

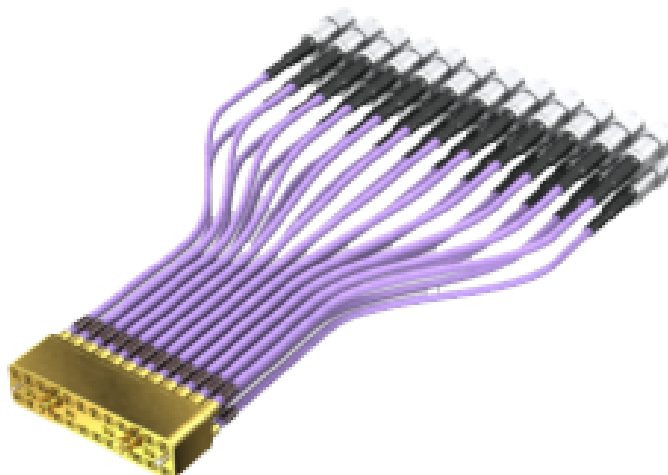


High Speed Characterization Report

BE70A-S-18SP-2-02-0152

BE70A-S-18SP-2-02-0305

BE70A-S-18SP-2-02-0610



Description:

**70 GHz, Bulls Eye®: Double Row, High-Performance Test System,
Stripline Transmission Type**

Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline
Transmission Type

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Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

Cable Assembly Overview

The BE70A series is a 4mm (0.157") pitch double row test assembly capable of 70GHz (1.85 mm end option) speeds. The BE70A-S-18XX-2-02-XXXX series connector accepts 1.85 mm male and female test points. The data in this report is only applicable to BE70A connector mated to female 1.85 mm test points. The device under test contained 0.152 meter, 0.305 meter and 0.610 meter cable samples. They were tested on a board with multiple launch structures shown below.

Case	Pins
Laser Drilled Microvia Layer 2	A1, A2, B1, B2
Thru Via w/Backside Pad Layer 5	A3, A4, B3, B4

Frequency Domain Data Summary

Laser Drilled Microvia Layer 2

Test Parameter	Configuration	Driver	Receiver	0.152 m	0.305 m	0.610 m
Insertion Loss	N/A	Test Board	BE70A	>-6.7dB@ 67 GHz	>-7.3dB@ 67 GHz	>-9.5dB@ 67 GHz
Return Loss	N/A	Test Board	BE70A	<-14.7dB to 60 GHz <-8.8dB to 67 GHz;	<-15.3dB to 60 GHz <-9.3dB to 67 GHz;	<-14.9dB to 60 GHz <-8.7dB to 67 GHz;
Isolation	In Row	Test Board	Test Board	<-72.4dB to 67 GHz	<-72.1dB to 67 GHz	<-71.6dB to 67 GHz

Thru Via w/Backside Pad Layer 5 (Layer 5 BE70 launch performance limited to 60GHz due to PCB manufacturing variation.)

Test Parameter	Configuration	Driver	Receiver	0.152 m	0.305 m	0.610 m
Insertion Loss	N/A	Test Board	BE70A	>-5.5dB@ 60 GHz	>-6.4dB@ 60GHz	>-7.9dB@ 60 GHz
Return Loss	N/A	Test Board	BE70A	<-17.2dB to 60 GHz	<-16.1dB to 60 GHz	<-17.3dB to 60 GHz
Isolation	In Row	Test Board	Test Board	<-57.6dB to 40 GHz; <-35.7dB to 60 GHz	<-58.3dB to 40 GHz; <-36.0dB to 60 GHz	<-58.3dB to 40 GHz; <-35.4dB to 60 GHz



Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

Time Domain Data Summary

Laser Drilled Microvia Layer 2

	7.5ps	22.5ps	37.5ps	75ps
Signal Rise-time				
Maximum Impedance (Ohm)	51.9	51.0	50.7	50.4
Minimum Impedance (Ohm)	48.7	48.8	48.9	49.2

Thru Via w/Backside Pad Layer 5

	7.5ps	22.5ps	37.5ps	75ps
Signal Rise-time				
Maximum Impedance (Ohm)	51.8	51.0	50.6	50.2
Minimum Impedance (Ohm)	47.7	48.9	48.9	49.0

Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

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: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

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.

Impedance mismatch versus length is measured by a DSA8300 Digital Serial Analyzer. It can also be extracted from frequency domain data via transform. This report shows cases transformed time domain data. Board related effects, such as pad-to-ground capacitance and trace loss, are included in the data presented in this report. The impedance data is provided in [Appendix E](#) of this report.

The measured S-Parameters from the network analyzer are post-processed using Automatic Fixture Removal. The 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.

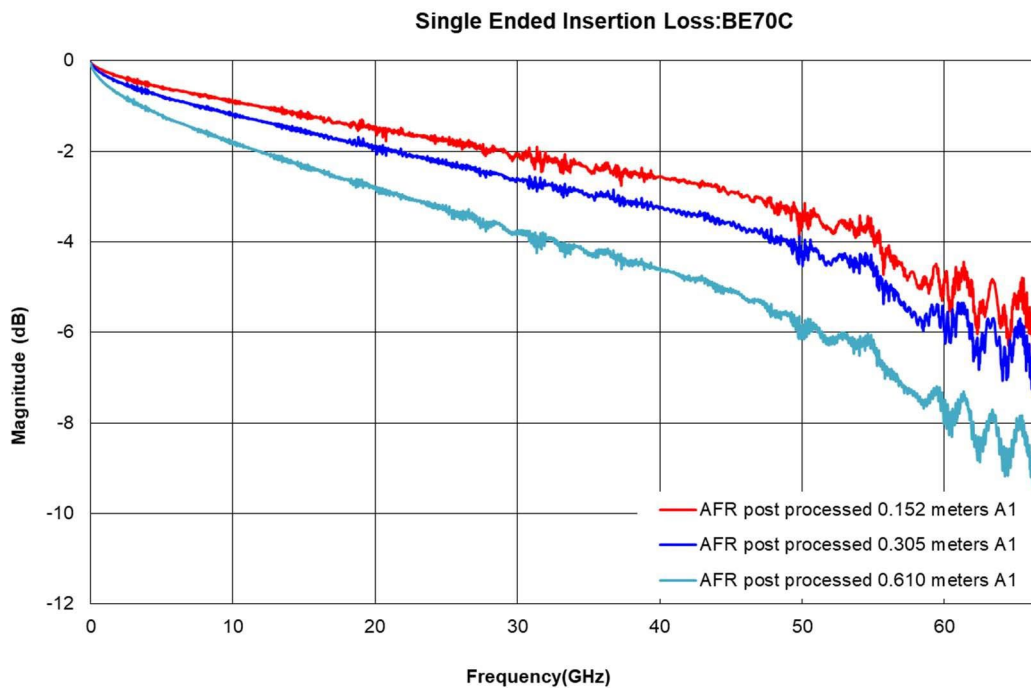
Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

Appendix A – Frequency Domain Response Figures

Insertion Loss

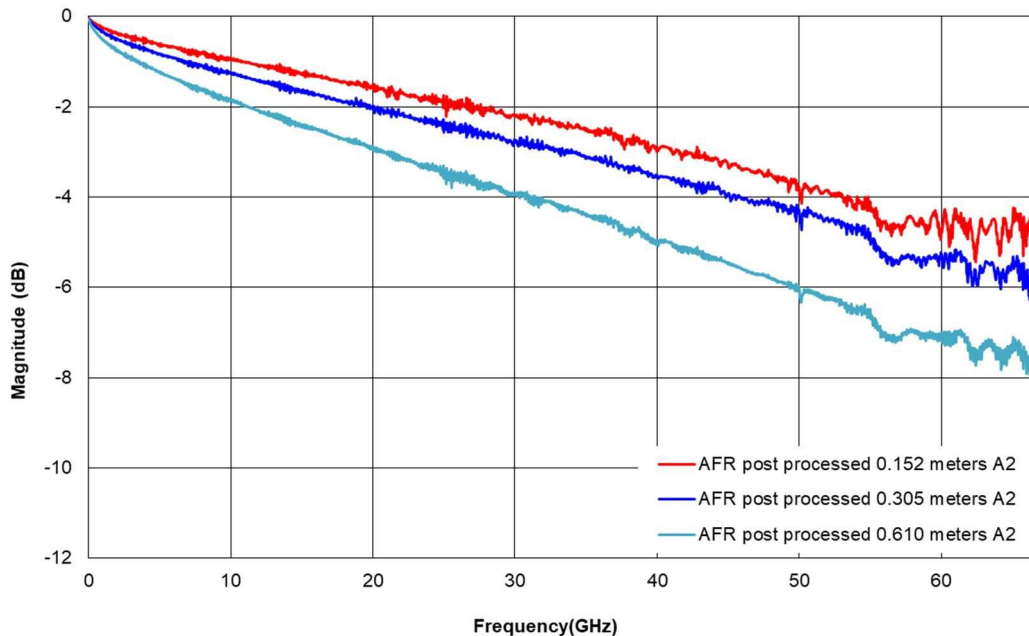
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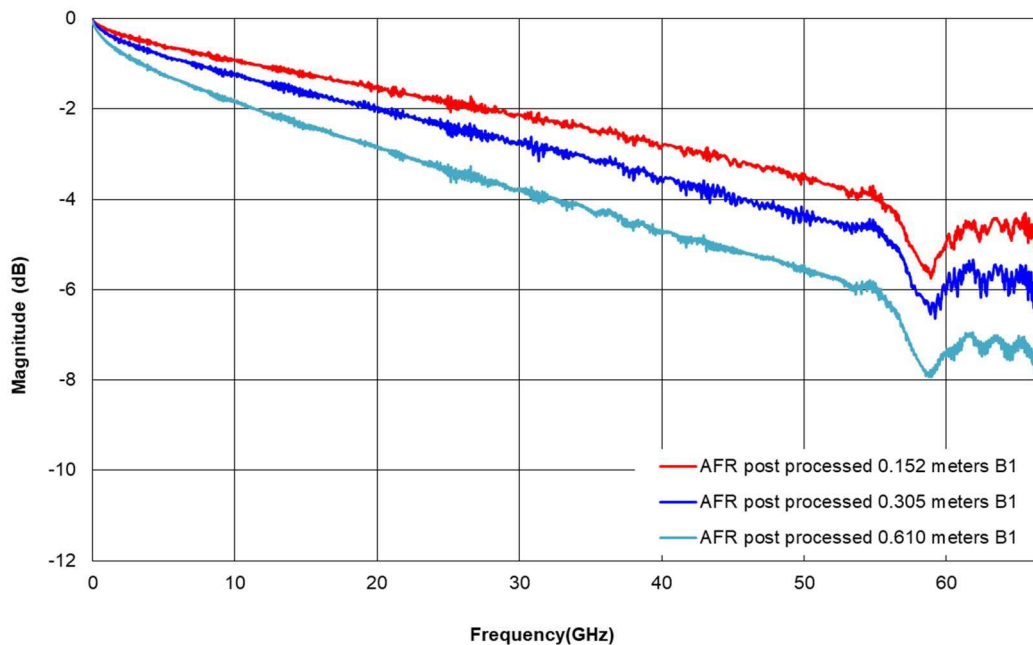
Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

