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Report On

FCC and Industry Canada Testing of the
1066 Labs Limited Highfive Roombox
In accordance with FCC CFR 47 Part 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN (Bluetooth)

COMMERCIAL-IN-CONFIDENCE

FCC ID: 2ACYQRB1
IC: 12326A-RB1

Document 75928172 Report 02 Issue 3 November 2014

Product Service

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
1066 Labs Limited Highfive Roombox
In accordance with FCC CFR 47 Part 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN (Bluetooth)

Document 75928172 Report 02 Issue 3

November 2014

PREPARED FOR

1066 Labs Limited
Innovation Centre
Highfield Drive
St Leonards-on-Sea
East Sussex
TN38 9UH

PREPARED BY

Natalie Bennett
Senior Administrator, Project Support

APPROVED BY

Matthew Russell
Authorised Signatory

DATED 11 November 2014

This report has been up-issued to Issue 3 to include additional measurements test results.

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 CFR 47 Part 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

T Guy J Hurley G Lawler J Tuckwell

UKAS TESTING 0141

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CONTENTS

Product Service

SECTION 1

REPORT SUMMARY

FCC and Industry Canada Testing of the
1066 Labs Limited Highfive Roombox
In accordance with FCC CFR 47 Part 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN (Bluetooth)

1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC and Industry Canada Testing of the 1066 Labs Limited Highfive Roombox to the requirements of FCC CFR 47 Part 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN.

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	1066 Labs Limited
Model Number(s)	RBS1
Serial Number(s)	RB1431A078 RBM4310055
Number of Samples Tested	2
Test Specification/Issue/Date	FCC CFR 47 Part 15C (2013) Industry Canada RSS-210 (2010) Industry Canada RSS-GEN (2010)
Incoming Release Date	Application Form 16 October 2014
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	Proforma Invoice 06 October 2014
Start of Test	10 October 2014
Finish of Test	7 November 2014
Name of Engineer(s)	T Guy J Hurley G Lawler J Tuckwell
Related Document(s)	ANSI C63.10: 2009

Product Service

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN is shown below.

Section	Spec Clause			Test Description	Result	Comments/Base Standard
	Pt 15C	RSS-210	RSS-GEN			
Bluetooth						
2.1	15.207	-	7.2.4	AC Line Conducted Emissions	Pass	
2.2	15.247 (a)(1)	A8.1 (a)(b)	-	Frequency Hopping Systems - 20 dB Bandwidth and Channel Separation	Pass	
2.3	15.247 (a)(1)(iii)	A8.1 (d)	-	Frequency Hopping Systems - Channel Dwell Time and Number of Hopping Channels	Pass	
2.4	15.247 (b)(1)	A8.4 (2)	-	Maximum Peak Conducted Output Power	Pass	
2.5	15.247 (b)(4)	A8.4 (2)	4.8	EIRP Peak Power	Pass	
2.6	15.247 (d)	A8.5	4.9	Spurious and Band Edge Emissions	Pass	

Product Service

1.3 APPLICATION FORM

APPLICANT'S DETAILS

COMPANY NAME : **1066 Labs Ltd** .....
ADDRESS : **Innovation Centre, Highfield Drive, St Leonards-on-Sea**.....
East Sussex. TN38 9UH.....
.....
NAME FOR CONTACT PURPOSES : **Dave Williams**.....

TELEPHONE NO: **01424 858182**..... FAX NO: .....
E-MAIL: **dave.williams@1066labs.com**

EQUIPMENT INFORMATION

Model name/number **Highfive Roombox**.... Identification/Part number **RB1**.....
Hardware Version ..... Software Version .....
Manufacturer **1066 Labs Ltd.** Country of Origin .....
FCC ID **2ACYQRB1**..... Industry Canada ID **12326A-RB1**.....
Technical description (a brief description of the intended use and operation)
Video conferencing system, affixed to the top edge of a TV, or computer monitor, using its own integral clamping method.

Supply Voltage:
[ ] AC mains State AC voltage ..... V and AC frequency ..... Hz
[**YES**] DC (external) State DC voltage **15**..... V and DC current **1.0 A**
[ ] DC (internal) State DC voltage ..... V and Battery type .....

Frequency characteristics:
Transmitter Frequency range **2.402** MHz to **2.480** MHz Channel spacing **1** MHz (if channelized)
Receiver Frequency range (if different) **2.402** MHz to **2.480** MHz Channel spacing **1** MHz (if channelized)
Designated test frequencies:
Bottom: **2.402** MHz Middle: **2.441** MHz Top: **2.480** MHz
Intermediate Frequencies : ..... MHz
Highest Internally Generated Frequency : **25** MHz

Power characteristics:
Maximum transmitter power 8 dBm Minimum transmitter power (if variable) **6** dBm
[ ] Continuous transmission
[**YES**] Intermittent transmission State duty cycle **Variable**
If intermittent, can transmitter be set to continuous transmit test mode? **YES**

Antenna characteristics:
[ ] Antenna connector State impedance ..... ohm
[ ] Temporary antenna connector State impedance ..... ohm
[**YES**] Integral antenna Type PCB State gain **2.67**..... dBi
[ ] External Antenna Type ..... State gain ..... dBi

Modulation characteristics:
[ ] Amplitude [**GSFK/DPSK**] Other
[ ] Frequency Details:
[ ] Phase
Can the transmitter operate un-modulated? **No**
ITU Class of emission: .....

Battery/Power Supply
Model name/number **AC/DC Adapter.** Identification/Part number **YLS0301A-T150160**
Manufacturer **Dongguan Yinli Electronics** Country of Origin **China**.....

Ancillaries (if applicable)
Model name/number ..... Identification/Part number .....
Manufacturer ..... Country of Origin .....

Extreme conditions:
Maximum temperature ..... °C Minimum temperature ..... °C
Maximum supply voltage ..... V Minimum supply voltage V

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I hereby declare that I am entitled to sign on behalf of the applicant and that the information supplied is correct and complete.

Signature : 

Name : Dave Williams

Position held : Testing and Laboratory Manager

Date : 16th October 2014

Product Service

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a 1066 Labs Limited Highfive Roombox. 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 110 V AC, 60 Hz 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.

Product Service

SECTION 2

TEST DETAILS

FCC and Industry Canada Testing of the
1066 Labs Limited Highfive Roombox
In accordance with FCC CFR 47 Part 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN (Bluetooth)

2.1 AC LINE CONDUCTED EMISSIONS

2.1.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.207
Industry Canada RSS-GEN, Clause 7.2.4

2.1.2 Equipment Under Test and Modification State

RBS1 S/N: RB1431A078 - Modification State 0

2.1.3 Date of Test

18 October 2014

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

A test environment and testing arrangement meeting the specification of ANSI C63.4 was used during all testing. The Equipment Under Test (EUT) was set upon a non-conducting platform at an elevation of 80 cm above a horizontal reference ground plane. A vertical reference ground plane was situated 40 cm from the EUT and bonded to the horizontal reference ground plane.

The EUT was powered by a Line Impedance Stabilization Network (LISN), whereby emissions measurements of the current-carrying conductors were made through this LISN. The LISN was bonded to the horizontal reference ground plane with a separation distance greater than 80 cm from the EUT. A mains supply cable of 1 m length was used to supply mains power to the EUT from the LISN.

A preliminary emissions scan was conducted for each current-carrying conductor of the EUT, using a peak detector over a frequency range of 150 kHz to 30 MHz. At least six of the greatest peak emissions, frequency positions were selected from each preliminary emissions scan for further evaluation as final measuring points.

Final measurement points were measured using quasi-peak and average detectors. All final measurements were assessed against the emission limits in Clause 15.207 of FCC CFR 47 FCC Part 15.

Testing was carried out using GFSK modulation which was established as being the worst case, (highest output power), prior to commencement of testing.

2.1.6 Environmental Conditions

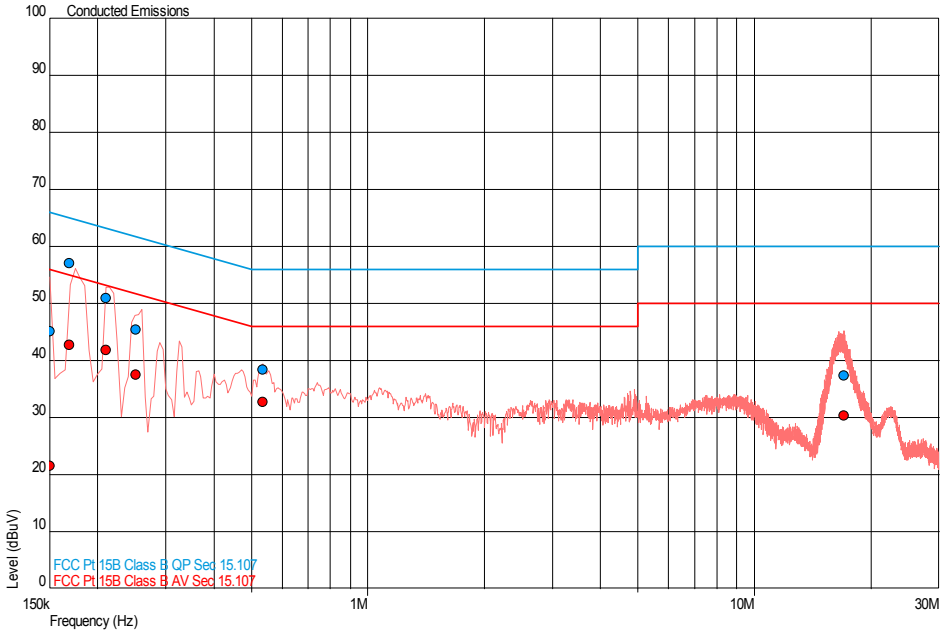
Ambient Temperature	20.3°C
Relative Humidity	59.0%

Product Service

2.1.7 Test Results

Modulation: GFSK

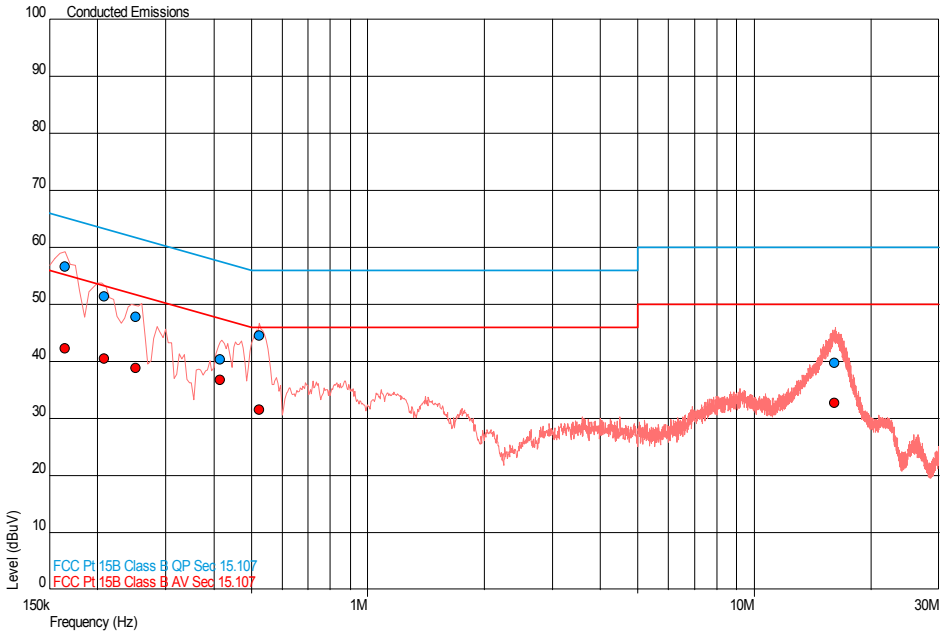
Live Line



Frequency (MHz)	QP Level (dBµV)	QP Limit (dBµV)	QP Margin (dBµV)	AV Level (dBµV)	AV Limit (dBµV)	AV Margin (dBµV)
0.150	45.1	66.0	-20.8	21.6	56.0	-34.4
0.169	57.2	65.0	-7.8	42.8	55.0	-12.2
0.210	51.0	63.2	-12.2	41.9	53.2	-11.3
0.251	45.5	61.7	-16.2	37.6	51.7	-14.1
0.535	38.4	56.0	-17.6	32.7	46.0	-13.3
17.037	37.5	60.0	-22.5	30.4	50.0	-19.6

Product Service

Neutral Line



Frequency (MHz)	QP Level (dBµV)	QP Limit (dBµV)	QP Margin (dBµV)	AV Level (dBµV)	AV Limit (dBµV)	AV Margin (dBµV)
0.165	56.7	65.2	-8.5	42.4	55.2	-12.8
0.208	51.4	63.3	-11.8	40.6	53.3	-12.7
0.251	47.8	61.7	-13.9	38.9	51.7	-12.8
0.415	40.3	57.5	-17.2	36.8	47.5	-10.8
0.524	44.5	56.0	-11.5	31.6	46.0	-14.4
16.101	39.8	60.0	-20.2	32.8	50.0	-17.2

2.2 FREQUENCY HOPPING SYSTEMS - 20 dB BANDWIDTH AND CHANNEL SEPARATION

2.2.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (a)(1)
Industry Canada RSS-210, Clause A8.1 (a)(b)

2.2.2 Equipment Under Test and Modification State

RBS1 S/N: RBM4310055 - Modification State 0

2.2.3 Date of Test

10 October 2014, 17 October 2014 & 5 November 2014

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 conducted in accordance with ANSI C63.10 Clause 6.9.1.

The EUT was transmitted at maximum power on bottom, middle and top hopping frequency channels for DH5, 2DH5 and 3DH5 packet types. The EUT was connected to a spectrum analyser via a cable and attenuator. The Analyser settings were adjusted to display the resultant trace on screen with an RBW of 30 kHz. The peak point of the trace was measured and the markers positioned to give the -20 dBc points of the displayed spectrum.

The EUT was then configured to transmit over all hopping frequencies. The trace was set to Max Hold to store several adjacent channels on screen. Using the marker delta function, the markers were positioned to show the separation between adjacent channels. Measurements were performed on one modulation type only as the channel separation is the same for all modulation and packet types.

2.2.6 Environmental Conditions

Ambient Temperature	21.5°C
Relative Humidity	54.6%

Product Service

2.2.7 Test Results

Modulation: GFSK

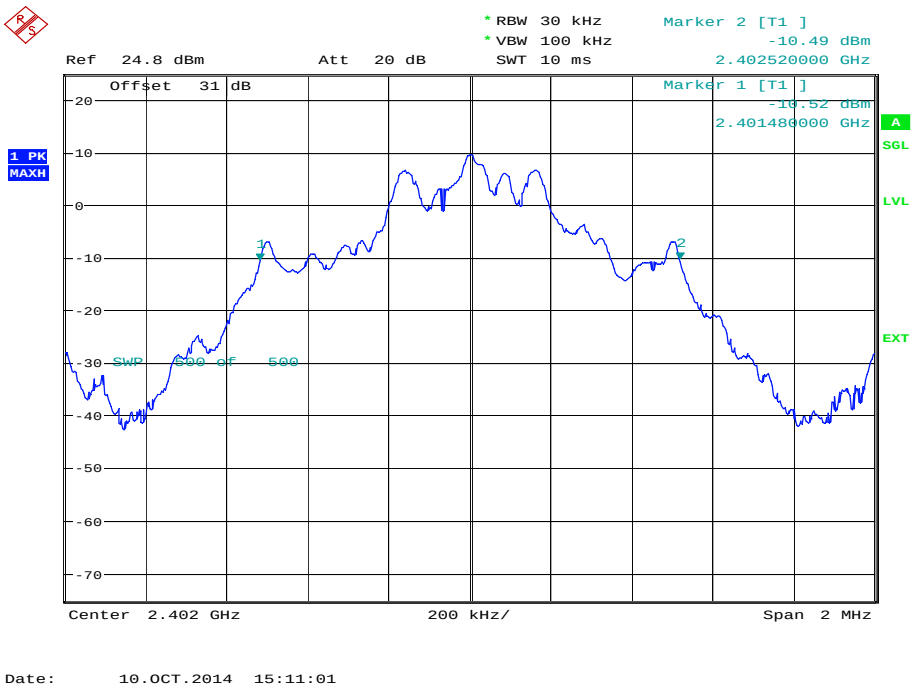
110 V AC, 60 Hz supply

20dB Bandwidth

2402 MHz

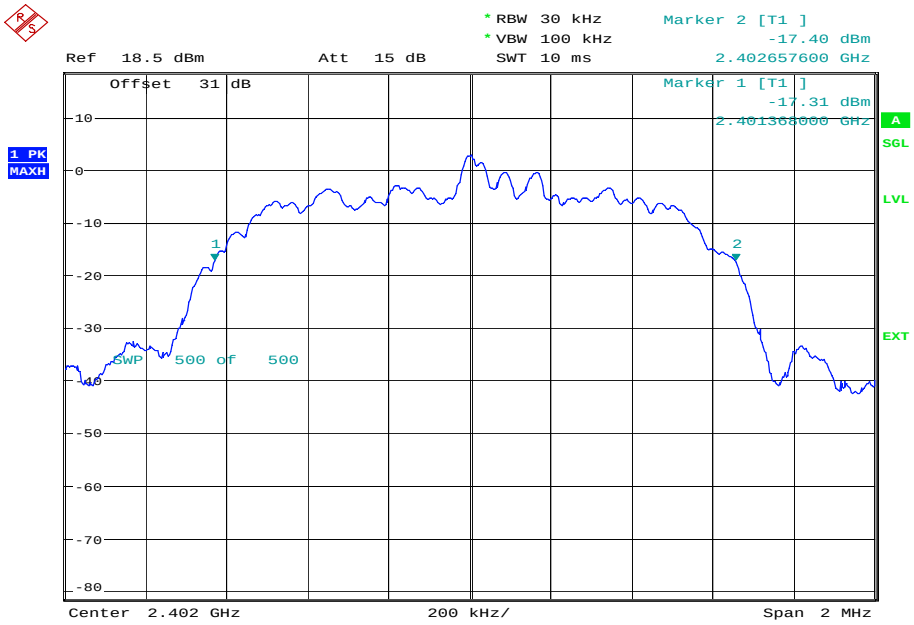
Data Rate (Mbps)	20dB Bandwidth (kHz)
DH5	1040.0
2DH5	1289.6
3DH5	1296.0

