TEST REPORT

Test Report No. : UL-RPT-RP10232014JD01A

Manufacturer	:	Wattio Corp SL
Model No.	:	SERIE V1
FCC ID	:	2ABTD-SERIE1
IC Certification No.	:	<*TBC*>
Test Standard(s)	:	FCC Parts 15.107(a), 15.109, 15.207, 15.209(a) & 15.247, Industry Canada RSS-210 A8.2(a), A8.2(b), A8.4(4) & A8.5 and RSS-Gen 4.6.1, 4.6.2, 4.8, 4.9 & 7.2.4

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. This 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 1.0

Date of Issue: 01 April 2014

Checked by:

Sarah Williams
Engineer, Radio Performance

Issued by :

pp

John Newell
Group Quality Manager,
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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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1. Customer Information

Company Name:	Wattio Corp SL
Address:	P Mikeletegi 54 local 15 Donostia, San Sebastián Gipuzkoa 20.009 Spain

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.247
Specification Reference:	47CFR15.107 and 47CFR15.109
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart B (Unintentional Radiators) - Sections 15.107 and 15.109
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
Specification Reference:	RSS-GEN Issue 3 December 2010
Specification Title:	General Requirements and Information for the Certification of Radio Apparatus
Specification Reference:	RSS-210 Issue 8 December 2010
Specification Title:	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
Site Registration:	FCC: 209735; Industry Canada: 3245B-2
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	05 March 2014 to 27 March 2014

2.2. Summary of Test Results

FCC Reference (47CFR)	IC Reference	Measurement	Result
Part 15.107(a)	N/A	Receiver/Idle Mode AC Conducted Emissions	✓
Part 15.109	N/A	Receiver/Idle Mode Radiated Spurious Emissions	✓
Part 15.207	RSS-Gen 7.2.4	Transmitter AC Conducted Emissions	✓
Part 15.247(a)(2)	RSS-Gen 4.6.2 RSS-210 A8.2(a)	Transmitter Minimum 6 dB Bandwidth	✓
N/A	RSS-Gen 4.6.1	Transmitter 99% Occupied Bandwidth	✓
Part 15.247(e)	RSS-210 A8.2(b)	Transmitter Power Spectral Density	✓
Part 15.247(b)(3)	RSS-Gen 4.8 RSS-210 A8.4(4)	Transmitter Maximum Peak Output Power	✓
Part 15.247(d)/ 15.209(a)	RSS-Gen 4.9 RSS-210 A8.5	Transmitter Radiated Emissions	✓
Part 15.247(d)/ 15.209(a)	RSS-Gen 4.9 RSS-210 A8.5	Transmitter Band Edge Radiated Emissions	✓

Key to Results

✓ = Complied ✗ = Did not comply

2.3. Methods and Procedures

Reference:	ANSI C63.4 (2009)
Title:	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Reference:	ANSI C63.10 (2009)
Title:	American National Standard for Testing Unlicensed Wireless Devices
Reference:	KDB 558074 D01 v03 April 9, 2013
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:	Wattiocorp SL
Model Name or Number:	SERIE V1
Test Sample Serial Number:	Not marked or stated
Hardware Version Number:	1v3
Software Version Number:	2
FCC ID:	2ABTD-SERIE1
Industry Canada Certification Number:	<*TBC*>

3.2. Description of EUT

The equipment under test was a 3.3V Zigbee-serie gateway module with power amplifier.

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:	IEEE 802.15.4 (Digital Transmission System)		
Type of Unit:	Transceiver		
Modulation:	O-QPSK		
Data Rate:	250 kbps		
Power Supply Requirement(s):	Nominal	3.3 V	
Maximum Conducted Output Power:	8.6 dBm		
Antenna Gain:	3.3 dBi		
Transmit Frequency Range:	2405 MHz to 2480 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	11	2405
	Middle	18	2440
	Top	26	2480
Receive Frequency Range:	2405 MHz to 2480 MHz		
Receive Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	11	2405
	Middle	18	2440
	Top	26	2480

3.5. Support Equipment

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

Description:	Laptop
Brand Name:	Dell
Model Name or Number:	D610
Serial Number:	PC480NT

Description:	CC Debugger
Brand Name:	Texas Instruments
Model Name or Number:	Z20100002C
Serial Number:	13776

Description:	DC Desktop power supply
Brand Name:	TTI
Model Name or Number:	EL303R
Serial Number:	395819 S0557

Description:	2 metre USB cables
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

- Receive/Idle Mode.
- Continuously transmitting at maximum power on the bottom, middle and top channels as required.

4.2. Configuration and Peripherals

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

- Controlled using the software application SmartRF Studio 7 on the laptop PC. The application was used to enable continuous transmission and receive mode (enabled but not transmitting) and to select the test channels as required.
- The maximum transmit power was set at 9 dBm for all Transmitter tests.
- In order to place the EUT into test mode it required a Texas Instruments debugger, this was connected between the EUT and test laptop by a Programming Interface cable and a USB cable.
- The EUT was powered via the USB port of the test computer.

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. Receiver/Idle Mode AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Mark Percival	**Test Date:**	25 March 2014
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Part 15.107(a)
Test Method Used:	As detailed in ANSI C63.10 Section 6.2 referencing ANSI C63.4

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	41

Results: Live / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
13.258	Live	48.3	60.0	11.7	Complied
14.199	Live	53.5	60.0	6.5	Complied
15.382	Live	56.3	60.0	3.7	Complied
15.859	Live	56.3	60.0	3.7	Complied
16.449	Live	53.7	60.0	6.3	Complied
20.116	Live	50.8	60.0	9.2	Complied
21.300	Live	51.1	60.0	8.9	Complied
22.249	Live	49.6	60.0	10.4	Complied

Results: Live / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
13.731	Live	36.0	50.0	14.0	Complied
14.203	Live	37.2	50.0	12.8	Complied
14.676	Live	37.9	50.0	12.1	Complied
14.923	Live	33.5	50.0	16.5	Complied
15.387	Live	39.7	50.0	10.3	Complied
16.345	Live	37.4	50.0	12.6	Complied
20.593	Live	35.5	50.0	14.5	Complied
21.304	Live	34.1	50.0	15.9	Complied

Receiver/Idle Mode AC Conducted Spurious Emissions (continued)

