

RF Test Report

Project Number: 4887489**Proposal: SUW-202201002180****Report Number: 4887489EMC01****Revision Level: 1****Client: Pison Technology, Inc.****Equipment Under Test: Hand Motion Control Band****Model Number: VT01****FCC ID: 2A4CW-VT01****IC ID: 28178-VT01****Applicable Standards: ANSI C63.10: 2013 (FCC Part 15 Subpart C, § 15.247)****RSS-247, Issue 2****RSS-GEN, Issue 5****Report issued on: 31 October 2022****Test Result: Compliant**

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 3212.01

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Tested by:

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Shawn McGuinness, EMC Engineering Leader

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1 Summary of Test Results

Test Description	Test Specification		Test Result
Bandwidth	15.247(a)(2)	RSS-247 5.2(a) RSS-GEN 6.7	Compliant
Peak Output Power	15.247(b)(3)	RSS-247 5.4 (d)	Compliant
Power Spectral Density	15.247(e)	RSS-247 5.2 (b)	Compliant
Conducted Spurious Emissions / Band Edge	15.247(d)	RSS-247 5.5	Compliant
Emissions in Restricted Frequency Bands	15.205, 15.209	RSS-GEN 8.9, 8.10	Compliant
Antenna Requirement	15.203	RSS-GEN 6.8	Compliant
AC Powerline Conducted Emissions	15.107, 15.207	RSS-GEN 8.8	Compliant

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: Pison Technology, Inc.
Address: 179 South Street 4th Floor
City, State, Zip, Country: Boston, MA 02111, USA

2.2 Test Laboratory

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

Accrediting Body: A2LA
Type of lab: Testing Laboratory
Certificate Number: 3212.01
Designation Number: US1126
CAB Identifier: US0186

2.3 General Information of EUT

Product Description: Vulcan Control Band
Model Number (HVIN): VT01
Firmware Version (FVIN): 1.0
Serial Number: 50A1675F (Original)
SUW_PK_20220700486 (Packing ID for C011)

Frequency Range: 2402 – 2480 MHz
Data Modes: Bluetooth LE / GFSK
Antenna Type / Gain: Internal Wire / 3.0dBi*

Rated Voltage: 3.6Vdc
Test Voltage: 3.6Vdc

Sample Received Date: 04 March 2022, 27 July 2022 (C011)

Dates of testing: 14 March 2022, 20-26 September 2022 (C011)

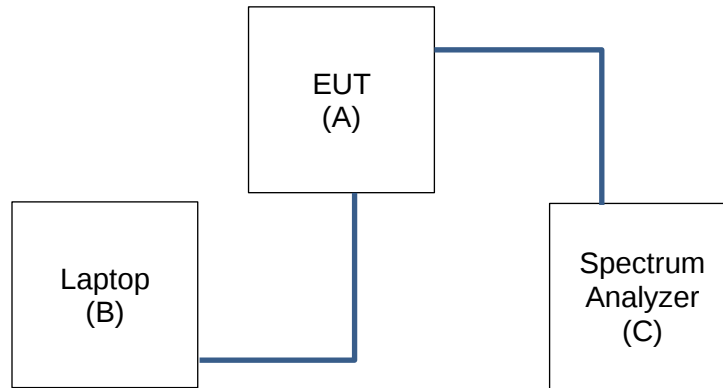
**Data was not measured by SGS laboratory and therefore not responsible for accuracy. Data obtained via customer, specification sheet, previous regulatory filing or other.*

2.4 Operating Modes and Conditions

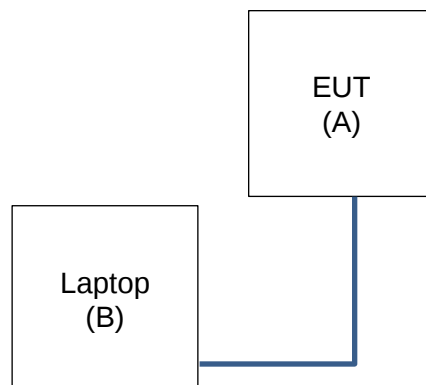
Using test commands through the Linux backbone, the EUT was programmed to transmit on low, mid and high channels. During testing the radio was configured for max power.

For all data rates, the device was configured to a target power of 4dBm. For spurious emissions testing, the worst-case data rate was PHY S8.

2.5 EUT Connection Block Diagram – Conducted Measurements



2.6 EUT Connection Block Diagram – Radiated Measurements

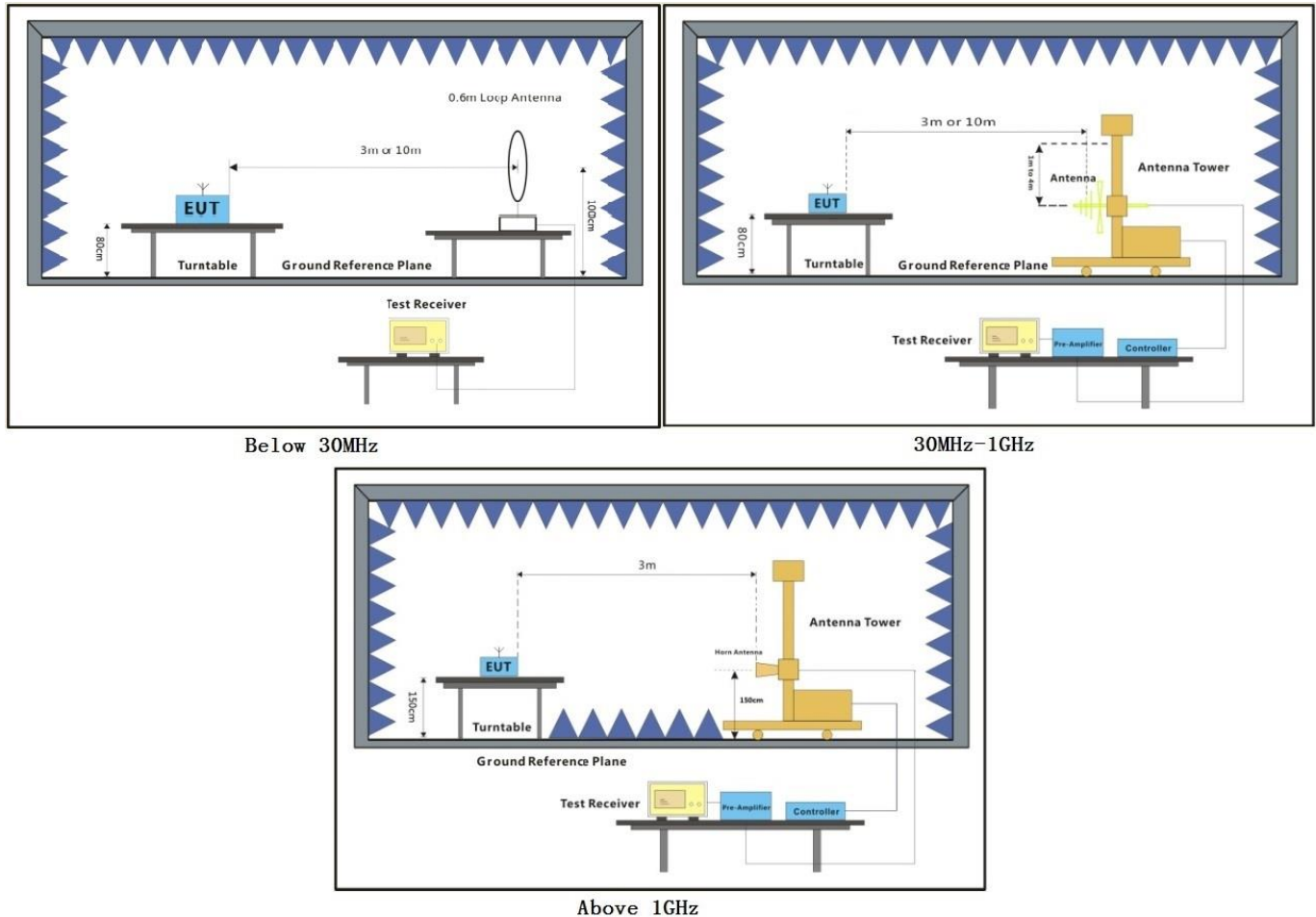


2.7 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Pison Technology, Inc.	Vulcan Control Band	VT01	50A1675F (Original) SUW_PK_20220700486
B	Lenovo	Laptop	T480	PF1EE6FD
C	Rohde & Schwarz	Spectrum Analyzer	FSV30	101595

Note: No serial number on product. Used sample package ID.

2.8 Configuration Diagrams (Radiated)



3 Intentional Radiator Antenna Requirement

3.1 Result

Test Description	Test Specification	Test Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.203	Compliant

3.2 Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit permanently attached antenna or of so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

3.3 Conclusion

The Antenna on this device is connected to an U.FL connector, under the battery pack. The antenna is Kapton taped to the battery pack. The housing screws are T7 size which is a difficult size to find.

4 Bandwidth

4.1 Test Result

Test Description	Test Specification		Test Result
6 dB Bandwidth 99% Occupied Bandwidth	15.247(a)(2)	RSS-247 5.2(a) RSS-GEN 6.7	Compliant

4.2 Test Method

The procedures from ANSI C63.10: 2013 clause 11.8 and 558074 D01 DTS Meas Guidance v05r2 were used to determine the 6 dB bandwidth.

The procedures from ANSI C63.10: 2013 clause 6.9.2 were used to measure the 99% Occupied Bandwidth.

4.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.3 °C

Relative Humidity: 54.3 %

Atmospheric Pressure: 97.79 kPa

4.4 Test Equipment

Test End Date: 26-Sep-2022

Tester: AB

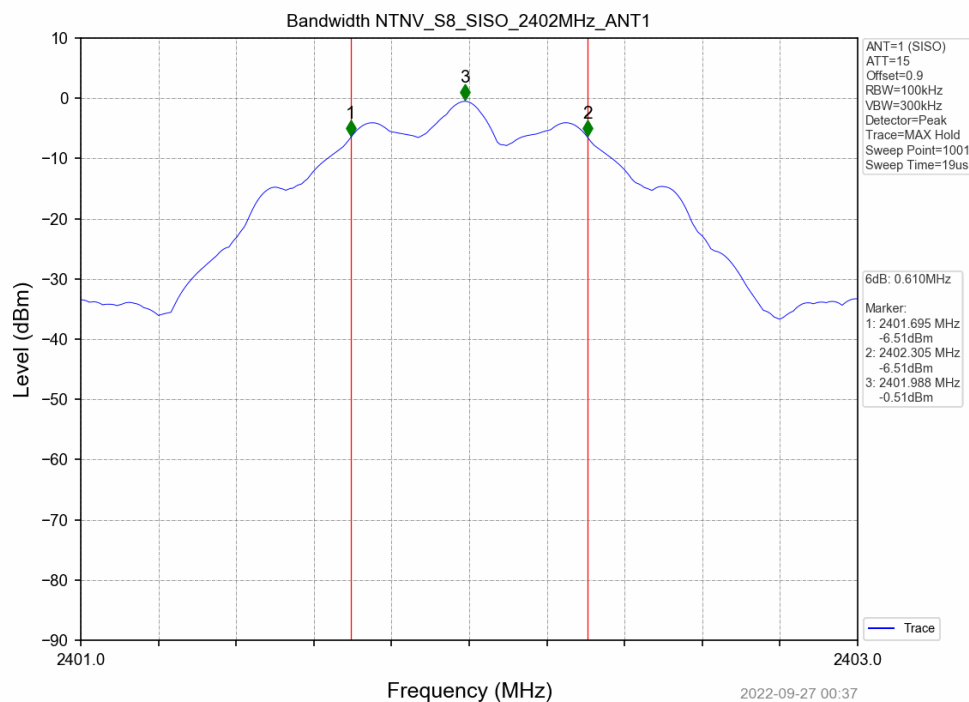
Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095587	13-Jul-2022	13-Jul-2023
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	4-Jan-2022	4-Jan-2024

4.5 Test Data – 6dB Bandwidth

Test Mode	Frequency (MHz)	TX Type	ANT No.	6dB BW (MHz)	Limit (MHz)	Verdict
S8	2402	SISO	1	0.610	≥0.5	PASS
	2440	SISO	1	0.610	≥0.5	PASS
	2480	SISO	1	0.611	≥0.5	PASS
S2	2402	SISO	1	0.712	≥0.5	PASS
	2440	SISO	1	0.707	≥0.5	PASS
	2480	SISO	1	0.709	≥0.5	PASS
1M	2402	SISO	1	0.706	≥0.5	PASS
	2440	SISO	1	0.703	≥0.5	PASS
	2480	SISO	1	0.716	≥0.5	PASS
2M	2402	SISO	1	1.144	≥0.5	PASS
	2440	SISO	1	1.146	≥0.5	PASS
	2480	SISO	1	1.144	≥0.5	PASS

Sample Plot

S8 Low Channel (2402MHz)

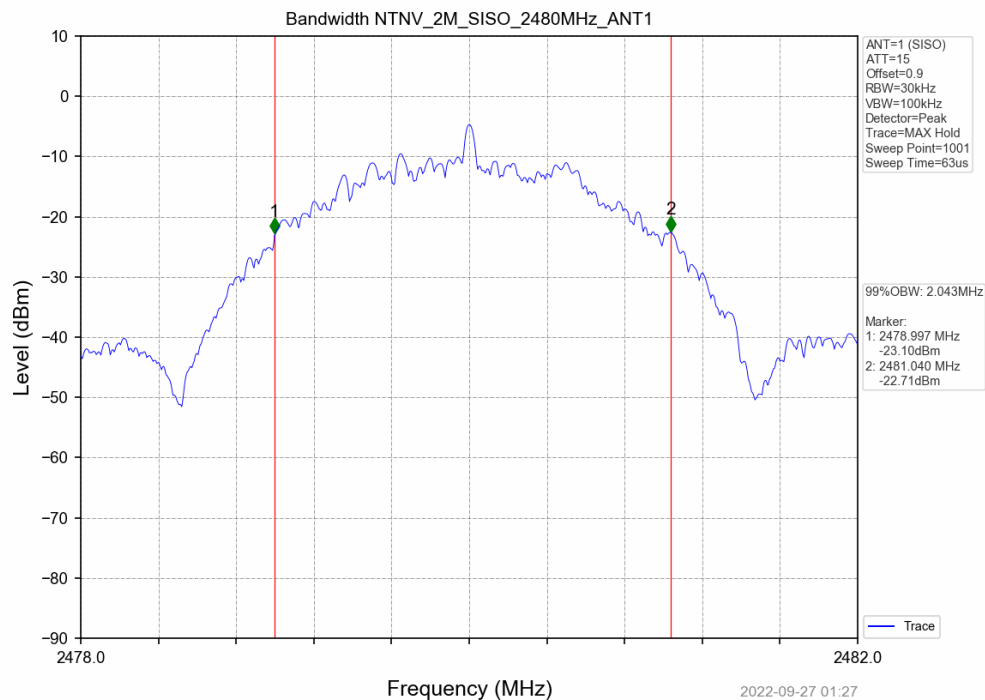


4.6 Test Data – 99% Bandwidth

Test Mode	Frequency (MHz)	TX Type	ANT No.	99% OBW (MHz)	Limit (MHz)	Verdict
S8	2402	SISO	1	1.077	≥0.5	Reported
	2440	SISO	1	1.081	≥0.5	Reported
	2480	SISO	1	1.086	≥0.5	Reported
S2	2402	SISO	1	1.037	≥0.5	Reported
	2440	SISO	1	1.039	≥0.5	Reported
	2480	SISO	1	1.041	≥0.5	Reported
1M	2402	SISO	1	1.045	≥0.5	Reported
	2440	SISO	1	1.048	≥0.5	Reported
	2480	SISO	1	1.051	≥0.5	Reported
2M	2402	SISO	1	2.039	≥0.5	Reported
	2440	SISO	1	2.041	≥0.5	Reported
	2480	SISO	1	2.043	≥0.5	Reported

Sample Plot

2M High Channel (2480MHz)



5 Peak Output Power

5.1 Test Result

Test Description	Test Specification		Test Result
Peak Output Power	15.247(b)(3)	RSS-247 S5.4 (d)	Compliant

5.2 Test Method

Fundamental peak power measurements were recorded using the procedures from ANSI C63.10: 2013 clause 11.9 and KDB 558074 D01 Measurement Guidance v05r2.

