SGS

RF Test Report

Project Number:	4782583	**Offer Number:**	SUW-202105001035
Report Number:	4782583EMC01	**Revision Level:**	1

Client: Owlet Baby Care Inc.

Equipment Under Test: Owlet Smart Sock V3

Model: OSS 3.0

FCC ID: 2AIEP-OSS3A

IC ID: 21386-OSS3A

Applicable Standards: FCC Part 15 Subpart C, § 15.247

RSS-247, Issue 2, February 2017

RSS-GEN, Issue 5, February 2021, Amendment 2

ANSI C63.10:2013

Report issued on: 06 January 2022

Test Result: Compliant

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 3212.01
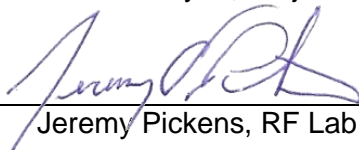This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Prepared by: _____
Martin Taylor, Project Engineer

Reviewed by: _____
Jeremy Pickens, RF Lab Manager

Table of Contents

1 Summary of Test Results

This testing was performed for a Class 2 Permissive Change in which the material of the EUT housing base was changed from metal to plastic.

Test Description	Test Specification		Test Result
Bandwidth	15.247(a)(2)	RSS-247 S5.2 (a) RSS-GEN S6.7	N/A [1]
Output Power	15.247(b)(3)	RSS-247 S5.4 (d)	N/A [1]
Power Spectral Density	15.247(e)	RSS-247 S5.2 (b)	N/A [1]
Conducted Spurious Emissions / Band Edge	15.247(d)	RSS-247 S5.5	N/A [1]
Emissions in Restricted Frequency Bands	15.247(d) 15.205, 15.209	RSS-247 S5.5 RSS-GEN S8.9, S8.10	Compliant
Band Edge Emissions in Restricted Frequency Bands	15.205, 15.209	RSS-GEN S8.9, S8.10	N/A [1]
Antenna Requirement	15.203	RSS-GEN S6.8	Compliant [2]

(1) Conducted data from original certification filing is still valid; only radiated emissions were retested.
(2) Device uses an internal bent metal inverted F antenna which cannot be replaced by the end user.

1.1 *Modifications Required for Compliance*

None.

2 General Information

2.1 *Client Information*

Name:	Owlet Baby Care Inc.
Address:	2500 Executive Parkway Suite 500
City, State, Zip, Country:	Lehi, UT 84043, 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
CAB ID:	US0186

2.3 *General Information of EUT*

Equipment Under Test:	Owlet Smart Sock V3
Model:	OSS 3.0
Serial Number:	OST027410
FCC ID:	2AIEP-OSS3A
IC ID:	21386-OSS3A
Frequency Range:	2402 – 2480 MHz
Data Modes:	Bluetooth Low Energy (GFSK)
Antenna:	Internal 3D Bent Metal Inverted F Antenna (-6.35 dBi)
Rated Voltage:	3.8 Vdc Rechargeable Lithium-Ion Coin Cell
Test Voltage:	3.8 Vdc Rechargeable Lithium-Ion Coin Cell
Sample Received Date:	19 August 2021
Dates of testing:	26 – 28 October 2021

2.4 *Operating Modes and Conditions*

The EUT was programmed by the manufacturer to allow test mode control using a Direct Test Mode software application from Nordic Semiconductor. The test sample was configured with a break-out board with a 10-pin header for radio control as well as 2 pins for charging the battery. Low, middle and high Bluetooth LE channels were tested using the same modulation and bandwidth as is used in normal operation. PRBS9 packet data was used with the packet length set to 37 bytes, which produced the highest available duty cycle. A Power setting of +8dBm was used.

2.5 EUT Connection Block Diagram
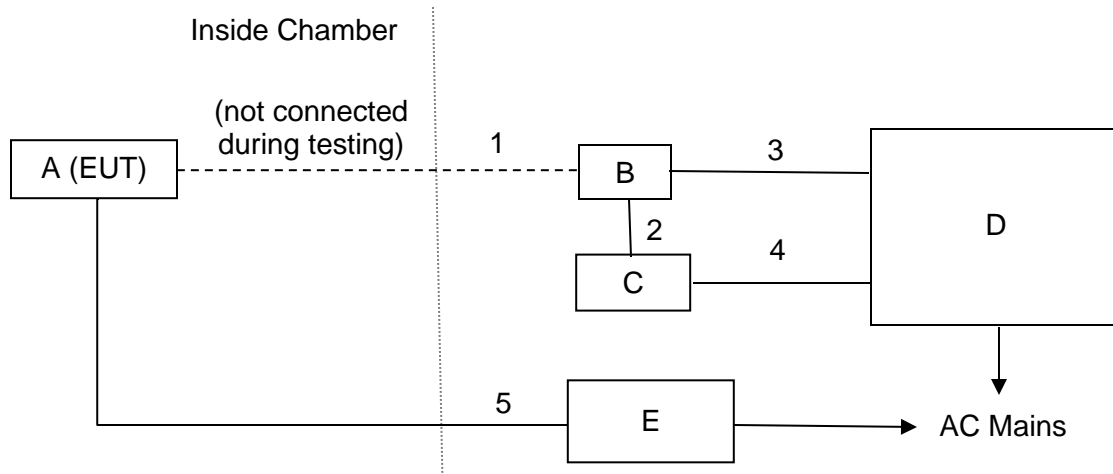
2.6 System Configurations

Device Reference	Manufacturer	Description	Model Number	Serial Number
A	Owlet Baby Care Inc.	Owlet Smart Sock (EUT)	OSS 3.0	OST027401
B	Owlet Baby Care Inc.	Developer Board	Sock Buddy v1.1	Not labeled
C	Nordic Semiconductor	Development Kit	nRF52840-DK	Not labeled
D	Lenovo	Laptop Computer	80XV	Asset # 17025
E	Rigol	DC Power Supply	DP711	DP7A202200419

2.7 Cable List

Cable reference	Port Name	Start	End	Cable Length (m)	Ferrite installed?	Shielded?
1	Comm.	EUT	Developer Board	0.15	N	N
2	Comm.	Dev Kit	Developer Board	0.15	N	N
3	USB	Laptop	Developer Board	1.80	N	N
4	Micro-USB	Laptop	Development Kit	1.45	N	N
5	DC Power	EUT	DC Power Supply	>3m	N	N

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3 Emissions in Restricted Frequency Bands

3.1 Test Result

Test Description	Test Specification		Test Result
Emissions in Restricted Frequency Bands	15.247(d) 15.205, 15.209	RSS-247 S5.5 RSS-GEN S8.9, S8.10	Compliant

3.2 Test Method

Radiated emissions in restricted frequency bands were measured using methods defined in ANSI C63.10 clause 11.12. These procedures are referenced in KDB 558074 D01 15.247 Meas Guidance v05r02.

Lowest, middle and highest channels were investigated – the device was commanded to continuously transmit on channels 37, 19 and 39. The EUT was tested in all three orthogonal axes and the worst-case data was reported.