DH5



Product Service

2DH5



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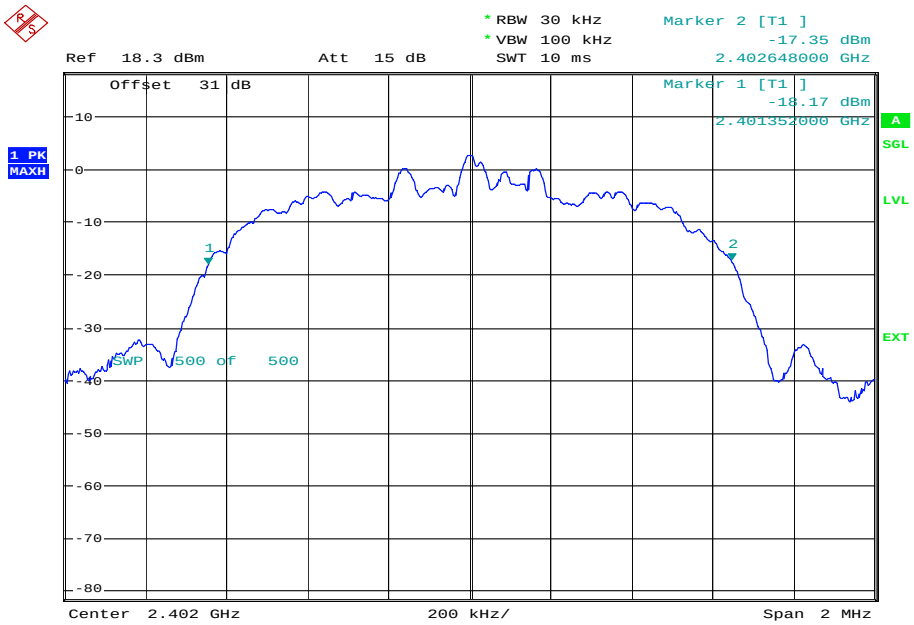
3DH5

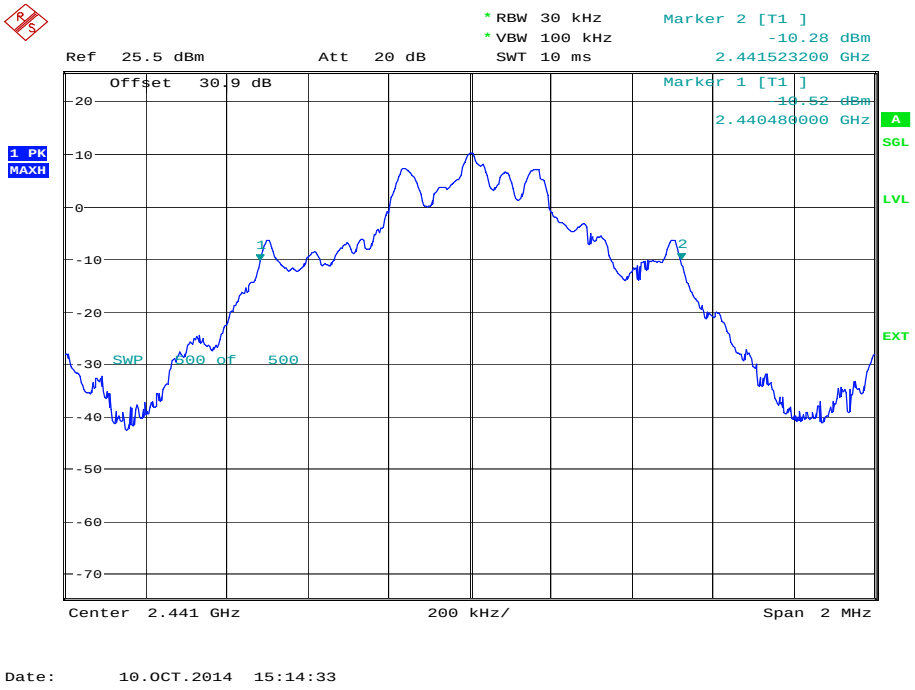


Date: 17.OCT.2014 09:29:39

2441 MHz

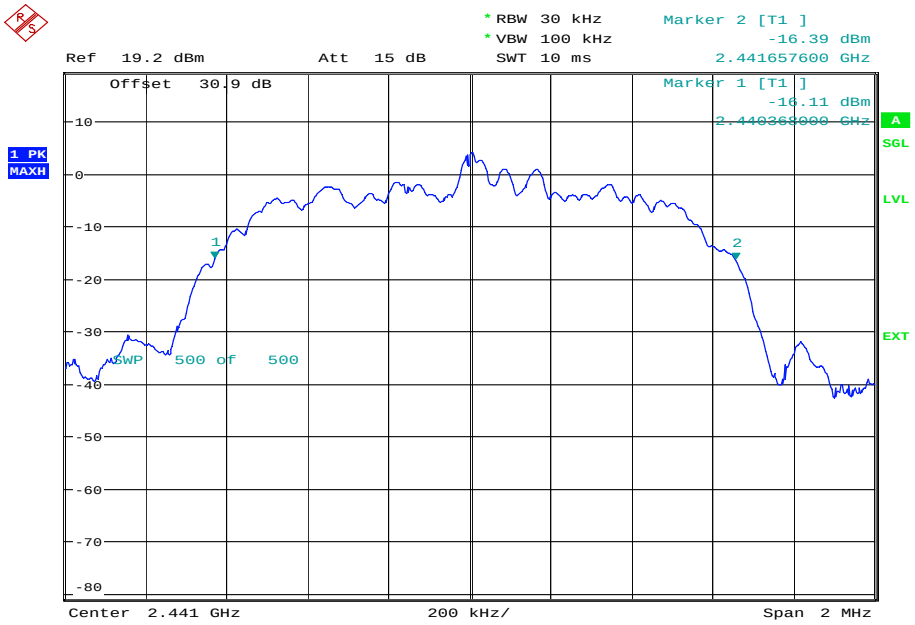
Data Rate (Mbps)	20dB Bandwidth (kHz)
DH5	1043.2
2DH5	1289.6
3DH5	1298.2

DH5



Product Service

2DH5



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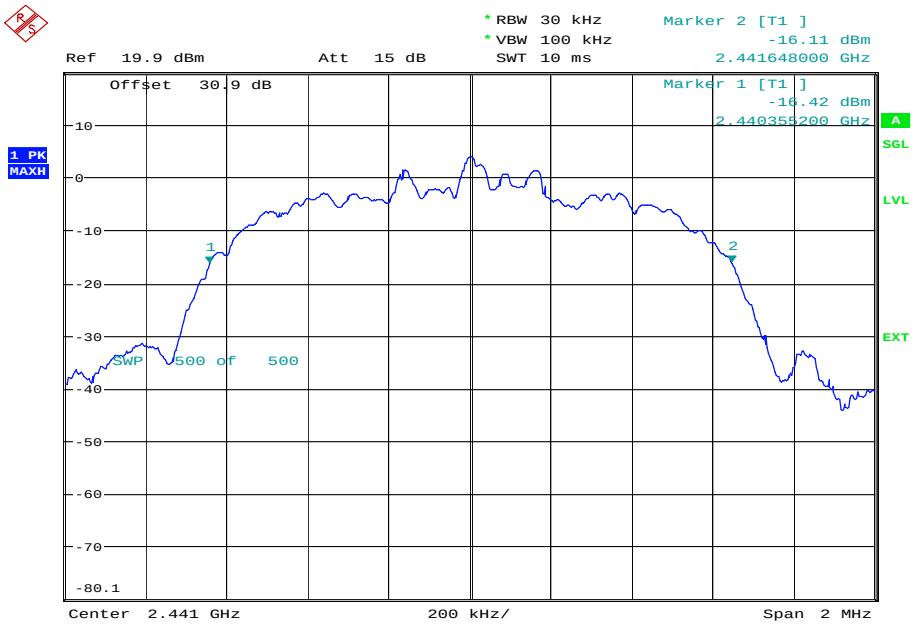
3DH5



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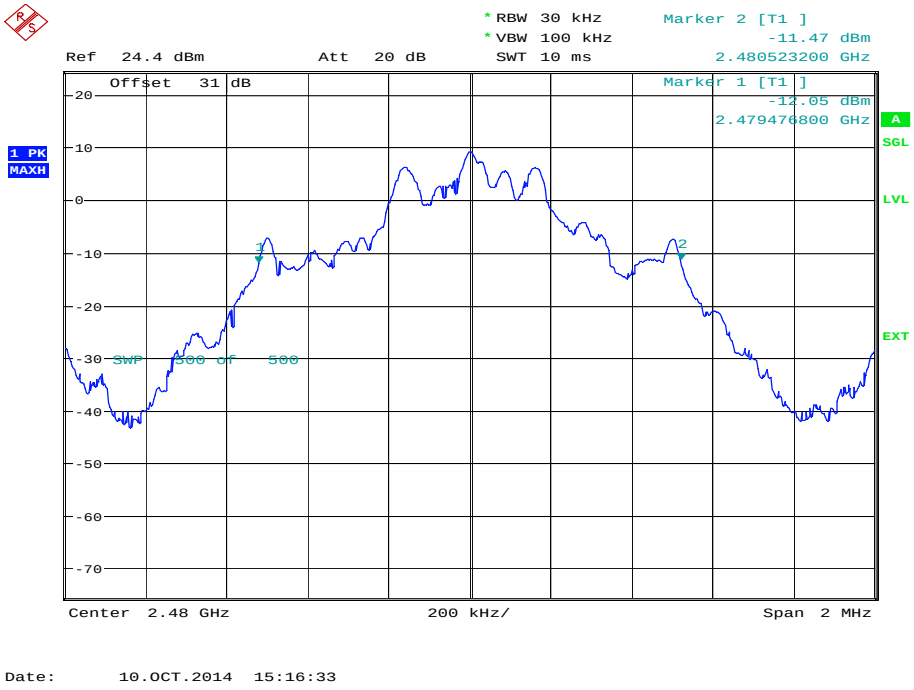
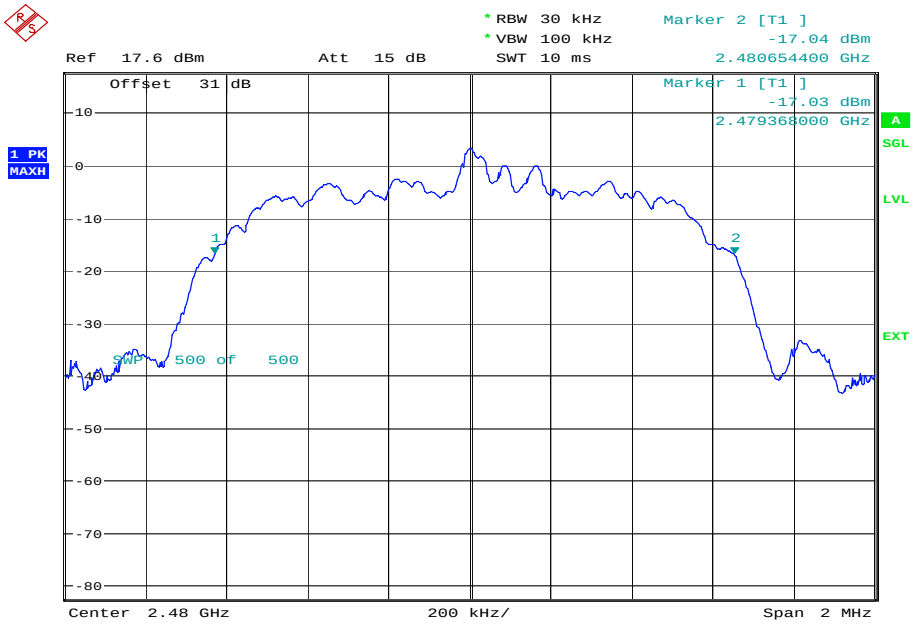
2480 MHz

Data Rate (Mbps)	20dB Bandwidth (kHz)
DH5	1046.4
2DH5	1286.4
3DH5	1296.0

DH5



2DH5



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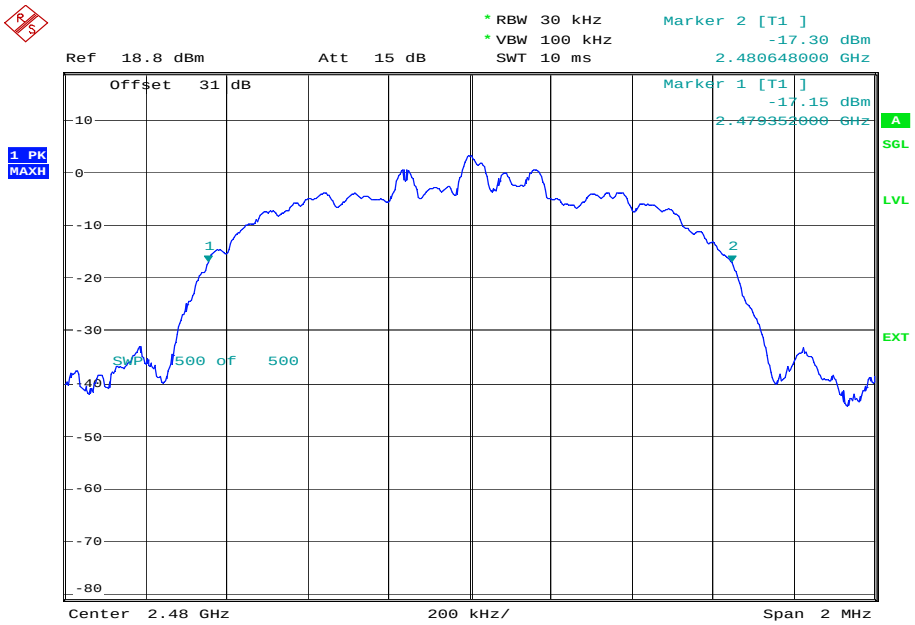
3DH5



Date: 17.OCT.2014 09:18:26

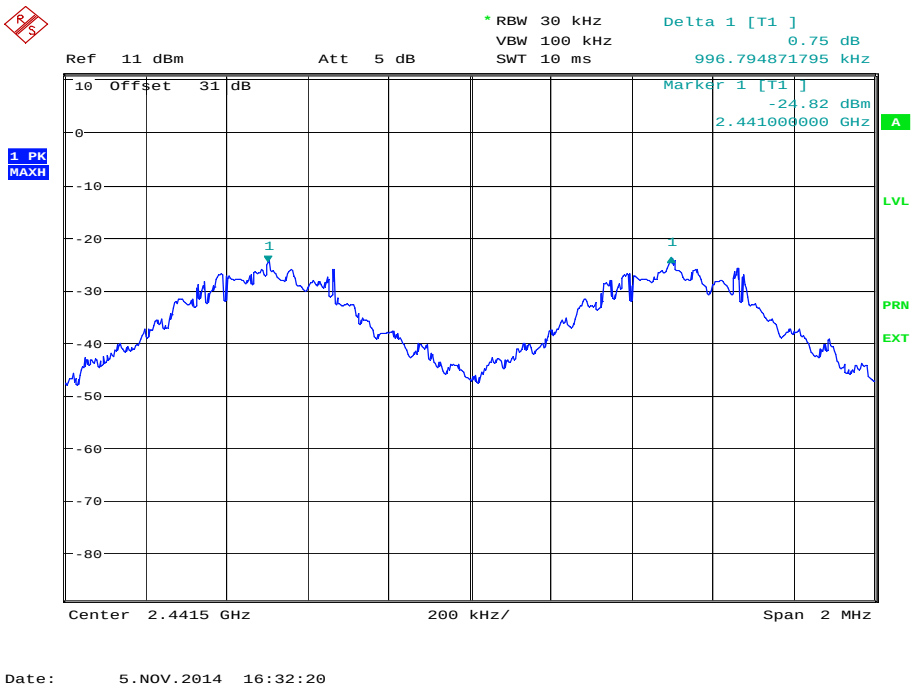
Limit Clause

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

Channel Separation

Modulation/Packet Type: GFSK/DH5

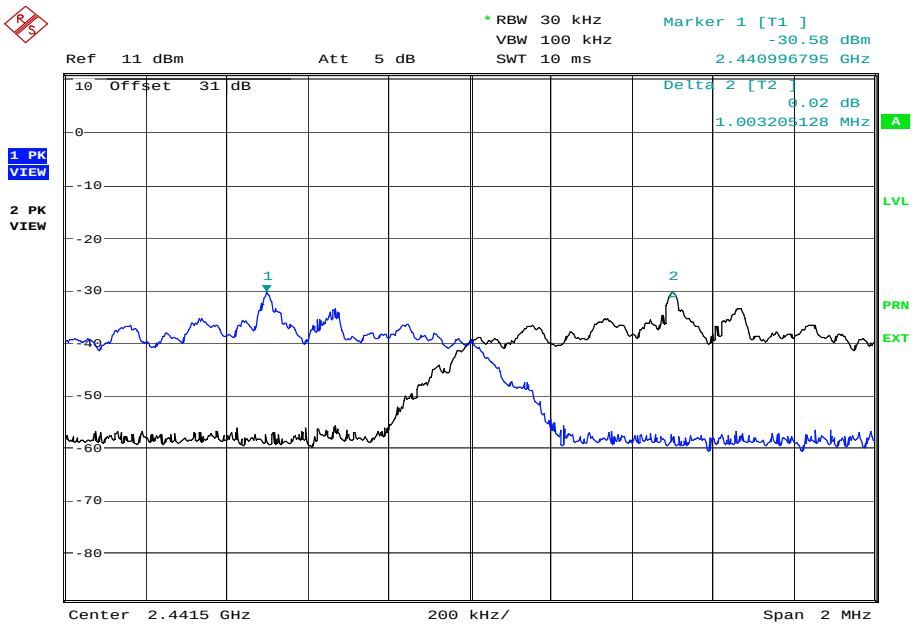
Channel Separation: 1 MHz



Product Service

Modulation/Packet Type: GFSK/2DH5

Channel Separation: 1 MHz



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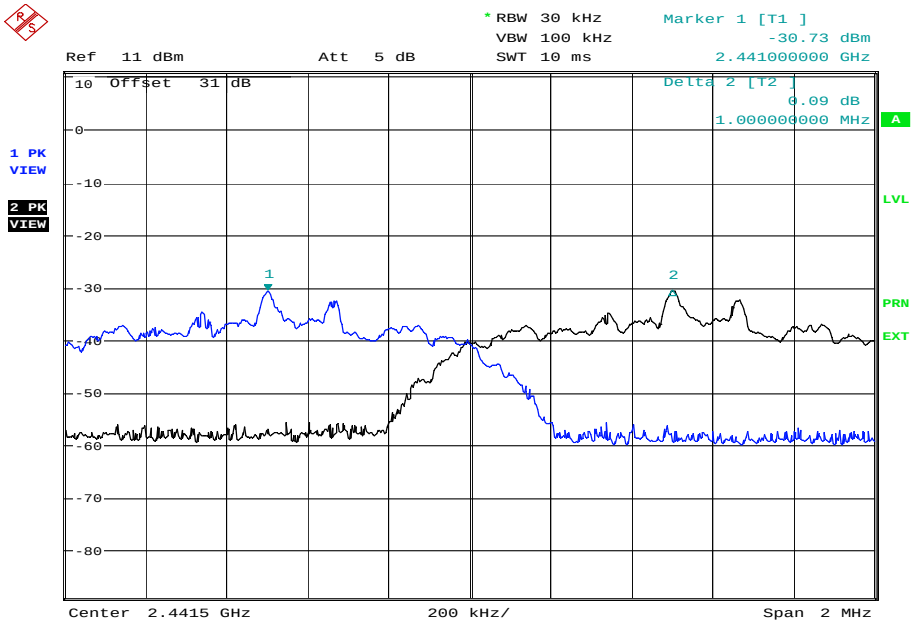
Modulation/Packet Type: GFSK/3DH5

Channel Separation: 1 MHz



Date: 5.NOV.2014 16:37:10

Limit Clause

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.

