

EMC Test Report

Report Number: 4202701

Project Number: 4202701EMC02

Revision Level: 1

Client: 3Si Security Systems Inc.

Equipment Under Test: Wireless Tracking Device

Model Number: AT170503US

FCC ID: Q6KAT170503A

IC ID: 5043A-AT170503A

FCC Rule Parts: FCC Part 15 Subpart C, § 15.247

RSS-247, Issue 2


ANSI C63.10: 2013

RSS-GEN, Issue 4

Report issued on: 18 January 2018


Test Result: Compliant

Tested by:



Jeremy Pickens, Senior EMC 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(d)	RSS-247 S5.2 (1) RSS-GEN S6.6	Compliant
Transmitter Output Power	15.247(b)(3)	RSS-247 S5.4 (4)	Compliant
Power Spectral Density	15.247(e)	RSS-247 S5.2 (2)	Compliant
Conducted Spurious Emissions / Band edge	15.247(d)	RSS-247 S5.5	Compliant
Radiated Spurious Emissions / Restricted Bands	15.35(b), 15.209	RSS-GEN S6.13 RSS-GEN S8.10	Compliant
Antenna Requirement	15.203	RSS-GEN S8.3	Compliant (1)
AC Powerline Conducted Emission	15.107, 15.207	RSS-GEN S8.8	NA(2)

(1) The device utilizes a PCB trace antenna.

(2) Not Applicable: The device is battery-powered with no facility to connect to AC mains.

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: 3Si Security Systems Inc.
Address: 2055 N Brown Rd, Ste 225
City, State, Zip, Country: Lawrenceville, GA 30043, 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

2.3 General Information of EUT

Type of Product: Wireless Tracking Device
Model Number: AT170503US
Prototype ID: P1-18

Frequency Range: 2402-2480 MHz
Channels: 40
Data Modes: Bluetooth Low Energy

Antenna: Trace Antenna

Rated Voltage: 3.7Vdc Battery
Tested Voltage: 3.7Vdc Battery

Sample Received Date: 02 September 2017
Dates of testing: 02 September – 12 October 2017

2.4 Operating Modes and Conditions

Continuous traffic was generated using test commands. Where the duty cycle measured below 99% and an RMS detector was employed, corrections of $10 \cdot \text{LOG}(1/D)$ were applied according to KDB publication 558074 D01 DTS Meas Guidance v04.

2.5 EUT Connection Block Diagram



2.6 System Configurations

Device reference	Manufacturer	Description	Model Number	Prototype ID
A	3Si Security	Wireless Tracking Device	AT170503US	P1-18

2.7 Cable List

Cable reference	Port Name	Start	End	Cable Length (m)	Ferrite installed?	Shielded?
None						

3 Occupied Bandwidth

3.1 Test Result

Test Description	Test Specification		Test Result
6 dB bandwidth / 99% OBW	15.247(d)	RSS-247 S5.2 (1) RSS-GEN S6.6	Compliant

3.2 Test Method

The procedures from ANSI C63.10: 2013 clause 11.8 and 558074 D01 DTS Meas Guidance v04 were used to determine the 6 dB bandwidth and 99% OBW.

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.8 °C

Relative Humidity: 44.6 %

3.4 Test Equipment

Test End Date: 20-Sep-2017

Tester: JOP

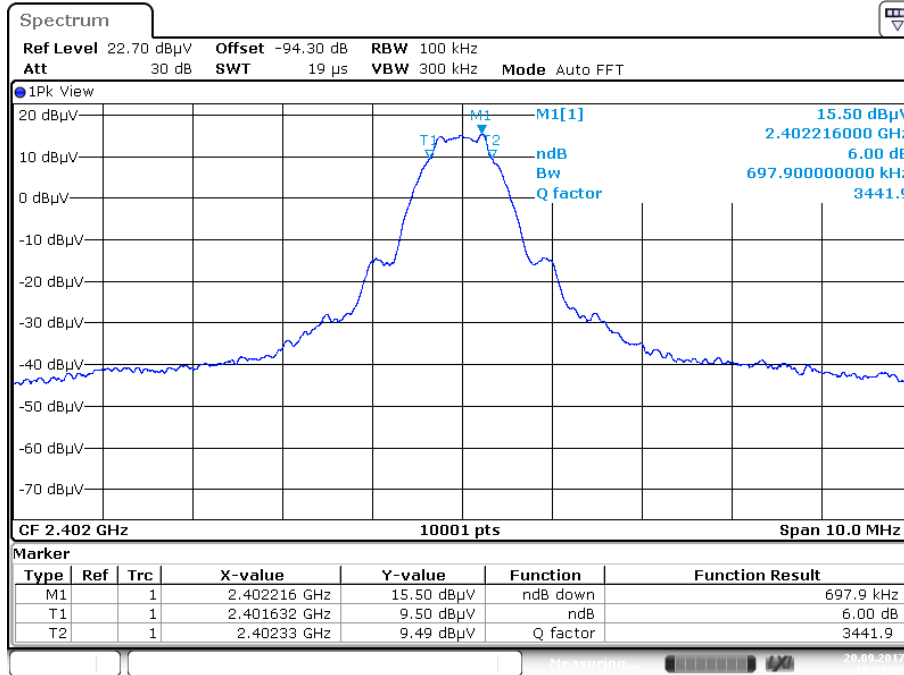
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079712	24-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	22-Feb-2018

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

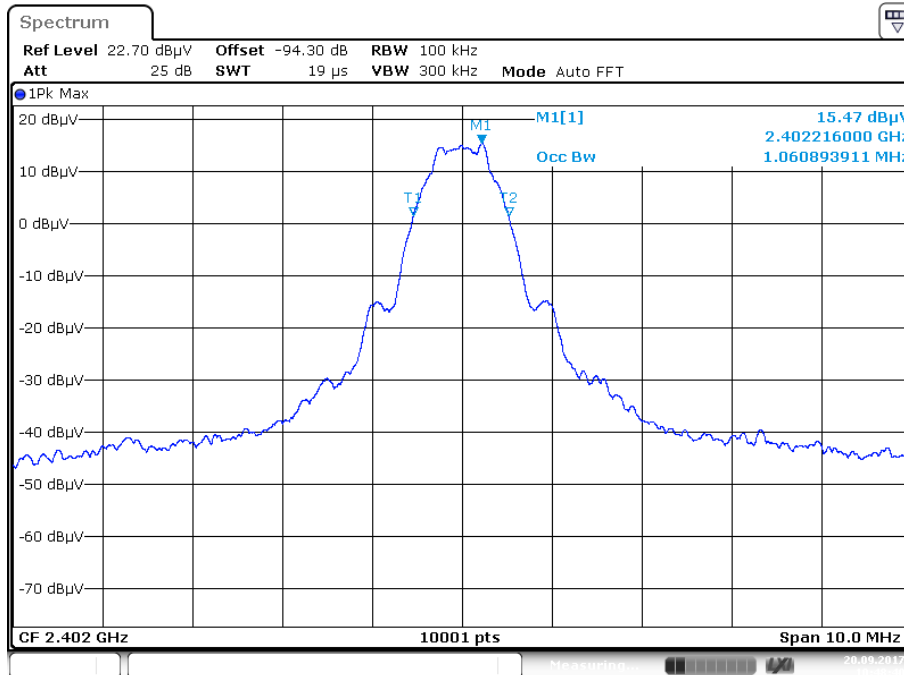
3.5 Test Data

Protocol	Channel	6dB Bandwidth (MHz)	Occupied Bandwidth (99%) (MHz)
BLE	0	0.698	1.061
BLE	12	0.699	1.064
BLE	39	0.695	1.061

Sample Plot



Date: 20.SEP.2017 10:54:22



Date: 20.SEP.2017 10:48:40

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 (4)	Compliant

4.2 Test Method

Using radiated methods, the peak power procedures from KDB 558074 D01 DTS Meas Guidance v04 Clause 9.1.1 were applied. The fundamental emission was maximized using the procedures in ANSI C63.10: 2013 and using a correction of 95.2dB, the field strength measurement was converted from a 3m field strength measurement in dB μ V/m to an EIRP value in dBm.