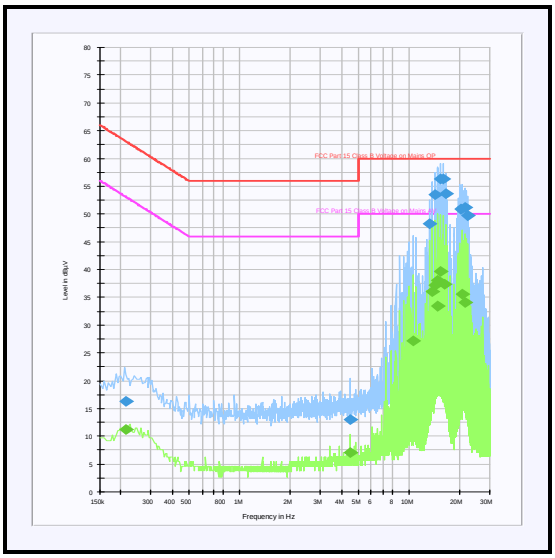
Results: Neutral / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
14.676	Neutral	51.4	60.0	8.6	Complied
14.910	Neutral	51.6	60.0	8.4	Complied
15.148	Neutral	49.5	60.0	10.5	Complied
15.265	Neutral	54.3	60.0	5.7	Complied
15.382	Neutral	54.3	60.0	5.7	Complied
15.859	Neutral	55.5	60.0	4.5	Complied
16.332	Neutral	54.2	60.0	5.8	Complied
16.449	Neutral	54.3	60.0	5.7	Complied

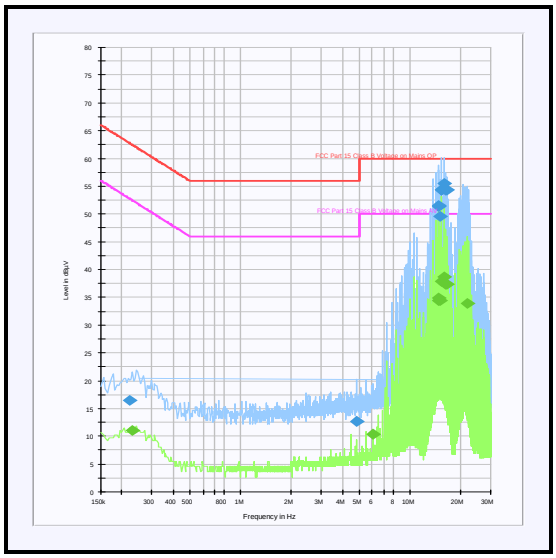
Results: Neutral / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
14.680	Neutral	34.3	50.0	15.7	Complied
14.910	Neutral	35.0	50.0	15.0	Complied
15.148	Neutral	34.3	50.0	15.7	Complied
15.387	Neutral	37.8	50.0	12.2	Complied
15.859	Neutral	38.7	50.0	11.3	Complied
16.332	Neutral	37.3	50.0	12.7	Complied
16.449	Neutral	37.4	50.0	12.6	Complied
21.777	Neutral	33.9	50.0	16.1	Complied

Receiver/Idle Mode 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)
M1625	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	14 May 2014	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	27 Feb 2015	12
M1263	Test receiver	Rohde & Schwarz	ESIB7	100265	14 Oct 2014	12

5.2.2. Receiver/Idle Mode Radiated Spurious Emissions

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	26 March 2014
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Part 15.109
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
Frequency Range:	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	37

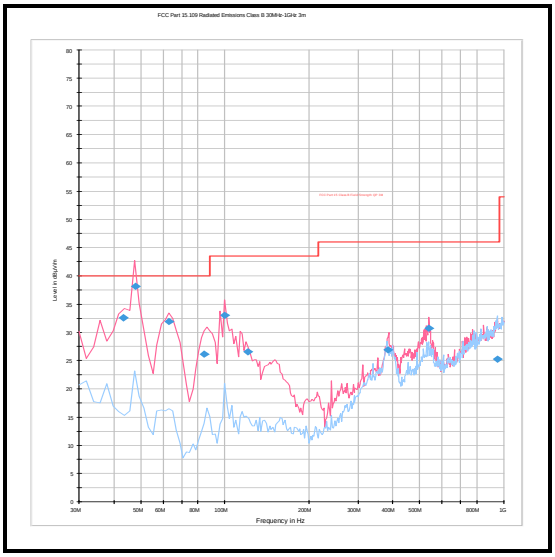
Note(s):

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. 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.

Results: Quasi Peak

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
43.236	Vertical	32.6	40.0	7.4	Complied
47.836	Vertical	38.1	40.0	1.9	Complied
63.089	Vertical	31.9	40.0	8.1	Complied
84.300	Vertical	26.1	40.0	13.9	Complied
99.590	Vertical	33.0	43.5	10.5	Complied
121.089	Vertical	26.6	43.5	16.9	Complied
383.832	Vertical	26.8	46.0	19.2	Complied
538.409	Vertical	30.7	46.0	15.3	Complied

Receiver/Idle Mode Radiated Spurious Emissions (continued)



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)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
G0543	Amplifier	Sonoma	310N	230801	18 May 2014	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	11 Feb 2015	12
A490	Antenna	Chase	CBL6111A	1590	18 Apr 2014	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12

Receiver/Idle Mode Radiated Spurious Emissions (continued)

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	07 March 2014
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Part 15.109
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
Frequency Range:	1 GHz to 12.5 GHz

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	37

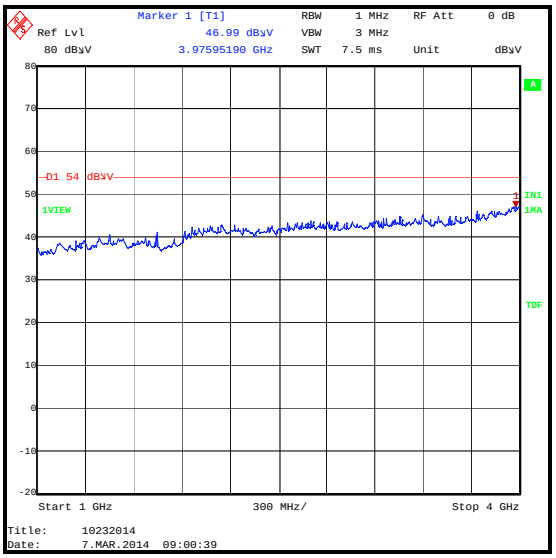
Note(s):

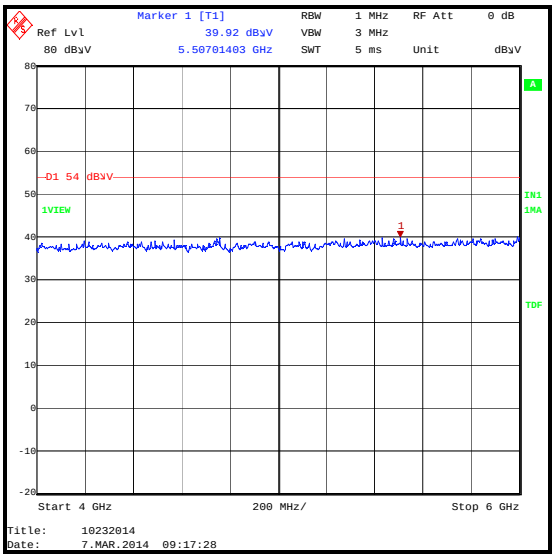
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak noise floor reading of the measuring receiver was recorded as shown in the table below. The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.
3. 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 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.

