Shielding Effectiveness Test Report

Project Number:	**5008251**	**Proposal Number:**	**SUW-202301004000**
Report Number:	**5008251EMC01**	**Revision Level:**	**0**
Client:	**V Technical Textiles Inc.**		

Equipment Under Test: **Portable RF Shielded Enclosure**

Model Name: **8324232T**

Applicable Standards: **IEEE 299**

Report issued on: **March 14, 2023**

Test Result: **Compliant to an average shielding effectiveness of 70 dB from 30 MHz to 40 GHz**

Tested by: Steven Frierson

Steven Frierson, Senior EMC Engineer

Reviewed by:

Shawn McGuinness, EMC Engineering Leader

Remarks: This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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1 General Information

1.1 *Client Information*

Name:	V Technical Textiles Inc
Address:	320 South Main Street
City, State, Zip, Country:	Newark, NY 14513, USA
Test Site Location:	2696 Manitou Road, Rochester NY, USA

1.2 *Test Laboratory*

Name:	SGS North America, Inc.
Address:	620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country:	Suwanee, GA 30024, USA

1.3 *General Information of EUT*

Model Name:	Portable RF Shielded Enclosure 8324232T
Serial Number:	023-0520
Sample Received Date:	December 12, 2022 & February 27, 2023
Dates of testing:	December 12-16, 2022 & February 27 – March 03, 2023

1.4 *Purpose:*

To measure the shielding effectiveness of Electromagnetic Interference (EMI).

Test Method of the shielding effectiveness:
The shielding effectiveness, SE is a parameter for the reduction of EMI at a specific frequency due to a shield and is defined as:

$$SE = 10 \times \log\left(\frac{P_0}{P_t}\right) = 20 \times \log\left(\frac{E_0}{E_t}\right) = 20 \times \log\left(\frac{H_0}{H_t}\right)$$

Where P_0, E_0 and H_0 are the energy, the electric and magnetic field intensity incident on the shield and P_t, E_t and H_t are the counter parts transmitted through the shield.

In this report, the shielding effectiveness (SE) of the test specimen was analyzed using near-field antenna measurement systems. The schematic of measurement system is illustrated in Fig.1, which consisted of a vector network analyzer and a pair of antennas from 30 MHz to 1 GHz. The test specimen was placed symmetrically in the path of radiation between the send and the receive antennas. Calibration of the system was carried out before each test to adjust changes in the calibration level and ambient conditions. The SE of the test specimen can be estimated by measuring the signal reached from port 1 to port 2. From 1 GHz to 40 GHz a spectrum analyzer, signal generator and pairs of antennas were used with TILE software to determine Shielding Effectiveness.

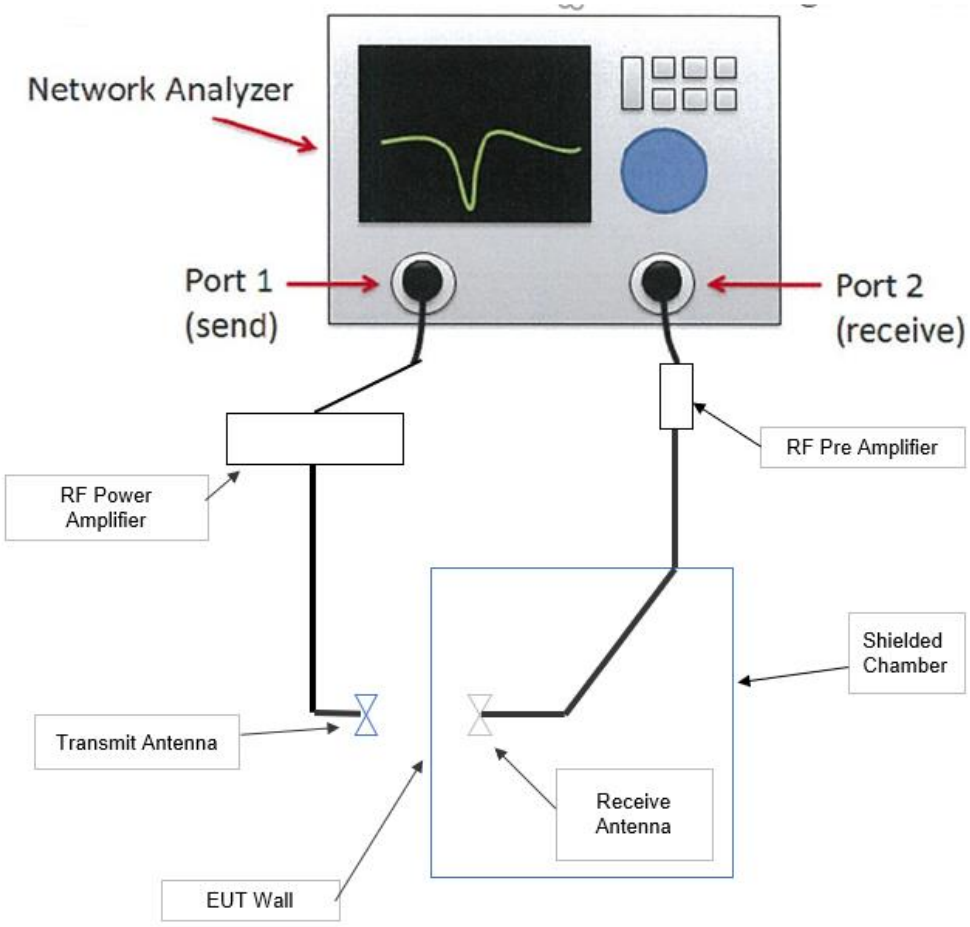
Summary of the test procedure:

1. Calibrate signal level and ambient noise of the free space measurement.
2. Insert the test specimen in between the antenna pair.
3. Perform the measurement of the shielding effectiveness by a Spectrum Analyzer and Signal Generator and a Vector Network Analyzer.

1.5 *Test Summary*

The portable RF shielded enclosure was tested for shielding effectiveness per IEEE 299 requirements from 30 MHz to 40 GHz and found to provide an average of 70 dB or more of shielding effectiveness across the above-mentioned frequency range. Some test positions appear to be below spec in the vertical polarization. A significant performance delta exists at 1 GHz between the 30-1000 MHz test method and the 1 – 40 GHz test method; this is likely due to the physically and electrically large size of the enclosure increasing performance across the frequency range of < 1 GHz, and the electrically small apertures which contribute to some level of reduced shielding performance in the frequency range > 1 Ghz.

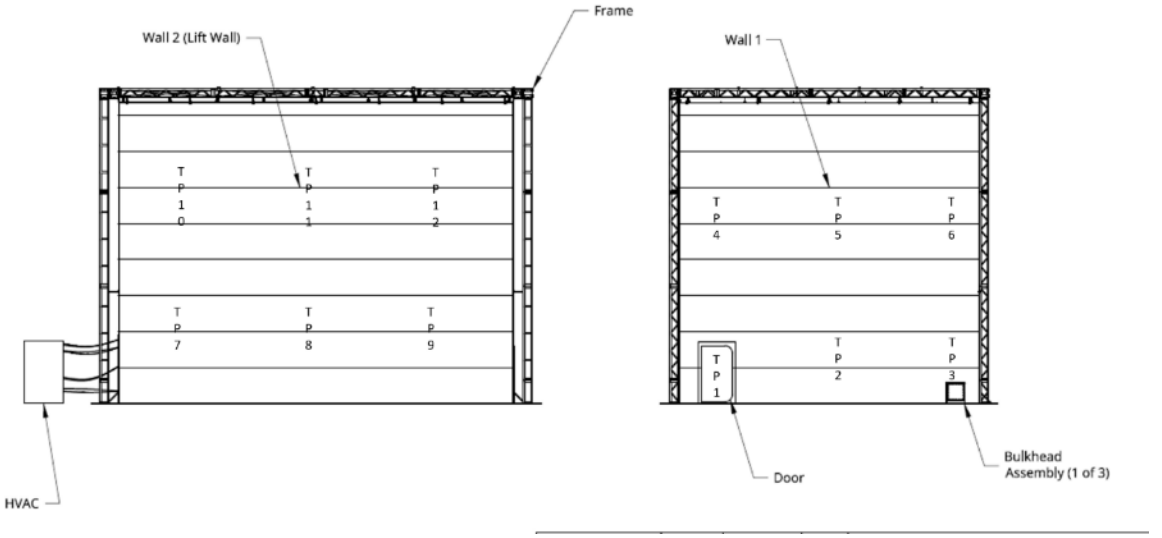
1.6 *EUT Connection Block Diagram*

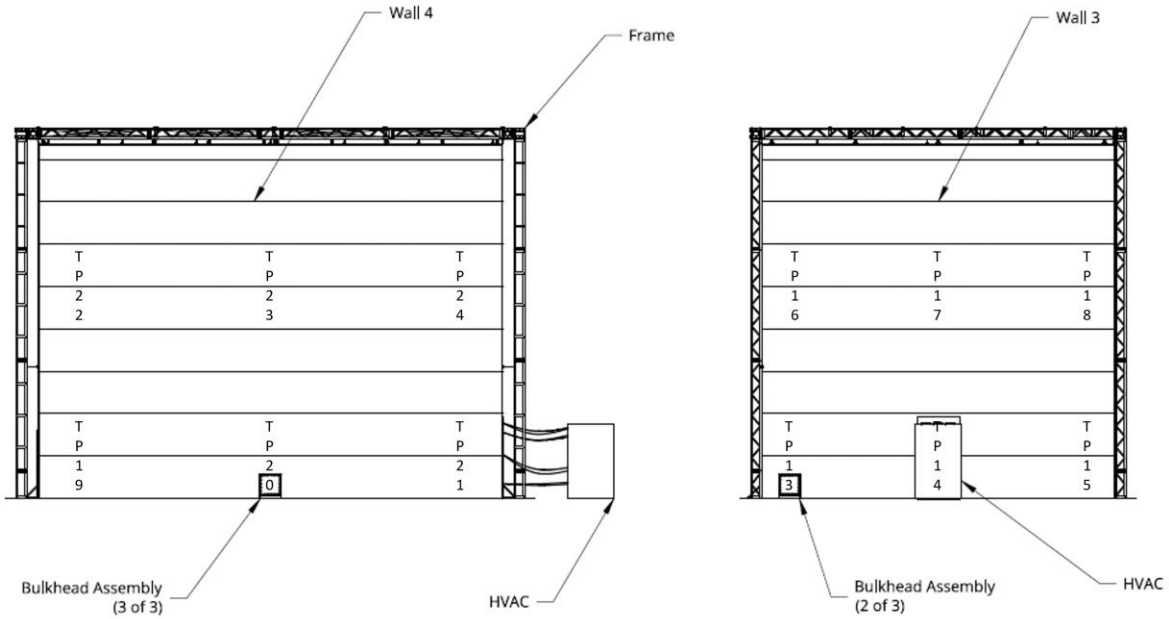


Note: In cases where the Signal Generator and Spectrum Analyzer were used for testing the above illustrated Network analyzer is substituted with the Signal Generator and Spectrum Analyzer.

1.7 *Test Point Locations*

TP = Test Point





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1.8 *Test Method 30 MHz – 1 GHz*

The VNA was programmed to transmit across the appropriate frequency range.
Transmit power emits from one side and receives on the other side of the EUT. The transmit power is measured in free space before placing the EUT in the transmit path. Delta between free space and EUT is the shielding effectiveness.

1.9 *Test Method 1 GHz – 40 GHz*

The spectrum analyzer and signal generator were programmed to transmit across the appropriate frequency range and controlled by TILE Software. Transmit power emits from one side and receives on the other side of the EUT. The transmit power is measured in free space before placing the EUT in the transmit path. Delta between free space and EUT is the shielding effectiveness.

1.10 *Test Site*

2696 Manitou Road, Rochester NY, USA

1.11 *Test Equipment*

30 MHz – 1 GHz:

Test End Date: 16-Dec-2022 Tester: SF

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
VECTOR NETWORK ANALYZER	S5180	COPPER MOUNTAIN	19012	19-Oct-2022	19-Oct-2023
BROADBAND PREAMPLIFIER 0,5-18GHZ	BBV 9718 C	SCHWARZBECK MESS ELEKTRONIK	20155	3-Oct-2022	3-Oct-2023
BROADBAND PREAMPLIFIER 10MHZ-6GHZ	BBV 9743 B	SCHWARZBECK MESS ELEKTRONIK	20156	3-Oct-2022	3-Oct-2023
RF CABLE NM TO NM, 0.01-18GHZ	90-195-118	TELEDYNE STORM MICROWAVE	20126	9-Feb-2023	9-Feb-2024
RF CABLE NM TO NM, 0.01-18GHZ	90-195-118	TELEDYNE STORM MICROWAVE	20125	25-Aug-2022	25-Aug-2023
HYGRO-THERMOMETER	28-Apr-3120	EXTECH	22006	1-Apr-2022	1-Apr-2023
MEASURING TAPE, 10M	10M	KUTIR	21026	CNR	CNR
RF CABLE, NM TO NM.	NPS-22801-300M-NPS	IW MICROWAVE	20160	23-Oct-2022	3-Oct-2023
RF CABLE	SF106	HUBER & SUHNER	B085895	23-Oct-2022	3-Oct-2023
RF CABLE, NM TO NM.	NPS-2801-100M-NPS	IW MICROWAVE	20161	23-Oct-2022	3-Oct-2023
RF CABLE, NM TO NM.	NPS-2801A-1000M-NPS	IW MICROWAVE	20162	3-Oct-2022	3-Oct-2023
RF CABLE NM TO BNCM, 0.01-4GHZ	90-2476-030	TELEDYNE STORM MICROWAVE	20128	3-Oct-2022	3-Oct-2023
RF CABLE, NM TO NM.	MULTIFLEX 141	HUBER & SUHNER	20159	23-Oct-2022	3-Oct-2023
TRIPOD	N/A	ETS LINDGREN	22018	CNR	CNR
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	3-Oct-2022	3-Oct-2023
BROADBAND PREAMPLIFIER 9KHZ-2GHZ	BBV 9745	SCHWARZBECK MESS ELEKTRONIK	20157	3-Oct-2022	3-Oct-2023
LAPTOP COMPUTER	20SM	LENOVO THINKBOOK 15-IIL	LROEHWFK	CNR	CNR
RF AMPLIFIER	150W1000	AMPLIFIER RESEARCH	331748	CNR	CNR
MICROWAVE AMPLIFIER	8349B	HEWLETT PACKARD	4331438	CNR	CNR
RF ADAPTER KIT	N/A	TEKBOX	N/A	CNR	CNR
TRIPOD	N/A	RIES	N/A	CNR	CNR
VECTOR NETWORK ANALYZER	37369C	ANRITSU	N/A	N/A	#N/A
LOW NOISE AMPLIFIER	PAM-1840VH	AH SYSTEMS	N/A	N/A	#N/A
MINI BICON ANTENNA	ETSL-3183	ETS LINDGREN	N/A	N/A	#N/A
MINI BICON ANTENNA	ETSL-3184	ETS LINDGREN	N/A	N/A	#N/A
BICONICAL ANTENNA	SAS-545	AH SYSTEMS	N/A	N/A	#N/A
BICONICAL ANTENNA	SAS-546	AH SYSTEMS	N/A	N/A	#N/A
2.9MM LOW LOSS CABLE	SAC-40G-1.5	AH SYSTEMS	N/A	N/A	#N/A
2.9MM LOW LOSS CABLE	SAC-40G-1.6	AH SYSTEMS	N/A	N/A	#N/A
2.9MM LOW LOSS CABLE	SAC-40G-1.7	AH SYSTEMS	N/A	N/A	#N/A
2.9MM LOW LOSS CABLE	SAC-40G-1.8	AH SYSTEMS	N/A	N/A	#N/A
2.9MM LOW LOSS CABLE	SAC-40G-1.9	AH SYSTEMS	N/A	N/A	#N/A
2.9MM LOW LOSS CABLE	SAC-40G-1.10	AH SYSTEMS	N/A	N/A	#N/A
2.9MM LOW LOSS CABLE	SAC-40G-1.11	AH SYSTEMS	N/A	N/A	#N/A
2.9MM LOW LOSS CABLE	SAC-40G-1.12	AH SYSTEMS	N/A	N/A	#N/A

1 GHz – 40 GHz:

Test End Date: 7-Mar-2023 Tester: SF & VC

Description	Manufacturer	Model	Serial No.	Cal. Due
Spectrum Analyzer	Hewlett Packard	8564E	3442A00245	14-Feb-2024
Signal Generator	Rohde & Schwarz	SMP04	DE33813	14-Feb-2024
Preamplifier	The EMC Shop	PA18G-HA	1323	23-Jun-2023
Preamplifier	The EMC shop	PA40G	18752-01	17-Feb-2025
RF Amplifier	Hewlett Packard	8349B	2644A01939	UWCE
RF Amplifier	Exodus Advanced Communications	AMP4037	10005	UWCE
DRG Horn Antenna	EMCO	3115	2436	UWCE
DRG Horn Antenna	EMCO	3115	2434	7-Apr-2024
DRG Horn Antenna	ETS Lindgren	3116	26390	2-May-2024
DRG Horn Antenna	EMCO	3160-08	1147	UWCE
Software, Tile (Version 3.4.k.6)	Quantum Change	None	None	UWCE
Laptop	Dell	E6420	9J3LDS1	N/A
(4x) GPIB to USB Adapters	National Instruments	GPIB-USB-HS & GPIB-USB-B	1CE4845 ; 1CE3B81 ; 109FBB6 ; 1BE4365	N/A
Fiber Extender Set	Black Box	--	BB404A-06R-A09132	N/A

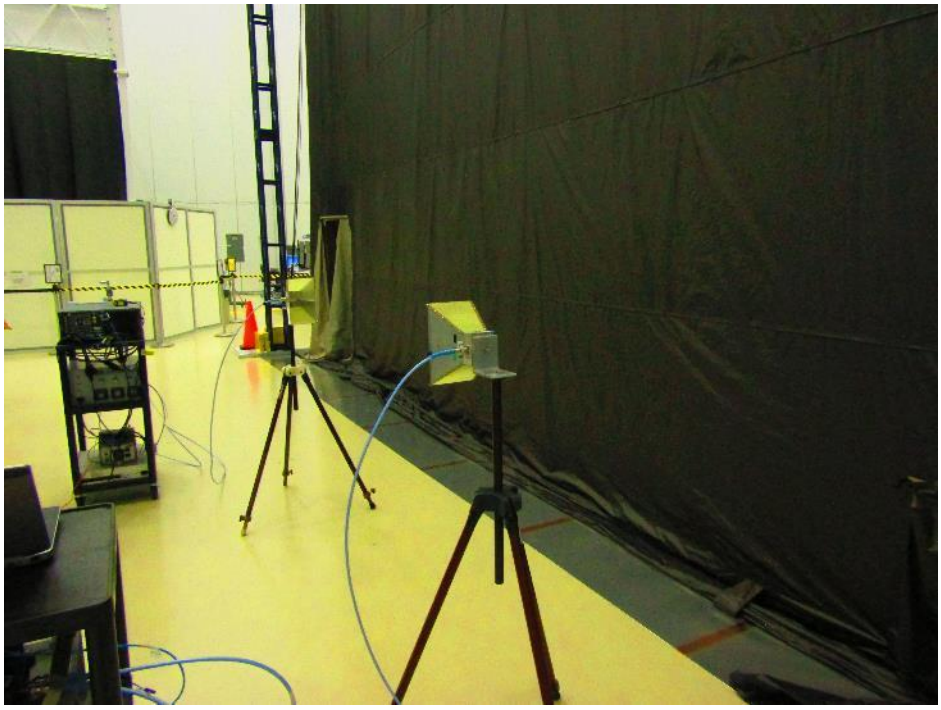
Note: UWCE = Used With Calibrated Equipment

