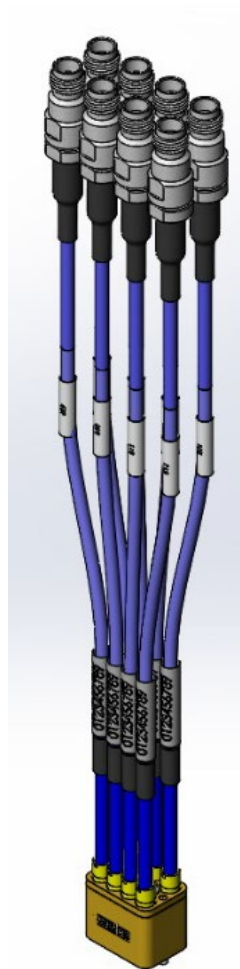




High Speed Characterization Report

BE40A-S-24SJ-X-X-XX-0250

BE40A-S-24SJ-X-X-XX-0500



Description:

**50 GHz, Bulls Eye®: Double Row, High-Performance Test System,
Stripline Transmission Type, 2.40 mm Straight Jack End Option**

Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline
Transmission Type, 2.40 mm Straight Jack End Option

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Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Cable Assembly Overview

The Bulls Eye®: BE40A series is a 4mm (0.157") pitch, 50 GHz, Double Row, High-Performance Test System. The BE40A employs 23 AWG solid dielectric low loss microwave cables with additional copper shielding, has options for stripline or microstrip transmission, and can be terminated on end 2 with either 2.92mm or 2.40mm plugs or jacks.

The data in this report is only applicable to BE40A stripline transmission type with 2.40mm jacks terminated on end 2. The Device Under Test (DUT) contained 0.25 meter and .050 meter cable samples. They were tested on a board with multiple launch structures shown below.

Case	Pins
Control Depth Drilled Via Layer 2	A1, B1
Back-drilled Via Layer 2 with 8 mil Stub	A2, A3, B2
Through Via Layer 5	A4, B3, B4

Frequency Domain Data Summary

Test Parameter	Configuration	Driver	Receiver	.250 m	.500m
Insertion Loss	GSG	Test Board	BE40A	>-3.6dB@ 40 GHz	>-4.5dB@ 40 GHz
Return Loss	GSG	Test Board	BE40A	<-12.9dB to 40 GHz	<-13.6dB to 40 GHz
Isolation	In Row	Test Board	BE40A	<-59dB to 40 GHz	<-59dB to 40 GHz
	Across row	Test Board	BE40A	<-63dB to 40 GHz	<-62dB to 40 GHz

Time Domain Data Summary

Signal Rise-time	7.5ps	22.5ps	37.5ps	75ps
Maximum Impedance	57.3	55.5	55.5	55.5
Minimum Impedance	48.6	49.3	49.3	49.3

Note: The data in the tables above for both frequency domain and time domain data summary just show the worst data for all pins.

Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Characterization Details

This report presents data that characterizes the signal integrity response of a connector pair in a controlled printed circuit board (PCB) environment. All efforts are made to reveal typical best-case responses inherent to the system under test (SUT).

In this report, the SUT includes the connector pair and footprint effects on a typical multi-layer PCB. PCB effects (trace loss) are de-embedded from test data. Board related effects, such as pad-to-ground capacitance, are included in the data presented in this report.

Additionally, intermediate test signal connections can mask the connector's true performance. Such connection effects are minimized by using high performance test cables and adapters. Where appropriate, calibration and de-embedding routines are also used to reduce residual effects.

Differential and Single-Ended Data

Most Samtec connectors can be used successfully in both differential and single-ended applications. However, electrical performance will differ depending on the signal drive type. In this report, data is presented for single-ended driven scenarios.

Signal Edge Speed (Rise Time):

In pulse signaling applications, the perceived performance of the interconnect can vary significantly depending on the edge rate or rise time of the exciting signal. For this report, the fastest rise time used was 7.5 ps. Generally, this should demonstrate worst-case performance.

In many systems, the signal edge rate will be significantly slower at the connector than at the driver launch point. To estimate interconnect performance at other edge rates, data is provided for several rise times between 7.5ps and 75ps.

For this report, measured rise times were at 20%-80% signal levels.

Frequency Domain Data

Frequency Domain parameters are helpful in evaluating the connector system's signal loss and crosstalk characteristics across a range of sinusoidal frequencies. In this report, parameters presented in the Frequency Domain are Insertion Loss, Return Loss, and Isolation. Other parameters or formats, such as VSWR or S-Parameters, may be available upon request. Please contact our Signal Integrity Group at sig@samtec.com for more information.

Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Frequency performance characteristics for the SUT are generated directly from network analyzer measurements.

Time Domain Data

Time Domain parameters indicate Impedance mismatch versus length, signal propagation time and crosstalk in a pulsed signal environment. The measured S-Parameters from the network analyzer are post-processed using Keysight Advanced Design System to obtain the time domain response. Time Domain procedure is provided in [Appendix E](#) of this report. Parameters or formats not included in this report may be available upon request. Please contact our Signal Integrity Group at sig@samtec.com for more information.

Data for other configurations may be available. Please contact our Signal Integrity Group at sig@samtec.com for further information.

Additional information concerning test conditions and procedures is located in the appendices of this report. Further information may be obtained by contacting our Signal Integrity Group at sig@samtec.com.

Series: BE40A

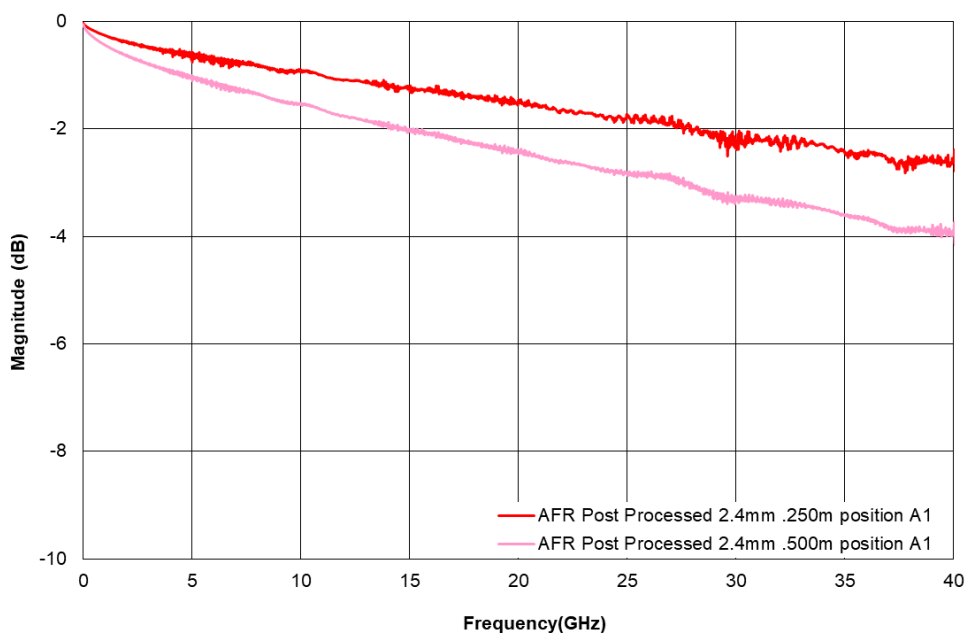
Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline
Transmission Type, 2.40 mm Straight Jack End Option

Appendix A – Frequency Domain Response Figures

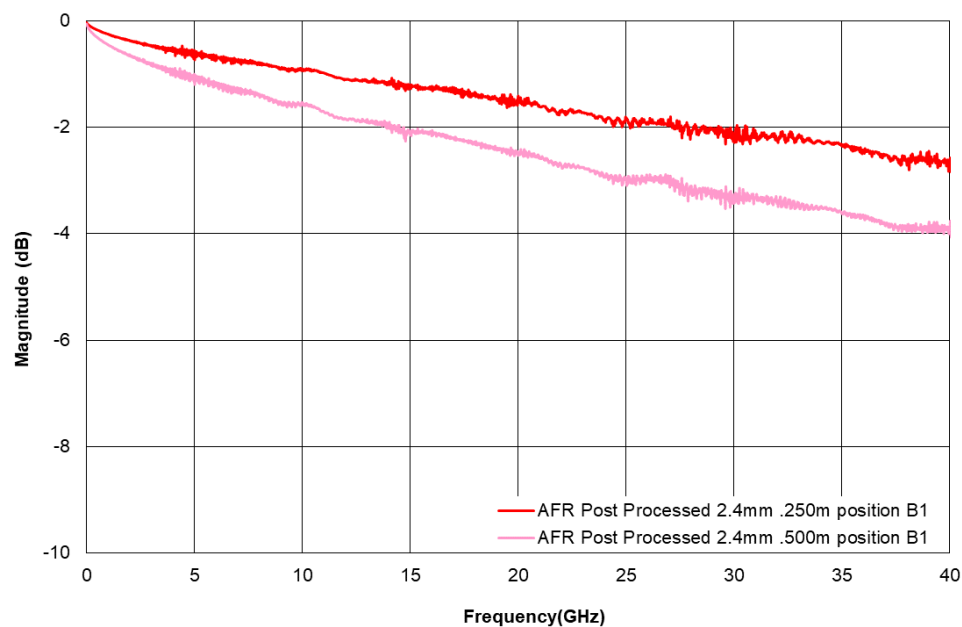
Insertion Loss

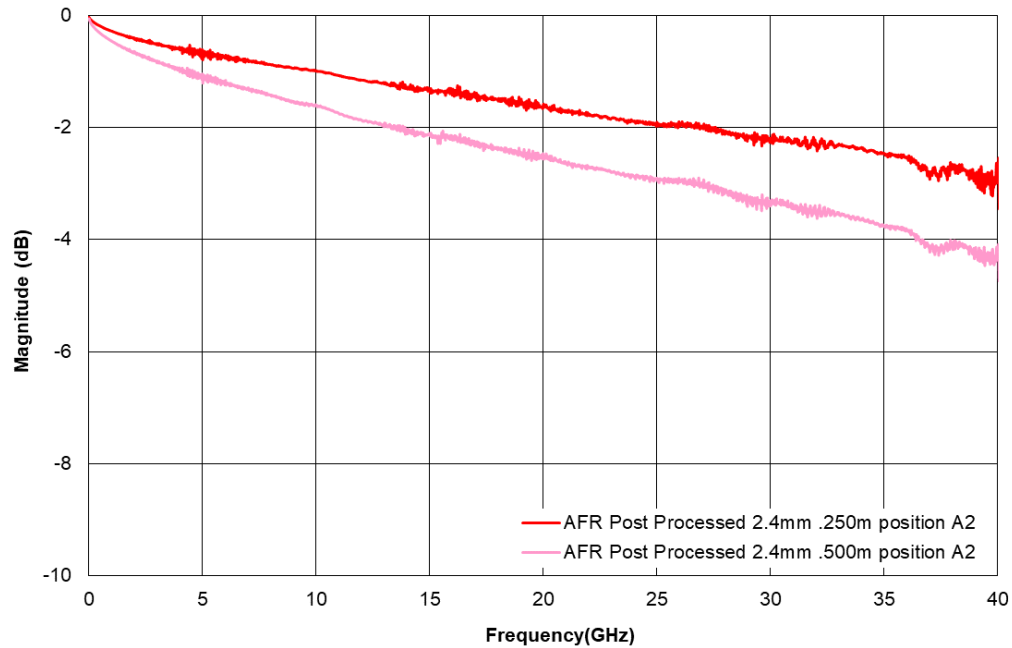
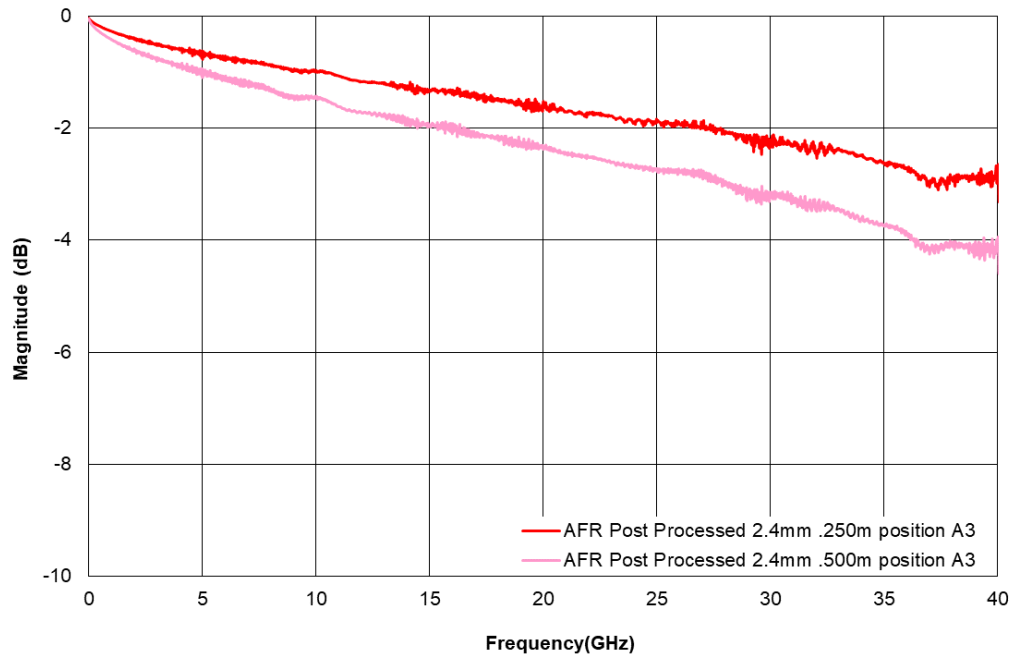
Control Depth Drilled Launches

