
# Report On

FCC and Industry Canada Testing of the
Naim Audio Ltd BLUE
In accordance with FCC CFR 47 Part 15C, Industry Canada RSS-210 and Industry Canada RSS-GEN

COMMERCIAL-IN-CONFIDENCE

FCC ID: 2ACURBLUE
IC: 12217A-BLUE

Document 75927770 Report 01 Issue 1 November 2014

Product Service

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**REPORT ON**

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Document 75927770 Report 01 Issue 1

November 2014

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**DATED** 05 November 2014

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);

G Lawler M Toubella

UKAS TESTING 0141

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**SECTION 1**

**REPORT SUMMARY**

FCC and Industry Canada Testing of the
Naim Audio Ltd BLUE
In accordance with FCC CFR 47 Part 15C,
Industry Canada RSS-210 and Industry Canada RSS-GEN

## 1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC and Industry Canada Testing of the Naim Audio Ltd BLUE 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 | Naim Audio Ltd |
| Model Number(s) | BLUE |
| Serial Number(s) | Not Serialised (75927770-TSR0001)<br>Not Serialised (75927770-TSR0008) |
| Number of Samples Tested | 2 |
| Test Specification/Issue/Date | FCC CFR 47 Part 15C (2013)<br>Industry Canada RSS-210 (2010)<br>Industry Canada RSS-GEN (2010) |
| Incoming Release<br>Date | Application Form<br>05 November 2014 |
| Disposal<br>Reference Number<br>Date | Held Pending Disposal<br>Not Applicable<br>Not Applicable |
| Order Number<br>Date | P-074692<br>18 August 2014 |
| Start of Test | 3 September 2014 |
| Finish of Test | 10 September 2014 |
| Name of Engineer(s) | G Lawler<br>M Toubella |
| Related Document(s) | ANSI C63.10: 2009<br>KDB 558074 D01 V03 R01 |

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## 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 |
|---|---|---|---|---|---|---|
| | FCC | RSS-210 | RSS-GEN | | | |
| Bluetooth | | | | | | |
| 2.1 | 15.247 (a)(1) | A8.1 (a)(b) | - | Frequency Hopping Systems - 20 dB Bandwidth and Channel Separation | Pass | |
| 2.2 | 15.247 (a)(1)(iii) | A8.1 (d) | - | Frequency Hopping Systems - Channel Dwell Time and Number of Hopping Channels | Pass | |
| 2.3 | 15.247 (b)(1) | A8.4 (2) | - | Maximum Peak Conducted Output Power | Pass | |
| 2.4 | 15.247 (d) | A8.5 | 4.9 | Spurious and Band Edge Emissions | Pass | |

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## 1.3 APPLICATION FORM

| EQUIPMENT DESCRIPTION | | |
|---|---|---|
| Model Name/Number | BLUE | |
| Part Number | BLUE | |
| FCC ID (if applicable) | | 2ACURBLUE |
| Industry Canada ID (if applicable) | | 12217A-BLUE |
| Technical Description (Please provide a brief description of the intended use of the equipment) | | This is to be approved as a standalone Bluetooth module intended to be fitted to Naim Audio products to connect to external Bluetooth devices to stream audio playback through the Naim product. UART or USB communication protocol to be used |

| 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: | |
| Minimum Channel Occupation 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 Channel Occupancy Time implemented by the equipment: ms | |
| ☐ | The equipment has implemented an LBT based DAA mechanism |
| In case of equipment using modulation different from FHSS: | |
| ☐ | The equipment is Frame Based equipment |
| ☐ | The equipment is Load Based equipment |
| ☐ | The equipment can switch dynamically between Frame Based and Load Based equipment |
| The CCA time implemented by the equipment: µs | |
| The value q as referred to in clause 4.3.2.5.2.2.2 is: | |
| ☐ | The equipment has implemented an non-LBT based DAA mechanism |
| ☐ | The equipment can operate in more than one adaptive mode |

Product Service

| | | |
|---|---|---|
| **In case of non-adaptive Equipment:** | | |
| The maximum RF Output Power (e.i.r.p.): 4 dBm | | |
| The maximum (corresponding) Duty Cycle: 50 % | | |
| Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared): | | |
| N/A | | |
| **The worst case operational mode for each of the following tests:** | | |
| RF Output Power: 4dBM | | |
| Power Spectral Density: | | |
| Duty cycle, Tx-Sequence, Tx-gap: 50% | | |
| Dwell time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment): | | |
| Hopping Frequency Separation (only for FHSS equipment): | | |
| Medium Utilisation: | | |
| Adaptivity & Receiver Blocking: | | |
| Occupied Channel Bandwidth: | | |
| Transmitter unwanted emissions in the OOB domain: | | |
| Transmitter unwanted emissions in the spurious domain: | | |
| Receiver spurious emissions: -155dBm/Hz | | |
| **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 Occupied Channel Bandwidth 1 |
| | ☐ | High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2 |
| *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 Occupied Channel Bandwidth 1 |
| | ☐ | High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2 |
| *NOTE: Add more lines if more channel bandwidths are supported.* | | |
| **In case of Smart Antenna Systems:** | | |
| The number of Receive chains: | | |
| The number of Transmit chains: | | |
| ☐ | symmetrical power distribution | |
| ☐ | asymmetrical power distribution | |
| In case of beam forming, the maximum beam forming gain: | | |
| *NOTE: Beam forming gain does not include the basic gain of a single antenna.* | | |

Product Service

| Operating Frequency Range(s) of the equipment: | |
|---|---|
| Operating Frequency Range 1: 2402 MHz to 2480 MHz | Bluetooth (e.g Bluetooth for EU) |
| Operating Frequency Range 2: MHz to MHz | (e.g WLAN for EU) |
| Operating Frequency Range 3: 2402 MHz to 2480 MHz | Bluetooth (e.g Bluetooth for FCC and/or Industry Canada) |
| Operating Frequency Range 4: MHz to MHz | (e.g WLAN for FCC and/or Industry Canada) |
| *NOTE: Add more lines if more Frequency Ranges are supported.* | |
| **Occupied Channel Bandwidth(s):** | |
| Occupied Channel Bandwidth1: 2402 MHz to 2480 MHz | |
| Occupied Channel Bandwidth2: MHz to MHz | |
| *NOTE: Add more lines if more channel bandwidths are supported.* | |
| **Type of Equipment (stand-alone, combined, plug-in radio device, etc.):** | |
| ☐ Stand-alone | |
| ☐ Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment) | |
| ☒ Plug-in radio device (Equipment intended for a variety of host systems) | |
| ☐ Other | |
| **The extreme operating conditions that apply to the equipment:** | |
| Operating temperature range: -40 °C to +85 °C | |
| Operating voltage range: -0.4 V to 5.75 V | ☐ AC ☒ DC |
| Details provided are for the: | |
| ☒ stand-alone equipment | |
| ☐ combined (or host) equipment | |
| ☐ test jig | |

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:** | | | |
|---|---|---|---|
| Antenna Type: | | | |
| ☐ Integral Antenna | | | |
| Antenna Gain: 10 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: 1 | | | |
| Power Level 1: 10dBi dBm | | | |
| Power Level 2: dBm | | | |
| Power Level 3: dBm | | | |
| Power Level 4: 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: 4 dBm | | | |
| Number of antenna assemblies provided for this power level: 1 | | | |
| **Assembly #** | **Gain (dBi)** | **e.i.r.p (dBm)** | **Part number or model number** |
| **1** | 10 | 4dBm | |
| **2** | | | |
| **3** | | | |
| **4** | | | |
| *NOTE: Add more rows in case more antenna assemblies are supported for this power level.* | | | |
| Power Level 2: dBm | | | |
| Number of antenna assemblies provided for this power level: | | | |
| **Assembly #** | **Gain (dBi)** | **e.i.r.p (dBm)** | **Part number or model number** |
| **1** | | | |
| **2** | | | |
| **3** | | | |
| **4** | | | |
| *NOTE: Add more rows in case more antenna assemblies are supported for this power level.* | | | |
| Power Level 3: dBm | | | |
| Number of antenna assemblies provided for this power level: | | | |
| **Assembly #** | **Gain (dBi)** | **e.i.r.p (dBm)** | **Part number or model number** |
| **1** | | | |
| **2** | | | |
| **3** | | | |
| **4** | | | |
| *NOTE: Add more rows in case more antenna assemblies are supported for this power level.* | | | |
| **The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test** | | | |

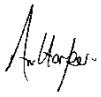
Product Service

| | |
|---|---|
| **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 | |
| ☒ State DC voltage 5V | |
| 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:** | |
| Paired | |
| **The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.):** | |
| Bluetooth | |
| **Combination for testing (see clause 5.1.3.3 of EN 300 328 V1.8.1)** | |
| From all combinations of conducted power settings and intended antenna assembly(ies) specified in clause 3.1 m), specify the combination resulting in the highest e.i.r.p. for the radio equipment.<br><br>Unless otherwise specified in EN 300 328, this power setting is to be used for testing against the requirements of 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 EN 300 328, clause 5.1.3.3. | |
| Highest overall e.i.r.p. value: dBm | |
| Corresponding Antenna assembly gain: 10 dBi | Antenna Assembly #: |
| Corresponding conducted power setting: 4 dBm | Listed as Power Setting #: |
| (also the power level to be used for testing) 4dBm | |
| **Additional information provided by the applicant** | |
| **Modulation** | |
| ITU Class(es) of emission: 2 | |
| Can the transmitter operate unmodulated? ☒ Yes ☐ No | |
| **Duty Cycle** | |
| The transmitter is intended for: | |
| ☐ Continuous duty | |
| ☒ Intermittent duty | |
| ☒ Continuous operation possible for testing purposes | |
| **About the UUT** | |
| ☒ The equipment submitted are representative production models | |
| ☐ If not, the equipment submitted are pre-production models ? | |
| ☐ If pre-production equipment are submitted, the final production equipment will be identical in all respects with the equipment tested | |
| ☐ If not, supply full details | |
| ☐ The equipment submitted is CE marked | |
| ☐ In addition to the CE mark, the Class-II identifier (Alert Sign) is affixed. | |

Product Service

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

Signature:  Name: Ashley Harper

Position held: Compliance Engineer Date: 05/11/2014

## 1.4 PRODUCT INFORMATION

### 1.4.1 Technical Description

The Equipment Under Test (EUT) was a Naim Audio Ltd BLUE. 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 5.0 V DC supply.

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

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

## 1.6 DEVIATIONS FROM THE STANDARD

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

## 1.7 MODIFICATION RECORD

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

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**SECTION 2**

**TEST DETAILS**

FCC and Industry Canada Testing of the
Naim Audio Ltd BLUE
In accordance with FCC CFR 47 Part 15C,
Industry Canada RSS-210 and Industry Canada RSS-GEN

## 2.1 FREQUENCY HOPPING SYSTEMS - 20 dB BANDWIDTH AND CHANNEL SEPARATION

### 2.1.1 Specification Reference

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

### 2.1.2 Equipment Under Test and Modification State

BLUE S/N: Not Serialised (75927770-TSR0001) - Modification State 0

### 2.1.3 Date of Test

9 September 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

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 15.247 (a) and Part 15.215 (c).

The EUT was transmitted at maximum power on bottom, middle and top hopping frequency channels for 3DH5 packet type. 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 using a DH5 packet type. 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.

