# TEST REPORT

## Test Report No. : UL-RPT-RP10950538JD09C V2.0

| | | |
|---|---|---|
| **Manufacturer** | : | Sigma Connectivity AB |
| **Model No.** | : | SSG-002 |
| **FCC ID** | : | 2AFCP-002 |
| **Technology** | : | *Bluetooth* – Low Energy |
| **Test Standard(s)** | : | FCC Parts 15.207, 15.209(a) & 15.247 |

1. This test report shall not be reproduced in full or partial, without the written approval of UL VS LTD.
2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

**Date of Issue:** 25 October 2016

**Checked by:**

Ian Watch
Senior Engineer, Radio Laboratory

**Company Signatory:**

Steven White
Service Lead, Radio Laboratory
UL VS LTD

0644

This laboratory is accredited by UKAS. The tests reported herein have been performed in accordance with its terms of accreditation.



**UL VS LTD**

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## Table of Contents

# 1. Customer Information

| | |
|---|---|
| **Company Name:** | Sigma Connectivity AB |
| **Address:** | Mobilevägen 10<br>223 62 Lund<br>Sweden |

# 2. Summary of Testing

## 2.1. General Information

| | |
|---|---|
| **Specification Reference:** | 47CFR15.247 |
| **Specification Title:** | Code of Federal Regulations Volume 47 (Telecommunications):<br>Part 15 Subpart C (Intentional Radiators) - Section 15.247 |
| **Specification Reference:** | 47CFR15.207 and 47CFR15.209 |
| **Specification Title:** | Code of Federal Regulations Volume 47 (Telecommunications):<br>Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209 |
| **Site Registration:** | 209735 |
| **Location of Testing:** | UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park,<br>Basingstoke, Hampshire, RG24 8AH, United Kingdom |
| **Test Dates:** | 16 February 2016 to 12 October 2016 |

## 2.2. Summary of Test Results

| FCC Reference (47CFR) | Measurement | Result |
|---|---|---|
| Part 15.207 | Transmitter AC Conducted Emissions | ✓ |
| Part 15.247(a)(2) | Transmitter Minimum 6 dB Bandwidth | ✓ |
| Part 15.247(e) | Transmitter Power Spectral Density | ✓ |
| Part 15.247(b)(3) | Transmitter Maximum Peak Output Power | ✓ |
| Part 15.247(d)/15.209(a) | Transmitter Radiated Emissions | ✓ |
| Part 15.247(d)/15.209(a) | Transmitter Band Edge Radiated Emissions | ✓ |

**Key to Results**

✓ = Complied ✗ = Did not comply

## 2.3. Methods and Procedures

| | |
|---|---|
| **Reference:** | ANSI C63.10-2013 |
| **Title:** | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| **Reference:** | KDB 558074 D01 DTS Meas Guidance v03r05, 08 April 2016 |
| **Title:** | Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 |

## 2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

# 3. Equipment Under Test (EUT)

## 3.1. Identification of Equipment Under Test (EUT)

| | |
|---|---|
| **Brand Name:** | Sensgate |
| **Model Name or Number:** | SSG-002 |
| **Test Sample Serial Number:** | 01001B8D *(Conducted sample with RF port)* |
| **Hardware Version:** | Revision 2.0 |
| **Software Version:** | Revision 219 |
| **FCC ID:** | 2AFCP -002 |

| | |
|---|---|
| **Brand Name:** | Sensgate |
| **Model Name or Number:** | SSG-002 |
| **Test Sample Serial Number:** | 02001-0354 *(Radiated sample #1)* |
| **Hardware Version:** | Revision 2.0 |
| **Software Version:** | Revision 219 |
| **FCC ID:** | 2AFCP-002 |

| | |
|---|---|
| **Brand Name:** | Sensgate |
| **Model Name or Number:** | SSG-002 |
| **Test Sample Serial Number:** | MC000170 *(Radiated sample #2)* |
| **Hardware Version:** | Revision 2.0 |
| **Software Version:** | Revision 219 |
| **FCC ID:** | 2AFCP-002 |

## 3.2. Description of EUT

The Equipment Under Test was a gateway in the SENS BY SIGMA system, collecting data from sensors and ensuring that all component parts are continuously under full control. The gateway communicates with the sensors via *Bluetooth* and is transmitting data to the Cloud via WiFi. SensGate is designed to be mounted in the ceiling or on the wall. It contains a battery for backup and is powered via the USB port.

## 3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

## 3.4. Additional Information Related to Testing

| | | | |
|---|---|---|---|
| **Technology Tested:** | *Bluetooth* Low Energy (Digital Transmission System) | | |
| **Type of Unit:** | Transceiver | | |
| **Channel Spacing:** | 2 MHz | | |
| **Modulation:** | GFSK | | |
| **Data Rate:** | 1 Mbps | | |
| **Power Supply Requirement(s):** | Nominal | 3.8 VDC via 120 VAC 60 Hz | |
| **Transmit Frequency Range:** | 2402 MHz to 2480 MHz | | |
| **Transmit Channels Tested:** | **Channel ID** | **RF Channel** | **Channel Frequency (MHz)** |
| | Bottom | 0 | 2402 |
| | Middle | 19 | 2440 |
| | Top | 39 | 2480 |

## 3.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

| | |
|---|---|
| **Description:** | Laptop PC |
| **Brand Name:** | Hewlett Packard |
| **Model Name or Number:** | Compaq 6910p |
| **Serial Number:** | HUB7451SGN |

| | |
|---|---|
| **Description:** | USB Cable |
| **Brand Name:** | Not marked or stated |
| **Model Name or Number:** | Not marked or stated |
| **Serial Number:** | Not marked or stated |

| | |
|---|---|
| **Description:** | Switching Power Supply |
| **Brand Name:** | Phihong |
| **Model Name or Number:** | PSA05E-050Q |
| **Serial Number:** | DE29003034A1 |

# 4. Operation and Monitoring of the EUT during Testing

## 4.1. Operating Modes

The EUT was tested in the following operating mode(s):

- Transmitting at maximum power in *Bluetooth* LE mode with a modulated carrier, maximum data length available and Pseudorandom Bit Sequence 9.

## 4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- Controlled using a terminal application on the laptop PC supplied by the customer. The application was used to enable continuous transmission and to select the test channels as required.
- The EUT was connected to a DC power supply for all conducted tests. A USB diagnostic cable was connected to the EUT to change channels as required.
- Transmitter radiated spurious emissions tests were performed with the AC/DC power supply and USB cable connected to the EUT. The power supply input was connected to a 120 VAC 60 Hz single phase supply.
- The EUT conducted sample was used for 6 dB bandwidth, power spectral density and maximum peak output power.
- The EUT radiated samples were used for AC conducted emissions and radiated spurious emissions tests.

