

Samtec Standard Cable Shielding Performance

Objective

- Evaluate the shielding performance of standard Samtec Cable offerings including:
 - 6 different coax cables
 - 2 different twinax cables
 - 1 RG-316 for comparison

Summary

- Results were consistent with expectations:
 - Served coax had an SE of ~30dB
 - Serve + tape coax had an SE of ~50-60 dB
 - Braided twinax had an SE of ~50 dB
 - Braided twinax and differential signaling had an SE of 60-70 dB
 - A low cost 24 AWG braided coax (RG-316) served as a reference and had an SE of ~45-55 dB
- Note that the results are for raw cable; the influence of connector leakage is intentionally removed by careful fixture design.
 - Cable assembly performance will be the same or lower than the results shown herein.



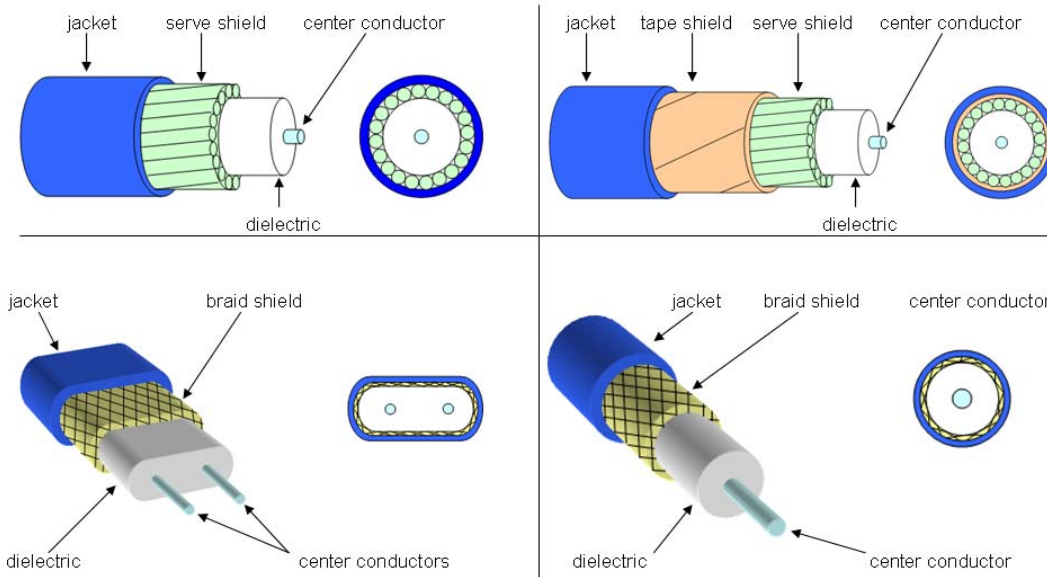
Cable Samples – Physical Properties

CABLE P/N*	DESCRIPTION*	CENTER CONDUCTOR*	DIELECTRIC*	SHIELD*
CX-3850-SLD-XX-X	38AWG Coax	38AWG 7 strand, Percon 24	FEP solid	46AWG 5/6 ends SPC 93%
CX-3875-SLD-01	38AWG Coax	38AWG 7 strand, Percon 24	FEP solid	44AWG 3/4 ends SPC 93%
TCF-3650F-XX-01	36AWG Coax	36AWG solid, Percon 24	FEP foam	46AWG 5/6 ends SPC 93%
CCA-26S-XX	Low Loss Served Shield Coax	26AWG SPC	FEP foam	38AWG 4/5 ends SPC aluminized polyester tape 95%
BBCS-3050F-01	Ribbonized Coax	30AWG 7 strand SPC	FEP foam	40AWG 3/4 ends SPC aluminized polyester tape 95%
CCS-131963-01-CC	42AWG Coax	42AWG solid, alloy 675	FEP solid	Aluminized polyester tape 44AWG 4/5 ends SPC 93%**
TX-30100-01	Twinax	30AWG 7 strand SPC	FEP solid	44AWG 7 ends SPC 90%
TF-30100-01	Twinax Flat	30AWG 7 strand SPC	FEP solid	44AWG 7 ends SPC 90%
M17/113-RG316***	RG316 Coax	24AWG Coax	PTFE solid	SPC braid
				SERVE
				SERVE + TAPE
				TAPE + SERVE
				BRAID
* Per Samtec drawings provided with samples				
** Samples provided have serve+tape shield stack-up which is opposite the drawing				
*** Harbour Industries				