1.12 *Test Setup Photographs*

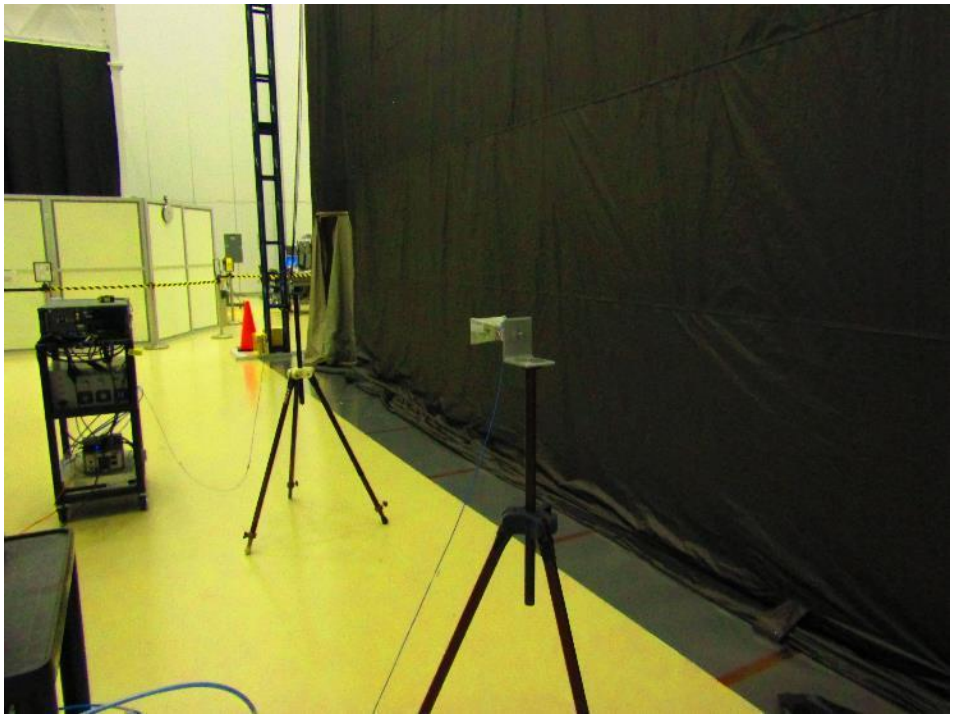
Signal Level Calibration
30 - 1000 MHz

Note: Example photo only, actual photo of this range not provided during test

1-18 GHz

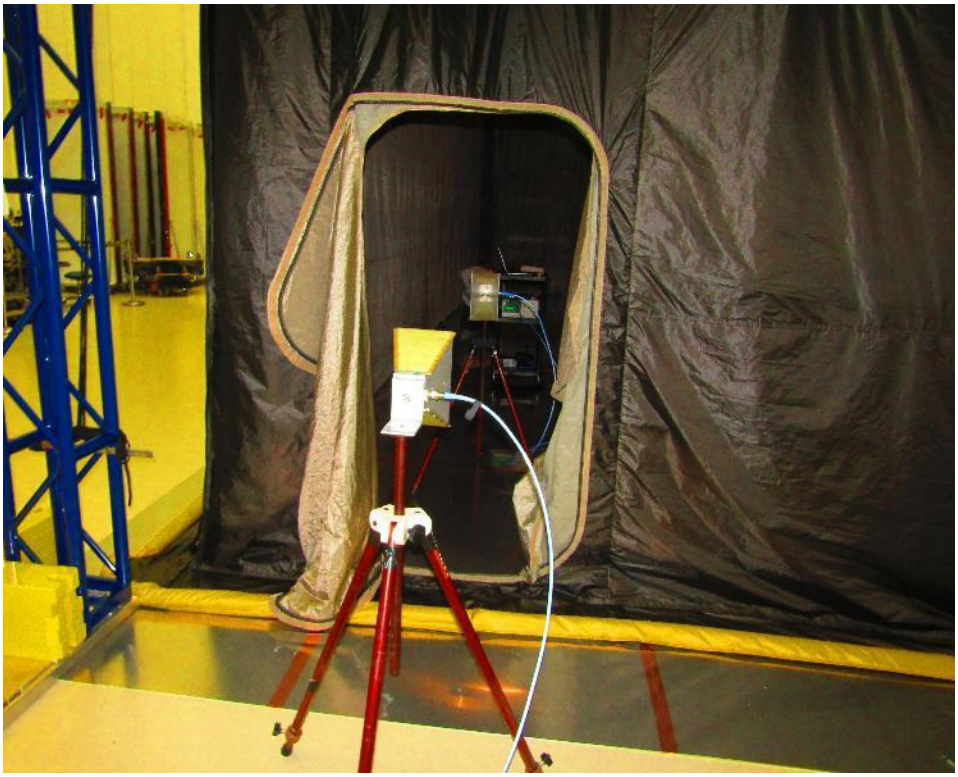


18-40 GHz

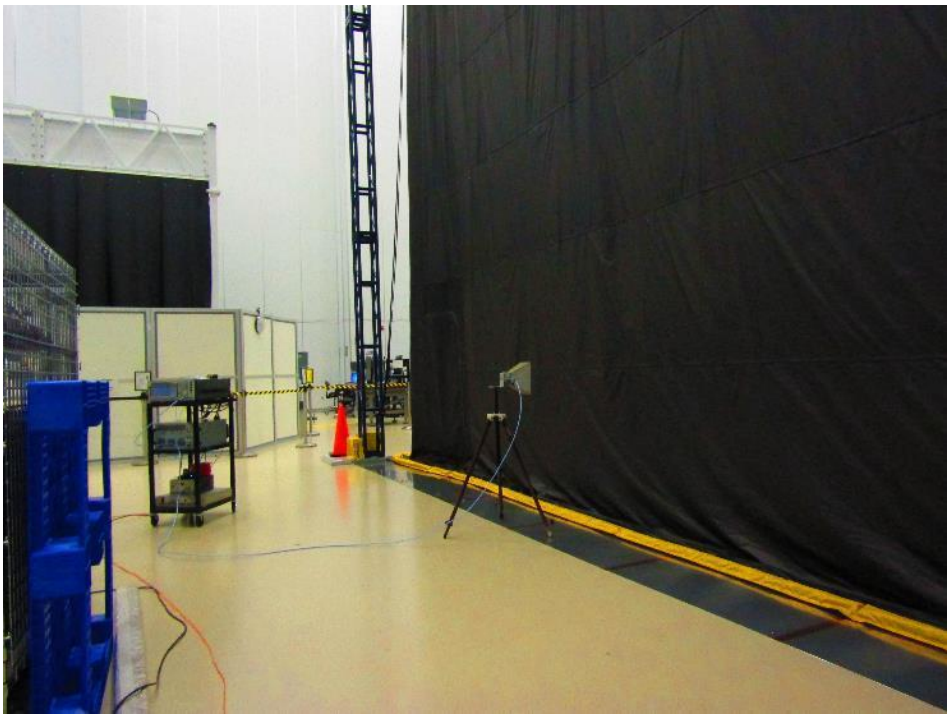


Shielded Measurements
30 – 1000 MHz

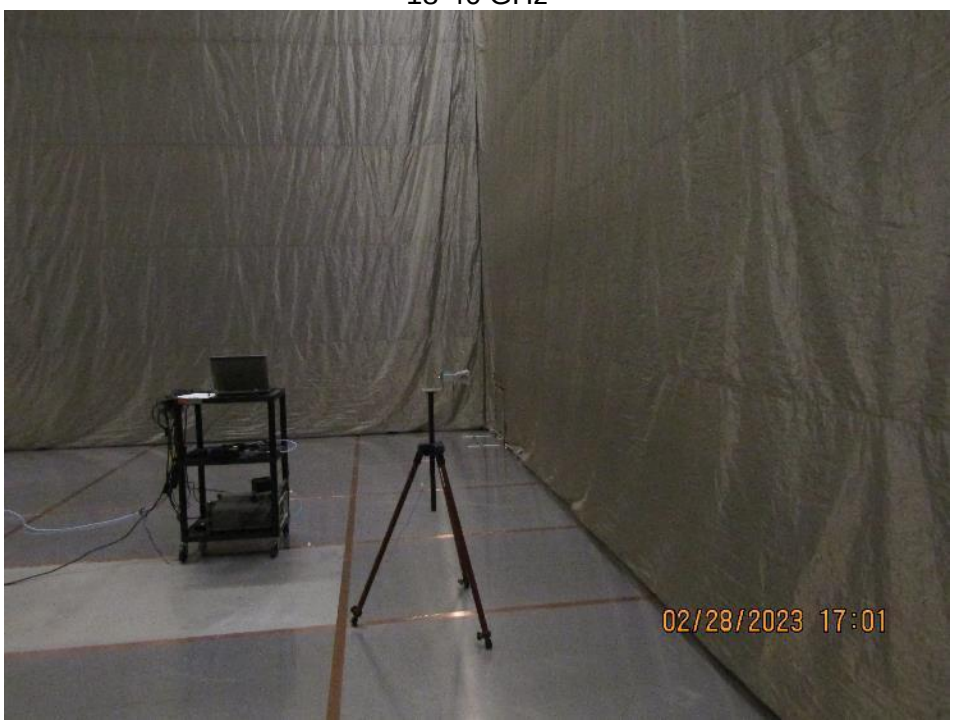
1-18 GHz



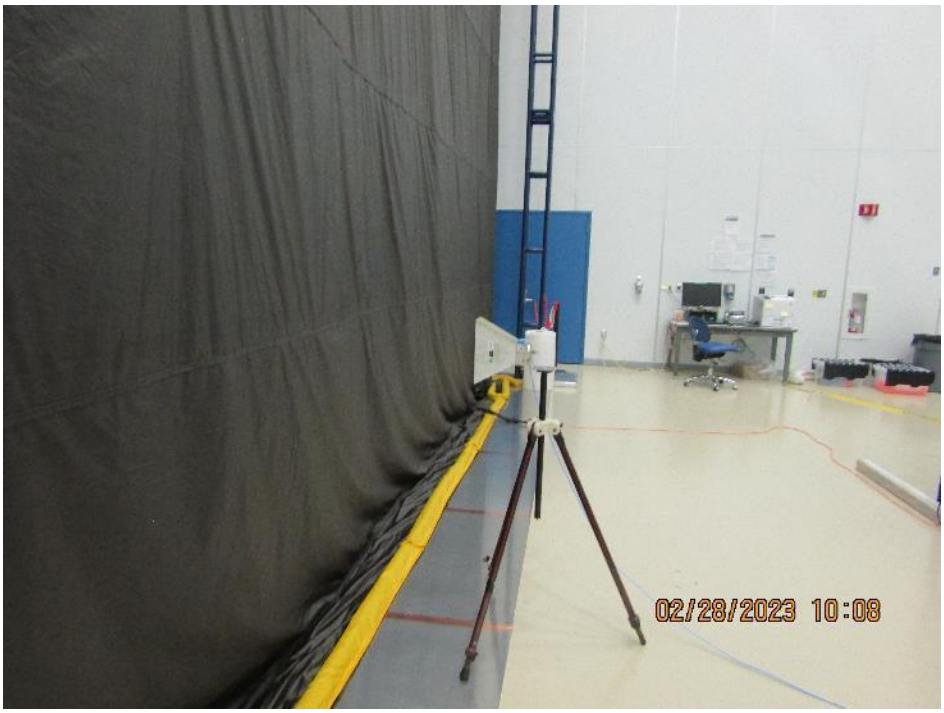
Shielded Measurements
1-18 GHz



18-40 GHz

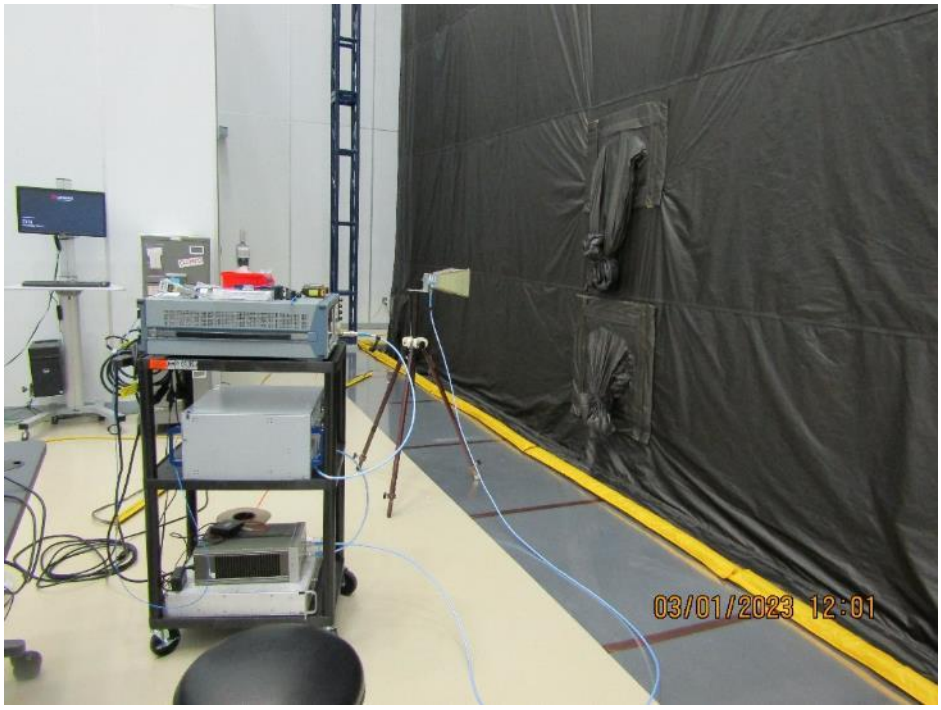


Shielded Measurements
1-18 GHz



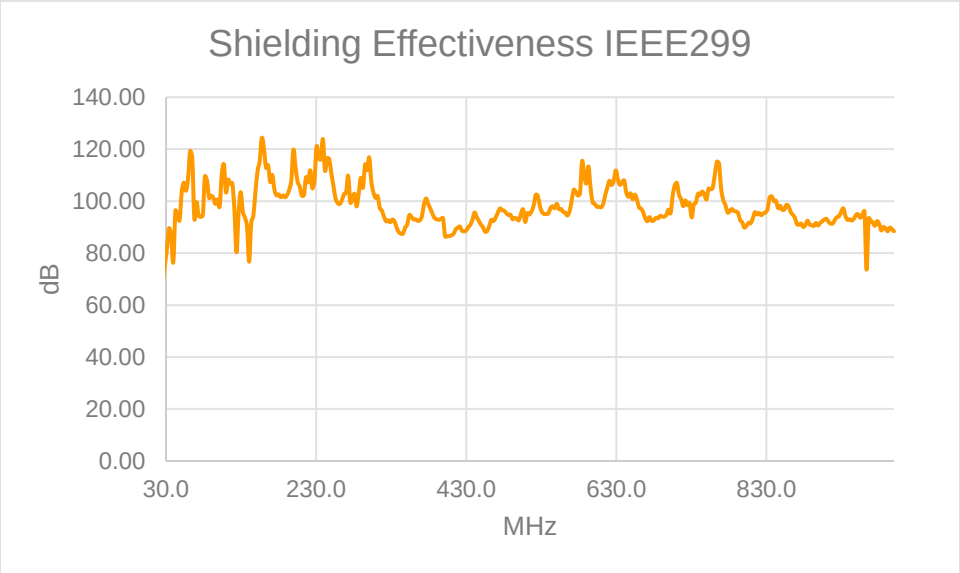
1-18 GHz

1-18 GHz

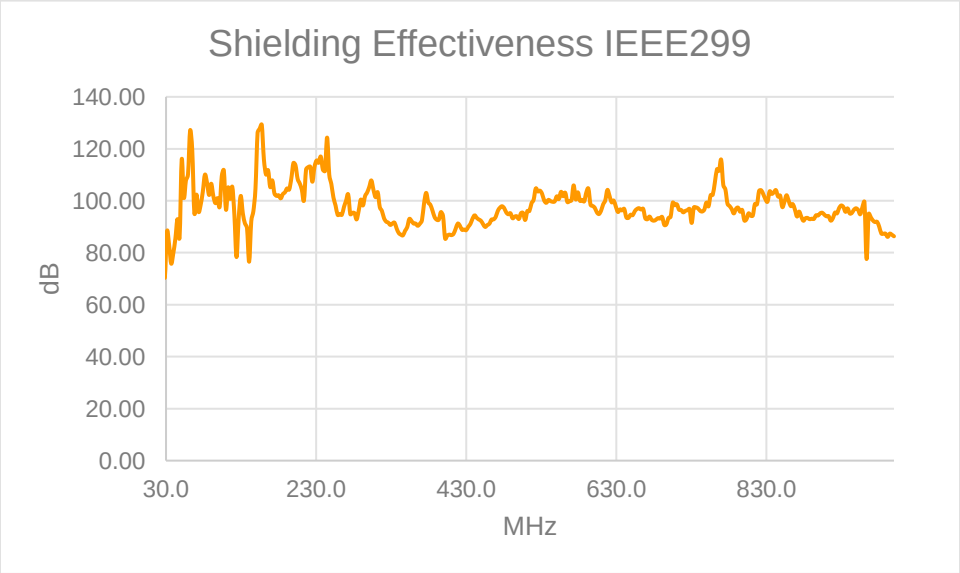


1.13 *Test Data*

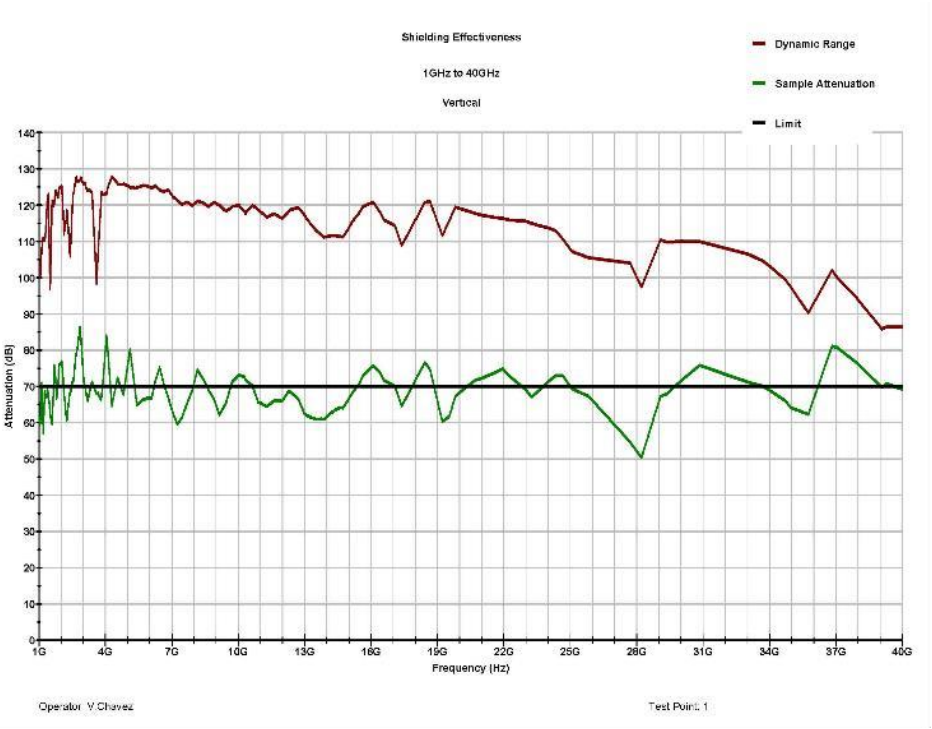
Test Position 1, 30-1000 MHz Vertical



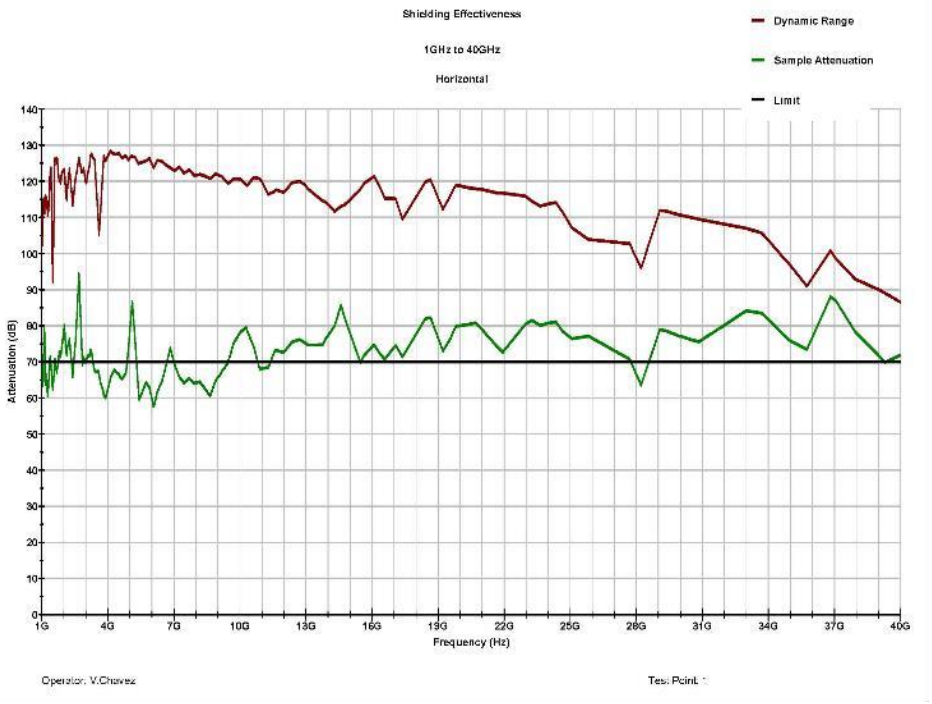
Test Position 1, 30-1000 MHz Horizontal



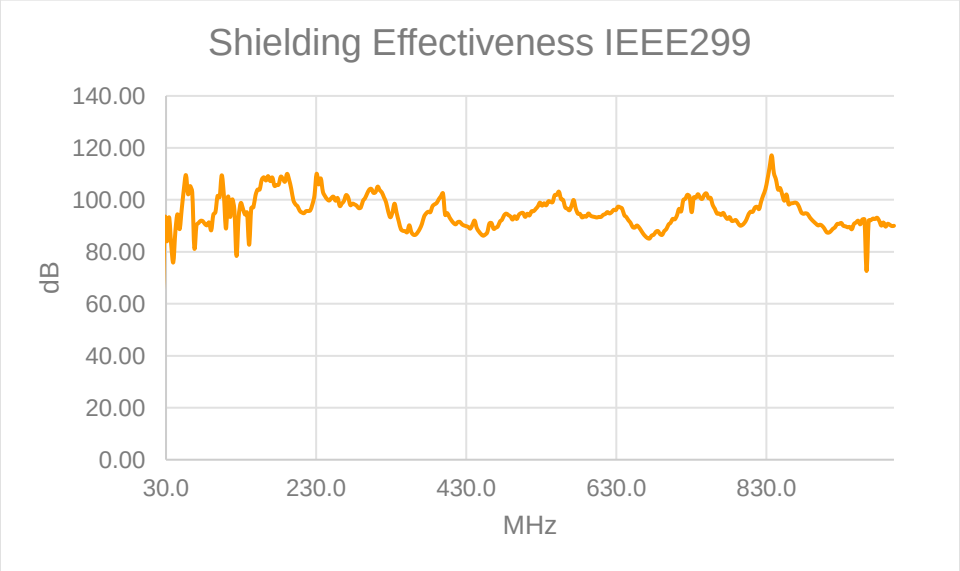
Test Position 1: 1,000 – 40,000 MHz Vertical



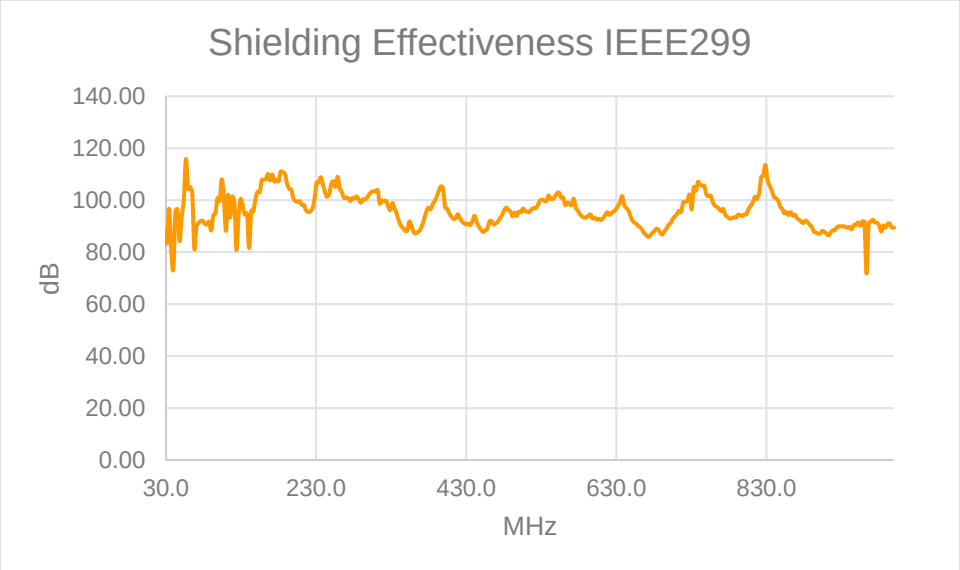
Test Position 1: 1,000 – 40,000 MHz Horizontal



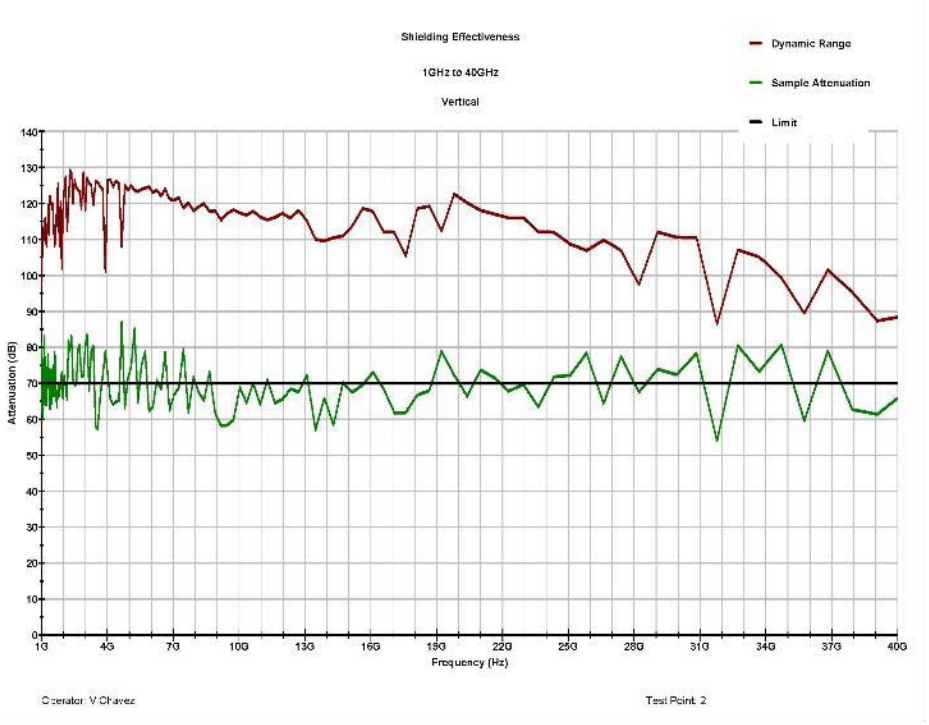
Test Position 2, 30 - 1000 MHz Vertical



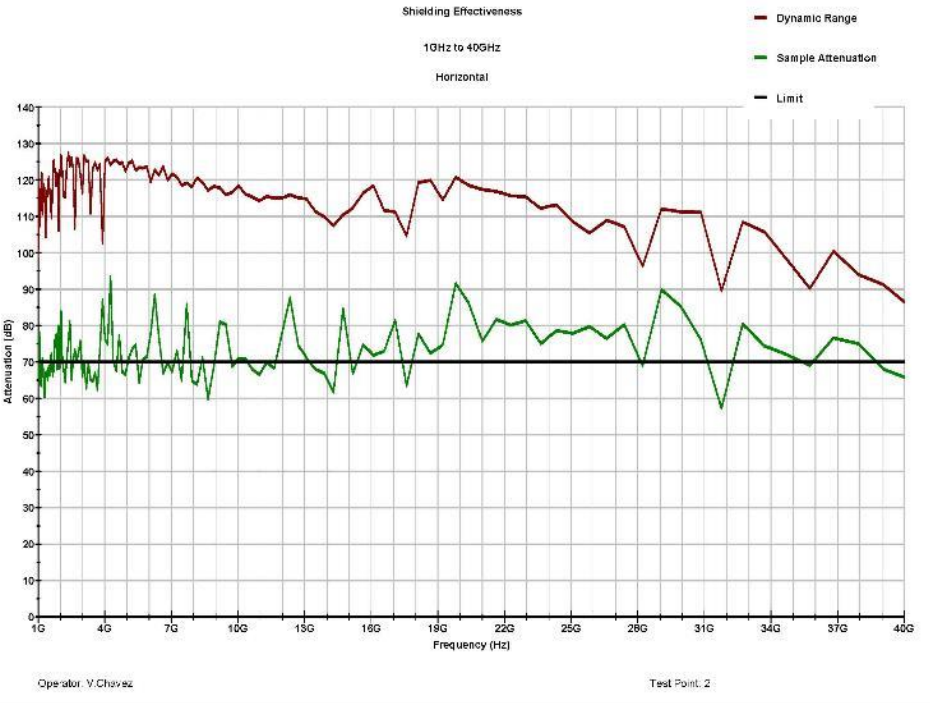
Test Position 2, 30 - 1000 MHz Horizontal



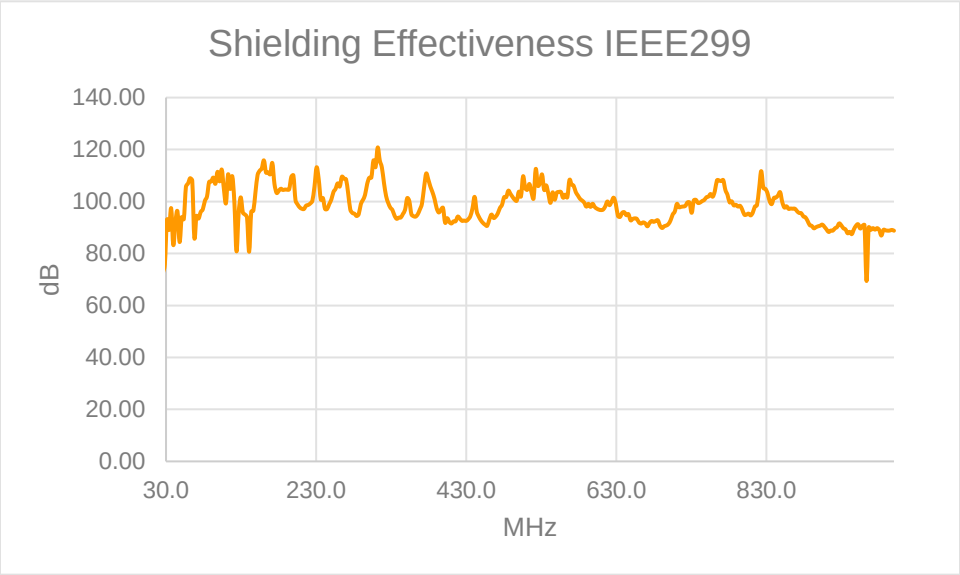
Test Position 2: 1,000 – 40,000 MHz Vertical



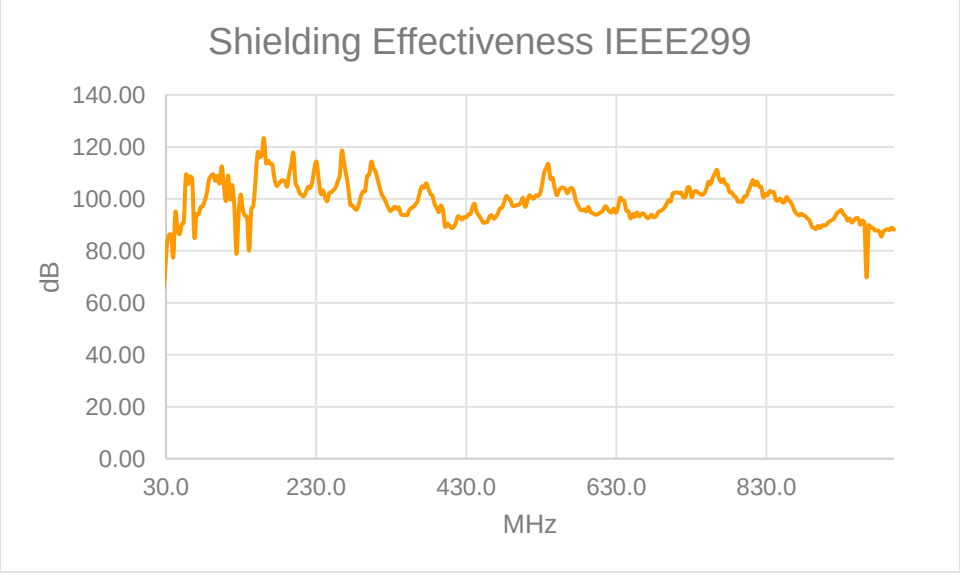
Test Position 2: 1,000 – 40,000 MHz Horizontal



Test Position 3, 30 - 1000 MHz Vertical



Test Position 3, 30 - 1000 MHz Horizontal



Test Position 3: 1,000 – 40,000 MHz Vertical

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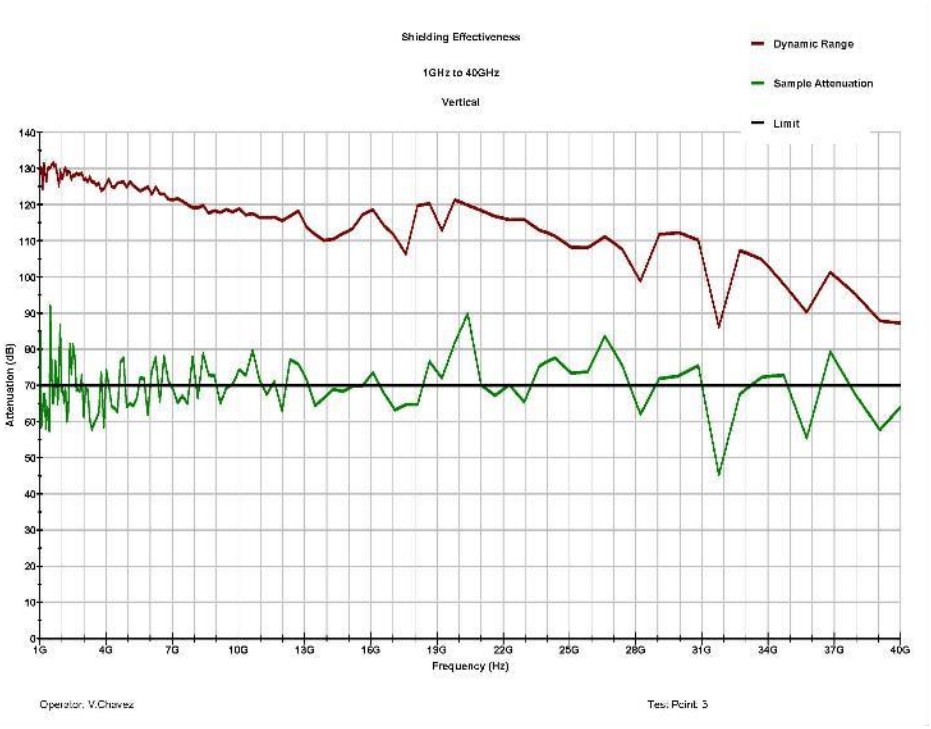
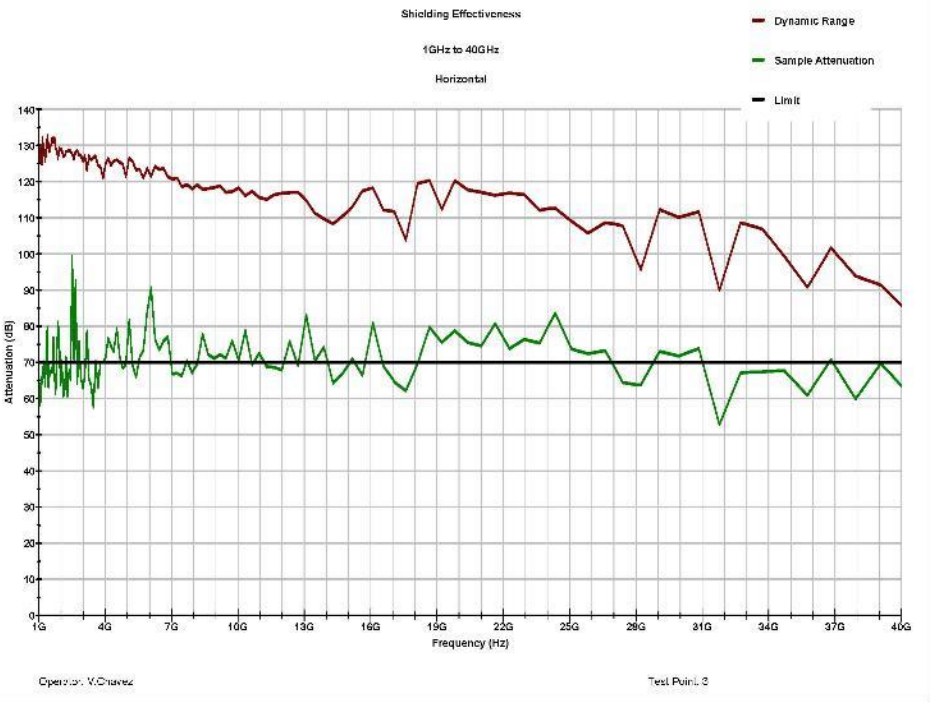
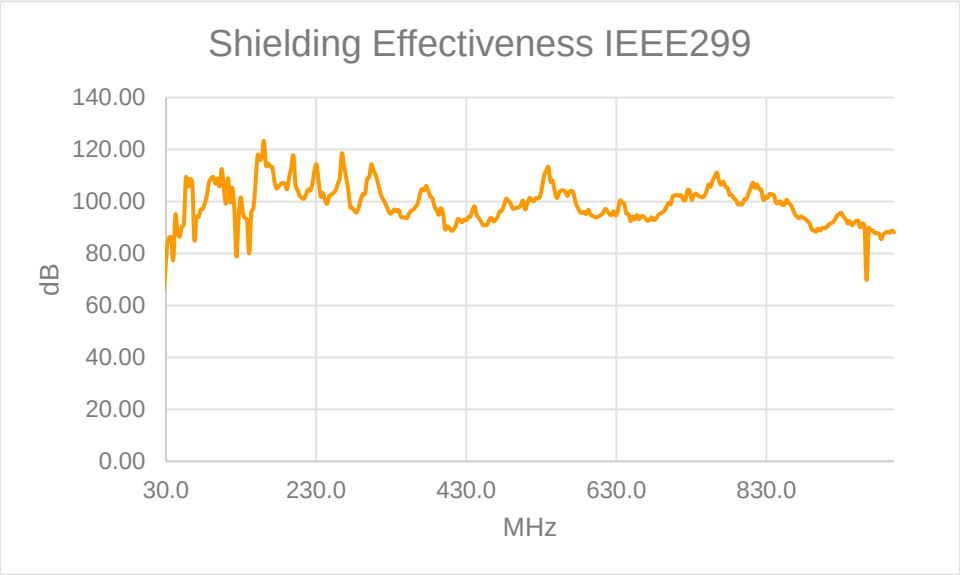