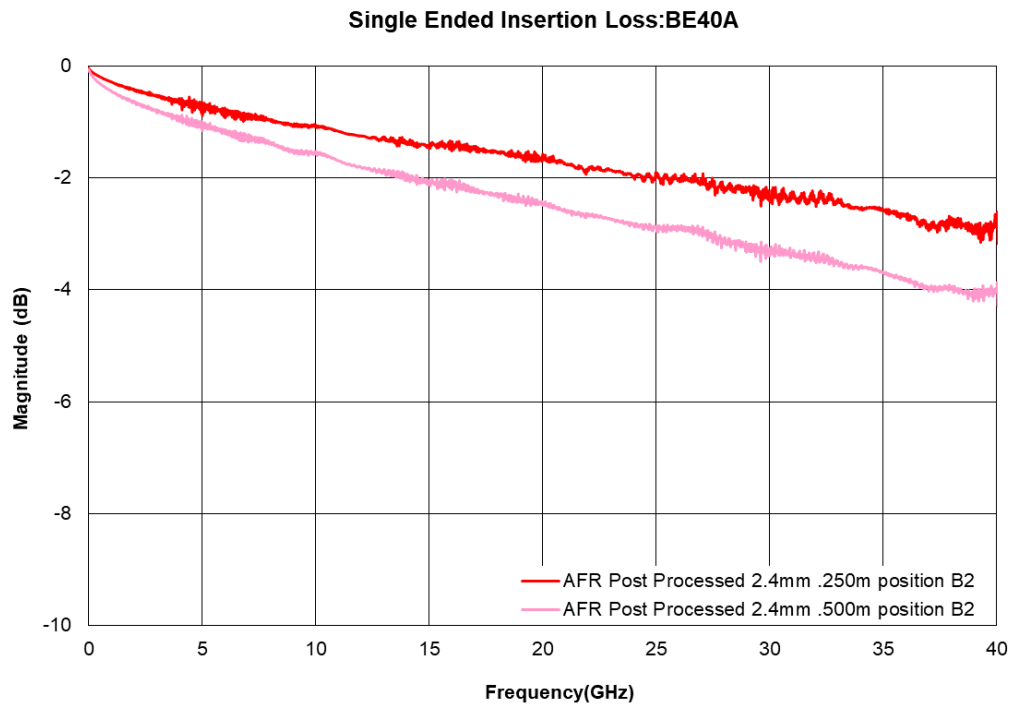
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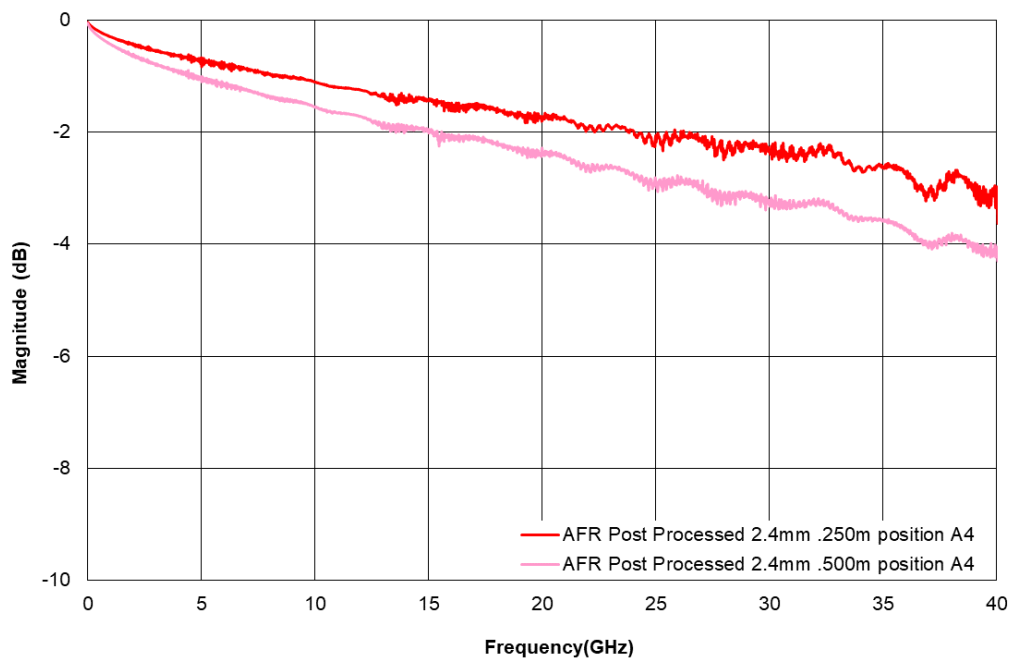
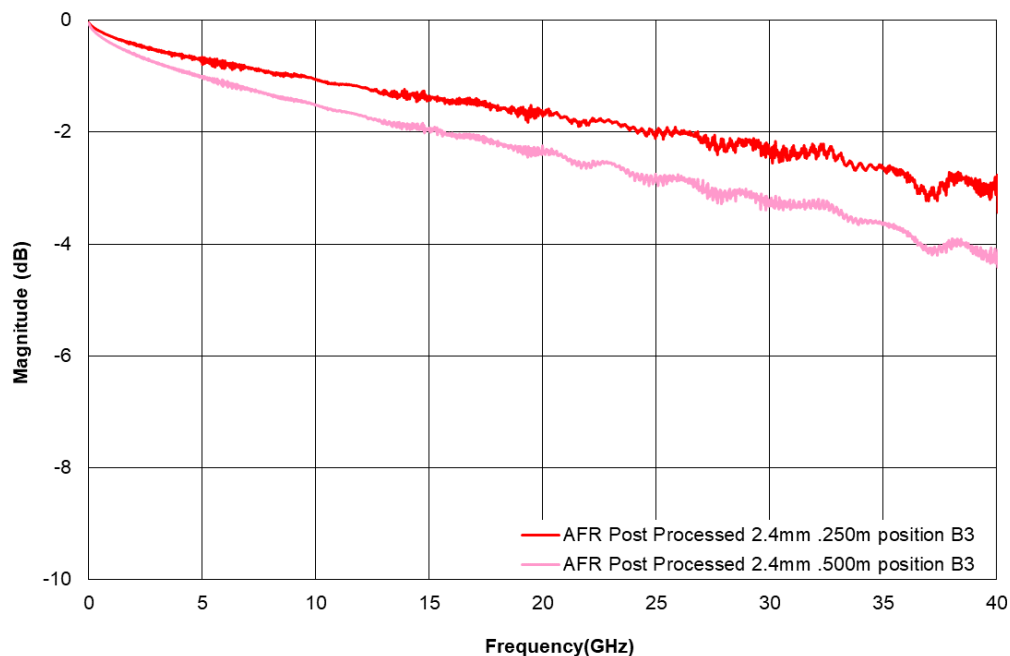


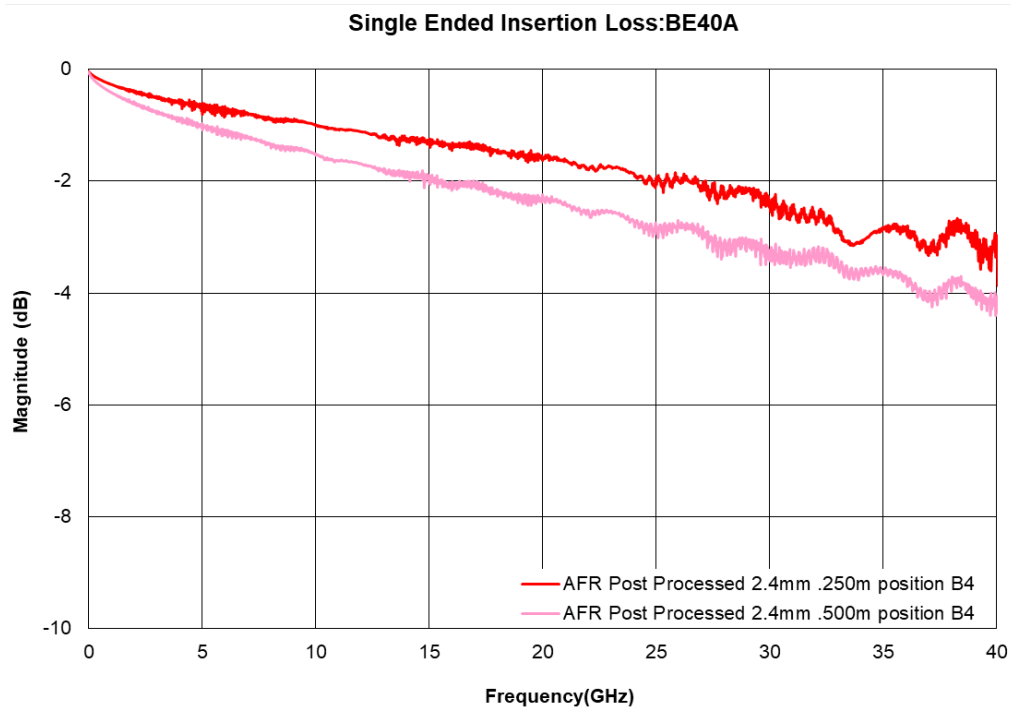
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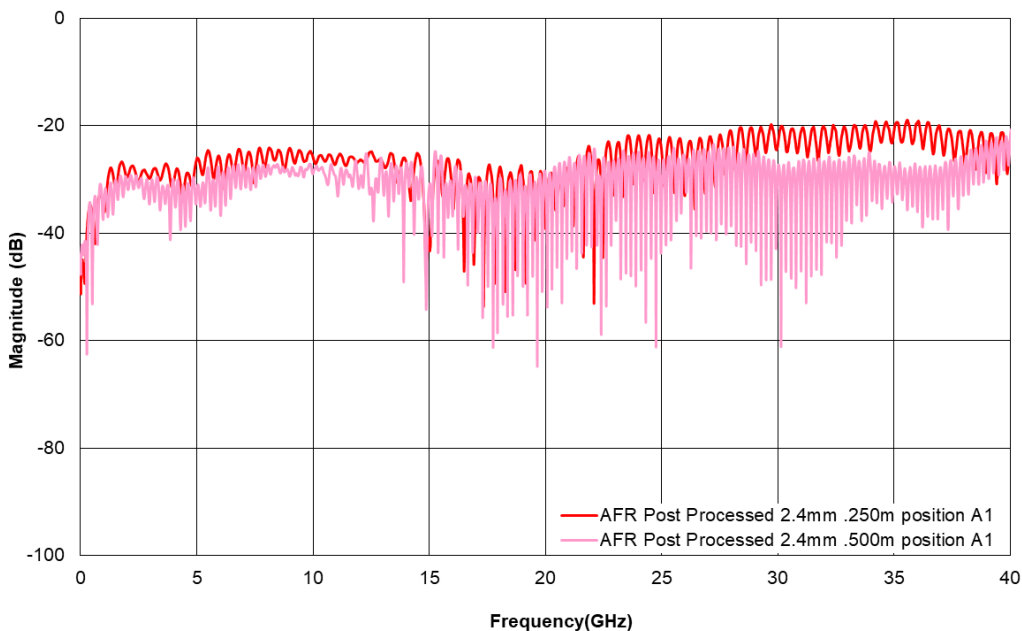
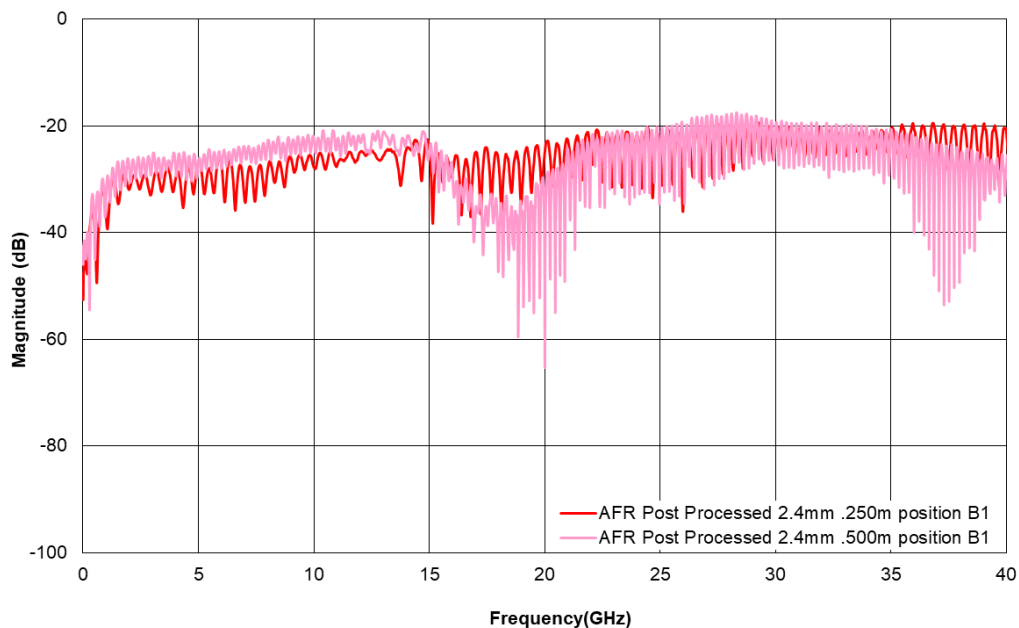


Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option**Back-drilled Launches (8 mil stub)****Single Ended Insertion Loss:BE40A****Single Ended Insertion Loss:BE40A**

Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End OptionThrough-Hole Via Layer 5 Launches**Single Ended Insertion Loss:BE40A****Single Ended Insertion Loss:BE40A**

Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

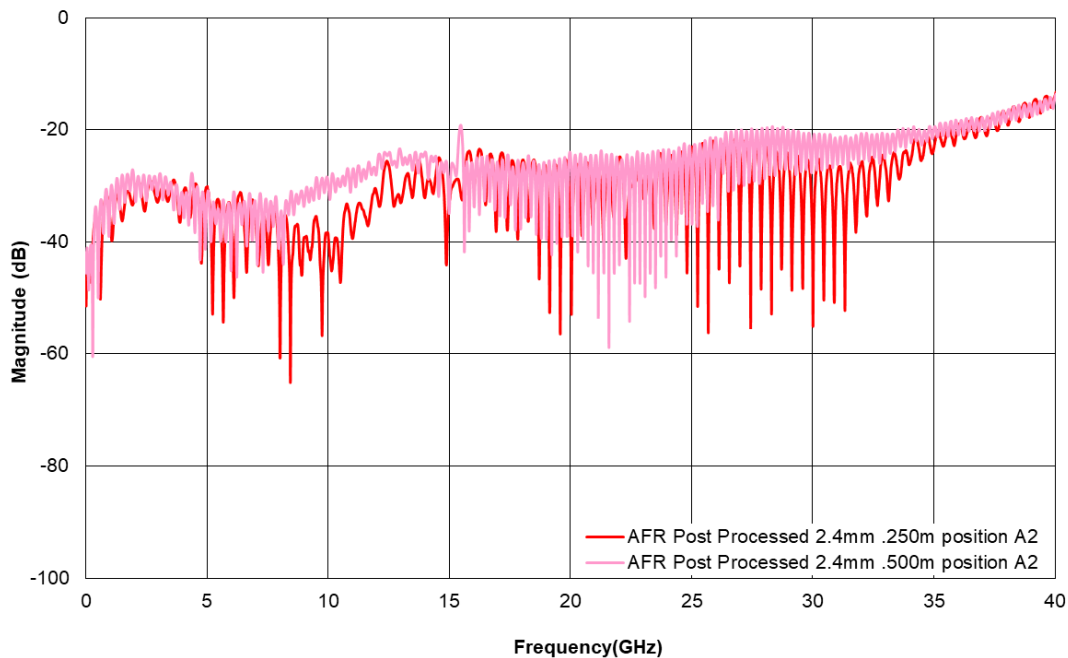
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Series: BE40A

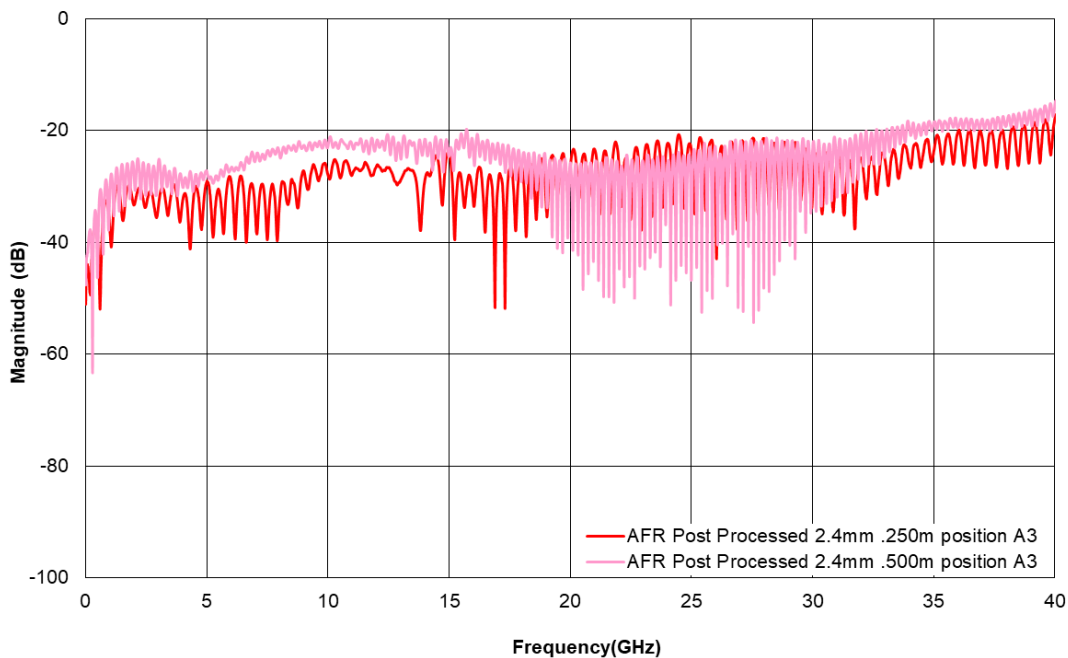
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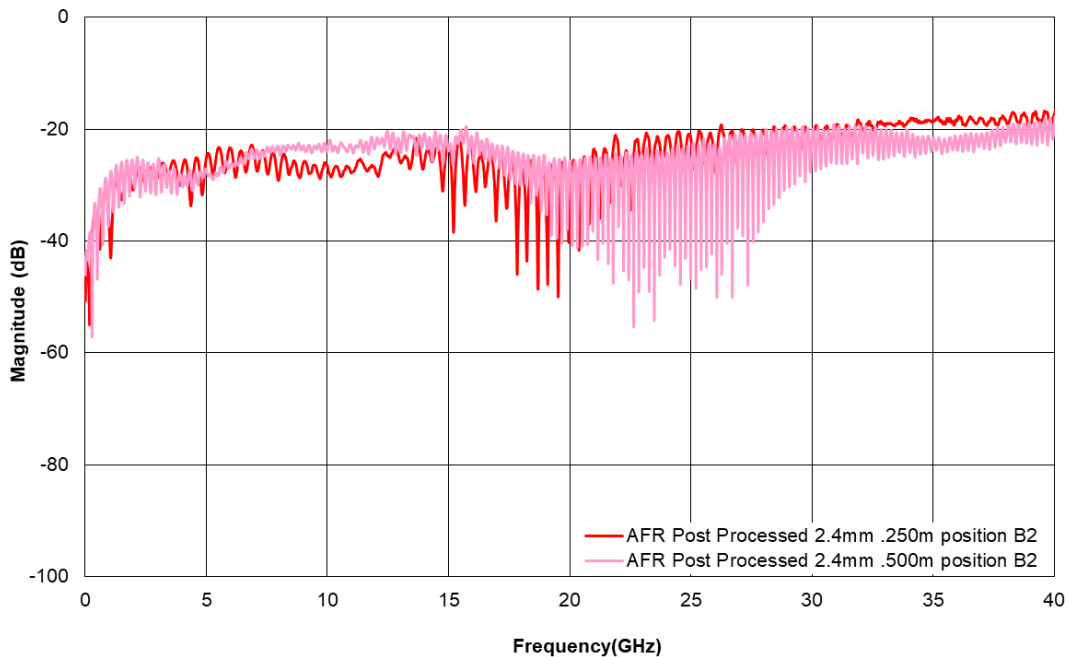
Back-drilled Launches (8 mil stub)

