



TEST REPORT

Test Report No. : UL-RPT-RP10017821JD01A V3.0

Manufacturer : Interlite AB
Model No. : W-DMX TRX
FCC ID: : NY2-WDMXTRXDB
Technology : Frequency Hopping System
Test Standard(s) : FCC Parts 15.109, 15.209(a) & 15.247

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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 3.0 supersedes all previous versions.

Date of Issue: 11 November 2014

Checked by:

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Senior Engineer, Radio Laboratory

Issued by :

pp

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This laboratory is accredited by UKAS.
The tests reported herein have been
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of accreditation.

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1. Customer Information










Company Name:	Interlite AB
Address:	Stureparkvagen 7 UDDEVALLA 45155 Sweden

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:	47CFR15.109 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart B (Unintentional Radiators) - Sections 15.107 and 15.109
Site Registration:	FCC: 209735
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	05 November 2013 to 22 November 2013

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.109	Receiver/Idle Mode Radiated Spurious Emissions	
Part 15.247(a)(1)(ii)	Transmitter 20 dB Bandwidth	
Part 15.247(a)(1)	Transmitter Carrier Frequency Separation	
Part 15.247(a)(1)(ii)	Transmitter Number of Hopping Frequencies and Average Time of Occupancy	
Part 15.247(b)(1)	Transmitter Maximum Peak Output Power	
Part 15.247(d)/ 15.209(a)	Transmitter Radiated Emissions	
Part 15.247(d)	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

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:	W-DMX TRX
Model Name or Number:	PRO Dualband DMX/RDM/A40904G4
Serial Number:	0000001003
Hardware Version Number:	L6
Software Version Number:	2.1.755
FCC ID:	NY2-WDMXTRXDB

3.2. Description of EUT

The Equipment Under Test was a DMX Transceiver. The DMX transceiver is a frequency hopping module which operates in the 5725 MHz to 5850 MHz band.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Tested Technology:	Frequency hopping system operating in the 5725 MHz to 5850 MHz band	
Power Supply Requirement:	Nominal	5.0 VDC via 120 VAC 60 Hz
Type of Unit:	Transceiver	
Channel Spacing:	1 MHz	
Modulation:	GFSK	
Data Rate	1 Mbit/s	
Maximum Conducted Output Power:	14.4 dBm	
Antenna Gain	4 dBi	
Transmit Frequency Range:	5725 MHz to 5850 MHz	
Transmit Channels Tested:	Channel ID	Channel Frequency (MHz)
	Bottom	5744
	Middle	5782
	Top	5821
Receive Frequency Range:	5725 MHz to 5850 MHz	
Receive Channels Tested:	Channel ID	Channel Frequency (MHz)
	Bottom	5744
	Middle	5782
	Top	5821

3.5. Support Equipment

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

Description:	Configuration dongle for W-DMX Radio cards
Brand Name:	W-DMX
Model Name or Number:	W-DMX Co-Existence / A40303
Serial Number:	S020121717023
Hardware Version Number:	1
Software Version Number:	2.22.701
PC Software:	W-DMX Configurator 3.2

Description:	12 volts regulated power supply
Brand Name:	CMP
Model Name or Number:	S008CM1200067
Serial Number:	Not marked or stated

Description:	Trx Interface PCB 2478-2 BB F1
Brand Name:	Wireless Solution
Model Name or Number:	Not marked or stated

Description:	DMX cable to connect W-DMX Co-Existence dongle to Trx Interface PCB
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated

Description:	Overlay
Brand Name:	Wireless Solution
Model Name or Number:	SET1.1745.2

Description:	USB cable
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	Latitude D610
Serial Number:	UL VS LTD 00062

3.6. Antenna

The table below lists the antennas that the manufacturer intends to use with this product when operating in the 5725-5850 MHz band:

Type	Stated Gain (dBi)	Manufacturer	Antenna Name	Used for Testing	Note
Omnidirectional	4.0	Wireless Solution	A40511G4	X	1

X = This antenna was used for testing purposes

Note(s):

1. Used in conjunction with a 0.15 metre length RP-SMA RF cable with a stated insertion loss of 0.5 dB.

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

- Constantly transmitting at maximum power with a modulated frequency hopping single as required.
- Receiver/idle mode

4.2. Configuration and Peripherals

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

- The EUT was placed into frequency hopping test mode using a laptop PC and application supplied by the manufacturer.
- The EUT (module) was connected to an interface PCB.
- The interface board was powered by a 120 VAC 60 Hz to 12 VDC regulated power supply. The interface board has a 5 VDC regulator to power the EUT.
- The interface board was connected to the configuration USB dongle via an XLM cable. The configuration USB dongle was connected to a test laptop which controlled the EUT and placed it into a frequency hopping test mode. The USB dongle was also used to select the appropriate channel, data rates and modulation schemes as required for testing.
- Radiated spurious emission pre-scans were performed with the omnidirectional antenna placed in various orientations. The highest emission levels were noted with the antenna vertical. Final measurements were made with the antenna vertical.
- Test application power setting of 10mW/2 bars was used for all transmitter measurements.

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 Radiated Spurious Emissions

Test Summary:

Test Engineer:	Andrew Edwards	Test Date:	08 November 2013
Test Sample Serial Number:	0000001003		

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

Environmental Conditions:

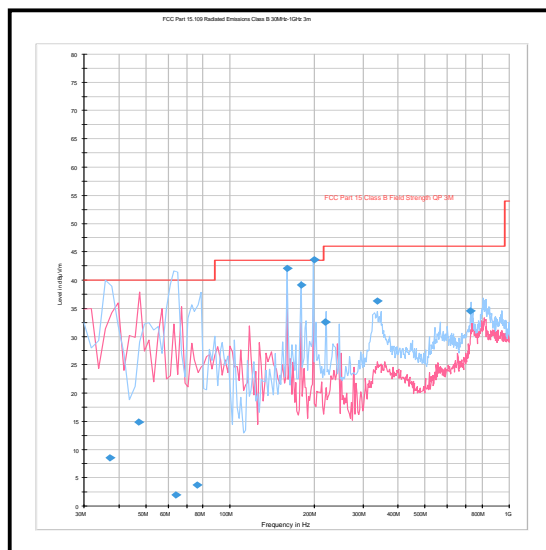
Temperature (°C):	22
Relative Humidity (%):	41

Note(s):

1. Radiated spurious emission pre-scans were performed with the omnidirectional antenna placed in various orientations. The highest emission levels were noted with the antenna vertical. Final measurements were made with the antenna vertical.
2. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss.
3. 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.
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-scan were performed and markers placed in the highest measured levels. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. The sweep time was set to auto couple. A peak detector was used and trace mode was set to 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. A quasi-peak detector was used.