Limit

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. For using antennas with greater than 6dBi of gain, the limit is reduced in dB by the amount the gain exceeds 6dBi (e.g. for a 7.4dBi antenna, the limit is reduced from 30dBm to 28.6dBm)

5.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.3 °C

Relative Humidity: 54.3 %

Atmospheric Pressure: 97.79 kPa

5.4 Test Equipment

Test End Date: 26-Sep-2022

Tester: AB

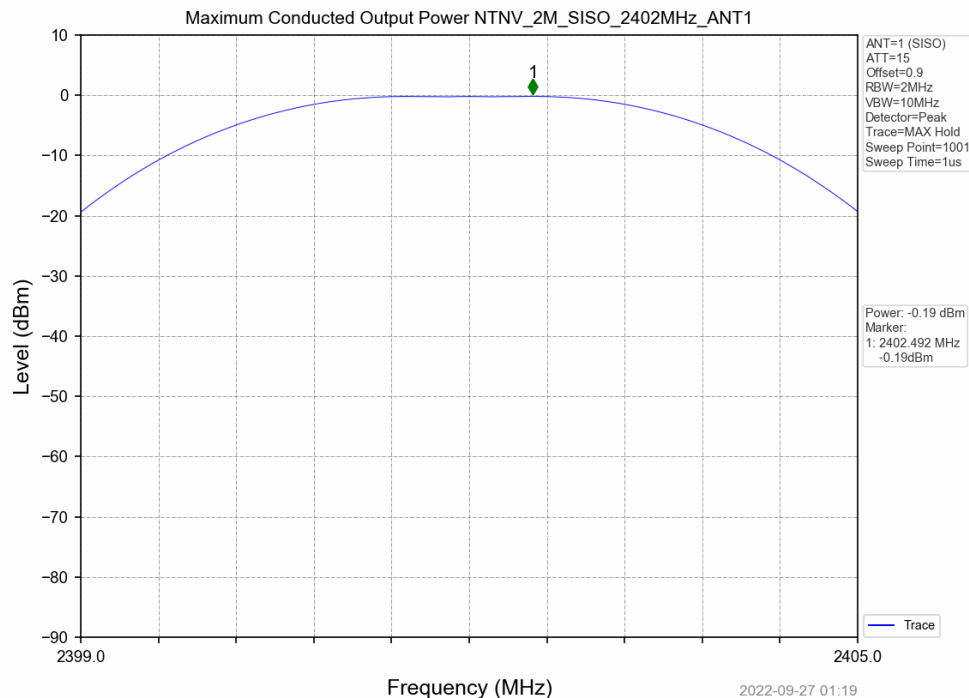
Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095587	13-Jul-2022	13-Jul-2023
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	4-Jan-2022	4-Jan-2024

5.5 Test Data

Test Mode	Frequency (MHz)	TX Type	ANT No.	Peak Output Power (dBm)	Limit (dBm)	Verdict
S8	2402	SISO	1	-0.41	30	PASS
	2440	SISO	1	-1.22	30	PASS
	2480	SISO	1	-2.16	30	PASS
S2	2402	SISO	1	-0.28	30	PASS
	2440	SISO	1	-1.13	30	PASS
	2480	SISO	1	-2.09	30	PASS
1M	2402	SISO	1	-0.23	30	PASS
	2440	SISO	1	-1.10	30	PASS
	2480	SISO	1	-2.07	30	PASS
2M	2402	SISO	1	-0.19	30	PASS
	2440	SISO	1	-1.06	30	PASS
	2480	SISO	1	-2.01	30	PASS

Sample Plot

2M Low Channel (2402MHz)



6 Power Spectral Density

6.1 Test Result

Test Description	Test Specification		Test Result
Power Spectral Density	15.247(e)	RSS-247 S5.2 (b)	Compliant

6.2 Test Method

Power spectral density measurements were recorded using the procedures from ANSI C63.10: 2013 clause 11.10 and KDB 558074 D01 Measurement Guidance v05r2.

Limit

The limit is 8 dBm.

6.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.3 °C

Relative Humidity: 54.3 %

Atmospheric Pressure: 97.79 kPa

6.4 Test Equipment

Test End Date: 26-Sep-2022

Tester: AB

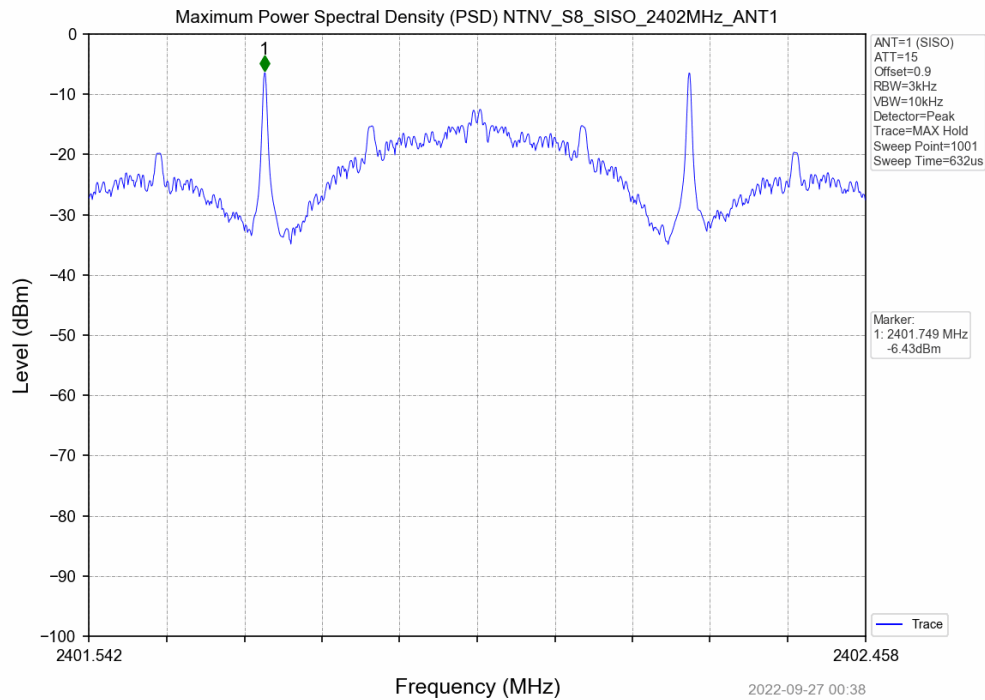
Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095587	13-Jul-2022	13-Jul-2023
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	4-Jan-2022	4-Jan-2024

6.5 Test Data

Test Mode	Frequency (MHz)	TX Type	ANT No.	Peak PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
S8	2402	SISO	1	-6.43	≤8	PASS
	2440	SISO	1	-7.21	≤8	PASS
	2480	SISO	1	-8.12	≤8	PASS
S2	2402	SISO	1	-6.47	≤8	PASS
	2440	SISO	1	-7.28	≤8	PASS
	2480	SISO	1	-8.22	≤8	PASS
1M	2402	SISO	1	-15.92	≤8	PASS
	2440	SISO	1	-16.86	≤8	PASS
	2480	SISO	1	-18.07	≤8	PASS
2M	2402	SISO	1	-18.16	≤8	PASS
	2440	SISO	1	-19.02	≤8	PASS
	2480	SISO	1	-19.93	≤8	PASS

Sample Plot

S8 Low Channel (2402MHz)



7 Conducted Spurious Emissions / Band Edge

7.1 Test Result

Test Description	Test Specification		Test Result
Conducted Spurious Emissions	15.247(d)	RSS-247 S5.5	Compliant

7.2 Test Method

Spurious emissions in non-restricted frequency bands were recorded using the methods defined in ANSI C63.10: 2013 clause 11.11 and KDB 558074 D01 Measurement Guidance v05r2.

Lowest, middle, and highest channels were investigated.

Because the maximum conducted peak output power was used to determine compliance with the output power limits, the limit in any 100 kHz band outside of the authorized band is 20 dB below the maximum in-band peak level.

7.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.3 °C

Relative Humidity: 54.3 %

Atmospheric Pressure: 97.79 kPa

7.4 Test Equipment

Test End Date: 26-Sep-2022

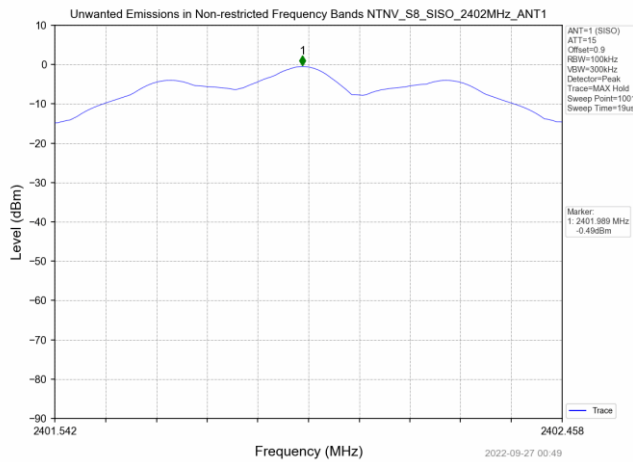
Tester: AB

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095587	13-Jul-2022	13-Jul-2023
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	4-Jan-2022	4-Jan-2024

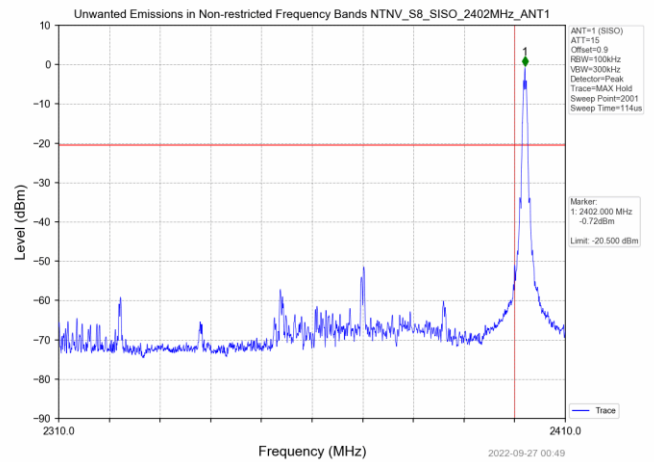
7.5 Test Data

Frequency (MHz)	Frequency (MHz)	TX Type	ANT No.	Spurious Conducted Emission (dBm)	Limit (dBm)	Verdict
S8	2402	SISO	1	Refer to test graph	-20.50	PASS
	2440	SISO	1	Refer to test graph	-20.50	PASS
	2480	SISO	1	Refer to test graph	-20.50	PASS
S2	2402	SISO	1	Refer to test graph	-20.31	PASS
	2440	SISO	1	Refer to test graph	-20.31	PASS
	2480	SISO	1	Refer to test graph	-20.31	PASS
1M	2402	SISO	1	Refer to test graph	-20.25	PASS
	2440	SISO	1	Refer to test graph	-20.25	PASS
	2480	SISO	1	Refer to test graph	-20.25	PASS
2M	2402	SISO	1	Refer to test graph	-20.31	PASS
	2440	SISO	1	Refer to test graph	-20.31	PASS
	2480	SISO	1	Refer to test graph	-20.31	PASS

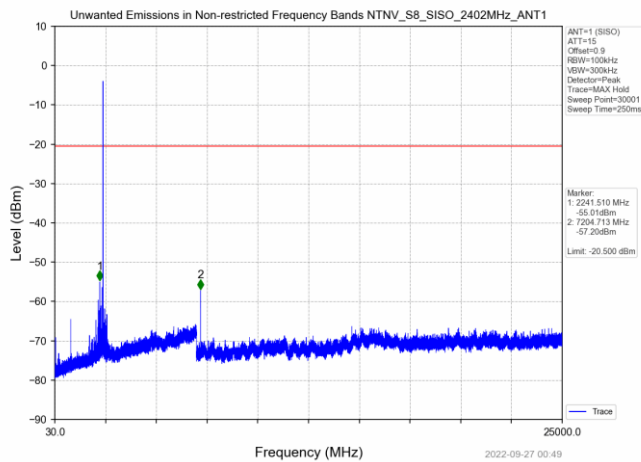
S8 In-Band Reference



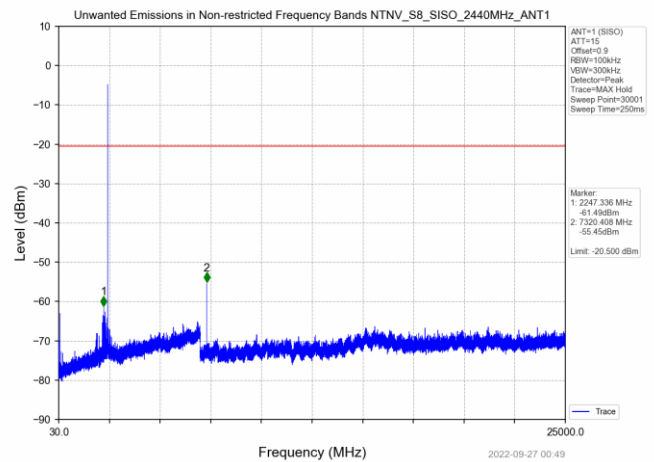
S8 Lower Band Edge - Low Channel (2402MHz)



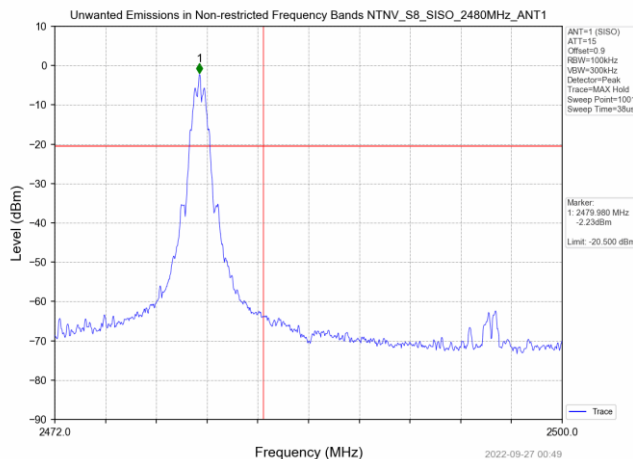
S8 Full Spectrum - Low Channel (2402MHz)



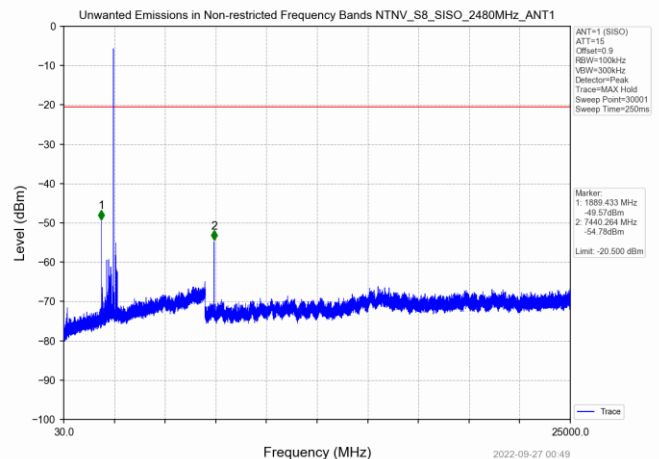
S8 Full Spectrum - Mid Channel (2440MHz)



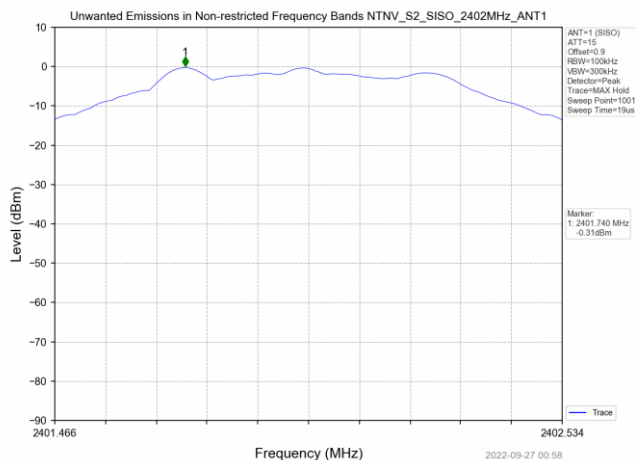
S8 Upper Band Edge – High Channel (2480MHz)



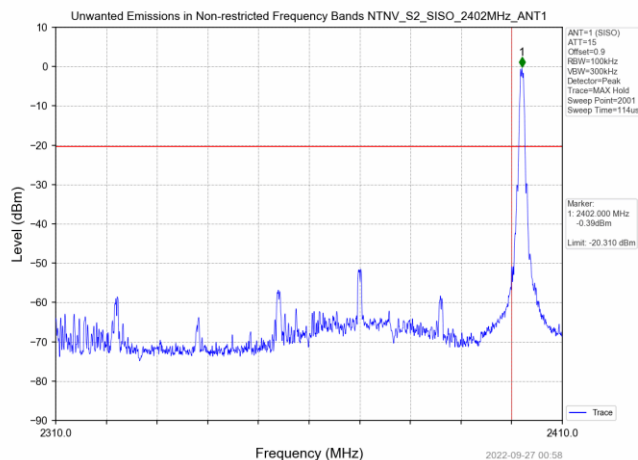
S8 Full Spectrum - High Channel (2480MHz)