### 2.1.6 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.5°C |
| Relative Humidity | 54.4% |

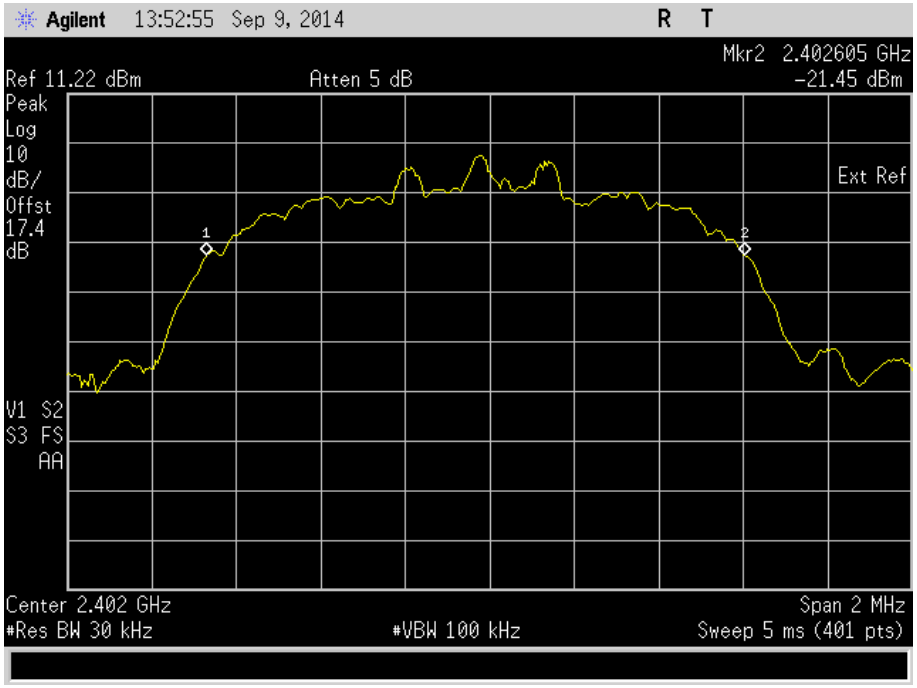
### 2.1.7 Test Results

5.0 V DC Supply

20dB Bandwidth

2402 MHz

| Packet Type | 20dB Bandwidth (kHz) |
|---|---|
| 3DH5 | 1275 |



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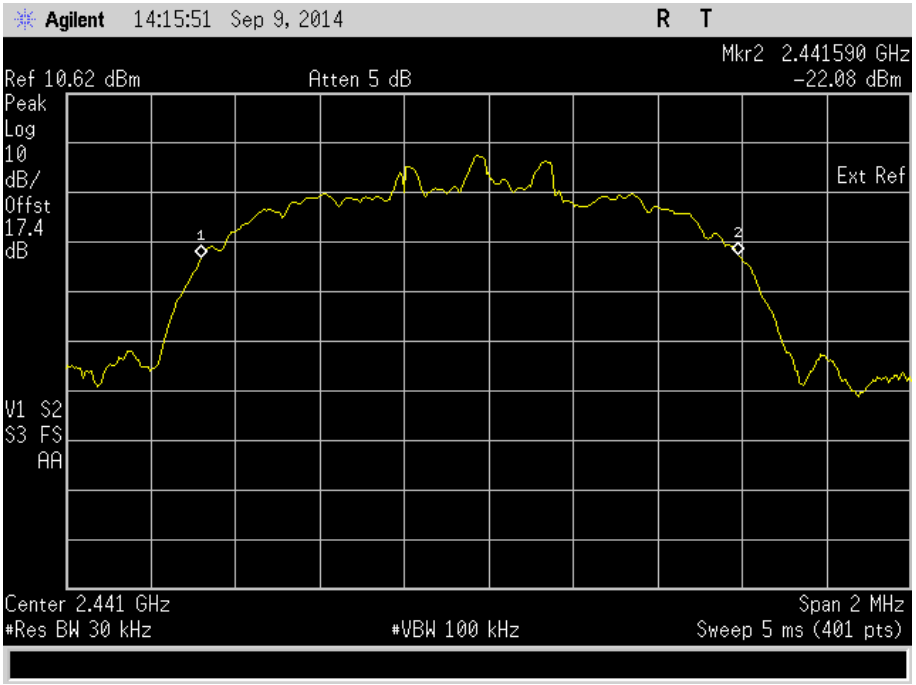
2441 MHz

| Packet Type | 20dB Bandwidth (kHz) |
|---|---|
| 3DH5 | 1270 |



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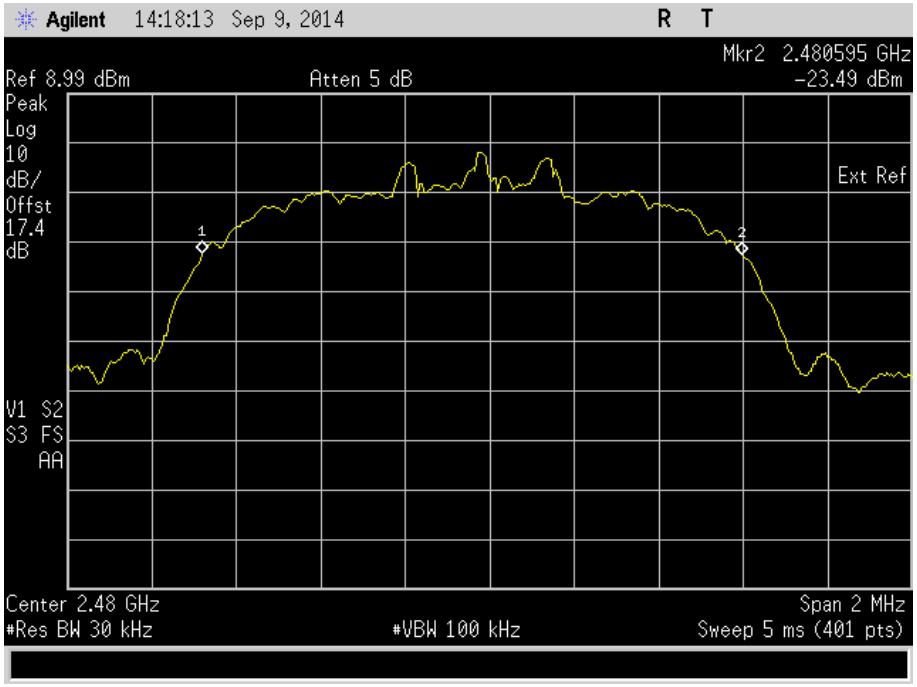
2480 MHz

| Packet Type | 20dB Bandwidth (kHz) |
|---|---|
| 3DH5 | 1275 |




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.

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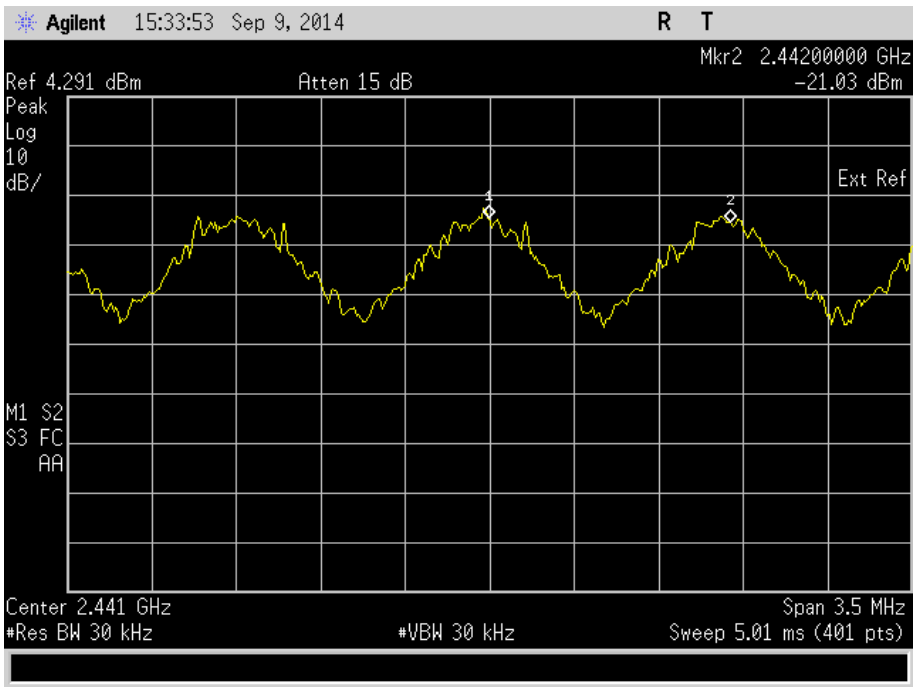
Channel Separation

Channel Separation: 1 MHz




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.

## 2.2 FREQUENCY HOPPING SYSTEMS - CHANNEL DWELL TIME AND NUMBER OF HOPPING CHANNELS

### 2.2.1 Specification Reference

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

### 2.2.2 Equipment Under Test and Modification State

BLUE S/N: Not Serialised (75927770-TSR0001) - Modification State 0

### 2.2.3 Date of Test

10 September 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 applied in accordance with the test method requirements of FCC CFR 47 Part 15.247 (a).

The EUT was transmitted at maximum power and hopping on the maximum of supported hopping channels for 3DH1, 3DH3 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. The frequency 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 hopping frequency employed by the EUT with an RBW of 300 kHz. The sweep time was set to a tenth of 0.4 seconds multiplied by the number of hopping channels employed to increase the measurement accuracy and the accumulative dwell time was calculated using post processing software and this result was multiplied by 10.

### 2.2.6 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.2°C |
| Relative Humidity | 49.4% |

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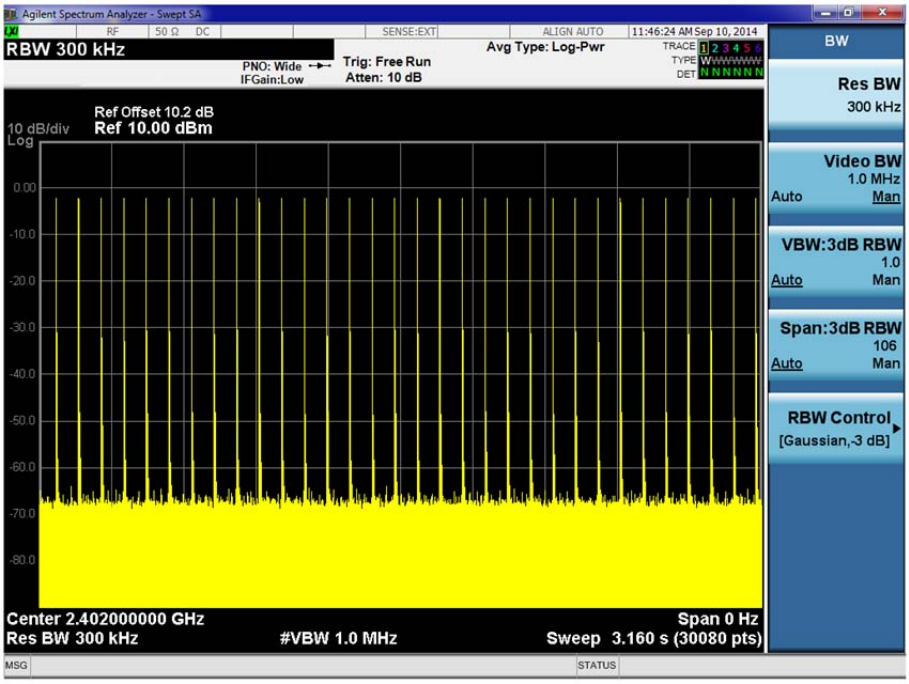
### 2.2.7 Test Results