The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

2.3 FREQUENCY HOPPING SYSTEMS - CHANNEL DWELL TIME AND NUMBER OF HOPPING CHANNELS

2.3.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (a)(1)(iii)
Industry Canada RSS-210, Clause A8.1 (d)

2.3.2 Equipment Under Test and Modification State

RBS1 S/N: RBM4310055 - Modification State 0

2.3.3 Date of Test

10 October 2014, 15 October 2014, 24 October 2014 & 6 November 2014

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 EUT was transmitted at maximum power in a frequency hopping mode of operation for DH1, DH3 and DH5 packet types. The EUT was connected to a spectrum analyser via a cable and attenuator. The Analyser settings were adjusted to display the resultant trace. The span of the analyser was then adjusted to display the entire band of operation to verify that the EUT employed a minimum of 15 hopping channels.

Finally, the analyser span was set to zero, centred on the bottom, middle or top hopping frequencies employed by the EUT with an RBW of 1 MHz. Initially the sweep time was adjusted to show the Tx on time of a single burst and the Tx on time was recorded. The sweep time was then set to 0.4 seconds multiplied by the number of hopping channels employed and the accumulative dwell time was calculated by counting the number of bursts and multiplying this by the Tx on time.

2.3.6 Environmental Conditions

Ambient Temperature	21.5 - 24.4°C
Relative Humidity	47.1 - 54.6%

Product Service

2.3.7 Test Results

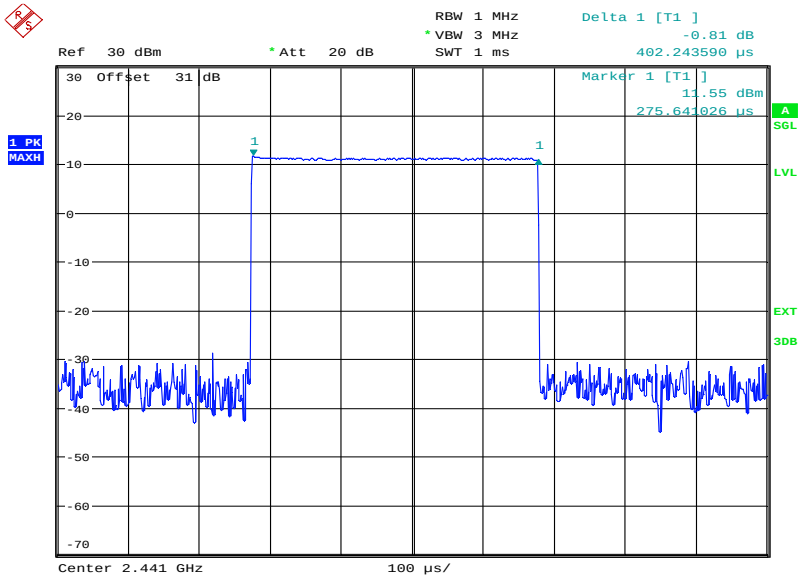
Modulation: GFSK

110 V AC, 60 Hz supply

Channel Dwell Time

DH1

Dwell Time (ms)	Number Of Transmissions	Average Occupancy Time (ms)
402.243	181	72.81



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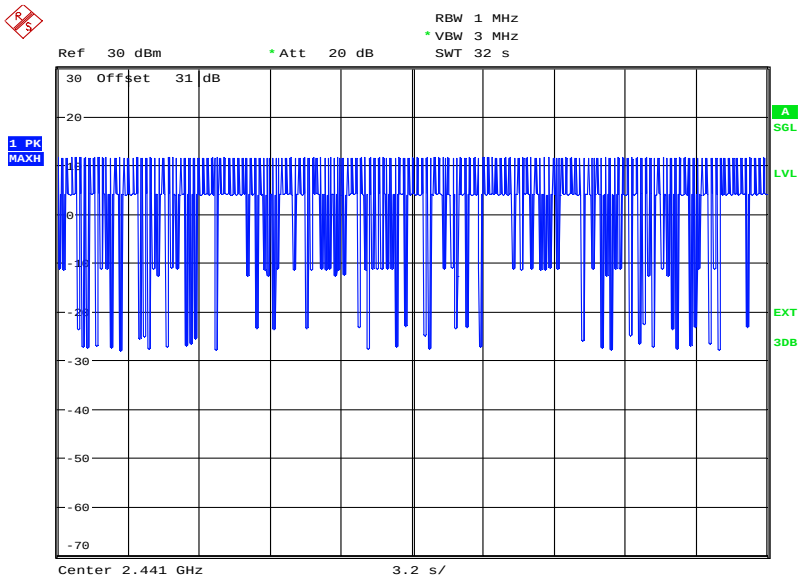
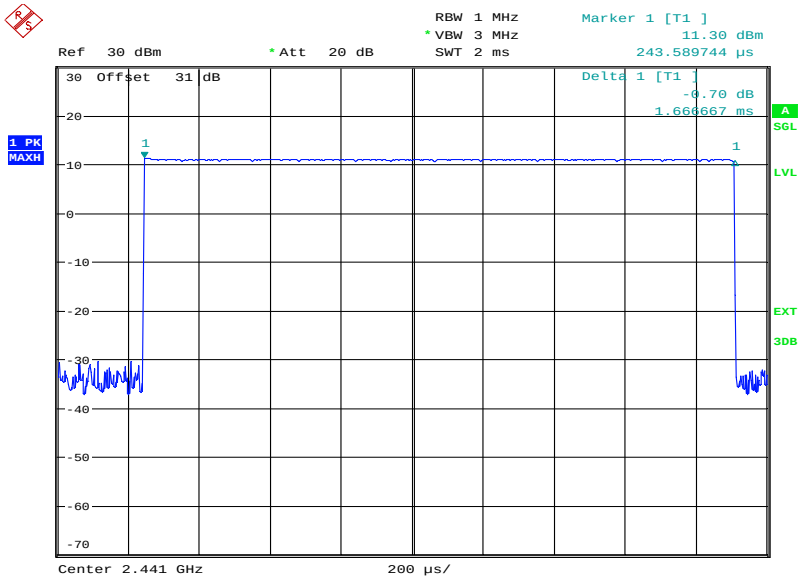


Date: 6.NOV.2014 10:17:11

DH3

Dwell Time (ms)	Number Of Transmissions	Average Occupancy Time (ms)
1.667	121	201.67



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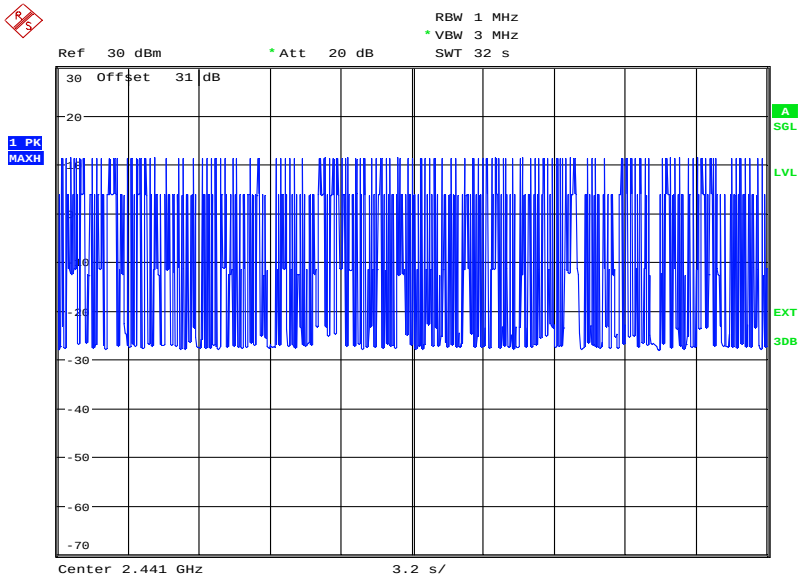

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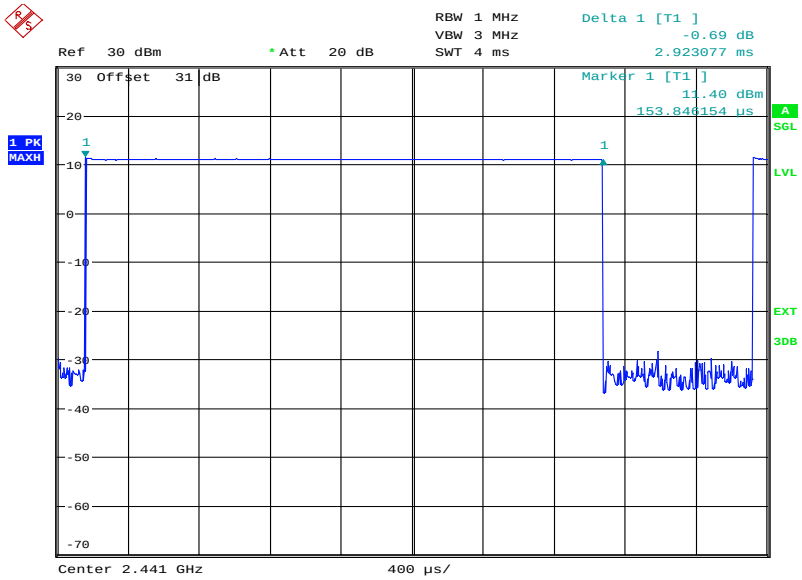
DH5

Dwell Time (ms)	Number Of Transmissions	Average Occupancy Time (ms)
2.923	92	268.92



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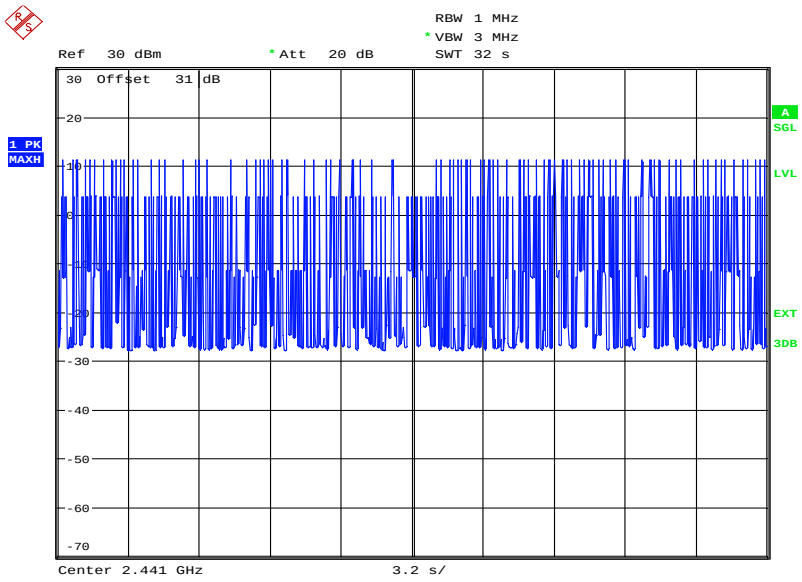


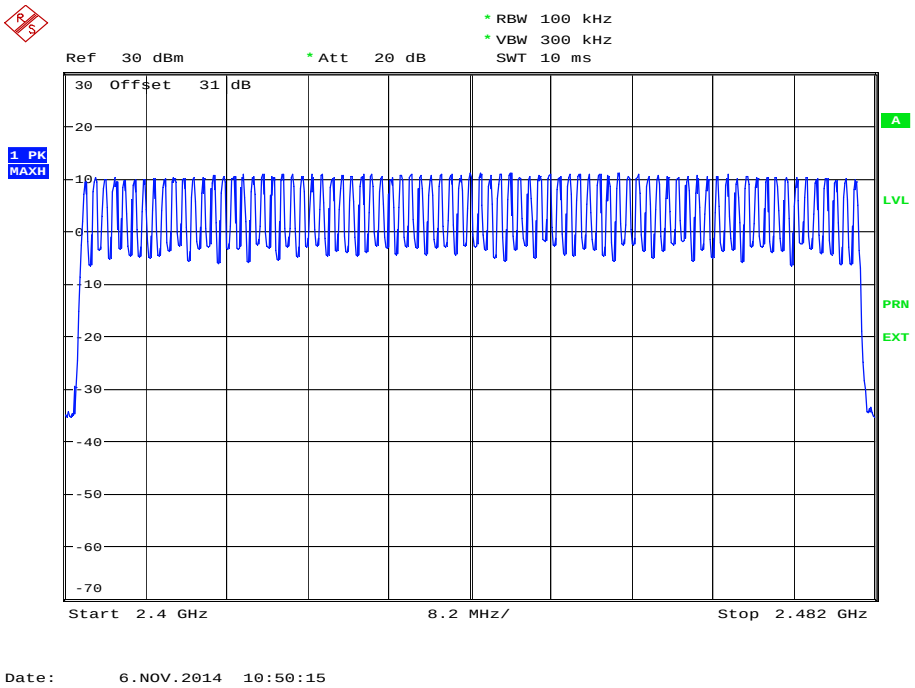
Date: 6.NOV.2014 10:25:14

Limit

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.

Number of Hopping Channels

79 channels



Limit

≥ 15 channels

Product Service

2.4 MAXIMUM PEAK CONDUCTED OUTPUT POWER

2.4.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (b)(1)
Industry Canada RSS-210, Clause A8.4 (2)

2.4.2 Equipment Under Test and Modification State

RBS1 S/N: RBM4310055 - Modification State 0

2.4.3 Date of Test

15 October 2014

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 conducted in accordance with ANSI C63.10 Clause 6.10.1.

The EUT was connected to a broadband peak RF power meter via a cable and attenuator. The EUT was transmitting at maximum power, for bottom, middle and top channels on the modulation scheme that was determined to give the highest conducted output power. The path loss between the EUT and sensor was measured and entered as a reference level offset. The peak power was recorded for measurements on the bottom, middle and top channels.

2.4.6 Environmental Conditions

Ambient Temperature	23.5°C
Relative Humidity	44.2%

Product Service

2.4.7 Test Results

Modulation: GFSK

110 V AC, 60 Hz supply

Packet Type	Maximum Peak Conducted Output Power					
	dBm			mW		
	2402 MHz	2441 MHz	2480 MHz	2402 MHz	2441 MHz	2480 MHz
DH1	9.38	9.77	9.38	8.670	9.484	8.670
DH3	9.55	9.99	9.48	9.016	9.977	8.872
DH5	9.56	9.93	9.61	9.037	9.840	9.141

Limit Clause

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.

2.5 EIRP PEAK POWER

2.5.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (b)(4)
Industry Canada RSS-210, Clause A8.4 (2)
Industry Canada RSS-GEN, Clause 4.8

2.5.2 Equipment Under Test and Modification State

RBS1 S/N: RB1431A078 - Modification State 0

2.5.3 Date of Test

10 October 2014

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

A test environment and testing arrangement meeting the specification of ANSI C63.4 was used during all testing. The Equipment Under Test (EUT) was set upon a non-conducting platform during testing. The EUT elevation was 80 cm above the horizontal reference ground plane. The Analyser settings were adjusted to display the resultant trace on screen and a resolution bandwidth and video bandwidth of 1 MHz were used to perform the measurement. The level on the spectrum analyser was maximised by rotating the EUT through 360° and a height search of the measuring antenna. A substitution was then performed using a suitable calibrated antenna and signal generator.

This level was maximised by adjusting the height of the measuring antenna once more. The level from the signal generator was then adjusted to achieve the same raw result as with the EUT. This level was then corrected to account for cable loss and antenna factor. A peak power analyser was also used to obtain a correction factor for the wideband signal.

A calculation was then performed to obtain the final figure.

Testing was carried out using GFSK modulation which was established as being the worst case, (highest output power), prior to commencement of testing.

2.5.6 Environmental Conditions

Ambient Temperature	19.6°C
Relative Humidity	47.6%

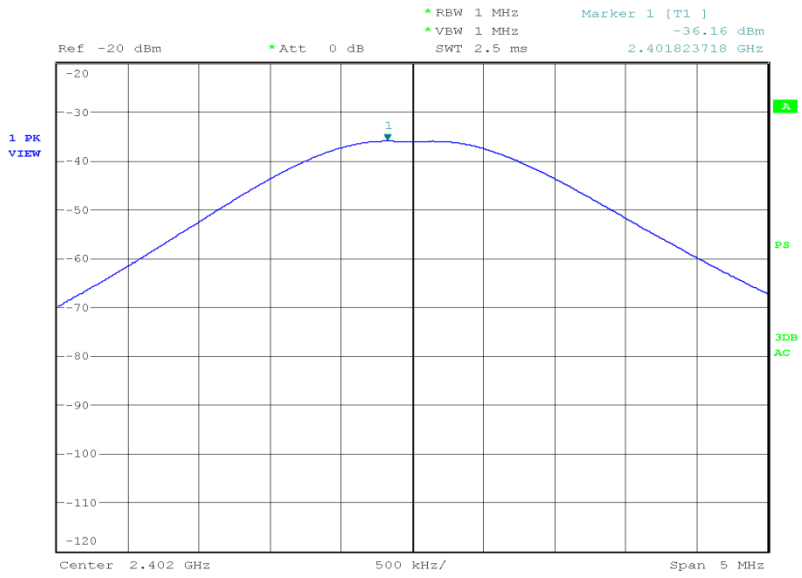
Product Service

2.5.7 Test Results

Modulation: GFSK

2402 MHz

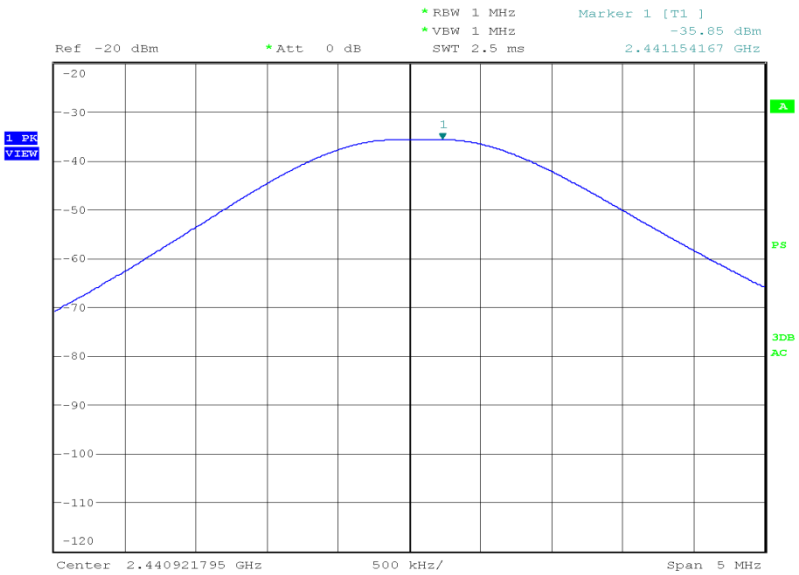
EIRP (dBm)	EIRP (mW)
7.33	5.41



Date: 9.OCT.2014 20:58:58

2441 MHz

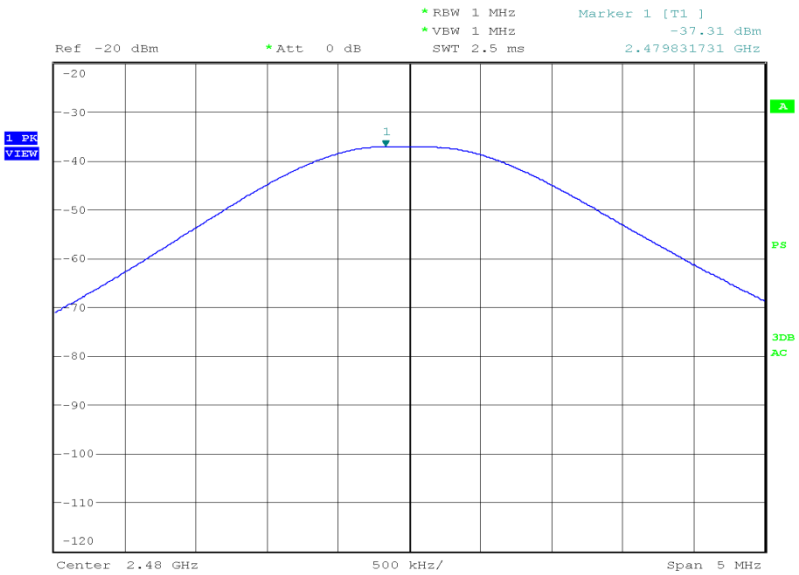
EIRP (dBm)	EIRP (mW)
7.35	5.43



Date: 9.OCT.2014 20:46:37

2480 MHz

EIRP (dBm)	EIRP (mW)
6.52	4.49



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Limit

Limit EIRP (dBm)	Limit EIRP(mW)
36.0	4000

2.6 SPURIOUS AND BAND EDGE EMISSIONS

2.6.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (d)
Industry Canada RSS-210, Clause A8.5
Industry Canada RSS-GEN, Clause 4.9

2.6.2 Equipment Under Test and Modification State

RBS1 S/N: RB1431A078 - Modification State 0

2.6.3 Date of Test

10 October 2014, 12 October 2014 & 7 November 2014

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 conducted in accordance with ANSI C63.10 Clauses 6.3, 6.5 and 6.6.

