

RF Test Report

Project Number: 4724254

Proposal: SUW-202101000320

Report Number: 4724254EMC10

Revision Level: 1

Client: Deere & Company

Equipment Under Test: JLink R Modem - 4G

Model Number: MA4R

FCC ID: OV5-MA4R

IC ID: 11137A-MA4R

Applicable Standards: ANSI C63.10: 2013 (FCC Part 15 Subpart C, § 15.247)

RSS-247, Issue 2

RSS-GEN Issue 5

Report issued on: 12 January 2022

Test Result: Compliant



FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 3212.01

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

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Reviewed by:


David Schramm, Operations Manager

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 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
Field Strength of Spurious Radiation	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	NA ¹

1) The device has no facility for connection to the AC mains.

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: Deere & Company
Address: One John Deere Place
City, State, Zip, Country: Moline, IL 61265, 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: JDLINK R Modem - 4G
Model Number: MA4R
Serial Number: PCMA4MA200091

Frequency Range: 2402 – 2480 MHz
Data Modes: Bluetooth LE / GFSK
Antenna: External Proprietary – (-2.62 to -0.44dBi)

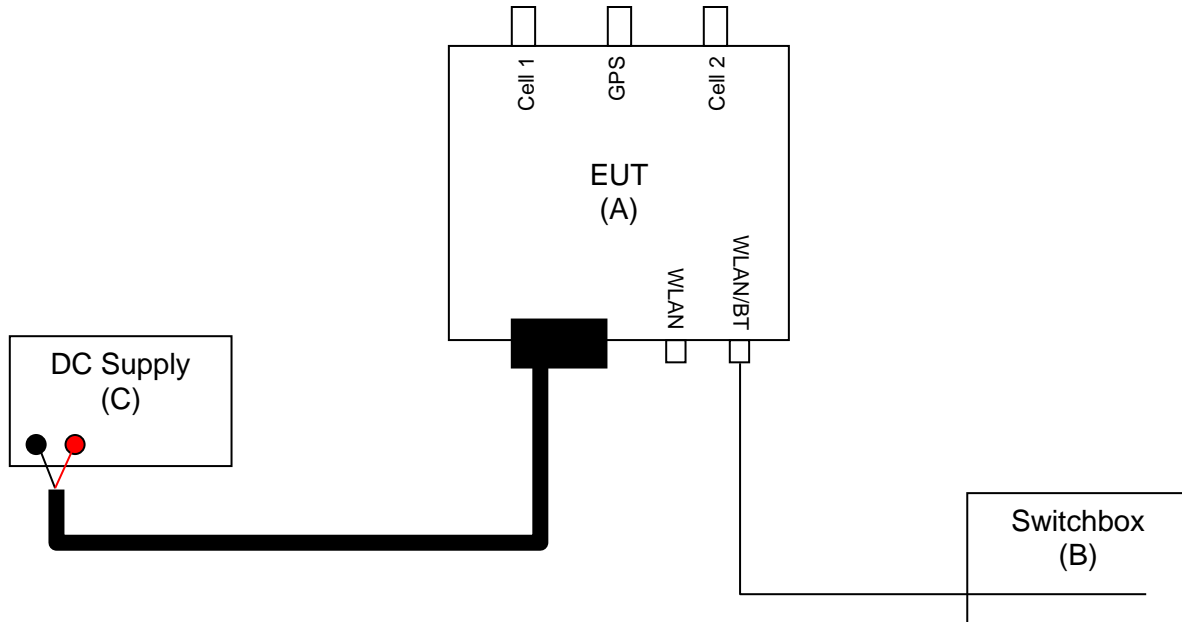
Rated Voltage: 9 – 32Vdc
Test Voltage: 12Vdc

Sample Received Date: 10 April 2021
Dates of testing: 20– 27 April 2021

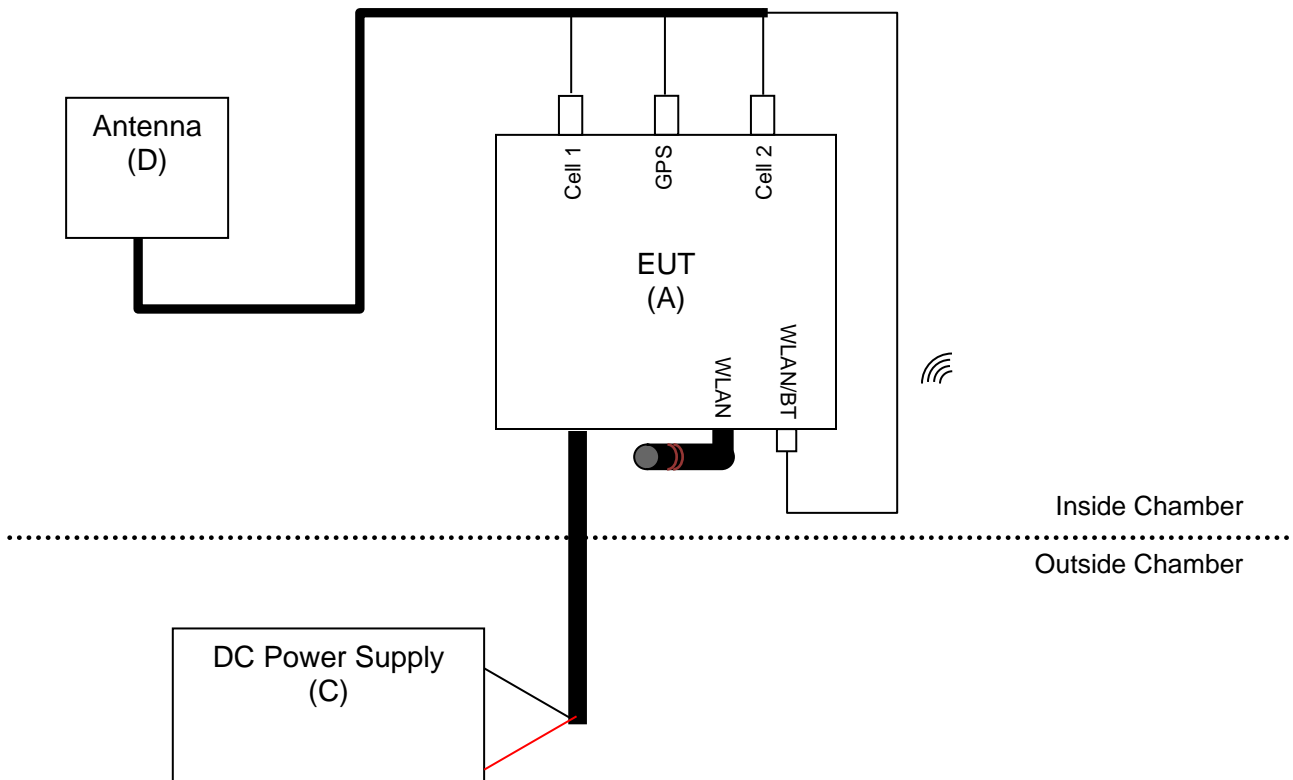
2.4 Operating Modes and Conditions

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.

2.5 EUT Connection Block Diagram – Conducted Measurements



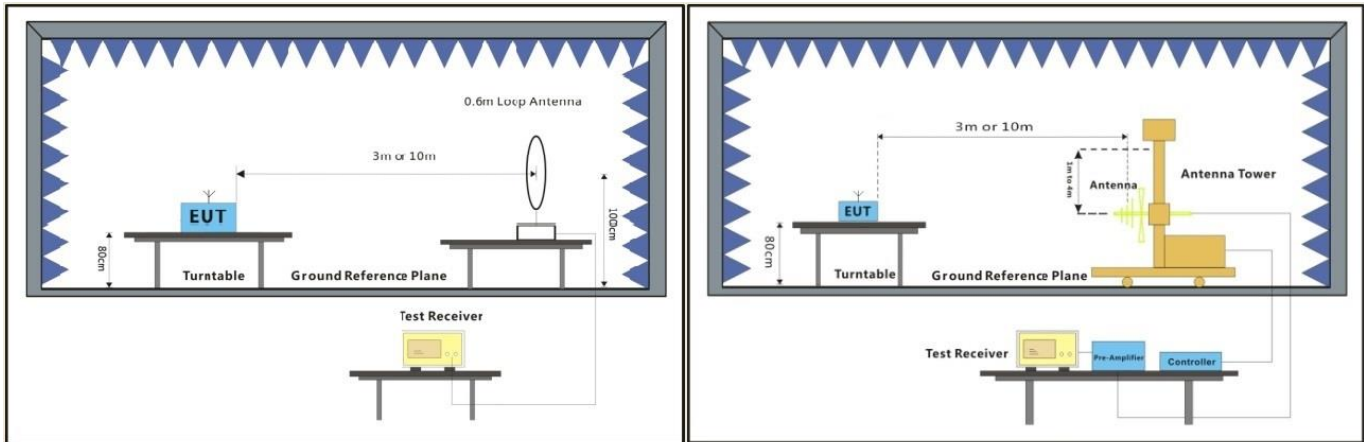
2.6 EUT Connection Block Diagram – Radiated Measurements



2.7 System Configurations

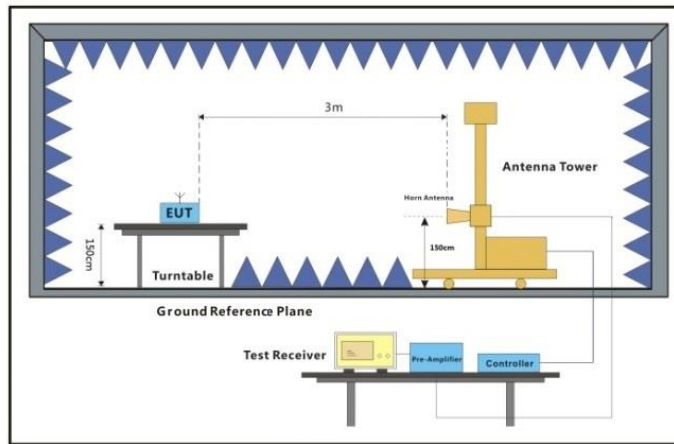
Device reference	Manufacturer	Description	Model Number	Serial Number
A	Deere & Company	JDLink R Modem - 4G	MA4R	PCMA4MA200091
B	TSTPASS	Switchbox	SB1	SUW_0001
C	Rigol	DC Power Supply	DP711	DP7A202200419
D	PCTEL	LTE/Wi-Fi/GPS/GLONASS Antenna	PFA10882	Sample ID: 20210400113

2.8 Configuration Diagrams (Radiated)



Below 30MHz

30MHz-1GHz



Above 1GHz

3 Bandwidth

3.1 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

3.2 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.

