

FCC and Industry Canada Testing of the
SPD Development Company Ltd
Connected Ovulation Test System,
Model: COTS Reader
In accordance with FCC 47 CFR Part 15C,
Industry Canada RSS-247 and
Industry Canada RSS-GEN

Prepared for: SPD Development Company Ltd
Clearblue Innovation Centre
Stannard Way
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United Kingdom



Product Service

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FCC ID: 2AKEK-CADOT1
IC: TBC

COMMERCIAL-IN-CONFIDENCE

Date: July 2017
Document Number: 75939338-02 | Issue: 02

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Steven White	10 July 2017	
Authorised Signatory	Matthew Russell	10 July 2017	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

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.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Mohamed Toubella	10 July 2017	
Testing	Mehadi Choudury	10 July 2017	
Testing Testing	Graeme Lawler	10 July 2017	

FCC Accreditation

90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation

IC2932B-1 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be in compliance with FCC 47 CFR Part 15C: 2016, Industry Canada RSS-247: Issue 2 (2017-02) and Industry Canada RSS-GEN: Issue 4 (2014-11).



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ACCREDITATION

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	07 July 2017
2	To amend the application form	10 July 2017

Table 1

1.2 Introduction

Applicant	SPD Development Company Ltd
Manufacturer	SPD Development Company Ltd / Swiss Precision Diagnostics GmbH
Model Number(s)	COTS Reader
wSerial Number(s)	Not serialised (75939338-TSR0004) Not serialised (75939338-TSR0008) Not serialised (75939338-TSR0010)
Hardware Version(s)	PCB710-041-REV08
Software Version(s)	Holtek Microcontroller Embedded Software: R.0036.400.01.03 Qualcomm (CSR) Embedded Software: R.0036.412.01.02
Number of Samples Tested	3
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2016 Industry Canada RSS-247: Issue 2 (2017-02) Industry Canada RSS-GEN: Issue 4 (2014-11)
Order Number	36056
Date	04-May-2017
Date of Receipt of EUT	08-June-2017
Start of Test	13-June-2017
Finish of Test	22-June-2017
Name of Engineer(s)	Mohamed Toubella and Graeme Lawler
Related Document(s)	ANSI C63.10 (2013)



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1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, 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			
Configuration: ANT795-4MX - 802.11b						
2.1	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.2	15.247 (a)(2)	5.2	6.6	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.3	15.247 (b)(3)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.4	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.5	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
2.6	15.247 (e)	5.4	6.12	Power Spectral Density	Pass	ANSI C63.10 (2013)

Table 2

1.4 Application Form

EQUIPMENT DESCRIPTION	
Model Name/Number	COTS Reader
Part Number	Not applicable
Hardware Version	PCB710-041-REV08
Software Version	Holtek Microcontroller Embedded Software: R.0036.400.01.03 Qualcomm (CSR) Embedded Software: R.0036.412.01.02
FCC ID (if applicable)	Grantee Code: 2AKEK Equipment Product Code: -CADOT1
Industry Canada ID (if applicable)	TBD
Technical Description (Please provide a brief description of the intended use of the equipment)	The CB COTS reader is a self-contained home use IVD digital ovulation test with an ancillary 2.4GHz ISM band digital radio that provides a WPAN link to an iOS or Android mobile phone.

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:	
In case of Adaptive Frequency Hopping Equipment:	
Maximum number of Hopping Frequencies:	
Minimum number of Hopping Frequencies:	
Dwell Time:	
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 maximum Channel Occupancy Time implemented by the equipment: 0.4 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: μs	
☒	The equipment has implemented an non-LBT based DAA mechanism



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Types of Modulations used by the Equipment	
☐	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.):	
The maximum (corresponding) Duty Cycle: %	
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: +4.5dBm	
Power Spectral Density: <10dbm/MHz	
Duty cycle, Tx-Sequence, Tx-gap: Not applicable	
Accumulated Transmit Time, Frequency Occupation & Hopping Sequence (only for FHSS equipment): Not applicable	
Hopping Frequency Separation (only for FHSS equipment): Not applicable	
Medium Utilisation: Not applicable	
Adaptivity & Receiver Blocking: Not applicable; RF output power to <10dBm	
Nominal Channel Bandwidth: 2MHz	
Transmitter unwanted emissions in the OOB domain:	
Transmitter unwanted emissions in the spurious domain:	
Receiver spurious emissions:	
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™ [i.3] 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™ [i.3] 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™ [i.3] 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.	



Product Service

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	
<i>NOTE: The additional beam forming gain does not include the basic gain of a single antenna.</i>	
Operating Frequency Range(s) of the equipment:	
Operating Frequency Range 1: 2400 MHz to 2483.5 MHz	
Operating Frequency Range 2:	MHz to MHz
Operating Frequency Range 3:	MHz to MHz
<i>NOTE: Add more lines if more Frequency Ranges are supported.</i>	
Nominal Channel Bandwidth(s):	
Nominal Channel Bandwidth1: 2 MHz	
Nominal Channel Bandwidth2:	MHz
Nominal Channel Bandwidth3:	MHz
Nominal Channel Bandwidth4:	MHz
Nominal Channel Bandwidth5:	MHz
<i>NOTE: Add more lines if more channel bandwidths are supported.</i>	
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 normal and extreme operating conditions that apply to the equipment:	
Normal operating conditions (if applicable):	
Operating temperature: +25 °C	
Other (please specify if applicable):	
Extreme operating conditions:	
Operating temperature range: Minimum +15 °C to Maximum +40 °C	
Other (please specify if applicable): Minimum °C to Maximum °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 (information to be provided in case of conducted measurements)			
Antenna Gain: 0 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	0	4.5	N/A
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			



Product Service

The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels:			
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 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:	
Carrier Wave Transmit, Packet Transmit (fixed channel) and Receive (fixed channel)	
The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3] IEEE 802.15.4™ [i.4], proprietary, etc.):	
Bluetooth	
If applicable, the statistical analysis referred in clause 5.4.1 q)	
If applicable, the statistical analysis referred in clause 5.4.1 r)	
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	
Describe the minimum performance criteria that apply to the equipment (see clause 4.3.1.12.3 or 4.3.2.11.3)	
PER less than or equal to 10 %.	
Combination for testing (see clause 5.3.2.3 of EN 300 328 V21.1)	
From all combinations of conducted power settings and intended antenna assembly(ies) specified in clause 5.4.1 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 5.3.2.3	
Highest overall e.i.r.p. value: 10 dBm	
Corresponding Antenna assembly gain:	dBi Antenna Assembly #:
Corresponding conducted power setting: (also the power level to be used for testing)	dBm Listed as Power Setting #:
Additional information provided by the applicant	
Modulation	
ITU Class(es) of emission:	



Product Service

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:
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
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 the information supplied is correct and complete.

Name: Steve Dix

Position held: Electronics Engineer

Date: 03-JUL-2017

1.5 Product Information

1.5.1 Technical Description

The CB COTS reader is a self-contained home use IVD digital ovulation test with an ancillary 2.4GHz ISM band digital radio that provides a WPAN link to an iOS or Android mobile phone.

1.6 Deviations from the Standard

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

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: Not serialised (75939338-TSR0004)			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: Not serialised (75939338-TSR0010)			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.8 Test Location

TÜV SÜD Product Service conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration: Bluetooth Low Energy		
Restricted Band Edges	Graeme Lawler	UKAS
Emission Bandwidth	Mohamed Toubella	UKAS
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Authorised Band Edges	Graeme Lawler	UKAS
Spurious Radiated Emissions	Graeme Lawler	UKAS
Power Spectral Density	Mohamed Toubella	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Restricted Band Edges

2.1.1 Specification Reference

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

2.1.2 Equipment Under Test and Modification State

COTS Reader, S/N: Not serialised (75939338-TSR0004) - Modification State 0

2.1.3 Date of Test

13-June-2017

2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.13.1.

Plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3. These are shown for information purposes and were used to determine the worst case measurement point. Final average measurements were then taken in accordance with ANSI C63.10 clause 4.1.4.2.2. to obtain the measurement result recorded in the test results tables.