Single Ended Return Loss:BE40A

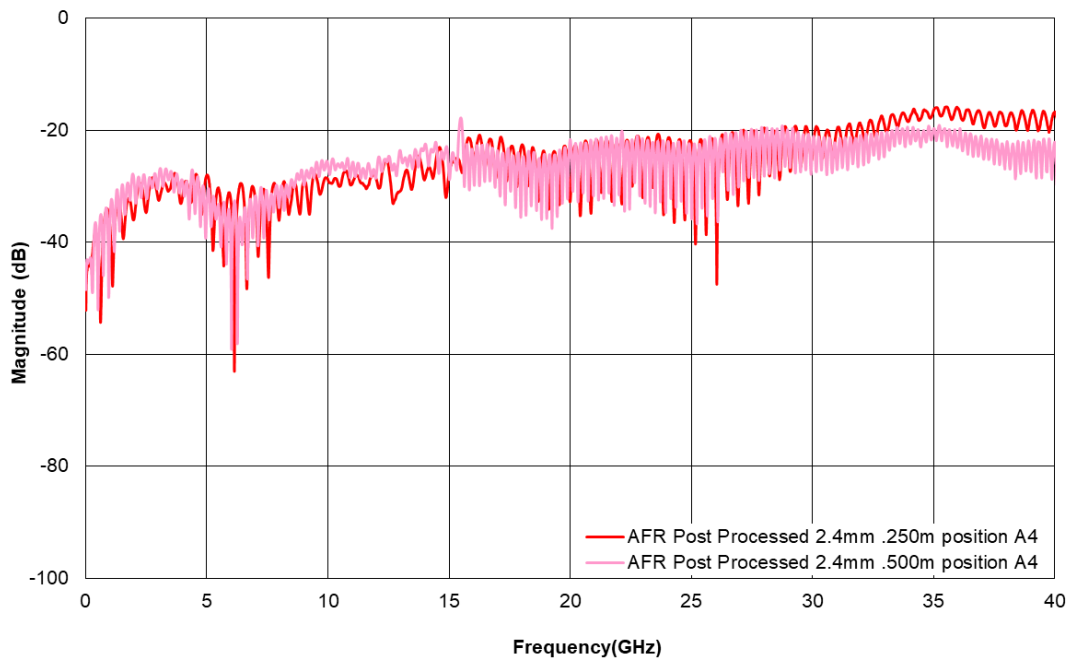


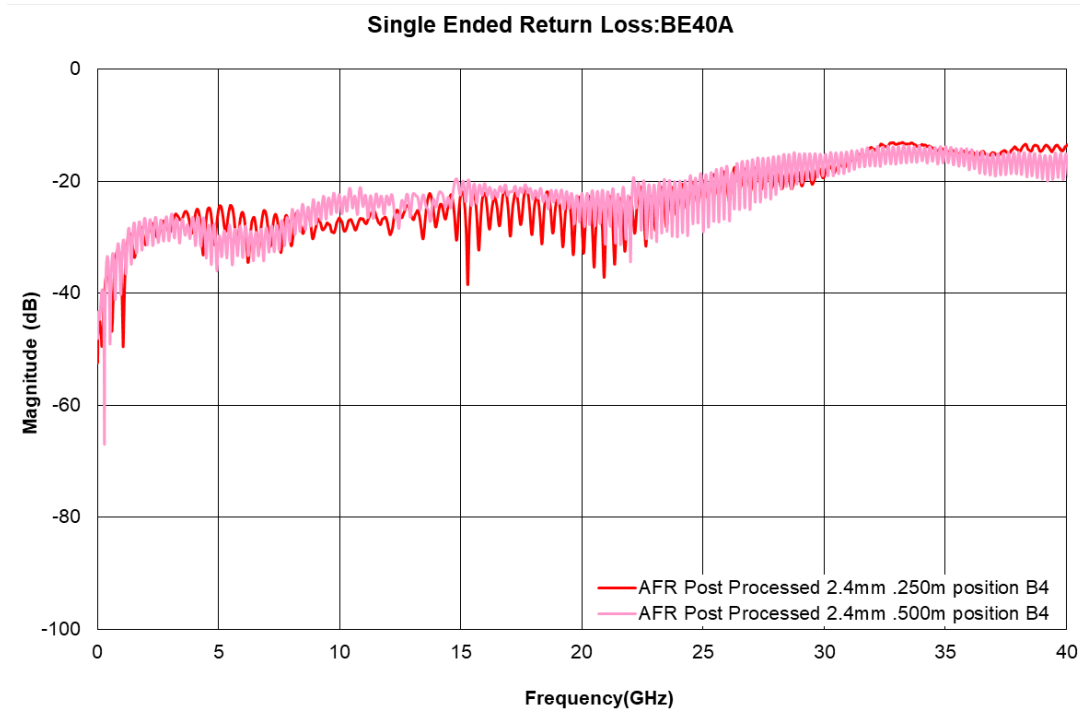
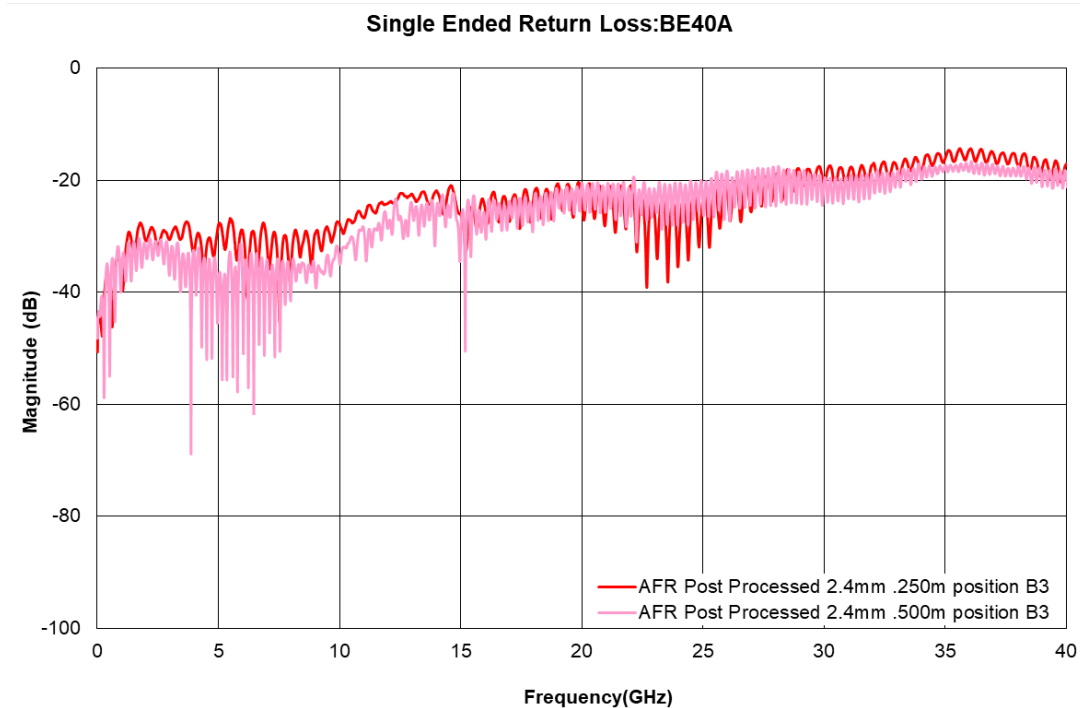
Single Ended Return Loss:BE40A



Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option**Single Ended Return Loss:BE40A**

Through-Hole Via Layer 5 Launches

Single Ended Return Loss:BE40A

Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Series: BE40A

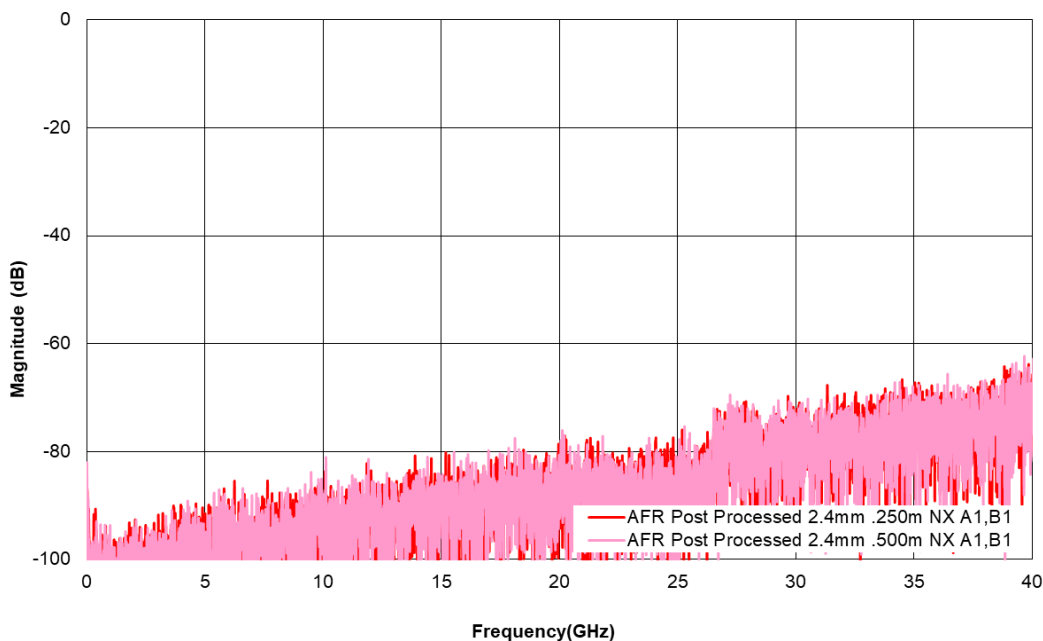
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Isolation

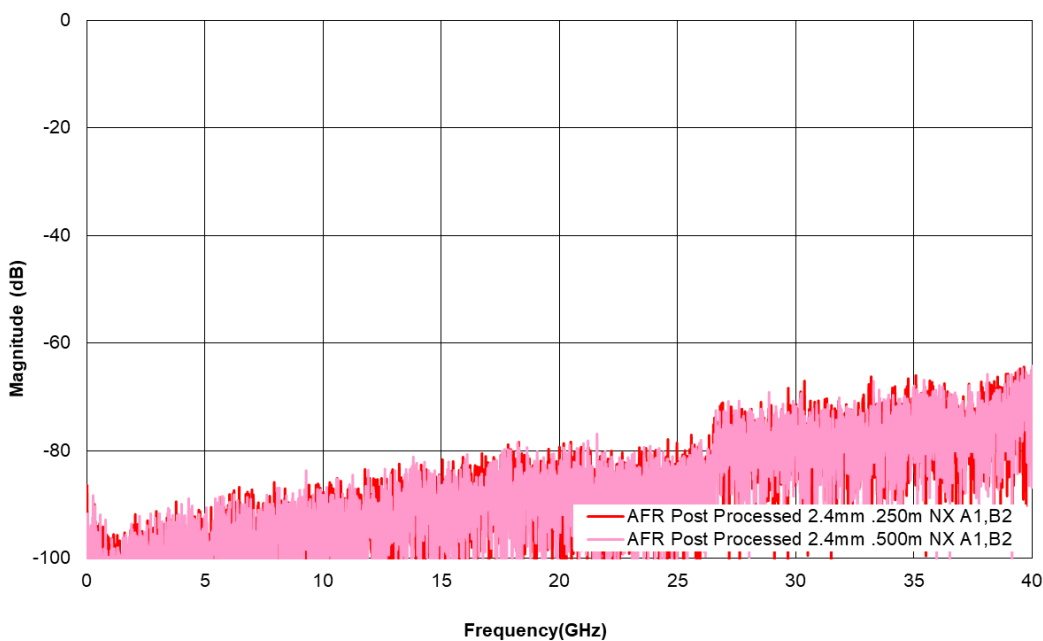
Cross Row Isolation

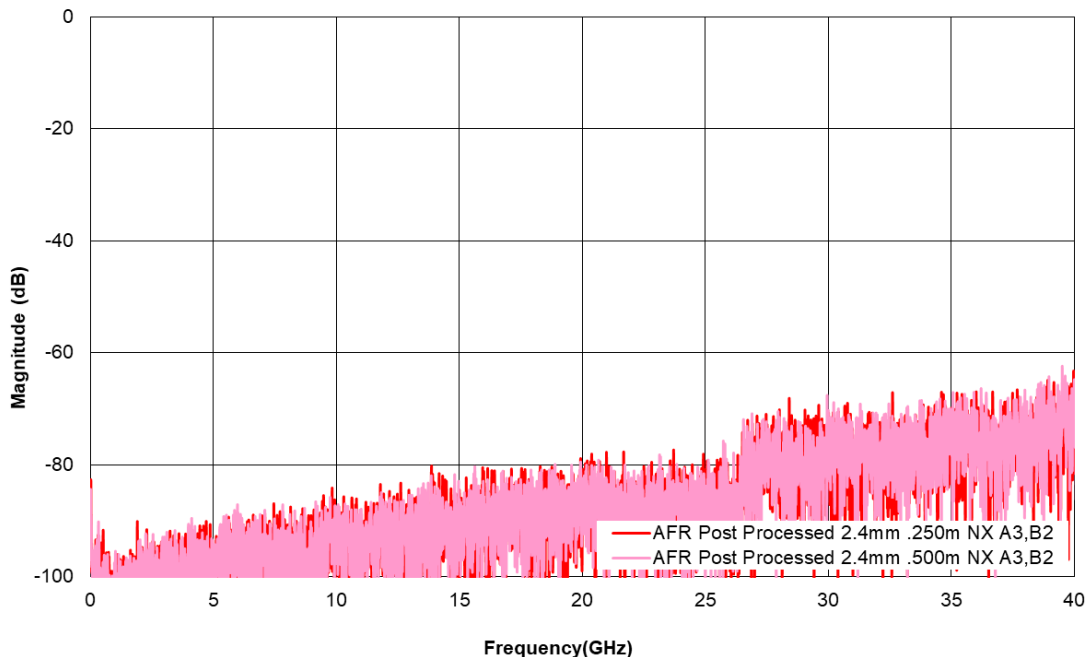
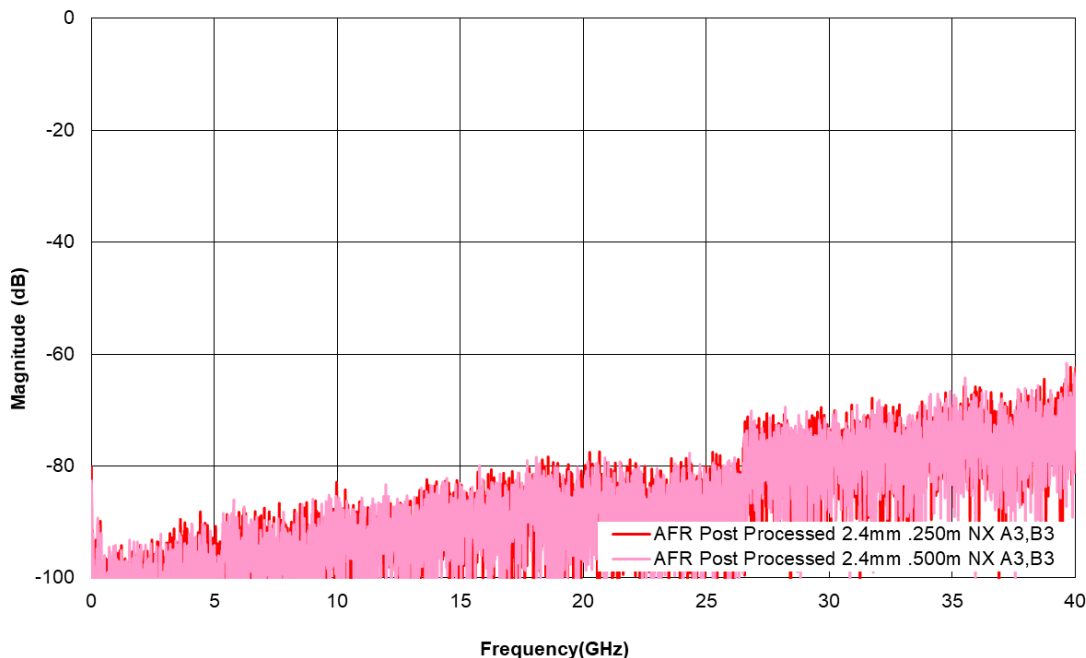
****No isolation data comes out of the noise floor in any of the cross-row measurements.**

