

EMC Test Report

Project Number: 4305499

Report Number: 4305499EMC01

Revision Level: 0

Client: Scientific Intake

Equipment Under Test: Smartbyte Wearable Reader 2.0

Model: SI-005.2

FCC ID: 2AJ3RBA10248

IC ID: 22044-BA10248

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

ANSI C63.4: 2014 (FCC Part 15 Subpart B)


RSS-247, Issue 2

RSS-GEN Issue 4


Report issued on: 24 July 2018

Test Result: Compliant

Tested by:


Aaron Froehlich, EMC Test 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
Peak 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
Field Strength of Spurious Radiation	15.247(d), 15.209	RSS-247 S5.5	Compliant
Emissions in Restricted Frequency Bands	15.205, 15.209	RSS-GEN S8.9, S8.10	Compliant
Antenna Requirement	15.203	RSS-GEN S8.3	Compliant ¹
AC Powerline Conducted Emissions	15.107, 15.207	RSS-GEN S8.8	N/A ²

- 1) Internal PCB antenna
- 2) DUT is batter powered.

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: Scientific Intake
 Address: 280 Merrimack Street Suite 503
 City, State, Zip, Country: Lawrence, MA 01843 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

Type of Product: Smartbyte Wearable Reader 2.0
 Model Number: SI-005.2
 Serial Number: NSN

Frequency Range: 2402-2480MHz
 Data Modes: Bluetooth Low Energy
 Antenna: Internal PCB Trace -7dBi

Rated Voltage: 3.9 V Battery
 Test Voltage: 3.9 V Battery

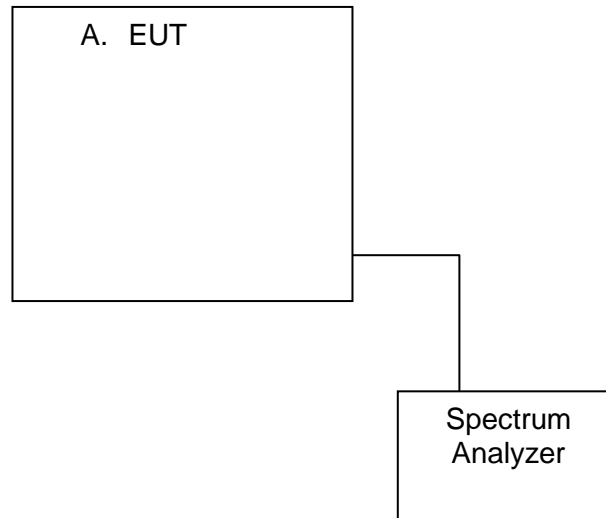
Sample Received Date: 5/17/2018
 Dates of testing: 5/17/2018 – 5/18/2018

2.4 Operating Modes and Conditions

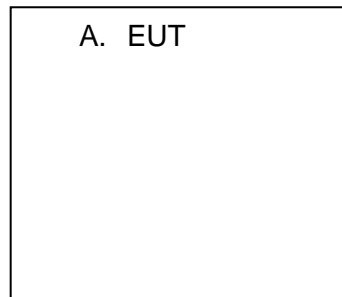
Continuous traffic was generated using test commands. The device was programmed to transmit at 100% duty cycle at low, middle, and high channels.

Channel 2, 2402MHz
 Channel 40, 2440MHz
 Channel 80, 2480MHz

2.5 *EUT Connection Block Diagram – Conducted Measurements*



2.6 *EUT Connection Block Diagram – Radiated Measurements*



Inside Chamber

.....
 Outside Chamber

2.7 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Scientific Intake	Smartbyte Wearable Reader 2.0	SI-005.2	NSN

3 Bandwidth

3.1 Test Result

Test Description	Test Specification		Test Result
6 dB bandwidth	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 option 1 and 558074 D01 DTS Meas Guidance v04 were used to determine the 6 dB bandwidth.

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.2 °C
Relative Humidity: 50.1 %
Atmospheric Pressure: 97.4 kPa

3.4 Test Equipment

Test End Date: 18-May-2018

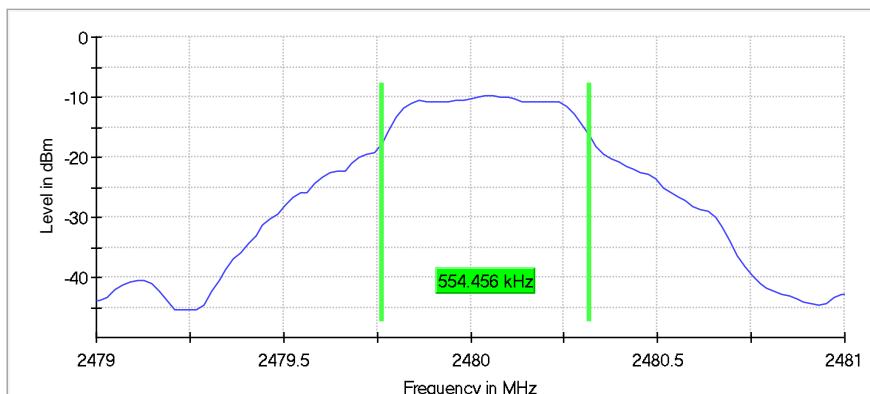
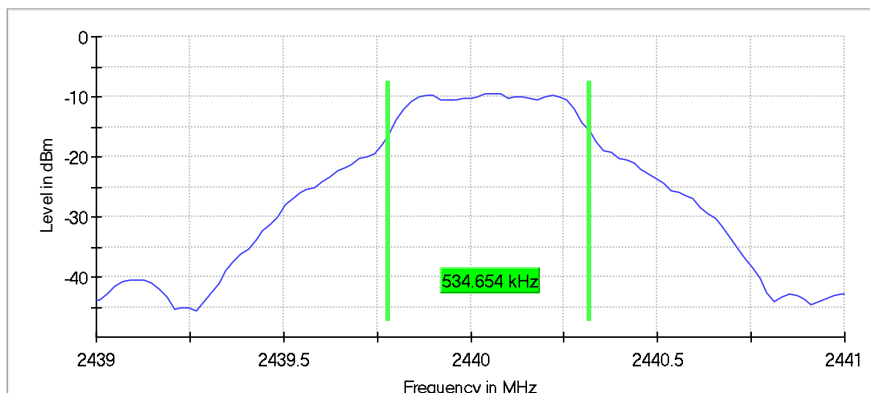
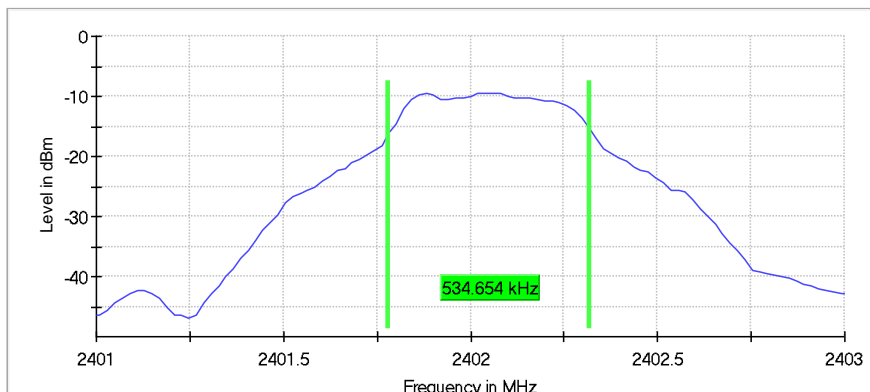
Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE	141	HUBER & SUHNER	B095585	26-Jul-2018
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095591	28-Jul-2018
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

Note: The equipment calibration period is 1 year.

3.5 Test Data

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2402.000000	0.534654	0.500000	2401.782178	2402.316832	-9.4	PASS
2440.000000	0.534654	0.500000	2439.782178	2440.316832	-9.5	PASS
2480.000000	0.554456	0.500000	2479.762376	2480.316832	-9.7	PASS



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

Fundamental peak power measurements were recorded using the procedures from ANSI C63.10: 2013 clause 11.9.1.1 and KDB 558074 D01 Measurement Guidance v04.

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: 23.2 °C
Relative Humidity: 50.1 %
Atmospheric Pressure: 97.4 kPa

4.4 Test Equipment

Test End Date: 18-May-2018

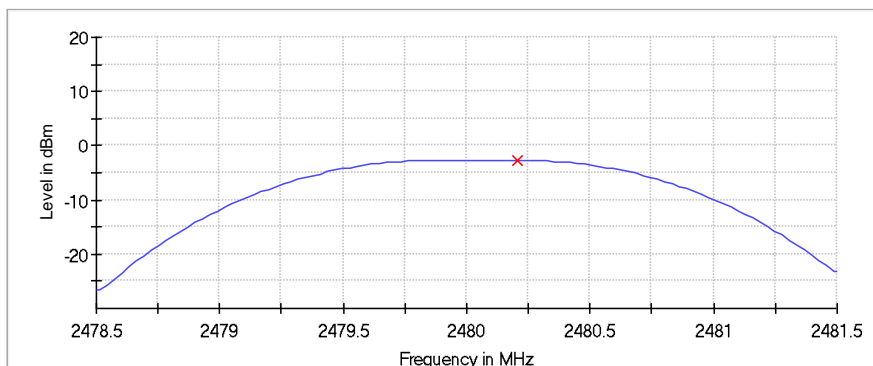
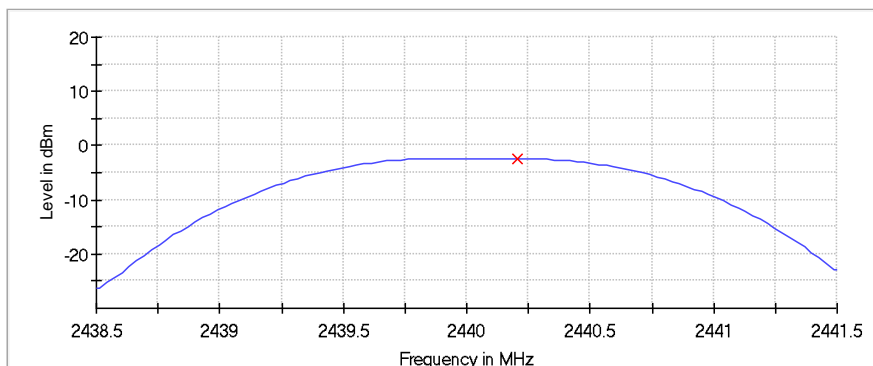
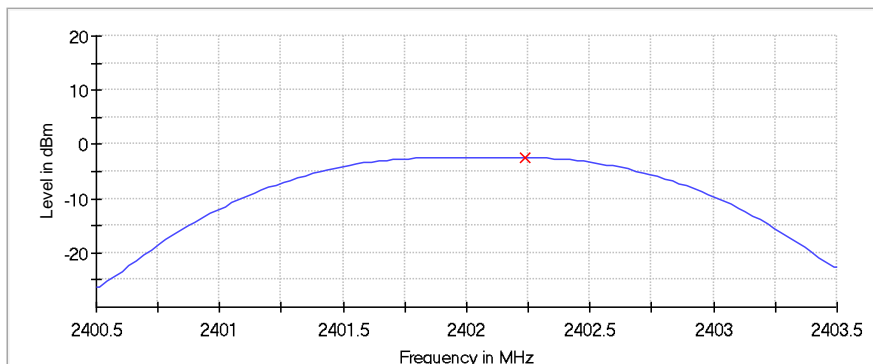
Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE	141	HUBER & SUHNER	B095585	26-Jul-2018
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095591	28-Jul-2018
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

Note: The equipment calibration period is 1 year.