5.0 V DC Supply

Channel Dwell Time

3DH1

106.117 ms



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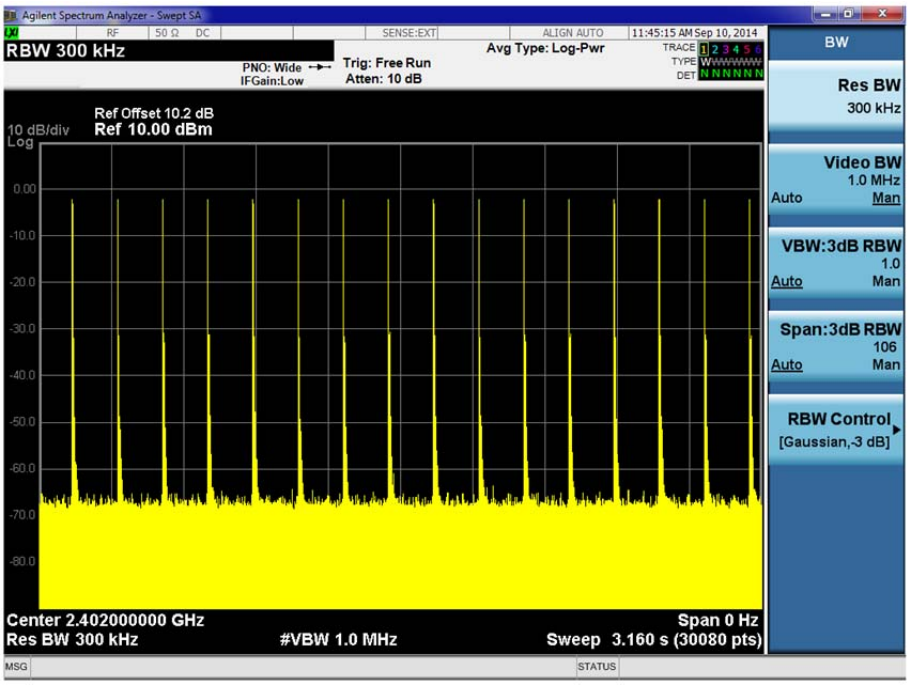
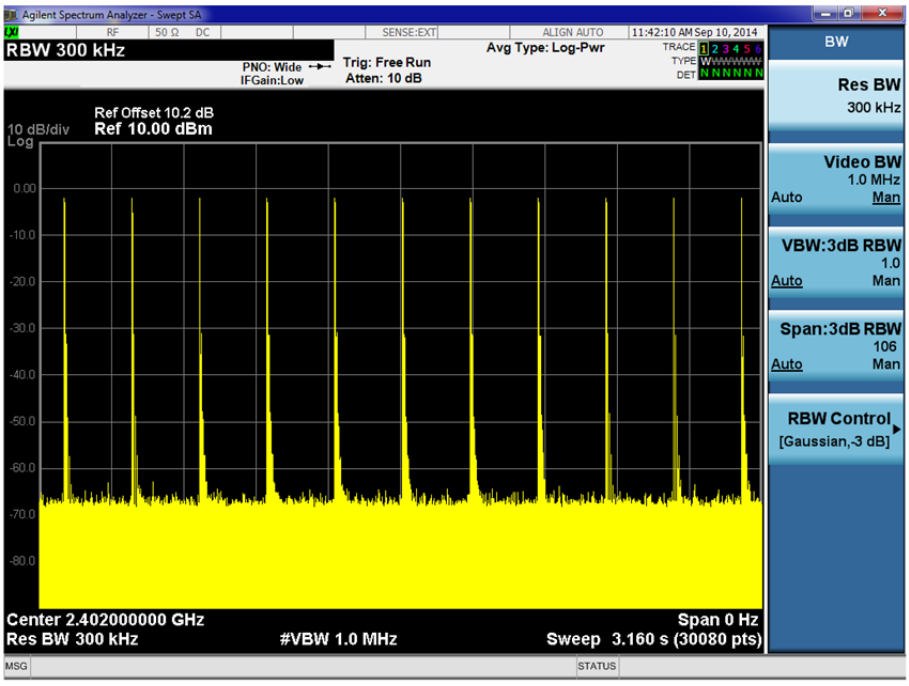
3DH3

155.499 ms




3DH5

177.563 ms



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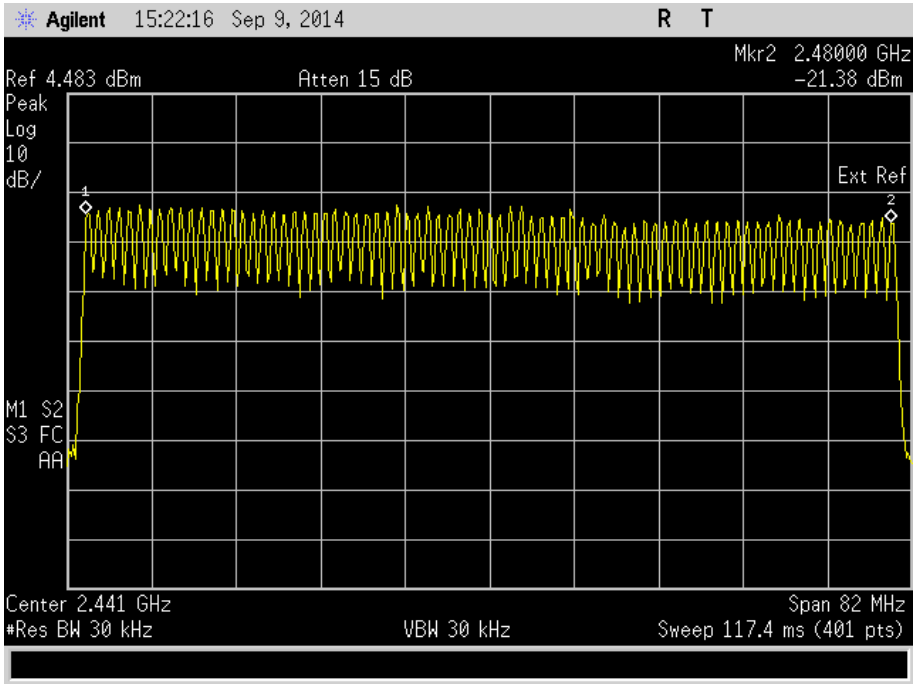
Limit

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

## 2.3 MAXIMUM PEAK CONDUCTED OUTPUT POWER

### 2.3.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (b)(3)
Industry Canada RSS-210, Clause A8.4 (2)

### 2.3.2 Equipment Under Test and Modification State

BLUE S/N: Not Serialised (75927770-TSR0001) - Modification State 0

### 2.3.3 Date of Test

9 September 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 test was applied in accordance with the test method requirements of FCC CFR 47 Part 15.247 (b).

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 3DH1, 3DH3 and 3DH5 packet types. 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.

### 2.3.6 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 23.6°C |
| Relative Humidity | 47.6% |

Product Service

### 2.3.7 Test Results

5.0 V DC Supply

| Packet Type | Maximum Peak Conducted Output Power | | | | | |
|---|---|---|---|---|---|---|
| | dBm | | | mW | | |
| | 2402 MHz | 2441 MHz | 2480 MHz | 2402 MHz | 2441 MHz | 2480 MHz |
| 3DH1 | 2.11 | 1.77 | 0.89 | 1.63 | 1.50 | 1.23 |
| 3DH3 | 1.93 | 1.54 | 0.93 | 1.56 | 1.42 | 1.24 |
| 3DH5 | 2.11 | 1.98 | 0.76 | 1.62 | 1.58 | 1.19 |

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.

Product Service

## 2.4 SPURIOUS AND BAND EDGE EMISSIONS

### 2.4.1 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

### 2.4.2 Equipment Under Test and Modification State

BLUE S/N: Not Serialised (75927770-TSR0008) - Modification State 0

### 2.4.3 Date of Test

3 September 2014, 7 September 2014 & 10 September 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 applied in accordance with the test method requirements of FCC CFR 47 Part 15.247 (d).

For conducted emissions, the EUT was set to operate at maximum power on the bottom, middle and top channels with a 3DH5 packet type. This was the packet type which yielded 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. The measurement path loss in each relevant frequency band was measured and entered as a reference level offset. The test was performed from 9 kHz to 25 GHz.

For radiated emissions, the test method described above was also used in addition to the guidelines specified for measurements in restricted bands as specified in KDB 558074. 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.

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. 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.

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 emission limits in Clause 15.205, 15.247(d) of FCC CFR 47 FCC Part 15 and RSS-210 Clause A8.5.