Single Ended Insertion Loss:BE70C

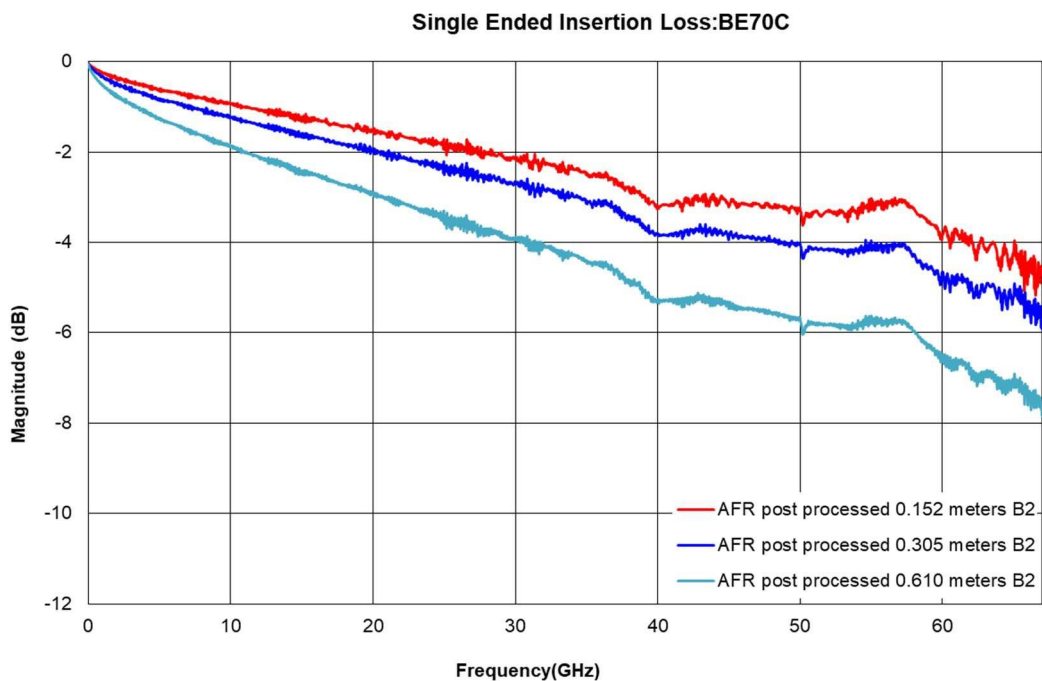


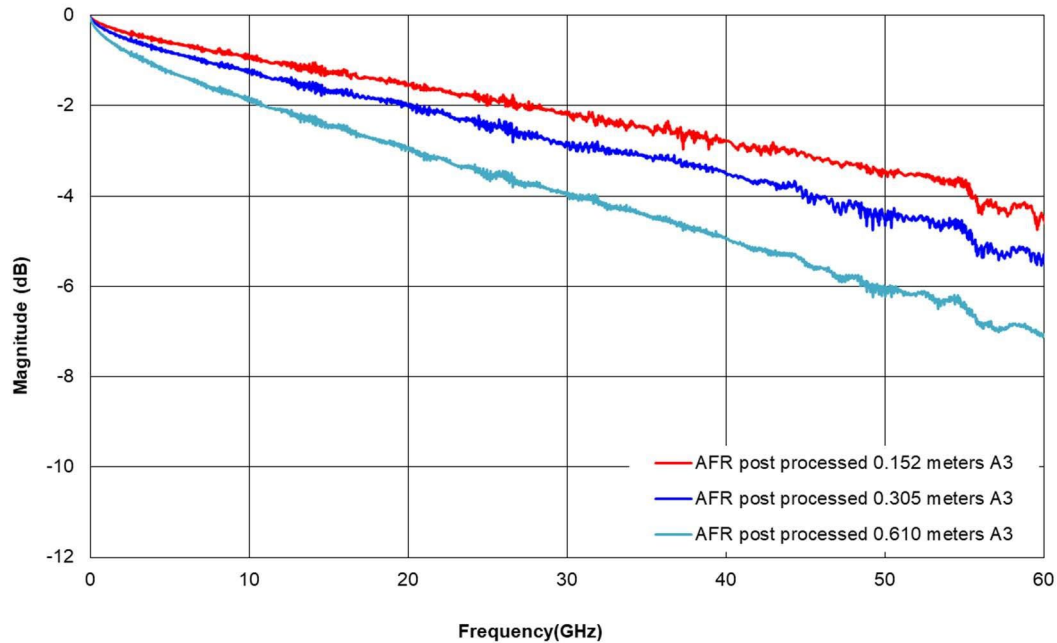
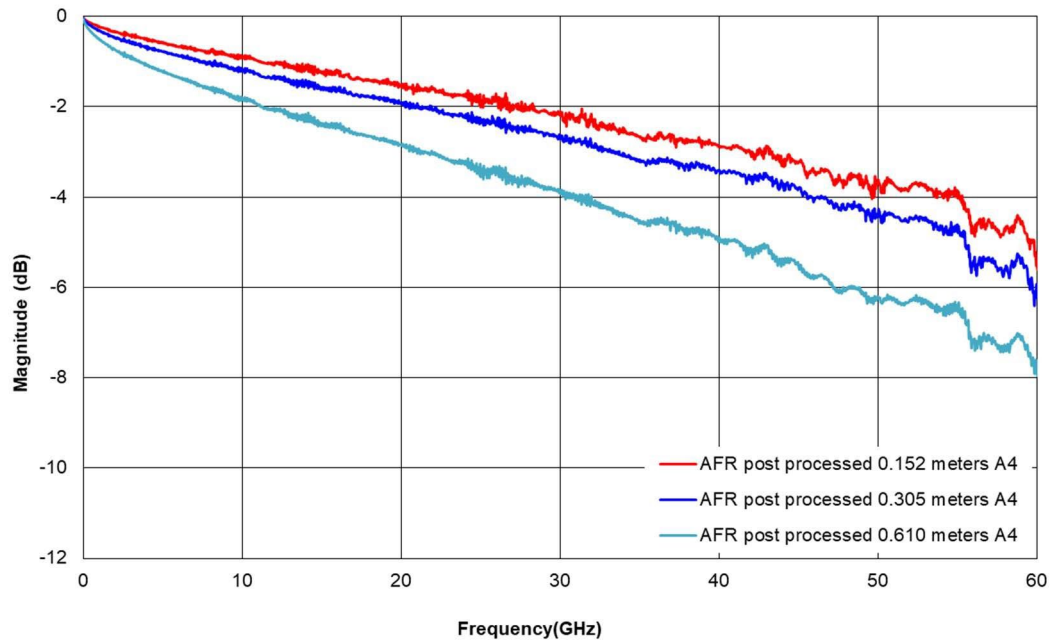
Single Ended Insertion Loss:BE70C



Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

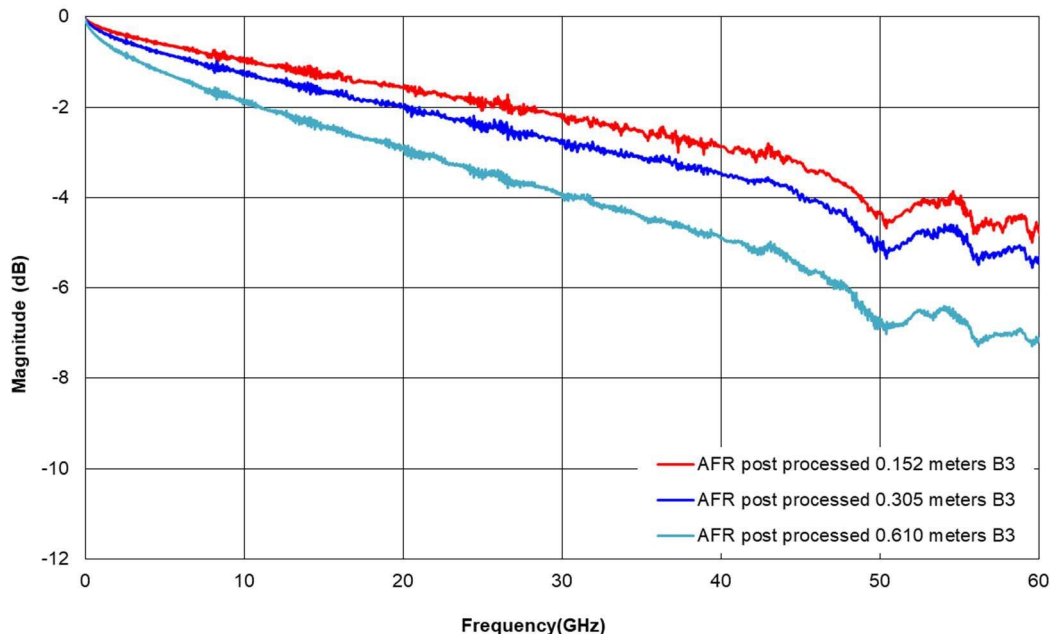


Series: BE70A-S Series**Description:** 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type**Through Via w/Backside Pad Layer 5****Single Ended Insertion Loss:BE70C****Single Ended Insertion Loss:BE70C**