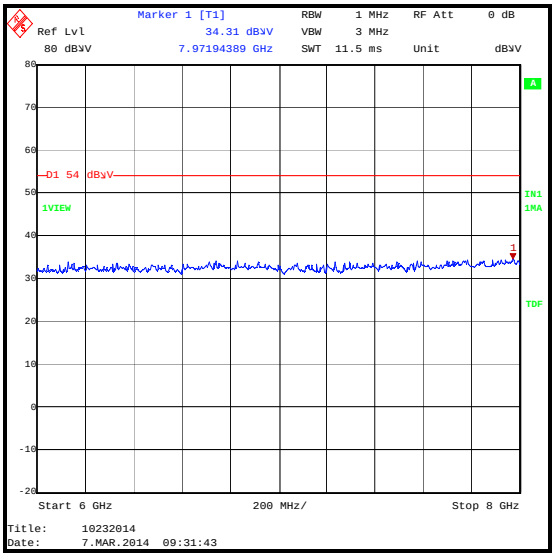
Results:

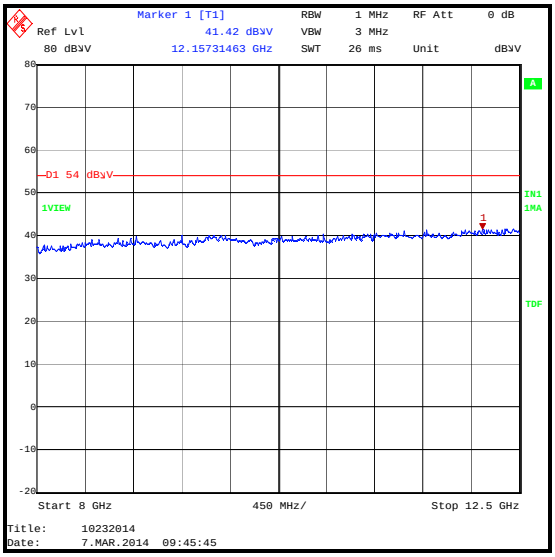
Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
3975.952	Vertical	47.0	54.0	7.0	Complied

Receiver/Idle Mode Radiated Spurious Emissions (continued)









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)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	14 Nov 2014	12
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12
A253	Antenna	Flann Microwave	12240-20	128	14 Nov 2014	12
A254	Antenna	Flann Microwave	14240-20	139	14 Nov 2014	12
A255	Antenna	Flann Microwave	16240-20	519	14 Nov 2014	12

5.2.3. Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Mark Percival	**Test Date:**	25 March 2014
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Part 15.207
Industry Canada Reference:	RSS-Gen 7.2.4
Test Method Used:	As detailed in ANSI C63.10 Section 6.2 referencing ANSI C63.4

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	41

Note(s):

1. The EUT was plugged into a USB cable which was connected to a DC desktop power supply which supplied the unit with 5 VDC. The DC desktop power supply was connected to 120 VAC 60 Hz single phase supply via a LISN.
2. Pre-scans were performed and markers placed on the highest live and neutral measured levels. Final measurements were performed on the marker frequencies and the results entered into the tables below.
3. A pulse limiter was fitted between the LISN and the test receiver.

Transmitter AC Conducted Spurious Emissions (continued)

Results: Live / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
13.137	Live	48.1	60.0	11.9	Complied
14.320	Live	54.1	60.0	5.9	Complied
14.793	Live	56.4	60.0	3.6	Complied
15.265	Live	56.3	60.0	3.7	Complied
15.859	Live	56.2	60.0	3.8	Complied
16.327	Live	52.8	60.0	7.2	Complied
19.644	Live	49.4	60.0	10.6	Complied
20.710	Live	52.1	60.0	7.9	Complied
21.183	Live	52.3	60.0	7.7	Complied

Results: Live / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
13.843	Live	32.3	50.0	17.7	Complied
14.793	Live	38.8	50.0	11.2	Complied
15.265	Live	38.5	50.0	11.5	Complied
15.976	Live	36.5	50.0	13.5	Complied
19.644	Live	31.5	50.0	18.5	Complied
20.899	Live	31.8	50.0	18.2	Complied
21.187	Live	34.2	50.0	15.8	Complied

Transmitter AC Conducted Spurious Emissions (continued)

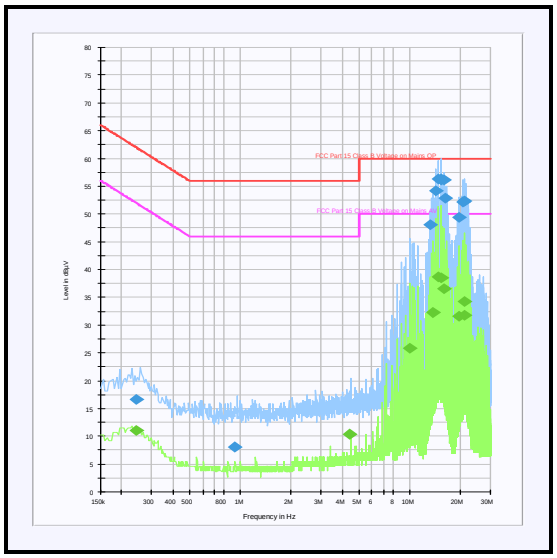
Results: Neutral / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
10.531	Neutral	43.3	60.0	16.7	Complied
14.199	Neutral	53.7	60.0	6.3	Complied
14.793	Neutral	56.8	60.0	3.2	Complied
15.387	Neutral	56.6	60.0	3.4	Complied
15.859	Neutral	56.6	60.0	3.4	Complied
16.332	Neutral	54.3	60.0	5.7	Complied
20.710	Neutral	52.5	60.0	7.5	Complied
22.249	Neutral	49.4	60.0	10.6	Complied

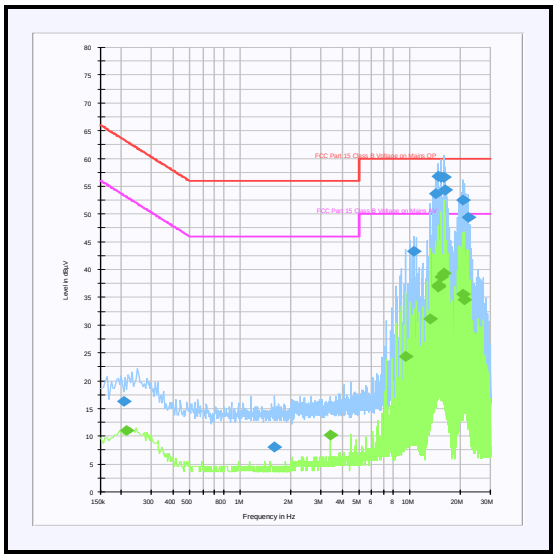
Results: Neutral / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
13.137	Neutral	31.1	50.0	18.9	Complied
14.676	Neutral	37.2	50.0	12.8	Complied
14.910	Neutral	36.8	50.0	13.2	Complied
15.382	Neutral	38.7	50.0	11.3	Complied
15.859	Neutral	39.3	50.0	10.7	Complied
20.710	Neutral	35.5	50.0	14.5	Complied
21.183	Neutral	34.6	50.0	15.4	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)
M1625	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	14 May 2014	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	27 Feb 2015	12
M1263	Test receiver	Rohde & Schwarz	ESIB7	100265	14 Oct 2014	12

