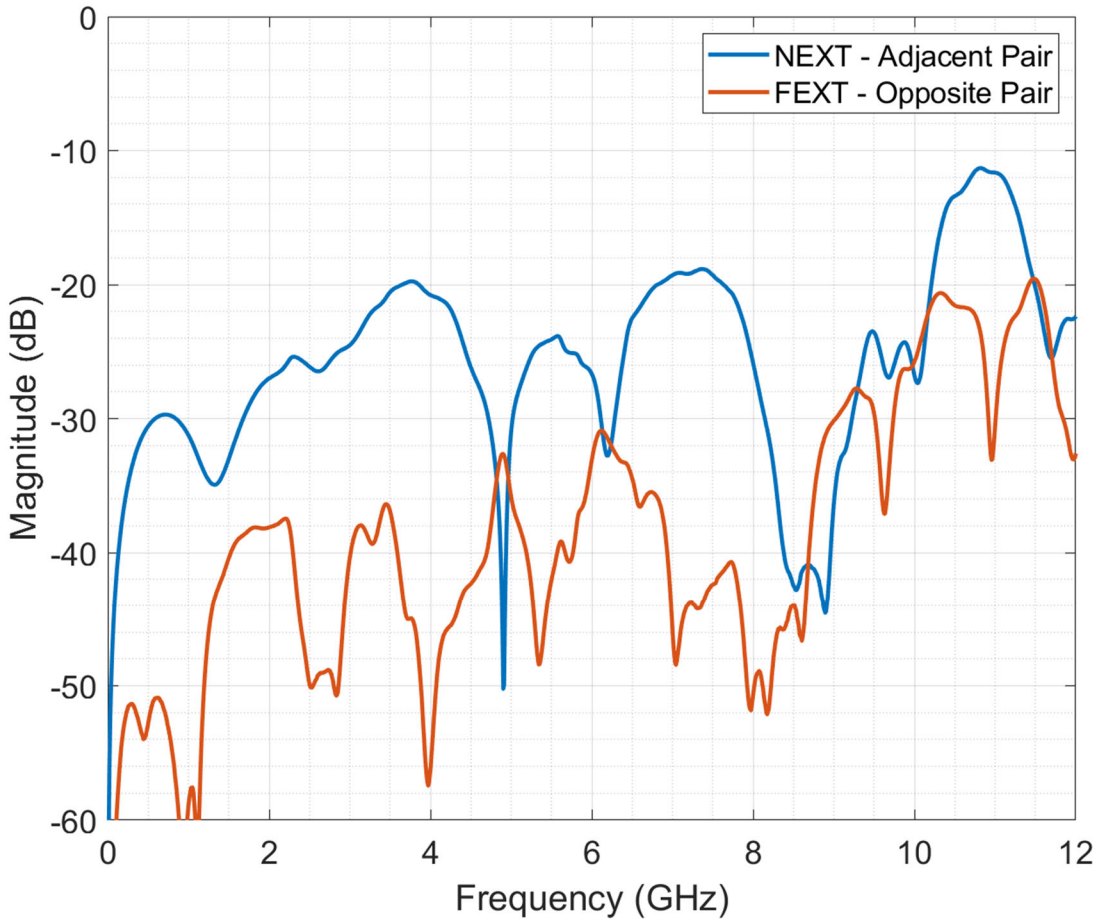

Figure 31. Right-angle PCB to Cable Assembly El Ochito Red NEXT

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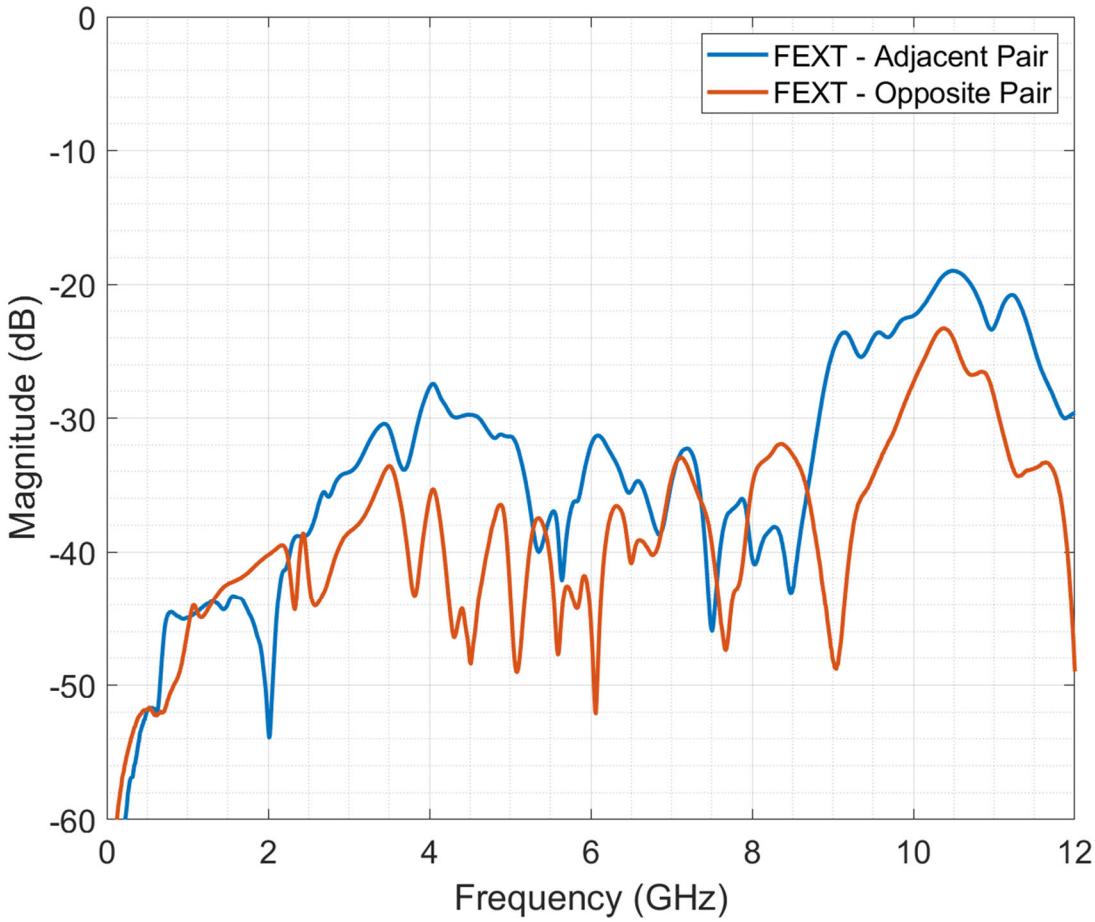

Figure 32. Right-angle PCB to Cable Assembly El Ochito Red FEXT

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10.2. Right-angle PCB to Cable Assembly El Ochito Red Time Domain Analysis

10.2.1. Right-angle PCB to Cable Assembly El Ochito Red TDR

A graph is shown below for various rise times. Rise time is defined at 10% to 90% of the signal's rising edge. Rise times of 50ps, 100ps, and 200ps were used. The following table shows the relative bandwidth, BW, for a given TDR test step rise time, t_r.