Test distances for radiated tests:

9k to 30 MHz – Near field prescan to determine if there were any emissions
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

3.3 *Test Setup Block Diagrams*

30MHz-1GHz

Above 1GHz
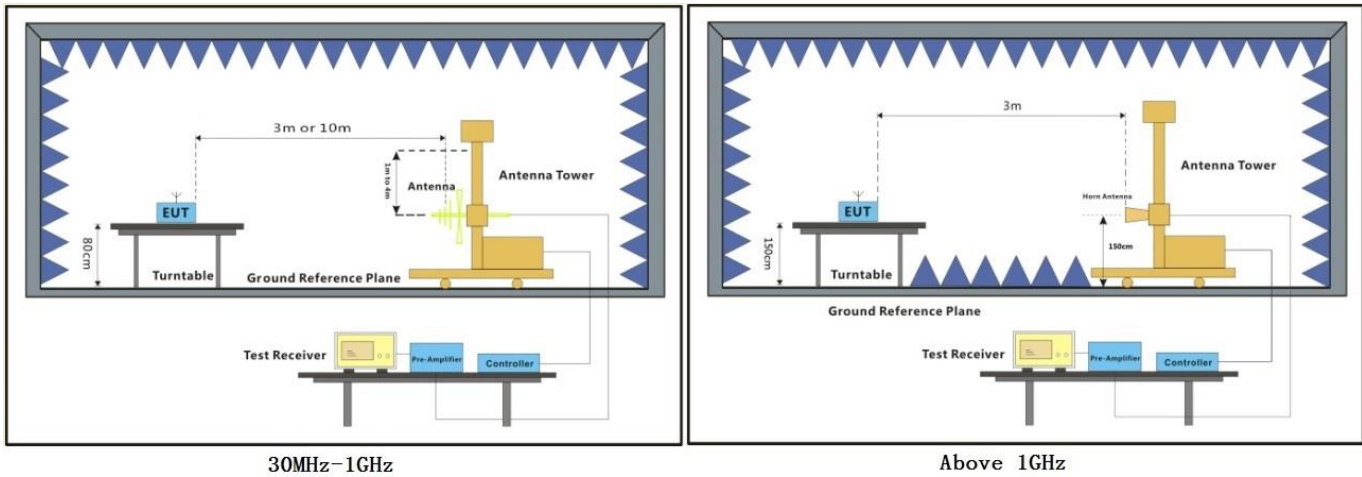
3.4 *Test Site*

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

Environmental Conditions

Temperature:	23.4 °C
Relative Humidity:	42.0%
Atmospheric Pressure:	97.85 kPa

3.5 *Test Equipment*

Test End Date: 26-Oct-2021   Tester: AB/ZH

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079690	13-Jan-2021	13-Jan-2023
RF CABLE	SF106	Huber & Suhner	B085903	25-Aug-2021	25-Aug-2022
RF Cable Nm to Nm, 0.01-18GHz	90-195-354	TELEDYNE STORM MICROWAVE	20119	18-Feb-2021	18-Feb-2022
RF CABLE, Nm to Nm.	90-195-157	TELEDYNE STORM MICROWAVE	21019	26-Mar-2021	26-Mar-2022
LOW NOISE AMPLIFIER	ZKL-2+	Mini-Circuits	B079800	7-Jul-2021	7-Jul-2022
RF CABLE	104PE	HUBER & SUHNER	B079793	24-Aug-2021	24-Aug-2022
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	9-Jul-2021	9-Jul-2022
ANTENNA, DRG HORN (MEDIUM)	3117	ETS Lindgren	B079699	15-Jul-2020	15-Jul-2022
RF Cable SMA to SMA, 0.01-40GHz	084-0505-138	TELEDYNE STORM MICROWAVE	20111	16-Mar-2021	16-Mar-2022
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	7-Jul-2021	7-Jul-2022
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	21-Jun-2021	21-Jun-2022
Laser Measure	GLM 35	Bosch	17012	21-Jan-2021	21-Jan-2022

Software:
RSE 30-1000 MHz T7 201007 dated 7 October 2020
RSE 1-3 GHz T7 210212 dated 12 February 2021

3.6 *Test Data*

BLE Channel 0
Vertical Plot (30-1000MHz)
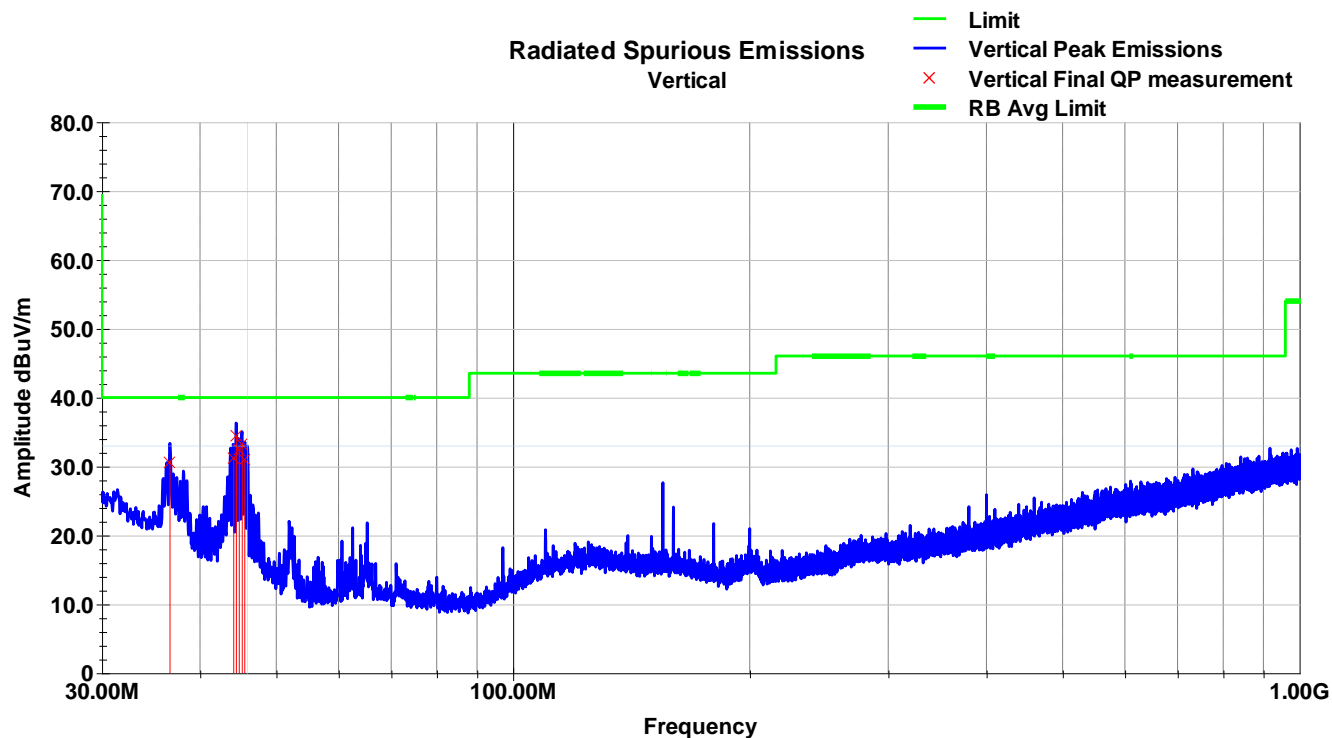
Radiated Spurious Emissions
Vertical

Legend:
— Limit
— Vertical Peak Emissions
× Vertical Final QP measurement
— RB Avg Limit

Vertical Data (30-1000MHz)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
36.63	43.6	V	48.0	110.0	17.1	1.0	31.0	30.6	40.0	-9.4
44.15	49.5	V	136.0	102.0	11.6	1.1	31.0	31.2	40.0	-8.8
44.48	53.0	V	39.0	102.0	11.4	1.1	31.0	34.4	40.0	-5.6
44.87	51.2	V	338.0	102.0	11.2	1.1	31.0	32.5	40.0	-7.5
45.26	52.2	V	139.0	102.0	10.9	1.1	31.0	33.2	40.0	-6.8
45.60	50.2	V	21.0	102.0	10.7	1.1	31.0	31.0	40.0	-9.0
QP Value = Raw QP+ AF + Loss - Amp										
Margin = QP Value - Limit										

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BLE Channel 0
Horizontal Plot (30-1000MHz)

Radiated Spurious Emissions
Horizontal

Legend:
— Limit
— Horizontal Peak Emission
× Horizontal Final QP meas
— RB Avg Limit

Horizontal Data (30-1000MHz)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.04	23.3	H	70.0	338.0	22.2	0.9	31.0	15.3	40.0	-24.7
757.38	24.2	H	312.0	109.0	21.2	4.6	31.2	18.7	46.0	-27.3
759.93	24.2	H	95.0	189.0	21.3	4.6	31.2	18.8	46.0	-27.2
873.41	24.1	H	224.0	124.0	22.7	4.9	31.1	20.6	46.0	-25.4
921.54	24.3	H	338.0	121.0	23.1	5.0	31.1	21.3	46.0	-24.7
959.27	24.1	H	315.0	129.0	23.4	5.1	31.0	21.7	46.0	-24.4
QP Value = Raw QP+ AF + Loss - Amp										
Margin = QP Value - Limit										