Receiver/Idle Mode Radiated Spurious Emissions (continued)**Results: Quasi-Peak**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
160.009	Horizontal	42.1	43.5	1.4	Complied
179.992	Horizontal	39.2	43.5	4.3	Complied
199.998	Horizontal	42.6	43.5	0.9	Complied
219.986	Horizontal	32.6	46.0	13.4	Complied
336.052	Horizontal	36.2	46.0	9.8	Complied
727.592	Horizontal	34.6	46.0	11.4	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)
A490	Antenna	Chase	CBL6111A	1590	09 Apr 2014	12
A1843	Attenuator	Hewlett Packard	8491B	10444	27 Jan 2014	12
G0543	Pre Amplifier	Sonoma	310N	230801	15 Feb 2014	3
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	24 Nov 2013	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	07 Feb 2014	12
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	Not Stated	24 May 2014	12

Receiver/Idle Mode Radiated Spurious Emissions (continued)**Test Summary:**

Test Engineer:	Andrew Edwards	Test Dates:	07 November 2013 & 08 November 2013
Test Sample Serial Number:	0000001003		

FCC Reference:	15.109
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
Frequency Range:	1 GHz to 30 GHz

Environmental Conditions:

Temperature (°C):	22 to 23
Relative Humidity (%):	42 to 45

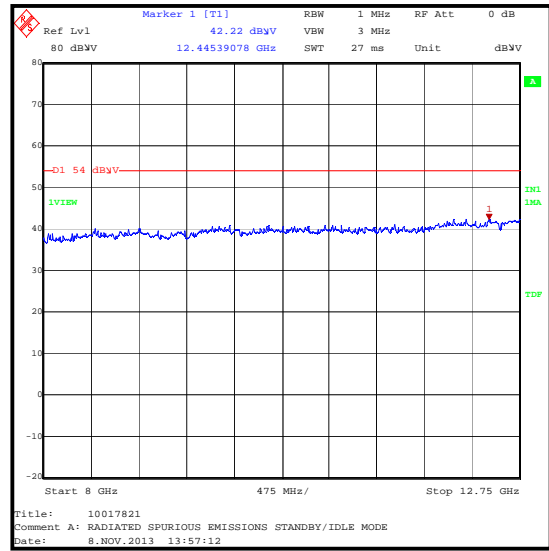
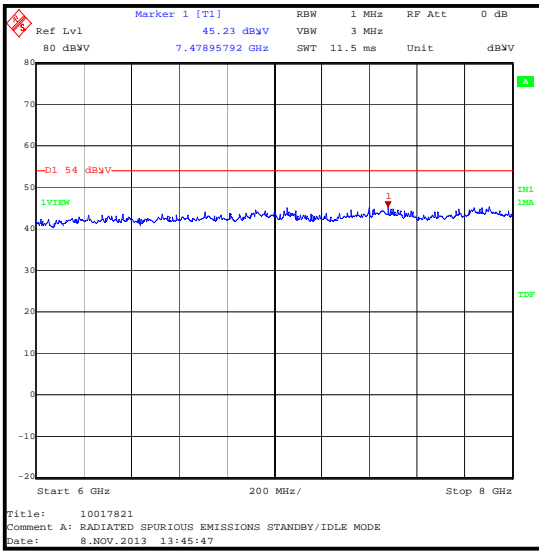
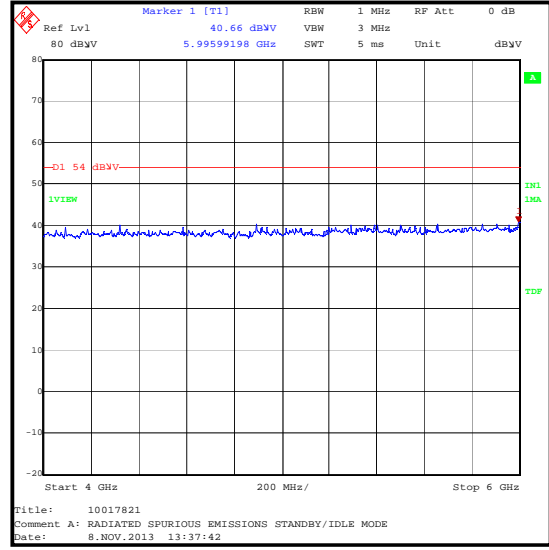
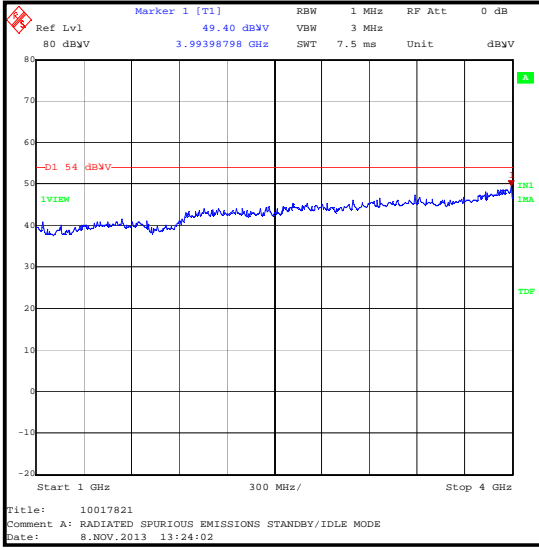
Note(s):

1. Radiated spurious emission pre-scans were performed with the omnidirectional antenna placed in various orientations. The highest emission levels were noted with the antenna vertical. Final measurements were made with the antenna vertical.
2. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss.
3. 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 above. 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.
4. Receive/idle mode radiated spurious emissions measurements were performed to $\geq 5^{\text{th}}$ harmonic of the highest frequency.
5. 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.
6. 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 couple.

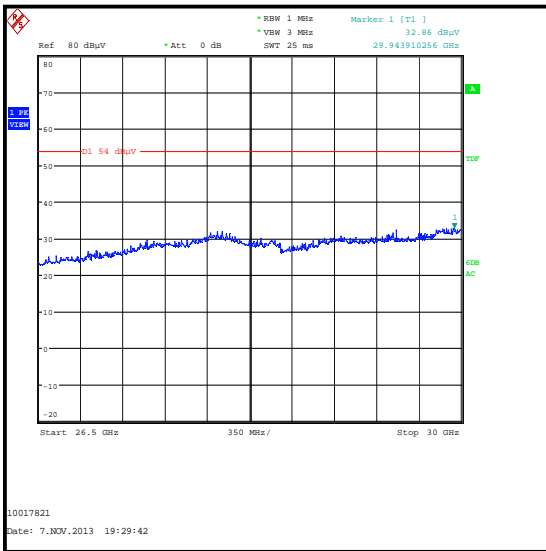
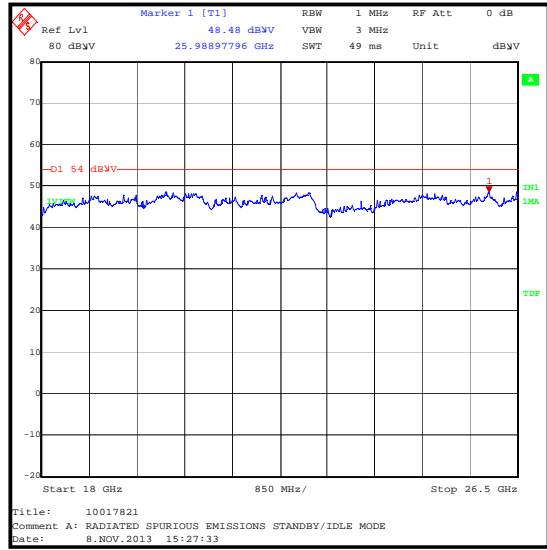
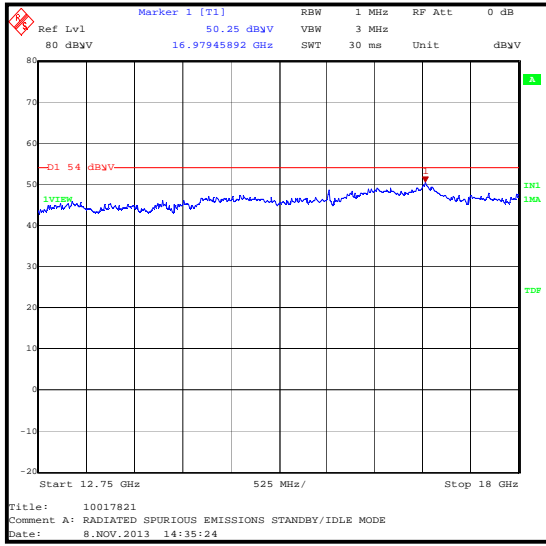
Results:

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
16979.459	Vertical	50.3	54.0	3.7	Complied

Receiver/Idle Mode Radiated Spurious Emissions (continued)



Receiver/Idle Mode Radiated Spurious Emissions (continued)



Receiver/Idle Mode Radiated Spurious Emissions (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A253	Antenna	Flann Microwave	12240-20	128	31 Jan 2014	12
A254	Antenna	Flann Microwave	14240-20	139	31 Jan 2014	12
A255	Antenna	Flann Microwave	16240-20	519	31 Jan 2014	12
A256	Antenna	Flann Microwave	18240-20	400	31 Jan 2014	12
A436	Antenna	Flann Microwave	20240-20	330	31 Jan 2014	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	31 Jan 2014	12
A1818	Antenna	EMCO	3115	00075692	31 Jan 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	31 Jan 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	24 May 2014	12
A203	Antenna	Flann Microwave	22240-20	343	19 May 2016	36
M1630	Test Receiver	Rohde & Schwarz	ESU 40	100233	07 Feb 2014	12
S0537	DC power supply	TTI	EL302D	249928	Calibrated before use	-
M1251	Multimeter	Fluke	175	89170179	12 Aug 2014	12

5.2.2. Transmitter 20 dB Bandwidth**Test Summary:**

Test Engineer:	Andrew Edwards	Test Date:	06 November 2013
Test Sample Serial Number:	0000001003		

FCC Reference:	15.247(a)(1)(ii)
Test Method Used:	ANSI C63.10 Section 6.9.1

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	46

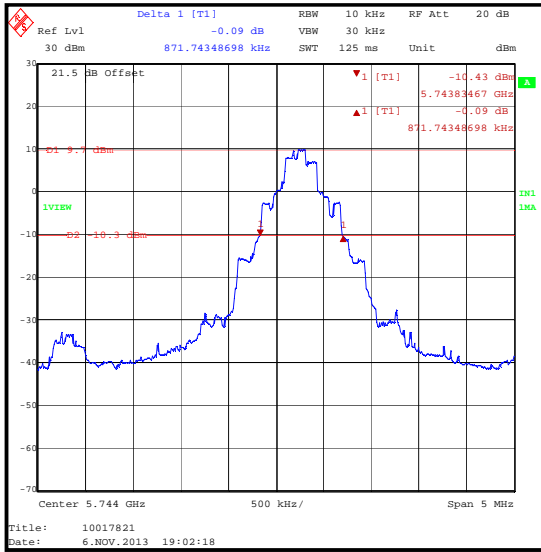
Note(s):

1. The test receiver resolution bandwidth was set to 10 kHz and the video bandwidth 30 kHz. A peak detector was used, sweep time was set to auto couple and the trace mode was set to Max Hold. The span was set to 5 MHz. Normal and delta markers were placed 20 dB down from the peak of the carrier.
2. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cables.

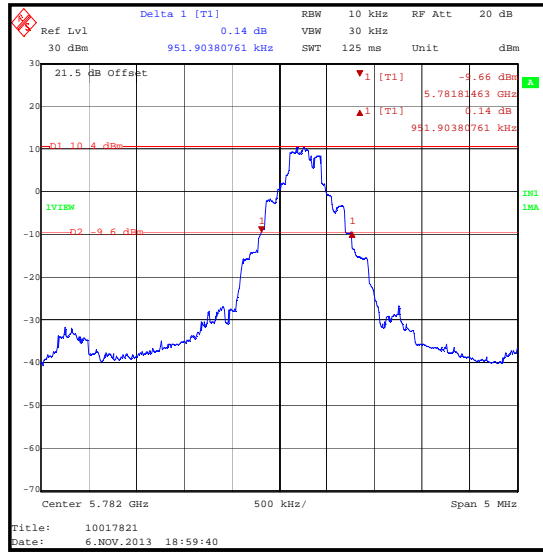
Results:

Channel	20 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	871.743	1000	128.257	Complied
Middle	951.904	1000	48.096	Complied
Top	871.743	1000	128.257	Complied

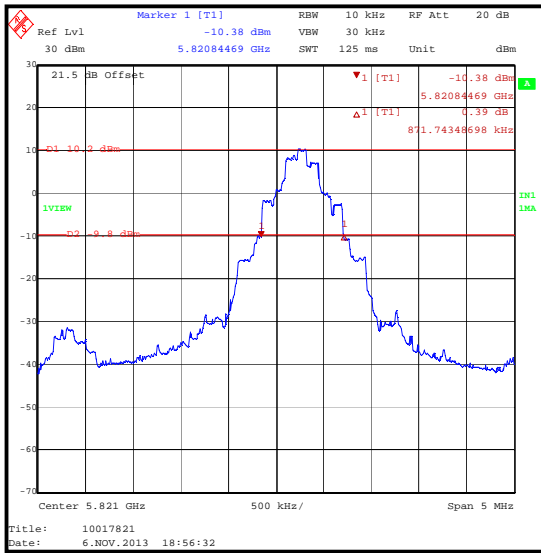
Transmitter 20 dB Bandwidth (continued)



Bottom Channel



Middle Channel



Top Channel

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A2144	Attenuator	AtlanTecRF	AN18-20	081120-23	10 May 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	24 May 2014	12

5.2.3. Transmitter Carrier Frequency Separation**Test Summary:**

Test Engineer:	Andrew Edwards	Test Date:	06 November 2013
Test Sample Serial Number:	0000001003		