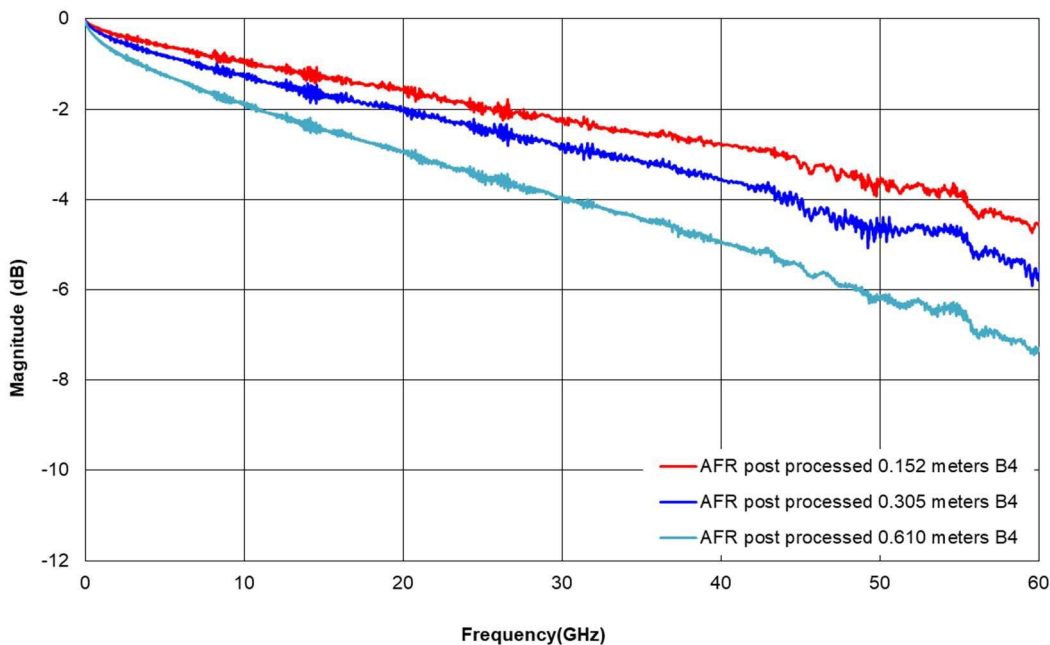
Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

Single Ended Insertion Loss:BE70C



Single Ended Insertion Loss:BE70C



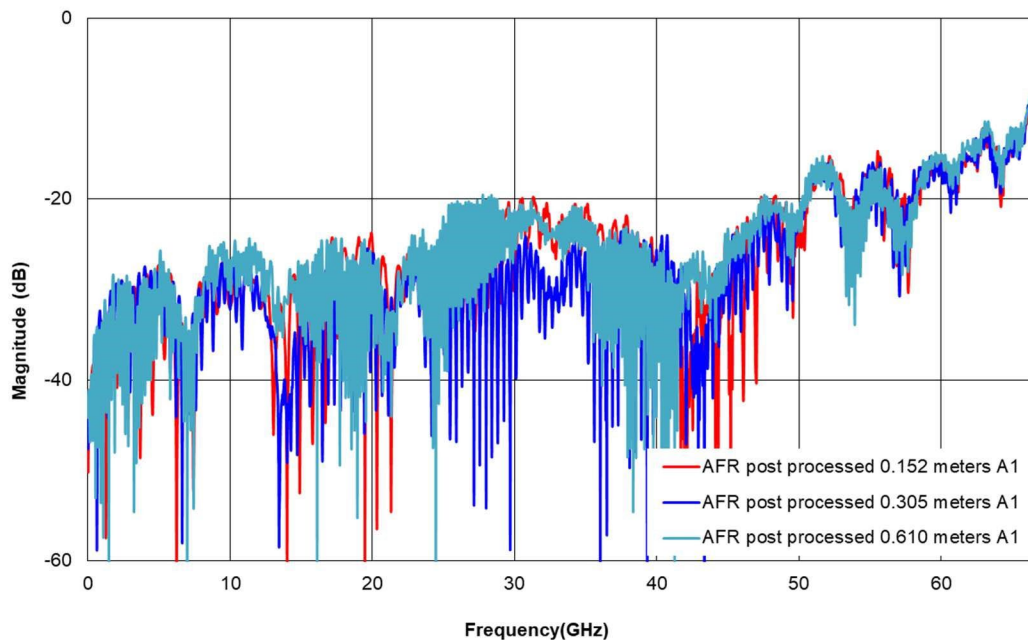
Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

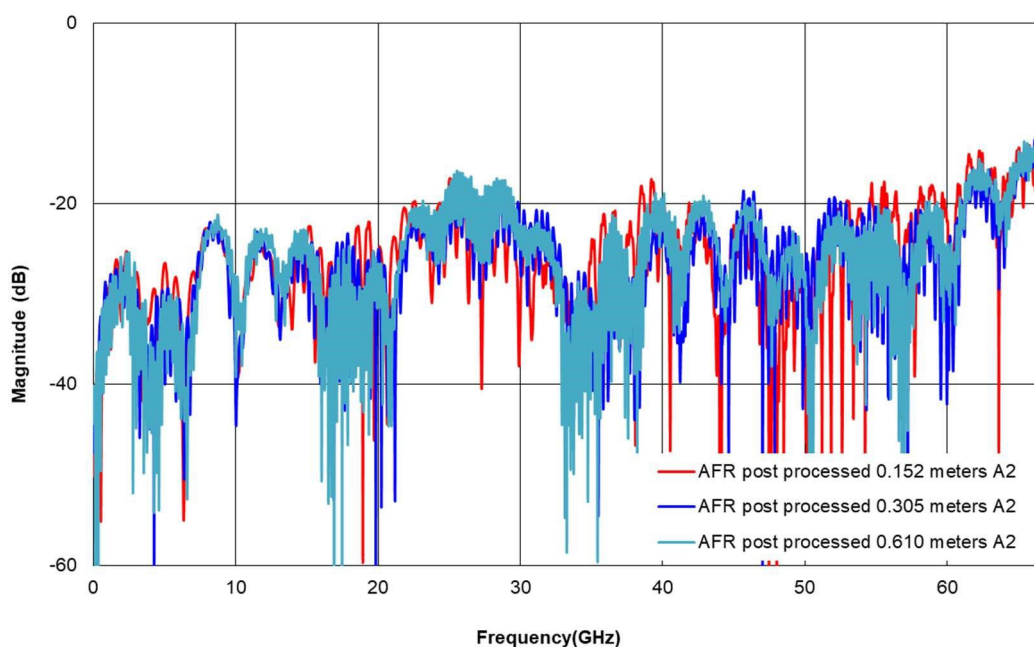
Return Loss

Laser Drilled Microvia Layer 2

Single Ended Return Loss:BE70C

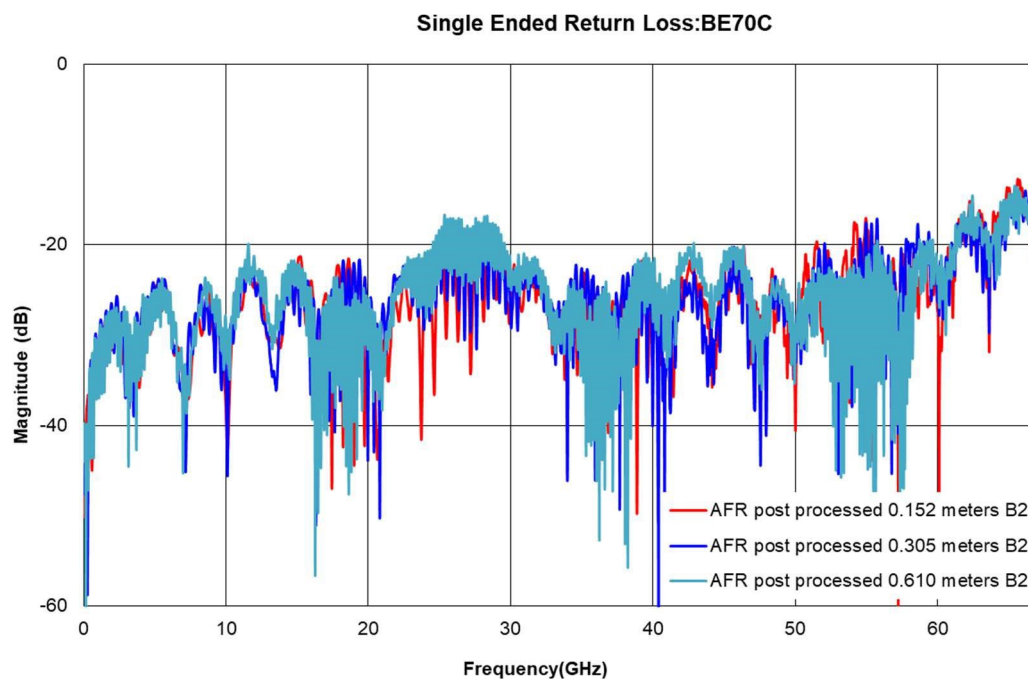
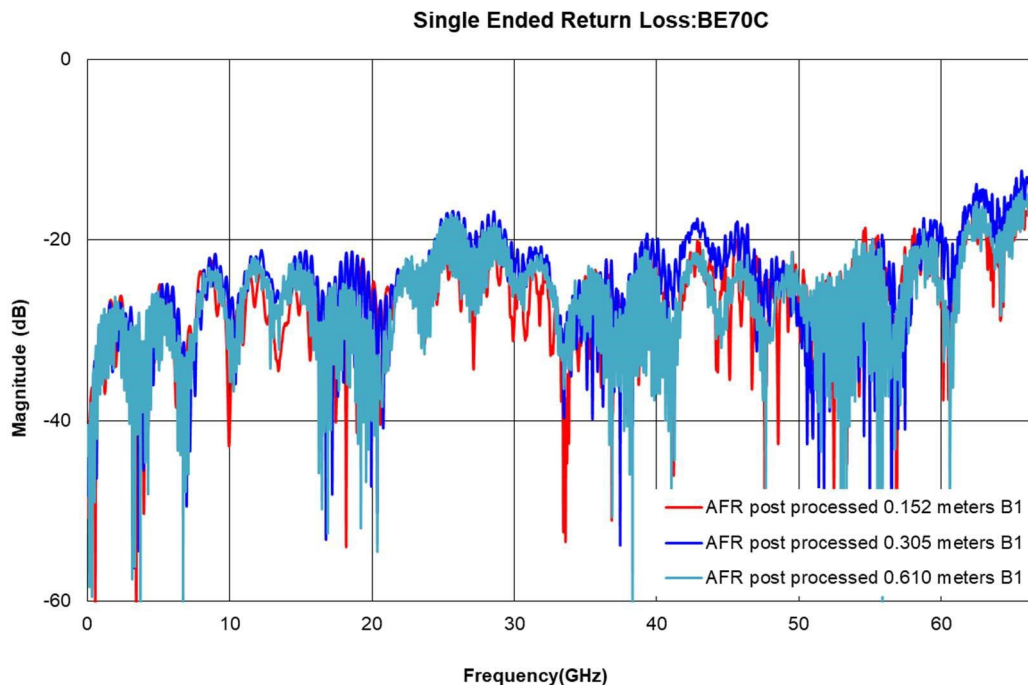


