Shielding Effectiveness Comparison Report

Shielded (RF316) and Double-Shielded (RS316) Series Cable Assemblies

Mates with

MCX, MMCX, MMCXV, SMA, SMB5, SSMB, BNC, TNC

Description:
50Ω RG316 RF Cable

Samtec Inc.
520 Park East Blvd.
New Albany IN 47151-1147 USA

WWW.SAMTEC.COM
1-800-SAMTEC-9 (US & Canada)
SIG@samtec.com

Phone: 812-944-6733
Fax: 812-948-5047
Report Revision: 10/29/2013

Series: 50Ω RG316 RF Cable
Description: Single Layer Shield vs. Double Layer Shield

Table of Contents

Overview 1
Shielding Effectiveness Summary Data 2
Characterization Details 4
Product and Test System Descriptions 4
Product Description 4
Appendix A– Test and Measurement Setup 5
ETS/Lindgren 2090 Multi-Device Controller and HP Vector Network Analyzer 6
Shielding Effectiveness Test Setup 7
Measurement Station Accessories 7
Shielded Room Noise Floor Verification 8

Series: 50Ω RG316 RF Cable
Description: Single Layer Shield vs. Double Layer Shield

Overview

Samtec has introduced an RG316 cable assembly with enhanced shielding effectiveness (SE) for applications with demanding electromagnetic requirements. Typical applications include microwave base stations where minimizing electromagnetic emissions is required to obtain the lowest possible noise floor for sensitive receivers. A second application is when sensitive industrial, automotive or military electronics must operate in an elevated field strength environment. A third common application is when standard RG316 cable assembly does not provide the shielding required to meet regulatory compliance requirements, such as FCC Class B or Mil-Std-461.

RG316 is a generic name for a flexible 50Ω coaxial cable. RF316 is the Samtec name for our single braid RG316 cable assembly. A new version of RG316 is available with two layers of shielding (RS316)