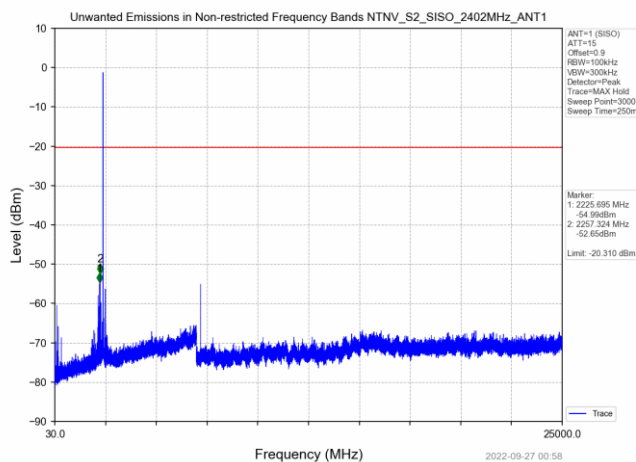
S2 In-Band Reference



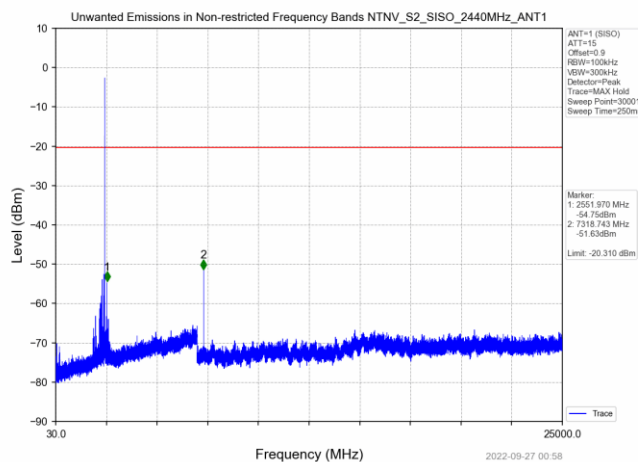
S2 Lower Band Edge - Low Channel (2402MHz)



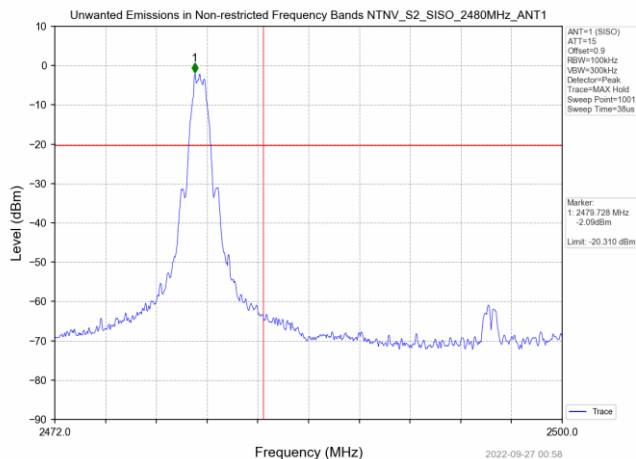
S2 Full Spectrum - Low Channel (2402MHz)



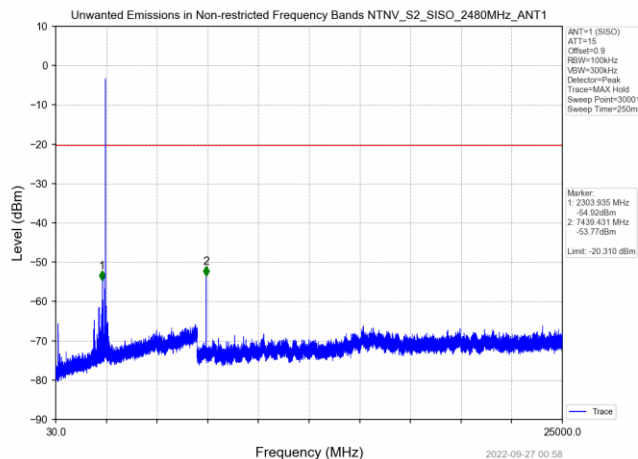
S2 Full Spectrum - Mid Channel (2440MHz)



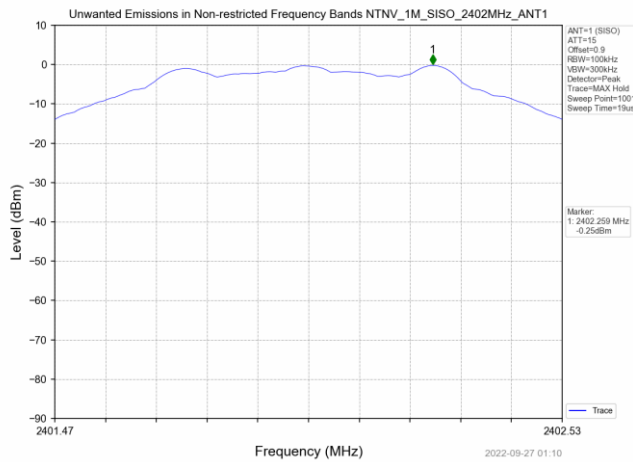
S2 Upper Band Edge – High Channel (2480MHz)



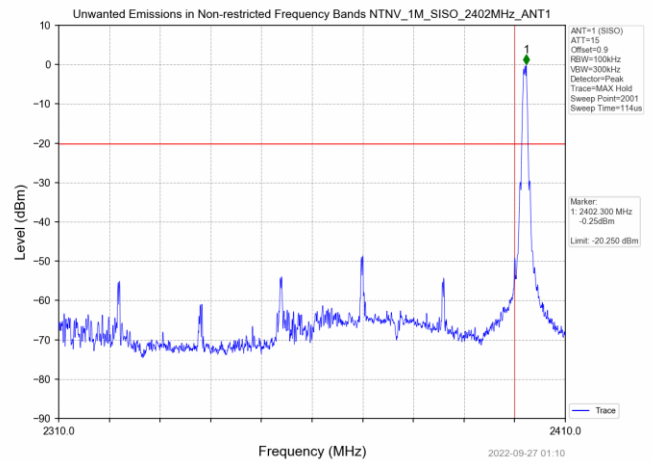
S2 Full Spectrum - High Channel (2480MHz)



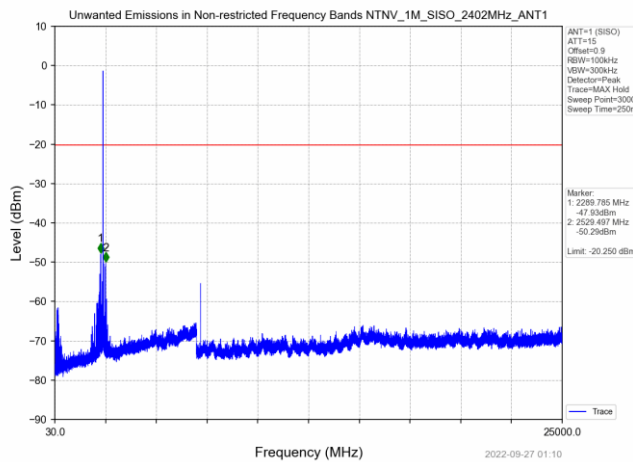
1M In-Band Reference



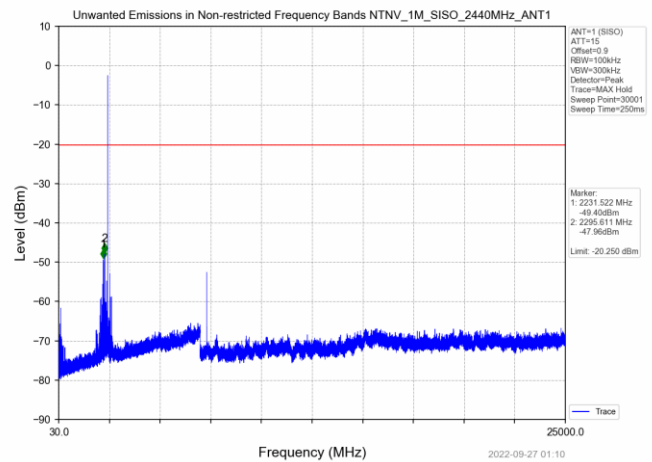
1M Lower Band Edge - Low Channel (2402MHz)



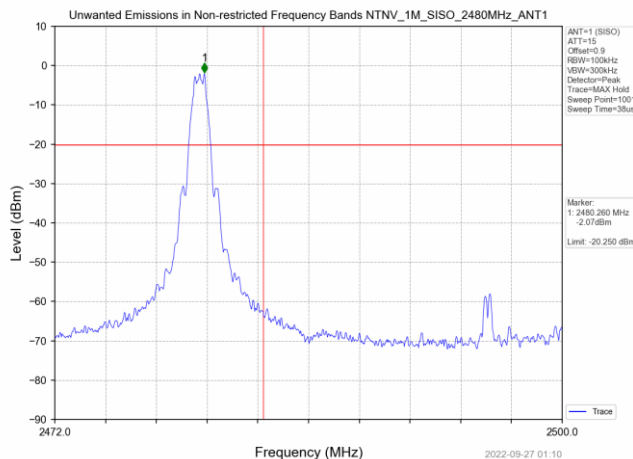
1M Full Spectrum - Low Channel (2402MHz)



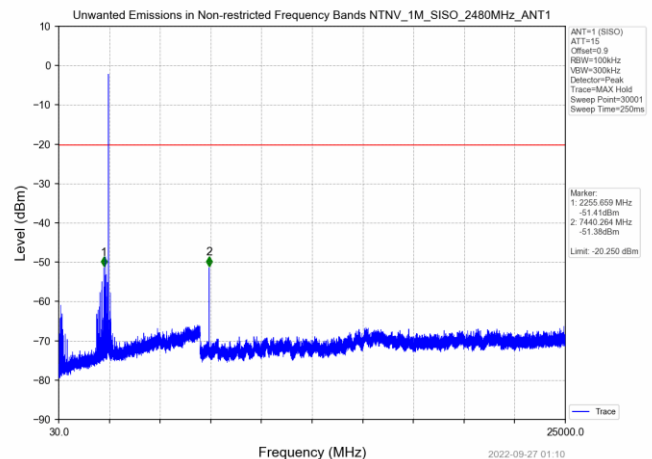
1M Full Spectrum - Mid Channel (2440MHz)



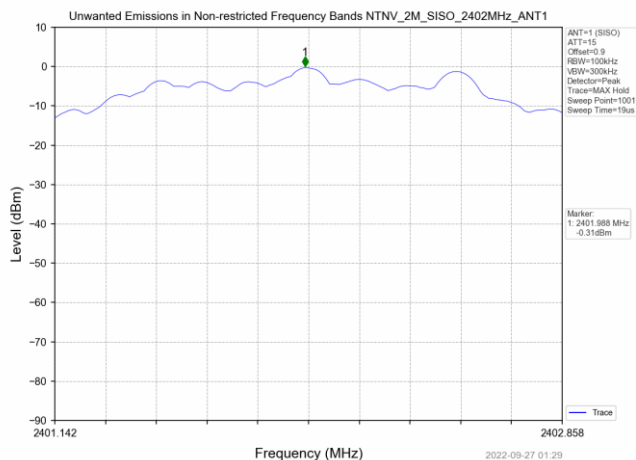
1M Upper Band Edge – High Channel (2480MHz)



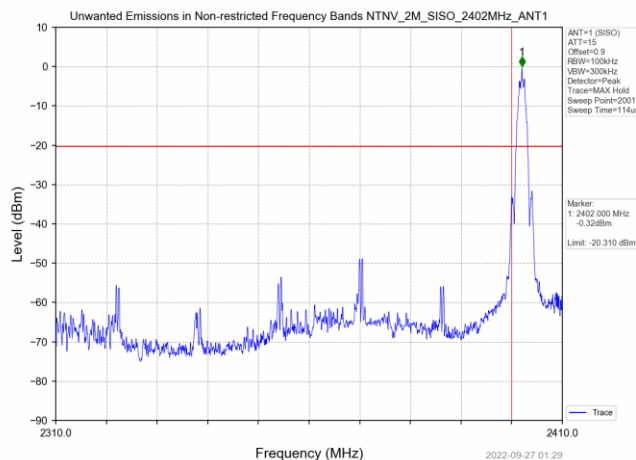
1M Full Spectrum - High Channel (2480MHz)



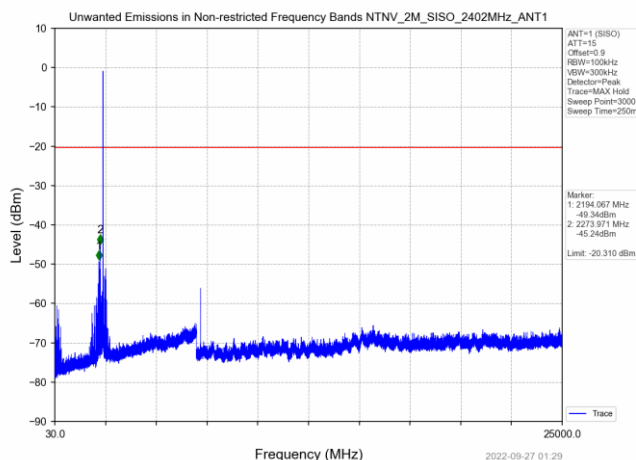
2M In-Band Reference



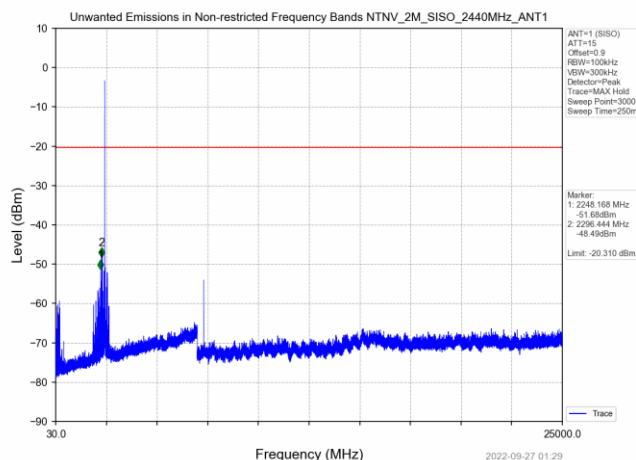
2M Lower Band Edge - Low Channel (2402MHz)



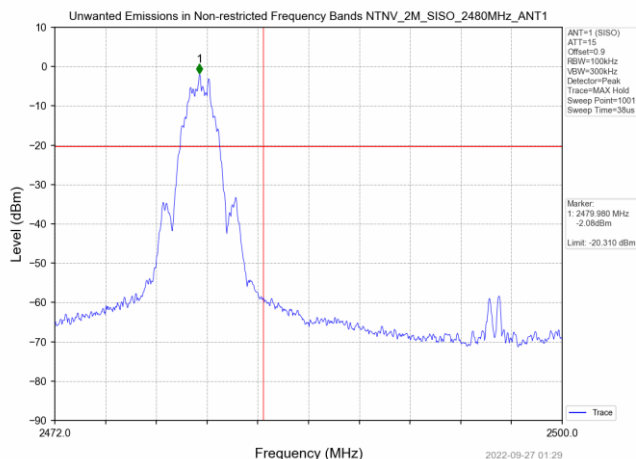
2M Full Spectrum - Low Channel (2402MHz)



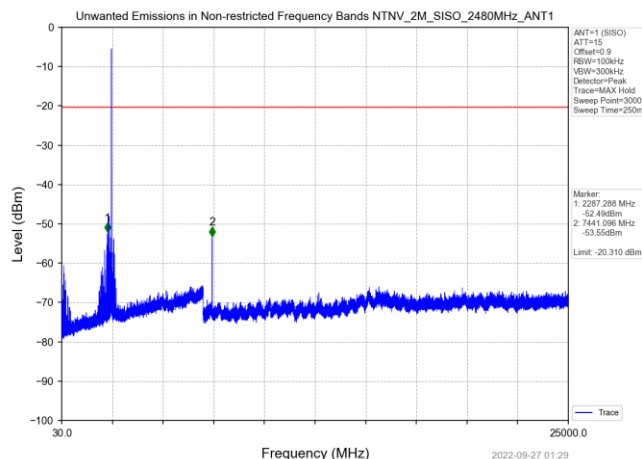
2M Full Spectrum - Mid Channel (2440MHz)



2M Upper Band Edge - High Channel (2480MHz)



2M Full Spectrum - High Channel (2480MHz)



8 Field Strength of Spurious Radiation (Restricted Bands)

8.1 Test Result

Test Description	Test Specification		Test Result
Radiated Spurious Emissions	15.247(d) and 15.209	RSS-247 S5.5	Compliant

8.2 Test Method

The measurement methods defined in ANSI C63.10: 2013 were used.