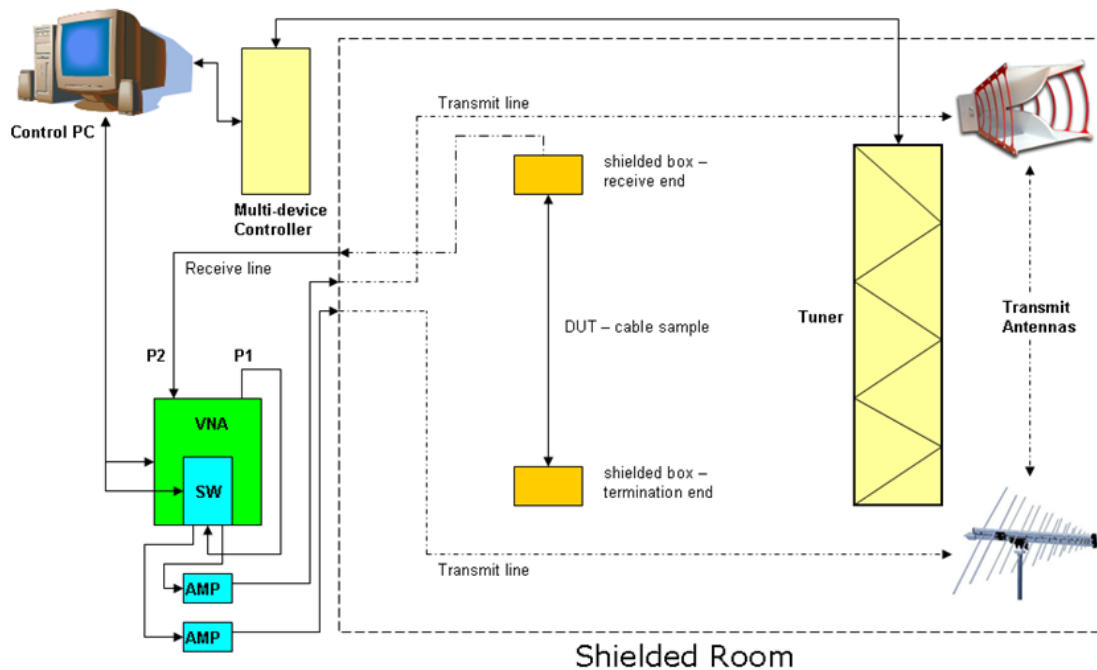
Cable Samples – Electrical Properties

CABLE P/N*	Z*	IL*	RL*	XTALK*	PROP DELAY*	SKEW*
CX-3850-SLD-XX-X	50 +/- 2	-3dB @250MHz, 5ft.	-20dB @500MHz, 5ft.	-50dB @1GHz	1.48ns/ft +/- 0.02	10ps/ft. within a ribbon
CX-3875-SLD-01	75 +/- 3.75	-3dB @500MHz, 5ft.	-20dB @500MHz, 5ft.	-50dB @1GHz	1.46ns/ft +/- 0.01	10ps/ft. within a ribbon
TCF-3650F-XX-01	50 +/- 2	-3dB @250MHz, 5ft.	-20dB @500MHz, 5ft.	-50dB @1GHz	1.33ns/ft +/- 0.02	10ps/ft. within a ribbon
CCA-26S-XX	50 +/- 1	-3dB @2.0GHz, 5ft.	-20dB @1.0GHz, 5ft.	n/a	1.27ns/ft +/- 0.01	n/a
BBCS-3050F-01	50 +/- 1	-3dB @1.3GHz, 5ft.	-20dB @1.0GHz, 5ft.	-50dB @1GHz	1.28ns/ft +/- 0.01	20ps/ft. within a ribbon
CCS-131963-01-CC	90 +/- 2	-3dB @250MHz, 5ft.	-20dB @500MHz, 5ft.	-50dB @1GHz	1.44ns/ft +/- 0.01	10ps/ft. within a ribbon
TX-30100-01	95 +/- 5%, diff	-3dB @1.66GHz, 1m	-20dB @750MHz, 1m	-20dB @1GHz	1.44ns/ft +/- 0.03	10ps/m within pair
TF-30100-01	95 +/- 5%, diff	-3dB @1.66GHz, 1m	-20dB @750MHz, 1m	-50dB @1GHz	1.44ns/ft +/- 0.03	33ps/m within pair, 164ps/m pair to pair
M17/113-RG316***	50 +/- 2	-3dB @6.95GHz, 1m**	-20dB @5.63GHz, 1m**	N/A	1.42ns/ft**	N/A
* Per Samtec drawings provided with samples						
** Measured data using IConnect 4.0, 1m cable assembly SMA						
*** Harbour Industries						