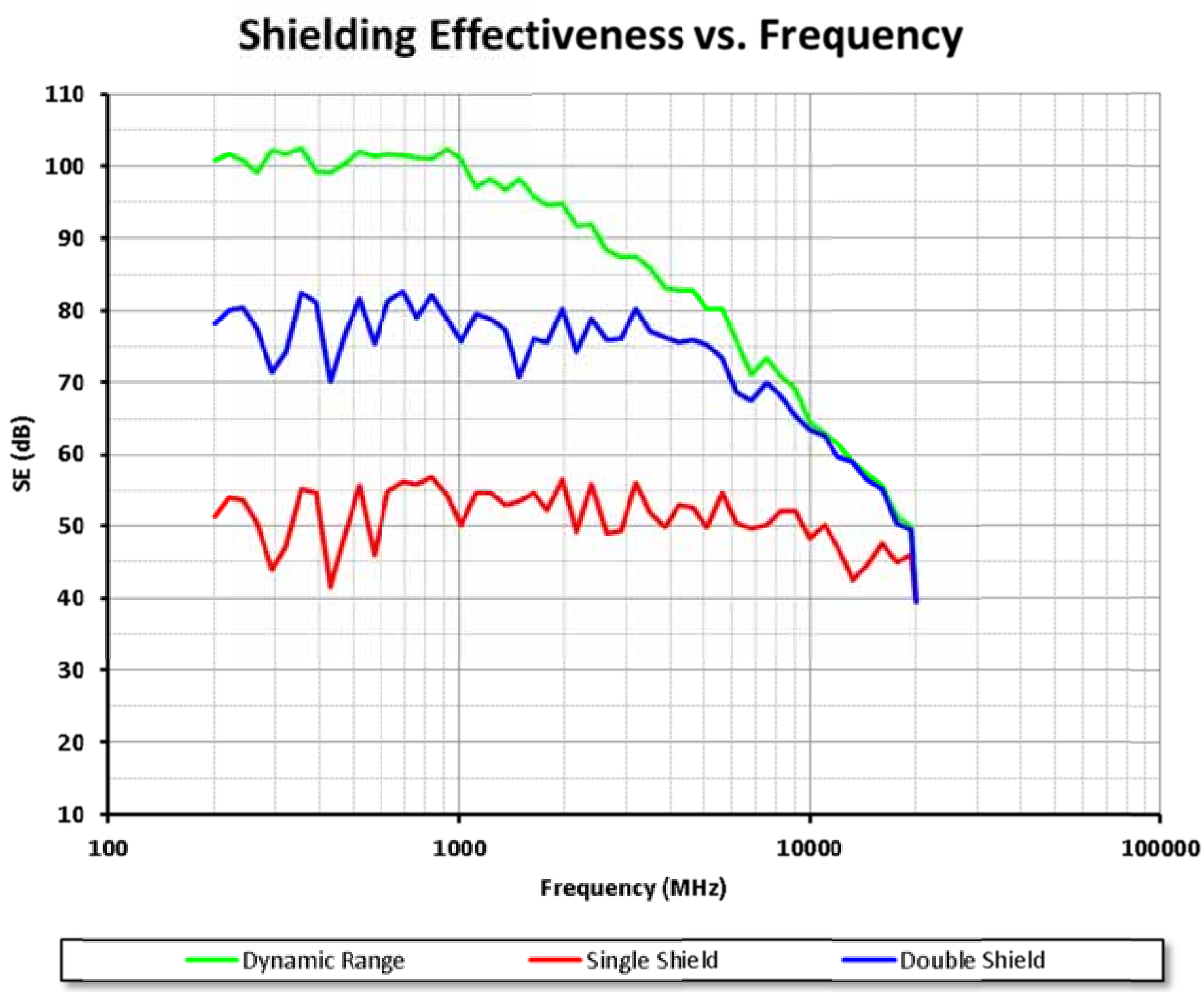
Standard RG316 cable assemblies (P/N RF316-01SP-1-01SP-1-1000, SMA male to SMA male, 1 meter in length) and RS316 cable assemblies with the new double-layer shield (P/N RS316-01SP1-01SP1-1000, SMA male to SMA male, 1 meter in length), were tested for SE. Samples were mated to Samtec SMA to SMA bulkhead jacks and terminated at the far end.

The test results show a significant performance improvement in SE. A standard RF316 cable assembly has a SE of roughly 50 dB whereas the double shielded RS316 achieves roughly 75 dB.

Series: 50Ω RG316 RF Cable
Description: Single Layer Shield vs. Double Layer Shield

