

RF Test Report

Project Number: 4598567**Proposal Number:** 10361 rev3**Report Number:** 4598567EMC05**Revision Level:** 1**Client:** Owlet Baby Care Inc.**Equipment Under Test:** Owlet Smart Sock Base Station V3**Model:** OBL 3.0**FCC ID:** 2AIEP-OBL3A**IC ID:** 21386-OBL3A**Applicable Standards:** FCC Part 15 Subpart C, § 15.247

RSS-247, Issue 2, February 2017

RSS-GEN, Issue 5, March 2019, Amendment 1

ANSI C63.10:2013

Report issued on: 07 July 2020**Test Result:** Compliant

Prepared by:



Martin Taylor, Project Engineer

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 S5.2 (a) RSS-GEN S6.7	Compliant
Output Power	15.247(b)(3)	RSS-247 S5.4 (d)	Compliant
Power Spectral Density	15.247(e)	RSS-247 S5.2 (b)	Compliant
Conducted Spurious Emissions / Band Edge	15.247(d)	RSS-247 S5.5	Compliant
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	Compliant
Antenna Requirement	15.203	RSS-GEN S6.8	Compliant ⁽¹⁾

(1) Device uses an internal PCB trace 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

2.3 General Information of EUT

Equipment Under Test: Owlet Smart Sock Base Station V3
Model: OBL 3.0
Sample ID: 5220
Firmware Version: B1.0.3-c9c4_S1.0.4-64c1_BB0.7.34_SB0.7.33_SD6.1.1

FCC ID: 2AIEP-OBL3A
IC ID: 21386-OBL3A

Frequency Range: 2402 – 2480 MHz
Data Modes: Bluetooth Low Energy (GFSK)
Antenna: Internal PCB Trace Inverted F Antenna (0.77 dBi)

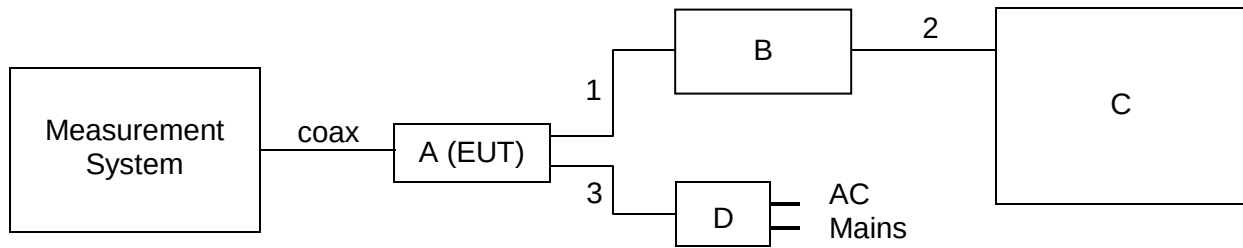
Rated Voltage: 5 Vdc from AC Adapter with input rated for 100-240Vac 50-60Hz
Test Voltage: 5 Vdc from AC Adapter powered by 120Vac 60Hz

Sample Received Date: 02 March 2020
Dates of testing: 31 March – 07 May 2020

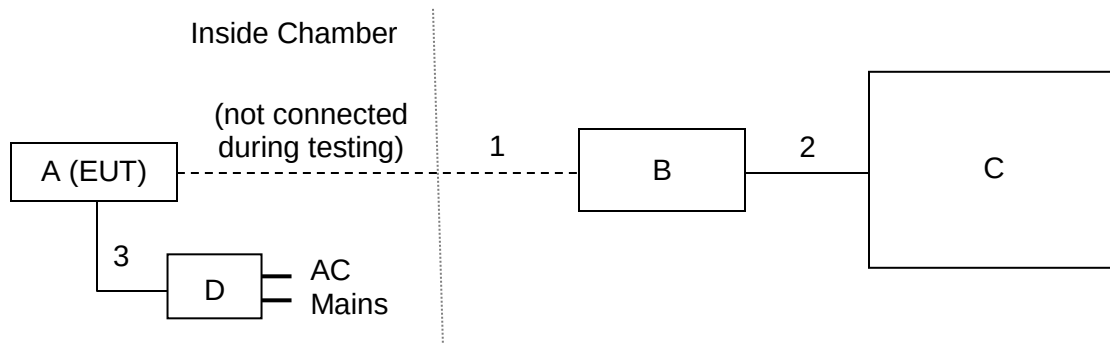
2.4 Operating Modes and Conditions

The EUT was programmed by the manufacturer to allow test mode control using a Direct Test Mode software application from Nordic Semiconductor. The conducted and radiated test mode samples were configured with 12-pin headers for radio control and were powered using USB C cables and AC Power Adapters supplied by the client. 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 -4dBm was used for all tests.

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	Owlet Baby Care Inc.	Owlet Base Station (EUT)	OBL 3.0	Not labeled
B	Owlet Baby Care Inc.	Developer Board	Super Base Buddy v1.0	Not labeled
C	Lenovo	Laptop Computer	T500	L3-ABV0N 08/12
D	Phihong USA	AC Power Adapter	PSA05A-050QL6	Not labeled

2.8 Cable List

Cable reference	Port Name	Start	End	Cable Length (m)	Ferrite installed?	Shielded?
1	Comm.	EUT	Developer Board	0.25	N	N
2	USB	Laptop	Developer Board	1.45	N	N
3	DC Power	EUT	AC Power Adapter	1.52	N	N

3 Bandwidth

3.1 Test Result

Test Description	Test Specification		Test Result
DTS Bandwidth (6dB)	15.247(a)(2)	RSS-247 S5.2 (a)	Compliant
Occupied Bandwidth (99%)		RSS-GEN S6.7	Reported

3.2 Test Methods

The DTS 6dB bandwidth measurements were performed using the procedure from ANSI C63.10 clause 11.8.1, and the 99% occupied bandwidth measurements were performed using the procedure from ANSI C63.10 clause 6.9.3. These procedures are referenced in KDB 558074 D01 15.247 Meas Guidance v05r02. See section 2.5 above for test setup diagram.

Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.9 °C

Relative Humidity: 33.8 %

Atmospheric Pressure: 98.5 kPa

3.4 Test Equipment

Test End Date: 28-Apr-2020

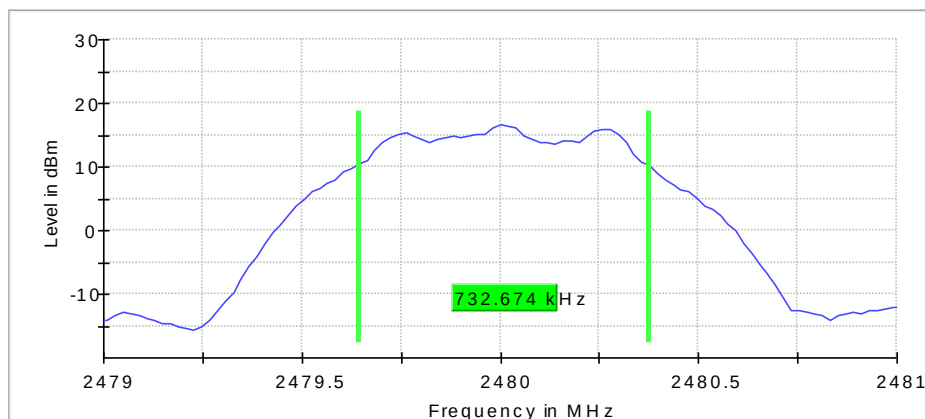
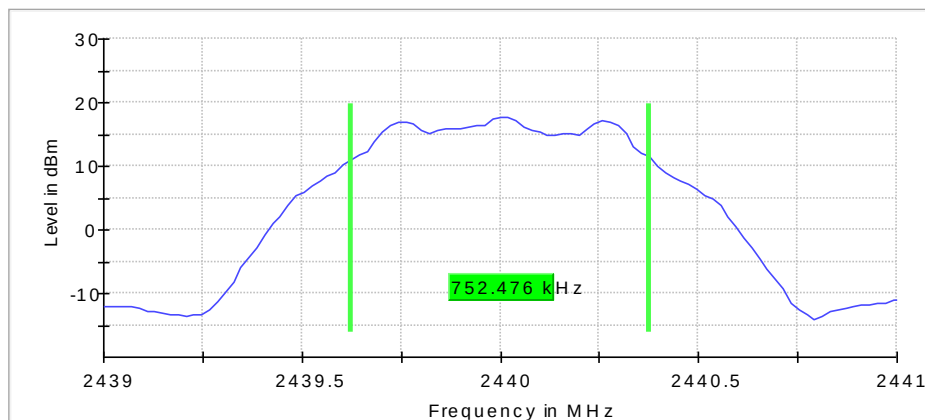
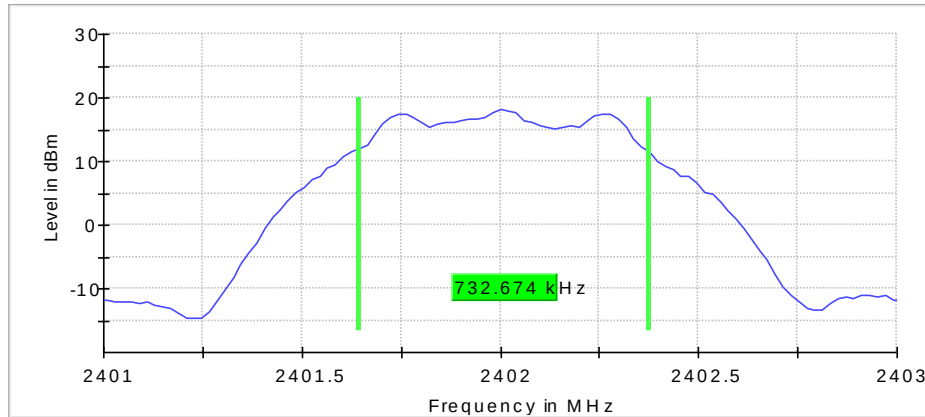
Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	Huber & Suhner	B095585	6-Sep-2020
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	7-Sep-2020
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	23-Dec-2020
POWER METER (TS8997)	OSP-B157	ROHDE & SCHWARZ	15040	26-Dec-2020
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2021

Note: The equipment calibration period is 1 year except for the FSV which is on a 2-year cycle.

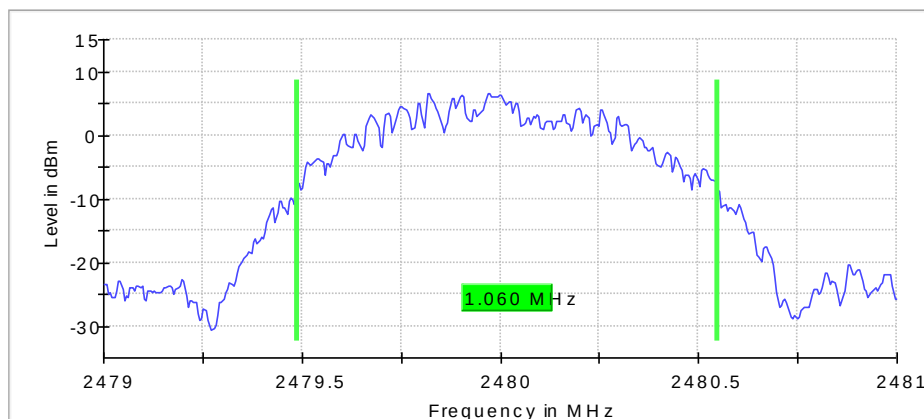
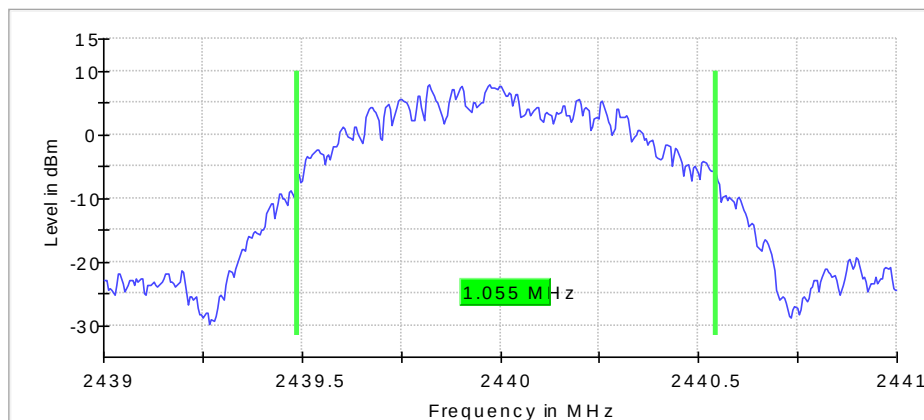
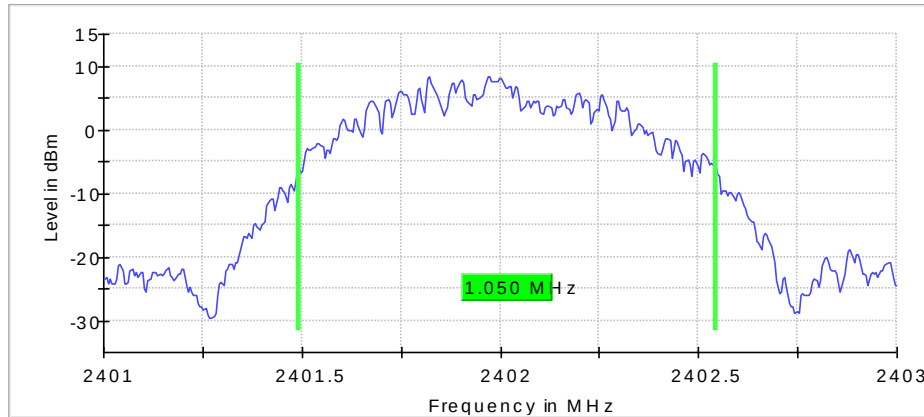
3.5 Test Data – DTS Bandwidth (6dB)

Channel	Frequency (MHz)	6dB Bandwidth (kHz)	Limit Min (kHz)	Result
0	2402	733	500	Pass
19	2440	752	500	Pass
39	2480	733	500	Pass



3.6 Test Data – 99% Occupied Bandwidth

Channel	Frequency (MHz)	99% Bandwidth (kHz)	Result
0	2402	1050	Reported
19	2440	1055	Reported
39	2480	1060	Reported



4 Output Power

4.1 Test Result

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

4.2 Test Method

Fundamental maximum conducted (average) output power measurements were performed using the method described in ANSI C63.10:2013 clause 11.9.2.3.2. This method uses a wideband gated RF power meter with gate parameters adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required. This procedure is referenced in KDB 558074 D01 15.247 Meas Guidance v05r02. See section 2.5 above for test setup diagram.

Limit

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). Also, the e.i.r.p. shall not exceed 4 Watts (36 dBm) based on RSS-247 S5.4 (d).

4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.9 °C
Relative Humidity: 33.8 %
Atmospheric Pressure: 98.5 kPa

4.4 Test Equipment

Test End Date: 28-Apr-2020

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	Huber & Suhner	B095585	6-Sep-2020
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	7-Sep-2020
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	23-Dec-2020
POWER METER (TS8997)	OSP-B157	ROHDE & SCHWARZ	15040	26-Dec-2020
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2021

Note: The equipment calibration period is 1 year except for the FSV which is on a 2-year cycle.

4.5 Test Data

Channel	Frequency (MHz)	RMS Power (dBm)	Limit Max (dBm)	EIRP (dBm)	Limit Max (dBm)	Result
0	2402	18.2	30	19.0	36	Pass
19	2440	17.8	30	18.5	36	Pass
39	2480	16.8	30	17.5	36	Pass

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 performed using the procedures from ANSI C63.10: 2013 clause 11.10. These procedures are referenced in KDB 558074 D01 15.247 Meas Guidance v05r02. See section 2.5 above for test setup diagram.

Limit

The maximum limit is 8 dBm / 3 kHz.