FCC Reference:	15.247(a)(1)
Test Method Used:	ANSI C63.10 Section 7.7.2

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	46

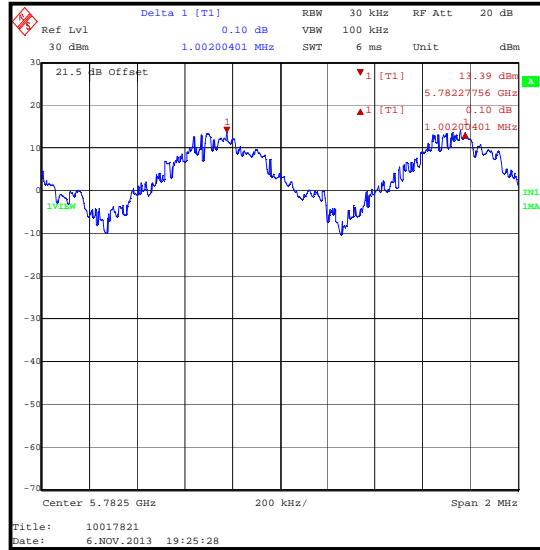
Note(s):

1. The previously measured 20 dB bandwidth of the middle channel was used as the limit.
2. The test receiver resolution bandwidth was set to 30 kHz and the video bandwidth 100 kHz. A peak detector was used, sweep time was set to auto couple and the trace mode was set to Max Hold. The span was set to 2 MHz. A normal marker was placed on the peak of the first channel and then a delta marker was placed on the peak of the second channel, the results are recorded in the table below.
3. The test receiver was connected to the RF port on the EUT using suitable attenuation.

Transmitter Carrier Frequency Separation (continue)

Results:

Carrier Frequency Separation (kHz)	Limit (20dB BW) (kHz)	Margin (kHz)	Result
1002.004	951.904	50.1	Complied



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A2144	Attenuator	AtlanTecRF	AN18-20	081120-23	10 May 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	24 May 2014	12

5.2.4. Transmitter Number of Hopping Frequencies and Average Time of Occupancy**Test Summary:**

Test Engineer:	Andrew Edwards	Test Date:	06 November 2013
Test Sample Serial Number:	0000001003		

Test Summary:

FCC Reference:	15.247(a)(1)(ii)
Test Method Used:	ANSI C63.10 Sections 7.7.3 and 7.7.4

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	54

Note(s):

- Frequency hopping systems operating in 5725 to 5850 MHz band shall use at least 75 hopping frequencies.
- Tests were performed to identify the average time of occupancy in number of channels with 30.0 second period.
- It was not possible to measure the EUT hopping in 30 seconds on a single plot so it has been measured using 1 second and this has been multiplied by 30 seconds.
- The EUT hops 21 times in 1 s. The average time of occupancy was calculated as:

Average Time of Occupancy: ((Number of Hops in 1 second) x (30 seconds)) x (Emission width in μs)

Average Time of Occupancy: ((21) x (30)) x (353.507)

Average Time of Occupancy: (630) x (353.507)

Average Time of Occupancy: 0.223 s
- Number of hopping channels; the resolution bandwidth was set to 100 kHz and the video bandwidth 300 kHz. A peak detector was used; sweep time was set to auto couple and trace mode set to max hold. The start frequency was set to 5725 MHz and the stop frequency was set to 5850 MHz.
- Emission width measurement; the resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. A peak detector was used; sweep time was set to 600μs with a span of zero Hz. The test receiver was set to trigger at 100 μs, with a marker placed at the start of the emission and a delta marked placed at the end of the emission. The emission width is recorded in the table below.
- The test receiver was set up for Number of Hopping frequencies in 30 seconds measurement as follows: the resolution bandwidth was set to 100 kHz and the video bandwidth 300 kHz. A peak detector was used; sweep time was set to 33 seconds, with the EUT triggered at 3 seconds. The EUT was set to transmit in a hopping frequency mode with the span set to zero. As it was not possible to read the results on the test receiver the measurement was repeated using 1 second sweep time. The test receiver sweep time 1.2 second and it was triggered at 200ms. The total numbers of hopping frequencies were recorded in the table below.
- The test receiver was connected to the RF port on the EUT using suitable attenuation.

Transmitter Number of Hopping Frequencies and Average Time of Occupancy (continued)**Results: Number of Hopping Frequencies:**

Number of Hops	Limit (Hops)	Result
78	≥75	Complied

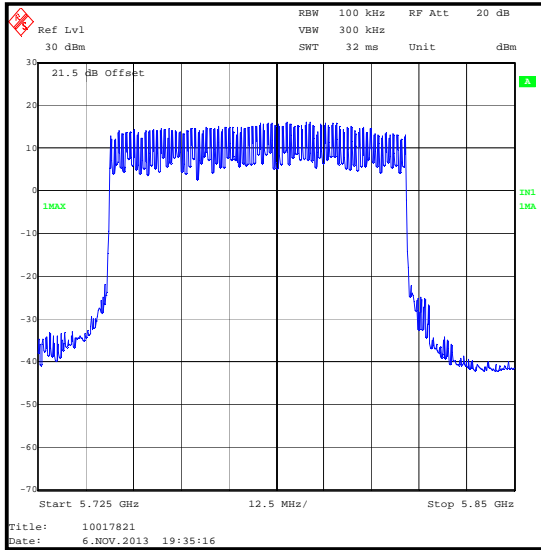
Results: Average Time of Occupancy

Emission Width (μs)	Average Time of Occupancy* (s)	Limit (s)	Margin (s)	Result
353.507	0.223	0.4	0.177	Complied

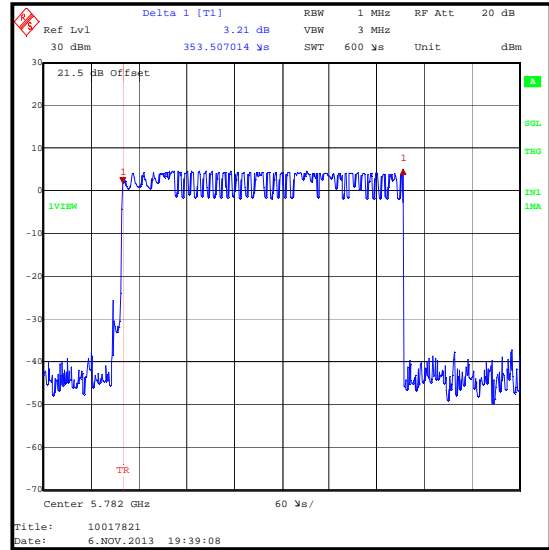
Limit:

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period

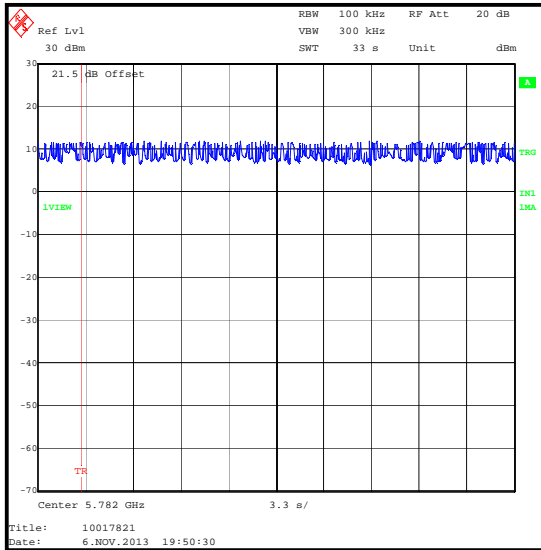
Transmitter Number of Hopping Frequencies and Average Time of Occupancy (continued)



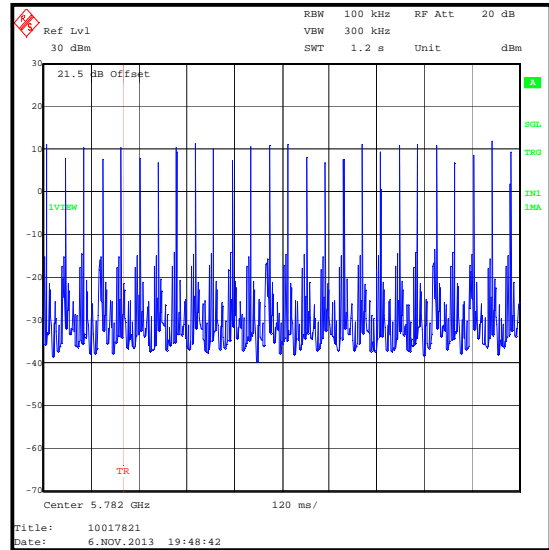
Number of Hopping Channels



Emission Width



TX on time in 30 second period



TX in 1 second period

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A2144	Attenuator	AtlanTecRF	AN18-20	081120-23	10 May 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
M1656	Thermohyrometer	JM Handelspunkt	30.5015.13	Not stated	24 May 2014	12

5.2.5. Transmitter Maximum Peak Output Power**Test Summary:**

Test Engineer:	Andrew Edwards	Test Date:	22 November 2013
Test Sample Serial Number:	0000001003		

FCC Reference:	15.247(b)(1)
Test Method Used:	ANSI C63.10 Section 6.10.1

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	38

Note(s):

1. The spectrum analyser resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. A peak detector was used, sweep time was set to auto couple and the trace mode was set to Max Hold. The span was set to 5 MHz. A marker was placed at the peak of the emission and the results recorded in the table below.
2. The spectrum analyser was connected to the RF port on the EUT using a 20 dB RF attenuator and two RF cables. One cable (RP-SMA-RF with 0.5 dB insertion loss) was supplied by the manufacturer. The second cable and 20 dB attenuator were test laboratory equipment with a combined insertion loss of 20.5 dB. The combined loss of these two cables and the attenuator was entered onto the spectrum analyser as an RF level offset of 21 dB:

$$(RF\ cable\ 1) + (RF\ cable\ 2\ and\ attenuator) = RF\ level\ offset$$

$$0.5 + 20.5 = 21.0\ dB$$

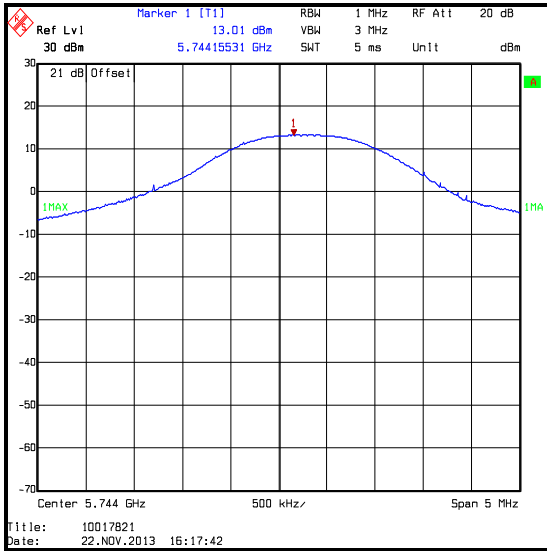
Transmitter Maximum Peak Output Power (continued)**Results:**

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	13.0	30.0	17.0	Complied
Middle	14.4	30.0	15.6	Complied
Top	12.7	30.0	17.3	Complied

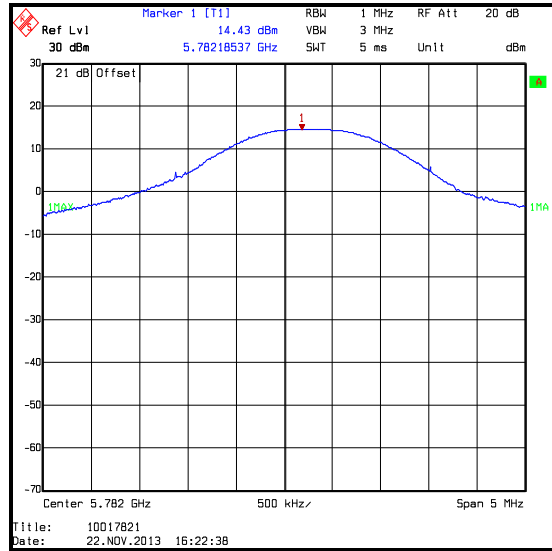
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	13.0	4.0	17.0	36.0	19.0	Complied
Middle	14.4	4.0	18.4	36.0	17.6	Complied
Top	12.7	4.0	16.7	36.0	19.3	Complied

Transmitter Maximum Peak Output Power (continued)

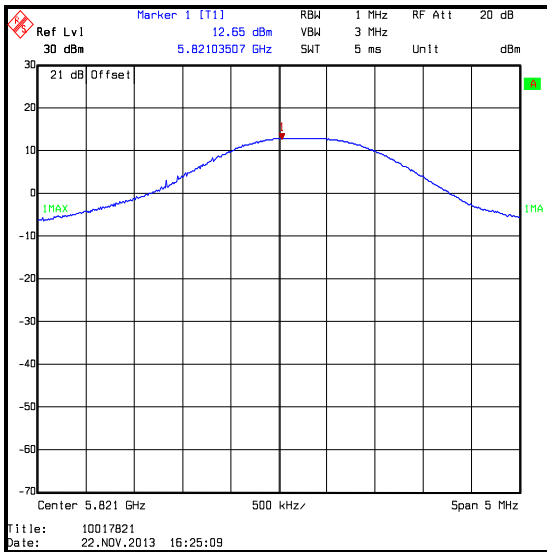
Results:



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)
A2144	Attenuator	AtlanTecRF	AN18-20	081120-23	10 May 2014	12
G085	Signal Generator	Hewlett Packard	83650L	3614A00104	28 Nov 2014	24
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1242	Spectrum Analyser	Rohde & Schwarz	FSEM30	845986/022	19 Dec 2013	12
M1267	Power sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12
M1696	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	24 May 2014	12