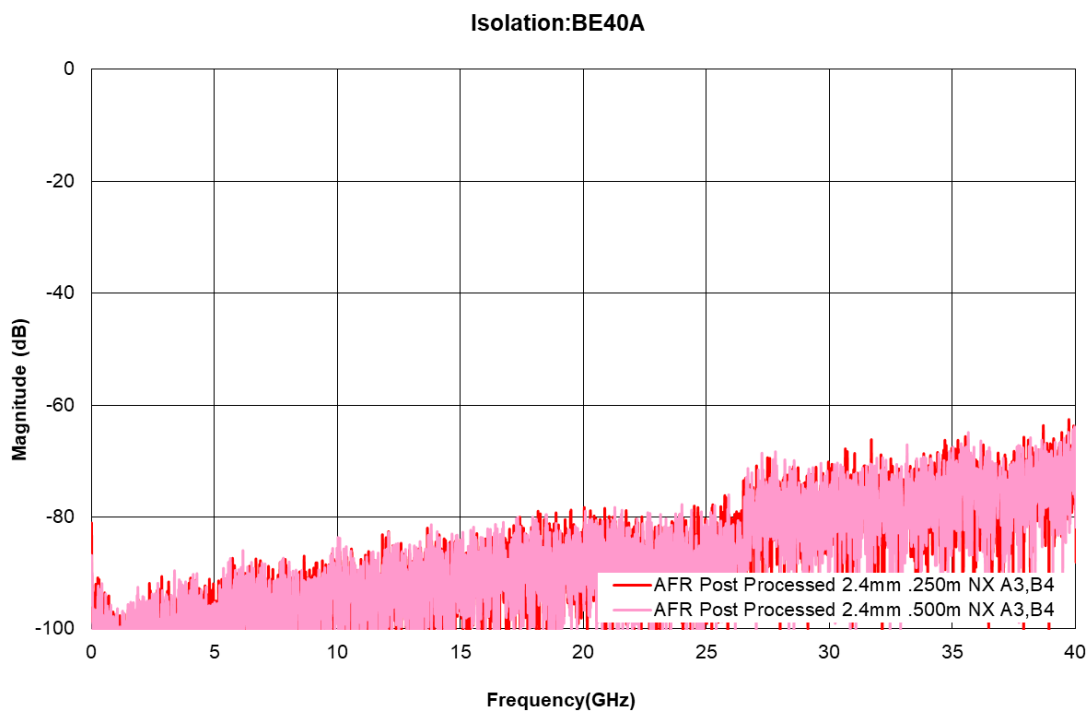
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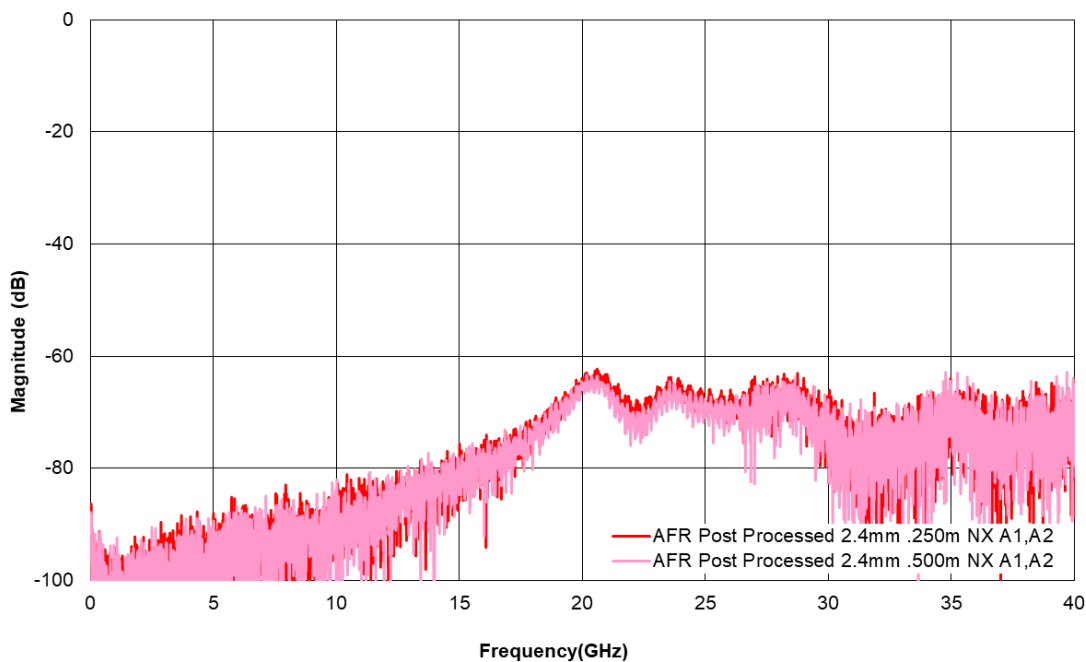
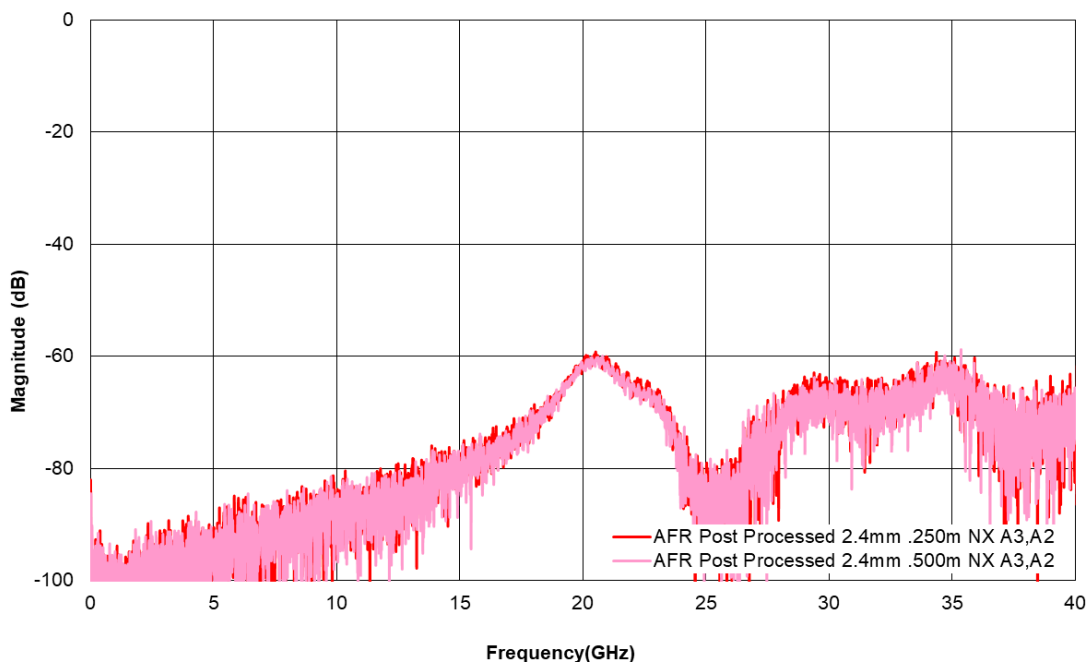


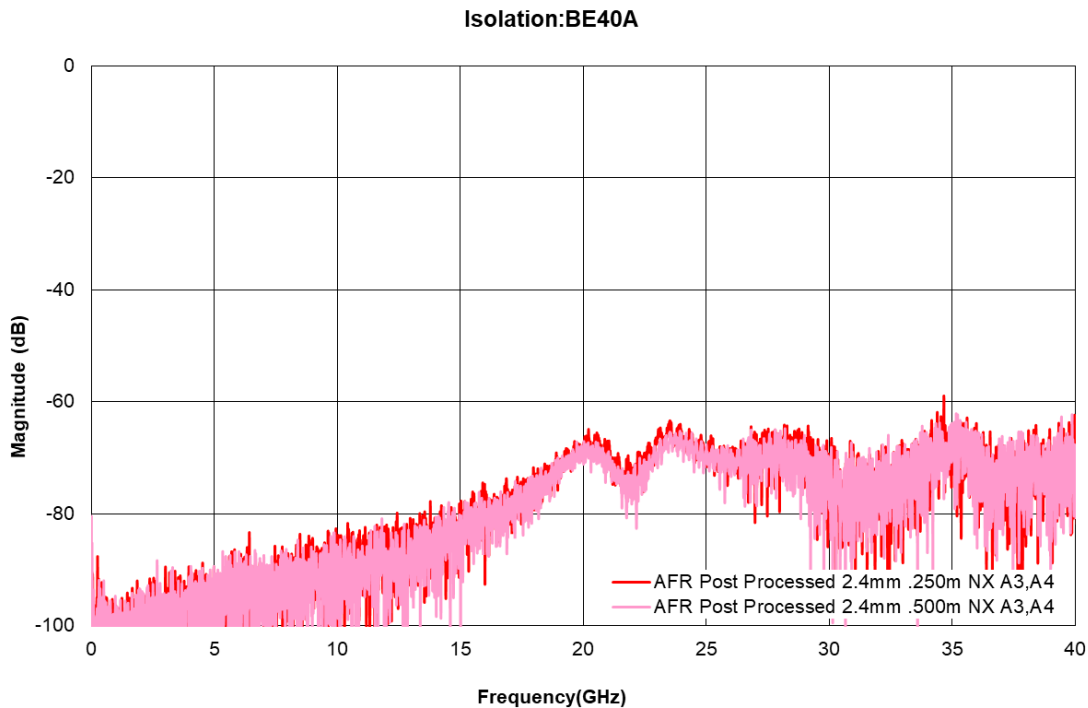
Isolation:BE40A



Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option**Isolation:BE40A****Isolation:BE40A**

Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End OptionIn Row Isolation**Isolation:BE40A****Isolation:BE40A**

Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Series: BE40A

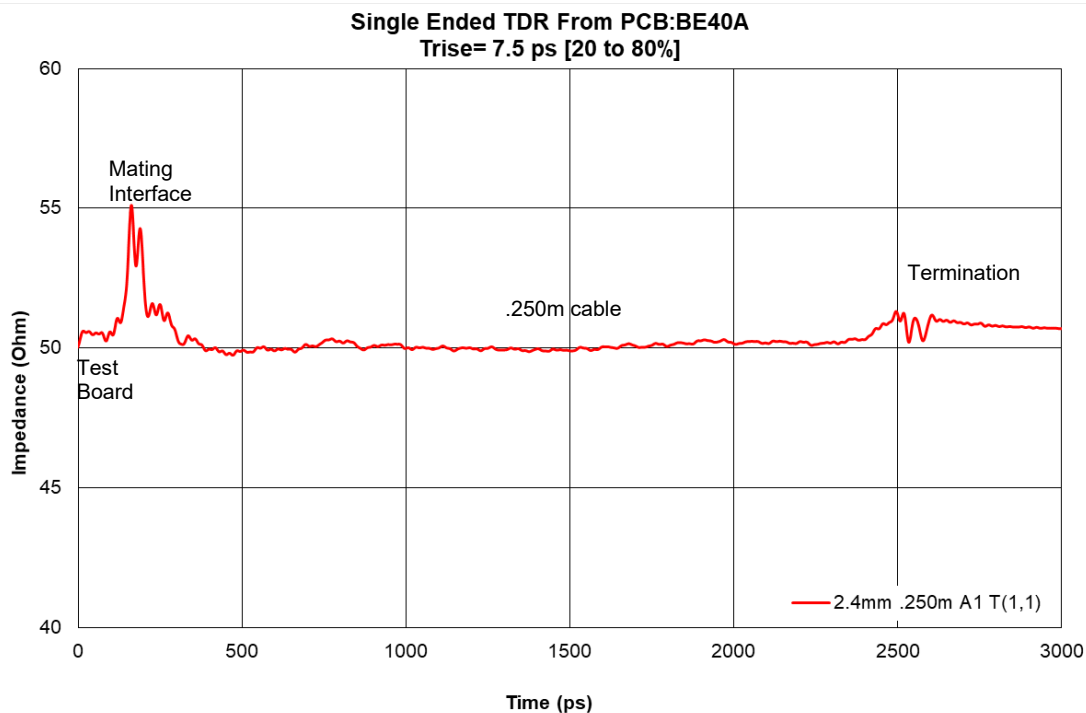
Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline
Transmission Type, 2.40 mm Straight Jack End Option