Cable Construction & Cross-Section

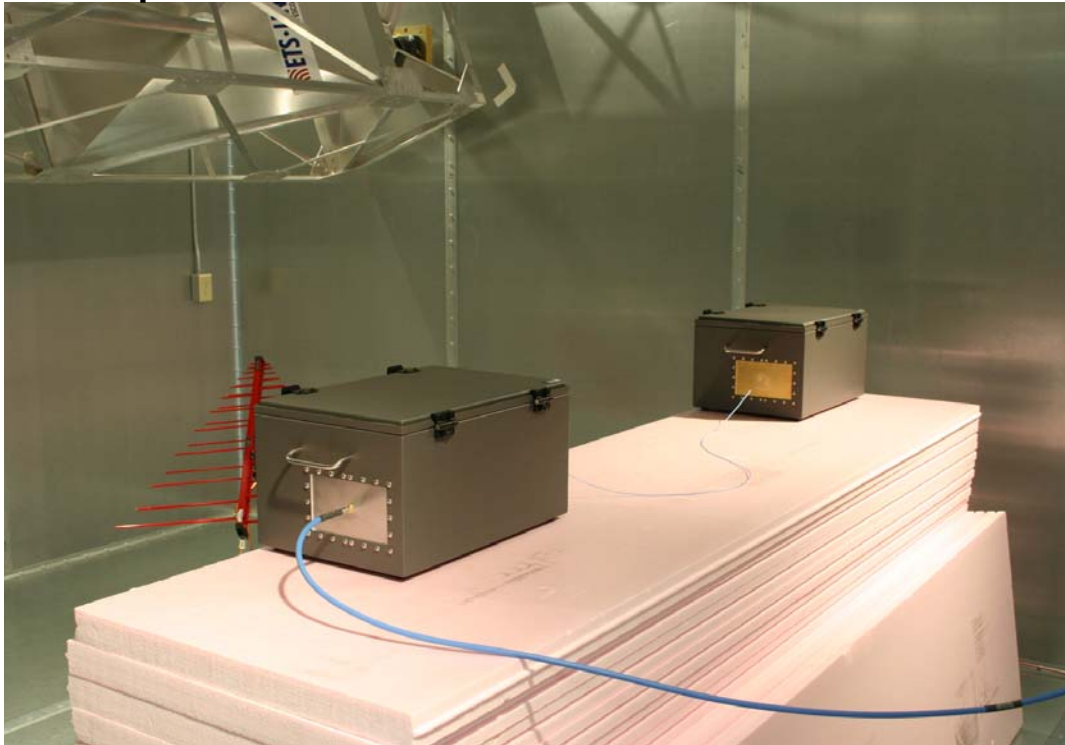


SMART200 Reverb Chamber – Overview



*Test Method is per IEC 61000-4-2, Annex F
 "Shielding effectiveness measurements of cable assemblies, cables, connectors,
 waveguides and passive microwave components"*