3.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 25.0 °C

Relative Humidity: 38.9 %

Atmospheric Pressure: 97.9 kPa

3.4 Test Equipment

Test End Date: 21-Apr-2021

Tester: JOP

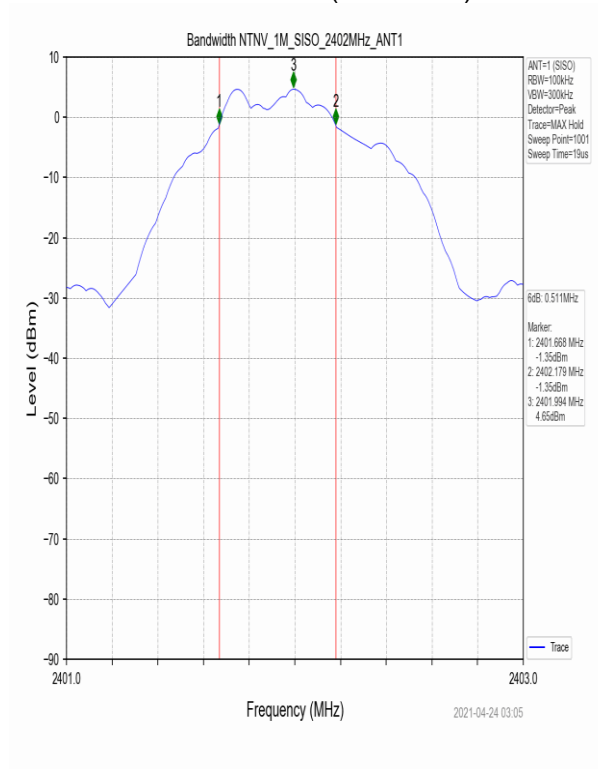
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
DC POWER SUPPLY, PROGRAMMABLE	DP711	RIGOL	18027	VBU	VBU
RF Cable SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19101	16-Mar-2021	16-Mar-2022
RF CABLE SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19102	16-Mar-2021	16-Mar-2022
TSTPASS SWITCHBOX	SB1	TSTPASS	20168	CNR	CNR
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021

3.5 Test Data – 6dB Bandwidth

Frequency (MHz)	TX Type	ANT No.	6dB BW (MHz)	Limit (MHz)	Verdict
2402	SISO	1	0.511	≥0.5	PASS
2440	SISO	1	0.512	≥0.5	PASS
2480	SISO	1	0.512	≥0.5	PASS

Sample Plot

Low Channel (2402MHz)

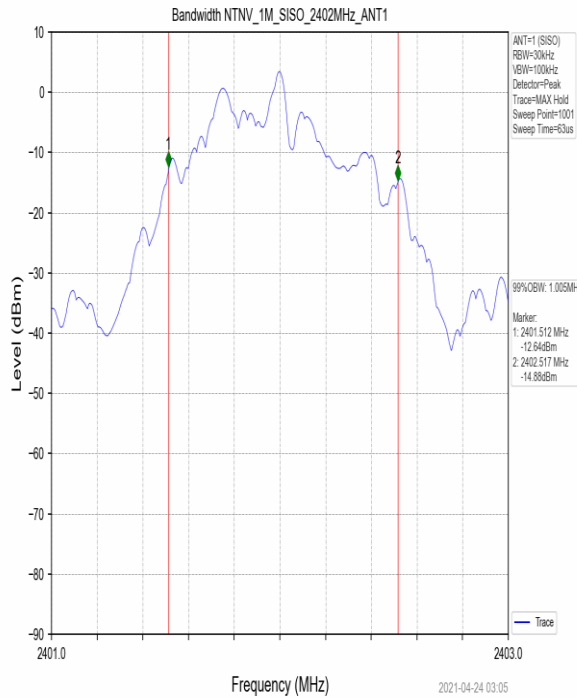


3.6 Test Data – 99% Bandwidth

Frequency (MHz)	TX Type	ANT No.	6dB BW (MHz)	Limit (MHz)	Verdict
2402	SISO	1	1.005	≥0.5	Reported
2440	SISO	1	1.008	≥0.5	Reported
2480	SISO	1	1.011	≥0.5	Reported

Sample Plot

Low Channel (2402MHz)



4 Peak Output Power

4.1 Test Result

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

4.2 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)

4.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 25.0 °C

Relative Humidity: 38.9 %

Atmospheric Pressure: 97.9 kPa

4.4 Test Equipment

Test End Date: 21-Apr-2021

Tester: JOP

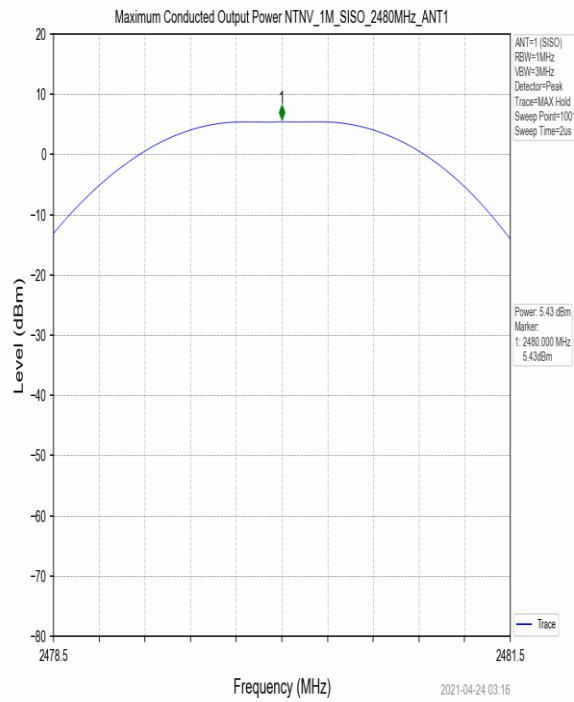
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
DC POWER SUPPLY, PROGRAMMABLE	DP711	RIGOL	18027	VBU	VBU
RF Cable SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19101	16-Mar-2021	16-Mar-2022
RF CABLE SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19102	16-Mar-2021	16-Mar-2022
TSTPASS SWITCHBOX	SB1	TSTPASS	20168	CNR	CNR
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021

4.5 Test Data

Frequency (MHz)	TX Type	ANT No.	Peak Output Power (dBm)	Limit (dBm)	Verdict
2402	SISO	1	4.66	30	PASS
2440	SISO	1	4.80	30	PASS
2480	SISO	1	5.43	30	PASS

Sample Plot

High Channel (2480MHz)



5 Power Spectral Density

5.1 Test Result

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

5.2 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.

5.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 25.0 °C

Relative Humidity: 38.9 %

Atmospheric Pressure: 97.9 kPa

5.4 Test Equipment

Test End Date: 21-Apr-2021

Tester: JOP

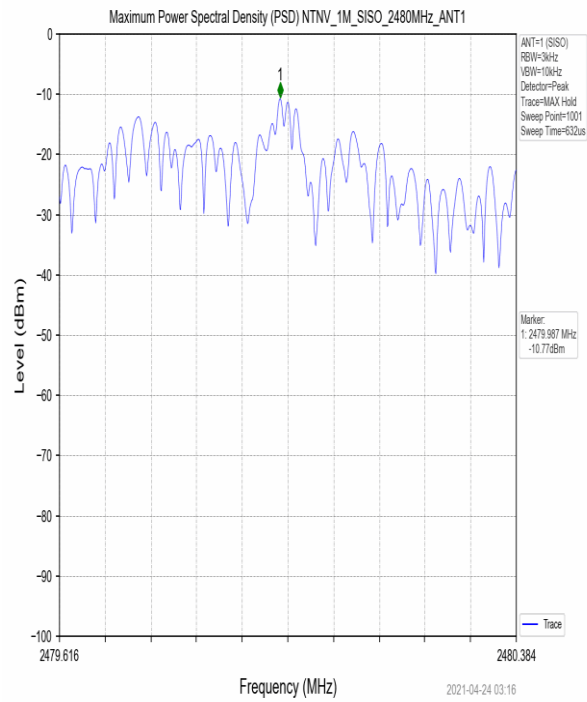
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
DC POWER SUPPLY, PROGRAMMABLE	DP711	RIGOL	18027	VBU	VBU
RF Cable SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19101	16-Mar-2021	16-Mar-2022
RF CABLE SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19102	16-Mar-2021	16-Mar-2022
TSTPASS SWITCHBOX	SB1	TSTPASS	20168	CNR	CNR
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021

5.5 Test Data

Frequency (MHz)	TX Type	ANT No.	Peak PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
2402	SISO	1	-11.45	≤8	PASS
2440	SISO	1	-11.27	≤8	PASS
2480	SISO	1	-10.77	≤8	PASS

Sample Plot

High Channel (2480MHz)



6 Conducted Spurious Emissions / Band Edge

6.1 Test Result

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

6.2 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.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.2 °C

Relative Humidity: 41.2 %

Atmospheric Pressure: 99.1 kPa

6.4 Test Equipment

Test End Date: 21-Apr-2021

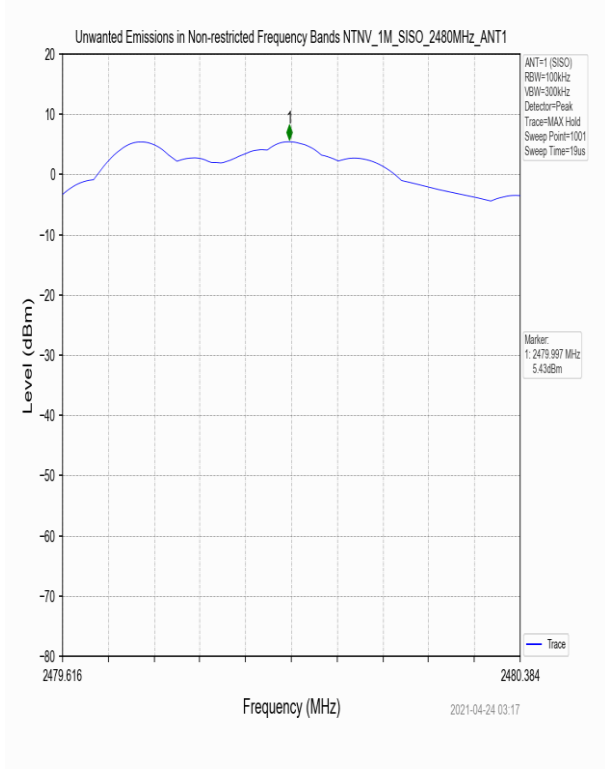
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
DC POWER SUPPLY, PROGRAMMABLE	DP711	RIGOL	18027	VBV	VBV
RF Cable SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19101	16-Mar-2021	16-Mar-2022
RF CABLE SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19102	16-Mar-2021	16-Mar-2022
TSTPASS SWITCHBOX	SB1	TSTPASS	20168	CNR	CNR
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021