Single Ended Return Loss:BE70C



Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

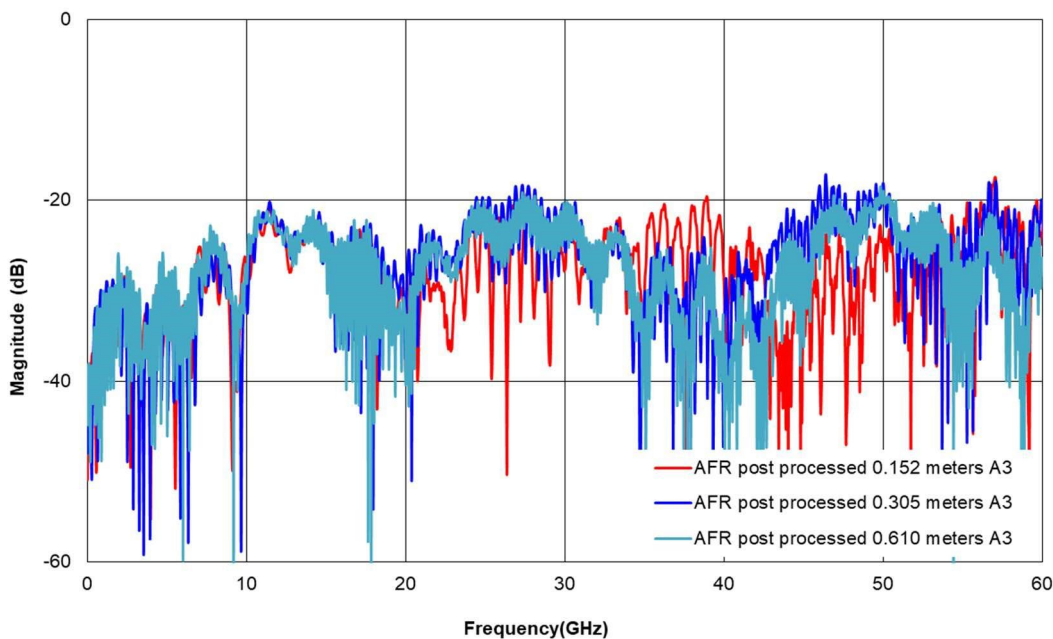


Series: BE70A-S Series

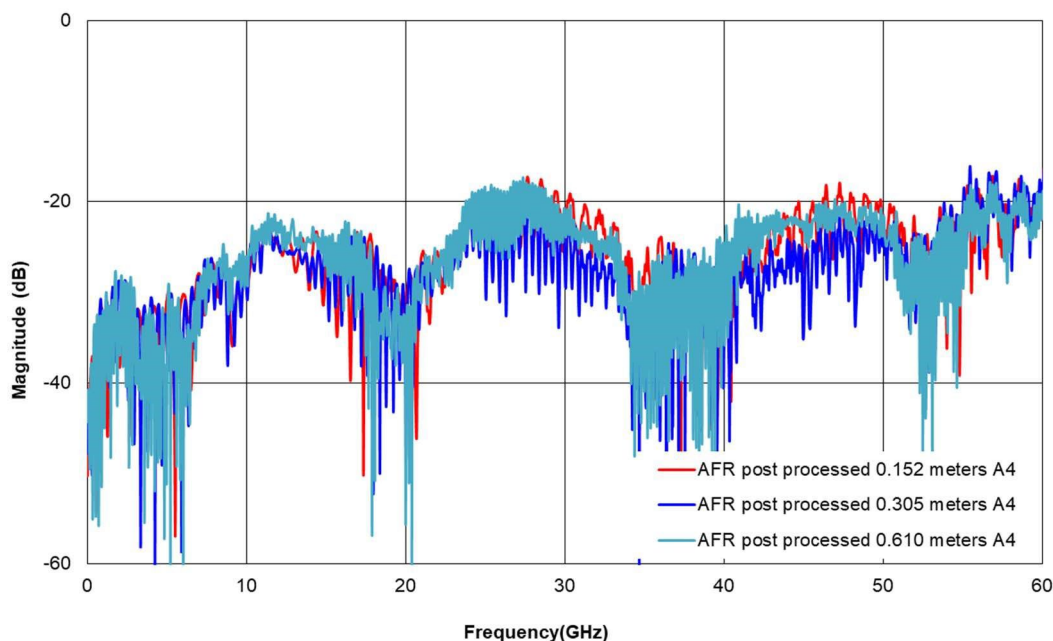
Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

Through Via w/Backside Pad Layer 5

Single Ended Return Loss:BE70C

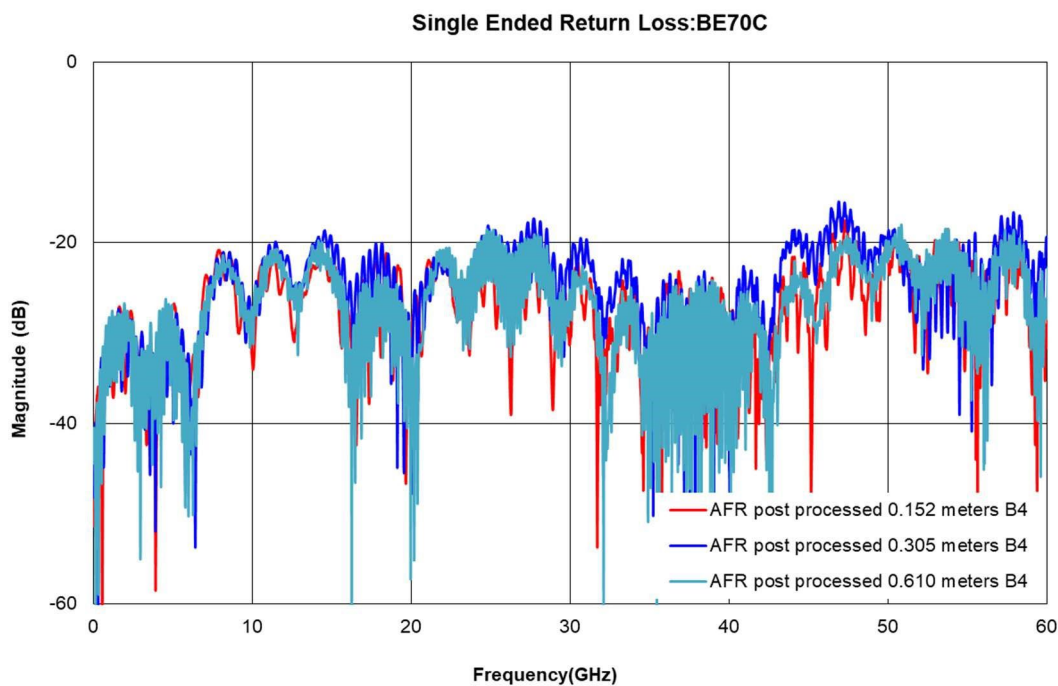
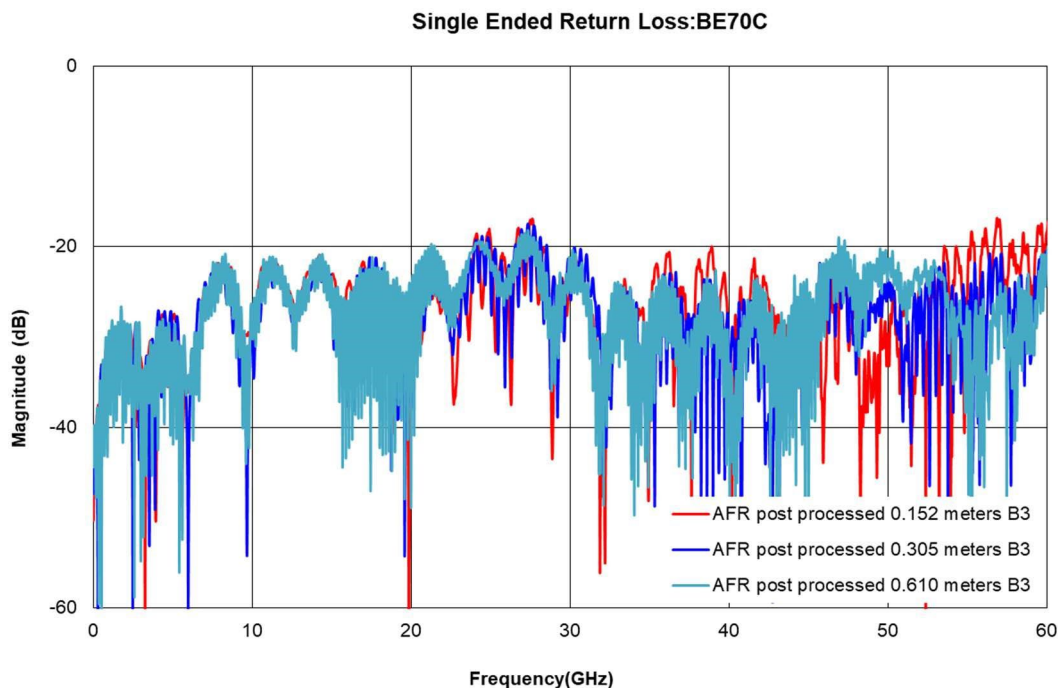