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.9 °C

Relative Humidity: 33.8 %

Atmospheric Pressure: 98.5 kPa

5.4 Test Equipment

Test End Date: 28-Apr-2020

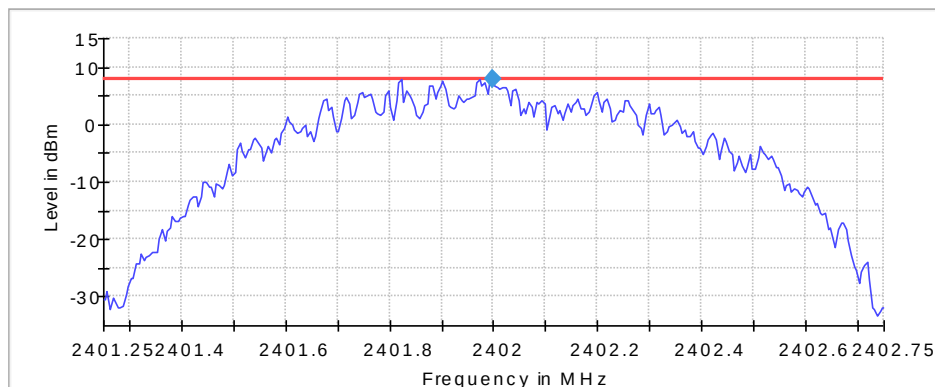
Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	Huber & Suhner	B095585	6-Sep-2020
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	7-Sep-2020
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	23-Dec-2020
POWER METER (TS8997)	OSP-B157	ROHDE & SCHWARZ	15040	26-Dec-2020
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2021

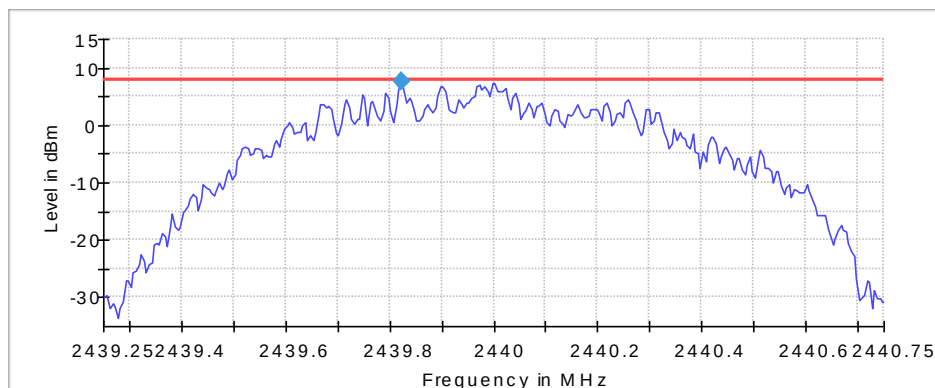
Note: The equipment calibration period is 1 year except for the FSV which is on a 2-year cycle.

5.5 Test Data

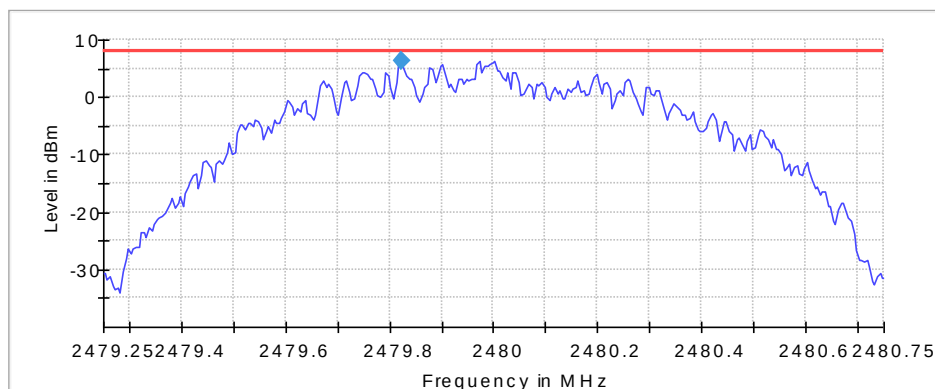
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit Max (dBm/3kHz)	Result
0	2402	7.9	8	Pass
19	2440	7.5	8	Pass
39	2480	6.3	8	Pass



— Limit — Sum Level ◆ PSD



— Limit — Sum Level ◆ PSD



— Limit — Sum Level ◆ PSD

6 Conducted Spurious Emissions / Band Edge

6.1 Test Result

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

6.2 Test Method

Conducted band edge and spurious band emissions in non-restricted frequency bands were measured using the method defined in ANSI C63.10 clause 11.11. This procedure is referenced in KDB 558074 D01 15.247 Meas Guidance v05r02. See section 2.5 above for test setup diagram.

Limit

Because the maximum conducted average 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 30 dB below the maximum in-band peak level.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions	Band Edge Emissions	Conducted Spurious Emissions
Temperature:	22.9 °C	24.1 °C
Relative Humidity:	33.8 %	45.4 %
Atmospheric Pressure:	98.5 kPa	97.2 kPa

6.4 Test Equipment

Band Edge Emissions

Test End Date: 28-Apr-2020

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	Huber & Suhner	B095585	6-Sep-2020
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	7-Sep-2020
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	23-Dec-2020
POWER METER (TS8997)	OSP-B157	ROHDE & SCHWARZ	15040	26-Dec-2020
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2021

Note: The equipment calibration period is 1 year except for the FSV which is on a 2-year cycle.

Conducted Spurious Emissions

Test End Date: 29-Apr-2020

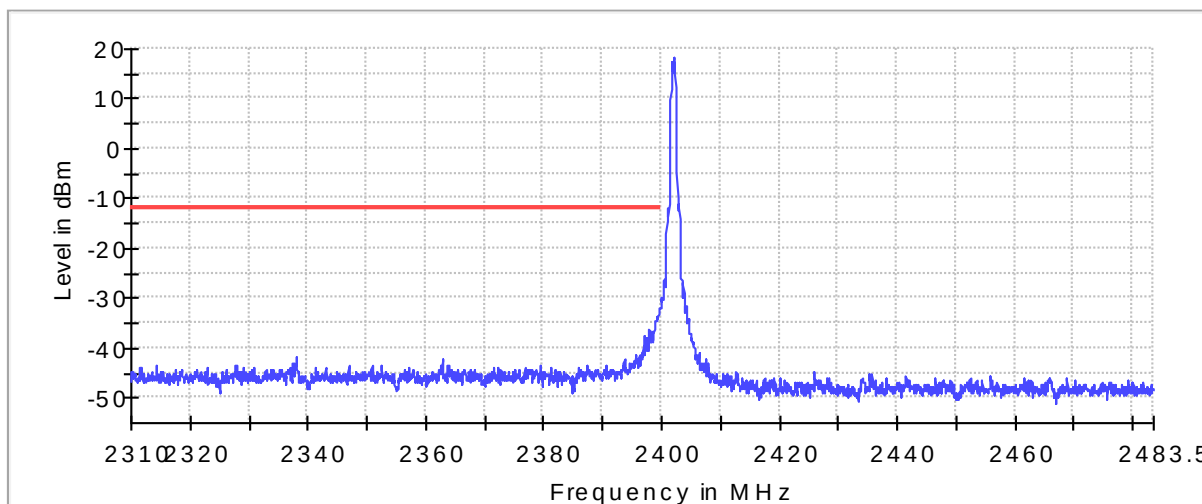
Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ATTENUATOR, 10DB	BW-S10W2	Mini-Circuits	15032	14-Sep-2020
ATTENUATOR, 10DB	BW-S10W2	Mini-Circuits	15033	14-Sep-2020
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	6-Apr-2021

Note: The equipment calibration period is 1 year.

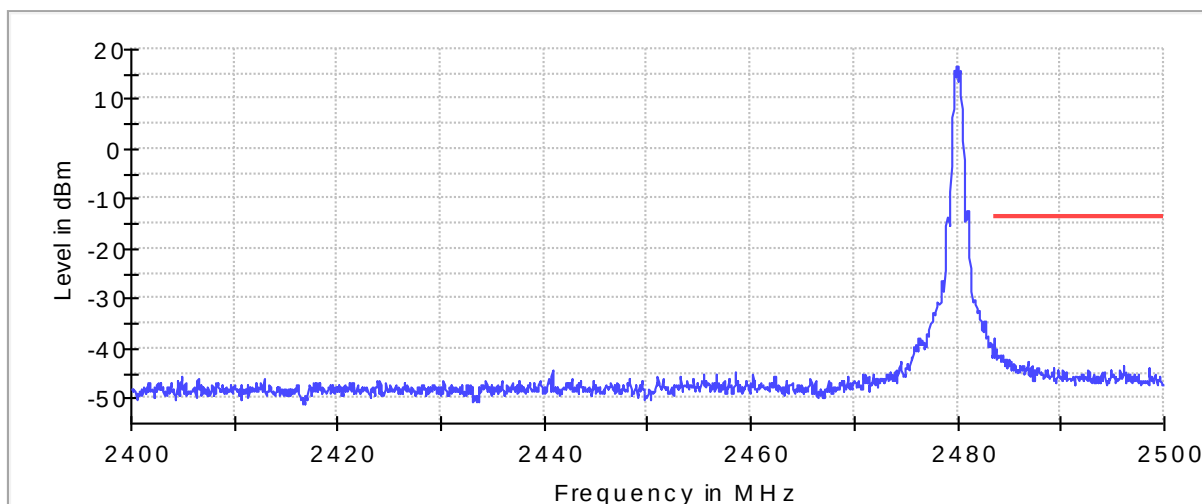
6.5 Test Data – DTS Band Edge

BLE - Lower band edge



— Limit — Sum Level × Fail

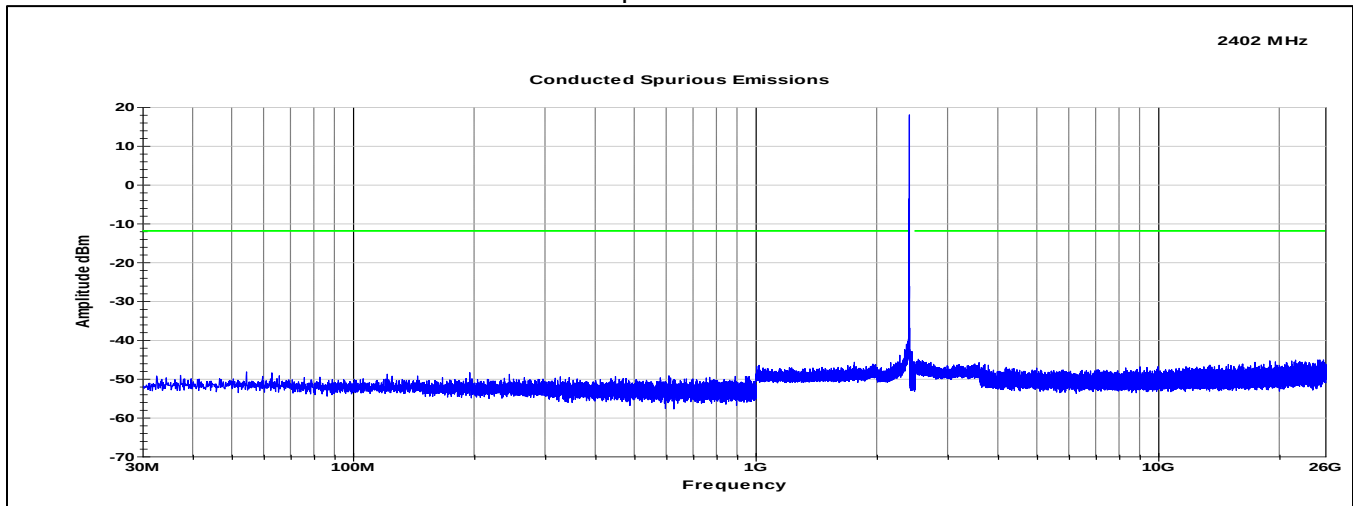
BLE - Upper band edge



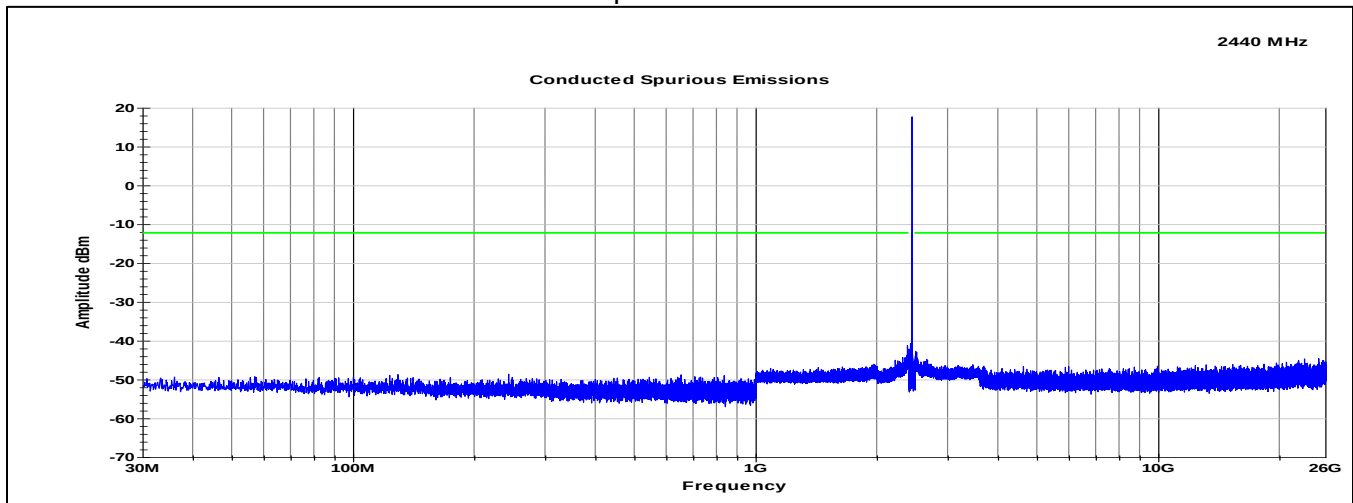
— Limit — Sum Level × Fail

6.6 Test Data – DTS Conducted Spurious Emissions

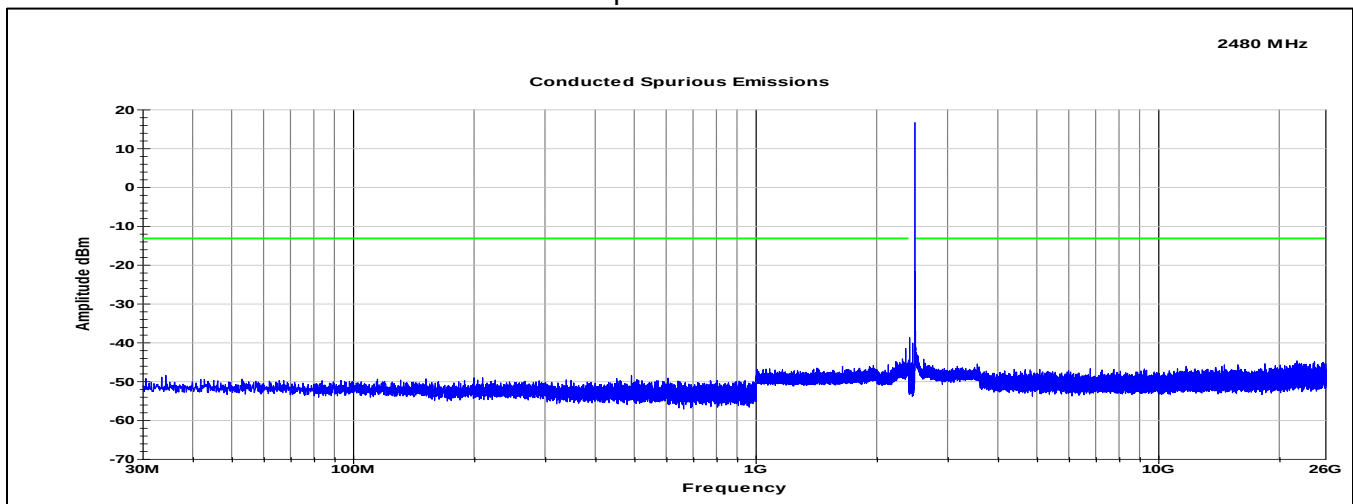
Conducted Spurs – BLE Channel 0



Conducted Spurs – BLE Channel 19



Conducted Spurs – BLE Channel 39



7 Emissions in Restricted Frequency Bands

7.1 Test Result

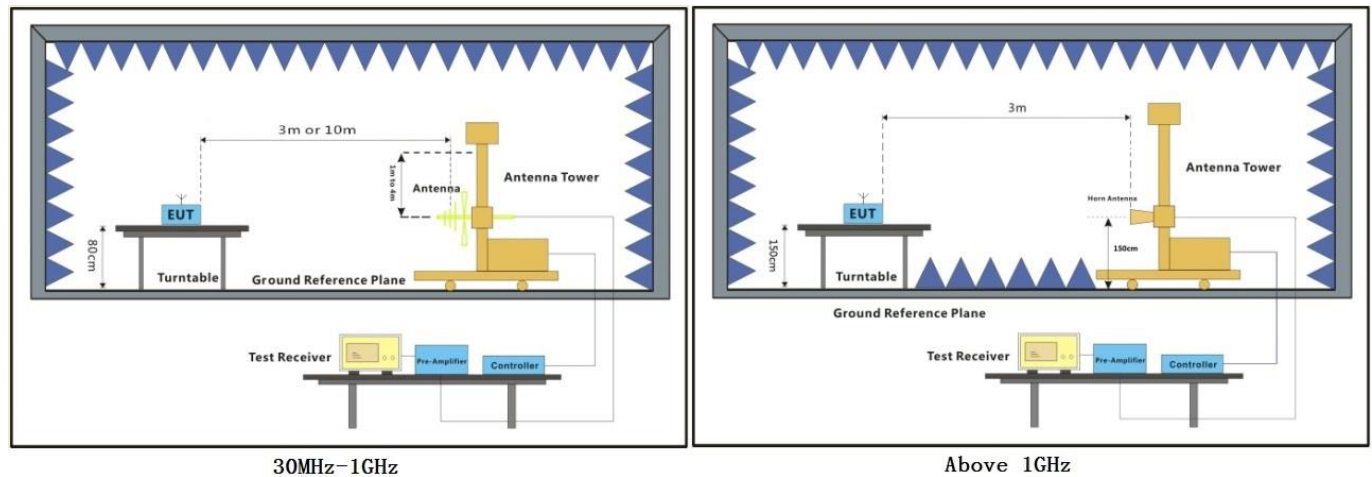
Test Description	Test Specification		Test Result
Emissions in Restricted Frequency Bands	15.247(d) 15.205, 15.209	RSS-247 S5.5 RSS-GEN S8.9, S8.10	Compliant

7.2 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 0, 19 and 39.