# 5. Measurements, Examinations and Derived Results

## 5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section 6. Measurement Uncertainty* for details.

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

## 5.2. Test Results

### 5.2.1. Transmitter AC Conducted Spurious Emissions

**Test Summary:**

| | | | |
|---|---|---|---|
| **Test Engineer:** | Matthew Galbraith | **Test Date:** | 07 October 2016 |
| **Test Sample Serial Number:** | MC000170 | | |

| | |
|---|---|
| **FCC Reference:** | Part 15.207 |
| **Test Method Used:** | ANSI C63.10 Section 6.2 |

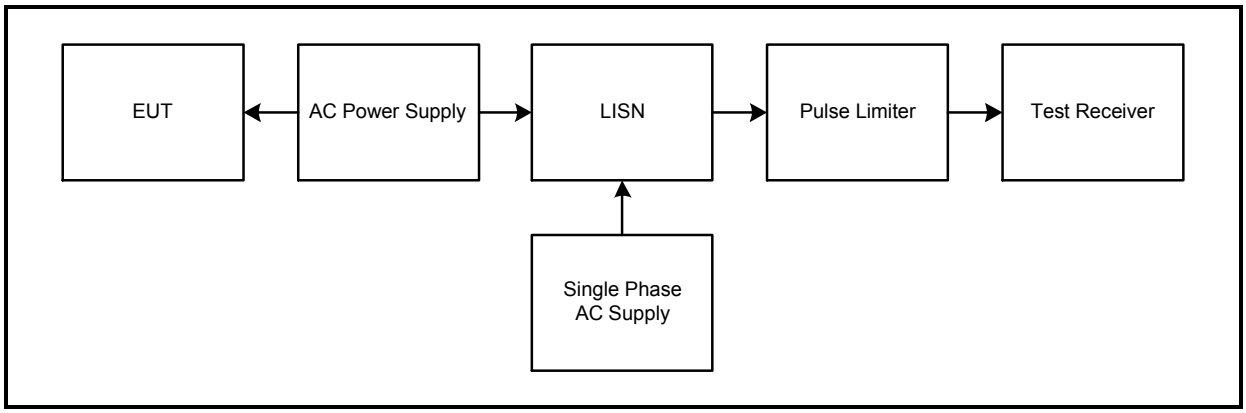
**Environmental Conditions:**

| | |
|---|---|
| **Temperature (°C):** | 22 |
| **Relative Humidity (%):** | 43 |

**Note(s):**

1. The EUT was connected to an AC/DC power supply via USB cable. The AC/DC power supply input was connected to a 120 VAC 60 Hz single phase supply via a LISN.
2. Pre-scans were initially performed on all supported technologies/modes and found to produce identical results. Final measurements were therefore only performed on one test case on frequencies that resulted in the highest live/neutral levels and the results entered into the tables below.
3. A pulse limiter was fitted between the LISN and the test receiver.

**Test setup:**



## Transmitter AC Conducted Spurious Emissions (continued)

### Results: Live / Quasi Peak

| Frequency (MHz) | Line | Level (dBµV) | Limit (dBµV) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 0.190500 | Live | 47.4 | 64.0 | 16.6 | Complied |
| 0.235500 | Live | 44.9 | 62.3 | 17.4 | Complied |
| 0.289500 | Live | 38.9 | 60.5 | 21.6 | Complied |
| 2.566500 | Live | 34.1 | 56.0 | 21.9 | Complied |
| 3.588000 | Live | 36.1 | 56.0 | 19.9 | Complied |
| 4.434000 | Live | 36.1 | 56.0 | 19.9 | Complied |

### Results: Live / Average

| Frequency (MHz) | Line | Level (dBµV) | Limit (dBµV) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 0.186000 | Live | 34.3 | 54.2 | 19.9 | Complied |
| 0.190500 | Live | 31.7 | 54.0 | 22.3 | Complied |
| 0.424500 | Live | 31.6 | 47.4 | 15.8 | Complied |
| 0.424500 | Live | 31.6 | 47.4 | 15.8 | Complied |
| 1.513500 | Live | 21.8 | 46.0 | 24.2 | Complied |
| 3.507000 | Live | 25.2 | 46.0 | 20.8 | Complied |

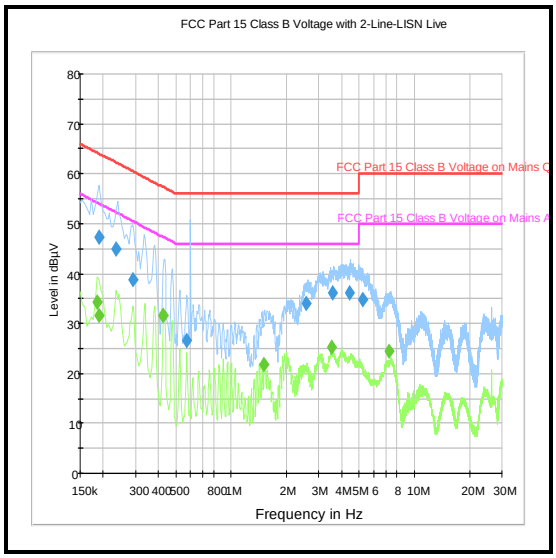
### Results: Neutral / Quasi Peak

| Frequency (MHz) | Line | Level (dBµV) | Limit (dBµV) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 0.190500 | Neutral | 43.7 | 64.0 | 20.3 | Complied |
| 0.235500 | Neutral | 42.6 | 62.3 | 19.7 | Complied |
| 0.379500 | Neutral | 40.6 | 58.3 | 17.7 | Complied |
| 0.469500 | Neutral | 37.3 | 56.5 | 19.2 | Complied |
| 1.374000 | Neutral | 36.6 | 56.0 | 19.4 | Complied |
| 2.368500 | Neutral | 36.7 | 56.0 | 19.3 | Complied |

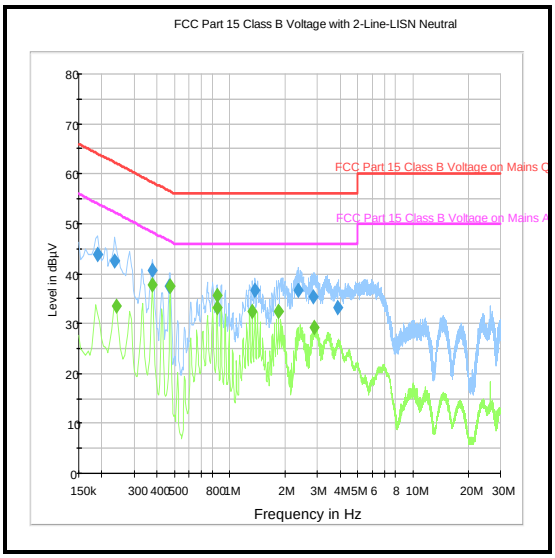
### Results: Neutral / Average

| Frequency (MHz) | Line | Level (dBµV) | Limit (dBµV) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 0.379500 | Neutral | 37.6 | 48.3 | 10.7 | Complied |
| 0.474000 | Neutral | 37.4 | 46.4 | 9.0 | Complied |
| 0.852000 | Neutral | 35.6 | 46.0 | 10.4 | Complied |
| 0.852000 | Neutral | 33.3 | 46.0 | 12.7 | Complied |
| 1.324500 | Neutral | 32.5 | 46.0 | 13.5 | Complied |
| 1.846500 | Neutral | 32.5 | 46.0 | 13.5 | Complied |

## Transmitter AC Conducted Spurious Emissions (continued)




**Live**




**Neutral**

*Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.*

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M2015 | Thermohygrometer | Testo | 608-H1 | 45046424 | 10 Jun 2017 | 12 |
| A649 | LISN | Rohde & Schwarz | ESH3-Z5 | 825562/008 | 09 Aug 2017 | 12 |
| A1830 | Pulse Limiter | Rohde & Schwarz | ESH3-Z2 | 100668 | 08 Mar 2017 | 12 |
| M1379 | Test Receiver | Rohde & Schwarz | ESIB7 | 100330 | 15 Dec 2016 | 12 |

## 5.2.2. Transmitter Minimum 6 dB Bandwidth

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Stefan Ho | **Test Date:** | 12 October 2016 |
| **Test Sample Serial Number:** | 01001B8D | | |

| | |
|---|---|
| **FCC Reference:** | Part 15.247(a)(2) |
| **Test Method Used:** | FCC KDB 558074 Section 8.1 Option 1 |

