Report On

FCC and Industry Canada Testing of
The Wand Company Ltd PC-010
In accordance with FCC 47 CFR Part 15C,
Industry Canada RSS-247 and Industry Canada RSS-GEN

COMMERCIAL-IN-CONFIDENCE

FCC ID: 2AFJA-1701
IC: 20592-1701

Document 75933714 Report 03 Issue 1   March 2016

TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuv-sud.co.uk

REPORT ON

FCC and Industry Canada Testing of
The Wand Company Ltd PC-010
In accordance with FCC 47 CFR Part 15C,
Industry Canada RSS-247 and Industry Canada RSS-GEN

Document 75933714 Report 03 Issue 1

March 2016

PREPARED FOR

The Wand Company Ltd
PO Box 11074
Dunmow
Essex
CM6 9BR

PREPARED BY

Natalie Bennett
Senior Administrator, Project Support

APPROVED BY

Stephen Milliken
Authorised Signatory

DATED

23 March 2016

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C, Industry Canada RSS-247 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

G Lawler

N Rouselll

CONTENTS

SECTION 1

REPORT SUMMARY

FCC and Industry Canada Testing of
The Wand Company Ltd PC-010
In accordance with FCC 47 CFR Part 15C, Industry Canada RSS-247
and Industry Canada RSS-GEN

1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC and Industry Canada Testing of The Wand Company Ltd PC-010 to the requirements of FCC 47 CFR Part 15C and Industry Canada RSS-247.

Objective	To perform FCC and Industry Canada Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	The Wand Company Ltd
Model Number(s)	PC-010
Serial Number(s)	Not Serialised (75933714-TSR0005) Not Serialised (75933714-TSR0007)
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C (2015) RSS-247 Issue 1 RSS-GEN Issue 4
Incoming Release Date	Application Form 01 Match 2016
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	1193 15 February 2016
Start of Test	23 February 2016
Finish of Test	9 March 2016
Name of Engineer(s)	G Lawler N Rousell
Related Document(s)	ANSI C63.4 (2014) ANSI C63.10 (2013)

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C and Industry Canada RSS-247 and Industry Canada RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Bluetooth						
2.1	15.207	-	8.8	AC Line Conducted Emissions	Pass	ANSI C63.10, clause 6.2
2.2	15.247(a)(1)	5.1(2)	-	Frequency Hopping Systems - Channel Separation	Pass	ANSI C63.10, clause 7.8.2
2.3	15.247(a)(1)(iii)	5.1(4)	-	Frequency Hopping Systems - Number of Hopping Channels	Pass	ANSI C63.10, clause 7.8.3
2.4	15.247(a)(1)	5.1(1)	-	Frequency Hopping Systems - 20 dB Bandwidth	Pass	ANSI C63.10, clause 6.9.2
2.5	15.247(a)(1)(iii)	5.1(4)	-	Frequency Hopping Systems - Average Time of Occupancy	Pass	ANSI C63.10, clause 7.8.4
2.6	15.247(b)(3)	5.4(2)	-	Maximum Conducted Output Power	Pass	KDB 558074 D01 v03r02, clause 9.1.1 RSS-GEN, clause 6.12
2.7	15.247(d) 15.209	5.5	-	Spurious Radiated Emissions	Pass	ANSI C63.10, clause 6.3, 6.5, 6.6, 7.5
2.8	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10, clause 6.10.5
2.9	15.247(d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10, clause 6.10.4

1.3 APPLICATION FORM

EQUIPMENT DESCRIPTION	
Model Name/Number	PC-010
Part Number	WRC-PC-010
Hardware Version	v1_0
Software Version	v1_0
FCC ID (if applicable)	2AFJA-1701
Industry Canada ID (if applicable)	20592-1701
Technical Description (Please provide a brief description of the intended use of the equipment)	Bluetooth "Classic" (v2.1+EDR) speakerphone module supporting the Hands-Free Profile (HFP), Headset Profile (HSP) and A2DP music streaming.

Types of Modulations used by the Equipment
☒   FHSS
☐   Other forms of modulation
In case of FHSS Modulation
In case of non-Adaptive Frequency Hopping equipment:
Number of Hopping Frequencies: 79
In case of Adaptive Frequency Hopping Equipment:
Maximum number of Hopping Frequencies: 79
Minimum number of Hopping Frequencies: 20
Dwell Time: 0.625 ms to 3.75 ms
Minimum Channel Occupation Time: 0.625 ms / 1.25 ms
Adaptive / non-adaptive equipment:
☐   non-adaptive Equipment
☐   adaptive Equipment without the possibility to switch to a non-adaptive mode
☒   adaptive Equipment which can also operate in a non-adaptive mode
In case of adaptive equipment:
The Channel Occupancy Time implemented by the equipment: ms
☐   The equipment has implemented an LBT based DAA mechanism
In case of equipment using modulation different from FHSS:
☒   The equipment is Frame Based equipment
☐   The equipment is Load Based equipment
☐   The equipment can switch dynamically between Frame Based and Load Based equipment
The CCA time implemented by the equipment: (N/A for Bluetooth) µs
☒   The equipment has implemented an non-LBT based DAA mechanism
☐   The equipment can operate in more than one adaptive mode

In case of non-adaptive Equipment:	
The maximum RF Output Power (e.i.r.p.): 8 dBm	
The maximum (corresponding) Duty Cycle: 77 %	
Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared):	
The worst case operational mode for each of the following tests:	
RF Output Power: DH5	
Power Spectral Density: DH5	
Duty cycle, Tx-Sequence, Tx-gap: DH5	
Accumulated Transmit Time, Frequency Occupation & Hopping Sequence (only for FHSS equipment): DH5	
Hopping Frequency Separation (only for FHSS equipment): DH5	
Medium Utilisation: N/A	
Adaptivity & Receiver Blocking: N/A	
Nominal Channel Bandwidth: 1 MHz	
Transmitter unwanted emissions in the OOB domain: DH5	
Transmitter unwanted emissions in the spurious domain: DH5	
Receiver spurious emissions: DH5	

	The different transmit operating modes (tick all that apply):	
☒	Operating mode 1: Single Antenna Equipment	
	☒	Equipment with only 1 antenna
	☐	Equipment with 2 diversity antennas but only 1 antenna active at any moment in time
	☐	Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used. (e.g. IEEE 802.11™ [2012] legacy mode in smart antenna systems)
☐	Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming	
	☐	Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [2012] legacy mode)
	☐	High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1
	☐	High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2
	☐	High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 3
	☐	High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 4
	☐	High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 5
NOTE: Add more lines if more channel bandwidths are supported.		
☐	Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming	
	☐	Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [2012] legacy mode)
	☐	High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1
	☐	High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2
	☐	High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 3
	☐	High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 4
	☐	High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 5
NOTE: Add more lines if more channel bandwidths are supported.		

In case of Smart Antenna Systems:
The number of Receive chains:
The number of Transmit chains:
☐   symmetrical power distribution
☐   asymmetrical power distribution
In case of beam forming, the maximum (additional) beam forming gain: dB
NOTE: The additional beam forming gain does not include the basic gain of a single antenna.
Operating Frequency Range(s) of the equipment:
Operating Frequency Range 1: 2402 MHz to 2480 MHz
Operating Frequency Range 2:   MHz to   MHz
Operating Frequency Range 3:   MHz to   MHz
NOTE: Add more lines if more Frequency Ranges are supported.
Nominal Channel Bandwidth(s):
Nominal Channel Bandwidth1: 1 MHz
Nominal Channel Bandwidth2:   MHz
Nominal Channel Bandwidth3:   MHz
Nominal Channel Bandwidth4:   MHz
Nominal Channel Bandwidth5:   MHz
NOTE: Add more lines if more channel bandwidths are supported.
Type of Equipment (stand-alone, combined, plug-in radio device, etc.):
☒   Stand-alone
☐   Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment)
☐   Plug-in radio device (Equipment intended for a variety of host systems)
☐   Other
The extreme operating conditions that apply to the equipment:
Operating temperature range: 0 °C to 50 °C
Details provided are for the:
☒   stand-alone equipment
☐   combined (or host) equipment
☐   test jig

The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels:			
Antenna Type:			
☒ Integral Antenna			
Antenna Gain: 3 dBi			
If applicable, additional beamforming gain (excluding basic antenna gain): dB			
☒ Temporary RF connector provided			
☐ No temporary RF connector provided			
☐ Dedicated Antennas (equipment with antenna connector)			
☐ Single power level with corresponding antenna(s)			
☐ Multiple power settings and corresponding antenna(s)			
Number of different Power Levels:			
Power Level 1: dBm			
Power Level 2: dBm			
Power Level 3: dBm			
NOTE 1: Add more lines in case the equipment has more power levels.			
NOTE 2: These power levels are conducted power levels (at antenna connector).			
For each of the Power Levels, provide the intended antenna assemblies, their corresponding gains (G) and the resulting e.i.r.p. levels also taking into account the beamforming gain (Y) if applicable			
Power Level 1: dBm			
Number of antenna assemblies provided for this power level:			

Assembly #	Gain (dBi)	e.i.r.p (dBm)	Part number or model number
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

Power Level 2: dBm

Number of antenna assemblies provided for this power level:

Assembly #	Gain (dBi)	e.i.r.p (dBm)	Part number or model number
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

Power Level 3: dBm

Number of antenna assemblies provided for this power level:

Assembly #	Gain (dBi)	e.i.r.p (dBm)	Part number or model number
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:
Details provided are for the: ☒ stand-alone equipment
☐   combined (or host) equipment
☐   test jig
Supply Voltage ☐ AC mains   State AC voltage   V
☒ DC   State DC voltage 3.7 V
In case of DC, indicate the type of power source
☐   Internal Power Supply
☐   External Power Supply or AC/DC adapter
☒   Battery
☐   Other:
Describe the test modes available which can facilitate testing:
Test modes initiated by standard CSR BlueTest3 software
The equipment type (e.g. Bluetooth®, IEEE 802.11™ [2012] IEEE 802.15.4™ [2011], proprietary, etc.):
Bluetooth
If applicable, the statistical analysis referred in clause 5.3.1 q)
To be provided as separate attachment, please state document name:
If applicable, the statistical analysis referred in clause 5.3.1 r)
To be provided as separate attachment, please state document name:
Geo-location capability supported by the equipment:
☐ Yes
☐ The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user.
☒ No
Combination for testing (see clause 5.1.3.3 of EN 300 328 V1.9.1)
From all combinations of conducted power settings and intended antenna assembly(ies) specified in clause 3.1 m), specify the combination resulting in the highest e.i.r.p. for the radio equipment. Unless otherwise specified in ETSI EN 300 328, this power setting is to be used for testing against the requirements of ETSI EN 300 328. In case there is more than one such conducted power setting resulting in the same (highest) e.i.r.p. level, the highest power setting is to be used for testing. See also ETS EN 300 328, clause 5.1.3.3.

Highest overall e.i.r.p. value: dBm	
Corresponding Antenna assembly gain: dBi	Antenna Assembly #:
Corresponding conducted power setting: dB (also the power level to be used for testing)	Listed as Power Setting #:

Additional information provided by the applicant
Modulation
ITU Class(es) of emission: 1M00FXD
Can the transmitter operate unmodulated? ☐   Yes   ☒ No
Duty Cycle
The transmitter is intended for:
☐   Continuous duty
☒   Intermittent duty
☒   Continuous operation possible for testing purposes

About the UUT	
☐	The equipment submitted are representative production models
☒	If not, the equipment submitted are pre-production models?
☒	If pre-production equipment are submitted, the final production equipment will be identical in all respects with the equipment tested
☐	If not, supply full details
☐	The equipment submitted is CE marked
☐	In addition to the CE mark, the Class-II identifier (Alert Sign) is affixed.
Additional items and/or supporting equipment provided	
☒	Spare batteries (e.g. for portable equipment)
☒	Battery charging device
☐	External Power Supply or AC/DC adapter
☒	Test Jig or interface box
☐	RF test fixture (for equipment with integrated antennas)
☐	Host System
	Manufacturer
	Model
	Model Name
☐	Combined equipment
	Manufacturer
	Model
	Model Name
☒	User Manual
☒	Technical documentation (Handbook and circuit diagrams)

I hereby declare that that the information supplied is correct and complete.

Name: Richard Blakesley   Position held: Director
Date: 01/03/2016

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was The Wand Company Ltd PC-010. A full technical description can be found in the manufacturer's documentation.

1.5 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure.

The EUT was powered from a 3.7 V DC supply.

FCC Measurement Facility Registration Number
90987 Octagon House, Fareham Test Laboratory

Industry Canada Company Address Code
IC2932B-1 Octagon House, Fareham Test Laboratory

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standard were made during testing.

1.7 MODIFICATION RECORD

Modification 0 - No modifications were made to the test sample during testing.

SECTION 2

TEST DETAILS

FCC and Industry Canada Testing of
The Wand Company Ltd PC-010
In accordance with FCC 47 CFR Part 15C and Industry Canada RSS-247

2.1 AC LINE CONDUCTED EMISSIONS

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.207
RSS-GEN, Clause 8.8

2.1.2 Equipment Under Test and Modification State

PC-010 S/N: Not Serialised (75933714-TSR0007) - Modification State 0

2.1.3 Date of Test

2 March 2016

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Test Procedure

The test was performed in accordance with ANSI C63.10, clause 6.2.

Remarks

A mains supply cable of 1 m length was used to supply mains power to the EUT from the LISN.

All final measurements were assessed against the Class B emission limits in Clause 15.207 of FCC 47 CFR Part 15.

2.1.6 Environmental Conditions

Ambient Temperature   20.6°C
Relative Humidity   25.0%

2.1.7 Test Results

Bluetooth, Live Line, AC Line Conducted Emissions Result

Frequency (MHz)	QP Level (dBµV)	QP Limit (dBµV)	QP Margin (dBµV)	AV Level (dBµV)	AV Limit (dBµV)	AV Margin (dBµV)
0.150	53.0	66.0	-13.0	37.1	56.0	-18.9
0.190	45.7	64.0	-18.3	32.1	54.0	-21.9
0.200	44.4	63.6	-19.2	33.1	53.6	-20.5
0.212	44.0	63.1	-19.1	32.3	53.1	-20.8
0.228	42.5	62.5	-20.0	30.8	52.5	-21.7
0.266	39.3	61.2	-21.9	27.4	51.2	-23.8

Bluetooth, Live Line, AC Line Conducted Emissions Plot
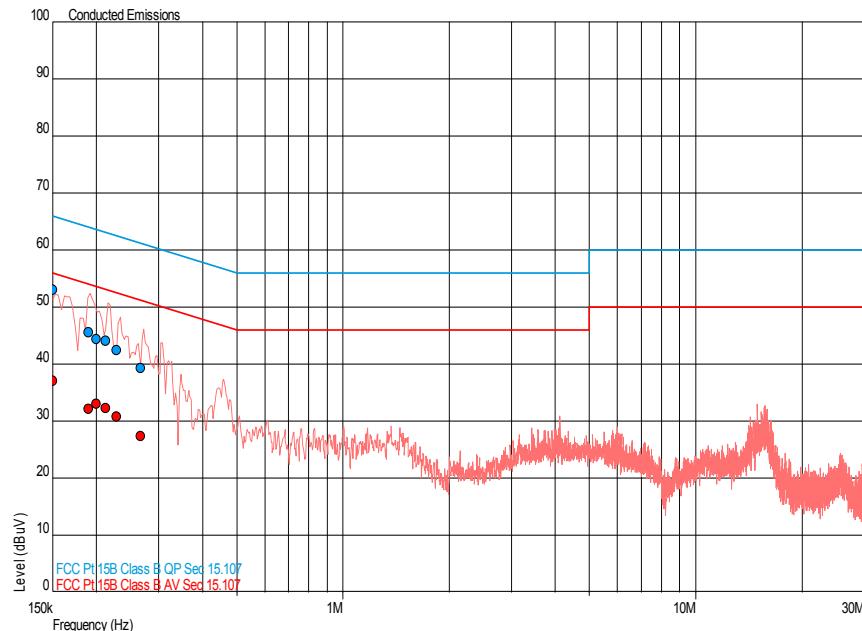
Bluetooth, Neutral Line, AC Line Conducted Emissions Result

Frequency (MHz)	QP Level (dBµV)	QP Limit (dBµV)	QP Margin (dBµV)	AV Level (dBµV)	AV Limit (dBµV)	AV Margin (dBµV)
0.153	54.9	65.8	-10.9	38.0	55.8	-17.8
0.168	49.4	65.1	-15.7	34.9	55.1	-20.2
0.190	49.0	64.0	-15.0	32.1	54.0	-21.9
0.205	45.7	63.4	-17.7	33.1	53.4	-20.3
0.209	46.4	63.3	-16.9	33.0	53.3	-20.3
0.226	43.1	62.6	-19.5	32.3	52.6	-20.3

Bluetooth, Neutral Line, AC Line Conducted Emissions Plot
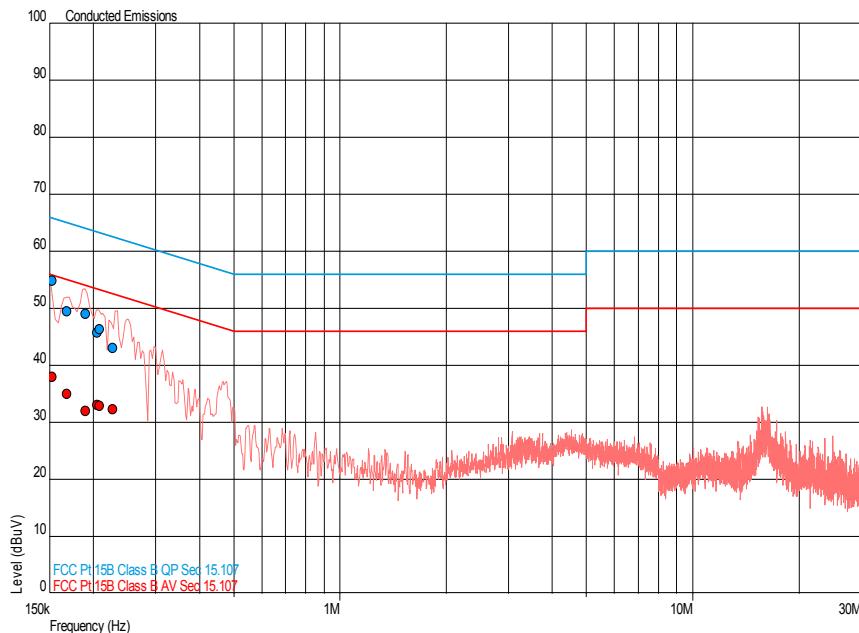
FCC 47 CFR Part 15, Limit Clause 15.207

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*Decreases with the logarithm of the frequency.

RSS-GEN, Limit Clause 8.8

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average**
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*Decreases with the logarithm of the frequency.
**A linear average detector is required

2.2 FREQUENCY HOPPING SYSTEMS - CHANNEL SEPARATION

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
RSS-247, Clause 5.1(2)

2.2.2 Equipment Under Test and Modification State

PC-010 S/N: Not Serialised (75933714-TSR0005) - Modification State 0

2.2.3 Date of Test

2 March 2016

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Procedure

The test was performed in accordance with ANSI C63.10, clause 7.8.2.