Single Ended Return Loss:BE70C



Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type



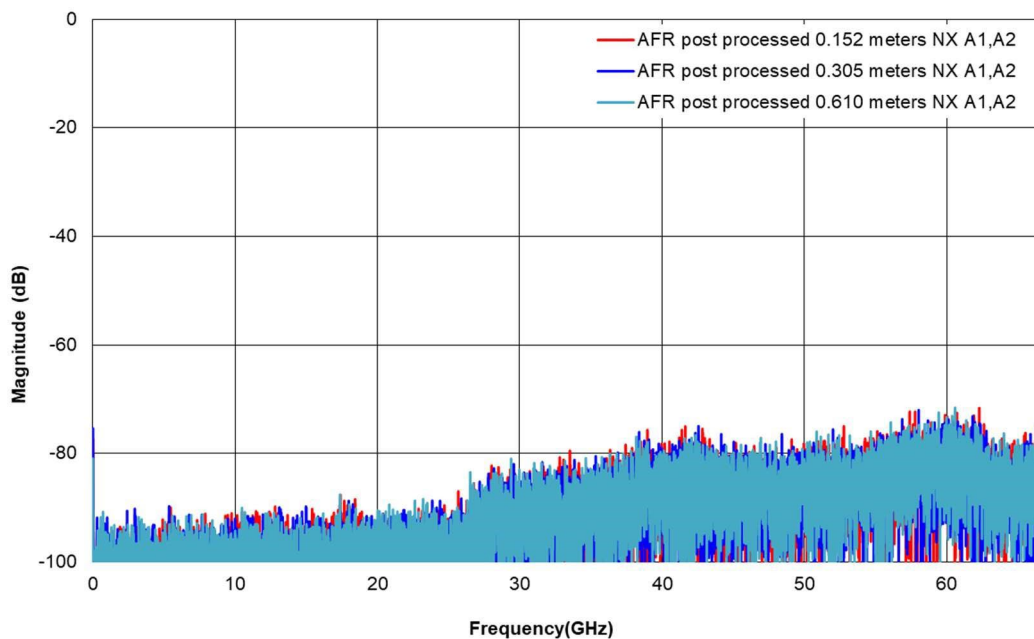
Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

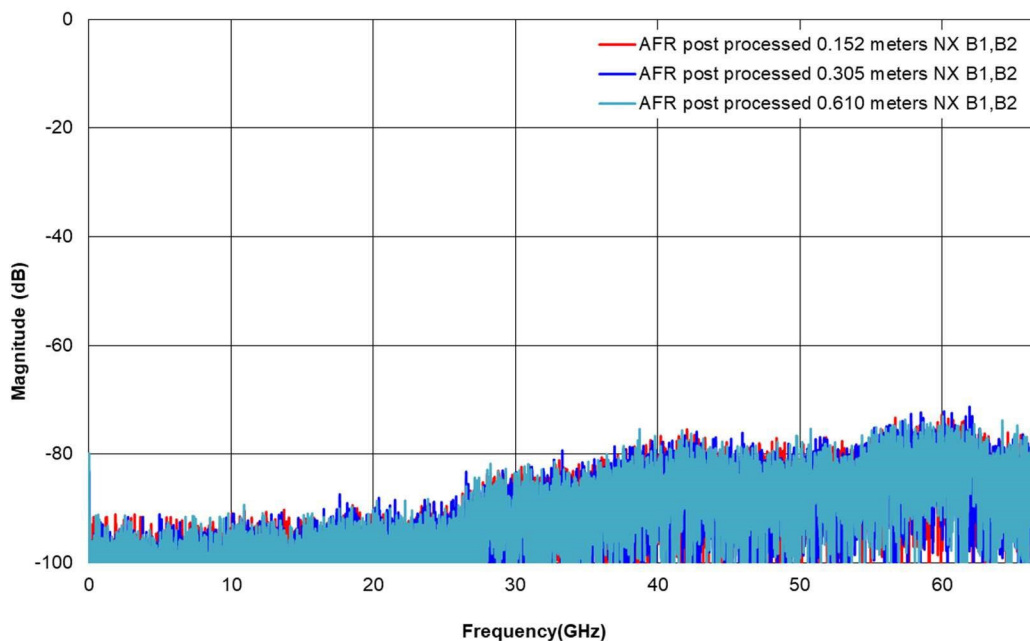
Isolation

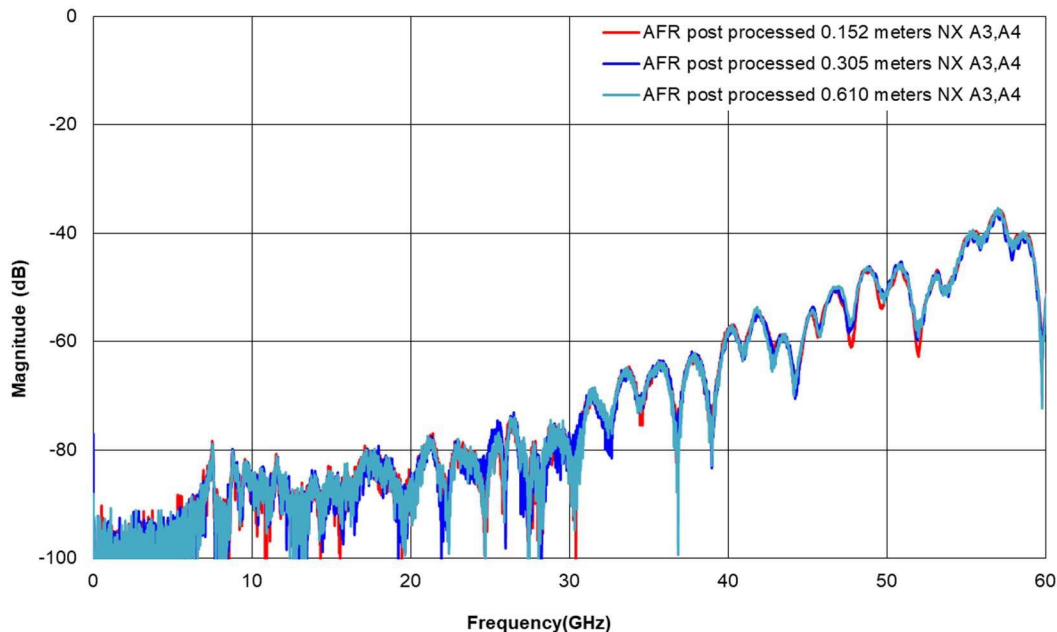
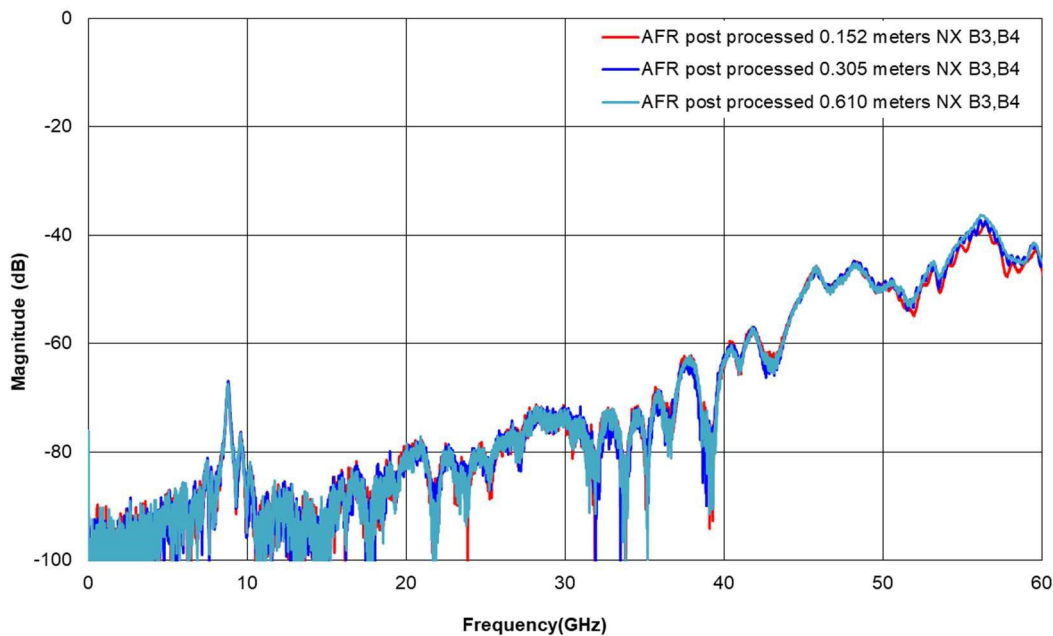
In Row Isolation

Isolation:BE70C



Isolation:BE70C



Series: BE70A-S Series**Description:** 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type**Isolation:BE70C****Isolation:BE70C**

Series: BE70A-S Series

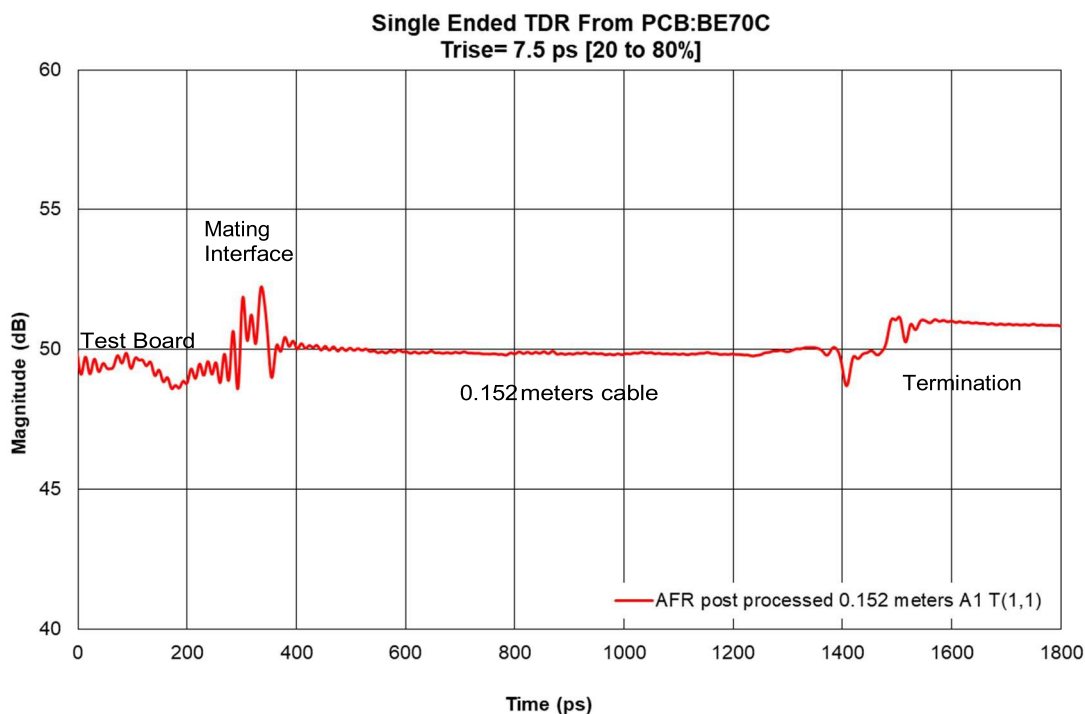
Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

