

EMC Test Report

Project Number: 4219718**Report Number:** 4219718EMC03**Revision Level:** 0**Client:** Johnson Controls Inc**Equipment Under Test:** Wireless Thermostat**Model Number:** SiO2**FCC ID:** OEJGLASWIFI**IC ID:** 279A-GLASWIFI**Applicable Standards:** FCC Part 15 Subpart C, § 15.247

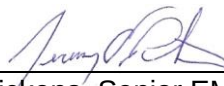
RSS-247, Issue 2

ANSI C63.10: 2013

RSS-GEN Issue 4

Report issued on: 31 October 2017**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
Occupied Bandwidth	15.247(a)(1)	RSS-247 5.1(1) RSS-GEN 6.6	Compliant
Peak Power Output	15.247(a)(1)	RSS-247 5.4(2)	Compliant
Conducted Spurious Emissions	15.247(d)	RSS-247 5.5	Compliant
Band Edge	15.247(d)	RSS-247 5.5	Compliant
Radiated Spurious Emissions	15.247(d), 15.35(b),15.209	RSS-GEN 8.10	Compliant
Pseudo-Random Hop Sequence	15.247(a)(1)	RSS-247 5.1(1)	Compliant
Channel Separation	15.247(a)(1)	RSS-247 5.1(2)	Compliant
Number of Hopping Channels	15.247(a)(1)(iii)	RSS-247 5.1(4)	Compliant
Dwell Time	15.247(a)(1)(iii)	RSS-247 5.1(4)	Compliant
Number of hopping frequencies	15.247(a)(1)(iii)	RSS-247 5.1(4)	Compliant
Antenna Requirement	15.203	RSS-GEN S8.3	Compliant (1)
AC Powerline Conducted Emission	15.107, 15.207	RSS-GEN 7.2.4	Compliant

1) Internal PCB trace antenna

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: Johnson Controls Inc
Address: 507 East Michigan Street
City, State, Zip, Country: Milwaukee, WI 53202, 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: Wireless Thermostat
Model Number: SiO2
Serial Number: 173800048

Frequency Range: 2402 to 2480 MHz, 79 Channels
Data Modes: Bluetooth GFSK, EDR-2, EDR-3 (DH1, DH3, DH5)
Antenna: Internal, 3.34 dBi Max Gain

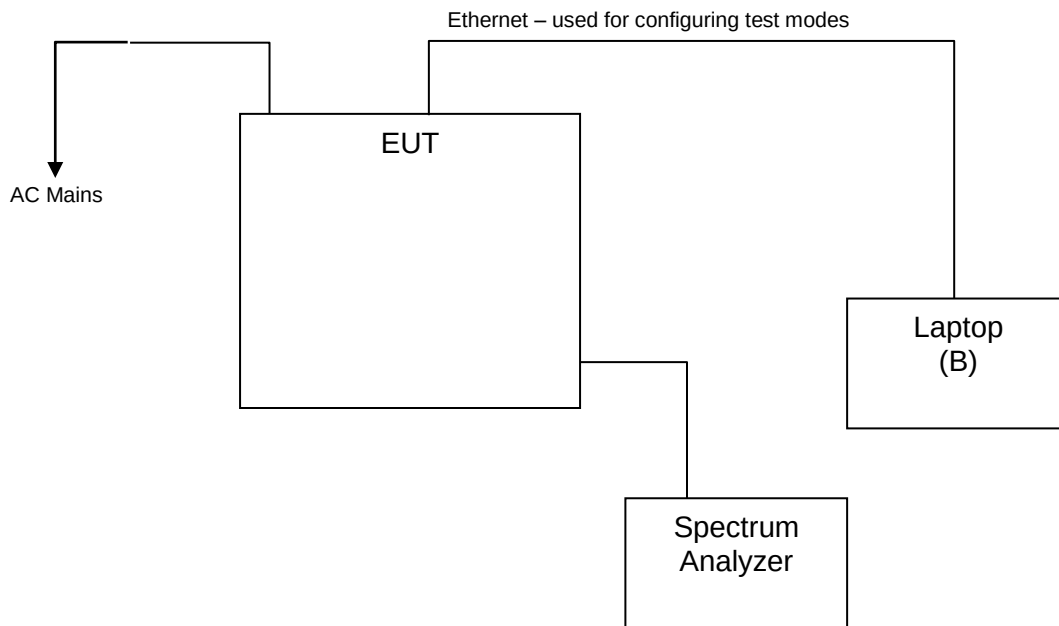
Rated Voltage: 24Vac, 60Hz
Test Voltage: 24Vac, 60Hz

Sample Received Date: 18 October 2017
Dates of testing: 18 - 31 October 2017

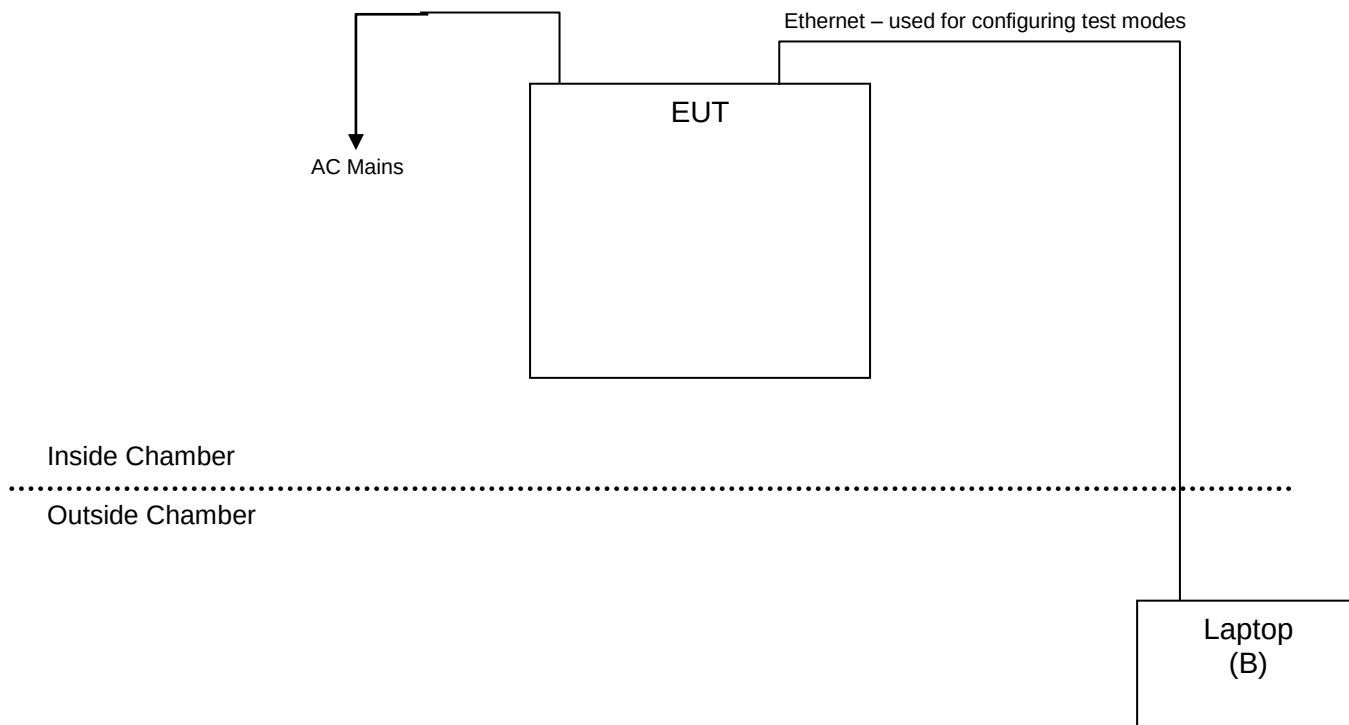
2.4 Operating Modes and Conditions

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

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	Johnson Controls Inc	Wireless Thermostat	SiO2	173800048
B	Dell	Laptop	Latitude ES420	11033846857

3 Occupied Bandwidth

3.1 Test Result

Test Description	Basic Standards	Test Result
99% bandwidth	15.247(a)(1) RSS-247 5.1(1) RSS-GEN 6.6 ANSI C63.10: 2013	Compliant

3.2 Test Method

Occupied bandwidth measurements were taken using the methods defined in ANSI C63.10, Clause 6.9; Measurements were recorded using the 99% OBW function of the measurement receiver.

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.7 °C

Relative Humidity: 42.0 %

Atmospheric Pressure: 98.8 kPa

3.4 Test Equipment

Test End Date: 19-Oct-2017

Tester: JOP

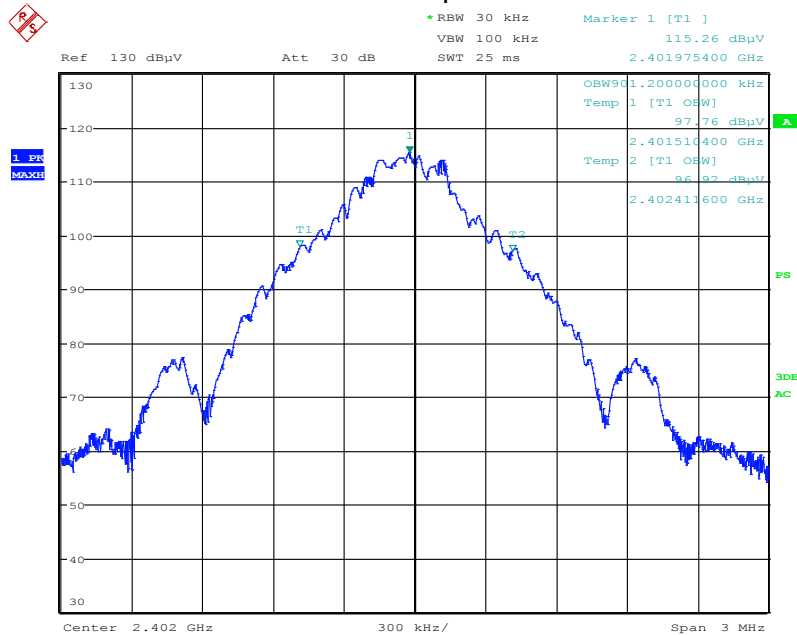
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-Apr-2018
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018

Note: The equipment calibration period is 1 year.

3.5 Test Data

Frequency	Channel No	Modulation	99% bandwidth MHz
2402	0	Basic Rate	0.901
		EDR-2	1.172
		EDR-3	1.180
2441	39	Basic Rate	0.905
		EDR-2	1.172
		EDR-3	1.181
2480	78	Basic Rate	0.904
		EDR-2	1.176
		EDR-3	1.176

Sample Plot



Date: 19.OCT.2017 13:03:23

4 Peak Output Power

4.1 Test Result

Test Description	Test Specification	Test Result
Peak Output Power	15.247(a)(1) RSS-247 5.4(2) ANSI C63.10: 2013	Compliant

4.2 Test Method

Output power measurements were taken using the methods defined in ANSI C63.10, Clause 7.8.5. A peak power meter was used for final measurements.

Limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels: 1 watt.

4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.7 °C

Relative Humidity: 42.0 %

Atmospheric Pressure: 98.8 kPa

4.4 Test Equipment

Test End Date: 19-Oct-2017

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-Apr-2018
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018

Note: The equipment calibration period is 1 year.

4.5 Test Data

Modulation	Frequency (MHz)	Peak Power (dBm)	Peak Power (Watts)
Basic Rate (DH5)	2402.000000	13.1	0.02042
	2441.000000	12.8	0.01905
	2480.000000	12.5	0.01778
EDR-2 (DH5)	2402.000000	12.9	0.0195
	2441.000000	12.7	0.01862
	2480.000000	12.3	0.01698
EDR-3 (DH5)	2402.000000	13.2	0.02089
	2441.000000	12.9	0.0195
	2480.000000	12.6	0.0182

Modulation	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Basic Rate (DH5)	2402.000000	13.1	30	-16.9
	2441.000000	12.8	30	-17.2
	2480.000000	12.5	30	-17.5
EDR-2 (DH5)	2402.000000	12.9	30	-17.1
	2441.000000	12.7	30	-17.3
	2480.000000	12.3	30	-17.7
EDR-3 (DH5)	2402.000000	13.2	30	-16.8
	2441.000000	12.9	30	-17.1
	2480.000000	12.6	30	-17.4

5 Conducted Spurious Emissions

5.1 Test Result

Test Description	Test Specification	Test Result
Conducted Spurious Emissions	15.247(d) RSS-247 5.4(2) ANSI C63.10: 2013	Compliant

5.2 Test Method

Conducted spurious emissions measurements were taken using the methods defined in ANSI C63.10, Clauses 5.5 and 5.6. Authorized band edge measurements were recorded using the methods in clause 6.10.4. Basic rate with a DH5 packet type was used as the worst-case mode of operation for spurious measurements. Band edge measurements were recorded using each modulation (Basic Rate, EDR-2, and EDR-3).

The limit is 20 dB below the measured peak power.