5.2.4. Transmitter Minimum 6 dB Bandwidth

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	05 March 2014
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Part 15.247(a)(2)
Industry Canada Reference:	RSS-Gen 4.6.2 / RSS-210 A8.2(a)
Test Method Used:	As detailed in FCC KDB 558074 Section 8.1 Option 1

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	33

Note(s):

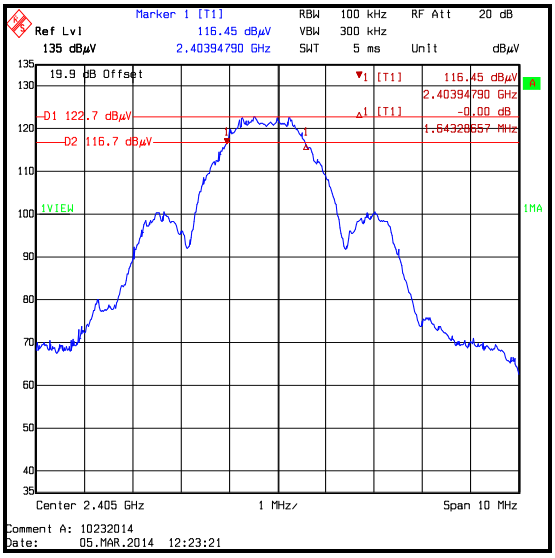
1. Transmitter minimum 6 dB bandwidth tests were performed using a spectrum analyser in accordance with FCC KDB 558074 Section 8.1 Option 1 measurement procedure.
2. The spectrum analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 10 MHz. Normal and delta markers were placed 6 dB down from the peak of the carrier. These results are documented in the table below.
3. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable

Results:

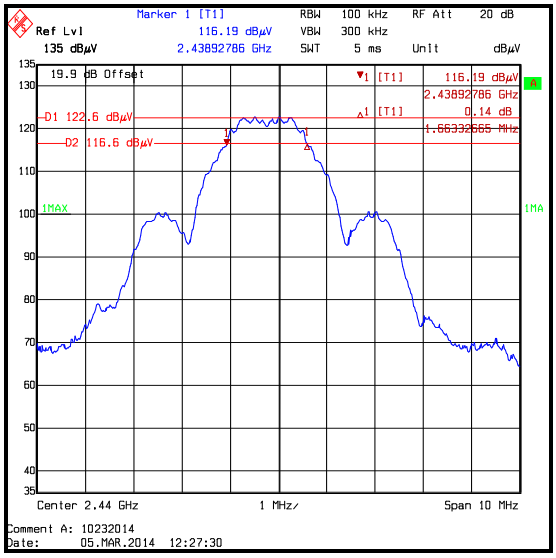
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	1643.287	≥500	1143.287	Complied
Middle	1663.327	≥500	1163.327	Complied
Top	1643.287	≥500	1143.287	Complied

Transmitter Minimum 6 dB Bandwidth (continued)

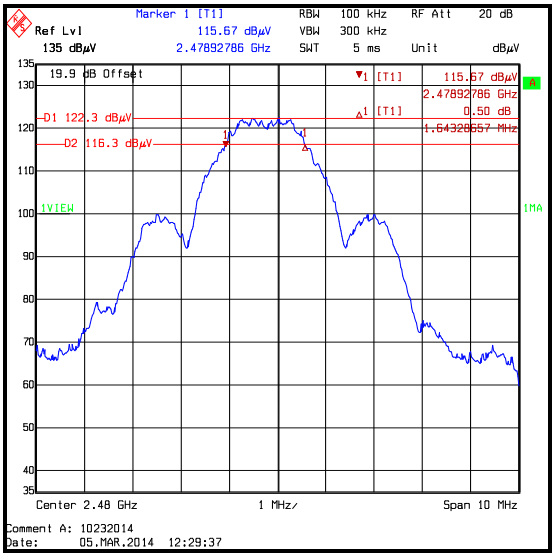
Results:



Bottom Channel



Middle Channel



Top Channel

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	19 Aug 2014	12
A2142	Attenuator	AtlanTecRF	AN18-20	081120-23	10 May 2014	12

5.2.5. Transmitter 99% Occupied Bandwidth

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	05 March 2014
Test Sample Serial Number:	Not marked or stated		

Industry Canada Reference:	RSS-Gen 4.6.1
Test Method Used:	The 99% occupied bandwidth was measured using the Occupied Bandwidth function of a spectrum analyser.

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	33

Note(s):

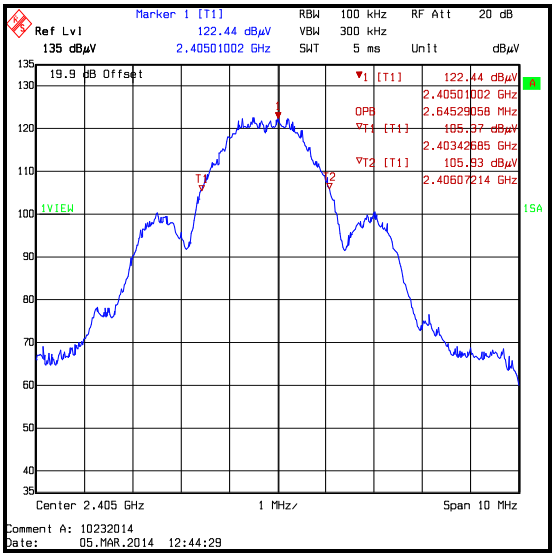
1. Occupied bandwidth (99% bandwidth) was measured using a spectrum analyser occupied bandwidth function. The span was wide enough to cover all possible emission skirts. The resolution bandwidth was set to 1% of the span and the video bandwidth set to 3 times the resolution bandwidth.
2. The spectrum analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A sample detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 10 MHz. The spectrum analyser function set the measurements to be made at 99% of the emission bandwidth. The results are given in the tables below.
3. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

Results:

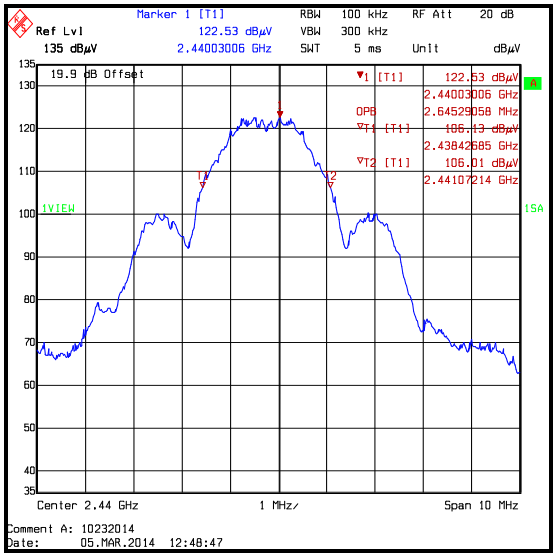
Channel	99% Occupied Bandwidth (kHz)
Bottom	2645.291
Middle	2645.291
Top	2645.291

Transmitter 99% Emission Bandwidth (continued)

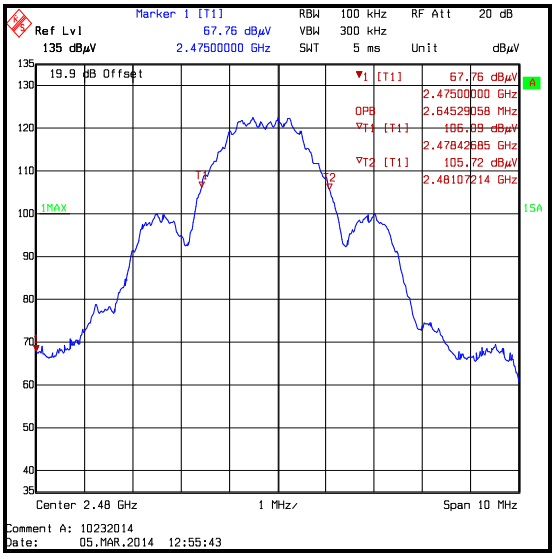
Results:



Bottom Channel



Middle Channel



Top Channel

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	19 Aug 2014	12
A2142	Attenuator	AtlanTecRF	AN18-20	081120-23	10 May 2014	12

5.2.6. Transmitter Power Spectral Density

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	19 March 2014
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Part 15.247(e)
Industry Canada Reference:	RSS-210 A8.2(b)
Test Method Used:	As detailed in FCC KDB 558074 Section 10.2

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	35

Note(s):

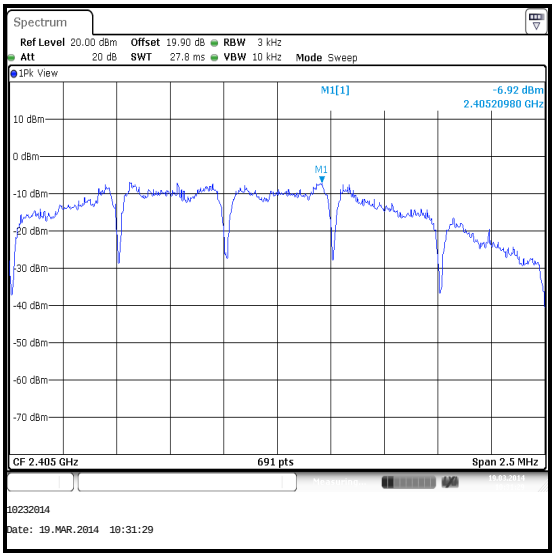
1. Transmitter Power Spectral Density tests were performed using a signal analyser in accordance with FCC KDB 558074 Section 10.2 measurement method PKPSD.
2. The signal analyser resolution bandwidth was set to 3 kHz and video bandwidth of 10 kHz. A peak detector was used, sweep time was set to auto 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.

Results:

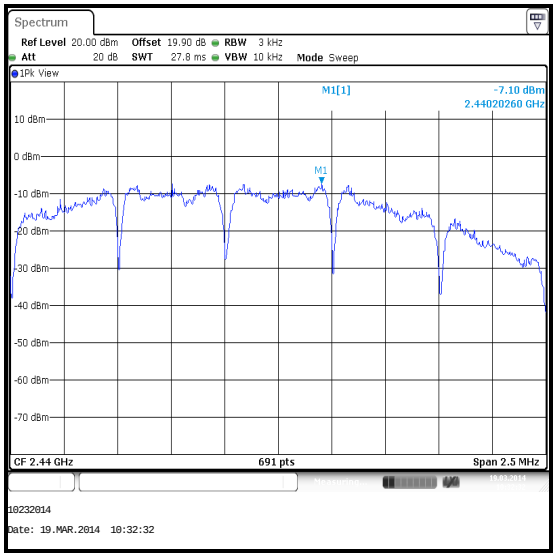
Channel	Output Power (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Margin (dB)	Result
Bottom	-6.9	8.0	14.9	Complied
Middle	-7.1	8.0	15.1	Complied
Top	-7.9	8.0	15.9	Complied

Transmitter Power Spectral Density (continued)

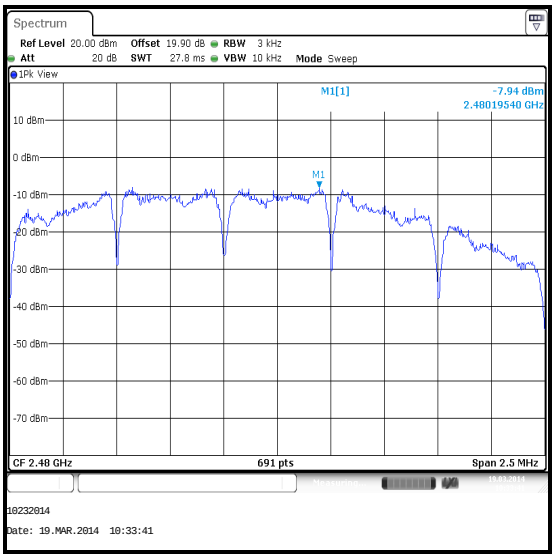
Results:



Bottom Channel



Middle Channel



Top Channel

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
L1028	Signal Analyser	Rohde & Schwarz	FSV 30	100854	23 May 2014	12
A2142	Attenuator	AtlanTecRF	AN18-20	081120-23	10 May 2014	12
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	25 Jun 2014	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12

5.2.7. Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	19 March 2014
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Part 15.247(b)(3)
Industry Canada Reference:	RSS-Gen 4.8 / RSS-210 A8.4(4)
Test Method Used:	As detailed in FCC KDB 558074 Section 9.1.1

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	35

Note(s):