The EUT was set to operate at maximum power on the bottom, middle and top channels for the modulation scheme which resulted in the highest conducted average output power. The power of each fundamental frequency was measured in 100 kHz RBW, the resultant limit line on the trace was set at -20 dBc of this value.

Measurements were performed from 30 MHz to 25 GHz and the path loss is incorporated as a transducer factor and entered into the spectrum analyser.

Band Edge measurements were performed using ANSI C63.10 Clause 6.9.2, however, a reference level of 120 dBµV was used as a reference level of 110 dBµV resulted in an IF overload. Measurements were performed using an RBW of 1MHz with a VBW of 3MHz for Peak measurements and a VBW of 10Hz for Average measurements. Measurements were made with the EUT configured in frequency hopping and static channel modes of operation for all supported modulation schemes.

A test environment and testing arrangement meeting the specification of ANSI C63.4 was used during all testing. The Equipment Under Test (EUT) was set upon a non-conducting platform at an elevation of 80 cm above a horizontal reference ground plane. The EUT was set upon a non-conducting platform during testing. When frequencies less than 18 GHz were measured; the EUT elevation was 80 cm above the horizontal reference ground plane. When frequencies greater than 18 GHz were measured; the EUT elevation was 1 m above the horizontal reference ground plane to ensure adequate vertical beam width coverage of the measuring antenna with respect to the EUT.

The horizontal reference ground plane encompasses a turntable which is used to adjust the azimuth of the EUT. An antenna positioner is used to elevate the measuring antenna above the horizontal reference ground plane whereby the antenna elevation is adjustable between 1 m and 4 m.

Product Service

Exploratory radiated emissions measurements were made by azimuth emissions searches over a range of 0° and 360°. These exploratory radiated emissions measurements were made using a peak detector over a frequency range of 30 MHz to 25 GHz, with the measuring antenna in both vertical and horizontal polarizations.

At least six of the greatest peak emissions, frequency positions were selected from the exploratory radiated emissions measurements for further evaluation as final measuring points.

To ascertain the azimuth and measuring antenna polarization that yields the highest peak emission level, each final measurement frequency was investigated by continuous azimuth emissions searching with the measuring antenna in both vertical and horizontal polarizations. For each final measurement frequency, the respective peak emission azimuth and measuring antenna polarization was used during a measuring antenna elevation search from 1 m to 4 m. Each final measurement frequency was then measured with the EUT azimuth, measuring antenna height and polarization that yielded the greatest peak emission level.

Final measurement points over the frequency range of 30 MHz to 1 GHz were measured using a quasi-peak detector. Final measurement points over the frequency range of 1 GHz and 25 GHz were measured using peak and average methods. Peak measurements were made using a peak detector with 1 MHz resolution and video bandwidths. Average measurements were made using a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

All final measurements were assessed against the Class B emission limits in Clause 15.209 of FCC CFR 47 FCC Part 15.

Testing was carried out using GFSK modulation which was established as being the worst case, (highest output power), prior to commencement of testing.

2.6.6 Environmental Conditions

Ambient Temperature	19.6 - 19.8°C
Relative Humidity	46.5 - 47.6%

Product Service

2.6.7 Test Results

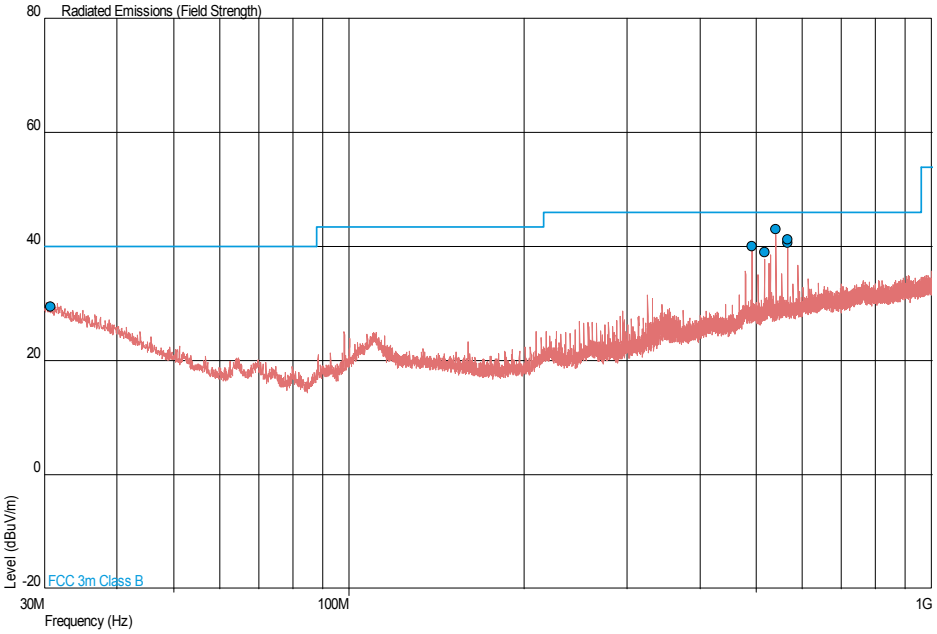
Modulation: GFSK

110 V AC, 60 Hz supply

Spurious Radiated Emissions

2402 MHz

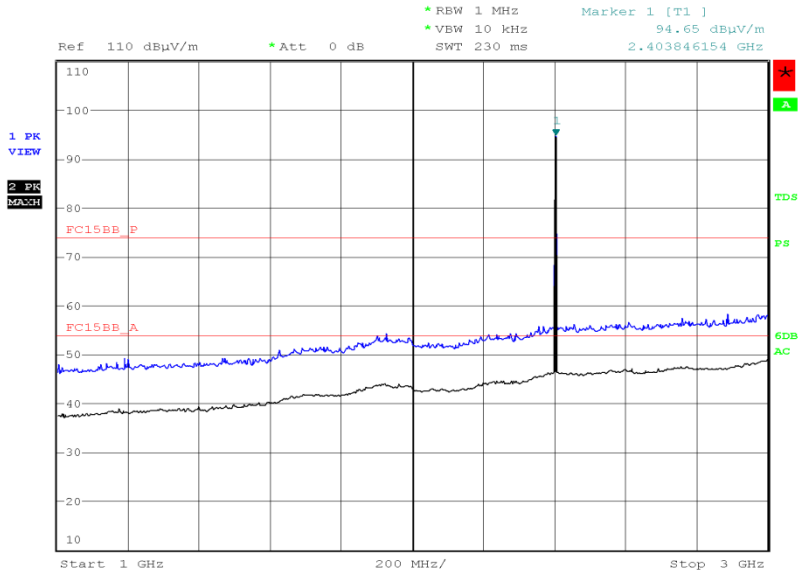
30 MHz to 1 GHz



Frequency (MHz)	QP Level (dBµV/m)	QP Level (uV/m)	QP Limit (dBµV/m)	QP Limit (uV/m)	QP Margin (dBµV/m)	QP Margin (uV/m)	Angle (Deg)	Height (m)	Polarity
30.733	29.5	29.9	40.0	100	-10.5	-70.1	248	1.00	Horizontal
491.516	40.1	101.2	46.0	200	-5.9	-98.8	215	1.06	Vertical
516.084	39.0	89.1	46.0	200	-7.0	-110.9	118	1.02	Vertical
540.671	43.0	141.3	46.0	200	-3.0	-58.7	102	1.12	Vertical
565.244	41.2	114.8	46.0	200	-4.8	-85.2	117	1.04	Vertical
565.249	40.7	108.4	46.0	200	-5.3	-91.6	143	1.46	Horizontal

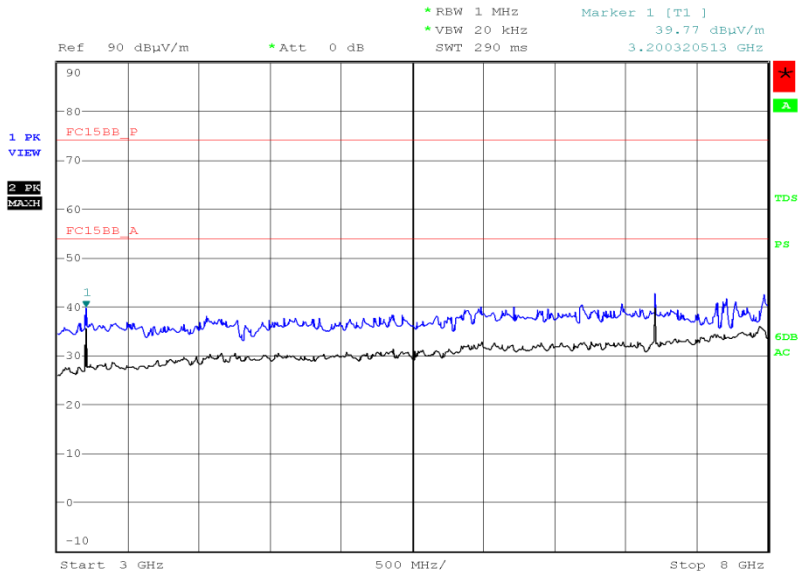
Product Service

1 GHz to 3 GHz



Date: 10.OCT.2014 00:22:00

3 GHz to 8 GHz



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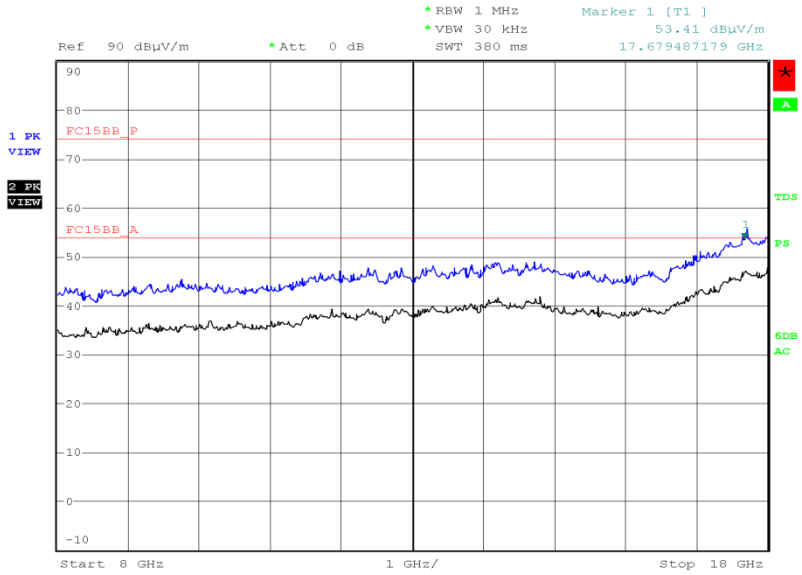
Product Service

8 GHz to 18 GHz



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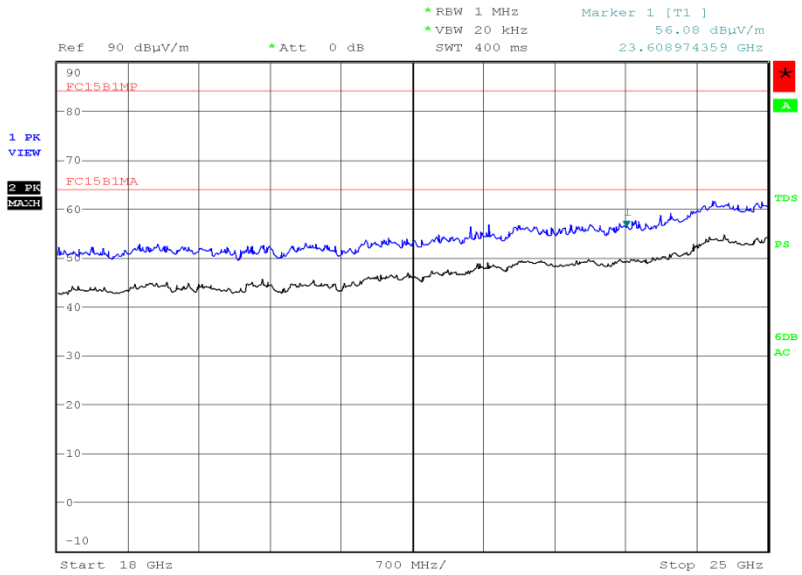
18 GHz to 25 GHz



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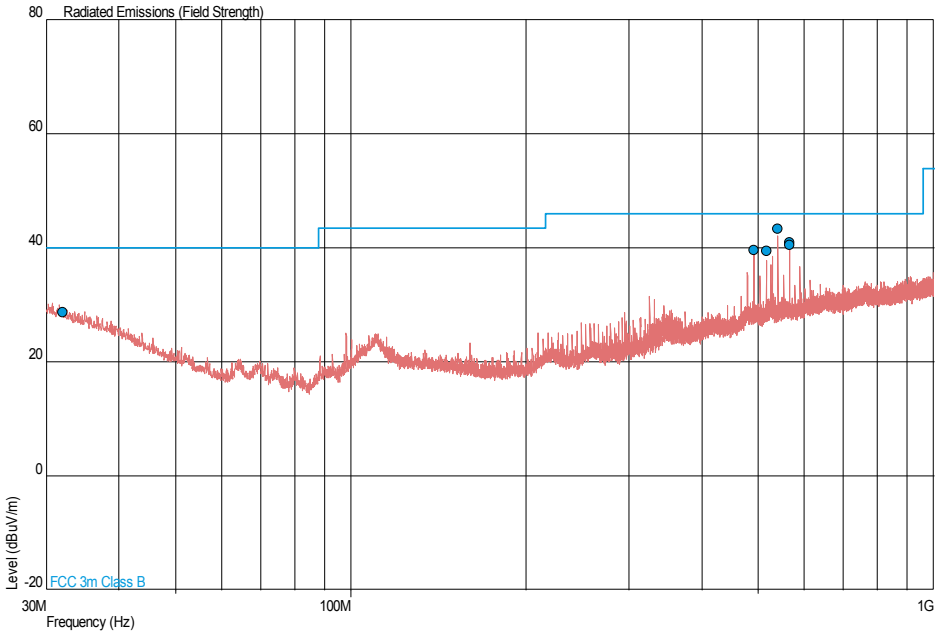
2441 MHz

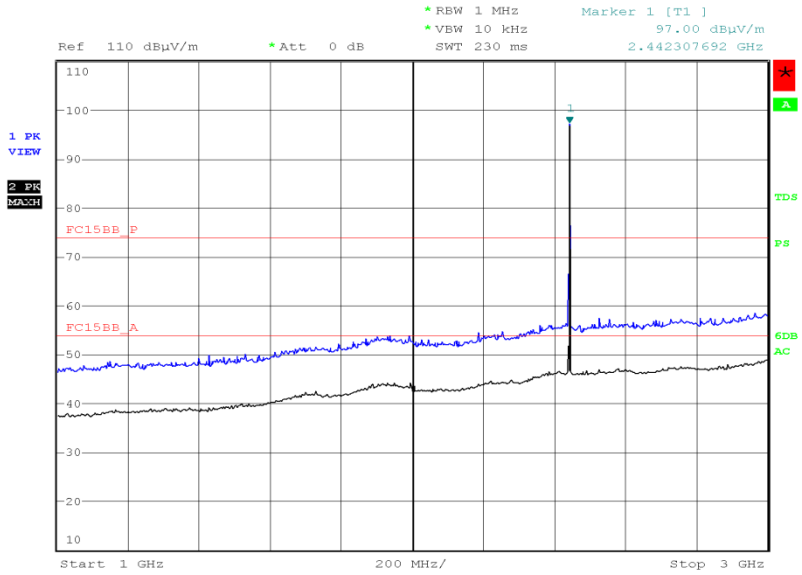
30 MHz to 1 GHz



Frequency (MHz)	QP Level (dBµV/m)	QP Level (uV/m)	QP Limit (dBµV/m)	QP Limit (uV/m)	QP Margin (dBµV/m)	QP Margin (uV/m)	Angle (Deg)	Height (m)	Polarity
31.991	28.8	27.5	40.0	100	-11.2	-72.5	316	1.82	Horizontal
491.518	39.6	95.5	46.0	200	-6.4	-104.5	107	1.00	Vertical
516.075	39.5	94.4	46.0	200	-6.5	-105.6	119	1.00	Vertical
540.673	43.4	147.9	46.0	200	-2.6	-52.1	123	1.00	Vertical
565.244	41.0	112.2	46.0	200	-5.0	-87.8	135	1.34	Horizontal
565.248	40.6	107.2	46.0	200	-5.4	-92.8	128	1.00	Vertical