4.5 Test Data

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	-2.4	30.0	PASS
2440.000000	-2.4	30.0	PASS
2480.000000	-2.7	30.0	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 (2)	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 v04.

Limit

The limit is 8 dBm.

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.2 °C
 Relative Humidity: 50.1 %
 Atmospheric Pressure: 97.4 kPa

5.4 Test Equipment

Test End Date: 18-May-2018

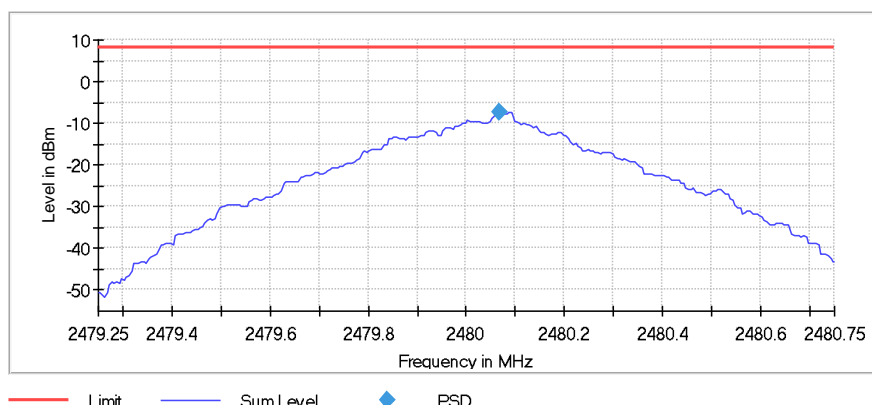
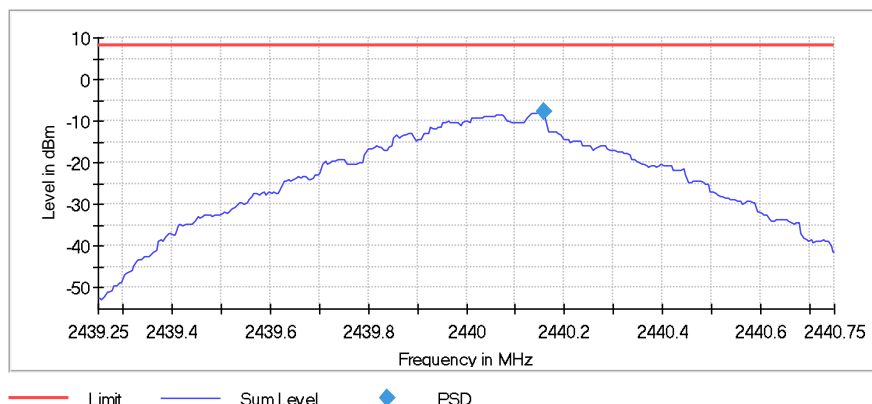
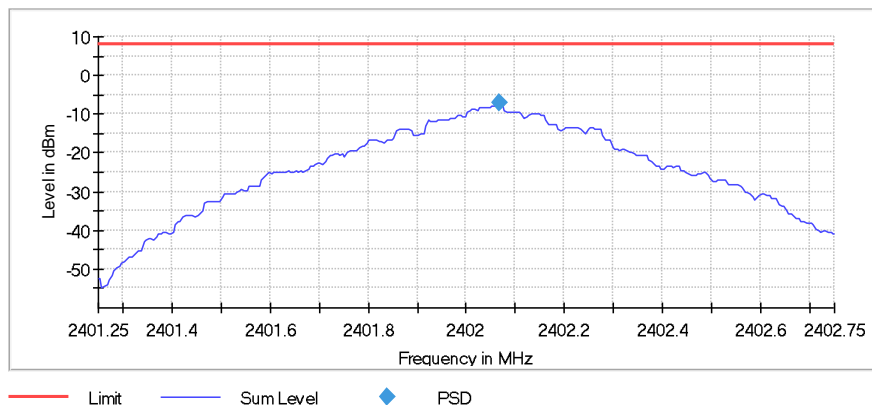
Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE	141	HUBER & SUHNER	B095585	26-Jul-2018
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095591	28-Jul-2018
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

Note: The equipment calibration period is 1 year.

5.5 Test Data

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	2402.067500	-6.955	8.0	PASS
2440.000000	2440.157500	-7.810	8.0	PASS
2480.000000	2480.067500	-7.199	8.0	PASS



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 v04.

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: 50.1 %
Atmospheric Pressure: 97.4 kPa

6.4 Test Equipment

Test End Date: 18-May-2018

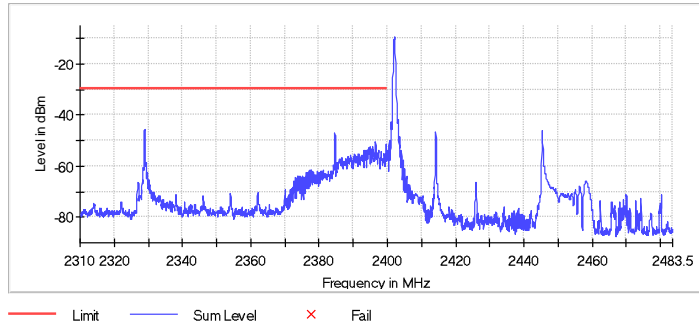
Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE	141	HUBER & SUHNER	B095585	26-Jul-2018
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095591	28-Jul-2018
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

Note: The equipment calibration period is 1 year.

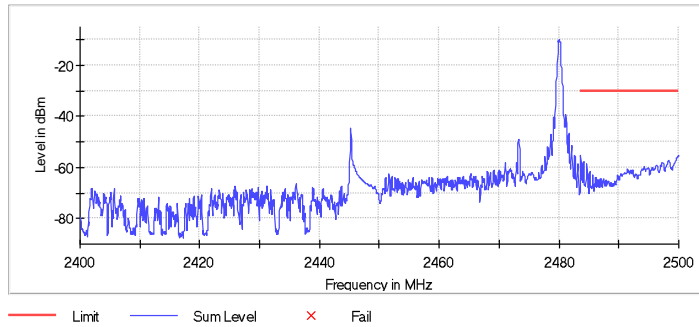
6.5 Test Data – DTS Band Edge

BLE - Lower band edge:



Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2328.925000	-45.8	16.2	-29.6	PASS
2328.975000	-45.8	16.2	-29.6	PASS
2328.875000	-46.2	16.6	-29.6	PASS
2329.025000	-46.6	17.0	-29.6	PASS
2384.625000	-47.2	17.6	-29.6	PASS
2384.675000	-47.3	17.7	-29.6	PASS
2328.825000	-47.5	17.9	-29.6	PASS
2384.725000	-47.9	18.3	-29.6	PASS
2384.575000	-48.2	18.6	-29.6	PASS
2329.075000	-48.4	18.8	-29.6	PASS
2384.775000	-49.4	19.8	-29.6	PASS
2328.775000	-49.9	20.3	-29.6	PASS
2384.525000	-50.2	20.6	-29.6	PASS
2396.525000	-50.4	20.8	-29.6	PASS
2396.475000	-50.4	20.8	-29.6	PASS

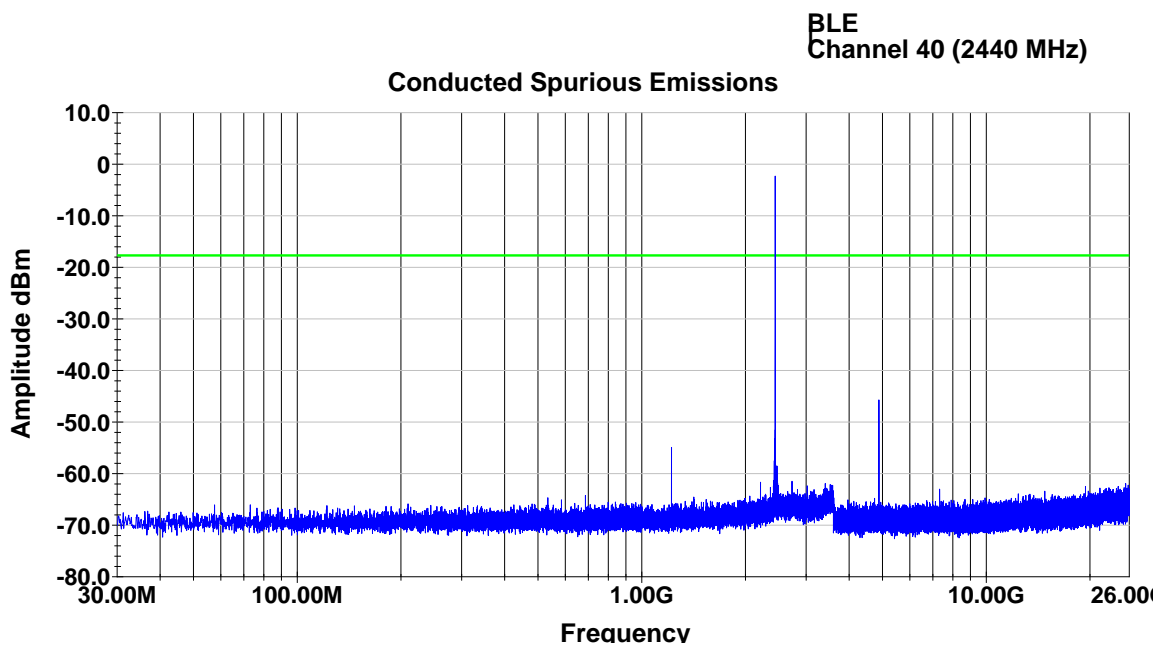
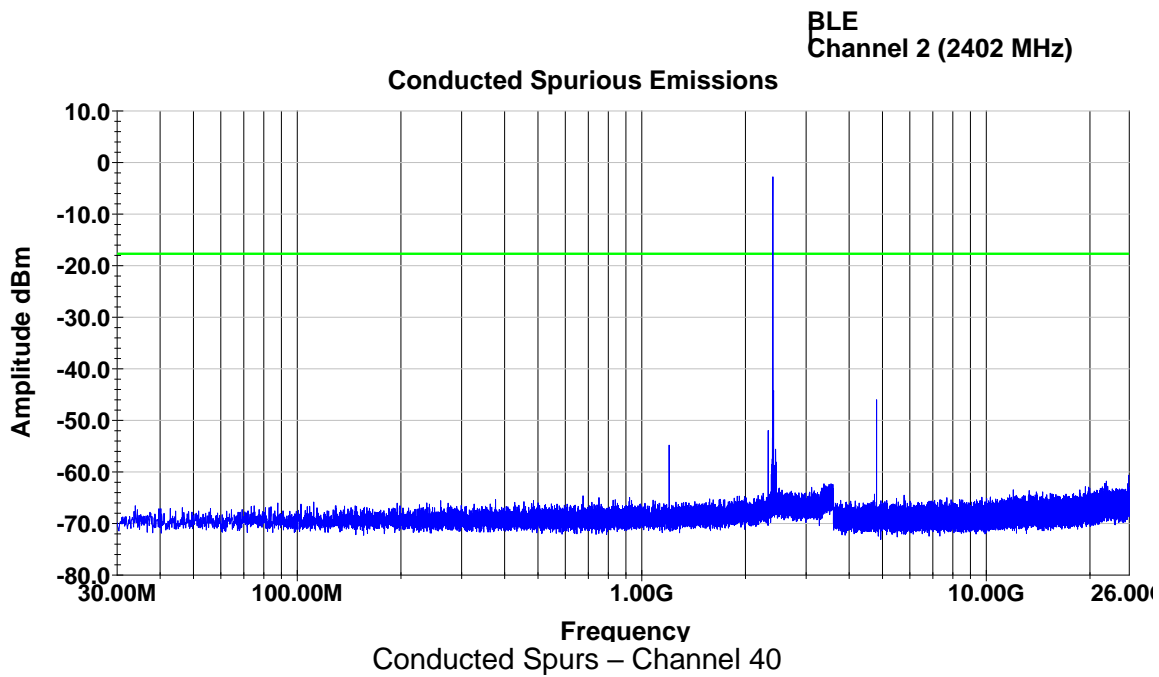
BLE - Upper band edge:



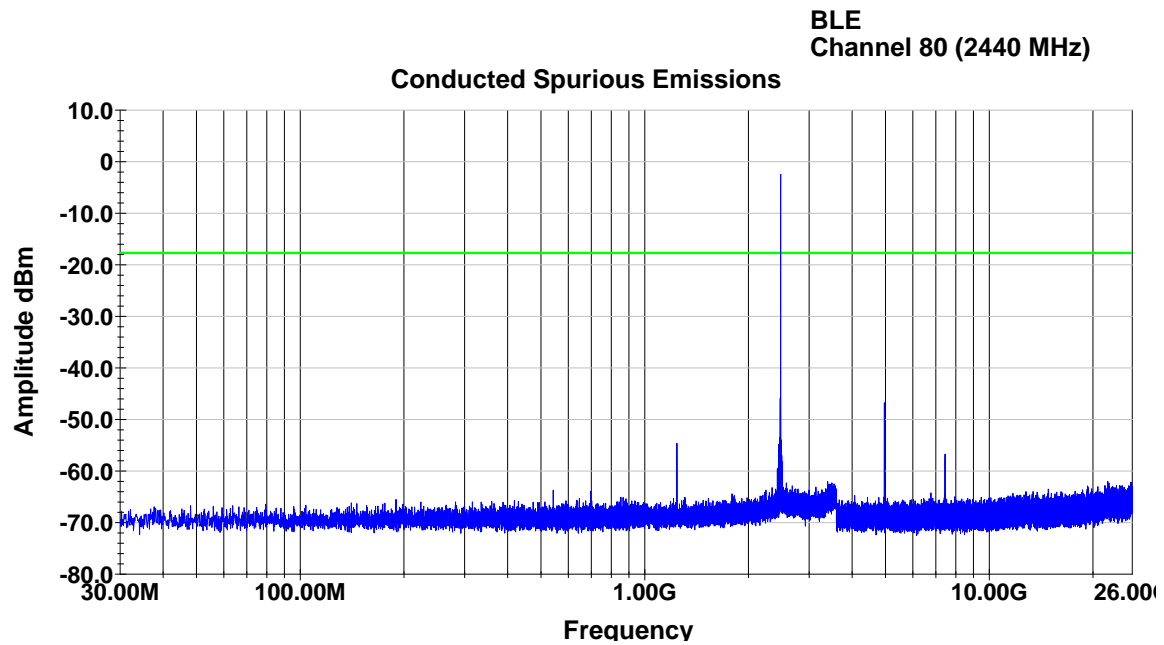
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.625000	-55.2	25.2	-30.0	PASS
2499.925000	-55.5	25.5	-30.0	PASS
2500.000000	-55.5	25.5	-30.0	PASS
2499.975000	-55.5	25.5	-30.0	PASS
2499.875000	-55.6	25.6	-30.0	PASS
2483.575000	-55.8	25.8	-30.0	PASS
2483.675000	-55.9	25.9	-30.0	PASS
2499.825000	-55.9	25.9	-30.0	PASS
2499.775000	-56.0	26.0	-30.0	PASS
2499.725000	-56.1	26.1	-30.0	PASS
2499.675000	-56.4	26.4	-30.0	PASS
2499.625000	-57.0	27.1	-30.0	PASS
2499.575000	-57.1	27.2	-30.0	PASS
2499.525000	-57.2	27.2	-30.0	PASS
2498.325000	-57.2	27.2	-30.0	PASS

6.6 Test Data – Conducted Spurious Emissions

Conducted Spurs – Channel 2



Conducted Spurs – Channel 80



7 Field Strength of Spurious Radiation

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 channels 2 (2402 MHz), 40 (2440 MHz), and 80 (2480 MHz).

Test distance:

- 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

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

- Temperature: 23.2 °C
- Relative Humidity: 50.1 %
- Atmospheric Pressure: 97.4 kPa

7.4 Test Equipment

Test End Date: 18-May-2018

Tester: ASF

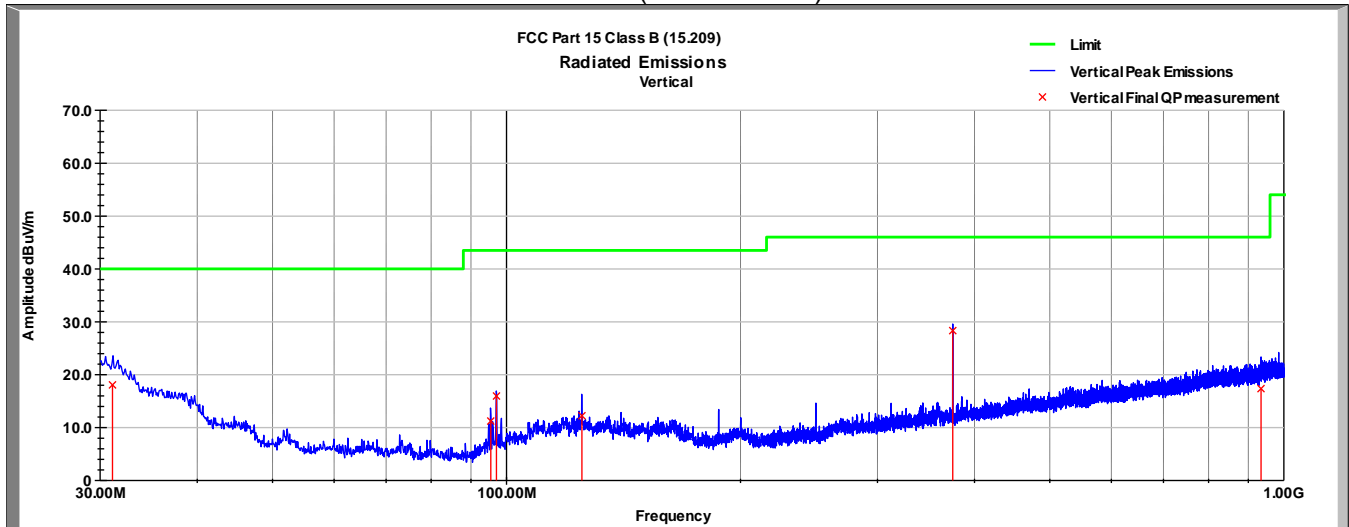
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	16-Oct-2018
RF CABLE	SF106	HUBER & SUHNER	B079712	24-Jul-2018
RF CABLE	NFS-290-78.7-NFS	FLORIDA RF LABS	B095019	24-Jul-2018
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17016	25-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	6-Mar-2019
RF CABLE	104PE	HUBER & SUHNER	B079793	24-Jul-2018
ANTENNA, DRG HORN (SMALL)	3116B	ETS LINDGREN	B079695	27-Jul-2018
RF CABLE	141	HUBER & SUHNER	B095590	26-Jul-2018
LOW NOISE AMPLIFIER	NSP1840-HG	MITEQ	B087572	28-Jul-2018
RF CABLE	SF102	HUBER & SUHNER	B079823	26-Jul-2018
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
FILTER, HIGH PASS (>2800MHZ)	HPM50111	MICRO-TRONICS	B085747	27-Jul-2018
EMI TEST RECEIVER	ESU 40	ROHDE & SCHWARZ	SN: 100364	2-Oct-2018

Note: The equipment calibration period is 1 year.

