



# TEST REPORT

**Test Report No. :** UL-RPT-RP10014952JD03A V2.0

**Manufacturer** : Sony Mobile Communications AB  
**Type No.** : PM-0500-BV  
**FCC ID** : PY7PM-0500  
**Technology** : WLAN  
**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:** 29 July 2013

**Checked by:**

Sarah Williams  
WiSE Laboratory Engineer

**Issued by :**

pp

John Newell  
Group Quality Manager, WiSE  
Basingstoke,  
UL VS LTD



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

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**1. Customer Information**









<b>Company Name:</b>	Sony Mobile Communications AB
<b>Address:</b>	Nya Vattentorget Lund SE-221 88 Sweden

## **2. Summary of Testing**

### **2.1. General Information**

<b>Specification Reference:</b>	47CFR15.247
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Section 15.247
<b>Specification Reference:</b>	47CFR15.207 and 47CFR15.209
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Sections 15.207 and 15.209
<b>Site Registration:</b>	FCC: 209735
<b>Location of Testing:</b>	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
<b>Test Dates:</b>	04 July 2013 to 17 July 2013

### **2.2. Summary of Test Results**

<b>FCC Reference (47CFR)</b>	<b>Measurement</b>	<b>Result</b>
Part 15.207	Transmitter AC Conducted Emissions	
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	
Part 15.35€	Transmitter Duty Cycle	Note 1
Part 15.247€	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	
<b>Key to Results</b>		
 = Complied  = Did not comply		

#### **Note(s):**

1. The measurement was performed to assist in the calculation of the level of maximum conducted output power, power spectral density and emissions. The EUT cannot transmit continuously and sweep triggering/signal gating cannot be implemented.

### **2.3. Methods and Procedures**

<b>Reference:</b>	ANSI C63.4 (2009)
<b>Title:</b>	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
<b>Reference:</b>	ANSI C63.10 (2009)
<b>Title:</b>	American National Standard for Testing Unlicensed Wireless Devices
<b>Reference:</b>	KDB 558074 D01 v03 April 9, 2013
<b>Title:</b>	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247
<b>Reference:</b>	KDB 644545 D02 v01 6/7/2012
<b>Title:</b>	Alternative Guidance for IEEE 802.11ac and Pre-ac Device Emissions Testing

### **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)**

<b>Brand Name:</b>	Sony
<b>IMEI:</b>	004402146858703 ( <i>Radiated sample</i> )
<b>Serial Number:</b>	CB5124U7HK
<b>Hardware Version Number:</b>	AP2
<b>Software Version Number:</b>	14.1.G.1.184
<b>FCC ID:</b>	PY7PM-0500

<b>Brand Name:</b>	Sony
<b>IMEI:</b>	004402146855113 ( <i>Conducted sample</i> )
<b>Serial Number:</b>	CB5124U74T
<b>Hardware Version Number:</b>	AP2
<b>Software Version Number:</b>	14.1.G.1.184
<b>FCC ID:</b>	PY7PM-0500

<b>Brand Name:</b>	Sony
<b>Description:</b>	AC Charger
<b>Model Name or Number:</b>	EP880

<b>Brand Name:</b>	Generic
<b>Description:</b>	MHL Cable
<b>Model Name or Number:</b>	Not marked or stated

<b>Brand Name:</b>	Sony
<b>Description:</b>	MHL Adaptor
<b>Model Name or Number:</b>	IM750

<b>Brand Name:</b>	Sony
<b>Description:</b>	Magnetic Plug
<b>Model Name or Number:</b>	EC21

<b>Brand Name:</b>	Sony
<b>Description:</b>	Charge/USB Data cable
<b>Model Name or Number:</b>	EC801

**Identification of Equipment Under Test (EUT) (continue)**

<b>Brand Name:</b>	Sony
<b>Description:</b>	PHF
<b>Model Name or Number:</b>	MH750

**3.2. Description of EUT**

The equipment under test (EUT) is a model of GSM/UMTS/LTE mobile phone with integrated antenna and inbuilt Li-Polymer battery.

The EUT supports GSM 850/900/1800/1900MHz bands, WCDMA FDD bands 1/2/4/5/8. It also supports GPRS service with multi-slots class 33 and EGPRS service with multi-slots class 33 too. The HSDPA and HSUPA features are also supported. It has MP3, camera, FM radio, USB memory, GPS receiver, NFC, Mobile High-Definition Link (MHL), Bluetooth (EDR and Bluetooth 4.0), WLAN (802.11 a/b/g/n/ac) and Wi-Fi hotspot functions.

**3.3. Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.



**3.4. Additional Information Related to Testing**

<b>Technology Tested:</b>	WLAN (IEEE 802.11b,g,n) / Digital Transmission System		
<b>Type of Unit:</b>	Transceiver		
<b>Modulation Type:</b>	DBPSK, DQPSK, BPSK, QPSK, 16QAM & 64QAM		
<b>Data Rates:</b>	802.11b	1, 2, 5.5 & 11 Mbps	
	802.11g	6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11n HT20	MCS0 to MCS7 (1 spatial stream) GI = 800 ns or 400 ns Greenfield & Mixed modes	
<b>Power Supply Requirement(s):</b>	Nominal	3.8 V	
<b>Maximum Conducted Output Power:</b>	20.6 dBm		
<b>Declared Antenna Gain:</b>	-4.7 dBi		
<b>Channel Spacing:</b>	20 MHz		
<b>Transmit Frequency Range:</b>	2412 MHz to 2462 MHz		
<b>Transmit Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	Bottom	1	2412
	Middle	6	2437
	Top	11	2462
<b>Transmit Frequency Range:</b>	5725 MHz to 5850 MHz		
<b>Transmit Channels (see Note 1):</b>	<b>Channel ID</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	Bottom	149	5745
	Middle	157	5785
	Top	165	5825

**Note(s):**

1. In accordance with FCC KDB 644545 D02, the testing of the 5 GHz frequency range has been covered in the 15.407 test report UL-RPT-RP10014948JD15A.

### **3.5. Support Equipment**

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

<b>Description:</b>	Laptop
<b>Brand Name:</b>	Dell
<b>Model Name or Number:</b>	Latitude E5400
<b>Serial Number:</b>	01150

<b>Description:</b>	2 GB Micro SD Card
<b>Brand Name:</b>	Generic
<b>Model Name or Number:</b>	Not marked or stated

<b>Brand Name:</b>	Logik
<b>Description:</b>	22" High Definition Television
<b>Model Name or Number:</b>	L22FE12A
<b>Serial Number:</b>	1309020661

## **4. Operation and Monitoring of the EUT during Testing**

### **4.1. Operating Modes**

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

- Continuously transmitting with a modulated carrier at maximum power on the bottom, middle and top channels as required using the supported data rates/modulation types.

### **4.2. Configuration and Peripherals**

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

- Controlled using a bespoke application on the laptop PC supplied by the Customer. The application was used to enable a continuous transmission mode and to select the test channels, data rates and modulation schemes as required.
- All supported modes and channel widths were initially investigated on one channel. The modes that produced the highest output power, highest power spectral density, narrowest and widest bandwidths were:
  - Highest output power
    - 802.11b – DQPSK / 11 Mbps
    - 802.11g – BPSK / 6 Mbps
    - 802.11n HT20 – 16QAM / 43.3 Mbps / MCS4 (GI = 400 ns)
  - Highest power spectral density
    - 802.11b – DQPSK / 11 Mbps
    - 802.11g – 16QAM / 36 Mbps
    - 802.11n HT20 – 16QAM / 43.3 Mbps / MCS4 (GI = 400 ns)
  - Narrowest bandwidth (DTS bandwidth / 6 dB)
    - 802.11b – DQPSK / 11 Mbps
    - 802.11g – BPSK / 6 Mbps
    - 802.11n HT20 – BPSK / 7.2 Mbps / MCS0 (GI = 400 ns)
  - Widest bandwidth (Occupied bandwidth / 99%)
    - 802.11b – DBPSK / 1 Mbps
    - 802.11g – BPSK / 6 Mbps
    - 802.11n HT20 – BPSK / 6.5 Mbps / MCS0 (GI = 800 ns)
- Transmitter spurious emissions were performed with the EUT transmitting with a data rate of 11 Mbps. This was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and, as this mode emits the highest output power level, it was deemed to be the worst case.