Product Service

1 GHz to 3 GHz



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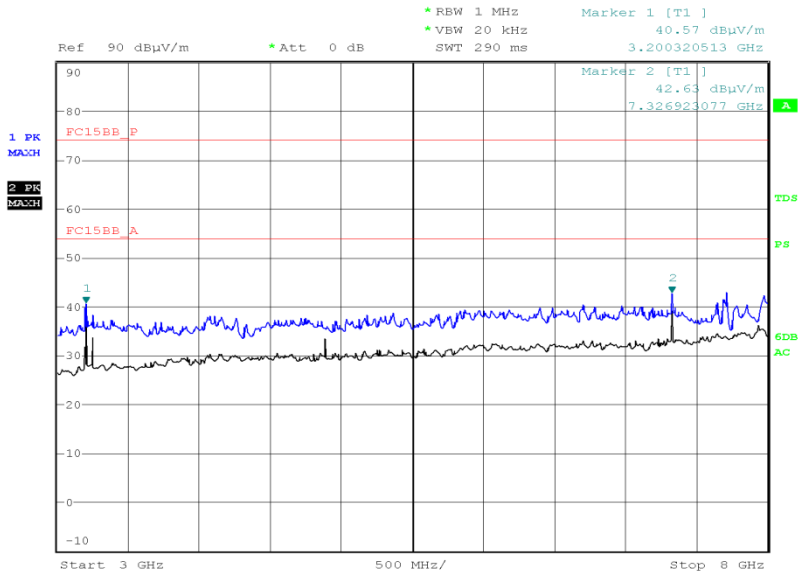
3 GHz to 8 GHz



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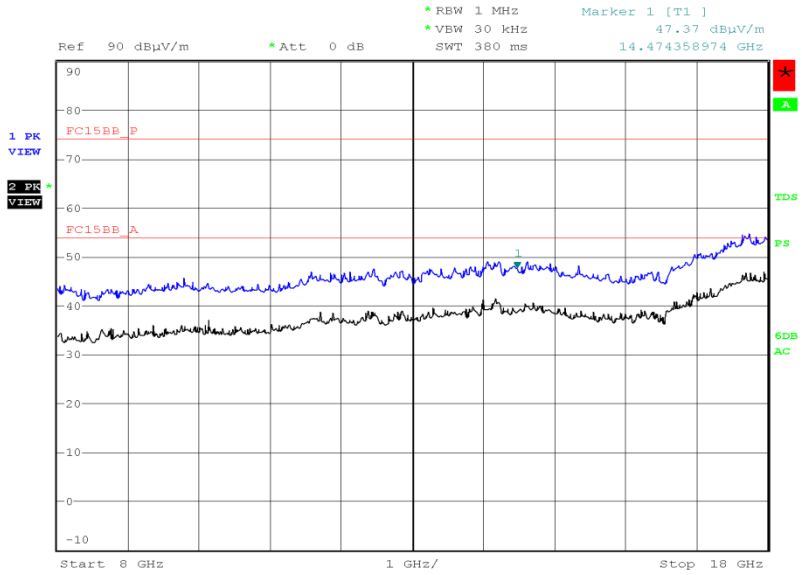
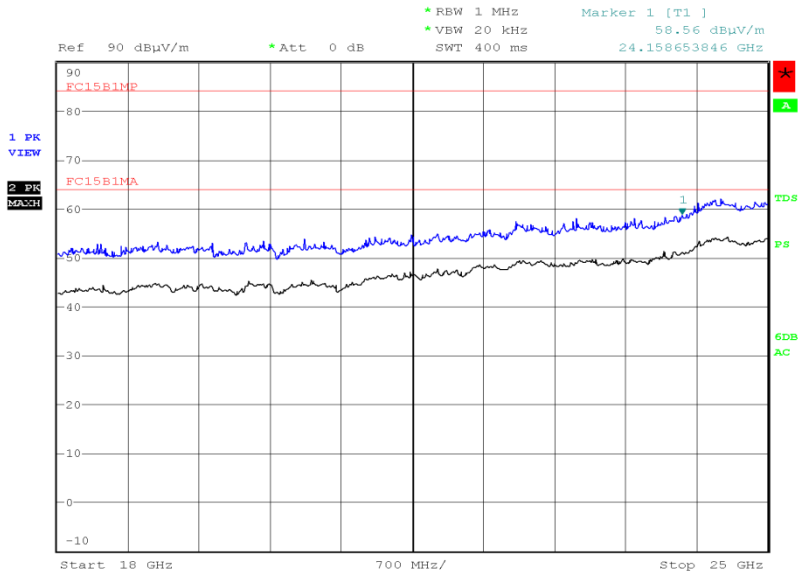
Product Service

8 GHz to 18 GHz



Date: 9.OCT.2014 23:39:15

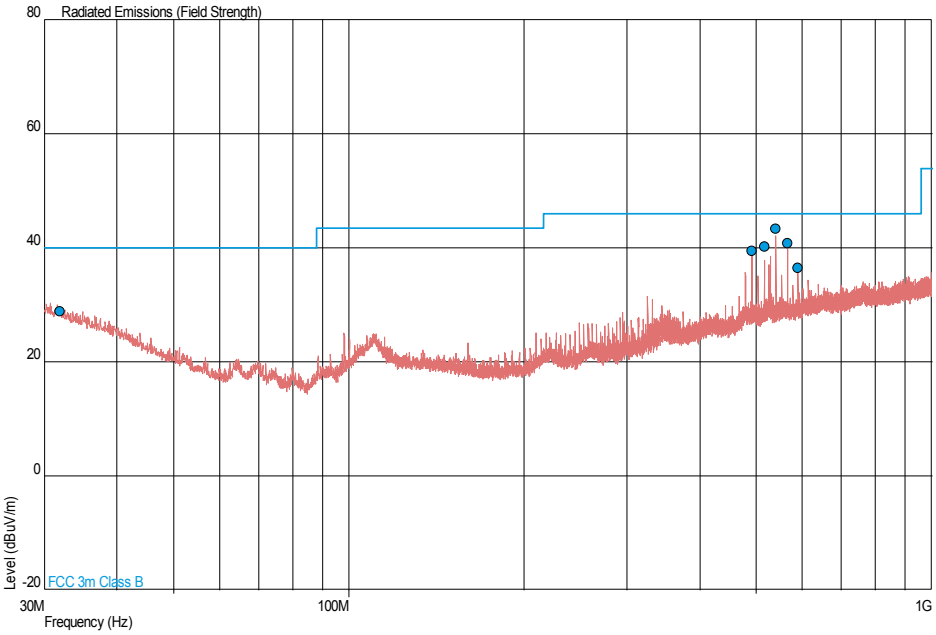
18 GHz to 25 GHz



Date: 10.OCT.2014 02:05:51

2480 MHz

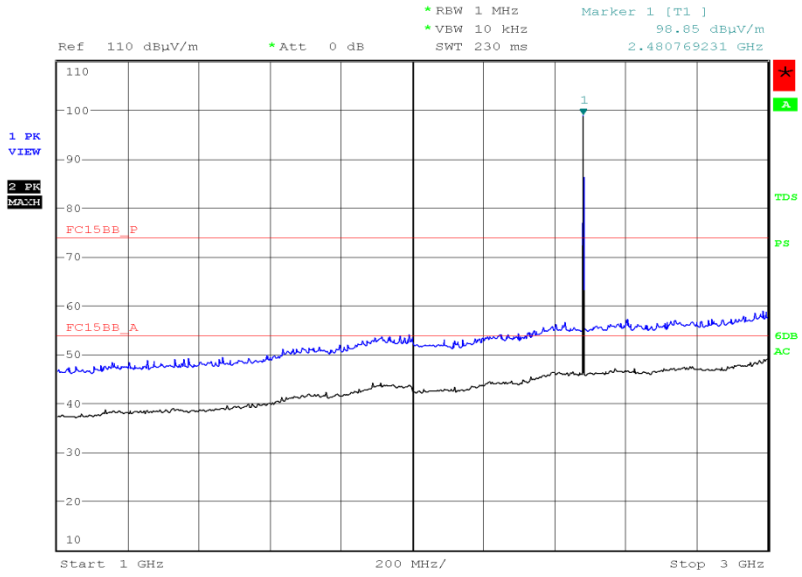
30 MHz to 1 GHz



Frequency (MHz)	QP Level (dBµV/m)	QP Level (uV/m)	QP Limit (dBµV/m)	QP Limit (uV/m)	QP Margin (dBµV/m)	QP Margin (uV/m)	Angle (Deg)	Height (m)	Polarity
31.961	28.8	27.5	40.0	100	-11.2	-72.5	8	1.00	Horizontal
491.516	39.5	94.4	46.0	200	-6.5	-105.6	230	1.20	Vertical
516.089	40.2	102.3	46.0	200	-5.8	-97.7	119	1.09	Vertical
540.671	43.4	147.9	46.0	200	-2.6	-52.1	126	1.00	Vertical
565.248	40.9	110.9	46.0	200	-5.1	-89.1	119	1.02	Vertical
589.822	36.5	66.8	46.0	200	-9.5	-133.2	280	1.00	Vertical

Product Service

1 GHz to 3 GHz



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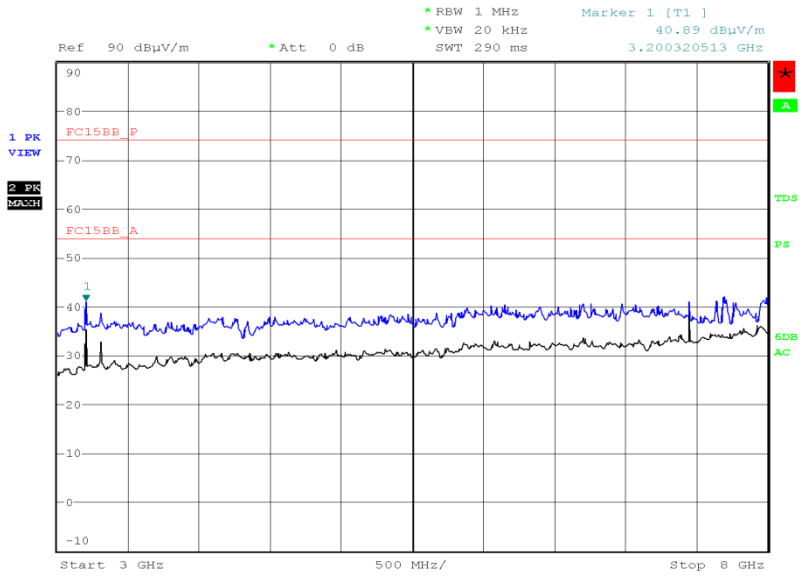
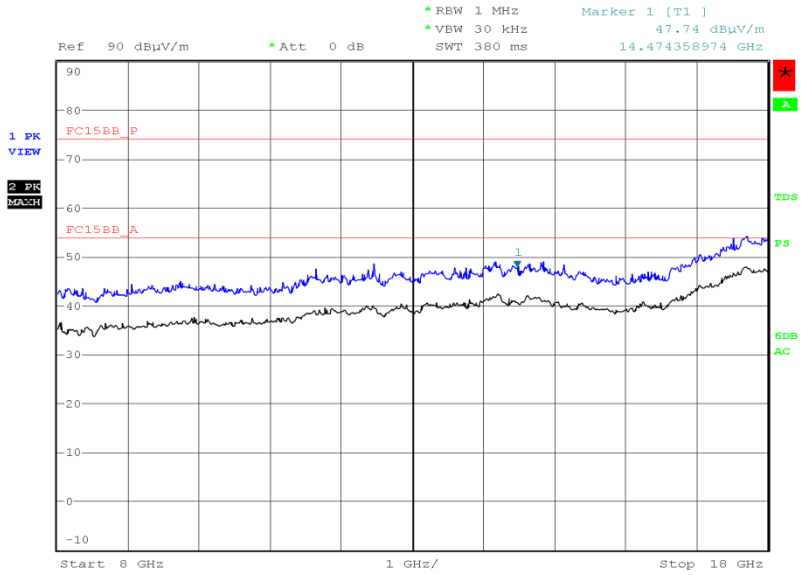
3 GHz to 8 GHz



Date: 9.OCT.2014 23:54:42

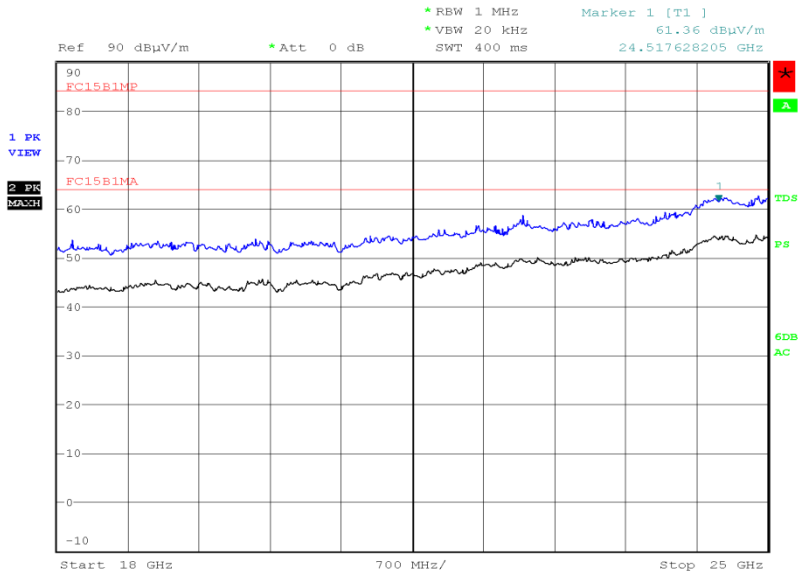
Product Service

8 GHz to 18 GHz



Date: 9.OCT.2014 23:45:45

18 GHz to 25 GHz



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Product Service

Limit

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

Radiated Emissions which fall only in the restricted bands as defined in 15.205 must also comply with the limits in the table above. The table above does not apply for Radiated Emissions which fall outside the restricted bands as defined in 15.205. These 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 transmitted complies with the conducted power limits, based on the use of RMS averaging over a time interal, the attenuator required shall be 30 dB below the fundamental instead on 20 dB.

Band Edge Emissions

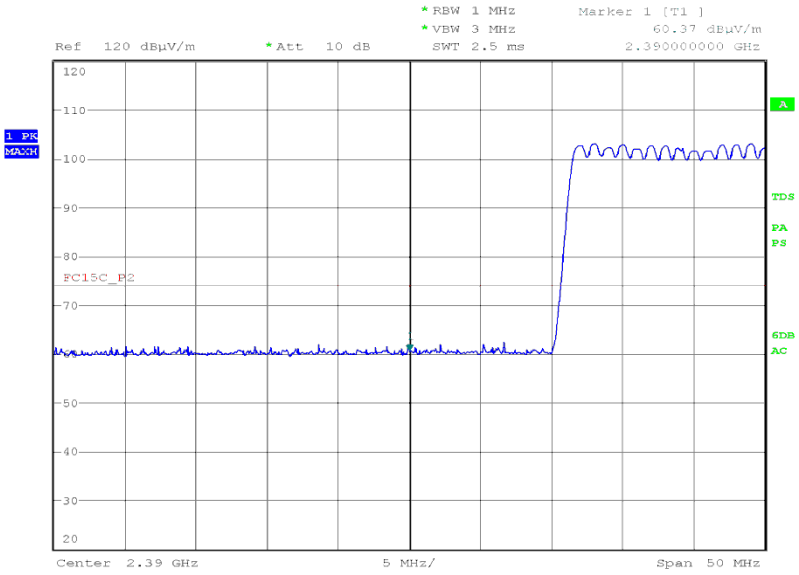
Hopping Mode

Modulation/Packet Type: GFSK/DH5

Restricted Bands of Operation		
Frequency (MHz)	Final Peak (dBµV/m)	Final Average (dBµV/m)
2390.0	60.37	47.86
2483.5	62.09	47.90

2390.0 MHz

Final Peak



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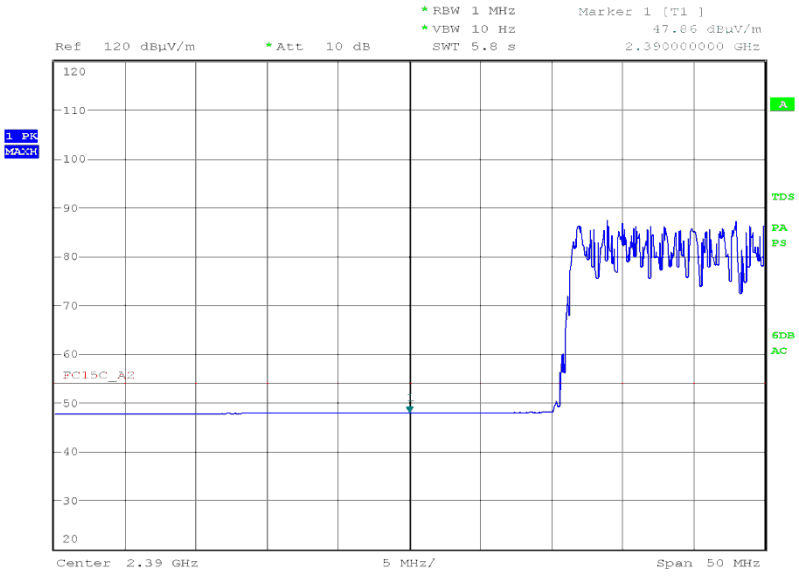
Product Service