BLE Channel 19
Vertical Plot (30-1000MHz)

Radiated Spurious Emissions
Vertical

Legend:
- Limit
- Vertical Peak Emissions
- × Vertical Final QP measurement
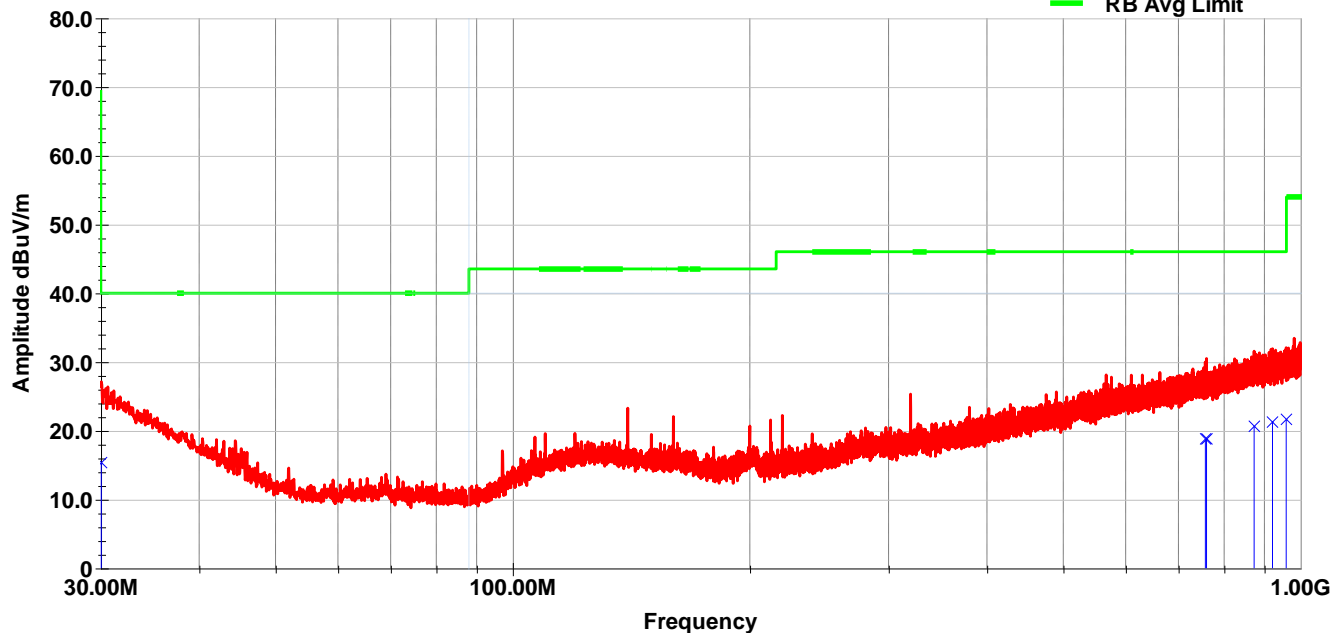- RB Avg Limit

Vertical Data (30-1000MHz)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
36.68	42.6	V	66.0	102.0	17.0	1.0	31.0	29.5	40.0	-10.5
44.14	49.7	V	77.0	102.0	11.6	1.1	31.0	31.4	40.0	-8.6
44.48	53.5	V	29.0	102.0	11.4	1.1	31.0	35.0	40.0	-5.0
44.87	51.7	V	127.0	102.0	11.2	1.1	31.0	33.0	40.0	-7.0
45.26	52.5	V	36.0	102.0	10.9	1.1	31.0	33.6	40.0	-6.4
45.60	50.9	V	132.0	102.0	10.7	1.1	31.0	31.7	40.0	-8.3
QP Value = Raw QP+ AF + Loss - Amp										
Margin = QP Value - Limit										

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BLE Channel 19
Horizontal Plot (30-1000MHz)
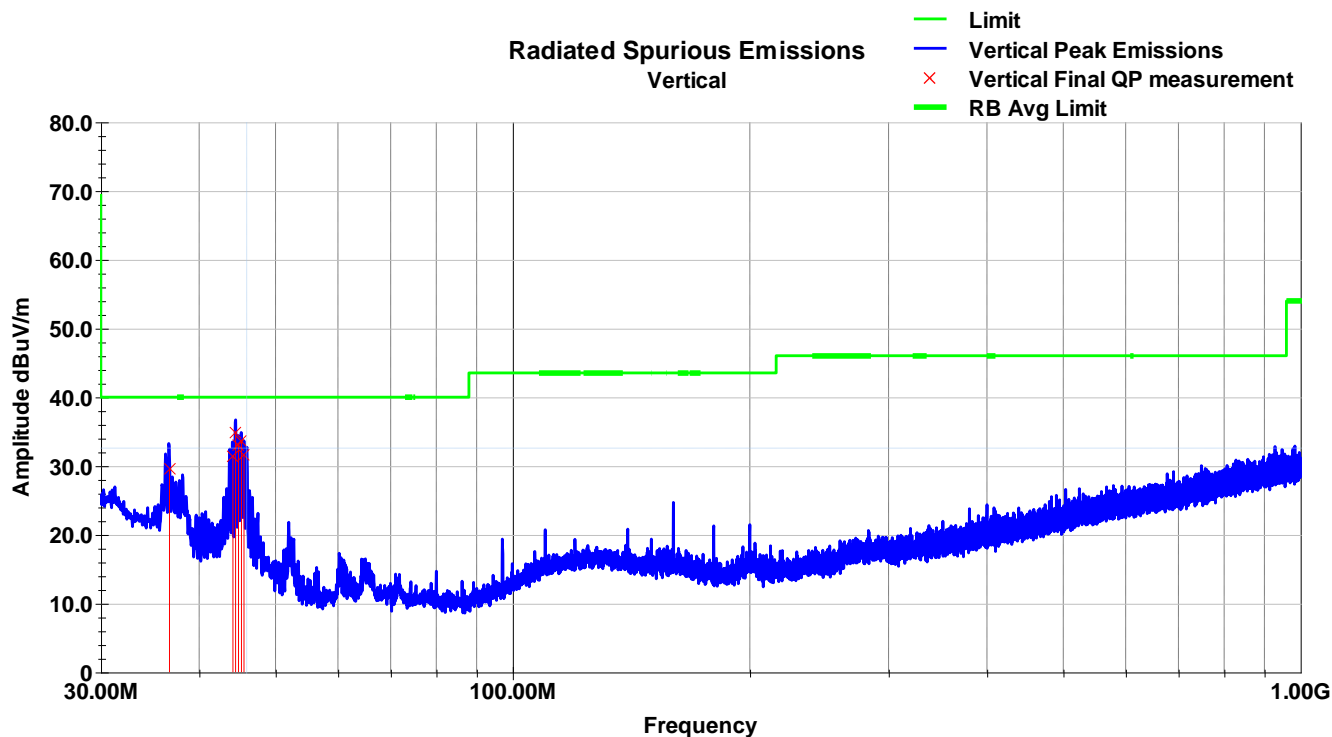

Radiated Spurious Emissions
Horizontal

Legend:
- Limit
- Horizontal Peak Emission
- × Horizontal Final QP meas
- RB Avg Limit

Horizontal Data (30-1000MHz)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.60	24.3	H	120.0	164.0	21.7	0.9	31.0	15.9	40.0	-24.1
609.95	33.0	H	58.0	237.0	19.7	4.1	31.3	25.5	46.0	-20.5
710.75	24.1	H	68.0	113.0	20.9	4.4	31.2	18.2	46.0	-27.8
781.28	24.0	H	15.0	208.0	21.6	4.6	31.2	19.0	46.0	-27.0
853.40	24.0	H	309.0	143.0	22.7	4.8	31.1	20.4	46.0	-25.6
942.36	24.1	H	48.0	124.0	23.3	5.1	31.0	21.5	46.0	-24.6
QP Value = Raw QP + AF + Loss - Amp										
Margin = QP Value - Limit										

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BLE Channel 39
Vertical Plot (30-1000MHz)