**Configuration and Peripherals (continued)**

- Transmitter radiated spurious emission tests were performed with the following configurations, employing all available accessories:
  - Configuration 1 – Handset with the AC charger, USB Cable, MHL cable (terminated in to a television), MHL adaptor and PHF
  - Configuration 2 – Handset with the AC charger, Magnetic plug and PHF
- Pre-scans below 1 GHz were performed in both configurations 1 and 2, with final measurements limited to the configuration which provided worst case results. Pre-scans above 1 GHz were performed in the configuration that employed the most accessories (Configuration 1), with any final measurements being performed in both configurations. Radiated emissions tests were performed with all unused ports terminated.
- The conducted sample with IMEI 004402146855113 was used for minimum 6 dB bandwidth, duty cycle, maximum output power and power spectral density tests.
- The radiated sample with IMEI 004402146858703 was used for all other 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:**

<b>Test Engineer:</b>	Nick Steele	<b>Test Date:</b>	14 July 2013
<b>Test Sample IMEI:</b>	004402146858703		

<b>FCC Reference:</b>	Part 15.207
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.2 referencing ANSI C63.4

**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	58

**Results: Live / Quasi Peak**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
1.010	Live	38.3	56.0	17.7	Complied
1.136	Live	39.3	56.0	16.7	Complied
1.149	Live	39.9	56.0	16.1	Complied
1.221	Live	40.9	56.0	15.1	Complied
1.226	Live	40.0	56.0	16.0	Complied
1.356	Live	42.6	56.0	13.4	Complied
1.361	Live	42.6	56.0	13.4	Complied
1.392	Live	39.6	56.0	16.4	Complied
1.613	Live	39.3	56.0	16.7	Complied
1.685	Live	38.9	56.0	17.1	Complied

**Results: Live / Average**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.452	Live	27.3	46.8	19.5	Complied
0.834	Live	26.6	46.0	19.4	Complied
0.902	Live	27.1	46.0	18.9	Complied
1.217	Live	28.7	46.0	17.3	Complied
1.478	Live	28.4	46.0	17.6	Complied
17.471	Live	31.8	50.0	18.2	Complied
17.471	Live	32.2	50.0	17.8	Complied
17.534	Live	29.7	50.0	20.3	Complied

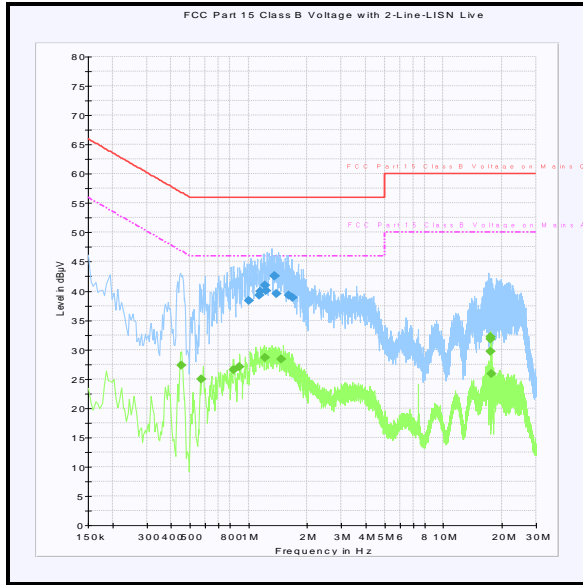
**Transmitter AC Conducted Spurious Emissions (continued)****Results: Neutral / Quasi Peak**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.470	Neutral	32.7	56.5	23.8	Complied
0.839	Neutral	31.4	56.0	24.6	Complied
1.190	Neutral	32.9	56.0	23.1	Complied
1.293	Neutral	32.4	56.0	23.6	Complied

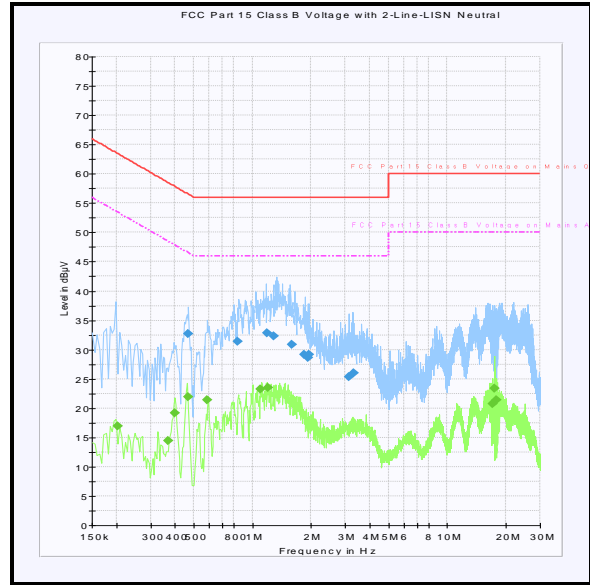
**Results: Neutral / Average**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.470	Neutral	22.0	46.5	24.5	Complied
0.582	Neutral	21.4	46.0	24.6	Complied
1.104	Neutral	23.3	46.0	22.7	Complied
1.208	Neutral	23.5	46.0	22.5	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)
M1625	Thermometer / Hygrometer station	JM Handelpunkt	30.5015.13	None stated	09 Jan 2014	12
A004	LISN	Rohde & Schwarz	ESH3-Z5	890604/027	30 Oct 2013	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	19 Feb 2014	12
M1020	Test Receiver	Rohde & Schwarz	SME-03	834617/030	14 Dec 2013	12



**5.2.2. Transmitter Minimum 6 dB Bandwidth****Test Summary:**

<b>Test Engineer:</b>	Nick Steele	<b>Test Dates:</b>	04 July 2013 & 05 July 2013
<b>Test Sample IMEI:</b>	004402146855113		

<b>FCC Reference:</b>	Part 15.247(a)(2)
<b>Test Method Used:</b>	As detailed in FCC KDB 558074 Section 8.1

**Environmental Conditions:**

<b>Temperature (°C):</b>	22 to 23
<b>Relative Humidity (%):</b>	36 to 38

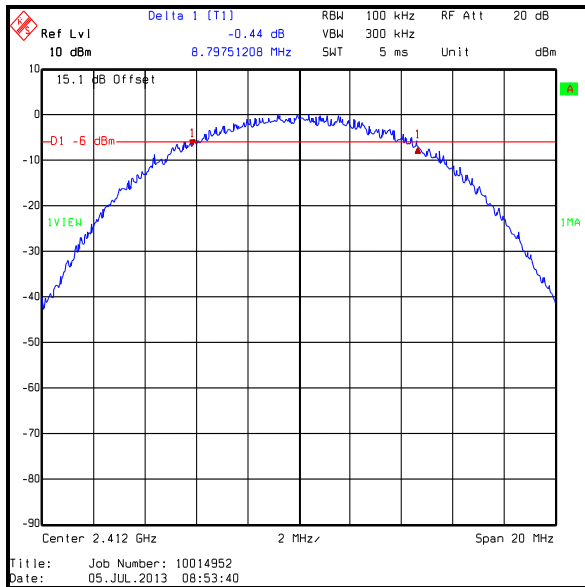
**Note(s):**

1. All configurations supported by the EUT were investigated on one channel in accordance with KDB 558074 Section 8.1 Option 1 measurement procedure. The data rates that produced the narrowest bandwidth and therefore deemed worst case were:
  - 802.11b – DQPSK / 11 Mbps
  - 802.11g – BPSK / 6 Mbps
  - 802.11n HT20 – BPSK / 7.2 Mbps / MCS0 (GI = 400 ns)
2. Final measurements were performed using the above configurations on the bottom, middle and top channels.
3. Plots for all data rates are archived on the Company server and available for inspection upon request.
4. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

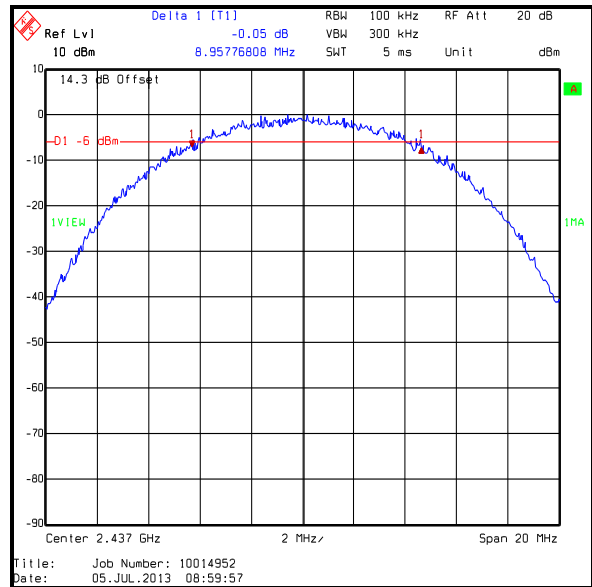
**Transmitter Minimum 6 dB Bandwidth (continued)**

**Results: 802.11b / 20 MHz / DQPSK / 11 Mbps**

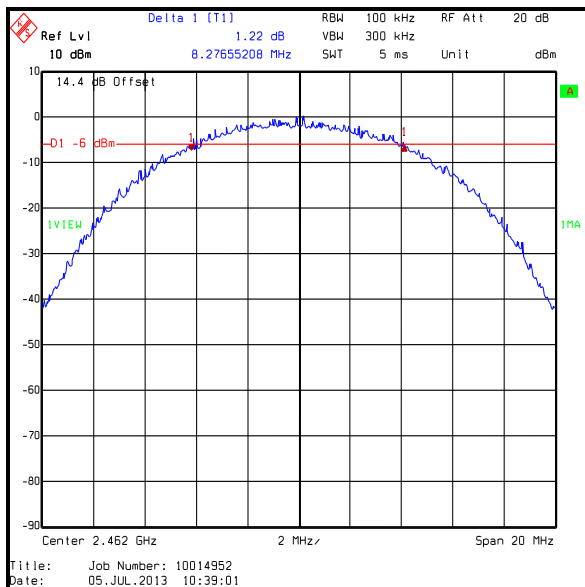
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	8797.512	≥500	8297.512	Complied
Middle	8957.768	≥500	8457.768	Complied
Top	8276.552	≥500	7776.552	Complied