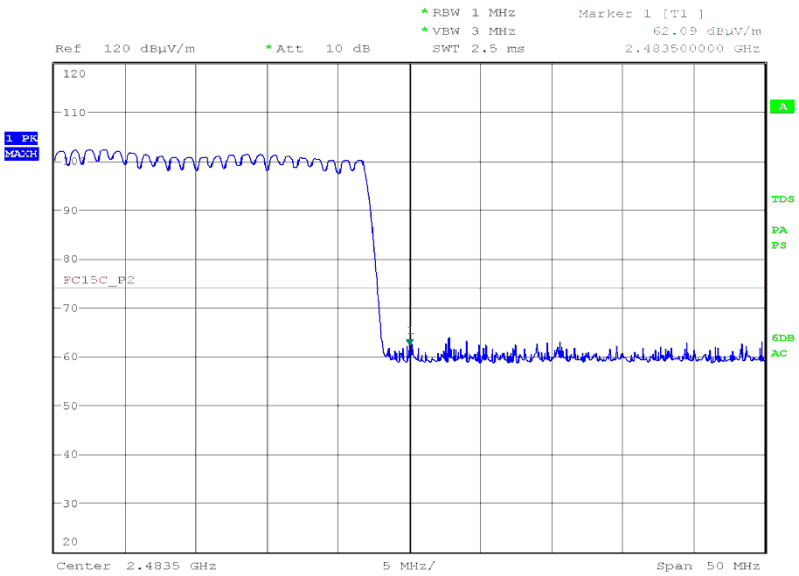
Final Average



Date: 5.NOV.2014 21:05:02

2483.5 MHz

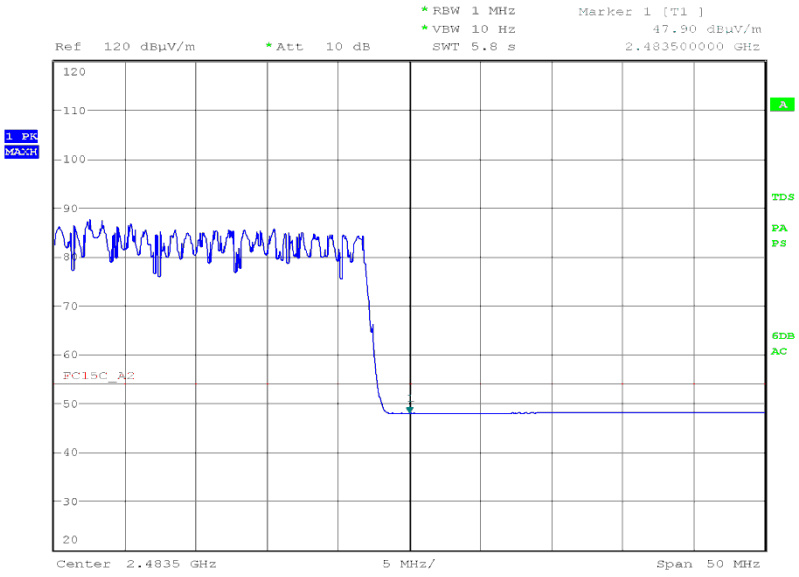
Final Peak



Date: 5.NOV.2014 20:55:24

Product Service

Final Average



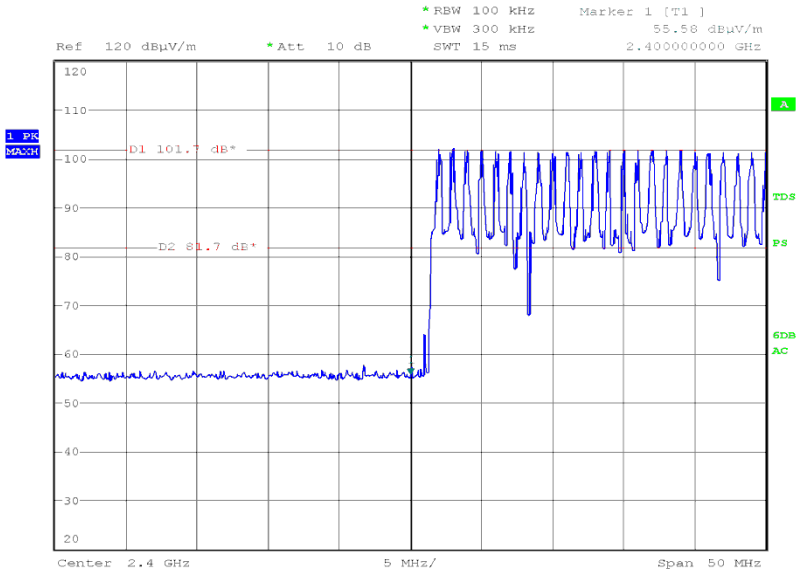
Date: 5.NOV.2014 21:01:50

Product Service

Band Edge	
Frequency (MHz)	Final Peak (dBµV/m)
2400.0	55.58
2483.5	55.31

2400.0 MHz

Final Peak

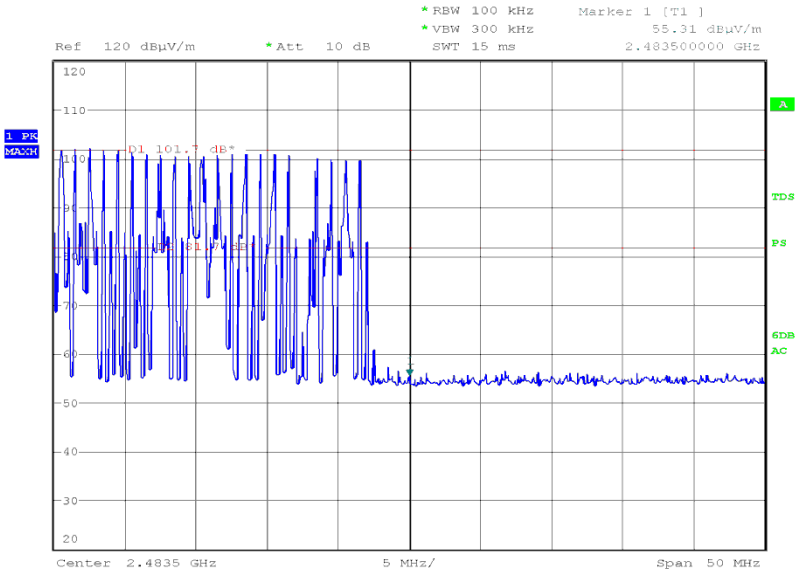


Date: 5.NOV.2014 20:52:59

Product Service

2483.5 MHz

Final Peak



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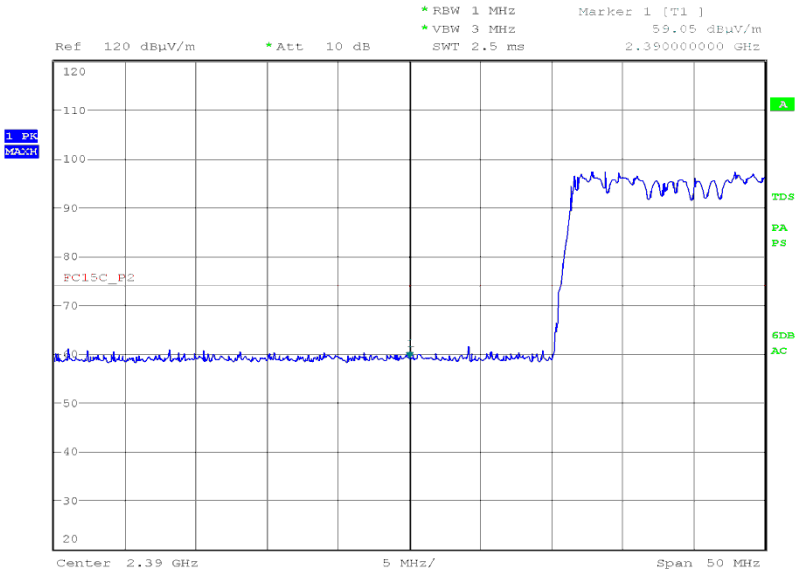
Modulation/Packet Type: GFSK/2DH5

Restricted Bands of Operation		
Frequency (MHz)	Final Peak (dBµV/m)	Final Average (dBµV/m)
2390.0	59.05	47.83
2483.5	59.40	47.87

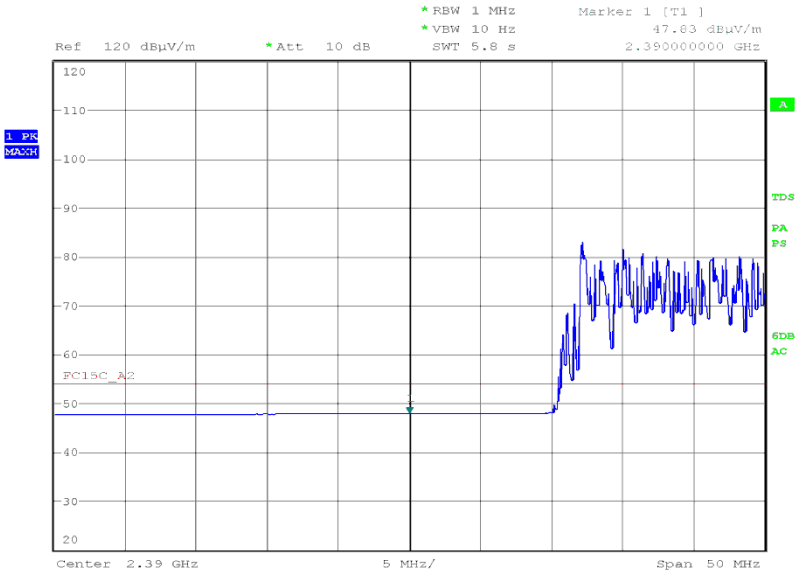
2390.0 MHz

Final Peak



Product Service

Final Average



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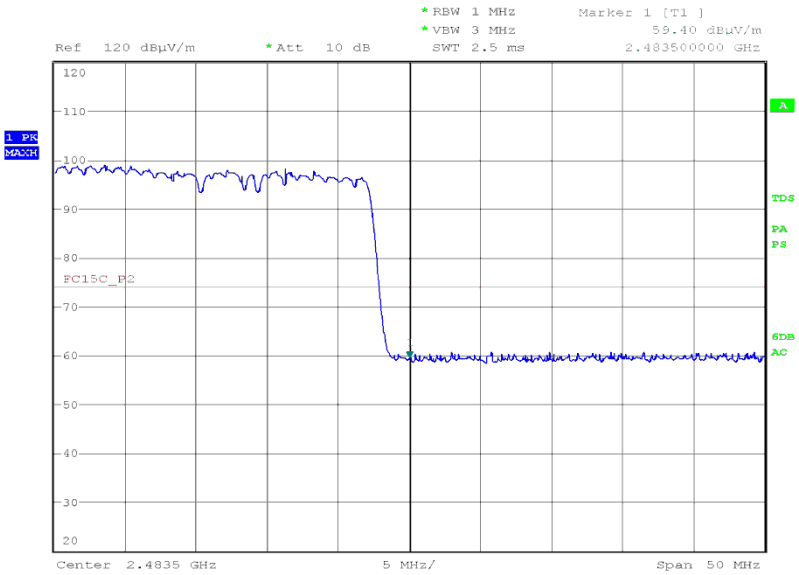
2483.5 MHz

Final Peak



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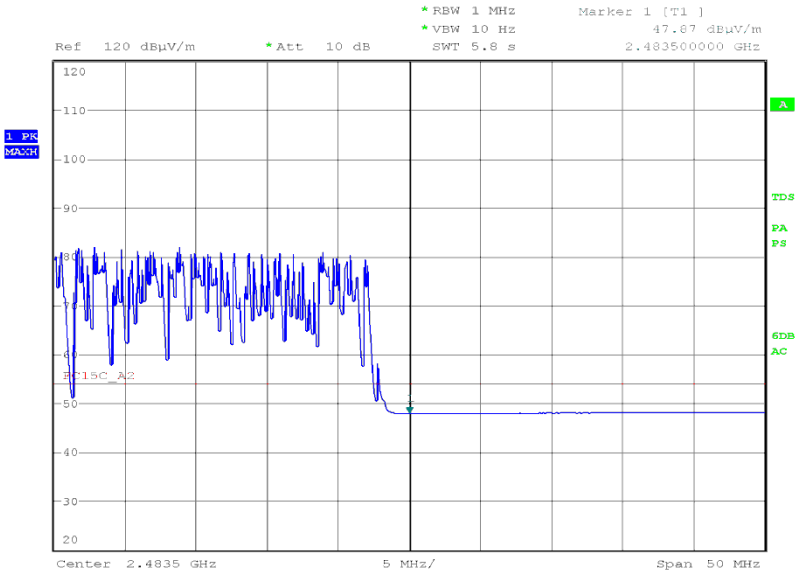
Product Service

Final Average



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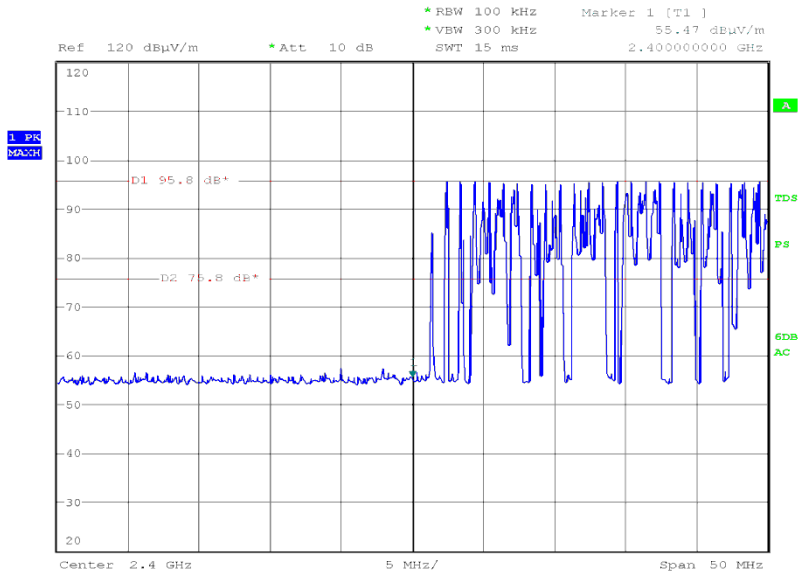
Band Edge	
Frequency (MHz)	Final Peak (dBµV/m)
2400.0	55.47
2483.5	55.76

2400.0 MHz

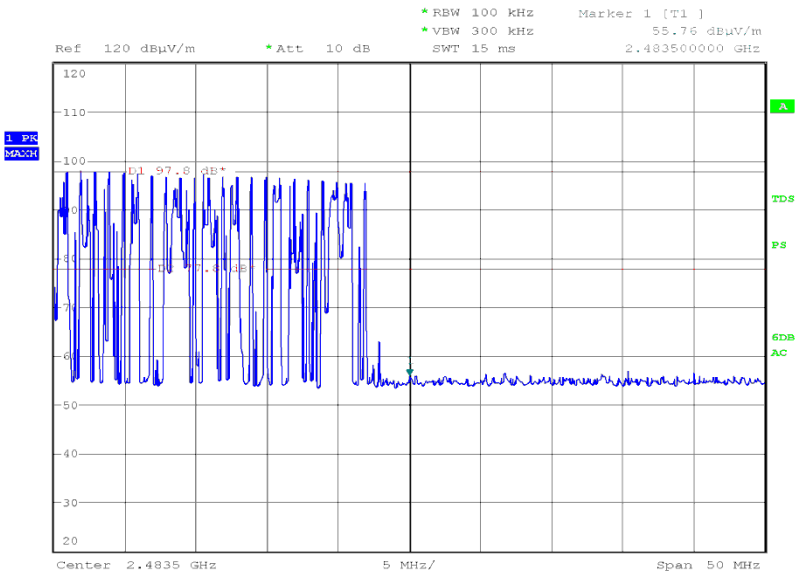
Final Peak



Product Service

2483.5 MHz

Final Peak

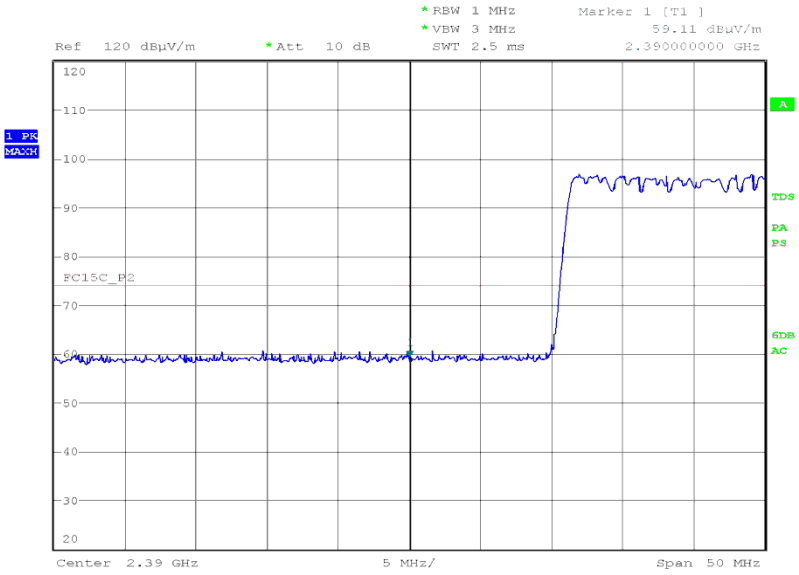


Modulation/Packet Type: GFSK/3DH5

Restricted Bands of Operation		
Frequency (MHz)	Final Peak (dBµV/m)	Final Average (dBµV/m)
2390.0	59.11	47.83
2483.5	59.99	47.86

2390.0 MHz

Final Peak



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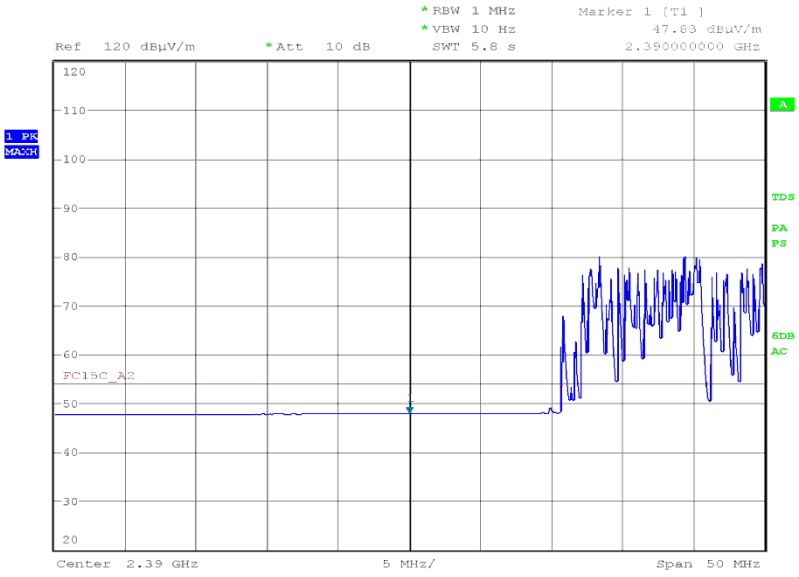
Product Service