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

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.8 °C
 Relative Humidity: 44.6 %

4.4 Test Equipment

Test End Date: 20-Sep-2017

Tester: JOP

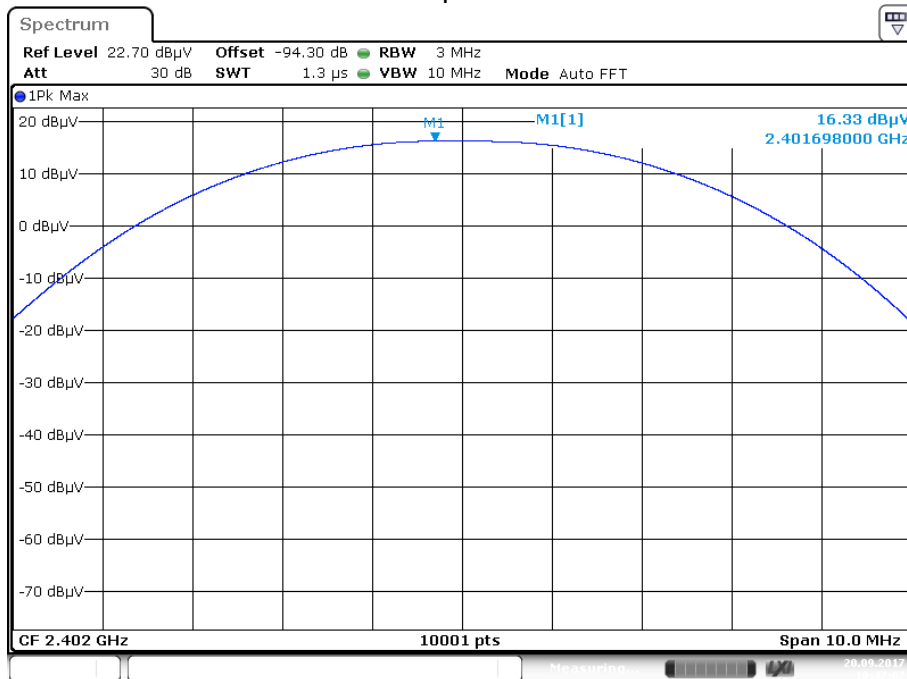
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079712	24-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	22-Feb-2018

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

4.5 Test Data

Frequency	Measured Field Strength (dB μ V/m@3m)	Free Space Correction Factor	Peak Output Power (dBm)	Peak Output Power (W)
2402	111.5	95.2	16.3	0.043
2426	112.1	95.2	16.9	0.049
2480	110.5	95.2	15.3	0.034

Sample Plot



Date: 20.SEP.2017 10:47:08

5 Power Spectral Density

5.1 Test Result

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

5.2 Test Method

Using radiated methods, the peak PSD procedures from KDB 558074 D01 DTS Meas Guidance v04 Clause 10.2 were applied. The fundamental emission was maximized using the procedures in ANSI C63.10: 2013 and using a correction of 95.2dB, the field strength measurement was converted from a 3m field strength measurement in dBμV/m to an ERP PSD value in dBm.

Limit

The limit is 8 dBm.

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.8 °C
Relative Humidity: 44.6 %

5.4 Test Equipment

Test End Date: 20-Sep-2017

Tester: JOP

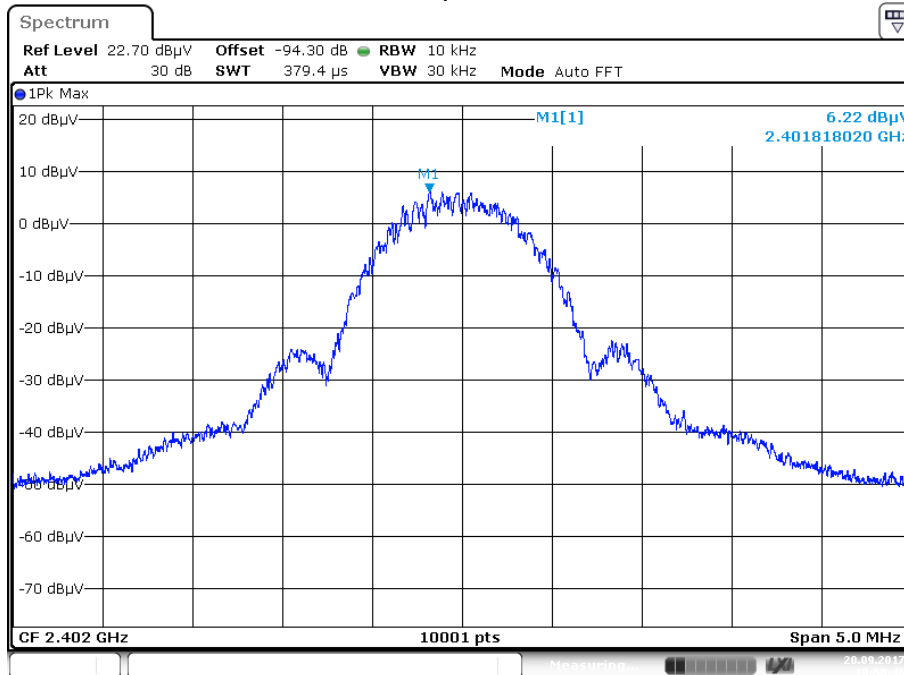
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079712	24-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	22-Feb-2018

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

5.5 Test Data

Channel (MHz)	Peak PSD (dBμV/m)	Correction (dB)	Peak PSD (dBm)	Limit (dBm)	Margin (dB)
2402	101.42	-95.2	6.22	8	-1.8
2426	101.7	-95.2	6.5	8	-1.5
2480	100.3	-95.2	5.1	8	-2.9

Sample Plot



Date: 20.SEP.2017 10:58:47

6 Conducted Spurious Emissions

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

Using radiated methods, the procedures from KDB 558074 D01 DTS Meas Guidance v04 Clause 11 were applied.

The limit is 20 dB below the measured peak power in any 100kHz band.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.8 °C

Relative Humidity: 44.6 %

6.4 Test Equipment

Test End Date: 20-Sep-2017

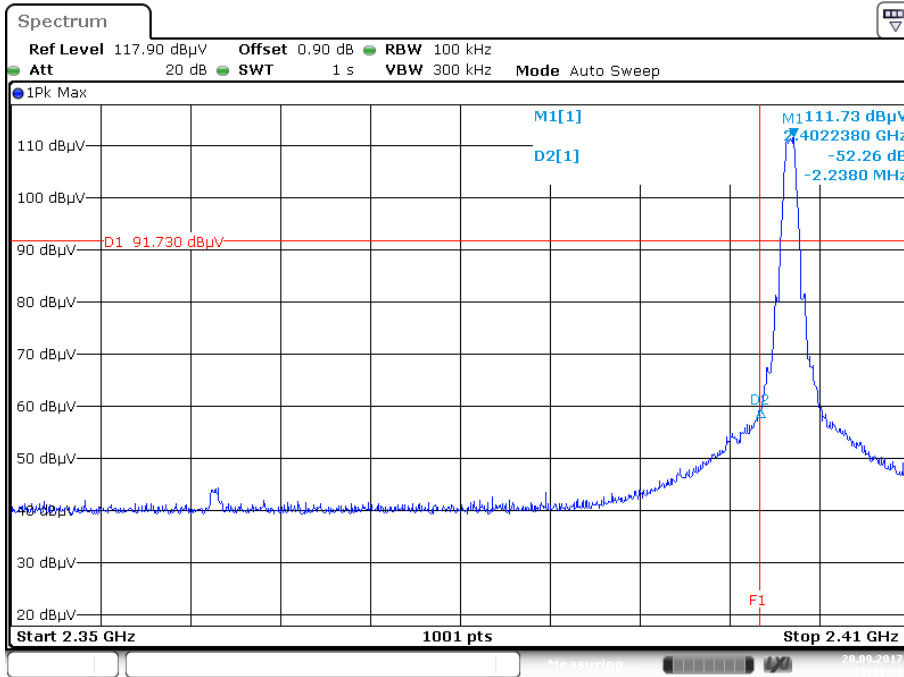
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079712	24-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	22-Feb-2018

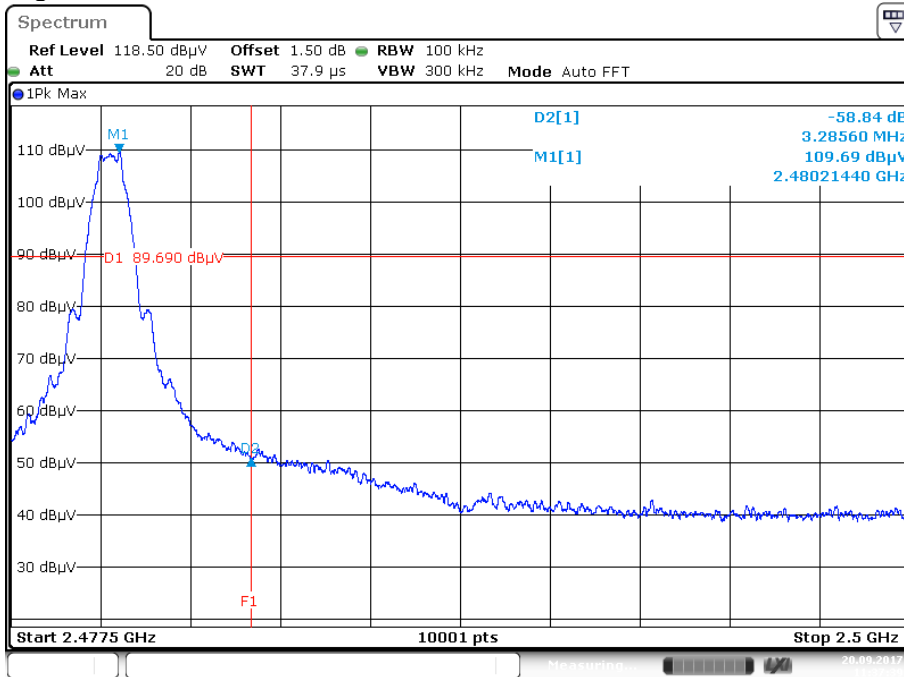
Note: The equipment calibration period is 1 year except for the FSV which is on a 2 year cycle.