**Bottom Channel**



**Middle Channel**

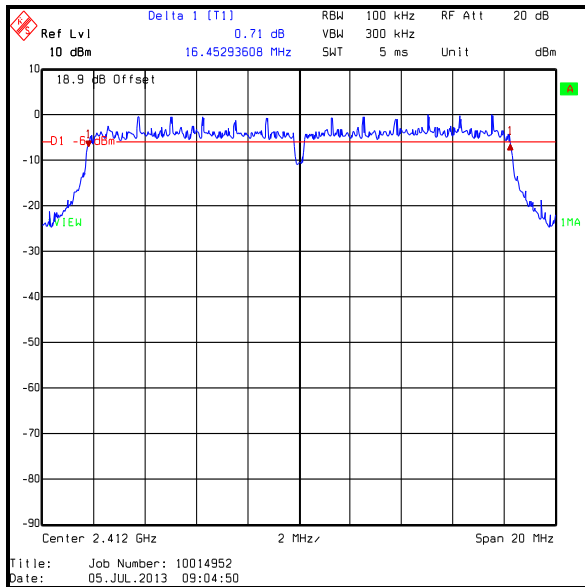


**Top Channel**

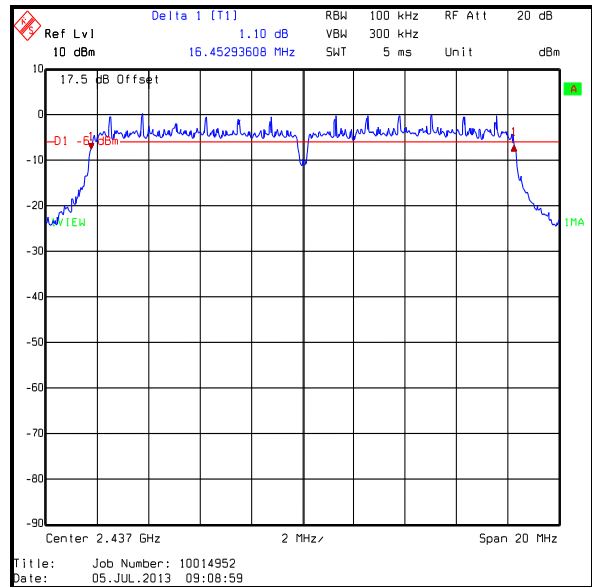
**Transmitter Minimum 6 dB Bandwidth (continued)**

**Results: 802.11g / 20 MHz / BPSK / 6 Mbps**

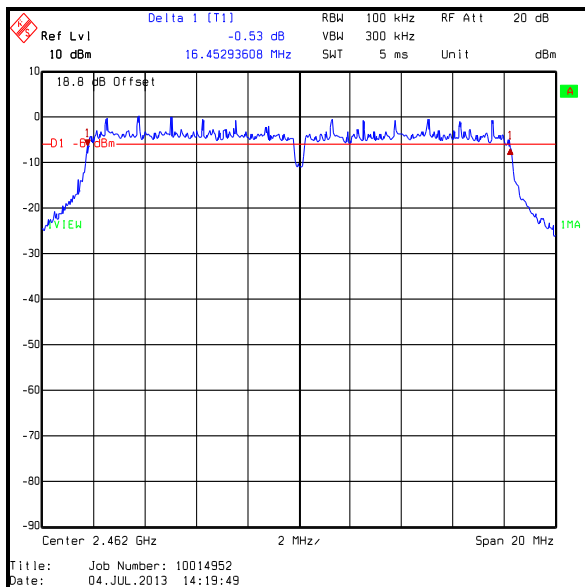
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	16452.936	≥500	15952.936	Complied
Middle	16452.936	≥500	15952.936	Complied
Top	16452.936	≥500	15952.936	Complied



**Bottom Channel**



**Middle Channel**

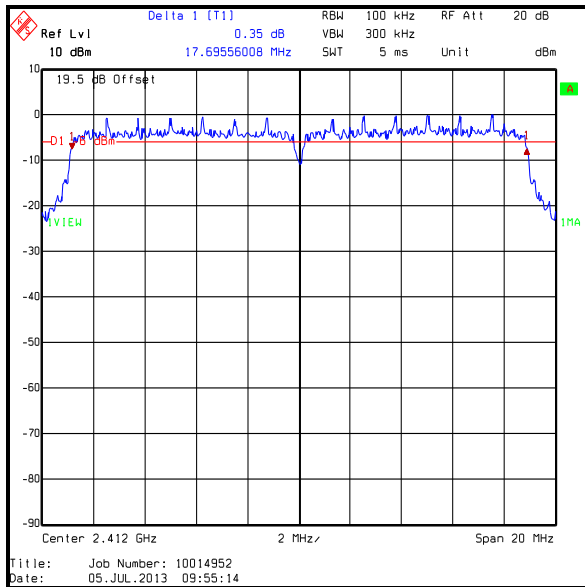


**Top Channel**

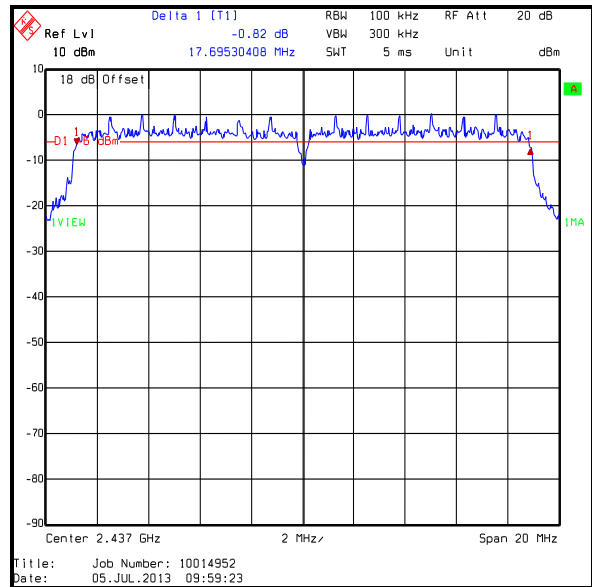
**Transmitter Minimum 6 dB Bandwidth (continued)**

**Results: 802.11n / 20 MHz / BPSK / 7.2 Mbps / MCS0**

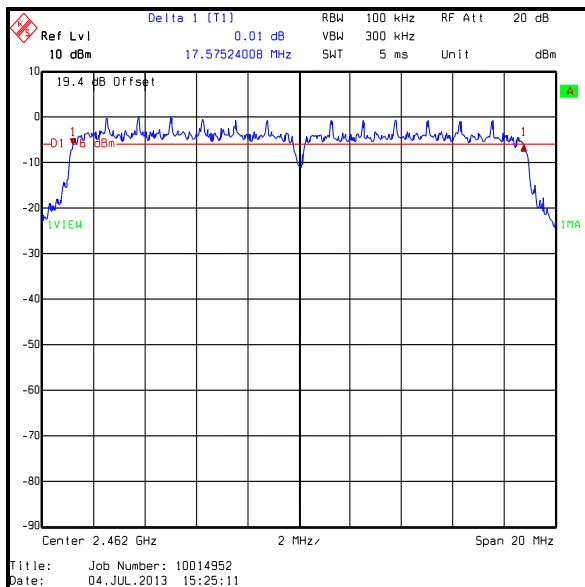
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	17695.560	≥500	17195.560	Complied
Middle	17695.304	≥500	17195.304	Complied
Top	17575.240	≥500	17075.240	Complied



**Bottom Channel**



**Middle Channel**



**Top Channel**

**Transmitter Minimum 6 dB Bandwidth (continued)****Test Equipment Used:**

<b>Asset No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval (Months)</b>
M1659	Thermometer / Hygrometer station	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	13 Aug 2013	12
A1999	Attenuator	Huber + Suhner	6820.17.B	07101	05 Apr 2014	12
M1269	Multimeter	Fluke	179	90250210	30 Jul 2013	12
S0520	DC Power Supply	GW Instek	GPC-3030	E835141	Calibrated before use	-

**5.2.3.Transmitter Duty Cycle****Test Summary:**

<b>Test Engineer:</b>	Nick Steele	<b>Test Date:</b>	14 July 2013
<b>Test Sample IMEI:</b>	004402146855113		

<b>FCC Reference:</b>	Part 15.35€
<b>Test Method Used:</b>	As detailed in FCC KDB 558074 Section 6.0

**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	44

**Note(s):**

- In order to assist with the determination of the average level of fundamental and spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

$$10 \log (1 / (\text{On Time} / [\text{Period or } 100 \text{ ms whichever is the lesser}])).$$

$$802.11g / 6 \text{ Mbps duty cycle } 10 \log (1 / (1.350/1.378)) = 0.1 \text{ dB}$$

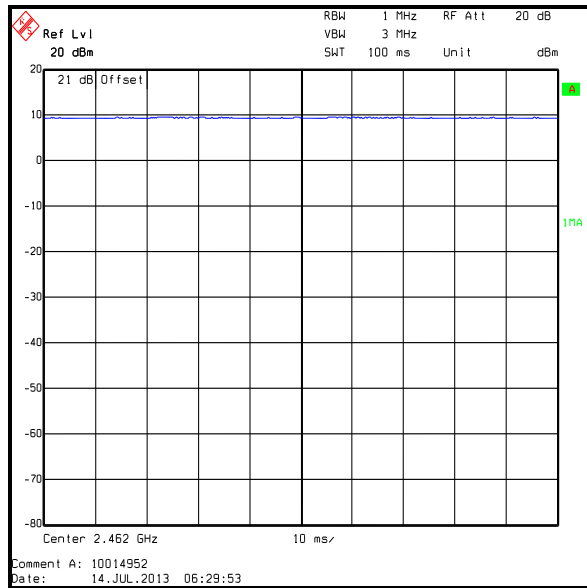
$$802.11g / 36 \text{ Mbps duty cycle } 10 \log (1 / (0.235/0.253)) = 0.3 \text{ dB}$$

$$802.11n \text{ HT20} / 43.3 \text{ Mbps MCS4 GI=400 ns duty cycle: } 10 \log (1 / (0.213/0.232)) = 0.4 \text{ dB}$$

- For 802.11b, the duty cycle was measured to be greater than 98%. Plots have been taken over 100 ms and can be seen below.