t_r (ps)	BW (GHz)
50	7.00
100	3.50
200	1.75

Table 7. Bandwidth to Rise Time Relationship

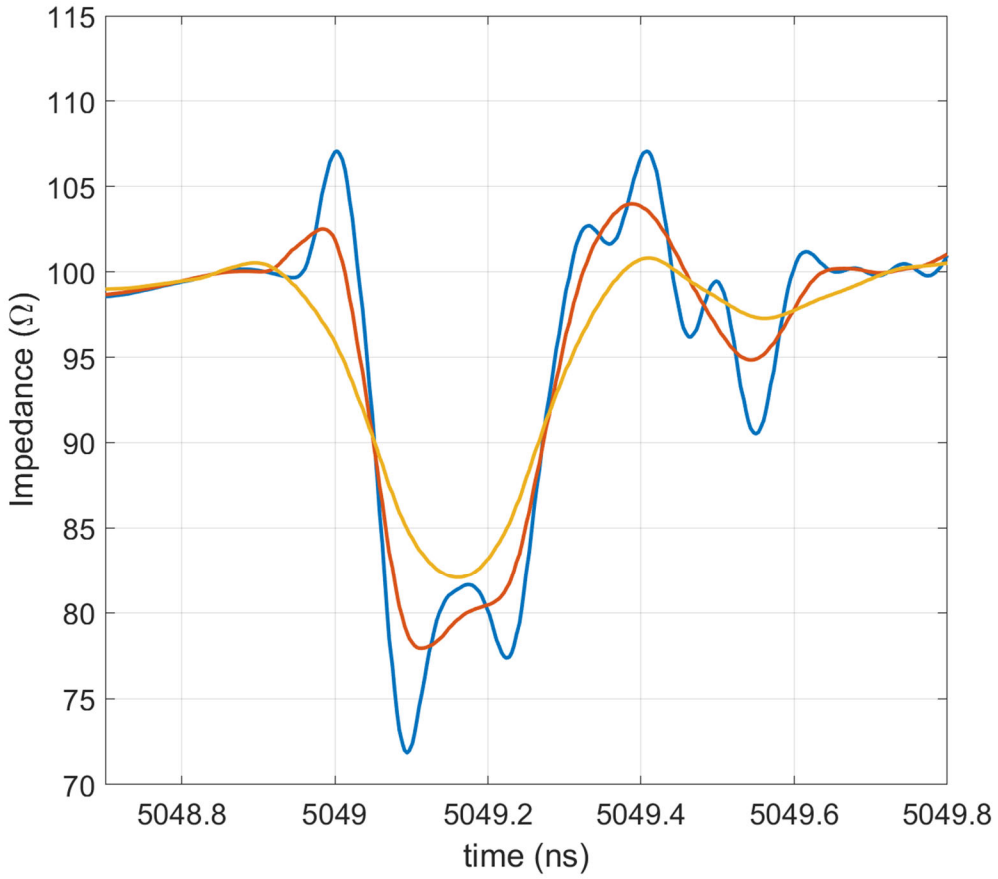

Figure 33. TDR – Right-angle PCB to Cable Assembly El Ochito Red

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11. Appendix A - 2x-Thru Fixture Performance

This section includes both frequency domain results of the 2x-thru PCBs used to extract the GHSM electrical characteristics from the overall measured DUT/fixturing data.