Below are the test setup diagrams used in this testing.



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

7.3 Test Site

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

Environmental Conditions	30-1000MHz	1-3GHz	3-18GHz	18-26GHz
Temperature:	22.1 °C	22.9 °C	24.2 °C	23.8 °C
Relative Humidity:	38.5 %	36.1 %	39.9 %	40.9 %
Atmospheric Pressure:	98.0 kPa	98.5 kPa	97.1 kPa	97.2 kPa

7.4 Test Equipment

30-1000MHz

Test End Date: 31-Mar-2020

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079690	11-Dec-2020
RF Cable Nm to Nm, 0.01-18GHz	90-195-276	TELEDYNE STORM MICROWAVE	20113	2-Mar-2021
RF CABLE	SF106	HUBER & SUHNER	B079713	7-Sep-2020
RF Cable Nm to Nm, 0.01-18GHz	90-195-118	TELEDYNE STORM MICROWAVE	20125	2-Mar-2021
RF CABLE	SUCOFLEX 100	Huber & Suhner	B108523	5-Sep-2020
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	6-Mar-2021
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	7-May-2021

Note: The equipment calibration period is 1 year.

1-18GHz

Test End Date: 28-Apr-2020

Tester: ZH

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS Lindgren	B079691	10-Aug-2020
RF Cable Nm to Nm, 0.01-18GHz	90-195-276	TELEDYNE STORM MICROWAVE	20113	2-Mar-2021
RF CABLE	104PE	HUBER & SUHNER	B079793	5-Sep-2020
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	3-Dec-2020
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	101585	3-Dec-2020

Note: The equipment calibration period is 1 year.

18-26GHz

Test End Date: 24-Apr-2020

Tester: MT

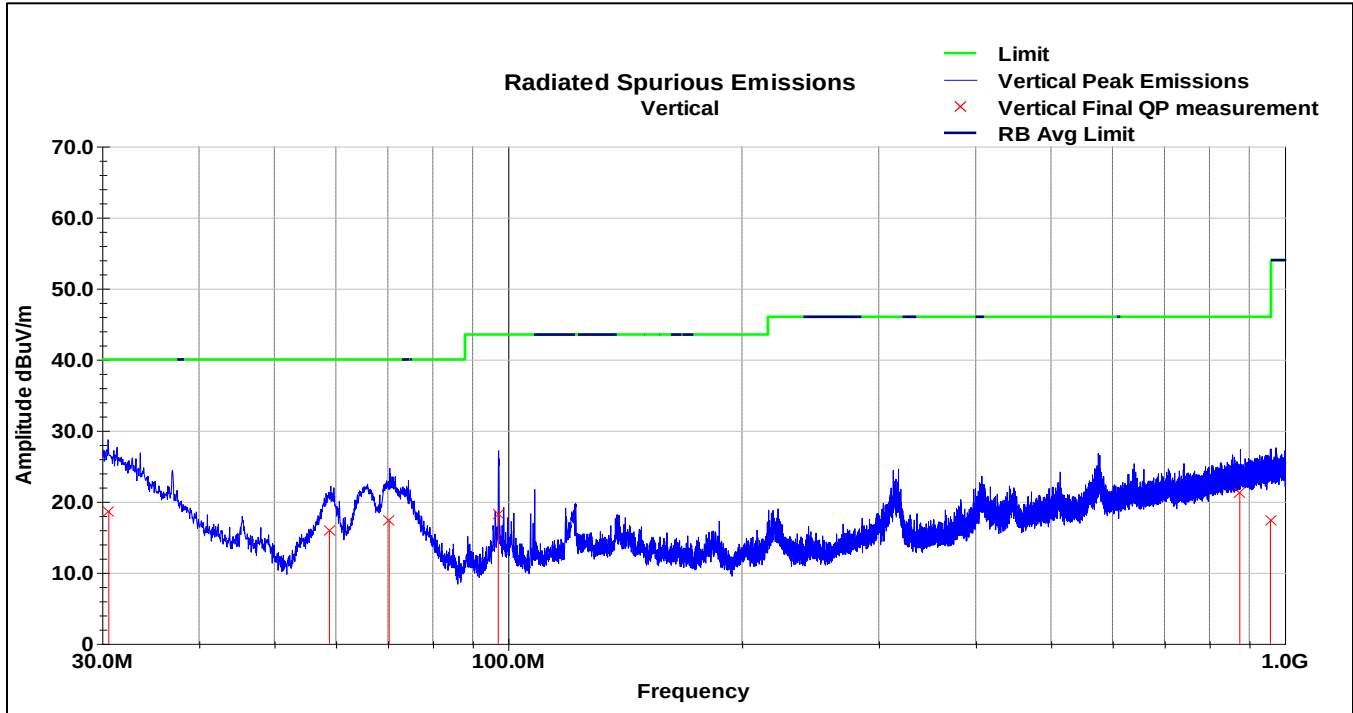
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, HORN (SMALL)	LB-180400-20-C-KF	A-INFO	15007	6-Apr-2022
RF Cable SMA to SMA, 0.01-40GHz	084-0505-059	TELEDYNE STORM MICROWAVE	20108	6-Mar-2021
RF Cable SMA to SMA, 0.01-40GHz	084-0505-138	TELEDYNE STORM MICROWAVE	20111	6-Mar-2021
RF CABLE	SF102	Huber & Suhner	B079823	17-Jul-2020
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	101585	3-Dec-2020
LOW NOISE AMPLIFIER	NSP1840-HG	MITEQ	B087572	7-Oct-2020

Note: The equipment calibration period is 1 year.

7.5 Test Data – Radiated Emissions

No emissions were detected in the 9kHz to 30MHz frequency range.

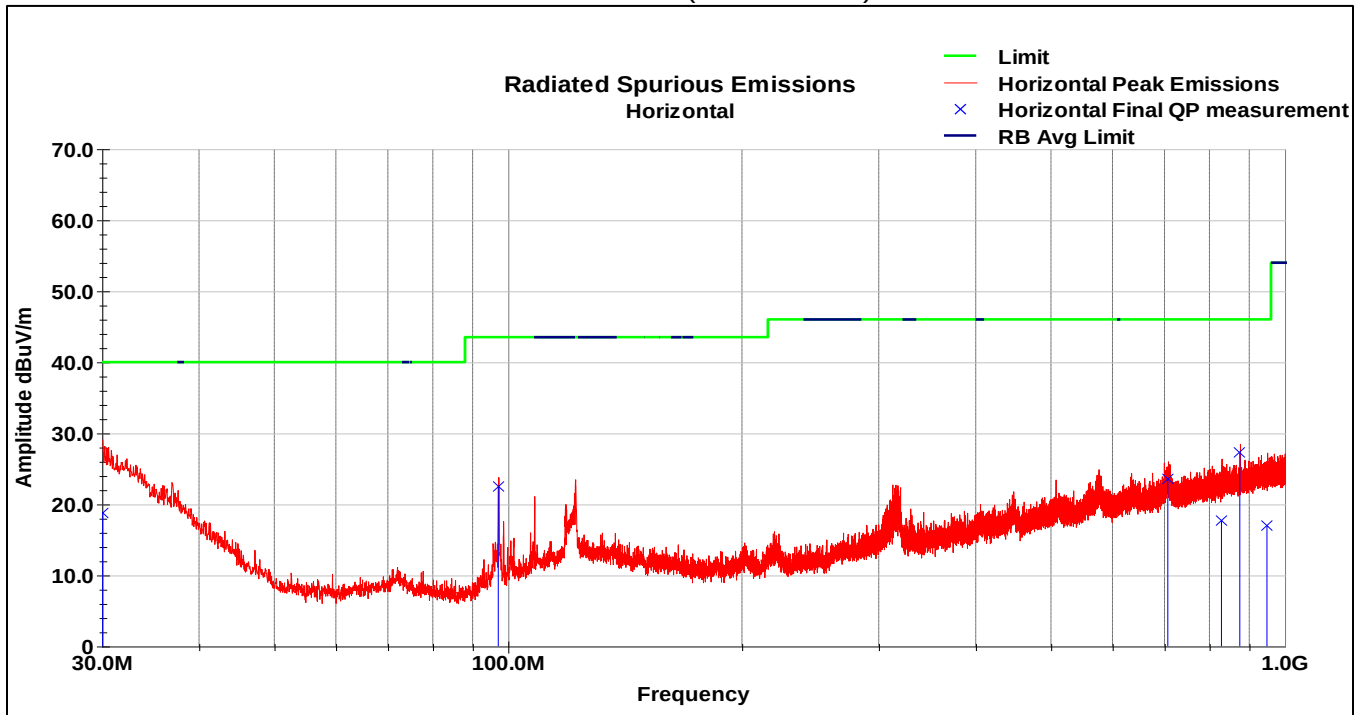
BLE Channel 0
Vertical Plot (30-1000MHz)



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)
30.61	25.6	V	313.0	131.0	21.7	0.5	29.1	18.7	40.0	-21.3
58.88	41.9	V	91.0	132.0	7.3	0.8	34.1	15.9	40.0	-24.1
70.28	42.6	V	135.0	142.0	8.2	0.9	34.4	17.3	40.0	-22.7
97.11	42.6	V	178.0	250.0	9.5	1.1	35.0	18.2	43.5	-25.3
875.09	30.4	V	206.0	175.0	22.7	3.2	35.0	21.3	46.0	-24.7
958.56	25.6	V	236.0	250.0	23.4	3.4	35.0	17.4	46.0	-28.6
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

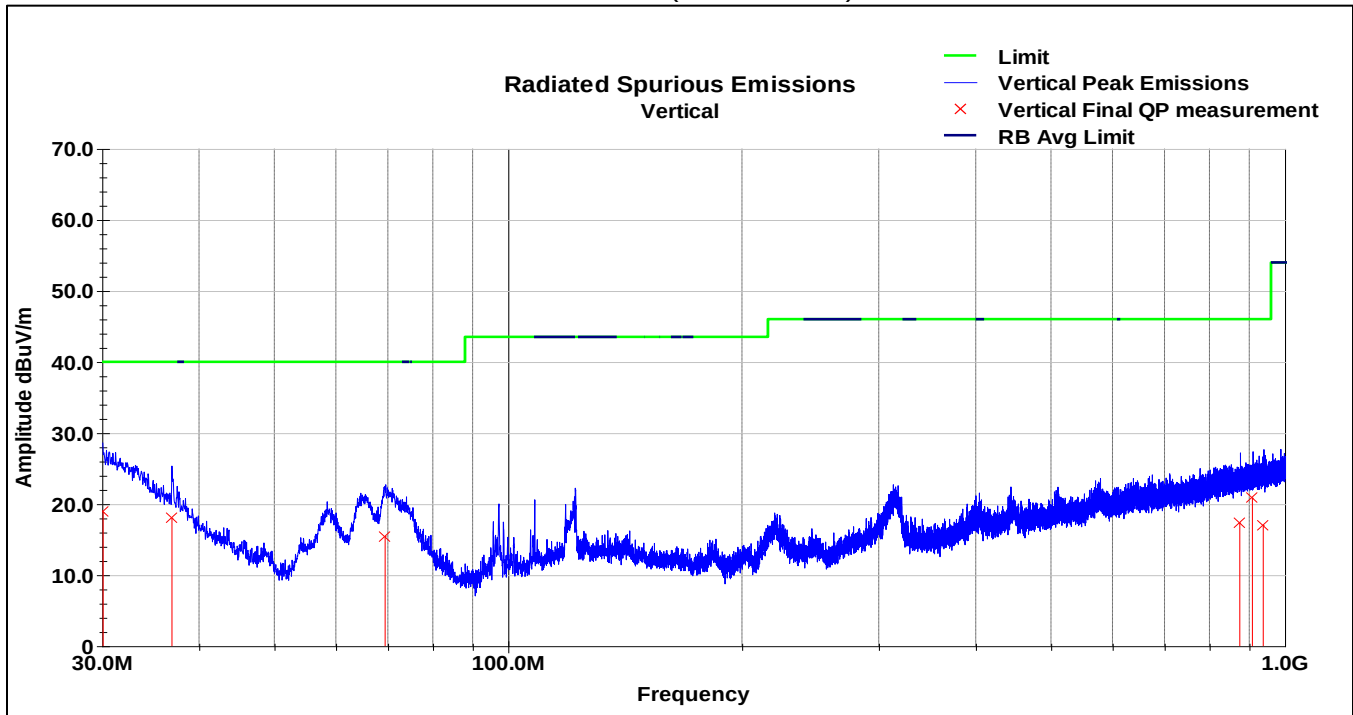
BLE Channel 0 Horizontal Plot (30-1000MHz)



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)
30.06	25.1	H	52.0	103.0	22.1	0.5	29.0	18.8	40.0	-21.2
97.11	47.0	H	213.0	203.0	9.5	1.1	35.0	22.5	43.5	-21.0
706.95	35.0	H	352.0	130.0	20.7	2.8	35.0	23.6	46.0	-22.5
828.81	27.3	H	355.0	111.0	22.3	3.1	35.0	17.7	46.0	-28.3
875.08	36.4	H	293.0	194.0	22.7	3.2	35.0	27.3	46.0	-18.8
948.44	25.4	H	0.0	124.0	23.2	3.3	35.0	17.0	46.0	-29.0
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