**Transmitter Duty Cycle (continued)**

**Results: 802.11b / 20 MHz**



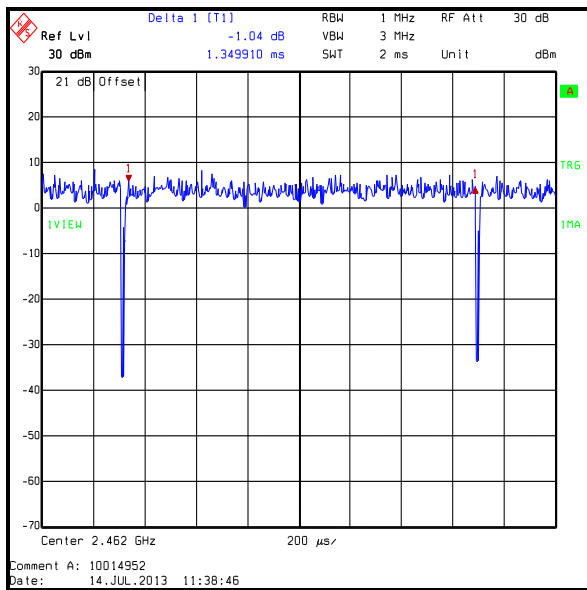
**11 Mbps / 100 ms**

**Transmitter Duty Cycle (continued)**

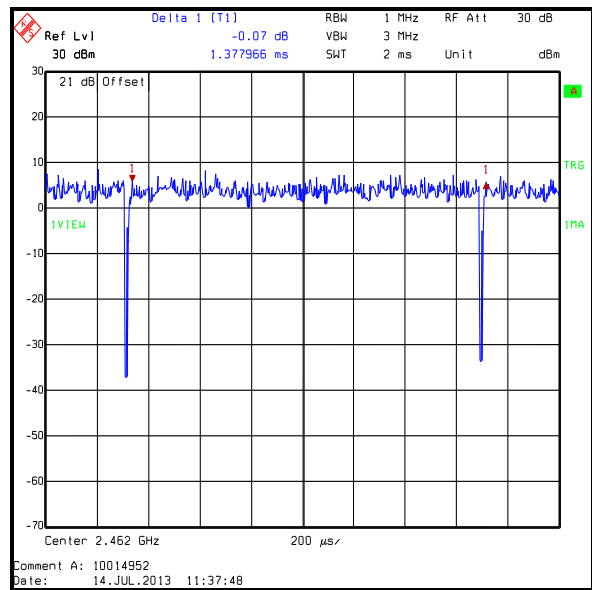
**Results: 802.11g / 20 MHz / 6 Mbps**

Pulse Duration (ms)	Duty Cycle (dB)
1.350	0.1

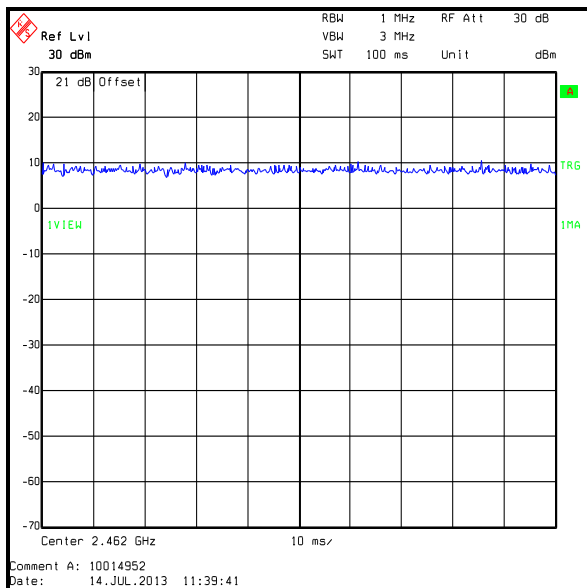
Period (ms)
1.378



**TX on time**



**TX on + off time / period**



**100 ms**

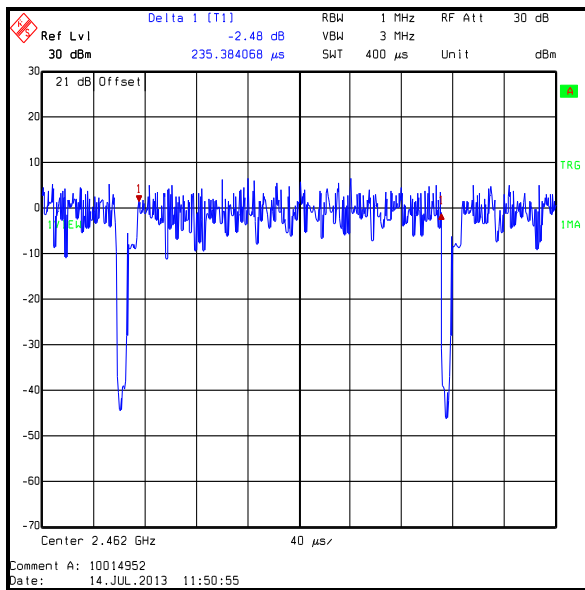


**Transmitter Duty Cycle (continued)**

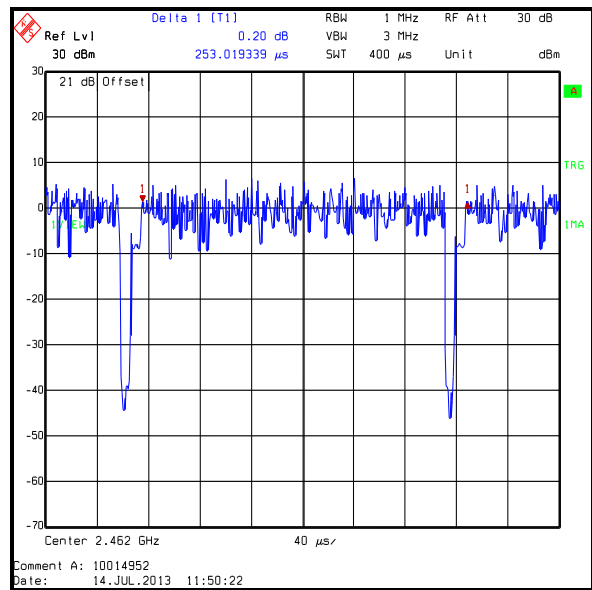
**Results: 802.11g / 20 MHz / 36 Mbps**

Pulse Duration (ms)	Duty Cycle (dB)
0.235	0.3

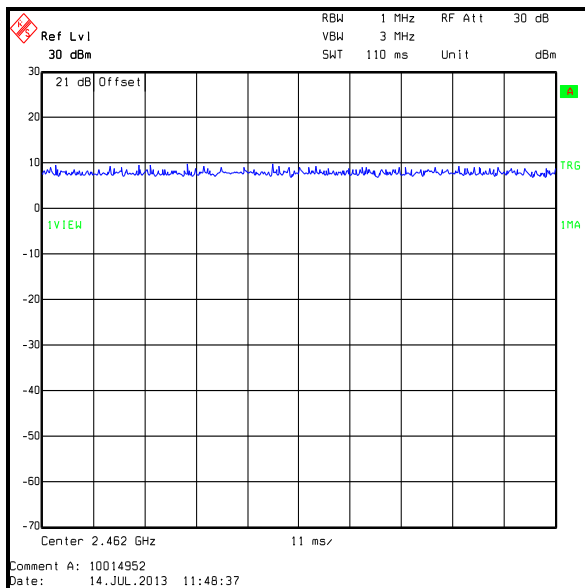
Period (ms)
0.253



**TX on time**



**TX on + off time / period**



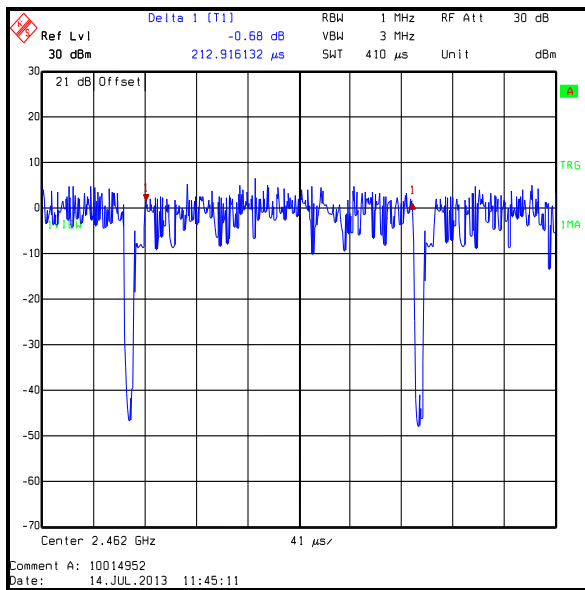
**100 ms**

**Transmitter Duty Cycle (continued)**

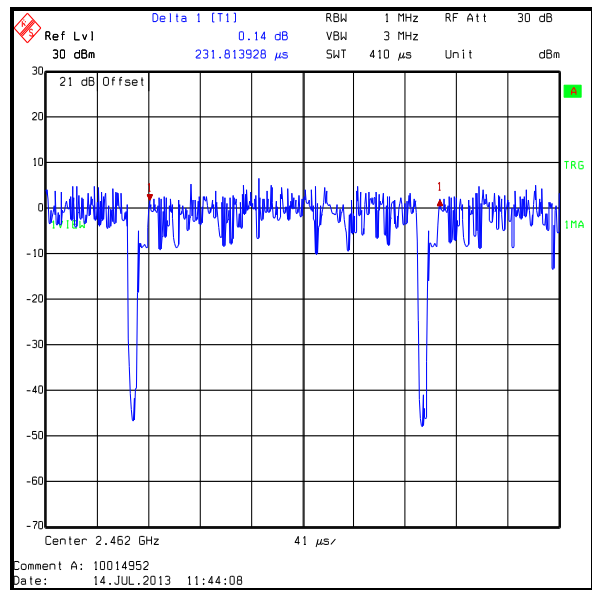
**Results: 802.11n / 20 MHz / 43.3 Mbps / MCS4**