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.7 °C
Relative Humidity: 42.0 %
Atmospheric Pressure: 98.8 kPa

5.4 Test Equipment

Test End Date: 19-Oct-2017

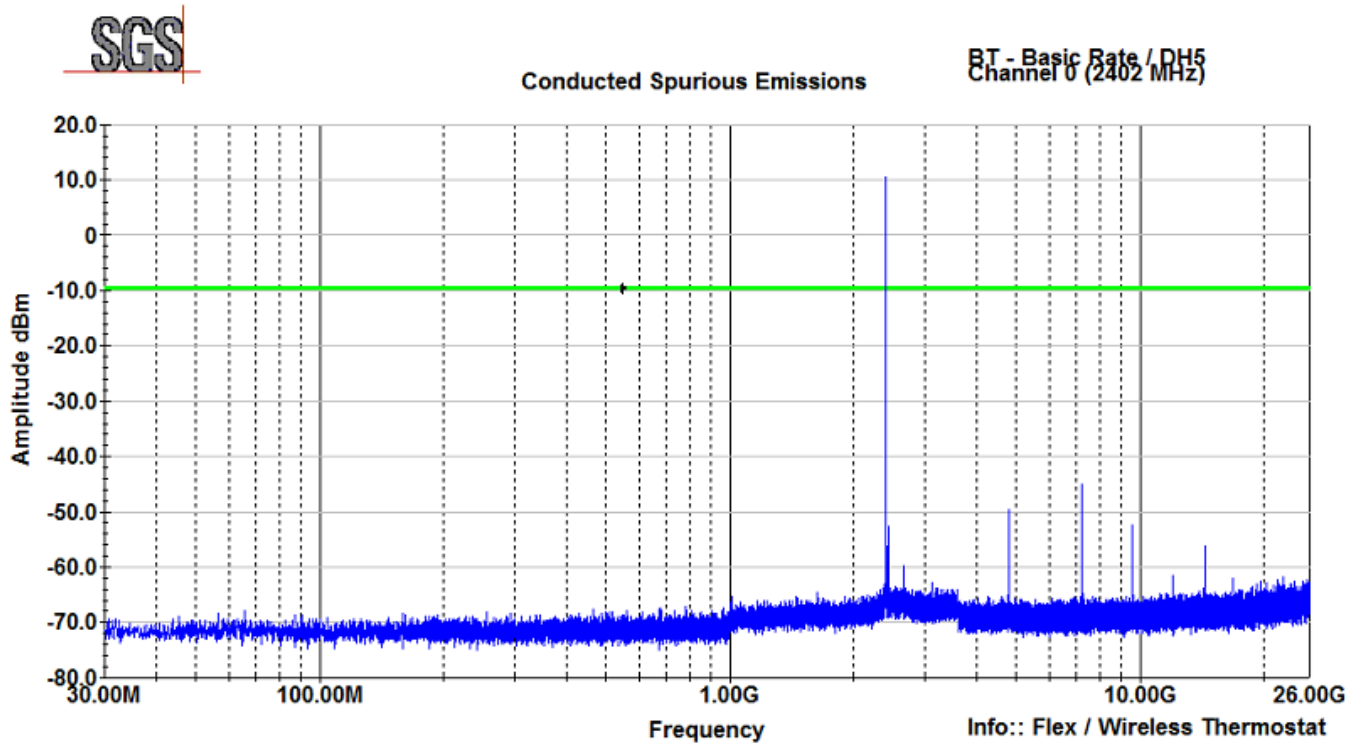
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-Apr-2018
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018

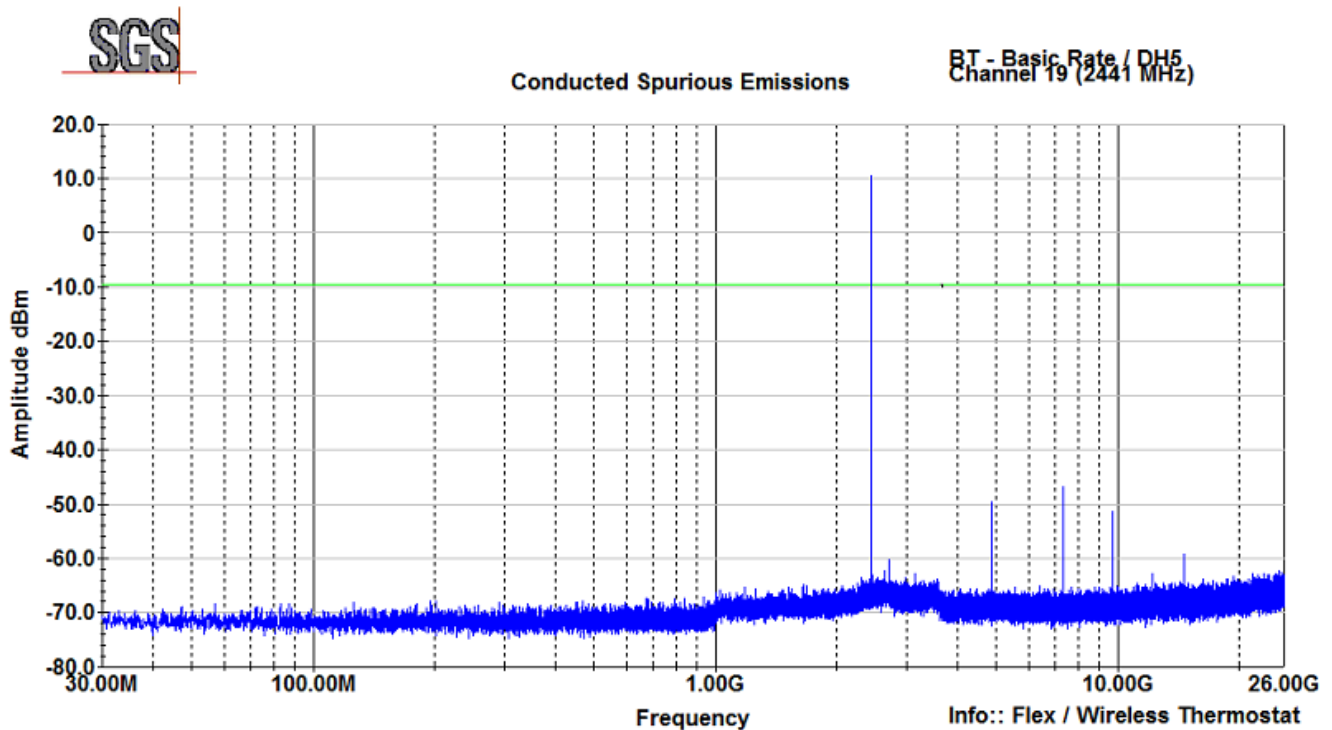
Note: The equipment calibration period is 1 year.

5.5 Test Data

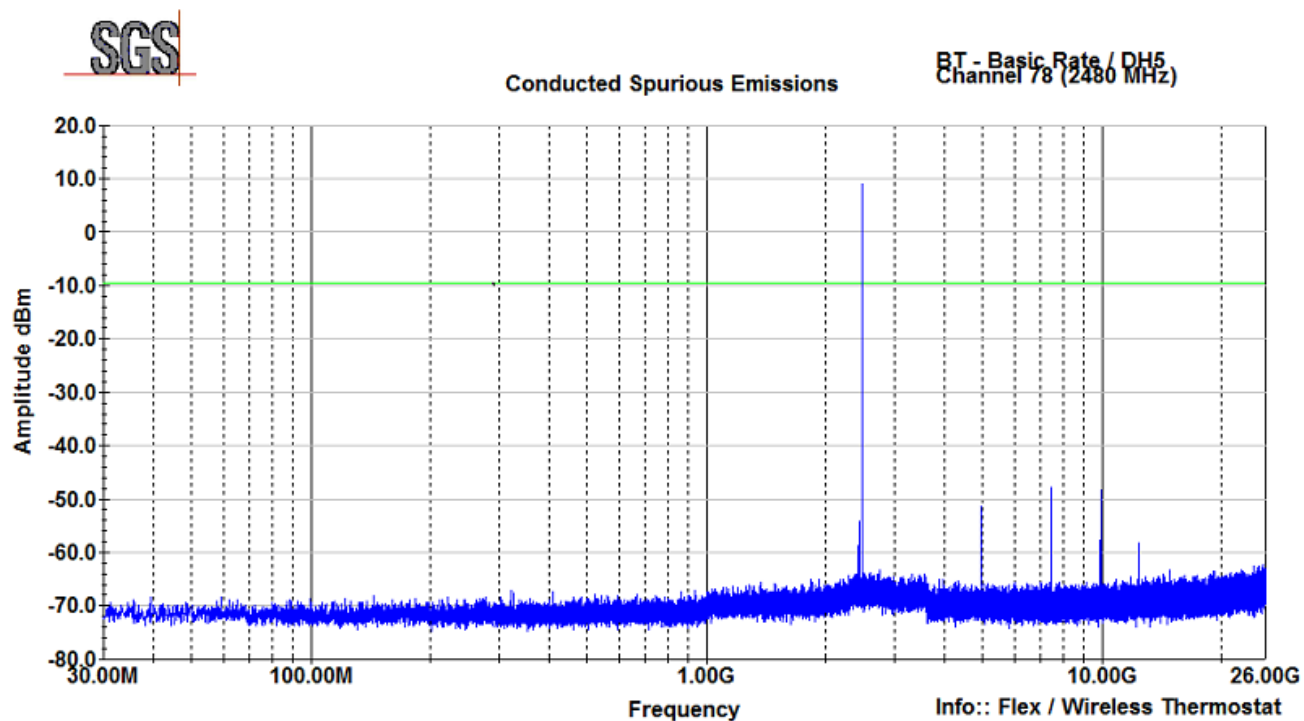
BR, Channel 0, 2402 MHz



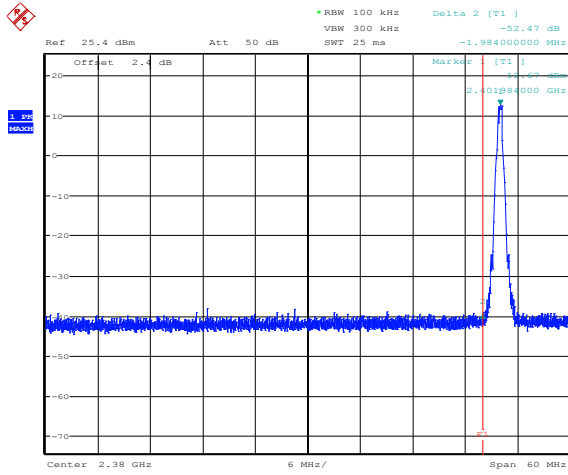
BR, Channel 39, 2441 MHz



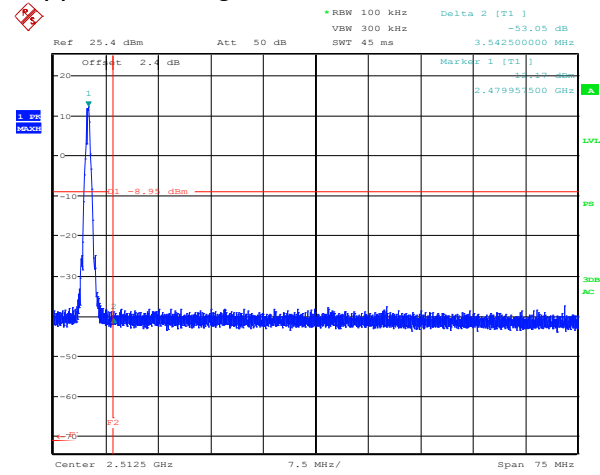
BR, Channel 78, 2480 MHz



Basic Rate Lower band edge / Upper band edge

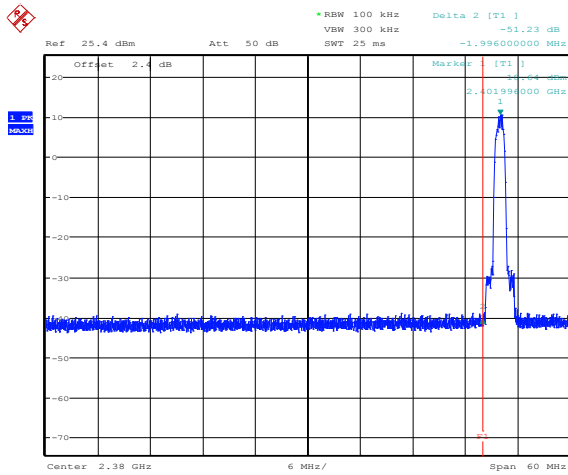


Date: 19.OCT.2017 13:25:12

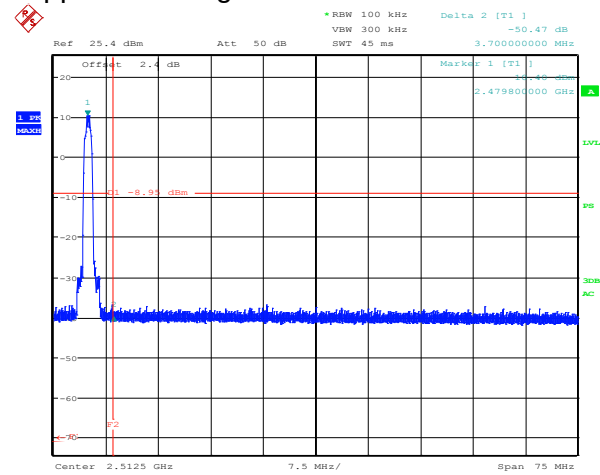


Date: 19.OCT.2017 13:47:30

EDR 2 Lower band edge / Upper band edge

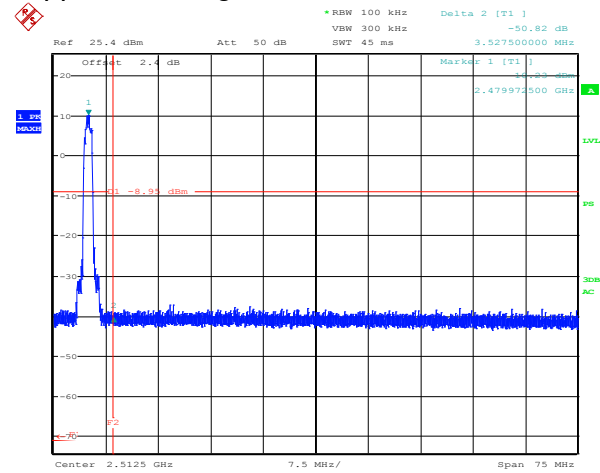
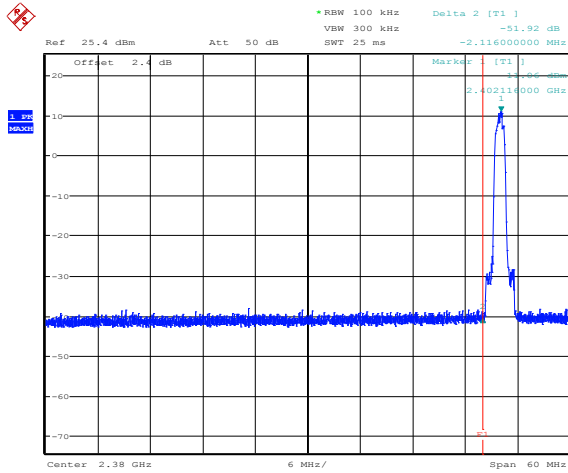


Date: 19.OCT.2017 13:26:11



Date: 19.OCT.2017 13:46:15

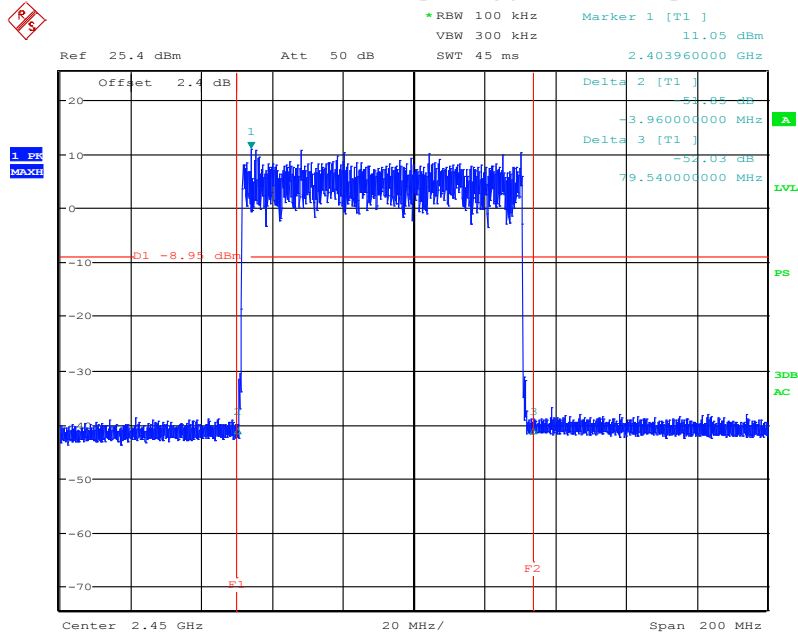
EDR 3 Lower band edge / Upper band edge



Date: 19.OCT.2017 13:29:34

Date: 19.OCT.2017 13:40:03

EDR 3 (Hopping Mode) Lower band edge / Upper band edge



Date: 19.OCT.2017 13:36:55

6 Field Strength of Spurious Radiation

6.1 Test Result

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

6.2 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 0, 39, and 78. Worst-case mode was determined to be Basic Rate with DH5 packet type.