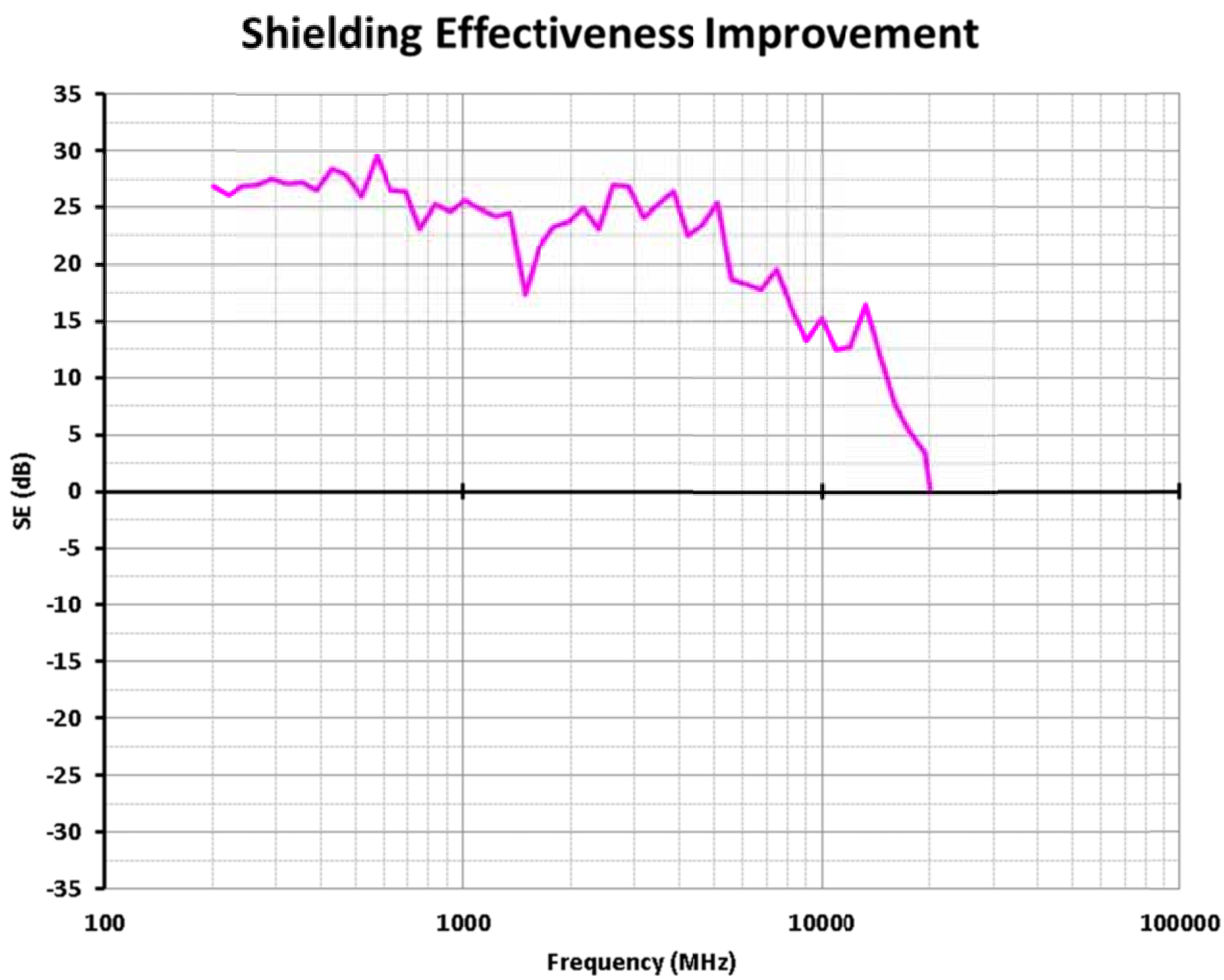
Shielding Effectiveness Summary Data

The figure below shows the measured SE for a standard RG316 cable assembly and the new RS316 cable assembly. Note that above 5 GHz the test method does not allow for an accurate measurement of the RS316 due to dynamic range limitations. For example at 10 GHz we know that the RS316 has a shielding effectiveness of at least 65 dB. It may actually be 70 dB (or higher) but the test equipment is dynamic range limited. This is discussed more fully in Appendix A.



Series: 50Ω RG316 RF Cable
Description: Single Layer Shield vs. Double Layer Shield

To more clearly illustrate the performance difference between the samples, the difference in SE is plotted in the figure below. This graph clearly shows that the RS316 cable assembly has approximately 25 dB more SE than the standard RG316 cable assembly.



Samtec Inc.
520 Park East Blvd.
New Albany IN 47151-1147 USA

WWW.SAMTEC.COM
1-800-SAMTEC-9 (US & Canada)
SIG@samtec.com

Phone: 812-944-6733
Fax: 812-948-5047
Report Revision: 10/29/2013

Series: 50Ω RG316 RF Cable
Description: Single Layer Shield vs. Double Layer Shield

Characterization Details

This report presents data that characterizes the SE of a cable assembly in a controlled environment. All efforts are made to reveal typical responses inherent to the system under test (SUT).