2.2.6 Environmental Conditions

Ambient Temperature   21.4°C
Relative Humidity   28.5%

2.2.7 Test Results

3.7 V DC Supply

Bluetooth, Channel Separation Results

Modulation	Frequency Hopping
	MHz
GFSK	0.998
pi/4 DQPSK	0.998
8-DPSK	1.002

Bluetooth, GFSK, Channel Separation Plot
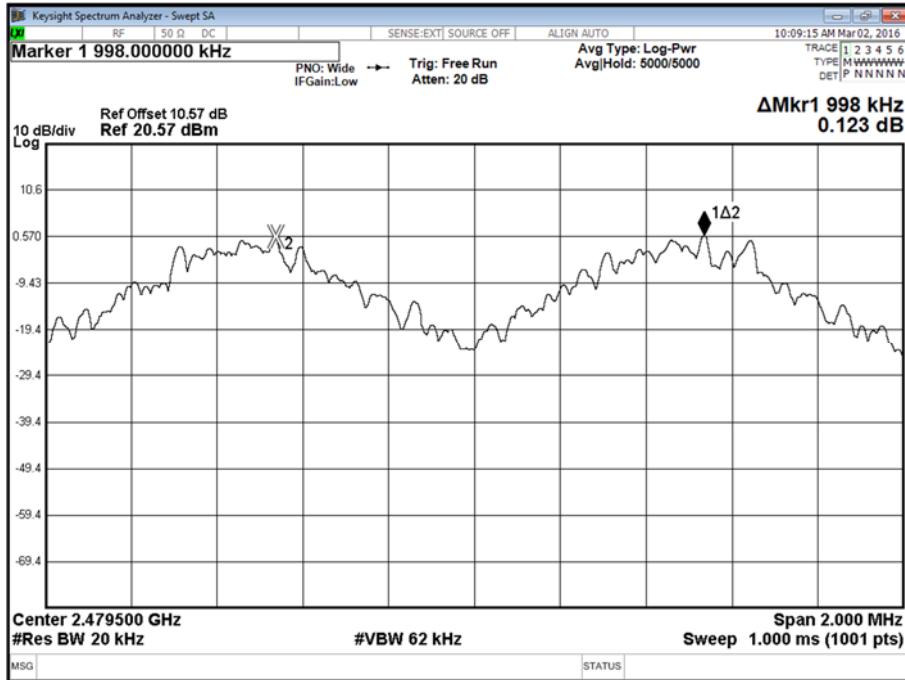
Bluetooth, pi/4 DQPSK, Channel Separation Plot
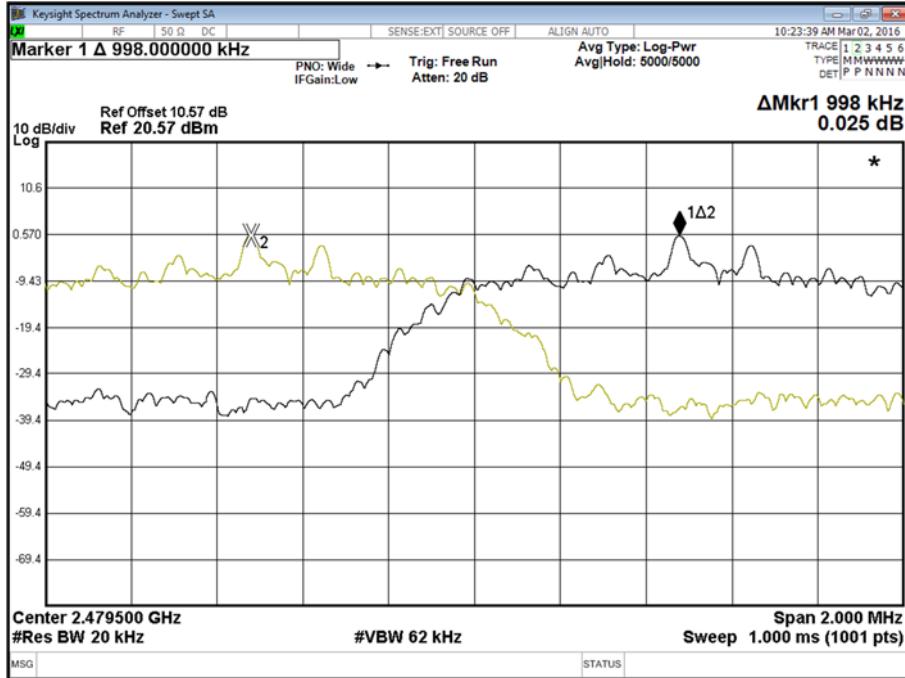
Bluetooth, 8-DPSK, Channel Separation Plot
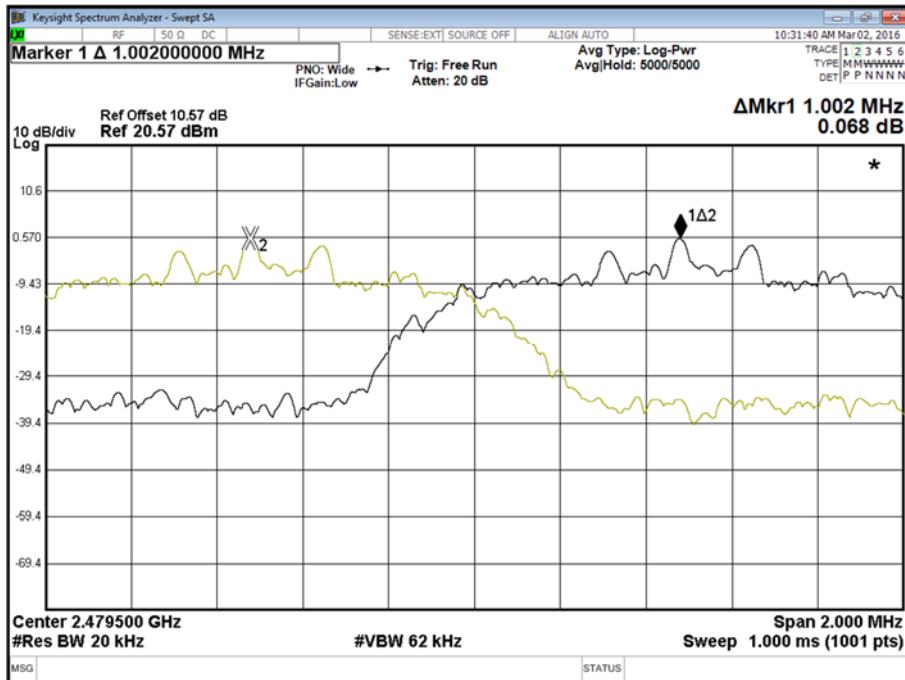
<u>FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)</u>

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 the systems operate with an output power no greater than 0.125 W.

<u>Industry Canada RSS-247, Limit Clause, 5.1(2)</u>

FHSs 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, FHSs 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.

2.3 FREQUENCY HOPPING SYSTEMS - NUMBER OF HOPPING CHANNELS

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)(iii)
RSS-247, Clause 5.1(4)

2.3.2 Equipment Under Test and Modification State

PC-010 S/N: Not Serialised (75933714-TSR0005) - Modification State 0

2.3.3 Date of Test

2 March 2016

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Test Procedure

The test was performed in accordance with ANSI C63.10, clause 7.8.3.

2.3.6 Environmental Conditions

Ambient Temperature   21.4°C
Relative Humidity   28.5%

2.3.7 Test Results

Bluetooth, Number of Hopping Channels Results

Number of Hopping Channels: 79

Bluetooth, Segment 1, DH1, Number of Hopping Channels Plot
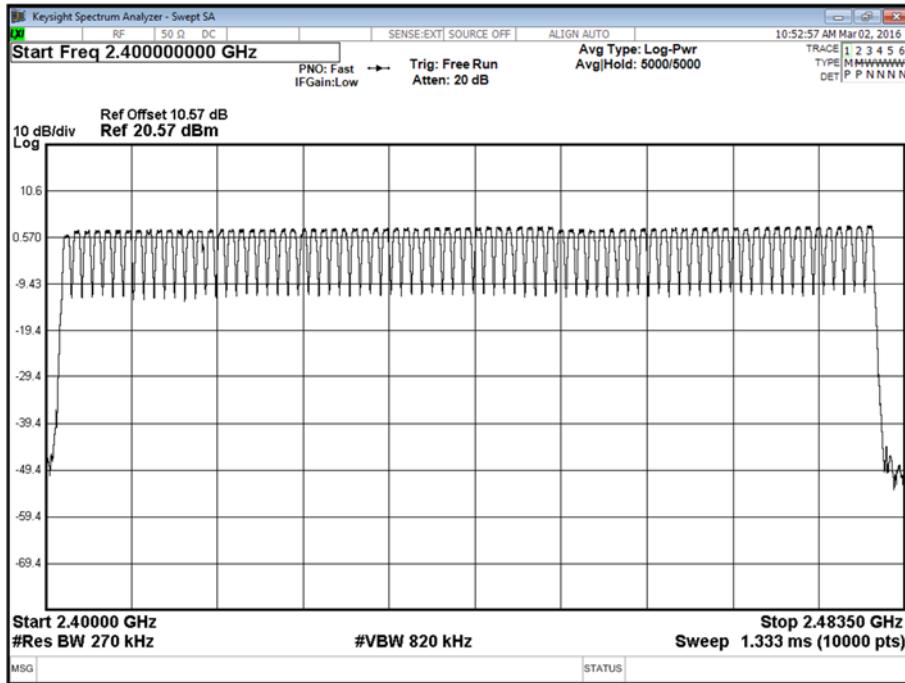
Bluetooth, Segment 1, DH3, Number of Hopping Channels Plot
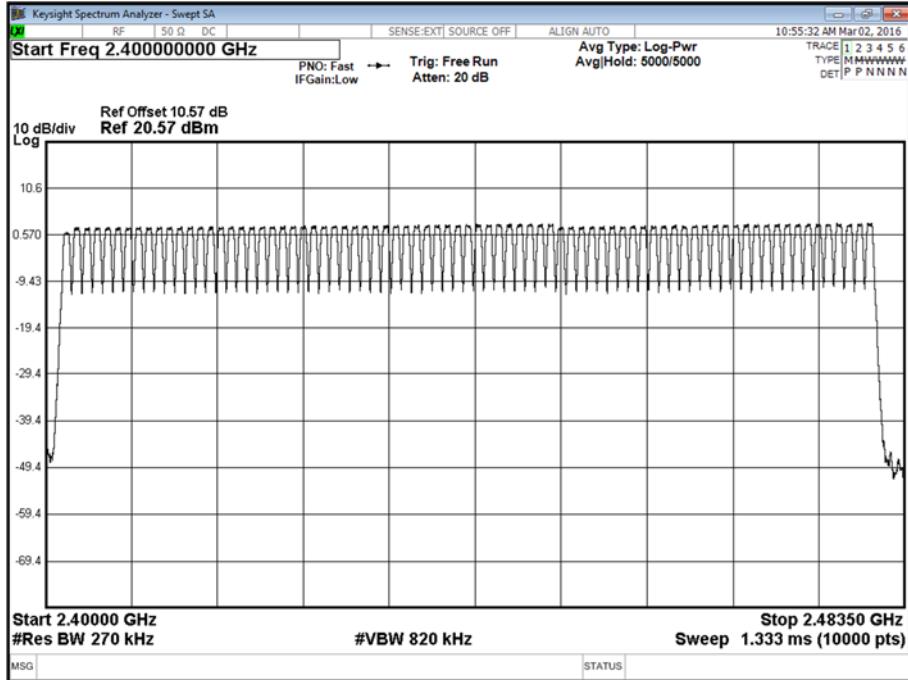
Bluetooth, Segment 1, DH5, Number of Hopping Channels Plot
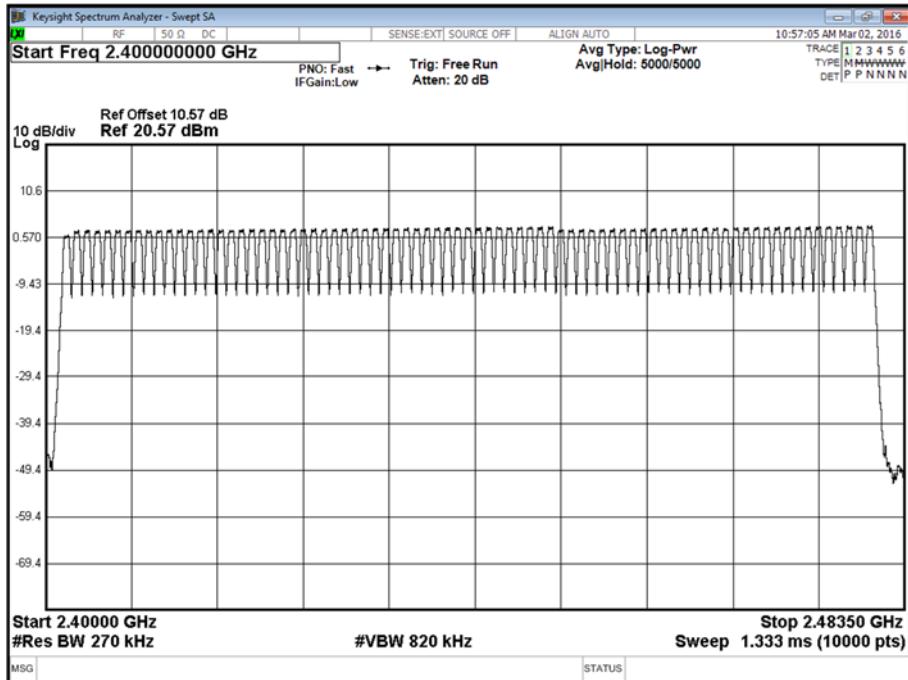
FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii) and Industry Canada RSS-247, Limit Clause, 5.1(4)

≥ 15 channels

2.4 FREQUENCY HOPPING SYSTEMS - 20 DB BANDWIDTH

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
RSS-247, Clause 5.1(1)

2.4.2 Equipment Under Test and Modification State

PC-010 S/N: Not Serialised (75933714-TSR0005) - Modification State 0

2.4.3 Date of Test

2 March 2016

2.4.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.5 Test Procedure

The test was performed in accordance with ANSI C63.10, clause 6.9.2.

2.4.6 Environmental Conditions

Ambient Temperature   21.4°C
Relative Humidity   28.5%

2.4.7 Test Results

3.7 V DC Supply

Bluetooth, 20 dB Bandwidth Results

Modulation	2402 MHz	2441 MHz	2480 MHz
	kHz	kHz	kHz
GFSK	940.02	937.22	936.39
pi/4 DQPSK	1269.93	1241.61	1263.05
8-DPSK	1255.22	1259.22	1261.79