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 meter

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

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.5 °C

Relative Humidity: 44.2 %

Atmospheric Pressure: 97.8 kPa

6.4 Test Equipment

Test End Date: 31-Oct-2017

Tester: JOP

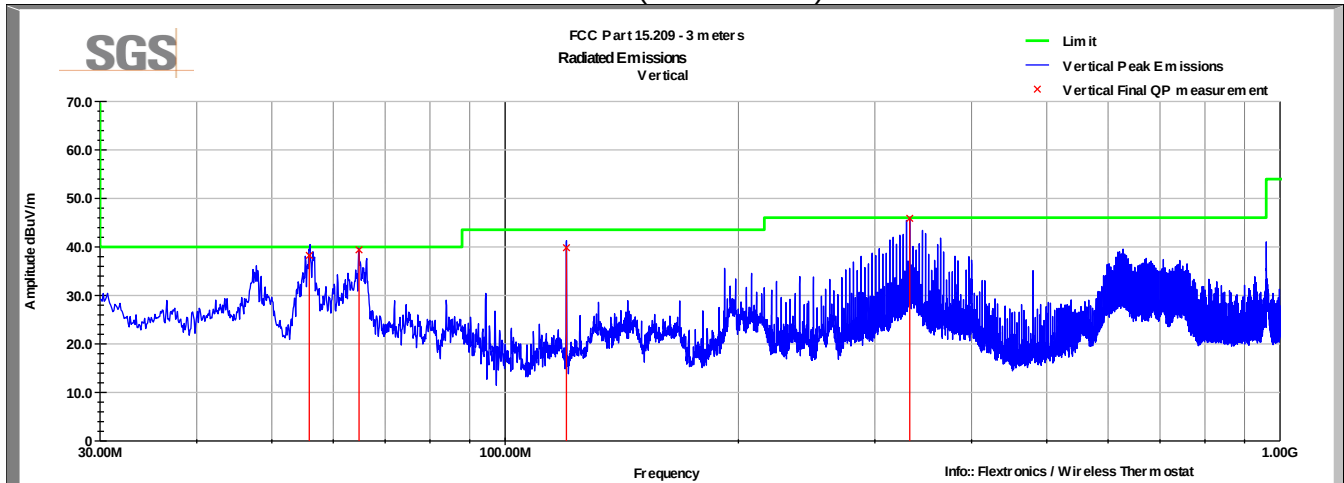
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	25-Jul-2018
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-Apr-2018
ANTENNA, BILOG	CBL 6143A	TESEQ	B085931	6-Dec-2017
RF CABLE	SF106	HUBER & SUHNER	B079661	25-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079713	24-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079659	25-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	22-Feb-2018
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-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.

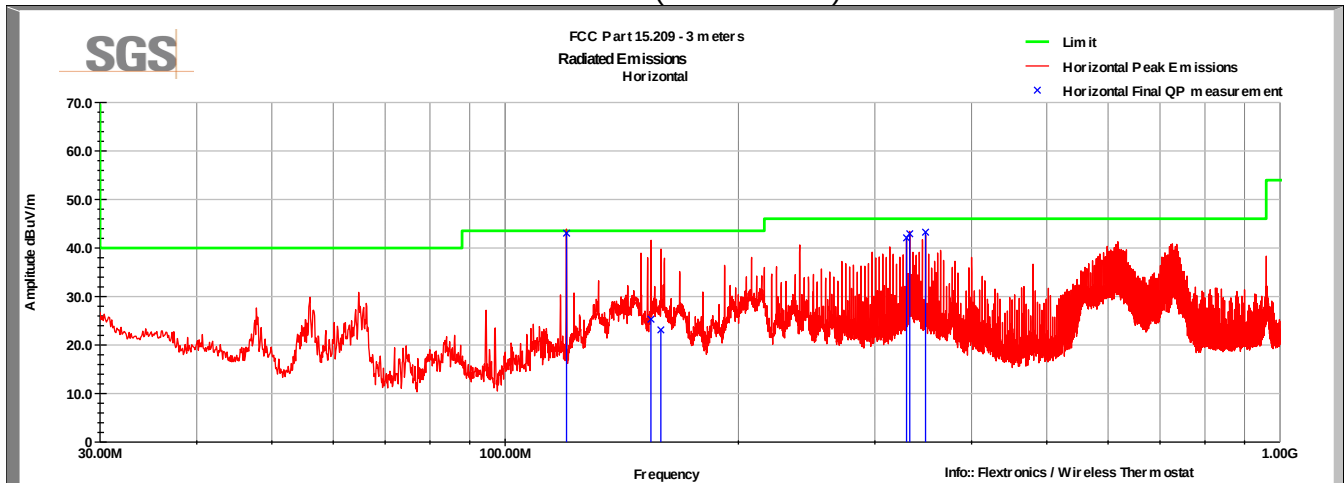
6.5 Test Data – Peak Plots

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

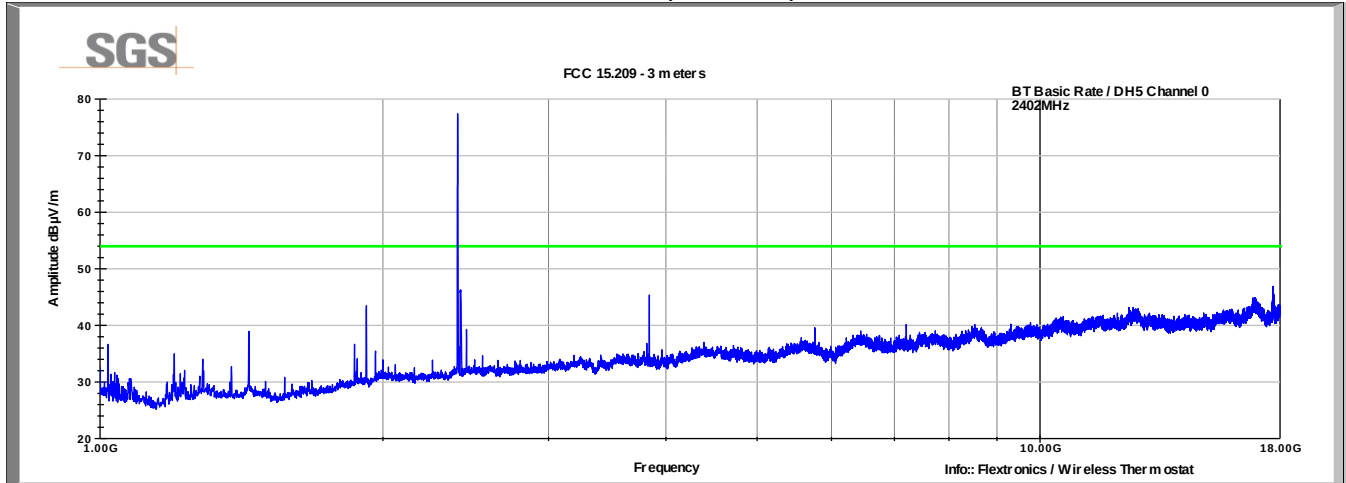
Bluetooth Channel 0
Vertical (30-1000MHz)



Bluetooth Channel 0
Horizontal (30-1000MHz)

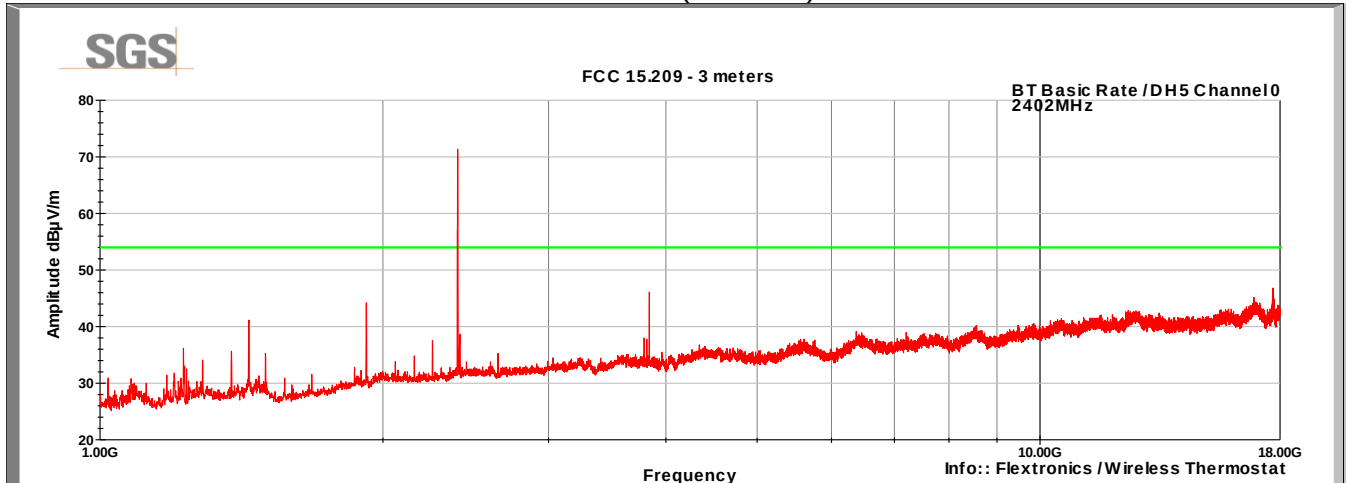


Bluetooth Channel 0 Vertical (1-18GHz)



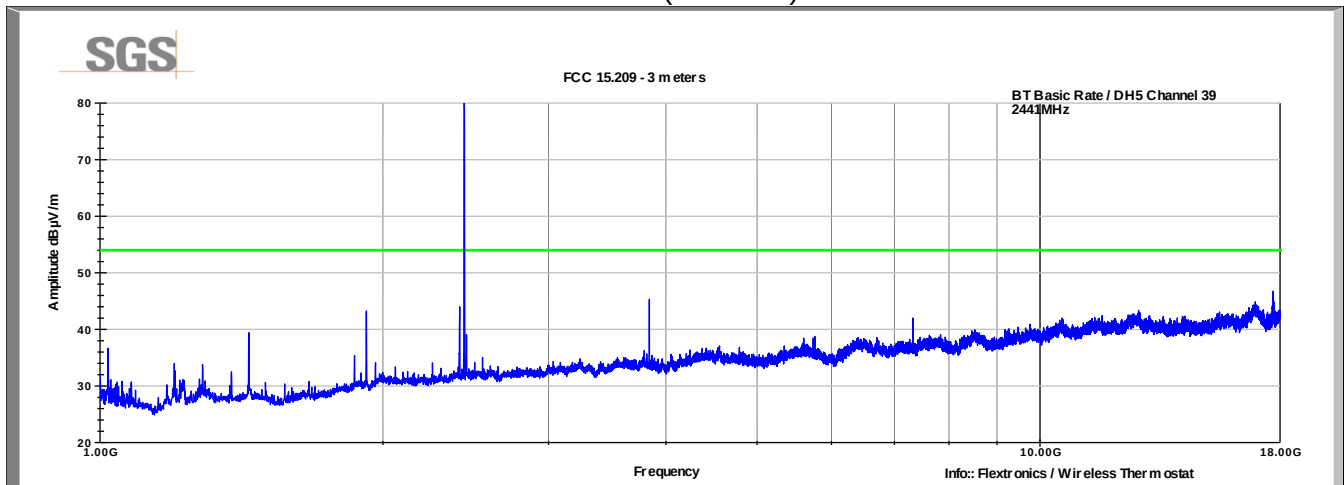
Antenna port was terminated into 50-Ohms

Bluetooth Channel 0 Horizontal (1-18GHz)



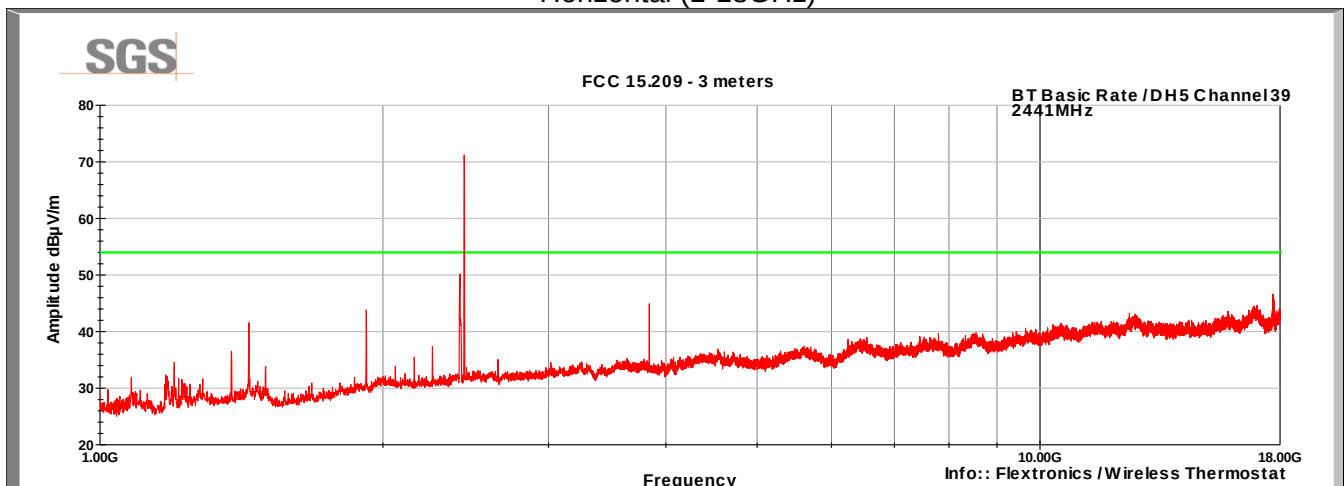
Antenna port was terminated into 50-Ohms