In this report, the SUT includes the cable assembly and mating connectors. The mating connectors are attached to bulkhead jacks. The bulkhead jacks are in specially manufactured bulkheads fitted to fully shielded boxes. The mating connector to chassis panel interface is critical to shielding performance, and every attempt was made to mimic typical installation practices. Where available, recommended chassis panel cutout dimensions were used, and the mating connector typically penetrates this panel cutout. Connection between the panel and the mating connector relies on mating connector features such as flanges or EMI gaskets when specified on the mating connector drawing.

Product and Test System Descriptions

Product Description

Product test samples were 1 meter long RG316 Cable Assemblies. The cable is terminated by means of a screw-on SMA terminator on the opposite side of the bulkhead connector. The actual part numbers that were tested are shown in Table 1, which also identifies End 1 and End 2 of the assembly.

Length	Shield	Part Number	End 1	End 2
1000mm	Single layer braid	RF316-01SP1-01SP1-1000	SMA straight plug	SMA straight plug
1000mm	Double layer braid	RS316-01SP1-01SP1-1000	SMA straight plug	SMA straight plug

Series: 50Ω RG316 RF Cable
Description: Single Layer Shield vs. Double Layer Shield

Appendix A– Test and Measurement Setup

The Mode Stirred Chamber Method is documented in IEC 61000-4-21 and was used in this testing. The method relies on exposing a device to electromagnetic energy in a large resonant cavity (shielded room). An electrically large tuner perturbs the boundary conditions of the cavity resulting in different standing wave patterns and a randomized excitation of the device. Multiple device measurements are made at different tuner positions, and the results are averaged. Shielding effectiveness is defined to be relative to an in-band reference antenna for IEC 61000-4-21. If the shielding effectiveness is 20 dB, it means that the received power with the sample in place is 20 dB lower than the received power when a reference antenna is in place. A log periodic antenna serves as the reference from 200 MHz to 2 GHz, and a double-ridge guide horn antenna is the reference from 2 GHz to 20 GHz. This method has a practical high frequency limit determined by the instrumentation used, in this case 20 GHz. The low frequency limit is determined by the size of the chamber, which in this case is 200 MHz. The system used for this testing is a SMART 200 system by ETS-Lindgren and is shown in Figure 1.