Appendix B – Time Domain Response Figures

Impedance

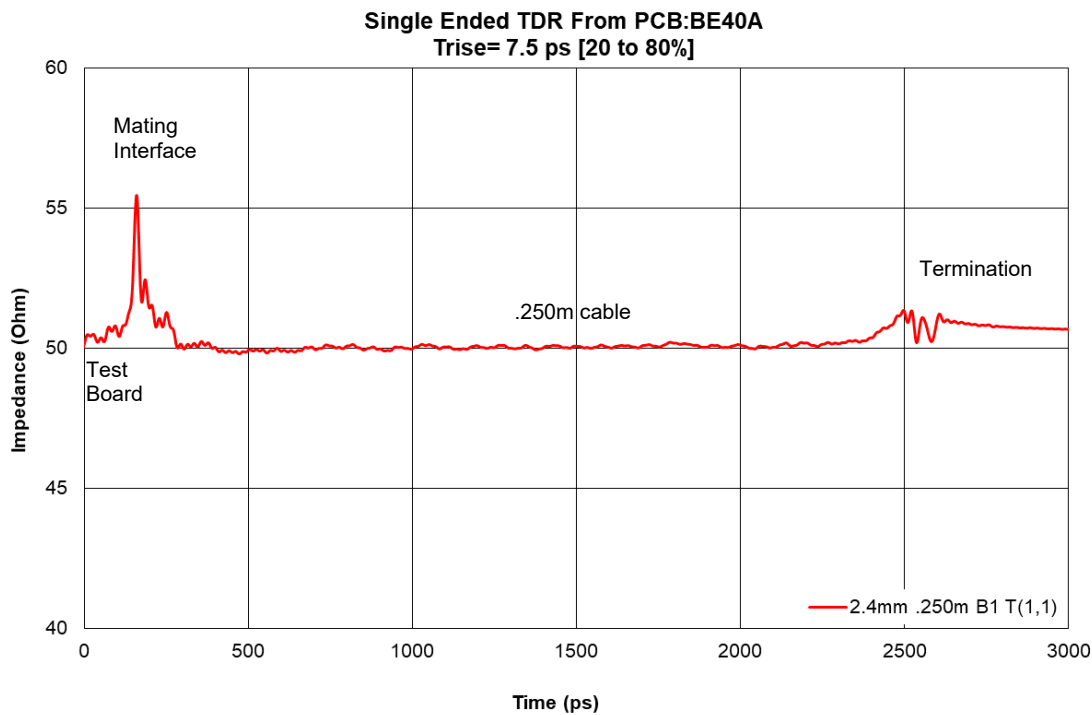
*All Impedance Profiles shown are of the 0.25 meter cable since the mating interfaces are identical.

Control Depth Drilled Launches

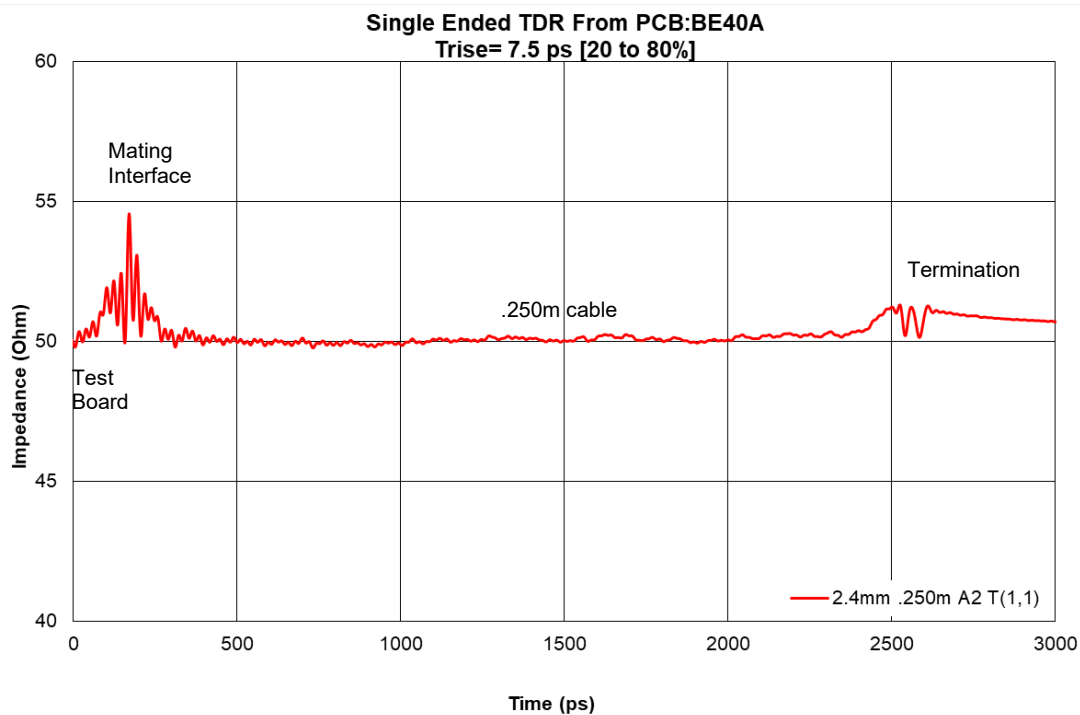


Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

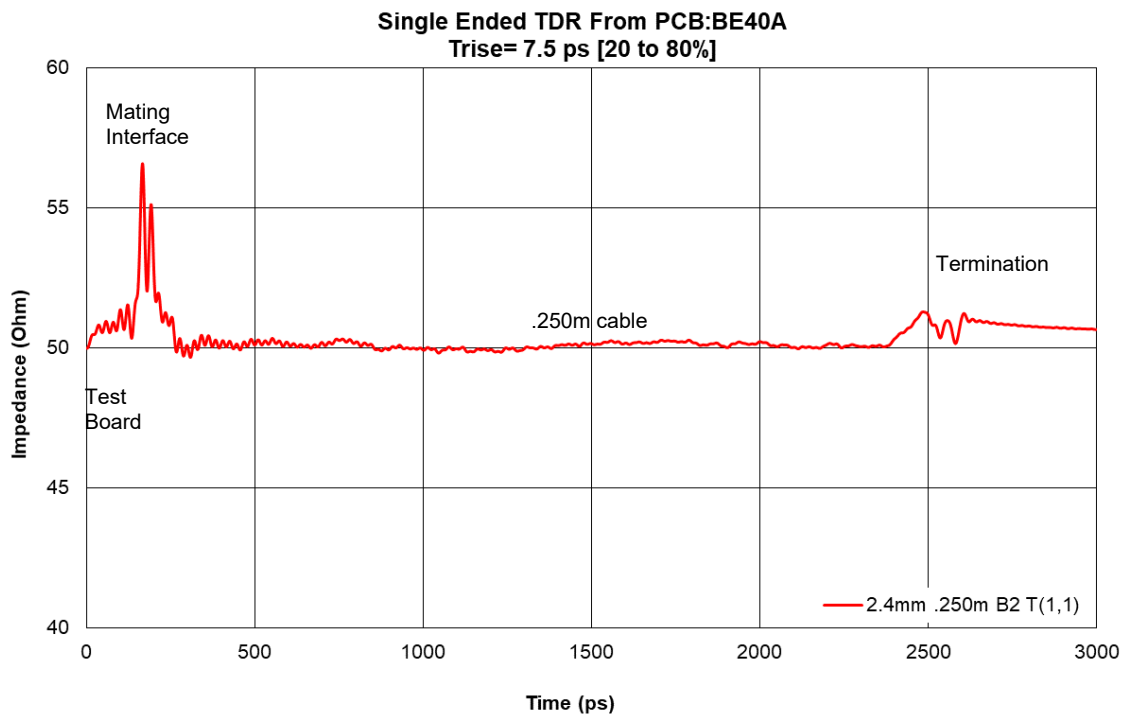
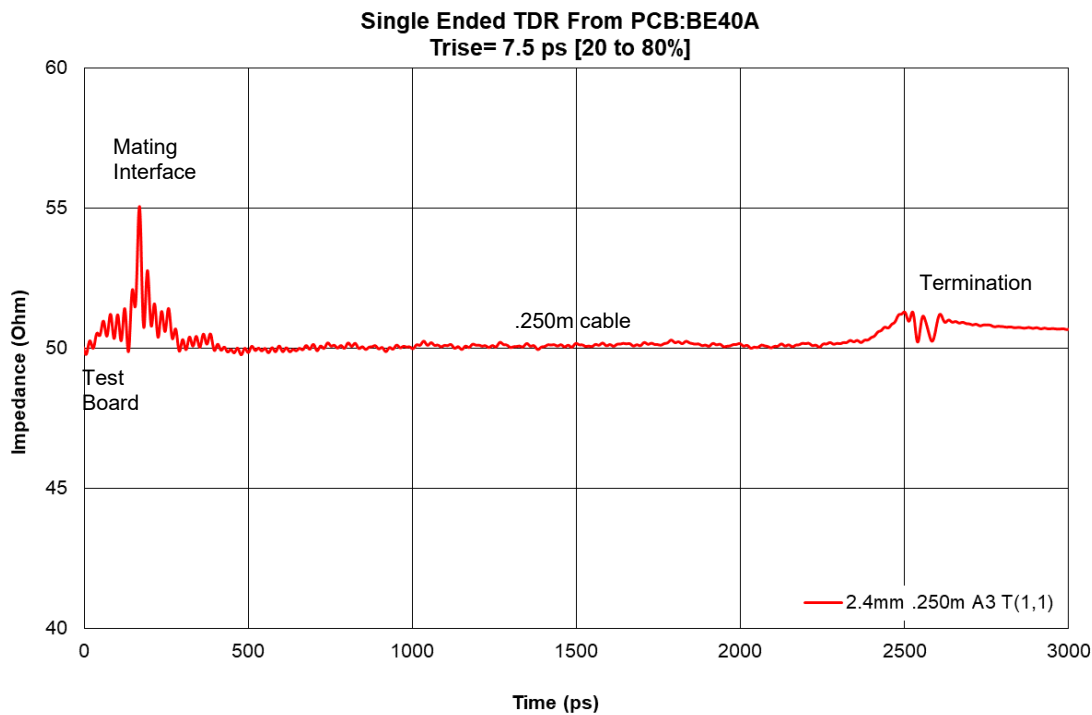


Back-drilled Launches (8 mil stub)