5.2.6. Transmitter Radiated Emissions**Test Summary:**

Test Engineer:	Andrew Edwards	Test Date:	07 November 2013
Test Sample Serial Number:	0000001003		

FCC Reference:	15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	41

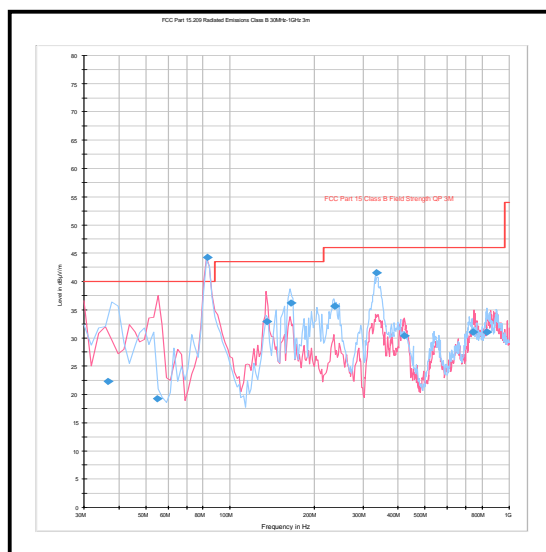
Note(s):

1. Radiated spurious emission pre-scans were performed with the omnidirectional antenna placed in various orientations. The highest emission levels were noted with the antenna vertical. Final measurements were made with the antenna vertical.
2. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss.
3. 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.
4. 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.
5. 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.
6. Pre-scans were performed and markers placed in the highest measured levels. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. The sweep time was set to auto couple. A peak detector was used and trace mode was set to Max hold.
7. The test receiver resolution bandwidth was set to 120 kHz for final measurements. A CISPR quasi-peak detector was used. Final measurements were recorded in the table below. All other emissions fell within non-restricted bands and a -20 dBc limit applies. All non-restricted band final measurements were >20 dB below the non-restricted band limit and were therefore, not recorded.

Transmitter Radiated Emissions (continued)

Results: Quasi-Peak

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
135.071	Vertical	32.9	43.5	10.6	Complied
164.912	Horizontal	36.2	43.5	7.3	Complied
333.606	Horizontal	41.5	46.0	4.5	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)
A490	Antenna	Chase	CBL6111A	1590	09 Apr 2014	12
A1843	Attenuator	Hewlett Packard	8491B	10444	27 Jan 2014	12
G0543	Pre Amplifier	Sonoma	310N	230801	15 Feb 2014	3
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	24 Nov 2013	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	07 Feb 2014	12
M1622	Thermohygrometer	JM Handlungspunkt	30.5015.06	Not Stated	24 May 2014	12

5.2.7. Transmitter Radiated Emissions**Test Summary:**

Test Engineer:	Andrew Edwards	Test Dates:	05 November 2013, 06 November 2013 & 07 November 2013
Test Sample Serial Number:	0000001003		

FCC Reference:	15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
Frequency Range	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	22 to 24
Relative Humidity (%):	46 to 48

Note(s):

1. Radiated spurious emission pre-scans were performed with the omnidirectional antenna placed in various orientations. The highest emission levels were noted with the antenna vertical. Final measurements were made with the antenna vertical.
2. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss
3. The emission shown on the 4 GHz to 6 GHz plot is the EUT fundamental at 5821 MHz.
4. All other emissions shown on the pre-scan plots were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement system noise floor.
5. 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.
6. The EUT operates below 10 GHz. Transmitter radiated spurious emissions measurements were performed up to 40 GHz.
7. 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 couple. Average final measurements were made with the test receiver resolution bandwidth set to 1 MHz and video bandwidth 10 Hz. The sweep time was set to auto couple. The detector type was set to peak and max hold function was used.
8. *The peak limit complied with the average limit, therefore average measurements were not performed.

Transmitter Radiated Emissions (continued)**Results: Peak Bottom Channel**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
5368.889	Vertical	62.4	74.0	11.6	Complied
11488.180	Vertical	63.5	74.0	10.5	Complied
22977.383	Vertical	47.1	54.0*	6.9	Complied

Results: Average Bottom Channel

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
5368.974	Vertical	51.1	54.0	2.9	Complied
11488.180	Vertical	46.1	54.0	7.9	Complied

Results: Peak Middle Channel

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
5147.162	Vertical	63.6	74.0	10.4	Complied
5400.996	Vertical	61.9	74.0	12.1	Complied
11568.715	Vertical	66.5	74.0	7.5	Complied

Results: Average Middle Channel

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
5147.057	Vertical	51.3	54.0	2.7	Complied
5401.067	Vertical	49.9	54.0	4.1	Complied
11568.520	Vertical	47.9	54.0	6.1	Complied

Transmitter Radiated Emissions (continued)**Results: Peak Top Channel**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
4959.713	Vertical	63.4	74.0	10.6	Complied
5069.429	Vertical	66.0	74.0	8.0	Complied
5123.908	Vertical	60.7	74.0	13.3	Complied
5403.145	Vertical	61.0	74.0	13.0	Complied
5434.004	Vertical	63.2	74.0	10.8	Complied
5444.995	Vertical	60.1	74.0	13.9	Complied
11642.440	Vertical	61.5	74.0	12.5	Complied

Results: Average Top Channel

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
4957.934	Vertical	51.3	54.0	2.7	Complied
5069.429	Vertical	53.7	54.0	0.3	Complied
5124.079	Vertical	48.4	54.0	5.6	Complied
5403.487	Vertical	49.2	54.0	4.8	Complied
5433.956	Vertical	51.4	54.0	2.6	Complied
5445.190	Vertical	47.1	54.0	6.9	Complied
11342.560	Vertical	44.5	54.0	9.5	Complied