### 2.4.6 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 19.2 - 25.0°C |
| Relative Humidity | 50.0 - 58.0% |

Product Service

### 2.4.7 Test Results

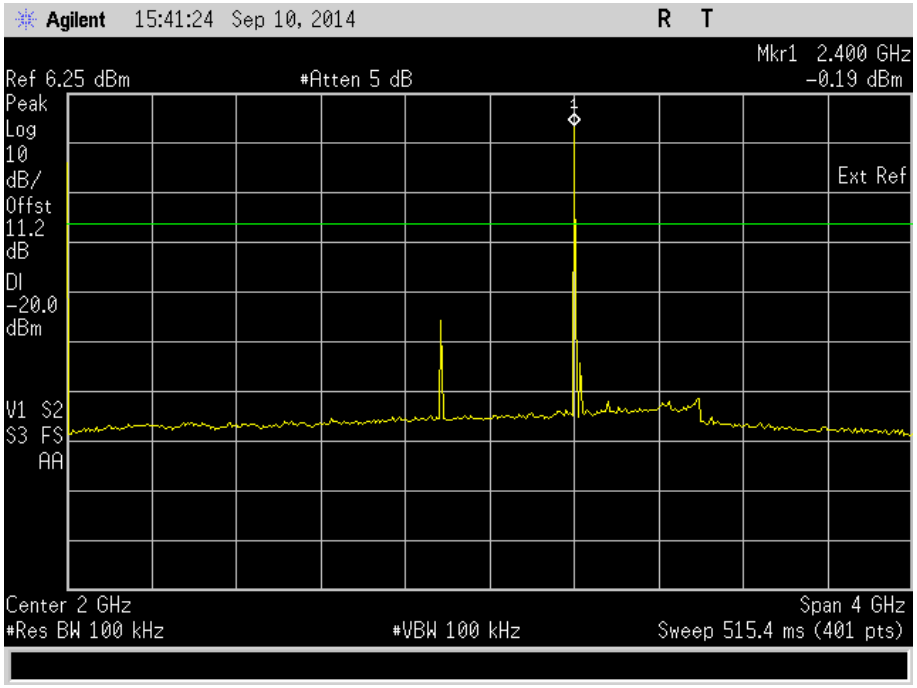
5.0 V DC Supply

Spurious Conducted Emissions

2402 MHz

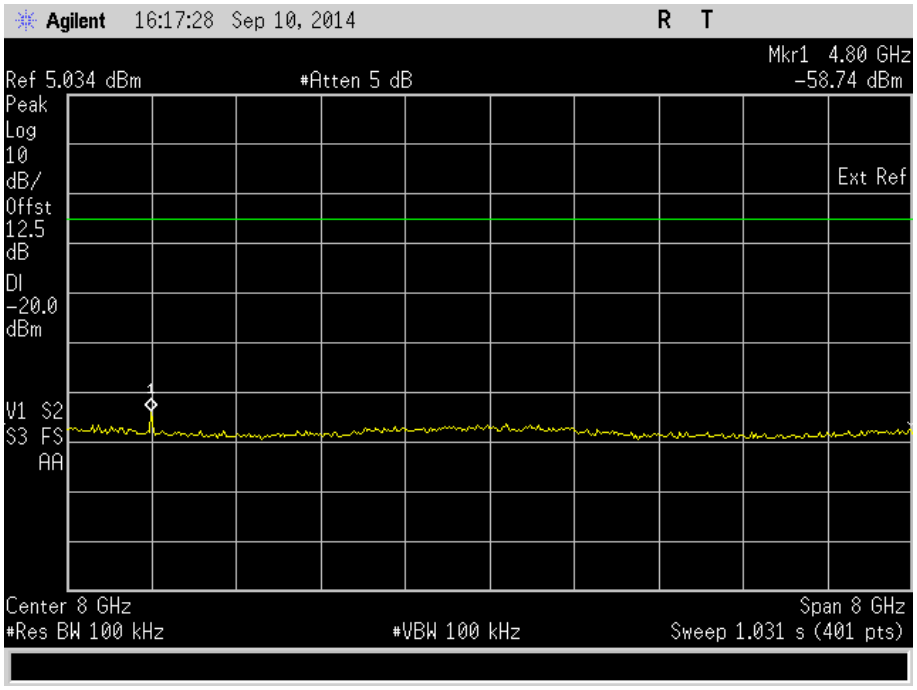
3DH5

9 kHz to 4 GHz

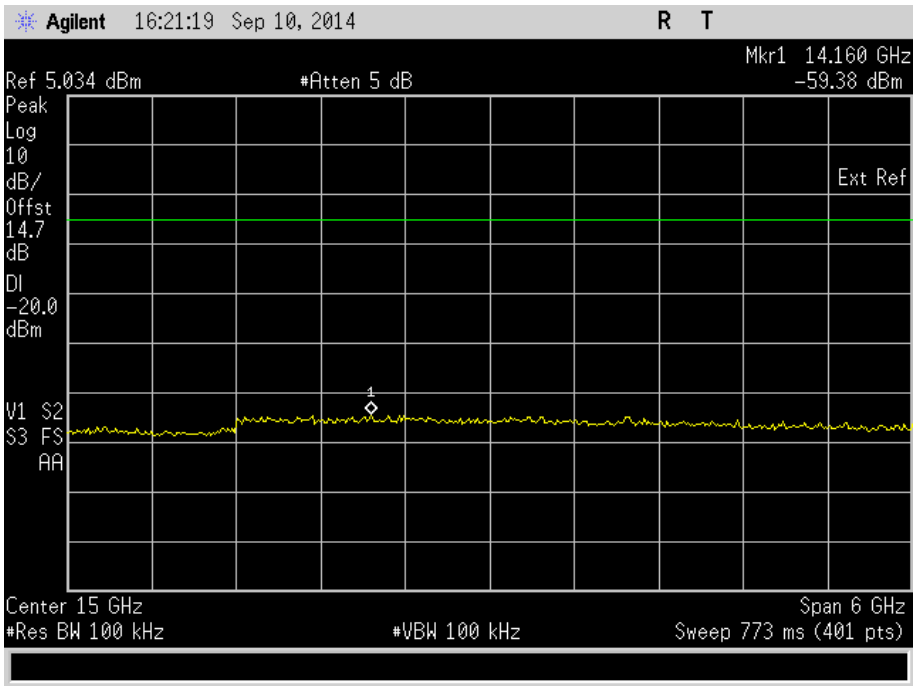


Product Service

4 GHz to 12 GHz

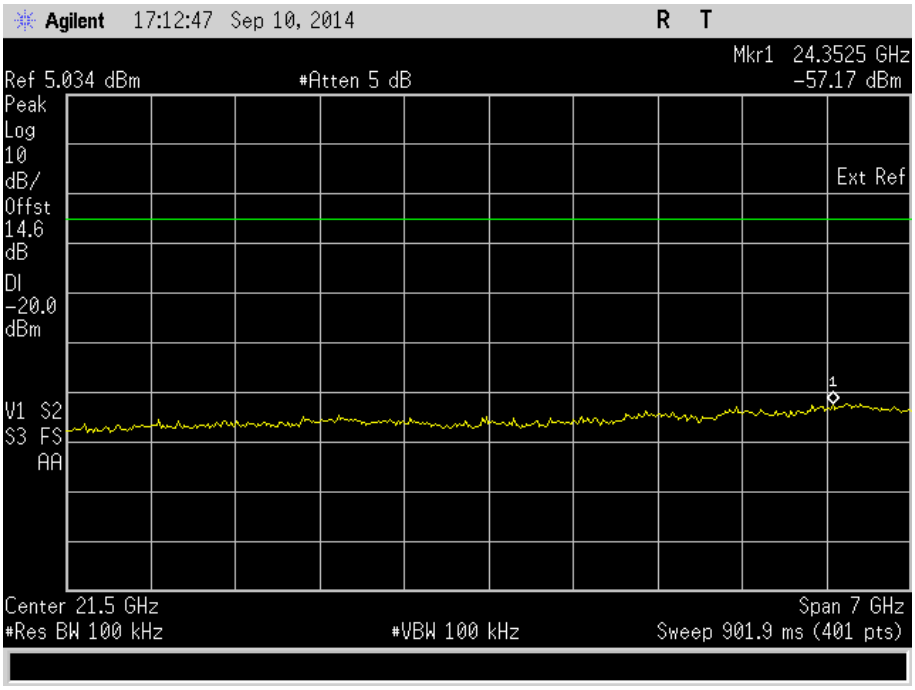



12 GHz to 18 GHz



Product Service

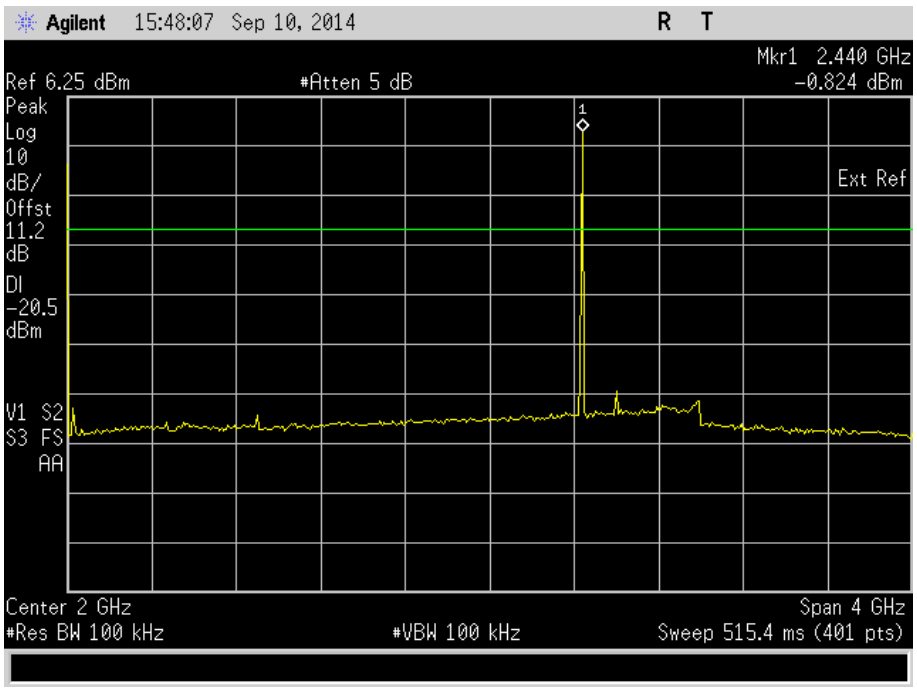
18 GHz to 25 GHz



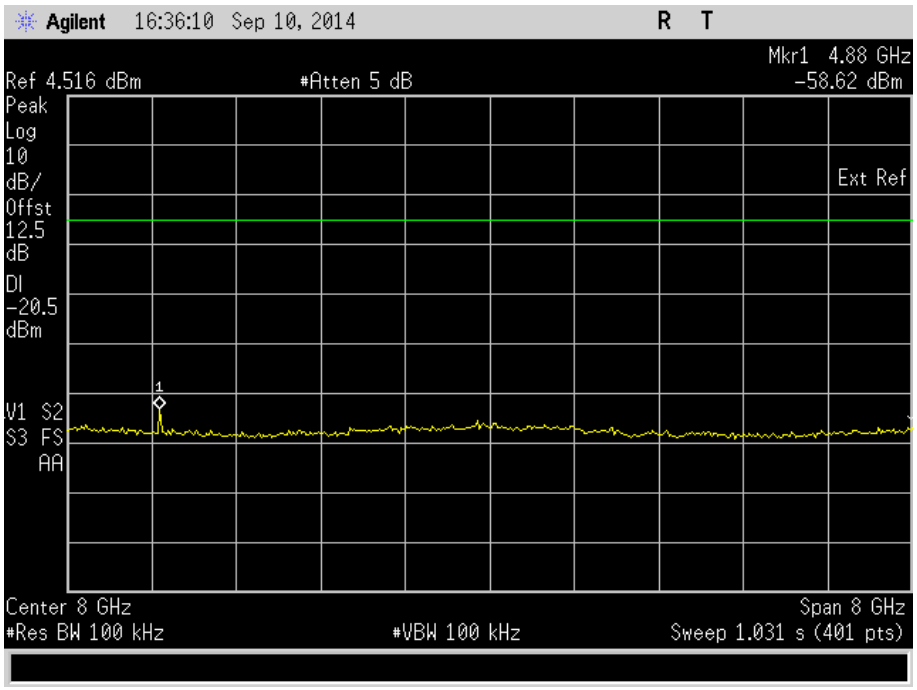
Product Service

2441 MHz

9 kHz to 4 GHz

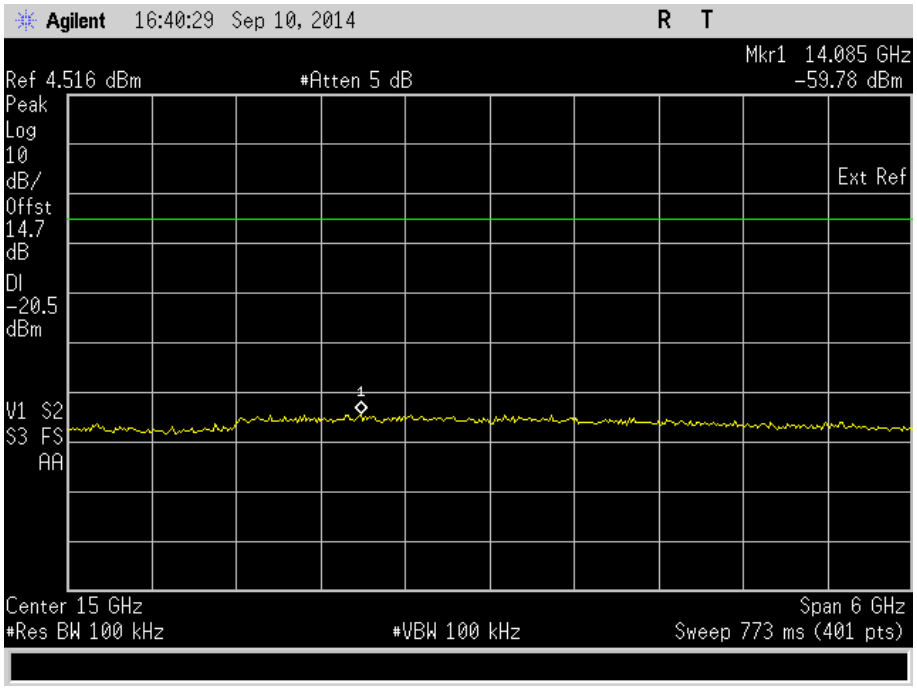