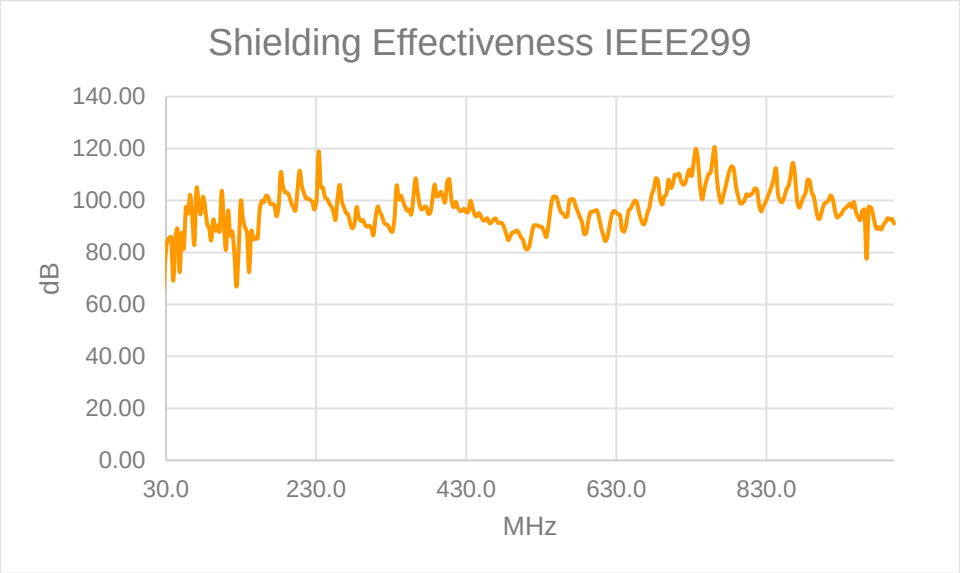
Test Position 3: 1,000 – 40,000 MHz Horizontal



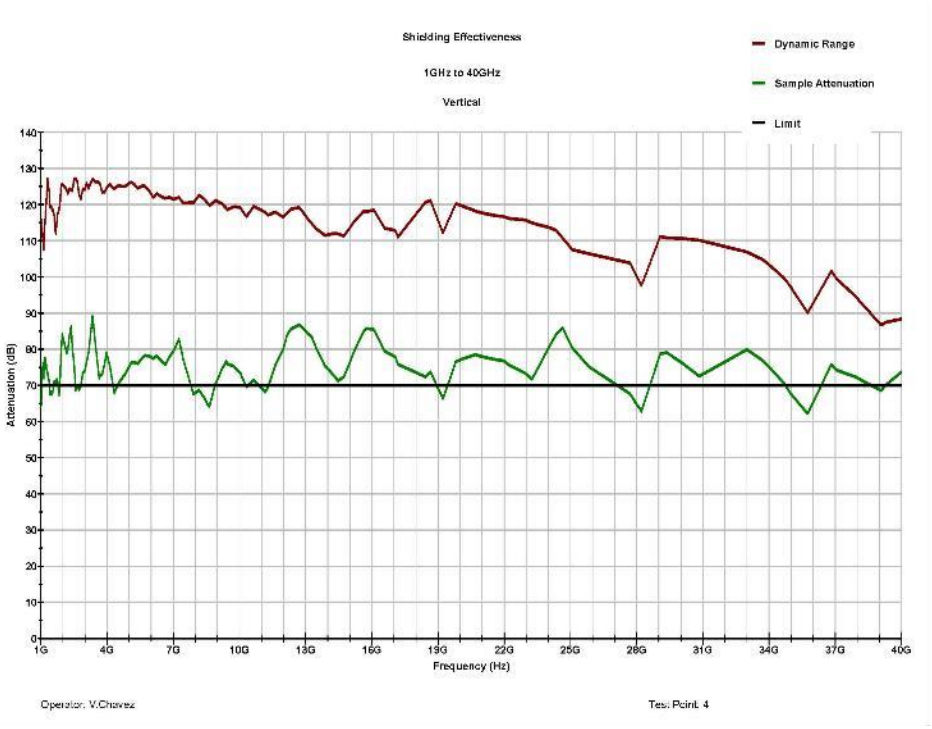
Test Position 4, 30-1000 MHz Vertical



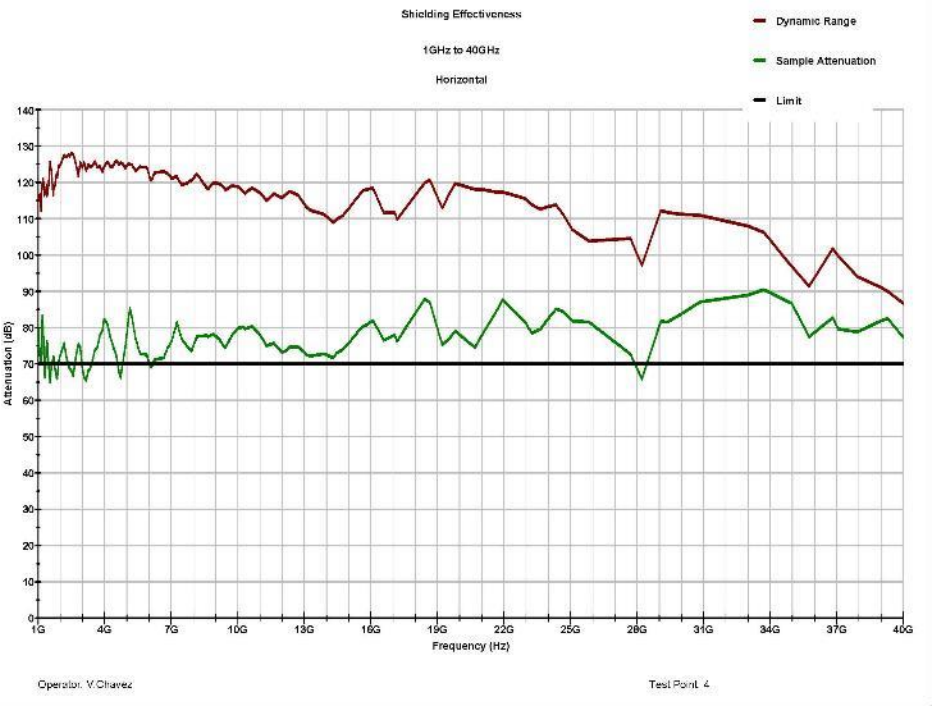
Test Position 4, 30-1000 MHz Horizontal



Test Position 4: 1,000 – 40,000 MHz Vertical



Test Position 4: 1,000 – 40,000 MHz Horizontal



Test Position 5, 30 - 1000 MHz Vertical

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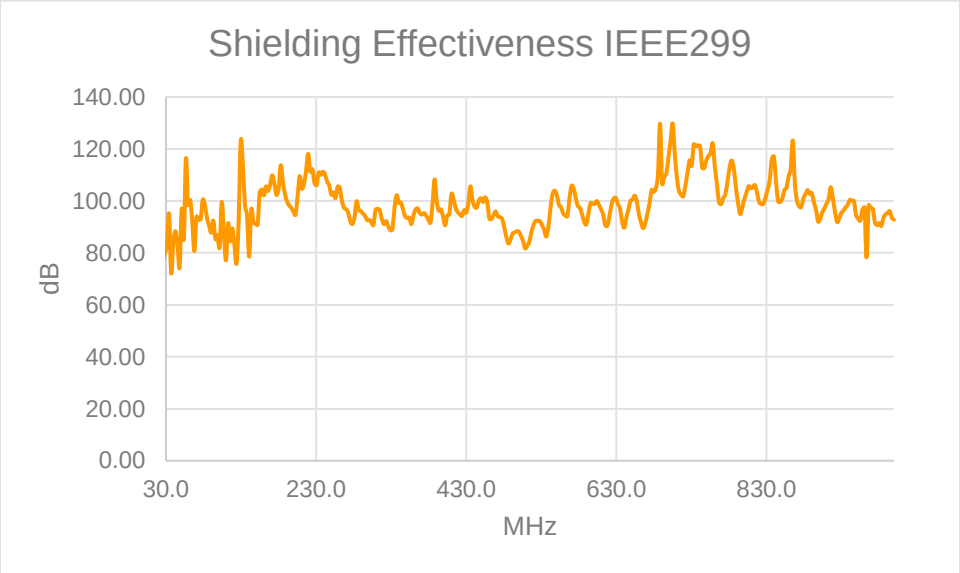
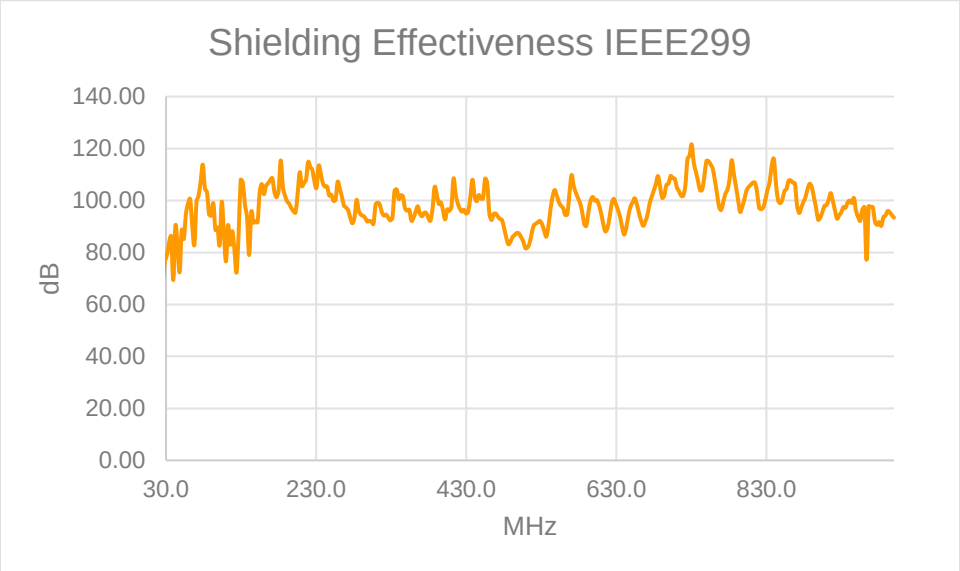
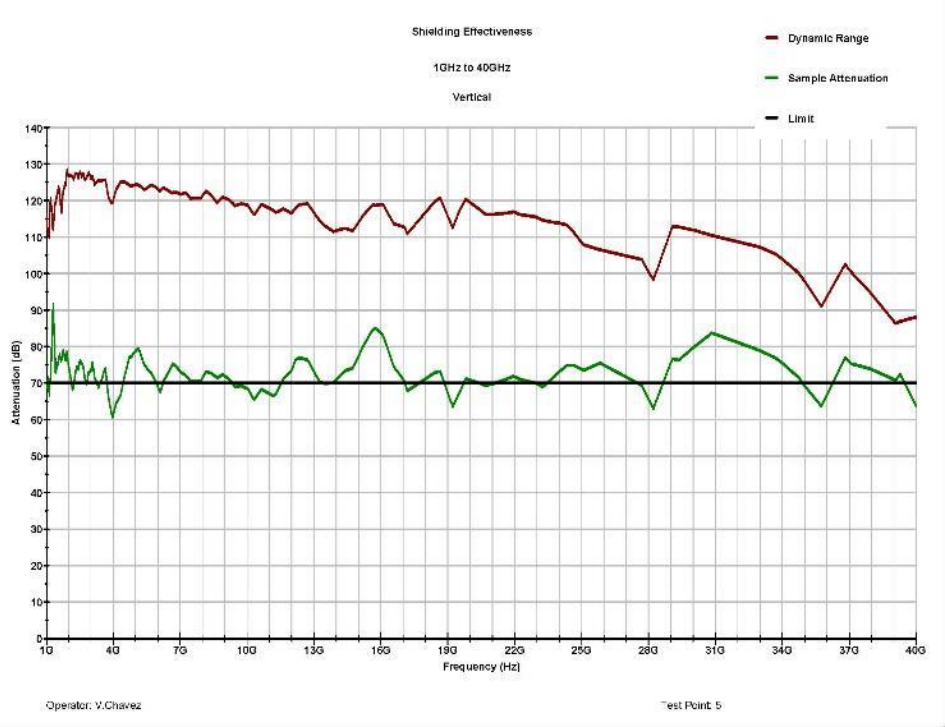


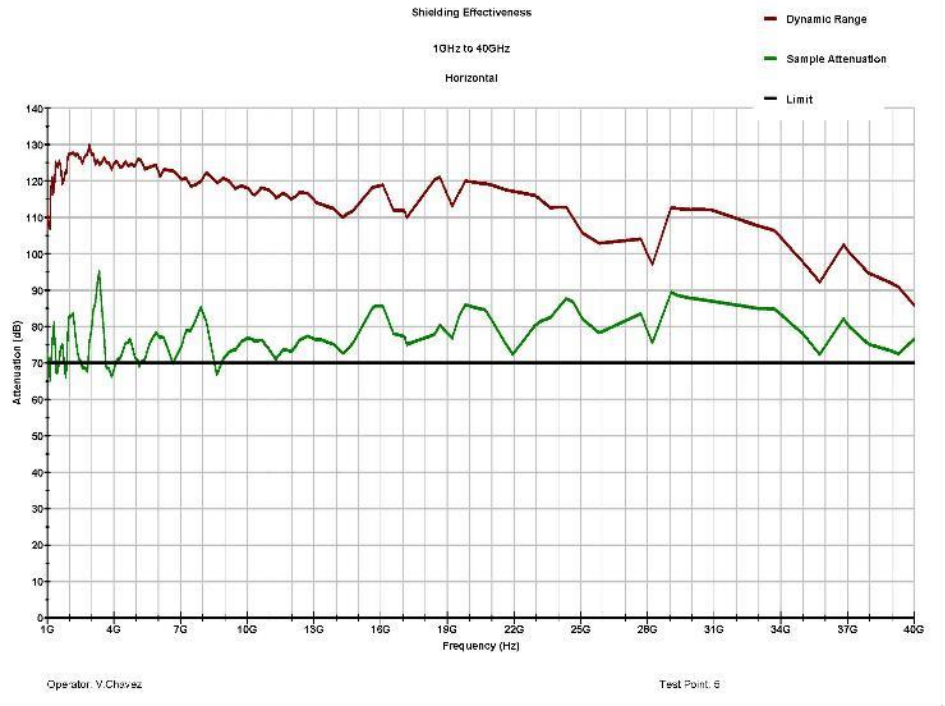
Test Position 5, 30 - 1000 MHz Horizontal



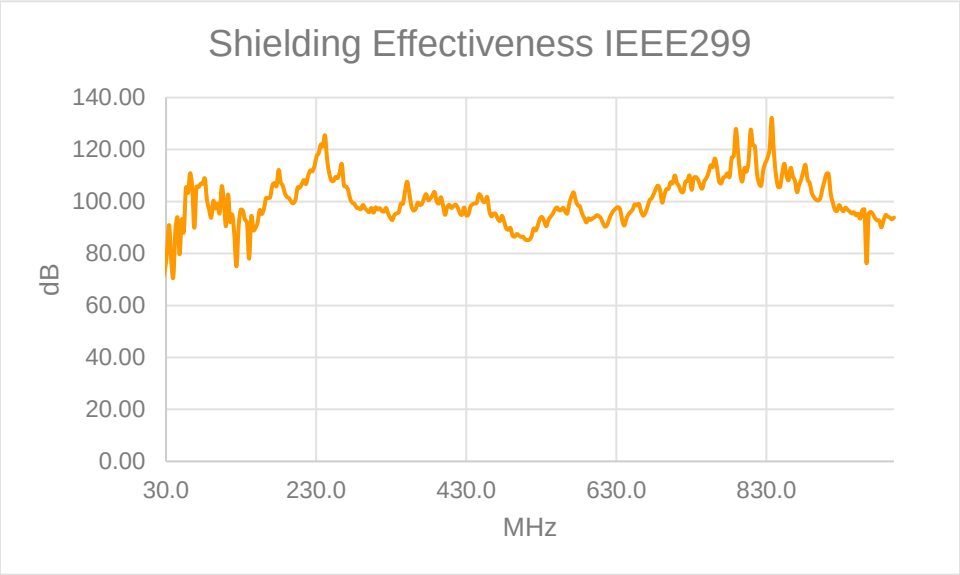
Test Position 5: 1,000 – 40,000 MHz Vertical



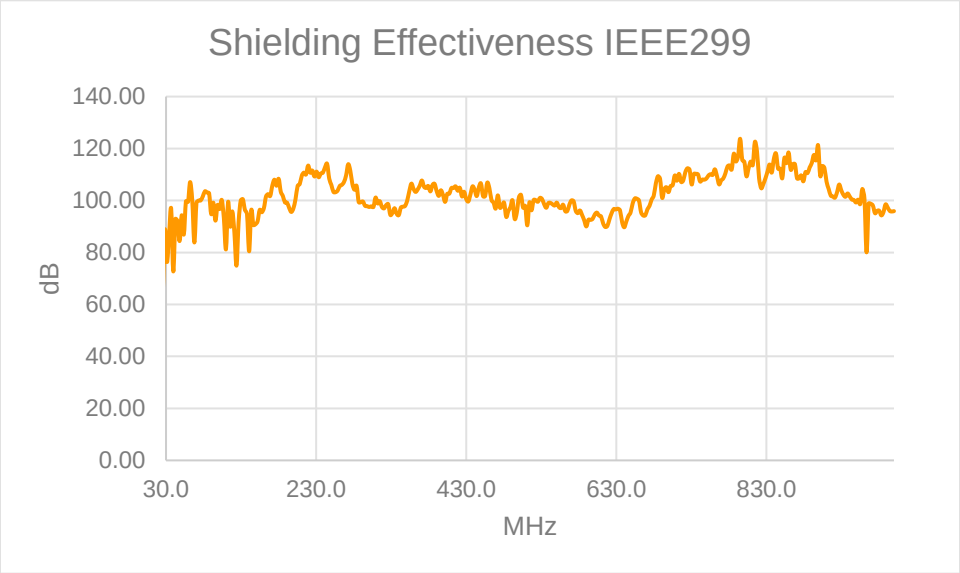
Test Position 5: 1,000 – 40,000 MHz Horizontal



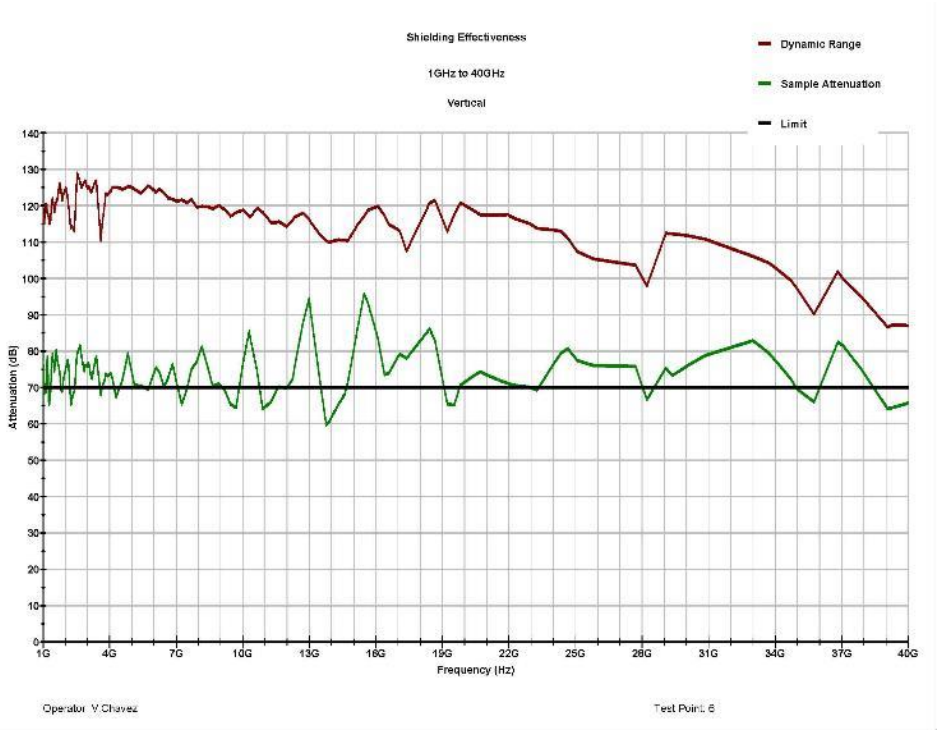
Test Position 6, 30 - 1000 MHz Vertical



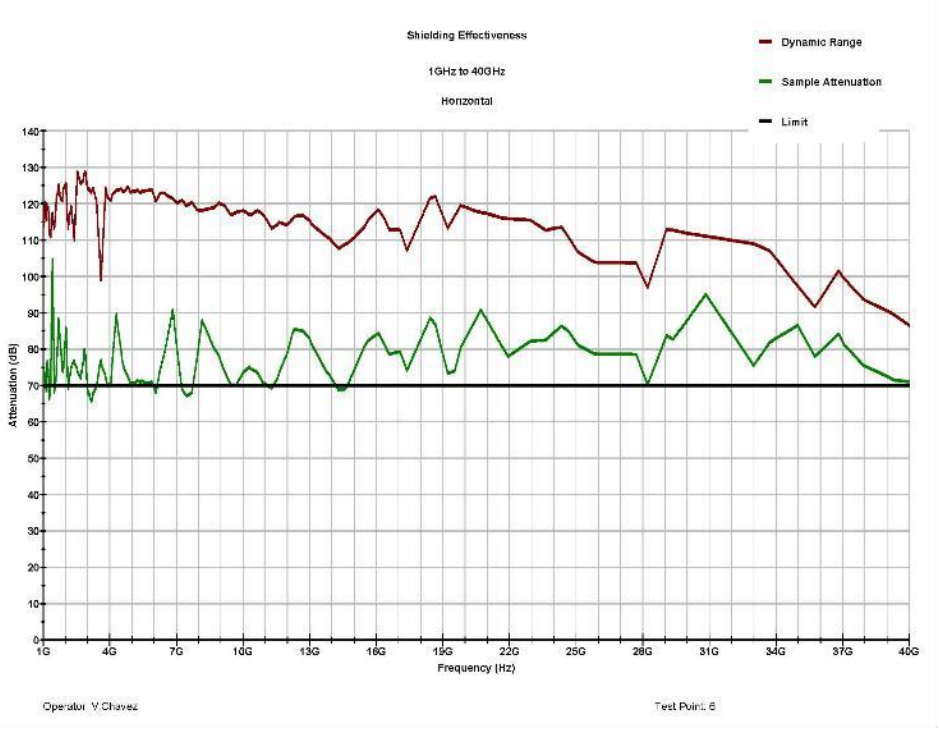
Test Position 6, 30 - 1000 MHz Horizontal



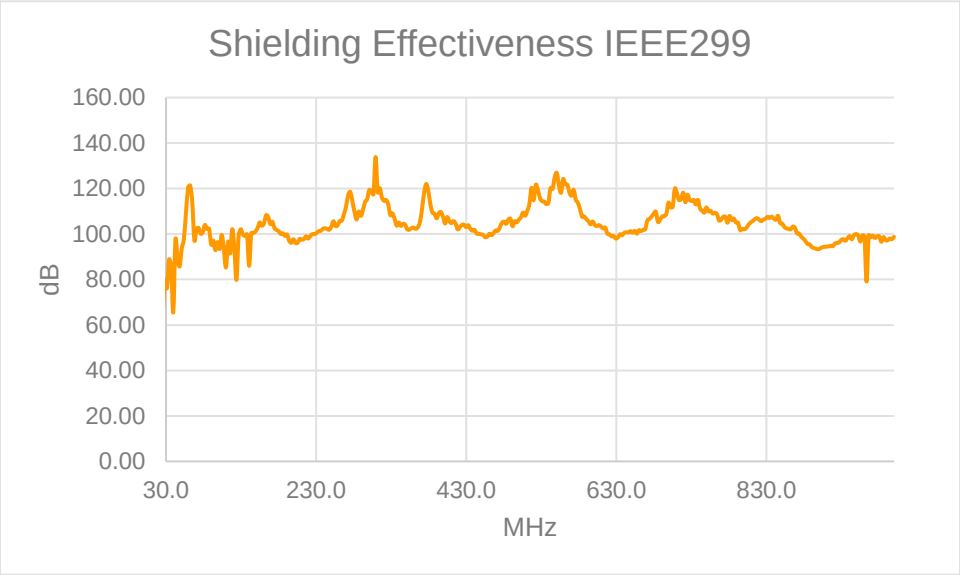
Test Position 6: 1,000 – 40,000 MHz Vertical



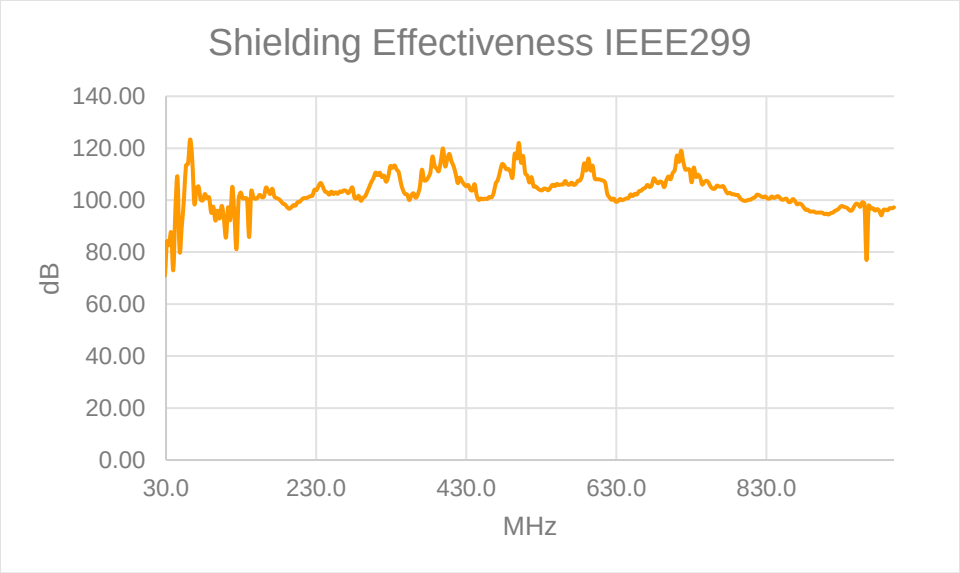
Test Position 6: 1,000 – 40,000 MHz Horizontal