6.5 Test Data (DTS Band-Edge)

Low Channel – 2402MHz



High Channel – 2480MHz

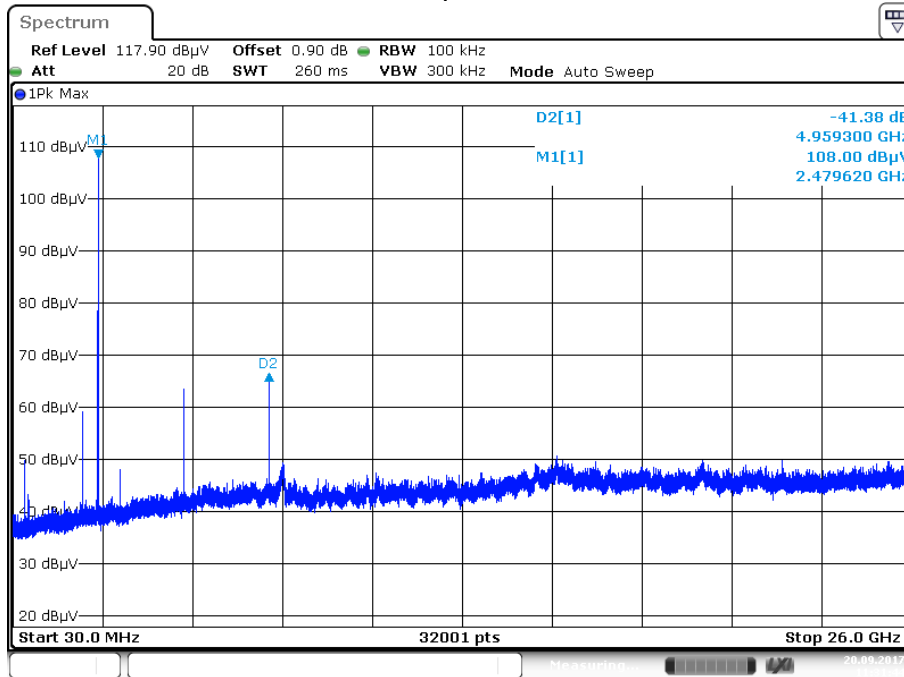


6.6 Test Data (Spurious Emissions)

Worst-case spurious emission

Frequency (MHz)	Peak 100kHz RBW (dBμV/m)	Delta dBc (dB)	Limit (dB)	Margin (dB)
2402	111.7	0	NA	NA
4804	70.9	-40.8	-20	-20.8
2440	109.1	0	NA	NA
4880	67.67	-41.43	-20	-21.4
2480	108	0	NA	NA
4960	66.6	-41.4	-20	-21.4

Sample Plot



Date: 20.SEP.2017 11:31:45

7 Field Strength of Spurious Radiation

7.1 Test Result

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

7.2 Test Method

Radiated spurious emissions measurements were recorded with the device configured to transmit at the lowest, middle, and highest channels. The frequency range investigated was up through the 10th harmonic of the fundamental transmit frequency. The methods defined in ANSI C63.10: 2013 were used.

For measurements below 1GHz, the device was manipulated through three orthogonal axes. Above 1GHz, the alternative method in Clause 6.6.5 was used.

Test distance:

- 9k to 30 MHz – Near field prescan to determine if there were any emissions.
- 30 MHz to 1 GHz - The EUT to measurement antenna distance was 3 meters
- 1 to 18 GHz - The EUT to measurement antenna distance was 3 meters
- 18 to 40 GHz - The EUT to measurement antenna distance was 3 meters

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 within the restricted bands of operation defined in FCC §15.205.
- (2) Quasi-peak limit
- (3) Average limit

7.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.3 °C
 Relative Humidity: 52.7 %

7.4 Test Equipment

Test End Date: 13-Oct-2017

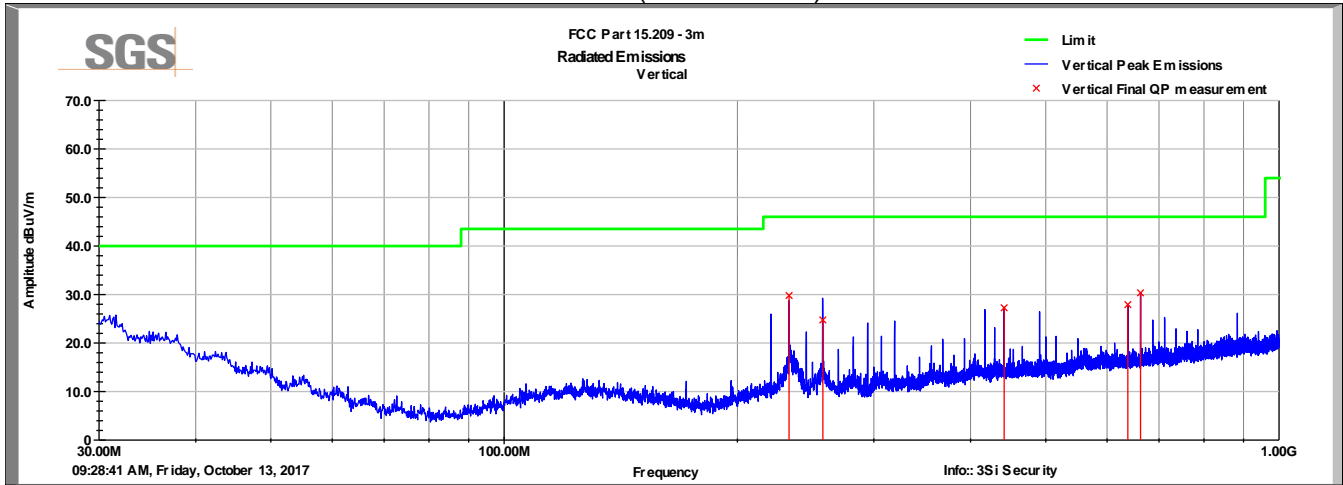
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-Apr-2018
ANTENNA, BILOG	CBL 6143A	TESEQ	B085931	6-Dec-2017
RF CABLE	SF106	HUBER & SUHNER	B079661	25-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079713	24-Jul-2018
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	25-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	22-Feb-2018
FILTER, HIGH PASS (>2800MHZ)	HPM50111	MICRO-TRONICS	B085747	27-Jul-2018
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079716	24-Jul-2018
HORN(SMALL)	LB-180400-20-C-KF	A-INFO	15007	21-Mar-2018
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018
RF CABLE	SF102	HUBER & SUHNER	B079824	26-Jul-2018
LOW NOISE AMPLIFIER	NSP1840-HG	MITEQ	B087572	28-Jul-2018

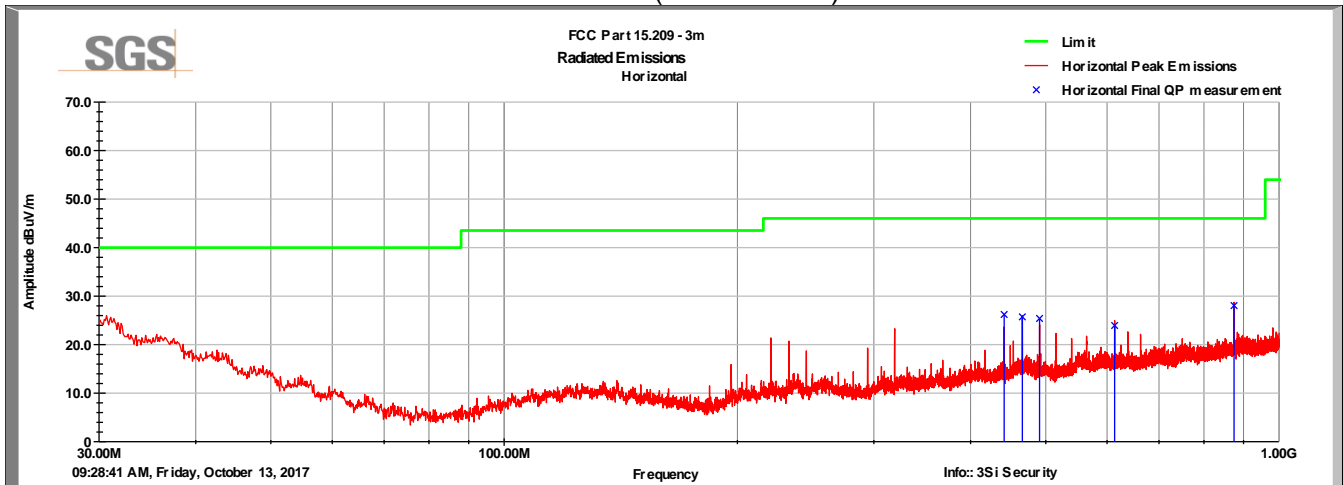
Note: The equipment calibration period is 1 year.