4 GHz to 12 GHz

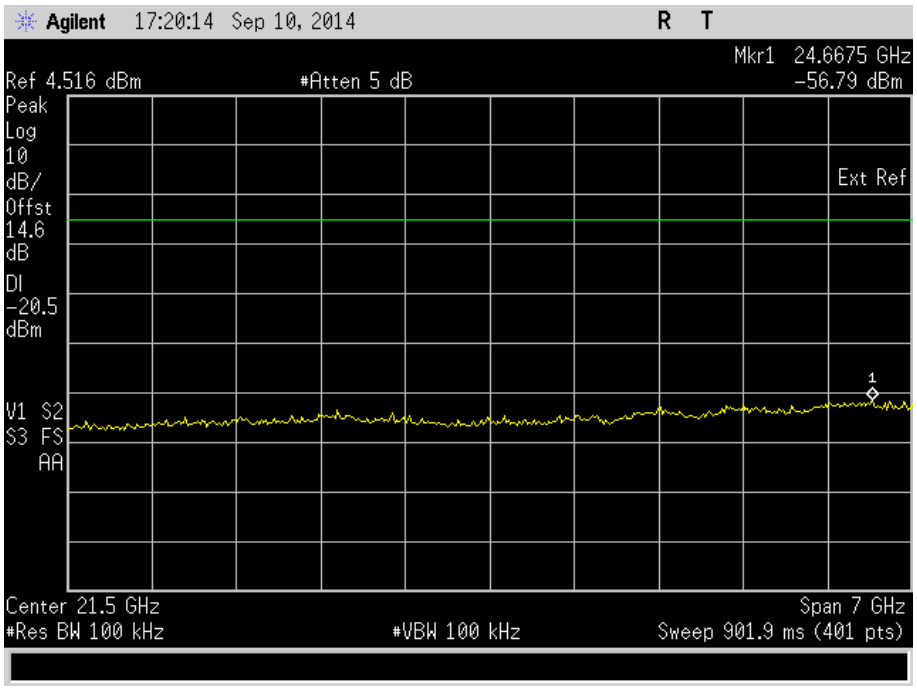


Product Service

12 GHz to 18 GHz



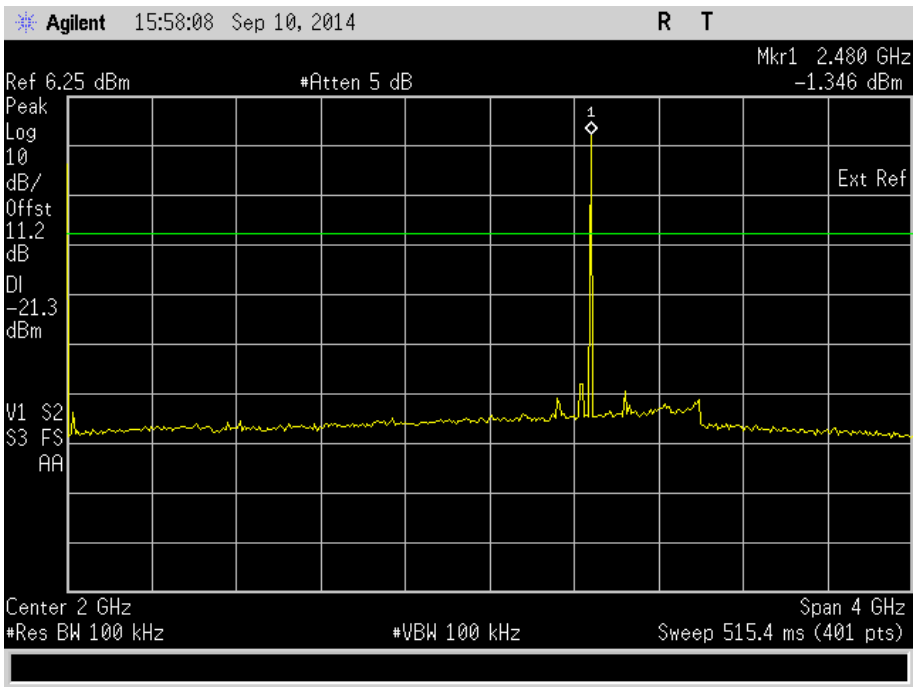

18 GHz to 25 GHz



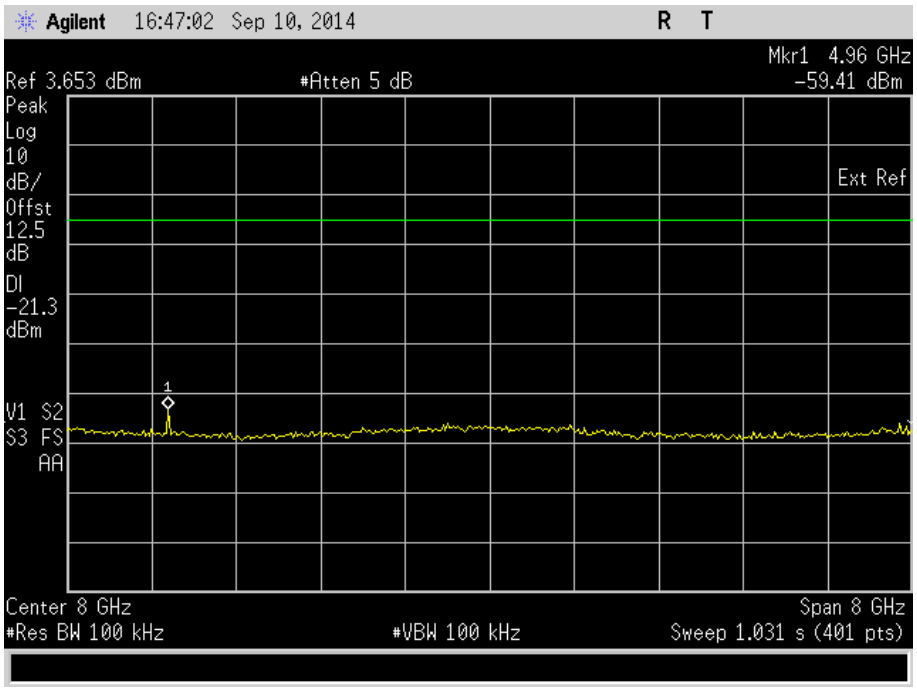
Product Service

2480 MHz

9 kHz to 4 GHz

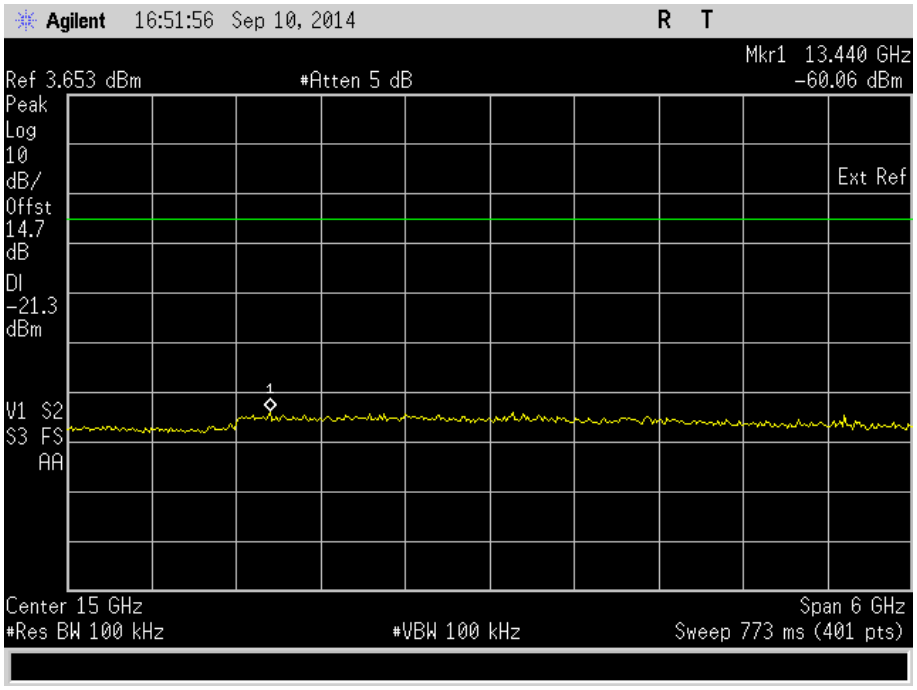



4 GHz to 12 GHz

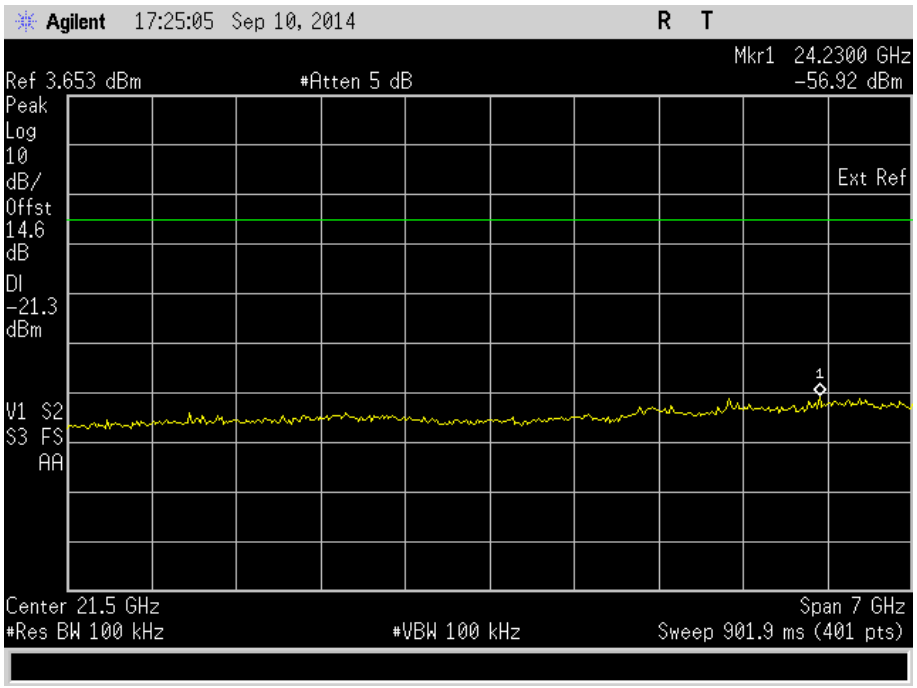


Product Service

12 GHz to 18 GHz




18 GHz to 25 GHz



Limit Clause

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.

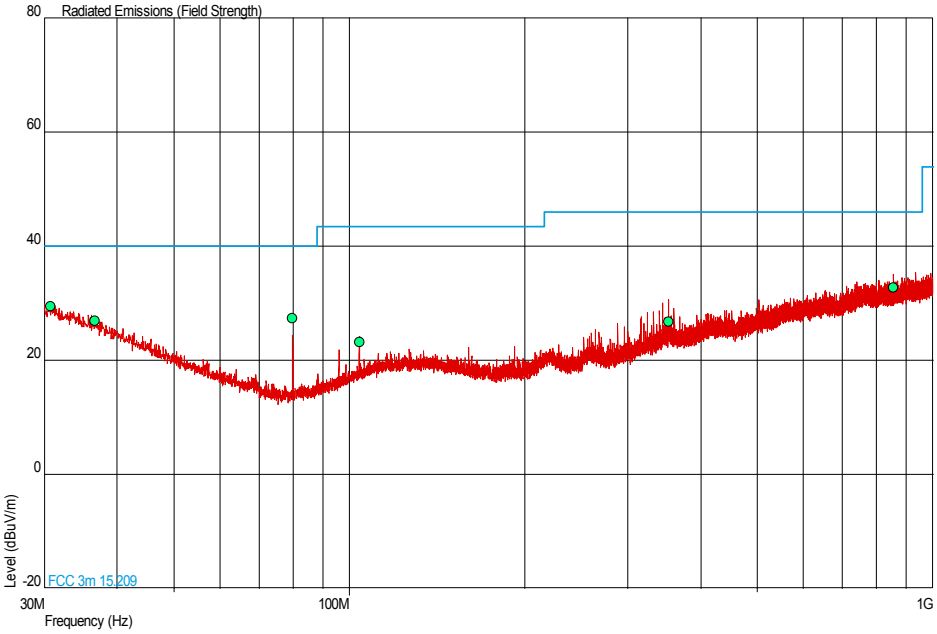
If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval the attenuation required shall be 30 dB instead of 20 dB.