Bluetooth, 2402 MHz, GFSK, 20 dB Bandwidth Plot
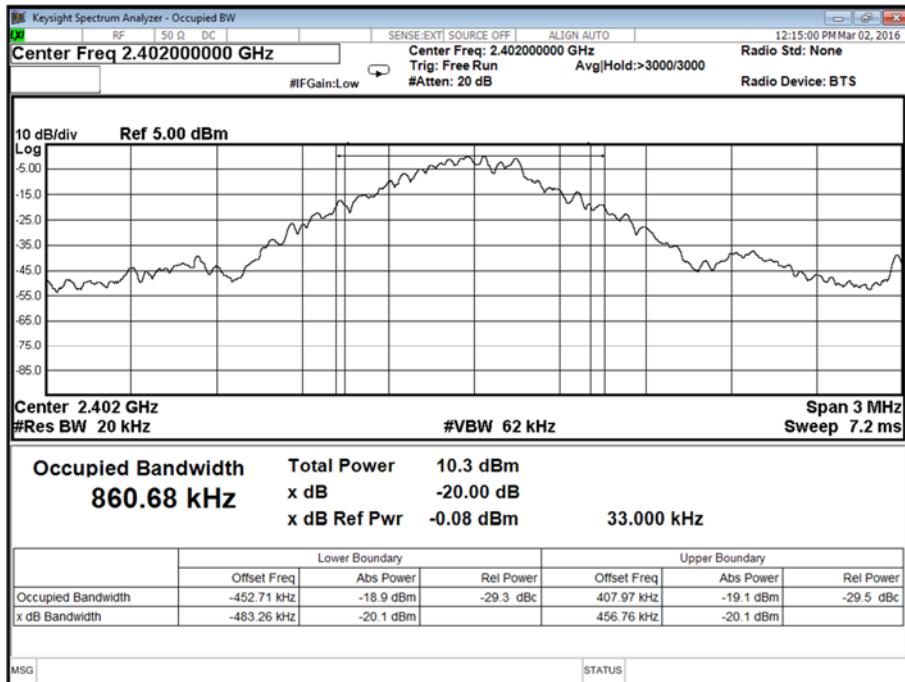
Bluetooth, 2402 MHz, pi/4 DQPSK, 20 dB Bandwidth Plot
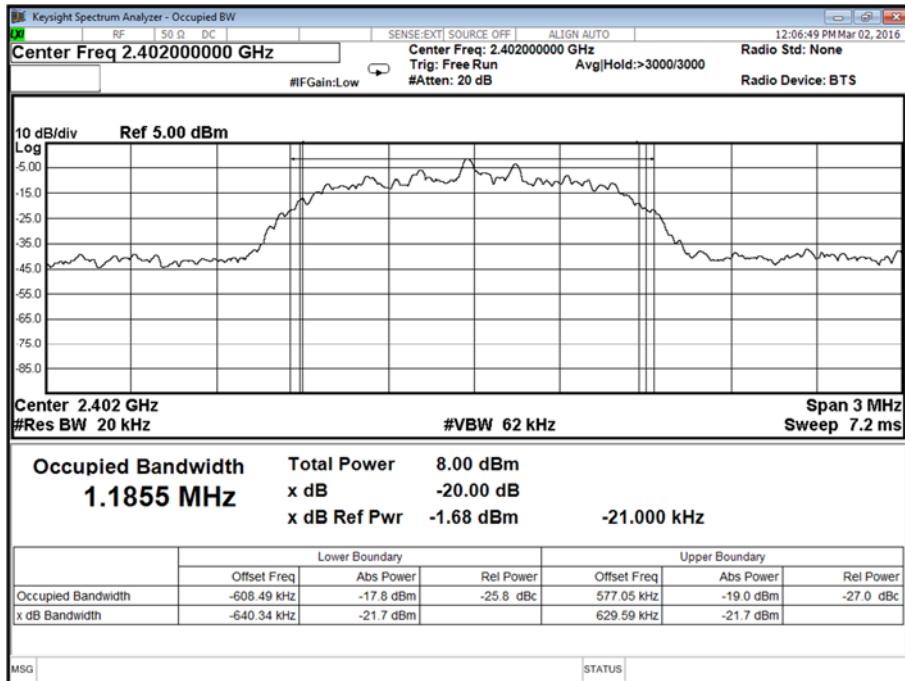
Bluetooth, 2402 MHz, 8-DPSK, 20 dB Bandwidth Plot
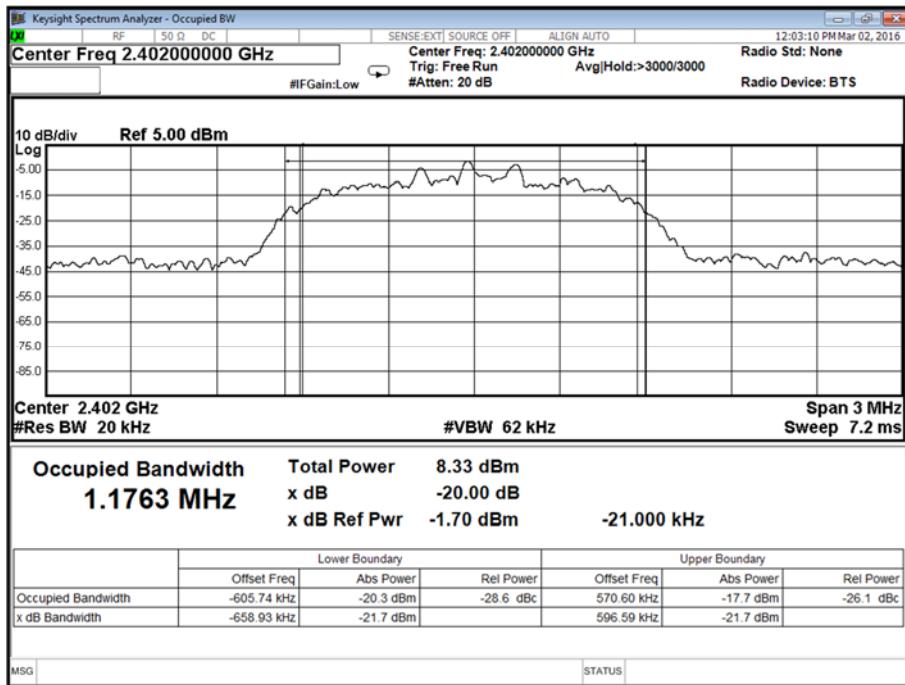
Bluetooth, 2441 MHz, GFSK, 20 dB Bandwidth Plot
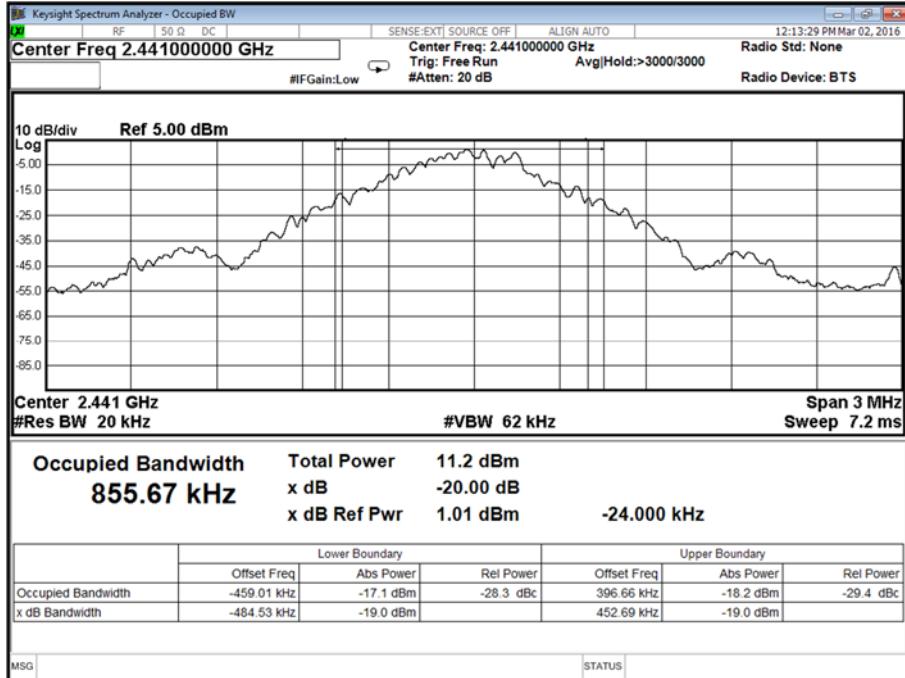
Bluetooth, 2441 MHz, pi/4 DQPSK, 20 dB Bandwidth Plot
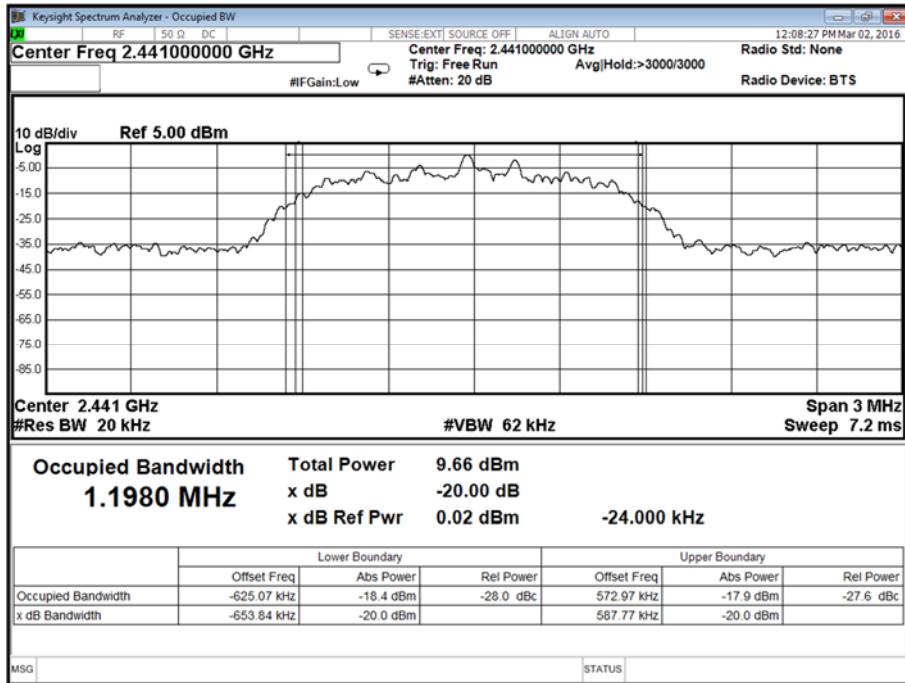
Bluetooth, 2441 MHz, 8-DPSK, 20 dB Bandwidth Plot
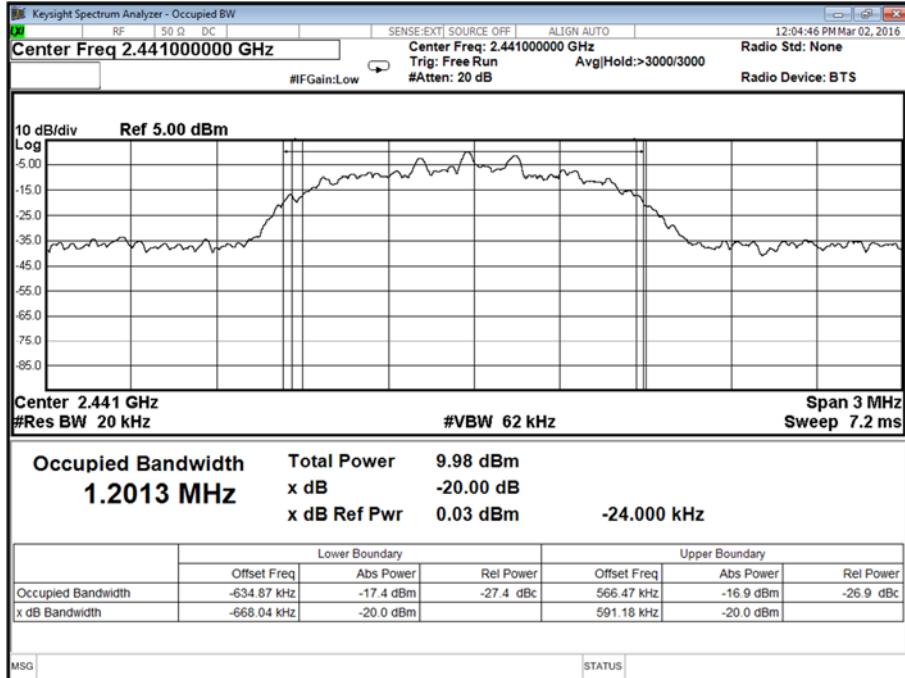
Bluetooth, 2480 MHz, GFSK, 20 dB Bandwidth Plot
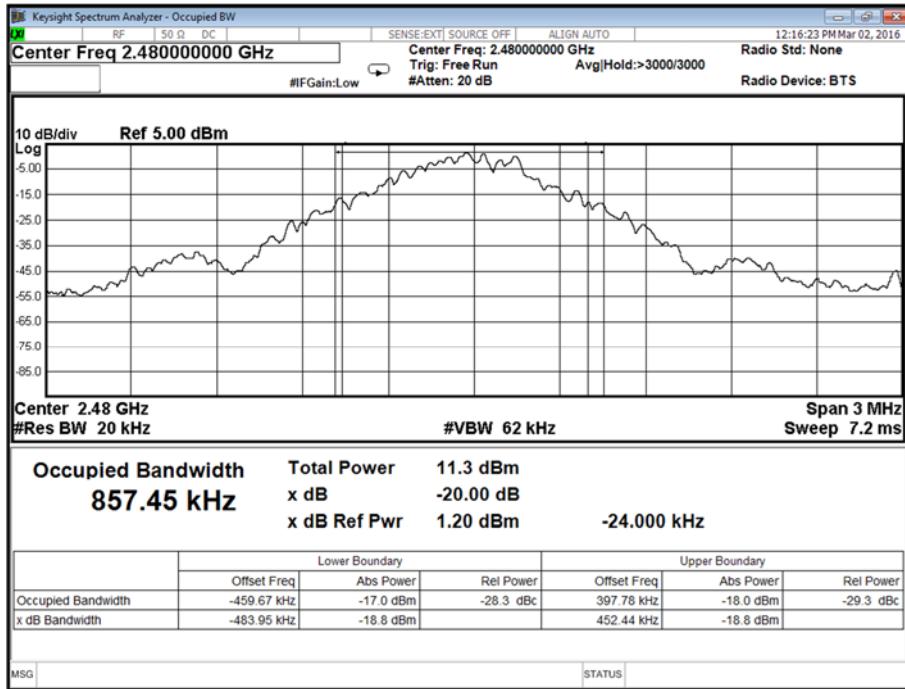
Bluetooth, 2480 MHz, pi/4 DQPSK, 20 dB Bandwidth Plot
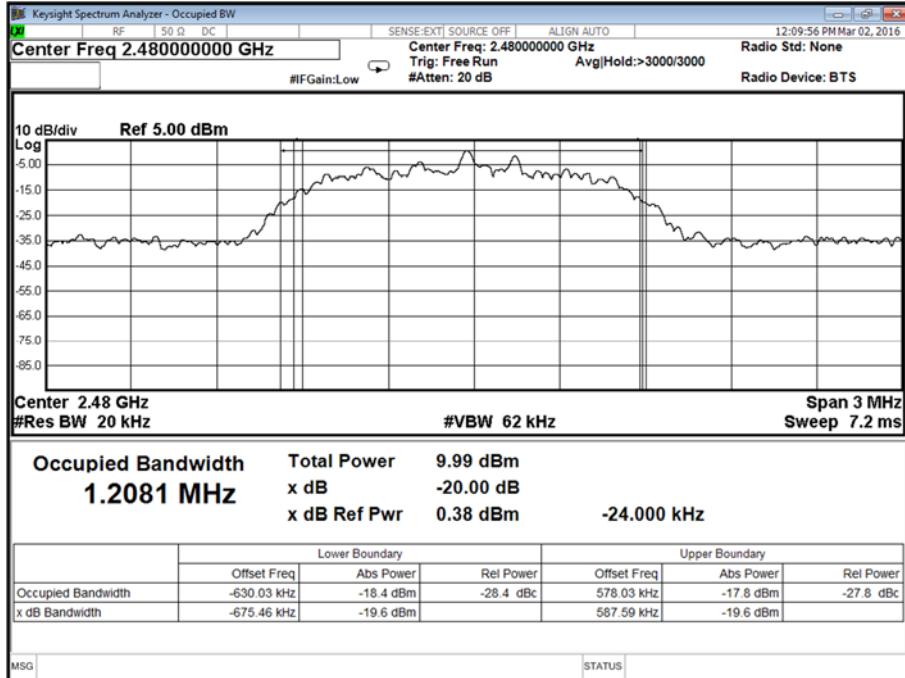
Bluetooth, 2480 MHz, 8-DPSK, 20 dB Bandwidth Plot
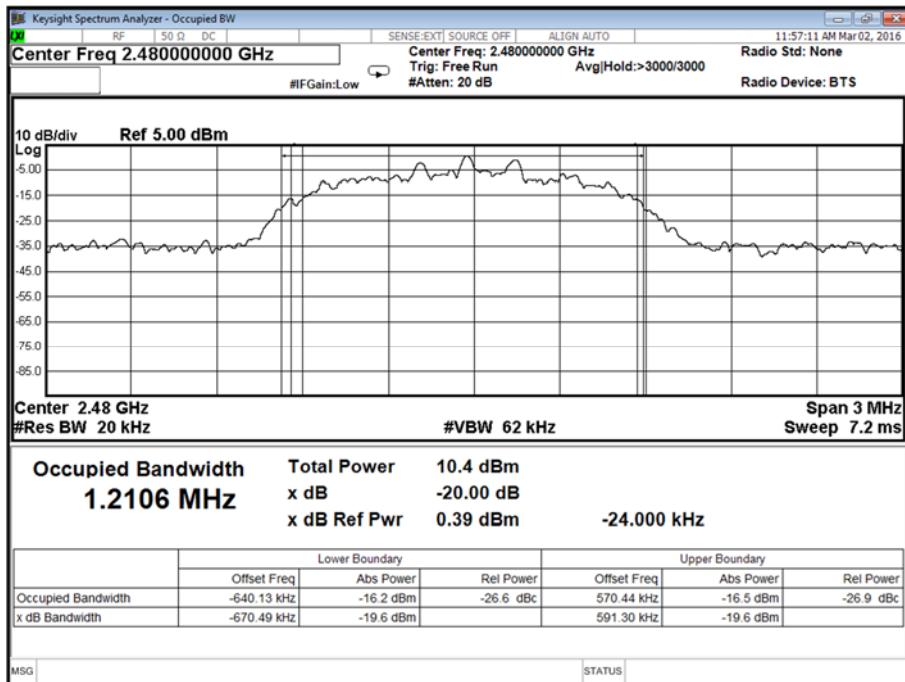
Remarks

The x bandwidth is shown on the plots by summing the lower and upper boundaries of the frequency offsets as shown in the table on the plots.

FCC 47 CFR Part 15, Limit Clause

None specified.

Industry Canada RSS-247, Limit Clause 5.1(1)

None specified.

2.5 FREQUENCY HOPPING SYSTEMS - AVERAGE TIME OF OCCUPANCY

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)(iii)
RSS-247, Clause 5.1(4)

2.5.2 Equipment Under Test and Modification State

PC-010 S/N: Not Serialised (75933714-TSR0005) - Modification State 0

2.5.3 Date of Test

2 March 2016 & 3 March 2016

2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.5 Test Procedure

The test was performed in accordance with ANSI C63.10, clause 7.8.4.

2.5.6 Environmental Conditions

Ambient Temperature   21.2 - 21.4°C
Relative Humidity   28.5 - 31.5%

2.5.7 Test Results

Bluetooth, Average Time of Occupancy Results

Packet Type	Dwell Time (ms)	Number of Transmissions	Average Occupancy Time (ms)
DH1	0.398	320	127.36
DH3	1.654	160	264.64
DH5	2.903	107	310.62

Bluetooth, DH1, Average Time of Occupancy Plot

Bluetooth, DH1, Total Average Time of Occupancy Plot
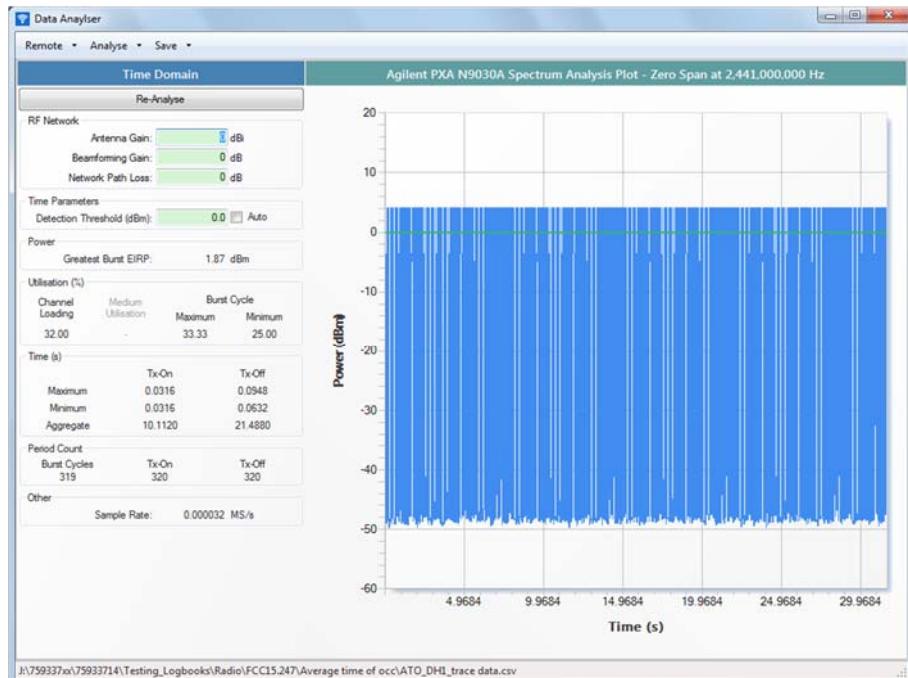

Bluetooth, DH3, Average Time of Occupancy Plot
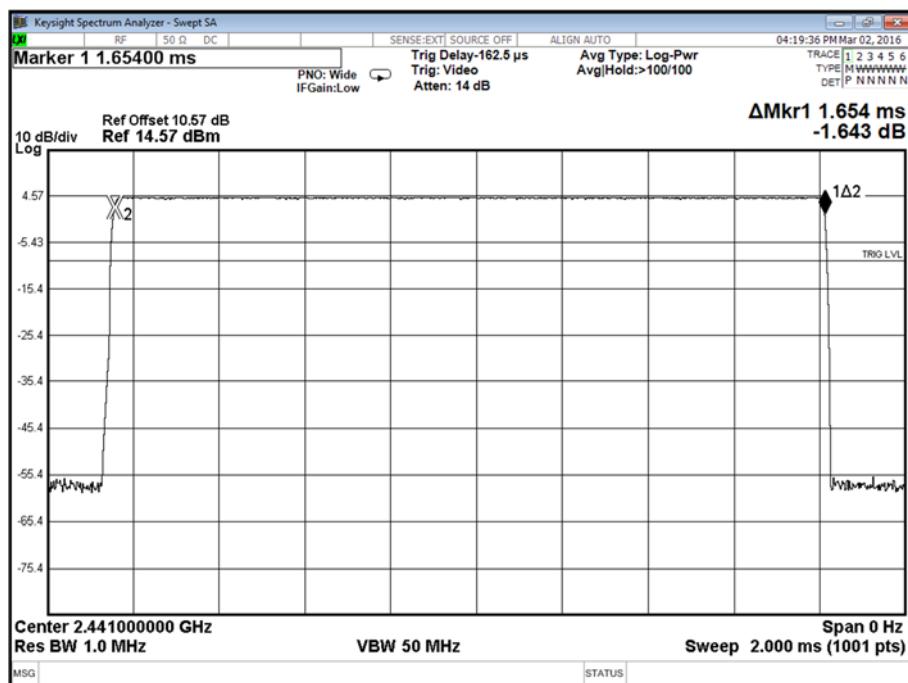
Bluetooth, DH3, Total Average Time of Occupancy Plot
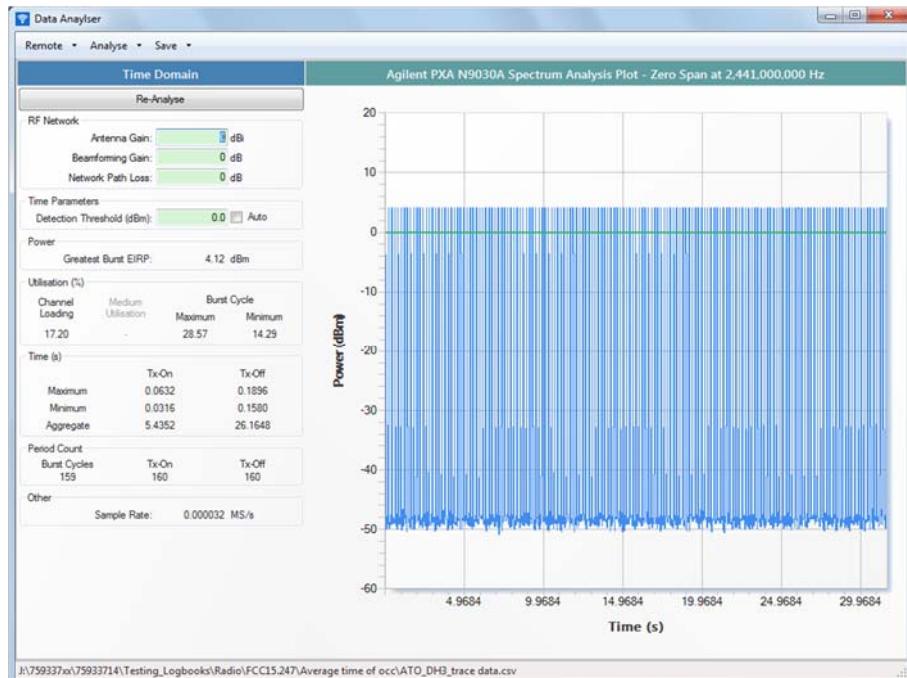
Bluetooth, DH5, Average Time of Occupancy Plot
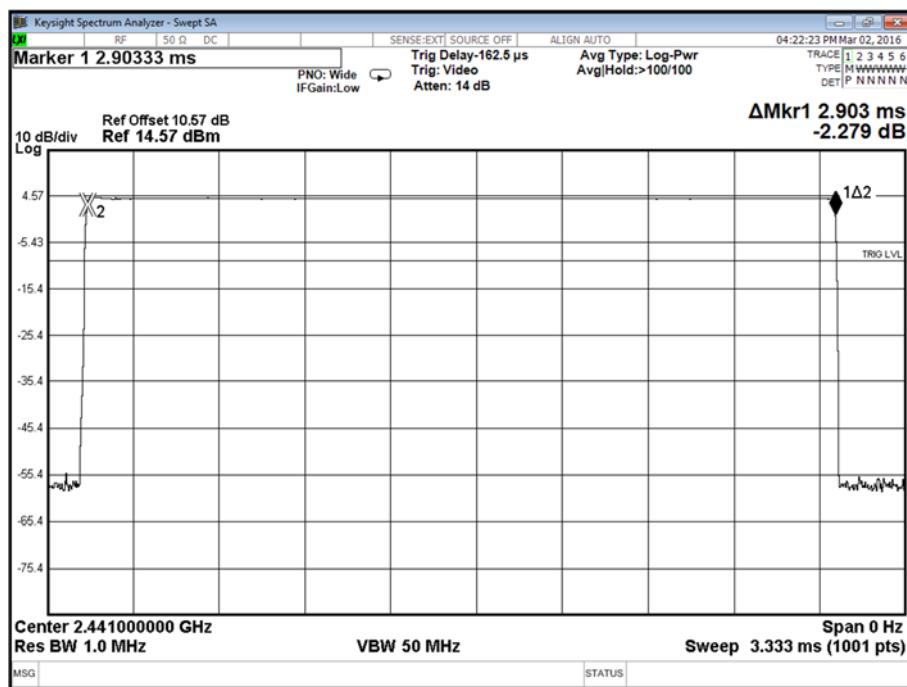
Bluetooth, DH5, Total Average Time of Occupancy Plot
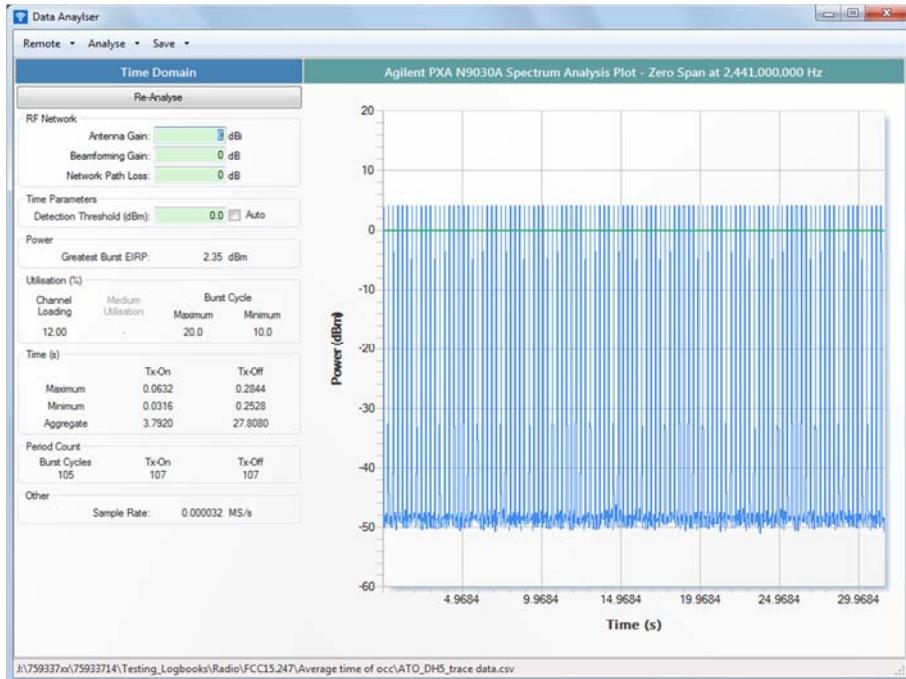
FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)

Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

Industry Canada RSS-247, Limit Clause, 5.1(4)

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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

2.6 MAXIMUM CONDUCTED OUTPUT POWER

2.6.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)(3)
RSS-247, Clause 5.4(2)

2.6.2 Equipment Under Test and Modification State

PC-010 S/N: Not Serialised (75933714-TSR0005) - Modification State 0

2.6.3 Date of Test

1 March 2016

2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Test Procedure

The test was performed in accordance with KDB 558074 D01 v03r02, clause 9.1.1 and Industry Canada RSS-GEN, clause 6.12.