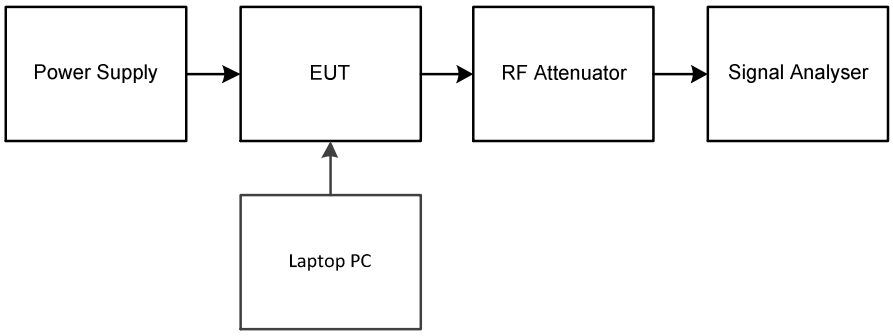
### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 25 |
| **Relative Humidity (%):** | 38 |

### Note(s):

1. 6 dB DTS bandwidth tests were performed using a signal analyser in accordance with FCC KDB 558074 Section 8.1 Option 1 measurement procedure. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The DTS bandwidth was measured at 6 dB down from the peak of the signal.
2. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

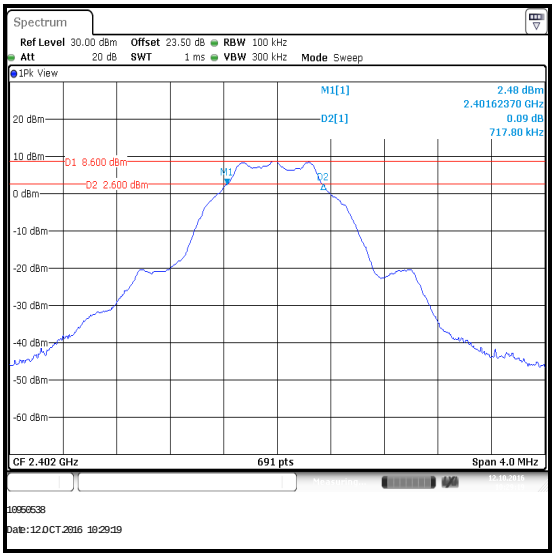
### Test setup:



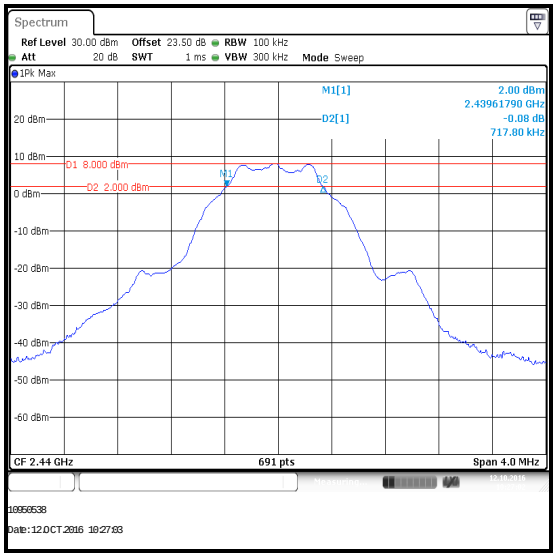
## Transmitter Minimum 6 dB Bandwidth (continued)

## Results:

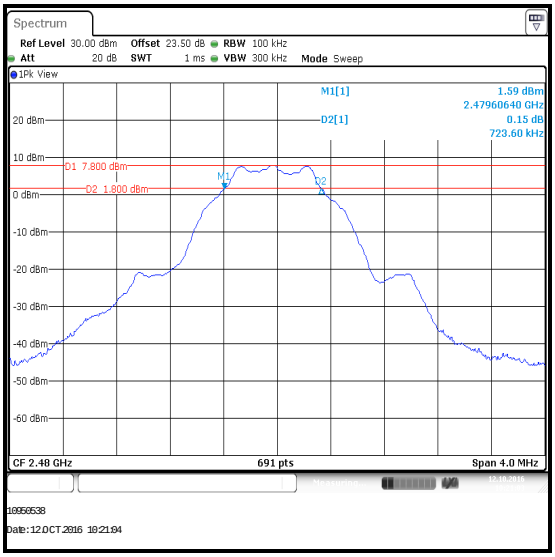
| Channel | 6 dB Bandwidth (kHz) | Limit (kHz) | Margin (kHz) | Result |
|---|---|---|---|---|
| Bottom | 717.800 | ≥500 | 217.800 | Complied |
| Middle | 717.800 | ≥500 | 217.800 | Complied |
| Top | 723.600 | ≥500 | 223.600 | Complied |




**Bottom Channel**




**Middle Channel**




**Top Channel**

## Transmitter Minimum 6 dB Bandwidth (continued)

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M1873 | Signal Analyser | Rohde & Schwarz | FSV30 | 103074 | 27 Jun 2017 | 12 |
| A2500 | Directional Coupler | AtlanTecRF | CDC-003060-10 | 13122501835 | Calibrated before use | - |
| A2526 | Attenuator | AtlanTecRF | AN18W5-20 | 832828#1 | Calibrated before use | - |
| S0562 | DC power supply | Thurlby Thandar Instruments | PL330QMD | 054895 | Calibrated before use | - |
| M1269 | Multimeter | Fluke | 179 | 90250210 | 13 May 2017 | 12 |
| M2002 | Thermohygrometer | Testo | 608-H1 | 45041825 | 02 Apr 2017 | 12 |

## 5.2.3. Transmitter Power Spectral Density

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Stefan Ho | **Test Date:** | 12 October 2016 |
| **Test Sample Serial Number:** | 01001B8D | | |

| | |
|---|---|
| **FCC Reference:** | Part 15.247(e) |
| **Test Method Used:** | FCC KDB 558074 Section 10.2 |

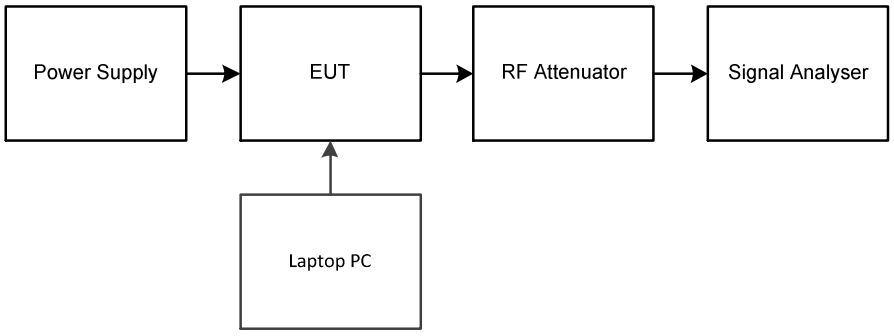
### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 25 |
| **Relative Humidity (%):** | 38 |

### Note(s):

1. Transmitter Power Spectral Density tests were performed using a signal analyser in accordance with FCC KDB 558074 Section 10.2.
2. The signal analyser resolution bandwidth was set to 30 kHz and video bandwidth of 100 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 1.5 times the measured DTS bandwidth. A marker was placed at the peak of the signal and the results recorded in the table below.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