Test Position 7, 30-1000 MHz Vertical



Test Position 7, 30-1000 MHz Horizontal



Test Position 7: 1,000 – 40,000 MHz Vertical

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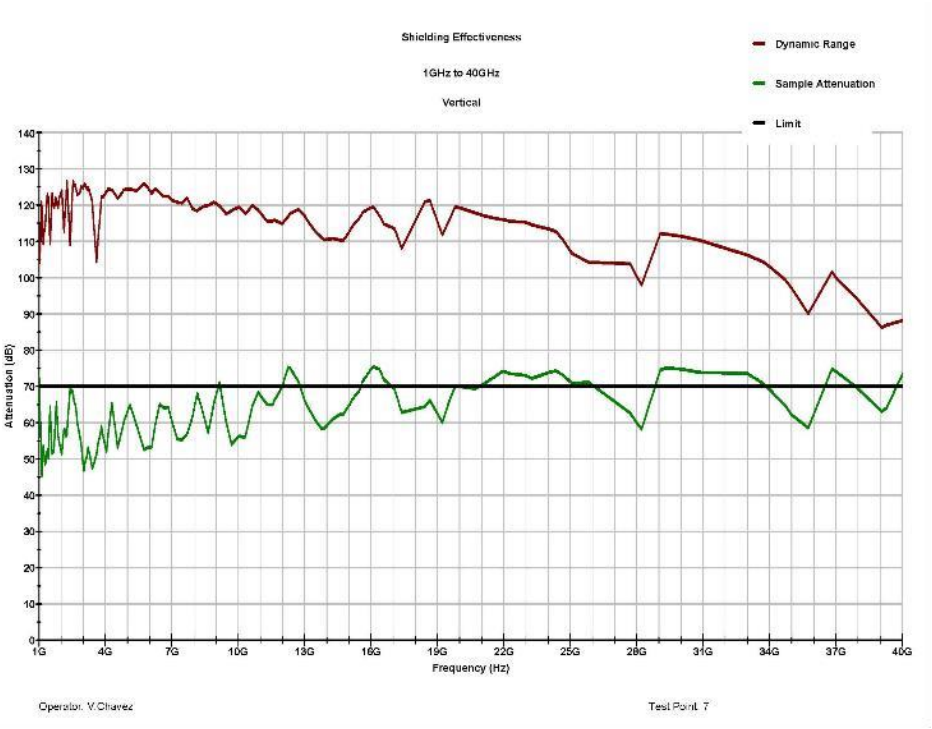
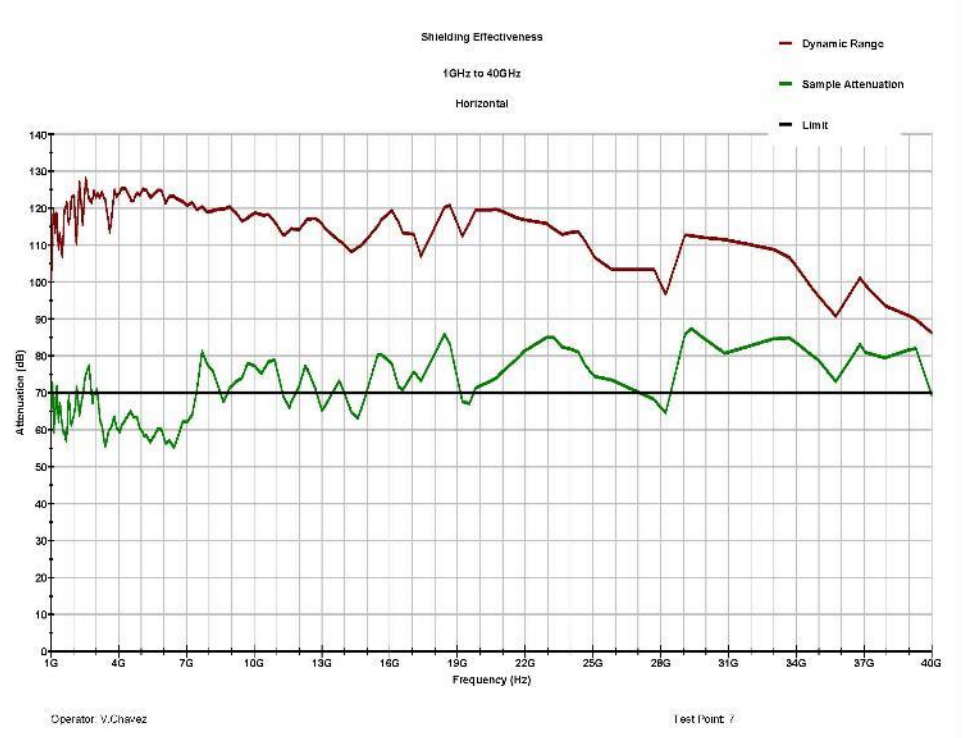
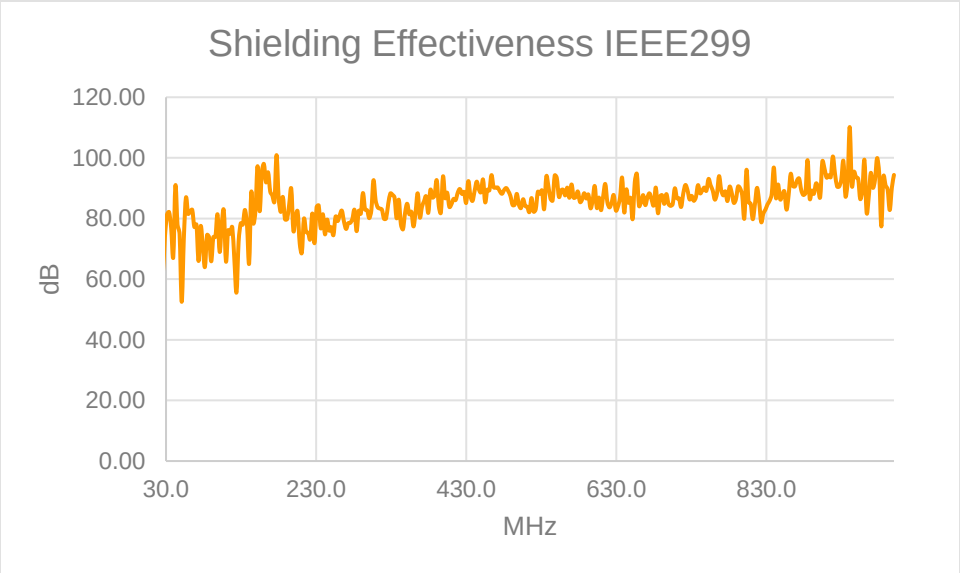


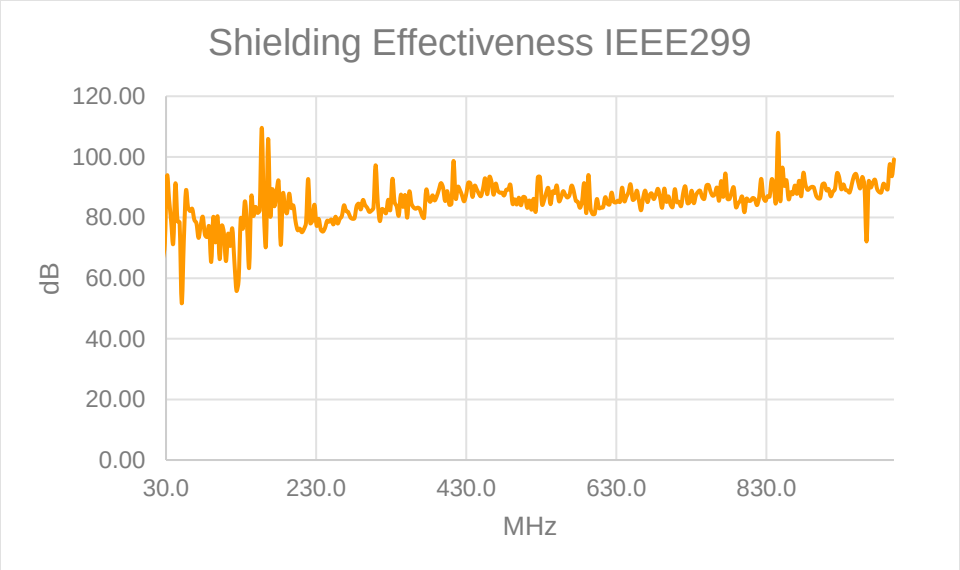
Test Position 7: 1,000 – 40,000 MHz Horizontal



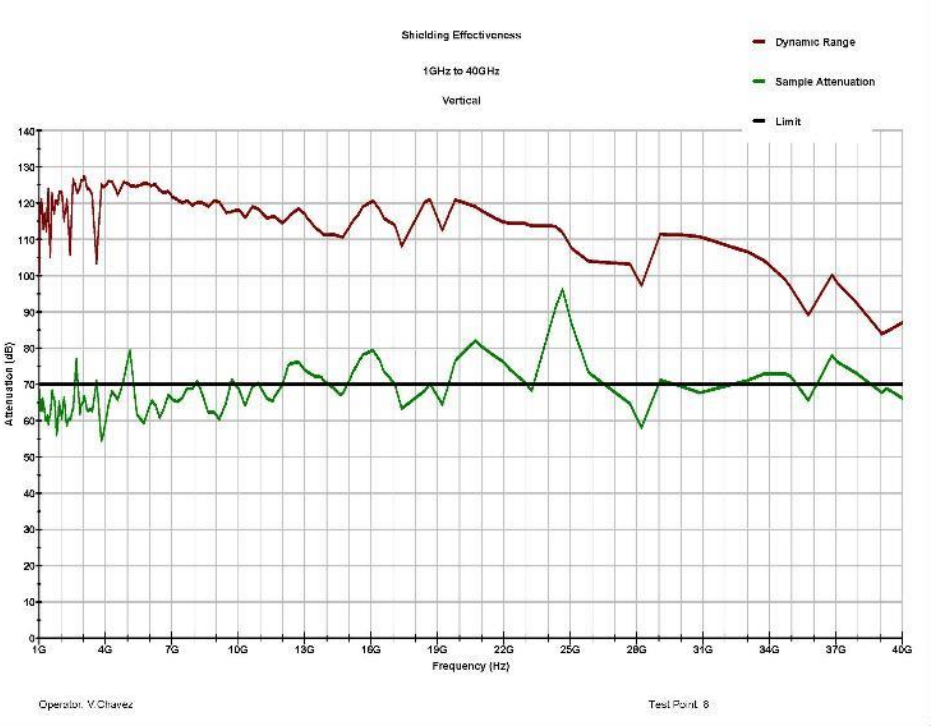
Test Position 8, 30-1000 MHz Vertical



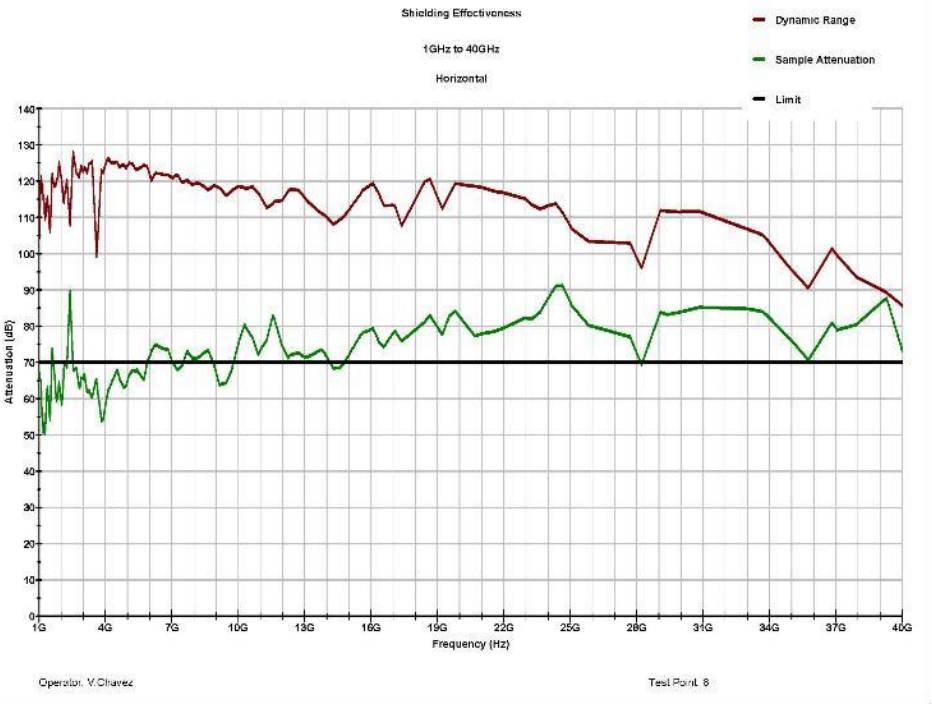
Test Position 8, 30-1000 MHz Horizontal



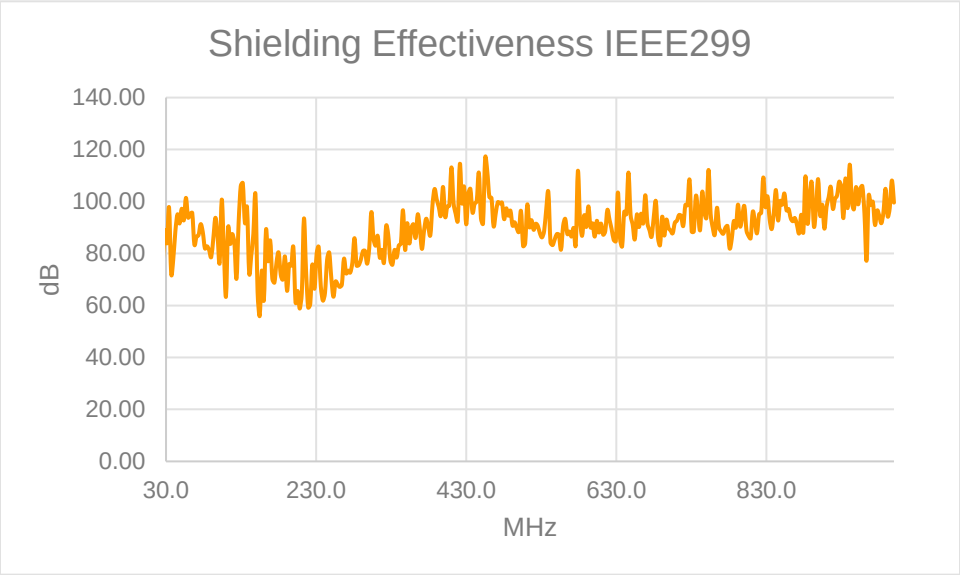
Test Position 8: 1,000 – 40,000 MHz Vertical



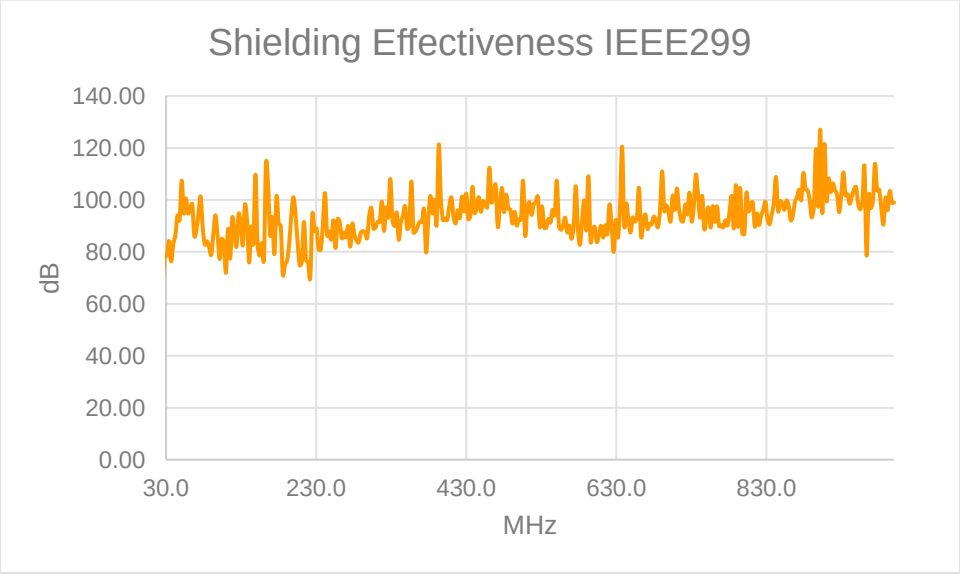
Test Position 8: 1,000 – 40,000 MHz Horizontal



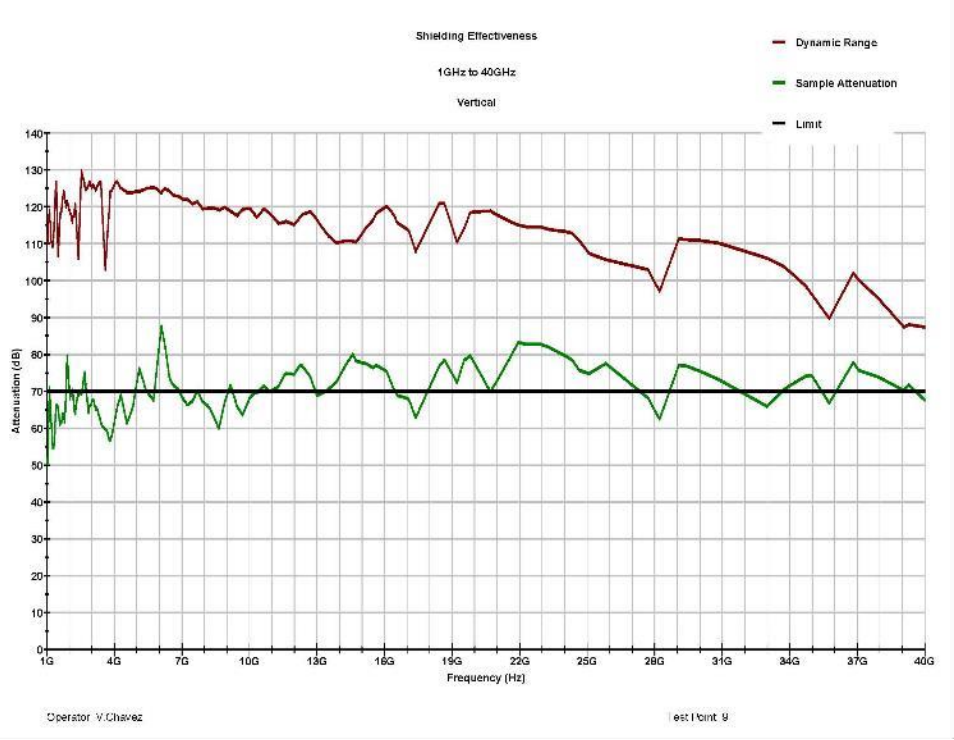
Test Position 9, 30-1000 MHz Vertical



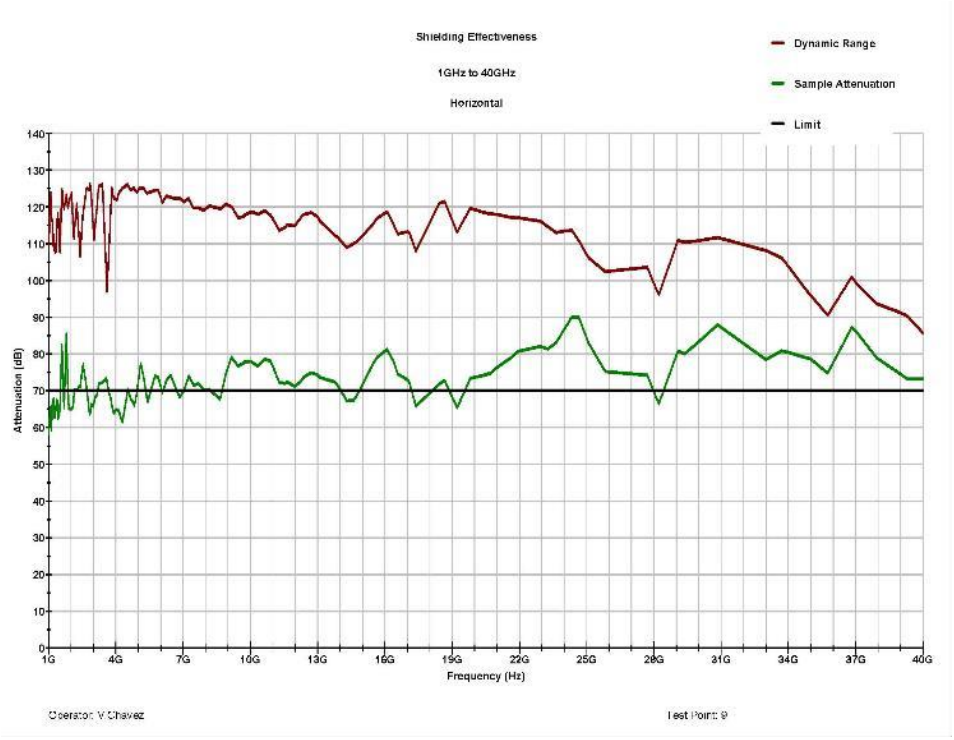
Test Position 9, 30-1000 MHz Horizontal



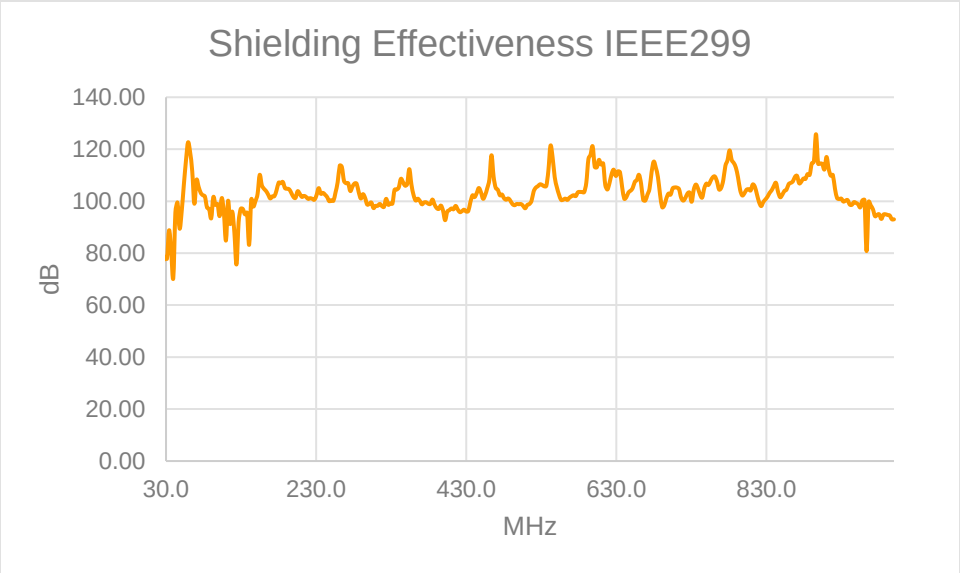
Test Position 9: 1,000 – 40,000 MHz Vertical



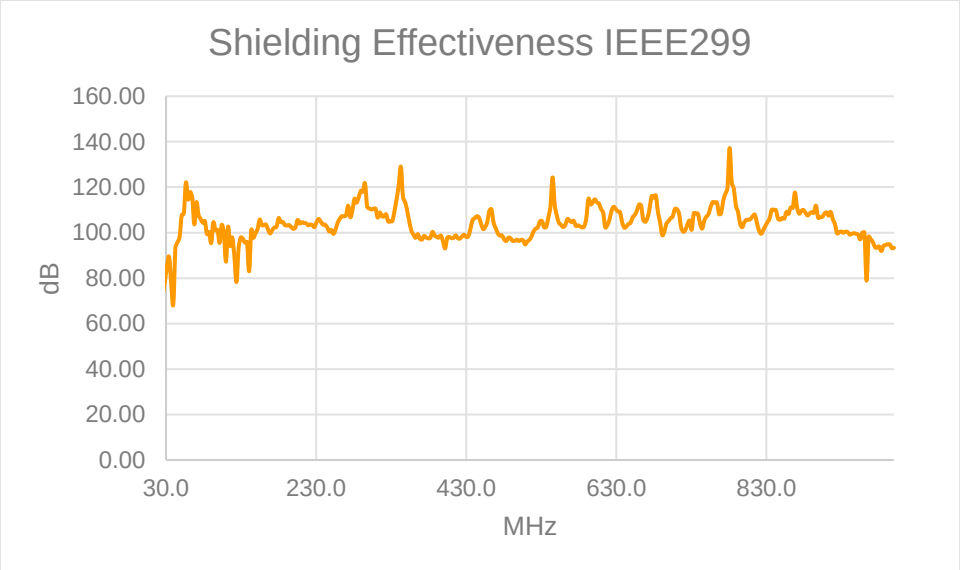
Test Position 9: 1,000 – 40,000 MHz Horizontal



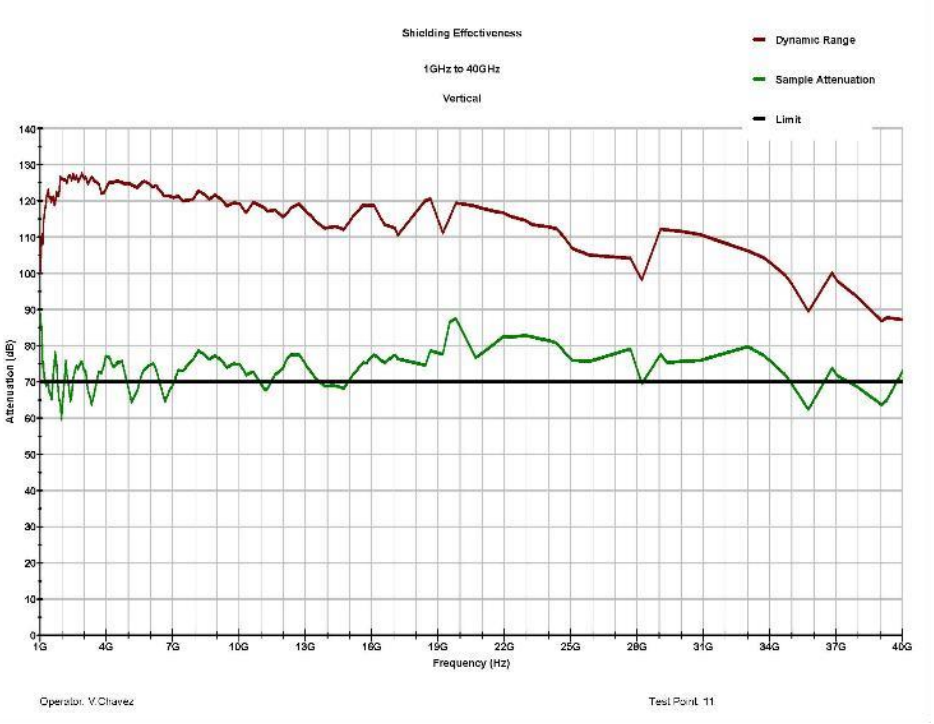
Test Position 10, 30-1000 MHz Vertical



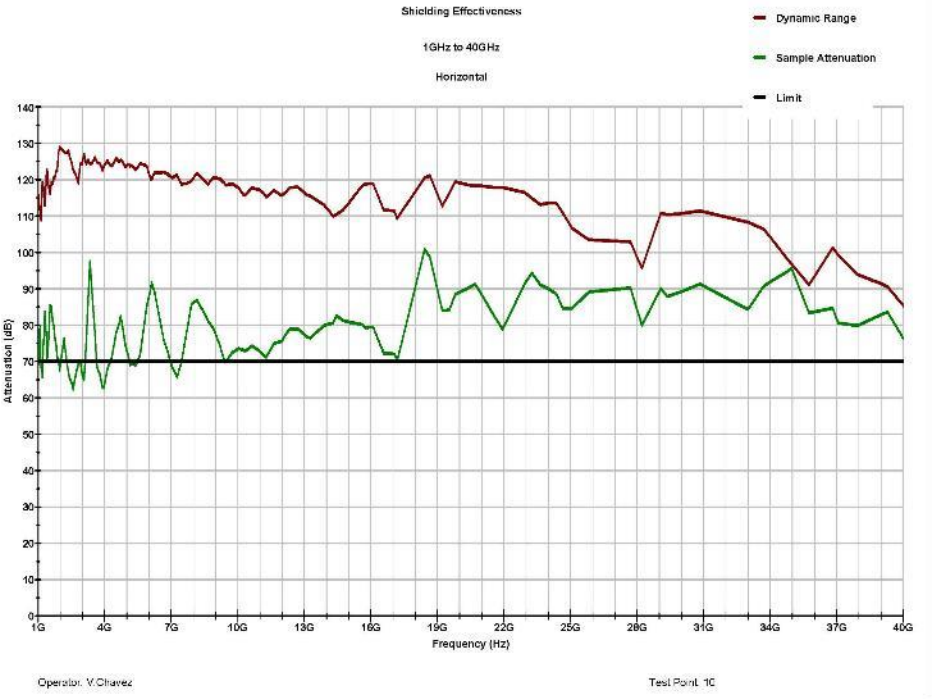
Test Position 10, 30-1000 MHz Horizontal