Radiated Spurious Emissions
Vertical

Legend:
— Limit
— Vertical Peak Emissions
× Vertical Final QP measurement
— RB Avg Limit

Vertical Data (30-1000MHz)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
36.67	43.4	V	20.0	102.0	17.0	1.0	31.0	30.4	40.0	-9.6
44.14	50.9	V	153.0	102.0	11.6	1.1	31.0	32.6	40.0	-7.4
44.48	55.7	V	56.0	102.0	11.4	1.1	31.0	37.2	40.0	-2.8
44.87	54.5	V	68.0	102.0	11.2	1.1	31.0	35.8	40.0	-4.2
45.26	55.0	V	86.0	103.0	10.9	1.1	31.0	36.1	40.0	-3.9
45.60	53.1	V	152.0	102.0	10.7	1.1	31.0	33.8	40.0	-6.2
QP Value = Raw QP+ AF + Loss - Amp										
Margin = QP Value - Limit										

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BLE Channel 39
Horizontal Plot (30-1000MHz)

Radiated Spurious Emissions
Horizontal

Legend:
- Limit
- Horizontal Peak Emission
- × Horizontal Final QP meas
- RB Avg Limit

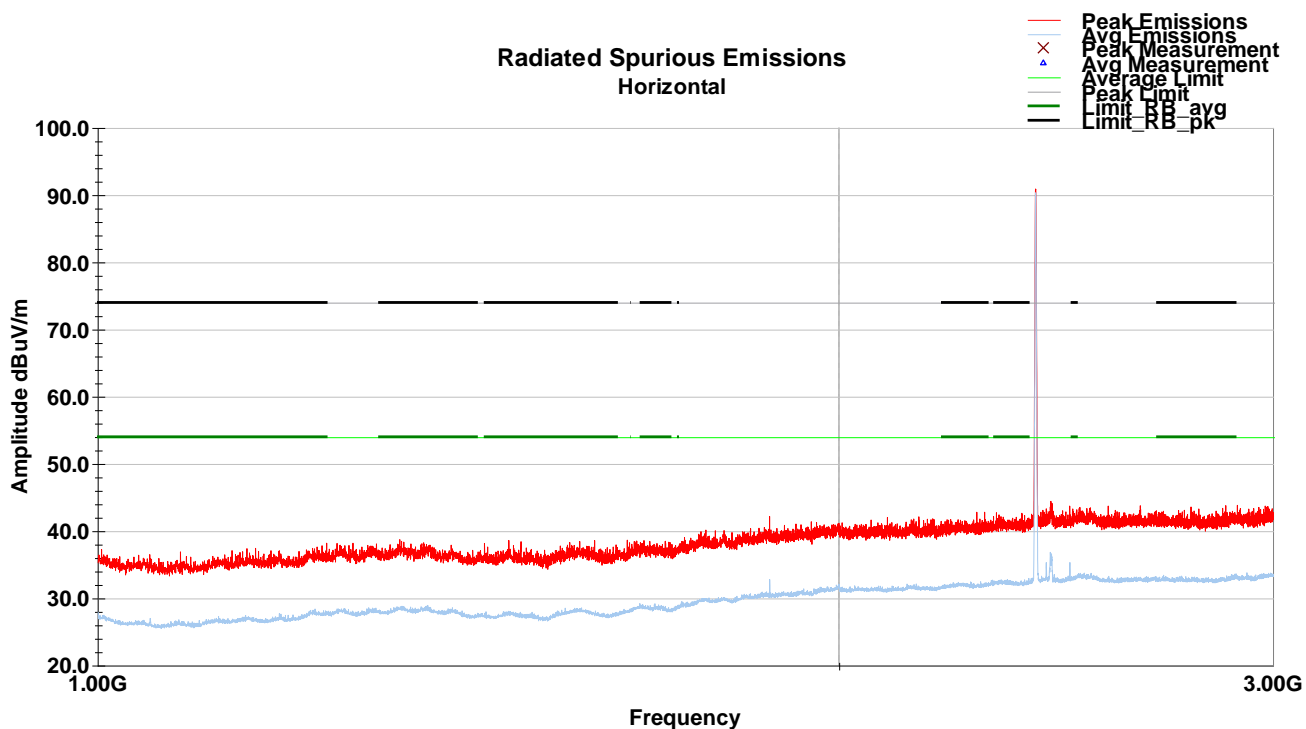### Horizontal Data (30-1000MHz)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
31.41	25.3	H	103.0	393.0	21.1	0.9	31.0	16.3	40.0	-23.7
220.01	37.7	H	101.0	101.0	11.5	2.4	31.5	20.2	46.0	-25.9
875.09	32.3	H	30.0	325.0	22.7	4.9	31.1	28.8	46.0	-17.2
880.75	24.0	H	118.0	246.0	22.7	4.9	31.1	20.6	46.0	-25.5
905.16	24.1	H	198.0	198.0	22.9	5.0	31.1	20.9	46.0	-25.2
939.50	24.1	H	222.0	196.0	23.3	5.1	31.0	21.5	46.0	-24.5
QP Value = Raw QP+ AF + Loss - Amp										
Margin = QP Value - Limit										

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BLE Channel 0
Vertical Plot (1-3GHz)

BLE Channel 0
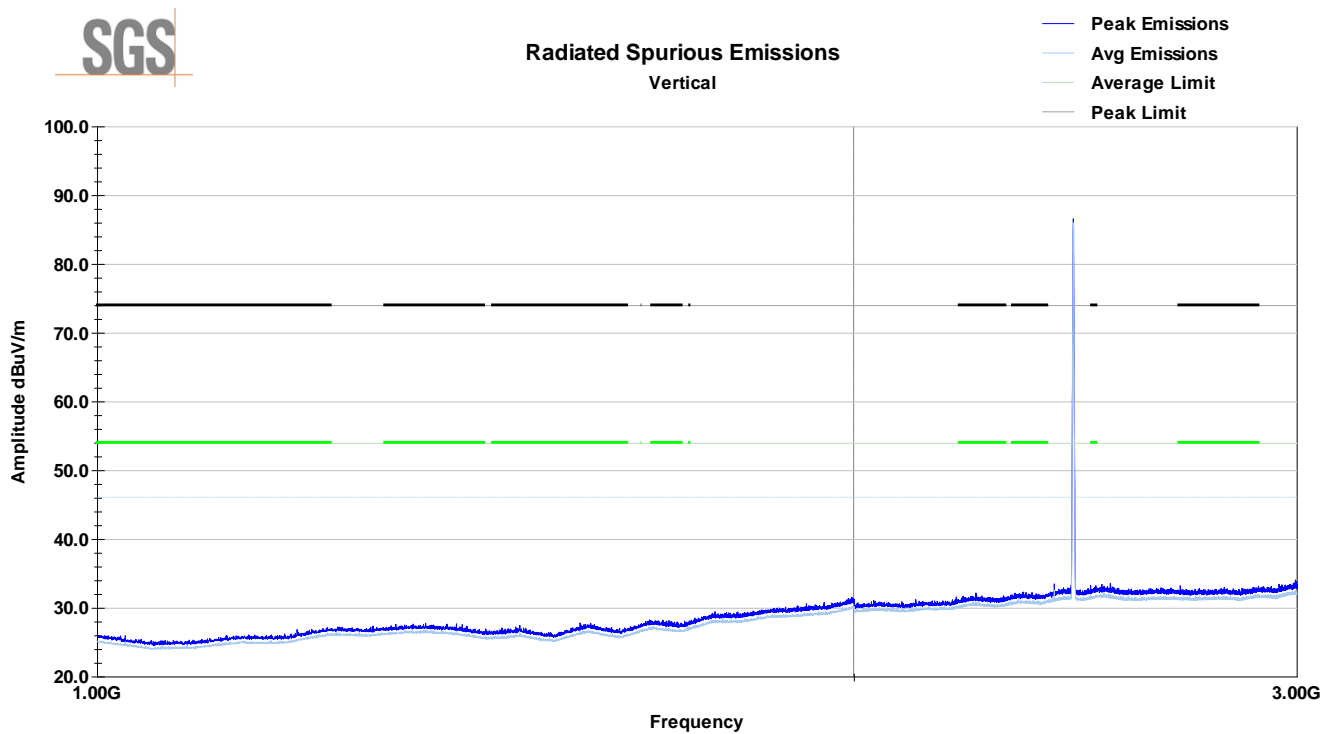## Horizontal Plot (1-3GHz)