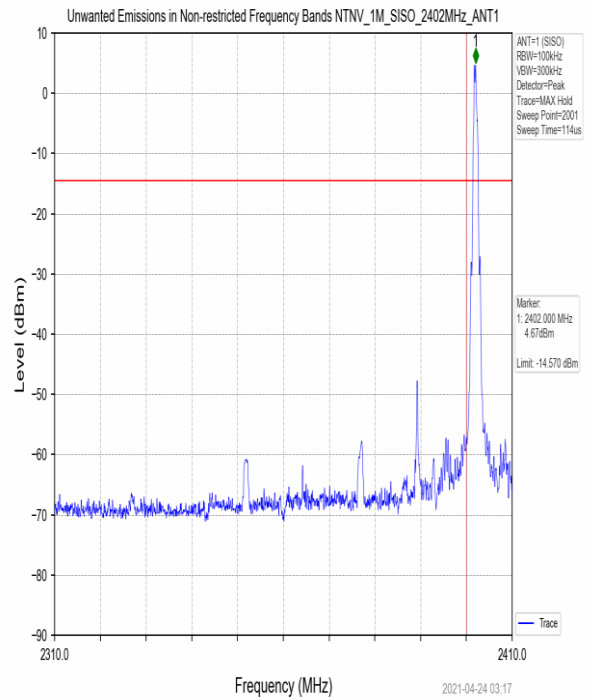
6.5 Test Data

Frequency (MHz)	TX Type	ANT No.	Spurious Conducted Emission (dBm)	Limit (dBm)	Verdict
2402	SISO	1	Refer to test graph	-14.57	PASS
2440	SISO	1	Refer to test graph	-14.57	PASS
2480	SISO	1	Refer to test graph	-14.57	PASS

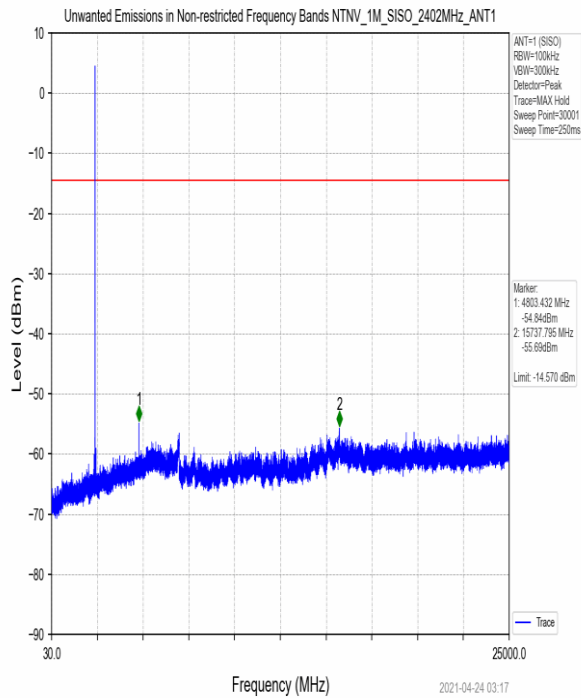
In-Band Reference



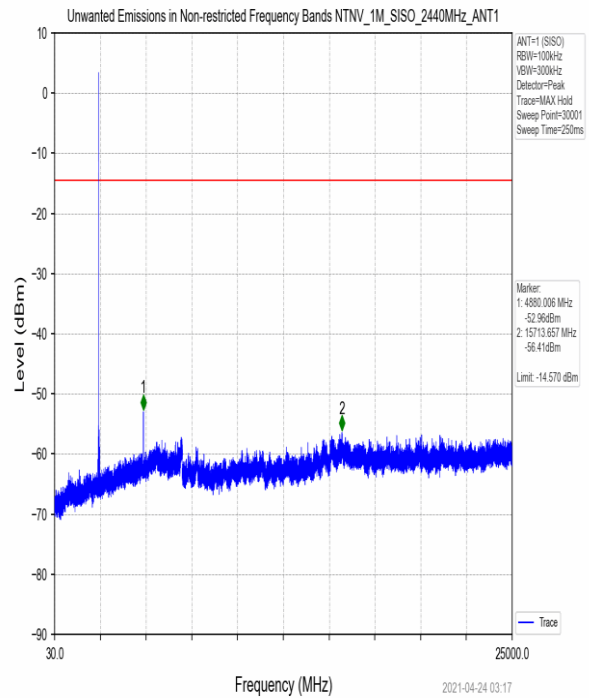
Lower Band Edge - Low Channel (2402MHz)



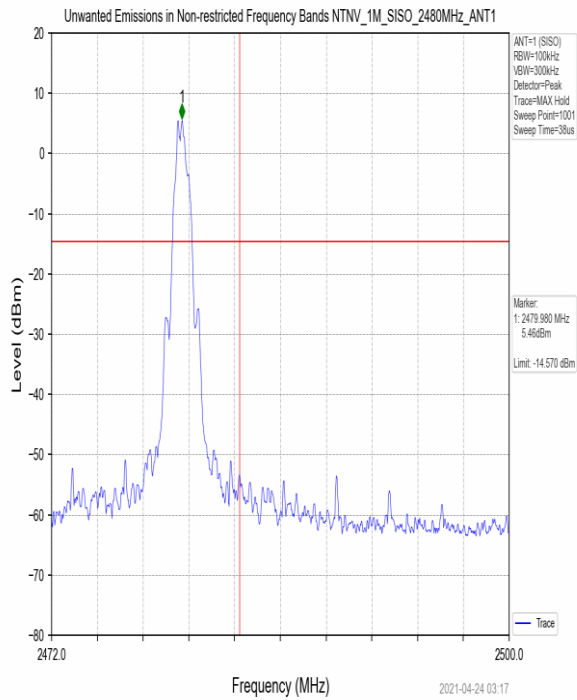
Full Spectrum - Low Channel (2402MHz)



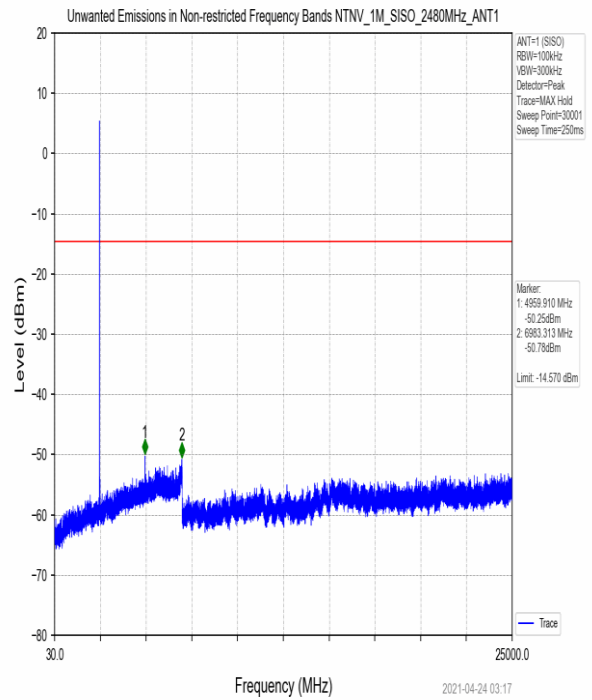
Full Spectrum - Mid Channel (2440MHz)



Upper Band Edge – High Channel (2480MHz)



Full Spectrum - High Channel (2480MHz)