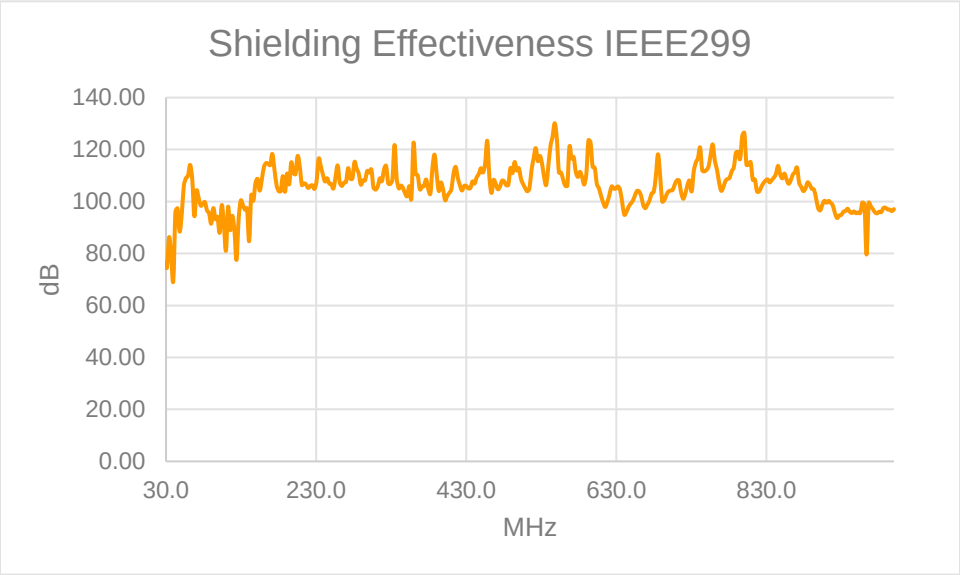
Test Position 10: 1,000 – 40,000 MHz Vertical



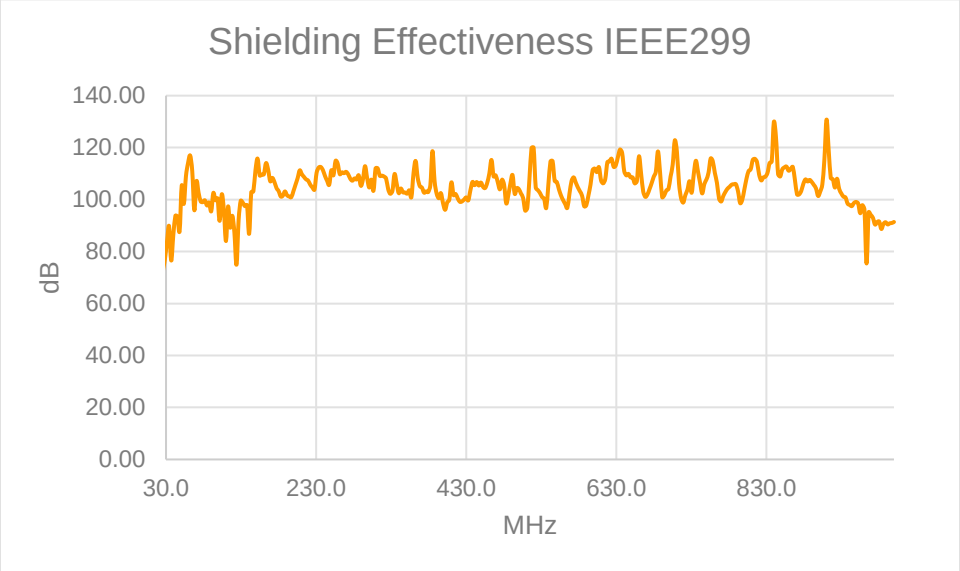
Test Position 10: 1,000 – 40,000 MHz Horizontal



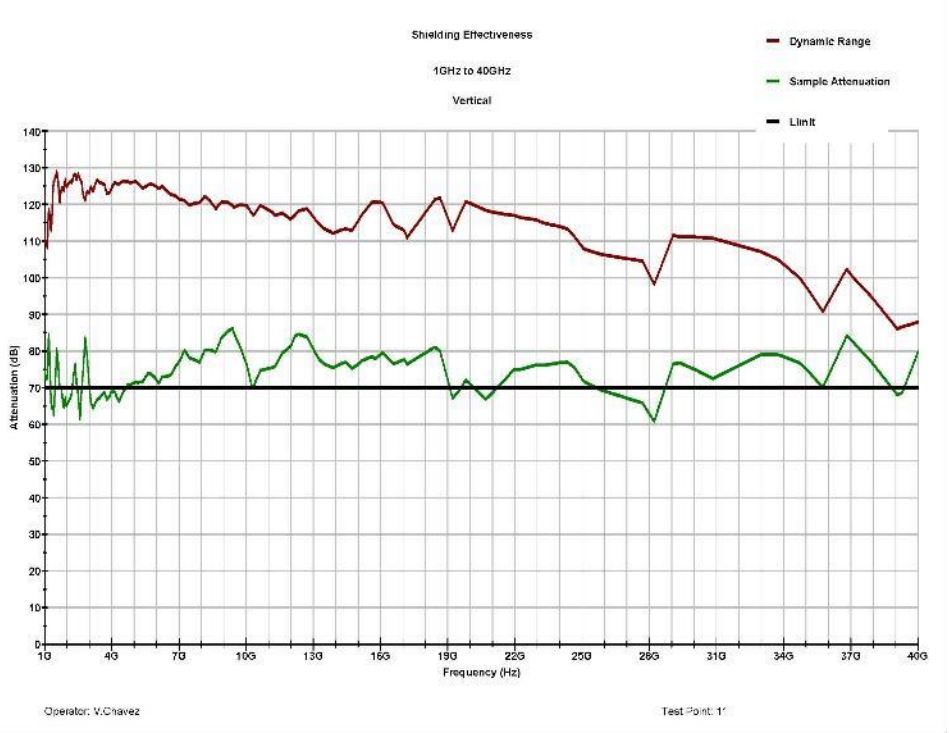
Test Position 11, 30 - 1000 MHz Vertical



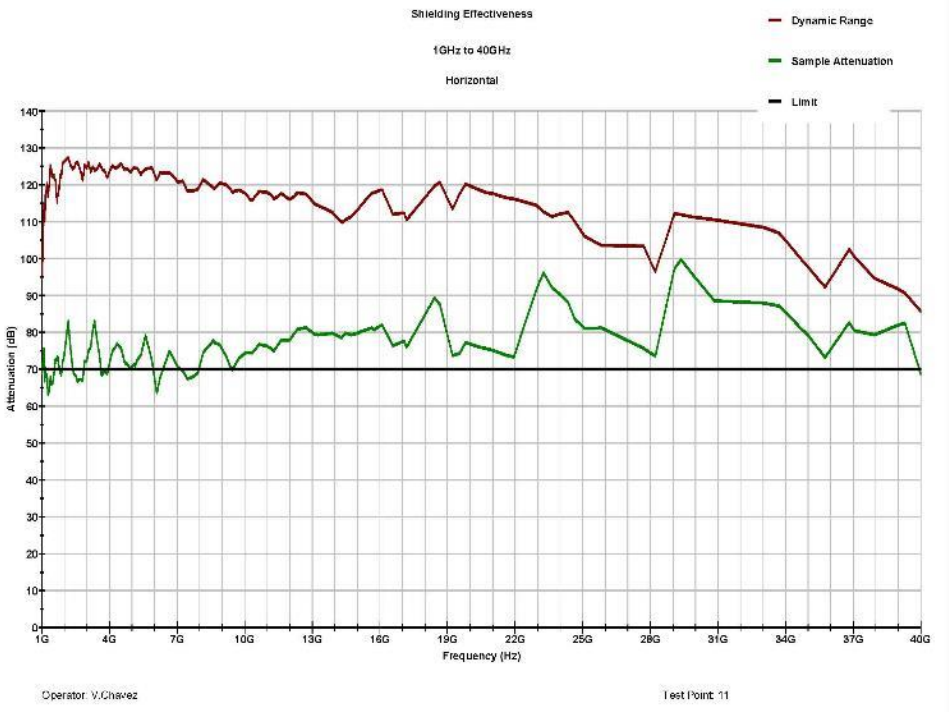
Test Position 11, 30 - 1000 MHz Horizontal



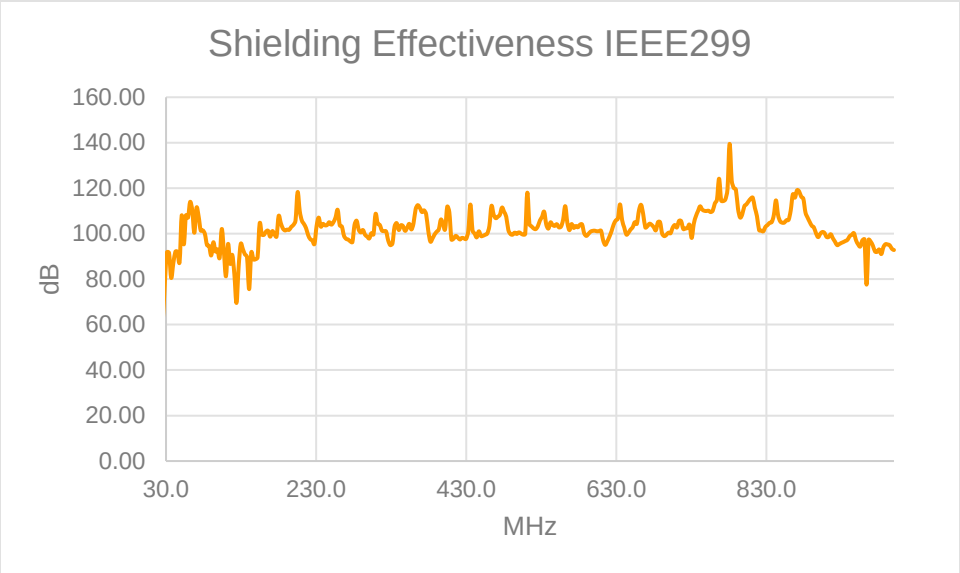
Test Position 11: 1,000 – 40,000 MHz Vertical



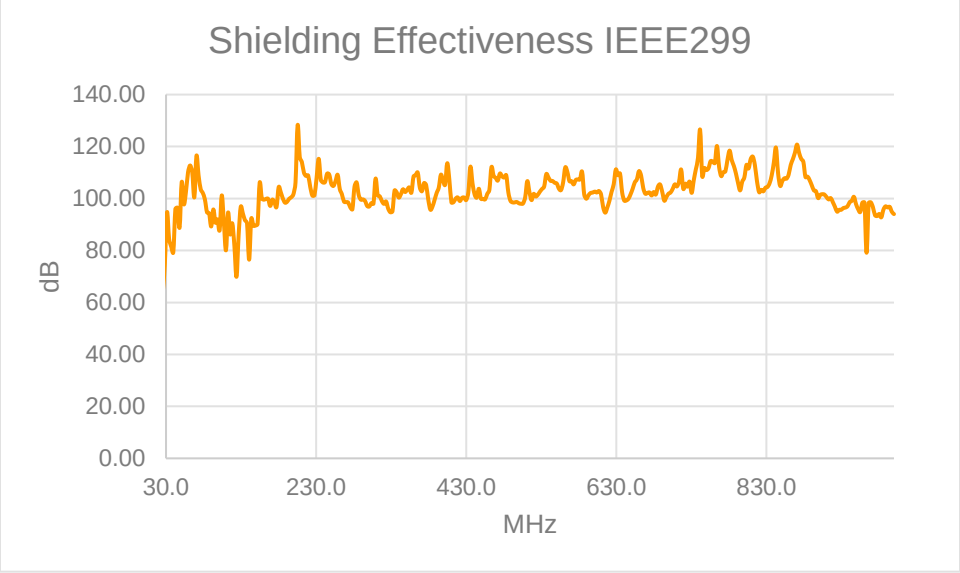
Test Position 11: 1,000 – 40,000 MHz Horizontal



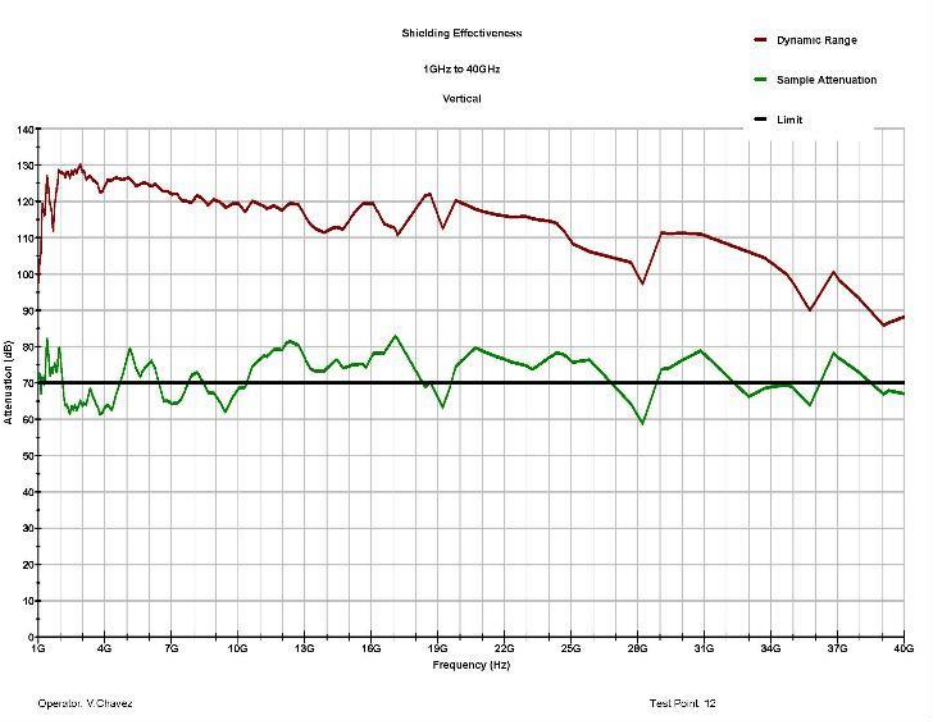
Test Position 12, 30 - 1000 MHz Vertical



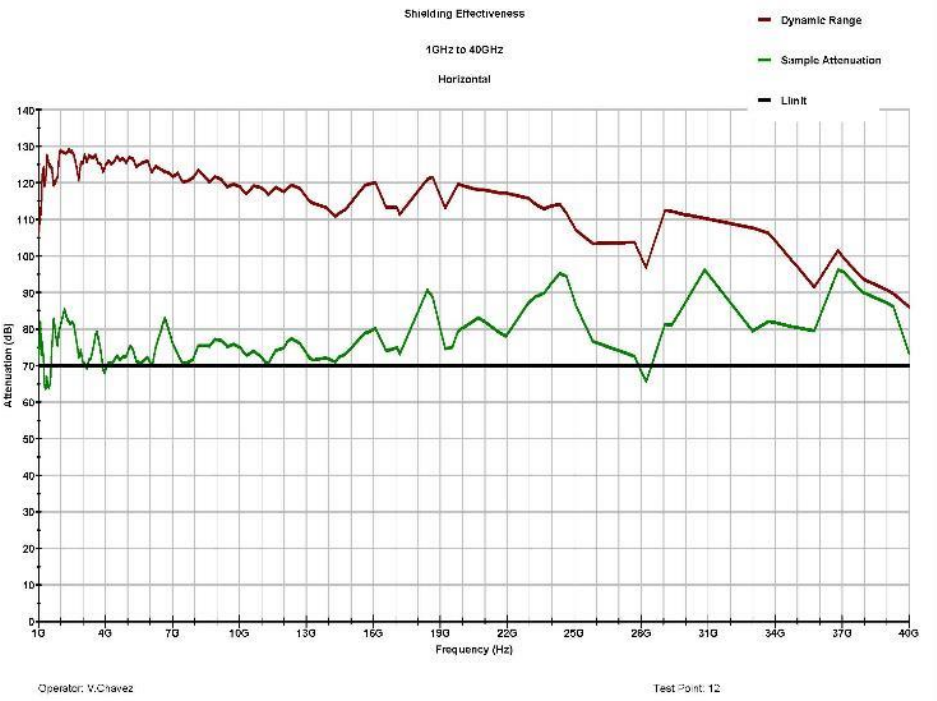
Test Position 12, 30 - 1000 MHz Horizontal



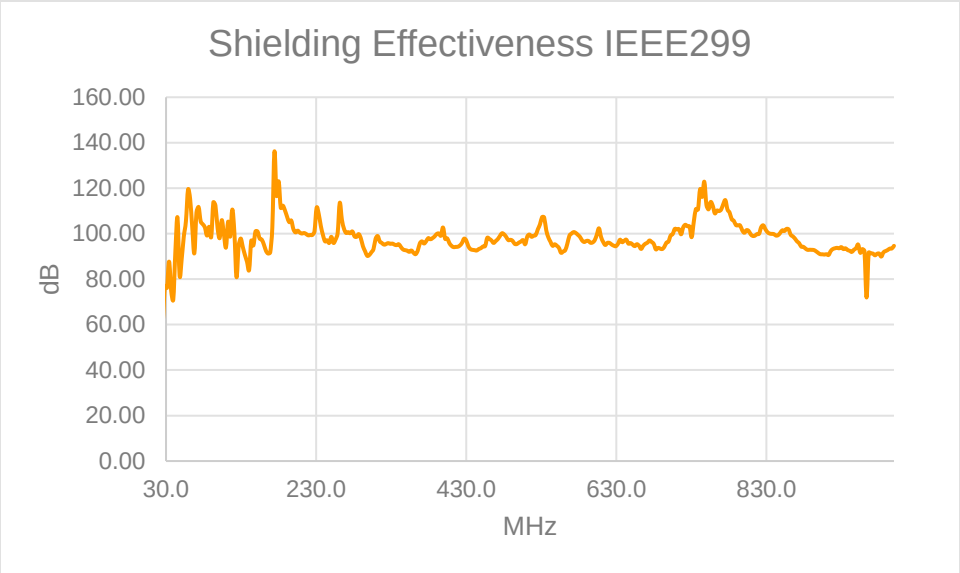
Test Position 12: 1,000 – 40,000 MHz Vertical



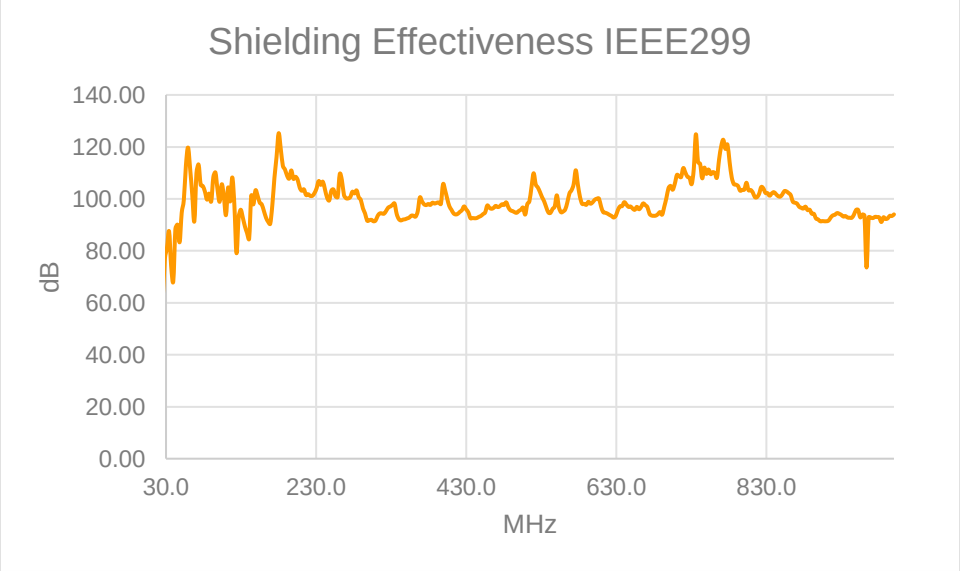
Test Position 12: 1,000 – 40,000 MHz Horizontal



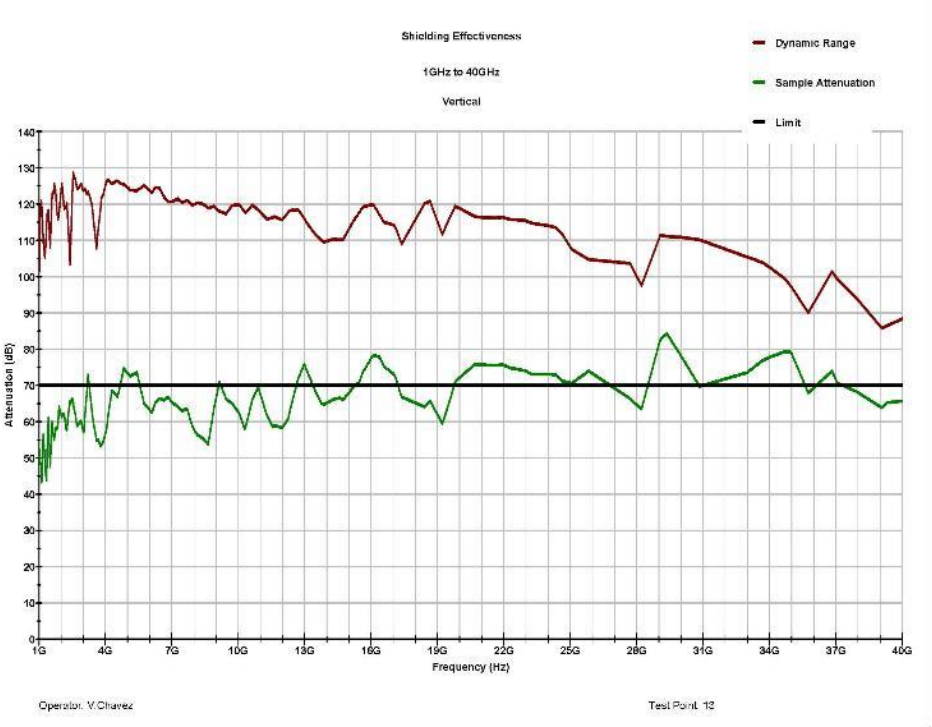
Test Position 13, 30 - 1000 MHz Vertical



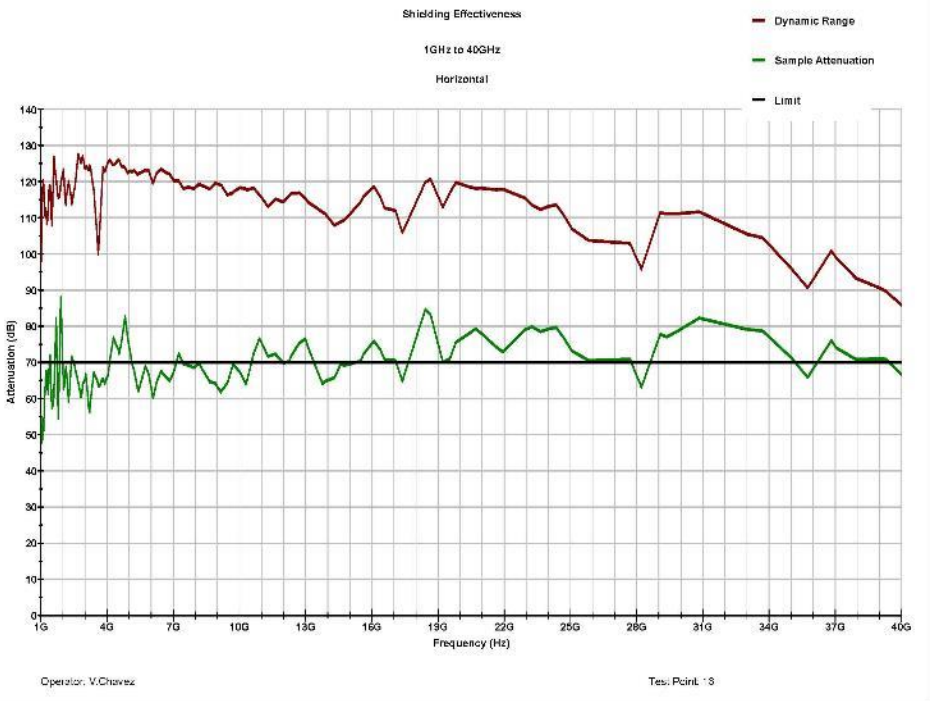
Test Position 13, 30 - 1000 MHz Horizontal



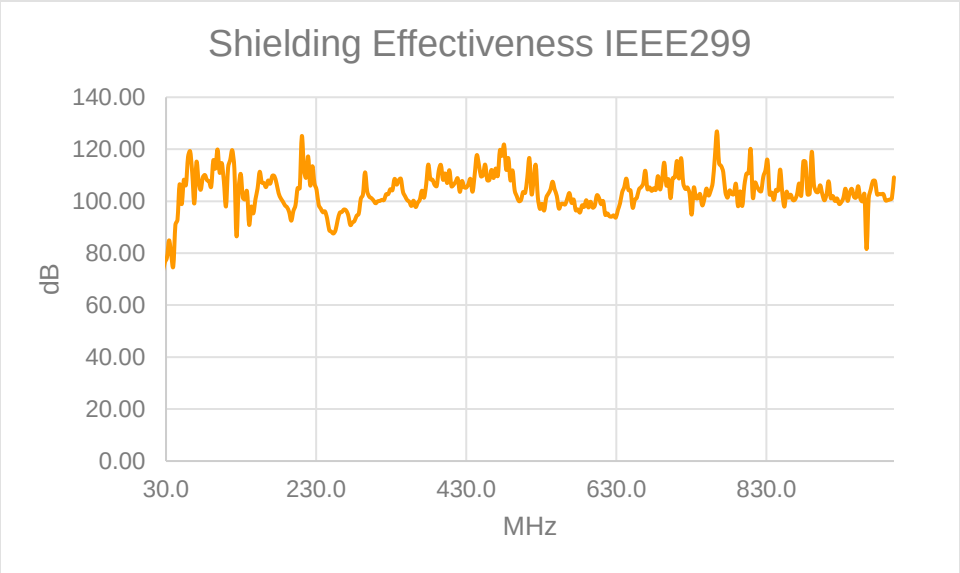
Test Position 13: 1,000 – 40,000 MHz Vertical



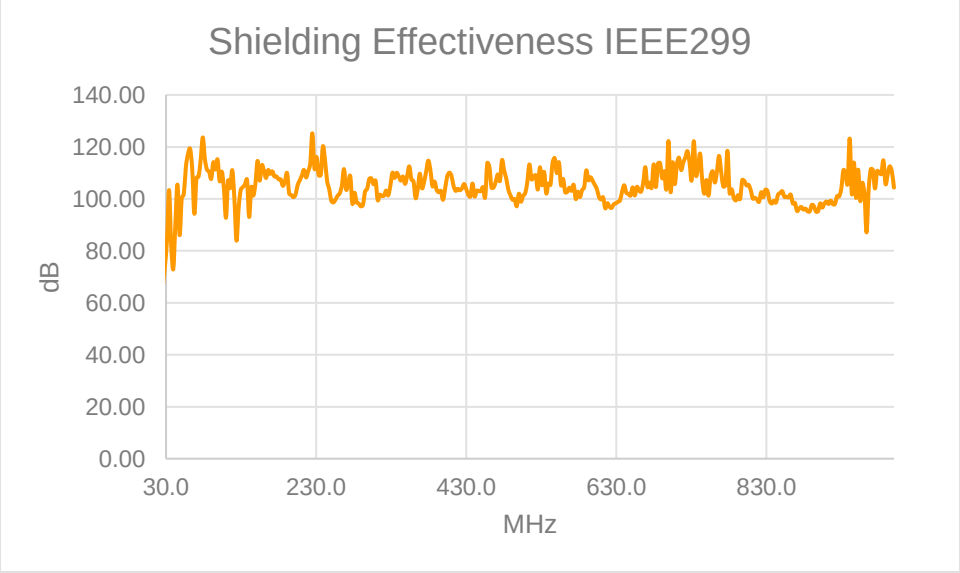
Test Position 13: 1,000 – 40,000 MHz Horizontal