2.1.5 Environmental Conditions

Ambient Temperature 20.7 °C
Relative Humidity 48.0 %

2.1.6 Test Results

Bluetooth Low Energy

Modulation	Packet Type	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
GFSK	DH1	2402	2390.0	56.10	45.28
GFSK	DH1	2480	2483.5	56.59	45.61

Table 5

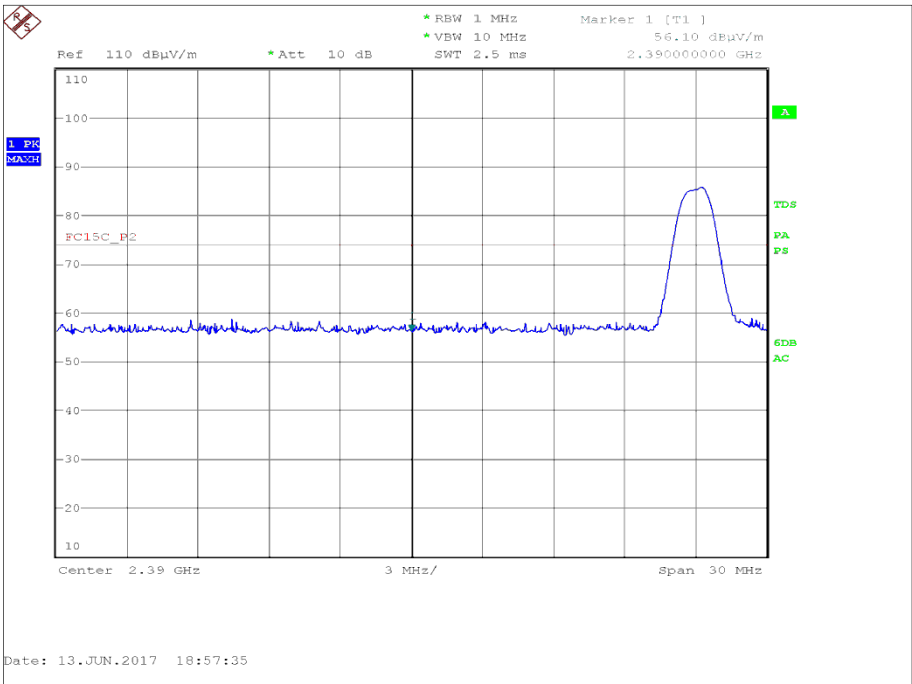


Figure 1 - GFSK/DH1 - 2402 MHz - Measured Frequency 2390.0 MHz - Peak

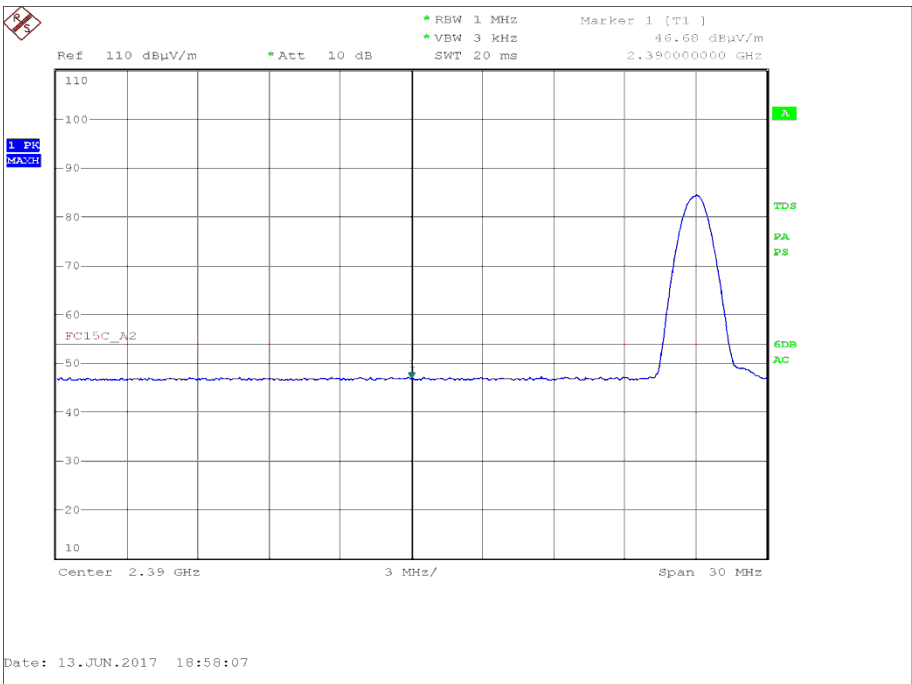


Figure 2 - GFSK/DH1 - 2402 MHz - Measured Frequency 2390.0 MHz - Average



Product Service

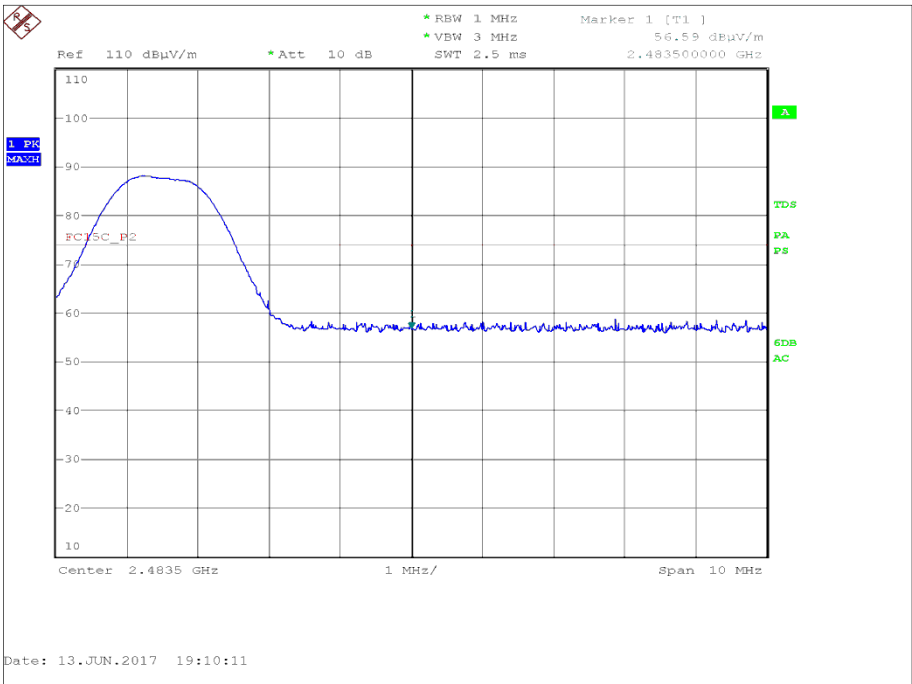


Figure 3 - GFSK/DH1 - 2480 MHz - Measured Frequency 2483.5 MHz - Peak

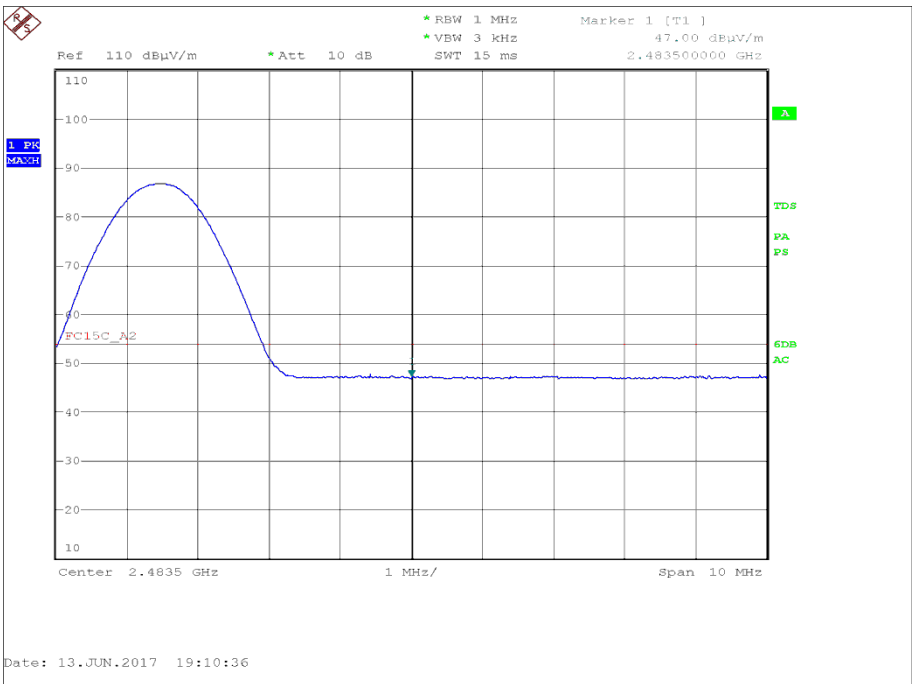


Figure 4 - GFSK/DH1 - 2480 MHz - Measured Frequency 2483.5 MHz - Average

FCC 47 CFR Part 15, Limit Clause 15.205

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

Table 6

Industry Canada RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength (μV/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

Table 7

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	A1	2138	12	2-Feb-2018
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	12	2-May-2018
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	12-Nov-2017
Tilt Antenna Mast	matur GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	matur GmbH	NCD	3917	-	TU
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	23-Jul-2017
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	17-Feb-2018

Table 8

TU - Traceability Unscheduled



2.2 Emission Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(2)
Industry Canada RSS-247, Clause 5.2
Industry Canada RSS-GEN, Clause 6.6

2.2.2 Equipment Under Test and Modification State

COTS Reader, S/N: Not serialised (75939338-TSR0010) - Modification State 0

2.2.3 Date of Test

22-June-2017

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.8.2.