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BLE Channel 19
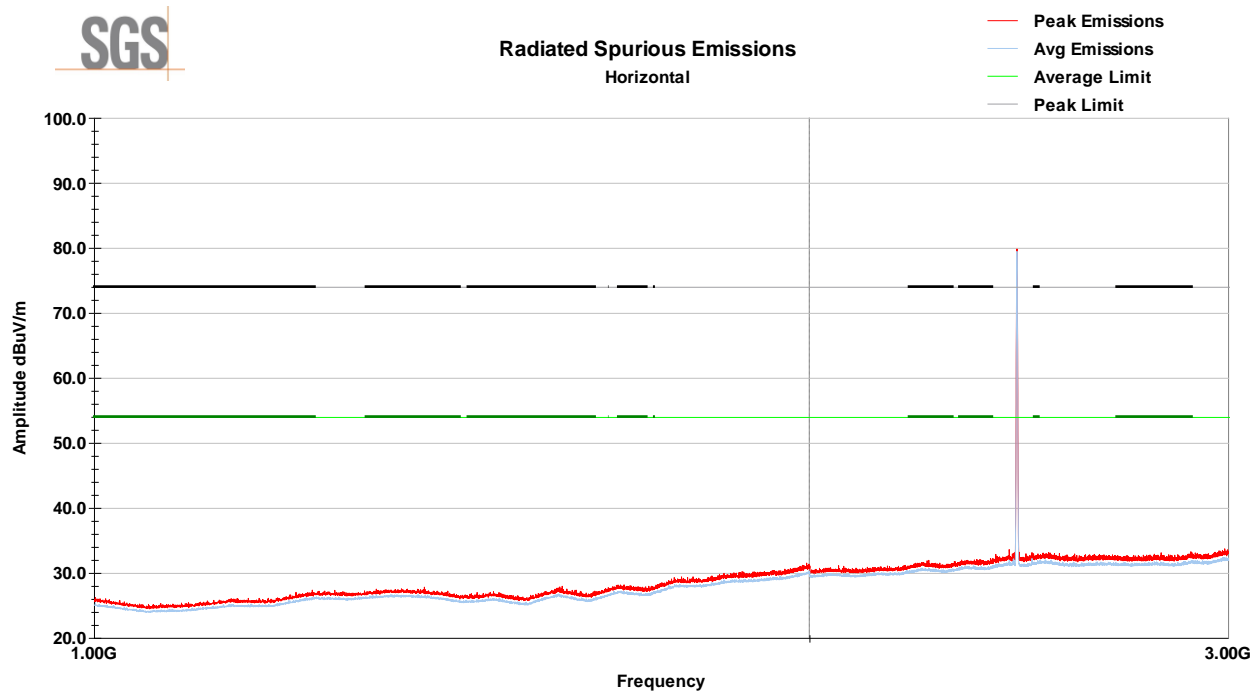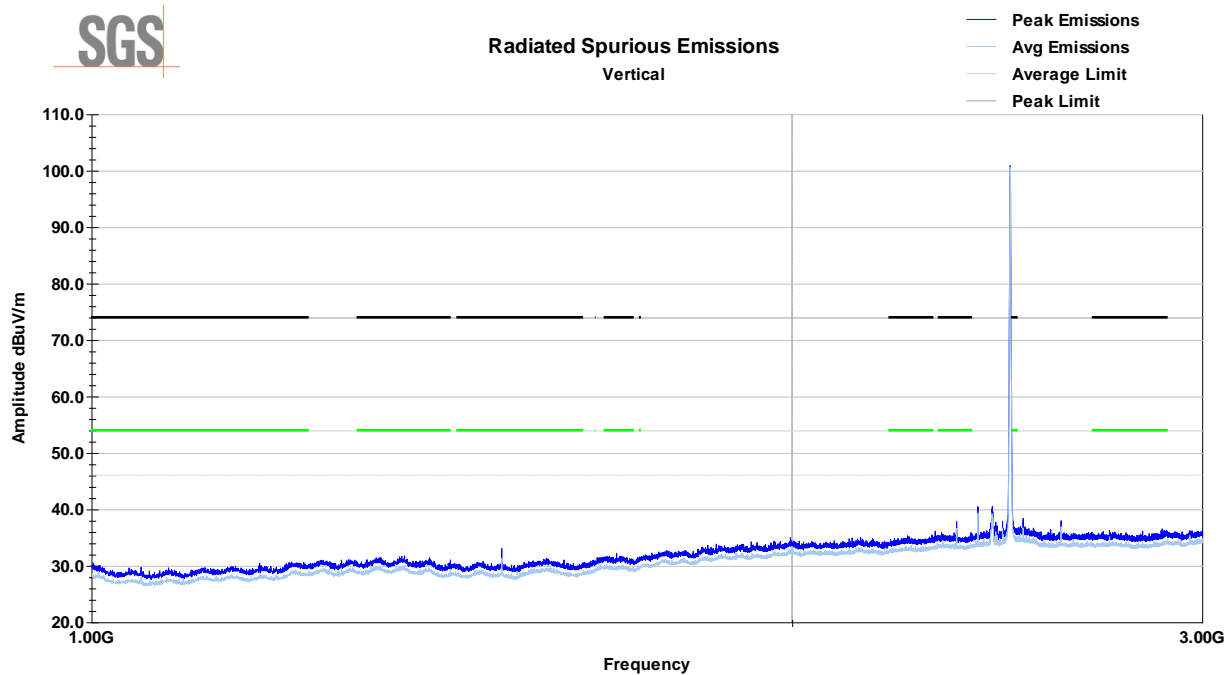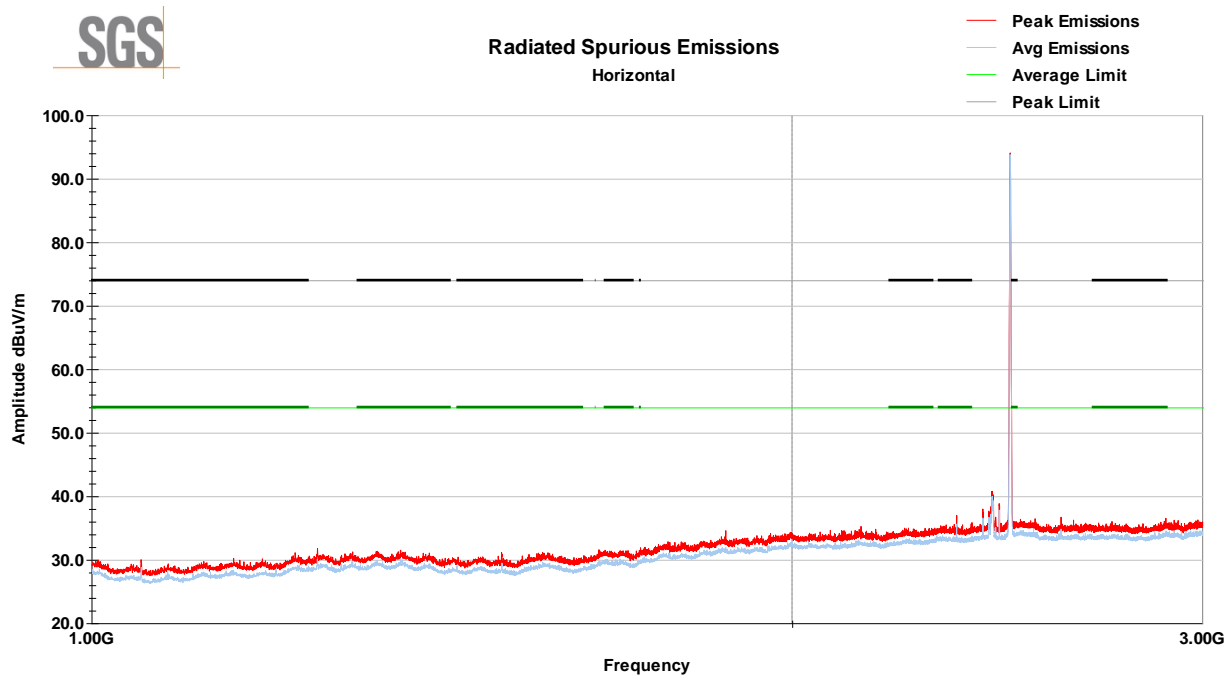### Vertical Plot (1-3GHz)