7 Field Strength of Spurious Radiation (Restricted Bands)

7.1 Test Result

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

7.2 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

7.3 Test Site

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature: 24.7 °C

Relative Humidity: 36.9 %

Atmospheric Pressure: 98.0 kPa

7.4 Test Equipment

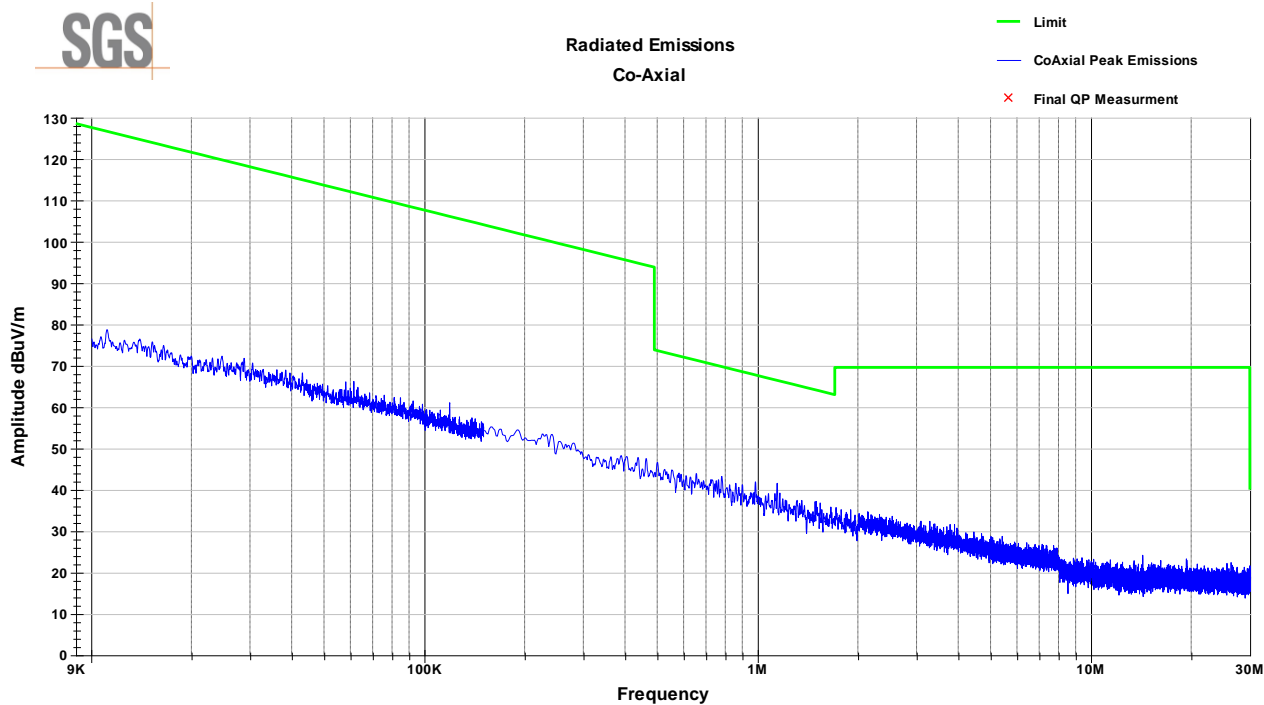
Test End Date: 26-Apr-2021

Tester: EW/PL

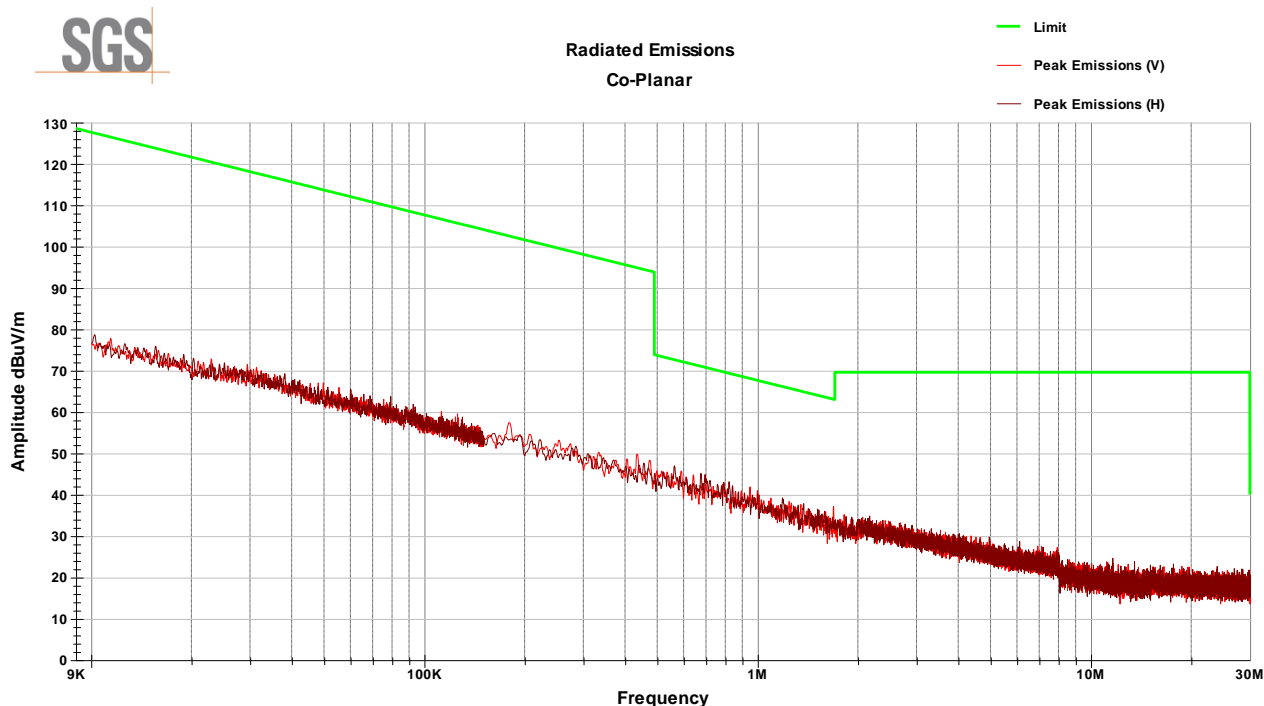
Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
RF Cable Nm to Nf, 0.01-18GHz	90-213-118	TELEDYNE STORM MICROWAVE	20117	17-Feb-2021	17-Feb-2022
RF Cable Nm to Nm, 0.01-18GHz	90-195-354	TELEDYNE STORM MICROWAVE	20120	17-Feb-2021	17-Feb-2022
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20125	17-Feb-2021	17-Feb-2022
RF CABLE, Nm to Nm.	90-195-157	TELEDYNE STORM MICROWAVE	21019	26-Mar-2021	26-Mar-2022
ANTENNA, DRG HORN (MEDIUM)	3117	ETS Lindgren	B079691	10-Aug-2020	10-Aug-2022
RF CABLE	104PE	HUBER & SUHNER	B079793	3-Sep-2020	3-Sep-2021
LOW NOISE AMPLIFIER	ZKL-2+	Mini-Circuits	B079817	28-Sep-2020	28-Sep-2021
FILTER, HIGH PASS, >2800MHz	HPM50111	MICRO-TRONICS	B085747	8-Sep-2020	8-Sep-2021
ANTENNA, BILOG	CBL 6143A	TESEQ	B085931	30-Jan-2020	30-Jan-2022
RF CABLE	SUCOFLEX 100	Huber & Suhner	B108523	3-Sep-2020	3-Sep-2021
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	S/N: 100280	19-Mar-2020	27-Dec-2021

7.5 Test Data – Peak Plots

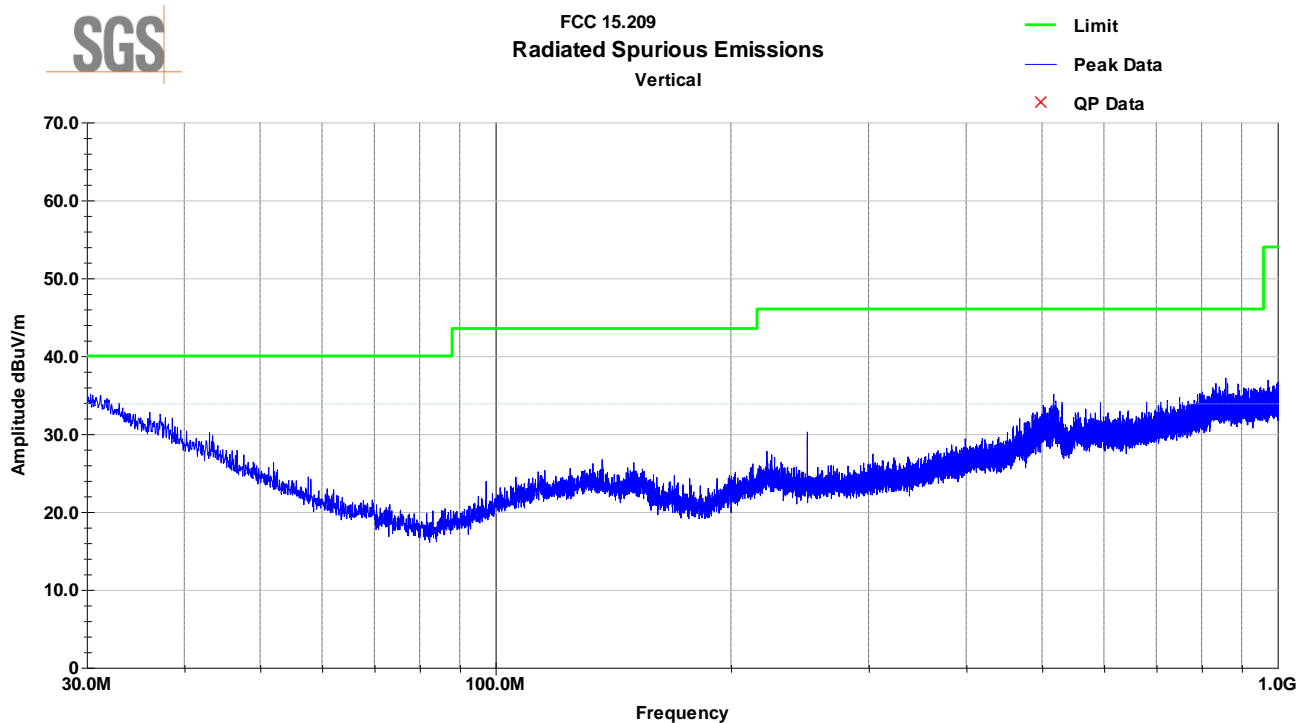
Between 9kHz and 1000MHz, there was no significant deviation with respect to axis or channel
 Co-Axial Radiated Spurious Emissions – 9kHz-30MHz (LCH)



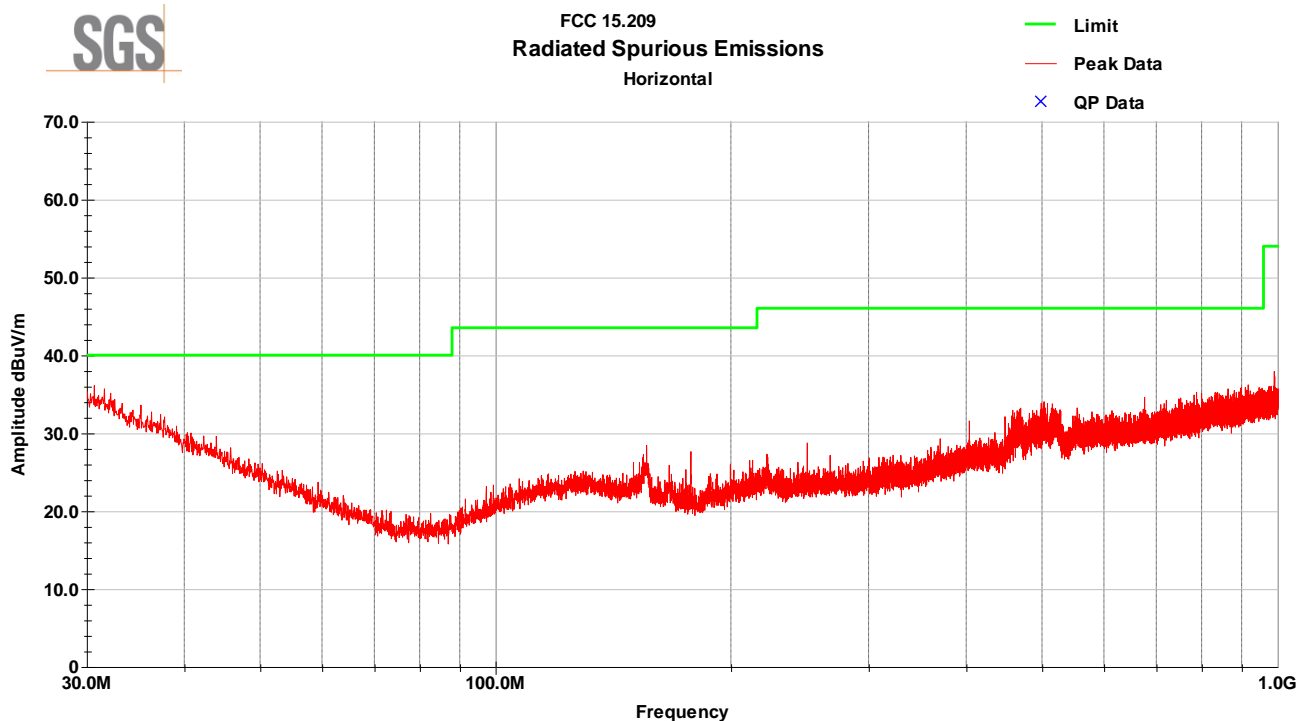
Co-Planar Radiated Spurious Emissions – 9kHz-30MHz (LCH)