Appendix B – Time Domain Response Figures

Impedance

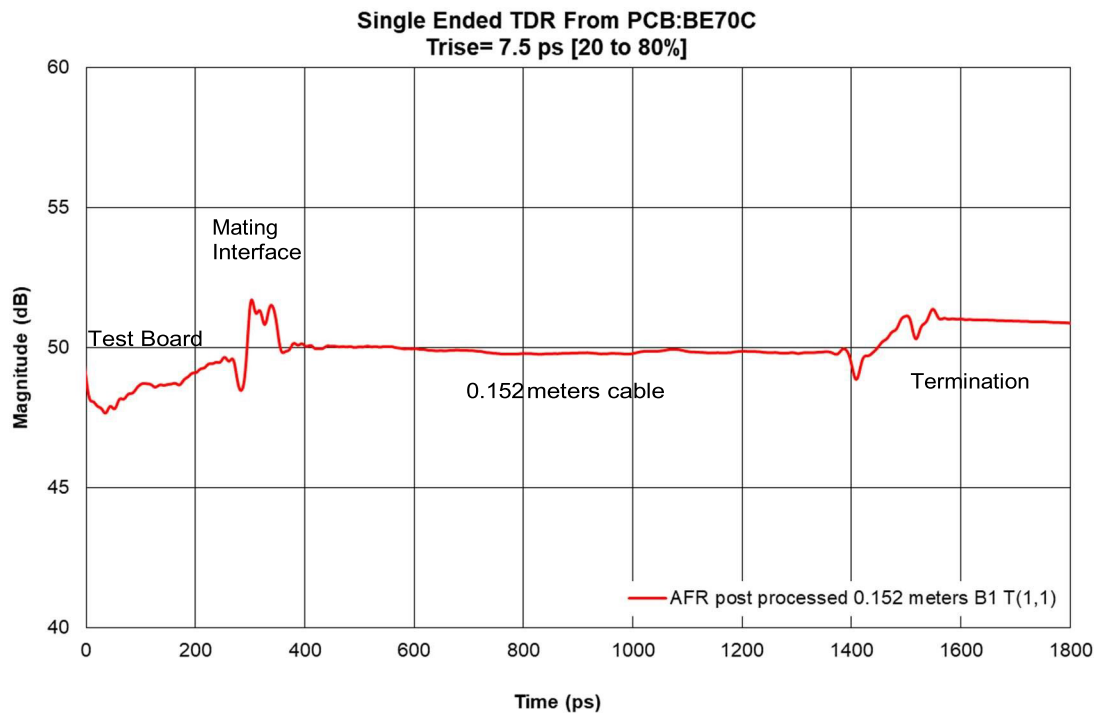
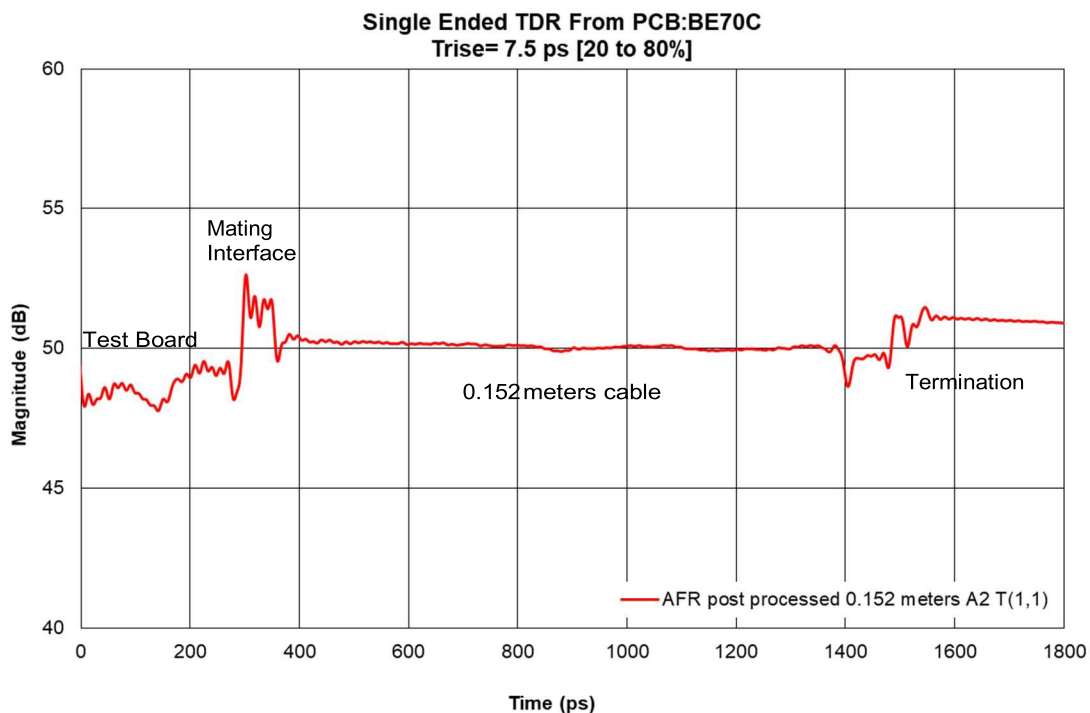
*All Impedance Profiles shown are of the 0.152 meter cable since the mating interfaces are identical.

Laser Drilled Microvia Layer 2



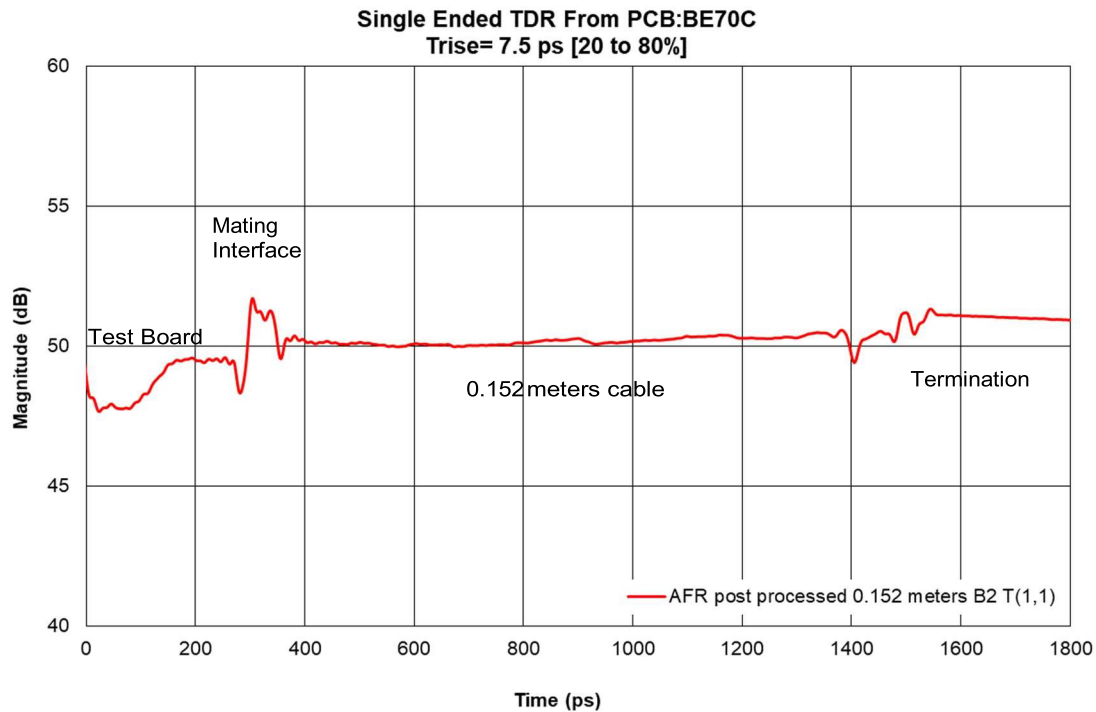
Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type



Series: BE70A-S Series

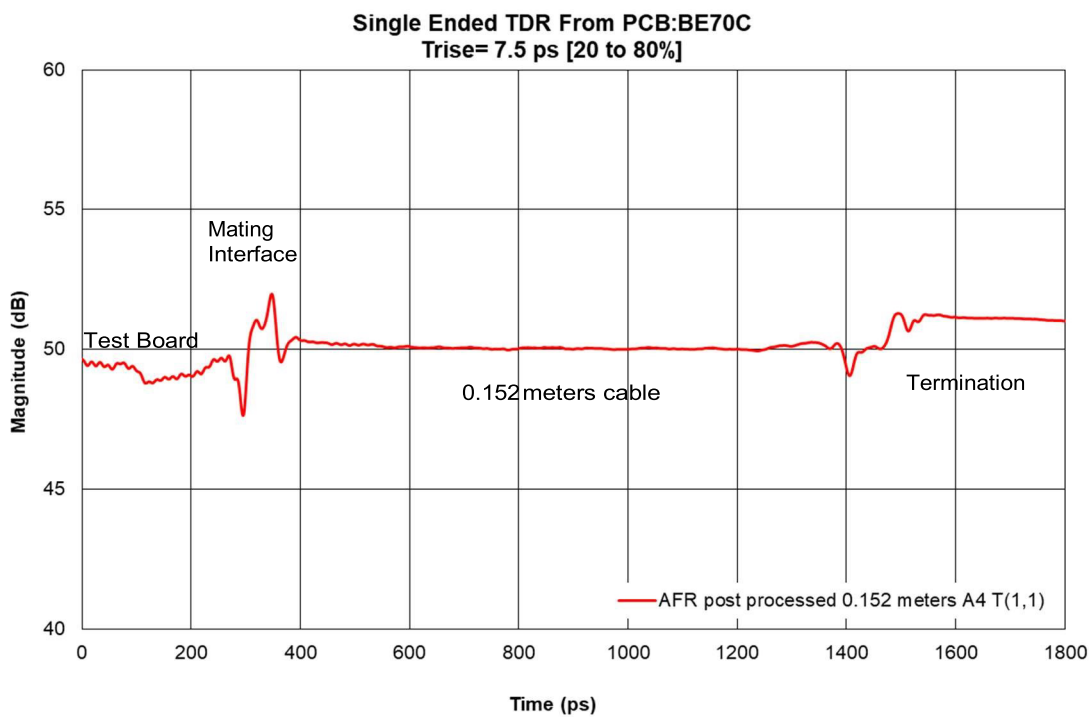
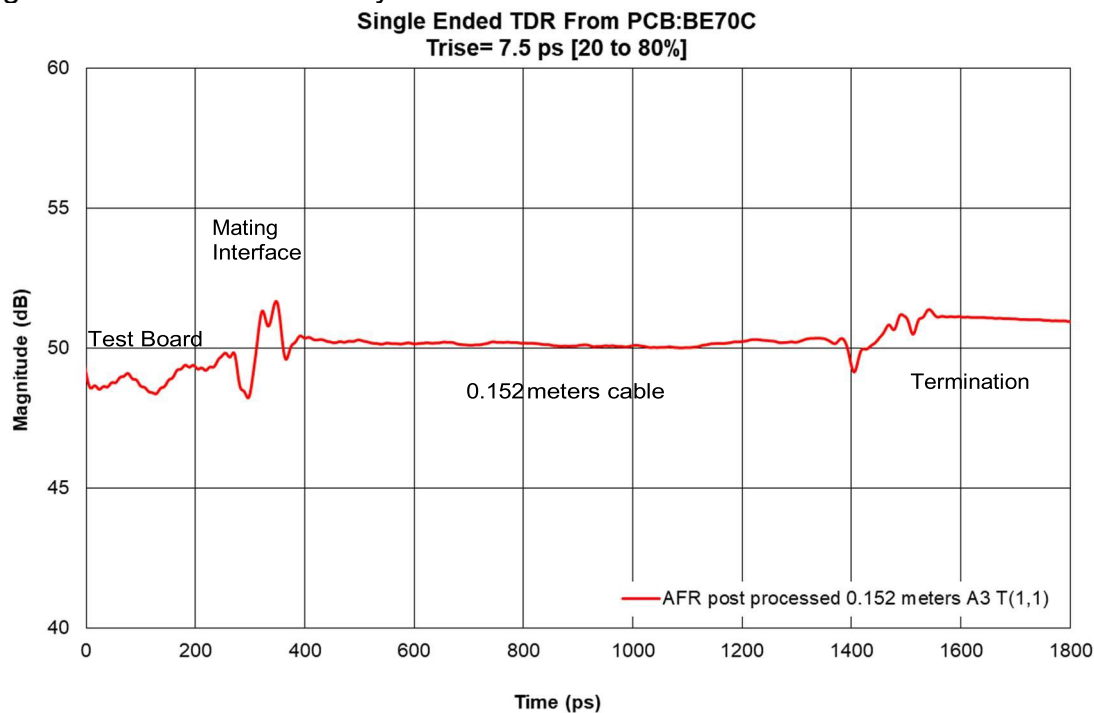
Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type