2.2.5 Environmental Conditions

Ambient Temperature 25.4 - 25.5 °C
Relative Humidity 45.5 %

2.2.6 Test Results

Bluetooth Low Energy

Modulation/Packet Type: GFSK/DH1

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2402	0.695	1.04
2440	0.717	1.04
2480	0.727	1.04

Table 9



Product Service

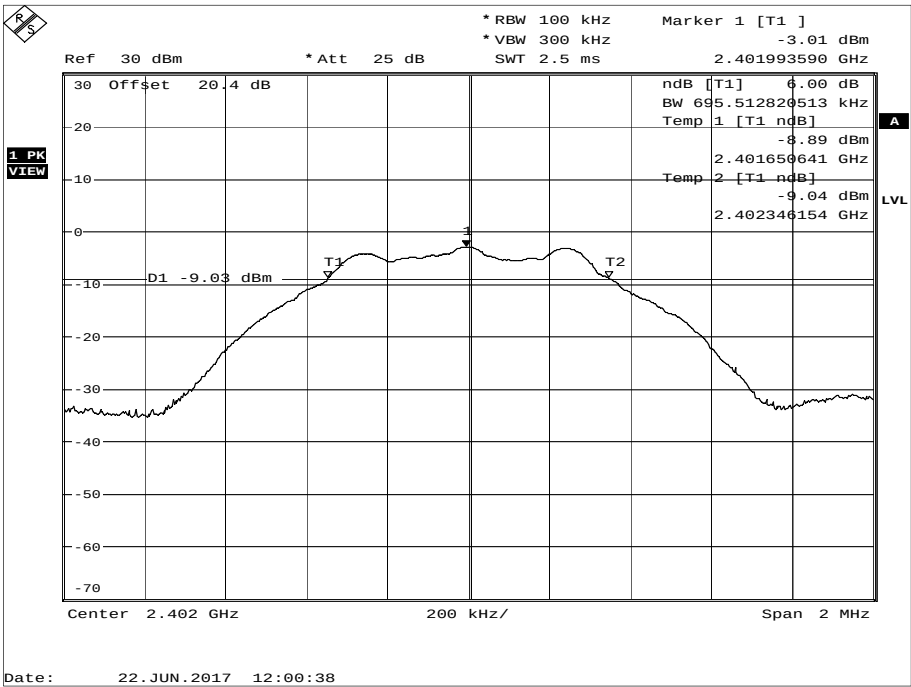


Figure 5 - 2402 MHz

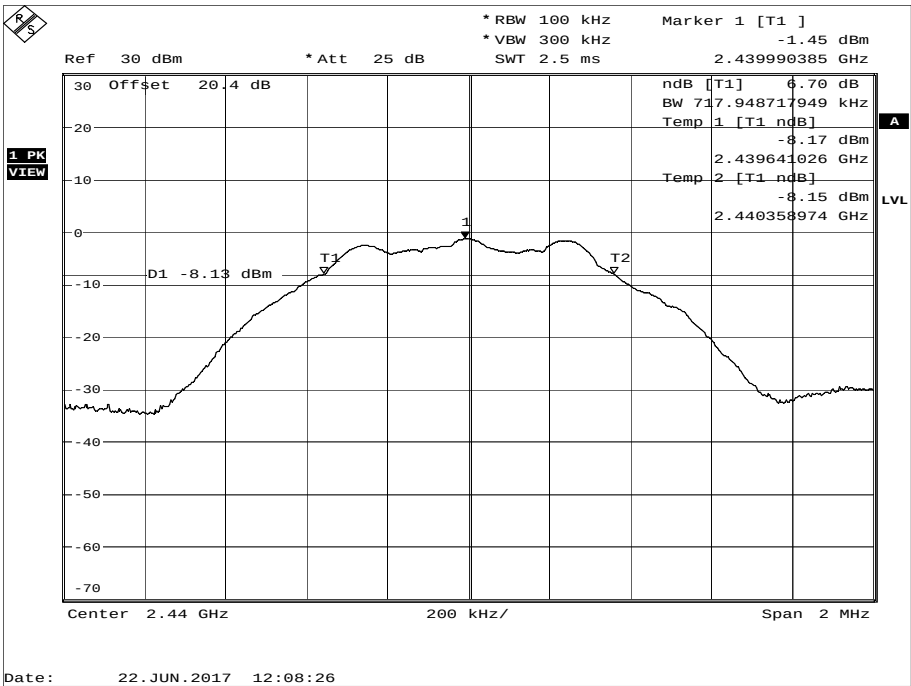


Figure 6 - 2440 MHz



Figure 7 - 2480 MHz

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2)

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

Industry Canada RSS-247, Clause 5.2(a)

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



2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	2-Feb-2018
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	30-Jun-2017
Hygrometer	Rotronic	I-1000	3220	12	23-Aug-2017
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3702	12	13-Dec-2017
True RMS Multimeter	Fluke	179	4007	12	14-Sep-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	8-Sep-2017

Table 10

O/P Mon – Output Monitored Using Calibrated Test Equipment.

2.3 Maximum Conducted Output Power

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)(3)
Industry Canada RSS-247, Clause 5.4
Industry Canada RSS-GEN, Clause 6.12

2.3.2 Equipment Under Test and Modification State

COTS Reader, S/N: Not serialised (75939338-TSR0008) - Modification State 0

2.3.3 Date of Test

29-June-2017

2.3.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.9.1.1.

2.3.5 Environmental Conditions

Ambient Temperature 20.7 °C
Relative Humidity 59.3 %

2.3.6 Test Results

Bluetooth Low Energy

Frequency (MHz)	Output Power	
	dBm	mW
2402	-1.69	-0.68
2440	-0.05	-0.99
2480	1.11	1.29

Table 11

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

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 (d)

For DTSS employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e) of the specification.



2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
20dB/2W Attenuator	Narda	4772-20	461	-	O/P Mon
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	9-Sep-2017
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
True RMS Multimeter	Fluke	179	4007	12	14-Sep-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	8-Sep-2017
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	9-Sep-2017

Table 12

O/P Mon – Output Monitored using calibrated equipment

2.4 Authorised Band Edges

2.4.1 Specification Reference

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

2.4.2 Equipment Under Test and Modification State

COTS Reader, S/N: Not serialised (75939338-TSR0004) - Modification State 0

2.4.3 Date of Test

13-June-2017

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 11.13.1.

2.4.5 Environmental Conditions

Ambient Temperature 20.7 °C
Relative Humidity 48.0 %

2.4.6 Test Results

Bluetooth Low Energy

Modulation	Packet Type	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dBµV/m)
GFSK	DH1	2402	2400.0	47.73
GFSK	DH1	2480	2483.5	45.63