2.6.6 Environmental Conditions

Ambient Temperature   23.6°C
Relative Humidity   43.1%

2.6.7 Test Results

3.7 V DC Supply

Bluetooth, DH5, Maximum Conducted Output Power Results

| 2402 MHz		2441 MHz		2480 MHz	
dBm	mW	dBm	mW	dBm	mW
3.373	2.174	4.167	2.610	4.249	2.660

Bluetooth, 2402 MHz, GFSK, DH5, Maximum Conducted Output Power Plot
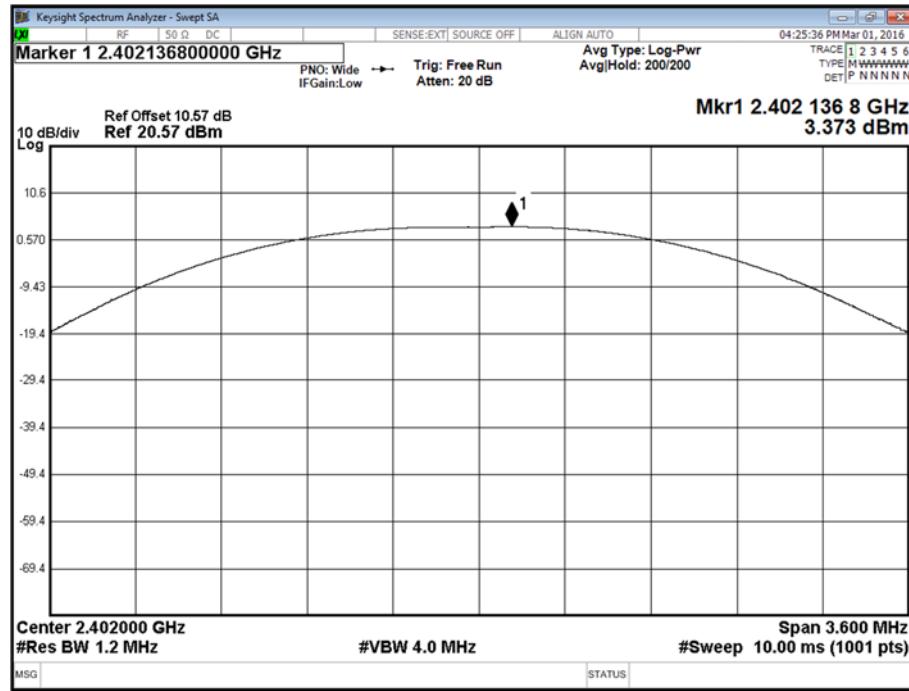
Bluetooth, 2441 MHz, GFSK, DH5, Maximum Conducted Output Power Plot
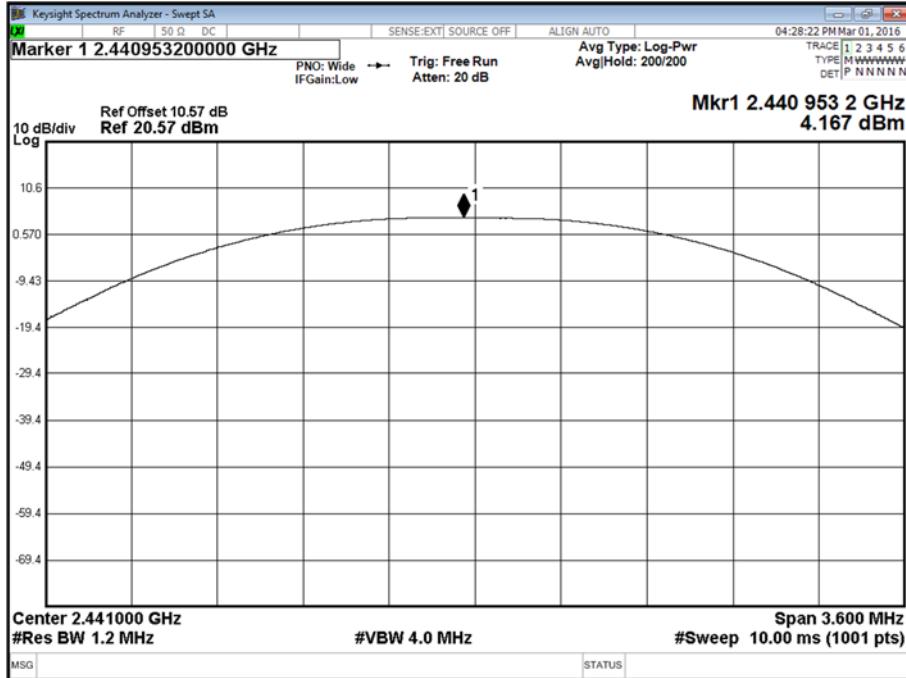
Bluetooth, 2480 MHz, GFSK, DH5, Maximum Conducted Output Power Plot
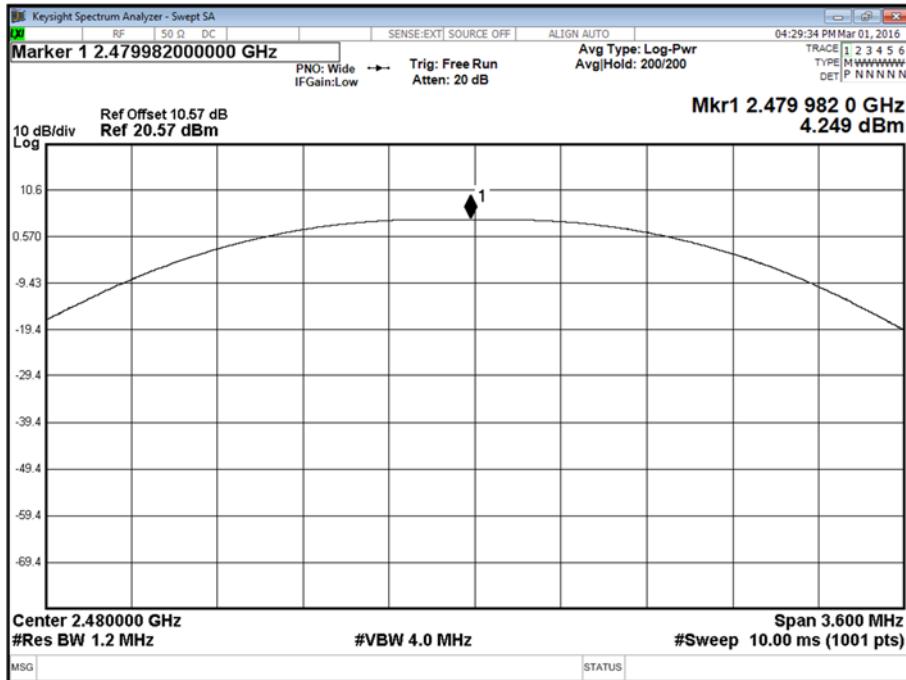
FCC 47 CFR Part 15, Limit Clause 15.247 (b)

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non overlapping hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

Industry Canada RSS-247, Limit Clause, 5.4(2)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels.

2.7 SPURIOUS RADIATED EMISSIONS

2.7.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d), 15.205 and 15.209
RSS-247, Clause 5.5

2.7.2 Equipment Under Test and Modification State

PC-010 S/N: Not Serialised (75933714-TSR0005) - Modification State 0
PC-010 S/N: Not Serialised (75933714-TSR0007) - Modification State 0

2.7.3 Date of Test

1 March 2016 and 9 March 2016

2.7.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.5 Test Procedure

The test was performed in accordance with ANSI C63.10, clause 6.3, 6.5, 6.6 and 7.5.

2.7.6 Environmental Conditions

Ambient Temperature   20.2-22.9°C
Relative Humidity   35.0-30.8%

2.7.7 Test Results

3.7 V DC Supply

Bluetooth, 2402 MHz, DH5, 30 MHz to 1 GHz, Spurious Radiated Emissions Results

Frequency (MHz)	QP Level (dBµV/m)	QP Margin (dBµV/m)	QP Level (µV/m)	QP Margin (µV/m)	Angle (°)	Height (m)	Polarisation
332.035	34.6	-11.4	53.7	-146.3	201	1.08	Horizontal
960.000	34.4	-11.6	52.5	-147.5	0	2.31	Vertical

Bluetooth, 2402 MHz, DH5, 30 MHz to 1 GHz, Spurious Radiated Emissions Plot
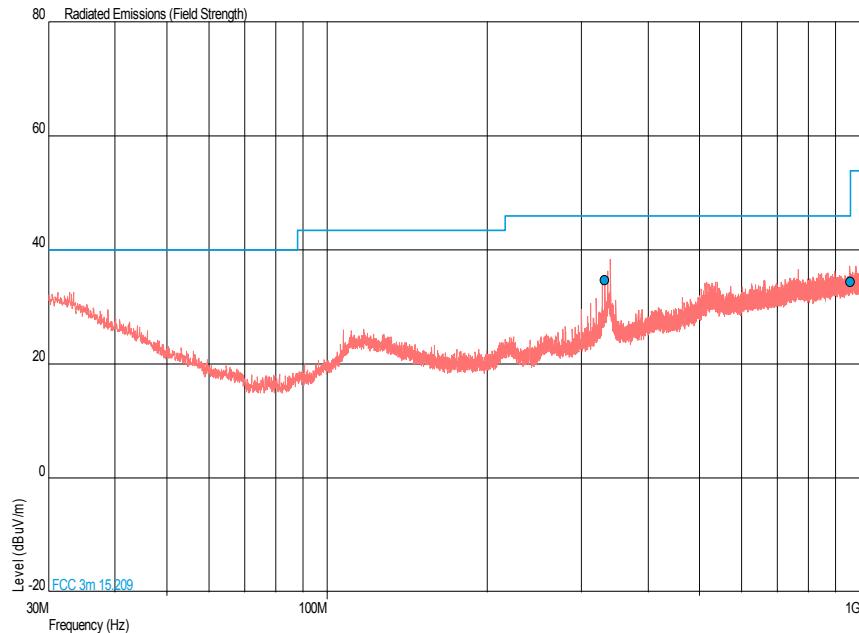
Bluetooth, 2402 MHz, DH5, 1 GHz to 25 GHz, Spurious Radiated Emissions Results

Frequency (MHz)	Final Peak (dBµV/m)	Final Average (dBµV/m)	Final Peak (µV/m)	Final Average (µV/m)	Angle (°)	Height (m)	Polarisation
2494.125	53.75	44.40	486.97	165.96	115	1.00	Horizontal

No other emissions were detected within 10 dB of the limit.

Bluetooth, 2402 MHz, DH5, 1 GHz to 3 GHz, Spurious Radiated Emissions Plot
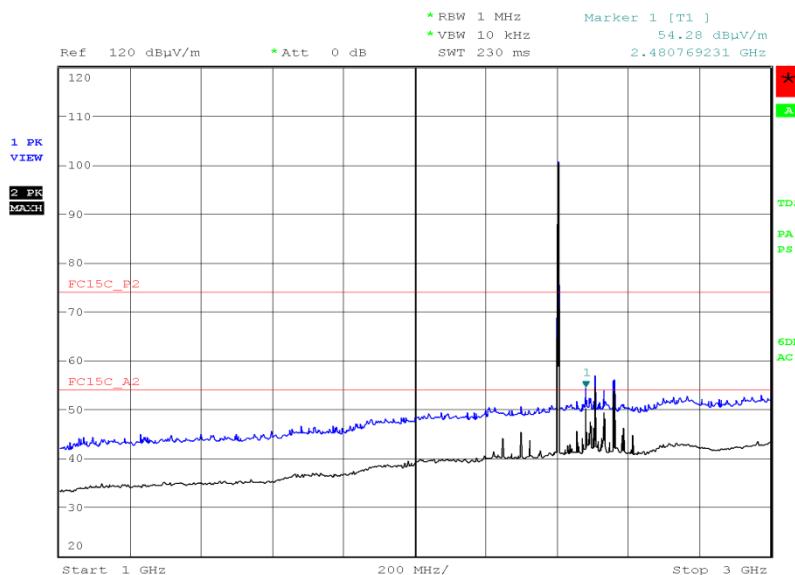
Date: 23.FEB.2016 20:38:59

Bluetooth, 2402 MHz, DH5, 3 GHz to 8 GHz, Spurious Radiated Emissions Plot
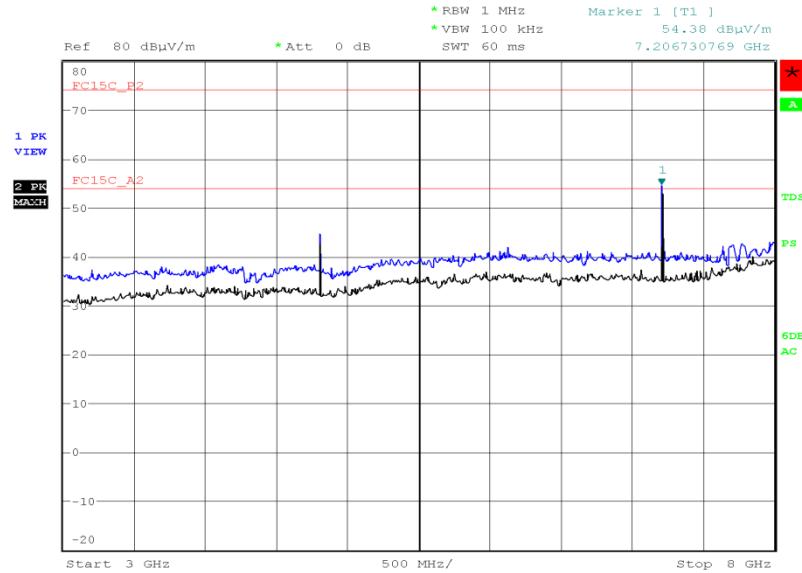
Date: 23.FEB.2016 22:41:48

Bluetooth, 2402 MHz, DH5, 8 GHz to 18 GHz, Spurious Radiated Emissions Plot
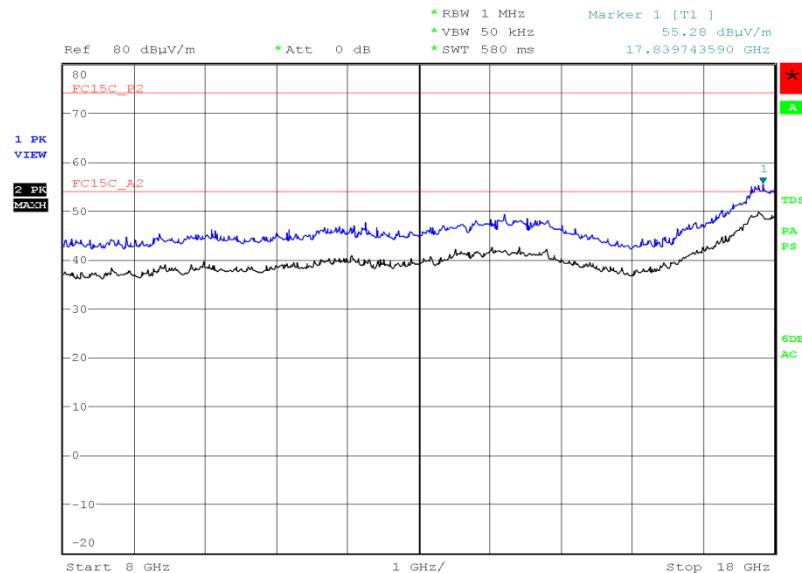
Date: 1.MAR.2016 18:58:38

Bluetooth, 2402 MHz, DH5, 18 GHz to 25 GHz, Spurious Radiated Emissions Plot


```
                                      *RBW  1 MHz      Marker 1 [T1 ]
                                      *VBW  50 kHz           55.49 dBμV/m
      Ref   90 dBμV/m      *Att  0 dB  *SWT 580 ms      23.530448718 GHz
```
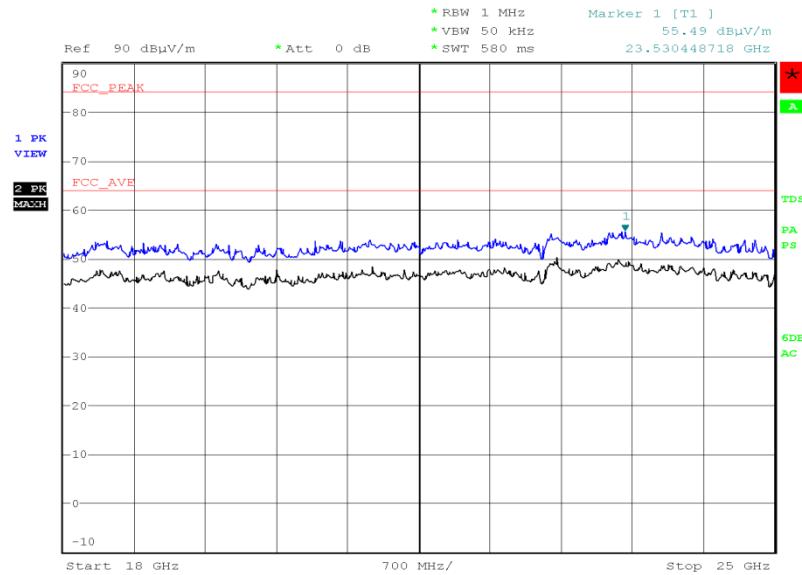
Date: 1.MAR.2016 19:34:31

Bluetooth, 2441 MHz, DH5, 30 MHz to 1 GHz, Spurious Radiated Emissions Results

Frequency (MHz)	QP Level (dBµV/m)	QP Margin (dBµV/m)	QP Level (µV/m)	QP Margin (µV/m)	Angle (°)	Height (m)	Polarisation
335.973	34.0	-12.0	50.1	-149.9	29	1.00	Horizontal
344.008	38.6	-7.4	85.1	-114.9	207	1.00	Horizontal
960.000	34.3	-11.7	51.9	-148.1	322	3.44	Vertical

Bluetooth, 2441 MHz, DH5, 30 MHz to 1 GHz, Spurious Radiated Emissions Plot
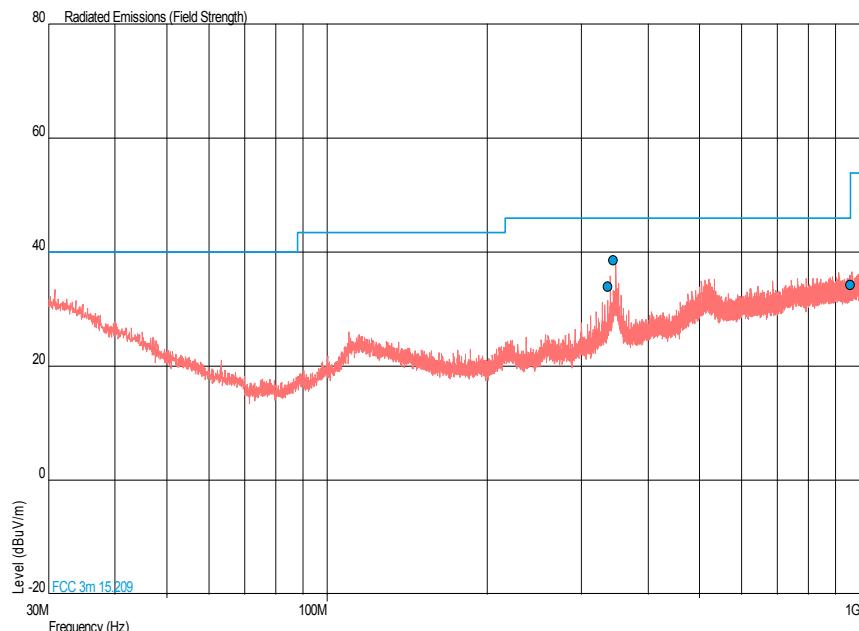
Bluetooth, 2441 MHz, DH5, 1 GHz to 25 GHz, Spurious Radiated Emissions Results

Frequency (MHz)	Final Peak (dBµV/m)	Final Average (dBµV/m)	Final Peak (µV/m)	Final Average (µV/m)	Angle (°)	Height (m)	Polarisation
2494.454	53.78	44.04	488.65	159.22	103	1.00	Horizontal
7323.010	62.29	32.45	1301.67	41.93*	100	154	Horizontal

No other emissions were detected within 10 dB of the limit.

*Emission has been corrected using a calculated duty cycle correction factor. See Annex A for details.