7.5 Test Data – Peak Plots

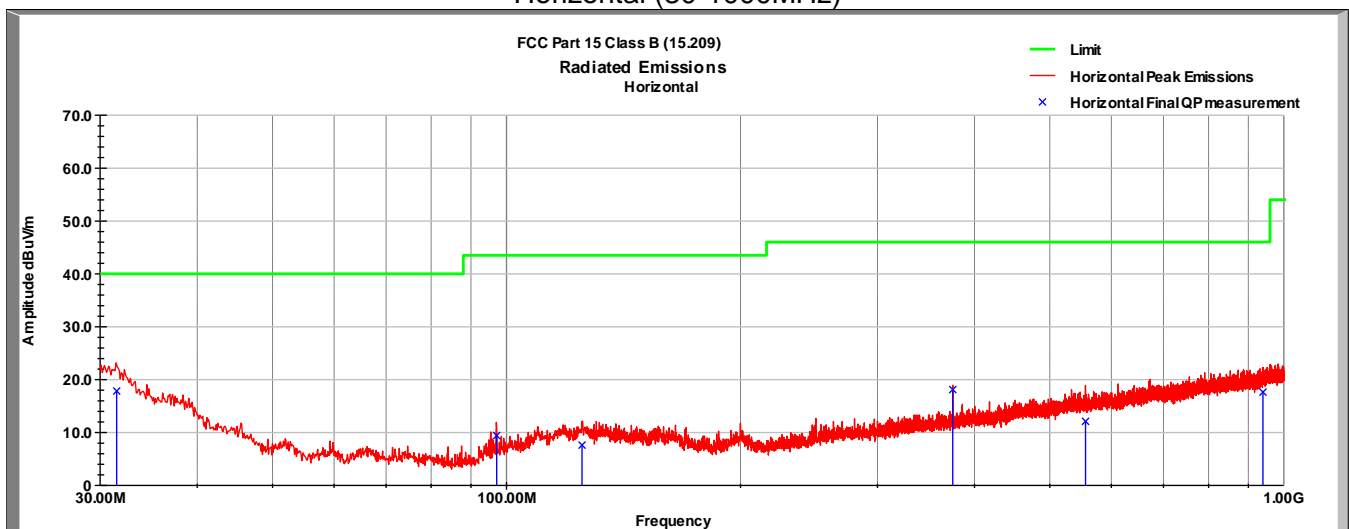
No emissions were detected in the range 9kHz to 30MHz.

BLE Channel 2 Vertical (30-1000MHz)



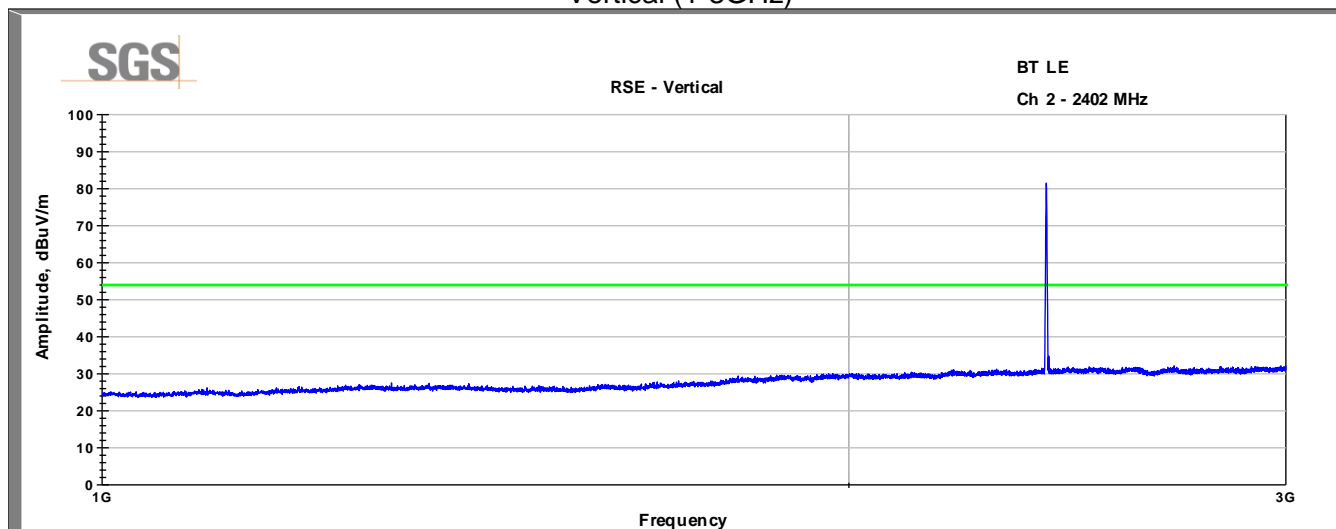
Below 1GHz, there was no discernible difference among the different transmit channels.

BLE Channel 2 Horizontal (30-1000MHz)

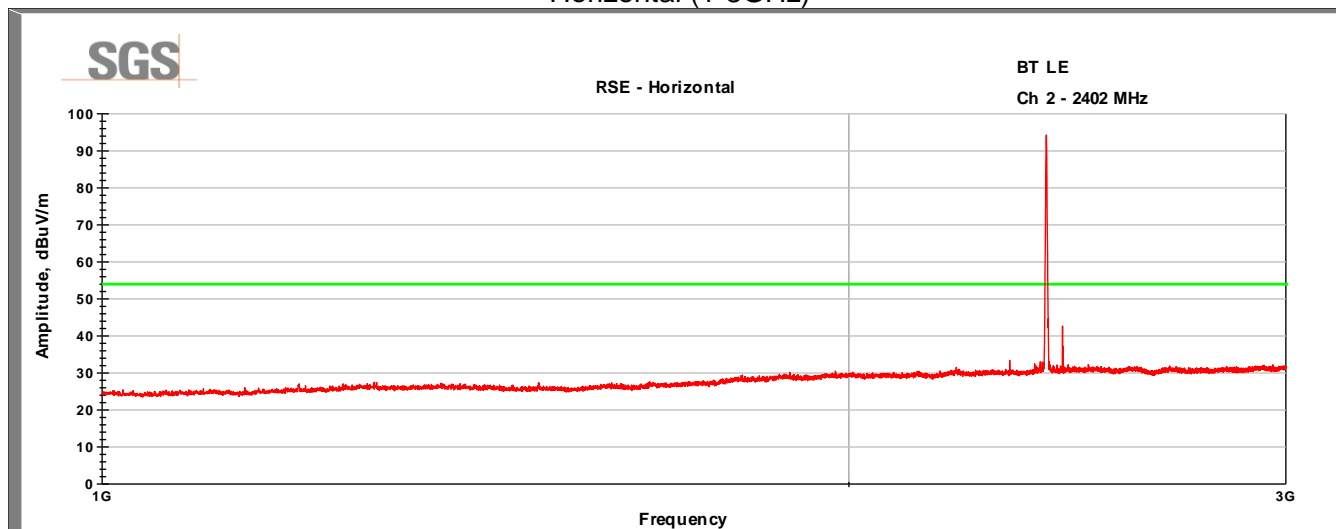


Below 1GHz, there was no discernible difference among the different transmit channels.

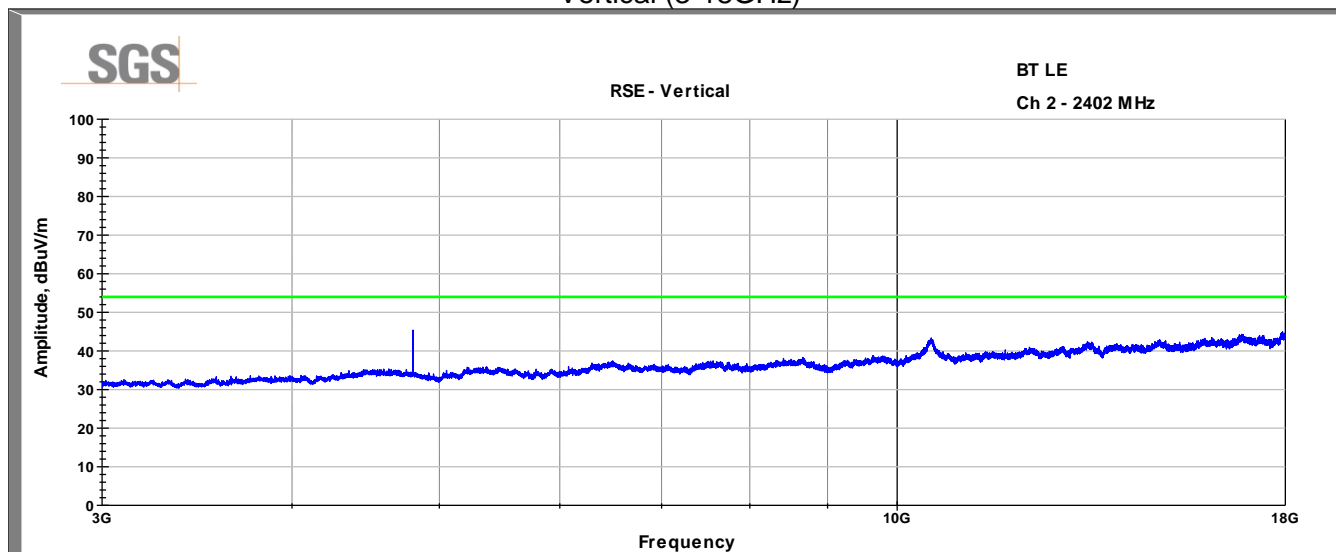
BLE Channel 2
 Vertical (1-3GHz)



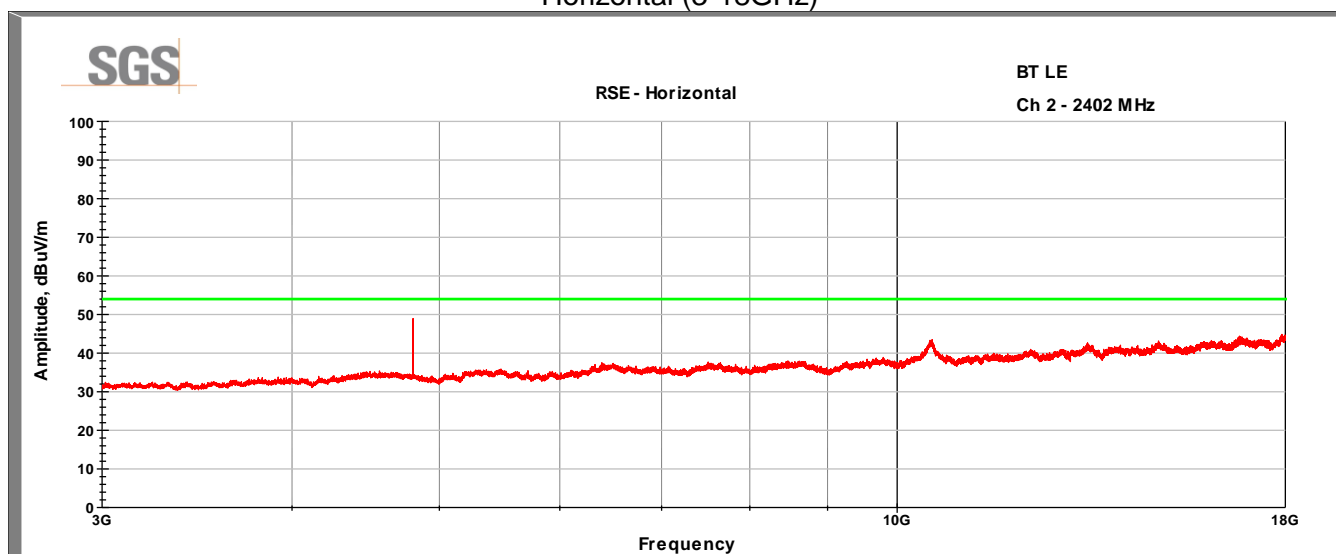
BLE Channel 2
 Horizontal (1-3GHz)