BLE Channel 19
Horizontal Plot (1-3GHz)

BLE Channel 39
Vertical Plot (1-3GHz)

BLE Channel 39
Horizontal Plot (1-3GHz)

BLE Channel 0
Vertical Plot (3-18GHz)

Radiated Spurious Emissions
Vertical

Legend:
- Peak Limit
- Average Limit
- Peak Emissions
- Avg Emissions
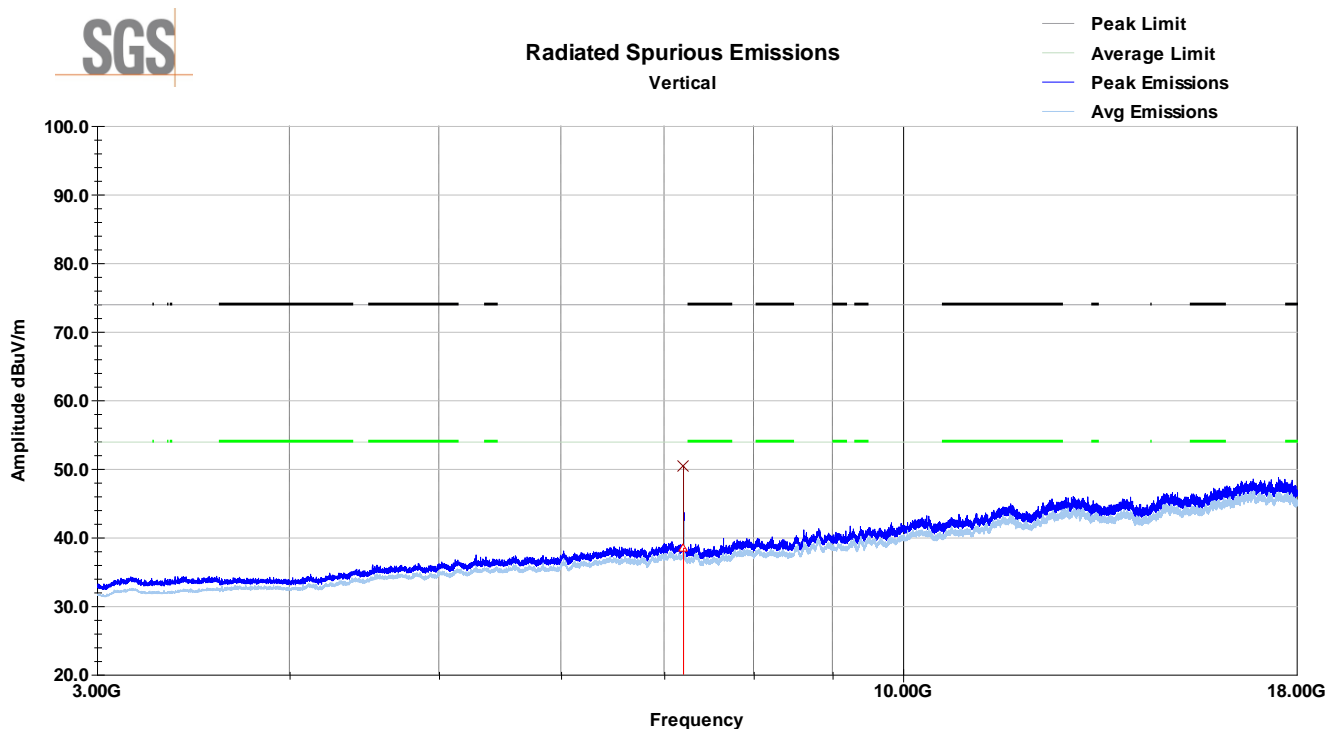
BLE Channel 0
Vertical Peak Data (3-18GHz)

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
7206.62	45.927	V	64	123	35.7	3.9	35.2	50.3	74	-23.7
QP Value = Raw Pk + AF + Loss - Amp										
Margin = QP Value - Limit										

Vertical Average Data (3-18GHz)

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)
7206.62	34.06	V	64	123	35.7	3.9	35.2	38.465	54	-15.5
QP Value = Raw Avg + AF + Loss - Amp										
Margin = QP Value - Limit										

BLE Channel 0
Horizontal Plot (3-18GHz)

BLE Channel 0
Horizontal Peak Data (3-18GHz)

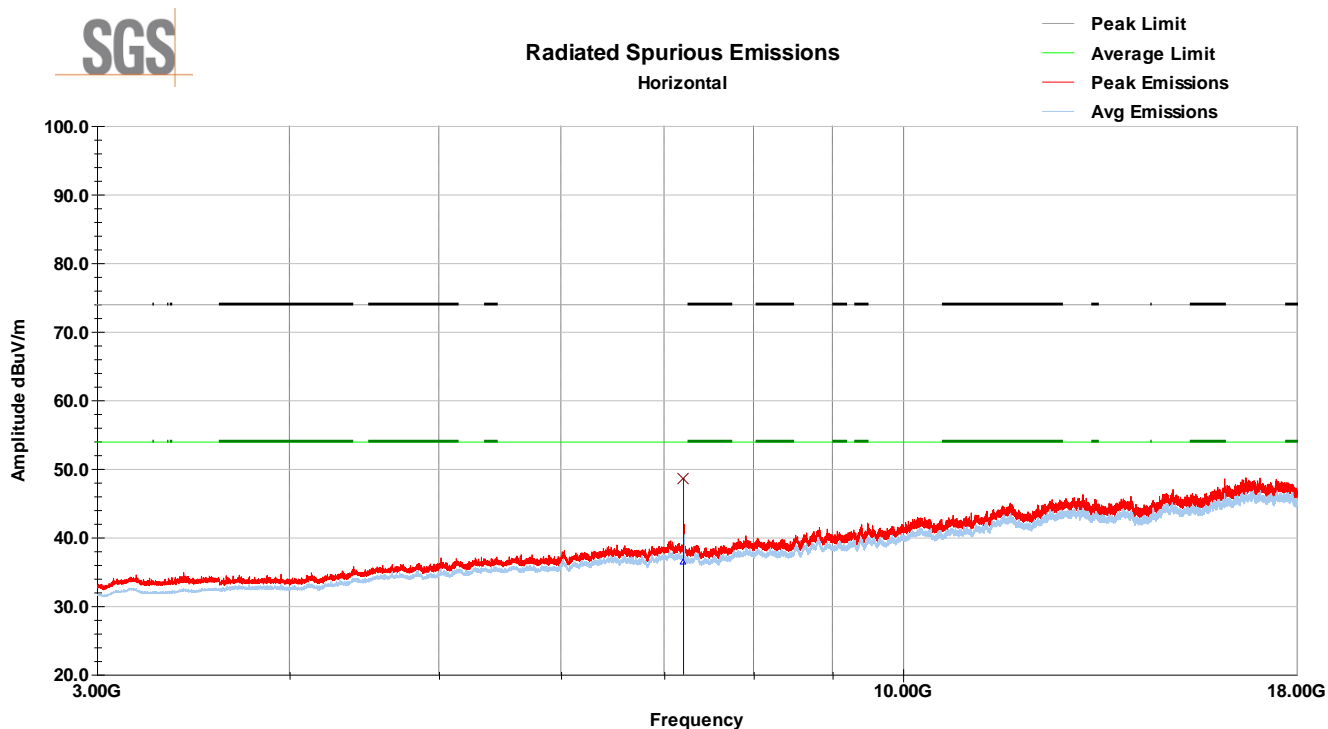| Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
7206.68	44.172	H	225	135	35.7	3.9	35.2	48.577	74	-25.4
QP Value = Raw Pk + AF + Loss - Amp										
Margin = QP Value - Limit										