Series: BE70A-S Series

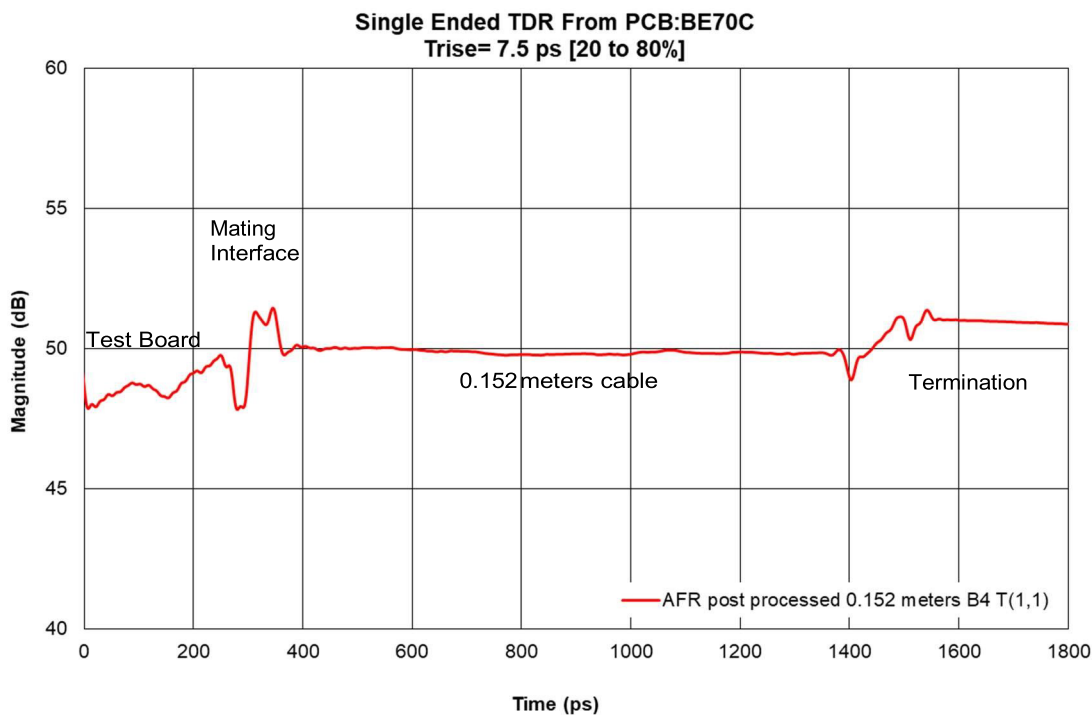
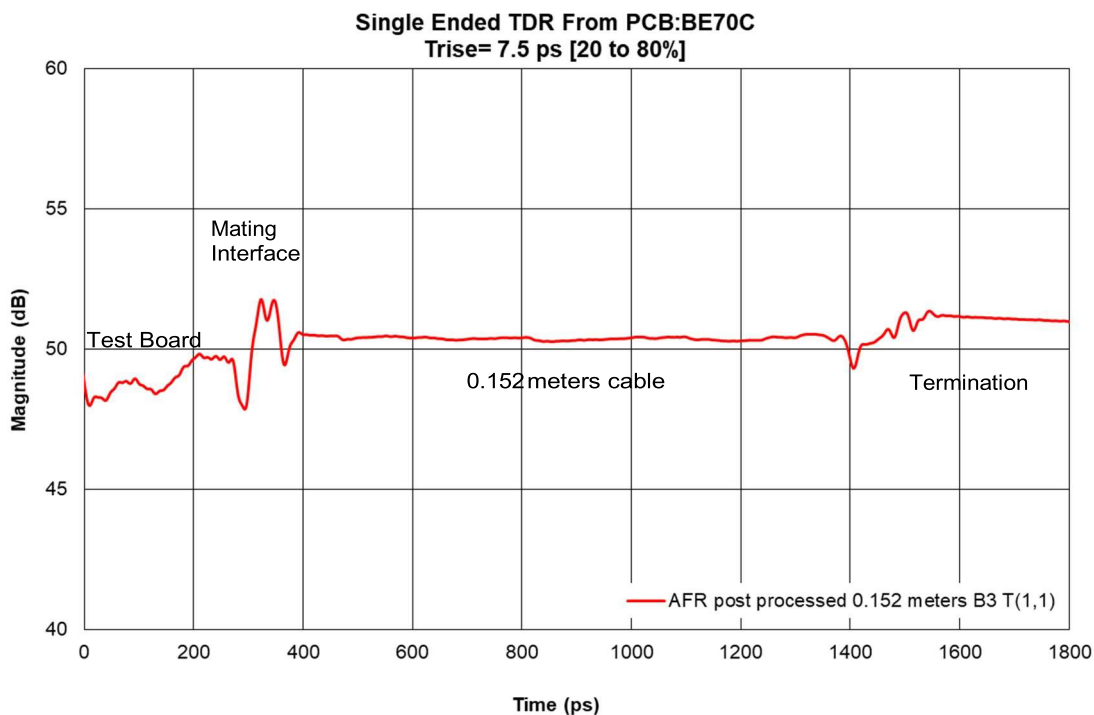
Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

Through Via w/Backside Pad Layer 5



Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type



Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

Appendix C – Product and Test System Descriptions

Product Description

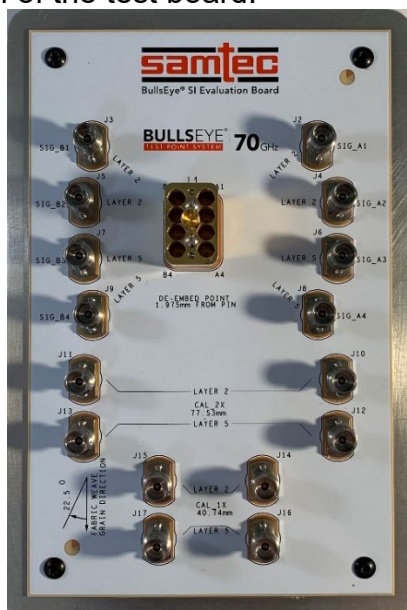
Product test samples are BE70A series connectors. The part number is BE70A-S-18SP-2-02-0152 for the 0.152 meter sample, BE70A-S-18SP-2-02-0305 for the 0.305 meter sample, and BE70A-S-18SP-2-02-0610 for the 0.610 meter sample. The BE70A Series is a high-speed double row test assembly. BE70A has two different ends, male 1.85mm test points, and the Bullseye housing. The part tested was made with 1.85mm straight plug male ends, and the Bullseye housing side was terminated to the 1.85mm female test points on the test board. A photo of the test points mounted to SI test boards is shown below.

Test System Description

The test fixture is composed of a Six-layer Isola Tachyon 100G material stack up with 50Ω signal trace and varying launch designs to reflect the different board manufacturing techniques used in application settings. A PCB mount 1.85 mm connector is used to interface the test cables to test fixtures. Optimization of the PCB mount 1.85 mm launch was performed using full wave simulation tools to minimize reflections, which Utilizing laser drilled microvias and thru-hole via in pad technology. These launch designs were implemented on PCB-BEYE70-110592-SIG-0. Calibration standards specific to the BE70A series are located on the calibration traces on the aforementioned PCB.

PCB-BEYE70-110592-SIG-0 Test Fixtures

Shown below is a photograph of the test board.