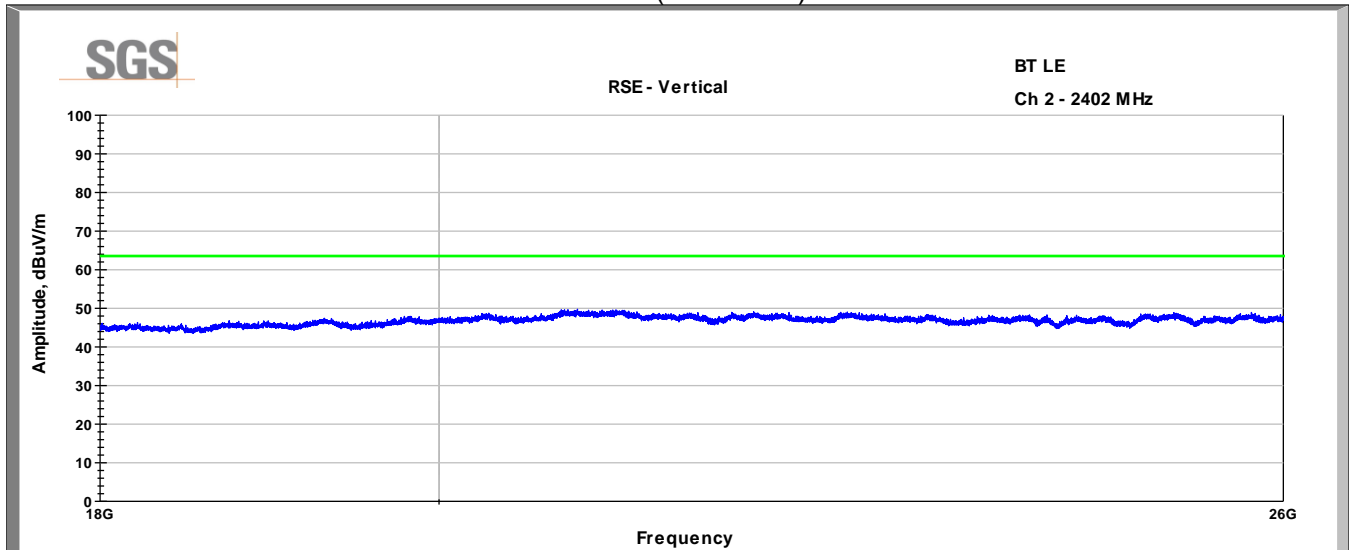
BLE Channel 2
 Vertical (3-18GHz)



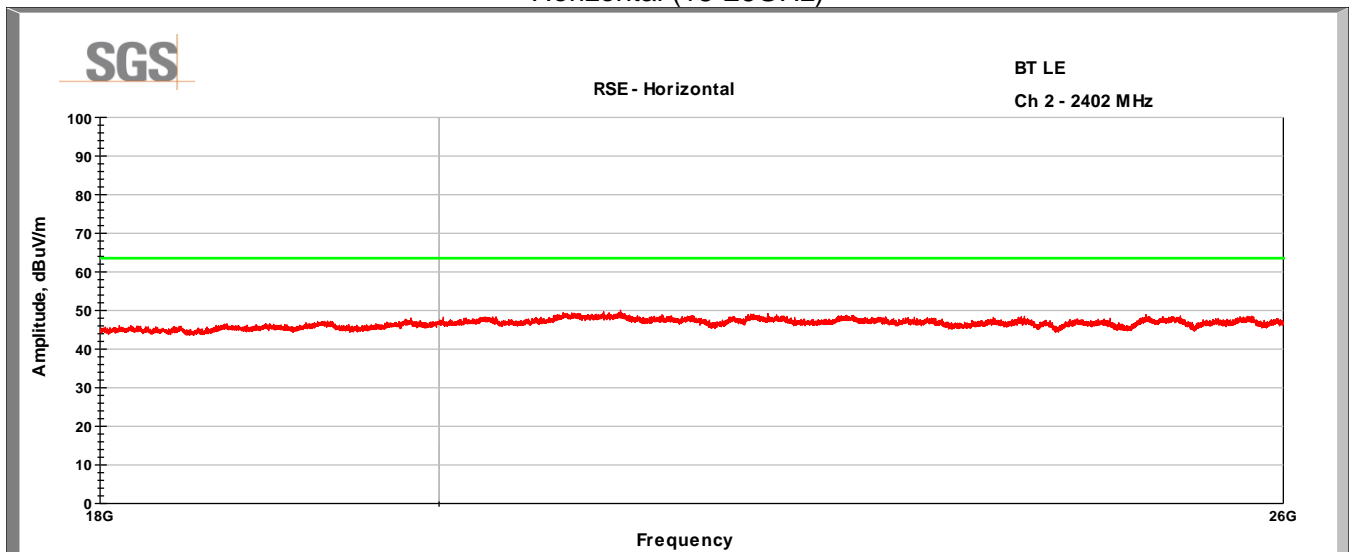
BLE Channel 2
 Horizontal (3-18GHz)



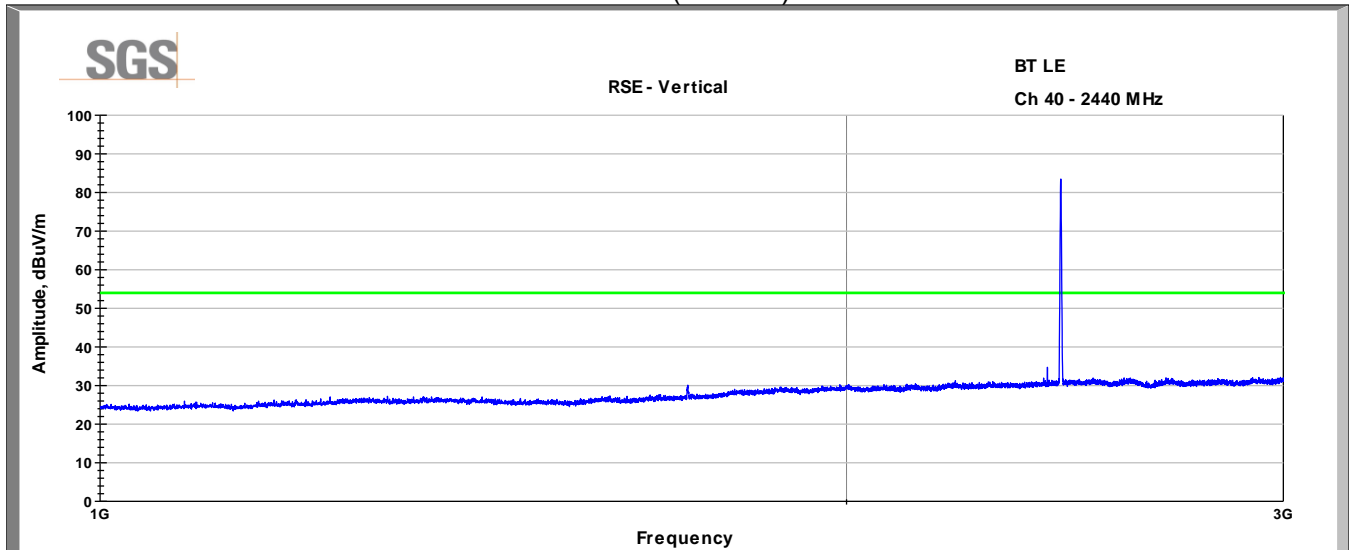
BLE Channel 0
Vertical (18-26GHz)



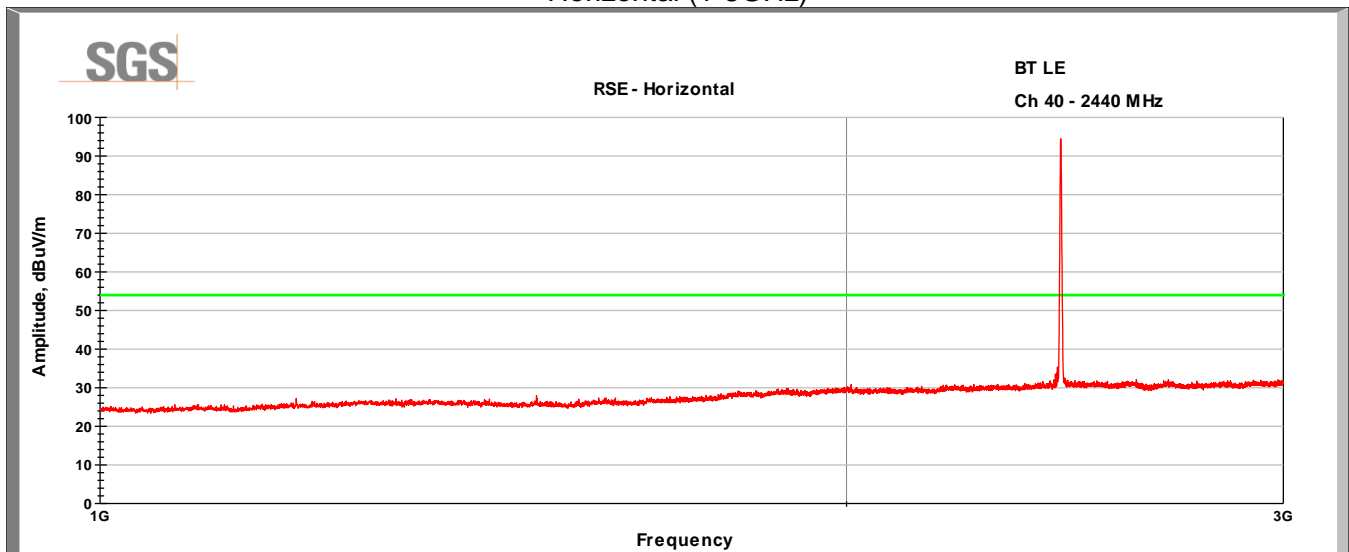
BLE Channel 0
Horizontal (18-26GHz)