7.5 Test Data – Peak Plots

BLE Channel 0
Vertical (30-1000MHz)

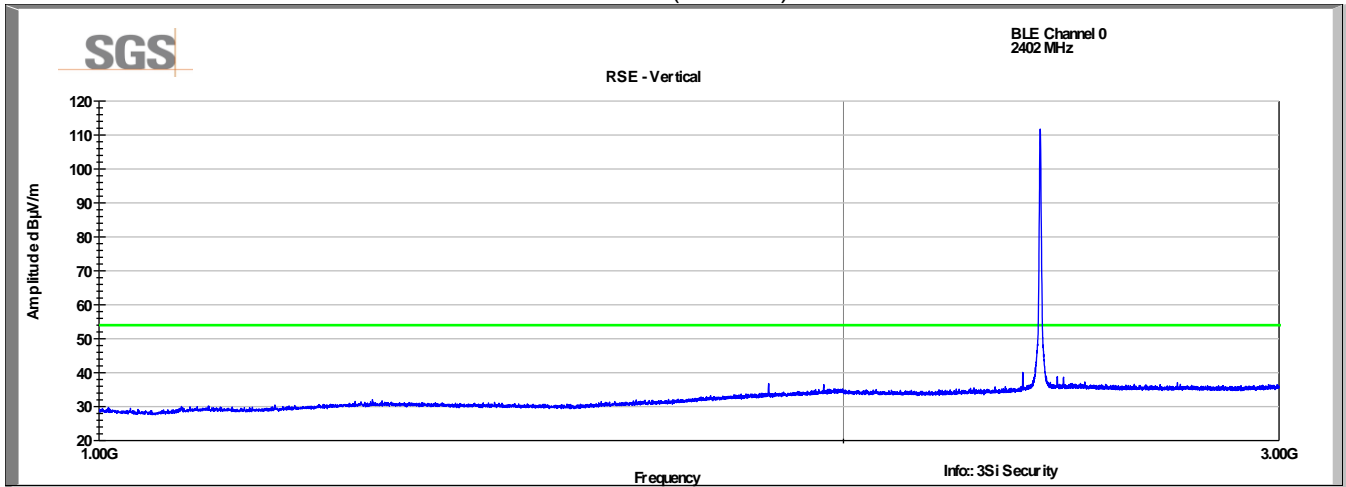


BLE Channel 0
Horizontal (30-1000MHz)

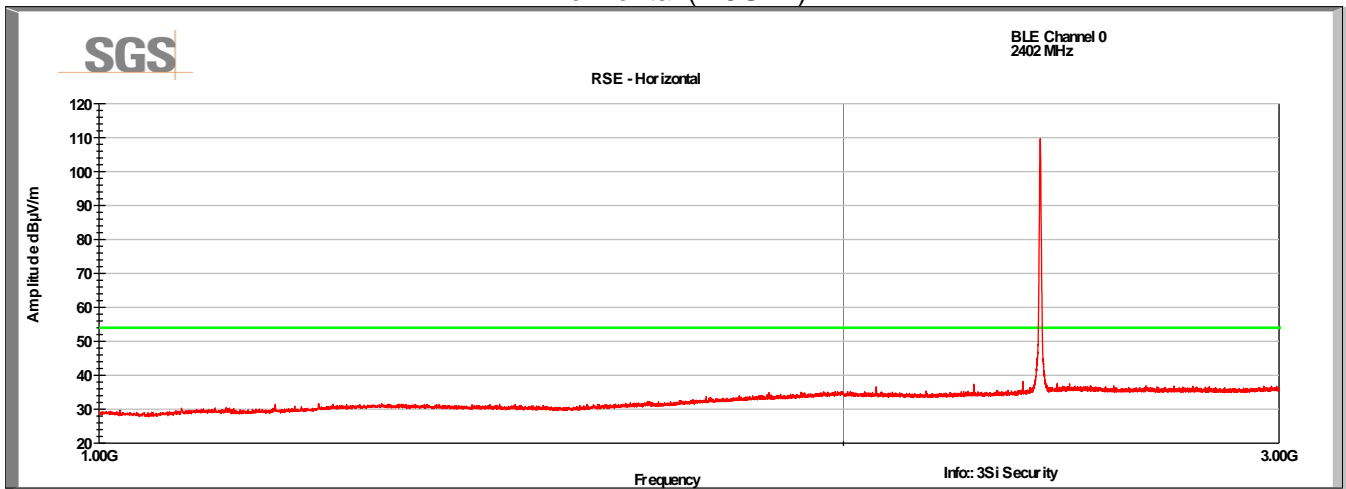


There was no discernible difference in the emissions profile below 1GHz when changing between BLE channels.

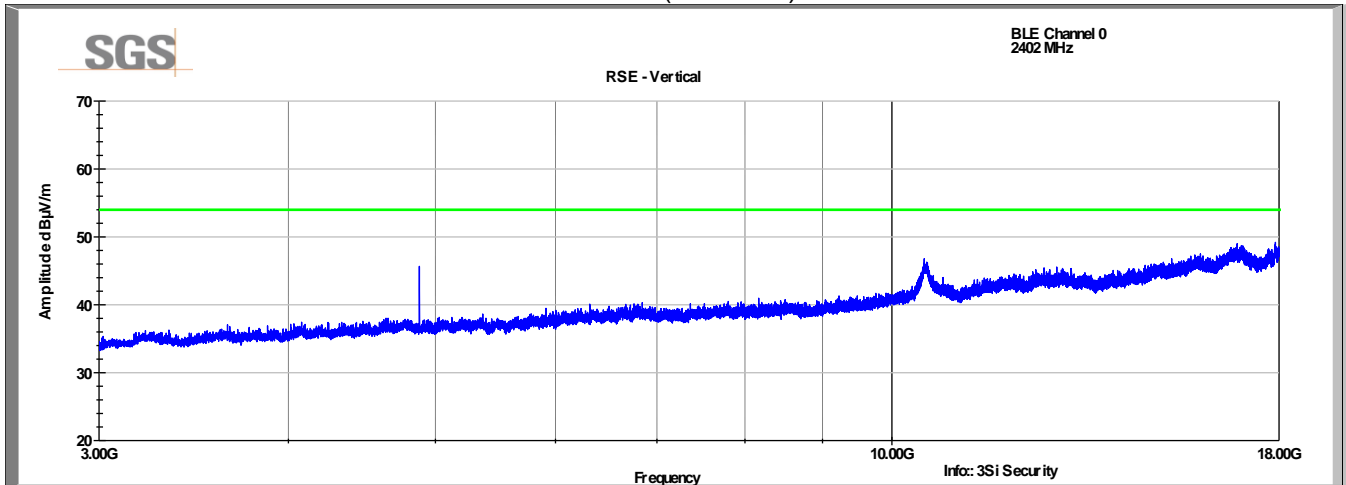
BLE Channel 0 Vertical (1-3GHz)



BLE Channel 0 Horizontal (1-3GHz)

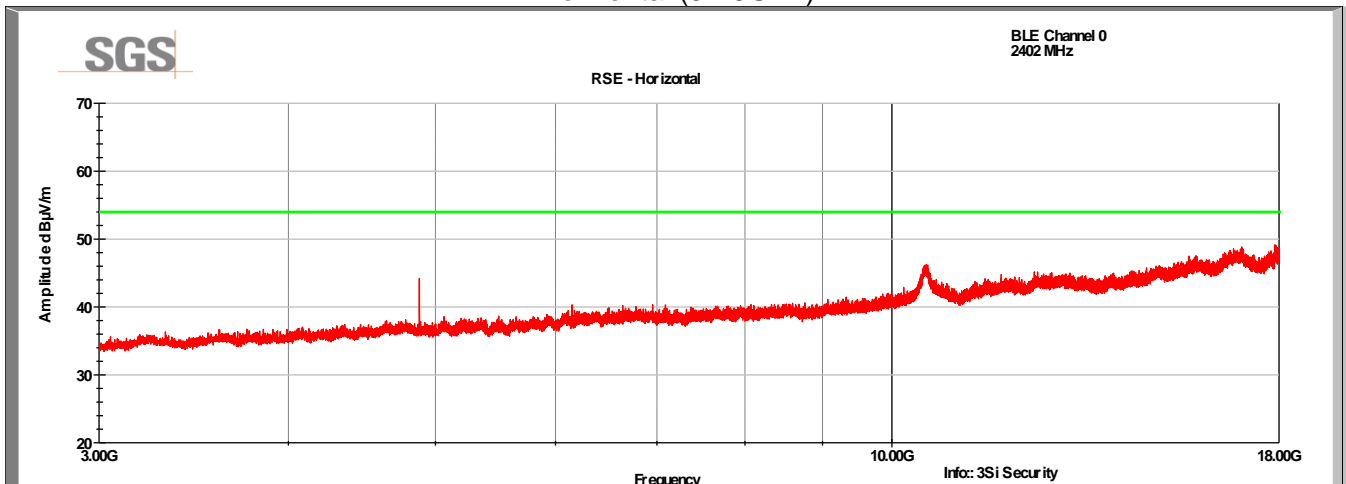


BLE Channel 0
Vertical (3-18GHz)