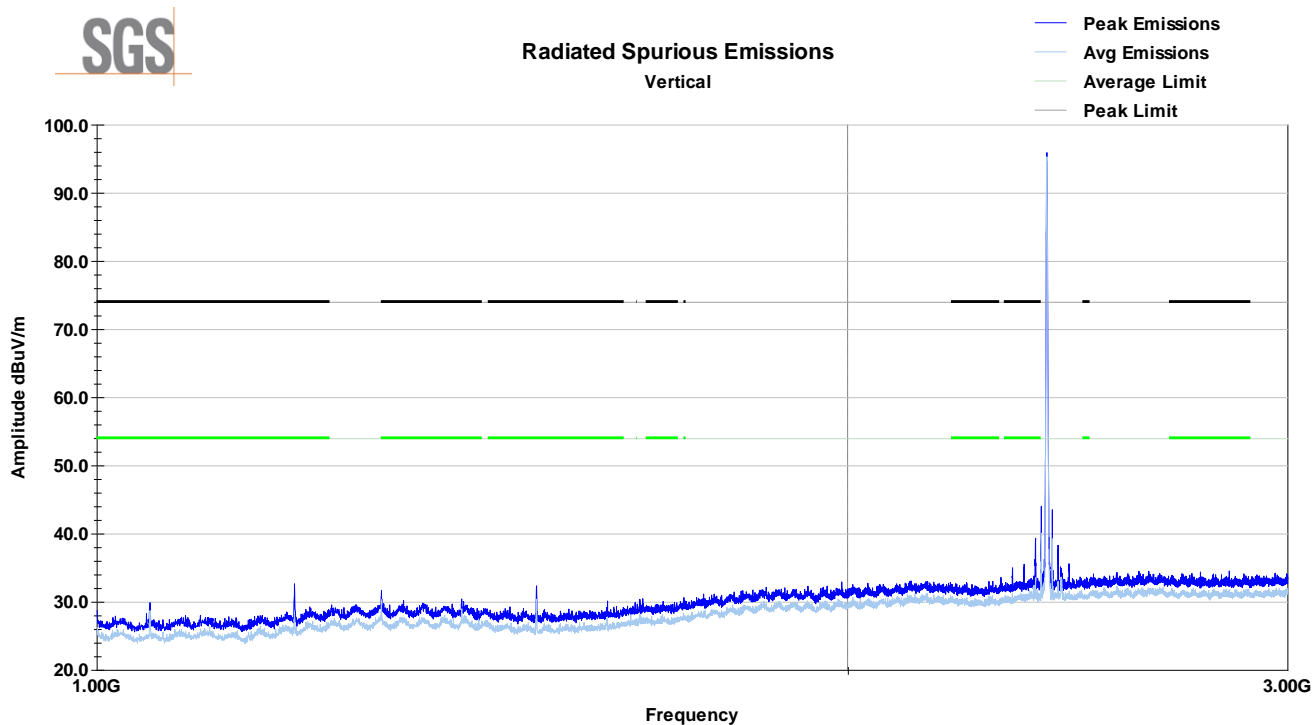
Vertical Radiated Spurious Emissions – 30-1000MHz (LCH)



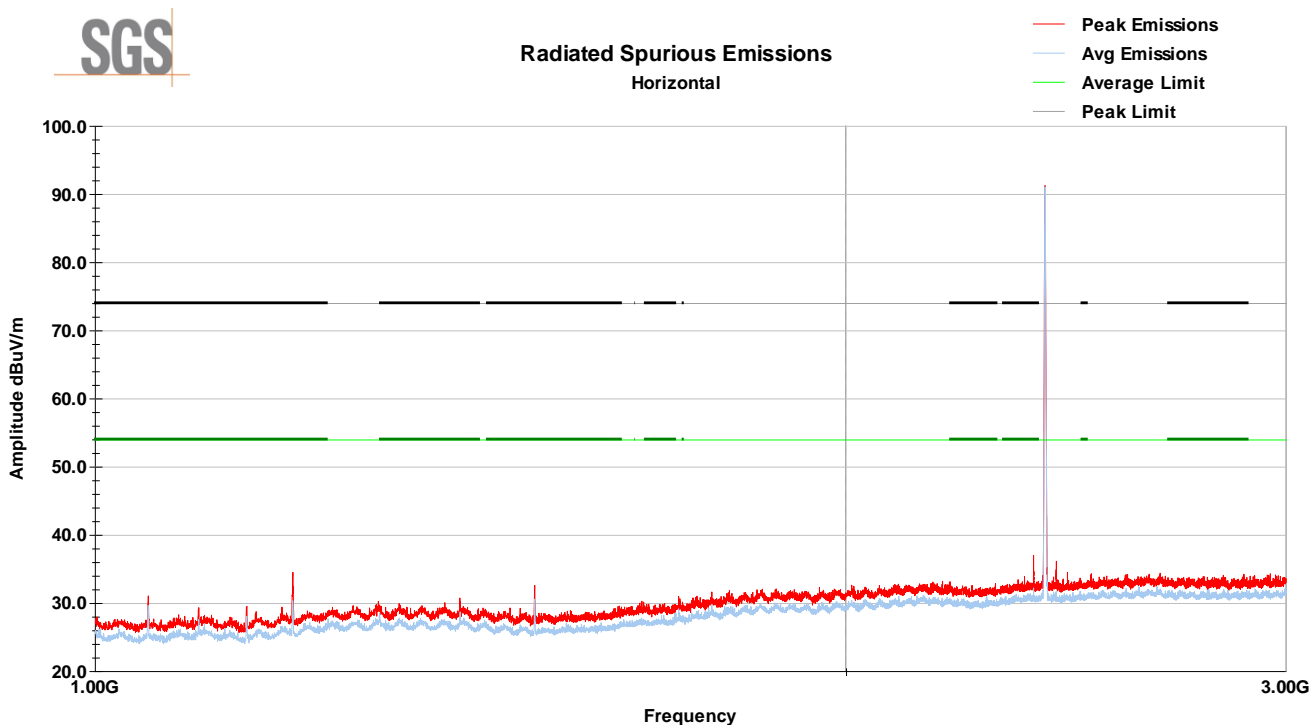
Horizontal Radiated Spurious Emissions – 30-1000MHz (LCH)



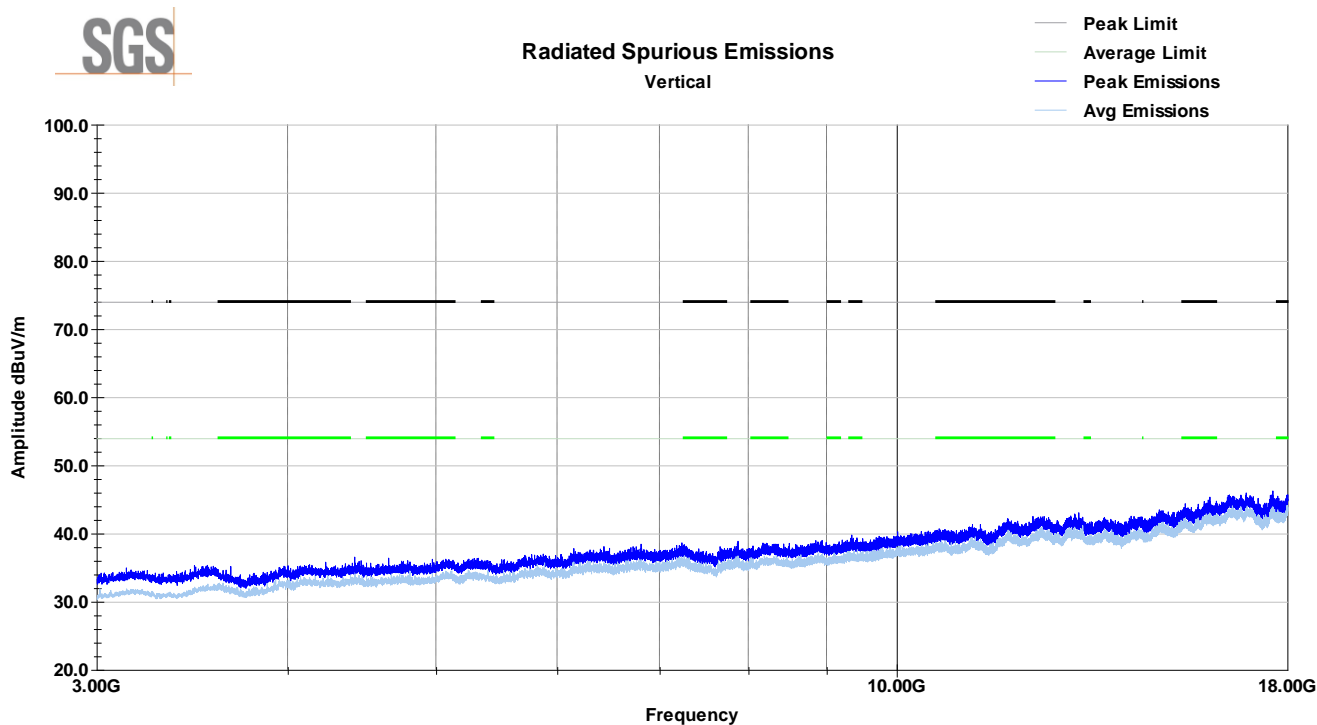
Vertical Radiated Spurious Emissions – 1-3GHz (LCH)



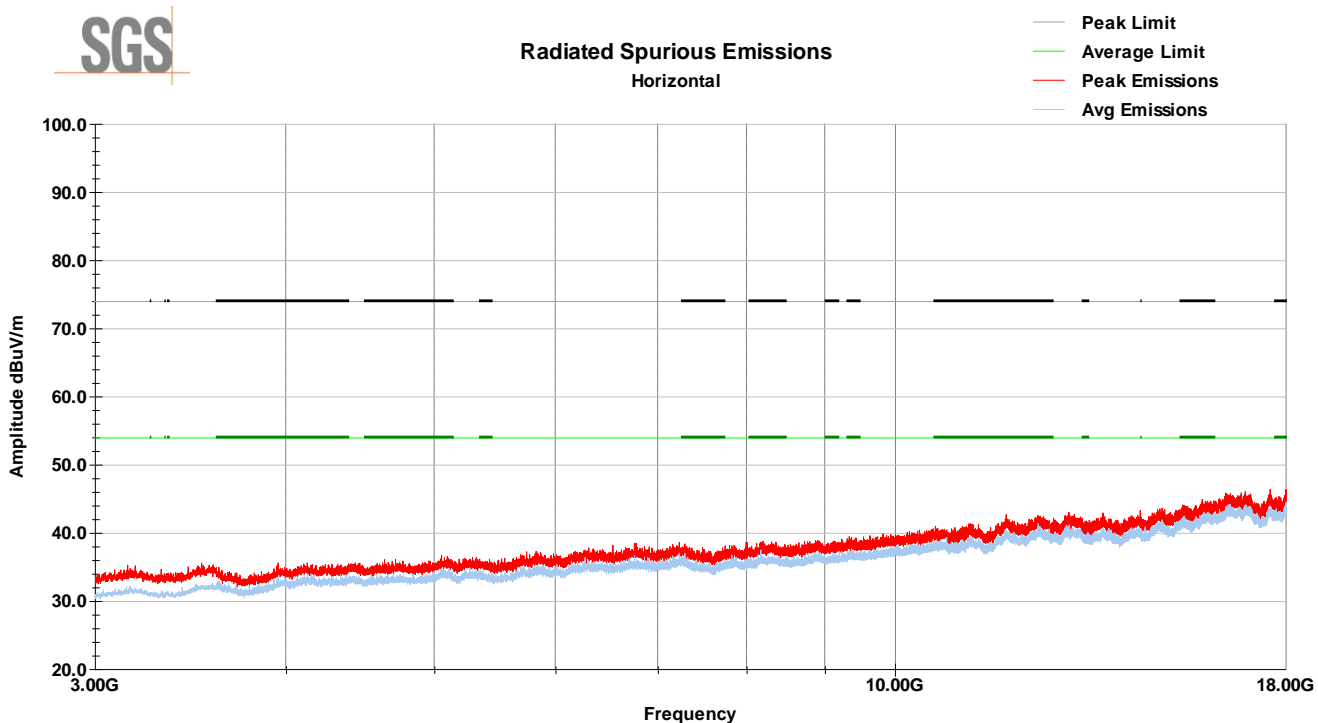
Horizontal Radiated Spurious Emissions – 1-3GHz (LCH)