Product Service

Spurious Radiated Emissions

2402 MHz

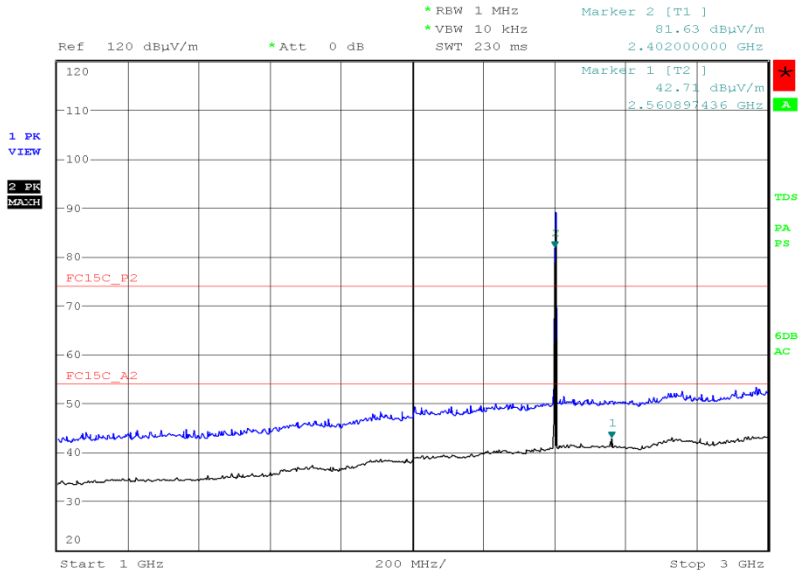
30 MHz to 1 GHz




| Frequency (MHz) | QP Level (dBuV/m) | QP Level (uV/m) | QP Limit (dBuV/m) | QP Limit (uV/m) | QP Margin (dBuV/m) | QP Margin (uV/m) | Angle (Deg) | Height (m) | Polarity |
|---|---|---|---|---|---|---|---|---|---|
| 30.797 | 29.5 | 29.9 | 40.0 | 100 | -10.5 | -70.1 | 341 | 2.21 | Vertical |
| 36.583 | 26.9 | 22.1 | 40.0 | 100 | -13.1 | -77.9 | 263 | 1.00 | Horizontal |
| 79.987 | 27.3 | 23.2 | 40.0 | 100 | -12.7 | -76.8 | 230 | 1.00 | Vertical |
| 103.991 | 23.1 | 14.3 | 43.5 | 150 | -20.4 | -135.7 | 250 | 1.00 | Vertical |
| 351.960 | 26.8 | 21.9 | 46.0 | 200 | -19.2 | -178.1 | 111 | 1.00 | Vertical |
| 856.316 | 32.8 | 43.7 | 46.0 | 200 | -13.2 | -156.3 | 155 | 1.00 | Vertical |

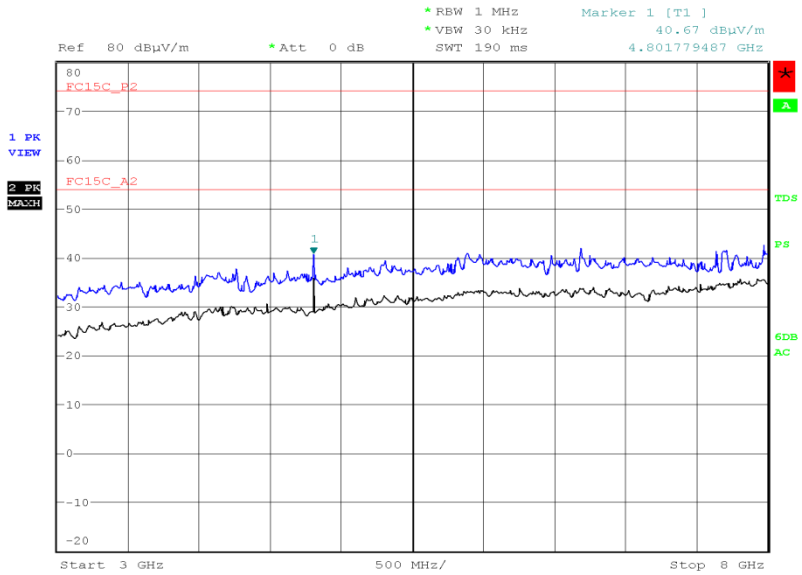
Product Service

1 GHz to 3 GHz




Date: 7.SEP.2014 10:37:02

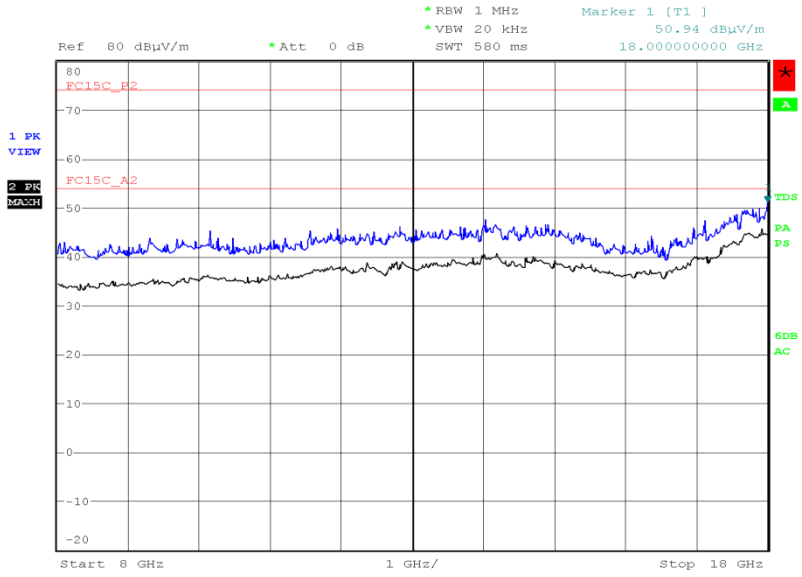
3 GHz to 8 GHz




Date: 7.SEP.2014 11:34:43

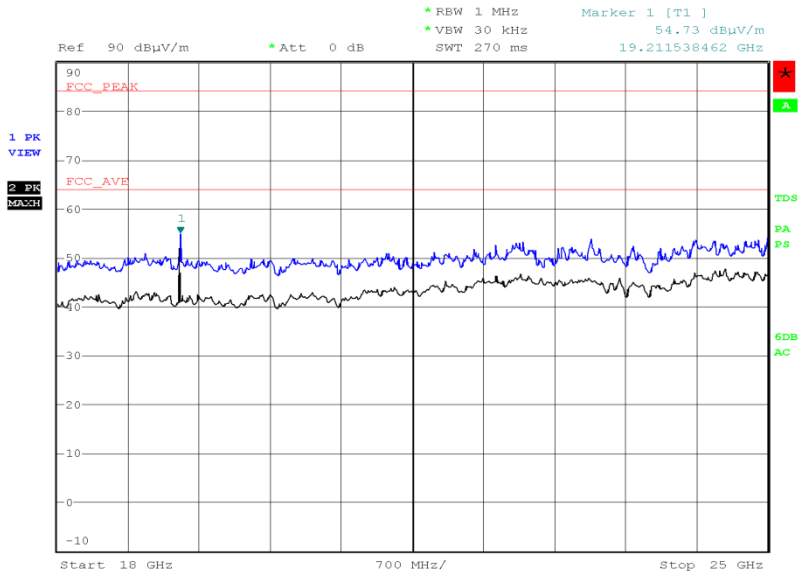
Product Service

8 GHz to 18 GHz




Date: 7.SEP.2014 11:53:15

18 GHz to 25 GHz

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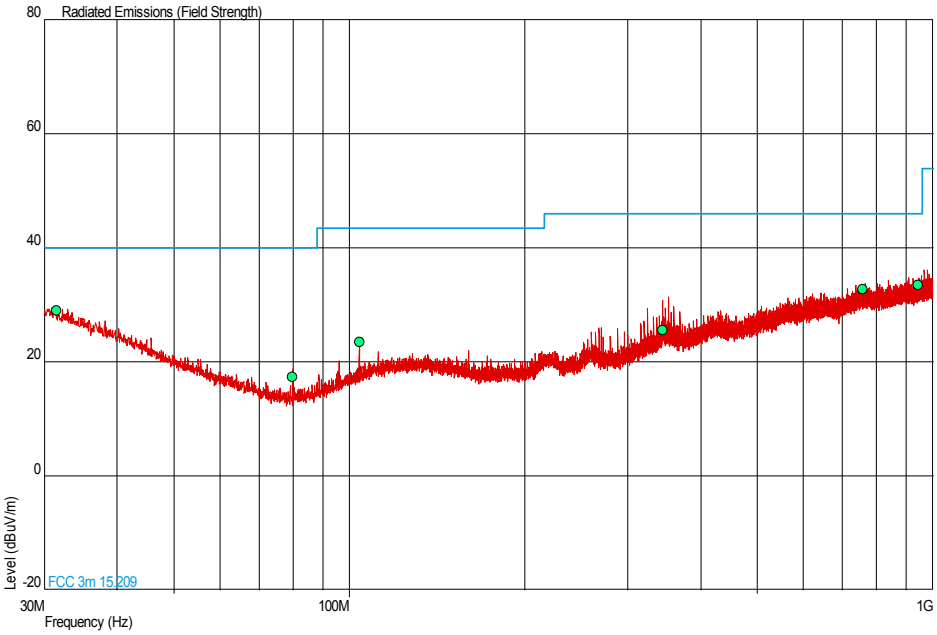
Product Service

2441 MHz

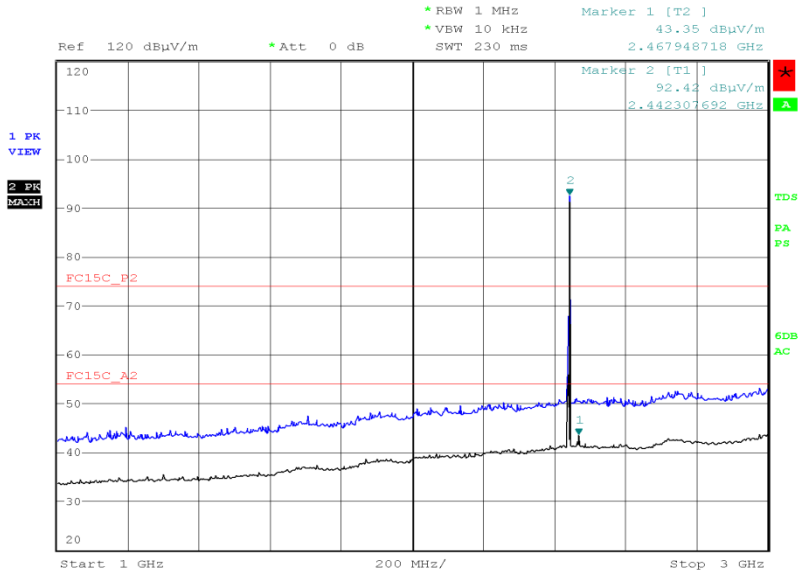
30 MHz to 1 GHz




| Frequency (MHz) | QP Level (dBuV/m) | QP Level (uV/m) | QP Limit (dBuV/m) | QP Limit (uV/m) | QP Margin (dBuV/m) | QP Margin (uV/m) | Angle (Deg) | Height (m) | Polarity |
|---|---|---|---|---|---|---|---|---|---|
| 31.483 | 29.1 | 28.5 | 40.0 | 100 | -10.9 | -71.5 | 300 | 2.60 | Vertical |
| 79.992 | 17.4 | 7.4 | 40.0 | 100 | -22.6 | -92.6 | 305 | 1.00 | Vertical |
| 103.983 | 23.5 | 15.0 | 43.5 | 150 | -20.0 | -135.0 | 164 | 1.00 | Vertical |
| 343.958 | 25.5 | 18.8 | 46.0 | 200 | -20.5 | -181.2 | 91 | 1.00 | Vertical |
| 758.629 | 32.8 | 43.7 | 46.0 | 200 | -13.2 | -156.3 | 147 | 3.62 | Vertical |
| 943.450 | 33.6 | 47.9 | 46.0 | 200 | -12.4 | -152.1 | 360 | 3.91 | Vertical |