Horizontal Average Data (3-18GHz)

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)
7206.68	32.038	H	225	135	35.7	3.9	35.2	36.442	54	-17.5
QP Value = Raw Avg + AF + Loss - Amp										
Margin = QP Value - Limit										

BLE Channel 19
Vertical Plot (3-18GHz)
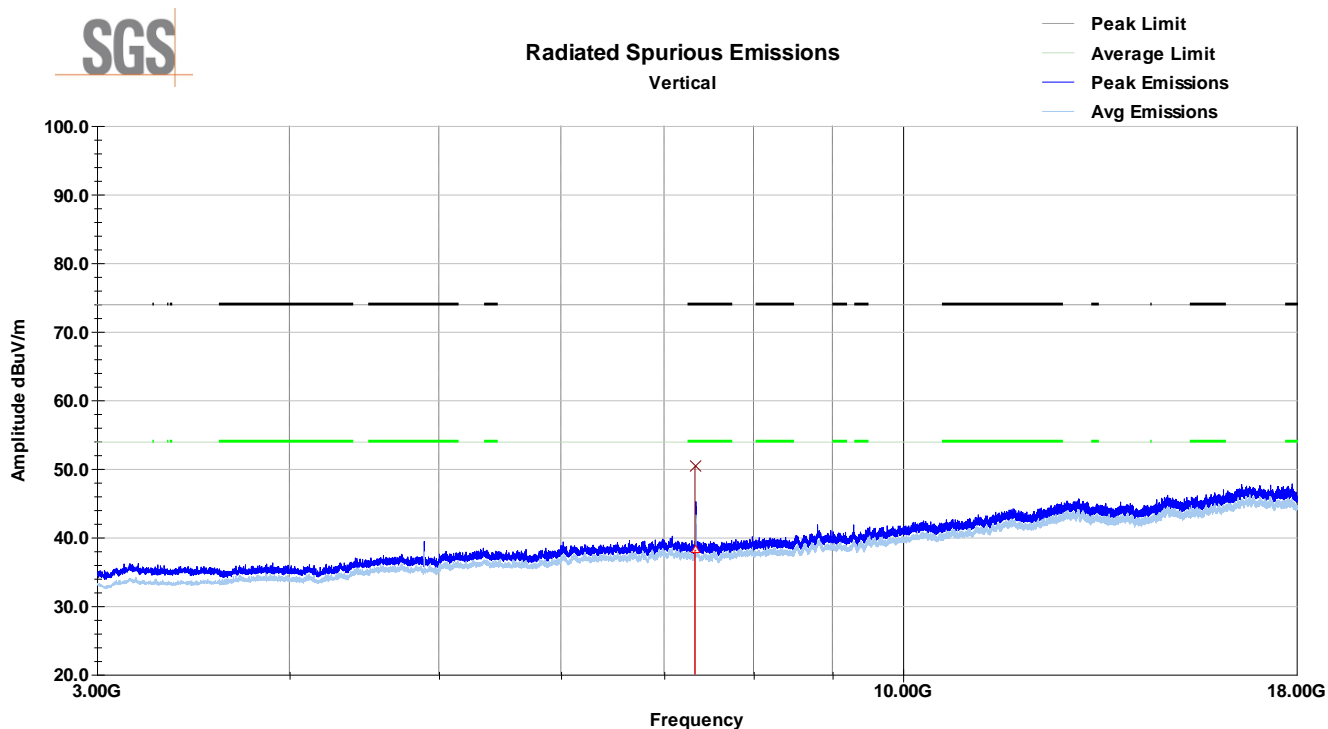
BLE Channel 19
Vertical Peak Data (3-18GHz)

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
7331.1	45.95	V	239	193	35.7	3.9	35.2	50.4	74	-23.6
QP Value = Raw Pk + AF + Loss - Amp										
Margin = QP Value - Limit										

Vertical Average Data (3-18GHz)

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)
7331.1	33.77	V	239	193	35.7	3.9	35.2	38.18	54	-15.8
QP Value = Raw Avg + AF + Loss - Amp										
Margin = QP Value - Limit										

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BLE Channel 19
Horizontal Plot (3-18GHz)

Radiated Spurious Emissions

Horizontal

Legend:
- Peak Limit
- Average Limit
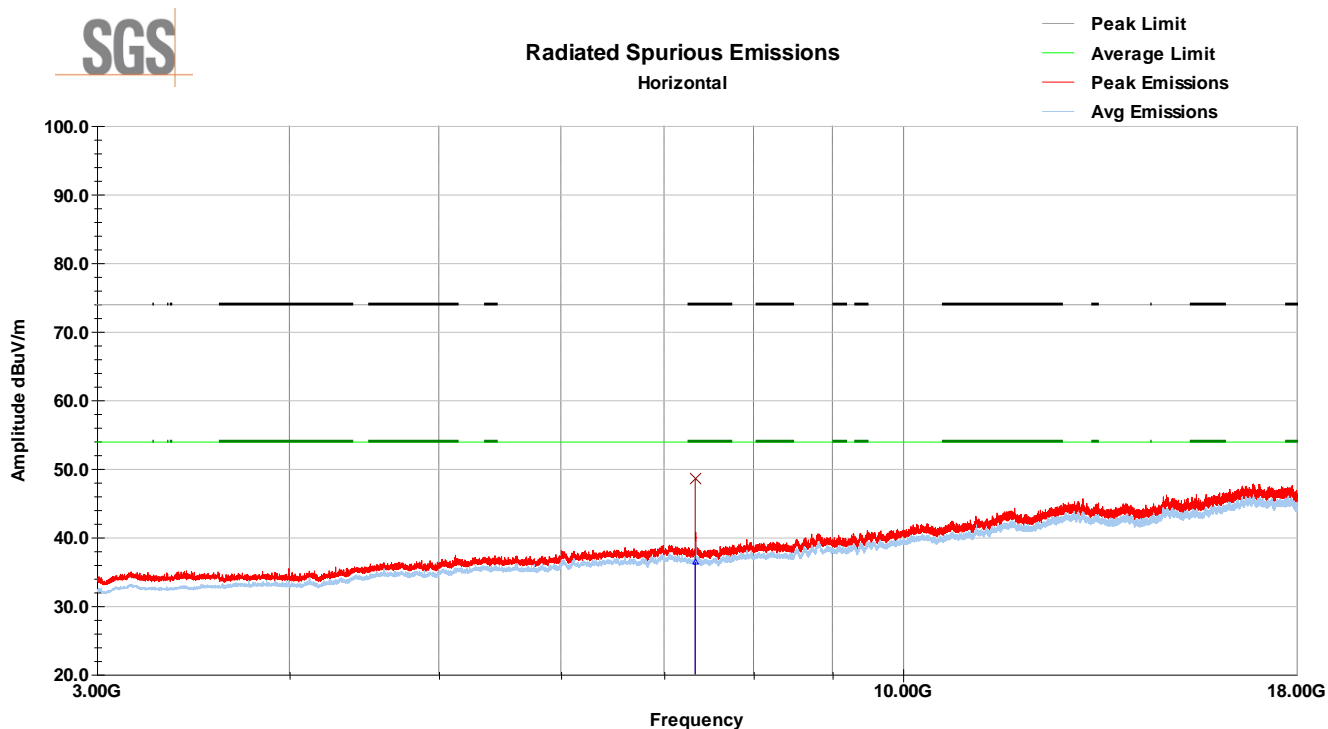- Peak Emissions
- Avg Emissions

BLE Channel 19
Horizontal Peak Data (3-18GHz)

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
7332.38	44.066	H	279	175	35.7	3.9	35.2	48.484	74	-25.5
QP Value = Raw Pk + AF + Loss - Amp										
Margin = QP Value - Limit										

Horizontal Average Data (3-18GHz)

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)
7332.38	32.019	H	279	175	35.7	3.9	35.2	36.437	54	-17.5
QP Value = Raw Avg + AF + Loss - Amp										
Margin = QP Value - Limit										