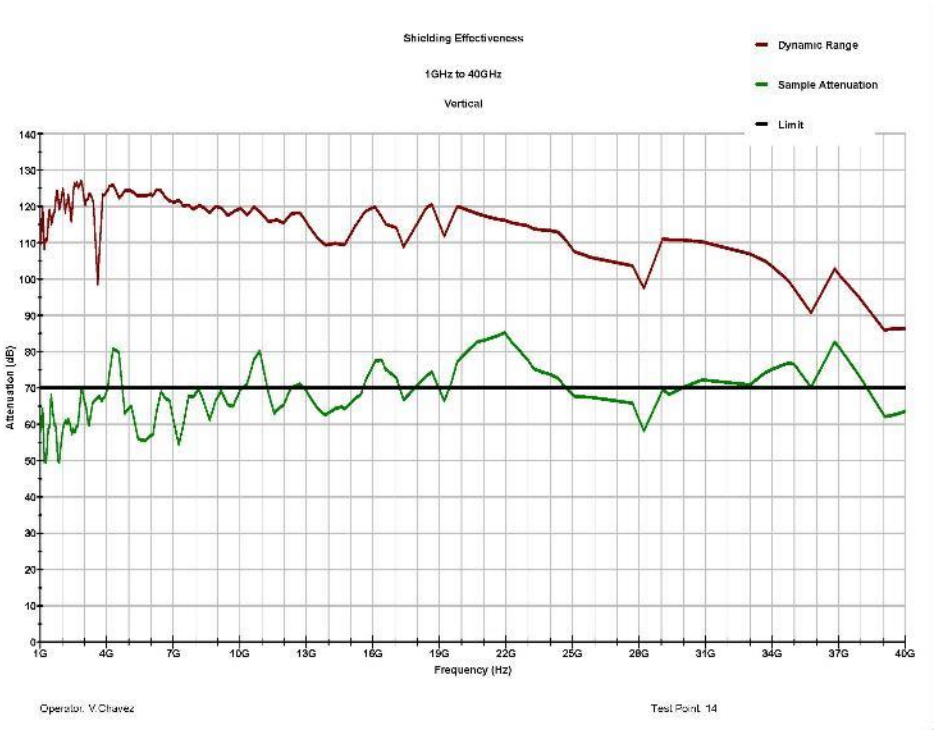
Test Position 14, 30 - 1000 MHz Vertical



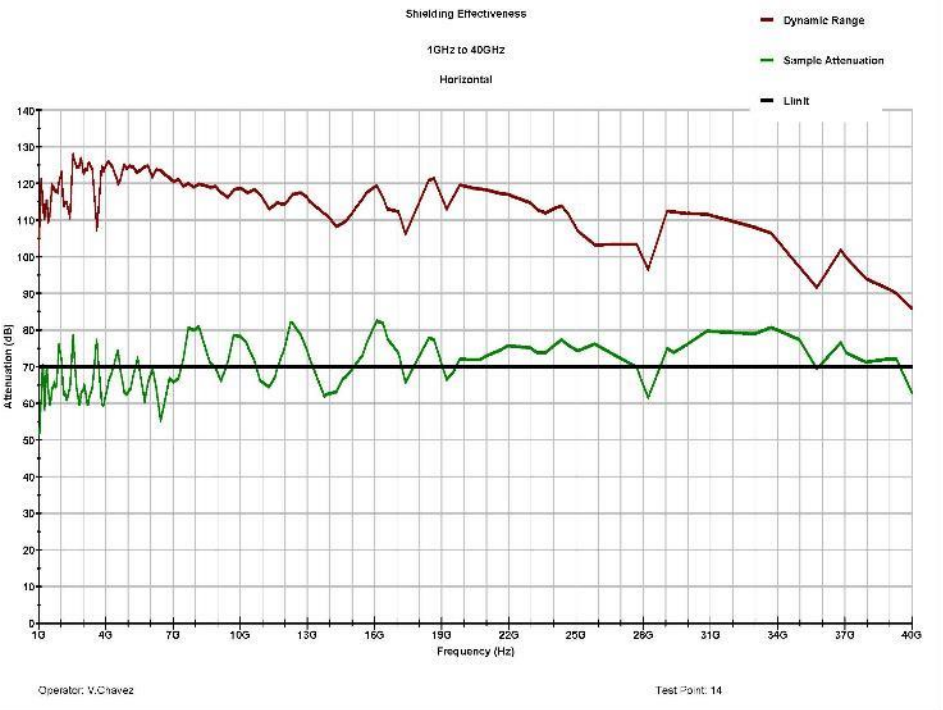
Test Position 14, 30 - 1000 MHz Horizontal



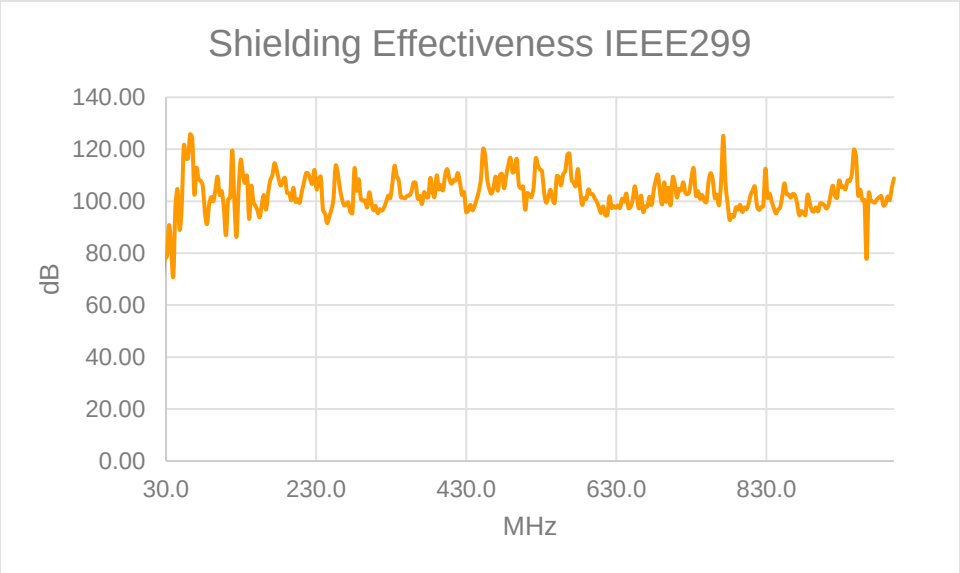
Test Position 14: 1,000 – 40,000 MHz Vertical



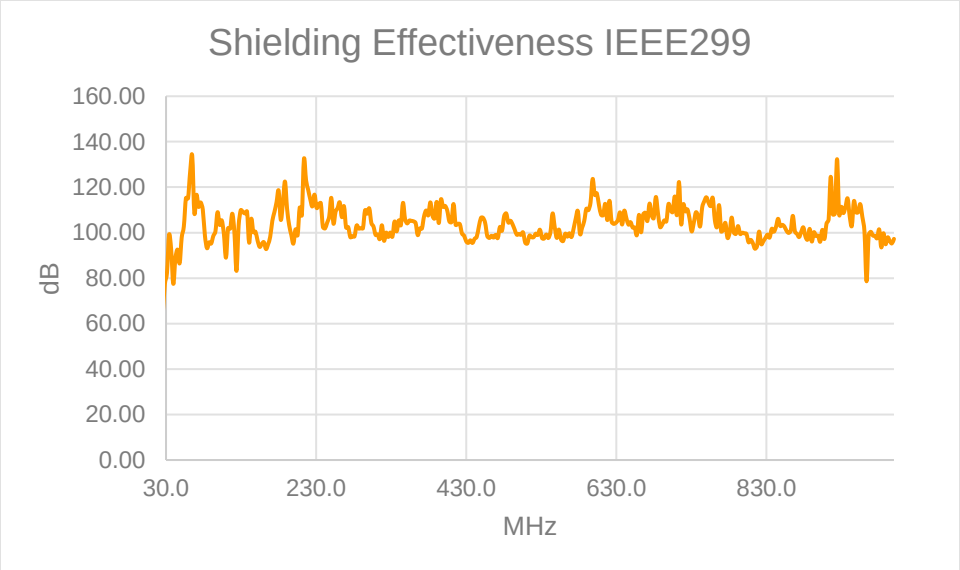
Test Position 14: 1,000 – 40,000 MHz Horizontal



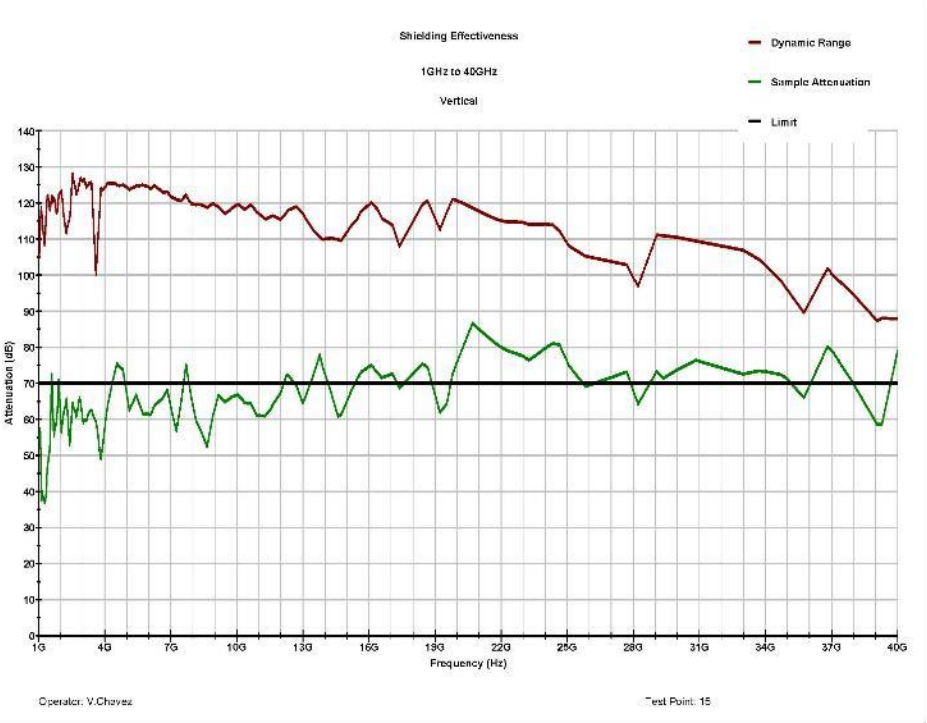
Test Position 15, 30 - 1000 MHz Vertical



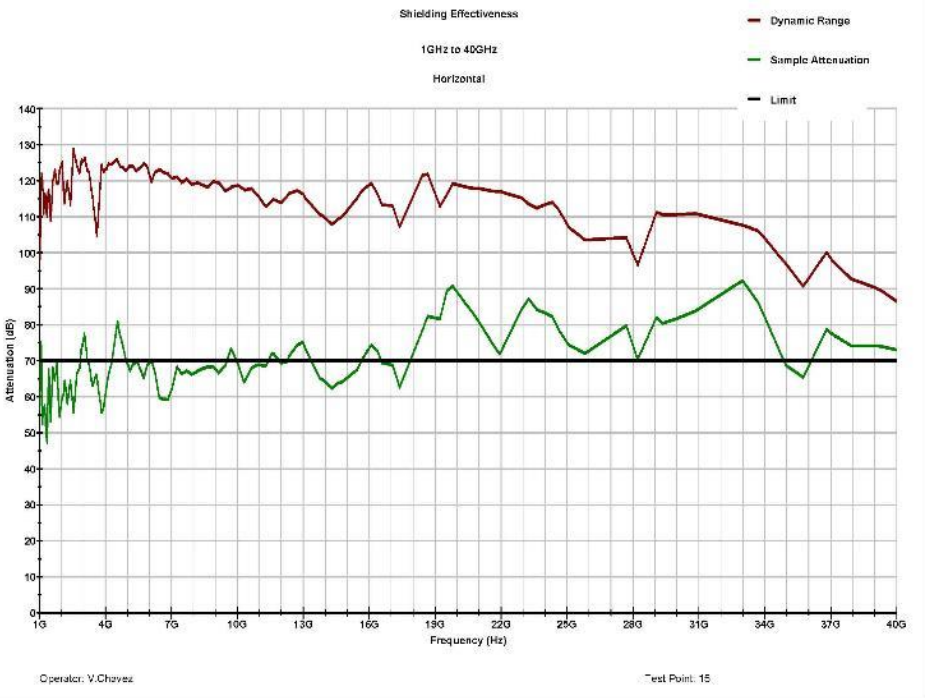
Test Position 15, 30 - 1000 MHz Horizontal



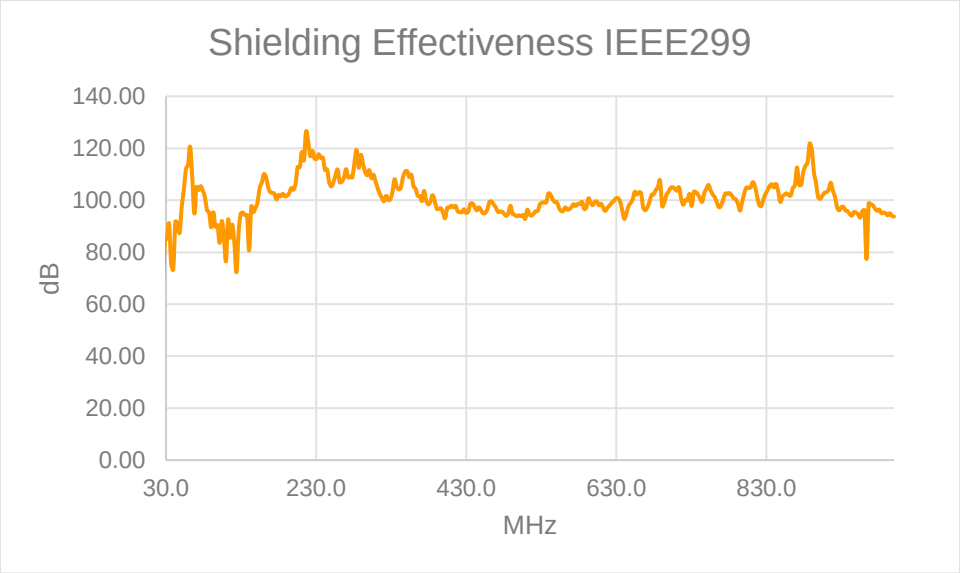
Test Position 15: 1,000 – 40,000 MHz Vertical



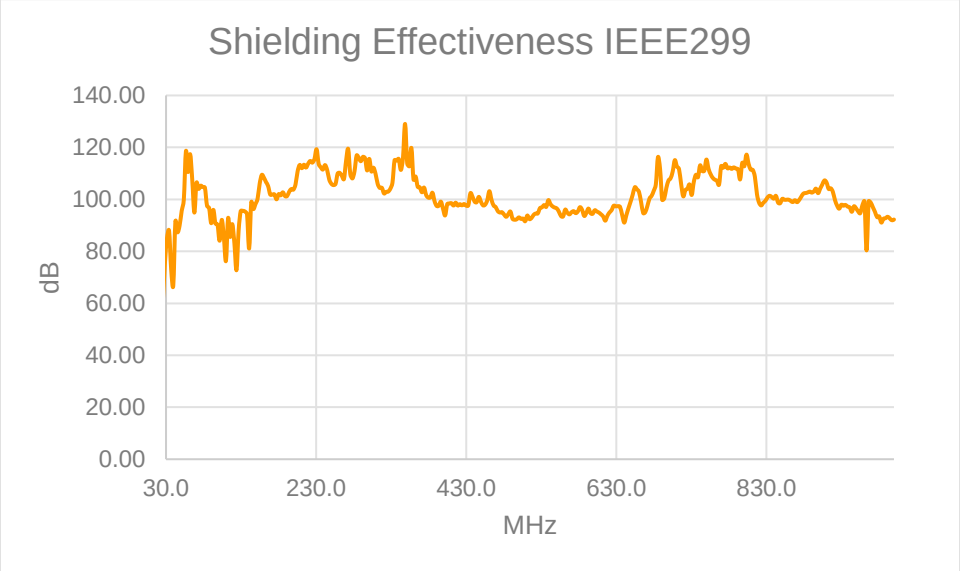
Test Position 15: 1,000 – 40,000 MHz Horizontal



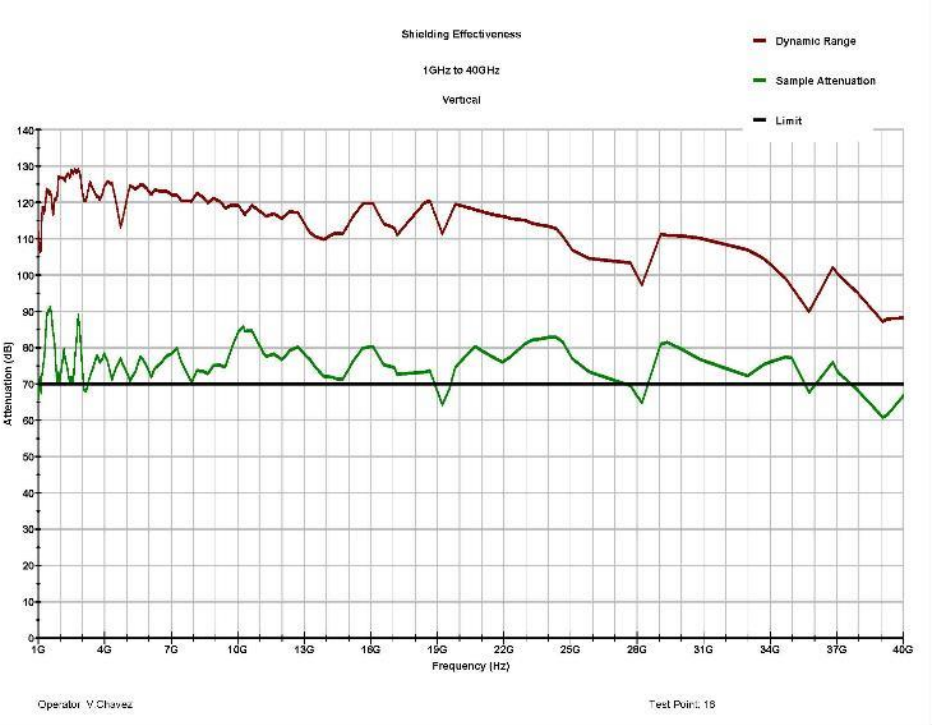
Test Position 16, 30 - 1000 MHz Vertical



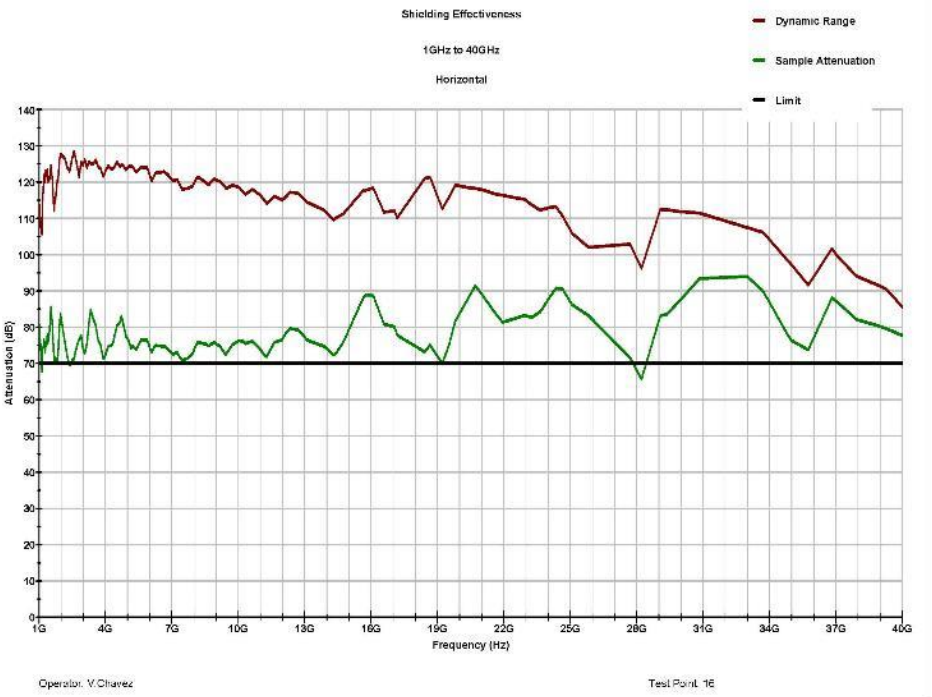
Test Position 16, 30 - 1000 MHz Horizontal



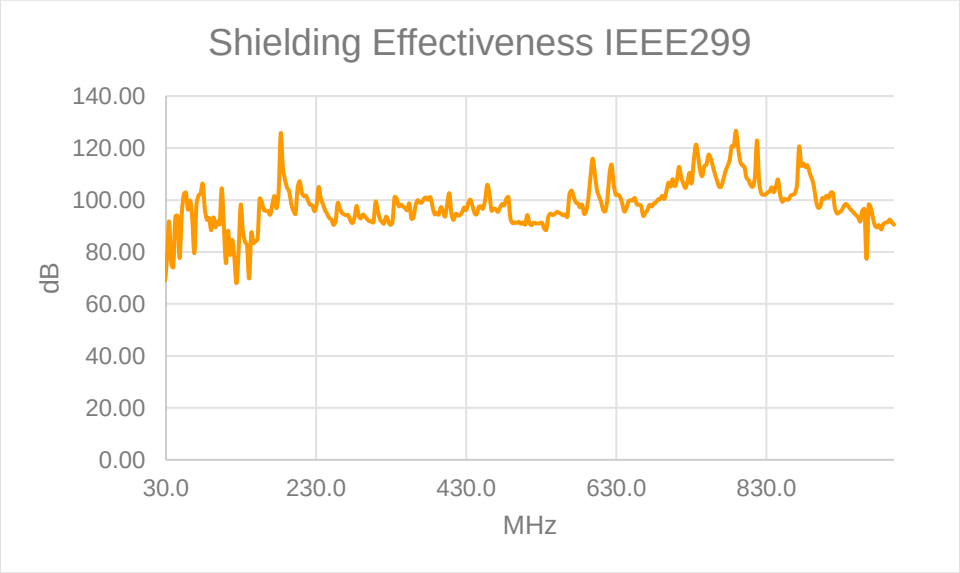
Test Position 16: 1,000 – 40,000 MHz Vertical



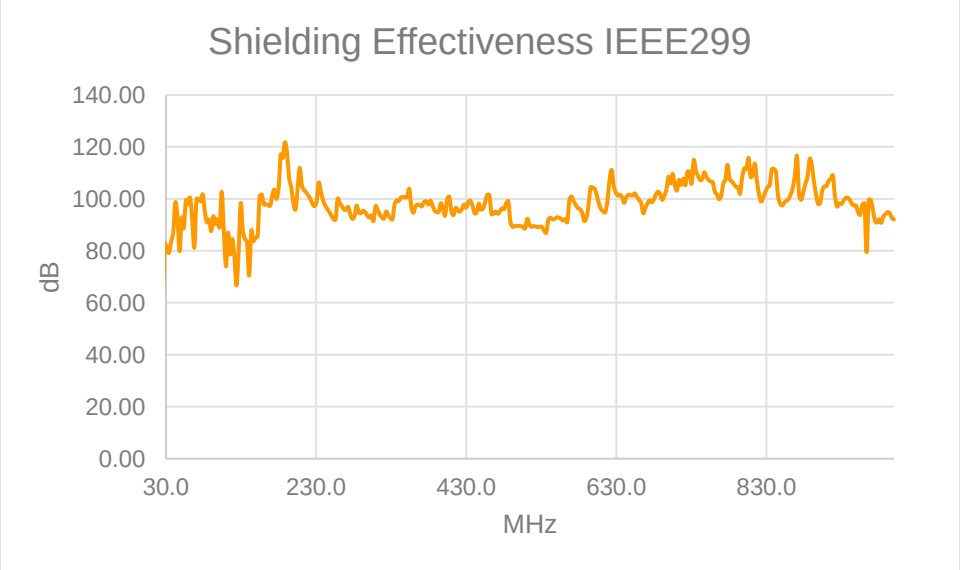
Test Position 16: 1,000 – 40,000 MHz Horizontal



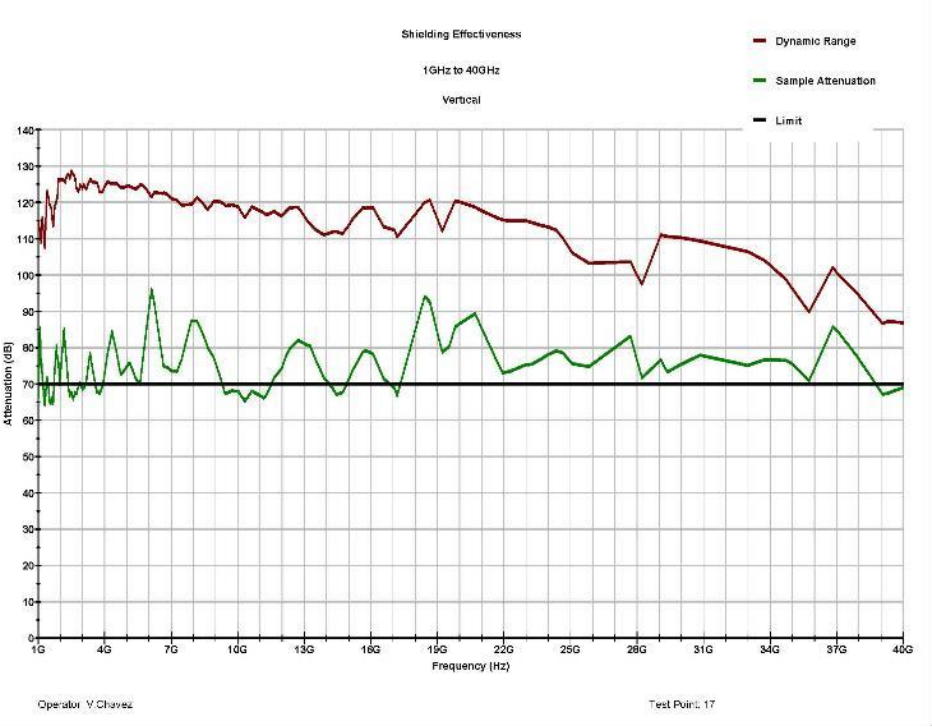
Test Position 17, 30 - 1000 MHz Vertical



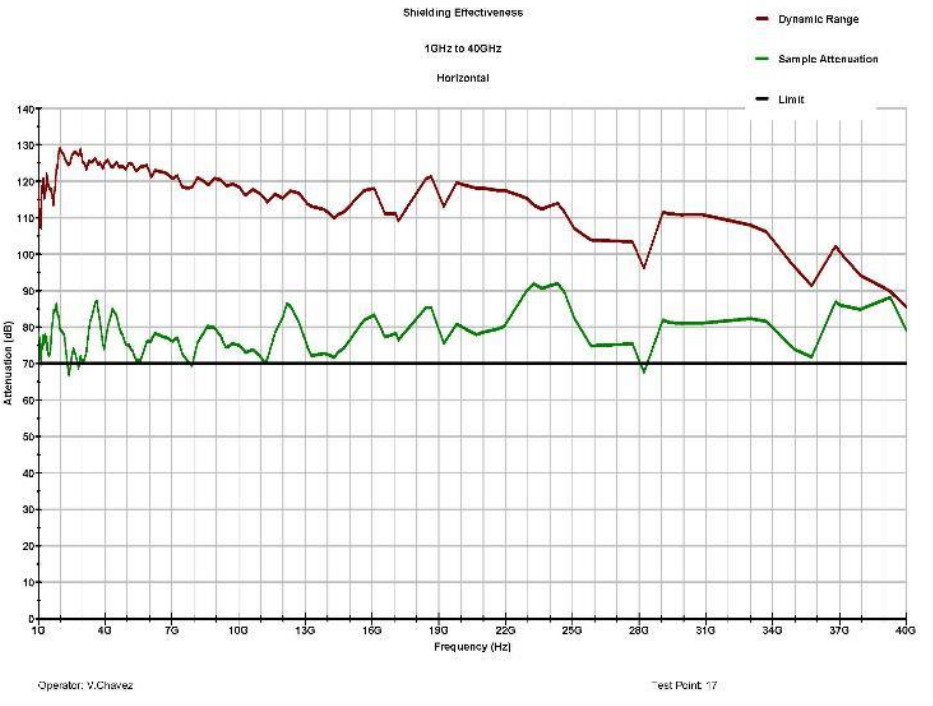
Test Position 17, 30 - 1000 MHz Horizontal