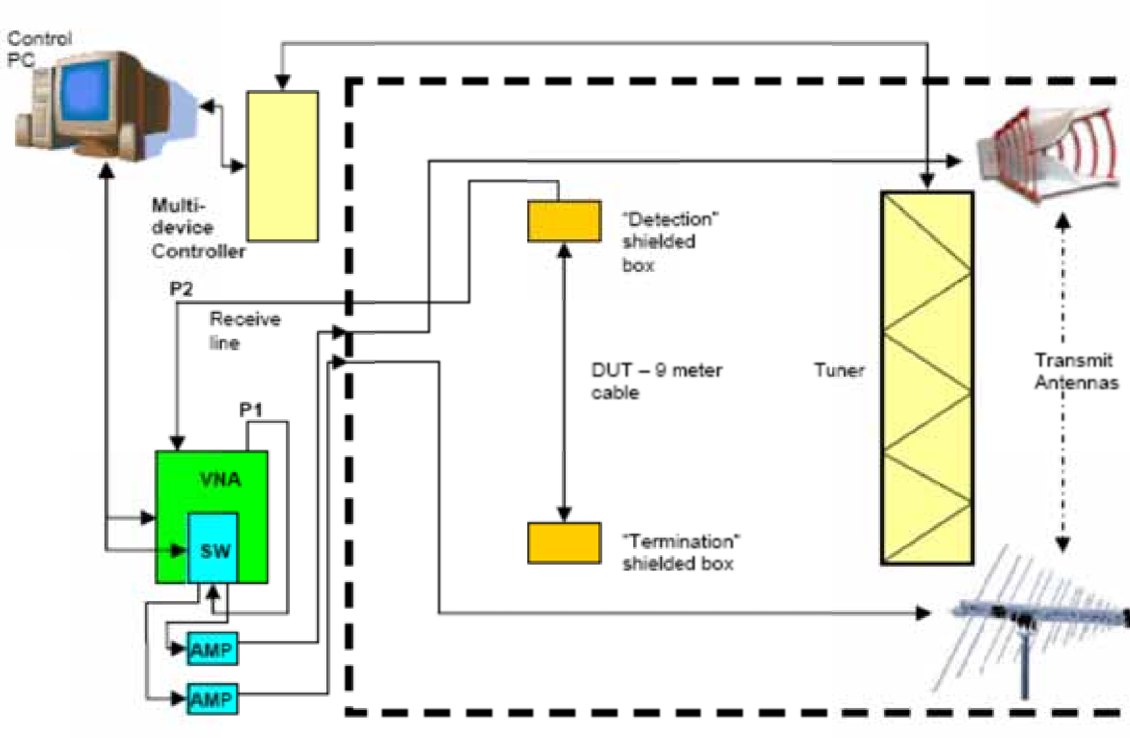


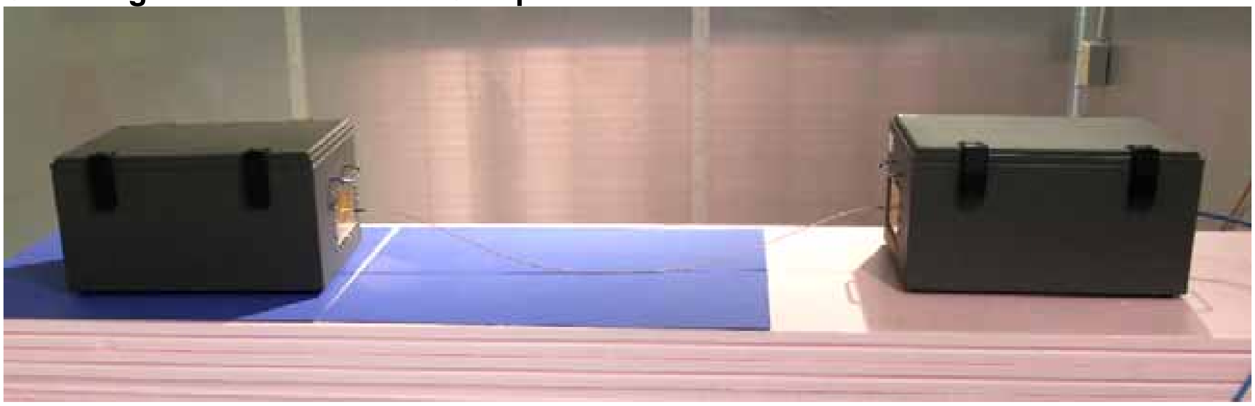
Figure 1: Mode Stirred Chamber Method

Series: 50Ω RG316 RF Cable
Description: Single Layer Shield vs. Double Layer Shield

ETS/Lindgren 2090 Multi-Device Controller and HP Vector Network Analyzer

Series: 50Ω RG316 RF Cable
Description: Single Layer Shield vs. Double Layer Shield

Shielding Effectiveness Test Setup



Test Instruments

QTY	Description
1	ETS/Lindgren Smart200 Reverberation Chamber
1	ETS/Lindgren 2090 Multi-Device Controller w/ Smart IMM Software
1	HP8720ES 50 MHz – 20 GHz Vector Network Analyzer