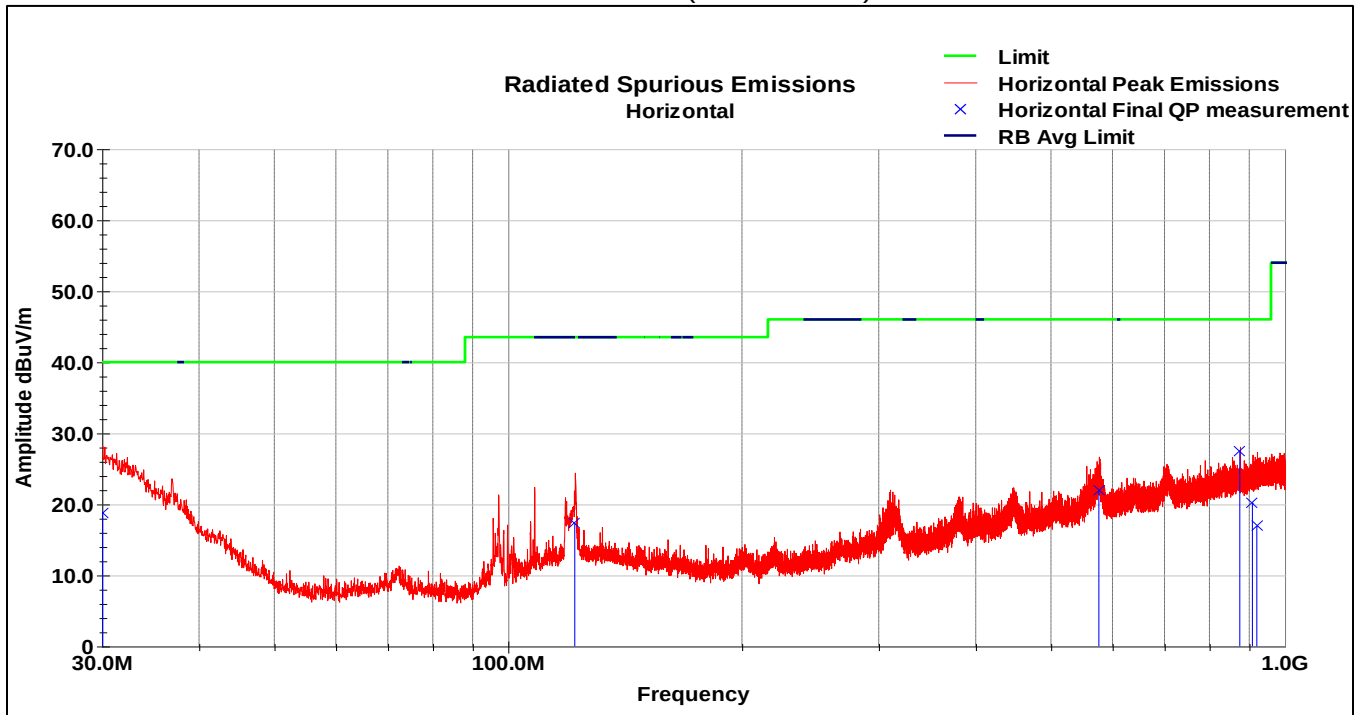
BLE Channel 19 Vertical Plot (30-1000MHz)



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)
30.10	25.2	V	288.0	175.0	22.1	0.5	29.0	18.9	40.0	-21.1
36.92	31.4	V	134.0	230.0	16.8	0.6	30.7	18.1	40.0	-21.9
69.46	40.8	V	314.0	250.0	8.1	0.9	34.4	15.5	40.0	-24.5
875.14	26.5	V	197.0	250.0	22.7	3.2	35.0	17.4	46.0	-28.6
908.41	29.8	V	165.0	250.0	22.8	3.2	35.0	20.9	46.0	-25.1
938.19	25.4	V	27.0	175.0	23.3	3.3	35.0	17.0	46.0	-29.0
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

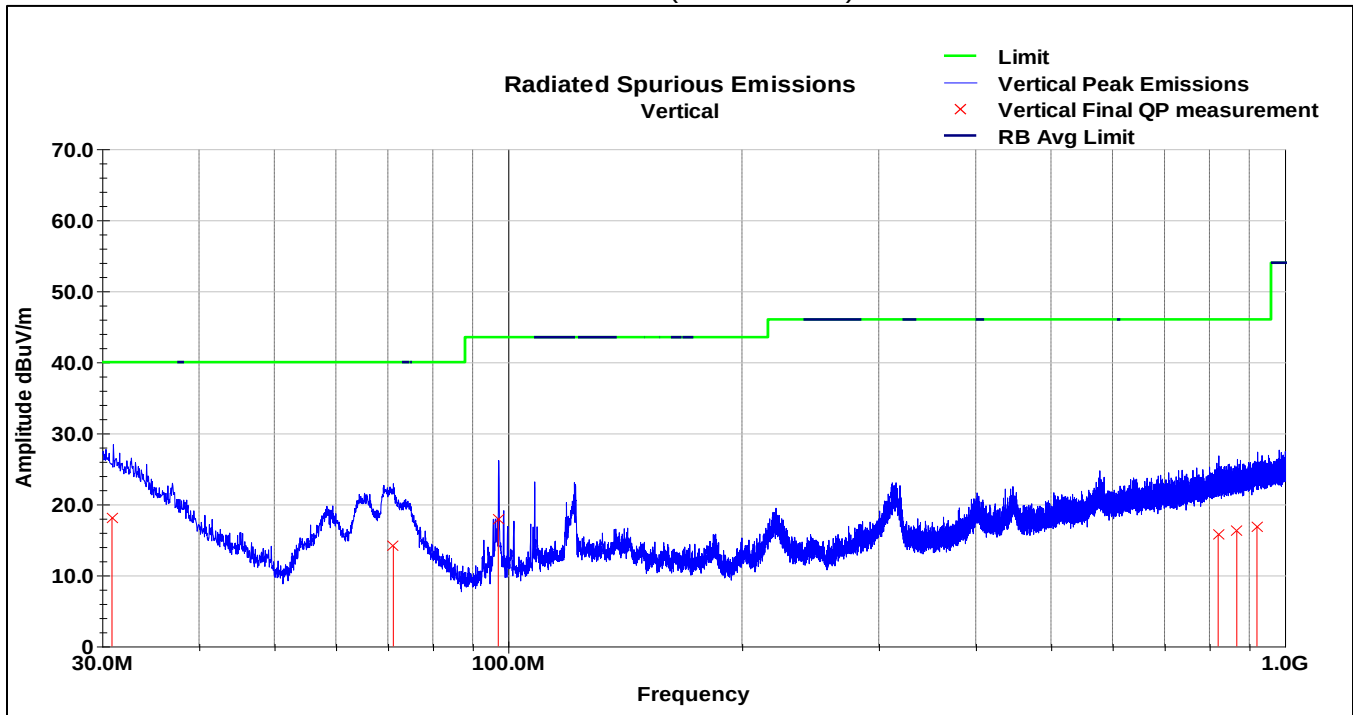
BLE Channel 19 Horizontal Plot (30-1000MHz)



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	25.1	H	190.0	186.0	22.2	0.5	29.0	18.8	40.0	-21.2
121.86	37.5	H	175.0	100.0	13.8	1.2	35.1	17.3	43.5	-26.2
576.16	35.0	H	7.0	165.0	19.4	2.6	35.0	22.0	46.0	-24.0
875.09	36.6	H	30.0	194.0	22.7	3.2	35.0	27.5	46.0	-18.5
908.37	29.1	H	292.0	208.0	22.8	3.2	35.0	20.2	46.0	-25.8
920.48	25.4	H	246.0	240.0	23.2	3.3	35.0	16.9	46.0	-29.1
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

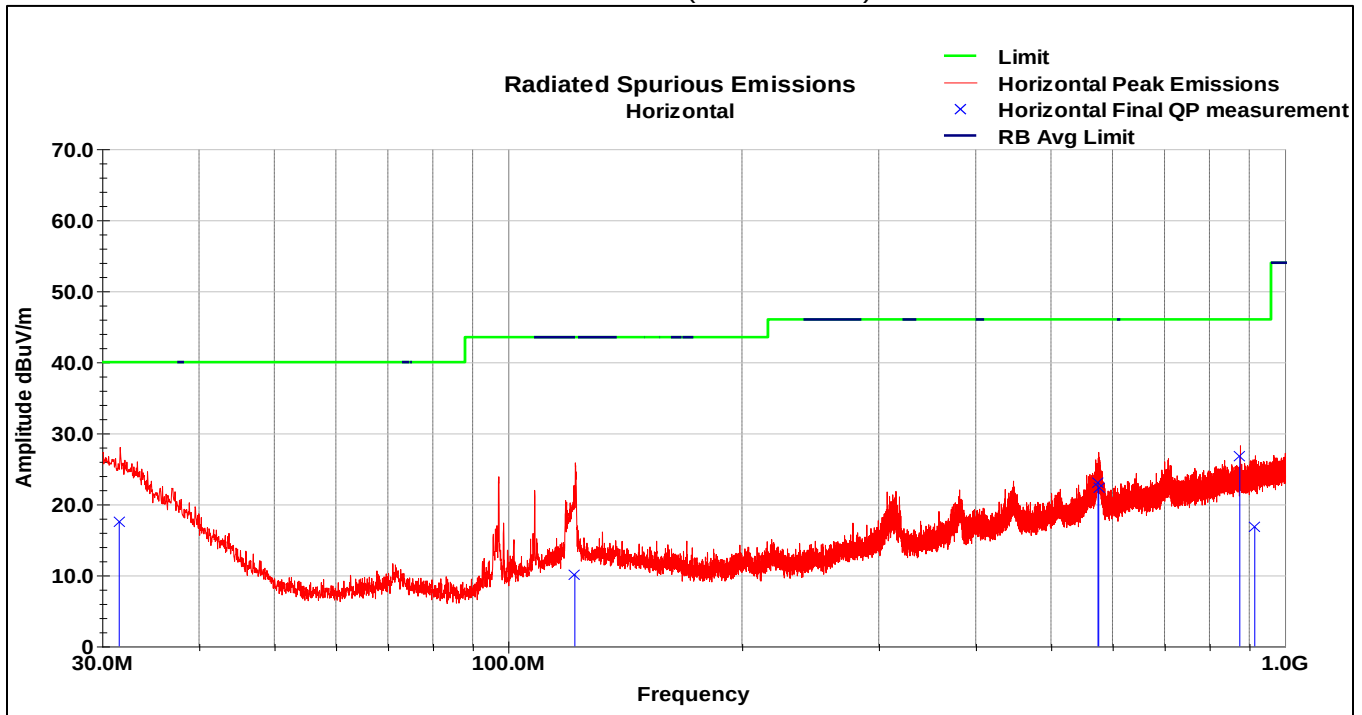
BLE Channel 39 Vertical Plot (30-1000MHz)



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)
30.90	25.4	V	298.0	216.0	21.4	0.5	29.2	18.1	40.0	-21.9
71.15	39.4	V	307.0	237.0	8.2	0.9	34.4	14.1	40.0	-25.9
97.11	42.3	V	166.0	250.0	9.5	1.1	35.0	17.9	43.5	-25.7
820.77	25.4	V	335.0	176.0	22.3	3.1	35.0	15.7	46.0	-30.3
867.19	25.4	V	252.0	250.0	22.7	3.2	35.0	16.2	46.0	-29.8
920.83	25.4	V	96.0	250.0	23.2	3.3	35.0	16.9	46.0	-29.1
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

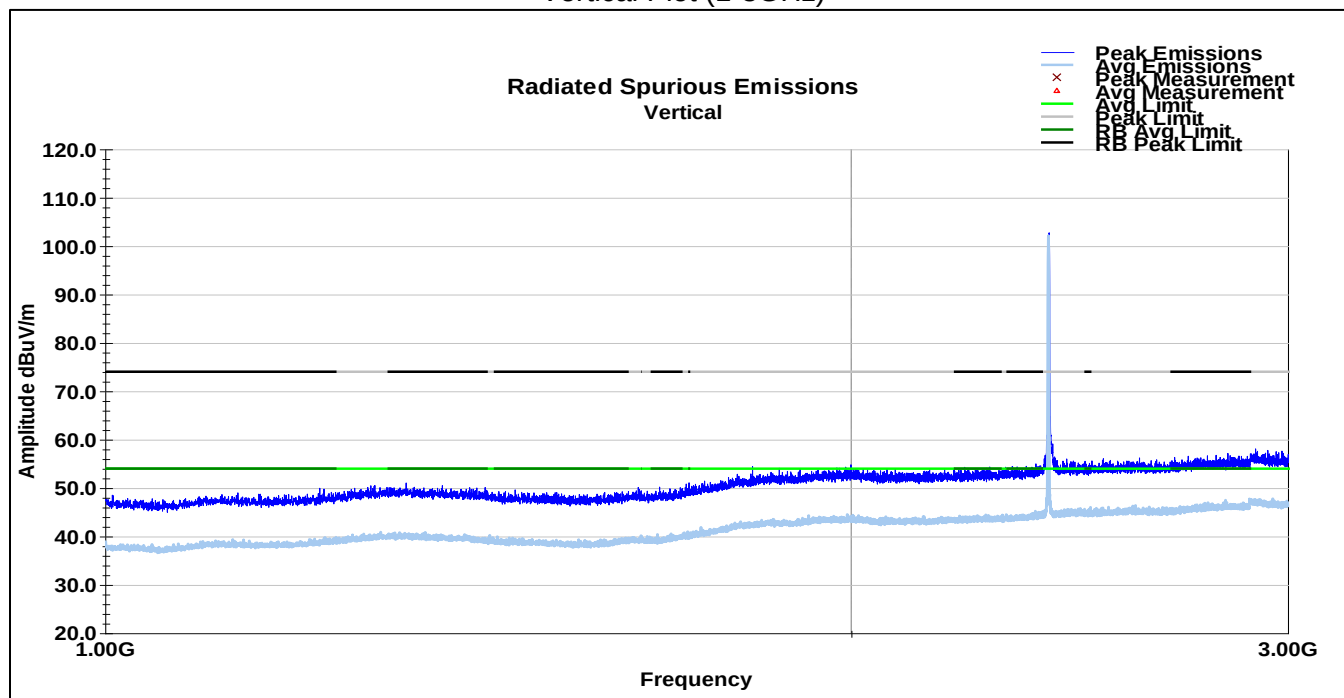
BLE Channel 39 Horizontal Plot (30-1000MHz)



Horizontal Data (30-1000MHz)

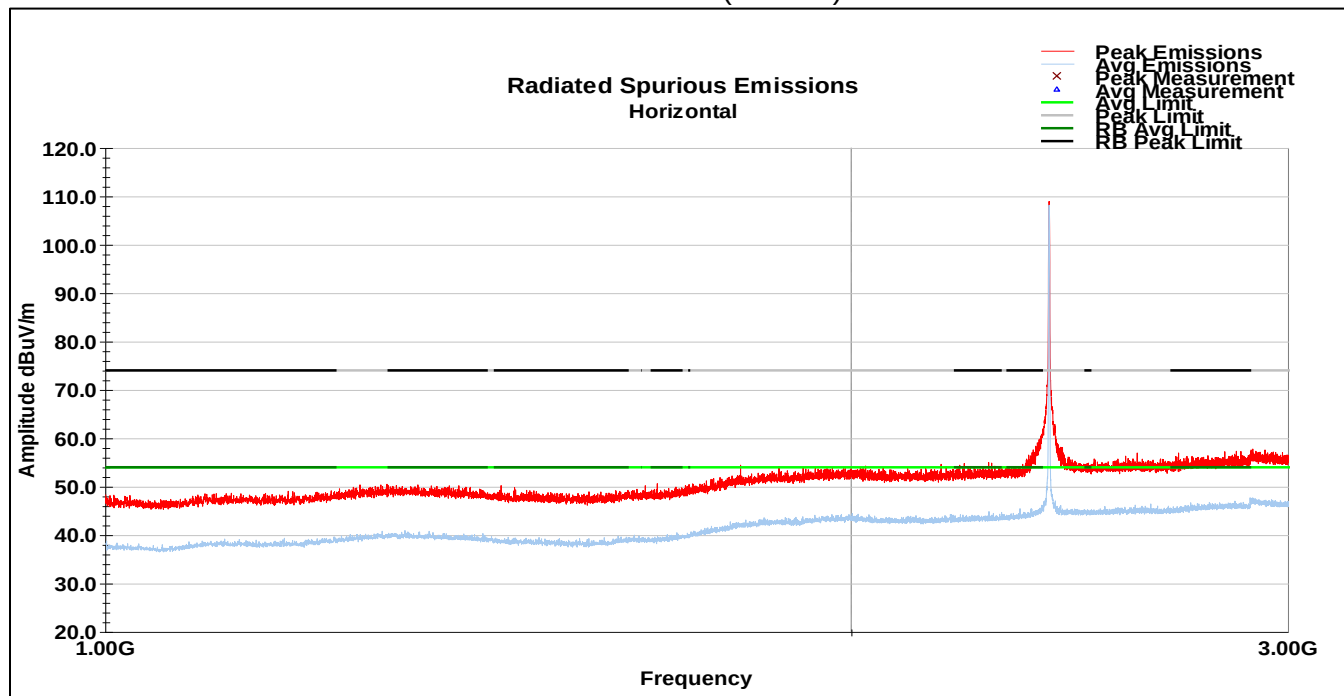
Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
31.57	25.5	H	320.0	145.0	20.9	0.6	29.4	17.6	40.0	-22.4
121.89	30.3	H	352.0	169.0	13.8	1.2	35.1	10.1	43.5	-33.4
574.85	36.0	H	326.0	167.0	19.5	2.6	35.0	23.1	46.0	-22.9
576.06	35.3	H	1.0	173.0	19.4	2.6	35.0	22.3	46.0	-23.7
875.10	35.8	H	328.0	222.0	22.7	3.2	35.0	26.7	46.0	-19.3
914.68	25.4	H	250.0	164.0	23.1	3.3	35.0	16.8	46.0	-29.2
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