Table 13



Product Service

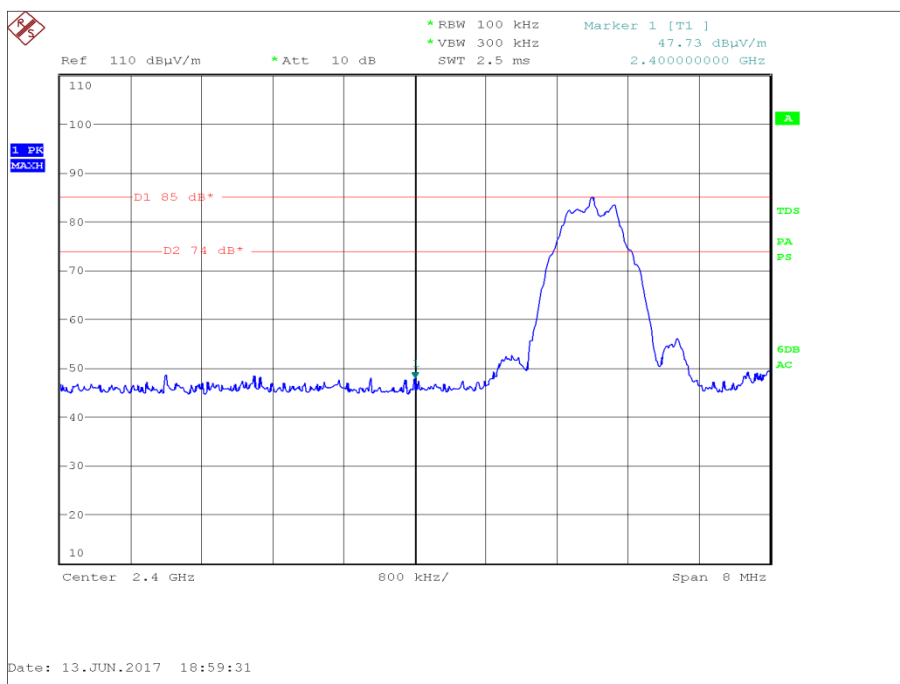


Figure 8 - GFSK/DH1 - 2402 MHz - Measured Frequency 2400.0 MHz

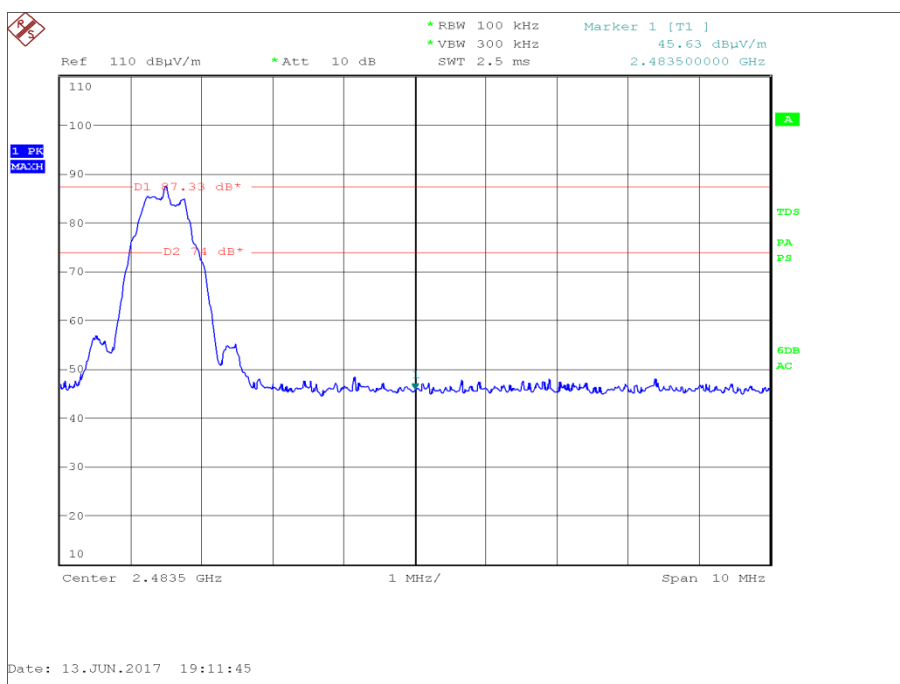


Figure 9 - GFSK/DH1 - 2480 MHz - Measured Frequency 2483.5 MHz

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

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.

2.4.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	A1	2138	12	2-Feb-2018
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	12	2-May-2018
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	12-Nov-2017
Tilt Antenna Mast	maturo GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturo GmbH	NCD	3917	-	TU
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	23-Jul-2017
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	17-Feb-2018

Table 14

TU - Traceability Unscheduled

2.5 Spurious Radiated Emissions

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205
Industry Canada RSS-247, Clause 5.5
Industry Canada RSS-GEN, Clause 6.13

2.5.2 Equipment Under Test and Modification State

COTS Reader, S/N: Not serialised (75939338-TSR0004) - Modification State 0

2.5.3 Date of Test

13-June-2017 to 18-June-2017

2.5.4 Test Method

Testing was performed in accordance with ANSI C63.10, clause 11.11, 11.12.1 and 11.12.2.7

Plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.3 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10-2013 clause 4.1.4.2.2.

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (54/74 dBuV/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

2.5.5 Environmental Conditions

Ambient Temperature 20.1 °C
Relative Humidity 58.0 %

2.5.6 Test Results

Bluetooth Low Energy

Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
30.055	30.9	40.0	-9.1	0	1.00	Vertical
30.786	30.5	40.0	-9.5	0	1.00	Vertical
32.413	29.8	40.0	-10.2	0	1.00	Vertical
888.254	33.6	46.0	-12.4	0	1.00	Vertical
918.129	33.8	46.0	-12.2	0	1.00	Vertical
960.000	34.3	46.0	-11.7	0	1.00	Vertical

Table 15 - 2402 MHz - 30 MHz to 1 GHz

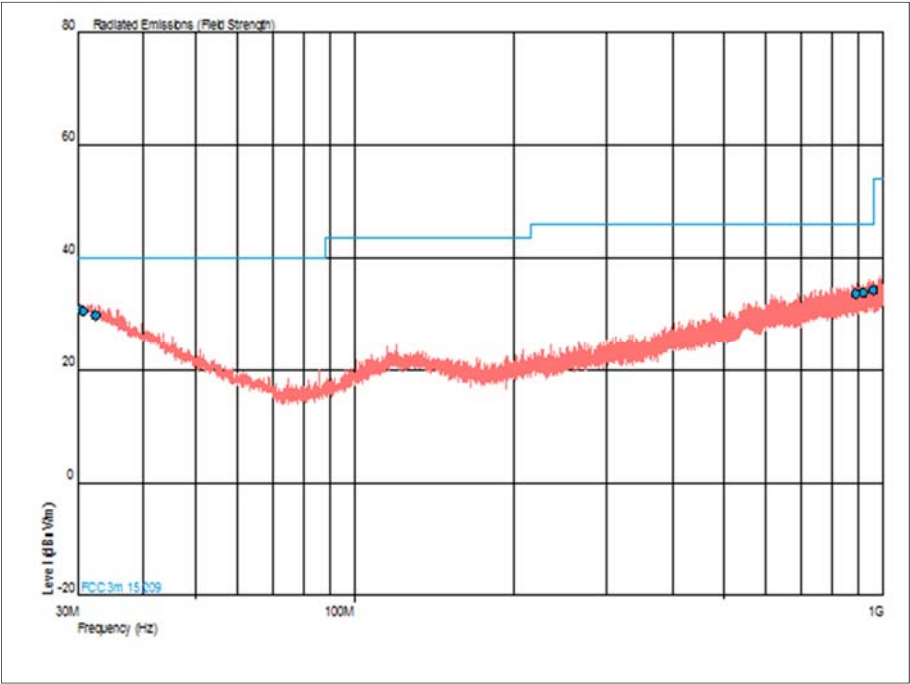


Figure 10 - 2402 MHz - 30 MHz to 1 GHz - Horizontal and Vertical

Frequency (MHz)	Result (µV/m)		Limit (µV/m)		Margin (µV/m)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 16 - 2402 MHz - 1 GHz to 25 GHz