Test set-up inside shielded room



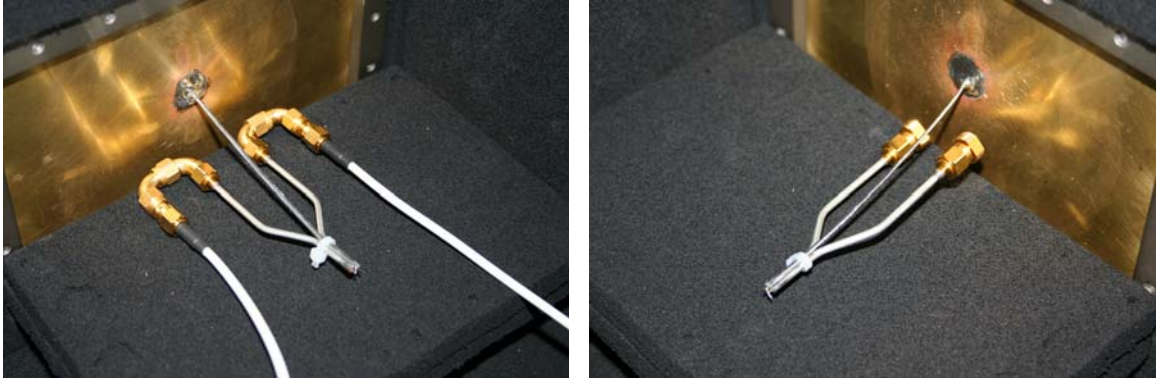
Shielded enclosures isolate the effect of fixturing to the cable under test.

Fixturing inside shielded box – Coax



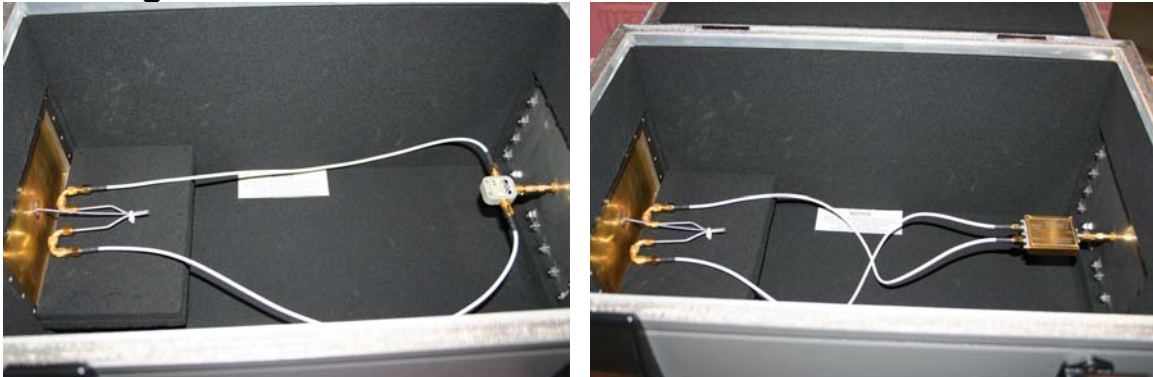
After exposing 4" of cable shield, the coax sample is soldered to a brass plate which then attaches to the wall of the shielded test box. Semi-rigid probes (DynaHz p/n F10-1220-210045A, 0.086" SMA) are soldered to each end of the coax sample. At one end, the probe is terminated with a 50 ohm load, and the other end is fed back through the shielded box to the receive line. The only exception was the termination for the 90 ohm coax; a 100 ohm resistor was used to better match the cable impedance.

Fixturing inside shielded box – Twinax



For differential-to-common mode analysis, phase-matched test cables and differential semi-rigid probes (DynaHz p/n F10-1221-210045A, 0.086" SMA) were used on the twinax sample. Again, at one end, the probes are terminated with two 50 ohm loads (100 ohms differential). The other ends are fed back to either a broadband balun or resistive power splitter/combiner.