Pulse Duration (ms)	Duty Cycle (dB)
0.213	0.4

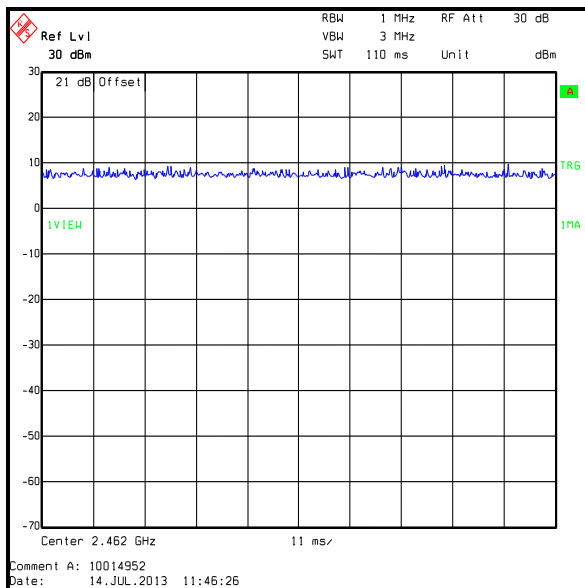
Period (ms)
0.232



**TX on time**



**TX on + off time / period**



**100 ms**

**Transmitter Duty Cycle (continued)****Test Equipment Used:**

<b>Asset No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval (Months)</b>
M1659	Thermometer / Hygrometer station	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	13 Aug 2013	12
A1999	Attenuator	Huber + Suhner	6820.17.B	07101	05 Apr 2014	12
M1269	Multimeter	Fluke	179	90250210	30 Jul 2013	12
S0520	DC Power Supply	GW Instek	GPC-3030	E835141	Calibrated before use	-

**5.2.4. Transmitter Power Spectral Density****Test Summary:**

<b>Test Engineer:</b>	Nick Steele	<b>Test Dates:</b>	04 July 2013 & 05 July 2013
<b>Test Sample IMEI:</b>	004402146855113		

<b>FCC Reference:</b>	Part 15.247€
<b>Test Method Used:</b>	As detailed in FCC KDB 558074 Sections 10.2 & 10.6

**Environmental Conditions:**

<b>Temperature (°C):</b>	22 to 23
<b>Relative Humidity (%):</b>	36 to 38

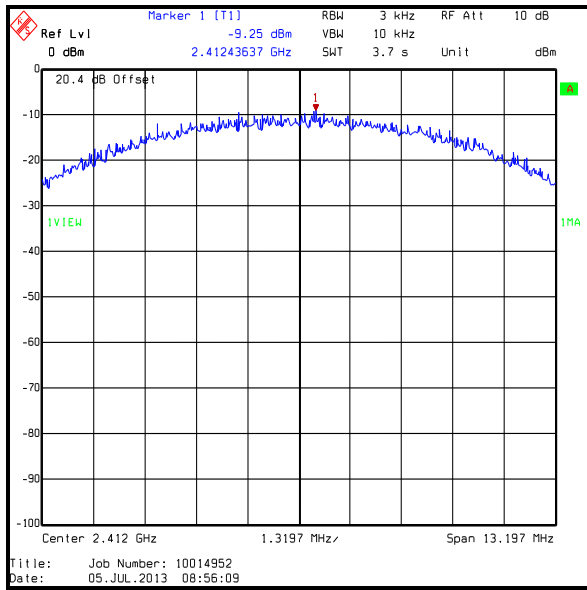
**Note(s):**

- All configurations supported by the EUT were investigated on one channel in accordance with KDB 558074 Section 10.6 measurement procedure Method AVGPS-2 Alternative. The data rates that produced the highest power and therefore deemed worst case were:
  - 802.11b – DQPSK / 11 Mbps
  - 802.11g – 16QAM / 36 Mbps
  - 802.11n HT20 – 16QAM / 43.3 Mbps / MCS4 (GI = 400 ns)
- Final measurements were performed using the above configurations on the bottom, middle and top channels.
- For 802.11b, the EUT was transmitting at 100% duty cycle and testing was performed in accordance with KDB 558074 Section 10.2.
- For 802.11g and 802.11n, the EUT was transmitting at <98% duty cycle. The calculated duty cycle in section 5.2.3 was added to the measured average power spectral density in order to compute the average power spectral density during the actual transmission time.
- The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the spectrum analyser to compensate for the loss of the attenuator and RF cable.

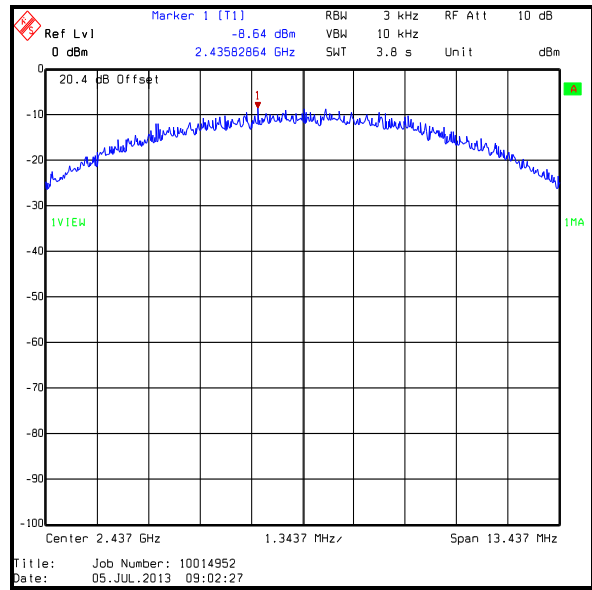
**Transmitter Power Spectral Density (continued)**

**Results: 802.11b / 20 MHz / DQPSK / 11 Mbps**

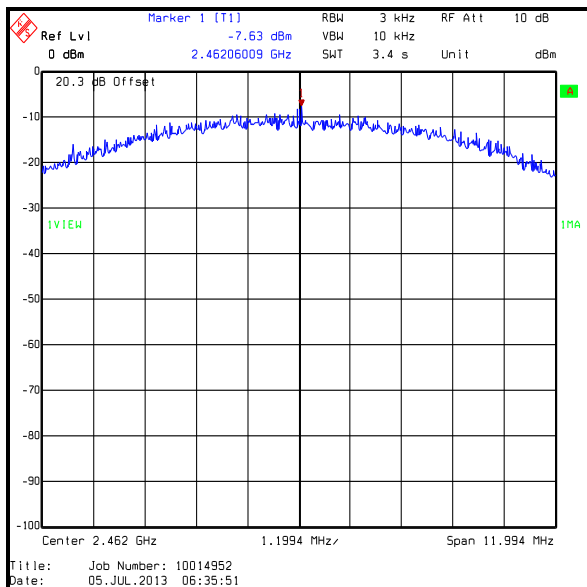
Channel	Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-9.3	8.0	17.3	Complied
Middle	-8.6	8.0	16.6	Complied
Top	-7.6	8.0	15.6	Complied



**Bottom Channel**



**Middle Channel**

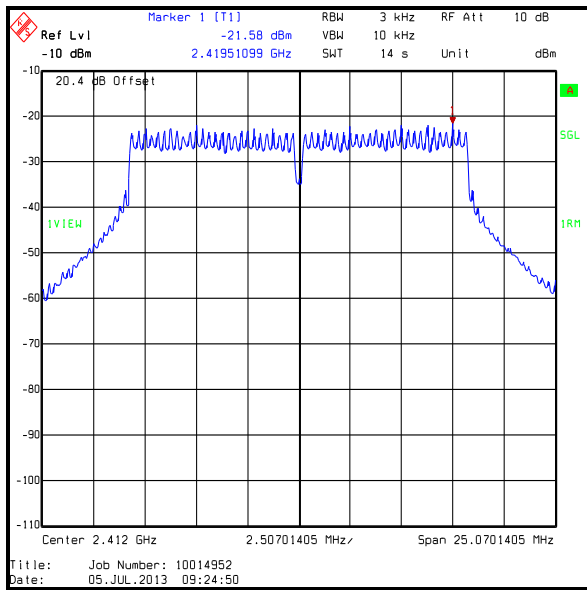


**Top Channel**

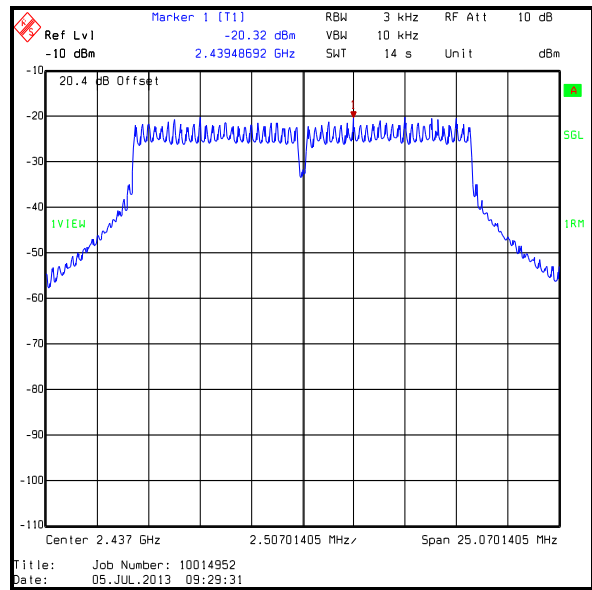
**Transmitter Power Spectral Density (continued)**