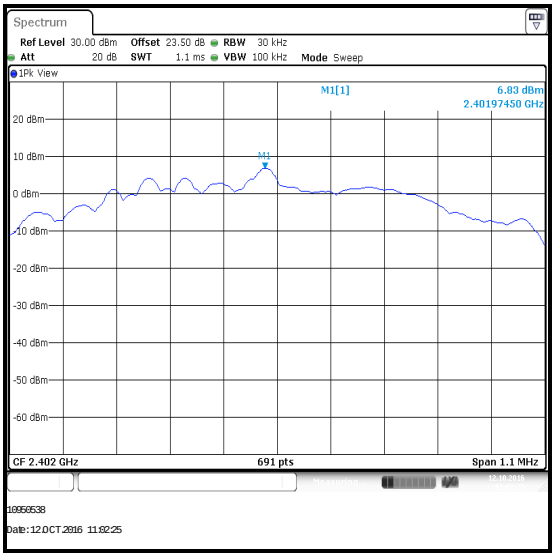
### Test setup:



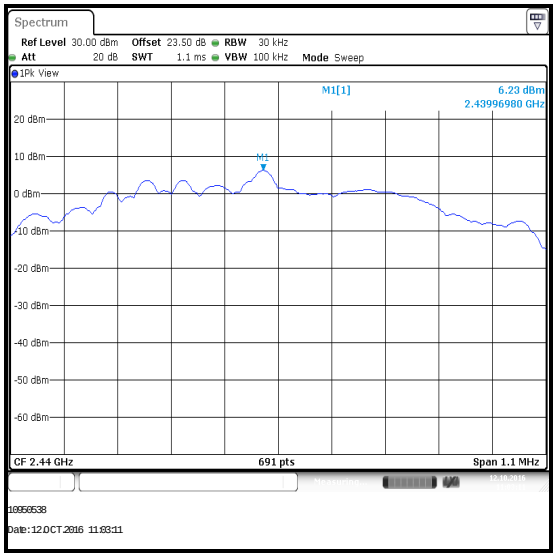
## Transmitter Power Spectral Density (continued)

## Results:

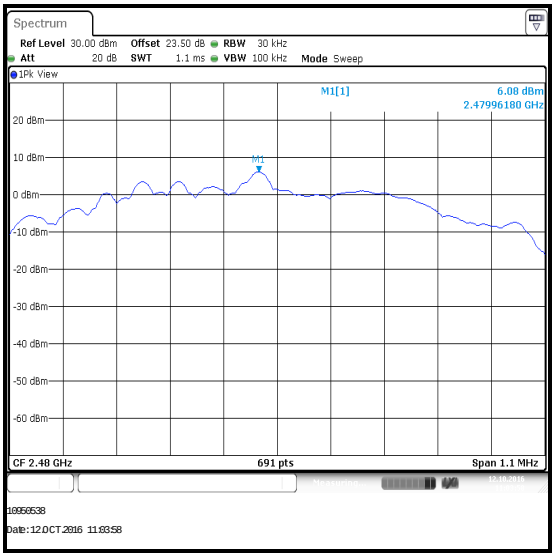
| Channel | Output Power (dBm / 3 kHz) | Limit (dBm / 3 kHz) | Margin (dB) | Result |
|---|---|---|---|---|
| Bottom | 6.8 | 8.0 | 1.2 | Complied |
| Middle | 6.2 | 8.0 | 1.8 | Complied |
| Top | 6.1 | 8.0 | 1.9 | Complied |




**Bottom Channel**




**Middle Channel**




**Top Channel**

## Transmitter Power Spectral Density (continued)

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M1873 | Signal Analyser | Rohde & Schwarz | FSV30 | 103074 | 27 Jun 2017 | 12 |
| A2500 | Directional Coupler | AtlanTecRF | CDC-003060-10 | 13122501835 | Calibrated before use | - |
| A2526 | Attenuator | AtlanTecRF | AN18W5-20 | 832828#1 | Calibrated before use | - |
| G0607 | Signal Generator | Rohde & Schwarz | SMU200A | 100943 | 10 May 2019 | 36 |
| M199 | Power Meter | Rohde & Schwarz | NRVS | 827023/075 | 11 Apr 2018 | 24 |
| M1267 | Thermal Power Sensor | Rohde & Schwarz | NRV-Z52 | 100155 | 15 Apr 2018 | 24 |
| S0562 | DC power supply | Thurlby Thandar Instruments | PL330QMD | 054895 | Calibrated before use | - |
| M1269 | Multimeter | Fluke | 179 | 90250210 | 13 May 2017 | 12 |
| M2002 | Thermohygrometer | Testo | 608-H1 | 45041825 | 02 Apr 2017 | 12 |

## 5.2.4. Transmitter Maximum Peak Output Power

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Stefan Ho | **Test Date:** | 12 October 2016 |
| **Test Sample Serial Number:** | 01001B8D | | |

| | |
|---|---|
| **FCC Reference:** | Part 15.247(b)(3) |
| **Test Method Used:** | FCC KDB 558074 Section 9.1.1 |

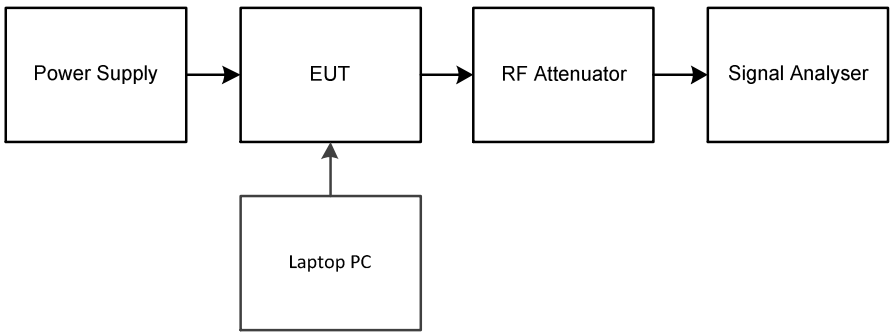
### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 25 |
| **Relative Humidity (%):** | 38 |

### Note(s):

1. Conducted power tests were performed using a signal analyser in accordance with FCC KDB 558074 Section 9.1.1 with the RBW > DTS bandwidth procedure. A resolution bandwidth of 1 MHz was used and the video bandwidth was set to 3 MHz.
2. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.
3. The conducted power was added to the declared antenna gain to obtain the EIRP.

### Test setup:



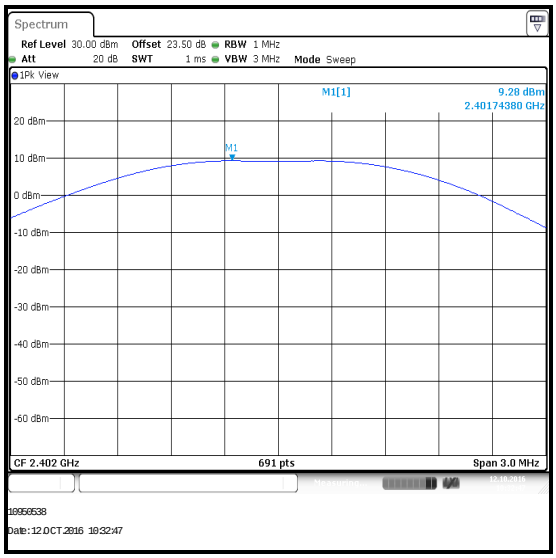
## Transmitter Maximum Peak Output Power (continued)