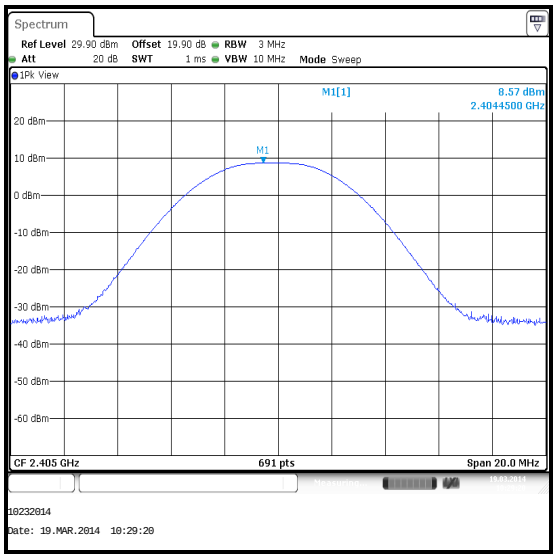
1. Conducted power tests were performed using a signal analyser in accordance with FCC KDB 558074 Section 9.1.1 measurement method RBW ≥ *DTS Bandwidth*.
2. The signal analyser resolution bandwidth was set to 3 MHz and video bandwidth of 10 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 20 MHz. 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.

Results:

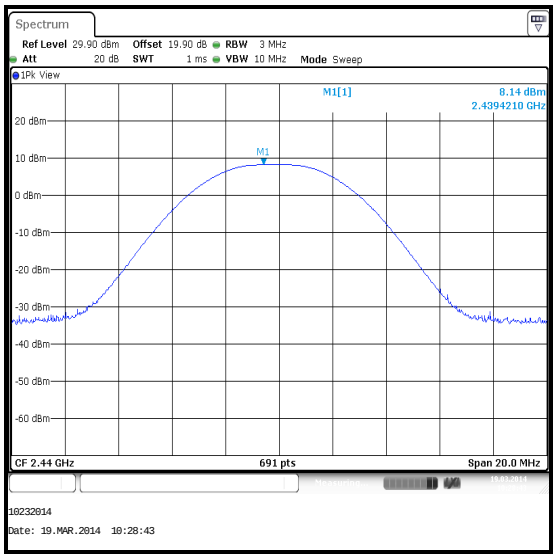
Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	8.6	30.0	21.4	Complied
Middle	8.1	30.0	21.9	Complied
Top	7.7	30.0	22.3	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	8.6	3.3	11.9	36.0	24.1	Complied
Middle	8.1	3.3	11.4	36.0	24.6	Complied
Top	7.7	3.3	11.0	36.0	25.0	Complied

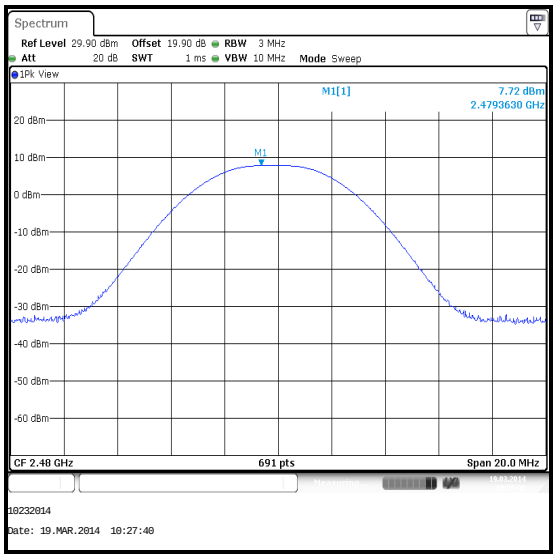
Transmitter Maximum Peak Output Power (continued)



Bottom Channel



Middle Channel



Top Channel

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
L1028	Signal Analyser	Rohde & Schwarz	FSV 30	100854	23 May 2014	12
A2142	Attenuator	AtlanTecRF	AN18-20	081120-23	10 May 2014	12
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	25 Jun 2014	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12

5.2.8. Transmitter Radiated Emissions

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	27 March 2014
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A8.5
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	31

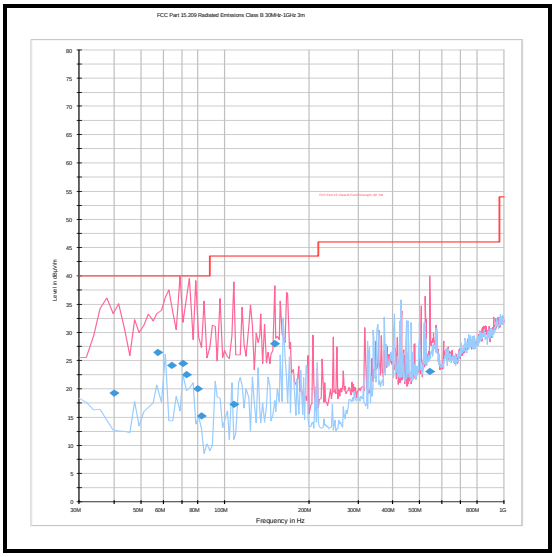
Note(s):

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 top channel only.
3. All emissions identified and measured were in the non-restrictive band and have been compared to the –20 dBc limit. The emission closest to the limit has been listed below.
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.
5. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
6. Final measurements were performed on the marker frequencies and the results entered into the table below. The test receiver resolution bandwidth was set to 120 kHz, using a CISPR quasi-peak detector and span big enough to see the whole emission.
7. * -20 dBc limit.

Results: Top Channel

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
150.853	Vertical	28.0	85.6*	57.6	Complied

Transmitter Radiated Emissions (continued)



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)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
G0543	Amplifier	Sonoma	310N	230801	18 May 2014	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	11 Feb 2015	12
A490	Antenna	Chase	CBL6111A	1590	18 Apr 2014	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	19 March 2014
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9, RSS-210 A8.5
Test Method Used:	As detailed in FCC KDB 558074 Sections 11.3 and 12.1
Frequency Range	1 GHz to 25 GHz

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	35

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 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.
5. Pre-scans were performed and markers placed on the highest measured levels the test receiver was set up as followed: a RBW set to 1 MHz, the VBW set to 3, with the sweep time set to auto couple. Peak and average measurements were performed with their own appropriate detectors during the pre-scan measurements.
6. *Emissions in restricted bands: In accordance with C63.10 section 6.6.4.2, Note 1, where the peak detected amplitude was shown to comply with the average limit, an average measurement was not performed.
7. ** -20 dBc limit applies in non-restricted bands
8. The pre scan for 12.75 GHz to 18 GHz does not show the 54 dBµV limit. The peak level as measured is correct.