Bluetooth Channel 39 Vertical (1-18GHz)



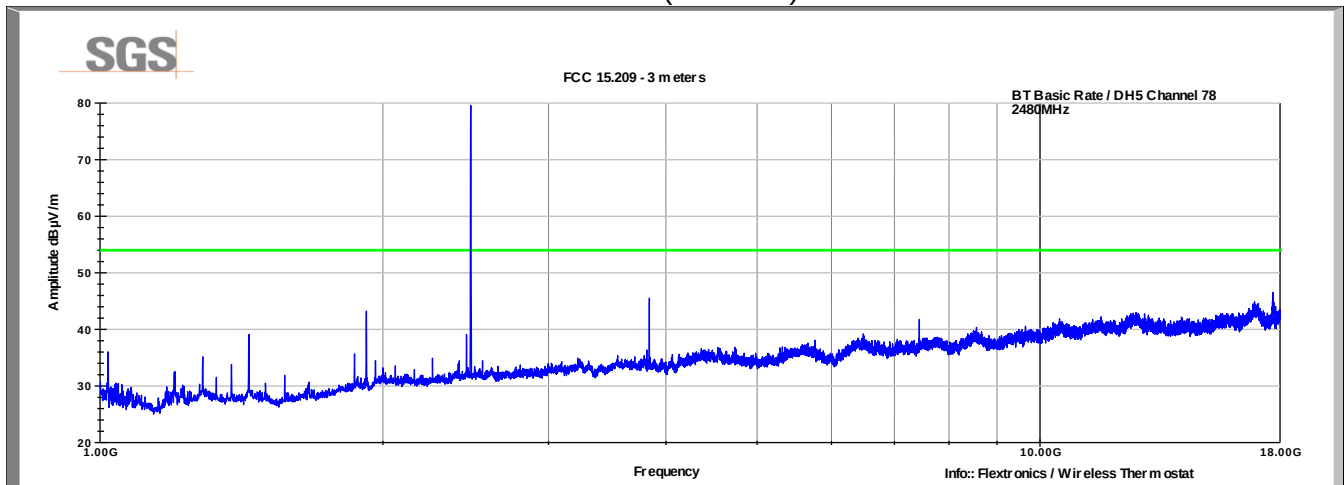
Antenna port was terminated into 50-Ohms

Bluetooth Channel 39 Horizontal (1-18GHz)



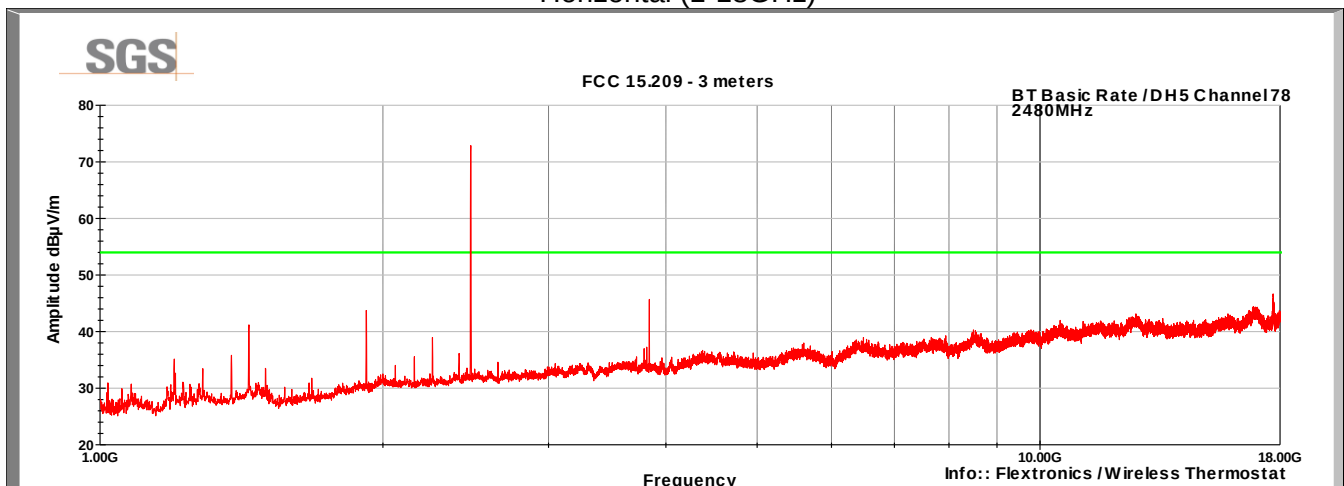
Antenna port was terminated into 50-Ohms

Bluetooth Channel 78 Vertical (1-18GHz)



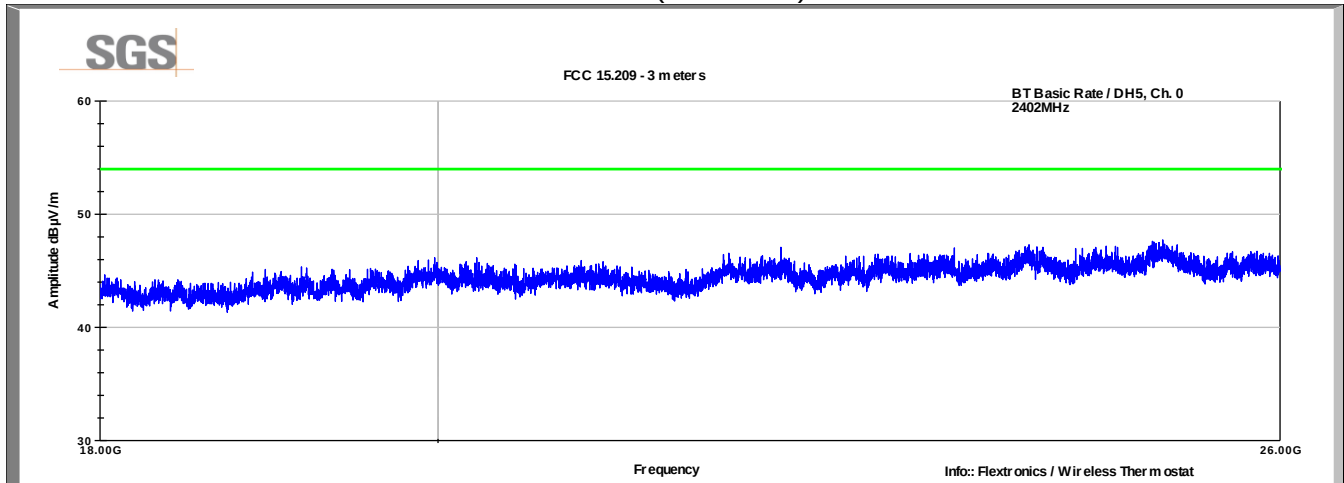
Antenna port was terminated into 50-Ohms

Bluetooth Channel 78 Horizontal (1-18GHz)

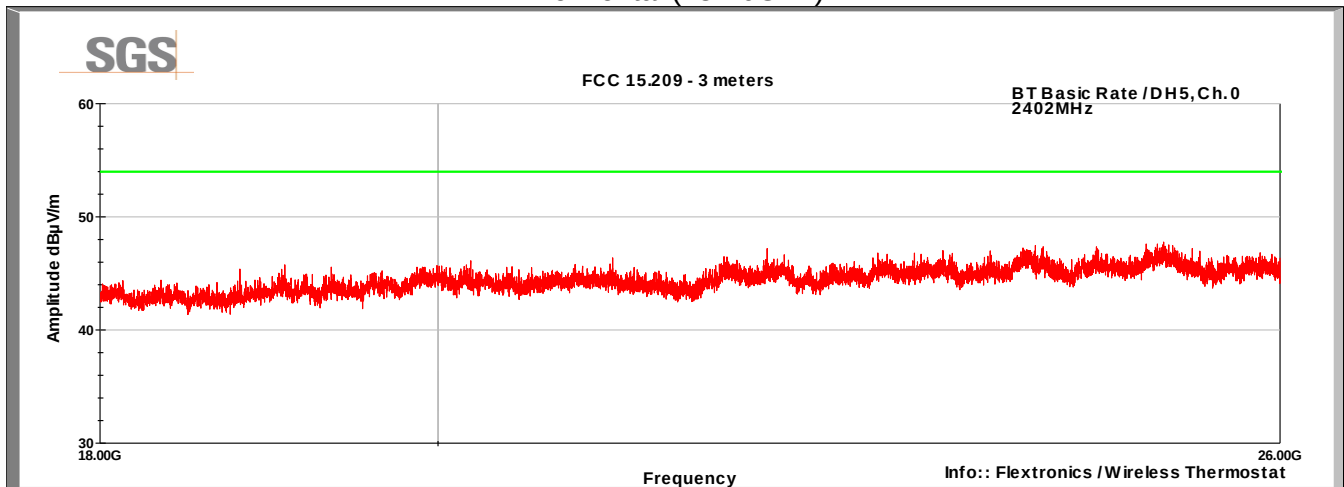


Antenna port was terminated into 50-Ohms

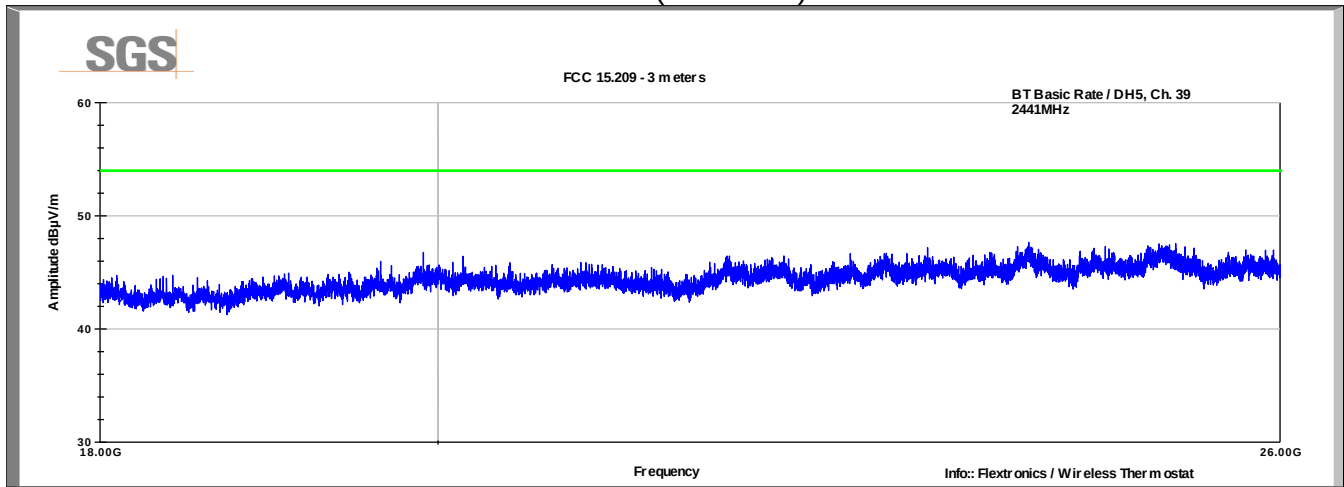
Bluetooth Channel 0 Vertical (18-26GHz)



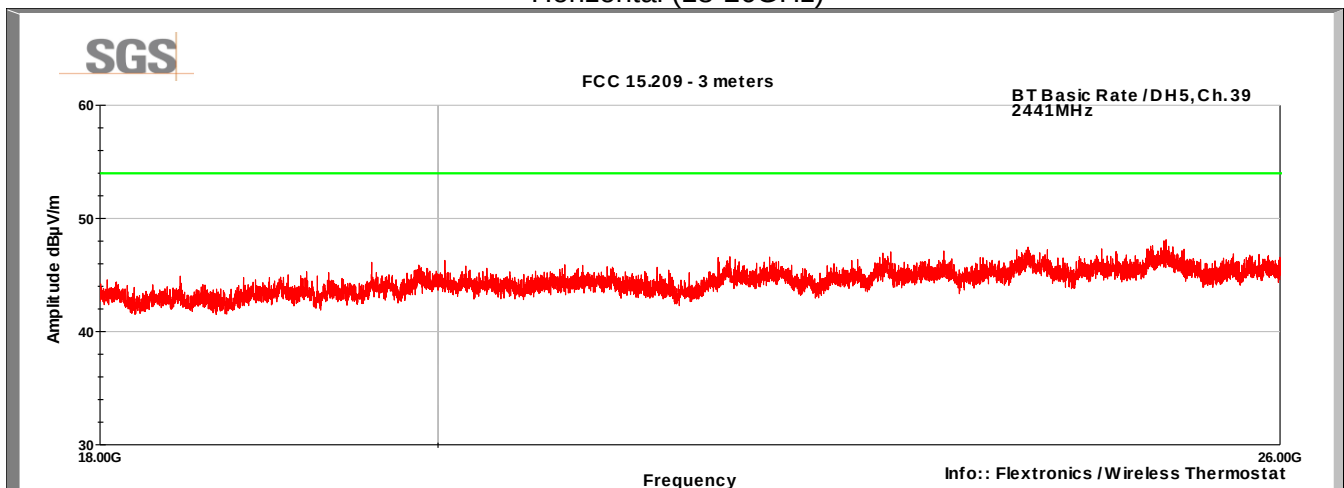
Bluetooth Channel 0 Horizontal (18-26GHz)