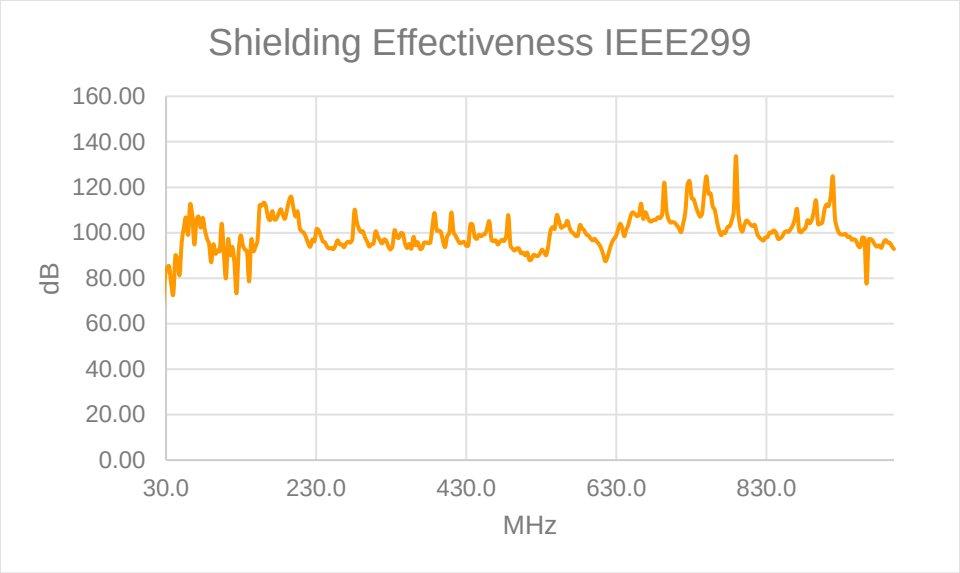
Test Position 17: 1,000 – 40,000 MHz Vertical



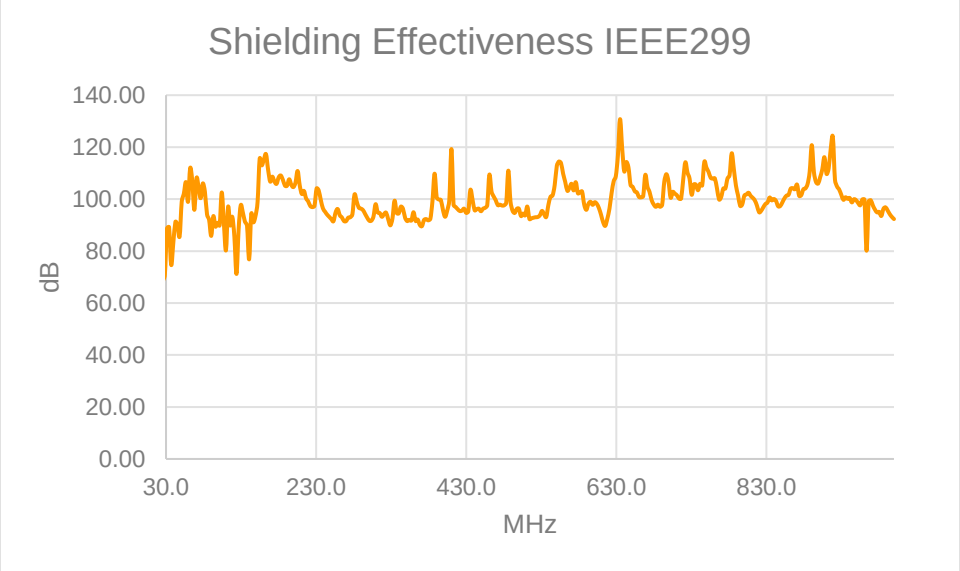
Test Position 17: 1,000 – 40,000 MHz Horizontal



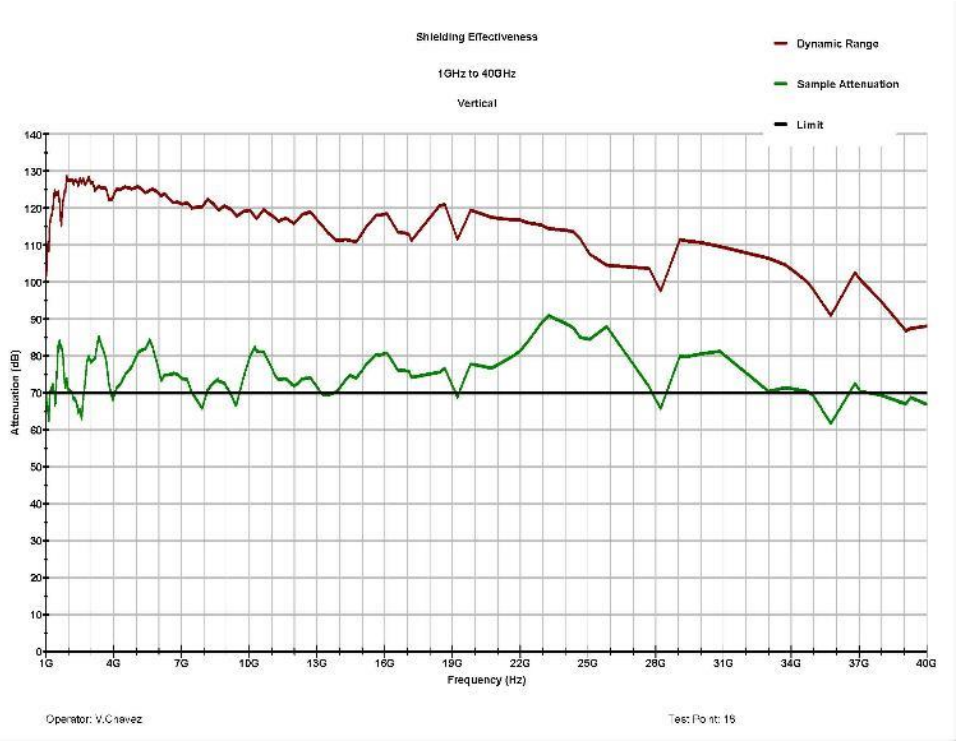
Test Position 18, 30 - 1000 MHz Vertical



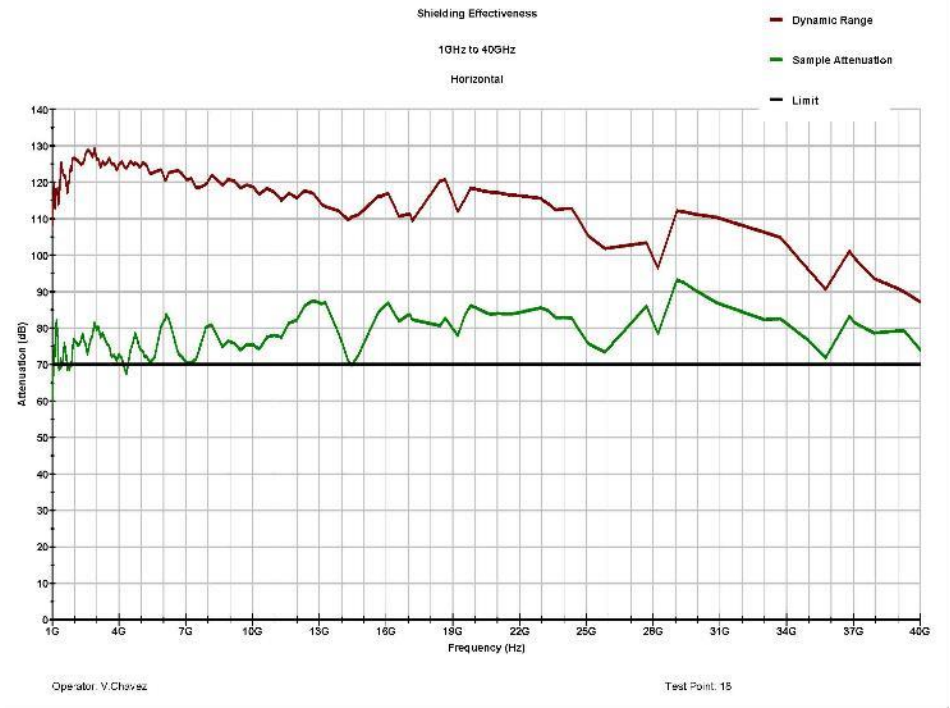
Test Position 18, 30 - 1000 MHz Horizontal



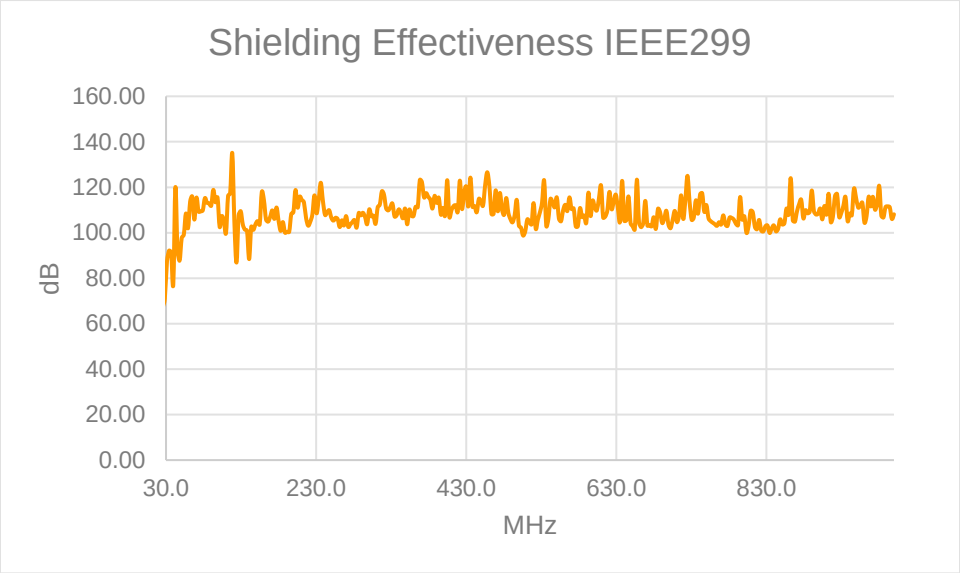
Test Position 18: 1,000 – 40,000 MHz Vertical



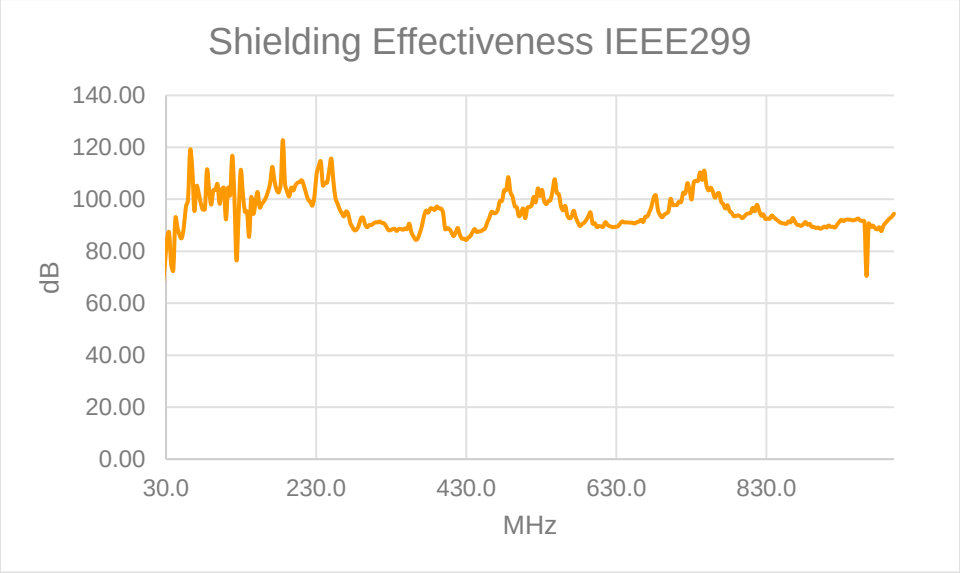
Test Position 18: 1,000 – 40,000 MHz Horizontal



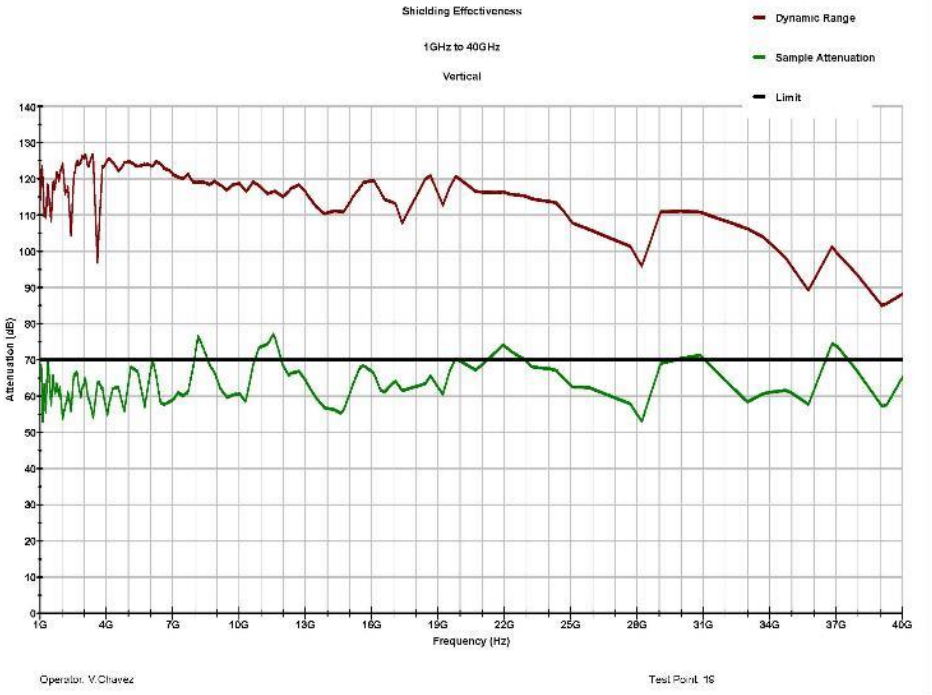
Test Position 19, 30 - 1000 MHz Vertical



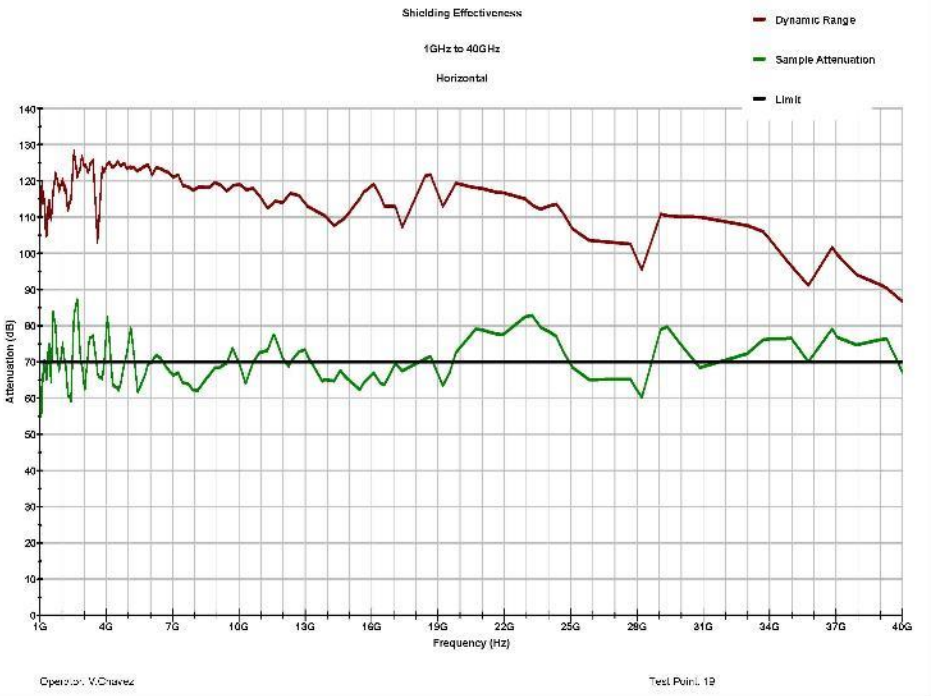
Test Position 19, 30 - 1000 MHz Horizontal



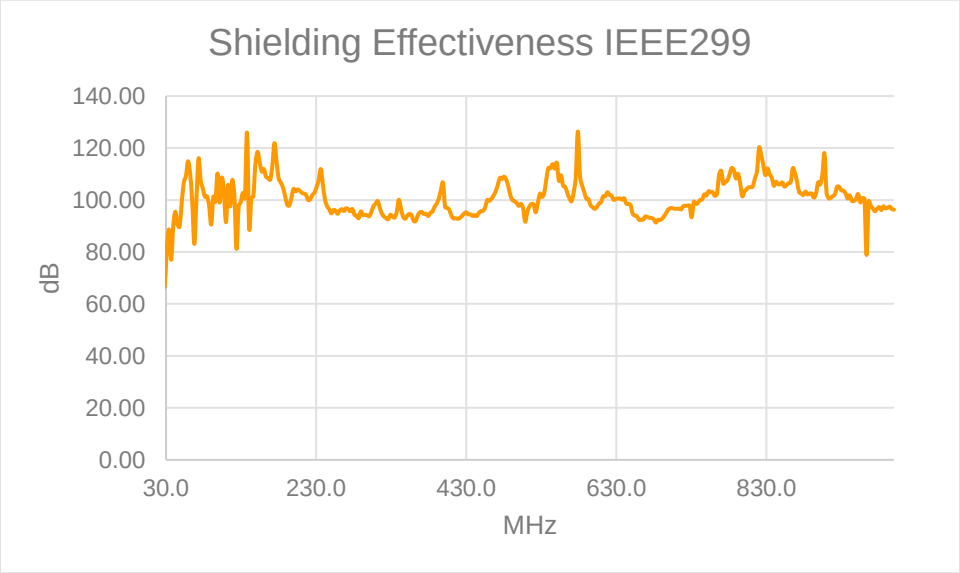
Test Position 19: 1,000 – 40,000 MHz Vertical



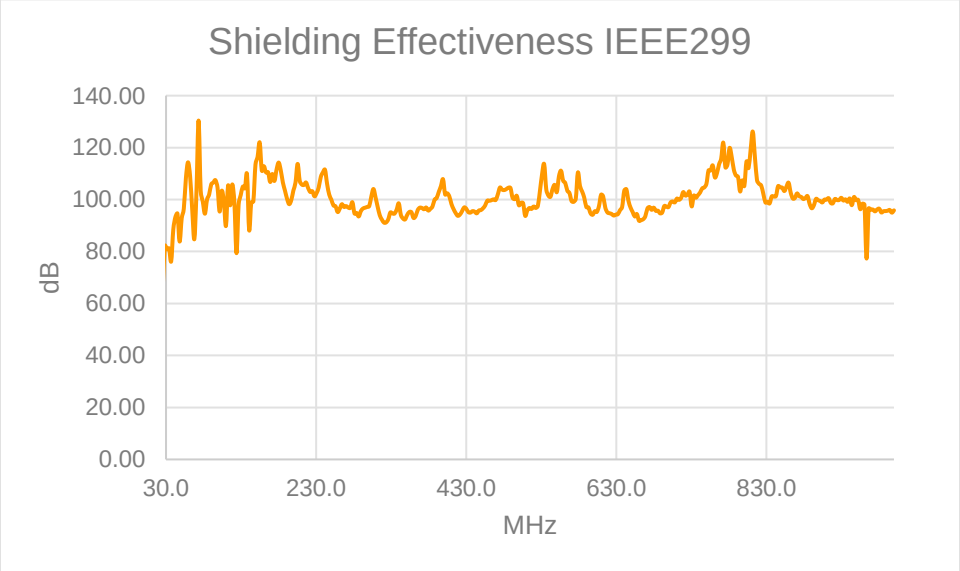
Test Position 19: 1,000 – 40,000 MHz Horizontal



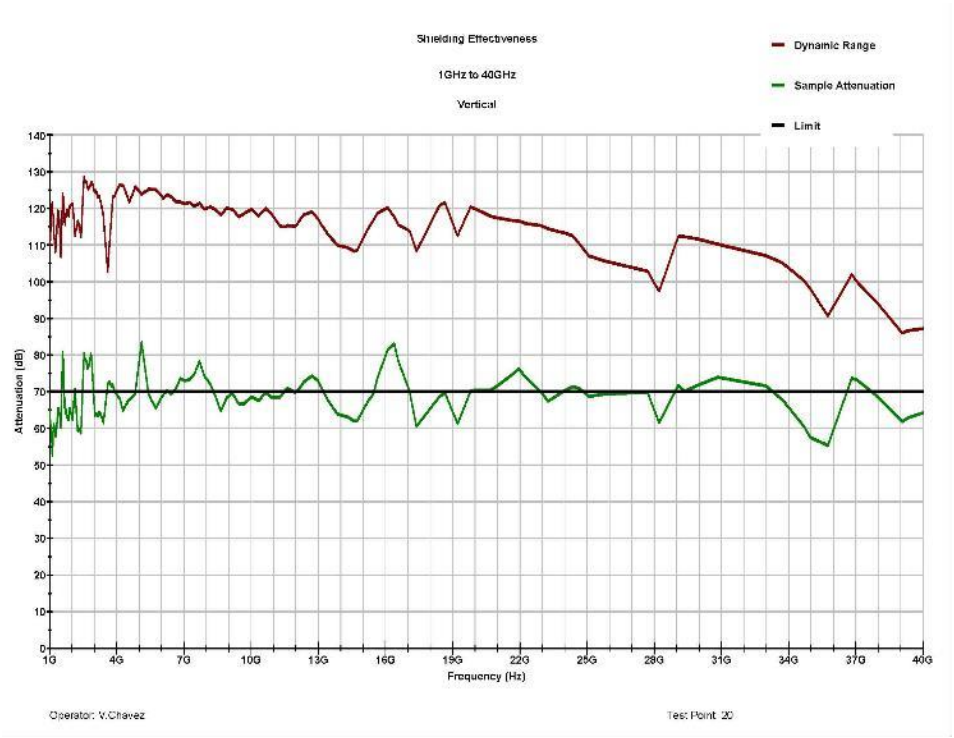
Test Position 20, 30 - 1000 MHz Vertical



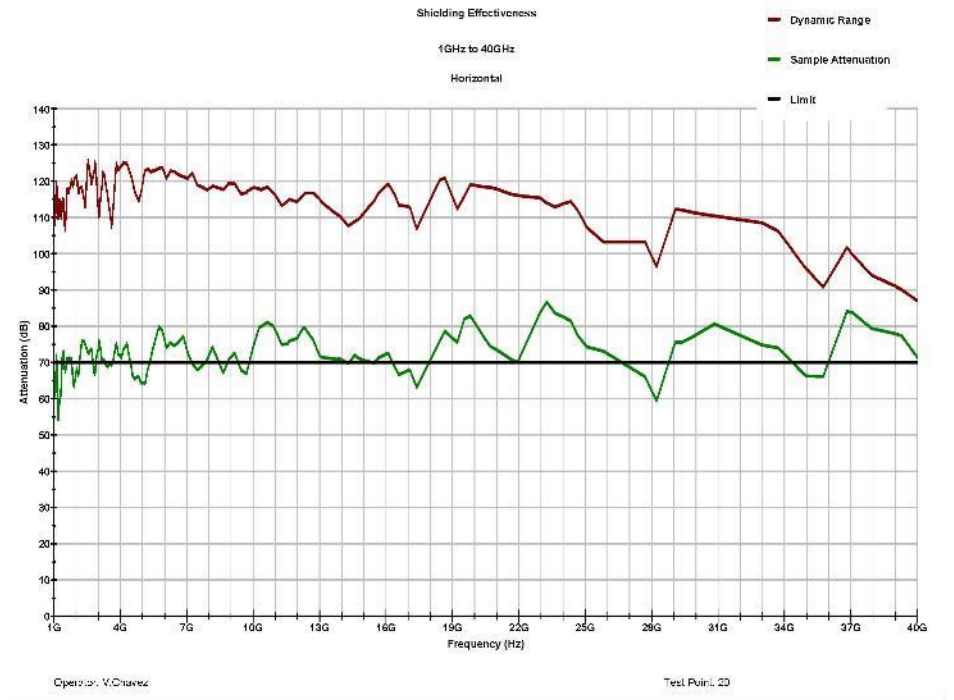
Test Position 20, 30 - 1000 MHz Horizontal



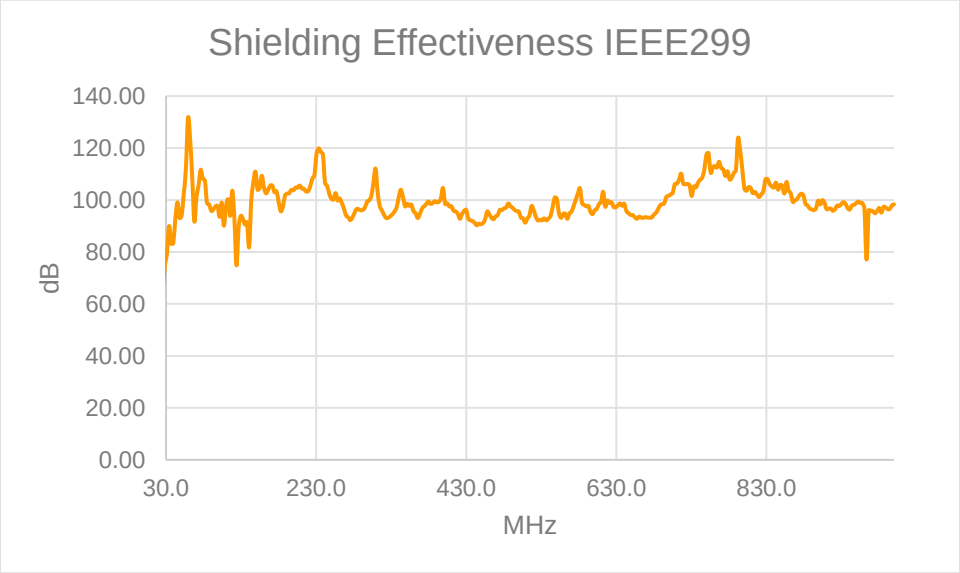
Test Position 20: 1,000 – 40,000 MHz Vertical



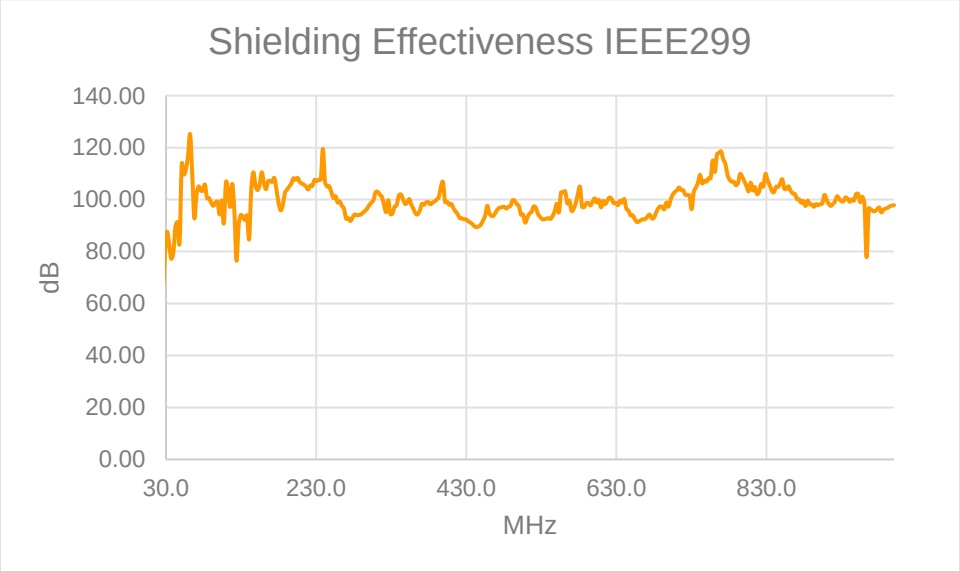
Test Position 20: 1,000 – 40,000 MHz Horizontal