Bluetooth, 2441 MHz, DH5, 1 GHz to 3 GHz, Spurious Radiated Emissions Plot
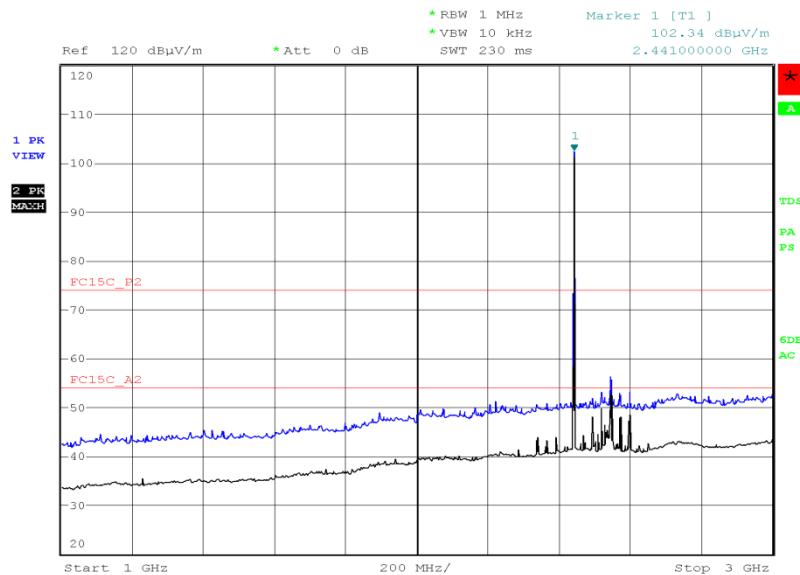
Date: 23.FEB.2016 21:11:55

Bluetooth, 2441 MHz, DH5, 3 GHz to 8 GHz, Spurious Radiated Emissions Plot
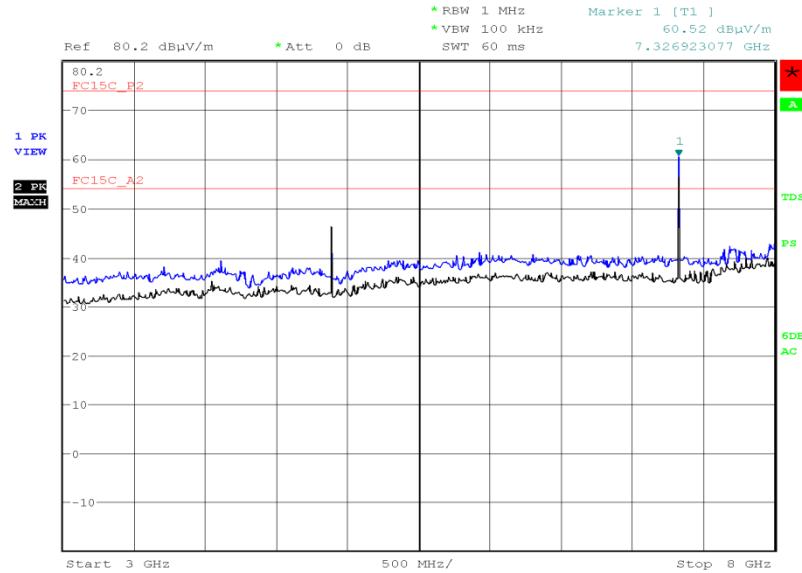
Date: 23.FEB.2016 23:09:55

Bluetooth, 2441 MHz, DH5, 8 GHz to 18 GHz, Spurious Radiated Emissions Plot
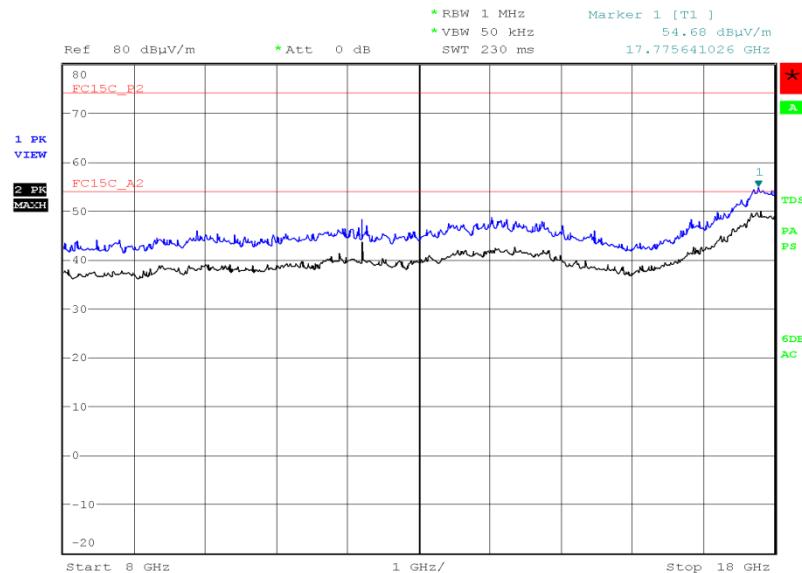
Date: 1.MAR.2016 18:48:18

Bluetooth, 2441 MHz, DH5, 18 GHz to 25 GHz, Spurious Radiated Emissions Plot
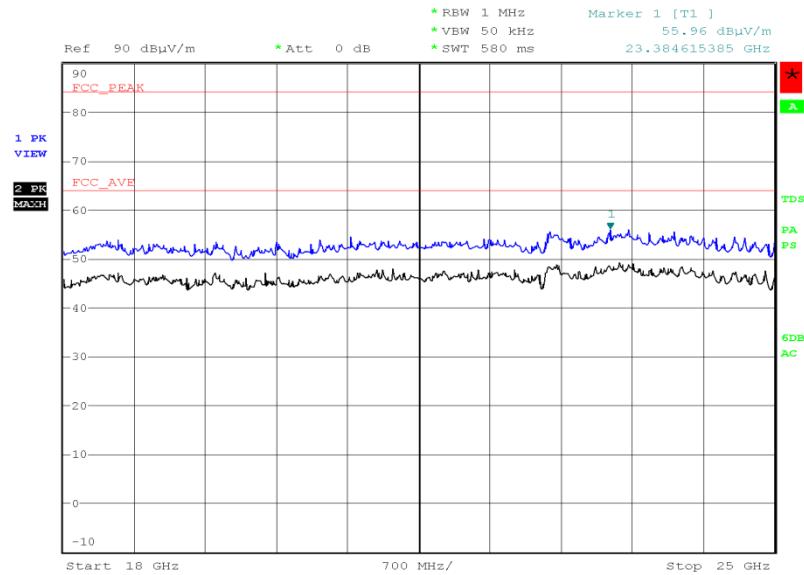
Date: 1.MAR.2016 19:39:30

Bluetooth, 2480 MHz, DH5, 30 MHz to 1 GHz, Spurious Radiated Emissions Results

Frequency (MHz)	QP Level (dBµV/m)	QP Margin (dBµV/m)	QP Level (µV/m)	QP Margin (µV/m)	Angle (°)	Height (m)	Polarisation
443.989	33.9	-12.1	49.5	-150.5	30	1.00	Horizontal
472.035	33.9	-12.1	49.5	-150.5	42	2.29	Horizontal
960.000	34.4	-11.6	52.5	-147.5	325	1.00	Horizontal

Bluetooth, 2480 MHz, DH5, 30 MHz to 1 GHz, Spurious Radiated Emissions Plot
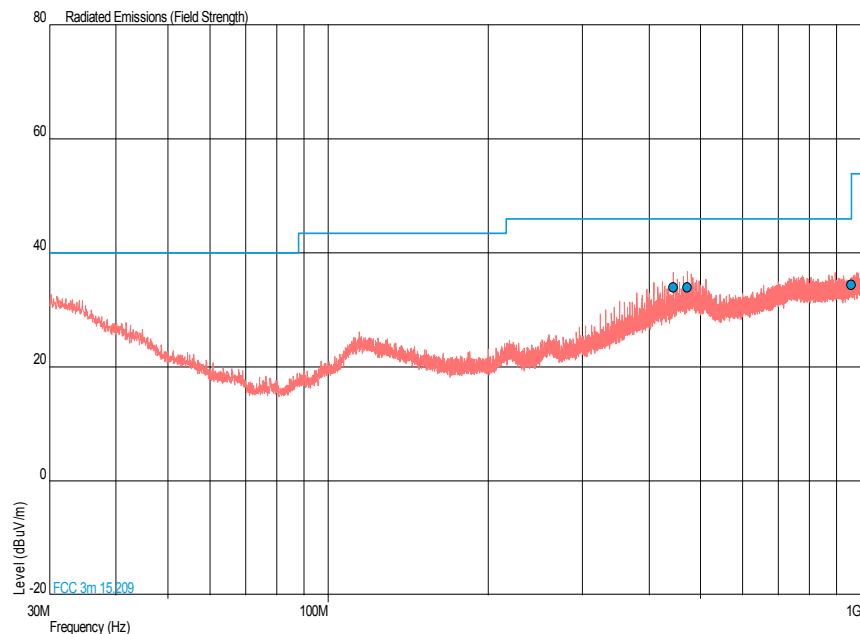
Bluetooth, 2480 MHz, DH5, 1 GHz to 25 GHz, Spurious Radiated Emissions Results

Frequency (MHz)	Final Peak (dBµV/m)	Final Average (dBµV/m)	Final Peak (µV/m)	Final Average (µV/m)	Angle (°)	Height (m)	Polarisation
7439.467	62.29	32.07*	1301.67	40.13	107	387	Horizontal

No other emissions were detected within 10 dB of the limit.

*Emission has been corrected using a calculated duty cycle correction factor. See Annex A for details.

Bluetooth, 2480 MHz, DH5, 1 GHz to 3 GHz, Spurious Radiated Emissions Plot
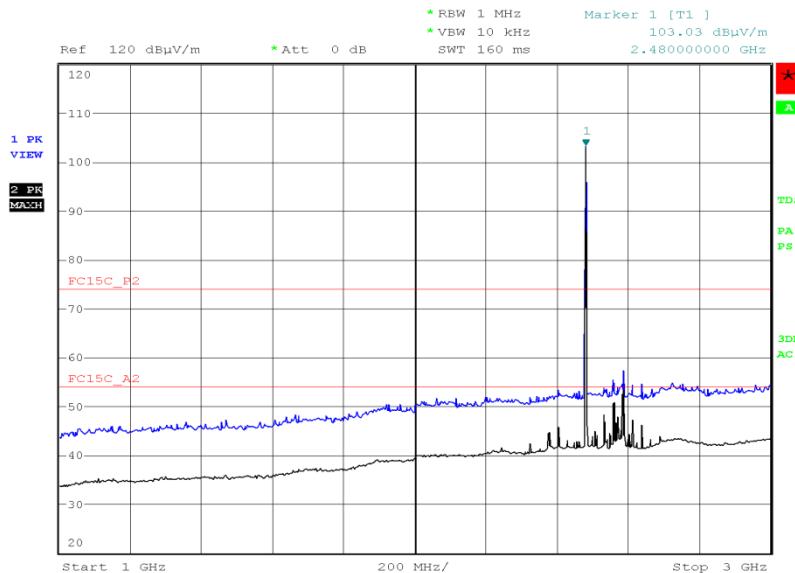
Date: 23.FEB.2016 21:31:01

Bluetooth, 2480 MHz, DH5, 3 GHz to 8 GHz, Spurious Radiated Emissions Plot
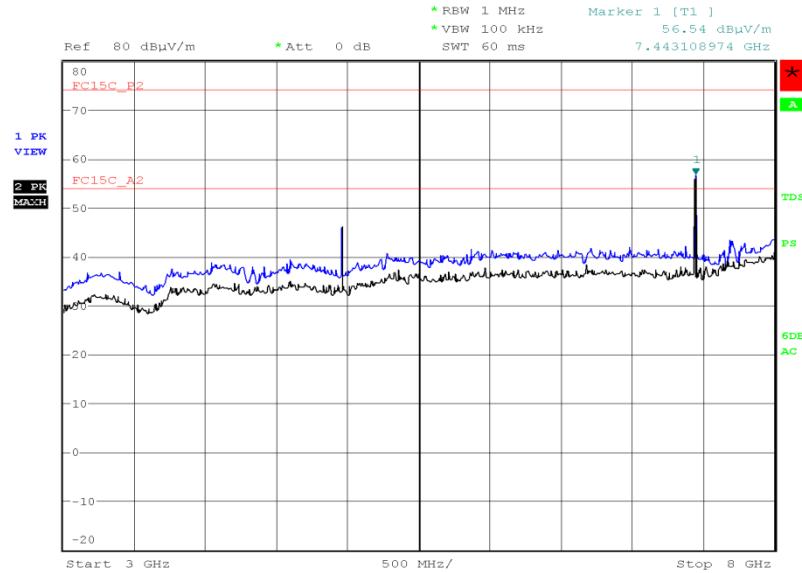

Date: 1.MAR.2016 17:55:07

Bluetooth, 2480 MHz, DH5, 8 GHz to 18 GHz, Spurious Radiated Emissions Plot
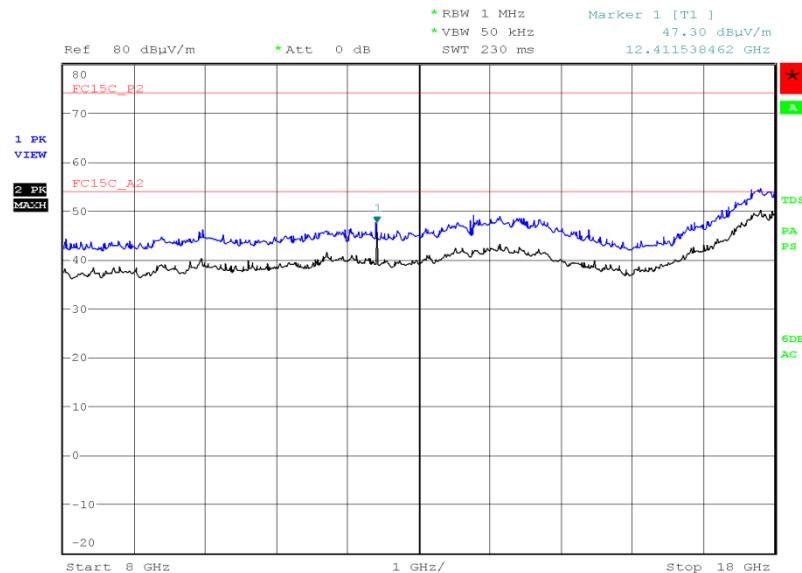
Date: 1.MAR.2016 18:38:44

Bluetooth, 2480 MHz, DH5, 18 GHz to 25 GHz, Spurious Radiated Emissions Plot
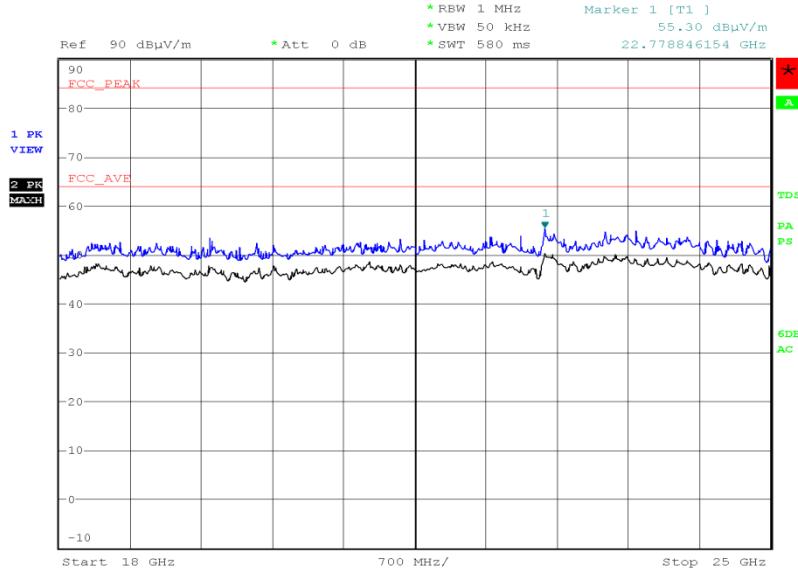
Date: 1.MAR.2016 19:51:29

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

Emissions outside the restricted bands shall be at least 20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

FCC 47 CFR Part 15, Limit Clause 15.205

	Peak (dBµV/m)	Average (dBµV/m)
Restricted Bands of Operation	74	54

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength			Measurement Distance (m)
	(µV/m)	Average (dBµV/m)	Peak (dBµV/m)	
30-88	100	40.0	60.0	3
88-216	150	43.5	63.5	3
216-960	200	46.0	66.0	3
Above 960	500	54.0	74.0	3

Industry Canada RSS-247, Limit Clause, 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power,

based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.8 RESTRICTED BAND EDGES

2.8.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205
RSS-GEN, Clause 8.10

2.8.2 Equipment Under Test and Modification State

PC-010 S/N: Not Serialised (75933714-TSR0007) - Modification State 0

2.8.3 Date of Test

23 February 2016 & 2 March 2016

2.8.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.8.5 Test Procedure

The test was performed in accordance with ANSI C63.10, clause 6.10.5

2.8.6 Environmental Conditions

Ambient Temperature   18.4 - 20.6°C
Relative Humidity   25.0 - 30.0%

2.8.7 Test Results

3.7 V DC Supply

<u>Hopping Mode</u>

<u>Bluetooth, GFSK, Restricted Band Edges Results</u>

2402 MHz		2480 MHz	
Measured Frequency 2390 MHz		Measured Frequency 2483.5 MHz	
dBµV/m		dBµV/m	
Final Peak	Final Average	Final Peak	Final Average
59.00	47.68	58.47	47.62

<u>Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, GFSK, Final Peak, Restricted Band Edges Plot</u>
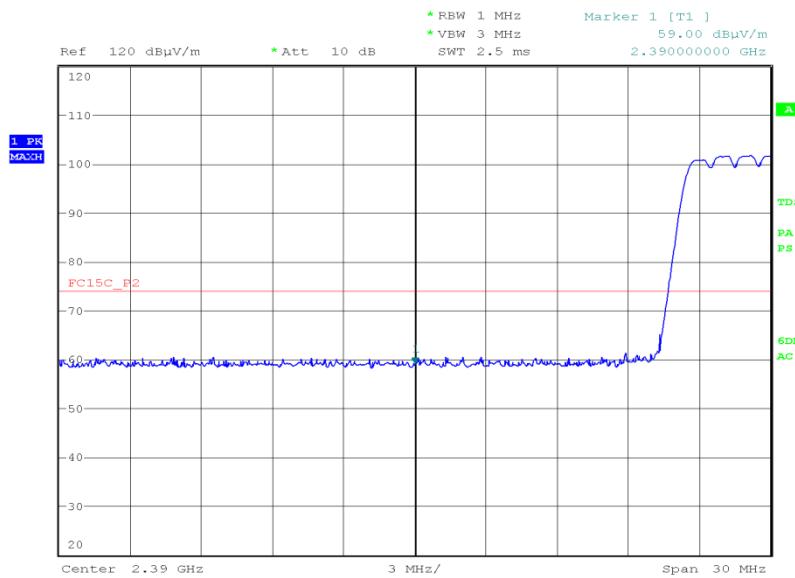

Date: 23.FEB.2016 22:06:41

Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, GFSK, Final Average, Restricted Band Edges Plot
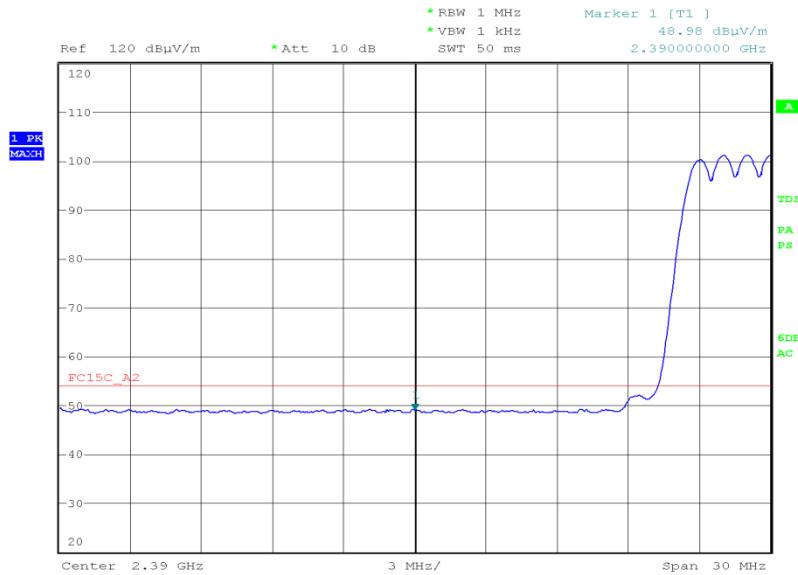
Date: 23.FEB.2016 22:07:26

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, GFSK, Final Peak, Restricted Band Edges Plot