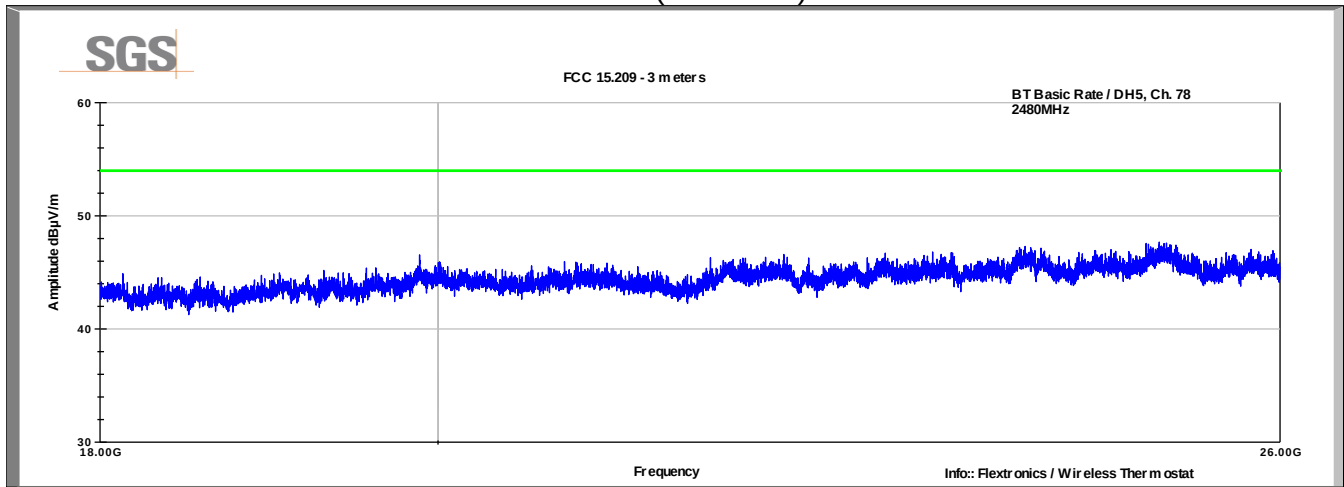
Bluetooth Channel 39 Vertical (18-26GHz)



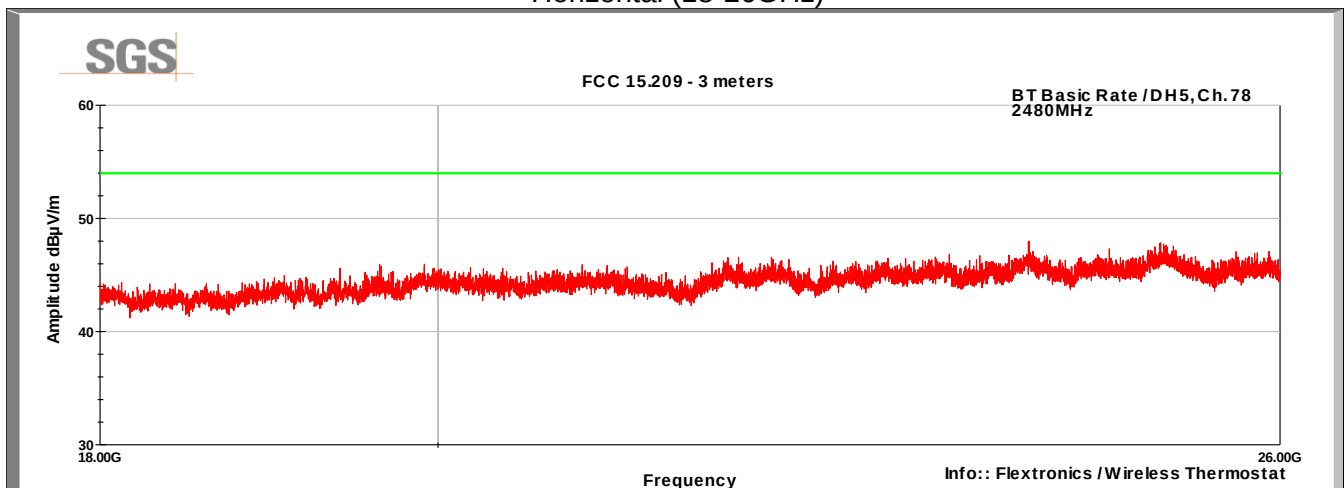
Bluetooth Channel 39 Horizontal (18-26GHz)



Bluetooth Channel 78 Vertical (18-26GHz)



Bluetooth Channel 78 Horizontal (18-26GHz)



6.6 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)
55.89	58.1	V	172.0	111.0	12.3	0.7	32.9	38.2	40.0	-1.8
64.78	61.9	V	135.0	138.0	9.8	0.7	33.1	39.4	40.0	-0.6
120.00	59.1	V	154.0	128.0	13.4	1.0	33.7	39.8	43.5	-3.7
332.80	63.0	V	309.0	166.0	14.6	1.8	33.5	45.9	46.0	-0.1
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)
120.02	62.3	H	93.0	253.0	13.4	1.0	33.7	43.1	43.5	-0.5
154.24	45.5	H	102.0	260.0	12.2	1.2	33.6	25.3	43.5	-18.2
158.83	43.6	H	98.0	110.0	11.9	1.2	33.6	23.1	43.5	-20.4
329.60	59.1	H	151.0	298.0	14.7	1.8	33.5	42.1	46.0	-3.9
332.80	60.0	H	135.0	327.0	14.6	1.8	33.5	42.9	46.0	-3.1
348.79	59.8	H	130.0	306.0	15.2	1.8	33.5	43.3	46.0	-2.8
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

No spurious emissions above 1GHz were within 10dB of the limit.

7 Radiated Emissions at Band Edge / Restricted Band

7.1 Test Result

Test Description	Test Specification	Test Result
Field strength of spurious radiation	15.247(d), 15.35(b), 15.209, RSS-GEN S8.10 ANSI C63.10: 2013	Compliant

7.2 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 Section 12 of FCC publication D01 DTS Meas Guidance v04. Conducted measurements across the entire band were used for showing compliance in all other restricted bands applying the same methods.

Offset Calculations:

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

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

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

D = 3m Distance
CL = 1.1 dB Cable Loss
DC = 1.1 dB (77.7%) Duty Cycle Correction Factor
AG = 3.34 dB Antenna Gain

$$\text{Offset} = -6.2 \text{ dB}$$

7.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.7 °C
Relative Humidity: 42.0 %
Atmospheric Pressure: 98.8 kPa

7.4 Test Equipment

Test End Date: 19-Oct-2017

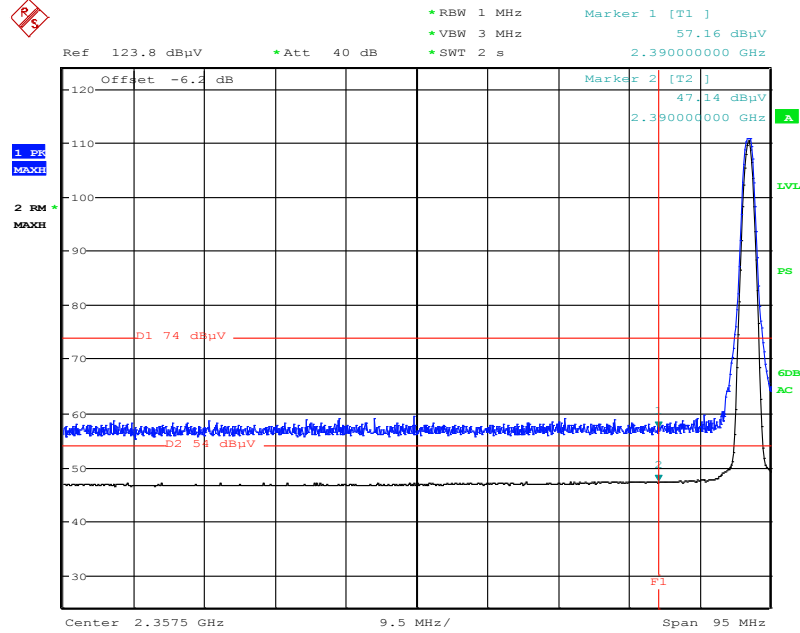
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-Apr-2018
RF CABLE	SF102	HUBER & SUHNER	B079823	26-Jul-2018
FILTER, BAND REJECT (2450MHZ)	BRM50709	MICRO-TRONICS	B079790	27-Jul-2018
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018

Note: The equipment calibration period is 1 year.