Lowest, middle, and highest channels were investigated – the device was commanded to continuously transmit on low, middle, and high channels.

Test distance:

- 9k to 30 MHz – The EUT to measurement antenna distance was 3 meters
- 30 to 1000 MHz - The EUT to measurement antenna distance was 3 meters
- 1 to 18 GHz - The EUT to measurement antenna distance was 3 meters
- 18 to 26 GHz - The EUT to measurement antenna distance was 3 meters

Limits within restricted bands of operation:

Frequency	Limits ⁽¹⁾		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 ⁽²⁾	--
88 - 216 MHz	150	43.5 ⁽²⁾	--
216 - 960 MHz	200	46 ⁽²⁾	--
960 - 1000 MHz	500	54 ⁽²⁾	--
1 - 40 GHz	500	54 ⁽³⁾	74

(1) These limits are applicable to emissions outside of the intentional transmit frequency band.

(2) Quasi-peak limit

(3) Average limit

8.3 Test Site

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions 21-Sep-2022

Temperature: 21.9°C

Relative Humidity: 52.2%

Atmospheric Pressure: 98.2kPa

8.4 Test Equipment

9kHz-30Mhz

Test End Date: 20-Sep-2022

Tester: PL

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
ANTENNA, LOOP, ACTIVE	6502	ETS LINDGREN	B085752	11-Aug-2022	11-Aug-2024
N to N RF Cable	NC12-N1N1-276	MEGAPHASE	22001	10-Jan-2022	10-Jan-2023
RF CABLE NM TO NF, 0.01-18GHZ	90-213-118	TELEDYNE STORM MICROWAVE	20117	17-Feb-2022	17-Feb-2023
RF CABLE NM TO NM, 0.01-18GHZ	90-195-157	TELEDYNE STORM MICROWAVE	20121	14-Feb-2022	14-Feb-2023
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	8-Sep-2022	8-Sep-2023

30-1000MHZ

Test End Date: 21-Sep-2022

Tester: ZH

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079690	19-Apr-2022	19-Apr-2024
N to N RF Cable	NC12-N1N1-27	MEGAPHASE	22000	10-Jan-2022	10-Jan-2023
RF CABLE NM TO NM, 0.01-18GHZ	90-195-354	TELEDYNE STORM MICROWAVE	20119	17-Feb-2022	17-Feb-2023
RF CABLE NM TO NM, 0.01-18GHZ	90-195-079	TELEDYNE STORM MICROWAVE	20123	14-Feb-2022	14-Feb-2023
RF CABLE	104PE	HUBER & SUHNER	B079793	25-Aug-2022	25-Aug-2023
LOW NOISE AMPLIFIER	ZKL-2+	MINI-CIRCUITS	B079817	25-Aug-2022	25-Aug-2023
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	8-Sep-2022	8-Sep-2023

1-18GHz

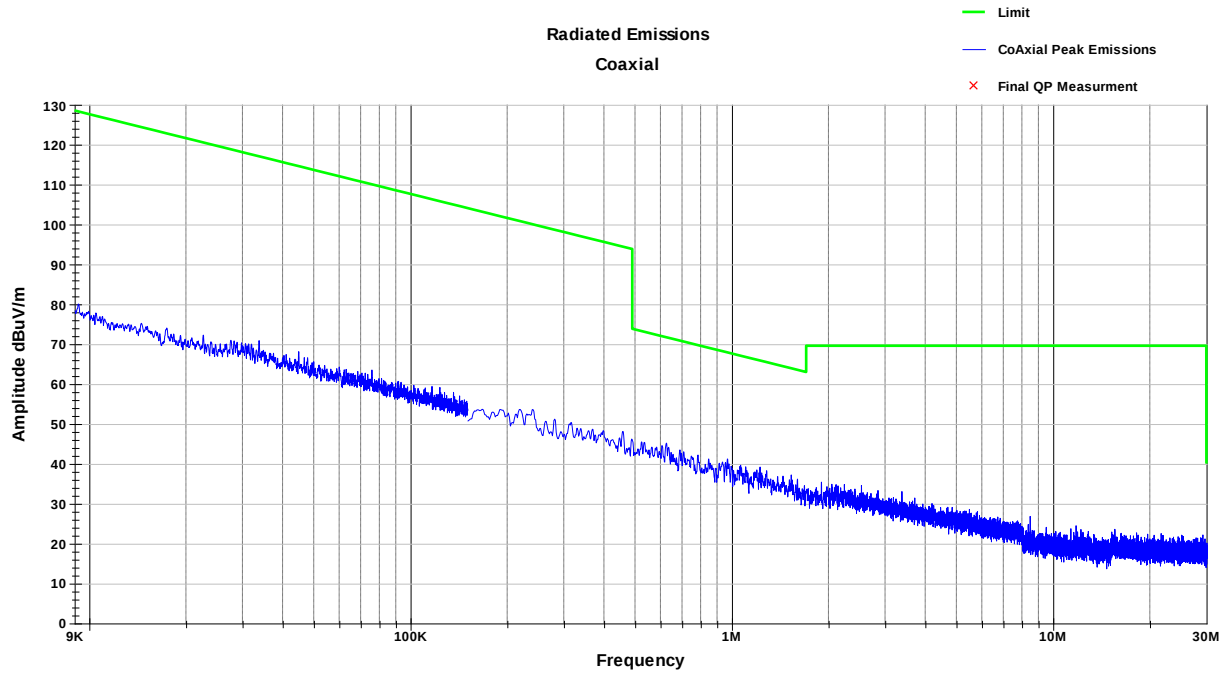
Test End Date: 20-Sep-2022

Tester: PL, ZH

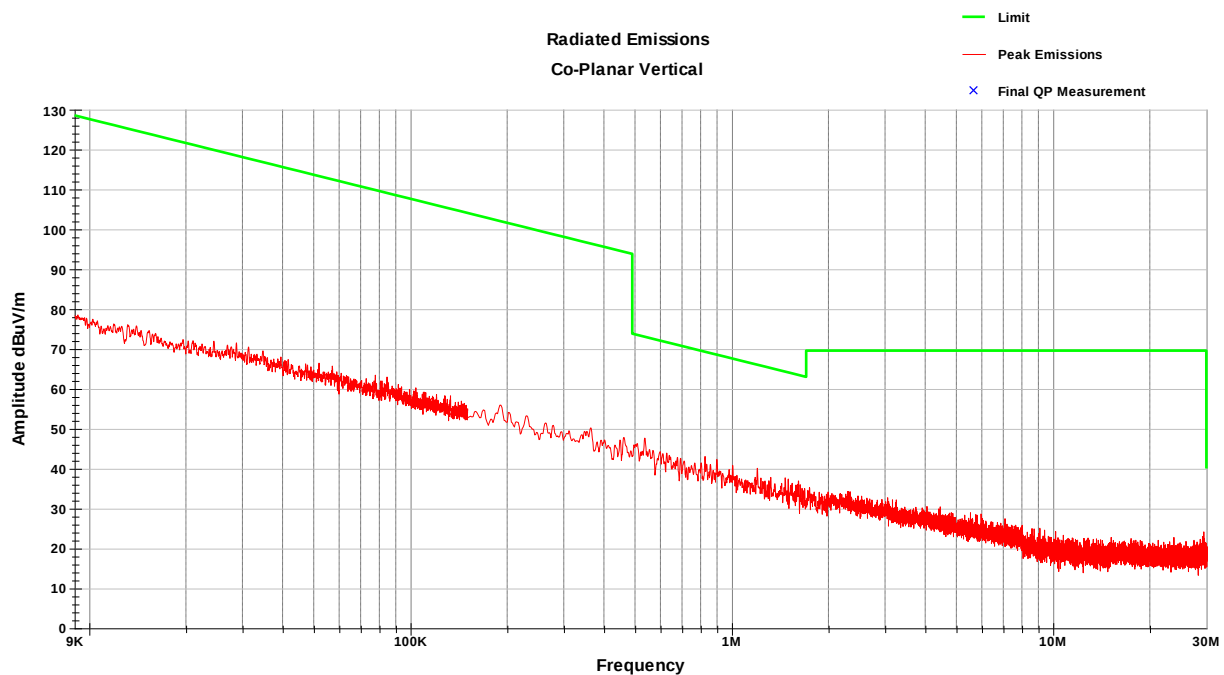
Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ANTENNA, DRG HORN	3117	ETS LINDGREN	B079691	15-Aug-2022	15-Aug-2024
RF CABLE NM TO NM, 0.01-18GHZ	90-195-157	TELEDYNE STORM MICROWAVE	20121	14-Feb-2022	14-Feb-2023
RF CABLE	104PE	HUBER & SUHNER	B079793	25-Aug-2022	25-Aug-2023
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	7-Oct-2021	7-Oct-2022
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22027	13-Sep-2022	13-Sep-2023
FILTER, HIGH PASS,	HPM50111	MICRO-TRONICS	22017	16-Jun-2022	16-Jun-2023

8.5 Test Data – Peak Plots

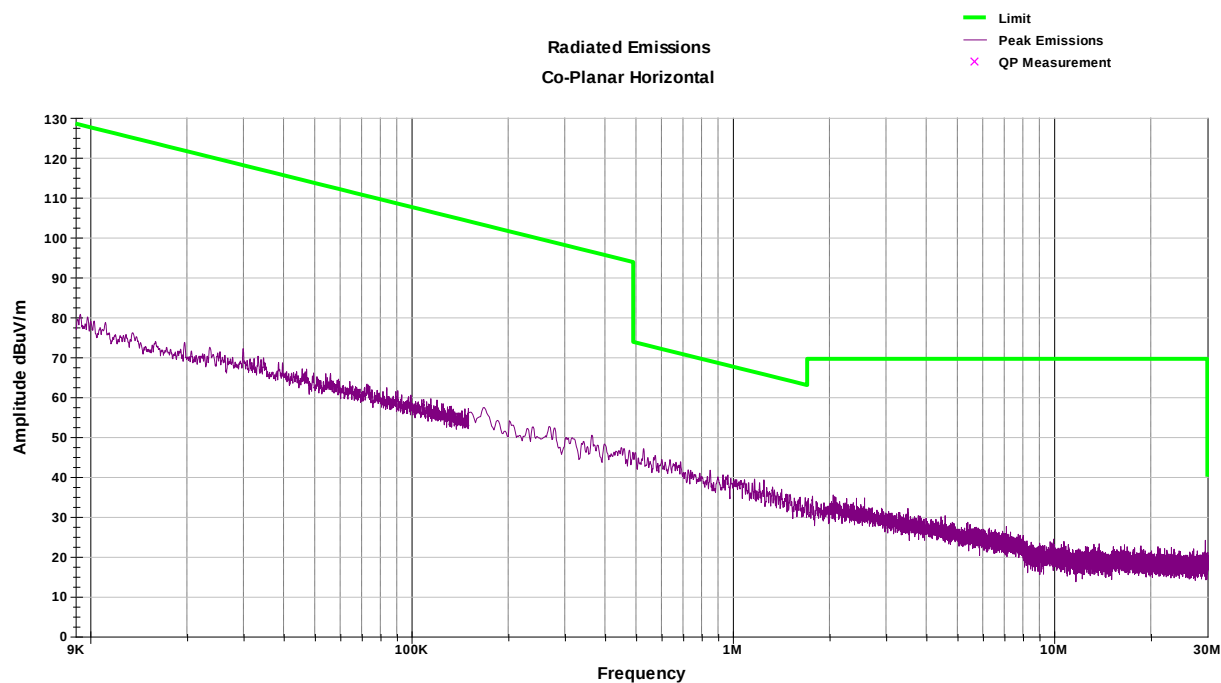
From 9kHz to 30MHz, there was no significant deviation with respect to axis or channel
Co-Axial Radiated Spurious Emissions – 9kHz-30MHz (MCH)



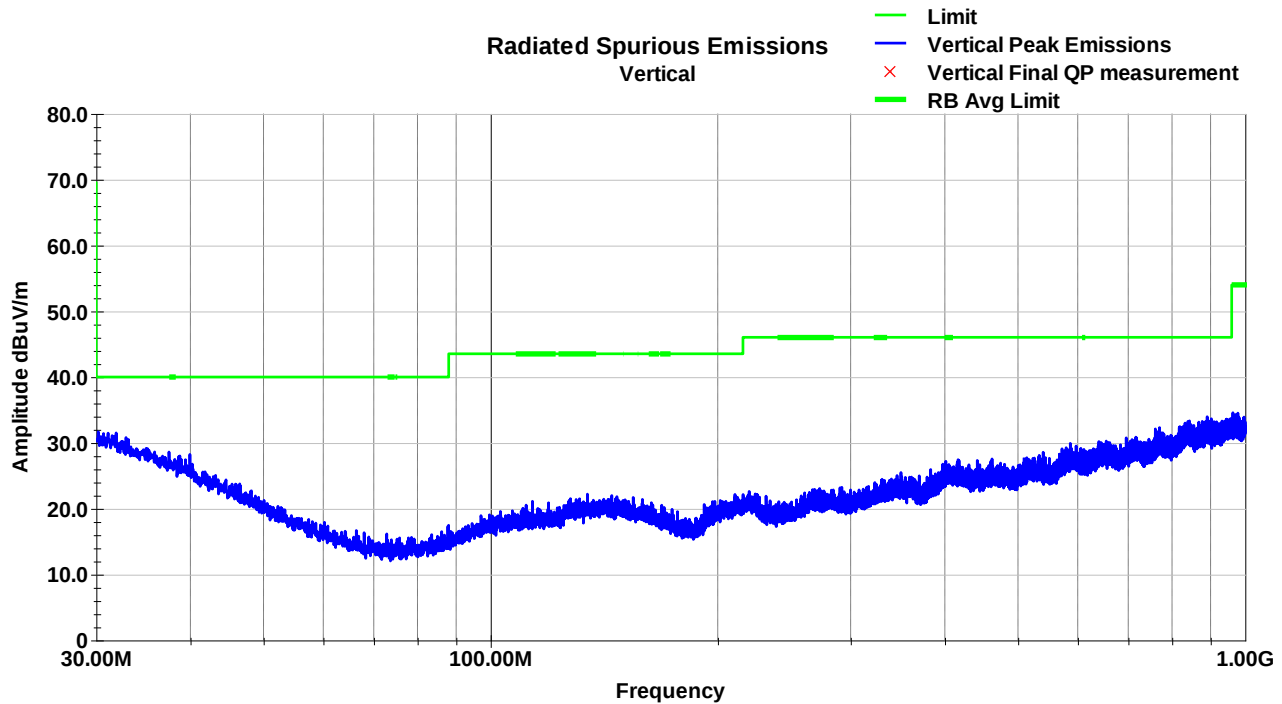
Co-Planar Radiated Spurious Emissions Vertical– 9kHz-30MHz (MCH)



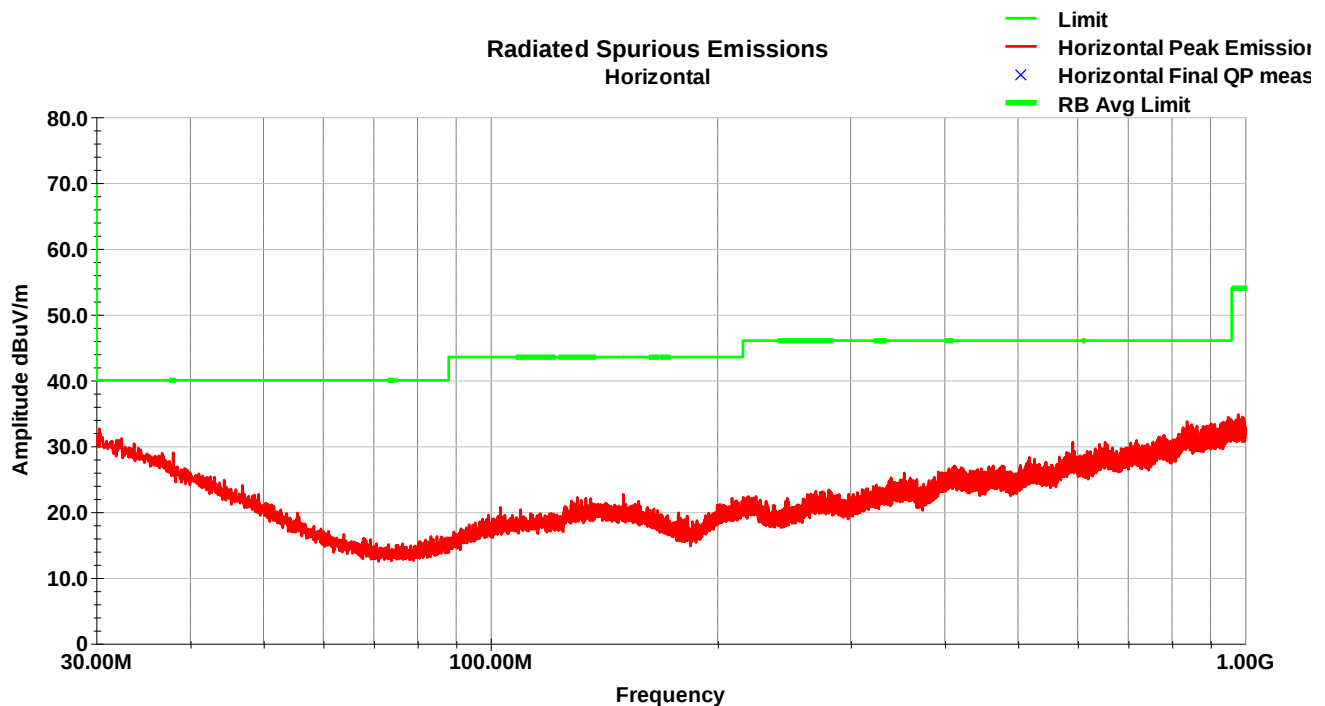
Co-Axial Radiated Spurious Emissions Horizontal – 9kHz-30MHz (MCH)