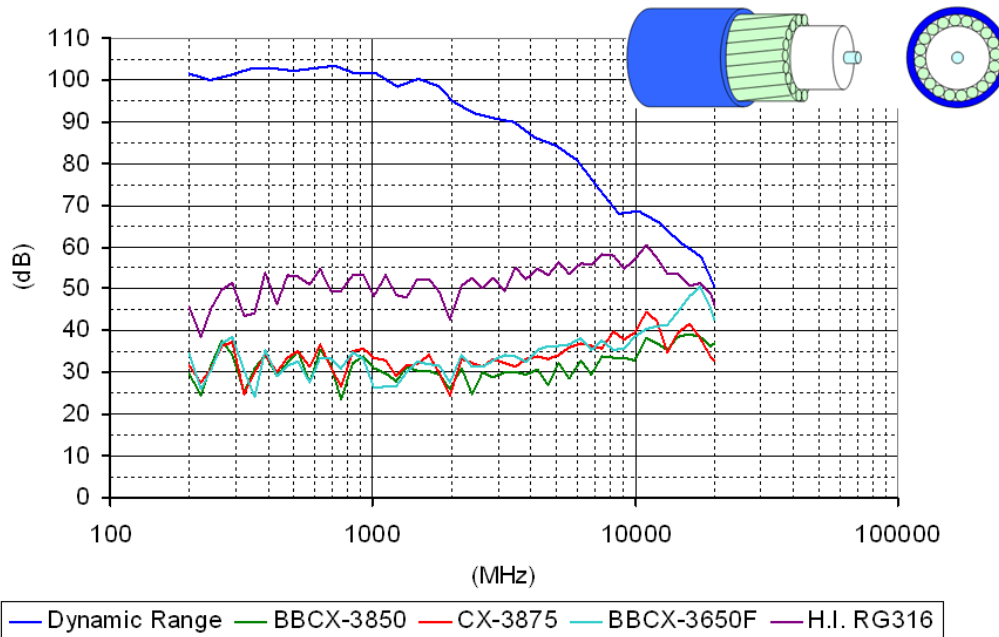
Fixturing inside shielded box – Twinax



Common-mode analysis of a differential pair using a resistive power splitter/combiner.

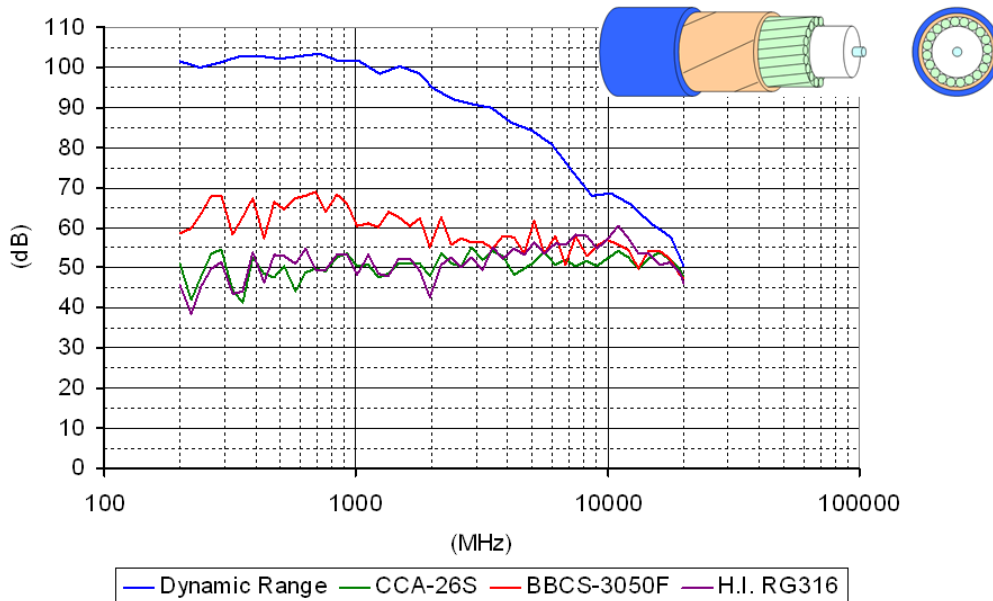
Differential to common-mode analysis using a broadband balun.