Product Service

## 1 GHz to 3 GHz

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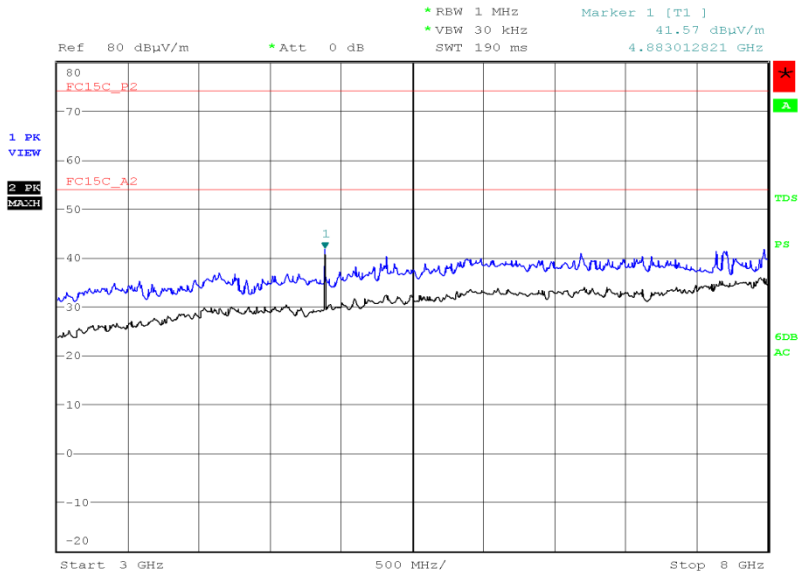
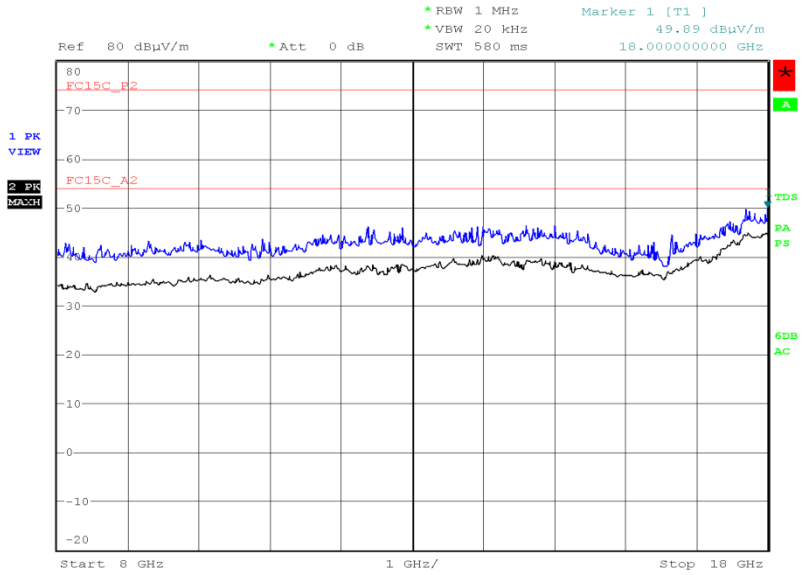
## 3 GHz to 8 GHz




Date: 7.SEP.2014 11:15:53

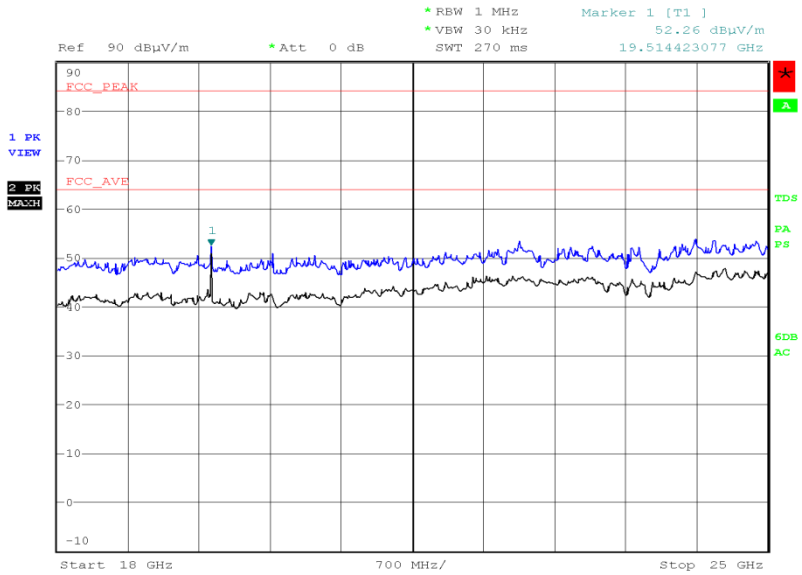
Product Service

8 GHz to 18 GHz




Date: 7.SEP.2014 12:02:43

18 GHz to 25 GHz

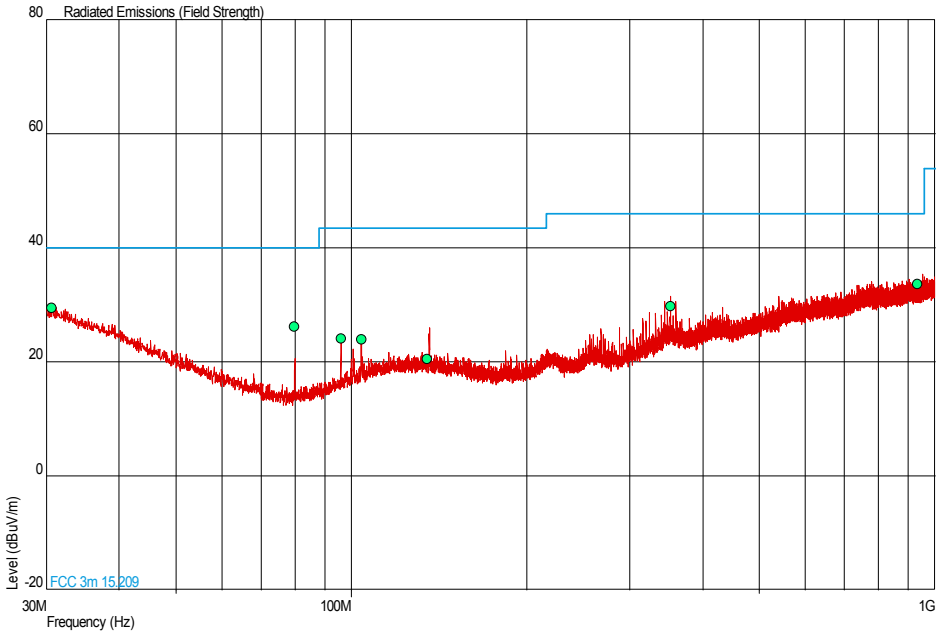



Date: 7.SEP.2014 13:31:14

Product Service

2480 MHz

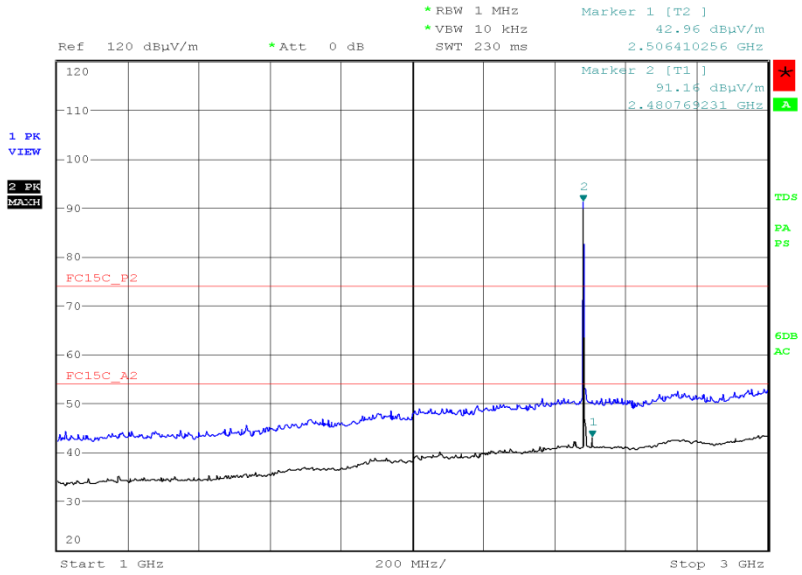
30 MHz to 1 GHz




| Frequency (MHz) | QP Level (dBuV/m) | QP Level (uV/m) | QP Limit (dBuV/m) | QP Limit (uV/m) | QP Margin (dBuV/m) | QP Margin (uV/m) | Angle (Deg) | Height (m) | Polarity |
|---|---|---|---|---|---|---|---|---|---|
| 30.642 | 29.5 | 29.9 | 40.0 | 100 | -10.5 | -70.1 | 360 | 3.73 | Vertical |
| 79.991 | 26.2 | 20.4 | 40.0 | 100 | -13.8 | -79.6 | 262 | 1.00 | Vertical |
| 95.985 | 24.1 | 16.0 | 43.5 | 150 | -19.4 | -134.0 | 62 | 1.02 | Vertical |
| 103.994 | 24.0 | 15.8 | 43.5 | 150 | -19.5 | -134.2 | 265 | 1.00 | Vertical |
| 134.723 | 20.6 | 10.7 | 43.5 | 150 | -22.9 | -139.3 | 67 | 3.89 | Vertical |
| 351.982 | 29.7 | 30.5 | 46.0 | 200 | -16.3 | -169.5 | 143 | 1.02 | Vertical |
| 933.852 | 33.6 | 47.9 | 46.0 | 200 | -12.4 | -152.1 | 249 | 1.00 | Vertical |

Product Service

## 1 GHz to 3 GHz

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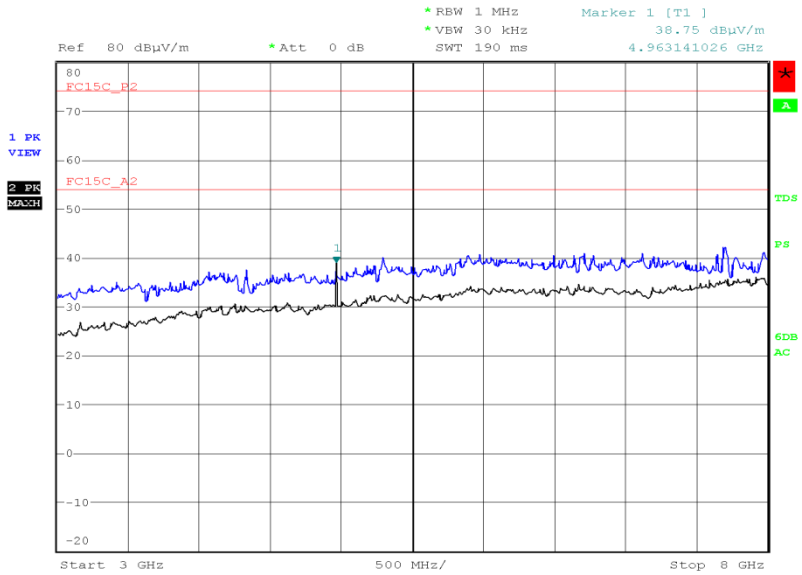
## 3 GHz to 8 GHz

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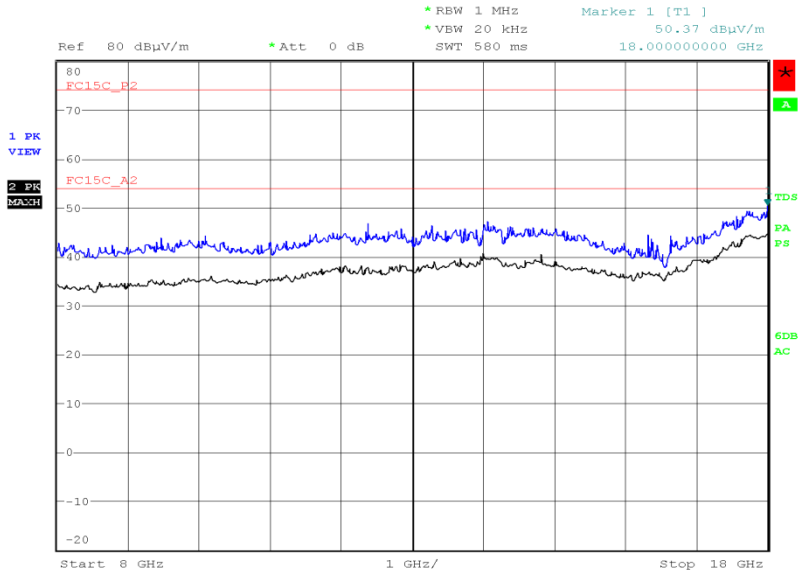
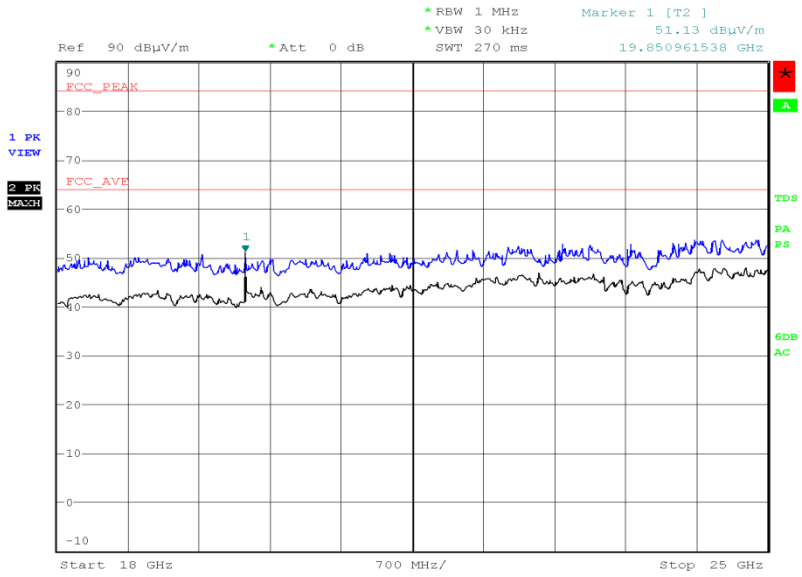
Product Service