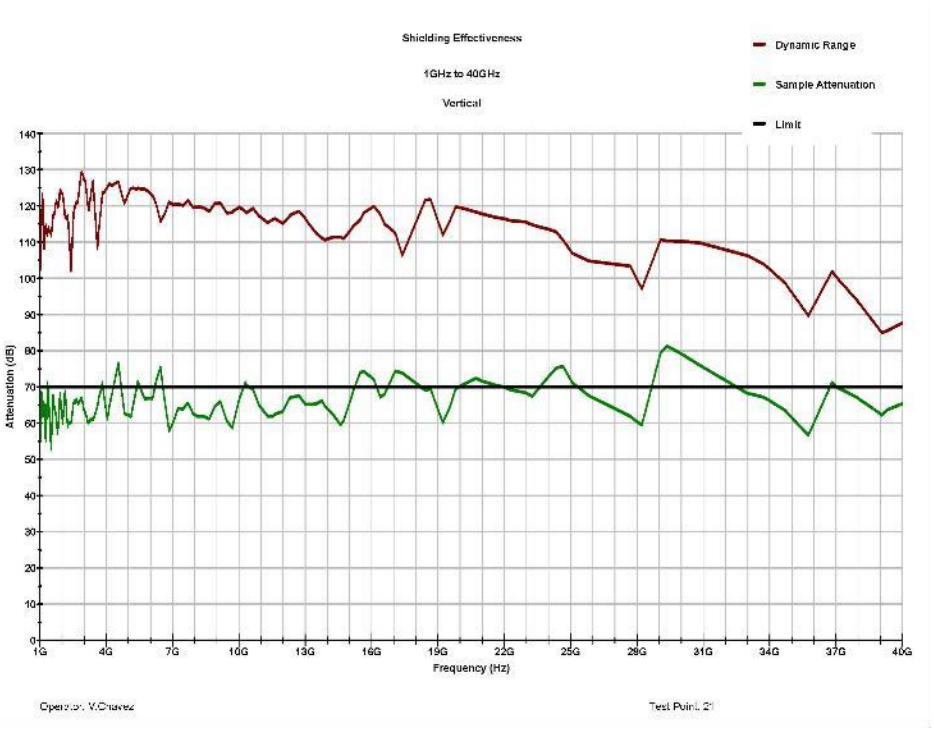
Test Position 21, 30 - 1000 MHz Vertical



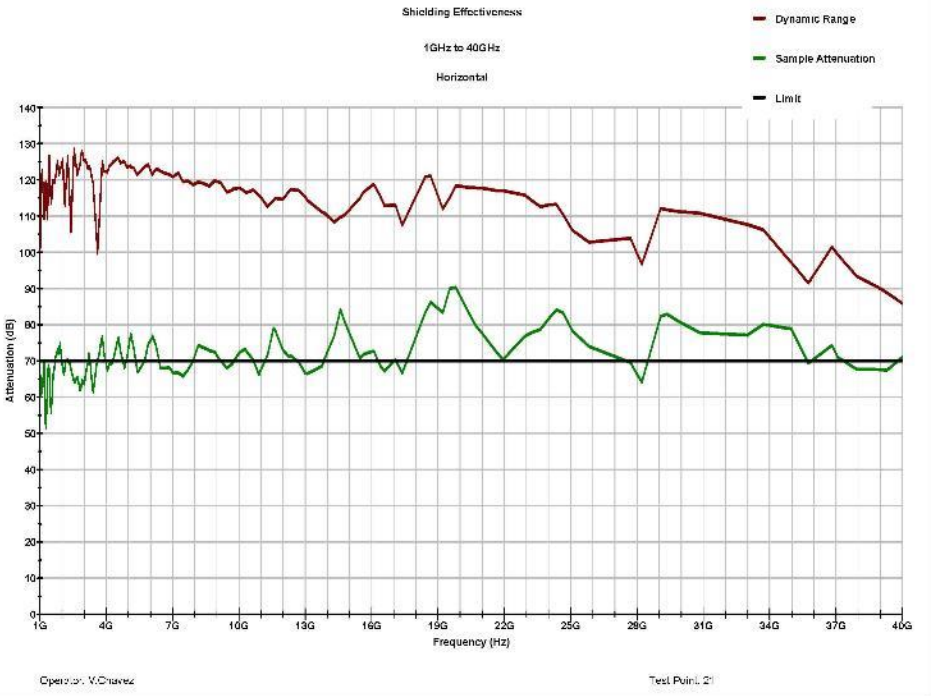
Test Position 21, 30 - 1000 MHz Horizontal



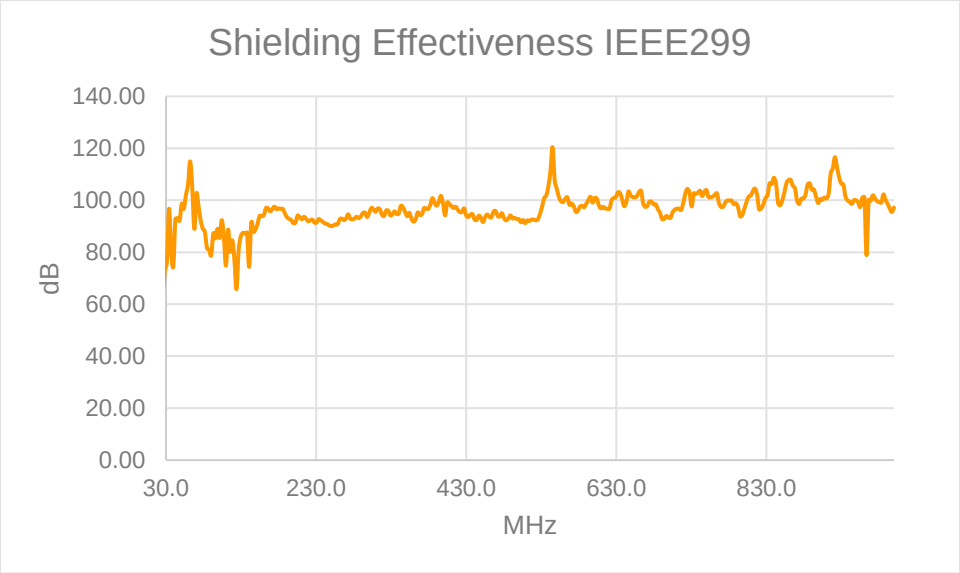
Test Position 21: 1,000 – 40,000 MHz Vertical



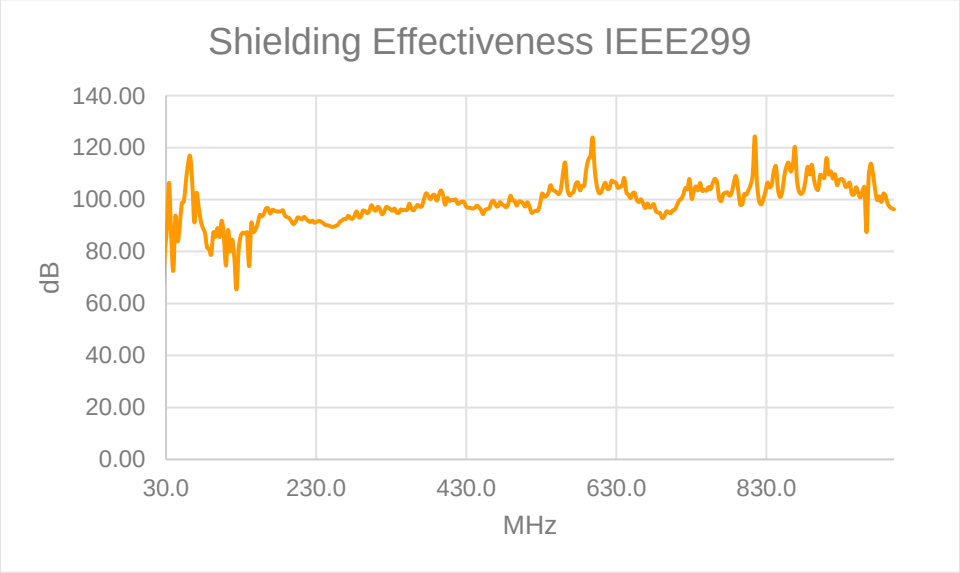
Test Position 21: 1,000 – 40,000 MHz Horizontal



Test Position 22, 30 - 1000 MHz Vertical



Test Position 22, 30 - 1000 MHz Horizontal



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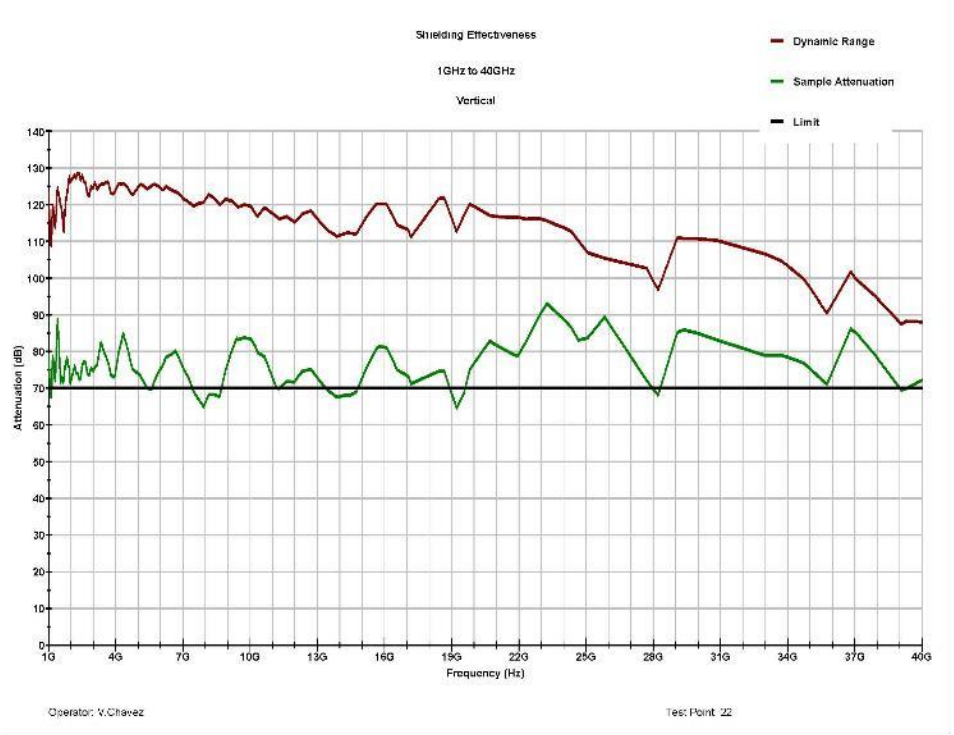
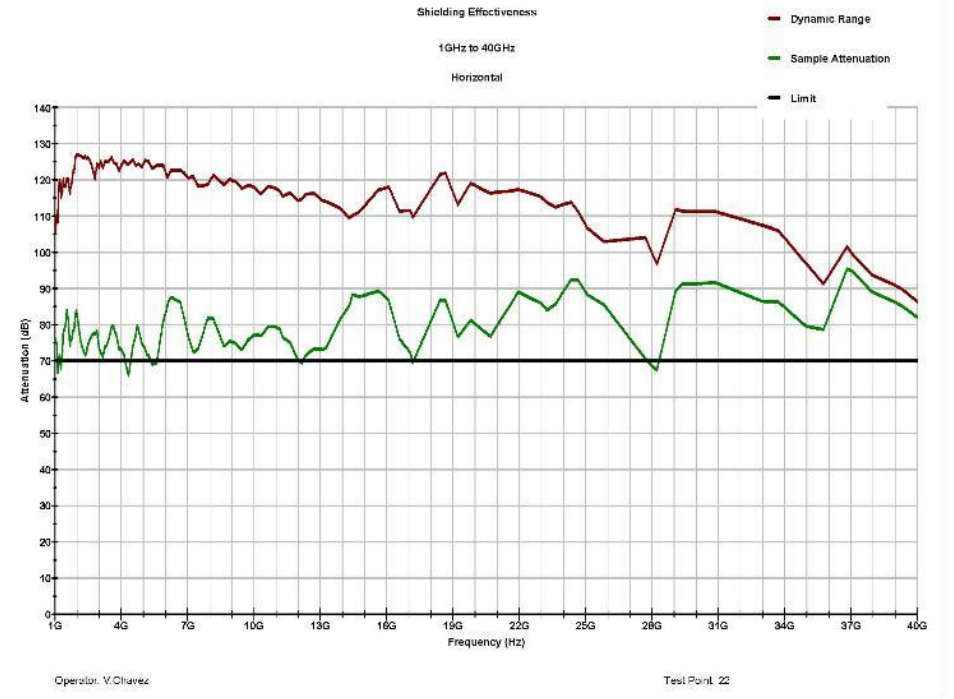
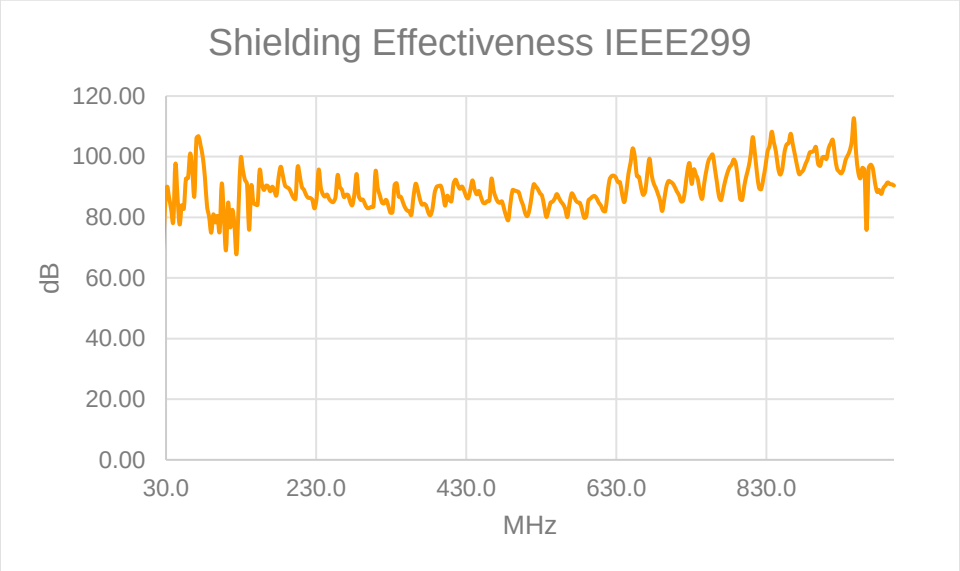
Test Position 22: 1,000 – 40,000 MHz Vertical



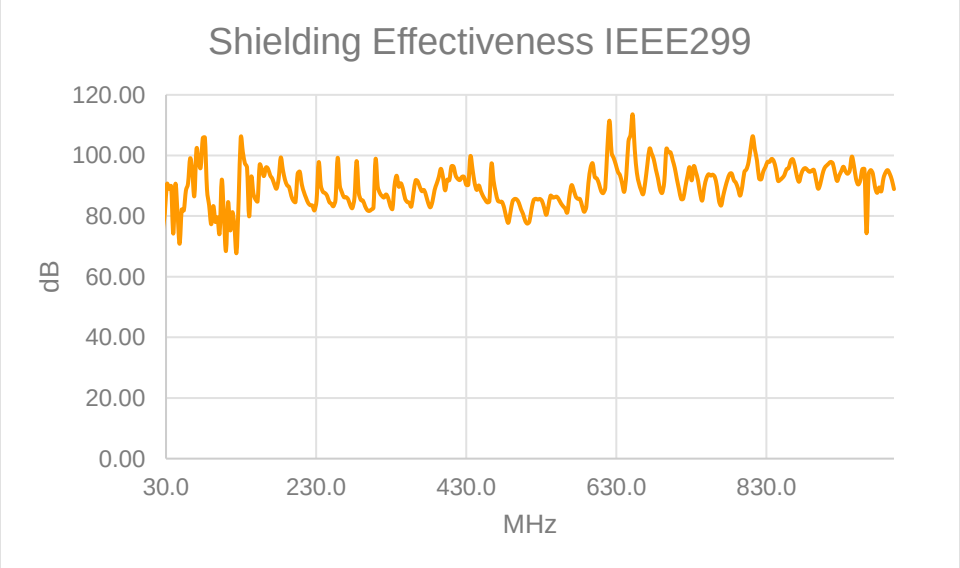
Test Position 22: 1,000 – 40,000 MHz Horizontal



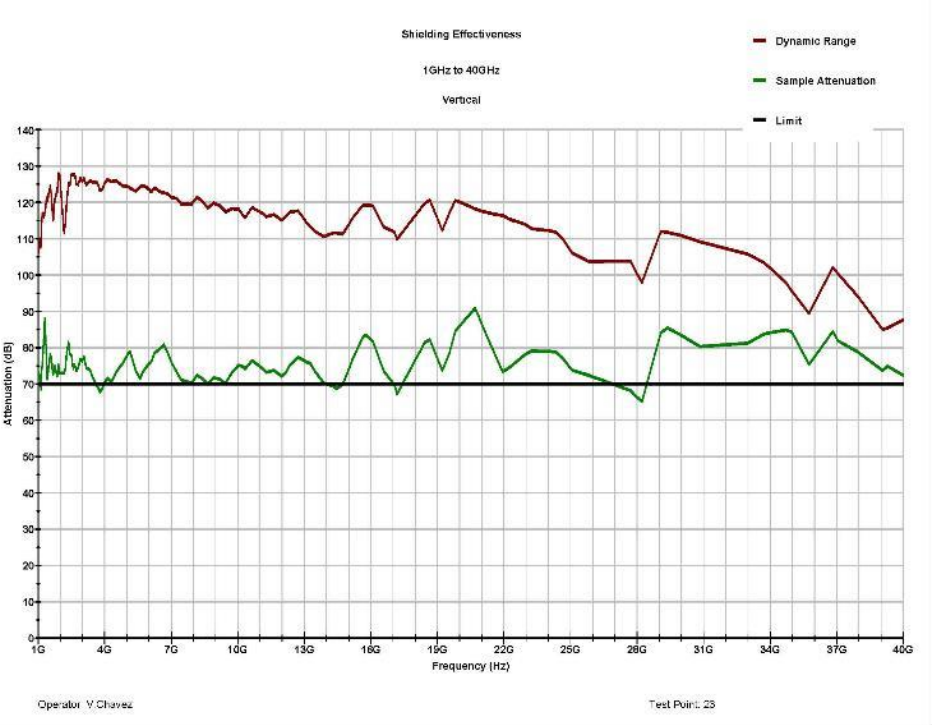
Test Position 23, 30 - 1000 MHz Vertical



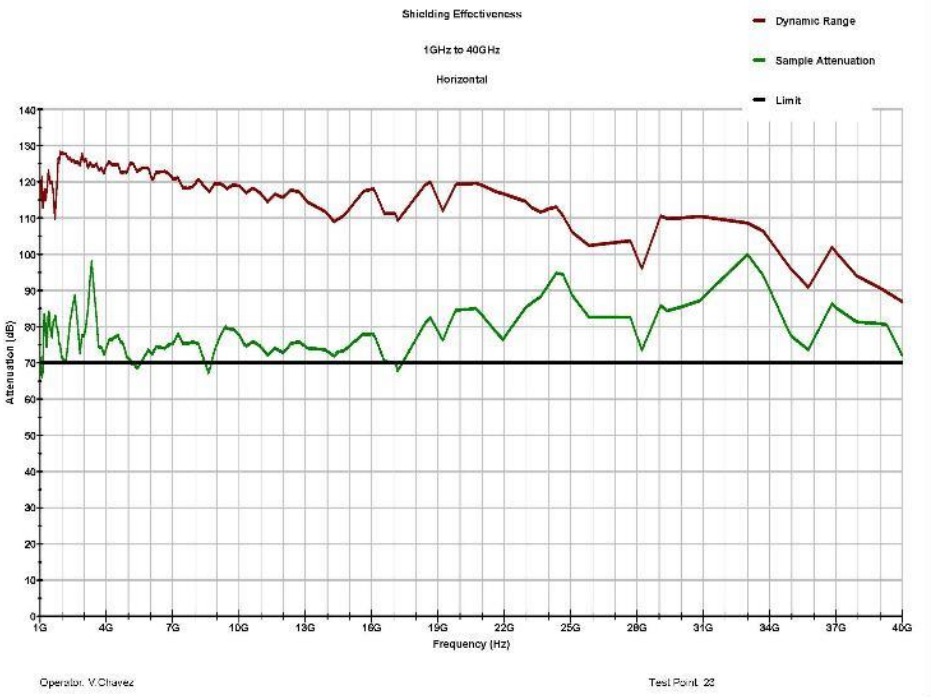
Test Position 23, 30 - 1000 MHz Horizontal



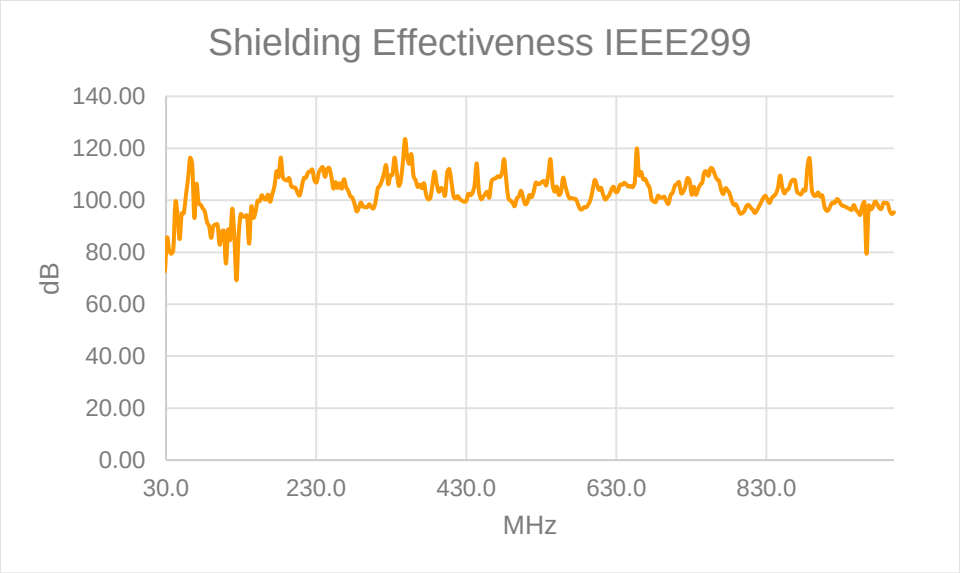
Test Position 23: 1,000 – 40,000 MHz Vertical



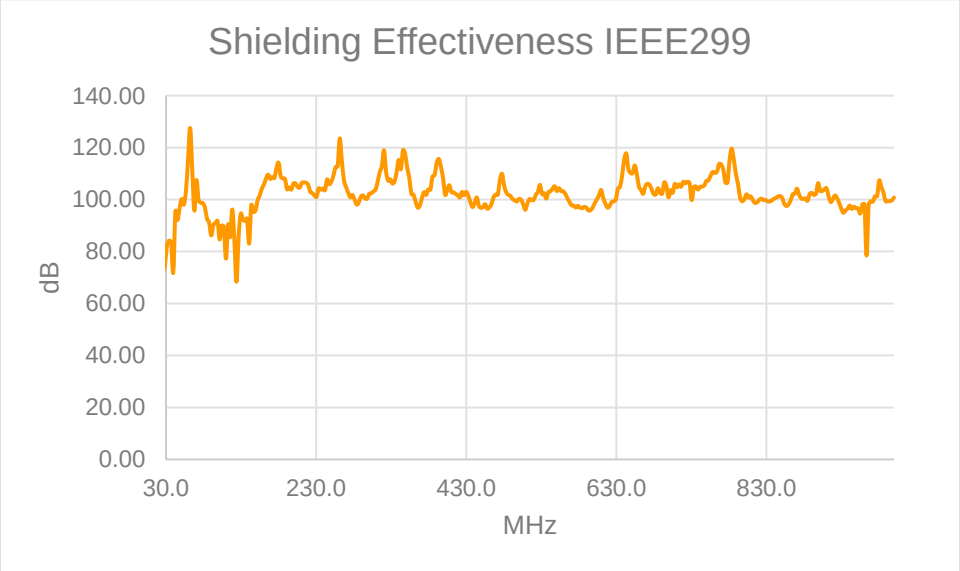
Test Position 23: 1,000 – 40,000 MHz Horizontal



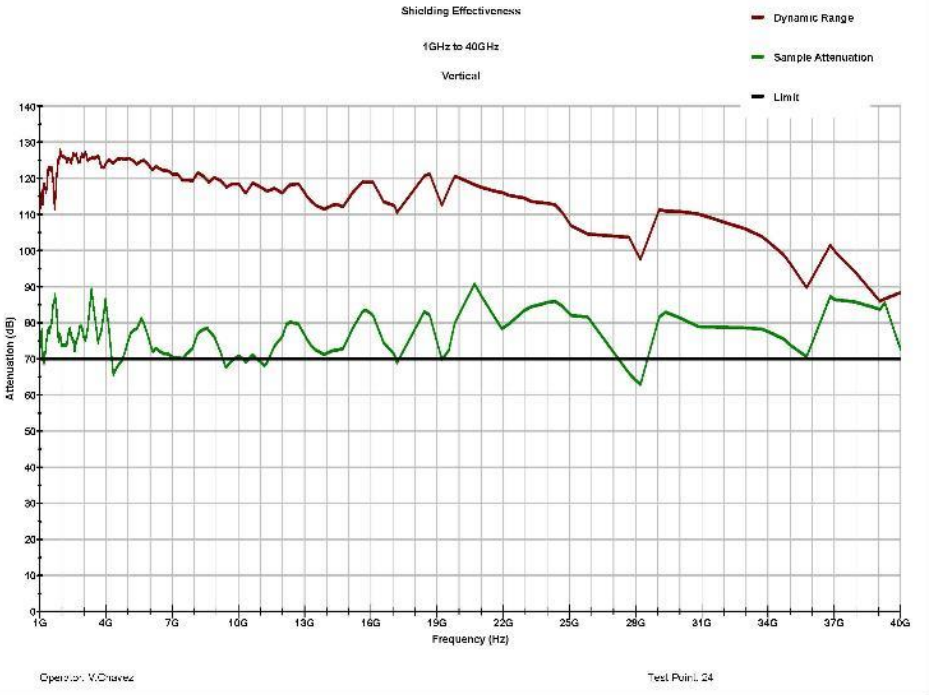
Test Position 24, 30 - 1000 MHz Vertical



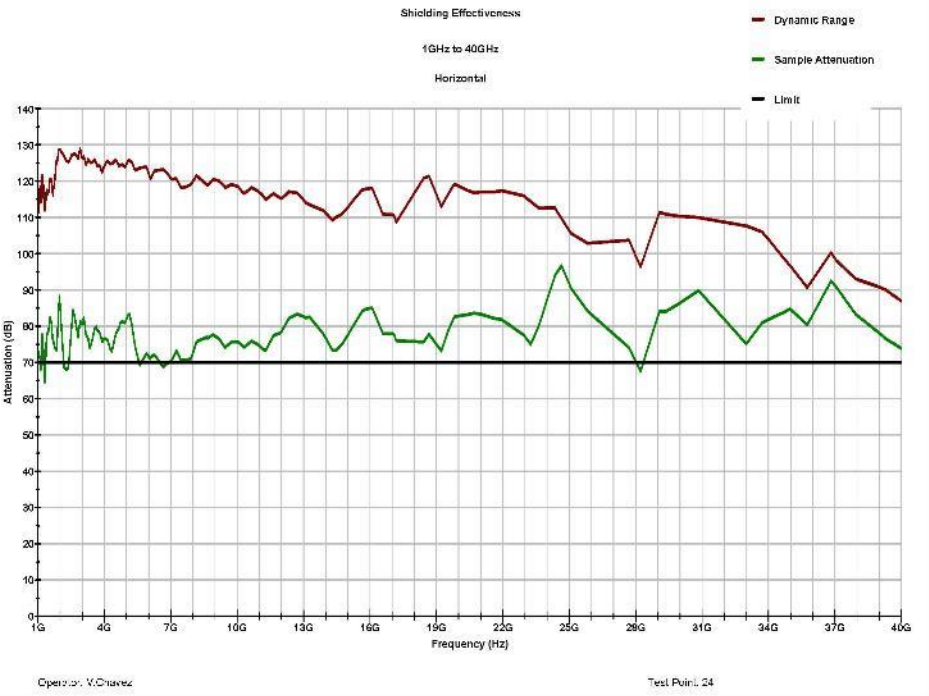
Test Position 24, 30 - 1000 MHz Horizontal



Test Position 24: 1,000 – 40,000 MHz Vertical



Test Position 24: 1,000 – 40,000 MHz Horizontal



2 Measurement Uncertainty

Measurement Uncertainty	
Test	Ulab (k=2 / 95% Confidence)
Test method 30 – 1000 MHz	± 8.1dB
Test Method 1 – 40 GHz	± 7.5dB

3 Revision History

Revision Level	Description of changes	Revision Date
DRAFT	--	
0	Initial Release	March 14, 2023