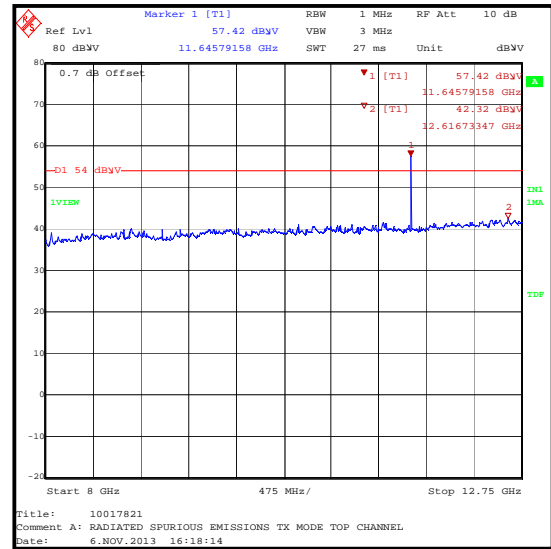
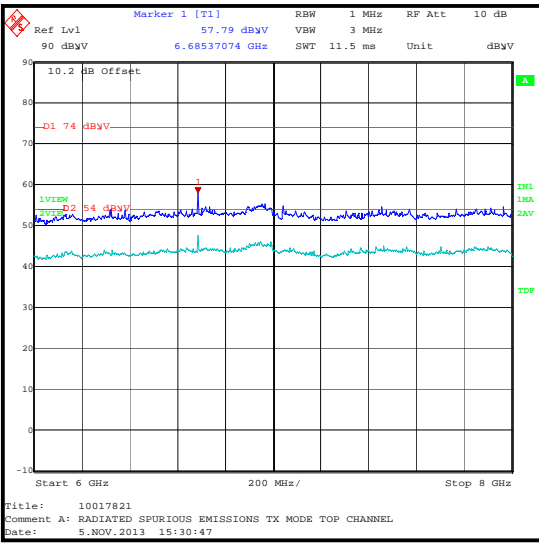
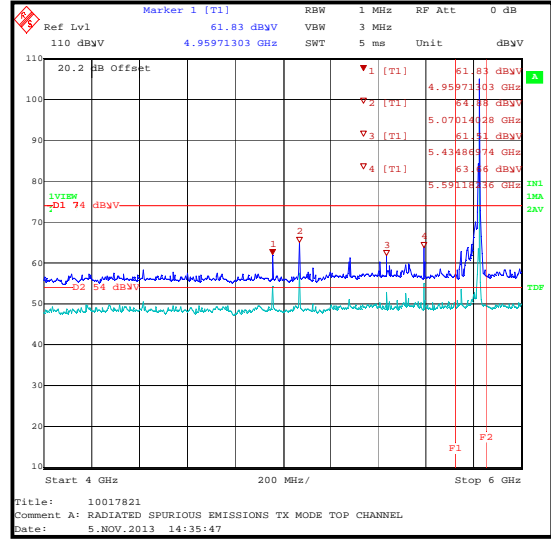
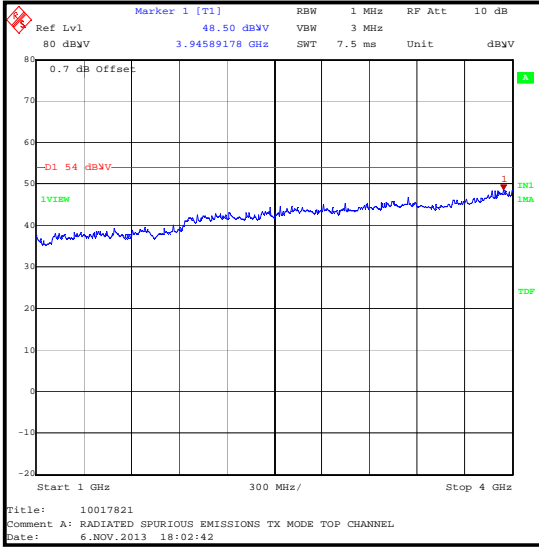
Results: Peak Hopping Mode

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
5120.396	Vertical	65.6	74.0	8.4	Complied
5423.017	Vertical	62.4	74.0	11.6	Complied
11588.598	Vertical	63.4	74.0	10.6	Complied
23113.583	Vertical	48.1	54.0*	5.9	Complied

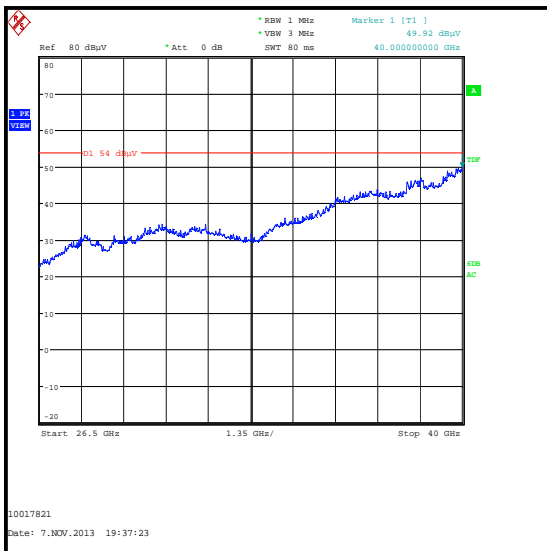
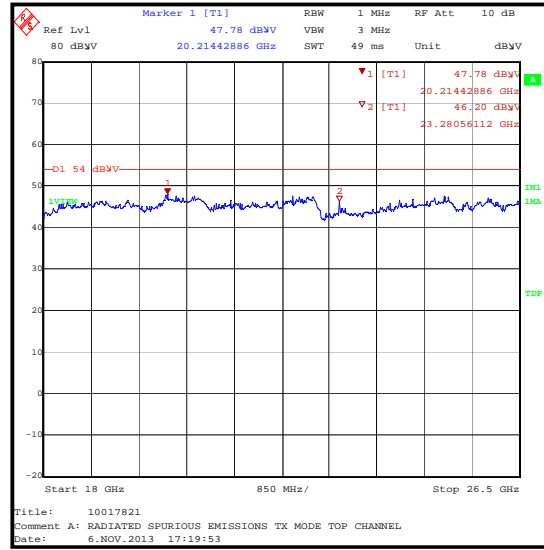
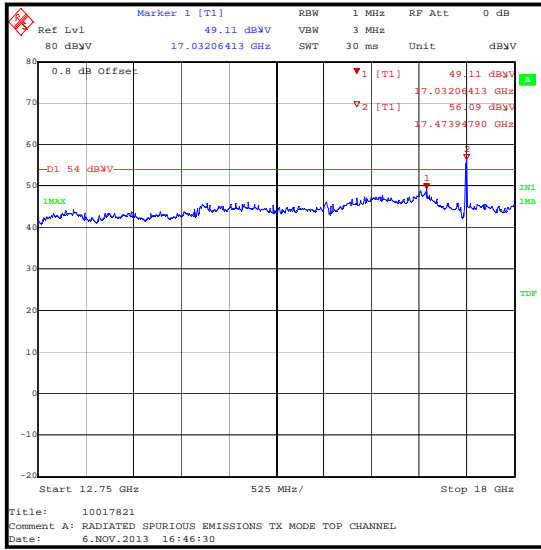
Results: Average Hopping Mode

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
5094.804	Vertical	45.0	54.0	9.0	Complied
5400.314	Vertical	45.9	54.0	8.1	Complied
11626.716	Vertical	26.8	54.0	27.2	Complied

Transmitter Radiated Emissions (continued)