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



Product Service

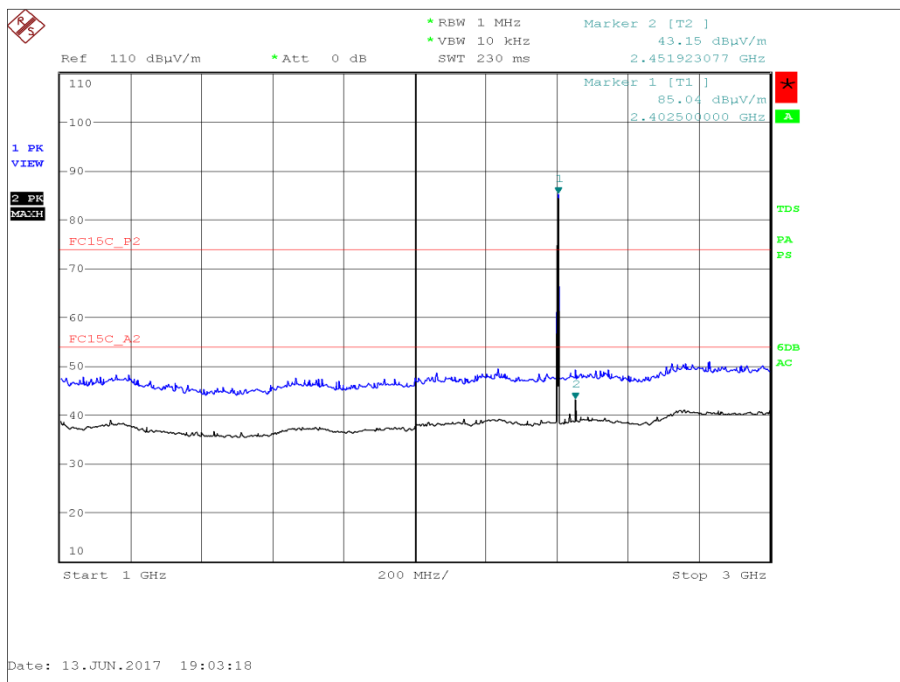


Figure 11 - 2402 MHz - 1 GHz to 3 GHz - Horizontal and Vertical

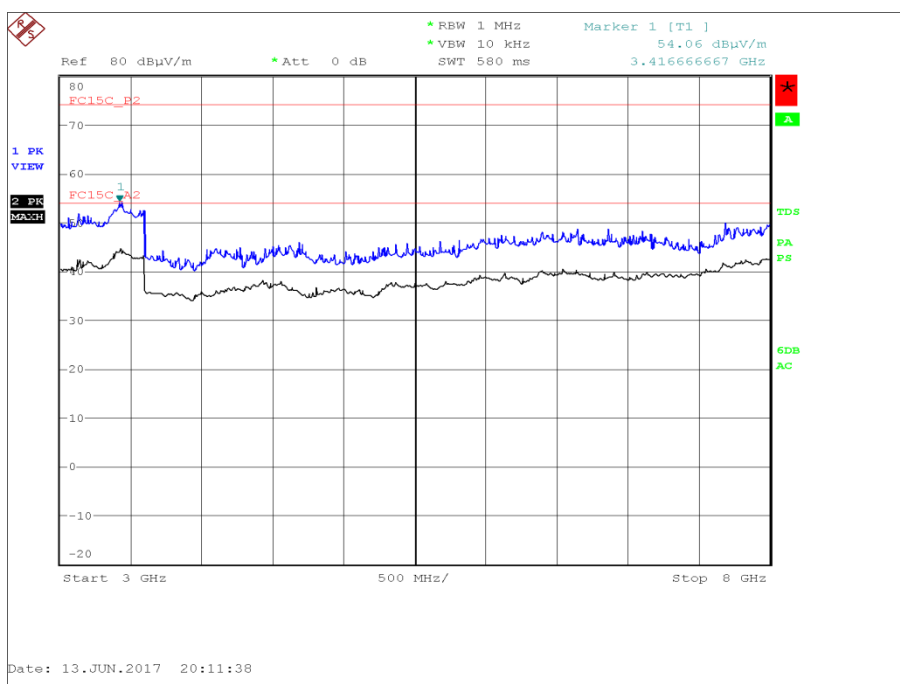


Figure 12 - 2402 MHz - 3 GHz to 8 GHz - Horizontal and Vertical

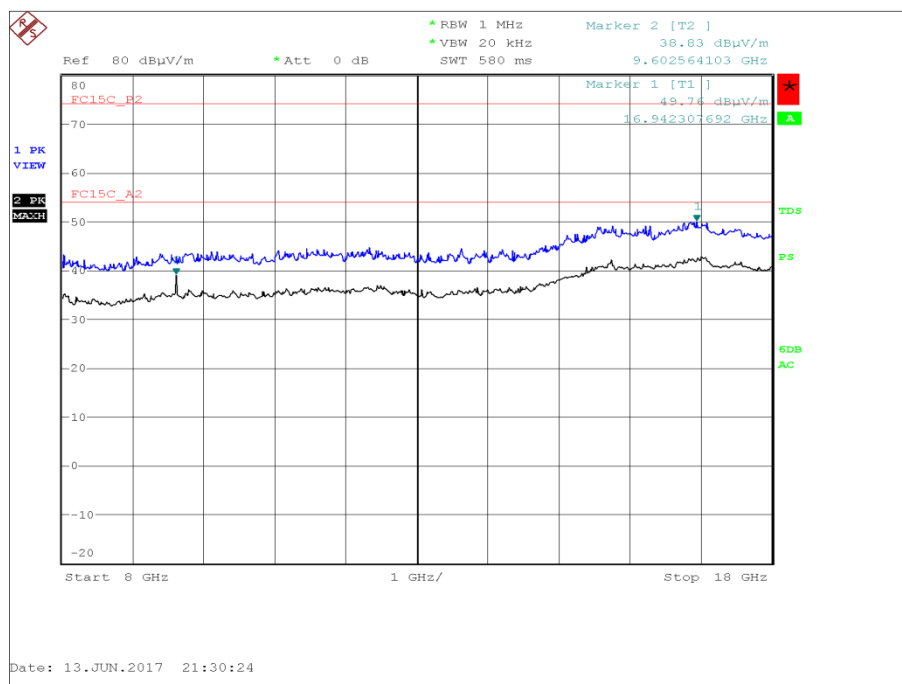


Figure 13 - 2402 MHz - 8 GHz to 18 GHz - Horizontal and Vertical

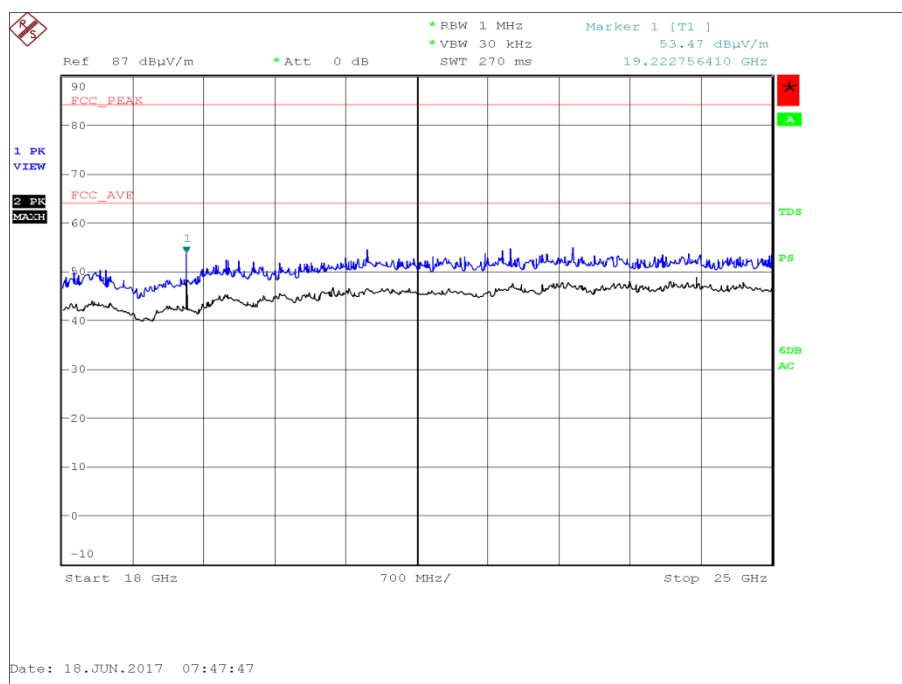


Figure 14 - 2402 MHz - 18 GHz to 25 GHz - Horizontal and Vertical



Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
30.665	30.6	40.0	-9.4	0	1.00	Vertical
31.795	30.1	40.0	-9.9	0	1.00	Vertical
34.342	29.0	40.0	-11.0	0	1.00	Vertical
764.243	33.0	46.0	-13.0	0	1.00	Vertical
861.752	33.4	46.0	-12.6	0	1.00	Vertical
960.000	34.3	46.0	-11.7	0	1.00	Vertical

Table 17 - 2440 MHz - 30 MHz to 1 GHz

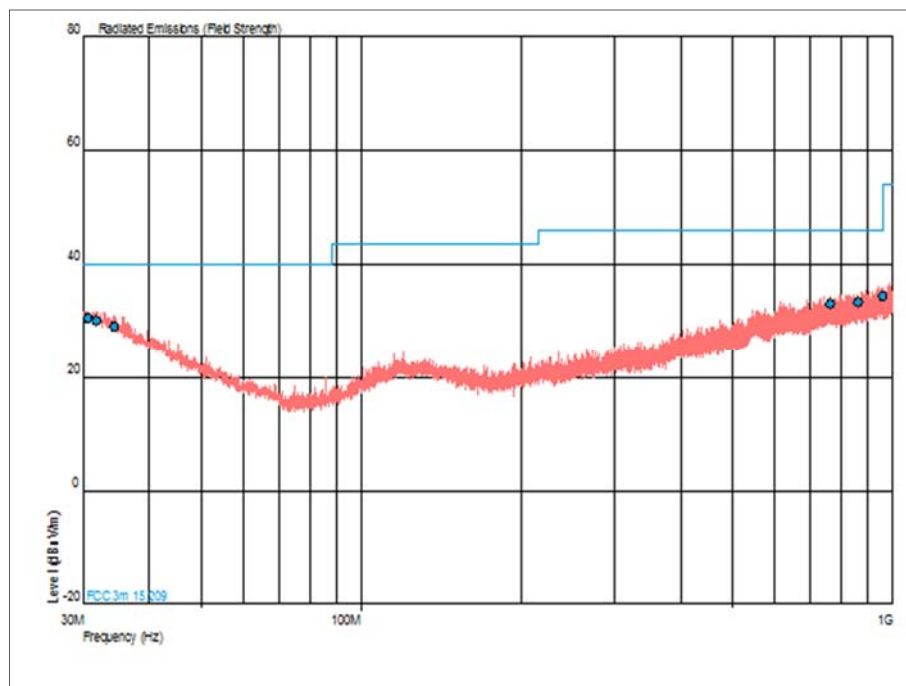


Figure 15 - 2440 MHz - 30 MHz to 1 GHz - Horizontal and Vertical

Frequency (MHz)	Result (μV/m)		Limit (μV/m)		Margin (μV/m)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 18 - 2440 MHz - 1 GHz to 25 GHz