8 GHz to 18 GHz




Date: 7.SEP.2014 12:17:10

18 GHz to 25 GHz

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Product Service

Limit

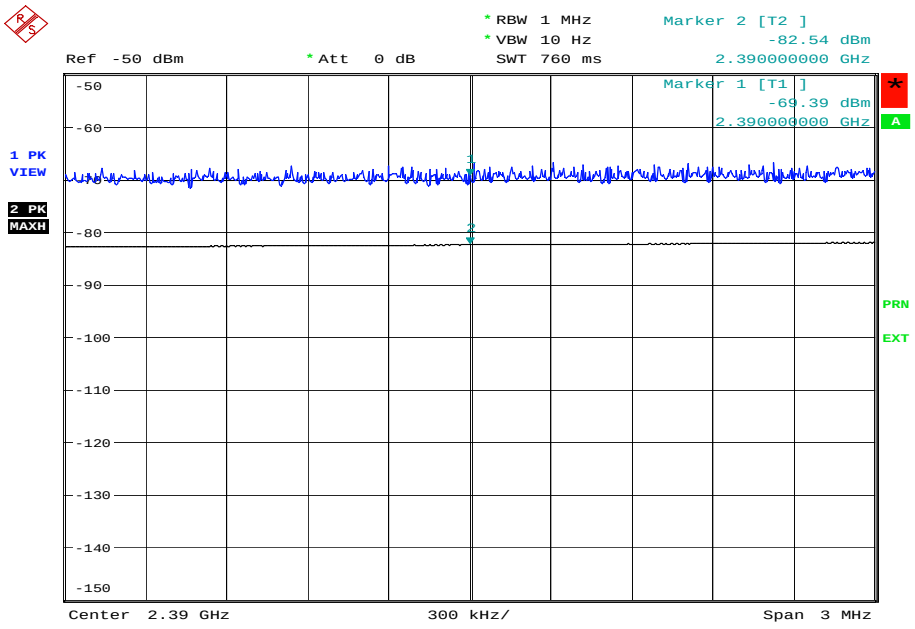
| Frequency (MHz) | Field Strength | | | Measurement Distance (m) |
|---|---|---|---|---|
| | (µV/m) | Average (dBµV/m) | Peak (dBµV/m) | |
| 30-88 | 100 | 40.0 | 60.0 | 3 |
| 88-216 | 150 | 43.5 | 63.5 | 3 |
| 216-960 | 200 | 46.0 | 66.0 | 3 |
| Above 960 | 500 | 54.0 | 74.0 | 3 |

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

2402 MHz

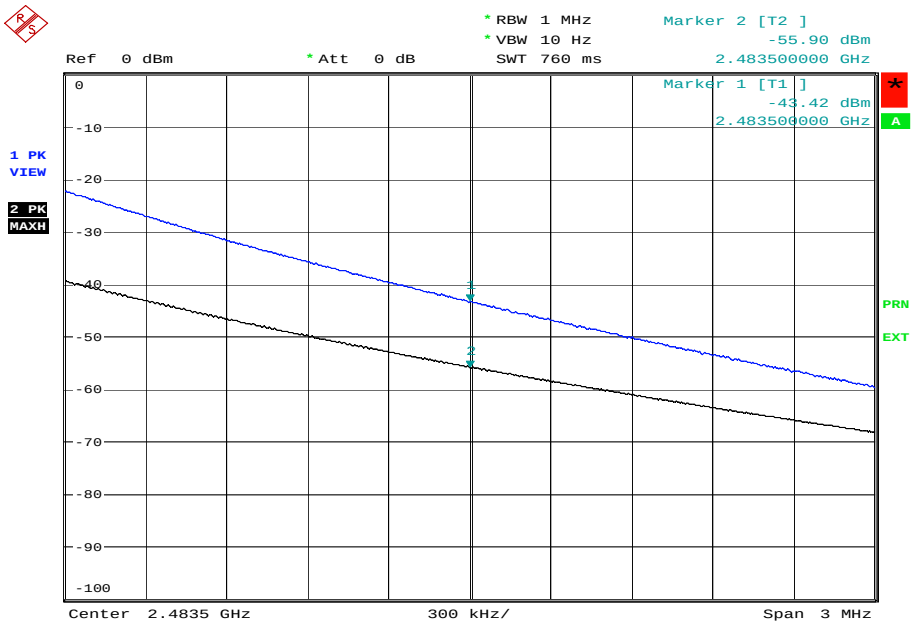
| Final Peak (dBµV/m) | Final Average (dBµV/m) |
|---|---|
| 25.87 | 12.72 |



Product Service

2480 MHz

| Final Peak (dBµV/m) | Final Average (dBµV/m) |
|---|---|
| 51.84 | 39.36 |




Date: 3.SEP.2014 17:12:37

The results in the tables were performed using a conducted method in accordance with KDB 558074 D01 and final field strength results were obtained using the following calculation:

E(dBµV/m) = EIRP – 20 LOG D + 104.8

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 - Frequency Hopping Systems - 20dB Bandwidth and Channel Separation** | | | | | |
| Attenuator (20dB/ 2W) | Pasternack | PE7004-20 | 489 | 12 | 30-Oct-2014 |
| Power Splitter | Weinschel | 1506A | 607 | 12 | 21-Mar-2015 |
| Signal Generator (10MHz to 40GHz) | Rohde & Schwarz | SMR40 | 1002 | 12 | 18-Sep-2014 |
| Spectrum Analyser | Agilent Technologies | E4407B | 1154 | 12 | 21-Aug-2015 |
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 18-Jan-2015 |
| Power Supply | Hewlett Packard | 6104A | 1948 | - | TU |
| Hygrometer | Rotronic | I-1000 | 3220 | 12 | 24-Jul-2015 |
| Attenuator (10dB, 20W) | Lucas Weinschel | 1 | 3225 | 12 | 12-Dec-2014 |
| 'N' - 'N' RF Cable (1m) | Rhophase | NPS-1803-1000-NPS | 3701 | 12 | 6-Mar-2015 |
| P-Series Power Meter | Agilent Technologies | N1911A | 3981 | 12 | 18-Sep-2014 |
| 50 MHz-18 GHz Wideband Power Sensor | Agilent Technologies | N1921A | 3983 | 12 | 18-Sep-2014 |
| 1 Metre K Type Cable | Rhophase | KPS-1501A-1000-KPS | 4106 | 12 | 5-Nov-2014 |
| Frequency Standard | Spectracom | Secure Sync 1200-0408-0601 | 4393 | 6 | 18-Jan-2015 |
| **Section 2.2 - Frequency Hopping Systems - Channel Dwell Time and Number of Hopping Channels** | | | | | |
| Signal Generator (10MHz to 40GHz) | Rohde & Schwarz | SMR40 | 1002 | 12 | 18-Sep-2014 |
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 18-Jan-2015 |
| Power Supply | Hewlett Packard | 6104A | 1948 | - | TU |
| Multimeter | Iso-tech | IDM101 | 2419 | 12 | 9-Oct-2014 |
| Hygrometer | Rotronic | I-1000 | 3220 | 12 | 24-Jul-2015 |
| Attenuator (10dB, 20W) | Lucas Weinschel | 1 | 3225 | 12 | 12-Dec-2014 |
| Signal Analyser | Rohde & Schwarz | FSQ 26 | 3545 | 12 | 6-Aug-2015 |
| 1 Metre K Type Cable | Rhophase | KPS-1501A-1000-KPS | 4105 | 12 | 5-Nov-2014 |
| 1 Metre K Type Cable | Rhophase | KPS-1501A-1000-KPS | 4106 | 12 | 5-Nov-2014 |
| Frequency Standard | Spectracom | Secure Sync 1200-0408-0601 | 4393 | 6 | 18-Jan-2015 |
| **Section 2.3 - Maximum Peak Conducted Output Power** | | | | | |
| Attenuator (20dB/ 2W) | Pasternack | PE7004-20 | 489 | 12 | 30-Oct-2014 |
| Power Splitter | Weinschel | 1506A | 607 | 12 | 21-Mar-2015 |
| Signal Generator (10MHz to 40GHz) | Rohde & Schwarz | SMR40 | 1002 | 12 | 18-Sep-2014 |
| Spectrum Analyser | Agilent Technologies | E4407B | 1154 | 12 | 21-Aug-2015 |
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 18-Jan-2015 |
| Power Supply | Hewlett Packard | 6104A | 1948 | - | TU |
| Hygrometer | Rotronic | I-1000 | 3220 | 12 | 24-Jul-2015 |
| Attenuator (10dB, 20W) | Lucas Weinschel | 1 | 3225 | 12 | 12-Dec-2014 |
| 'N' - 'N' RF Cable (1m) | Rhophase | NPS-1803-1000-NPS | 3701 | 12 | 6-Mar-2015 |
| P-Series Power Meter | Agilent Technologies | N1911A | 3981 | 12 | 18-Sep-2014 |
| 50 MHz-18 GHz Wideband Power Sensor | Agilent Technologies | N1921A | 3983 | 12 | 18-Sep-2014 |
| 1 Metre K Type Cable | Rhophase | KPS-1501A-1000-KPS | 4106 | 12 | 5-Nov-2014 |
| Frequency Standard | Spectracom | Secure Sync 1200-0408-0601 | 4393 | 6 | 18-Jan-2015 |

| Instrument | Manufacturer | Type No. | TE No. | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| **Section 2.4 - 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 |
| Pre-Amplifier | Phase One | PSO4-0087 | 1534 | 12 | 30-Sep-2014 |
| Screened Room (5) | Rainford | Rainford | 1545 | 24 | 10-Jan-2015 |
| Turntable Controller | Inn-Co GmbH | CO 1000 | 1606 | - | TU |
| Spectrum Analyser | Rohde & Schwarz | FSU26 | 2747 | 12 | 15-Nov-2014 |
| Antenna (Bilog) | Chase | CBL6143 | 2904 | 24 | 10-Jun-2015 |
| Amplifier (8 - 18GHz) | Phase One | PS06-0061 | 3176 | 12 | 11-Aug-2015 |
| EMI Test Receiver | Rohde & Schwarz | ESU40 | 3506 | 12 | 22-Oct-2014 |
| 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 |
| 1 Metre SMA Cable | Rhophase | 3PS-1801A-1000-3PS | 4099 | 12 | 5-Nov-2014 |
| 1 Metre SMA Cable | Rhophase | 3PS-1801A-1000-3PS | 4101 | 12 | 5-Nov-2014 |
| 1GHz to 8GHz Low Noise Amplifier | Wright Technologies | APS04-0085 | 4365 | 12 | 1-Oct-2014 |
| Suspended Subtrate Highpass Filter | Advance Power Components | 11SH10-3000/X18000-O/O | 4411 | 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<br>Radiated: 30 MHz to 1 GHz: ± 5.1 dB<br>Radiated: 1 GHz to 40 GHz: ± 6.3 dB |
| Frequency Hopping Systems - 20 dB Bandwidth and Channel Separation | ± 21.87 kHz |
| Maximum Peak Conducted Output Power | ± 0.70 dB |

## SECTION 4

## ACCREDITATION, DISCLAIMERS AND COPYRIGHT

## 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).