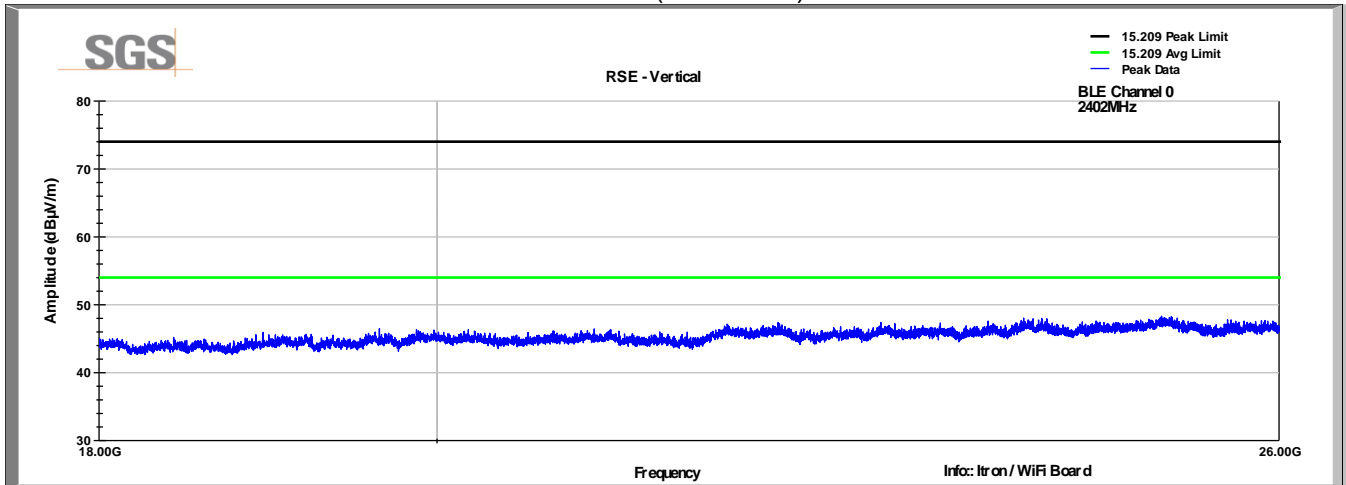
Worst case spur at 4804MHz = 45.3dBµV/m Peak

BLE Channel 0
Horizontal (3-18GHz)

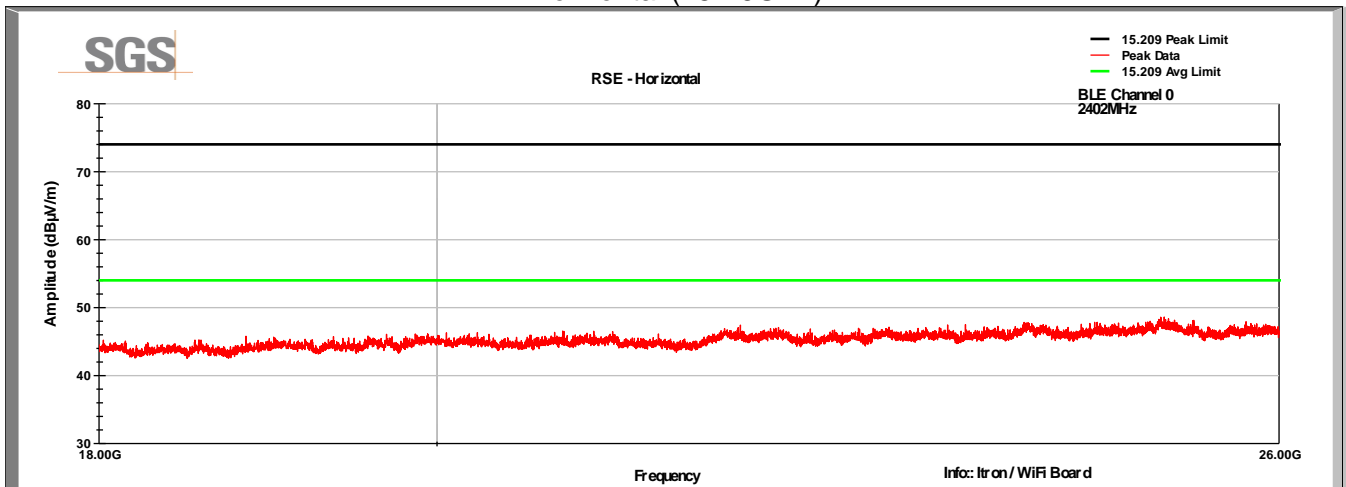


Worst case spur at 4804MHz = 44.0dBµV/m Peak

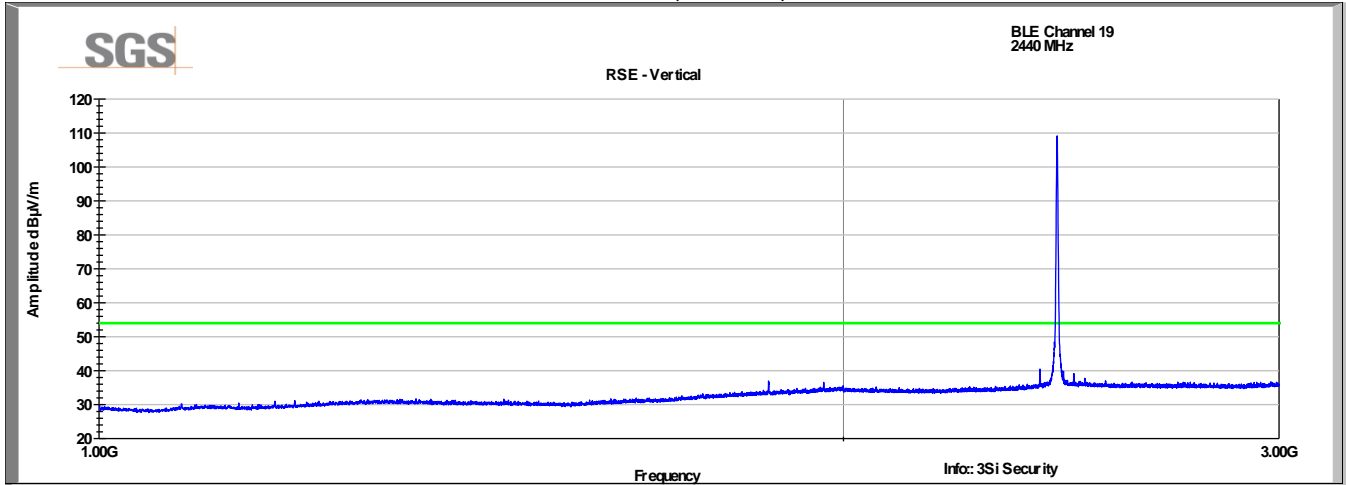
BLE Channel 0
 Vertical (18-26GHz)



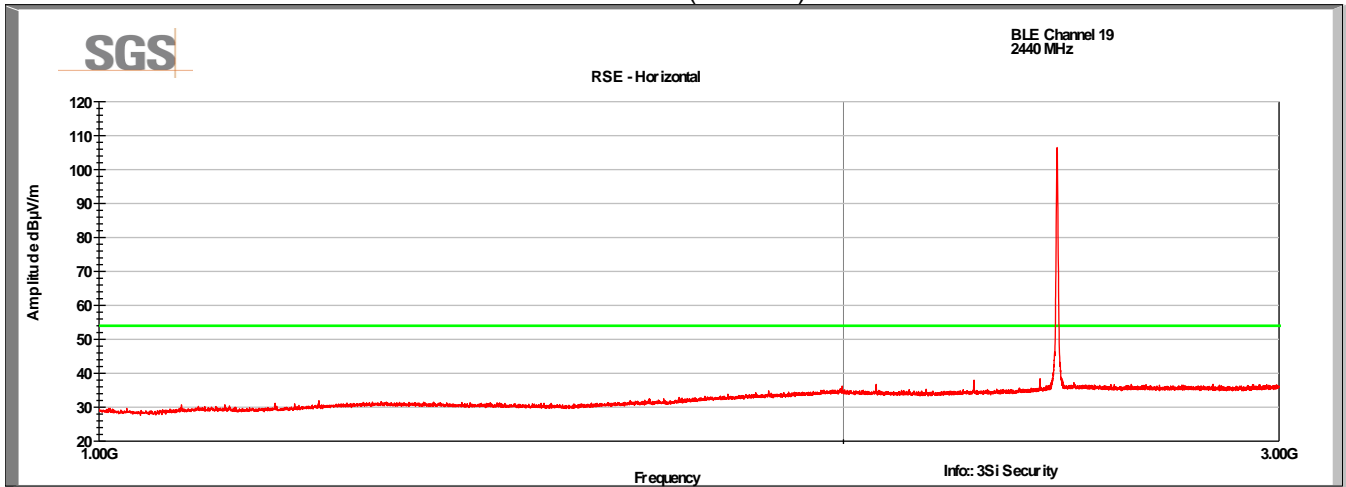
BLE Channel 0
 Horizontal (18-26GHz)