BLE Channel 0 Vertical Plot (1-3GHz)



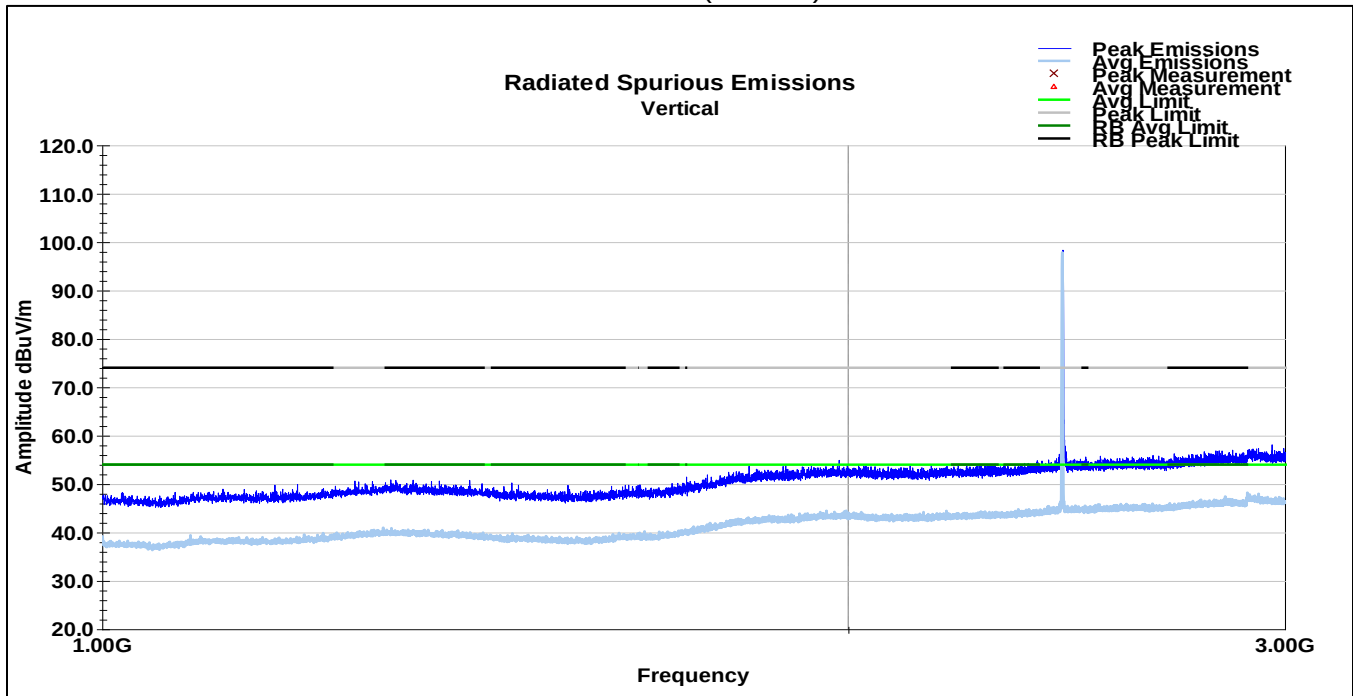
No spurious emissions observed

BLE Channel 0 Horizontal Plot (1-3GHz)



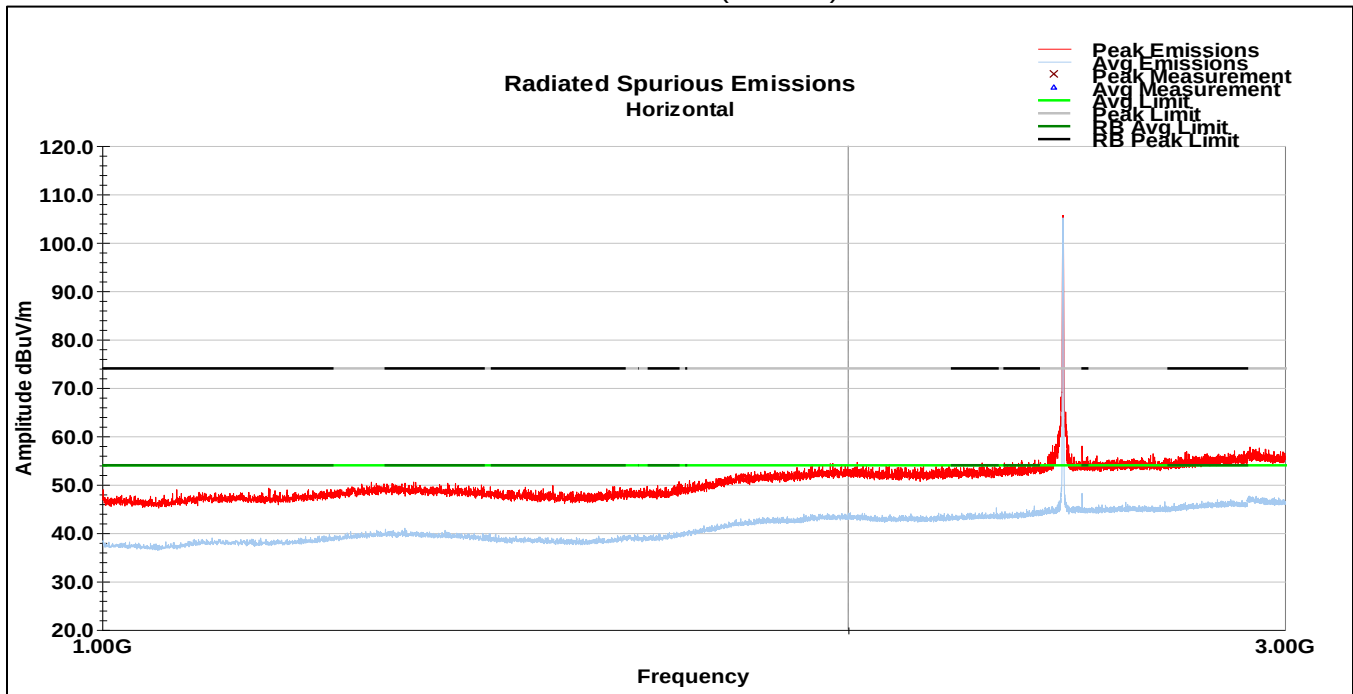
No spurious emissions observed

BLE Channel 19 Vertical Plot (1-3GHz)



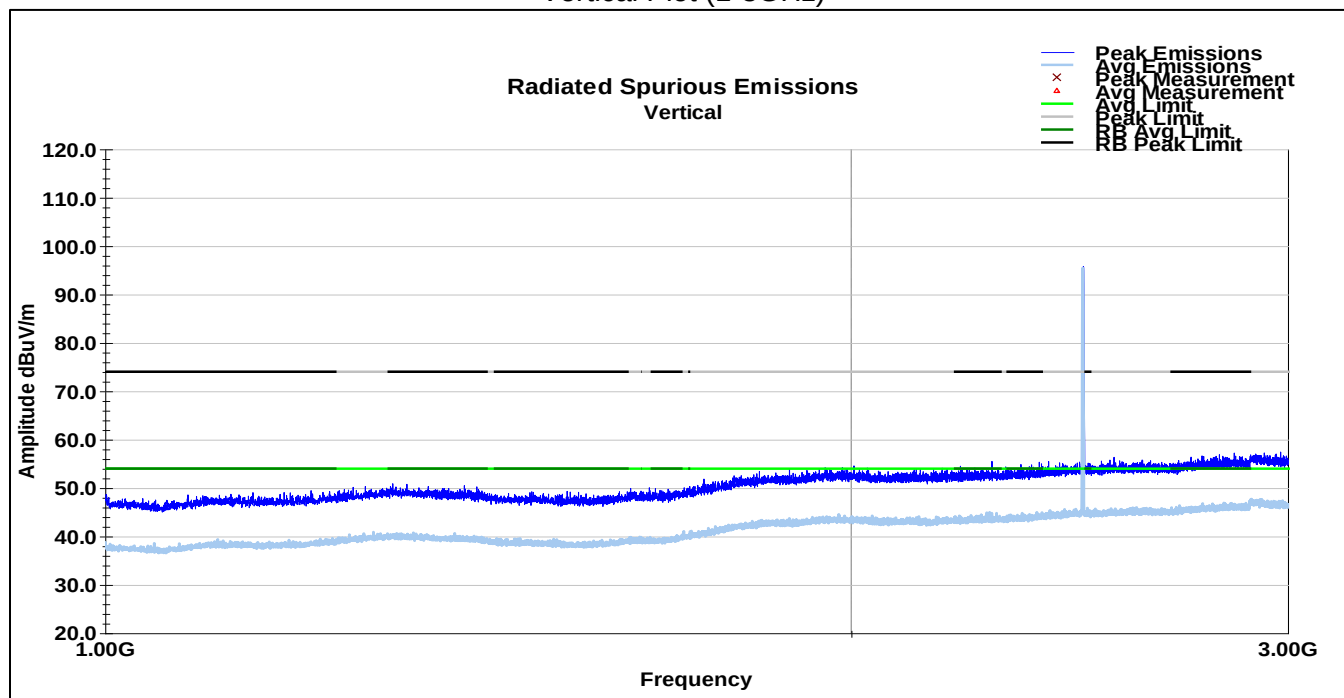
No spurious emissions observed

BLE Channel 19 Horizontal Plot (1-3GHz)



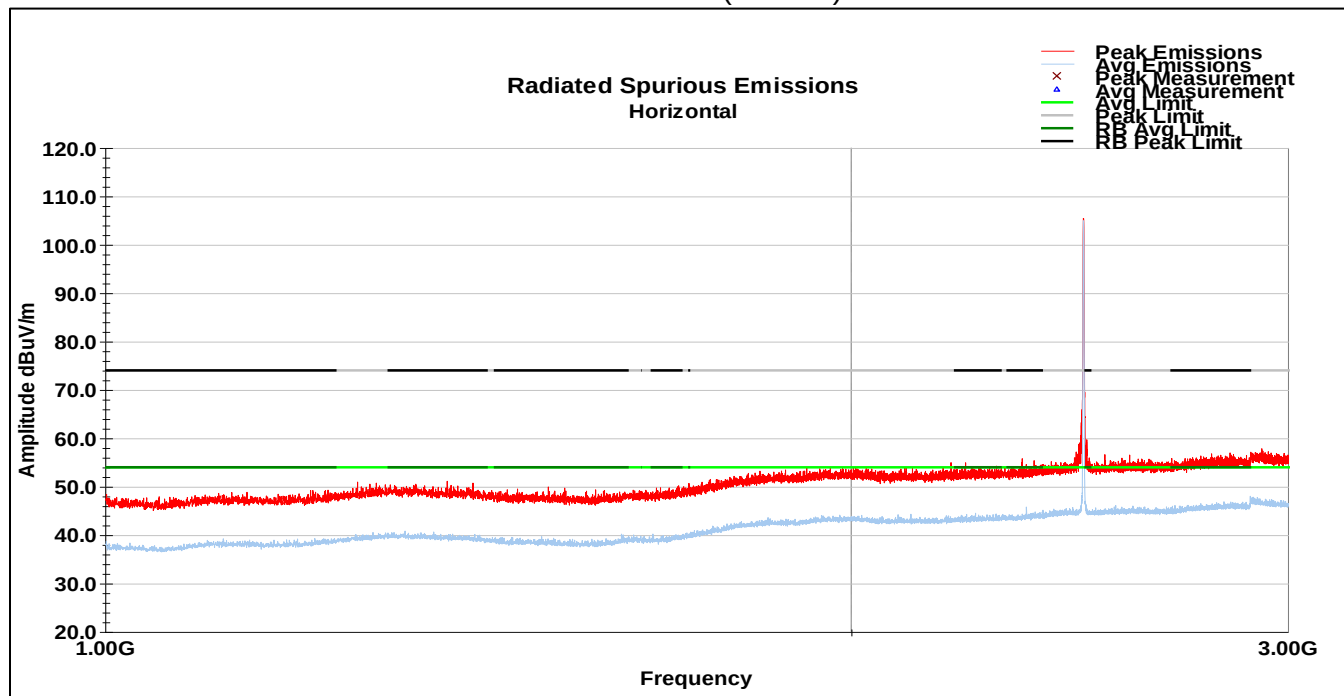
No spurious emissions observed

BLE Channel 39 Vertical Plot (1-3GHz)



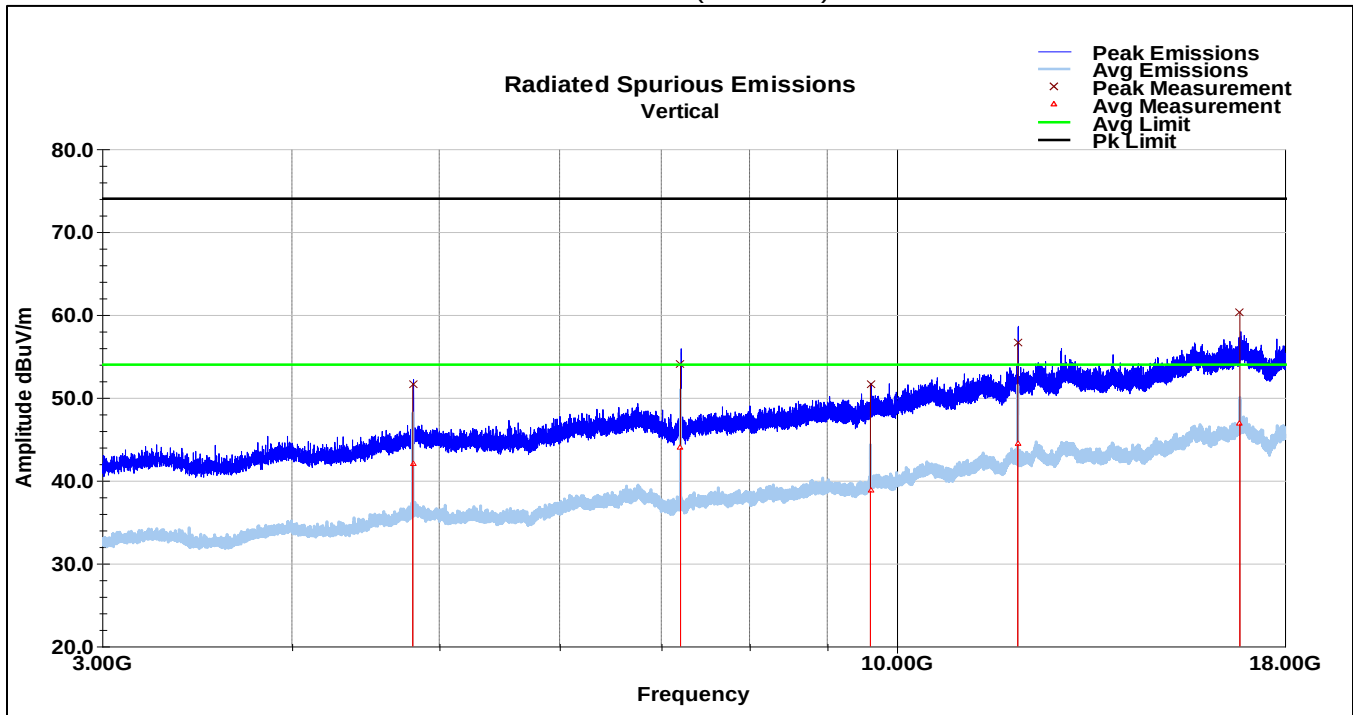
No spurious emissions observed

BLE Channel 39 Horizontal Plot (1-3GHz)



No spurious emissions observed

BLE Channel 0 Vertical Plot (3-18GHz)



Vertical Data (3-18GHz)