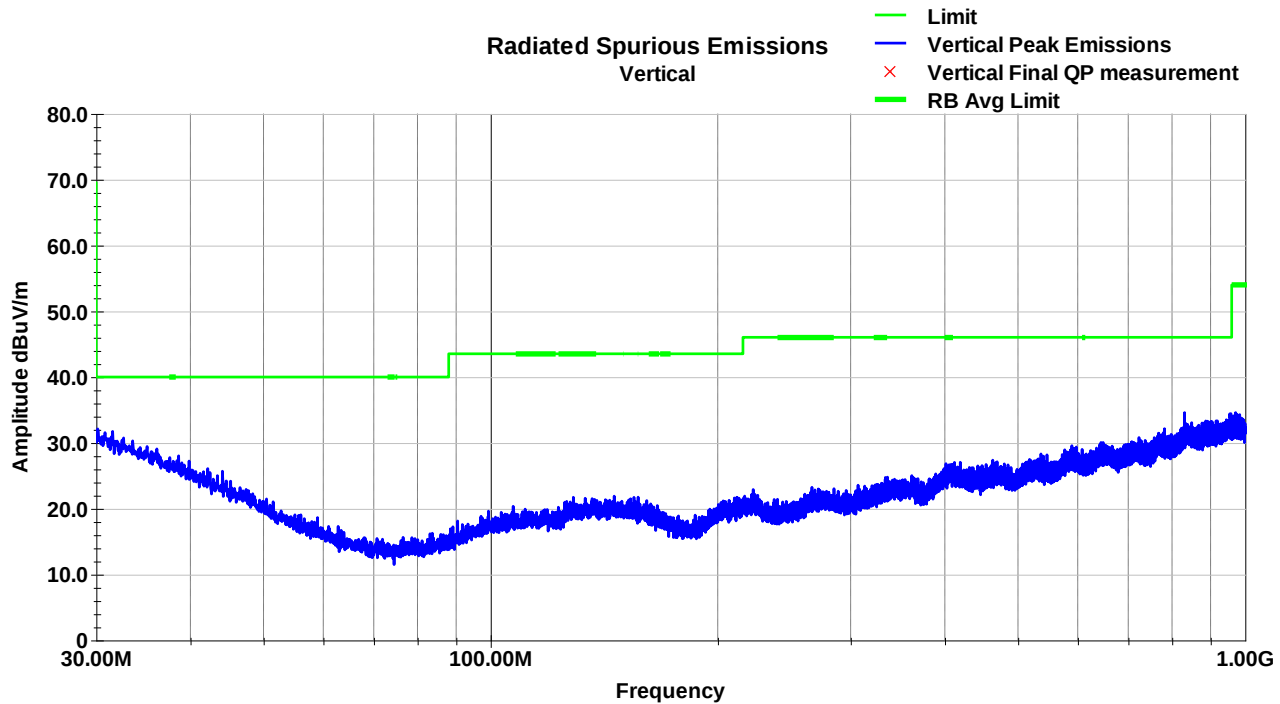
Vertical Radiated Spurious Emissions Plot – 30-1000MHz (LCH)



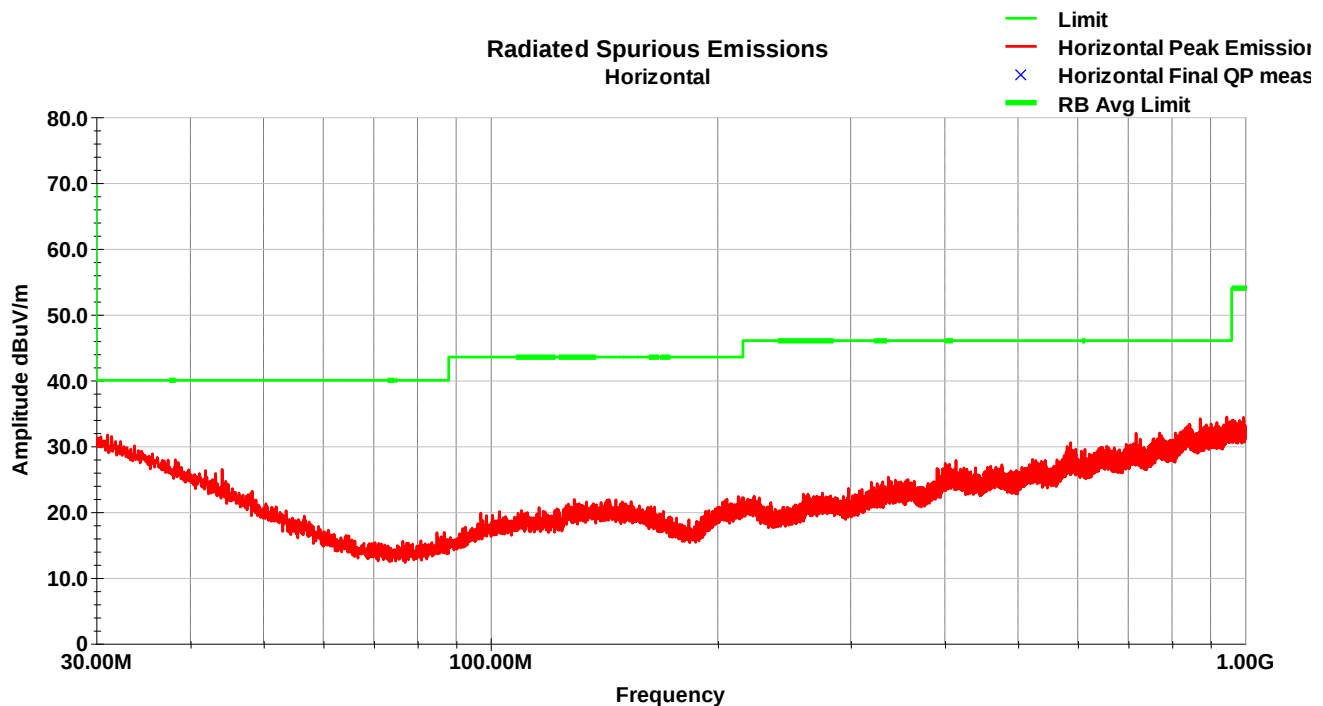
Horizontal Radiated Spurious Emissions– 30-1000MHz (LCH)



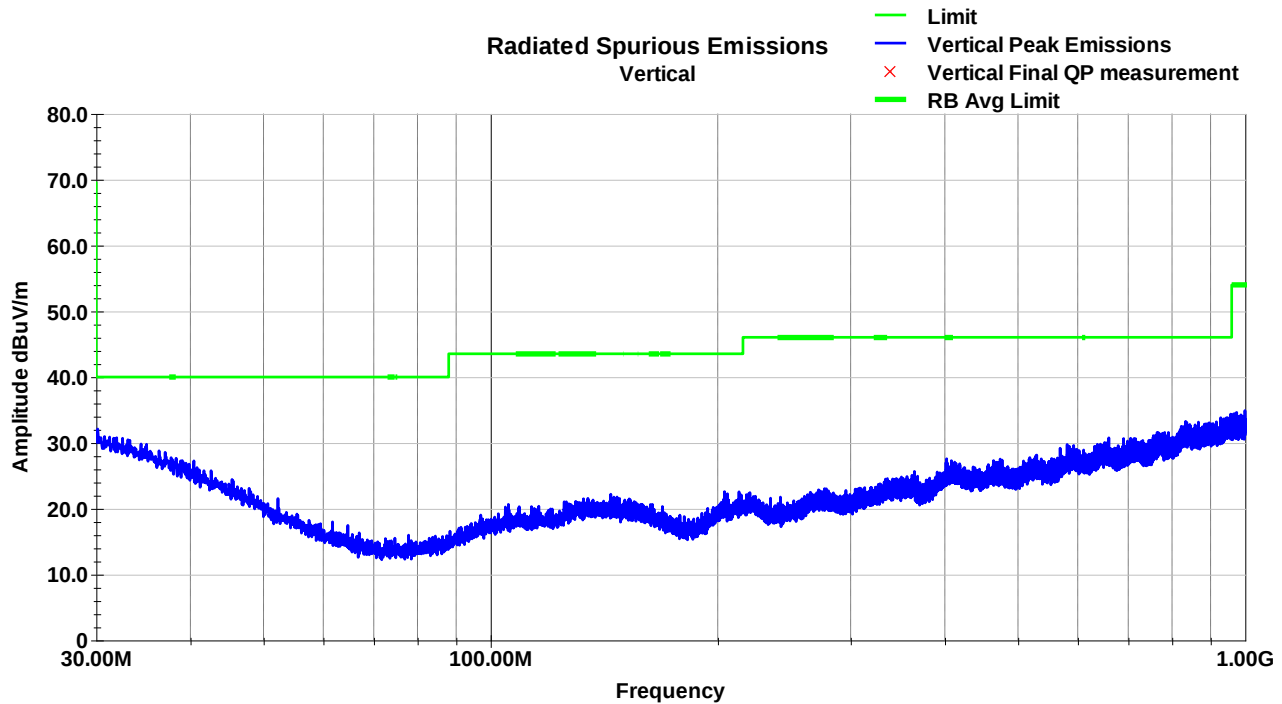
Vertical Radiated Spurious Emissions – 30-1000MHz (MCH)



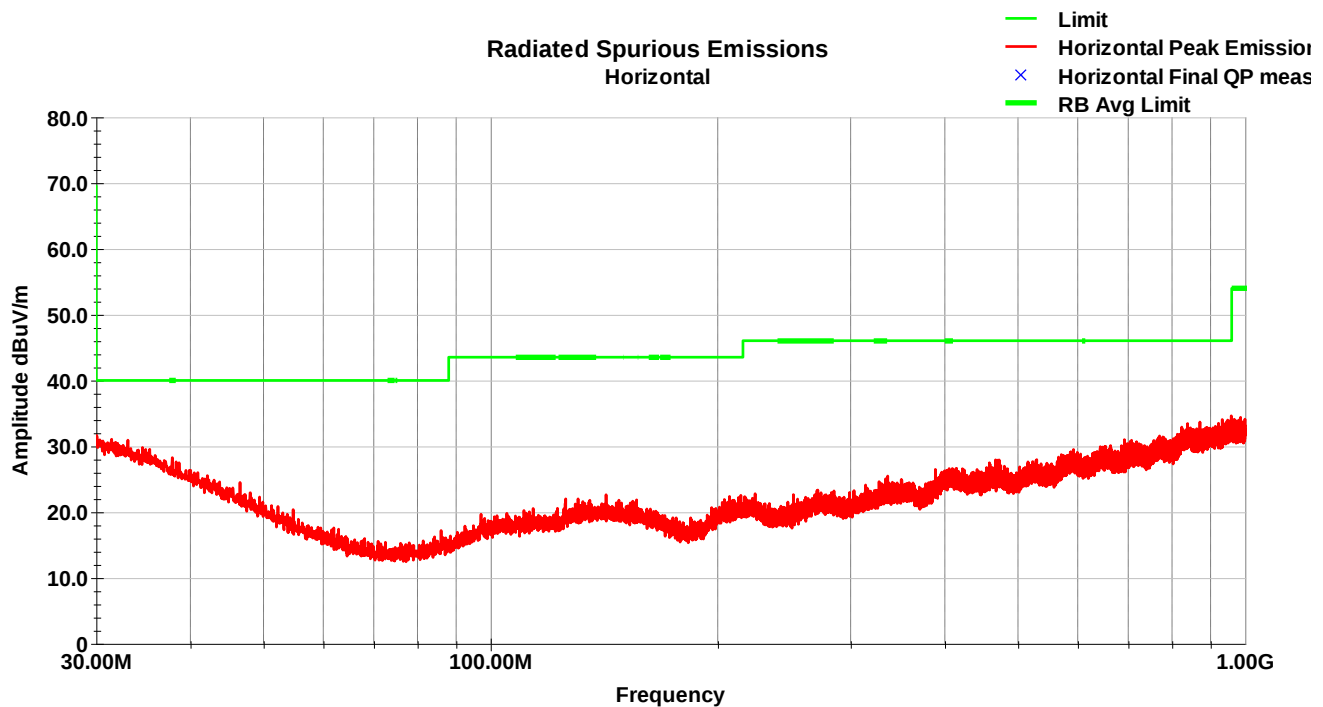
Horizontal Radiated Spurious Emissions– 30-1000MHz (MCH)



Vertical Radiated Spurious Emissions Plot – 30-1000MHz (HCH)

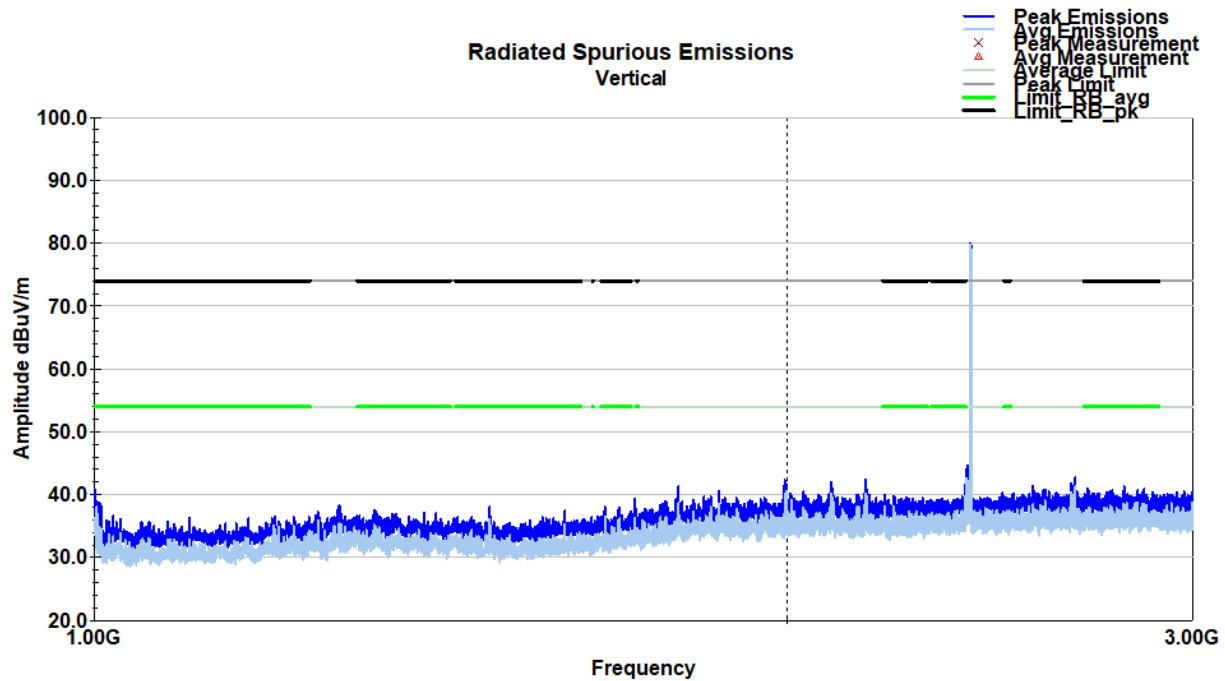


Horizontal Radiated Spurious Emissions– 30-1000MHz (HCH)

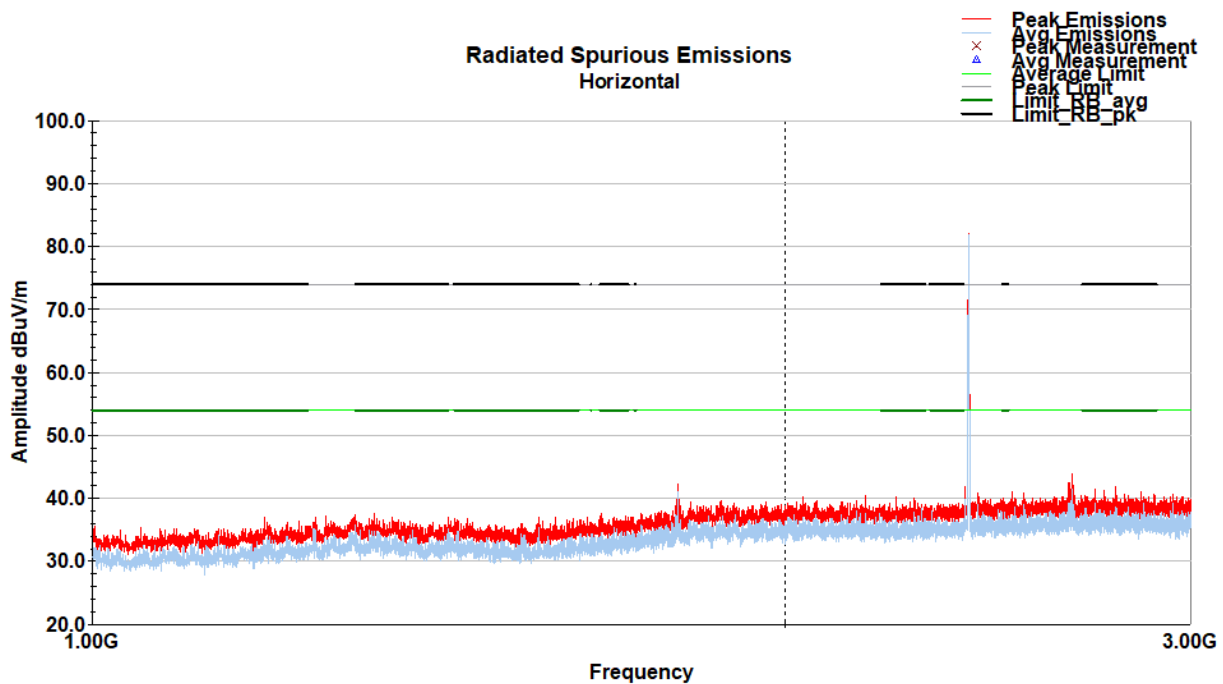


Note: No emissions exceeded above noise floor.