Shielding Effectiveness – Coax, serve shield



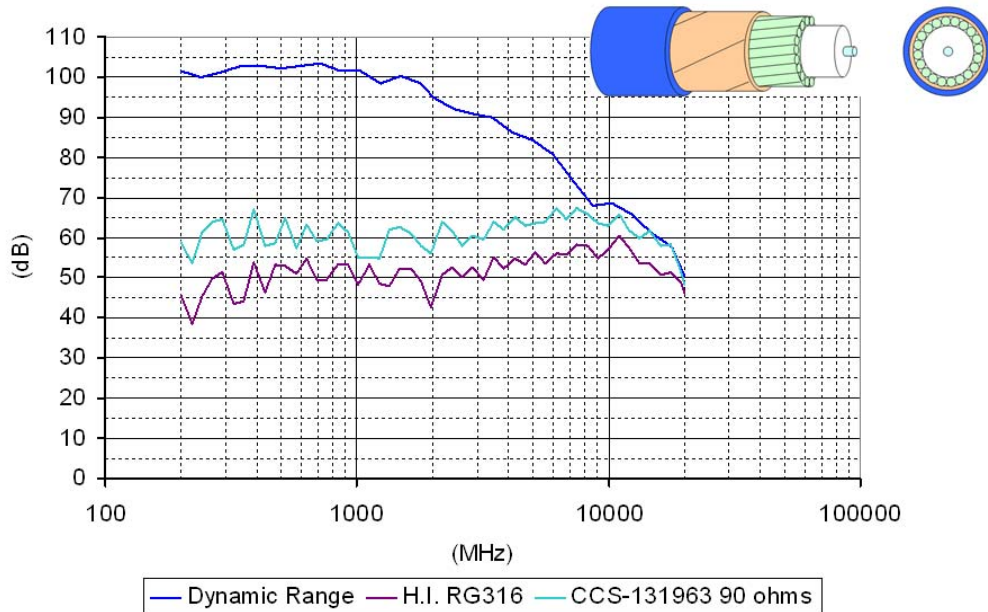
Dynamic range is the maximum shielding effectiveness that can be measured

Shielding Effectiveness – Coax, serve + tape shield



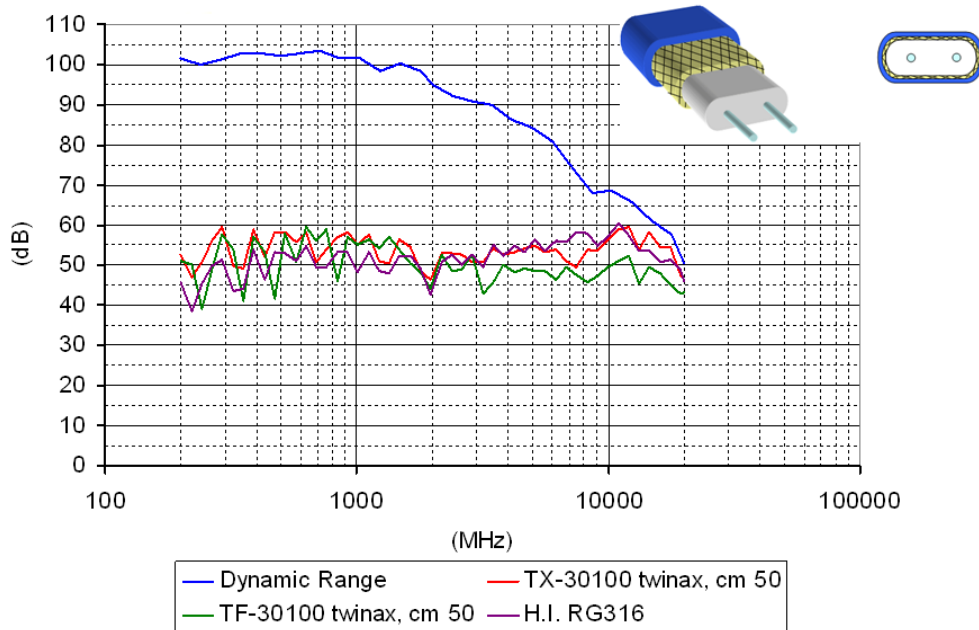
Dynamic range is the maximum shielding effectiveness that can be measured