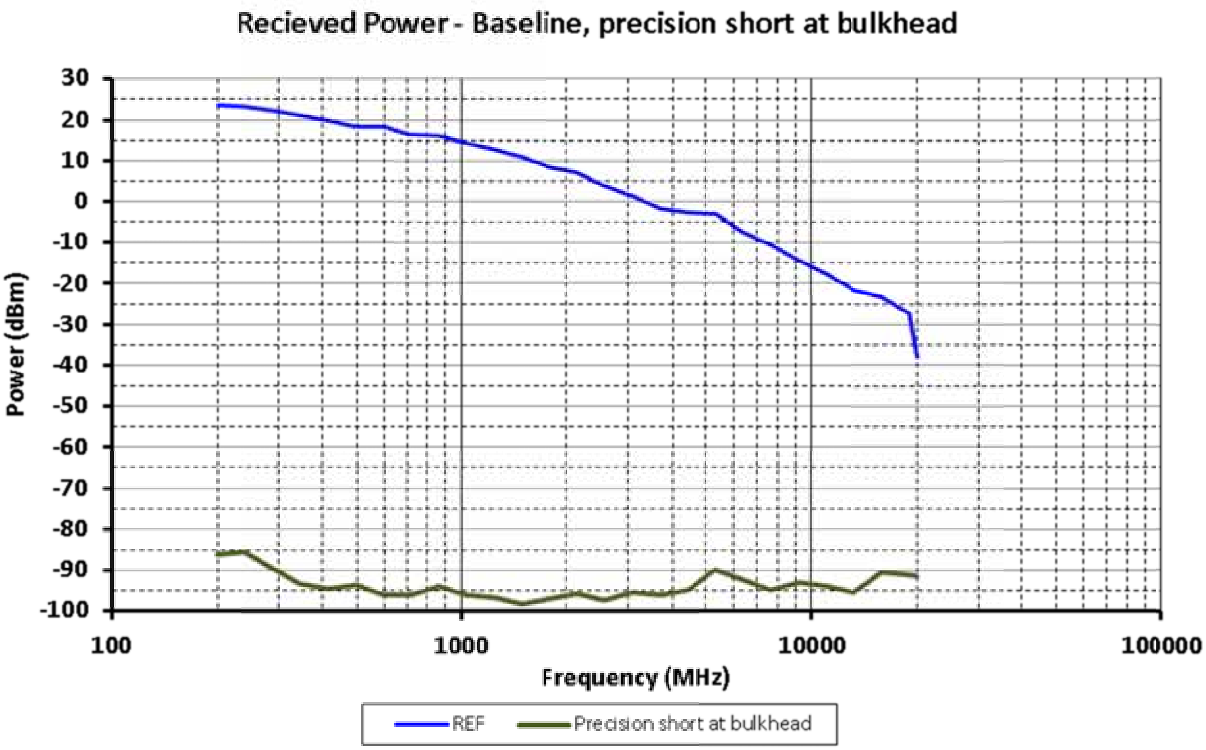
Measurement Station Accessories

QTY	Description
1	Agilent 3499B Switch Controller
1	Agilent 8762C Coaxial Switch (DC – 26.5 GHz)
1	Mini-Circuits ZHL – 42W Coaxial Amplifier (10 MHz – 4.2 GHz, +30 dB gain)
1	Microwave Power L0218-30 Wideband Amplifier (2–18 GHz, +30 dB gain)
2	Ramsey STE300 Shielded Boxes

Series: 50Ω RG316 RF Cable
Description: Single Layer Shield vs. Double Layer Shield

Shielded Room Noise Floor Verification
Prior to performing shielding effectiveness testing of a particular sample, it is important to establish the noise floor of the anechoic test chamber by measuring the shielding effectiveness of the receive line while terminated at the bulkhead connector with a precision short. The measurement noise floor data is shown in the figure below labeled “Precision short at bulkhead”. The difference between this measurement and that of an “in-band” antenna (per IEC 6100-4-21) is the maximum dynamic range of the measurement system. In the graph below the blue trace is the received power with the test sample replaced by a reference antenna

Note that the units of the vertical scale are dBm and represent measured power levels. Any sample that has a shielding effectiveness greater than the dynamic range will therefore not be adequately characterized.



Series: 50Ω RG316 RF Cable
Description: Single Layer Shield vs. Double Layer Shield

By subtracting the minimum power level (noise floor) from the maximum power level (in-band antenna) the measurement dynamic range is computed and is shown in the figure below.