Date: 23.FEB.2016 22:14:27

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, GFSK, Final Average, Restricted Band Edges Plot
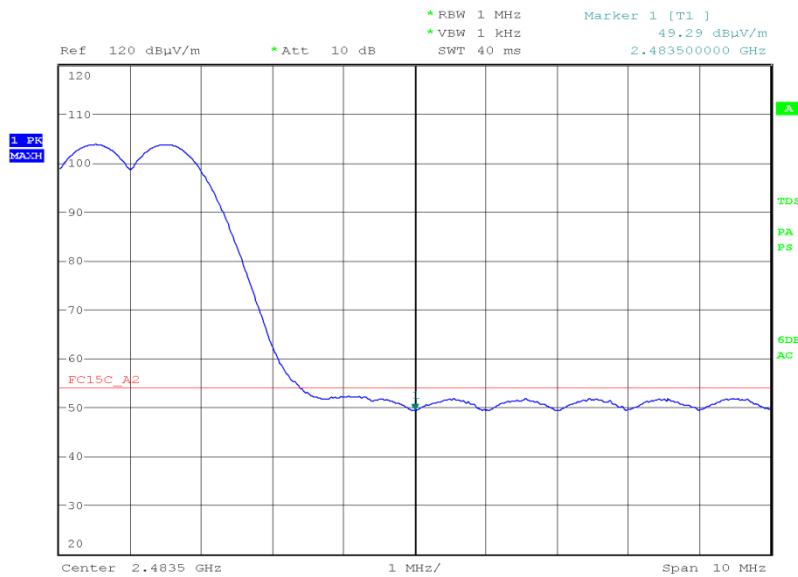

Date: 23.FEB.2016 22:17:15

Bluetooth, pi/4 DQPSK, Restricted Band Edges Results

2402 MHz		2480 MHz	
Measured Frequency 2390 MHz		Measured Frequency 2483.5 MHz	
dBµV/m		dBµV/m	
Final Peak	Final Average	Final Peak	Final Average
58.96	47.90	59.54	47.84

Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, pi/4 DQPSK, Final Peak, Restricted Band Edges Plot
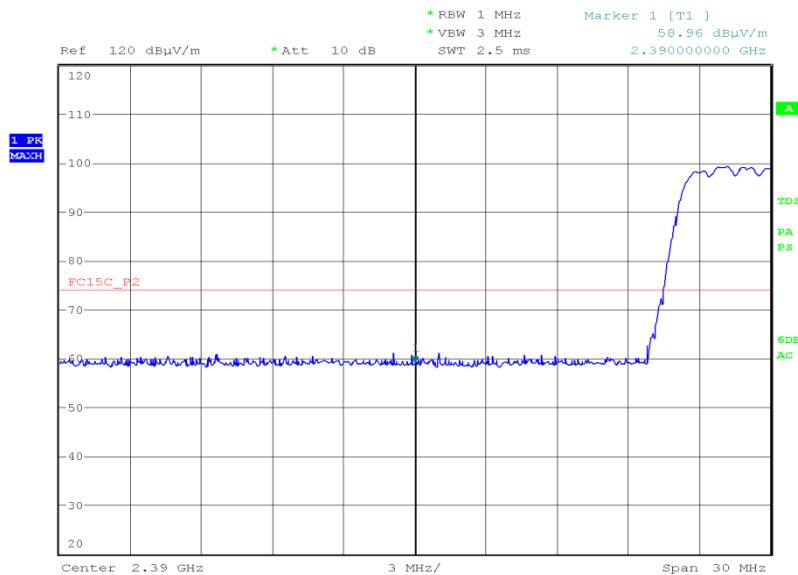

Date: 2.MAR.2016 19:36:01

Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, pi/4 DQPSK, Final Average, Restricted Band Edges Plot
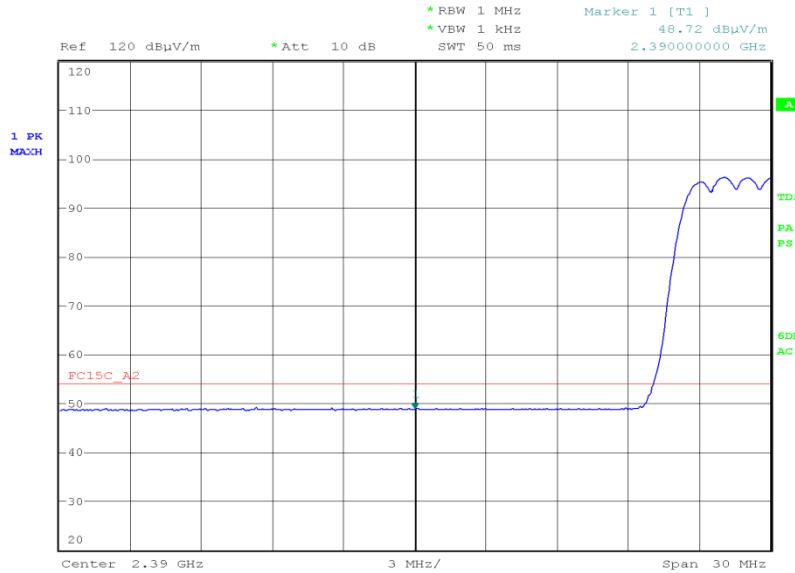
Date: 2.MAR.2016 19:34:34

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, pi/4 DQPSK, Final Peak, Restricted Band Edges Plot


Date: 2.MAR.2016 19:26:15

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, pi/4 DQPSK, Final Average, Restricted Band Edges Plot
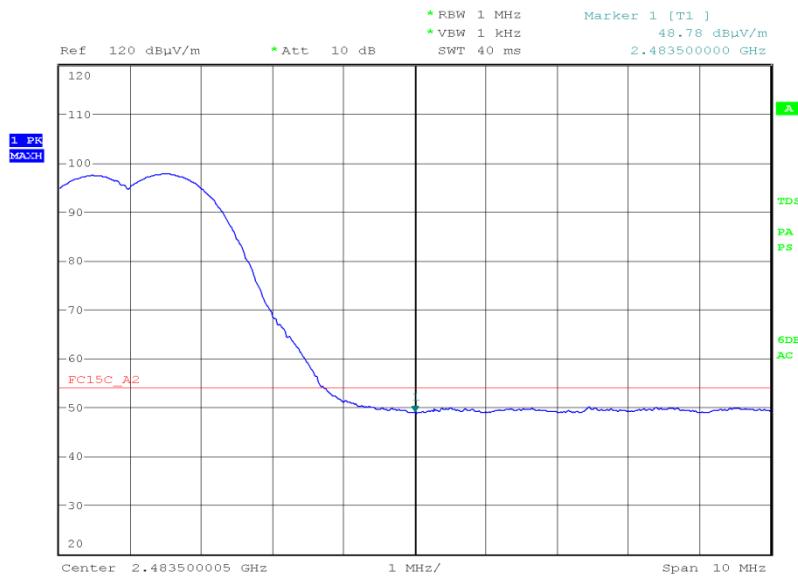

Date: 2.MAR.2016 19:26:43

Bluetooth, 8-DPSK, Restricted Band Edges Results

2402 MHz		2480 MHz	
Measured Frequency 2390 MHz		Measured Frequency 2483.5 MHz	
dBµV/m		dBµV/m	
Final Peak	Final Average	Final Peak	Final Average
58.72	47.91	58.76	47.89

### Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, 8-DPSK, Final Peak, Restricted Band Edges Plot
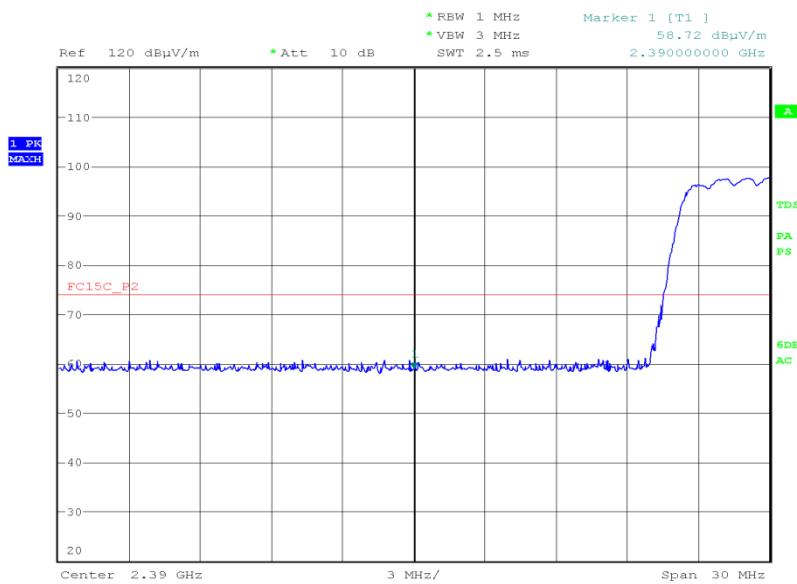

Date: 2.MAR.2016 19:06:14

Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, 8-DPSK, Final Average, Restricted Band Edges Plot
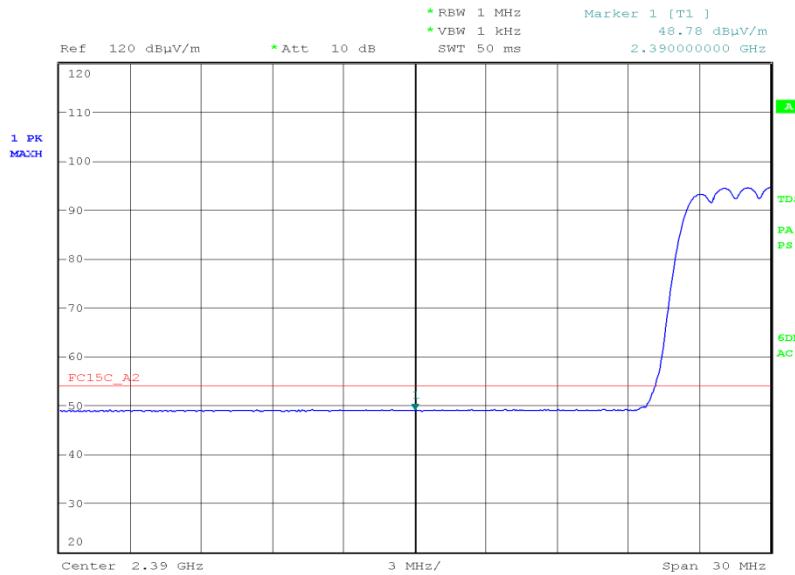
Date: 2.MAR.2016 19:00:42

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, 8-DPSK, Final Peak, Restricted Band Edges Plot

Date: 2.MAR.2016 19:13:29

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, 8-DPSK, Final Average, Restricted Band Edges Plot
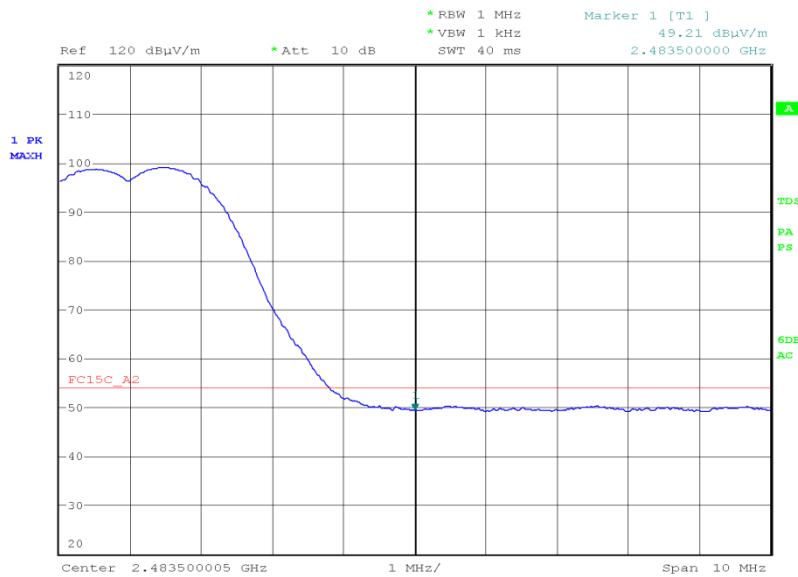

Date: 2.MAR.2016 19:14:15

Static Mode

Bluetooth, GFSK, Restricted Band Edges Results

2402 MHz		2480 MHz,	
Measured Frequency 2390 MHz		Measured Frequency 2483.5 MHz	
dBµV/m		dBµV/m	
Final Peak	Final Average	Final Peak	Final Average
59.37	47.67	59.45	48.02

Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, GFSK, Final Peak, Restricted Band Edges Plot
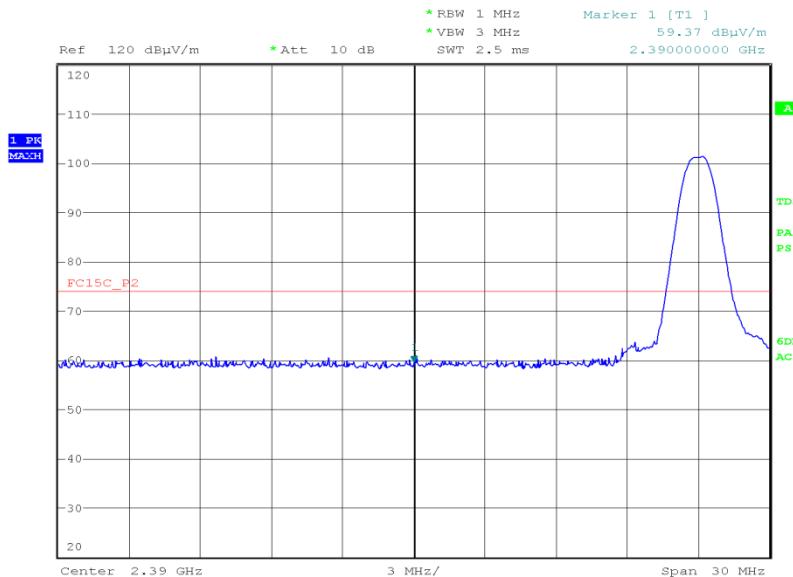

Date: 23.FEB.2016 20:26:11

Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, GFSK, Final Average, Restricted Band Edges Plot
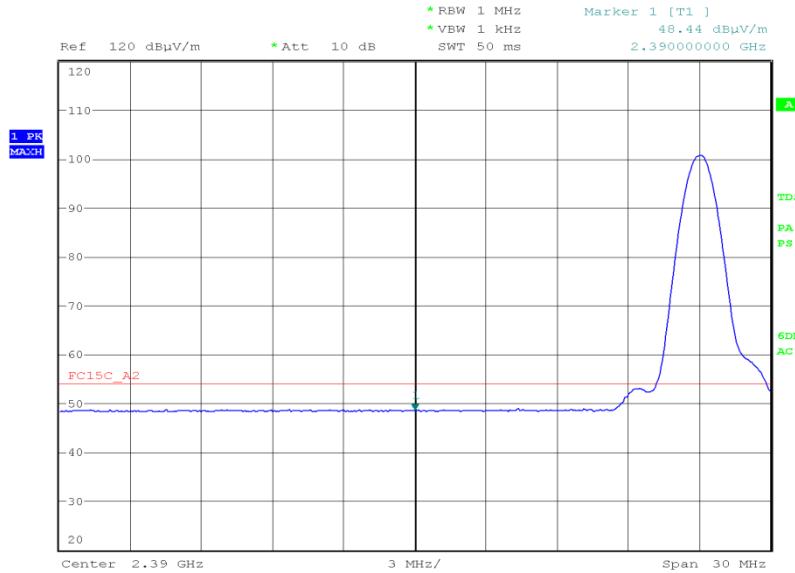
Date: 23.FEB.2016 20:26:43

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, GFSK, Final Peak, Restricted Band Edges Plot

Date: 23.FEB.2016 21:50:11

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, GFSK, Final Average, Restricted Band Edges Plot
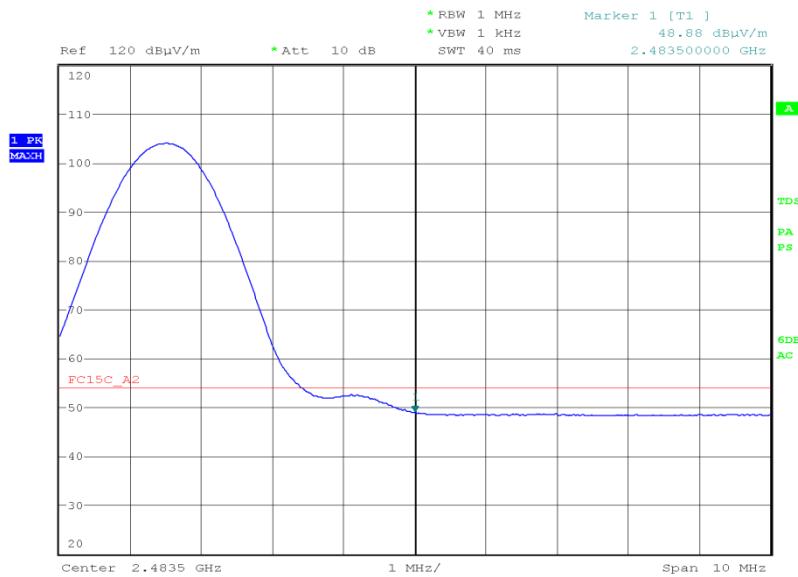
Date: 23.FEB.2016 21:51:42

Bluetooth, pi/4 DQPSK, Restricted Band Edges Results

2402 MHz		2480 MHz,	
Measured Frequency 2390 MHz		Measured Frequency 2483.5 MHz	
dBµV/m		dBµV/m	
Final Peak	Final Average	Final Peak	Final Average
59.36	47.60	59.71	48.44

Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, pi/4 DQPSK, Final Peak, Restricted Band Edges Plot
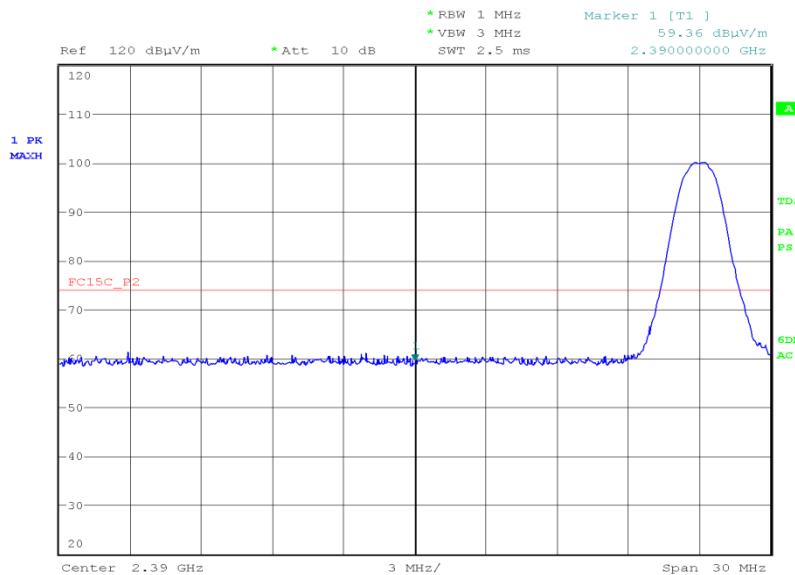

Date: 2.MAR.2016 17:39:21

Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, pi/4 DQPSK, Final Average, Restricted Band Edges Plot
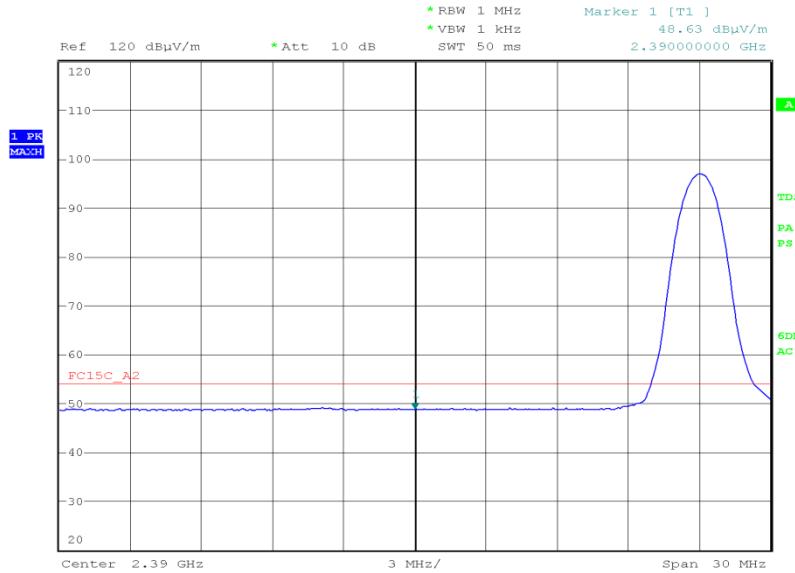
Date: 2.MAR.2016 17:44:12

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, pi/4 DQPSK, Final Peak, Restricted Band Edges Plot


Date: 2.MAR.2016 18:04:10

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, pi/4 DQPSK, Final Average, Restricted Band Edges Plot

Date: 2.MAR.2016 18:04:40
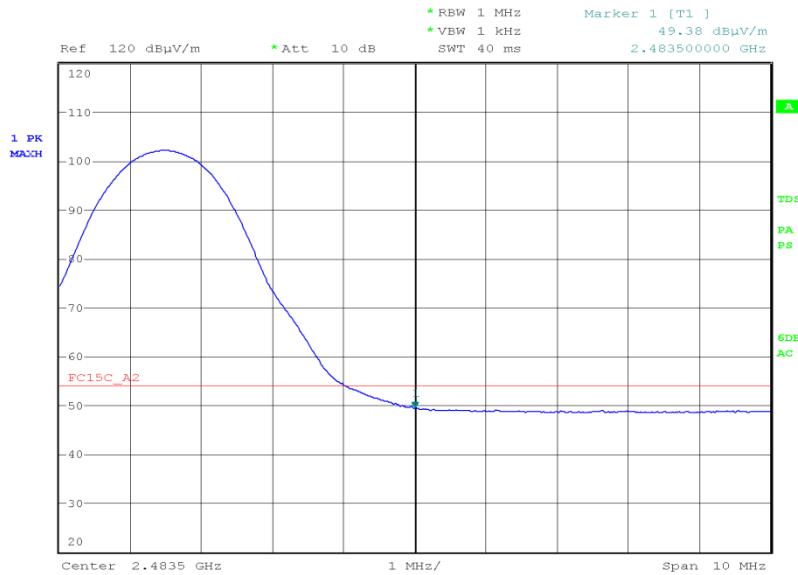
Bluetooth, 8-DPSK, Restricted Band Edges Results