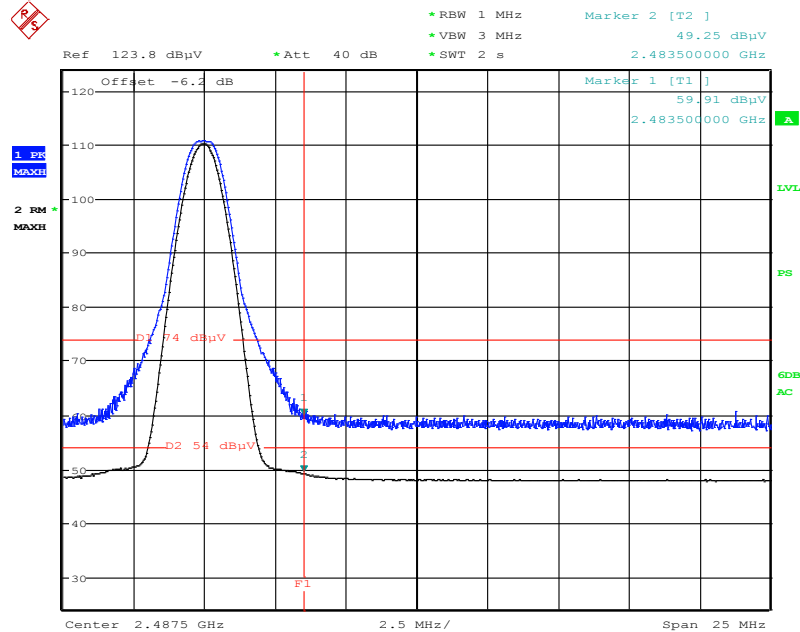
7.5 Test Data – Restricted Band Edge

Basic Rate - DH5, Ch0



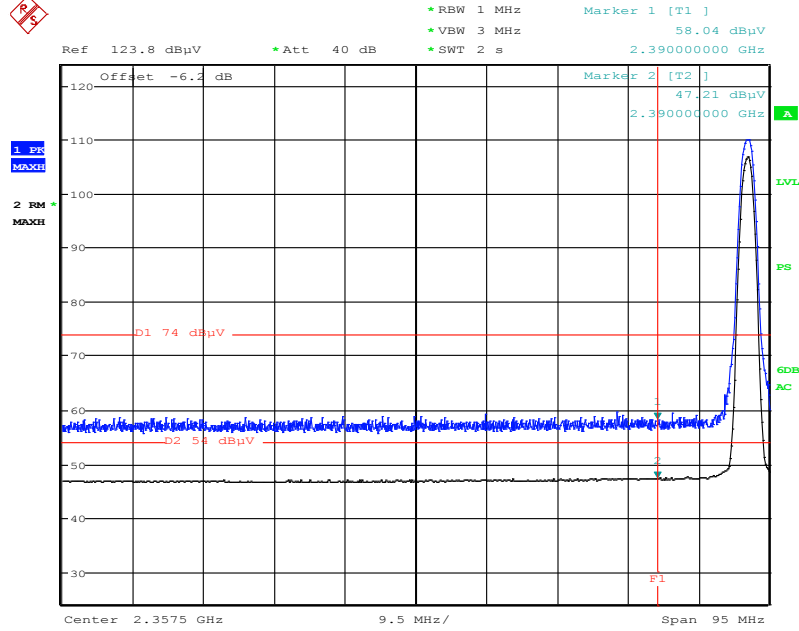
Date: 19.OCT.2017 16:20:11

Basic Rate - DH5, Ch78



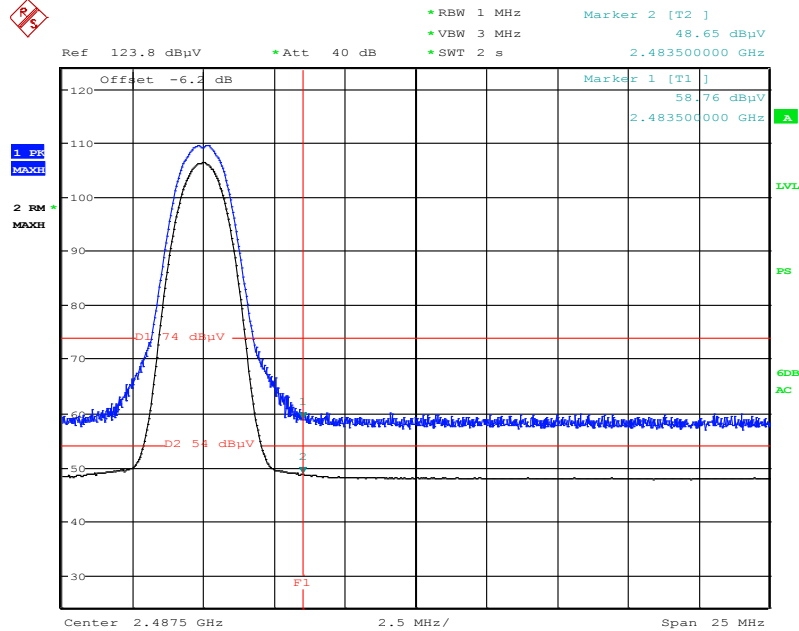
Date: 19.OCT.2017 16:18:55

EDR-2 - DH5, Ch0



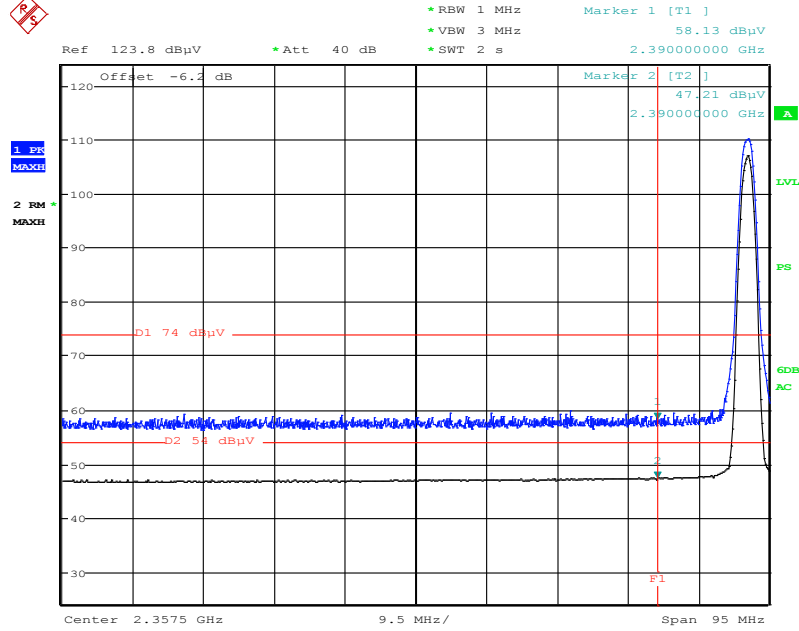
Date: 19.OCT.2017 16:20:53

EDR-2 - DH5, Ch78



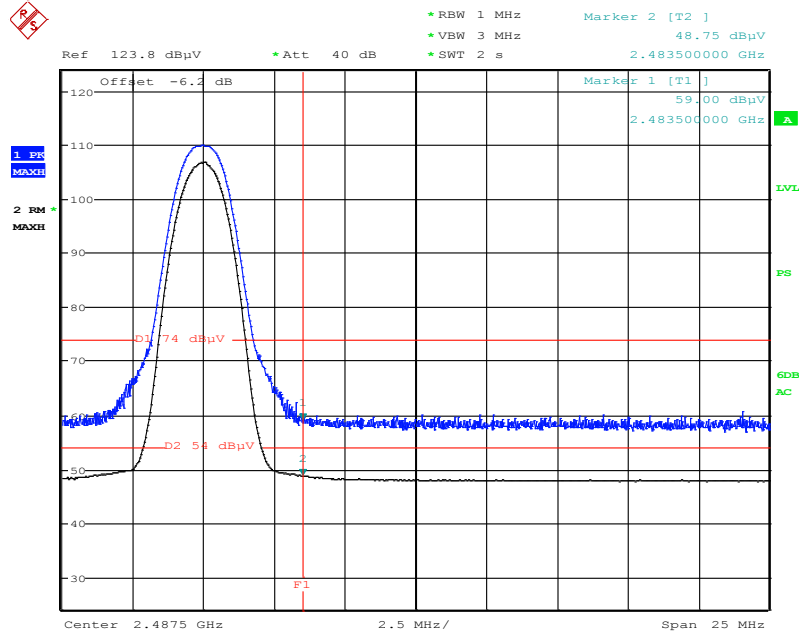
Date: 19.OCT.2017 16:18:03

EDR-3 - DH5, Ch0



Date: 19.OCT.2017 16:22:22

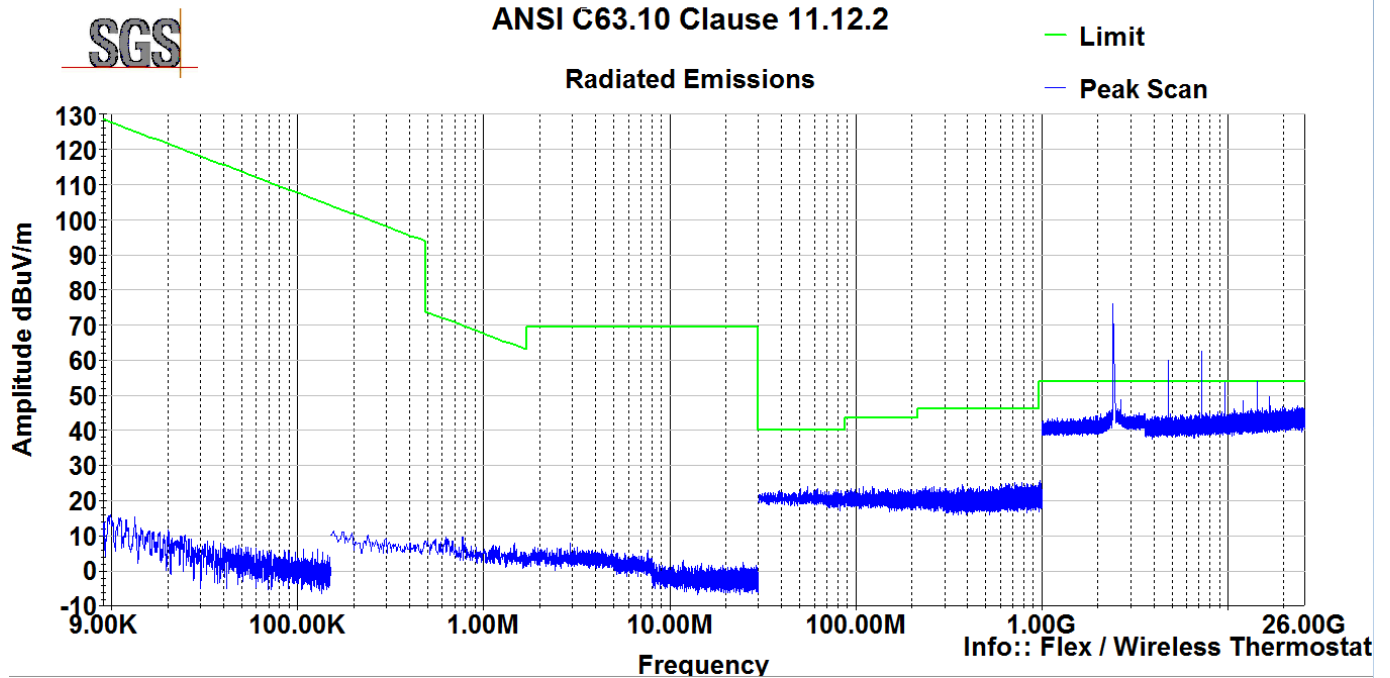
EDR-3 - DH5, Ch78



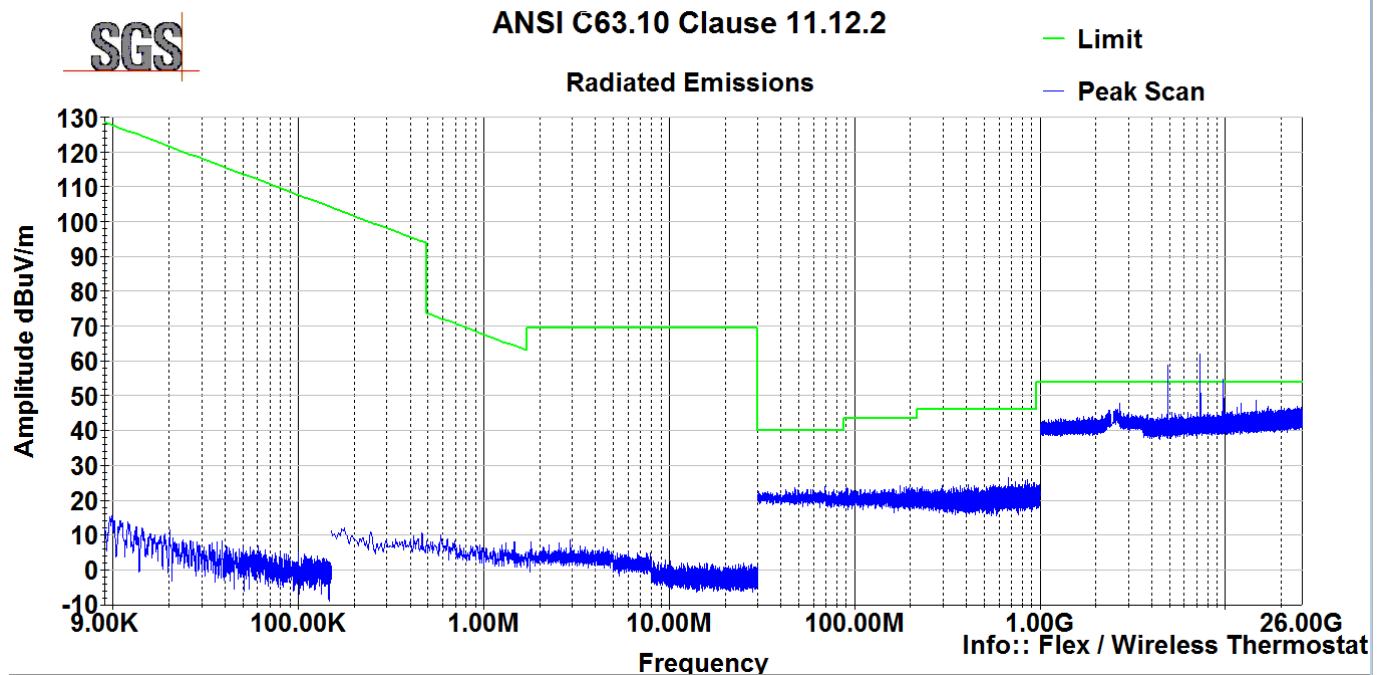
Date: 19.OCT.2017 16:17:20

7.6 Test Data – Restricted Bands

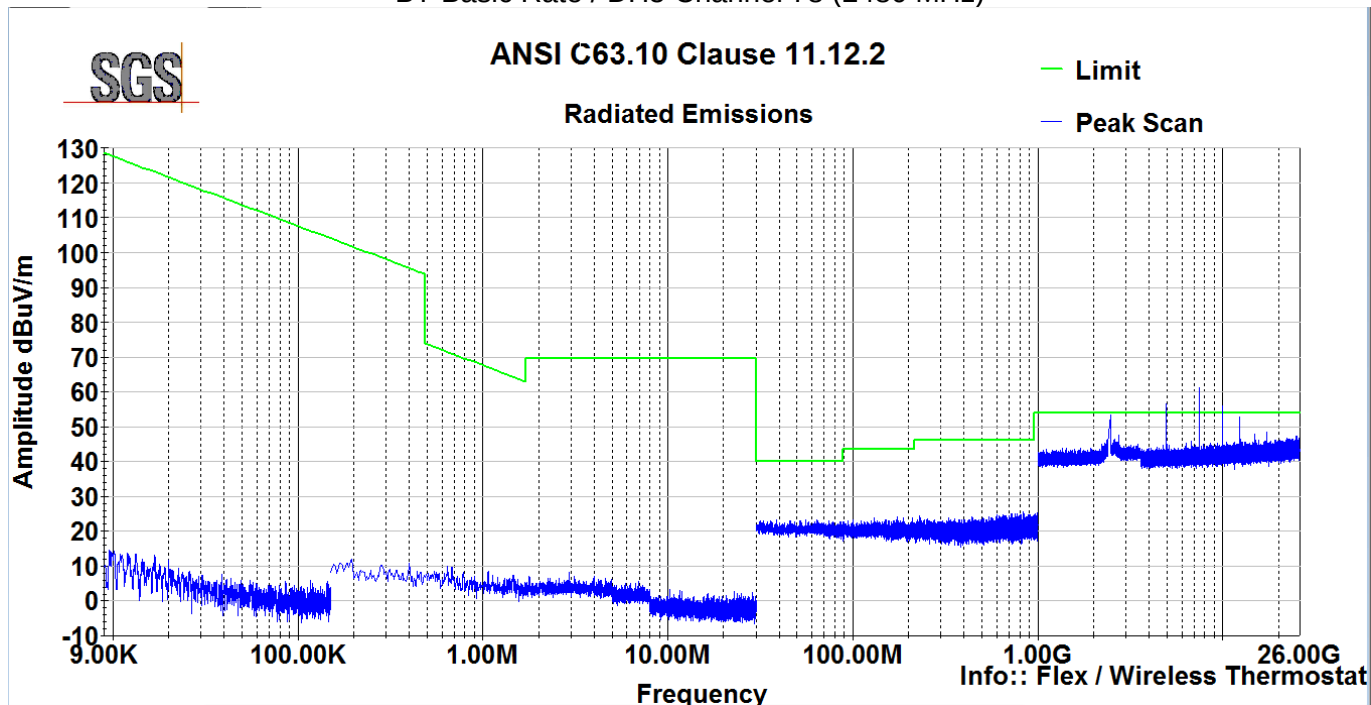
BT Basic Rate / DH5 Channel 0 (2402 MHz)



BT Basic Rate / DH5 Channel 39 (2441 MHz)



BT Basic Rate / DH5 Channel 78 (2480 MHz)



Frequency MHz	Raw Meas (dBuV)	Correction (dB/m)	Corr Value dBuV/m	Limit (dBuV/m)	Margin (dB)	Detector
Fundamental frequency: 2402 MHz						
4804.00	61.1	-1.2	59.9	74.0	-14.1	Peak
4804.00	47.7	-1.2	46.5	54.0	-7.5	Average
7208.00	63.2	-0.8	62.4	74.0	-11.6	Peak
7208.00	53.0	-0.8	52.2	54.0	-1.8	Average
Fundamental frequency: 2441 MHz						
4882.00	59.7	-1.2	58.5	74.0	-15.5	Peak
4882.00	45.0	-1.2	43.8	54.0	-10.2	Average
7323.00	62.7	-0.8	61.9	74.0	-12.1	Peak
7323.00	52.2	-0.8	51.4	54.0	-2.6	Average
Fundamental frequency: 2480 MHz						
4960.00	57.6	-1.2	56.4	74.0	-17.6	Peak
4960.00	45.0	-1.2	43.8	54.0	-10.2	Average
7440.00	62.1	-0.8	61.3	74.0	-12.7	Peak
7440.00	51.9	-0.8	51.1	54.0	-2.9	Average

No other spurious emissions fell within a restricted band.

8 Pseudo-Random Hop Sequence

8.1 Test Result

Test Description	Test Specification	Test Result
Pseudo-Random Hop Sequence	15.247(a)(1), RSS-247 5.1(1) ANSI C63.10	Compliant ⁽¹⁾

Note (1): The theory of operation states that the device is Bluetooth and operates using a pseudo-random hopping technique.

8.2 Test Method

Compliance is demonstrated by Manufacturer's declaration or is stated in the Theory of Operation.

Requirement

The hopset shall be such that the near-term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset, while the long-term distribution appears evenly distributed.

9 Channel Separation

9.1 Test Result

Test Description	Test Specification	Test Result
Number of Hopping Channels	15.247(a)(1)(iii) RSS-247 5.1(2) ANSI C63.10	Compliant

9.2 Test Method

Measurements were taken using the methods defined in ANSI C63.10, Clause 7.8.2. The test data was measured using a spectrum analyzer with Peak detector (max hold) and a resolution bandwidth of 100 kHz. The trace was allowed to stabilize until all channels were displayed.