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



Product Service

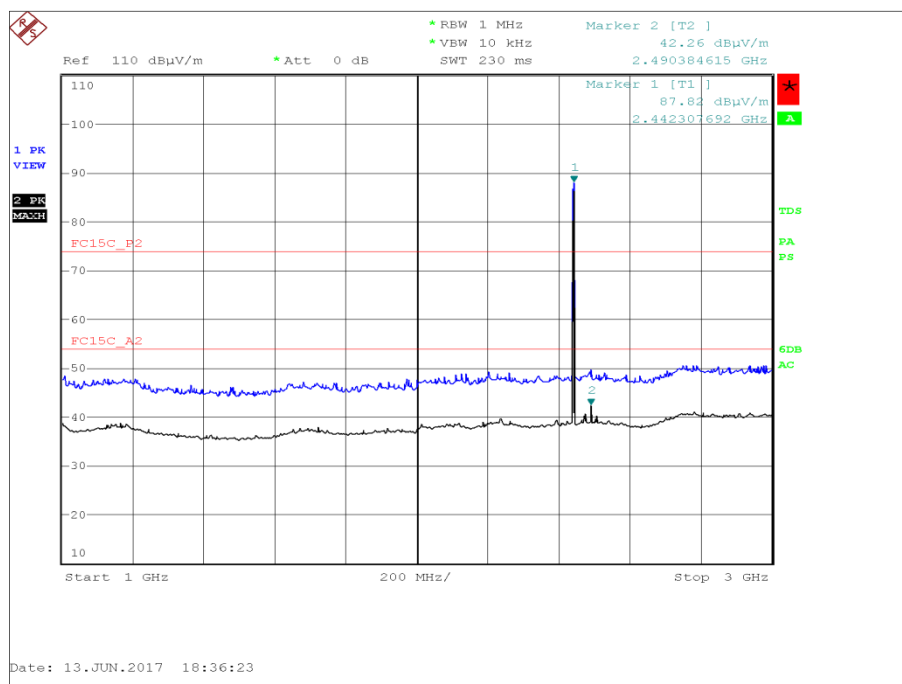


Figure 16 - 2440 MHz - 1 GHz to 3 GHz - Horizontal and Vertical

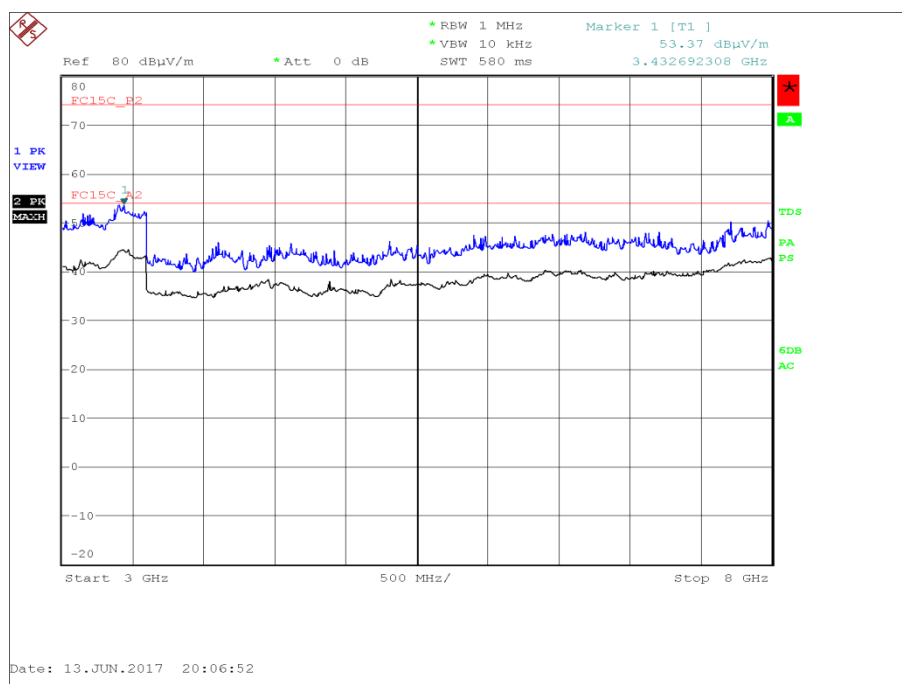


Figure 17 - 2440 MHz - 3 GHz to 8 GHz - Horizontal and Vertical

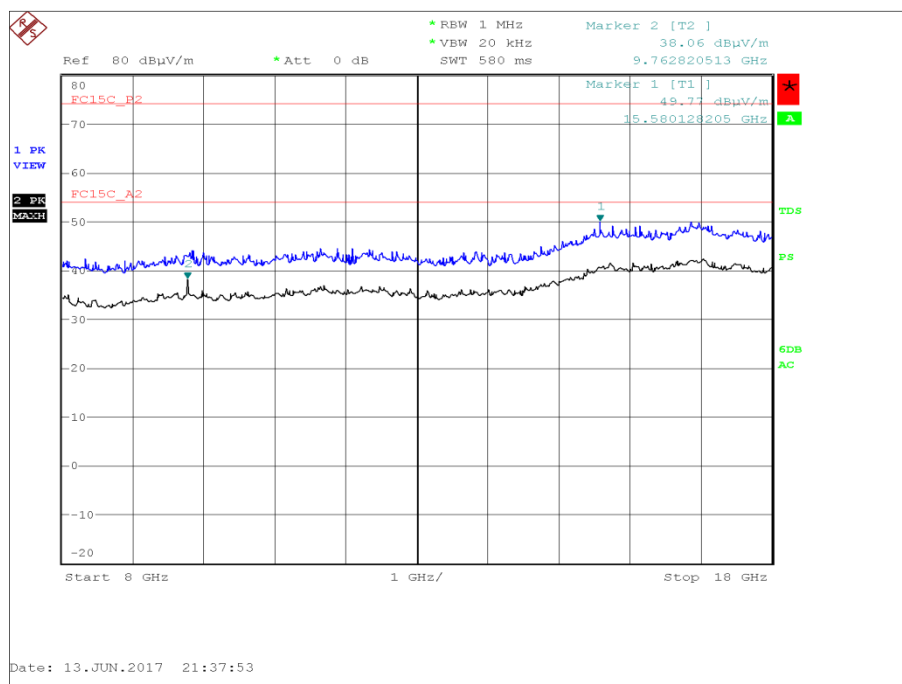


Figure 18 - 2440 MHz - 8 GHz to 18 GHz - Horizontal and Vertical

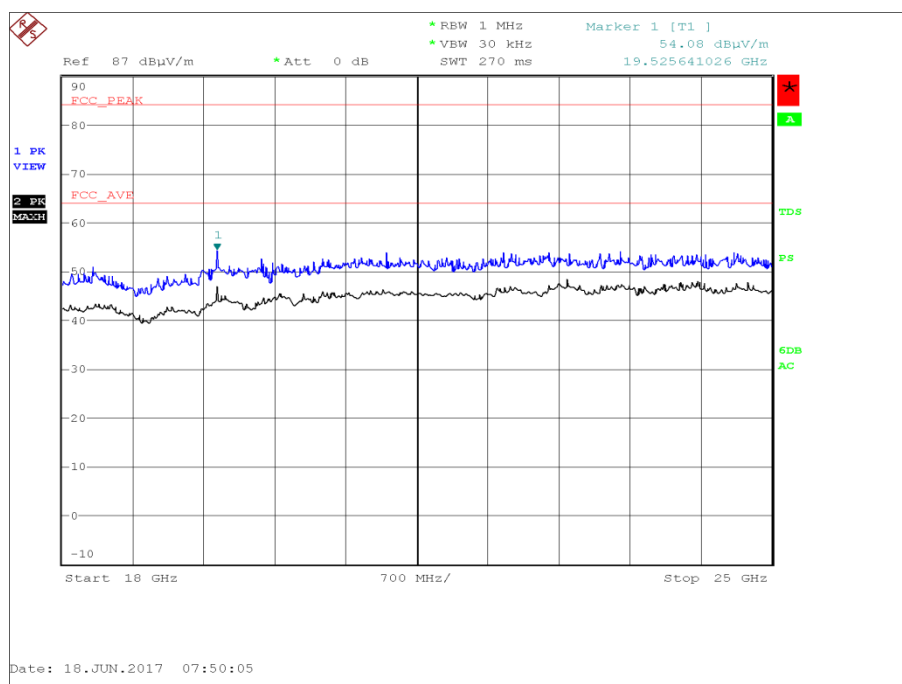


Figure 19 - 2440 MHz - 18 GHz to 25 GHz - Horizontal and Vertical

Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
30.011	30.9	40.0	-9.1	0	1.00	Vertical
32.023	30.1	40.0	-9.9	0	1.00	Vertical
36.017	28.3	40.0	-11.7	0	1.00	Vertical
844.696	33.2	46.0	-12.8	0	1.00	Vertical
872.260	33.4	46.0	-12.6	0	1.00	Vertical
960.000	34.4	46.0	-11.6	0	1.00	Vertical