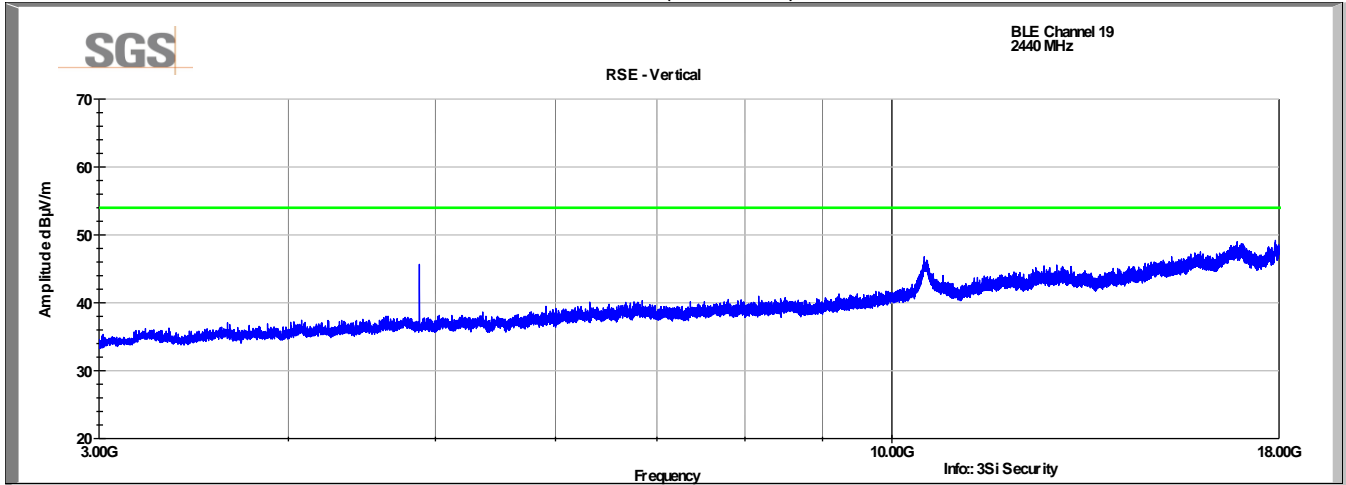
BLE Channel 19 Vertical (1-3GHz)



BLE Channel19 Horizontal (1-3GHz)

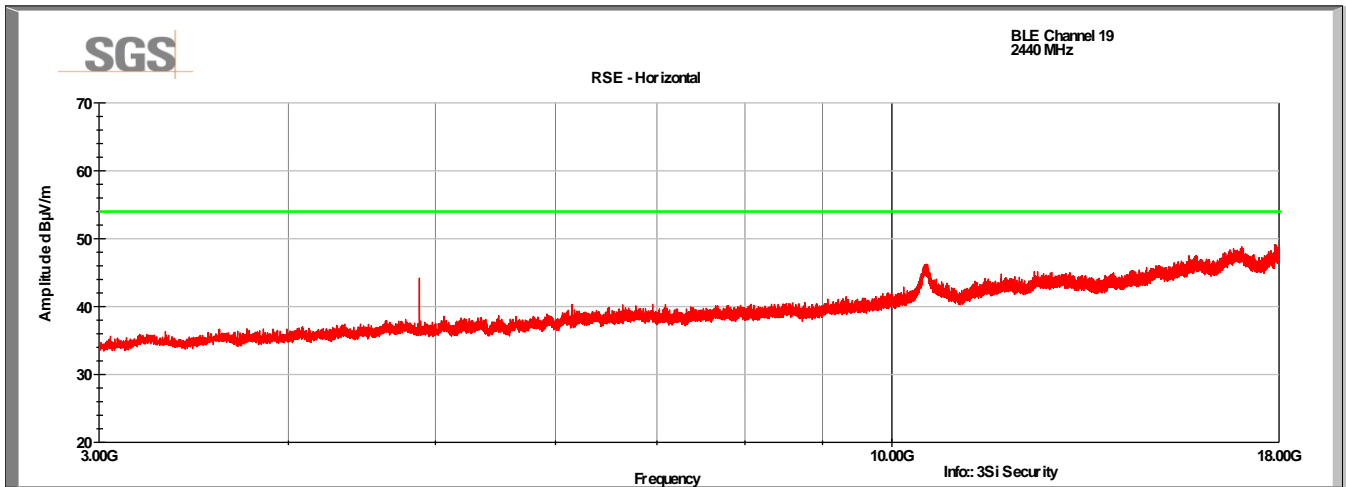


BLE Channel 19
Vertical (3-18GHz)



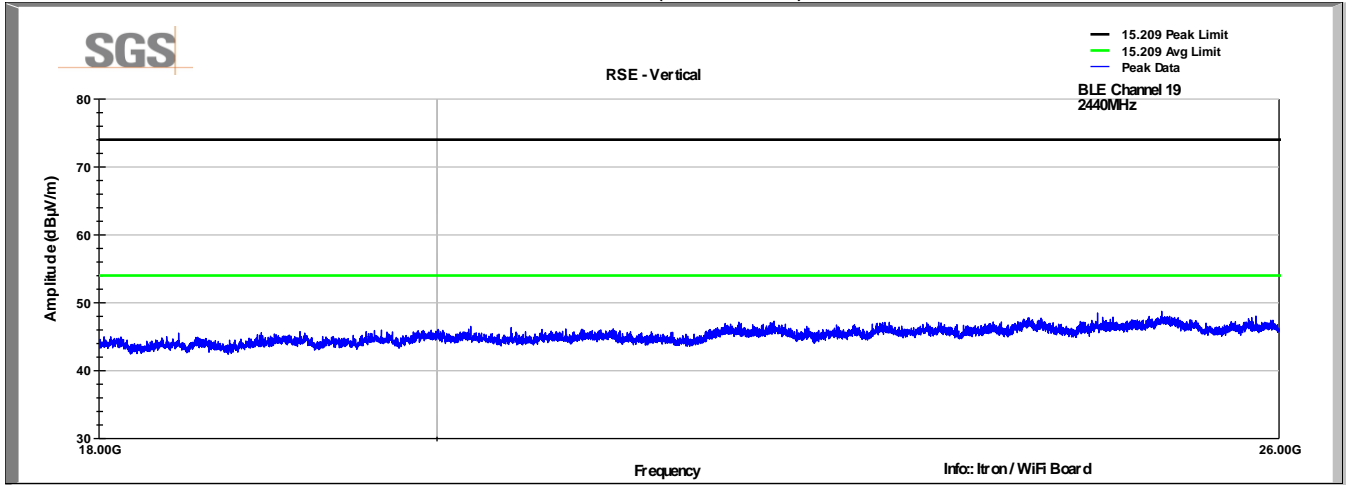
Worst case spur at 4880MHz = 45.6dB μ V/m Peak

BLE Channel 19
Horizontal (3-18GHz)

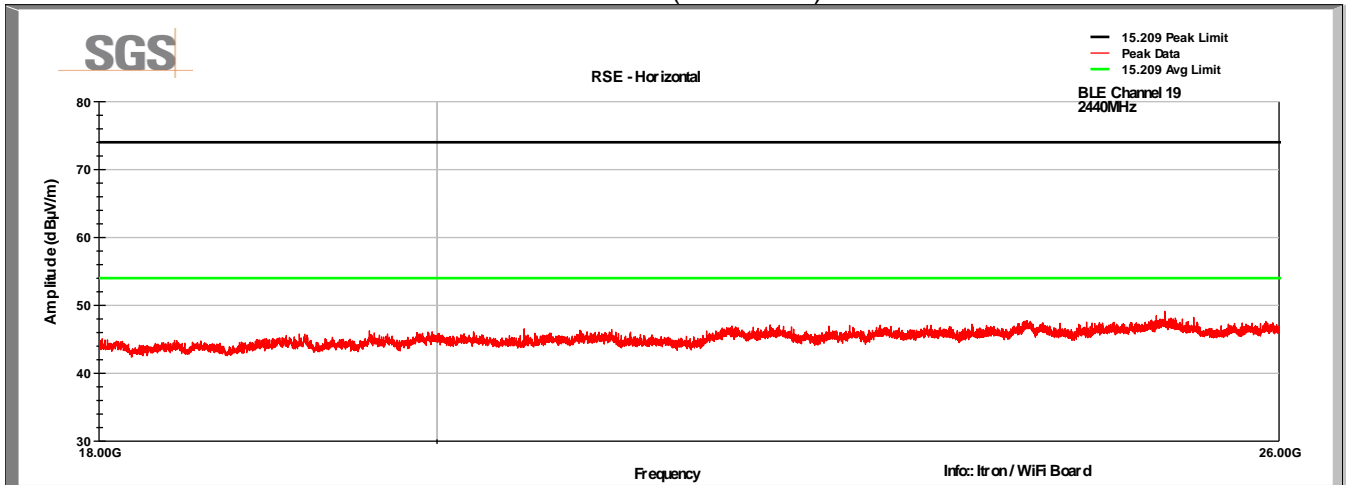


Worst case spur at 4880MHz = 44.2dB μ V/m Peak

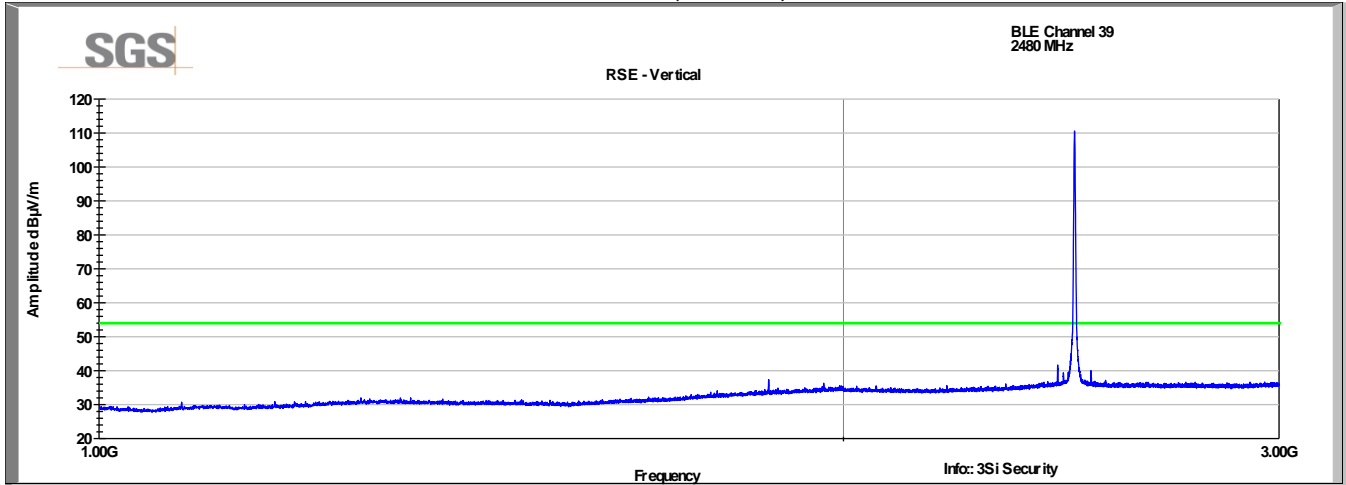
BLE Channel 19
 Vertical (18-26GHz)