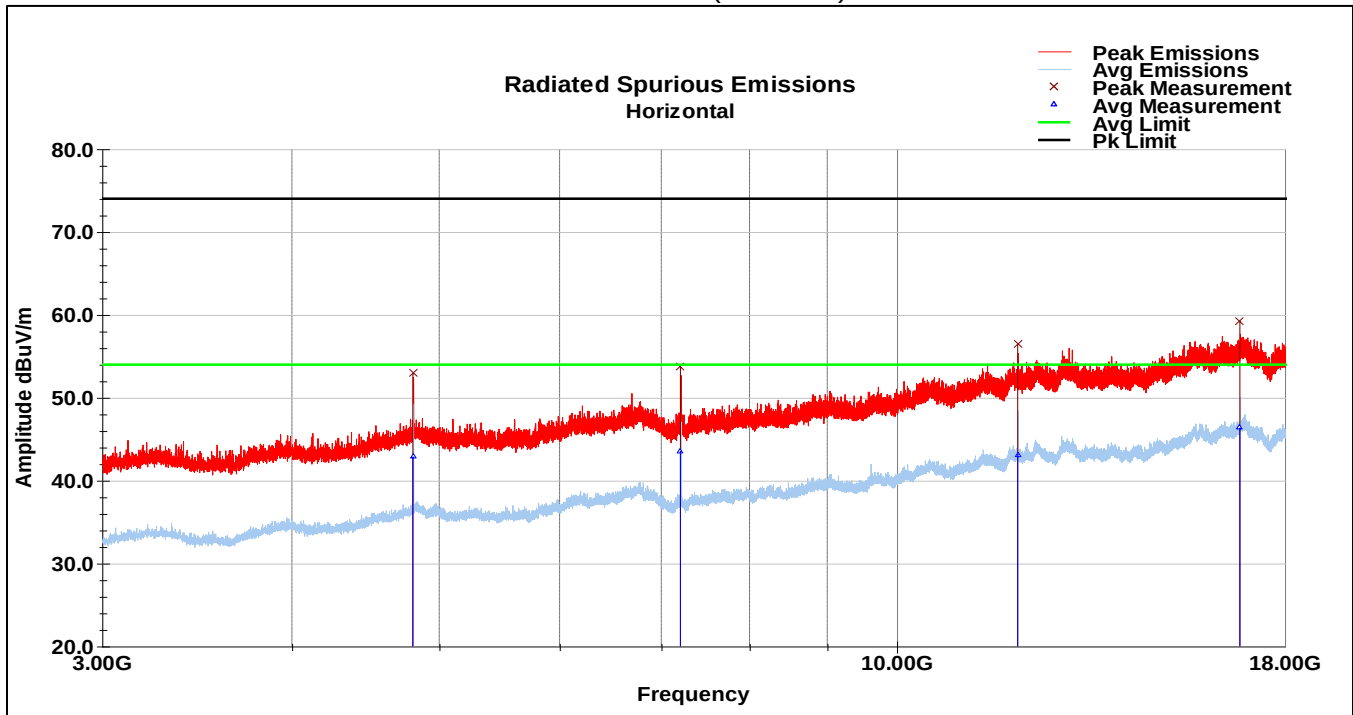
Average Data

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)
4803.68	37.9	V	290.0	250.0	35.4	3.6	34.8	42.1	54.0	-11.9
7206.16	39.3	V	111.0	250.0	35.4	4.6	35.4	43.9	54.0	-10.0
9609.20	32.3	V	72.0	250.0	36.6	5.2	35.4	38.8	54.0	-15.2
12011.16	35.7	V	121.0	250.0	38.7	5.9	35.9	44.4	54.0	-9.6
16815.92	35.0	V	272.0	245.0	41.8	7.0	36.9	46.9	54.0	-7.1

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
4803.68	47.5	V	290.0	250.0	35.4	3.6	34.8	51.6	74.0	-22.4
7206.16	49.5	V	111.0	250.0	35.4	4.6	35.4	54.1	74.0	-19.9
9609.20	45.1	V	72.0	250.0	36.6	5.2	35.4	51.6	74.0	-22.4
12011.16	48.0	V	121.0	250.0	38.7	5.9	35.9	56.7	74.0	-17.3
16815.92	48.4	V	272.0	245.0	41.8	7.0	36.9	60.3	74.0	-13.7

BLE Channel 0 Horizontal Plot (3-18GHz)



Horizontal Data (3-18 GHz)

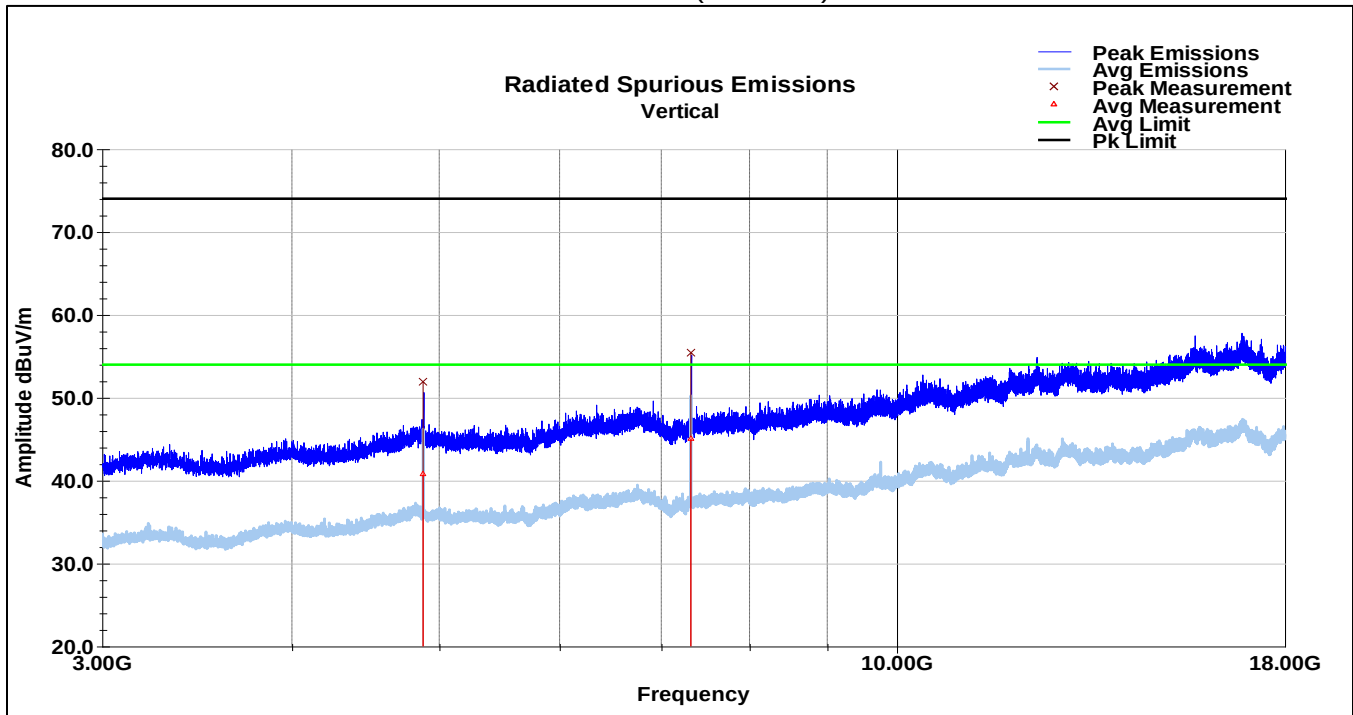
Average Data

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)
4804.36	38.7	H	13.0	177.0	35.4	3.6	34.8	42.9	54.0	-11.1
7205.84	39.0	H	85.0	101.0	35.4	4.6	35.4	43.6	54.0	-10.4
12009.88	34.5	H	25.0	105.0	38.7	5.9	35.9	43.2	54.0	-10.8
16815.30	34.5	H	26.0	101.0	41.8	7.0	36.9	46.4	54.0	-7.6

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
4804.36	48.7	H	13.0	177.0	35.4	3.6	34.8	52.9	74.0	-21.1
7205.84	49.1	H	85.0	101.0	35.4	4.6	35.4	53.7	74.0	-20.3
12009.88	47.8	H	25.0	105.0	38.7	5.9	35.9	56.5	74.0	-17.5
16815.30	47.4	H	26.0	101.0	41.8	7.0	36.9	59.2	74.0	-14.8

BLE Channel 19 Vertical Plot (3-18GHz)



Vertical Data (3-18GHz)

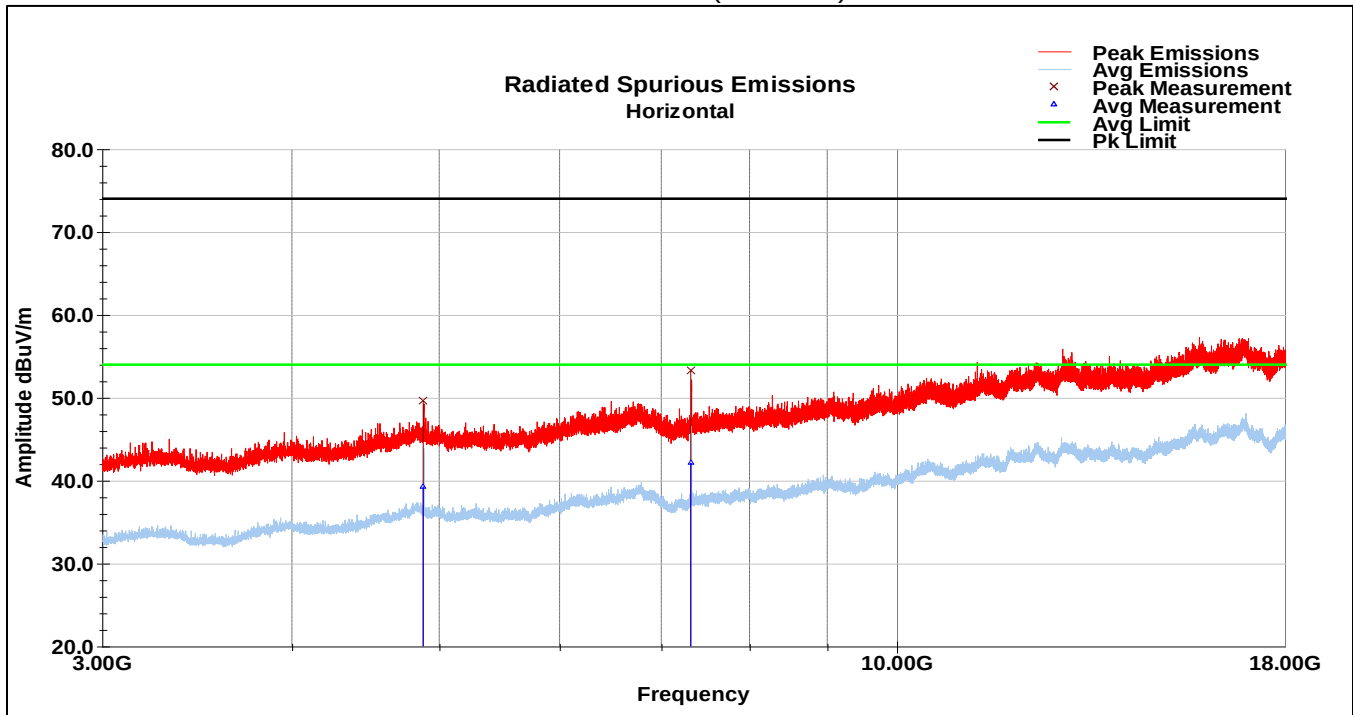
Average Data

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)
4879.32	36.7	V	299.0	103.0	35.3	3.6	34.8	40.9	54.0	-13.1
7320.32	40.3	V	109.0	116.0	35.6	4.6	35.4	45.1	54.0	-8.9

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
4879.32	47.8	V	299.0	103.0	35.3	3.6	34.8	51.9	74.0	-22.1
7320.32	50.7	V	109.0	116.0	35.6	4.6	35.4	55.4	74.0	-18.6

BLE Channel 19 Horizontal Plot (3-18GHz)



Horizontal Data (3-18GHz)

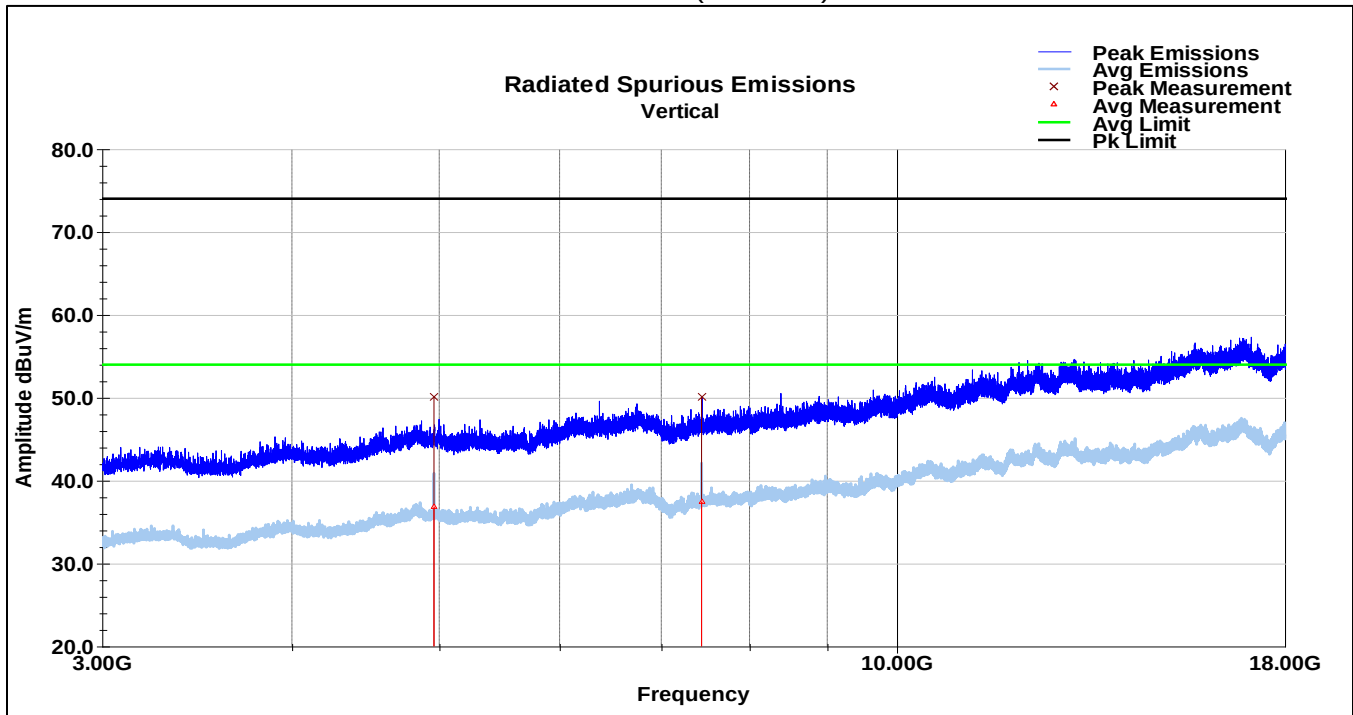
Average Data

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)
4880.28	35.1	H	358.0	107.0	35.3	3.6	34.8	39.3	54.0	-14.7
7319.36	37.4	H	15.0	100.0	35.6	4.6	35.4	42.1	54.0	-11.8

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
4880.28	45.5	H	358.0	107.0	35.3	3.6	34.8	49.6	74.0	-24.4
7319.36	48.5	H	15.0	100.0	35.6	4.6	35.4	53.3	74.0	-20.7

BLE Channel 39 Vertical Plot (3-18GHz)



Vertical Data (3-18GHz)