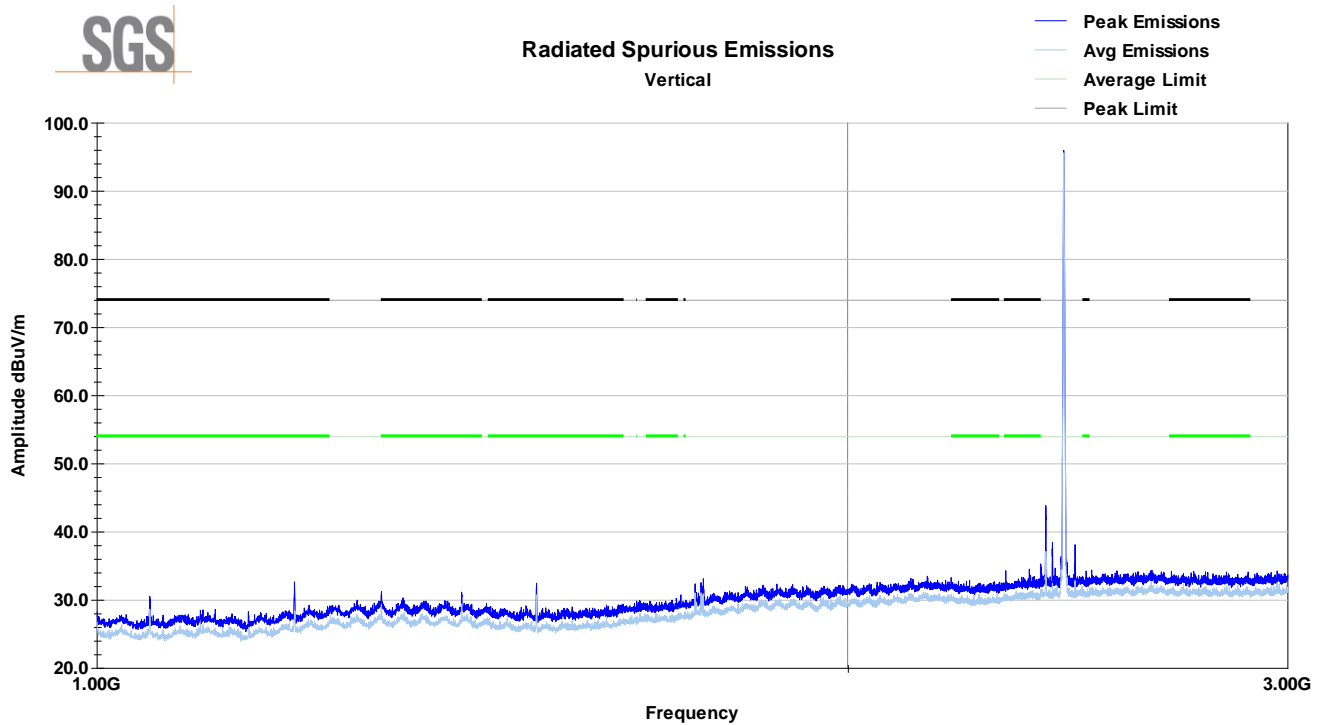
Vertical Radiated Spurious Emissions – 3-18GHz (LCH)



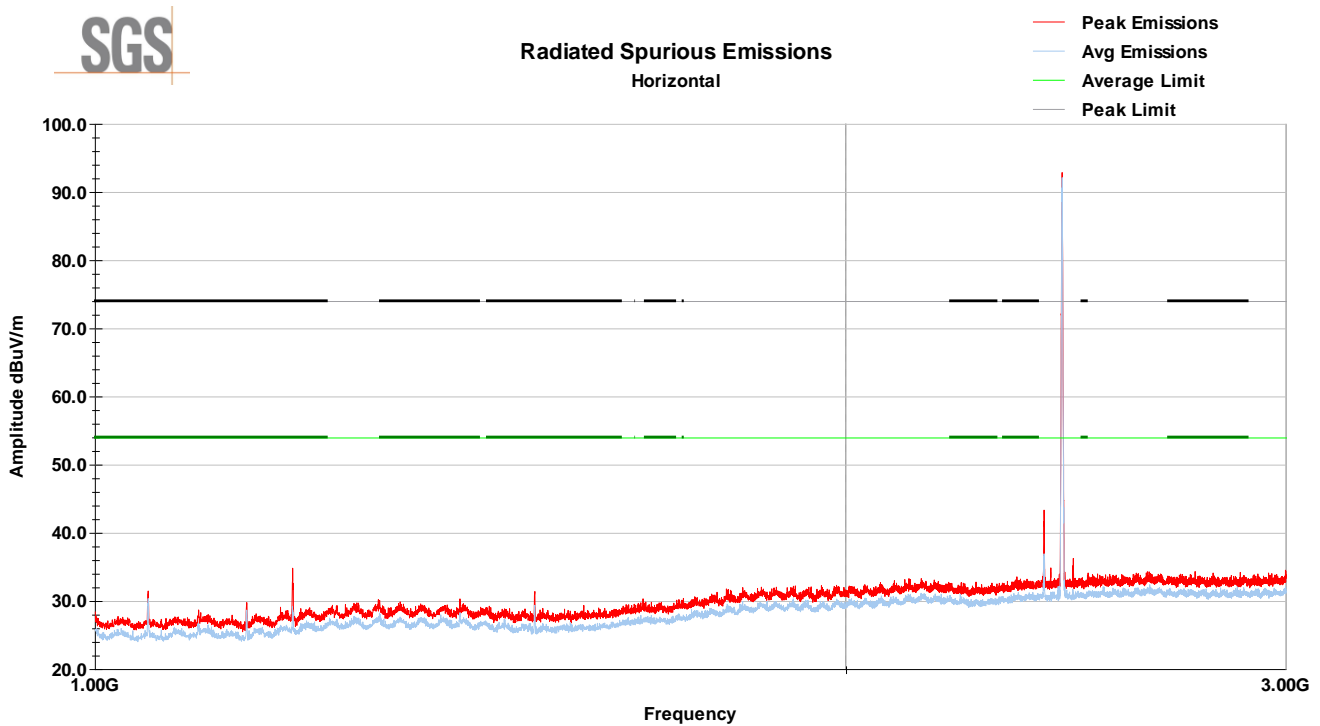
Horizontal Radiated Spurious Emissions – 3-18GHz (LCH)



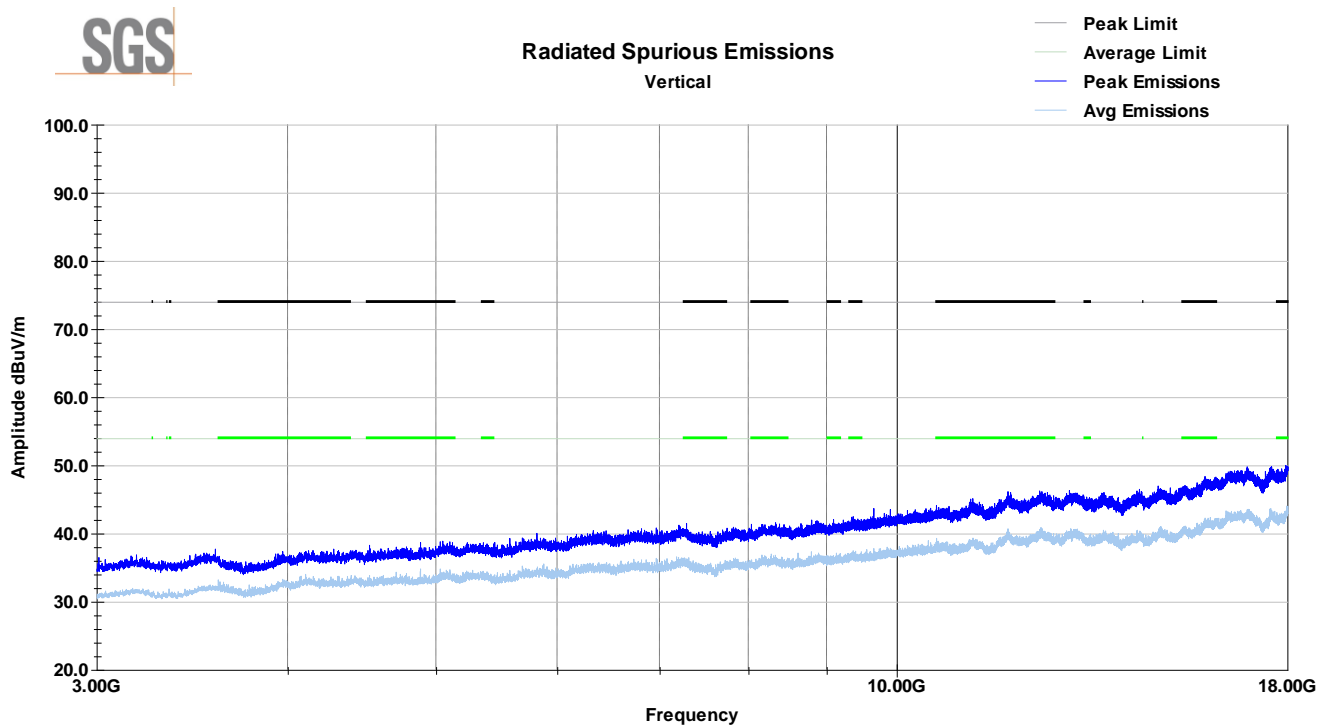
Vertical Radiated Spurious Emissions – 1-3GHz (MCH)