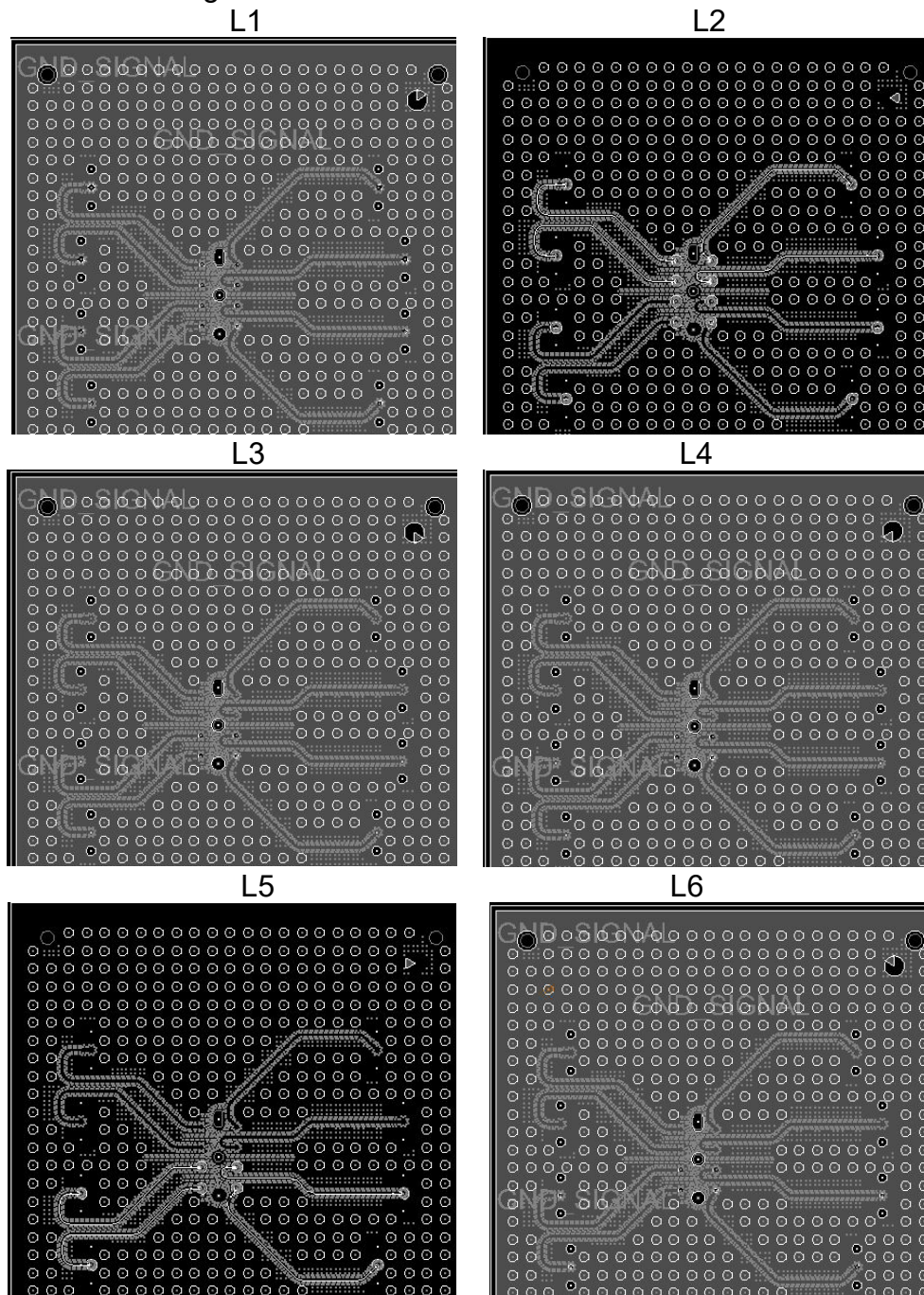


Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

PCB-BEYE70-110592-SIG-0 PCB Layout Panel

Artwork of the PCB design is shown below.



Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

PCB Fixtures

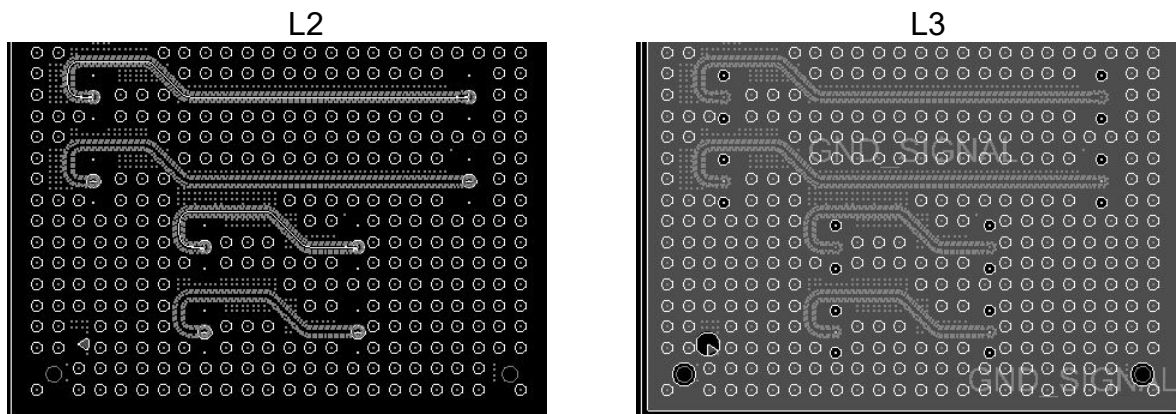
The test fixtures used are as follows:

PCB-BEYE70-110592-SIG-0

SIG_A1: Laser Drilled Microvia Launch
SIG_A2: Laser Drilled Microvia Launch
SIG_A3: Thru Via w/ Backside Pad Launch
SIG_A4: Thru Via w/ Backside Pad Launch
SIG_B1: Laser Drilled Microvia Launch
SIG_B2: Laser Drilled Microvia Launch
SIG_B3: Thru Via w/ Backside Pad Launch
SIG_B4: Thru Via w/ Backside Pad 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, and the test board effects were included in the measurements. AFR application extracts fixture S-parameters from 1X THRU measurement and performs de-embedding on the DUT+Fixture measurement to characterize only the DUT.



THRU line – 40.74 mm

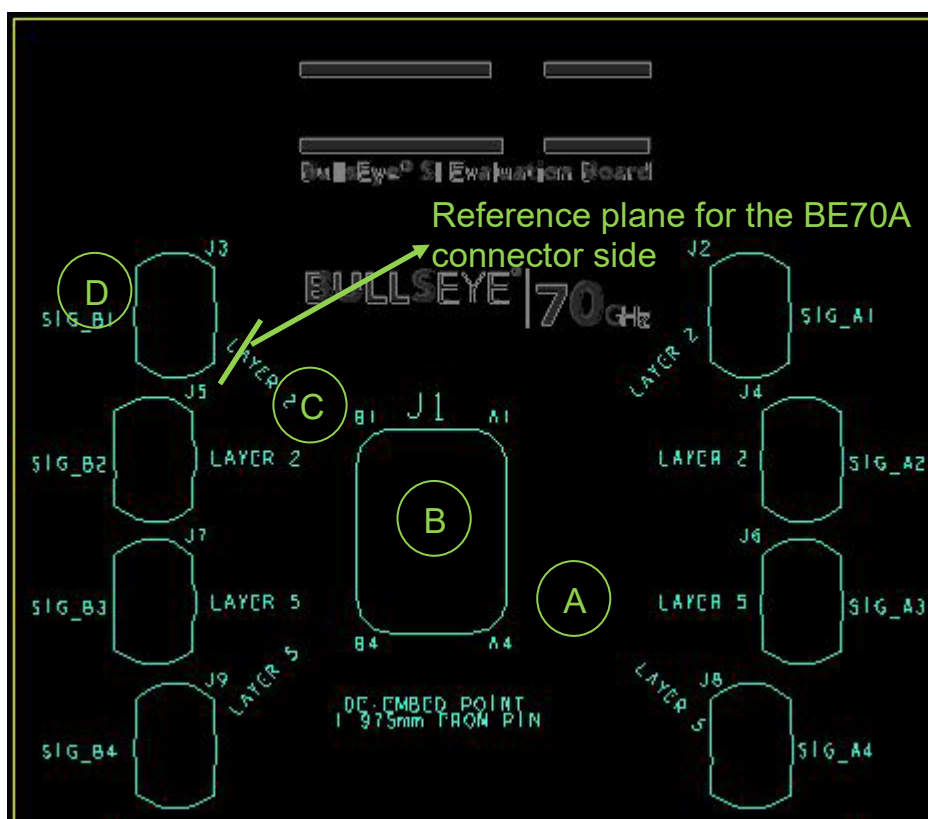
Series: BE70A-S Series

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All traces on the test boards are length matched to the 1.85 mm PCB mount test connectors. The AFR application effectively removes most of test board trace effects. This means that 20.37 mm of test board stripline trace length effects are included in the measurement. The S-Parameter measurement includes:

- A- The BE70A connector set
- B- Test board vias, pads (footprint effects) for the BE70A connector side
- C- 20.37 mm of stripline trace
- D- Test board vias, pads (footprint effects)

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



Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

Appendix D – Test and Measurement Setup

For frequency domain measurements, the test instrument is the Keysight N5227A 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:

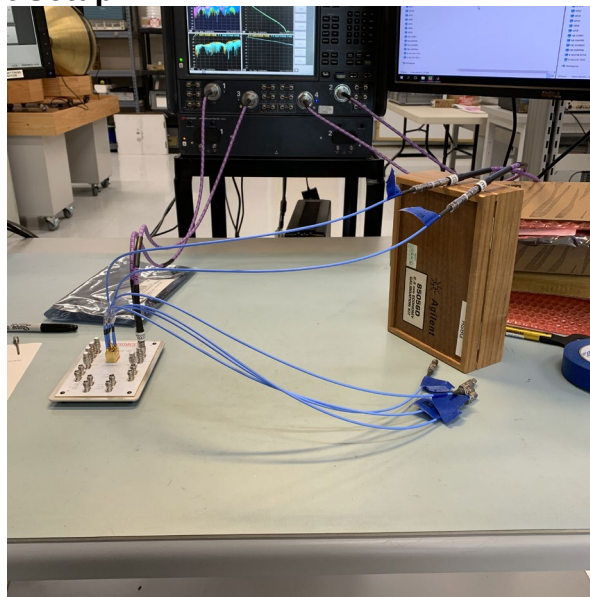
Start Frequency – 10 MHz

Stop Frequency – 67 GHz

Step Size –10 MHz

IFBW –200 Hz

N5227A Measurement Setup



Test Instruments

<u>QTY</u>	<u>Description</u>
1	Keysight N5227A PNA-L Network Analyzer (10 MHz to 67 GHz)
1	Keysight 85058B E Cal module (10MHz to 67 GHz)

Test Cables & Adapters

<u>QTY</u>	<u>Description</u>
4	Gore 1.85mm male to female test cables (DC-67 GHz)

Series: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline Transmission Type

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 85058B 1.85mm electronic 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 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: BE70A-S Series

Description: 70 GHz, Bulls Eye®: Double Row, High-Performance Test System, Stripline
Transmission Type

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)