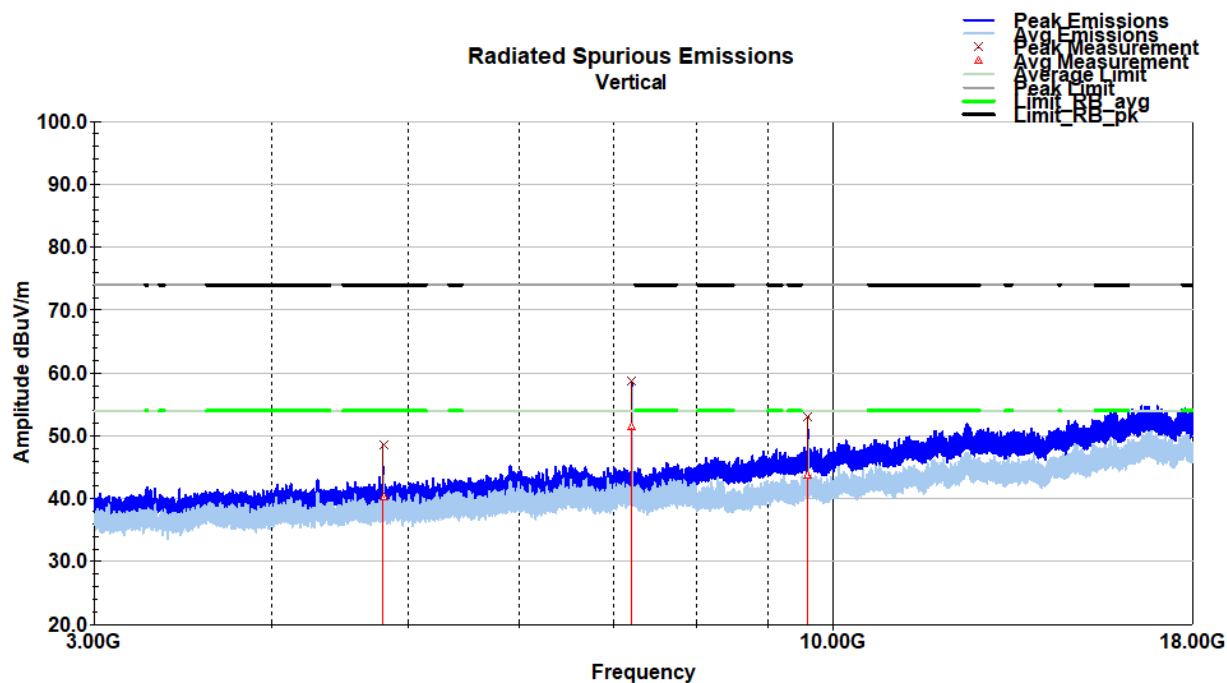
Vertical Radiated Spurious Emissions – 1-3GHz (LCH)



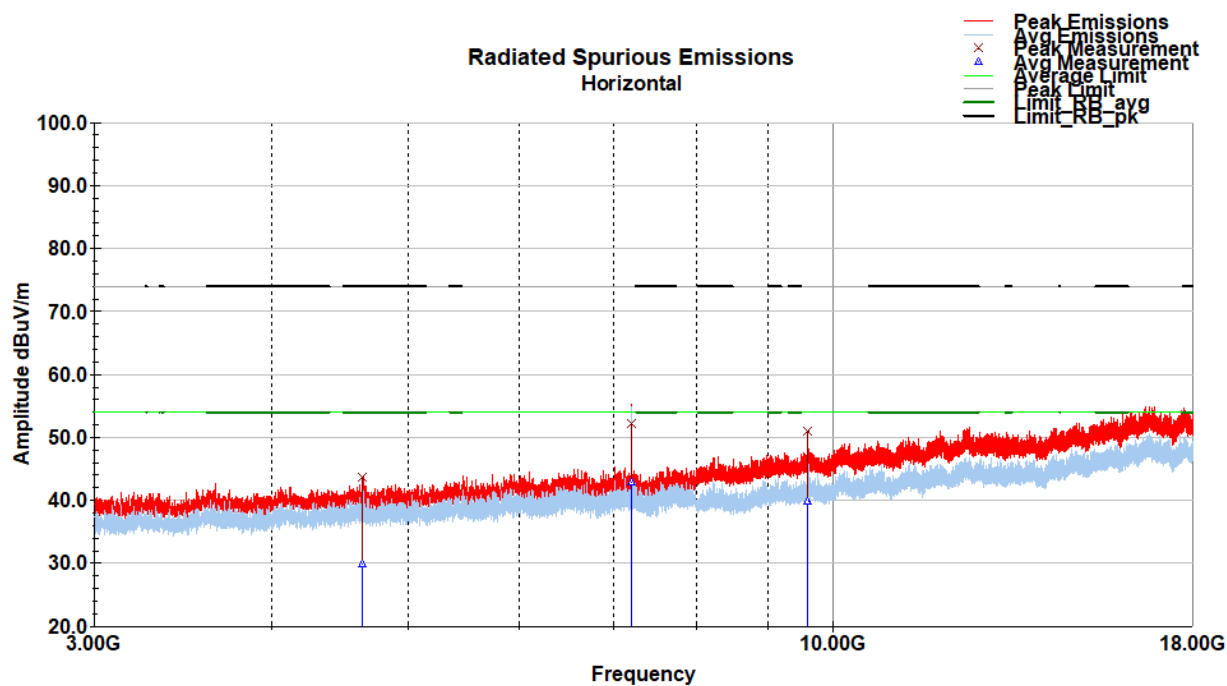
Horizontal Radiated Spurious Emissions – 1-3GHz (LCH)



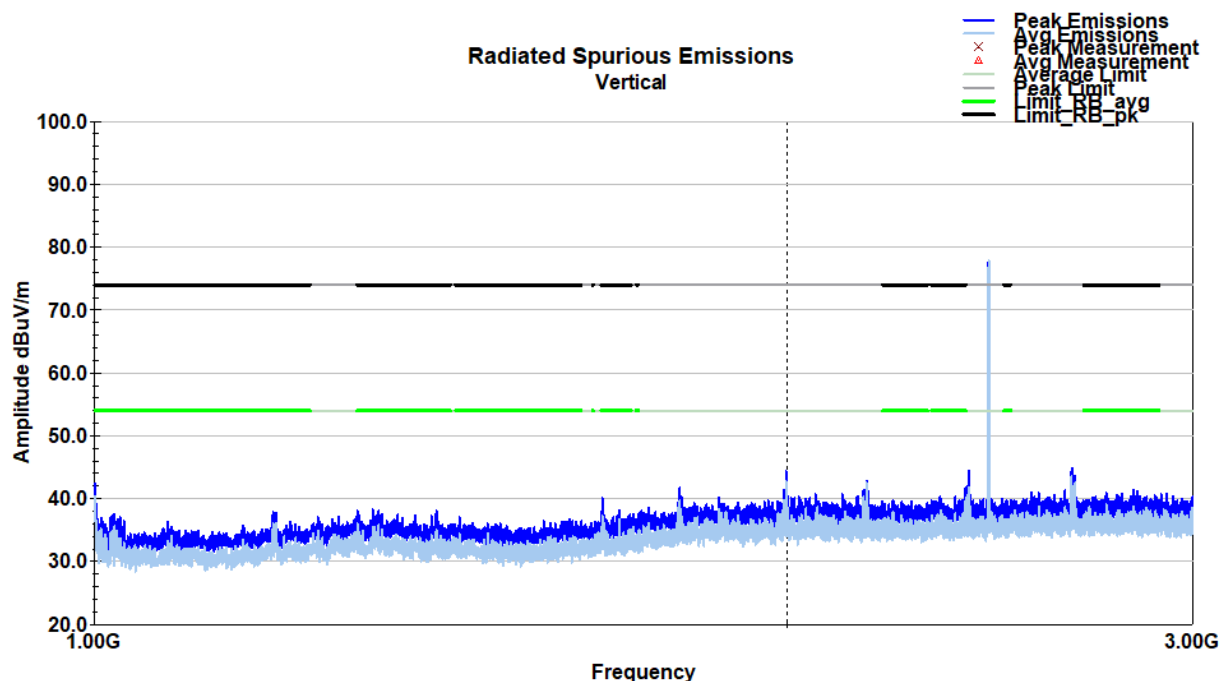
Vertical Radiated Spurious Emissions – 3-18GHz (LCH)



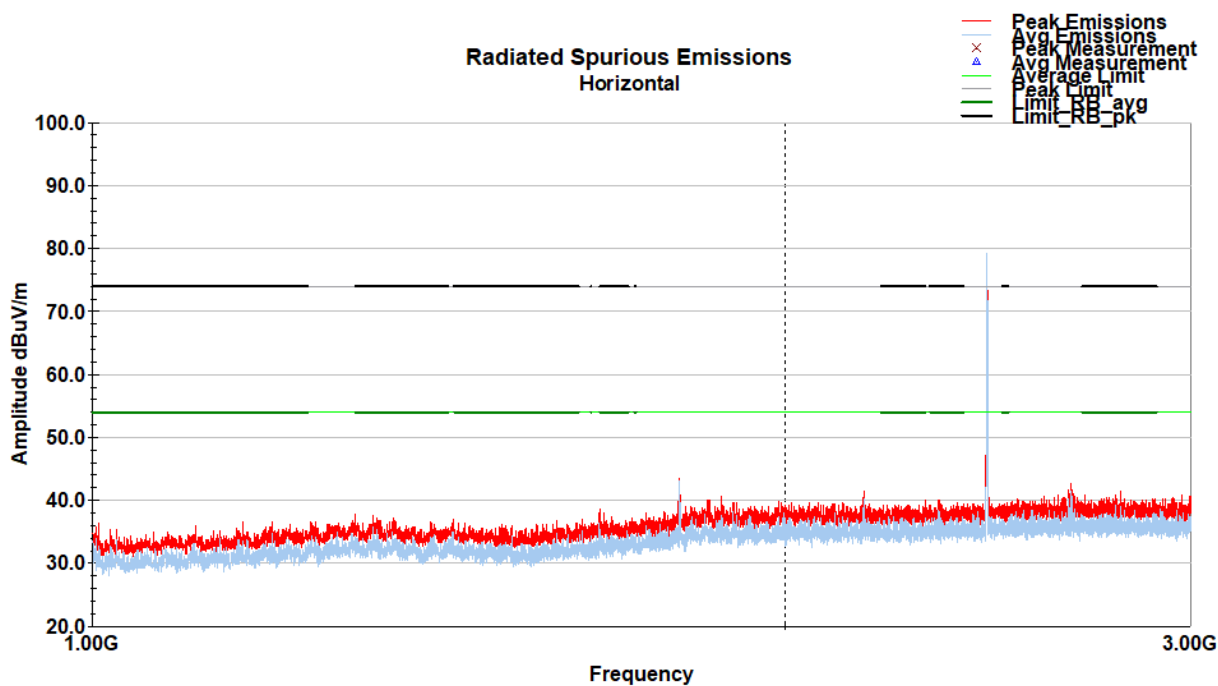
Horizontal Radiated Spurious Emissions – 3-18GHz (LCH)



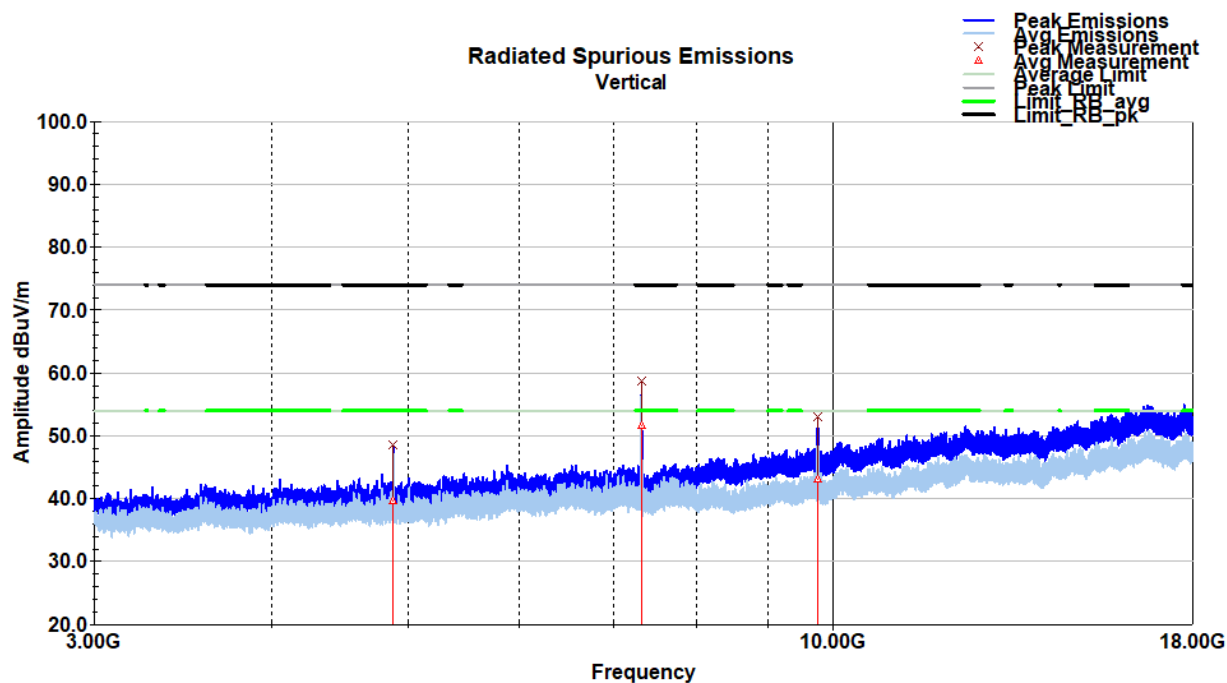
Vertical Radiated Spurious Emissions – 1-3GHz (MCH)