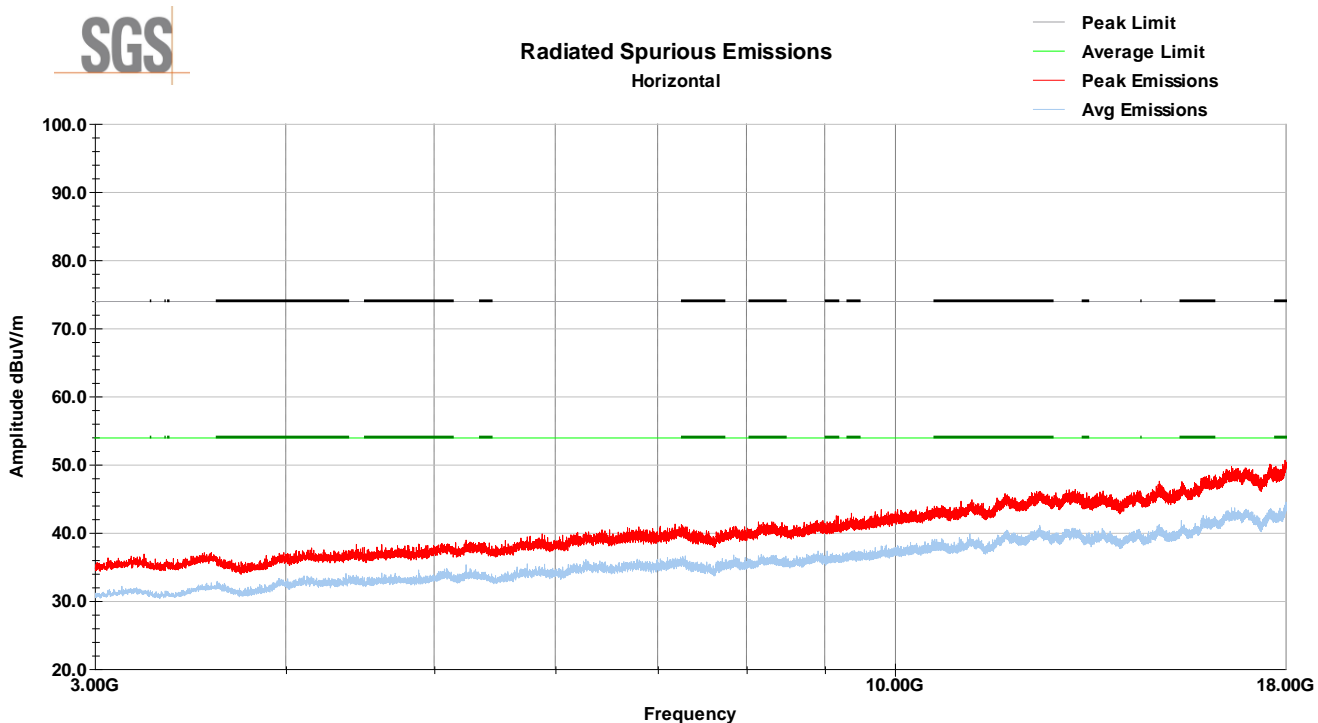
Horizontal Radiated Spurious Emissions – 1-3GHz (MCH)



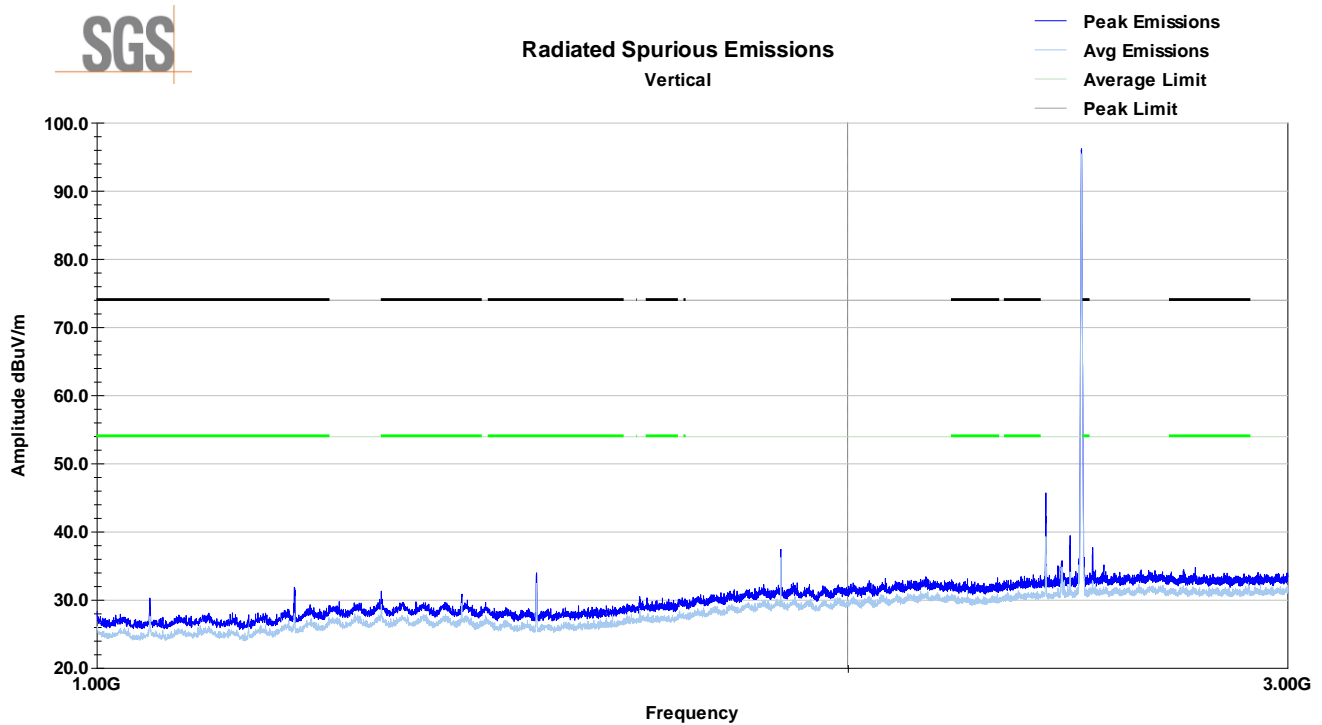
Vertical Radiated Spurious Emissions – 3-18GHz (MCH)



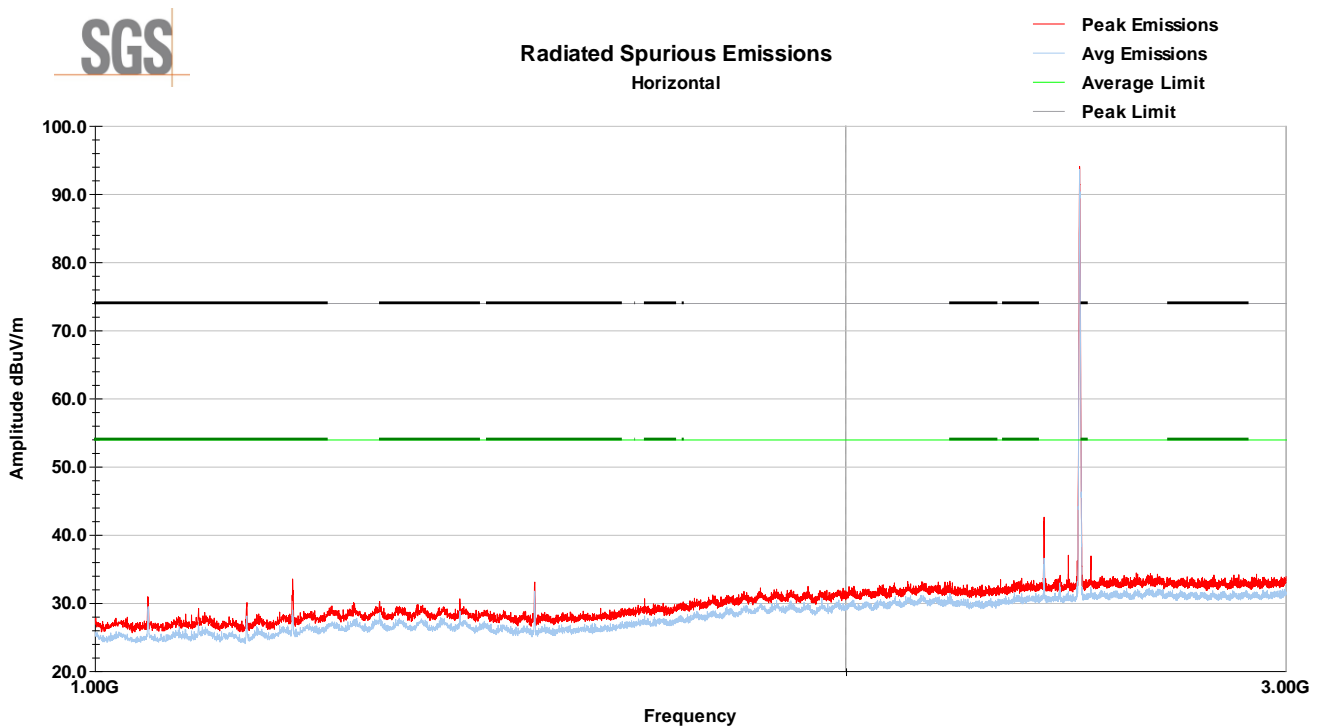
Horizontal Radiated Spurious Emissions – 3-18GHz (MCH)