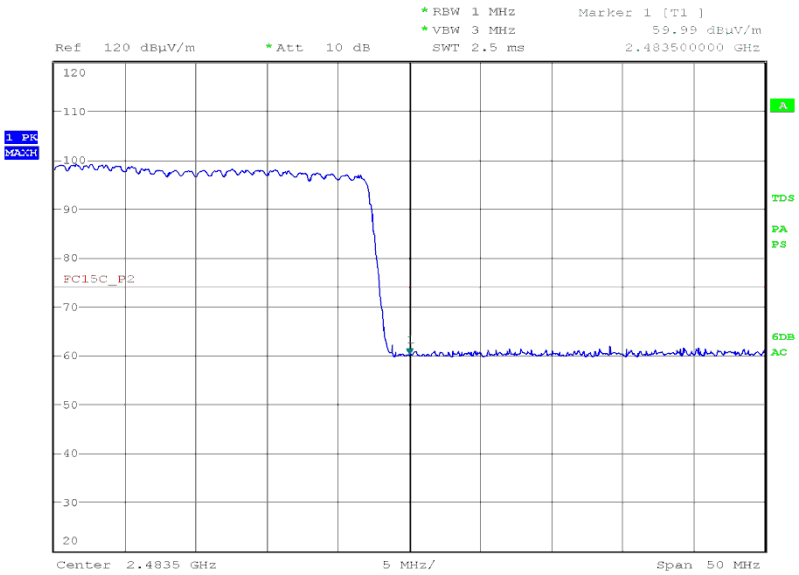
Final Average



Date: 5.NOV.2014 22:09:13

2483.5 MHz

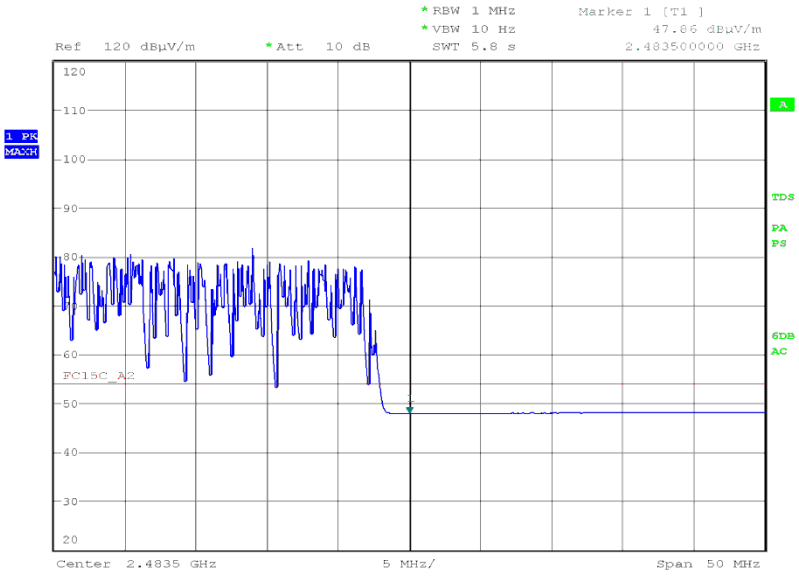
Final Peak



Date: 5.NOV.2014 22:01:32

Product Service

Final Average

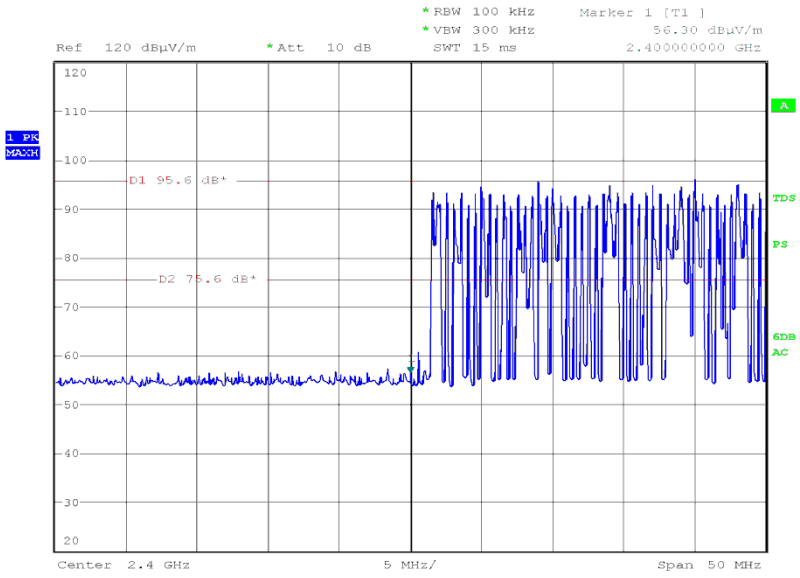


Date: 5.NOV.2014 22:02:28

Band Edge	
Frequency (MHz)	Final Peak (dBµV/m)
2400.0	56.30
2483.5	55.25

2400.0 MHz

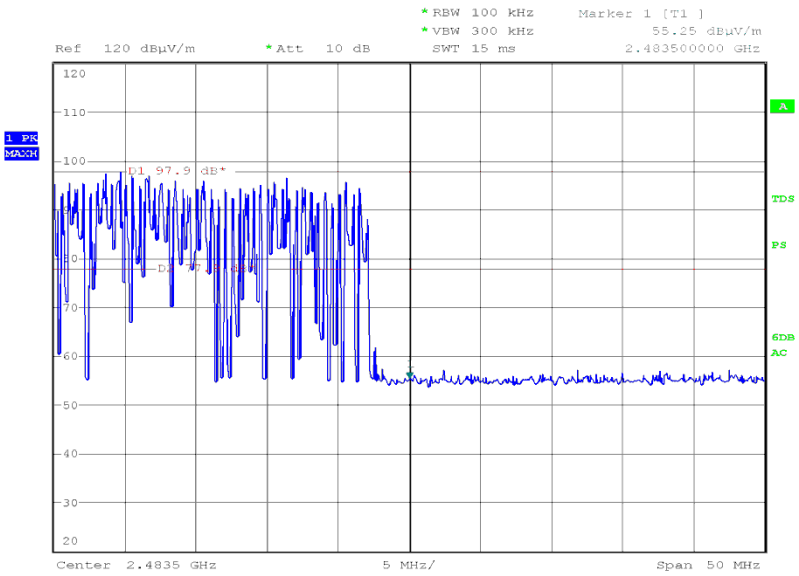
Final Peak



Product Service

2483.5 MHz

Final Peak



Date: 5.NOV.2014 22:04:33

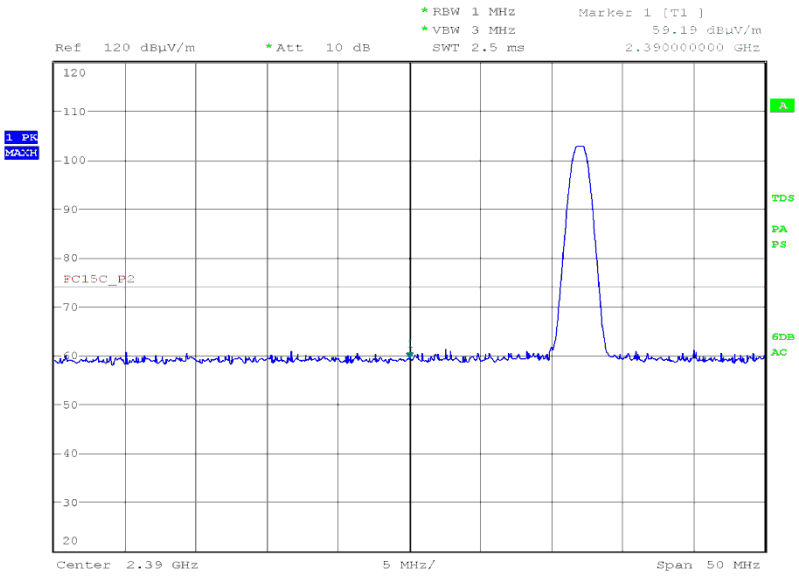
Static Mode

Modulation/Packet Type: GFSK/DH5

Restricted Bands of Operation		
Frequency (MHz)	Final Peak (dBµV/m)	Final Average (dBµV/m)
2390.0	59.19	47.83
2483.5	59.84	48.49

2390.0 MHz

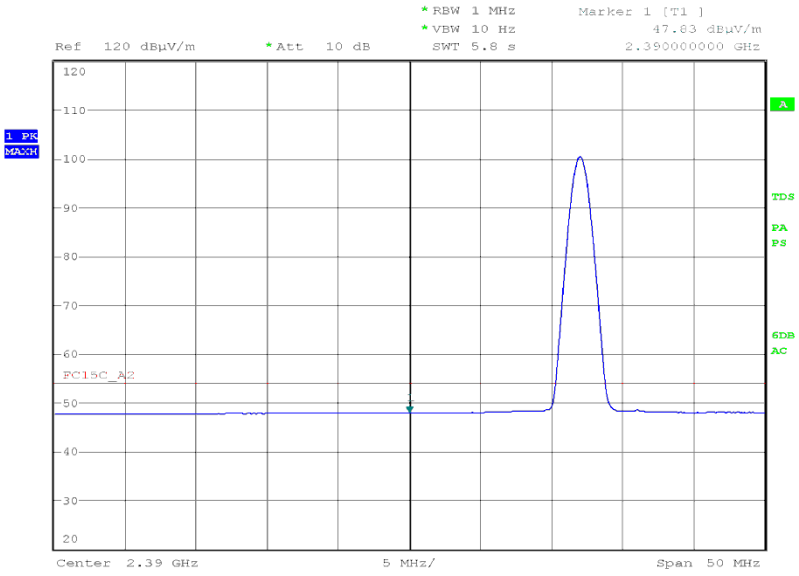
Final Peak



Date: 5.NOV.2014 19:26:03

Product Service

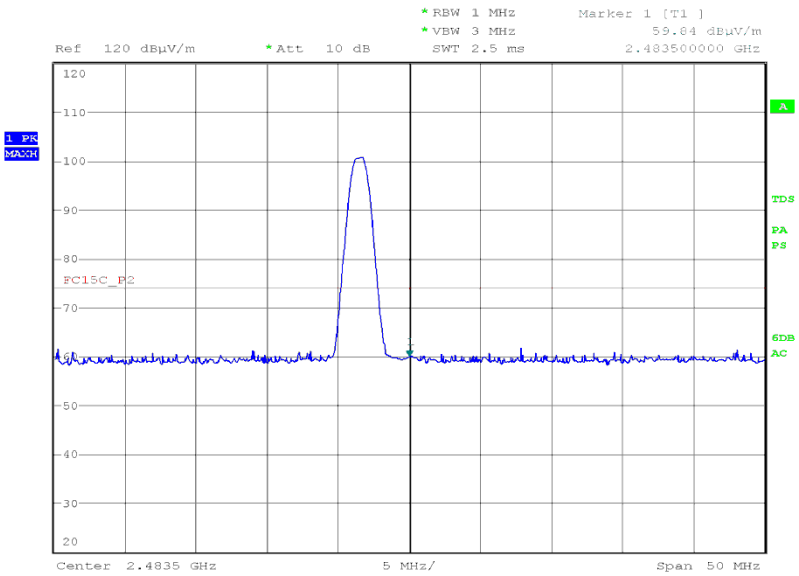
Final Average



Date: 5.NOV.2014 19:21:49

2483.5 MHz

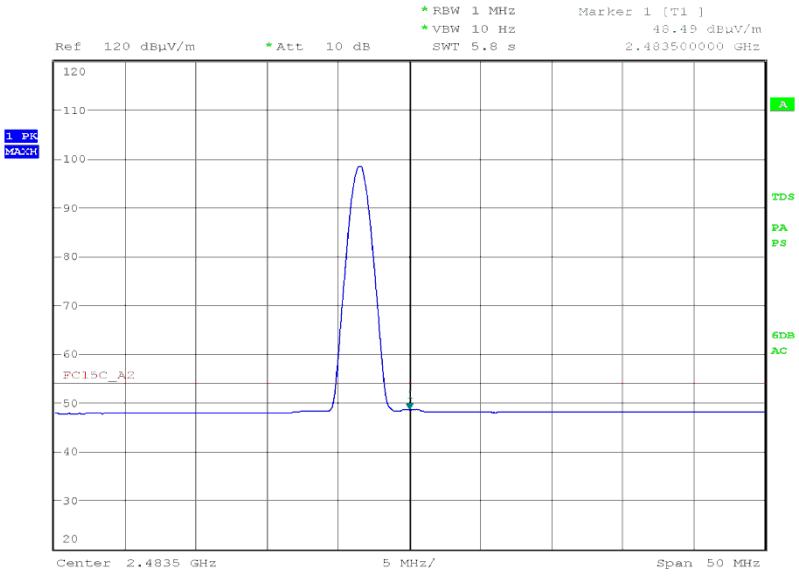
Final Peak



Date: 5.NOV.2014 20:07:47

Product Service

Final Average

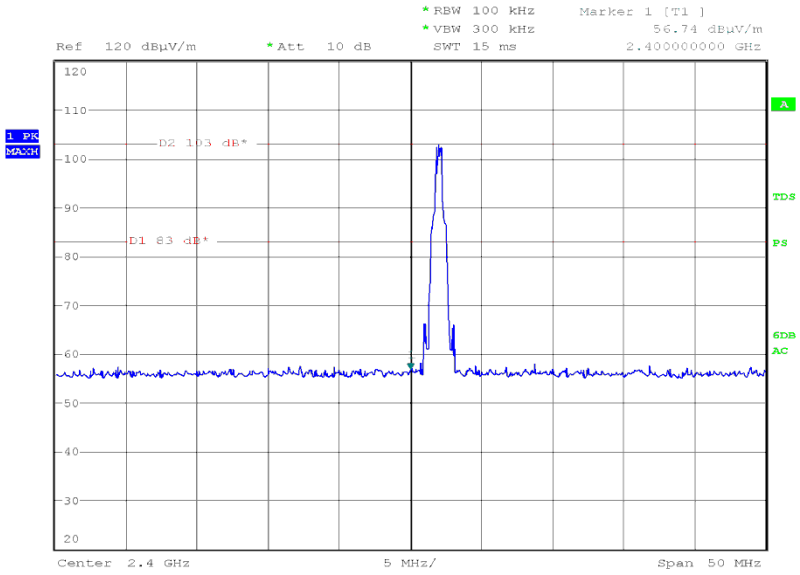


Date: 5.NOV.2014 20:06:35

Band Edge	
Frequency (MHz)	Final Peak (dBµV/m)
2400.0	56.74
2483.5	55.55

2400.0 MHz

Final Peak

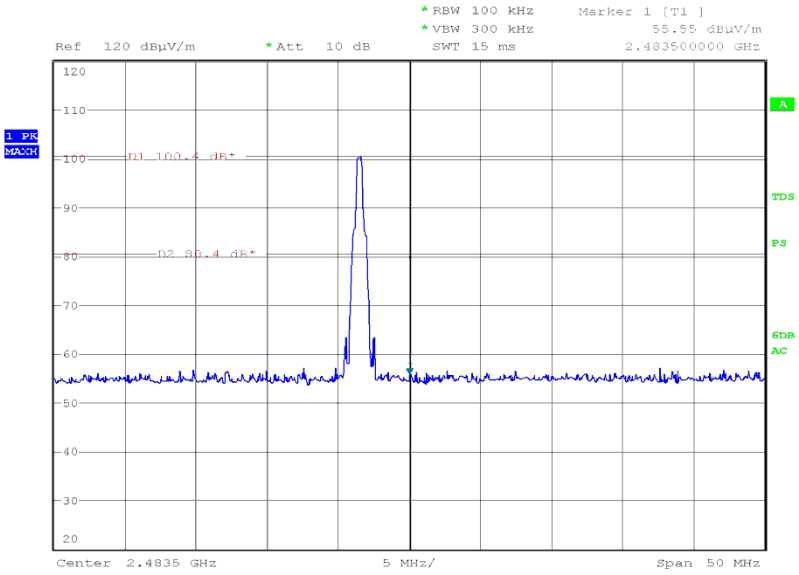


Date: 5.NOV.2014 19:15:56

Product Service

2483.5 MHz

Final Peak



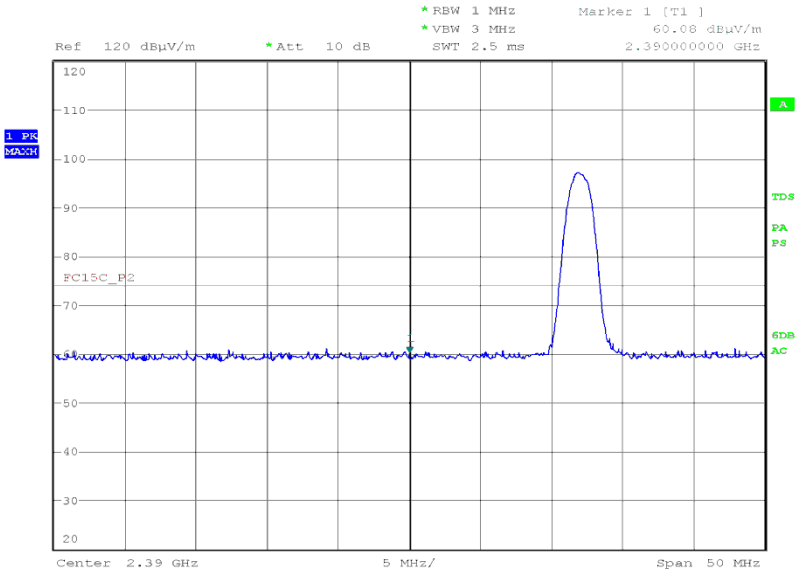
Product Service

Modulation/Packet Type: GFSK/2DH5

Restricted Bands of Operation		
Frequency (MHz)	Final Peak (dBµV/m)	Final Average (dBµV/m)
2390.0	60.08	47.84
2483.5	60.26	47.95