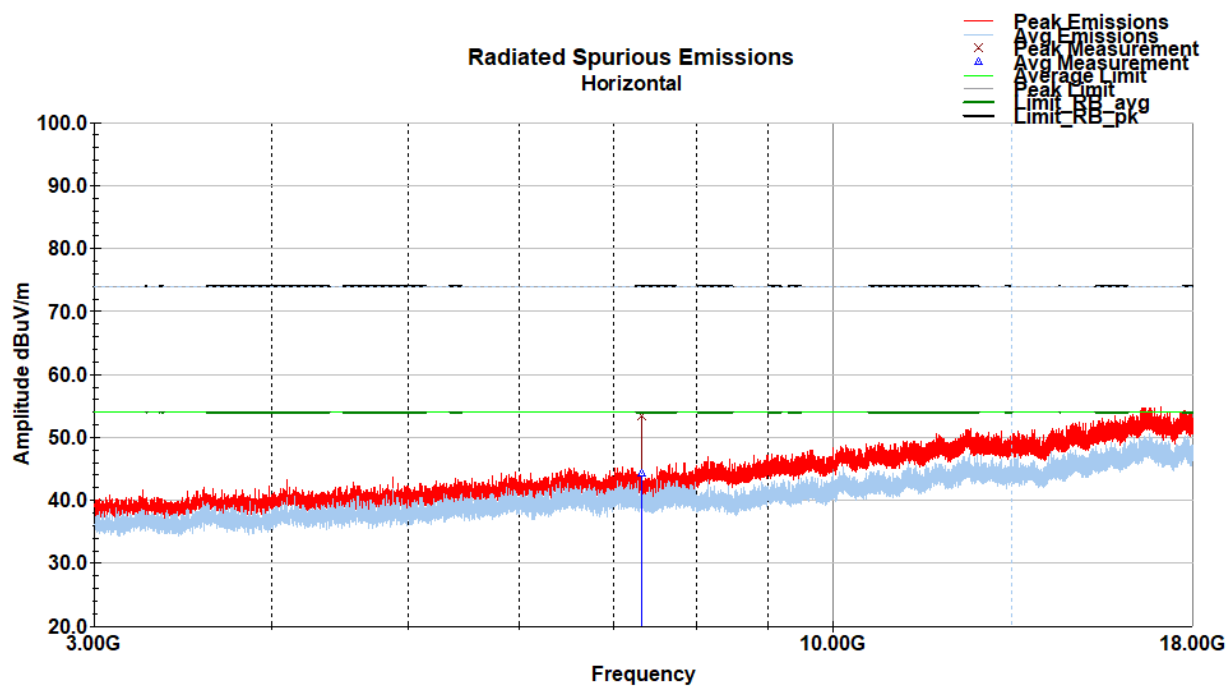
Horizontal Radiated Spurious Emissions – 1-3GHz (MCH)



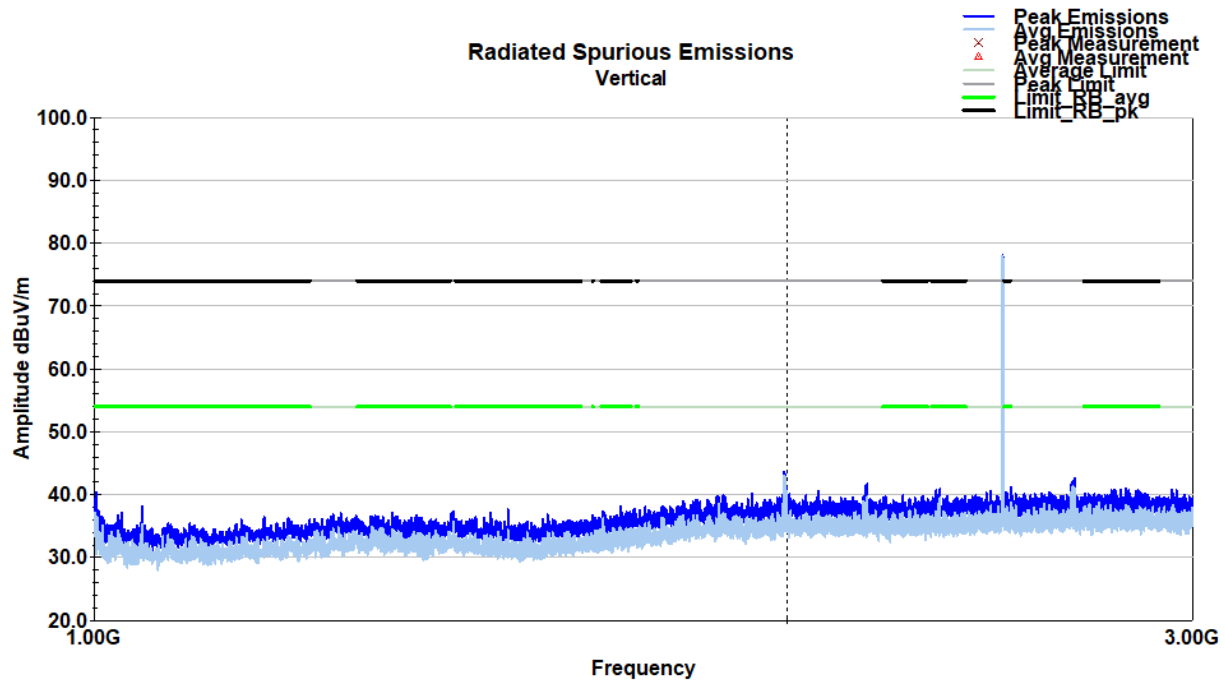
Vertical Radiated Spurious Emissions – 3-18GHz (MCH)



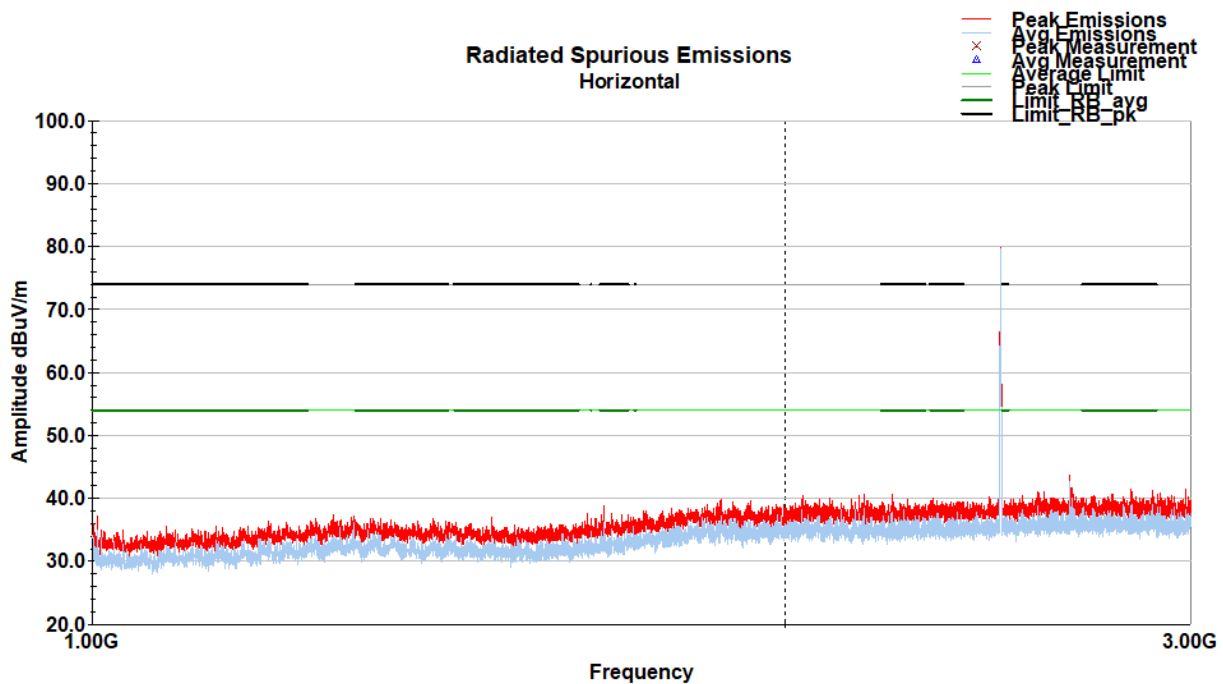
Horizontal Radiated Spurious Emissions – 3-18GHz (MCH)



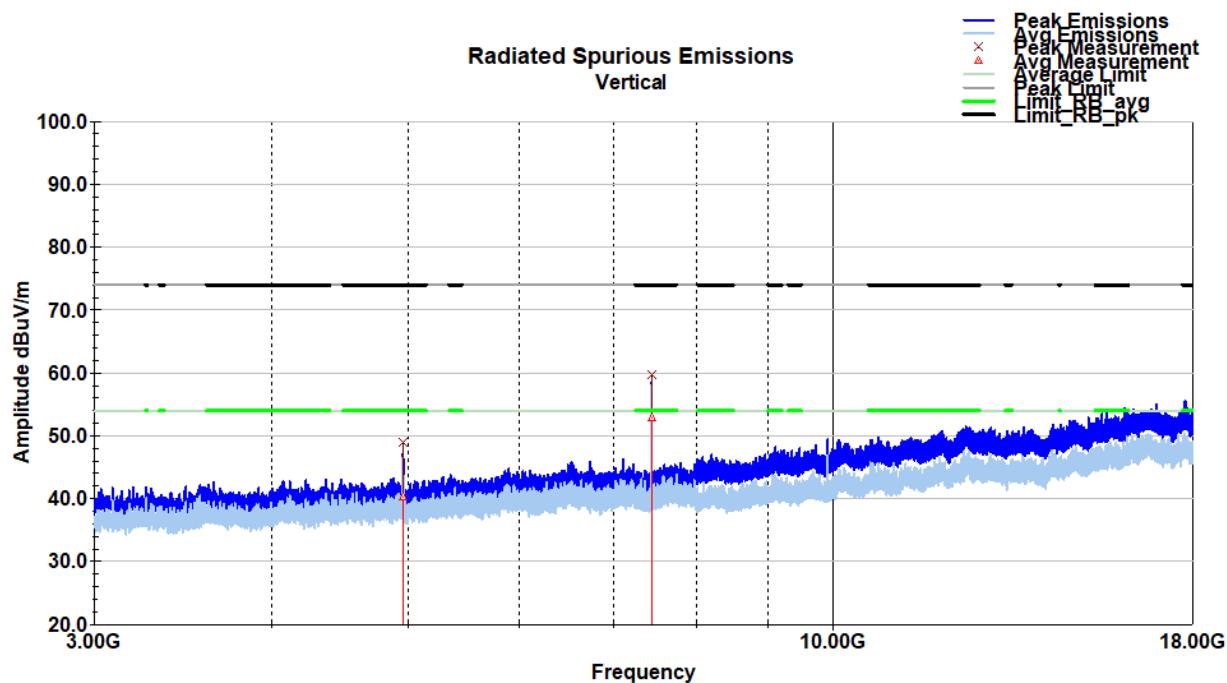
Vertical Radiated Spurious Emissions – 1-3GHz (HCH)



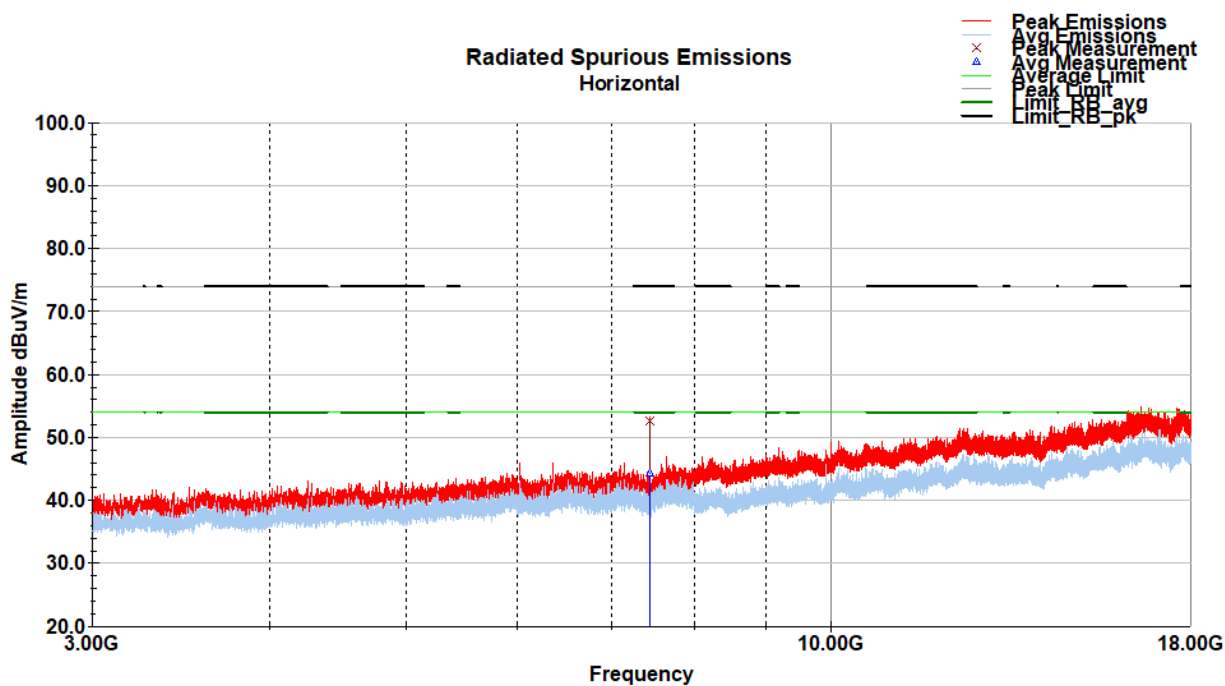
Horizontal Radiated Spurious Emissions – 1-3GHz (HCH)



Vertical Radiated Spurious Emissions – 3-18GHz (HCH)



Horizontal Radiated Spurious Emissions – 3-18GHz (HCH)



8.1 Tabulated Data

Tabular Test Results – (LCH)

Vertical Peak Data

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
4803.66	53.8	V	334.0	107.0	33.9	2.8	42.0	48.6	74.0	-25.4
7206.68	61.2	V	37.0	100.0	35.6	3.5	41.7	58.7	74.0	-15.3
9607.16	54.0	V	118.0	132.0	36.6	4.3	41.9	53.0	74.0	-21.0
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Vertical Average Data

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	Limit (dBuV/m)	Margin (dB)
4803.66	45.4	V	334.0	107.0	33.9	2.8	42.0	40.2	54.0	-13.8
7206.68	53.8	V	37.0	100.0	35.6	3.5	41.7	51.3	54.0	-2.7
9607.16	44.7	V	118.0	132.0	36.6	4.3	41.9	43.8	54.0	-10.2
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Horizontal Peak Data

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
7319.16	55.8	H	251.0	250.0	35.5	3.6	41.6	53.3	74.0	-20.7
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Horizontal Average Data

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
7319.16	46.8	H	251.0	250.0	35.5	3.6	41.6	44.3	54.0	-9.6
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Tabular Test Results – MCH

Vertical Peak Data

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
4879.34	53.6	V	340.0	116.0	34.1	2.9	42.0	48.6	74.0	-25.4
7320.74	61.2	V	169.0	105.0	35.5	3.6	41.6	58.7	74.0	-15.3
9758.92	53.9	V	236.0	166.0	36.8	4.3	41.9	53.1	74.0	-20.9
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Vertical Average Data

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	Limit (dBuV/m)	Margin (dB)
4879.34	44.6	V	340.0	116.0	34.1	2.9	42.0	39.6	54.0	-14.4
7320.74	54.0	V	169.0	105.0	35.5	3.6	41.6	51.5	54.0	-2.4
9758.92	44.0	V	236.0	166.0	36.8	4.3	41.9	43.1	54.0	-10.8
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Horizontal Peak Data

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
7319.16	55.8	H	251.0	250.0	35.5	3.6	41.6	53.3	74.0	-20.7
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Horizontal Average Data

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
7319.16	46.8	H	251.0	250.0	35.5	3.6	41.6	44.3	54.0	-9.6
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Tabular Test Results – HCH

Vertical Peak Data

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	Limit (dBuV/m)	Margin (dB)
4960.64	45.2	V	354.0	100.0	34.0	2.9	42.0	40.2	54.0	-13.8
7440.64	55.4	V	168.0	120.0	35.5	3.6	41.6	52.9	54.0	-1.1
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Vertical Average Data

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
4960.64	54.0	V	354.0	100.0	34.0	2.9	42.0	49.0	74.0	-25.0
7440.64	62.1	V	168.0	120.0	35.5	3.6	41.6	59.7	74.0	-14.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Horizontal Peak Data

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
7440.64	46.8	H	126.0	250.0	35.5	3.6	41.6	44.3	54.0	-9.7
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Horizontal Average Data

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
7440.64	55.1	H	126.0	250.0	35.5	3.6	41.6	52.6	74.0	-21.4
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

9 Emissions in Restricted Frequency Bands (Band Edge)

9.1 Test Result

Test Description	Test Specification		Test Result
Restricted Band Emissions	15.205 / 15.209	RSS-GEN S8.9 / 8.10	Compliant

9.2 Test Method

Field strength measurements were performed at the restricted band edges of 2390MHz and 2483.5MHz for each modulation. Measurements were made using the conducted methods defined in ANSI C63.10, Section 11.12.2.