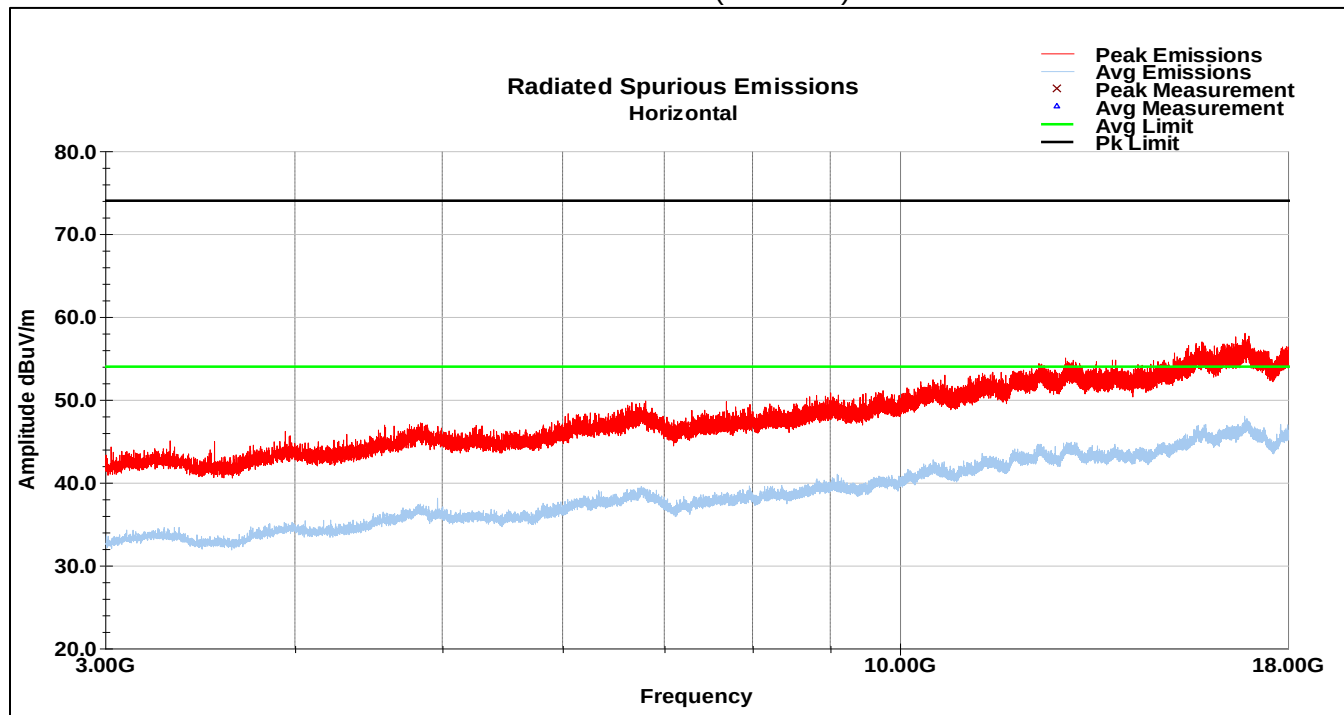
Average Data

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)
4960.40	32.9	V	285.0	175.0	35.1	3.7	34.8	36.9	54.0	-17.1
7439.18	32.5	V	105.0	250.0	35.7	4.6	35.4	37.5	54.0	-16.5

Peak Data

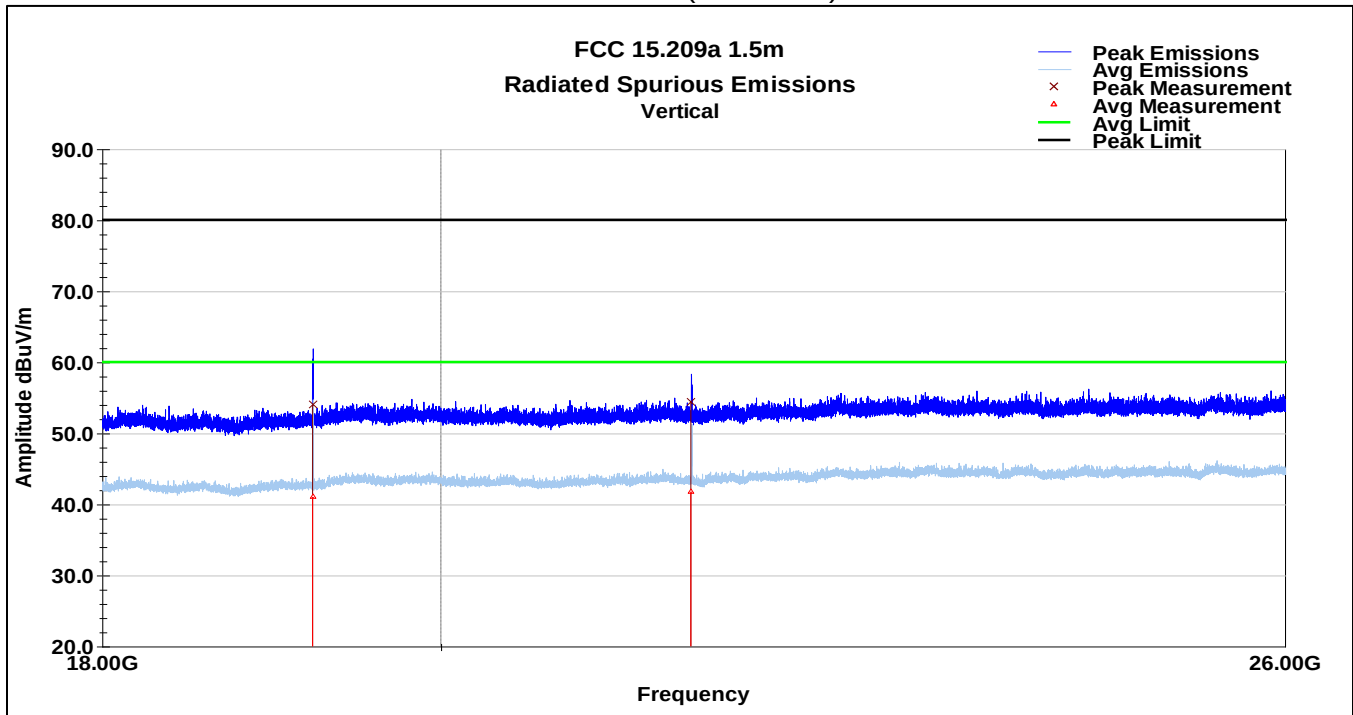
Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
4960.40	46.1	V	285.0	175.0	35.1	3.7	34.8	50.1	74.0	-23.9
7439.18	45.1	V	105.0	250.0	35.7	4.6	35.4	50.0	74.0	-24.0

BLE Channel 39
Horizontal Plot (3-18GHz)



No spurious emissions observed

BLE Channel 0 Vertical Plot (18-26GHz)



Vertical Data (18-26GHz)

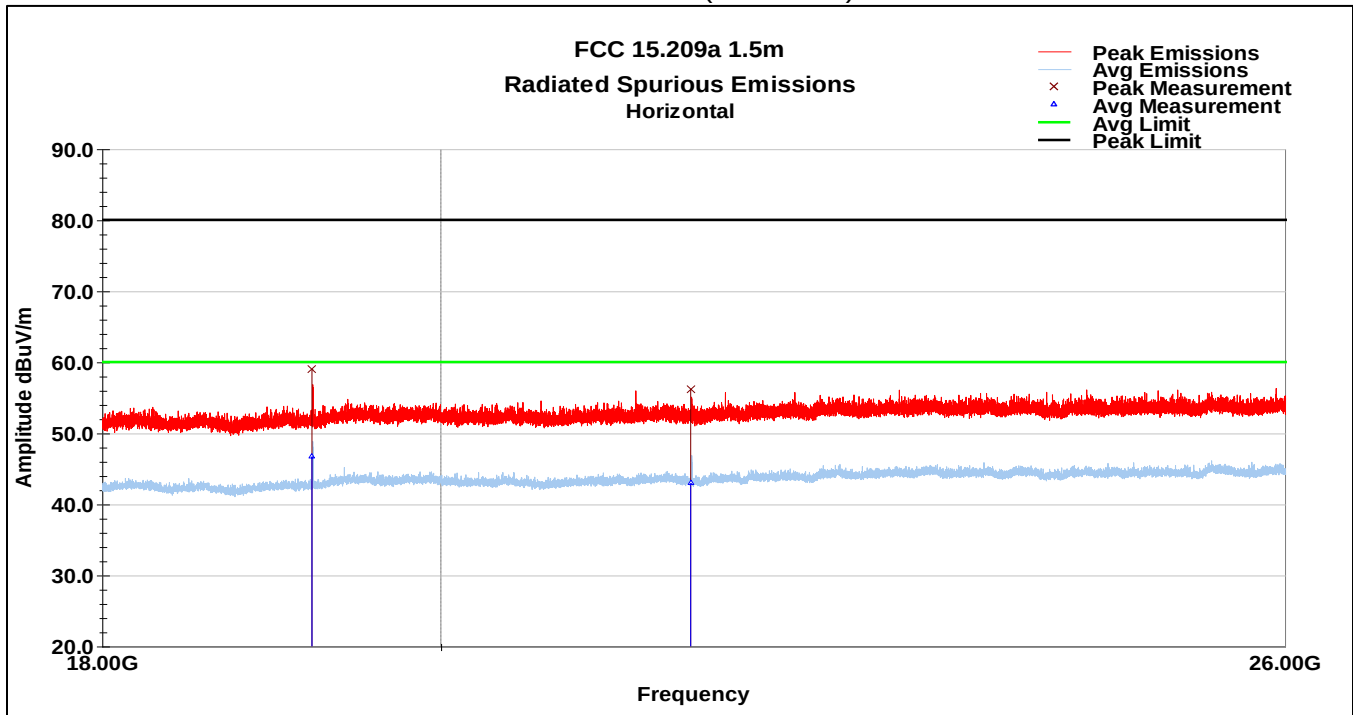
Average Data

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
19217.96	58.2	V	60.0	250.0	38.5	8.2	50.9	54.0	80.0	-26.0
21616.00	59.0	V	288.0	250.0	38.4	8.7	51.7	54.3	80.0	-25.7

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)
19217.96	45.3	V	60.0	250.0	38.5	8.2	50.9	41.0	60.0	-19.0
21616.00	46.4	V	288.0	250.0	38.4	8.7	51.7	41.8	60.0	-18.2

BLE Channel 0 Horizontal Plot (18-26GHz)



Horizontal Data (18-26GHz)

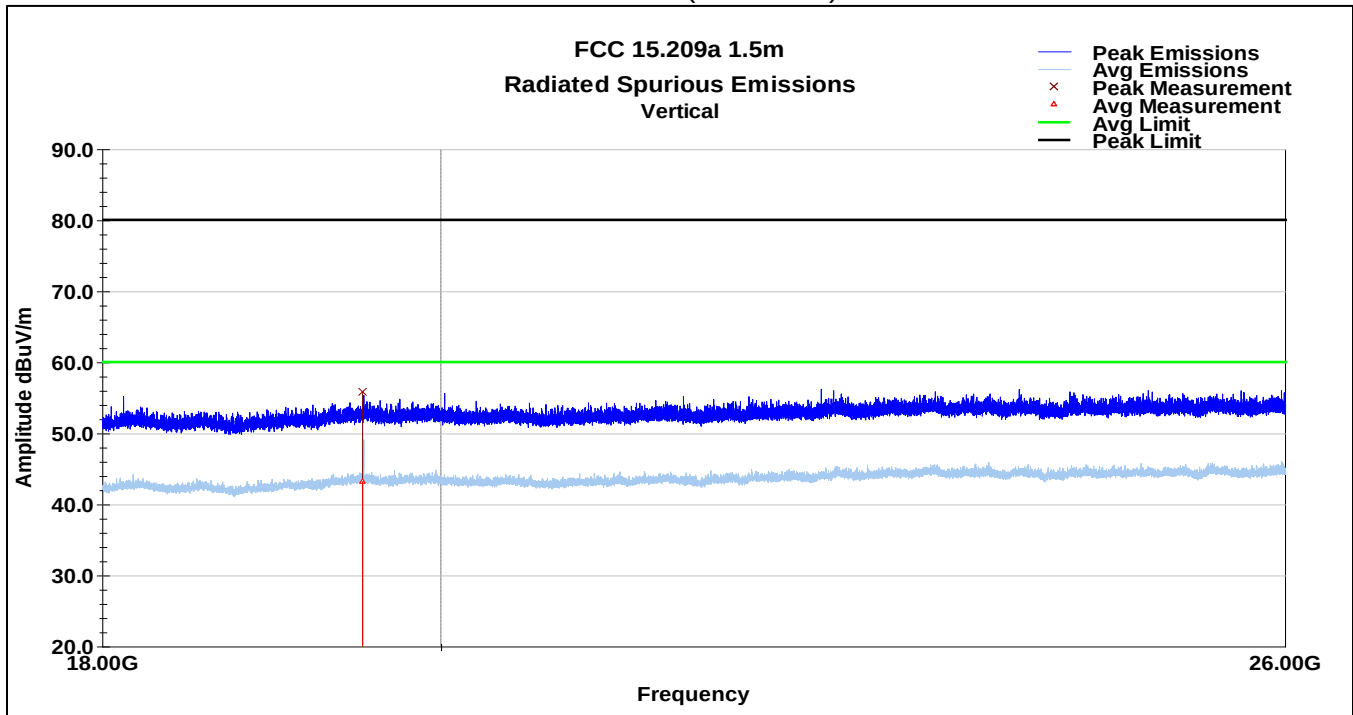
Average Data

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
19214.24	63.3	H	280.0	113.0	38.5	8.2	50.9	59.0	80.0	-21.0
21615.04	60.9	H	177.0	161.0	38.4	8.7	51.7	56.2	80.0	-23.8

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)
19214.24	51.0	H	280.0	113.0	38.5	8.2	50.9	46.7	60.0	-13.3
21615.04	47.6	H	177.0	161.0	38.4	8.7	51.7	43.0	60.0	-17.0

BLE Channel 19
Vertical Plot (18-26GHz)



Vertical Data (18-26GHz)

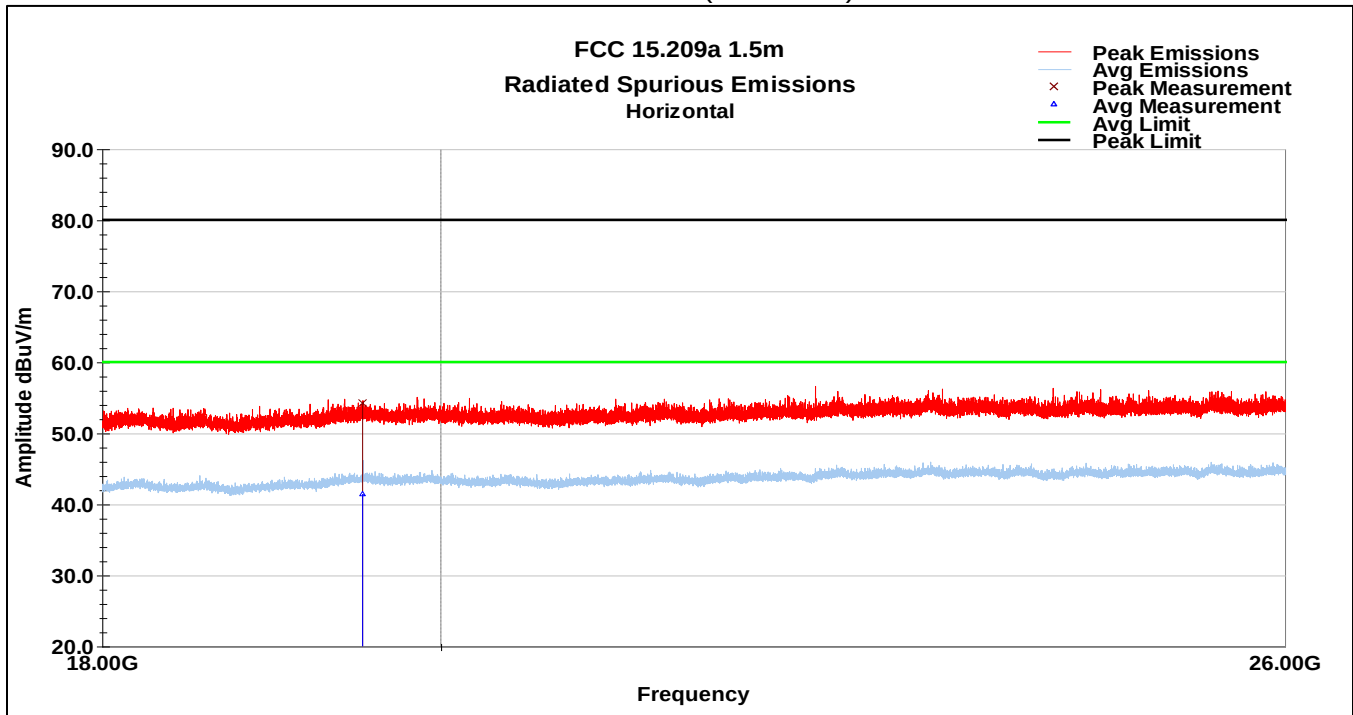
Average Data

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
19518.84	59.8	V	276.0	173.0	38.9	8.3	51.1	55.9	80.0	-24.1