## Results:

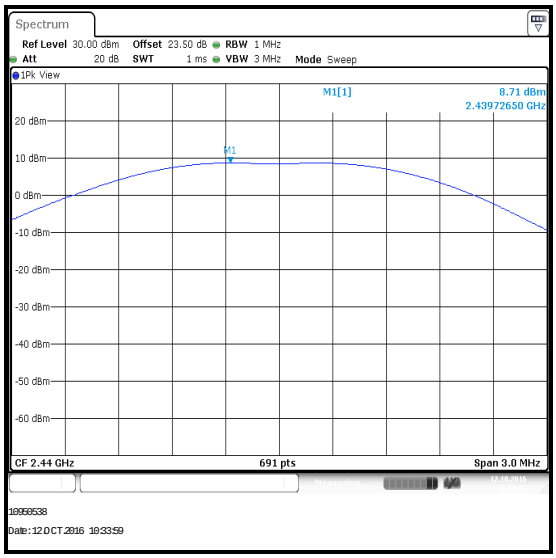
| Channel | Conducted Peak Power (dBm) | Conducted Peak Power Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|
| Bottom | 9.3 | 30.0 | 20.7 | Complied |
| Middle | 8.7 | 30.0 | 21.3 | Complied |
| Top | 8.6 | 30.0 | 21.4 | Complied |

| Channel | Conducted Peak Power (dBm) | Declared Antenna Gain (dBi) | EIRP (dBm) | De Facto EIRP Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|---|---|
| Bottom | 9.3 | 2.0 | 11.3 | 36.0 | 24.7 | Complied |
| Middle | 8.7 | 2.0 | 10.7 | 36.0 | 25.3 | Complied |
| Top | 8.6 | 2.0 | 10.6 | 36.0 | 25.4 | Complied |

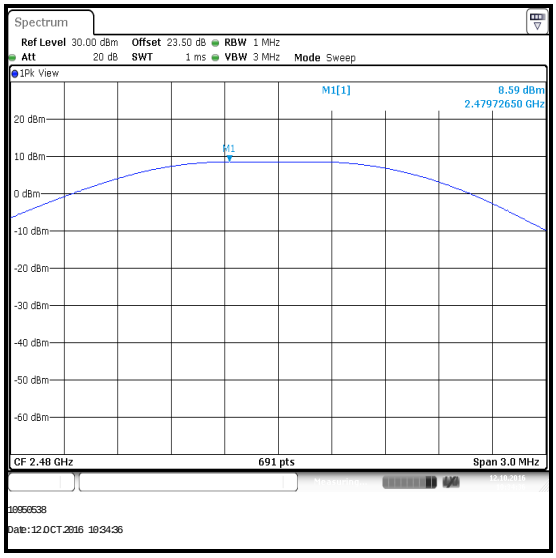
## Transmitter Maximum Peak Output Power (continued)




**Bottom Channel**




**Middle Channel**




**Top Channel**

## Transmitter Maximum Peak Output Power (continued)

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M1873 | Signal Analyser | Rohde & Schwarz | FSV30 | 103074 | 27 Jun 2017 | 12 |
| A2500 | Directional Coupler | AtlanTecRF | CDC-003060-10 | 13122501835 | Calibrated before use | - |
| A2526 | Attenuator | AtlanTecRF | AN18W5-20 | 832828#1 | Calibrated before use | - |
| G0607 | Signal Generator | Rohde & Schwarz | SMU200A | 100943 | 10 May 2019 | 36 |
| M199 | Power Meter | Rohde & Schwarz | NRVS | 827023/075 | 11 Apr 2018 | 24 |
| M1267 | Thermal Power Sensor | Rohde & Schwarz | NRV-Z52 | 100155 | 15 Apr 2018 | 24 |
| S0562 | DC power supply | Thurlby Thandar Instruments | PL330QMD | 054895 | Calibrated before use | - |
| M1269 | Multimeter | Fluke | 179 | 90250210 | 13 May 2017 | 12 |
| M2002 | Thermohygrometer | Testo | 608-H1 | 45041825 | 02 Apr 2017 | 12 |

## 5.2.5. Transmitter Radiated Emissions

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Nick Steele | **Test Date:** | 09 March 2016 |
| **Test Sample Serial Number:** | 02001-0354 | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.247(d) & 15.209(a) |
| **Test Method Used:** | ANSI C63.10 Sections 6.3 and 6.5 |
| **Frequency Range** | 30 MHz to 1000 MHz |

### Environmental Conditions:

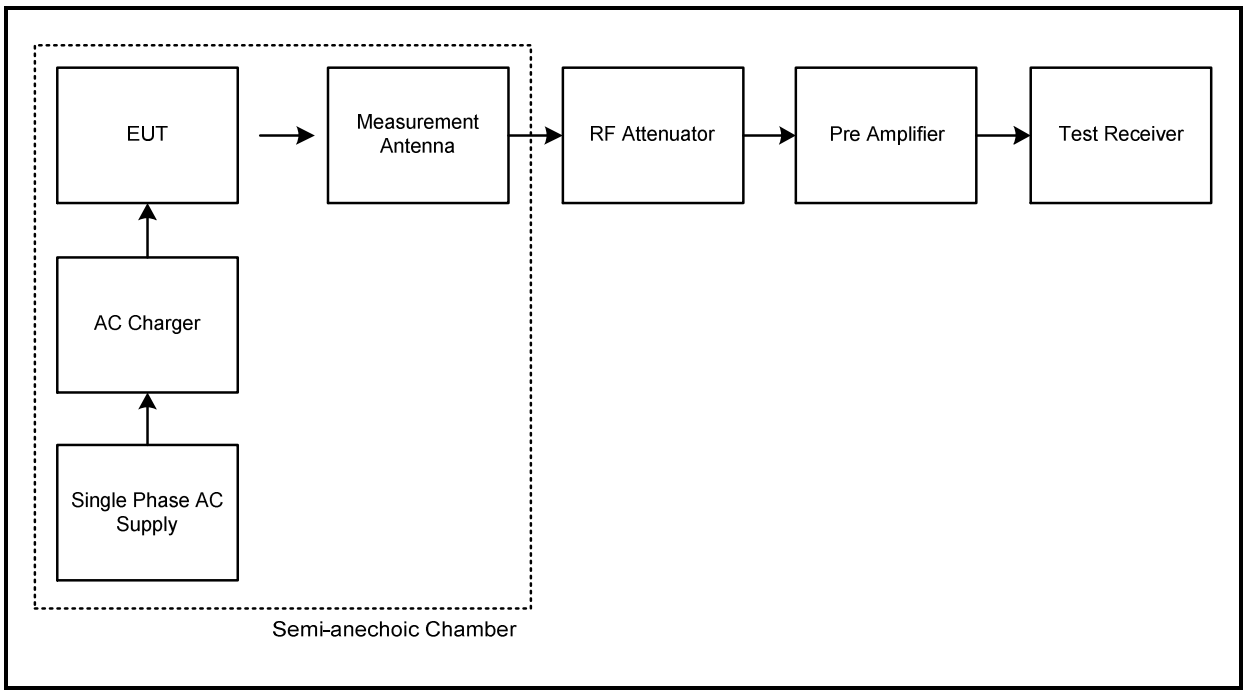
| | |
|---|---|
| **Temperature (°C):** | 24 |
| **Relative Humidity (%):** | 31 |