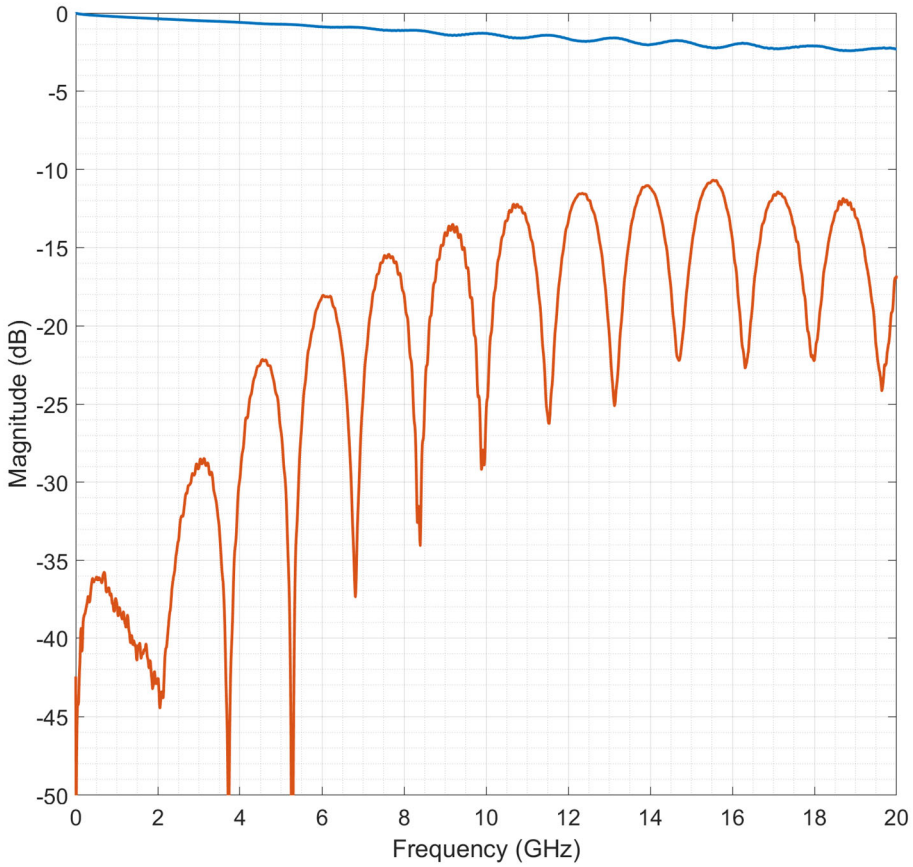

Figure 34. Straight El Ochito Red 2x-Thru PCB Response

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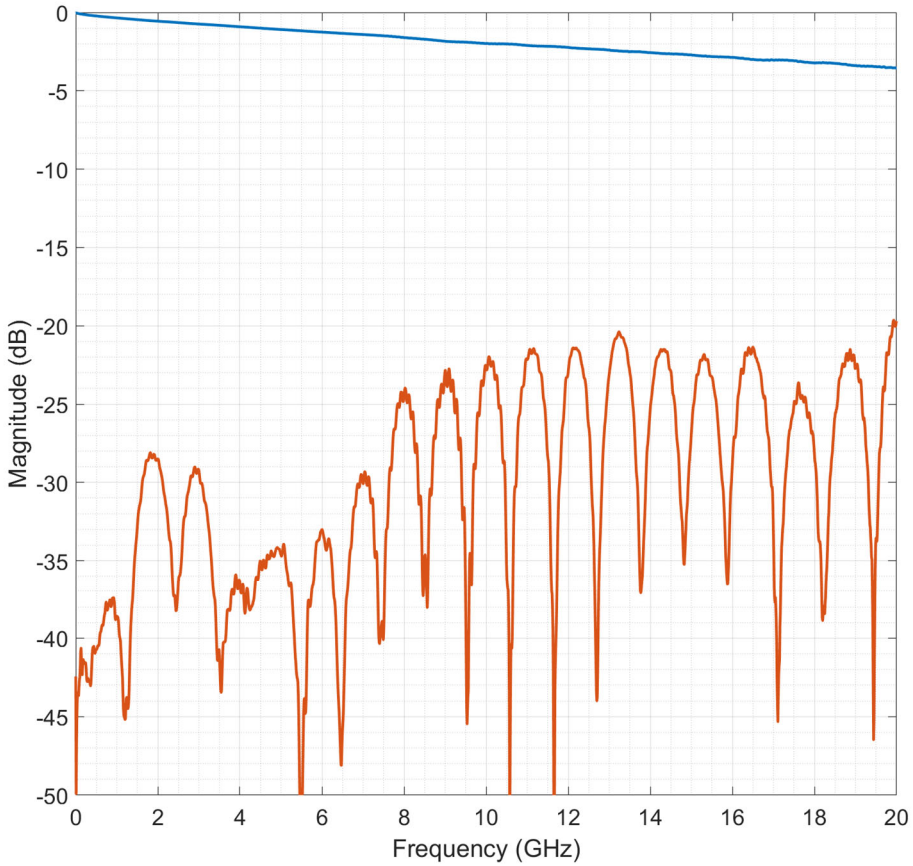

Figure 35. Right Angle El Ochito Red 2x-Thru PCB Response