Transmitter Radiated Emissions (continued)

Results: Peak / Bottom Channel

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
4811.054	Vertical	47.5	54.0*	6.5	Complied
7216.457	Horizontal	54.7	88.5**	33.8	Complied
9621.904	Horizontal	44.8	88.5**	43.7	Complied

Results: Peak / Middle Channel

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
4880.729	Vertical	46.6	54.0*	7.4	Complied
7321.411	Horizontal	55.9	74.0	18.1	Complied
9757.884	Horizontal	46.2	86.4**	40.2	Complied

Results: Average / Middle Channel

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
7320.970	Horizontal	46.8	54.0	7.2	Complied

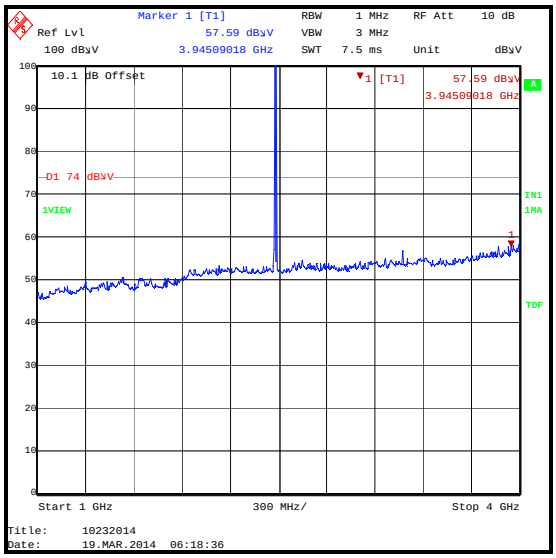
Results: Peak / Top Channel

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
4960.932	Vertical	44.3	54.0*	9.7	Complied
7438.447	Horizontal	55.8	74.0	18.2	Complied
9921.898	Horizontal	43.2	85.6**	42.4	Complied

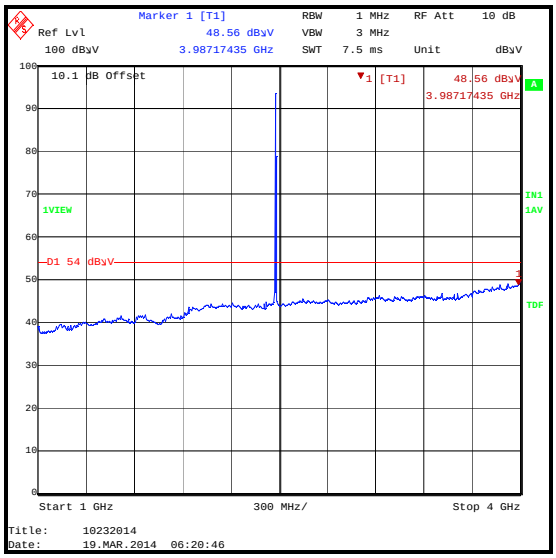
Results: Average / Top Channel

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
7441.012	Horizontal	46.1	54.0	7.9	Complied

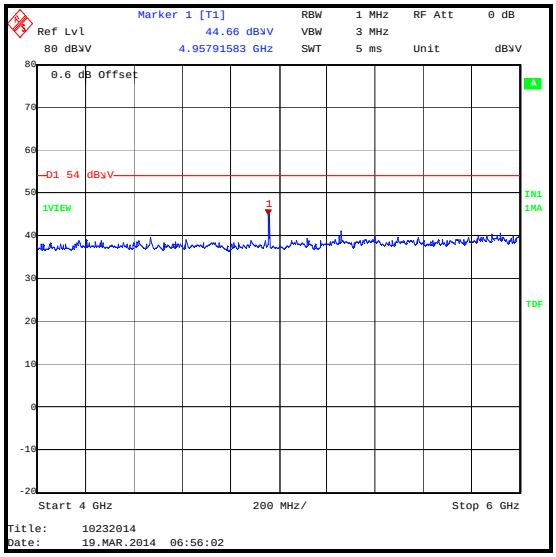
Transmitter Radiated Emissions (continued)

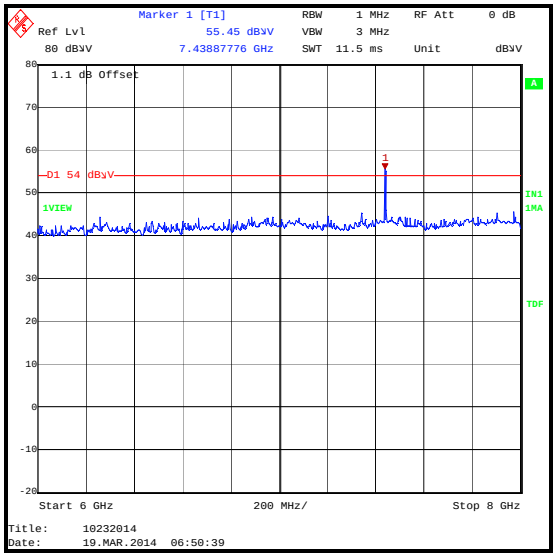


Peak detector / Peak limit

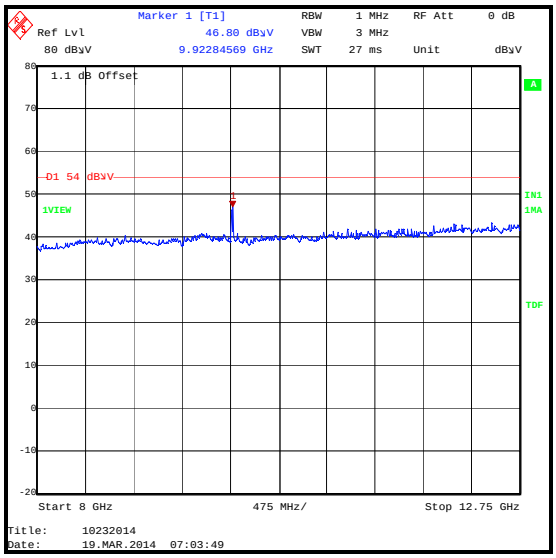


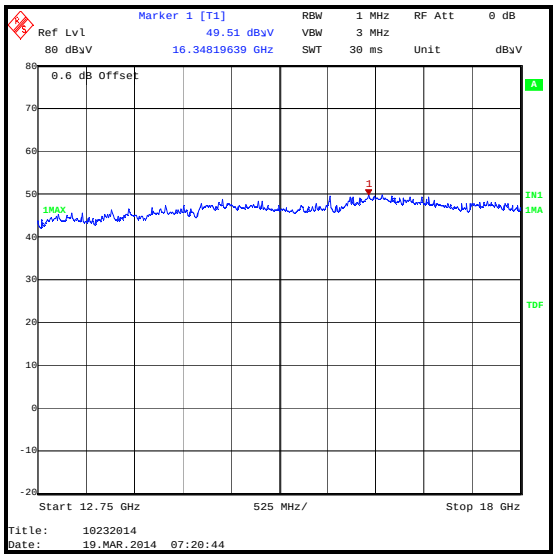
Average detector / Average limit

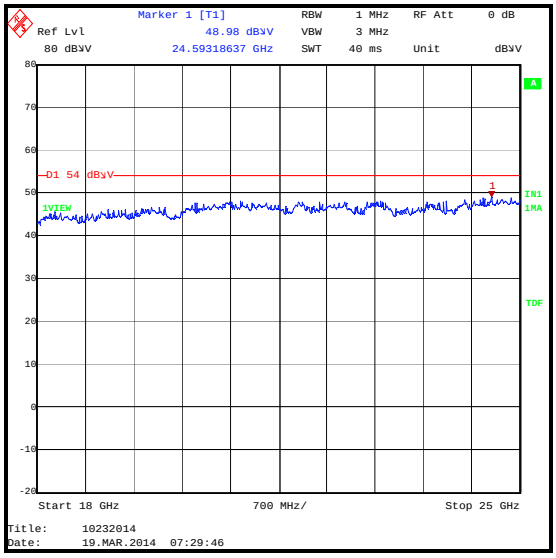




Transmitter Radiated Emissions (continued)