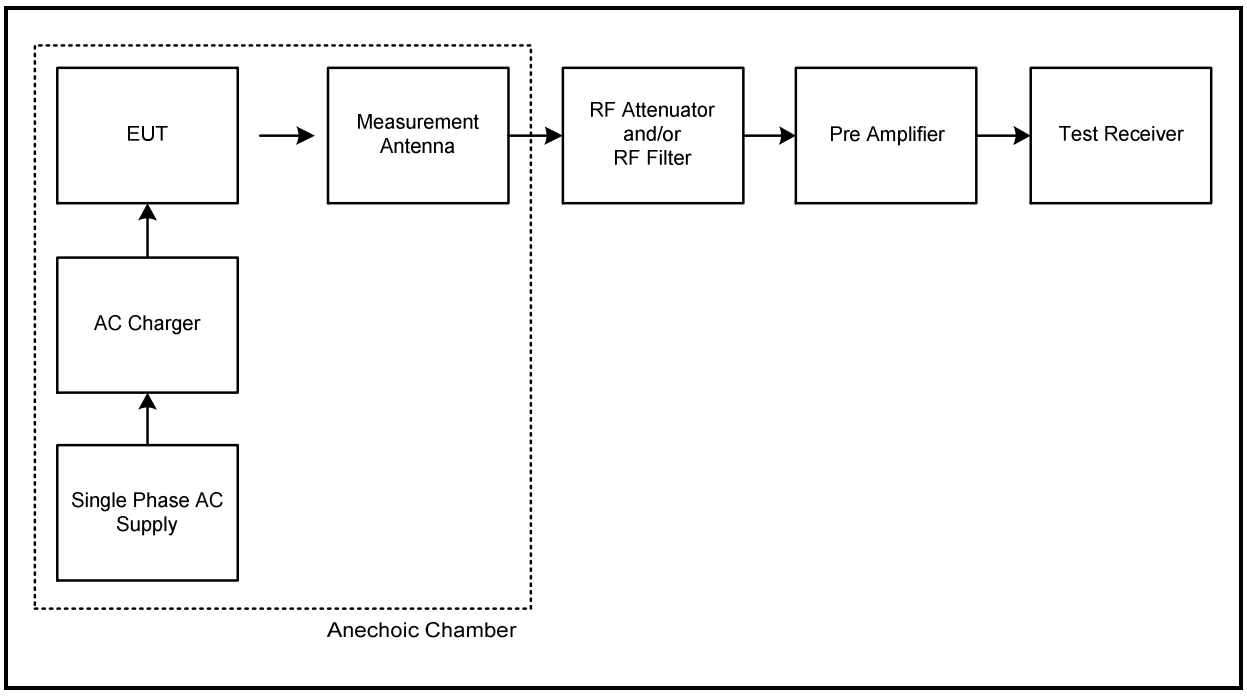
### Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the middle channel only.
3. All other emissions shown on the pre-scans were investigated and found to be ambient, or > 20 dB below the appropriate limit or below the noise floor of the measurement system.
4. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

## Transmitter Radiated Emissions (continued)

## Test setup for radiated measurements:

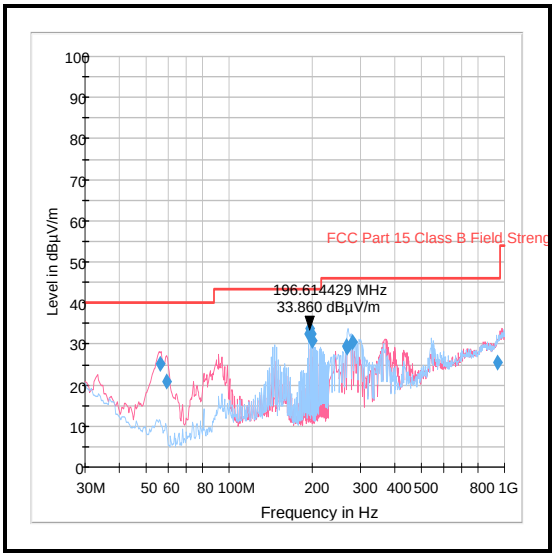


## Transmitter Radiated Emissions (continued)

## Results: Middle Channel

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 266.541 | Horizontal | 29.5 | 46.0 | 16.5 | Complied |
| 268.746 | Horizontal | 29.3 | 46.0 | 16.7 | Complied |
| 279.599 | Horizontal | 30.3 | 46.0 | 15.7 | Complied |




*Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.*

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M1627 | Thermohygrometer | JM Handelspunkt | 30.5015.10 | Not stated | 11 Jan 2017 | 12 |
| K0001 | 5 m RSE Chamber | Rainford EMC | N/A | N/A | 19 Mar 2016 | 12 |
| M1273 | Test Receiver | Rohde & Schwarz | ESIB26 | 100275 | 19 Mar 2016 | 12 |
| A259 | Antenna | Chase | CBL6111A | 1513 | 09 Apr 2016 | 12 |
| G0543 | Amplifier | Sonoma | 310N | 230801 | 28 Feb 2017 | 12 |
| A1834 | Attenuator | Hewlett Packard | 8491B | 10444 | 28 Feb 2017 | 12 |

## Transmitter Radiated Emissions (continued)

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | David Doyle | **Test Date:** | 16 February 2016 |
| **Test Sample Serial Number:** | 02001-0354 | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.247(d) & 15.209(a) |
| **Test Method Used:** | FCC KDB 558074 Sections 11 & 12 referencing ANSI C63.10 Sections 6.3 & 6.6 |
| **Frequency Range** | 1 GHz to 25 GHz |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 23 |
| **Relative Humidity (%):** | 31 |

### Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. All other emissions shown on the pre-scan plot were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement system noise floor.
3. The emission shown on the 1 GHz to 4 GHz plot is the EUT fundamental.
4. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
5. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. The sweep time was set to auto.
6. In accordance with ANSI C63.10 Section 6.6.4.3, Note 1, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.

## Transmitter Radiated Emissions (continued)

### Results: Peak / Bottom Channel

| Frequency (MHz) | Antenna Polarity | Peak Level (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 4804.598 | Vertical | 47.2 | 54.0 | 6.8 | Complied |

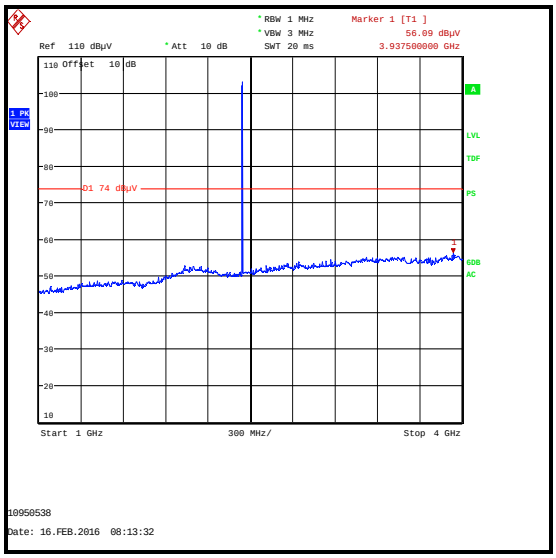
### Results: Peak / Middle Channel

| Frequency (MHz) | Antenna Polarity | Peak Level (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 4879.551 | Vertical | 47.7 | 54.0 | 6.3 | Complied |