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)
A253	Antenna	Flann Microwave	12240-20	128	31 Jan 2014	12
A254	Antenna	Flann Microwave	14240-20	139	31 Jan 2014	12
A255	Antenna	Flann Microwave	16240-20	519	31 Jan 2014	12
A256	Antenna	Flann Microwave	18240-20	400	31 Jan 2014	12
A436	Antenna	Flann Microwave	20240-20	330	31 Jan 2014	12
A1393	Attenuator	Huber & Suhner	6820.17.B	757456	10 May 2014	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	10 May 2014	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	31 Jan 2014	12
A1818	Antenna	EMCO	3115	00075692	31 Jan 2014	12
A2176	High Pass Filter	AtlanTec RF	AFH-07000	800980	10 May 2014	12
A2133	Low Pass Filter	AtlanTec RF	AFL-04000	JFB1006-002	26 Apr 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	31 Jan 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	24 May 2014	12
A203	Antenna	Flann Microwave	22240-20	343	19 May 2016	36
M1630	Test Receiver	Rohde & Schwarz	ESU 40	100233	07 Feb 2014	12
S0537	DC power supply	TTI	EL302D	249928	Calibrated before use	-
M1251	Multimeter	Fluke	175	89170179	12 Aug 2014	12

5.2.8. Transmitter Band Edge Radiated Emissions**Test Summary:**

Test Engineer:	Andrew Edwards	Test Date:	06 November 2013
Test Sample Serial Number:	0000001003		

FCC Reference:	15.247(d)
Test Method Used:	ANSI C63.10 Section 6.9.2

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	45

Note(s):

1. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss.
2. As both lower and upper band edges fall within the non-restricted band only peak measurements are required. 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 couple 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. A marker placed was placed at the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent band (where a higher level emission was present). Marker frequencies and levels were recorded.

Transmitter Band Edge Radiated Emissions (continued)**Results: Static Mode**

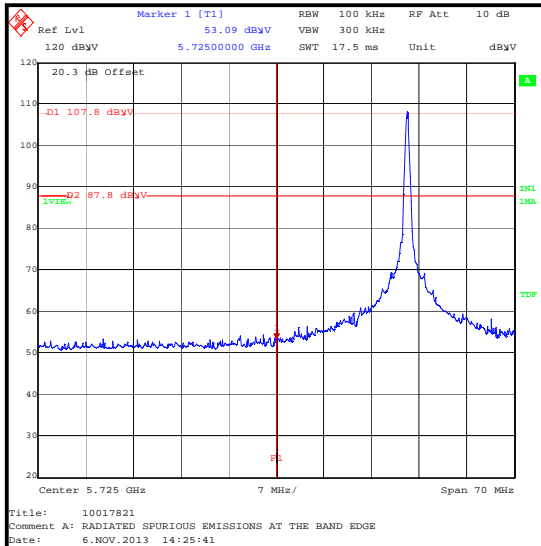
Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
5725	Vertical	53.1	87.8	34.7	Complied
5850	Vertical	53.1	84.5	31.4	Complied

Results: Hopping Mode

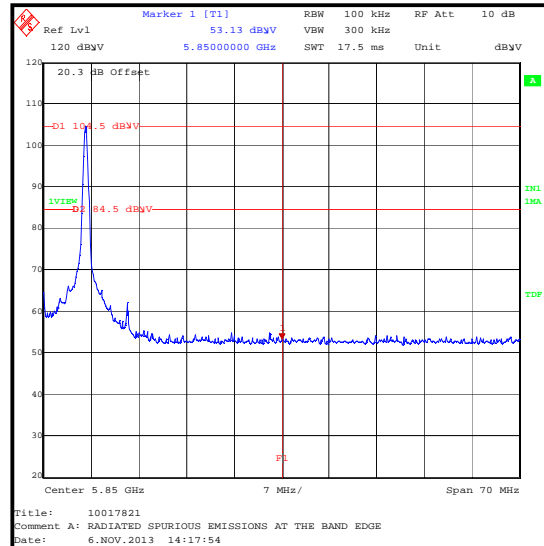
Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
5711.814	Vertical	61.3	87.8	26.5	Complied
5725	Vertical	51.9	87.8	35.9	Complied
5850	Vertical	52.7	85.5	32.8	Complied
5857.996	Vertical	54.4	85.5	31.1	Complied

Transmitter Band Edge Radiated Emissions (continued)

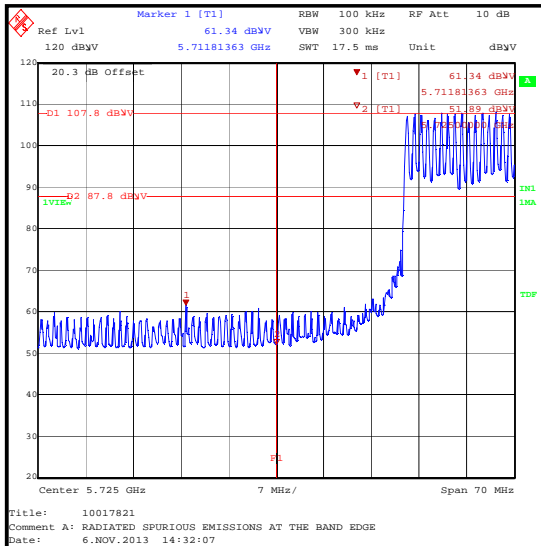
Results:



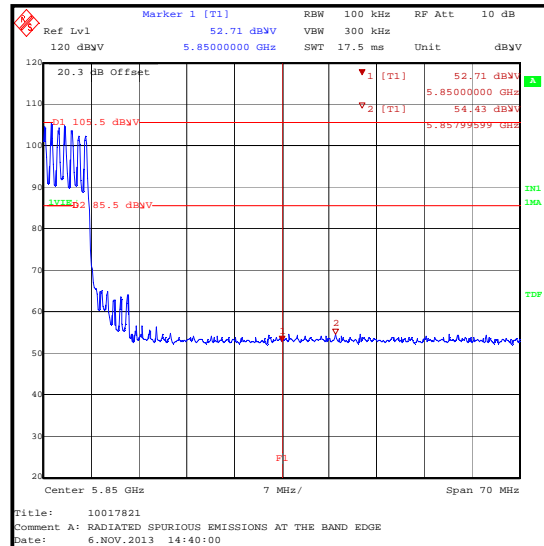
Lower Band Edge Peak Static



Upper Band Edge Peak Static



Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping

Transmitter Band Edge Radiated Emissions (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A253	Antenna	Flann Microwave	12240-20	128	31 Jan 2014	12
A1393	Attenuator	Huber & Suhner	6820.17.B	757456	10 May 2014	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	31 Jan 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	31 Jan 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	24 May 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
Conducted Maximum Peak Output Power	5725 MHz to 5850 MHz	95%	±1.13 dB
Carrier Frequency Separation	5725 MHz to 5850 MHz	95%	±3.92%
Average Time of Occupancy	5725 MHz to 5850 MHz	95%	±0.3 ns
20 dB Bandwidth	5725 MHz to 5850 MHz	95%	±3.92%
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 MHz to 40 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	1 & 7	-	Changed Model No.
	1 & 7	-	Changed FCC ID
	7	-	Updated Section 3.2, Description of EUT
	8	-	Section 3.4. Changed maximum output power from 16 to 14.4 dBm
	10	-	Added antenna A40518G4W and Note 4
	All	-	Removed Industry Canada references at the request of the TCB
3.0	10	-	Removed 3 dBi gain antennas at the request of the TCB

---END OF REPORT---