2402 MHz		2480 MHz	
Measured Frequency 2390 MHz		Measured Frequency 2483.5 MHz	
dBµV/m		dBµV/m	
Final Peak	Final Average	Final Peak	Final Average
59.72	47.90	59.34	48.67

Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, 8-DPSK, Final Peak, Restricted Band Edges Plot
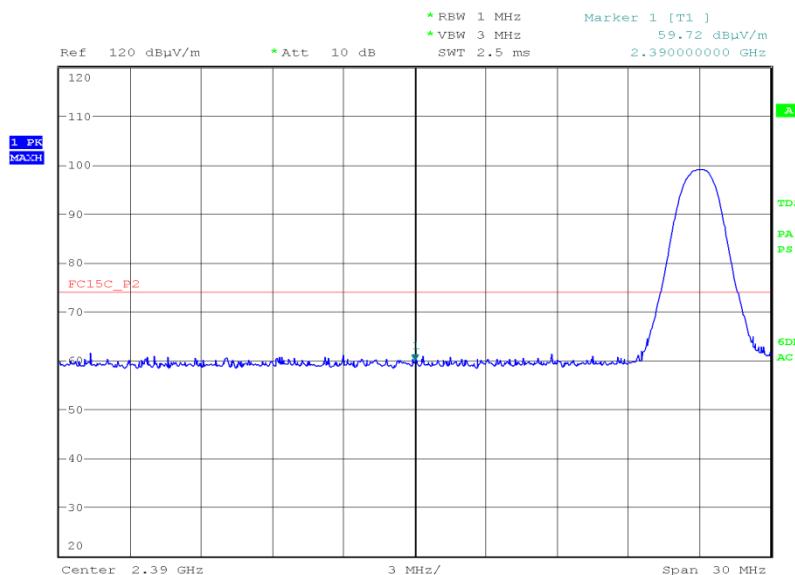
Date: 2.MAR.2016 18:36:22

Bluetooth, 2402 MHz, Measured Frequency 2390 MHz, 8-DPSK, Final Average, Restricted Band Edges Plot
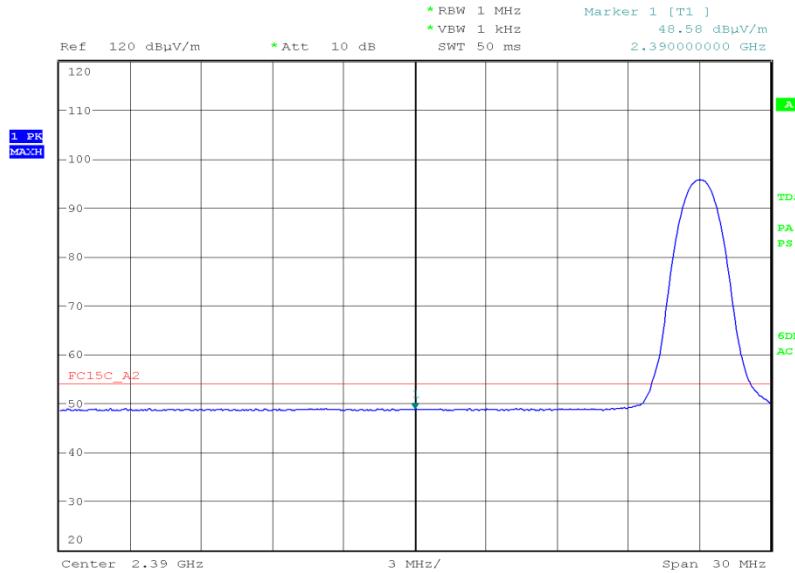
Date: 2.MAR.2016 18:36:44

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, 8-DPSK, Final Peak, Restricted Band Edges Plot
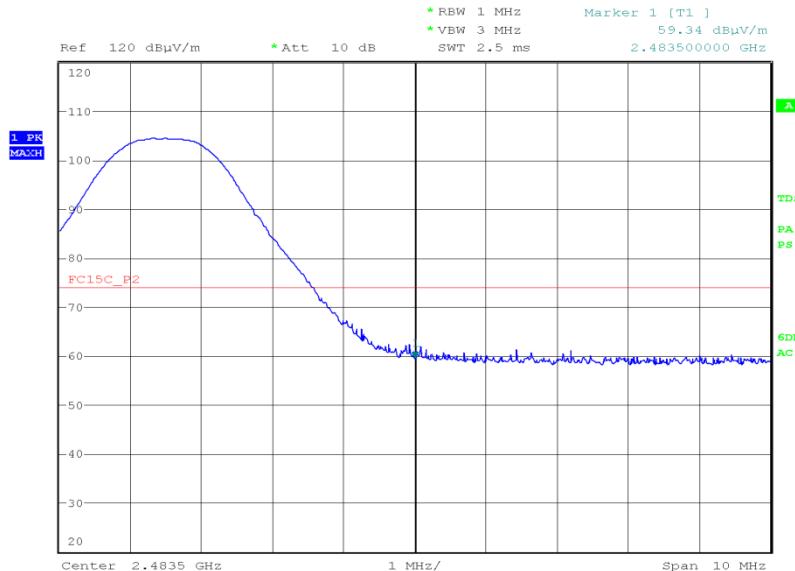
Date: 2.MAR.2016 18:27:22

Bluetooth, 2480 MHz, Measured Frequency 2483.5 MHz, 8-DPSK, Final Average, Restricted Band Edges Plot
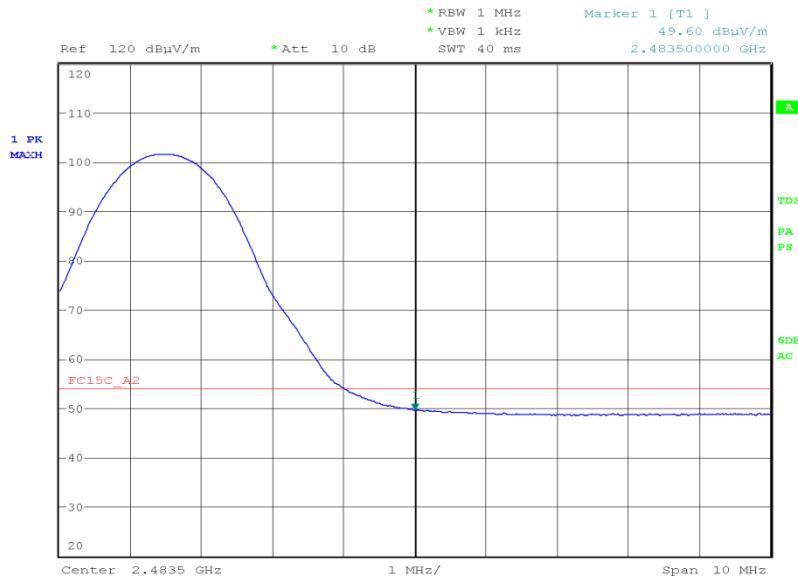
Date: 2.MAR.2016 18:26:04

Bluetooth, 2480 MHz, Measured Frequency 960 MHz, GFSK, Final Average, Restricted Band Edges Plot
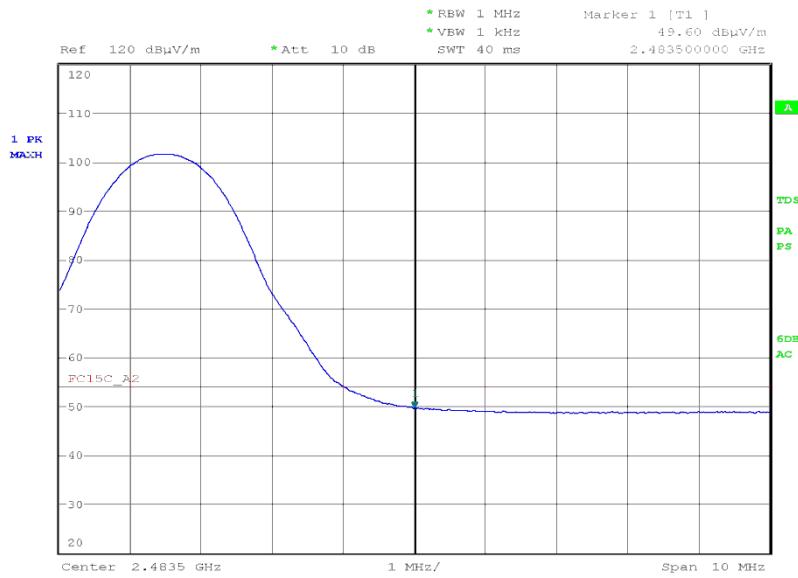
Date: 2.MAR.2016 18:26:04

Remarks

Testing was perfomed on the bottom and top channels using GFSK modulation because this was the modulation which produced the highest level of conducted average power.

Testing was performed on the bottom channel using pi/4 DQPSK modulation because this was the modulation which produced the widest value of 20 dB bandwidth.

Testing was performed on the top channel using 8-DPSK modulation because this was the modulation which produced the widest value of 20 dB bandwidth.

Final average results in the table of results show the final CISPR average result determined from the highest emission recorded within the restricted band as shown by the plots included in this section.

FCC 47 CFR Part 15, Limit Clause 15.205

	Peak (dBµV/m)	Average (dBµV/m)
Restricted Bands of Operation	74	54

Industry Canada RSS-GEN, Limit Clause 8.10

	Peak (dBµV/m)	Average (dBµV/m)
Restricted Bands of Operation	74	54

2.9   AUTHORISED BAND EDGES

2.9.1   Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d)
RSS-247, Clause 5.5

2.9.2   Equipment Under Test and Modification State

PC-010 S/N: Not Serialised (75933714-TSR0007) - Modification State 0

2.9.3   Date of Test

23 February 2016 & 2 March 2016

2.9.4   Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.9.5   Test Procedure

The test was performed in accordance with ANSI C63.10, clause 6.10.4

2.9.6   Environmental Conditions

Ambient Temperature   18.4 - 20.6°C
Relative Humidity   25.0 - 30.0%

2.9.7 Test Results

3.7 V DC Supply

Hopping Mode

Bluetooth, GFSK, Authorised Band Edges Results

2402 MHz	2480 MHz
Measured Frequency 2400.00 MHz	Measured Frequency 2483.50 MHz
dBµV/m	dBµV/m
Final Peak	Final Peak
51.97	48.32

Bluetooth, 2402 MHz, Measured Frequency 2400.00 MHz, GFSK, Final Peak, Authorised Band Edges Plot
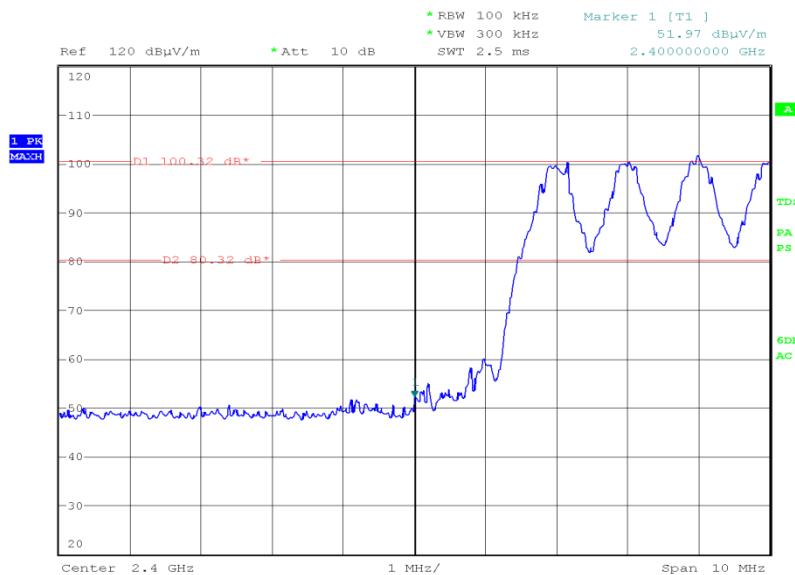
Date: 23.FEB.2016 22:05:17

Bluetooth, 2480 MHz, Measured Frequency 2483.50 MHz, GFSK, Final Peak, Authorised Band Edges Plot
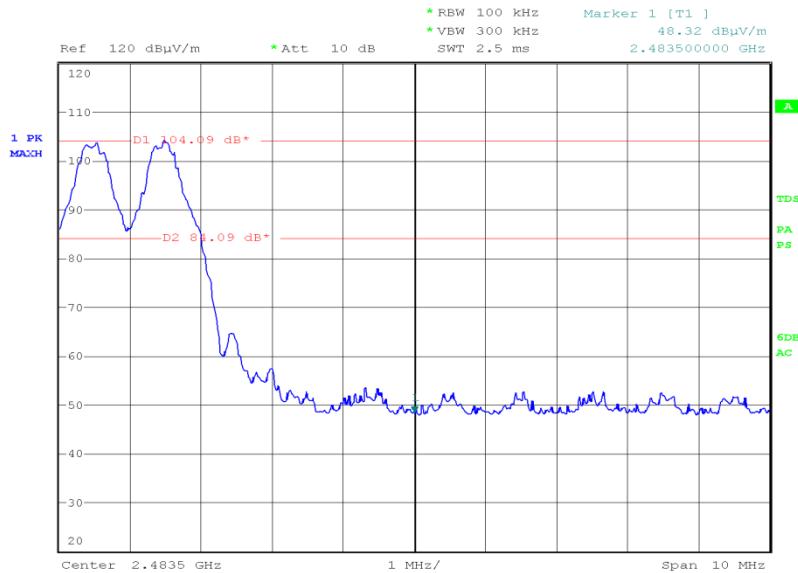
Date: 23.FEB.2016 22:13:49

Bluetooth, pi/4 DQPSK, Authorised Band Edges Results

2402 MHz	2480 MHz
Measured Frequency 2400.00 MHz	Measured Frequency 2483.50 MHz
dBµV/m	dBµV/m
Final Peak	Final Peak
48.78	48.67

Bluetooth, 2402 MHz, Measured Frequency 2400.00 MHz, pi/4 DQPSK, Final Peak, Authorised Band Edges Plot
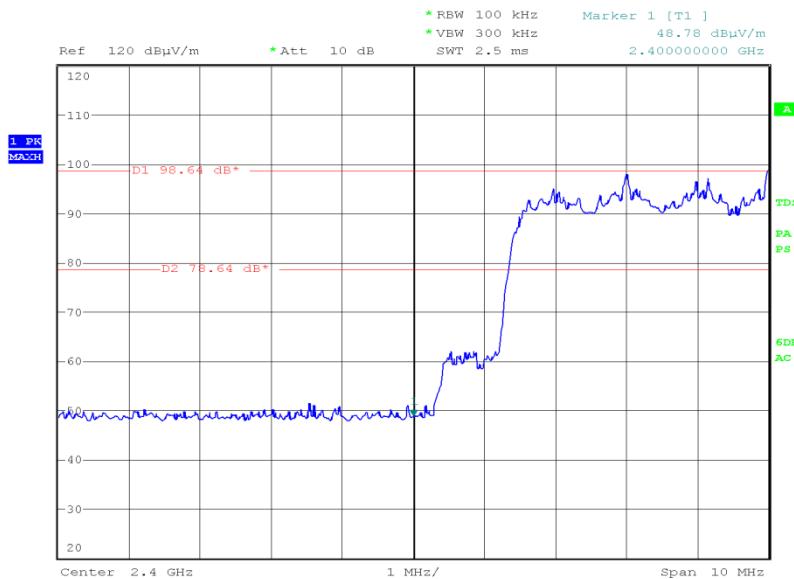
Date: 2.MAR.2016 19:41:46

Bluetooth, 2480 MHz, Measured Frequency 2483.50 MHz, pi/4 DQPSK, Final Peak, Authorised Band Edges Plot
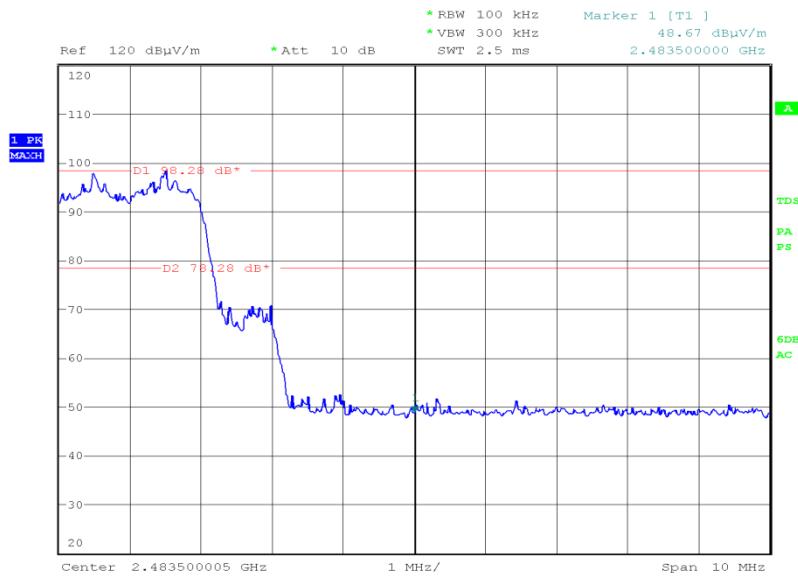
Date: 2.MAR.2016 19:25:39

Bluetooth, 8-DPSK, Authorised Band Edges Results

2402 MHz	2480 MHz
Measured Frequency 2400.00 MHz	Measured Frequency 2483.50 MHz
dBµV/m	dBµV/m
Final Peak	Final Peak
48.97	48.06

### Bluetooth, 2402 MHz, Measured Frequency 2400.00 MHz, 8-DPSK, Final Peak, Authorised Band Edges Plot
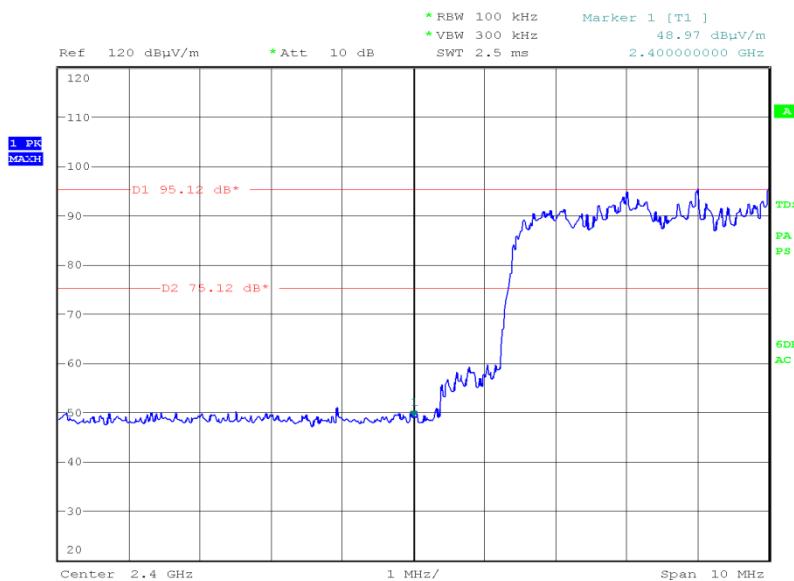
Date: 2.MAR.2016 19:05:33

Bluetooth, 2480 MHz, Measured Frequency 2483.50 MHz, 8-DPSK, Final Peak, Authorised Band Edges Plot
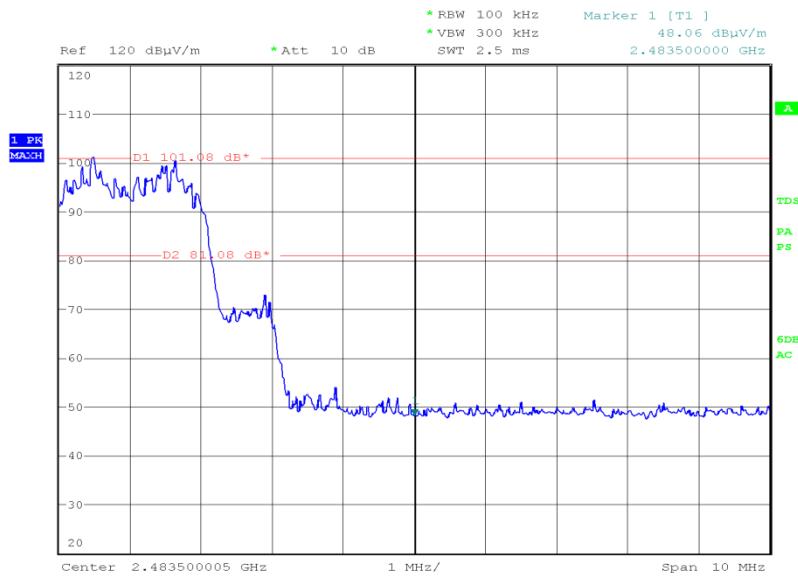
Date: 2.MAR.2016 19:16:20