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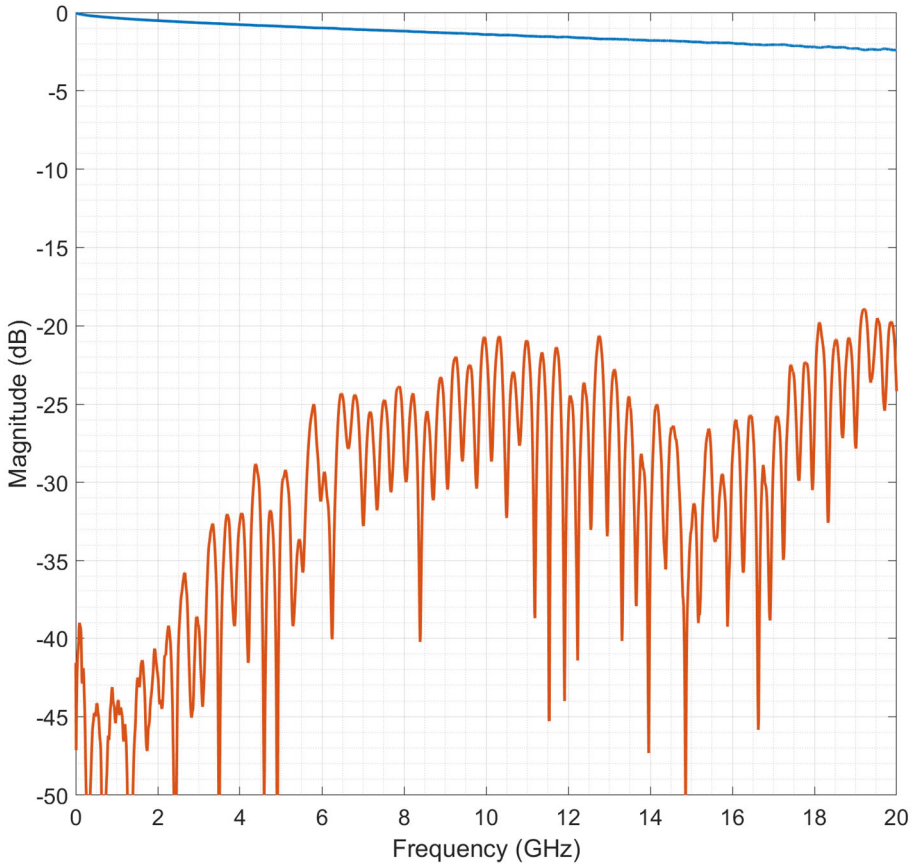

Figure 36. Cable Assembly El Ochito Red 2x-Thru PCB Response

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