**Results: 802.11g / 20 MHz / 16QAM / 36 Mbps**

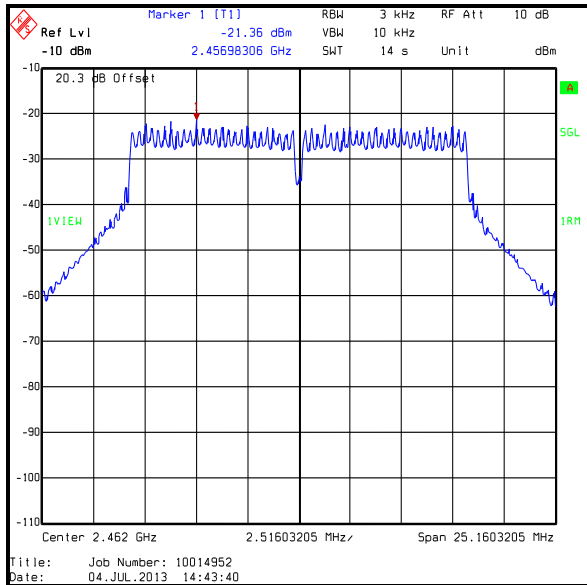
Channel	Output Power (dBm/3 kHz)	Duty cycle correction (dB)	Corrected Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-21.6	0.3	-21.3	8.0	29.3	Complied
Middle	-20.3	0.3	-20.0	8.0	28.0	Complied
Top	-21.4	0.3	-21.1	8.0	29.1	Complied



**Bottom Channel**



**Middle Channel**

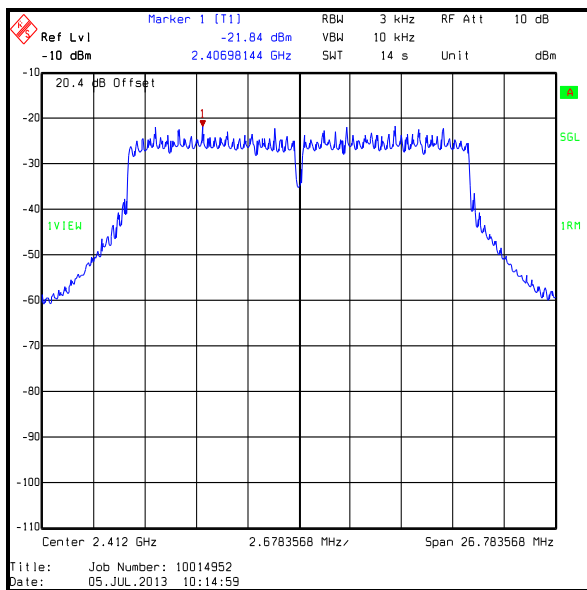


**Top Channel**

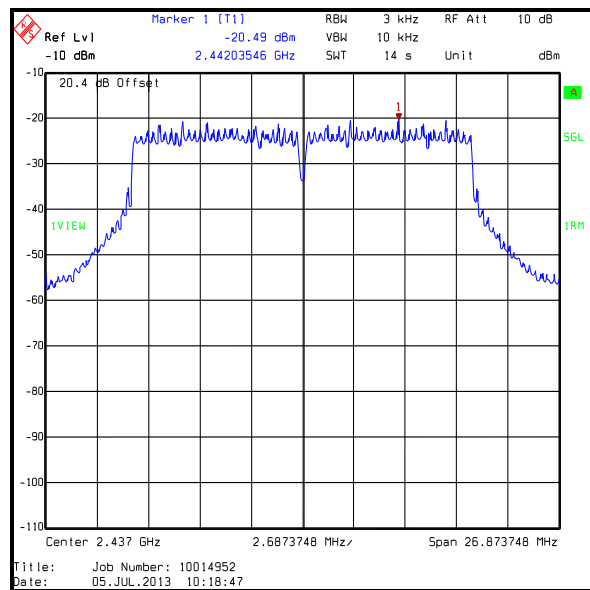
**Transmitter Power Spectral Density (continued)**

**Results: 802.11n / 20 MHz / 16QAM / 43.3 Mbps / MCS4**

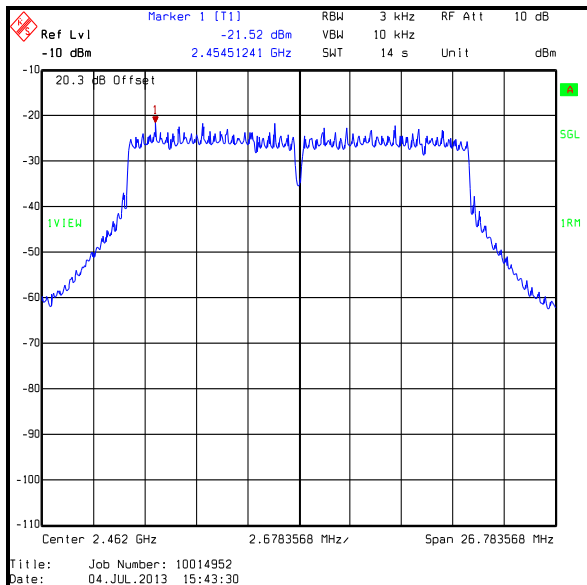
Channel	Output Power (dBm/3 kHz)	Duty cycle correction (dB)	Corrected Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-21.8	0.4	-21.4	8.0	29.4	Complied
Middle	-20.5	0.4	-20.1	8.0	28.1	Complied
Top	-21.5	0.4	-21.1	8.0	29.1	Complied



**Bottom Channel**



**Middle Channel**



**Top Channel**

**Transmitter Power Spectral Density (continued)****Test Equipment Used:**

<b>Asset No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval (Months)</b>
M1659	Thermometer / Hygrometer station	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	13 Aug 2013	12
A1999	Attenuator	Huber + Suhner	6820.17.B	07101	05 Apr 2014	12
M1269	Multimeter	Fluke	179	90250210	30 Jul 2013	12
S0520	DC Power Supply	GW Instek	GPC-3030	E835141	Calibrated before use	-



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

<b>Test Engineer:</b>	Nick Steele	<b>Test Dates:</b>	04 July 2013 & 05 July 2013
<b>Test Sample IMEI:</b>	004402146855113		

<b>FCC Reference:</b>	Part 15.247(b)(3)
<b>Test Method Used:</b>	As detailed in FCC KDB 558074 Sections 9.1.2 & 9.2.2.5

**Environmental Conditions:**

<b>Temperature (°C):</b>	22 to 23
<b>Relative Humidity (%):</b>	36 to 38

**Note(s):**

1. All configurations supported by the EUT were investigated on one channel in accordance with KDB 558074 Section 9.2.2.5 measurement procedure AVGSA-2 Alternative. The data rates that produced the highest power and therefore deemed worst case were:
  - 802.11b – DQPSK / 11 Mbps
  - 802.11g – BPSK / 6 Mbps
  - 802.11n HT20 – 16QAM / 43.3 Mbps / MCS4 (GI = 400 ns)
2. Final measurements were performed using the above configurations on the bottom, middle and top channels.
3. For 802.11b, the EUT was transmitting at 100% duty cycle and testing was performed in accordance with KDB 558074 Section 9.1.2.
4. For 802.11g and 802.11n, the EUT was transmitting at <98% duty cycle. The calculated duty cycle in section 5.2.3 was added to the measured power in order to compute the average power during the actual transmission time.
5. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the spectrum analyser to compensate for the loss of the attenuator and RF cable.

**Transmitter Maximum Output Power (continued)****Results: 802.11b / 20 MHz / DQPSK / 11 Mbps****Conducted Peak Limit Comparison**

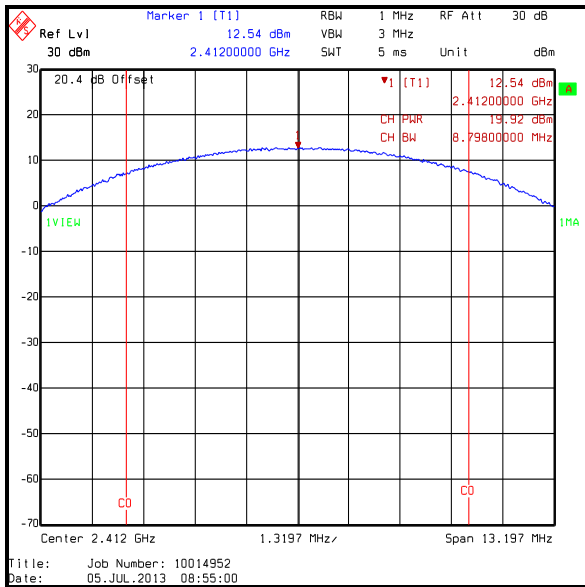
Channel	Conducted Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	19.9	30.0	10.1	Complied
Middle	20.6	30.0	9.4	Complied
Top	20.1	30.0	9.9	Complied