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)
19518.84	47.2	V	276.0	173.0	38.9	8.3	51.1	43.2	60.0	-16.8

BLE Channel 19 Horizontal Plot (18-26GHz)



Horizontal Data (18-26GHz)

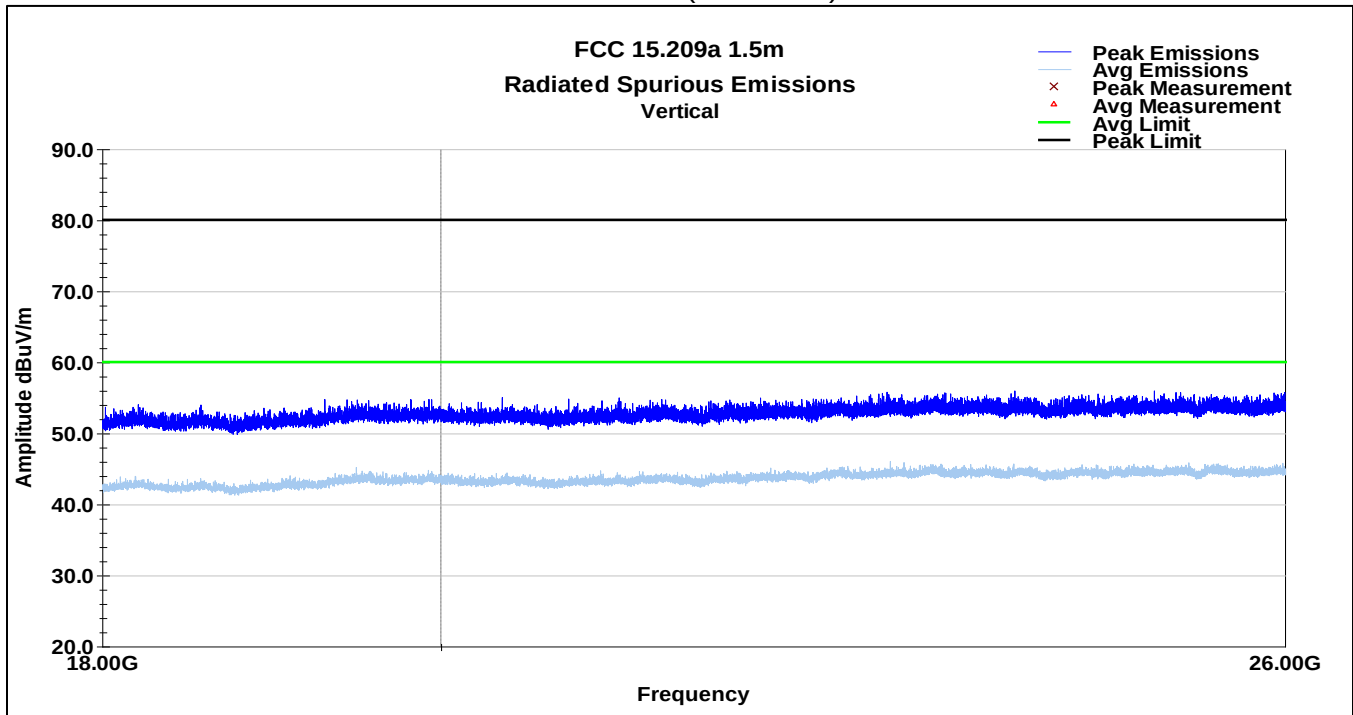
Average Data

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
19519.20	58.2	H	359.0	231.0	38.9	8.3	51.1	54.3	80.0	-25.7

Peak Data

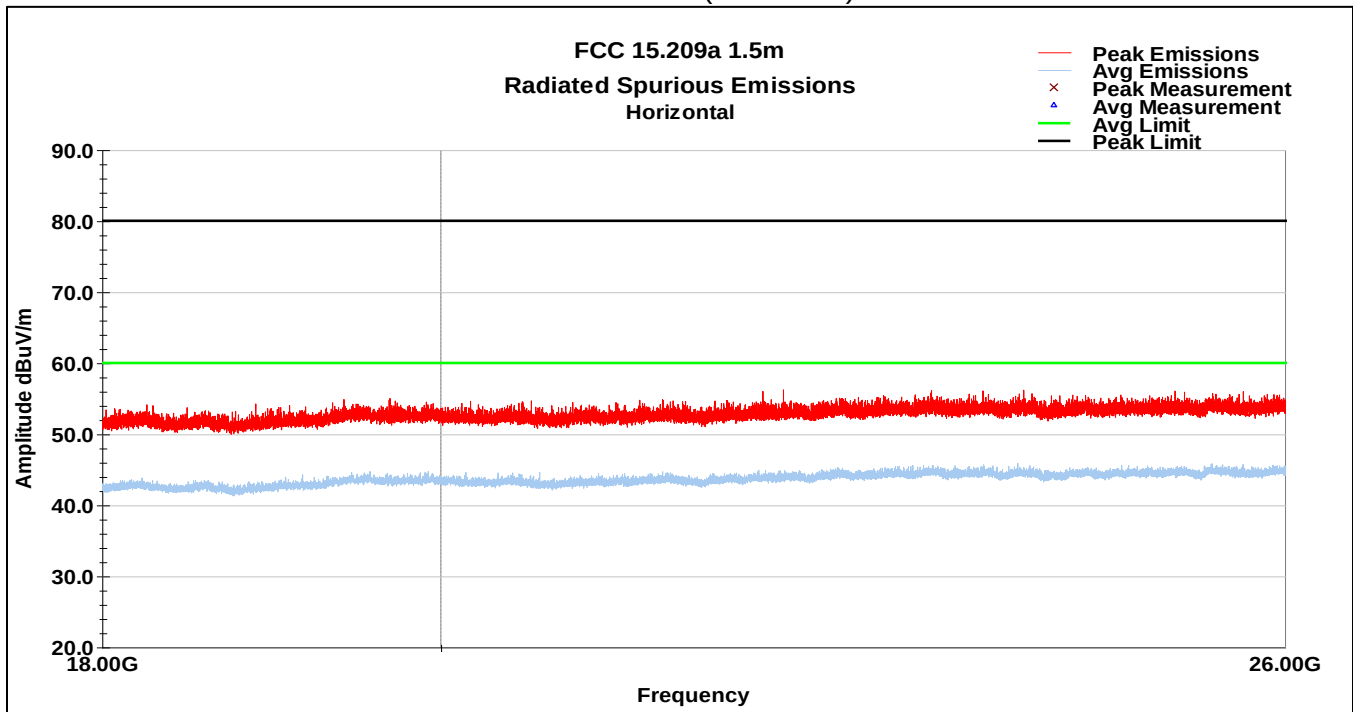
Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Avg Value dBuV/m	Limit (dBuV/m)	Margin (dB)
19519.20	45.3	H	359.0	231.0	38.9	8.3	51.1	41.4	60.0	-18.6

BLE Channel 39
Vertical Plot (18-26GHz)



No spurious emissions observed

Horizontal Plot (18-26GHz)



No spurious emissions observed

8 Band Edge Emissions in Restricted Frequency Bands

8.1 Test Result

Test Description	Test Specification		Test Result
Band Edge Emissions in Restricted Frequency Bands	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. Measurements were made using the conducted methods defined in ANSI C63.10: 2013 clause 11.12.2. The measurements were converted to a radiated field strength equivalent using the equations defined in that section. Both peak and average measurements were performed at the antenna port. These procedures are referenced in KDB 558074 D01 15.247 Meas Guidance v05r02. See section 2.5 above for test setup diagram.

Offset Calculations:

A reference level offset was applied to the spectrum analyzer so that conducted measurements in dBμV represent field strength measurements in dBμV/m.

$$\text{Offset} = -20\log(D) + 104.8 - 107 + \text{CL} + \text{DC} + \text{AG}$$

$$\text{Offset}_{3m} = -11.7 + \text{CL} + \text{DC} + \text{AG}$$

Where:

D = 3m	Distance
CL = 0.73 dB	Cable Loss
DC = 1.9 dB (64.8%)	Duty Cycle Correction Factor [10Log(1/Duty Cycle)]
AG = 2 dB	Antenna Gain [2 dB is the minimum allowed by the test method]

$$\text{Offset} = -7.07 \text{ dB}$$

8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	24.1 °C
Relative Humidity:	42.0 %
Atmospheric Pressure:	97.4 kPa

8.4 Test Equipment

Test End Date: 23-Apr-2020

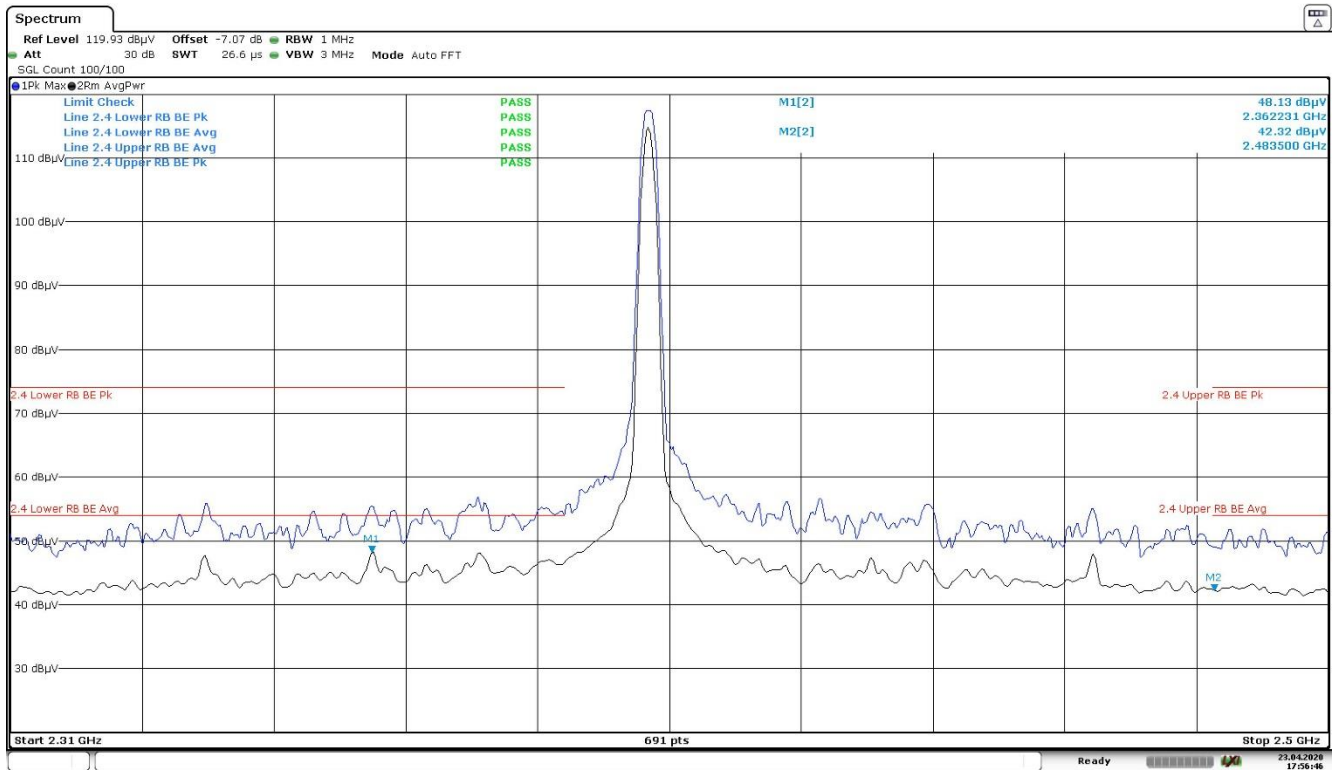
Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	Huber & Suhner	B095585	6-Sep-2020
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	27-Dec-2021

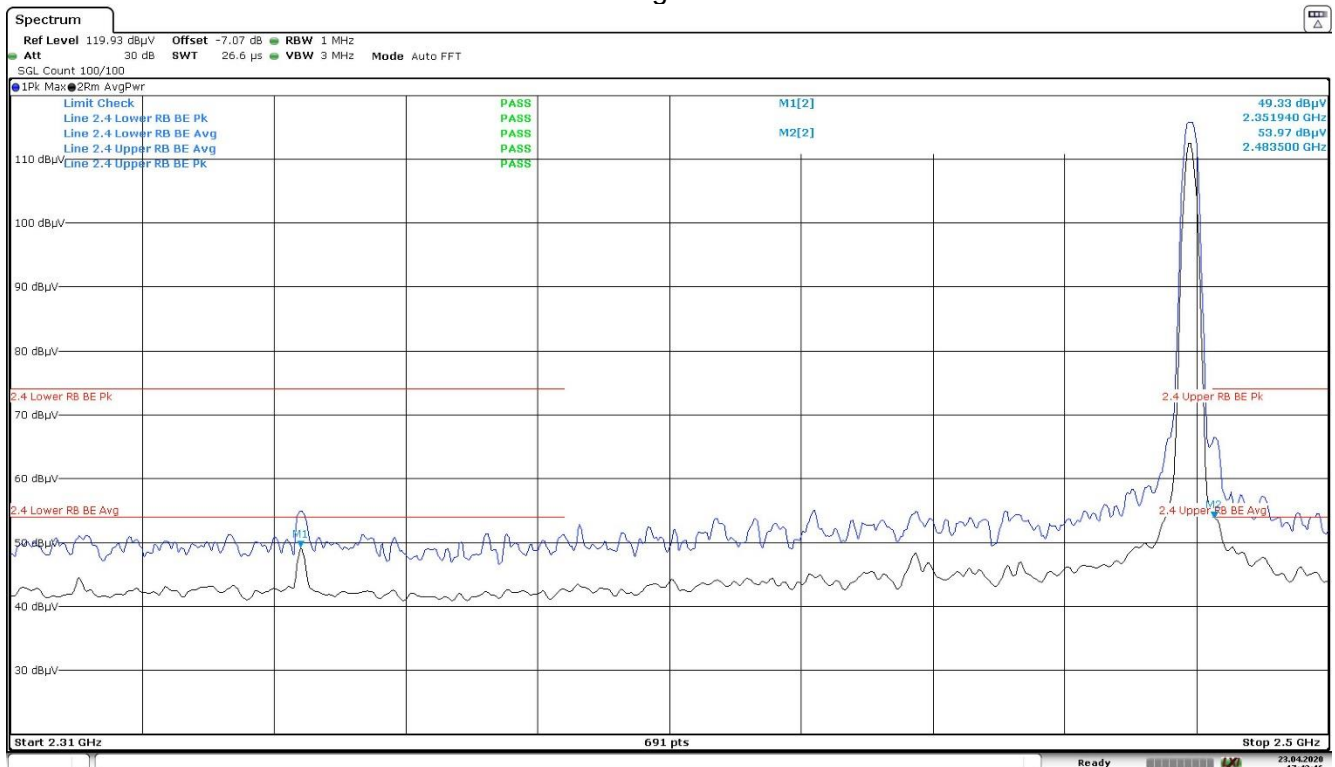
Note: The equipment calibration period is 1 year except for the FSV which is on a 2-year cycle.

8.5 Test Data

BLE – Low Channel



BLE – High Channel



9 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	$\pm 1^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$
humidity	± 5 %	$\pm 3.5\%$
DC and low frequency voltages	± 3 %	$\pm 0.4\%$
Conducted disturbance at mains port using AMN	± 3.4 dB	± 2.5 dB

10 Revision History

Revision Level	Description of changes	Revision Date
Draft	--	22 May 2020
0	Initial release	05 June 2020
1	- Added sample ID in section 2.3 - Added EUT firmware version in section 2.3 - Added references to current version of KDB 558074 in sections 3.2, 4.2, 5.2, 6.2, 7.2 & 8.2 - Added test setup diagrams in section 7.2 and references to test setup diagrams in sections 3.2, 4.2, 5.2, 6.2 & 8.2	07 July 2020