9.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.3 °C

Relative Humidity: 54.3 %

Atmospheric Pressure: 97.79 kPa

9.4 Test Equipment

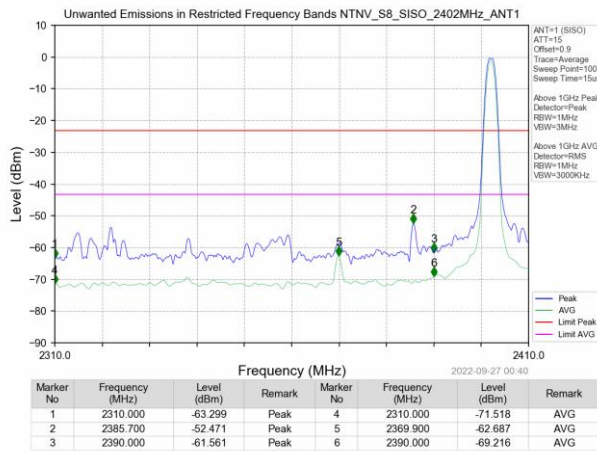
Test End Date: 26-Sep-2022

Tester: AB

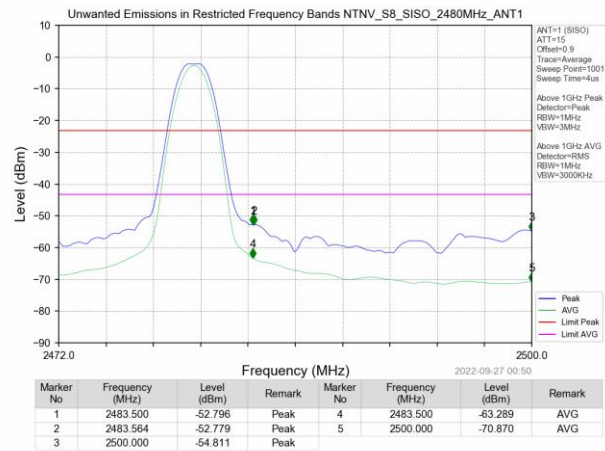
Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095587	13-Jul-2022	13-Jul-2023
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	4-Jan-2022	4-Jan-2024

9.5 Test Data – Restricted Band Edges

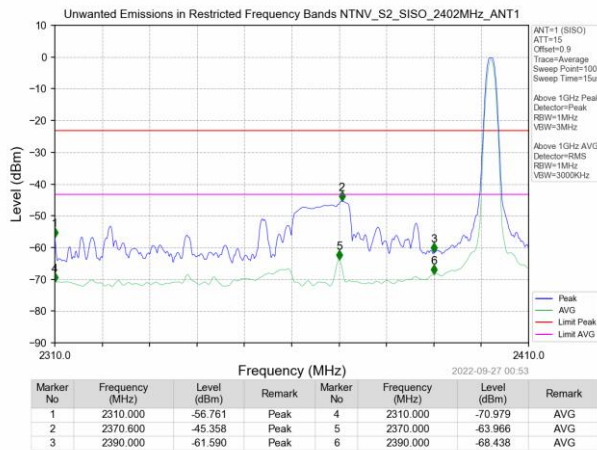
S8 Low Channel



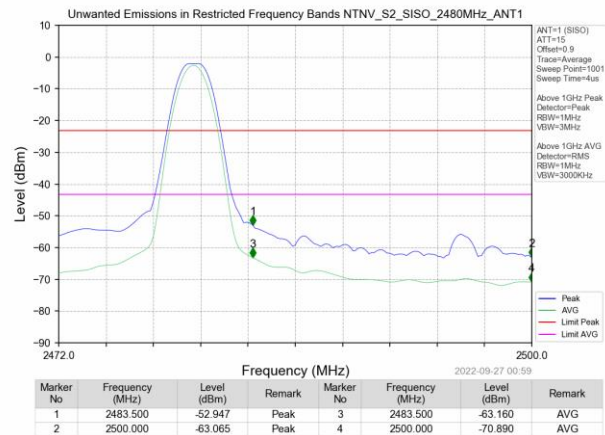
S8 High Channel



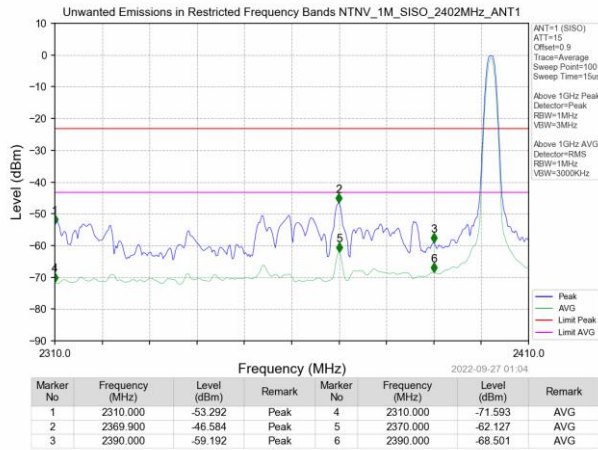
S2 Low Channel



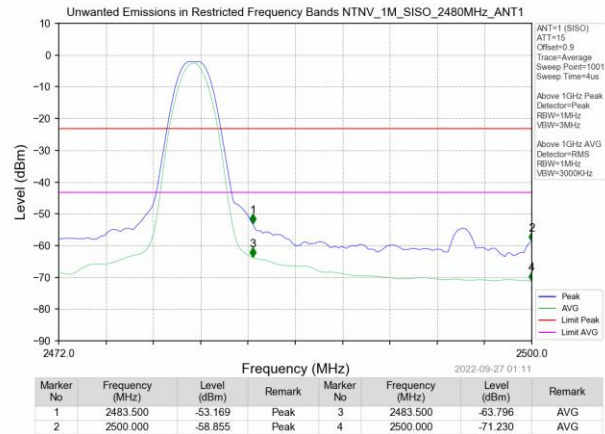
S2 High Channel



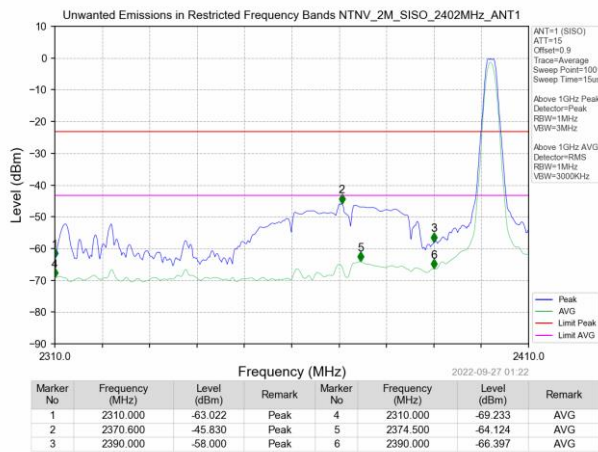
1M Low Channel



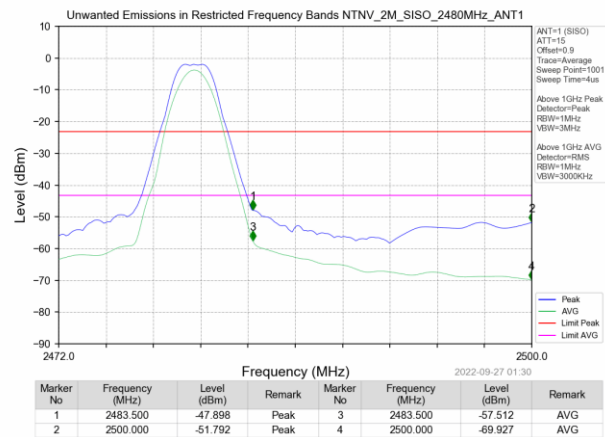
1M High Channel



2M Low Channel



2M High Channel



10 Conducted Emissions

10.1 Test Result

Test Description	Test Specification	Test Result
Conducted Emissions	RSS-GEN ANSI C63.4:2014	Compliant

10.2 Test Method

With the receiver's Resolution Bandwidth (RBW) set to 9 kHz, exploratory scans were performed over the measuring frequency range (0.15MHz to 30MHz) using a max hold mode incorporating a Peak detector and using the TILE! software. The final test data was measured using a 9kHz RBW in conjunction with a Quasi-Peak detector and Average detector and compared against the limits indicated in the table below.

Frequency Range	Limits (dBμV)
0.15 to 0.5 MHz	Quasi-Peak 66 to 56 / Average 56 to 46
0.5 to 5 MHz	Quasi-Peak 56 / Average 46
5 to 30 MHz	Quasi-Peak 60 / Average 50

10.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.7°C

Relative Humidity: 25.5%

Atmospheric Pressure: 98.78 kPa

10.4 Test Equipment

Test End Date: 14-Mar-2022

Tester: ZH

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	9-Jul-2021	9-Jul-2022
LINE IMPEDANCE STABILIZATION NETWORK	NNB 51	TESEQ	B087573	3-Feb-2022	3-Feb-2023
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17016	25-Aug-2021	25-Aug-2022

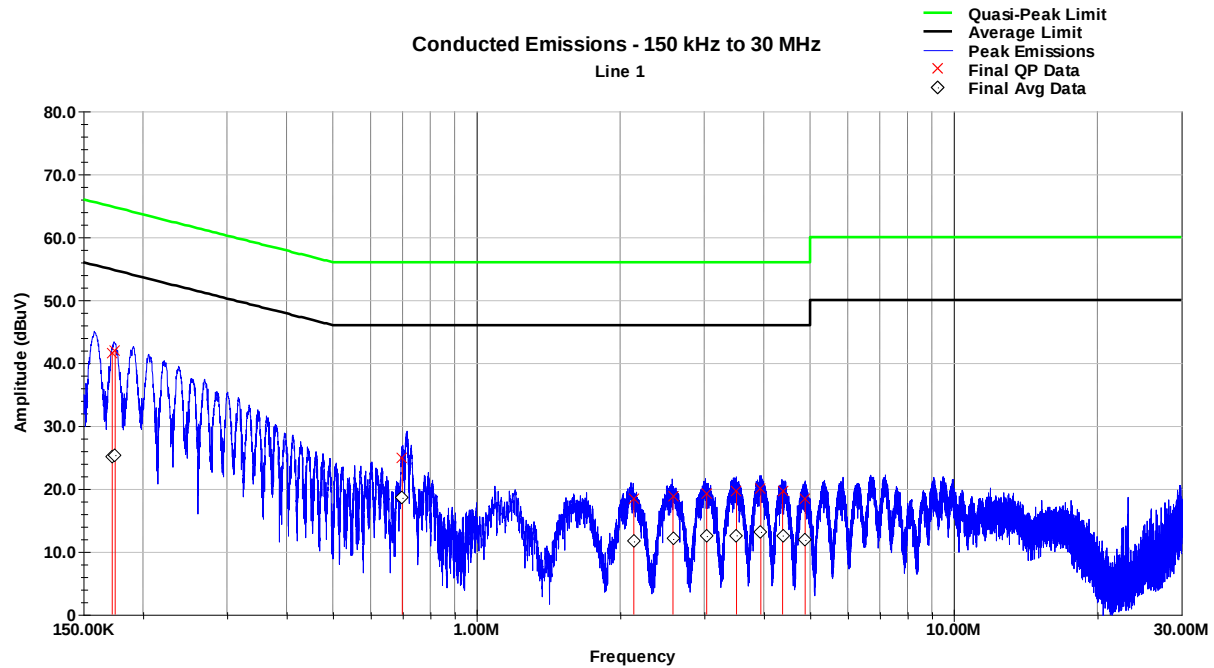
Note: Refer to the table for calibration intervals.

Software:

TILE! software profile "Conducted Emissions Tile7 210216.til" dated 16 02 2021

10.5 Test Data

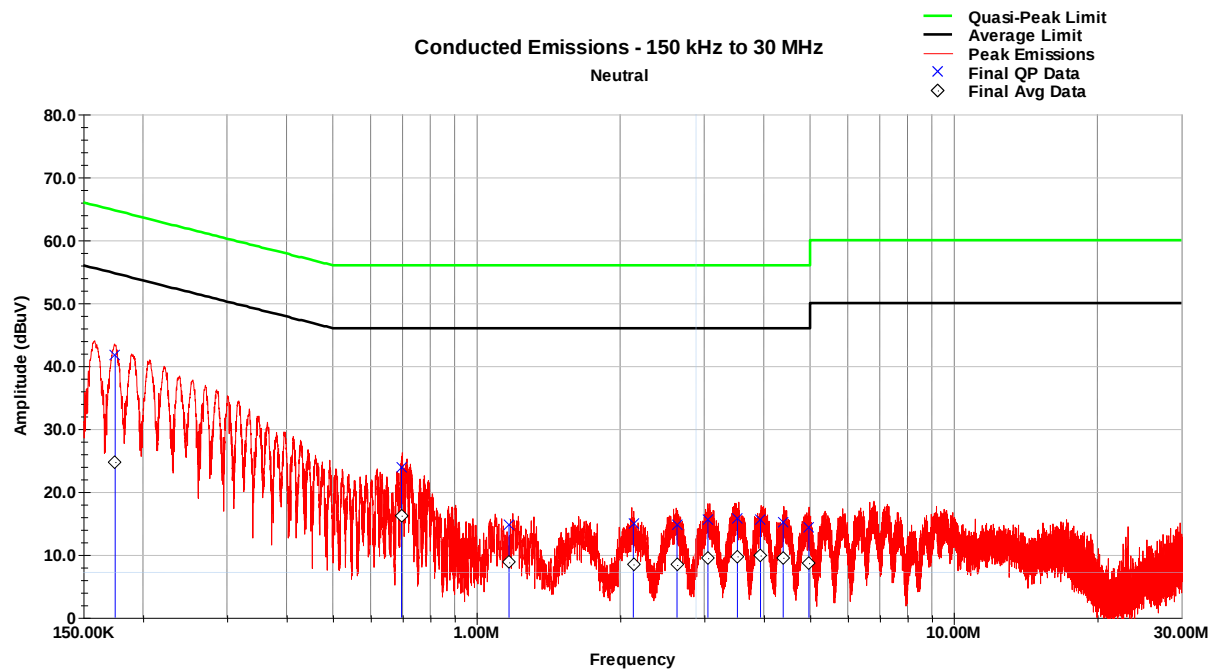
Line 1 Conducted Emissions – Peak Plot



Line 1 Conducted Emissions – Tabular Data

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.172	41.6	64.8	-23.2	25.1	54.9	-29.7
0.175	42.0	64.7	-22.7	25.4	54.7	-29.3
0.699	25.0	56.0	-31.0	18.6	46.0	-27.4
2.136	18.4	56.0	-37.6	11.6	46.0	-34.4
2.581	18.8	56.0	-37.2	12.0	46.0	-34.0
3.037	19.3	56.0	-36.7	12.5	46.0	-33.5
3.507	19.6	56.0	-36.4	12.6	46.0	-33.4
3.943	20.0	56.0	-36.0	13.2	46.0	-32.8
4.379	19.5	56.0	-36.5	12.6	46.0	-33.4
4.883	18.5	56.0	-37.5	11.9	46.0	-34.1

Neutral Conducted Emissions – Peak Plot



Neutral Conducted Emissions – Tabular Data

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.175	41.7	64.7	-23.0	24.8	54.7	-29.9
0.696	23.9	56.0	-32.1	16.2	46.0	-29.8
1.170	14.8	56.0	-41.2	8.8	46.0	-37.2
2.132	14.9	56.0	-41.1	8.5	46.0	-37.5
2.631	14.7	56.0	-41.3	8.4	46.0	-37.6
3.055	15.5	56.0	-40.5	9.5	46.0	-36.5
3.521	15.7	56.0	-40.3	9.8	46.0	-36.2
3.937	15.7	56.0	-40.3	9.9	46.0	-36.1
4.393	15.1	56.0	-40.9	9.5	46.0	-36.5
4.974	14.3	56.0	-41.7	8.7	46.0	-37.3

11 Measurement Uncertainty

The measurement uncertainty figures are be calculated in accordance with TR 100 028-1 [2] and correspond to an expansion factor (coverage factor) $k = 2$ (which provide confidence levels of 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Parameter	Expanded Uncertainty for Normal k factor equal to 2	
	Required	Laboratory Actual
Radio Frequency	$\pm 1 \times 10^{-5}$	$\pm 9.8 \times 10^{-8}$
total RF power, conducted	± 1.5 dB	± 1.2 dB
RF power density, conducted	± 3 dB	± 0.7 dB
spurious emissions, conducted	± 3 dB	± 2.1 dB
all emissions, radiated	± 6 dB	± 4.8 dB
temperature	$\pm 1^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$
humidity	± 5 %	± 3.5 %
DC and low frequency voltages	± 3 %	± 0.4 %

12 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	28 September 2022
1	Added section 3 – Antenna requirement	31 October 2022