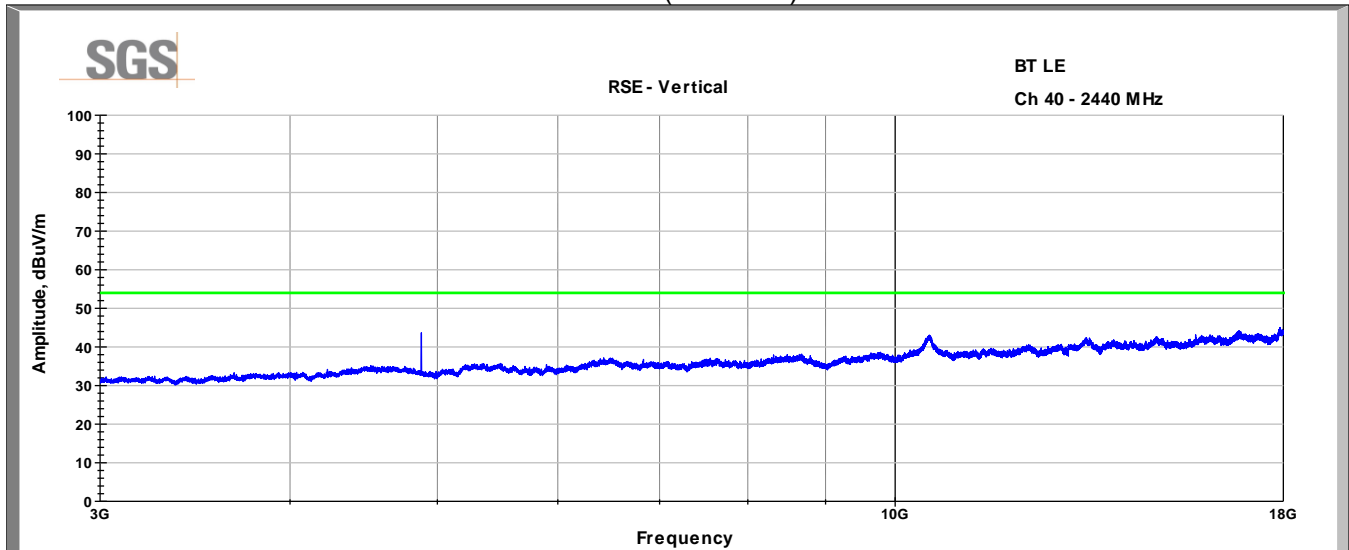
BLE Channel 40
Vertical (1-3GHz)



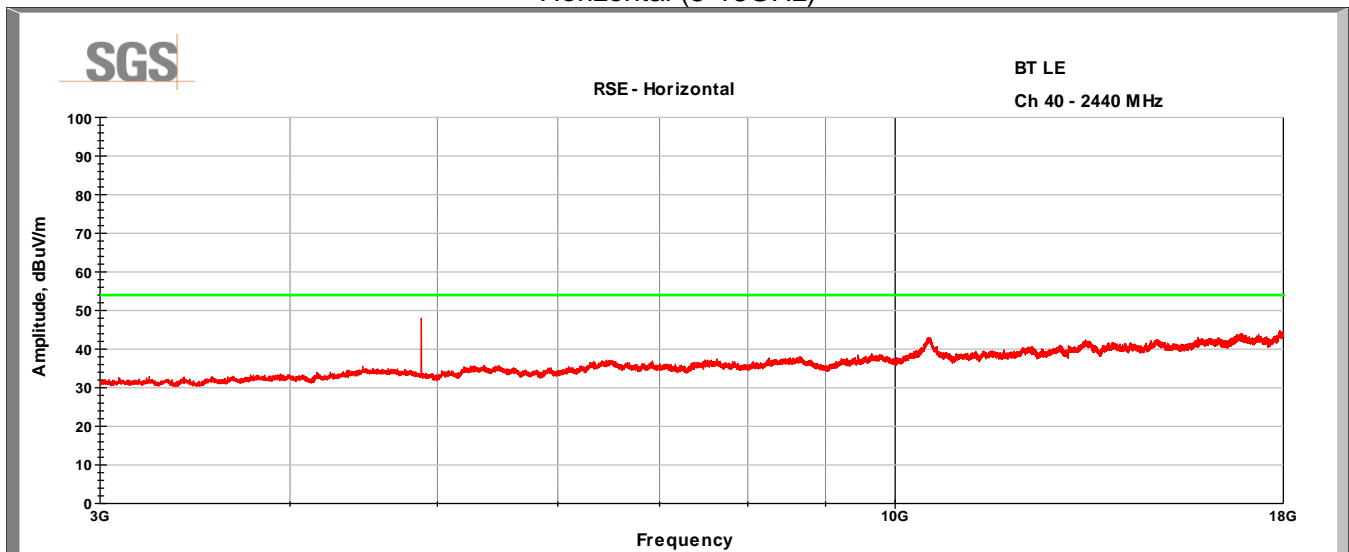
BLE Channel 40
Horizontal (1-3GHz)



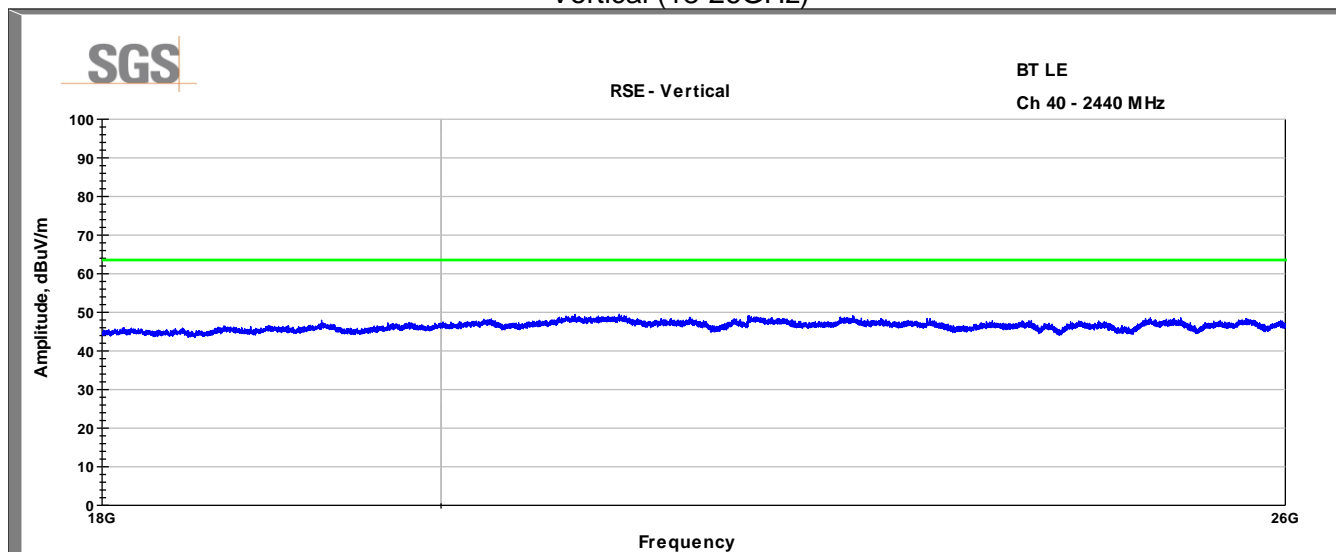
BLE Channel 40
Vertical (3-18GHz)



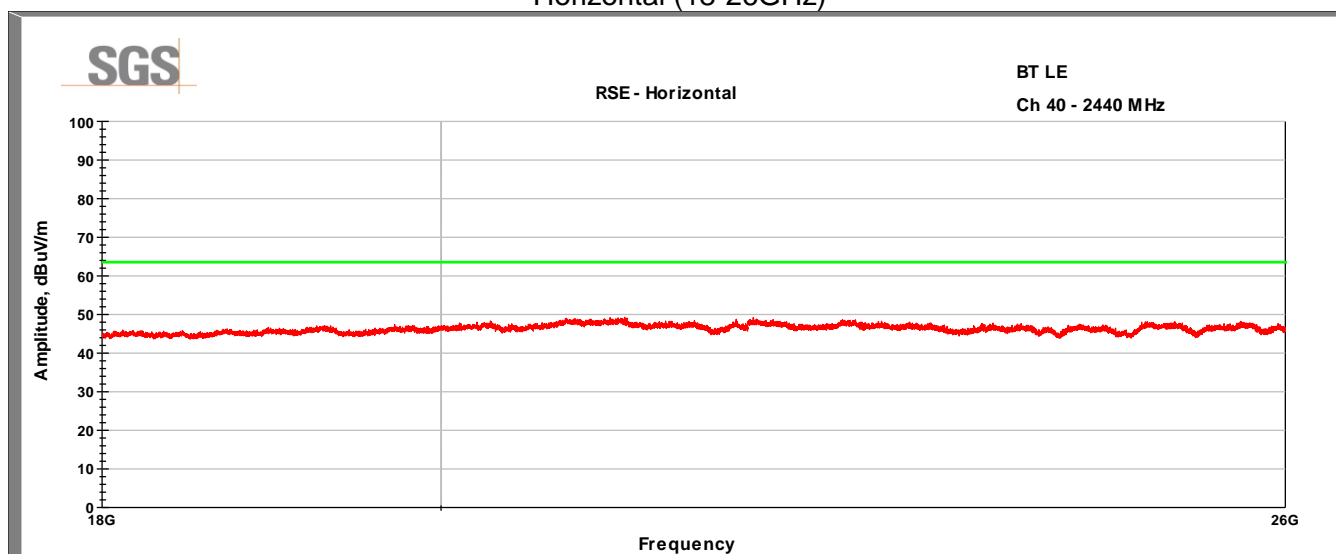
BLE Channel 40
Horizontal (3-18GHz)