**De Facto EIRP Limit Comparison**

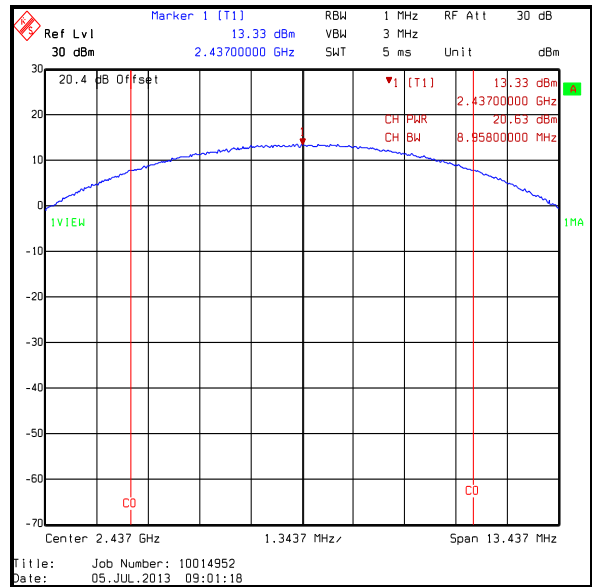
Channel	Conducted Power(dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	19.9	-4.7	15.2	36.0	20.8	Complied
Middle	20.6	-4.7	15.9	36.0	20.1	Complied
Top	20.1	-4.7	15.4	36.0	20.6	Complied

### Transmitter Maximum Output Power (continued)

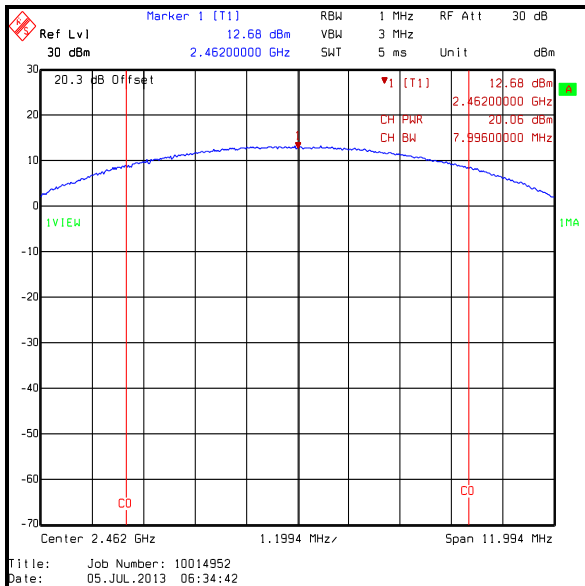
#### Results: 802.11b / 20 MHz / DQPSK / 11 Mbps



Bottom Channel



Middle Channel



Top Channel

**Transmitter Maximum Output Power (continued)****Results: 802.11g / 20 MHz / BPSK / 6 Mbps****Conducted Peak Limit Comparison**

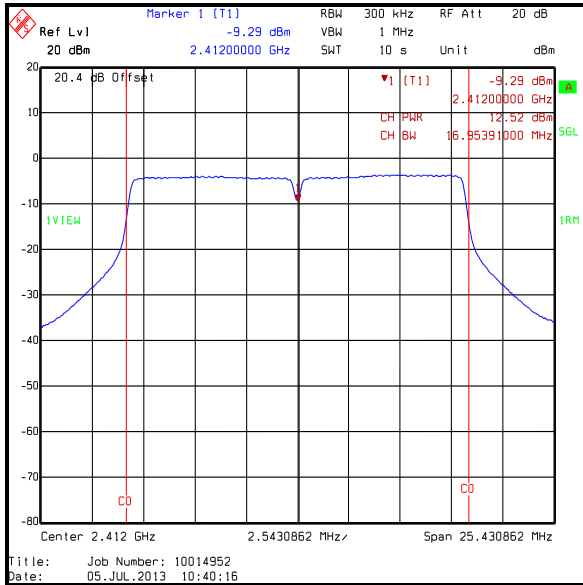
Channel	Conducted Power (dBm)	Duty cycle correction (dB)	Corrected Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	12.5	0.1	12.6	30.0	17.4	Complied
Middle	14.1	0.1	14.2	30.0	15.8	Complied
Top	12.5	0.1	12.6	30.0	17.4	Complied

**De Facto EIRP Limit Comparison**

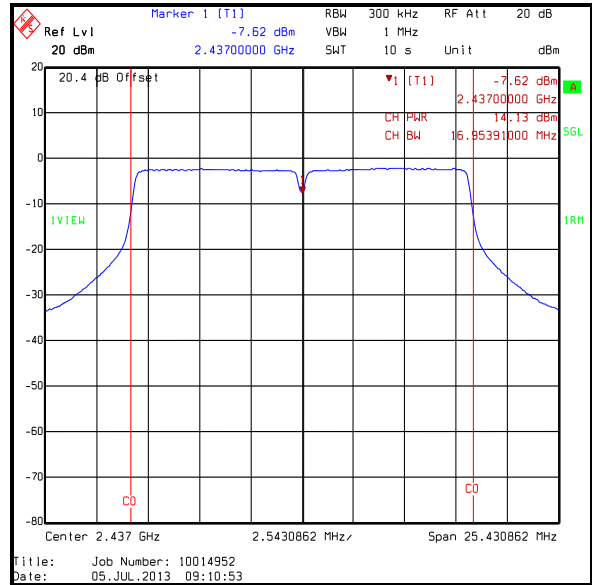
Channel	Corrected Conducted Power(dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	12.6	-4.7	7.9	36.0	28.1	Complied
Middle	14.2	-4.7	9.5	36.0	26.5	Complied
Top	12.6	-4.7	7.9	36.0	28.1	Complied

**Transmitter Maximum Output Power (continued)**

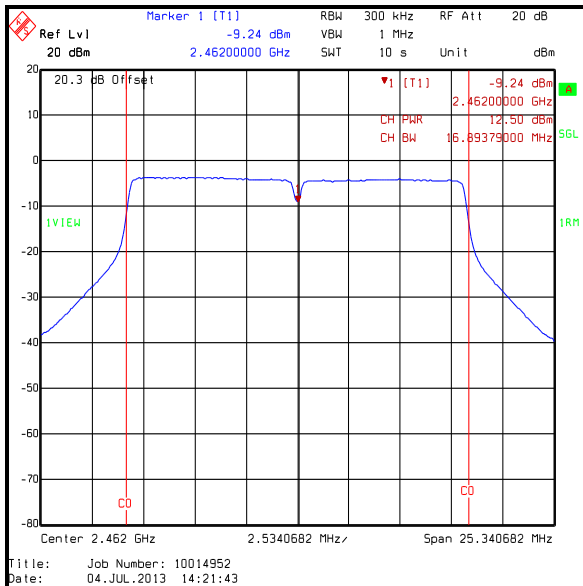
**Results: 802.11g / 20 MHz / BPSK / 6 Mbps**



**Bottom Channel**



**Middle Channel**



**Top Channel**

**Transmitter Maximum Output Power (continued)****Results: 802.11n / 20 MHz / 16QAM / 43.3 Mbps / MCS4****Conducted Peak Limit Comparison**

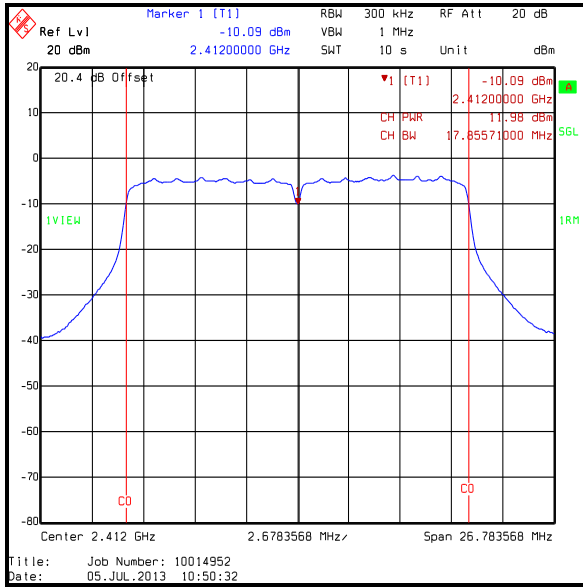
Channel	Conducted Power (dBm)	Duty cycle correction (dB)	Corrected Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	12.0	0.4	12.4	30.0	17.6	Complied
Middle	13.5	0.4	13.9	30.0	16.1	Complied
Top	12.0	0.4	12.4	30.0	17.6	Complied

**De Facto EIRP Limit Comparison**

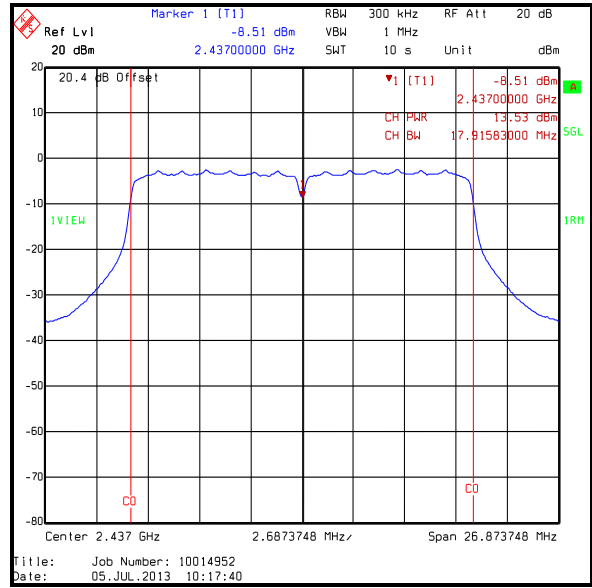
Channel	Corrected Conducted Power(dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	12.4	-4.7	7.7	36.0	28.3	Complied
Middle	13.9	-4.7	9.2	36.0	26.8	Complied
Top	12.4	-4.7	7.7	36.0	28.3	Complied