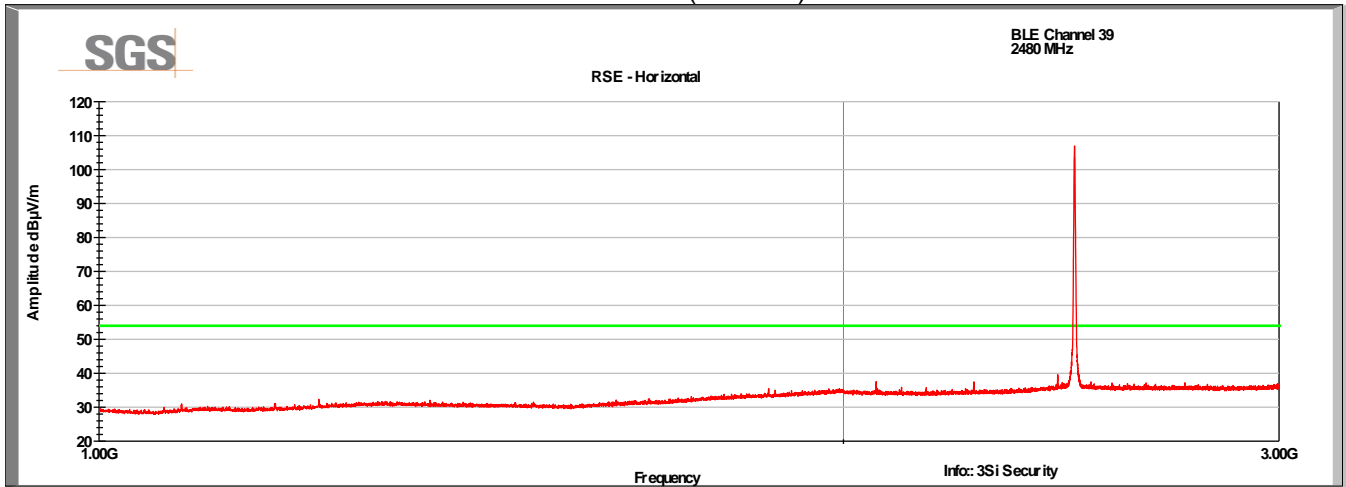
BLE Channel 19
 Horizontal (18-26GHz)



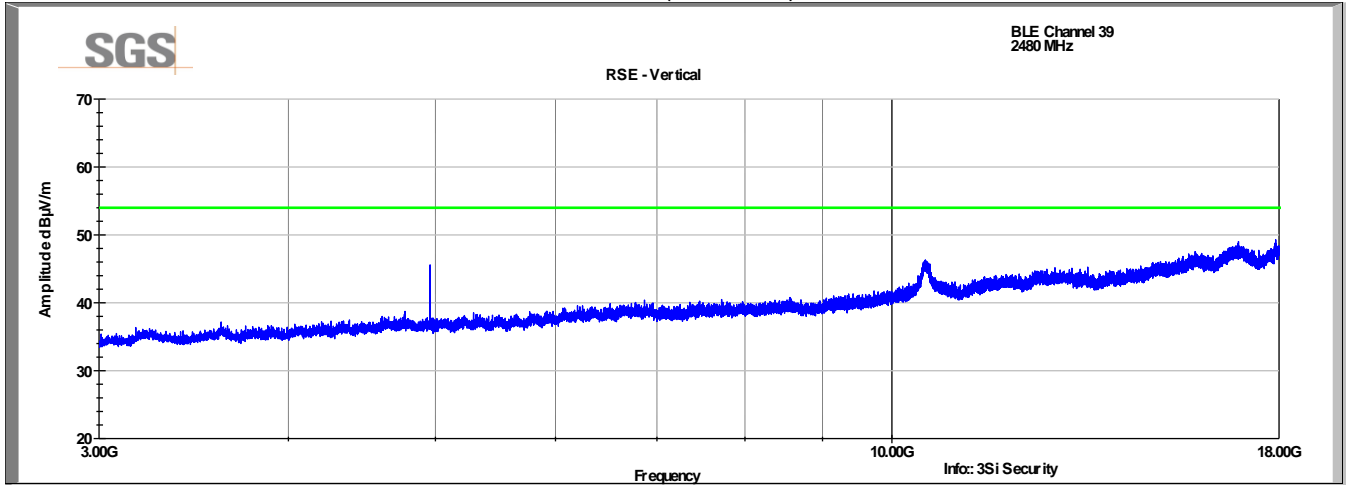
BLE Channel 39 Vertical (1-3GHz)



BLE Channel 39 Horizontal (1-3GHz)

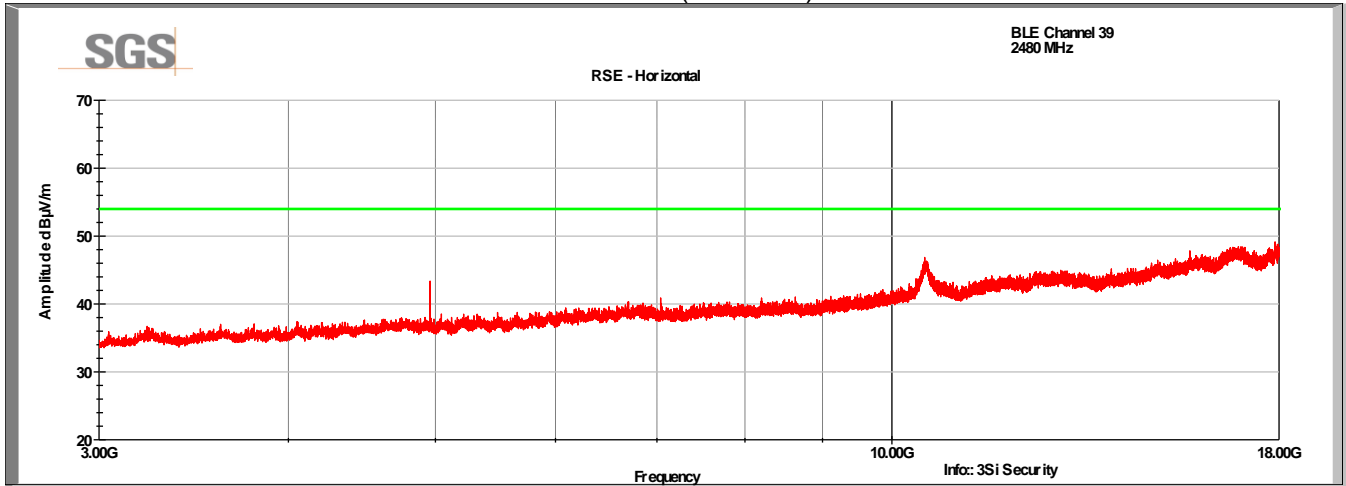


BLE Channel 39
Vertical (3-18GHz)



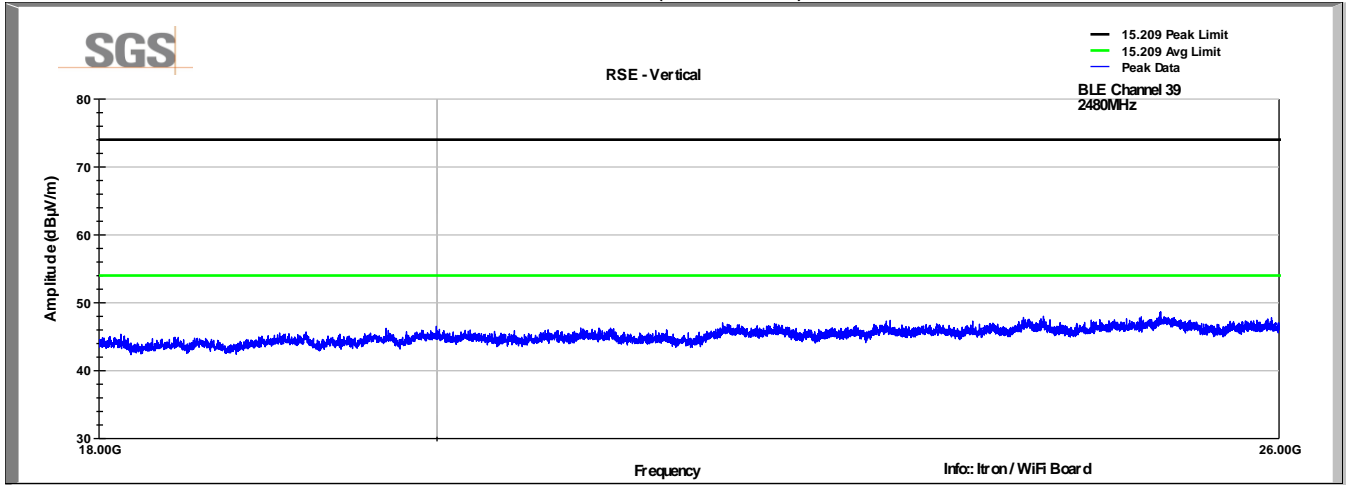
Worst case spur at 4960MHz = 45.6dBµV/m Peak