Requirement

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the -20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

9.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.7 °C
Relative Humidity: 42.0 %
Atmospheric Pressure: 98.8 kPa

9.4 Test Equipment

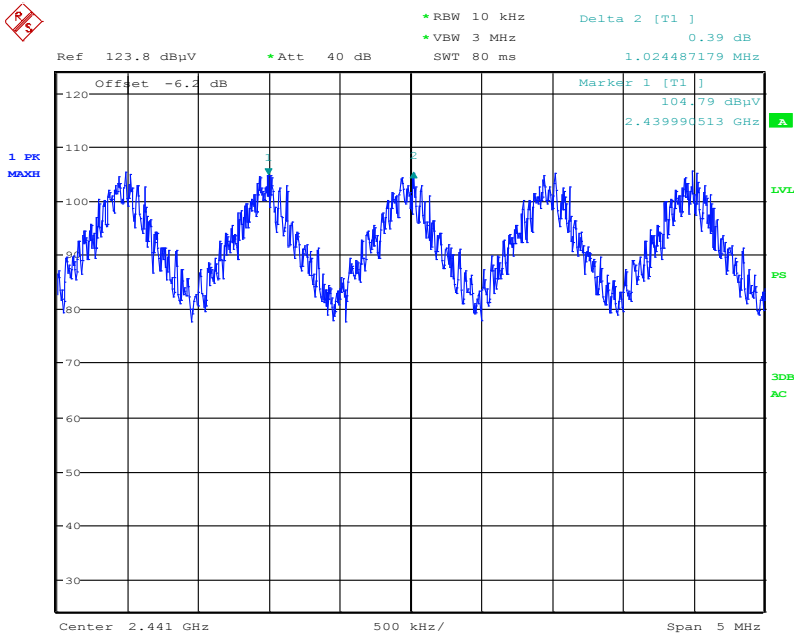
Test End Date: 19-Oct-2017

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-Apr-2018
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018

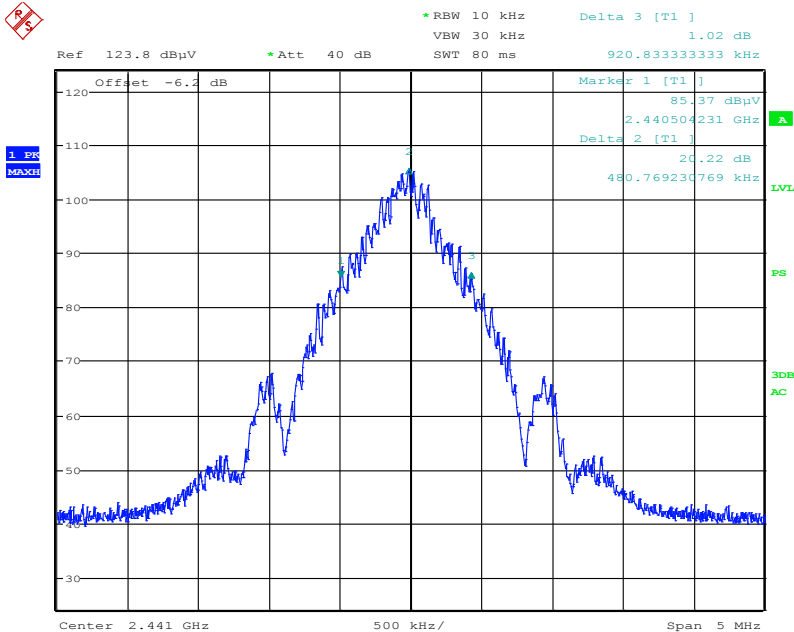
Note: The equipment calibration period is 1 year.

9.5 Test Data



Date: 19.OCT.2017 16:41:43

20dB BW



Date: 19.OCT.2017 16:49:15

10 Number of Hopping Channels

10.1 Test Result

Test Description	Test Specification	Test Result
Number of Hopping Channels	15.247(a)(1)(iii) RSS-247 5.1(4)	Compliant

10.2 Test Method

Measurements were taken using the methods defined in ANSI C63.10, Clause 7.8.3. The test data was measured using a spectrum analyzer with Peak detector (max hold) and a resolution bandwidth of 30 kHz. The trace was allowed to stabilize until all channels were displayed.

Requirement

Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.

10.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.2 °C
Relative Humidity: 41.7 %
Atmospheric Pressure: 98.7 kPa

10.4 Test Equipment

Test End Date: 20-Oct-2017

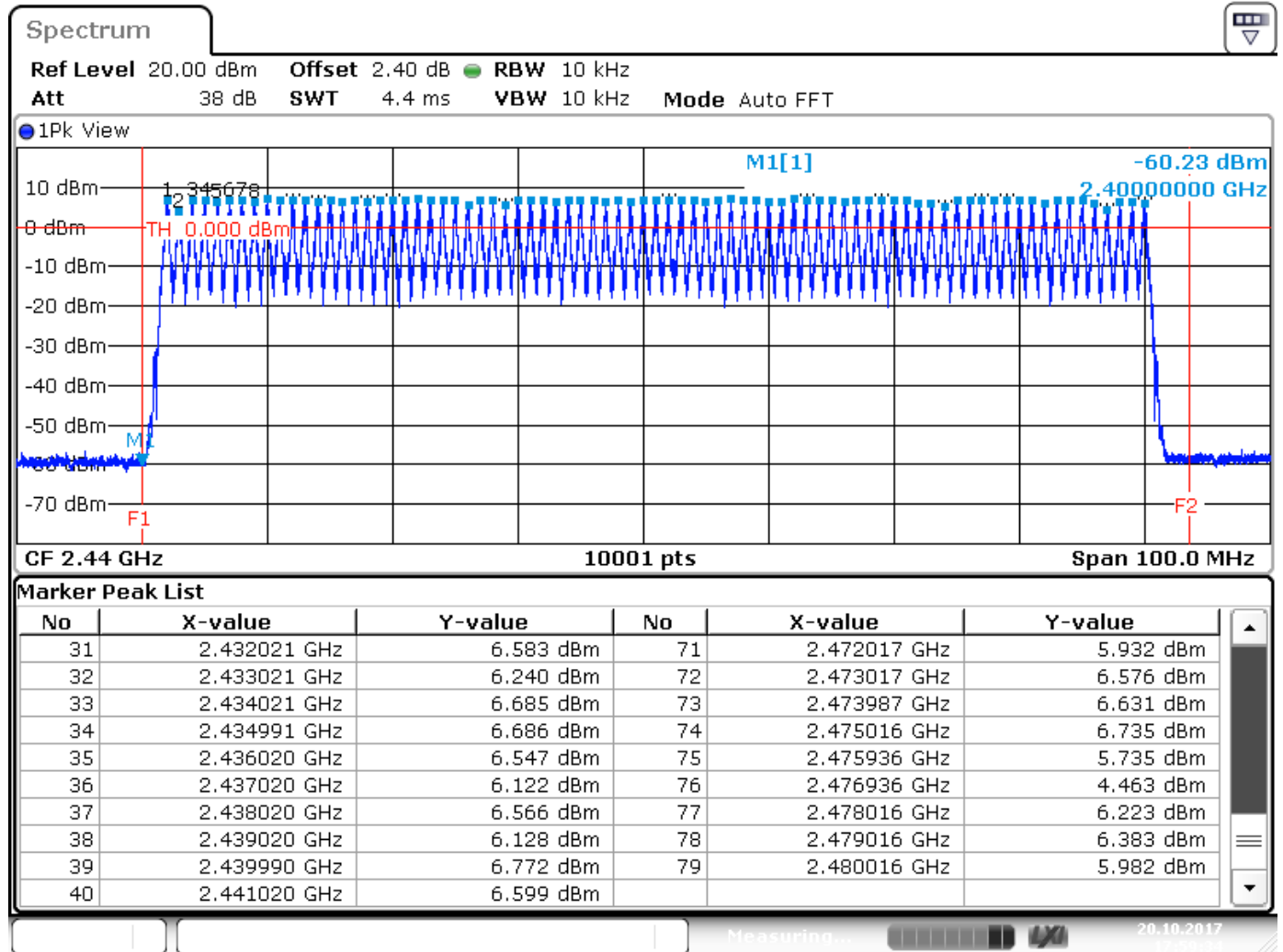
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SPCTRUM ANALYZER	FSV30	ROHDE & SCHWARZ	S/N: 103106	24-Jul-2018
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018

Note: The equipment calibration period is 1 year.

10.5 Test Data

There are 79 Channels.



Date: 20.OCT.2017 17:59:34

11 Dwell Time

11.1 Test Result

Test Description	Test Specification	Test Result
Dwell Time	15.247(a)(1)(iii) RSS-247 5.1(4)	Compliant

11.2 Test Method

Measurements were taken using the methods defined in ANSI C63.10, Clause 7.8.4. The EUT was set to test mode which allowed it to be controlled by the Bluetooth Tester. The Bluetooth Tester was then set to operate on US/EU Hopping Scheme with pseudo-random data. For each packet type and data rate, the pulse width of the packet was measured and the pulses were counted over the total observation period.

Requirement

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed ($0.4 \times 79 = 31.6s$).

11.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.2 °C
Relative Humidity: 41.7 %
Atmospheric Pressure: 98.7 kPa

11.4 Test Equipment

Test End Date: 20-Oct-2017

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SPCTRUM ANALYZER	FSV30	ROHDE & SCHWARZ	S/N: 103106	24-Jul-2018
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018

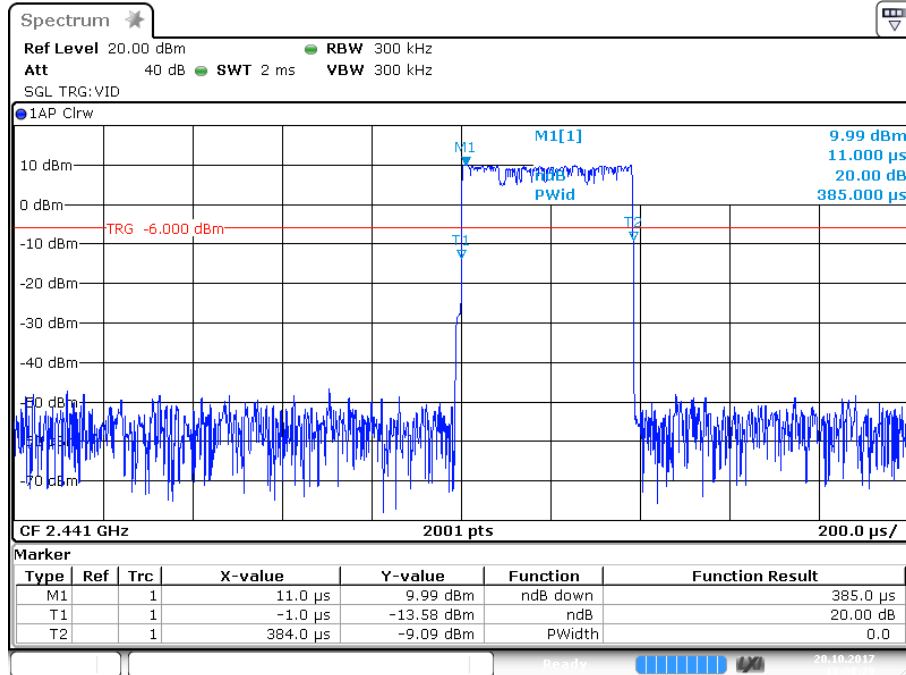
Note: The equipment calibration period is 1 year.

11.5 Test Data

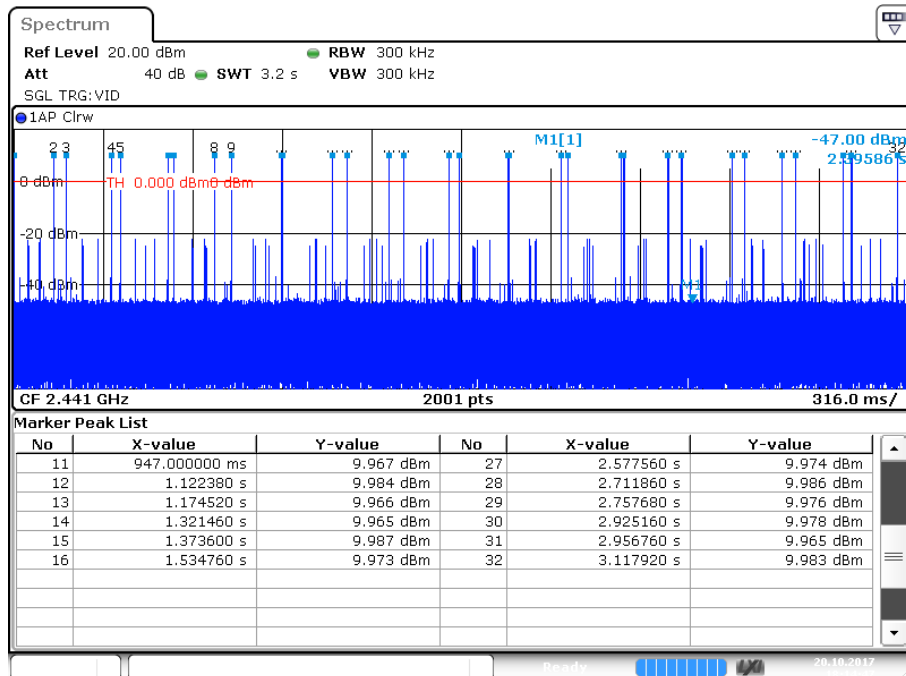
	Packet Type	Pulse Width ms	Pulses per 31.6 sec	Dwell Time Sec	Limit	Result
BR	DH1	0.385	320	0.123	0.4	PASS
	DH3	1.643	150	0.246	0.4	PASS
	DH5	2.893	100	0.289	0.4	PASS
EDR2	DH1	0.393	330	0.130	0.4	PASS
	DH3	1.645	170	0.280	0.4	PASS
	DH5	2.893	110	0.318	0.4	PASS
EDR3	DH1	0.393	320	0.126	0.4	PASS
	DH3	1.643	160	0.263	0.4	PASS
	DH5	2.895	110	0.318	0.4	PASS