Shielding Effectiveness – Coax, 90 ohm, server + tape shield



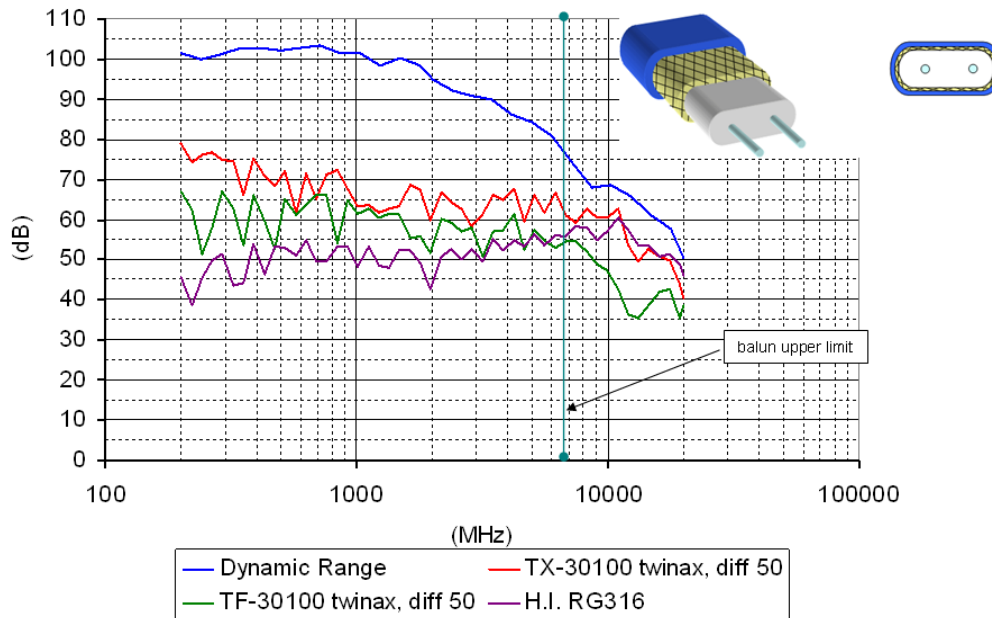
Dynamic range is the maximum shielding effectiveness that can be measured

Shield Effectiveness – Twinax, common-mode, braid shield



Dynamic range is the maximum shielding effectiveness that can be measured

Shielding Effectiveness – Twinax, differential, braid shield



Dynamic range is the maximum shielding effectiveness that can be measured

Conclusions

- Samtec has several cable technologies to support standard catalog offerings as well as custom applications
 - Coax and twinax cable types
 - Serve, foil and braided shield types
- Samtec has developed an internal capability to characterize and optimize shielding performance with offerings that can provide 30-70 dB of shielding performance.
- Contact our Signal Integrity Group at SIG@Samtec.com with questions on shielded product offerings.

Test Equipment, Software, and References

- HP 8720ES VNA, 50MHz-20GHz, utilized as an RF transmitter and receiver
- Agilent 3499B Switch Controller
- Agilent 8762C Coaxial Switch, DC-26.5GHz
- Mini-Circuits ZHL-42W Coaxial Amplifier, 10MHz-4.2GHz, +30dB gain
- Microwave Power L0218-30 Wideband Amplifier, 2-18GHz, +30dB gain
- HP 11667B Power Splitter/Combiner, DC-26.5GHz
- ETS/LINDGREN Smart200 Reverberation Chamber
- ETS/LINDGREN 2090 Multi-Device Controller
- ETS/LINDGREN Smart IMM software, version 2.0
- Picosecond Pulse Labs Phase-Matched Balun, model 5310-104, 4MHz – 6.5GHz
- Ramsey STE3300 Shielded Enclosure
- IEC EN61000-4-21