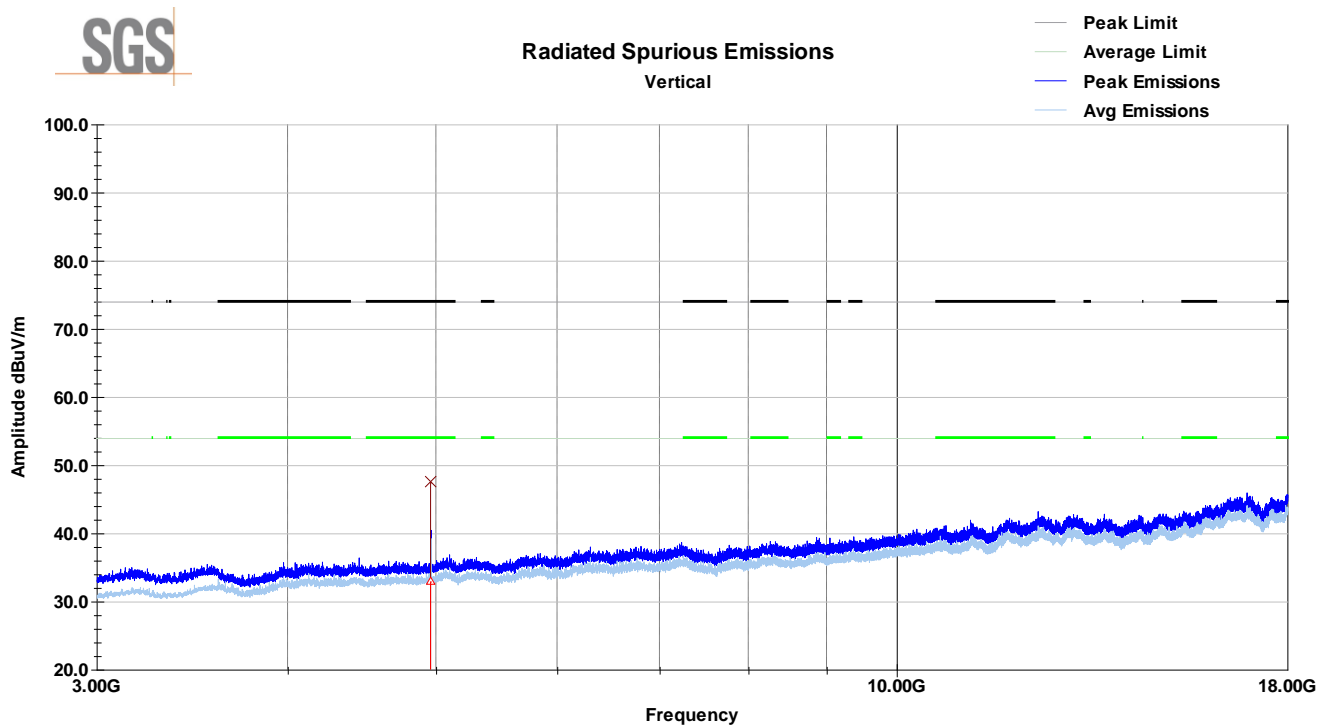
Vertical Radiated Spurious Emissions – 1-3GHz (HCH)



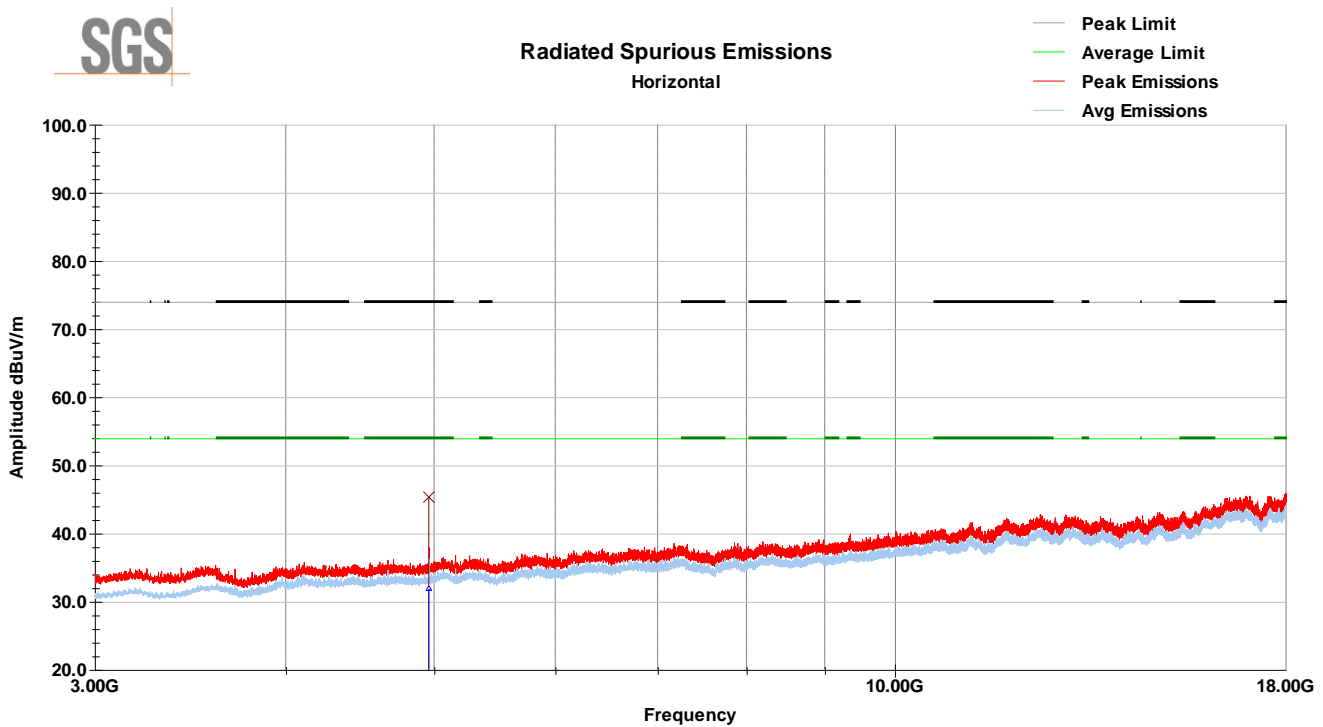
Horizontal Radiated Spurious Emissions – 1-3GHz (HCH)



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



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



7.6 Test Data – Tabular Data

Tabular Test Results – 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
4960.16	52.6	V	57.0	203.0	34.6	2.3	42.1	47.5	74.0	-26.5
4960.02	50.5	H	216.0	142.0	34.6	2.3	42.1	45.3	74.0	-28.7
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Tabular Test Results – 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)
4960.16	38.1	V	57.0	203.0	34.6	2.3	42.1	32.9	54.0	-21.1
4960.02	37.0	H	216.0	142.0	34.6	2.3	42.1	31.8	54.0	-22.1
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Note: There no emissions detected above 18GHz

8 Emissions in Restricted Frequency Bands (Band Edge)

8.1 Test Result

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

8.2 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.

8.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 25.0 °C

Relative Humidity: 38.9 %

Atmospheric Pressure: 97.9 kPa

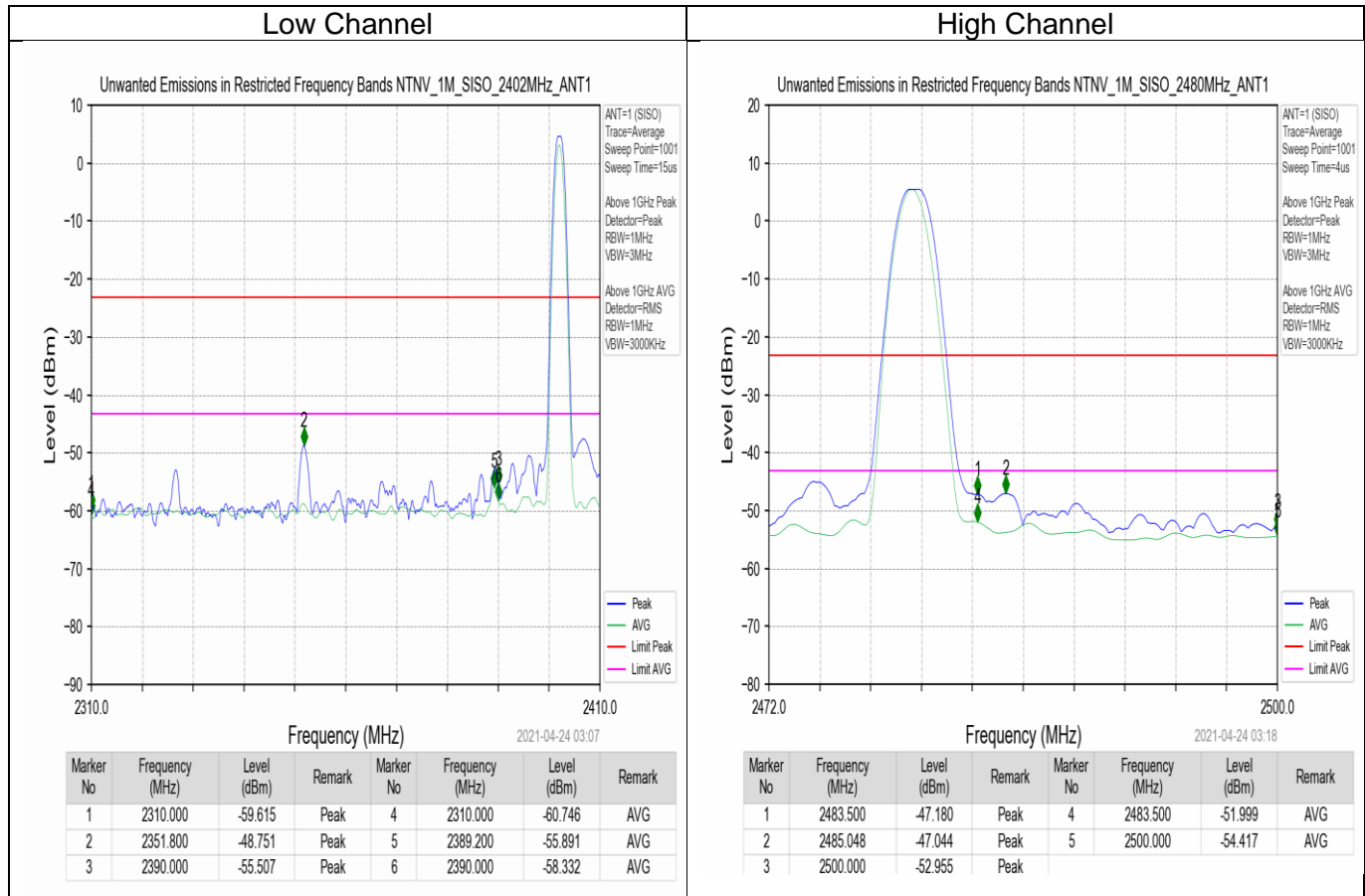
8.4 Test Equipment

Test End Date: 21-Apr-2021

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
DC POWER SUPPLY, PROGRAMMABLE	DP711	RIGOL	18027	VBU	VBU
RF Cable SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19101	16-Mar-2021	16-Mar-2022
RF CABLE SMA	HULL150A-29P-29P-36	HASCO COMPONENTS	19102	16-Mar-2021	16-Mar-2022
TSTPASS SWITCHBOX	SB1	TSTPASS	20168	CNR	CNR
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2019	27-Dec-2021

8.5 Test Data – Restricted Band Edges



9 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 %

10 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	25 August 2021
1	<ul style="list-style-type: none"> - Updated product marketing name throughout report - Added CAB identifier to Section 2.2 	12 January 2022