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	14 Mar 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	14 Nov 2014	12
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12
A253	Antenna	Flann	12240-20	128	14 Nov 2014	12
A254	Antenna	Flann	14240-20	139	14 Nov 2014	12
A255	Antenna	Flann	16240-20	519	14 Nov 2014	12
A256	Antenna	Flann	18240-20	400	14 Nov 2014	12
A436	Antenna	Flann	20240-20	330	14 Nov 2014	12
A1975	High pass filter	AtlanTecRF	AFH-03000	090424010	19 Apr 2014	12
A1980	High pass filter	AtlanTecRF	AFH-06000	09110900303	19 Apr 2014	12
A2130	High pass filter	AtlanTecRF	AFH-08000	80rJFBD06-002	26 Apr 2104	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	10 May 2014	12

5.2.9. Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineer:	David Doyle	**Test Dates:**	18 March 2014 & 19 March 2014
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A8.5
Test Method Used:	As detailed in FCC KDB 558074 Sections 11.1, 13.2 and 13.3.2

Environmental Conditions:

Temperature (°C):	23 to 25
Relative Humidity (%):	35 to 37

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. For the lower band edge measurements: As the lower band edge falls within the non-restricted band only peak measurements are required. In accordance with FCC KDB 558074 Section 11.1, the test method in Section 11.3 was followed: the test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. As the maximum conducted output power was measured using a peak detector in accordance with FCC KDB 558074 Section 9.1.1 an out-of-band limit line was placed 20 dB below the peak level (FCC KDB 558074 Section 11.1(a)). A marker was placed on the band edge frequency, the marker frequency and the level were recorded.
3. For the upper band edge measurements: As the upper band edge falls within restricted band both peak and average measurements were recorded by placing a marker at the edge of the band (2483.5 MHz). In accordance with FCC KDB 558074 Section 12.1, the test method in ANSI C63.10 Section 6.9.2 was followed: for peak measurements the test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. In accordance with FCC KDB 558074 Section 13.3.2, for average measurements the test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. An RMS detector was used, sweep time was set to auto and a trace average was performed over 100 traces. The average power was computed by integrating the power spectrum over 1 MHz by using the receiver's band power measurement function. The measured power in dBm at 3 metres has been then converted to dBµV with the formula: *dBµV = dBm + 95.2.*
4. * -20 dBc limit.

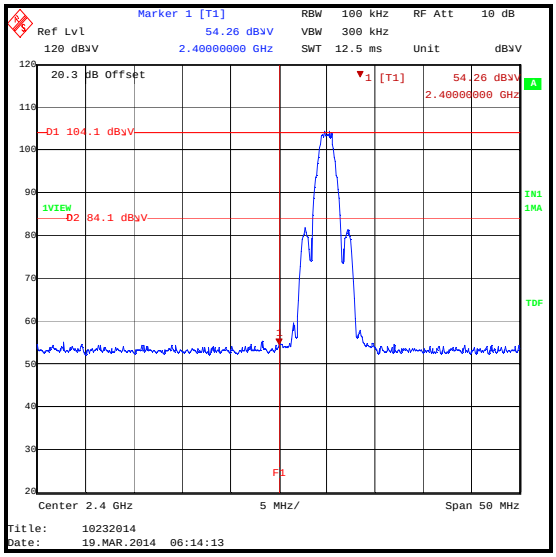
Transmitter Band Edge Radiated Emissions (continued)

Results: Peak

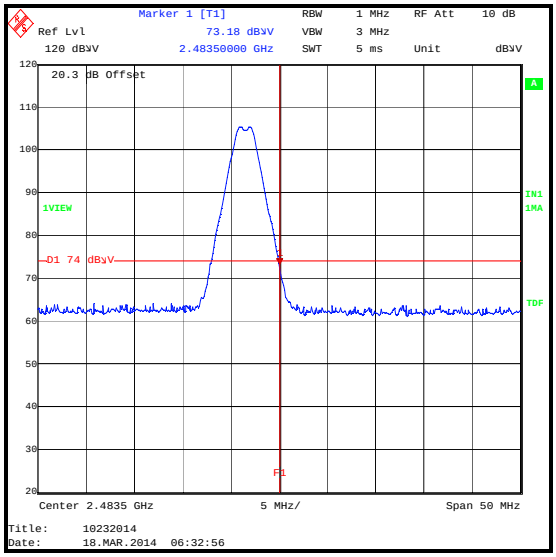
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2400	54.3	84.1*	29.8	Complied
2483.5	73.2	74.0	0.8	Complied

Results: Average

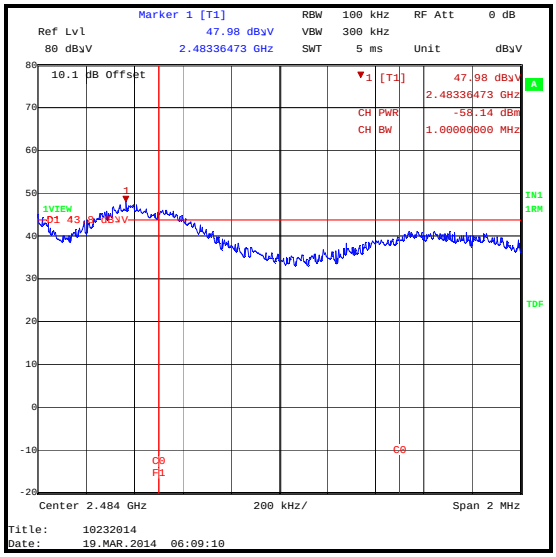
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	37.1	54.0	16.9	Complied



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Upper Band Edge Average Measurement

Transmitter Band Edge 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	24 May 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	14 Nov 2014	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	10 May 2014	12
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	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 of the measurand (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%	±0.92 ppm
99% Emission Bandwidth	2.4 GHz to 2.4835 GHz	95%	±3.92 %
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

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