Table 19 - 2480 MHz - 30 MHz to 1 GHz

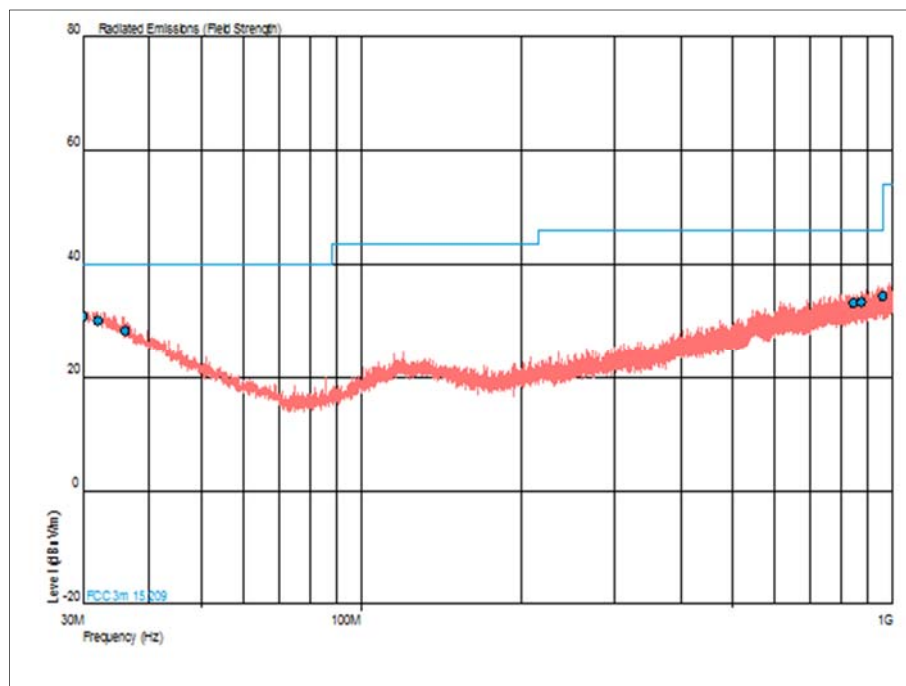


Figure 20 - 2480 MHz - 30 MHz to 1 GHz - Horizontal and Vertical

Frequency (MHz)	Result (μV/m)		Limit (μV/m)		Margin (μV/m)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 20 - 2480 MHz - 1 GHz to 25 GHz