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BLE Channel 39
Vertical Plot (3-18GHz)
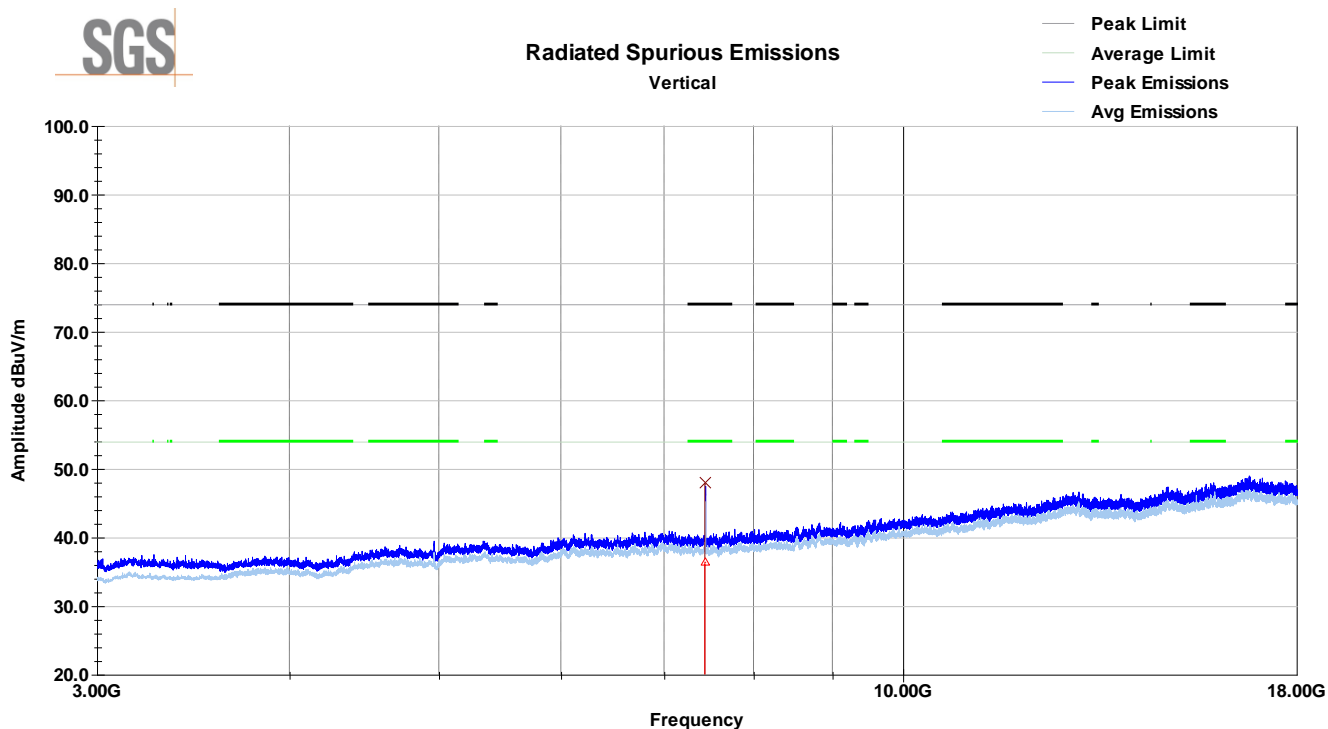

BLE Channel 39
Vertical Peak Data (3-18GHz)

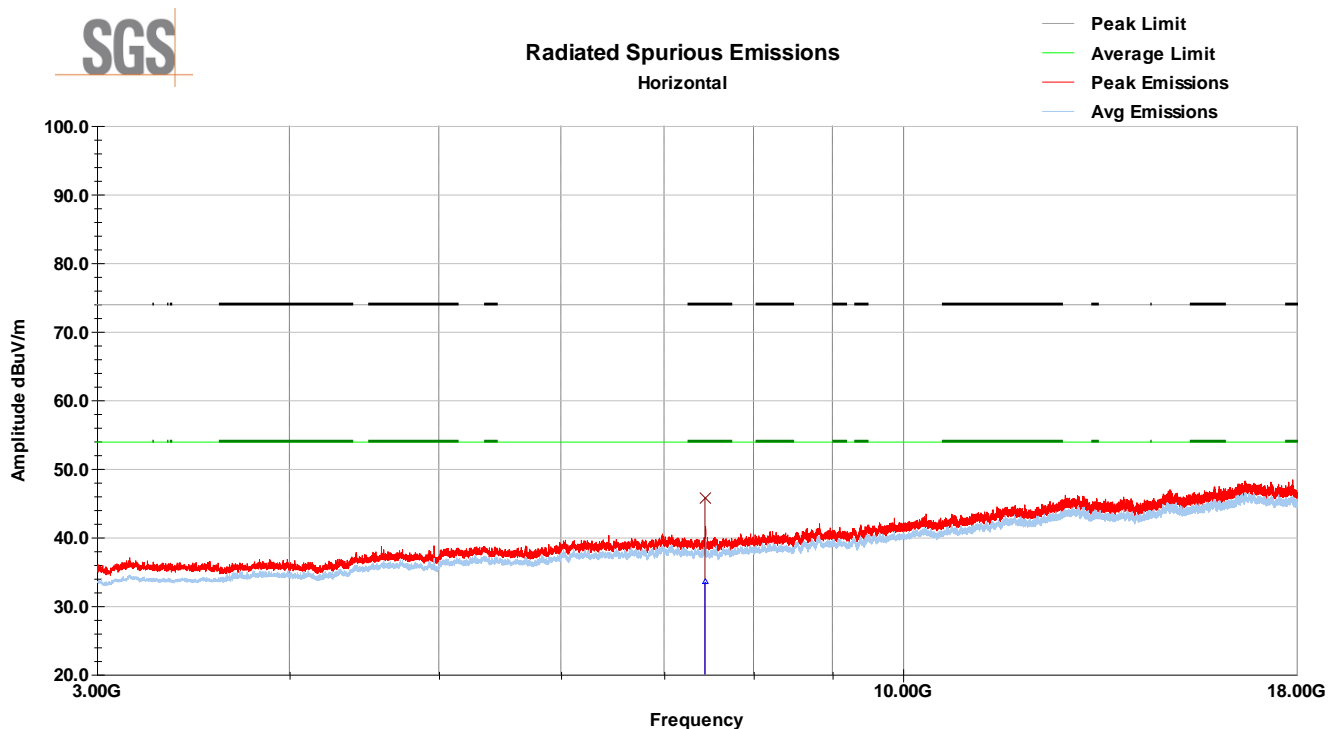| Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
7439.22	43.432	V	247	108	35.7	4	35.3	47.9	74	-26.1
QP Value = Raw Pk + AF + Loss - Amp										
Margin = QP Value - Limit										

Vertical Average Data (3-18GHz)

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)
7439.22	32.012	V	247	108	35.7	4	35.3	36.435	54	-17.5
QP Value = Raw Avg + AF + Loss - Amp										
Margin = QP Value - Limit										

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BLE Channel 39
Horizontal Plot (3-18GHz)

BLE Channel 39
Horizontal Peak Data (3-18GHz)

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
7440.6	41.319	H	359	157	35.7	4	35.3	45.746	74	-28.3
QP Value = Raw Pk + AF + Loss - Amp										
Margin = QP Value - Limit										

Horizontal Average Data (3-18GHz)

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)
7440.6	29.045	H	359	157	35.7	4	35.3	33.472	54	-20.5
QP Value = Raw Avg + AF + Loss - Amp										
Margin = QP Value - Limit										

There were no emissions in the 18-26GHz frequency range.

4 Measurement Uncertainty

The measurement uncertainty figures are calculated in accordance with TR 100 028-1 [2] and correspond to an expansion factor (coverage factor) k = 2 (which provides 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	±1°C	±0.5°C
humidity	±5 %	±3.5%
DC and low frequency voltages	±3 %	±0.4%
Conducted disturbance at mains port using AMN	± 3.4 dB	± 2.5 dB

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5 Revision History

Revision Level	Description of changes	Revision Date
Draft	--	29 October 2021
0	Initial release	03 December 2021
1	- Added CAB ID in section 2.2 - Added new section 3.3 with test setup block diagrams	06 January 2022