11.6 Sample Plots

DH1 Packet Type, Basic Rate

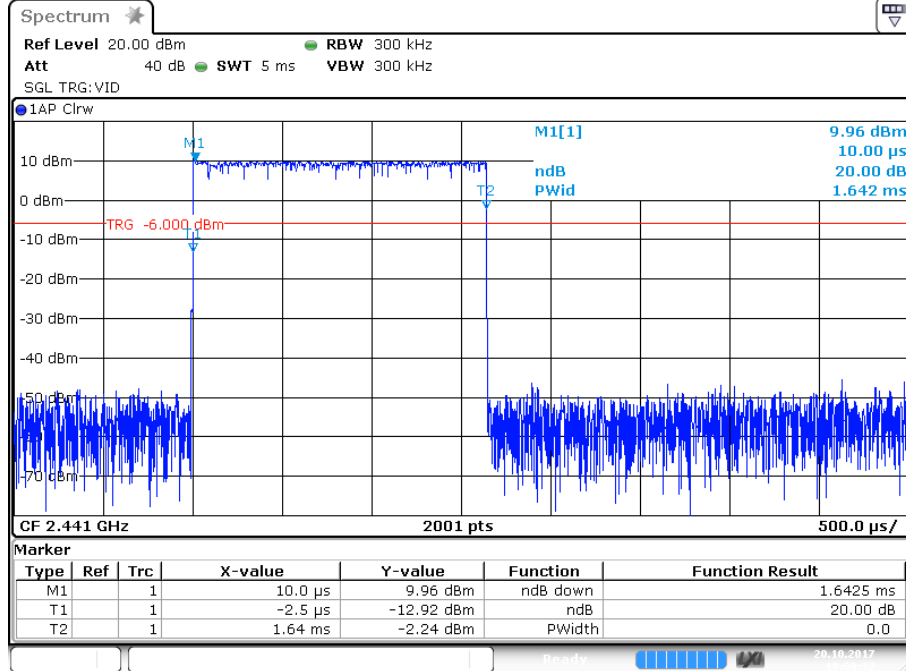


Date: 20.OCT.2017 18:08:30

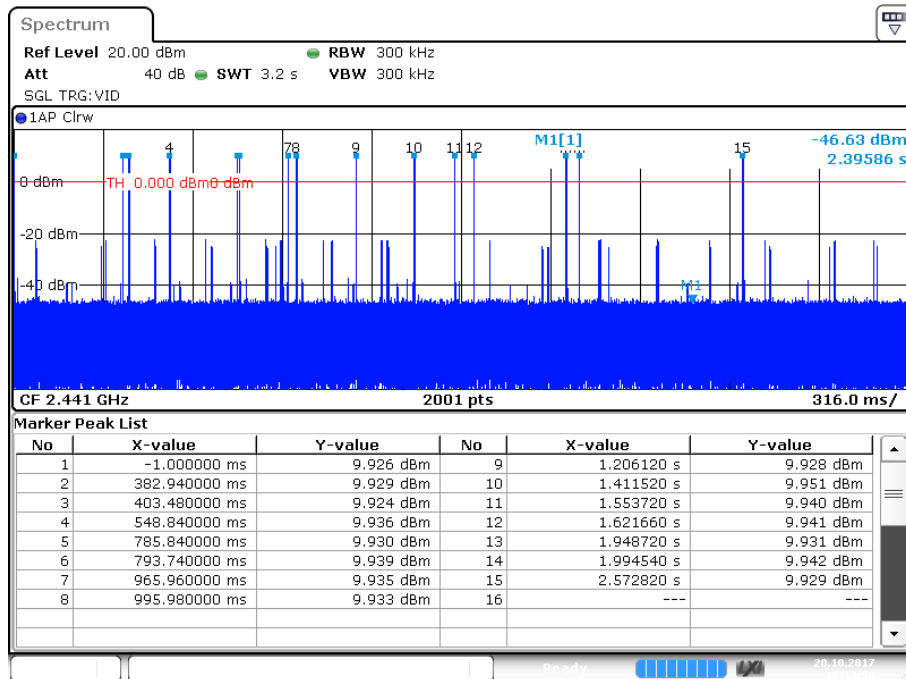


Date: 20.OCT.2017 18:14:47

DH3 Packet Type, Basic Rate

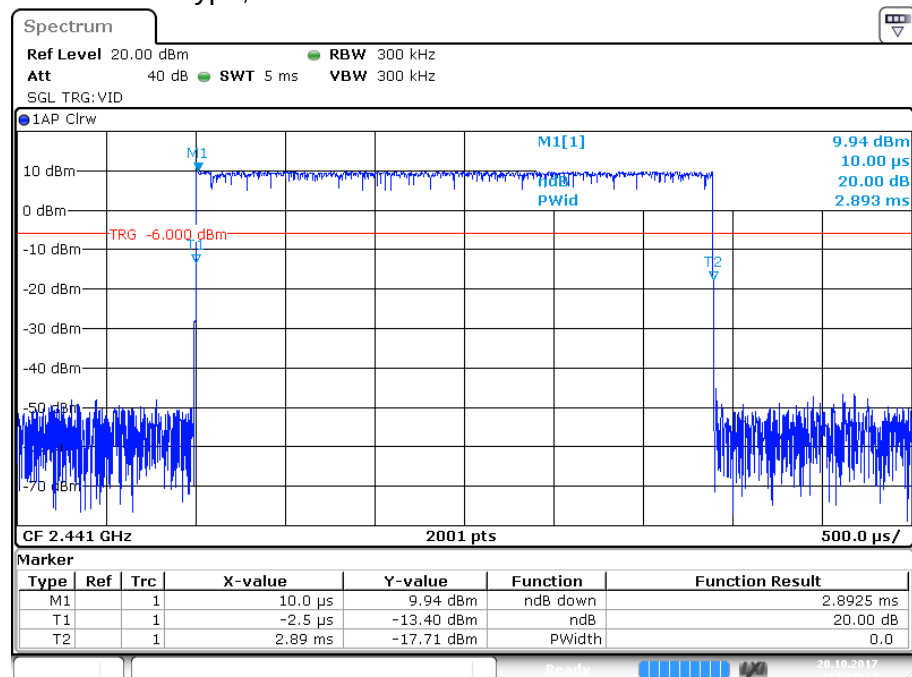


Date: 20 OCT 2017 18:09:32

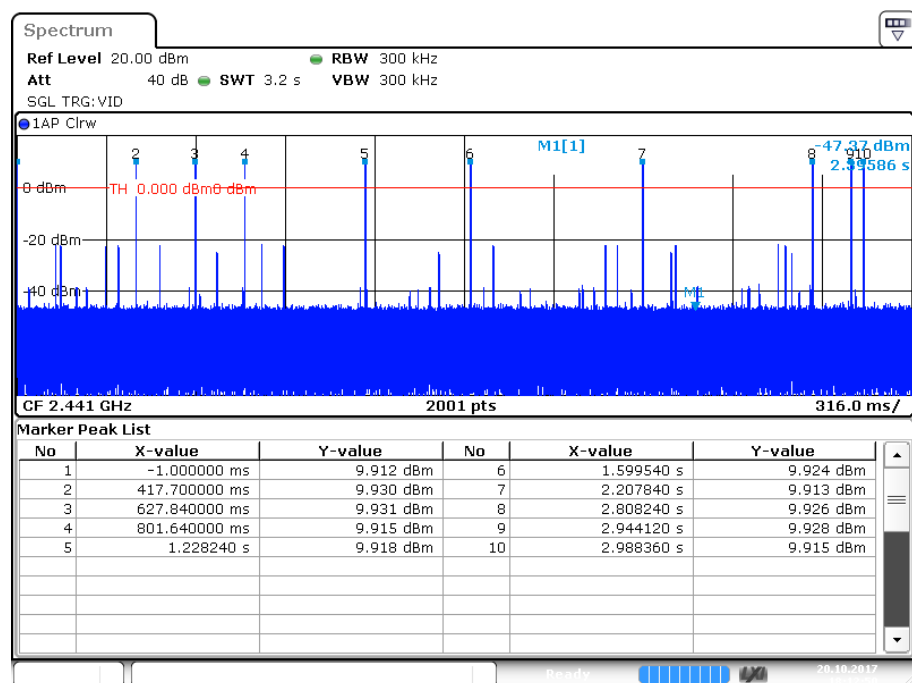


Date: 20 OCT 2017 18:13:56

DH5 Packet Type, Basic Rate



Date: 20.OCT.2017 18:10:24



Date: 20.OCT.2017 18:12:50

12 Conducted Emissions

12.1 Test Result

Test Description	Basic Standards	Test Result
Conducted Emissions, Class B	RSS-GEN, Issue 4 ANSI C63.4:2014	Compliant

12.2 Test Method

With the receivers resolution bandwidth was set to 9 kHz the exploratory scans were performed over the measuring frequency range (0.15MHz to 30MHz) using a max hold mode incorporating a Peak detector and Average detector and using the TILE! software. The final test data was measured using a Quasi-Peak detector and Average detector and compared against the limits indicated in the table below.

Frequency Range	Class A Limits (dBuV)	Class B Limits (dBuV) CISPR
0.15 to 0.5 MHz	Avg 66 QP 79	Avg 56 to 46 QP 66 to 56
0.5 to 5 MHz	Avg 60 QP 73	Avg 46 Pk 56
5 to 30 MHz	Avg 60 QP 73	Avg 50 Pk 60

12.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.5°C

Relative Humidity: 42.8%

12.4 Test Equipment

Test End Date: 17-Oct-2017

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-Apr-2018
LINE IMPEDANCE STABILIZATION NETWORK	NNB 51	TESEQ	B087573	16-Nov-2017
RF CABLE	CBL-25FT-NMNM	MINI-CIRCUITS	B094941	25-Jul-2018

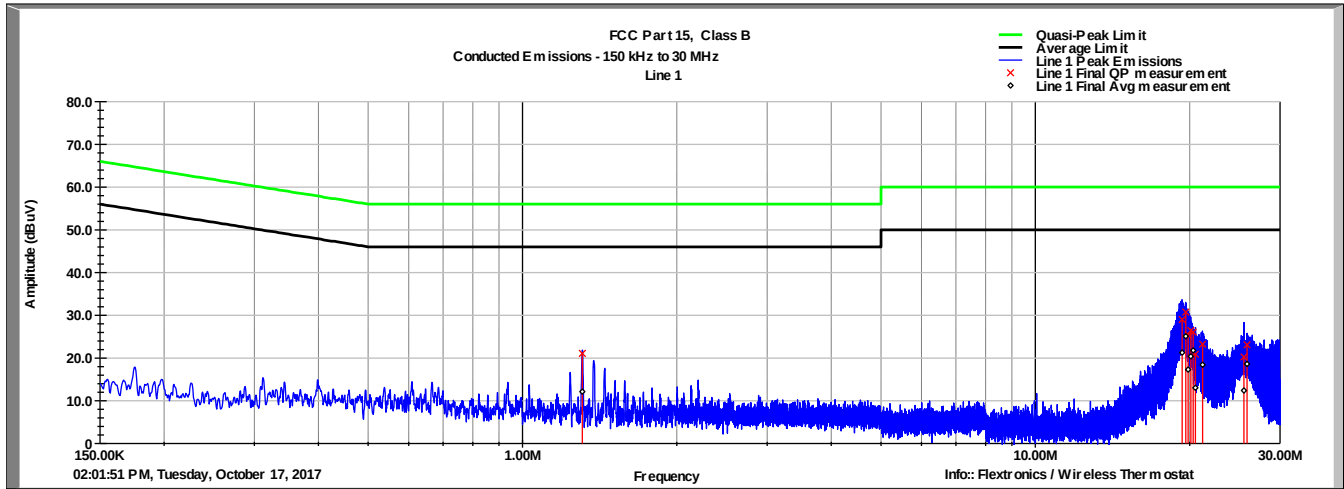
Note: The equipment calibration period is 1 year.

Software:

"Conducted Emissions" TILE! profile dated Dec 2015

12.5 Test Data

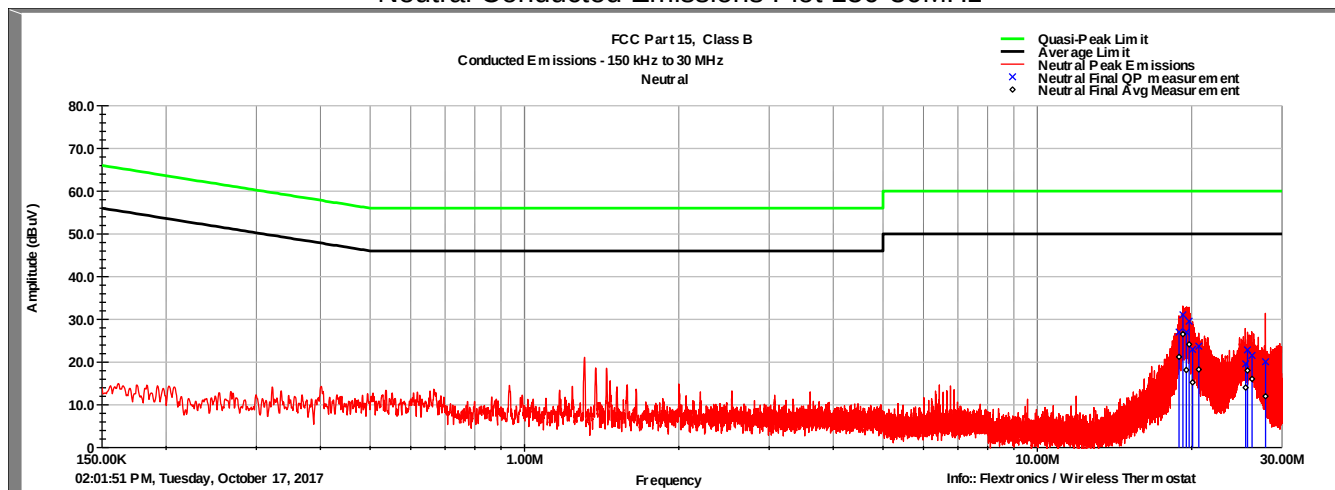
Line 1 Conducted Emissions Plot 150-30MHz



Line 1 Conducted Emissions Data 150-30MHz

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
1.308	21.1	56.0	-34.9	12.1	46.0	-33.9
19.335	29.0	60.0	-31.0	21.3	50.0	-28.7
19.655	30.7	60.0	-29.3	25.1	50.0	-24.9
19.860	25.4	60.0	-34.6	17.3	50.0	-32.7
20.098	26.4	60.0	-33.6	20.4	50.0	-29.6
20.313	26.1	60.0	-33.9	21.8	50.0	-28.2
20.520	20.9	60.0	-39.1	13.0	50.0	-37.0
21.189	23.2	60.0	-36.8	18.4	50.0	-31.6
25.520	20.2	60.0	-39.8	12.4	50.0	-37.6
25.878	23.1	60.0	-36.9	18.6	50.0	-31.4

Neutral Conducted Emissions Plot 150-30MHz



Neutral Conducted Emissions Data 150-30MHz

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
18.893	27.0	60.0	-33.0	21.2	50.0	-28.8
19.225	31.0	60.0	-29.0	26.5	50.0	-23.5
19.528	27.0	60.0	-33.0	18.1	50.0	-31.9
19.771	29.6	60.0	-30.4	24.1	50.0	-25.9
20.084	23.0	60.0	-37.0	15.2	50.0	-34.8
20.646	23.7	60.0	-36.3	18.3	50.0	-31.7
25.482	19.6	60.0	-40.4	14.0	50.0	-36.0
25.695	22.8	60.0	-37.2	18.0	50.0	-32.0
26.224	21.6	60.0	-38.4	16.0	50.0	-34.0
27.865	20.1	60.0	-39.9	12.0	50.0	-38.0

13 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	31 October 2017