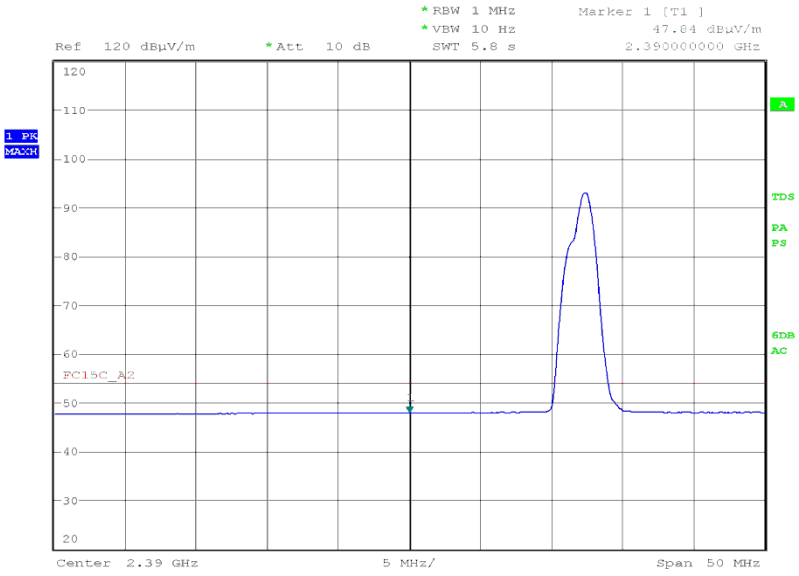
2390.0 MHz

Final Peak



Product Service

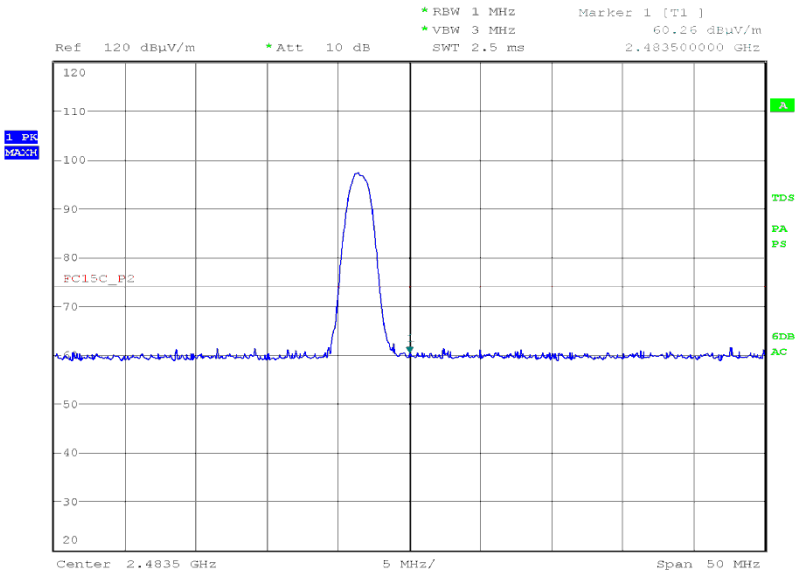
Final Average



Date: 5.NOV.2014 19:35:01

2483.5 MHz

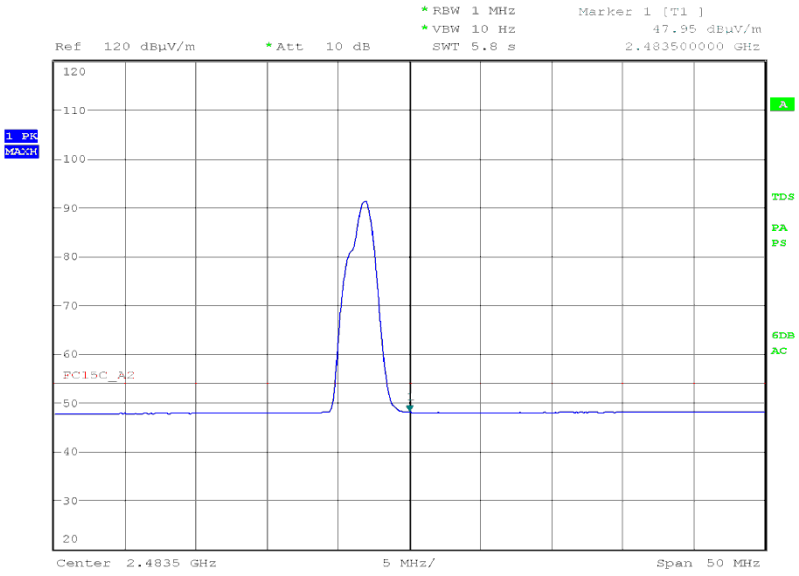
Final Peak



Date: 5.NOV.2014 21:46:03

Product Service

Final Average

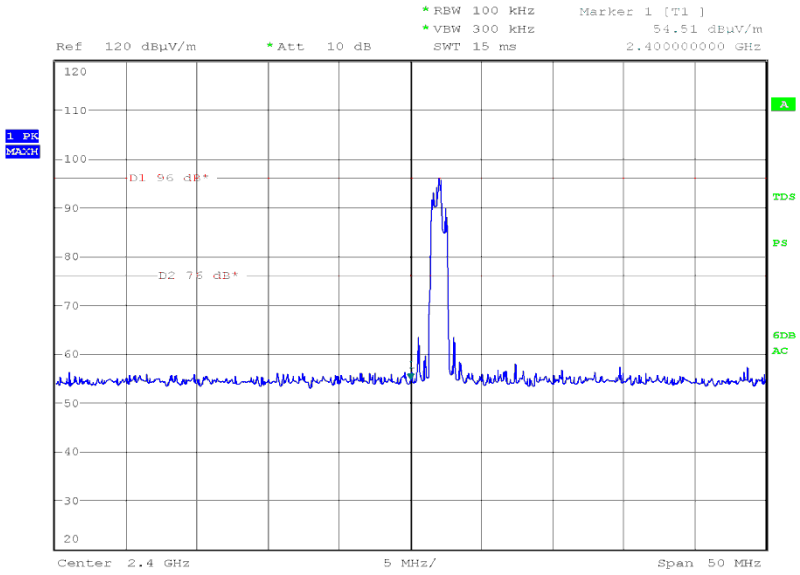


Date: 5.NOV.2014 20:23:51

Band Edge	
Frequency (MHz)	Final Peak (dBµV/m)
2400.0	54.51
2483.5	54.71

2400.0 MHz

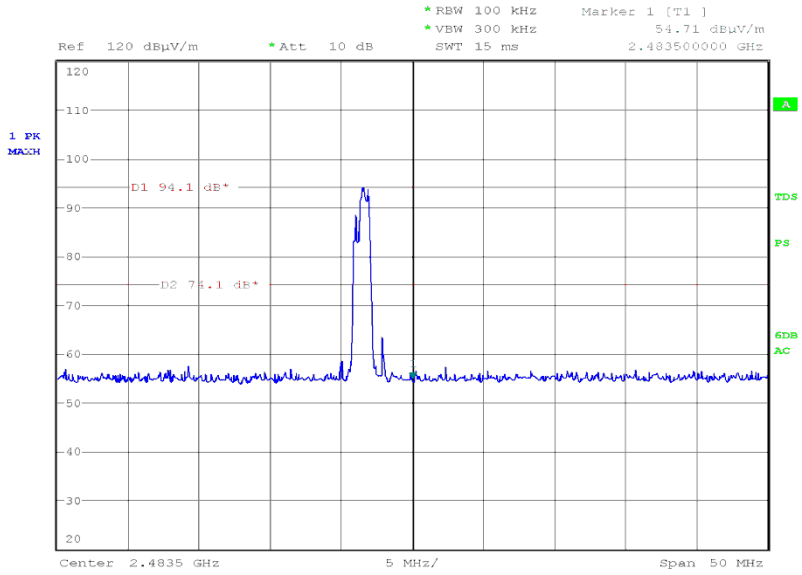
Final Peak



Product Service

2483.5 MHz

Final Peak



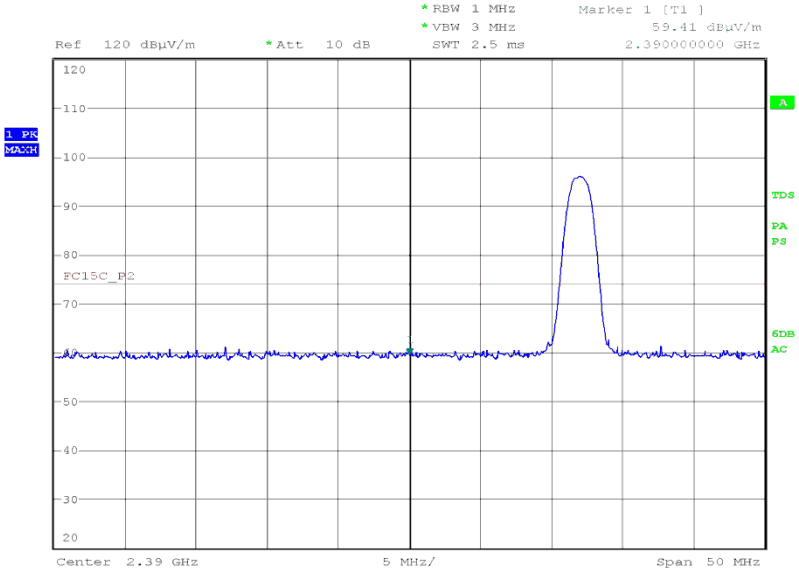
Date: 5.NOV.2014 20:20:27

Modulation/Packet Type: GFSK/3DH5

Restricted Bands of Operation		
Frequency (MHz)	Final Peak (dBµV/m)	Final Average (dBµV/m)
2390.0	59.41	47.85
2483.5	59.35	48.10

2390.0 MHz

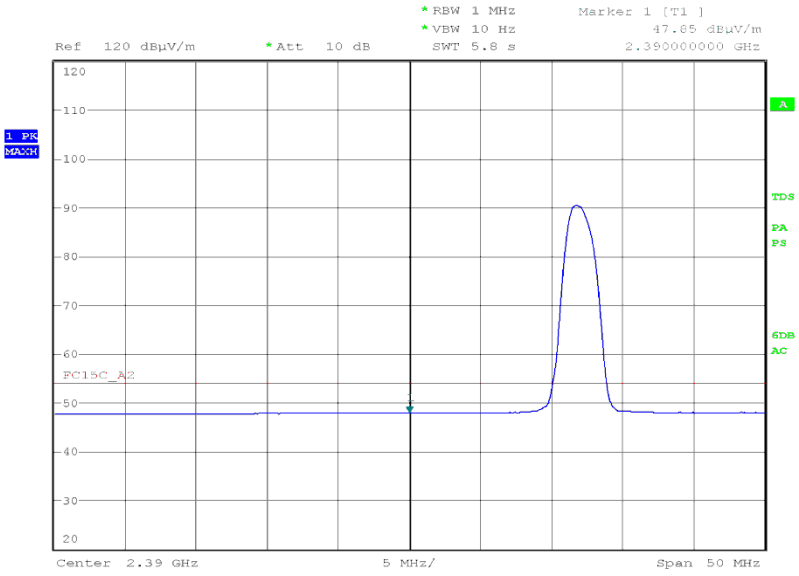
Final Peak



Date: 5.NOV.2014 19:55:39

Product Service

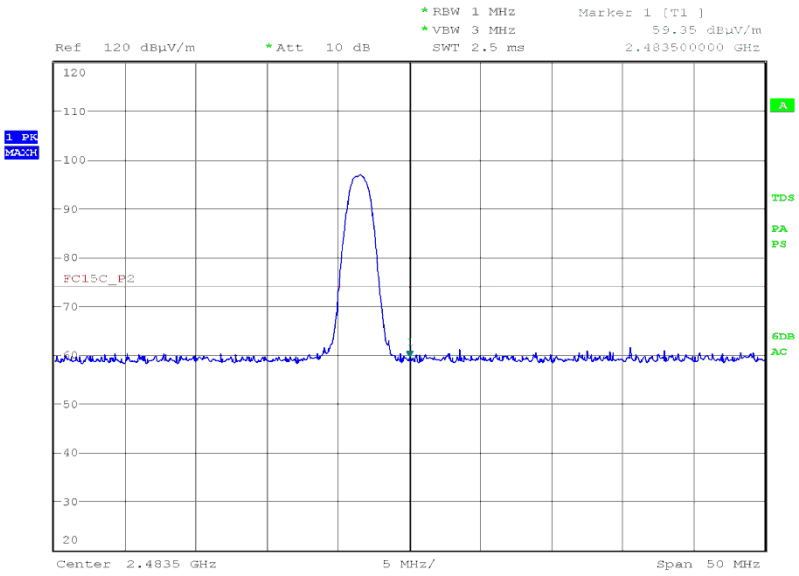
Final Average



Date: 5.NOV.2014 19:57:05

2483.5 MHz

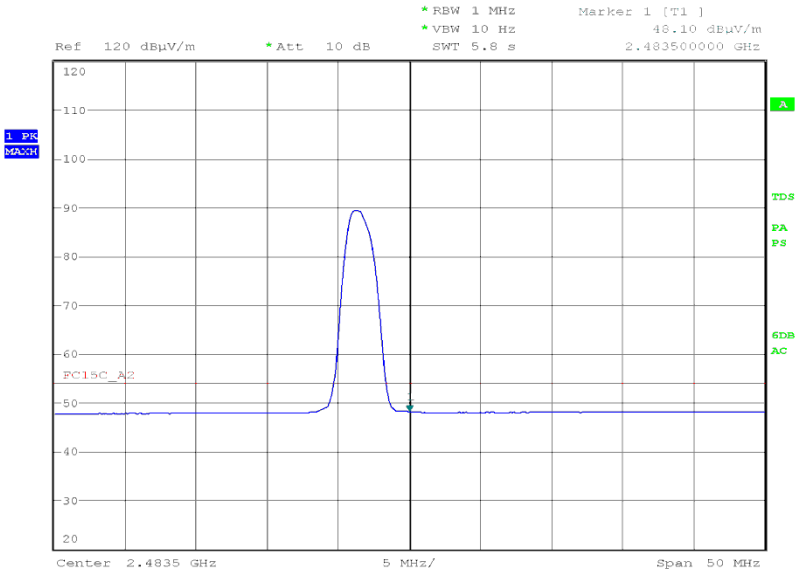
Final Peak



Date: 5.NOV.2014 21:48:24

Product Service

Final Average

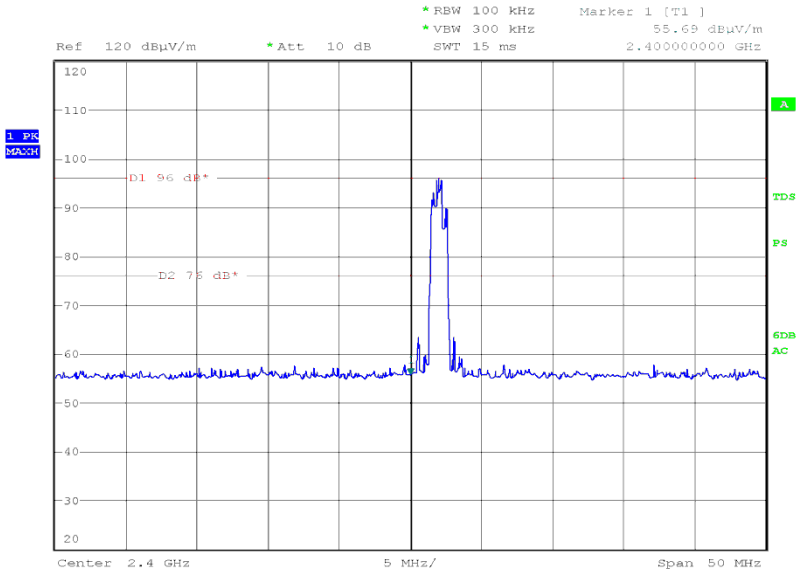


Date: 5.NOV.2014 20:28:29

Band Edge	
Frequency (MHz)	Final Peak (dBµV/m)
2400.0	55.69
2483.5	54.46

2400.0 MHz

Final Peak

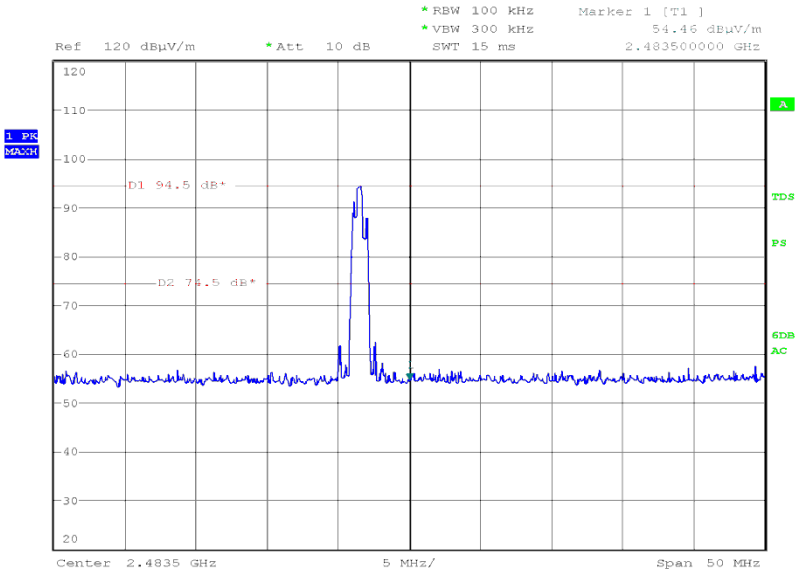


Date: 5.NOV.2014 19:49:18

Product Service

2483.5 MHz

Final Peak



Product Service

Limit

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

Radiated Emissions which fall only in the restricted bands as defined in 15.205 must also comply with the limits in the table above. The table above does not apply for Radiated Emissions which fall outside the restricted bands as defined in 15.205. These 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 transmitted complies with the conducted power limits, based on the use of RMS averaging over a time interal, the attenuator required shall be 30 dB below the fundamental instead on 20 dB.

Product Service

SECTION 3

TEST EQUIPMENT USED

Product Service

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	28-Mar-2015
Transient Limiter	Hewlett Packard	11947A	2378	12	1-Jul-2015
EMI Test Receiver	Rohde & Schwarz	ESIB26	3763	12	3-Jul-2015
Section 2.2 - Frequency Hopping Systems - 20dB Bandwidth and Channel Separation					
Power Splitter	Weinschel	1506A	606	12	14-Jan-2015
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	15-Nov-2014
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	28-Mar-2015
Section 2.3 - Frequency Hopping Systems - Channel Dwell Time and Number of Hopping Channels					
Power Splitter	Weinschel	1506A	606	12	14-Jan-2015
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	15-Nov-2014
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	28-Mar-2015
Section 2.4 - Maximum Peak Conducted Output Power					
Power Splitter	Weinschel	1506A	606	12	14-Jan-2015
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	28-Mar-2015
P-Series Power Meter	Agilent Technologies	N1911A	3980	12	22-Sep-2015
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3982	12	22-Sep-201
Section 2.5 - EIRP Peak Power					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	2-May-2015
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	8-Nov-2014
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	1002	12	19-Sep-2015
Screened Room (5)	Rainford	Rainford	1545	24	10-Jan-2015
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Charge Amplifier	Endevco	133	2506	12	27-Nov-2014
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Oct-2014
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
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

Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.6 - Spurious and Band Edge Emissions					
Antenna (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	26-Nov-2015
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	2-May-2015
Dual Power Supply Unit	Thurlby	PL320	288	-	TU
Pre-Amplifier	Phase One	PS04-0086	1533	12	19-Dec-2014
Pre-Amplifier	Phase One	PSO4-0087	1534	12	1-Oct-2015
Screened Room (5)	Rainford	Rainford	1545	24	10-Jan-2015
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna (Bilog)	Chase	CBL6143	2904	24	10-Jun-2015
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	27-Oct-2015
'3.5mm' - '3.5mm' RF Cable (1m)	Rhophase	3PS-1803-1000-3PS	3697	12	28-Feb-2015
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	1-Oct-2015
Suspended Subtrate Highpass Filter	Advance Power Components	11SH10-3000/X18000-O/O	4411	12	21-Mar-2015
Suspended Substrate Highpass Filter	Advance Power Components	11SH10-3000/X18000-O/O	4412	12	21-Mar-2015

TU – Traceability Unscheduled
O/P MON – Output Monitored with Calibrated Equipment

Product Service

3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	MU
Frequency Hopping Systems - Channel Dwell Time and Number of Hopping Channels	-
Spurious and Band Edge Emissions	Conducted: ± 3.08 dB Radiated: 30 MHz to 1 GHz: ± 5.1 dB Radiated: 1 GHz to 40 GHz: ± 6.3 dB
Frequency Hopping Systems - 20 dB Bandwidth and Channel Separation	± 16.74 kHz
EIRP Peak Power	30MHz to 1GHz: ± 5.1 dB 1GHz to 40GHz: ± 6.3 dB
Maximum Peak Conducted Output Power	± 0.70 dB
AC Line Conducted Emissions	± 3.2 dB

Product Service

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

Product Service

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).