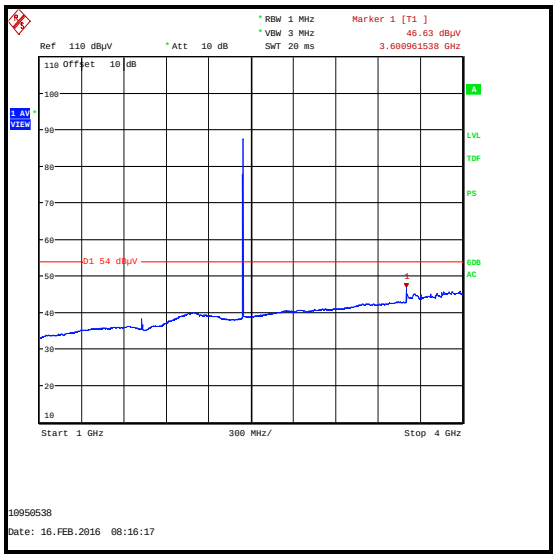
### Results: Peak / Top Channel

| Frequency (MHz) | Antenna Polarity | Peak Level (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 4959.484 | Vertical | 47.8 | 54.0 | 6.2 | Complied |

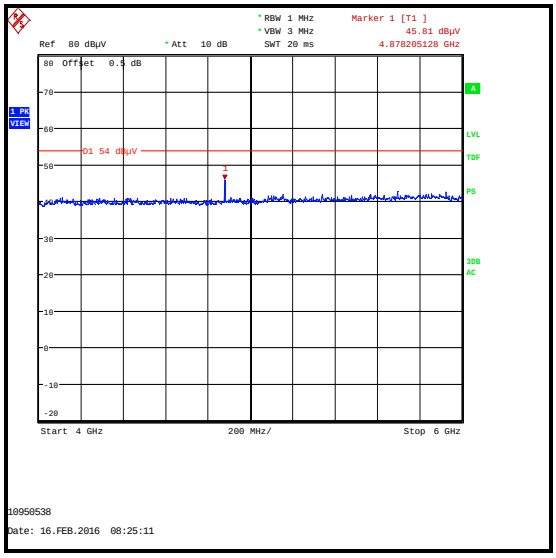
## Transmitter Radiated Emissions (continued)

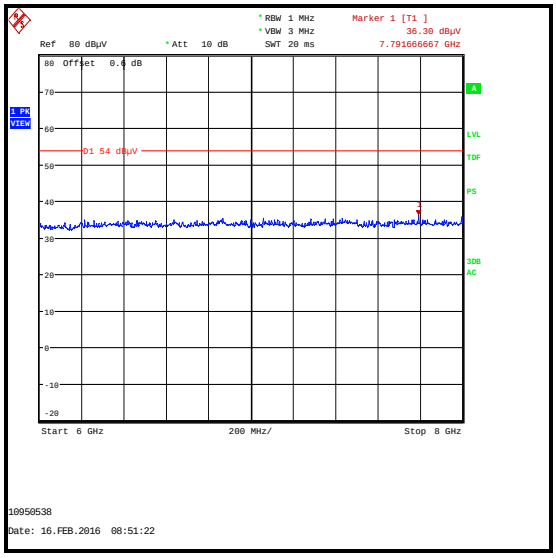



**Peak Detector**

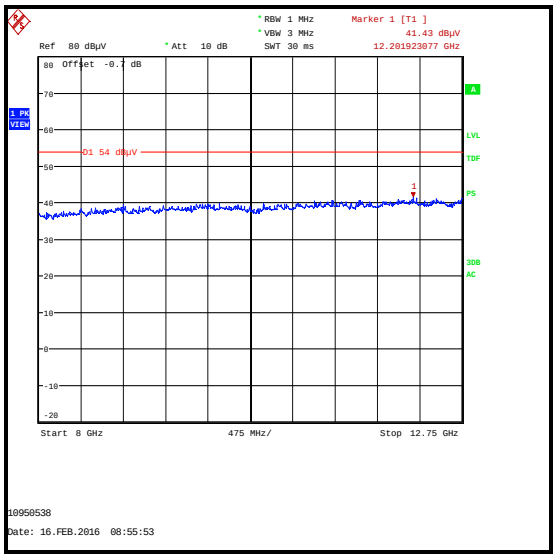


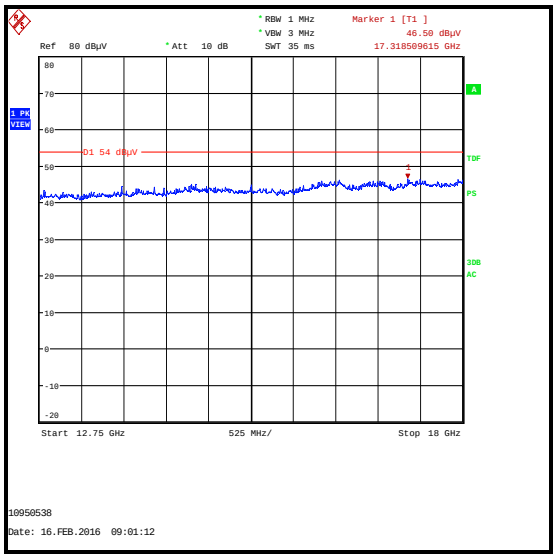

**Average Detector**

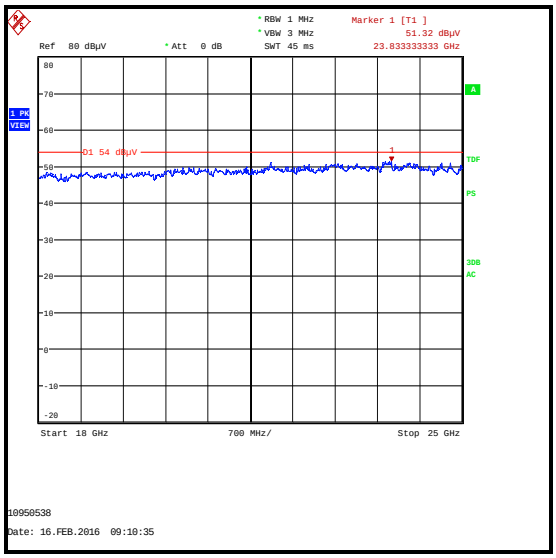


## Transmitter Radiated Emissions (continued)




*Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.*

## Transmitter Radiated Emissions (continued)

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M1656 | Thermohygrometer | JM Handelspunkt | 30.5015.13 | None stated | 23 Apr 2016 | 12 |
| K0002 | 3m RSE Chamber | Rainford EMC | N/A | N/A | 21 Dec 2016 | 12 |
| M1886 | Test Receiver | Rohde & Schwarz | ESU26 | 100554 | 21 May 2016 | 12 |
| A1534 | Pre Amplifier | Hewlett Packard | 8449B | 3008A00405 | 19 Dec 2016 | 12 |
| A1818 | Antenna | EMCO | 3115 | 00075692 | 17 Dec 2016 | 12 |
| A253 | Antenna | Flann Microwave | 12240-20 | 128 | 17 Dec 2016 | 12 |
| A254 | Antenna | Flann Microwave | 14240-20 | 139 | 17 Dec 2016 | 12 |
| A255 | Antenna | Flann Microwave | 16240-20 | 519 | 17 Dec 2016 | 12 |
| A256 | Antenna | Flann Microwave | 18240-20 | 400 | 17 Dec 2016 | 12 |
| A436 | Antenna | Flann Microwave | 20240-20 | 330 | 19 Dec 2016 | 12 |
| A1396 | Attenuator | Huber & Suhner | 6810.17.B | 757987 | 05 May 2016 | 12 |
| A1975 | High Pass Filter | AtlanTecRF | AFH-03000 | 090424010 | 17 Apr 2016 | 12 |

## 5.2.6. Transmitter Band Edge Radiated Emissions

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | David Doyle | **Test Date:** | 16 February 2016 |
| **Test Sample Serial Number:** | 02001-0354 | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.247(d) & 15.209(a) |
| **Test Method Used:** | ANSI C63.10 Section 6.10.4, 6.10.5 & KDB 558074 Section 11 |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 23 |
| **Relative Humidity (%):** | 31 |

### Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The maximum peak conducted output power was previously measured. In accordance with FCC KDB 558074 Section 11.1(a), the lower band edge measurement was performed with a peak detector and the -20 dBc limit applied.
3. There is a restricted band 10 MHz below the lower band edge. The test receiver was set up as follows: the RBW set to 1 MHz, the VBW set to 3 MHz, with the sweep time set to auto couple. Peak and average measurements were performed with their respective detectors. Markers were placed on the highest point on each trace.
4. * -20 dBc limit.