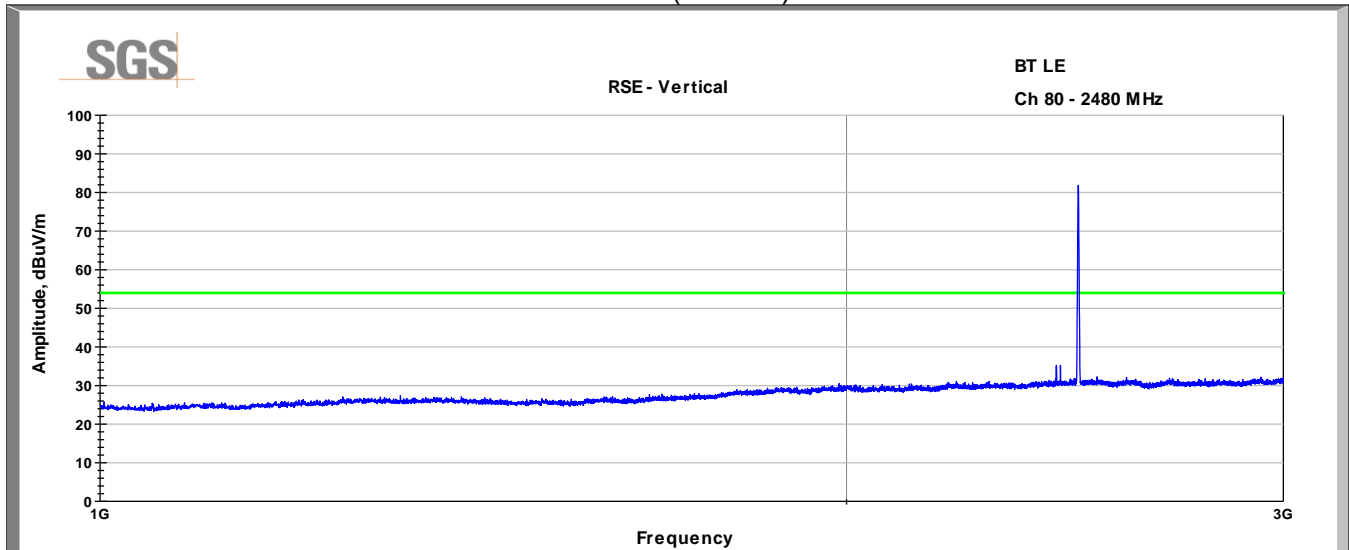
BLE Channel 40
 Vertical (18-26GHz)



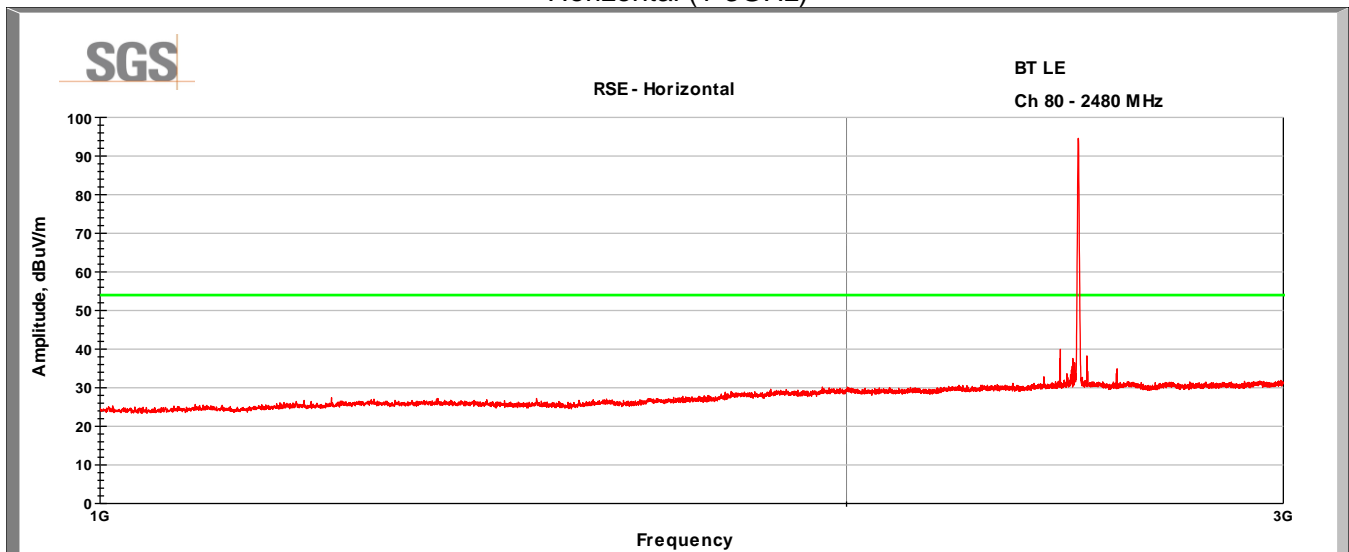
BLE Channel 40
 Horizontal (18-26GHz)



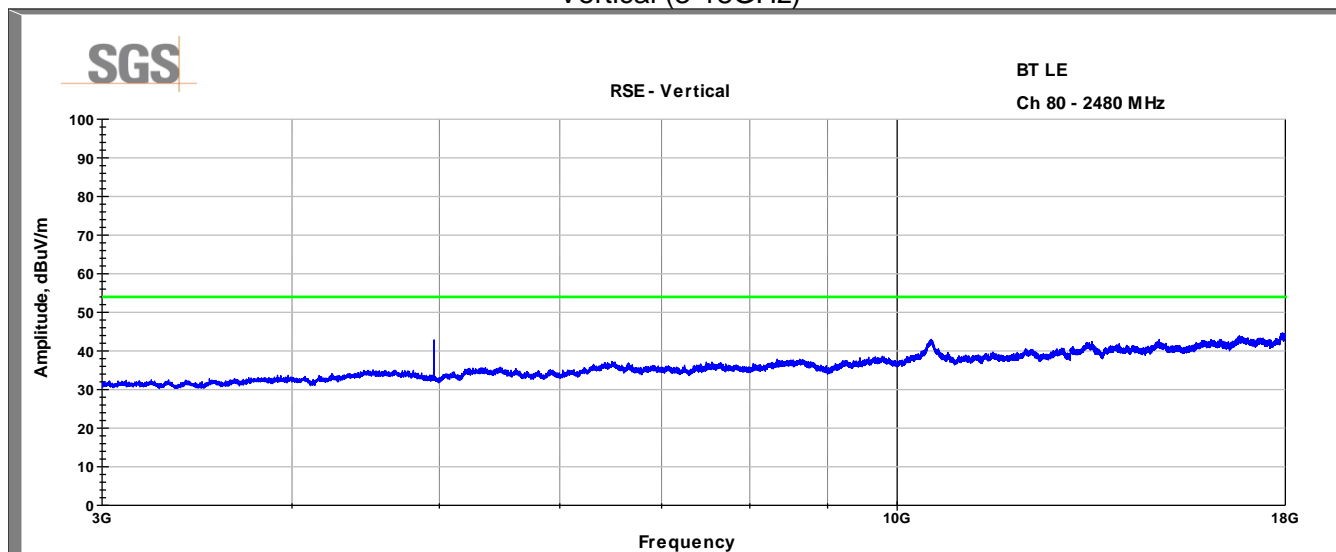
BLE Channel 80
Vertical (1-3GHz)



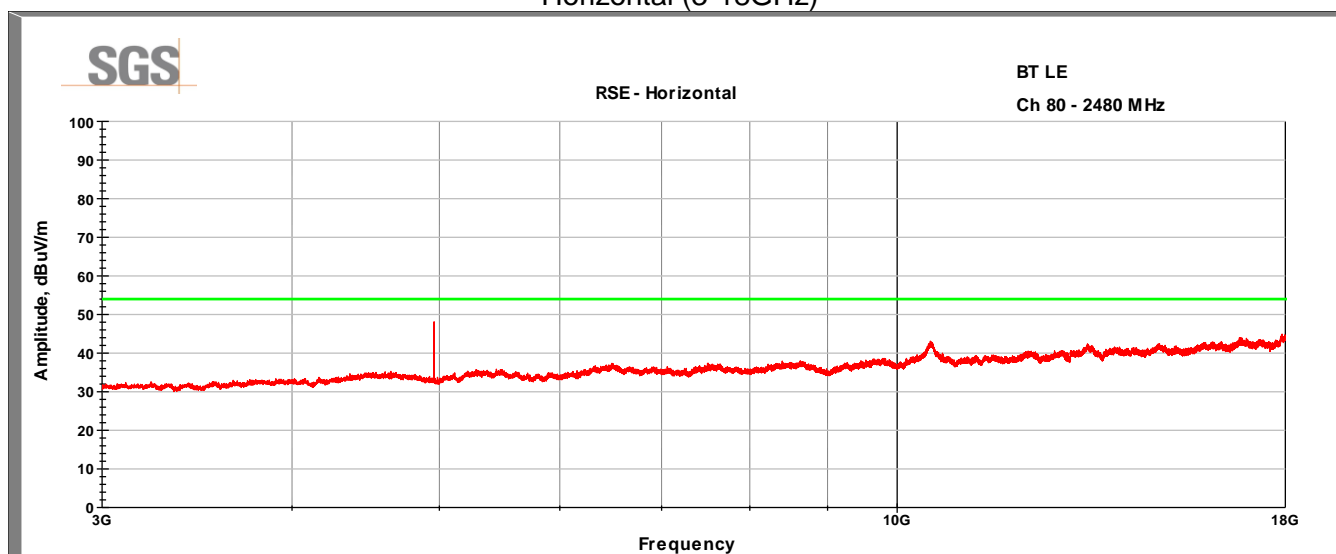
BLE Channel 80
Horizontal (1-3GHz)



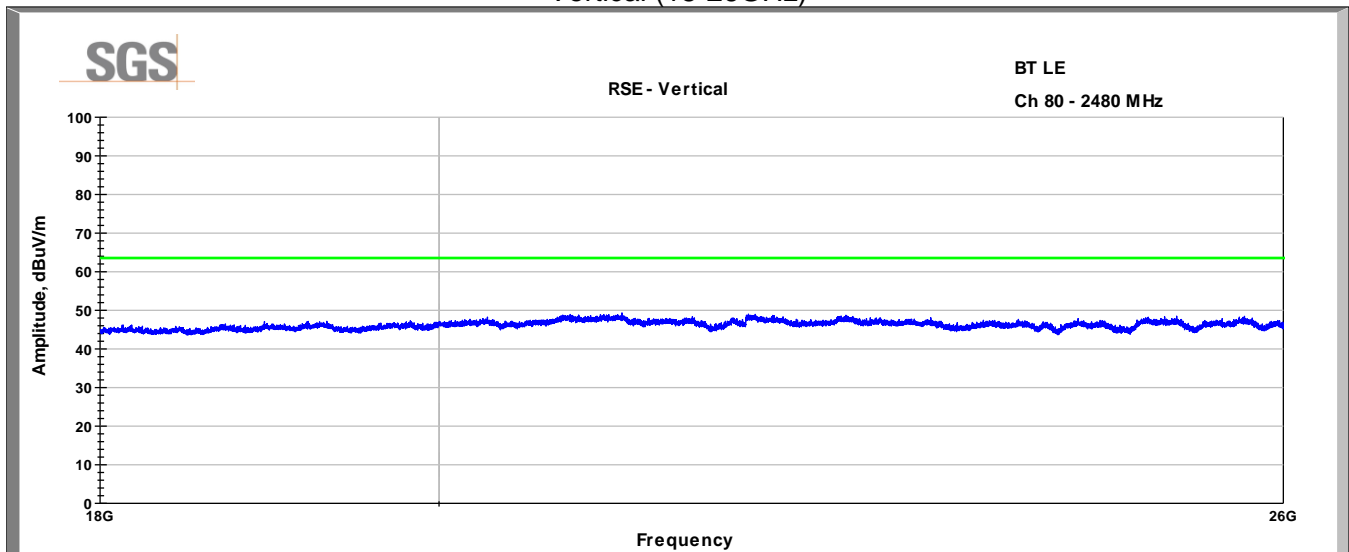
BLE Channel 80
 Vertical (3-18GHz)