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



Product Service

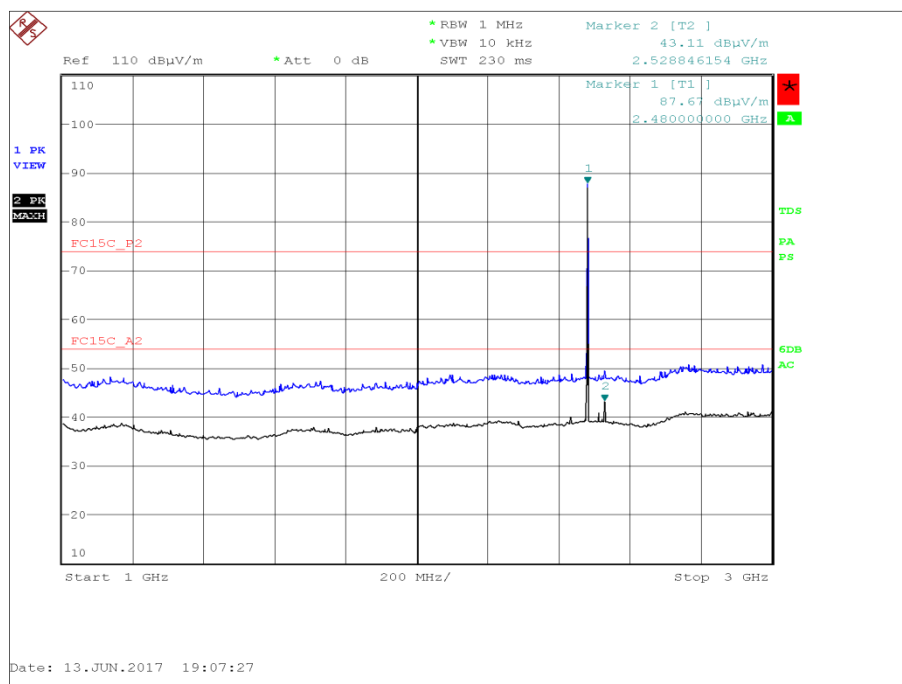


Figure 21 - 2480 MHz - 1 GHz to 3 GHz - Horizontal and Vertical

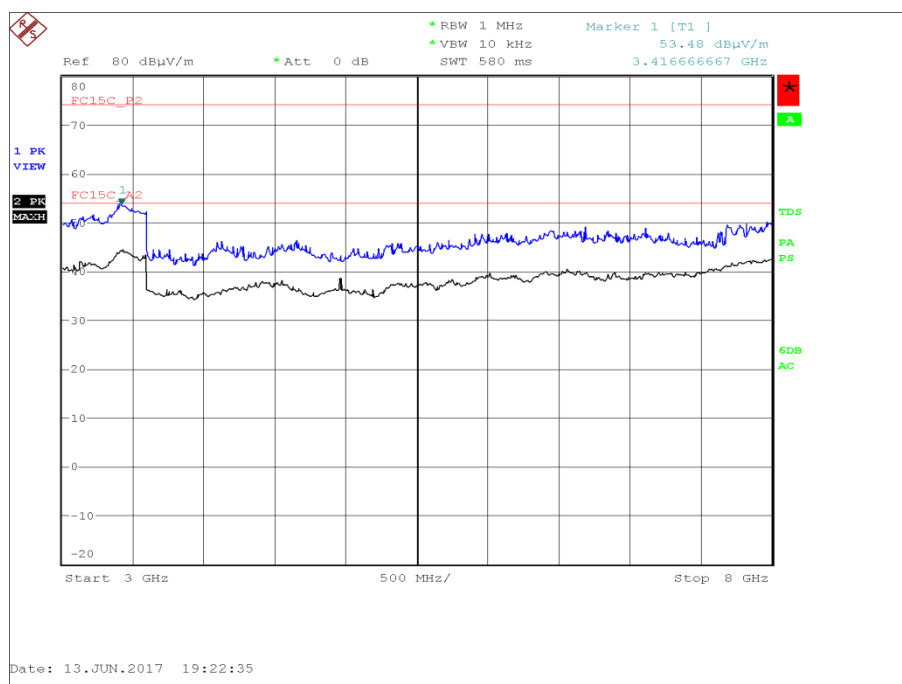


Figure 22 - 2480 MHz - 3 GHz to 8 GHz - Horizontal and Vertical

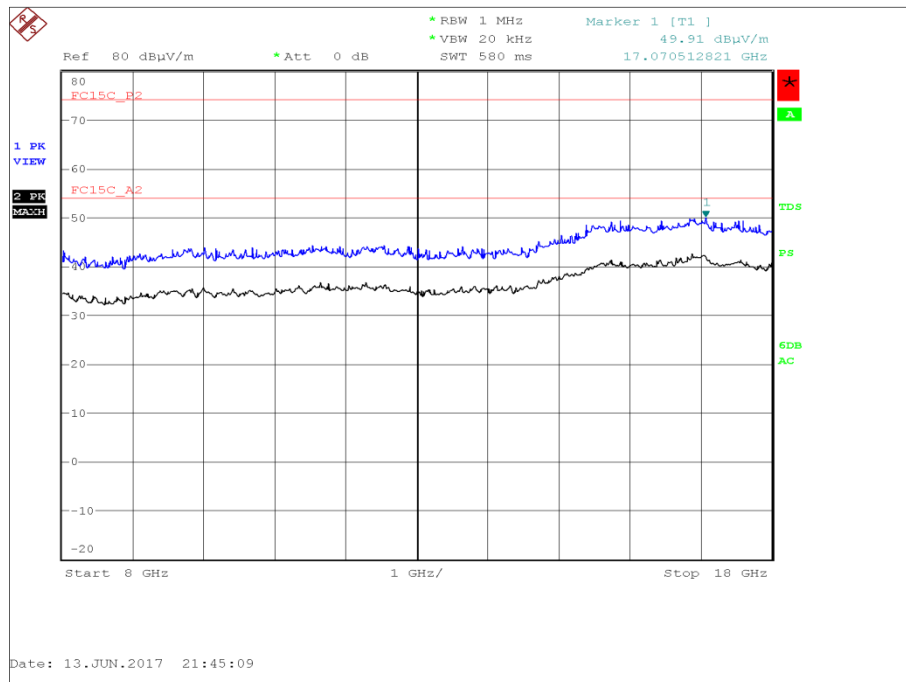


Figure 23 - 2480 MHz - 8 GHz to 18 GHz - Horizontal and Vertical

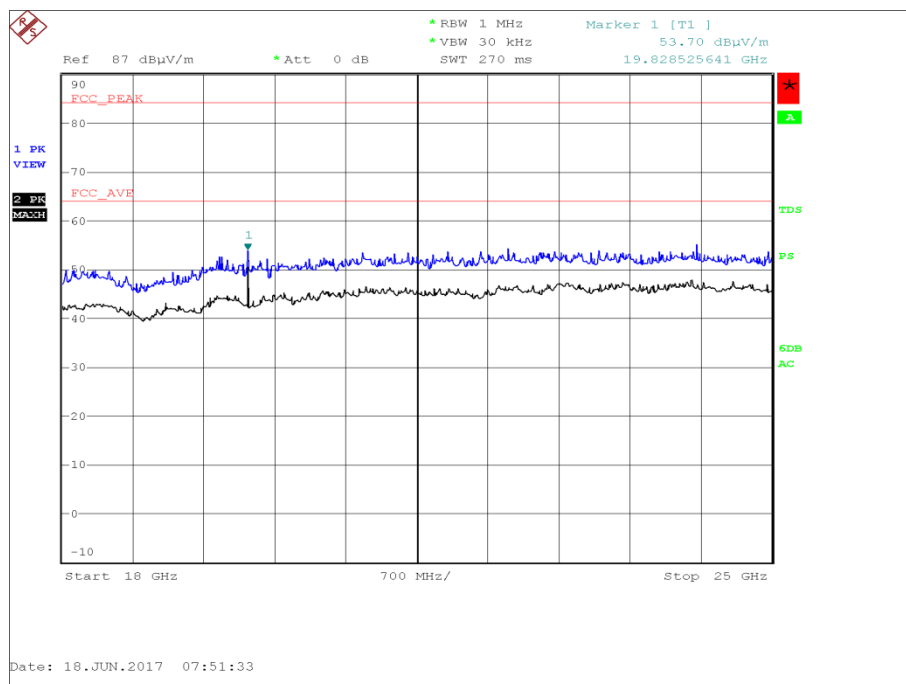


Figure 24 - 2480 MHz - 18 GHz to 25 GHz - Horizontal and Vertical



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

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

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.

2.5.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	12-Feb-2018
Antenna (Bilog)	Schaffner	CBL6143	287	24	18-Apr-2018
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	1002	12	14-Oct-2017
Pre-Amplifier	Phase One	PS04-0086	1533	12	29-Jul-2017
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	23-Jan-2018
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	A1	2138	12	2-Feb-2018
Comb Generator	Schaffner	RSG1000	3034	-	TU
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	12	2-May-2018
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	12-Nov-2017
Tilt Antenna Mast	matur GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	matur GmbH	NCD	3917	-	TU
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	23-Jul-2017
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	6	4-Nov-2017
Cable (Rx, SMAM-SMAM 0.5m)	Scott Cables	SLSLL18-SMSM-00.50M	4528	-	O/P Mon
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	17-Feb-2018
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	17-Feb-2018

Table 21

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment



2.6 Power Spectral Density

2.6.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (e)
Industry Canada RSS-247, Clause 5.4
Industry Canada RSS-GEN, Clause 6.12

2.6.2 Equipment Under Test and Modification State

COTS Reader, S/N: Not serialised (75939338-TSR0010) - Modification State 0

2.6.3 Date of Test

22-June-2017

2.6.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.10.2.

2.6.5 Environmental Conditions

Ambient Temperature 25.2 °C
Relative Humidity 45.5 %

2.6.6 Test Results

Bluetooth Low Energy

Modulation/Packet Type: GFSK/DH1

Frequency (MHz)	Power Spectral Density (dBm)
2402	-18.33
2440	-16.86
2480	-15.93

Table 22



Product Service

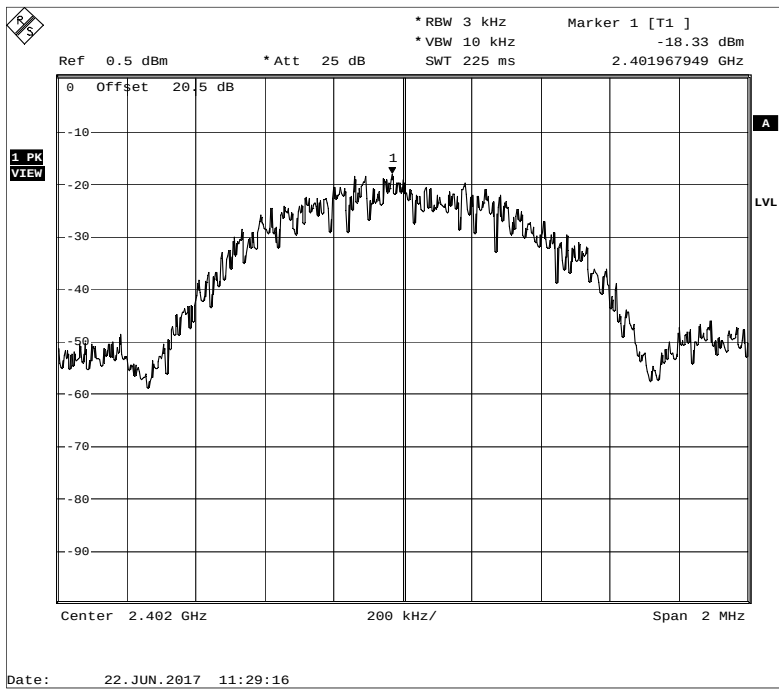


Figure 25 - 2402.0 MHz

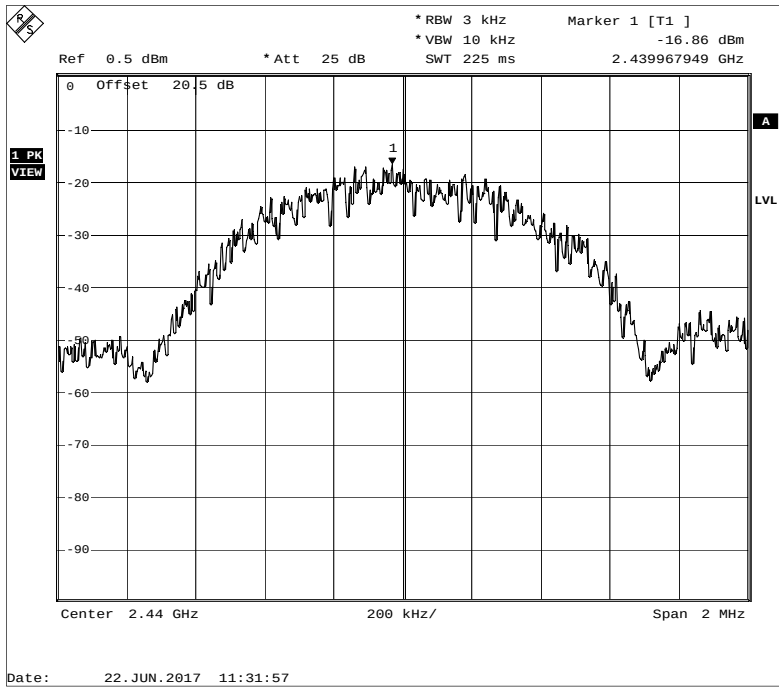


Figure 26 - 2440.0 MHz

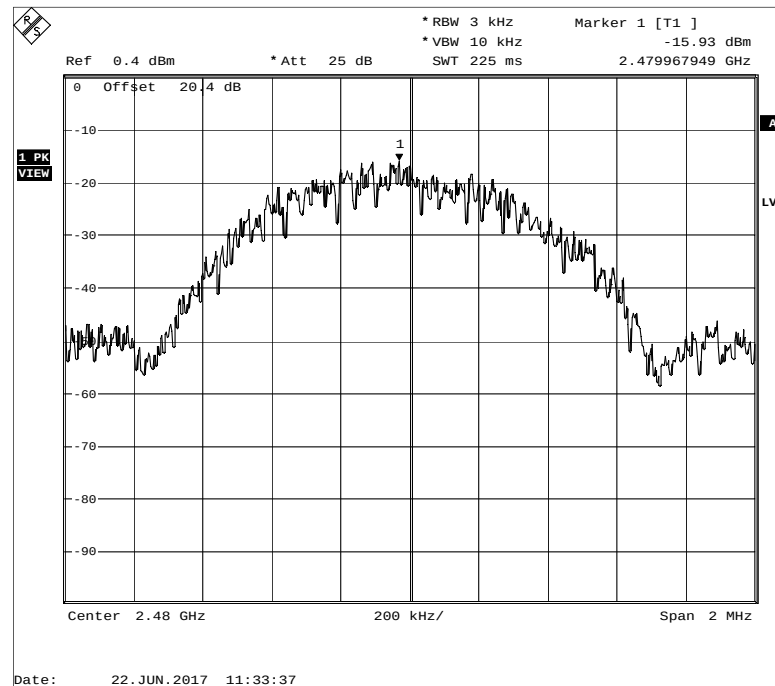


Figure 27 - 2480.0 MHz

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

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Industry Canada RSS-247, Limit Clause 5.2(b)

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.



2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	2-Feb-2018
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	30-Jun-2017
Hygrometer	Rotronic	I-1000	3220	12	23-Aug-2017
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3702	12	13-Dec-2017
True RMS Multimeter	Fluke	179	4007	12	14-Sep-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	8-Sep-2017

Table 23

O/P Mon – Output Monitored using calibrated equipment



3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	± 0.96 dB
Power Spectral Density	± 0.96 dB
Emission Bandwidth	± 33.08 KHz
Authorised Band Edges	30 MHz to 1 GHz: ± 5.1 dB 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
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 24