Series: BE40A

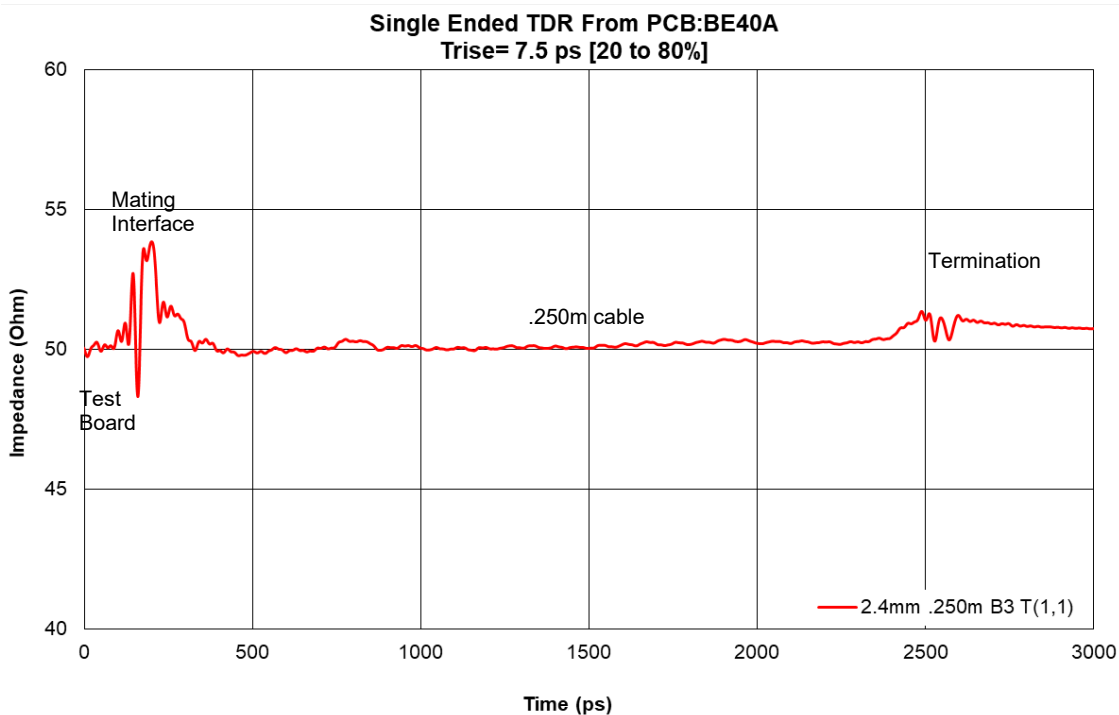
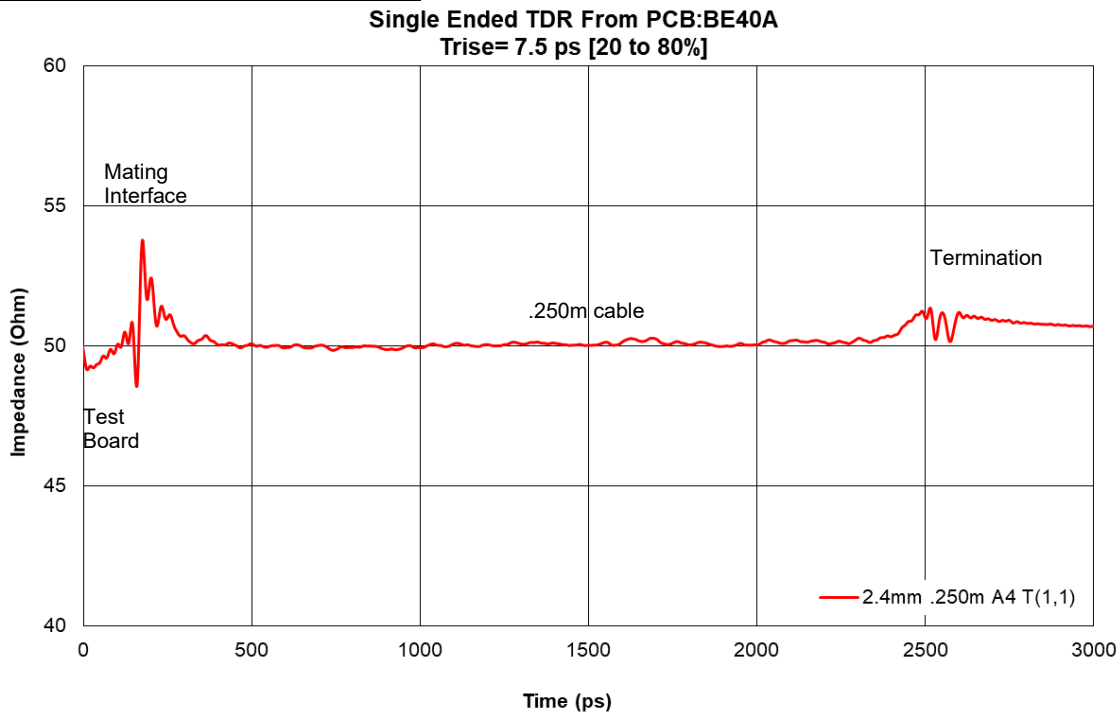
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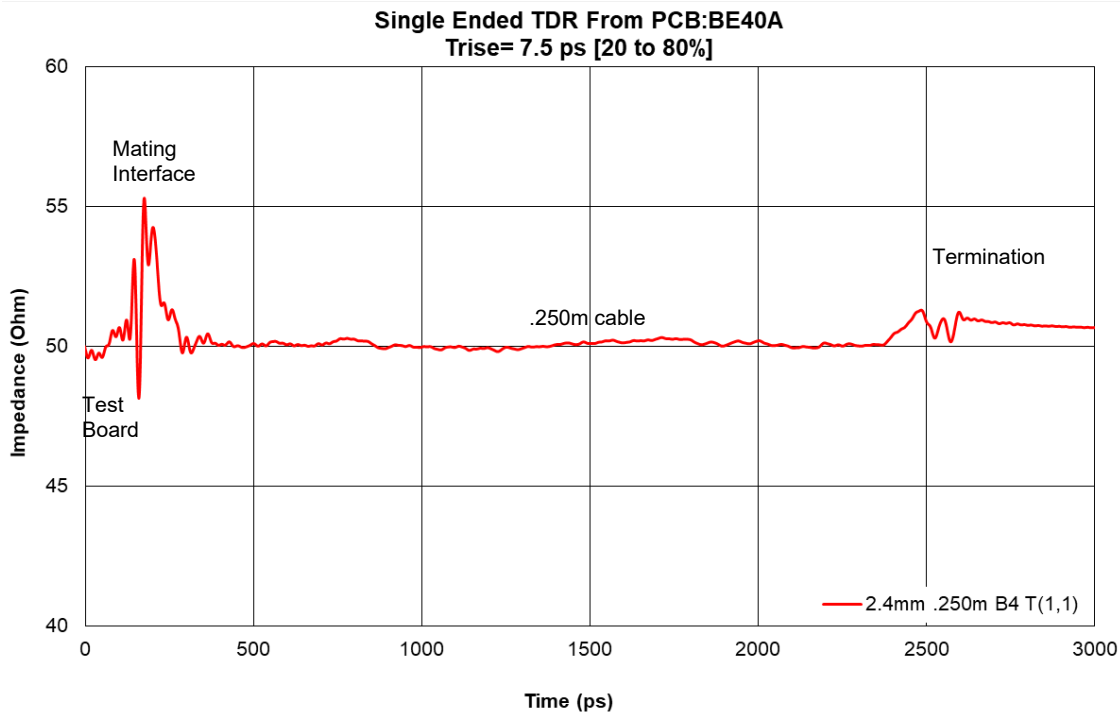


Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Through-Hole Via Layer 5 Launch



Series: BE40A**Description:** 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Appendix C – Product and Test System Descriptions

Product Description

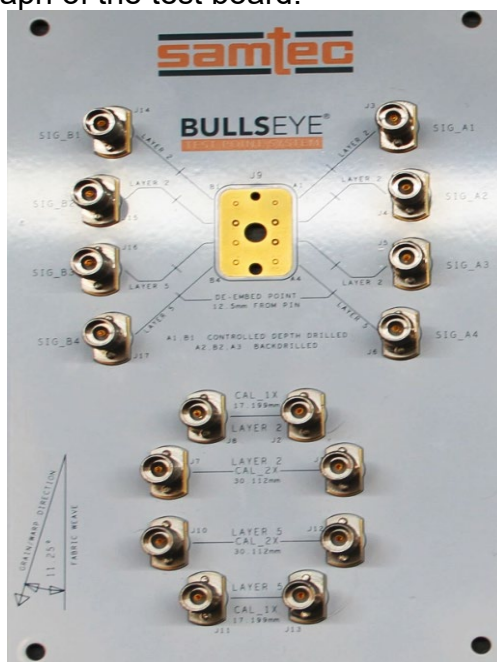
Product test samples are B40A series connectors. The part number is BE40A-S-24SJ-2-2-04-0250 for the .250m sample, and BE40A-S-24SJ-2-2-04-0500 for the .500m sample. The BE40A Series is a high-speed double row test assembly. BE40A has two different ends, male 2.4mm test points, and the Bullseye housing. The part tested was made with 2.4mm male ends, and the Bullseye housing side was terminated to the 2.4mm female test points on the test board. A photo of the test articles mounted to SI test boards is shown below.

Test System Description

The test fixture is composed of a six-layer Isola material with 50Ω signal trace and varying launch designs to reflect the different board manufacturing techniques used in application settings. A PCB mount SMA connector is used to interface the test cables to test fixtures. Optimization of the SMA launch was performed using full wave simulation tools to minimize reflections, which utilizing controlled depth drilling, back-drilling, and thru-hole via technology. These launch designs were implemented on PCB-108523-SIG. Calibration standards specific to the BE40A series are located on the calibration traces on the aforementioned PCB.

PCB-108523-SIG-01 Test Fixtures

Shown below is a photograph of the test board.

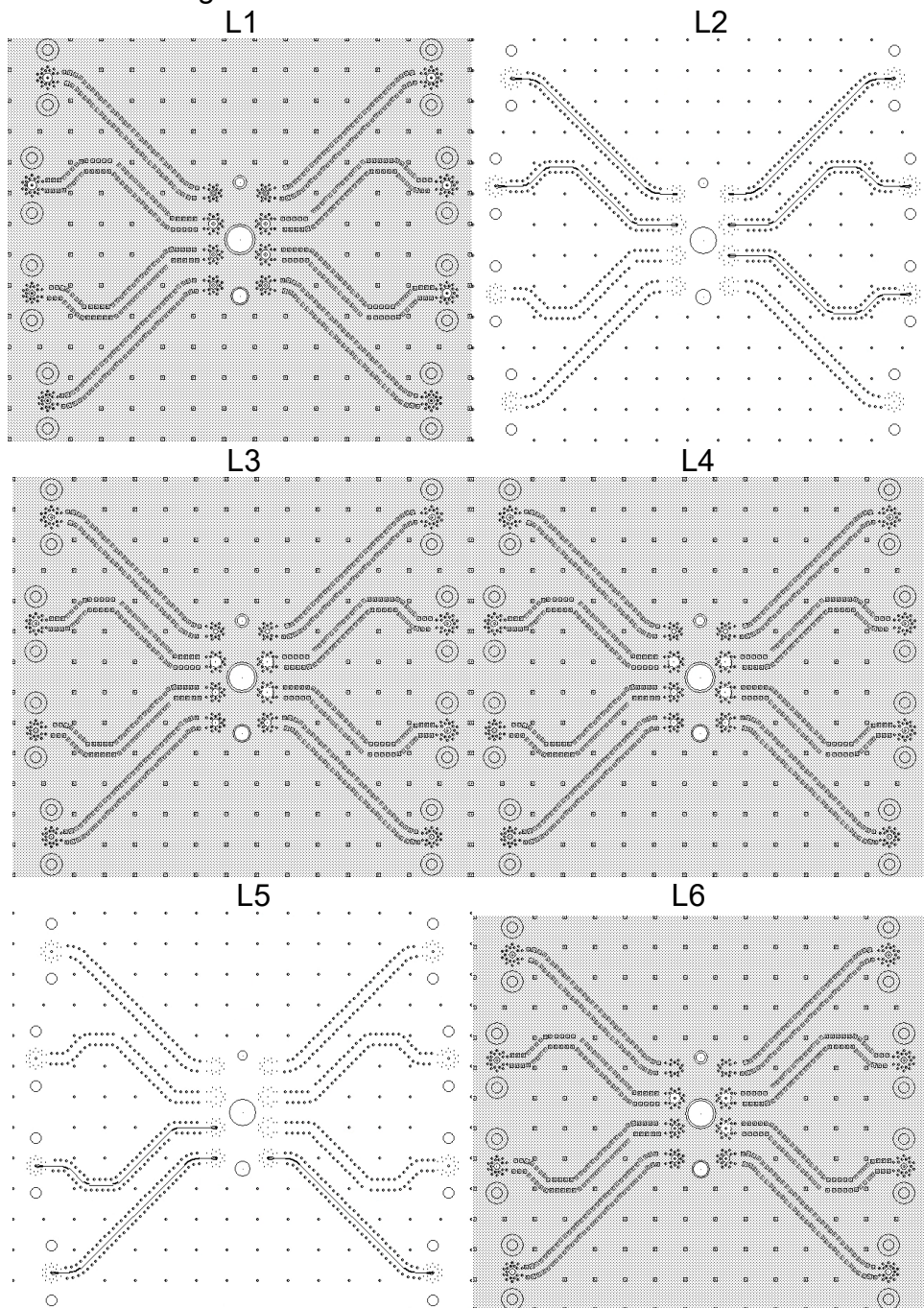


Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

PCB-108523-SIG-01 PCB Layout Panel

Artwork of the PCB design is shown below.



Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

PCB Fixtures

The test fixtures used are as follows:

PCB-108523-SIG

SIG_A1: Controlled Depth Drilled Launch

SIG_A2: Back-drilled Launch

SIG_A3: Back-drilled Launch

SIG_A4: Through-Hole Via Launch

SIG_B1: Controlled Depth Drilled Launch

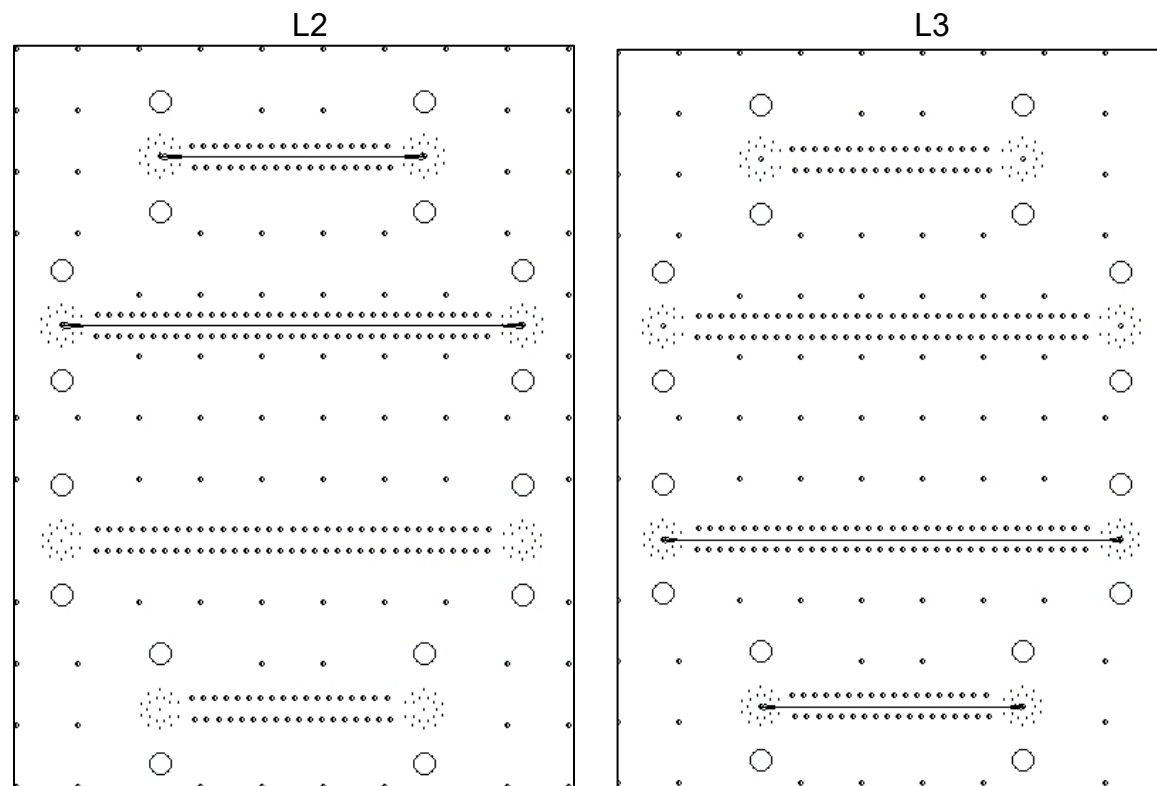
SIG_B2: Back-drilled Launch

SIG_B3: Through-Hole Via Launch

SIG_B4: Through-Hole Via Launch

Calibration Traces

Test fixture losses and test point reflections were removed from the data by use of Automatic Fixture Removal (AFR) application. The calibration traces are shown below. The measurements were performed under SOLT calibration with the test board effects included in the measurements. AFR application extracts fixture S-parameters from 2X THRU measurement and performs de-embedding on the DUT+Fixture measurement to characterize only the DUT.



THRU line – 1185.51 mils

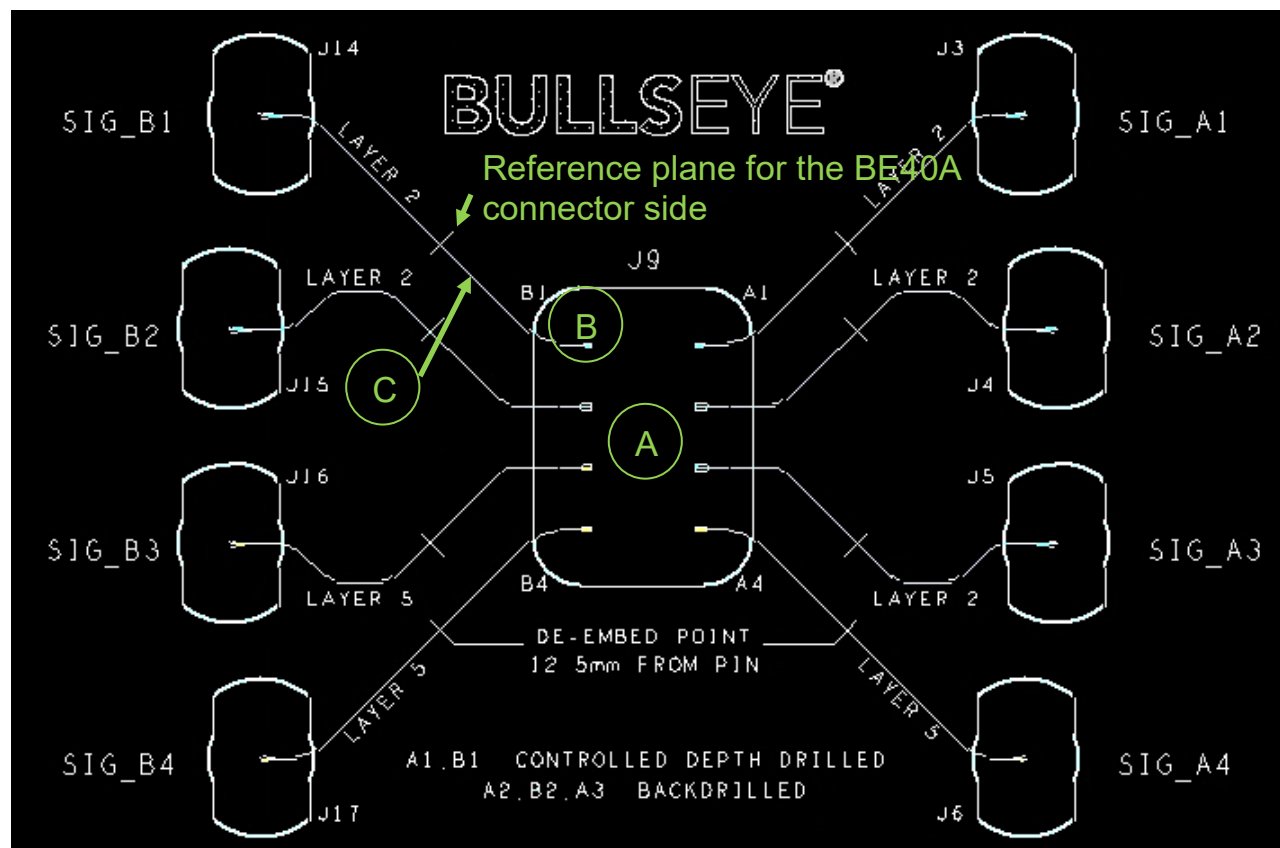
Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

All traces on the test boards are length matched to the 2.4mm RF test connectors. The AFR application effectively removes most of test board trace effects. This means that 12.5 mm of test board trace length effects are included in the test board side in the measurement. The S-Parameter measurement includes:

- A- The BE40A Series connector set
- B- Test board vias, pads (footprint effects) for the BE40A connector side
- C- 12.5 mm of stripline trace

The figure below shows the location of the reference plane performing AFR application.



Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Appendix D – Test and Measurement Setup

For frequency domain measurements, the test instrument is the Agilent N5225B PNA network analyzer. Frequency domain data and graphs are extracted from the instrument by AFR application. Time domain data was not de-embedded and is a raw measurement of the system. The network analyzer is configured as follows:

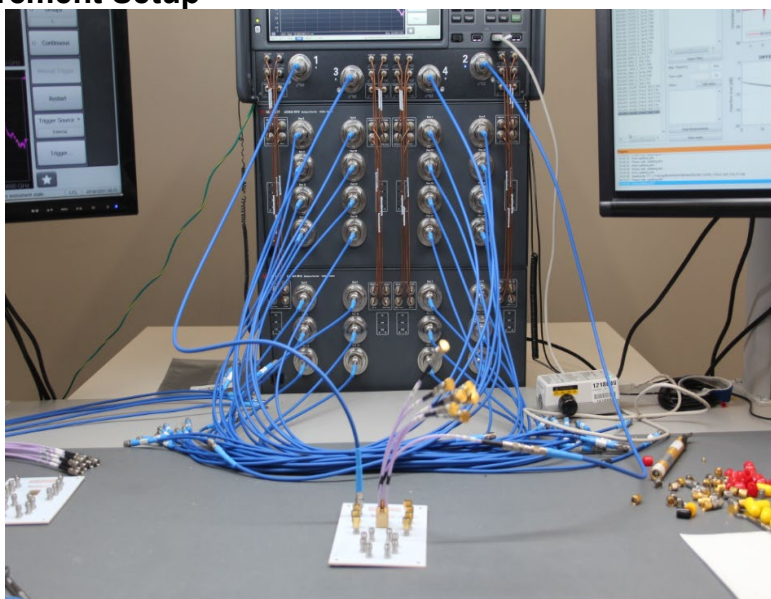
Start Frequency – 10 MHz

Stop Frequency – 50 GHz

Step Size – 10 MHz

IFBW – 500 Hz

N5225B Measurement Setup



Test Instruments

<u>QTY</u>	<u>Description</u>
1	Agilent N5225B PNA-L Network Analyzer (10 MHz to 50 GHz)
1	Agilent Maury 8770D module (DC to 40 GHz)

Test Cables & Adapters

<u>QTY</u>	<u>Description</u>
4	Junkosha 2.4mm Cables (DC-40 GHz)

Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Appendix E - Frequency and Time Domain Measurements

Frequency (S-Parameter) Domain Procedures

The quality of any data taken with a network analyzer is directly related to the quality of the calibration standards and the use of proper test procedures. For this reason, extreme care is taken in the design of the through calibration standards, the SI test boards, and the selection of the PCB vendor.

A coaxial SOLT calibration is performed using a Maury 85056D 2.4mm mechanical calibration kit. Then DUT measurements are performed under SOLT calibration. The measurements include the effect of test fixture. The measurements of the 2X THRU line standards are required to remove the test fixture effect.

Time Domain Procedures

Mathematically, Frequency Domain data can be transformed to obtain a Time Domain response. Perfect transformation requires Frequency Domain data from DC to infinity Hz. Fortunately, a very accurate Time Domain response can be obtained with bandwidth-limited data, such as measured with modern network analyzer.

The time domain data in this report was taken from time domain transforms of frequency domain data. An example of a similar transform methodology is provided in the Samtec Technical Note on domain transformation.

http://www.samtec.com/Technical_Library/reference/articles/pdfs/tech-note_using-PLTS-for-time-domain-data_web.pdf

Impedance (TDR)

Measurements involving digital pulses are performed using either Time Domain Reflectometer (TDR) or Time Domain Transmission (TDT) methods. The TDR method is used for the impedance measurements in this report.

The signal line(s) of the SUT's is energized with a TDR pulse and the far-end of the energized signal line is terminated in the test systems characteristic impedance (e.g., 50Ω or 100Ω terminations). By terminating the adjacent signal lines in the test systems characteristic impedance, the effects on the resultant impedance shape of the waveform are limited. The "best case" signal mapping was tested and is presented in this report.

Series: BE40A

Description: 50 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type, 2.40 mm Straight Jack End Option

Appendix F – Glossary of Terms

AFR – Automatic Fixture Removal

DUT – Device under test

FD – Frequency domain

FEXT – Far-End Crosstalk

NEXT – Near-End Crosstalk

PCB – Printed Circuit Board

SOLT – Acronym used to define Short, Open, Load & Thru Calibration Standards

SUT – System Under Test

TDR – Time Domain Reflectometry

VSWR – Voltage Standing Wave Ratio

Z – Impedance (expressed in ohms)