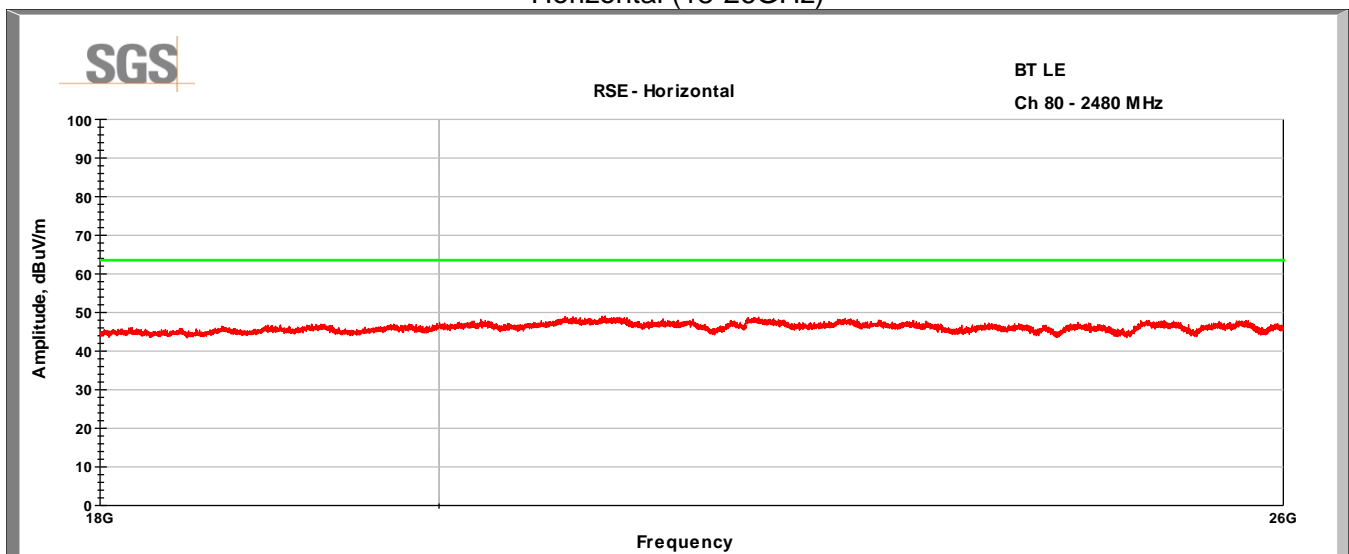
BLE Channel 80
 Horizontal (3-18GHz)



BLE Channel 80
 Vertical (18-26GHz)



BLE Channel 80
 Horizontal (18-26GHz)



7.6 Test Data – Tabular Data

7.6.1 30-1000 MHz

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)
31.12	28.5	V	300.0	204.0	20.9	0.4	31.7	18.1	40.0	-21.9
95.45	35.0	V	182.0	140.0	9.1	0.7	33.6	11.2	43.5	-32.3
97.06	39.2	V	32.0	122.0	9.7	0.7	33.7	15.9	43.5	-27.6
125.01	31.3	V	140.0	138.0	13.9	0.8	33.8	12.2	43.5	-31.3
375.04	44.7	V	340.0	139.0	15.7	1.4	33.5	28.3	46.0	-17.7
934.59	24.8	V	200.0	148.0	23.5	2.3	33.2	17.3	46.0	-28.7
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

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)
31.52	28.6	H	180.0	400.0	20.7	0.4	31.8	17.8	40.0	-22.2
97.12	32.7	H	83.0	186.0	9.7	0.7	33.7	9.4	43.5	-34.1
125.07	26.7	H	336.0	323.0	13.9	0.8	33.8	7.6	43.5	-35.9
375.04	34.5	H	217.0	275.0	15.7	1.4	33.5	18.1	46.0	-27.9
555.67	24.8	H	269.0	335.0	18.8	1.7	33.3	12.1	46.0	-33.9
940.03	25.0	H	68.0	345.0	23.6	2.3	33.2	17.6	46.0	-28.4
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

7.6.2 Above 1 GHz

Per FCC Part 15.31 (o) – “The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.”

No Peak data found above 54 dBuV/m therefore no additional measurements were made.

Peak Data Vs. Avg Limit Table

Channel Number	Ant. Pol. V/H	Frequency MHz	Peak dBuV/m	Avg Limit dBuV/m	Margin dB
2.00	V	4804.0	45.4	54.0	-8.6
2.00	H	4804.0	48.9	54.0	-5.1
40.00	V	4880.0	43.6	54.0	-10.4
40.00	H	4880.0	48.0	54.0	-6.0
80.00	V	4960.0	42.9	54.0	-11.1
80.00	H	4960.0	48.1	54.0	-5.9

8 Emissions in Restricted Frequency Bands

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.

Offset Calculations:

Offset calculations so that conducted measurements on the spectrum analyzer in dBμV represent field strength measurements in dBμV/m.

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

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

D = 3m	Distance
CL = 0.384 dB	Cable Loss
DC = 0.0 dB	Duty Cycle Correction Factor
AG = 2.0 dB	Antenna Gain

$$\text{Offset} = -7.1 \text{ dB}$$

8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	23.2 °C
Relative Humidity:	50.1 %

8.4 Test Equipment

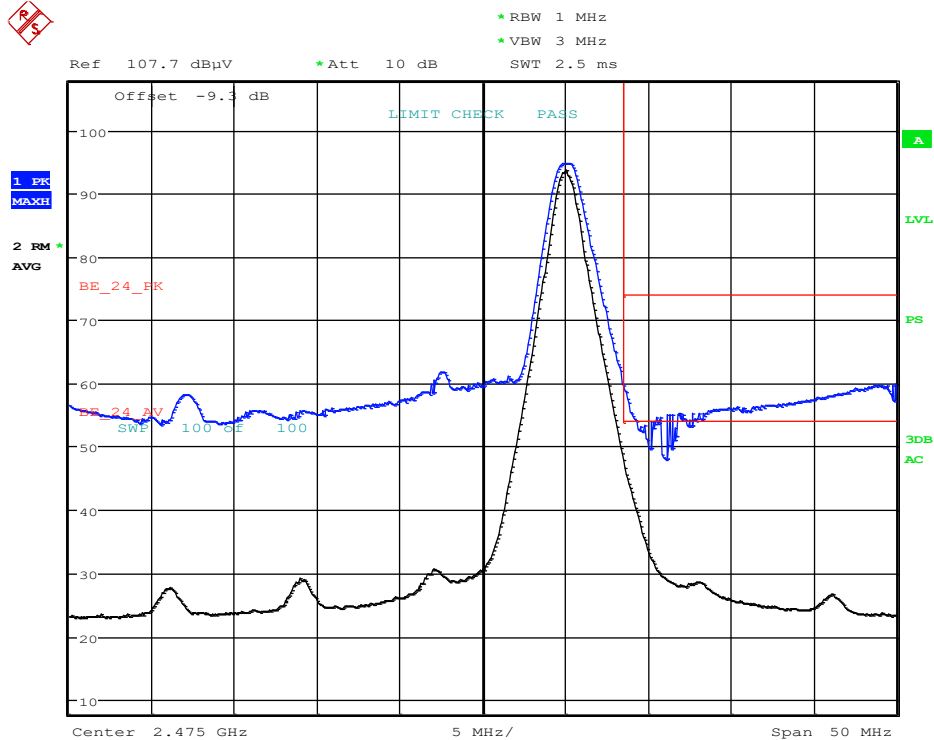
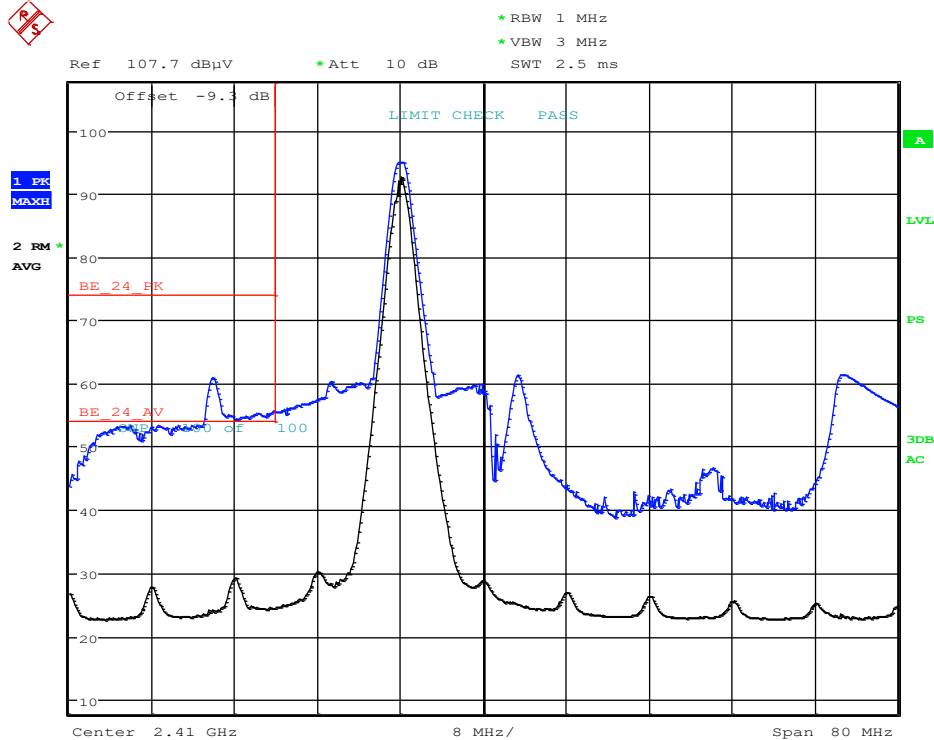
Test End Date: 18-May-2018

Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE	SF102	HUBER & SUHNER	B079824	26-Jul-2018
EMI TEST RECEIVER	ESU 40	ROHDE & SCHWARZ	SN: 100364	2-Oct-2018

Note: The equipment calibration period is 1 year.

8.5 Test Data – Restricted Band Edge



9 Revision History

Revision Level	Description of changes	Revision Date
-	Draft	30 May 2018
0	Initial release	24 July 2018