Static Mode

Bluetooth, GFSK, Authorised Band Edges Results

2402 MHz	2480 MHz
Measured Frequency 2400.00 MHz	Measured Frequency 2483.50 MHz
dBµV/m	dBµV/m
Final Peak	Final Peak
55.89	47.67

Bluetooth, 2402 MHz, Measured Frequency 2400.00 MHz, GFSK, Final Peak, Authorised Band Edges Plot
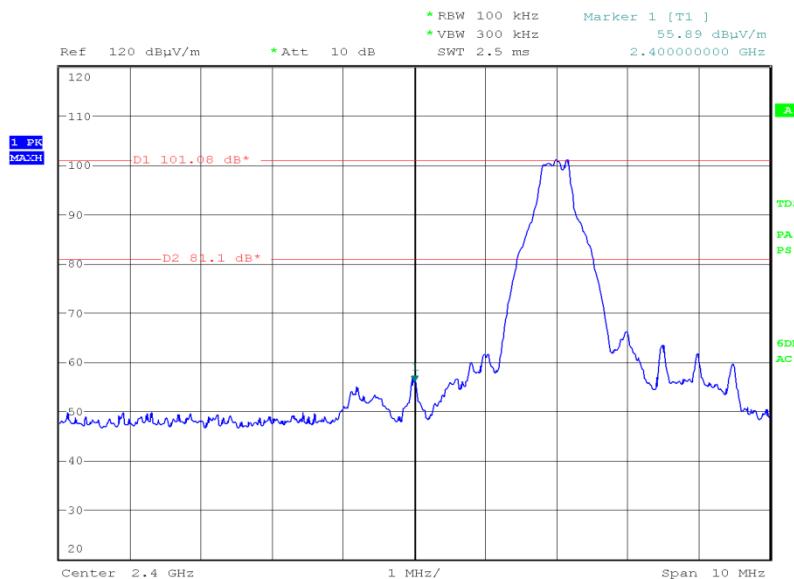
Date: 23.FEB.2016 20:24:08

Bluetooth, 2480 MHz, Measured Frequency 2483.50 MHz, GFSK, Final Peak, Authorised Band Edges Plot
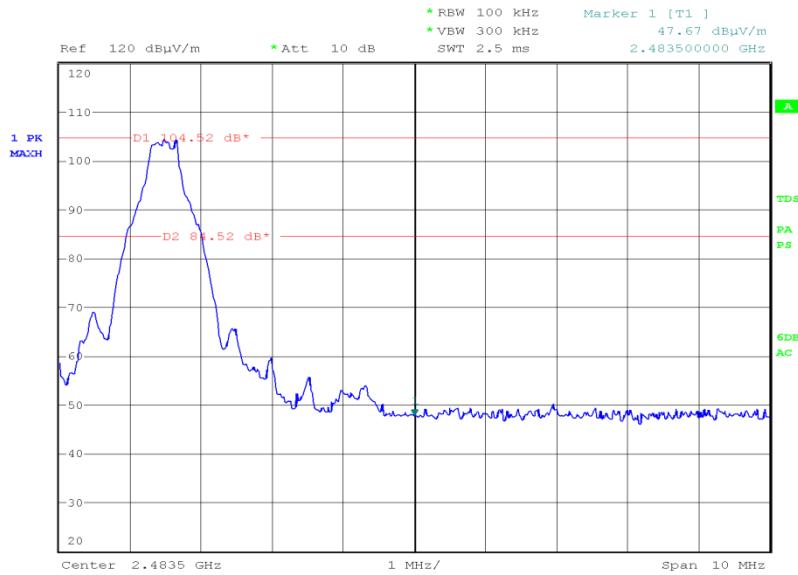
Date: 23.FEB.2016 21:48:50

Bluetooth, pi/4 DQPSK, Authorised Band Edges Results

2402 MHz	2480 MHz
Measured Frequency 2400.00 MHz	Measured Frequency 2483.50 MHz
dBµV/m	dBµV/m
Final Peak	Final Peak
53.04	50.59

Bluetooth, 2402 MHz, Measured Frequency 2400.00 MHz, pi/4 DQPSK, Final Peak, Authorised Band Edges Plot


Date: 2.MAR.2016 17:45:23

Bluetooth, 2480 MHz, Measured Frequency 2483.50 MHz, pi/4 DQPSK, Final Peak, Authorised Band Edges Plot
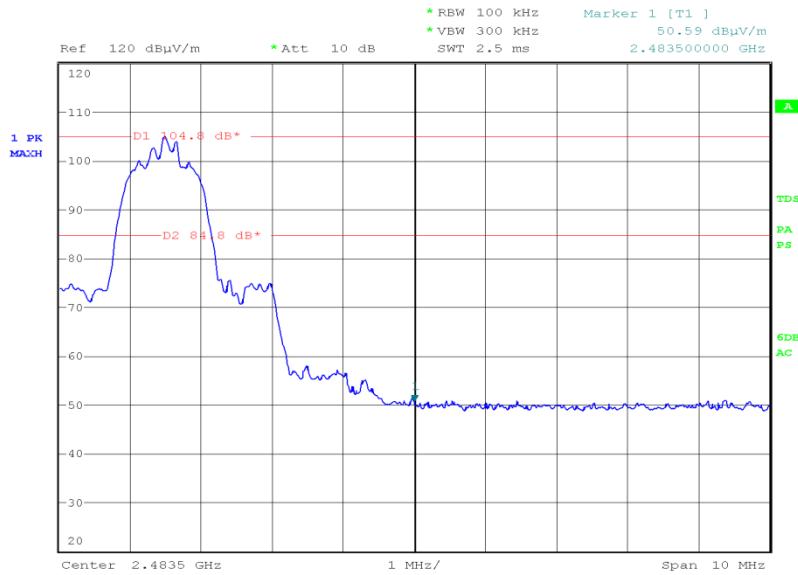
Date: 2.MAR.2016 18:03:02

Bluetooth, 8-DPSK, Authorised Band Edges Results

2402 MHz	2480 MHz
Measured Frequency 2400.00 MHz	Measured Frequency 2483.50 MHz
dBµV/m	dBµV/m
Final Peak	Final Peak
51.59	49.48

Bluetooth, 2402 MHz, Measured Frequency 2400.00 MHz, 8-DPSK, Final Peak, Authorised Band Edges Plot
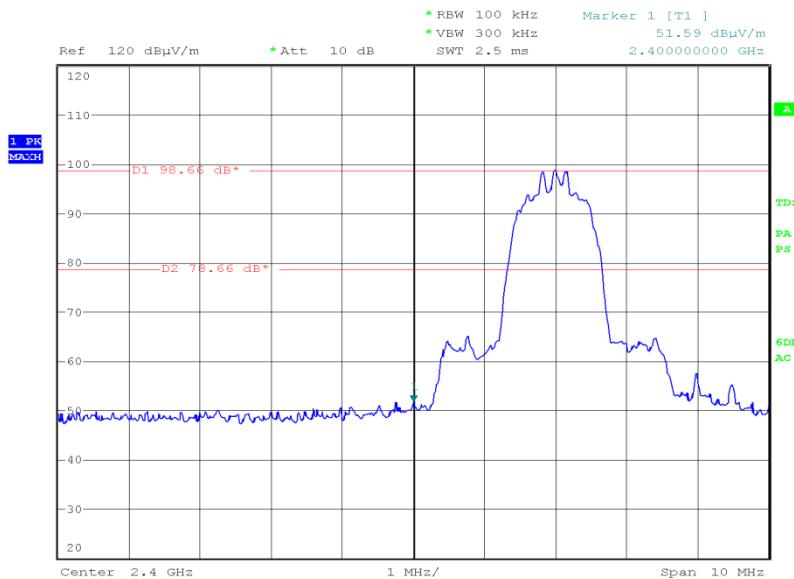
Date: 2.MAR.2016 18:35:14

Bluetooth, 2480 MHz, Measured Frequency 2483.50 MHz, 8-DPSK, Final Peak, Authorised Band Edges Plot
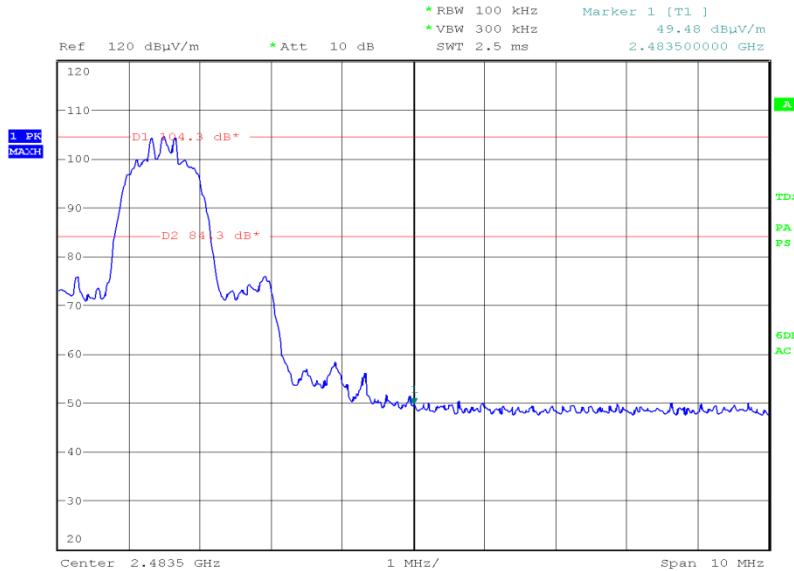

Date: 2.MAR.2016 18:28:11

Remark

Testing was perfomed on the bottom and top channels using GFSK modulation because this was the modulation which produced the highest level of conducted average power.

Testing was performed on the bottom channel using pi/4 DQPSK modulation because this was the modulation which produced the widest value of 20 dB bandwidth.

Testing was performed on the top channel using 8-DPSK modulation because this was the modulation which produced the widest value of 20 dB bandwidth.

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

Industry Canada RSS-247, Limit Clause 5.5

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

SECTION 3

TEST EQUIPMENT USED

3.1   TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1 – AC Line Conducted Emissions					
LISN (1 Phase)	Chase	MN 2050	336	12	1-Apr-2016
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Transient Limiter	Hewlett Packard	11947A	2378	12	1-Jul-2016
Hygromer	Rotronic	A1	2677	12	11-Jun-2016
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	2-Nov-2016
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
Section 2.2 - Frequency Hopping Systems - Channel Separation					
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	4-Mar-2016
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	4-Mar-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	8-Oct-2016
Section 2.3 - Frequency Hopping Systems - Number of Hopping Channels					
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	4-Mar-2016
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	4-Mar-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	8-Oct-2016
Section 2.4 - Frequency Hopping Systems - 20 dB Bandwidth					
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	4-Mar-2016
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	4-Mar-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	8-Oct-2016
Section 2.5 - Frequency Hopping Systems - Average Time of Occupancy					
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	4-Mar-2016
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	4-Mar-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	8-Oct-2016
Section 2.6- Maximum Conducted Output Power					
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	4-Mar-2016
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	4-Mar-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	8-Oct-2016

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.7 - Spurious Radiated Emissions					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	27-Nov-2016
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	18-Jun-2016
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016
Antenna 18-40GHz (Double Ridge Guide)	Q-Par Angus Ltd	QSH 180K	1511	24	27-Nov-2016
Pre-Amplifier	Phase One	PS04-0086	1533	12	30-Jul-2016
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	23-Dec-2016
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Power Supply	Hewlett Packard	6104A	1948	-	TU
Cable (2m)	Rosenberger	FA147A2020002020	2195	12	19-Aug-2016
Antenna (Bilog)	Chase	CBL6143	2904	24	11-Jun-2017
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	2-Nov-2016
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	19-Aug-2016
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	6-Oct-2016
Suspended Substrate Highpass Filter	Advance Power Components	11SH10-3000/X18000-O/O	4412	12	24-Mar-2016
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	-	TU
Section 2.8 - Restricted Band Edges					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	27-Nov-2016
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygromer	Rotronic	A1	2677	12	11-Jun-2016
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	2-Nov-2016
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	-	TU
Section 2.9 - Authorised Band Edges					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	27-Nov-2016
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygromer	Rotronic	A1	2677	12	11-Jun-2016
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	2-Nov-2016
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	-	TU

TU – Traceability Unscheduled

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	MU
Frequency Hopping Systems - Average Time of Occupancy	-
Frequency Hopping Systems - Channel Separation	± 16.74 kHz
Frequency Hopping Systems - 20 dB Bandwidth	± 16.74 kHz
Maximum Conducted Output Power	± 0.70 dB
AC Line Conducted Emissions	± 3.2 dB
Frequency Hopping Systems - Number of Hopping Channels	-
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 40 GHz: ± 6.3 dB
Authorised Band Edges	Radiated: 30 MHz to 1 GHz: ± 5.1 dB Radiated: 1 GHz to 40 GHz: ± 6.3 dB
Restricted Band Edges	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 40 GHz: ± 6.3 dB

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

ANNEX A

DWELL TIME CORRECTION FACTOR DATA

TÜV
SÜD

Product Service

Bluetooth Harmonic Emission Averaging Correction

The EUT was configured with GFSK modulation in Adaptive Frequency Hopping mode (AFH) as this was identified as the modulation scheme resulting in the highest output power and was the modulation scheme used when measuring emissions. The EUT was also configured to hop using the minimum number of hopping frequencies (20) as shown by the plot below.
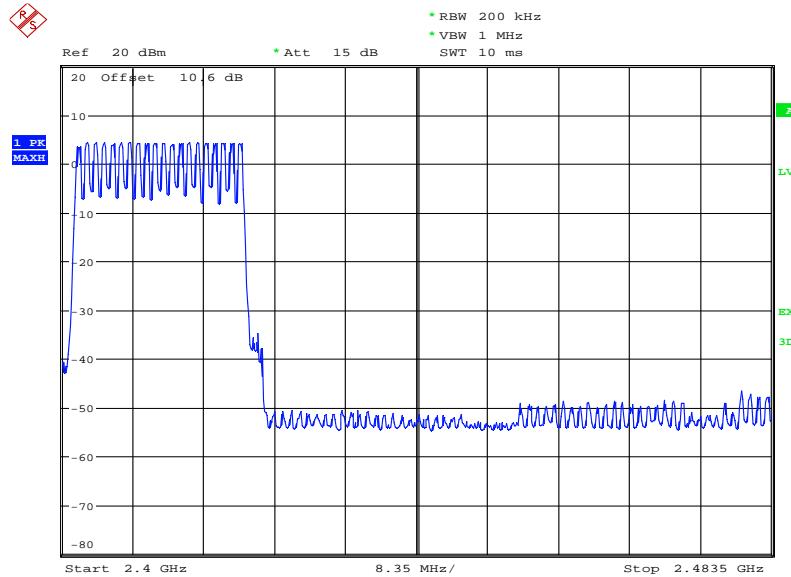

Date: 9.MAR.2016 10:43:39

Packet types DH1, DH3 and DH5 were then investigated to determine which packet type resulted in the highest dwell time within a 100 ms period. No other packet types using GFSK modulation were supported by the EUT.

| Packet Type	Accumulated Dwell Time (ms)
DH1	2.404
DH3	3.686
DH5	6.250
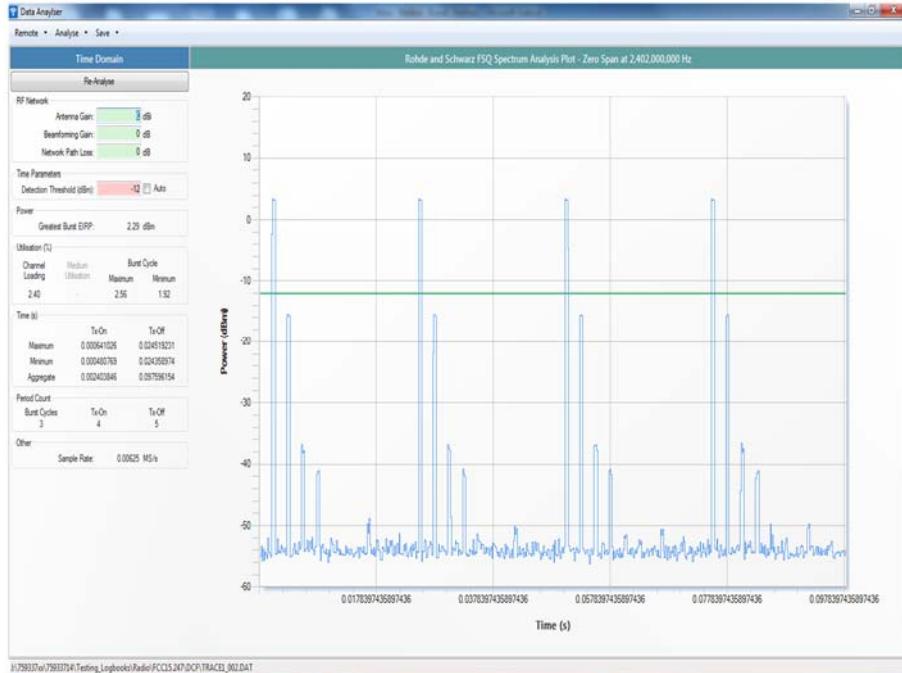
Dwell Time – DH1

Dwell Time – DH3
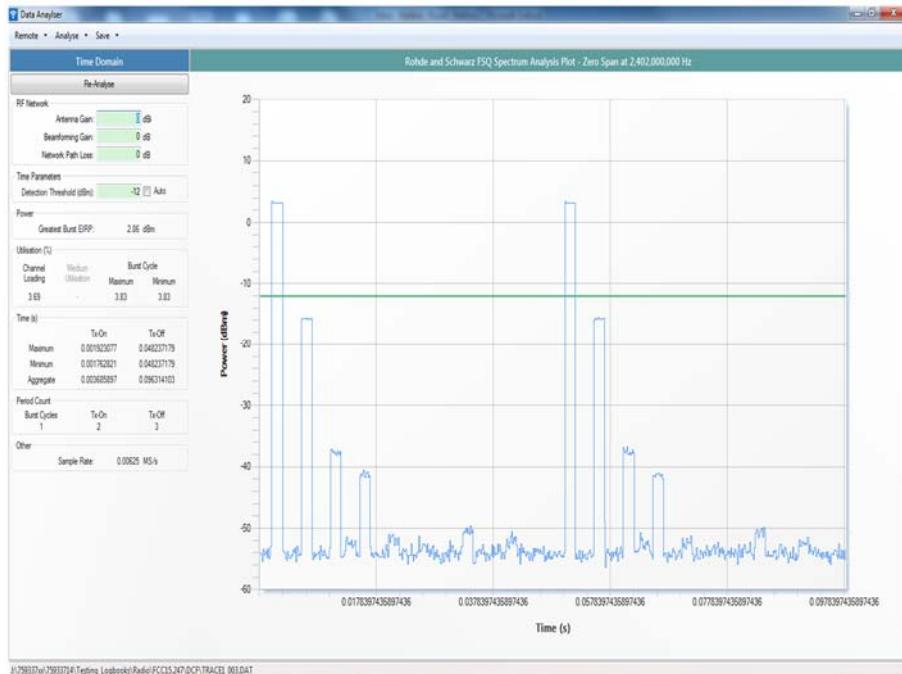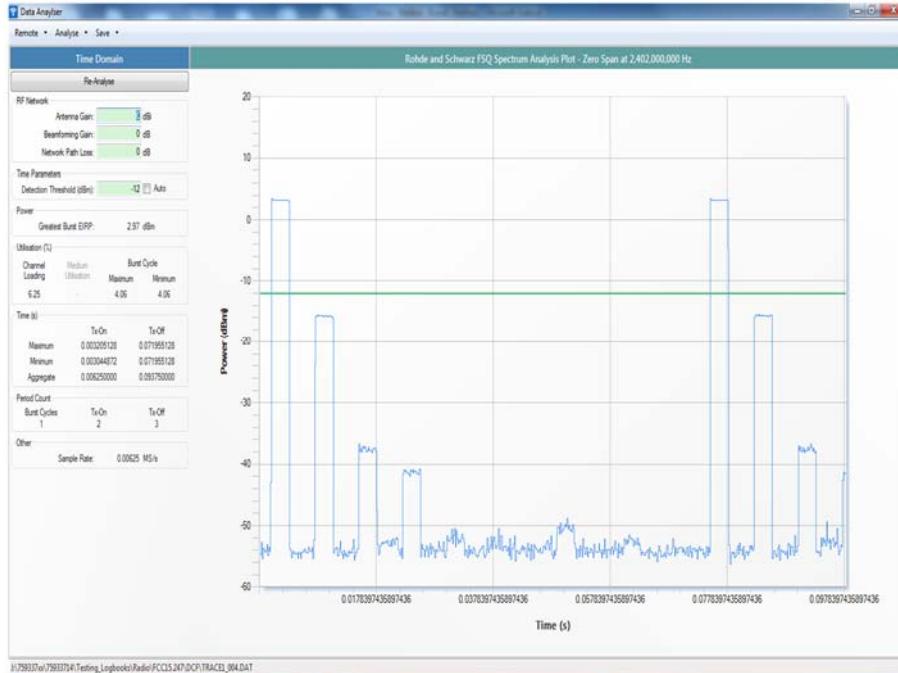
Dwell Time – DH5

D.C.F (Duty cycle Correction Factor) = 20log(worst case dwell time ms / 100 ms)
= 20log(6.25 ms /100 ms) = -24.08 dB