BLE Channel 39
Horizontal (3-18GHz)

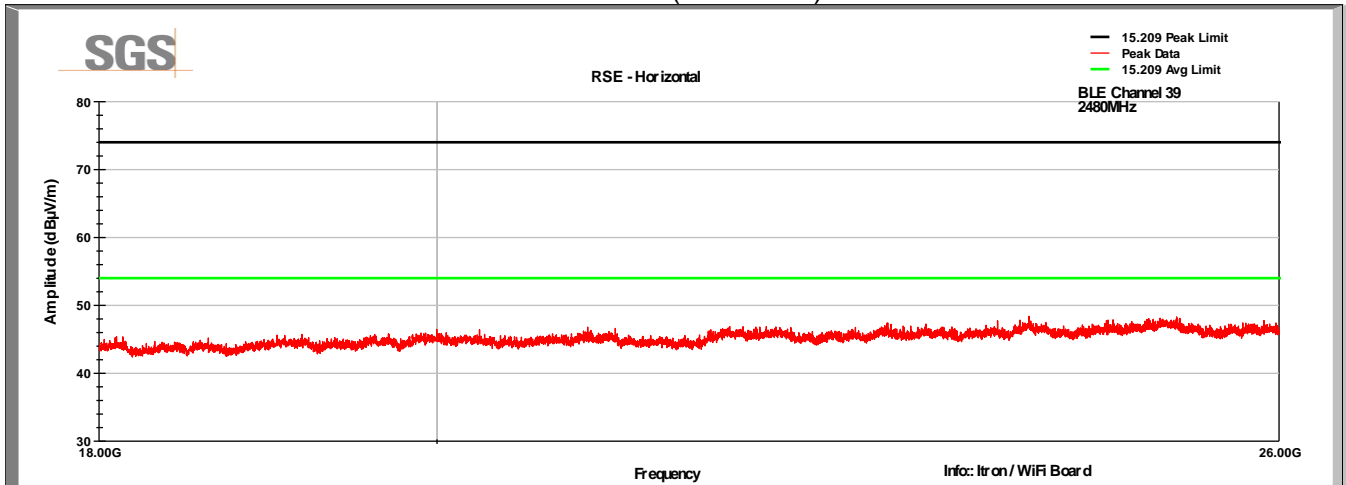


Worst case spur at 4960MHz = 43.4dBµV/m Peak

BLE Channel 39
Vertical (18-26GHz)



BLE Channel 39
Horizontal (18-26GHz)



7.6 Test Data – Tabular Data

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)
233.18	49.1	V	325.0	317.0	12.9	1.4	33.5	29.8	46.0	-16.2
257.77	43.5	V	27.0	100.0	13.4	1.5	33.5	24.7	46.0	-21.3
441.82	41.5	V	135.0	258.0	17.2	1.9	33.4	27.3	46.0	-18.7
638.18	39.4	V	54.0	364.0	19.4	2.3	33.2	27.9	46.0	-18.1
662.73	41.7	V	28.0	393.0	19.5	2.4	33.2	30.3	46.0	-15.7
441.82	40.4	H	5.0	186.0	17.2	1.9	33.4	26.2	46.0	-19.8
466.36	39.6	H	205.0	131.0	17.5	2.0	33.3	25.7	46.0	-20.3
490.90	38.9	H	23.0	223.0	17.7	2.0	33.3	25.4	46.0	-20.6
613.64	35.6	H	180.0	137.0	19.3	2.3	33.2	23.9	46.0	-22.1
875.09	37.1	H	319.0	176.0	21.4	2.7	33.2	28.0	46.0	-18.0
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Note: There was no discernible difference in the measurement data below 1GHz when transmitting at different channels. QP measurements were only recorded with the device transmitting on Channel 0.

8 Radiated Emissions at Band Edge / Restricted Band

8.1 Test Result

Test Description	Test Specification		Test Result
Spurious 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 using the radiated methods defined in Section 12 of FCC publication D01 DTS Meas Guidance v04.

8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.8 °C

Relative Humidity: 44.6 %

8.4 Test Equipment

Test End Date: 20-Sep-2017

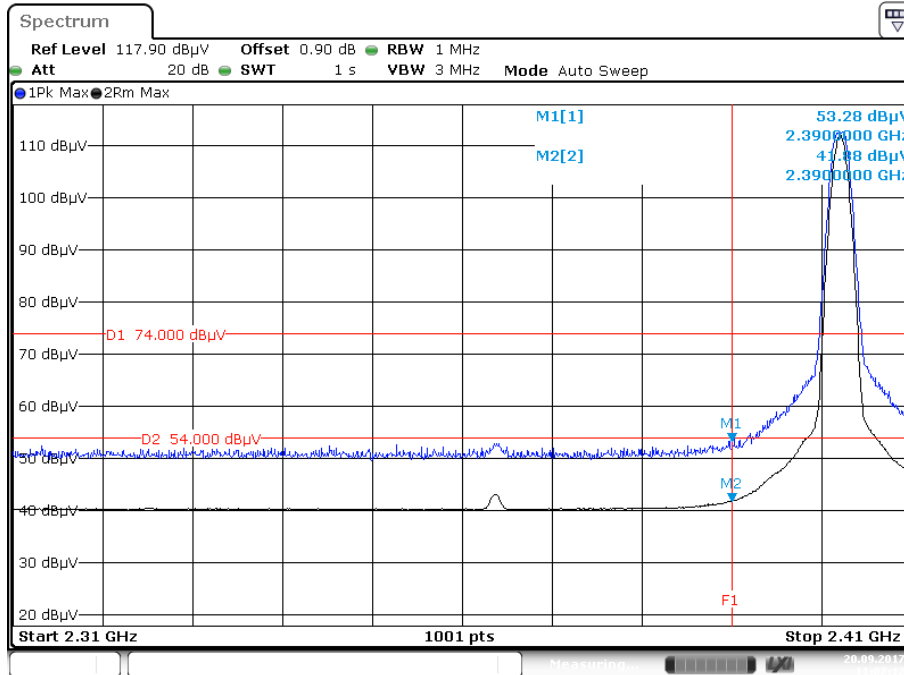
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079712	24-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	22-Feb-2018

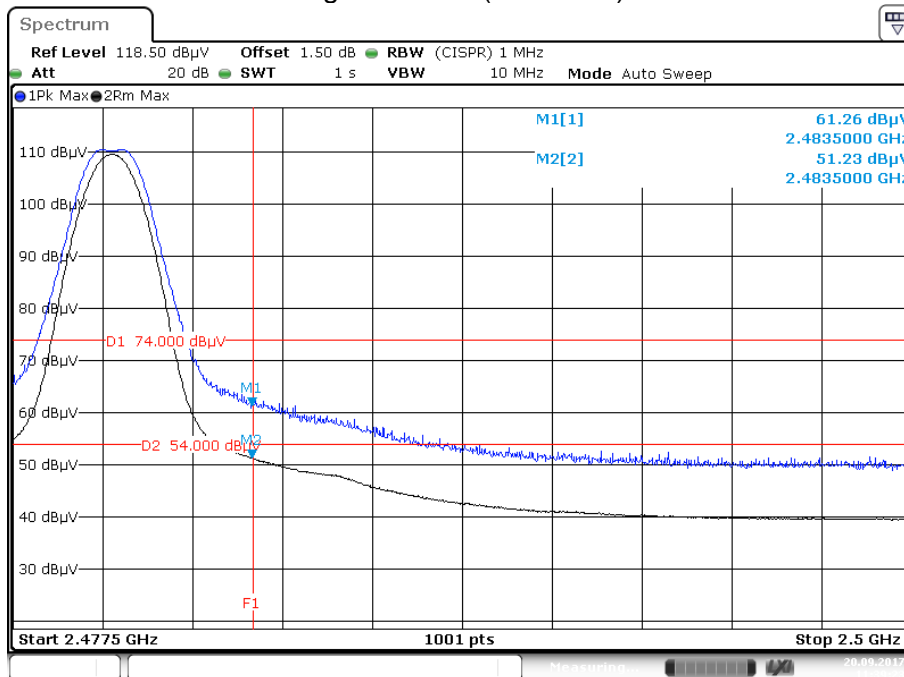
Note: The equipment calibration period is 1 year except for the FSV which is on a 2 year cycle.

8.5 Test Data – Restricted Band Edge

Low Channel (2402MHz)



High Channel (2480MHz)



9 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	20 November 2017
1	<ul style="list-style-type: none"> - Added antenna requirement info to page 4 - Corrected sample receive date in Section 2.3 	18 January 2018