## Transmitter Band Edge Radiated Emissions (continued)

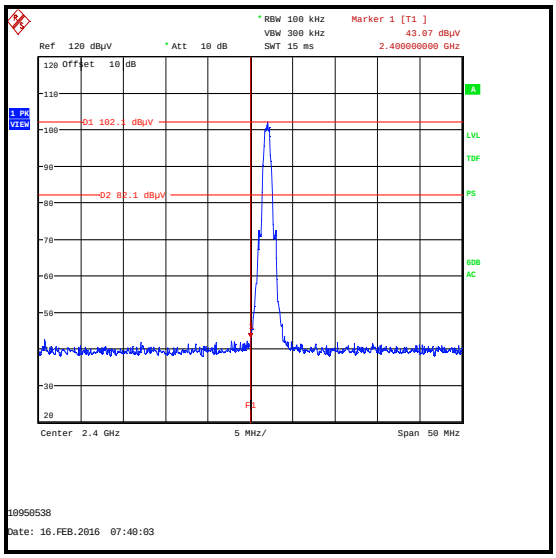
### Results: Peak

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|
| 2317.051 | 51.2 | 74.0 | 22.8 | Complied |
| 2400.000 | 43.1 | 82.1* | 39.0 | Complied |
| 2483.500 | 51.8 | 74.0 | 22.2 | Complied |
| 2496.962 | 54.0 | 74.0 | 20.0 | Complied |

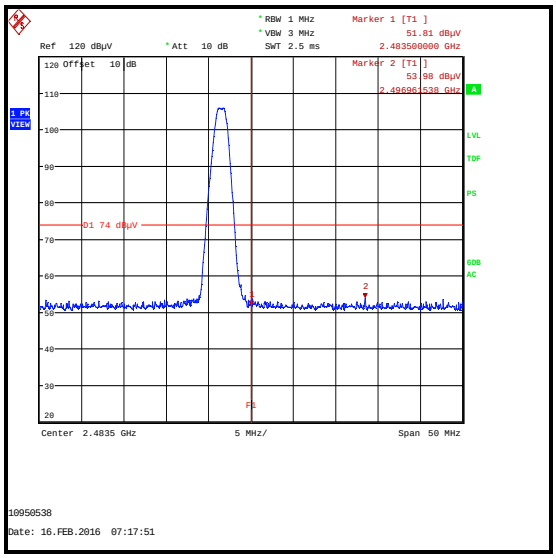
### Results: Average

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|
| 2332.179 | 42.5 | 54.0 | 11.5 | Complied |
| 2483.500 | 45.2 | 54.0 | 8.8 | Complied |
| 2484.702 | 45.9 | 54.0 | 8.1 | Complied |

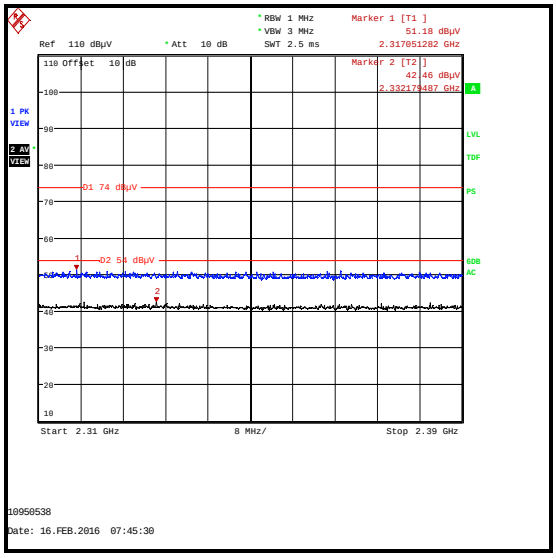
## Transmitter Band Edge Radiated Emissions (continued)



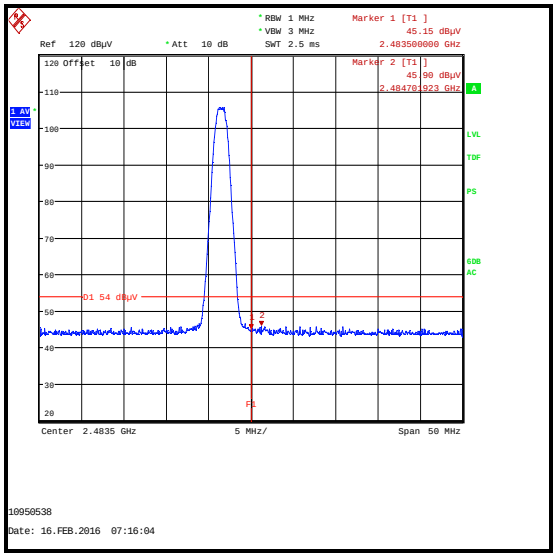

**Lower Band Edge Peak Measurement**




**Upper Band Edge Peak Measurement**




**2310 MHz to 2390 MHz Restricted Band**




**Upper Band Edge Average Measurement**

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M1656 | Thermohygrometer | JM Handelspunkt | 30.5015.13 | None stated | 23 Apr 2016 | 12 |
| K0002 | 3m RSE Chamber | Rainford EMC | N/A | N/A | 12 Jan 2017 | 12 |
| M1886 | Test Receiver | Rohde & Schwarz | ESU26 | 100554 | 21 May 2016 | 12 |
| A1534 | Pre Amplifier | Hewlett Packard | 8449B | 3008A00405 | 19 Dec 2016 | 12 |
| A1818 | Antenna | EMCO | 3115 | 00075692 | 17 Dec 2016 | 12 |
| A1396 | Attenuator | Huber & Suhner | 6810.17.B | 757987 | 05 May 2016 | 12 |

# 6. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value measured (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

| Measurement Type | Range | Confidence Level (%) | Calculated Uncertainty |
|---|---|---|---|
| AC Conducted Spurious Emissions | 0.15 MHz to 30 MHz | 95% | ±4.69 dB |
| Conducted Maximum Peak Output Power | 2.4 GHz to 2.4835 GHz | 95% | ±1.13 dB |
| Spectral Power Density | 2.4 GHz to 2.4835 GHz | 95% | ±1.13 dB |
| Minimum 6 dB Bandwidth | 2.4 GHz to 2.4835 GHz | 95% | ± 4.59% |
| Radiated Spurious Emissions | 30 MHz to 1 GHz | 95% | ±5.65 dB |
| Radiated Spurious Emissions | 1 GHz to 25 GHz | 95% | ±2.94 dB |

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

# 7. Report Revision History

| Version Number | Revision Details | | |
|---|---|---|---|
| | Page No(s) | Clause | Details |
| 1.0 | - | - | Initial Version |
| 2.0 | 33 | - | Corrected calibration due date for Asset No. A1534 |

**--- END OF REPORT ---**