**Transmitter Maximum Output Power (continued)**

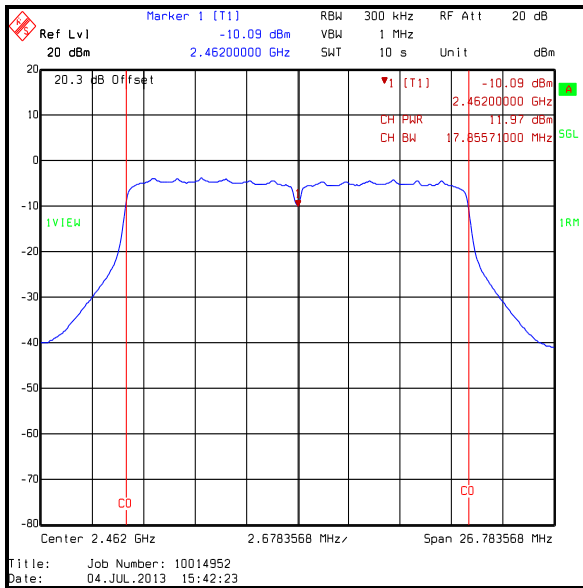
**Results: 802.11n / 20 MHz / 16QAM / 43.3 Mbps / MCS4**



**Bottom Channel**



**Middle Channel**



**Top Channel**

**Transmitter Maximum Output Power (continued)****Test Equipment Used:**

<b>Asset No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval (Months)</b>
M1659	Thermometer / Hygrometer station	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	13 Aug 2013	12
A1999	Attenuator	Huber + Suhner	6820.17.B	07101	05 Apr 2014	12
M1269	Multimeter	Fluke	179	90250210	30 Jul 2013	12
S0520	DC Power Supply	GW Instek	GPC-3030	E835141	Calibrated before use	-



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

<b>Test Engineer:</b>	Andrew Edwards	<b>Test Date:</b>	17 July 2013
<b>Test Sample IMEI:</b>	004402146858703		

<b>FCC Reference:</b>	Parts 15.247(d) & 15.209(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
<b>Frequency Range</b>	30 MHz to 1000 MHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	26
<b>Relative Humidity (%):</b>	33

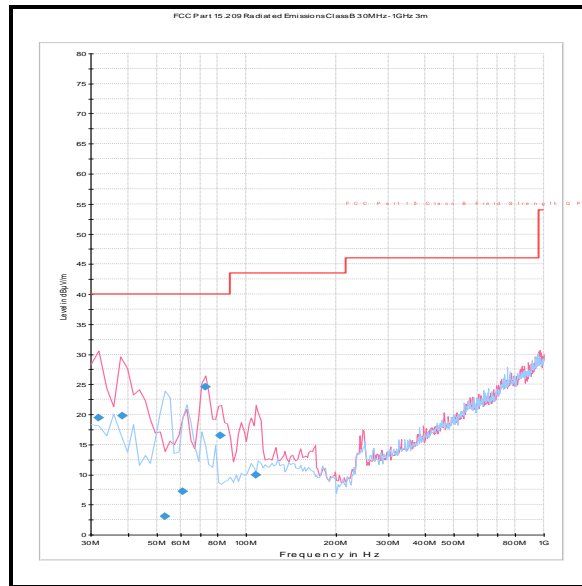
**Note(s):**

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 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.
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.

**Results: Top Channel / 802.11b / 20 MHz / 11 Mbps**

<b>Frequency (MHz)</b>	<b>Antenna Polarity</b>	<b>Level (dB<math>\mu</math>V/m)</b>	<b>Limit (dB<math>\mu</math>V/m)</b>	<b>Margin (dB)</b>	<b>Result</b>
73.117	Vertical	24.6	40.0	15.4	Complied

**Transmitter Radiated 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)
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	05 Oct 2013	3
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	24 Oct 2013	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	07 Feb 2014	12
M1622	Thermometer / Hygrometer station	JM Handelpunkt	30.5015.13	None stated	24 May 2014	12

**Transmitter Radiated Emissions (continued)****Test Summary:**

<b>Test Engineer:</b>	Nick Steele	<b>Test Date:</b>	13 July 2013
<b>Test Sample IMEI:</b>	004402146858703		

<b>FCC Reference:</b>	Parts 15.247(d) & 15.209(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
<b>Frequency Range</b>	1 GHz to 26.5 GHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	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 and average noise floor readings of the measuring receiver were recorded as shown in the tables below.
3. The emission shown approximately at 2462 MHz 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.

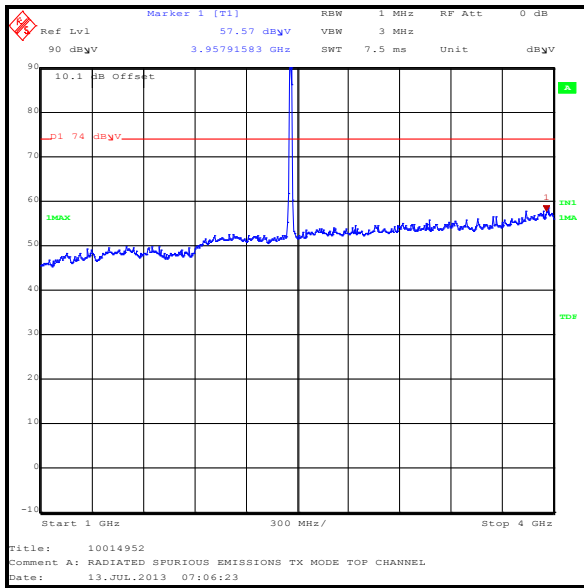
**Results: Peak**

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Peak Limit (dB $\mu$ V/m)	Margin (dB)	Result
3957.916	Vertical	57.6	74.0	16.4	Complied

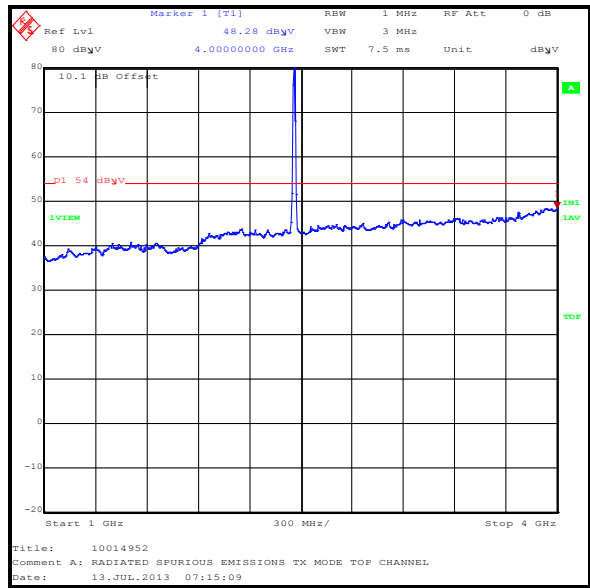
**Results: Average**

Frequency (MHz)	Antenna Polarity	Average Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Margin (dB)	Result
4000.000	Vertical	48.3	54.0	5.7	Complied

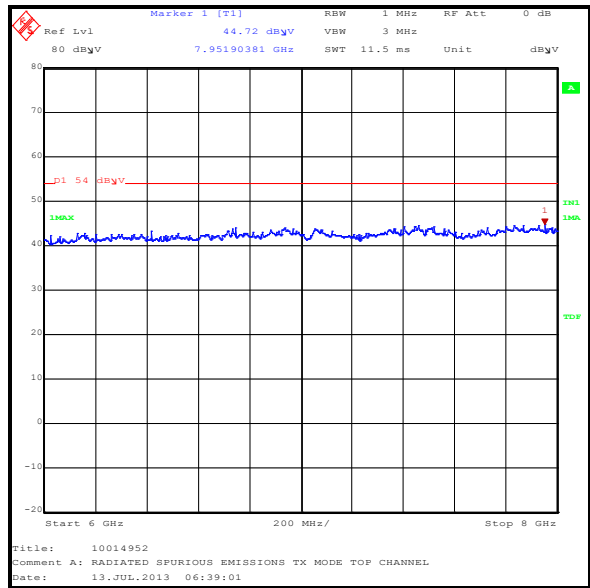
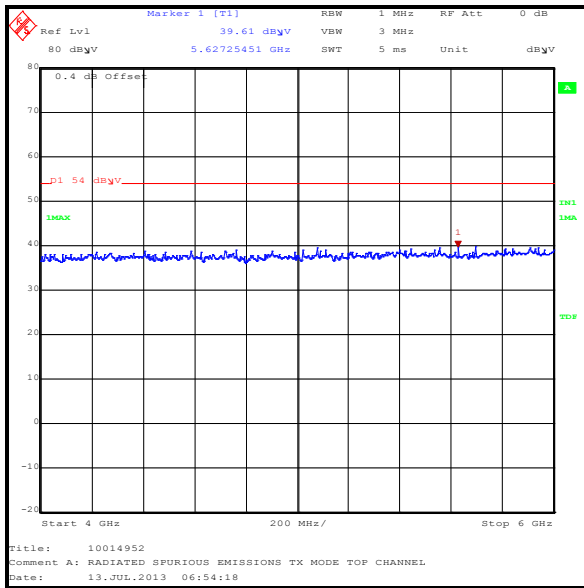
**Transmitter Radiated Emissions (continued)**



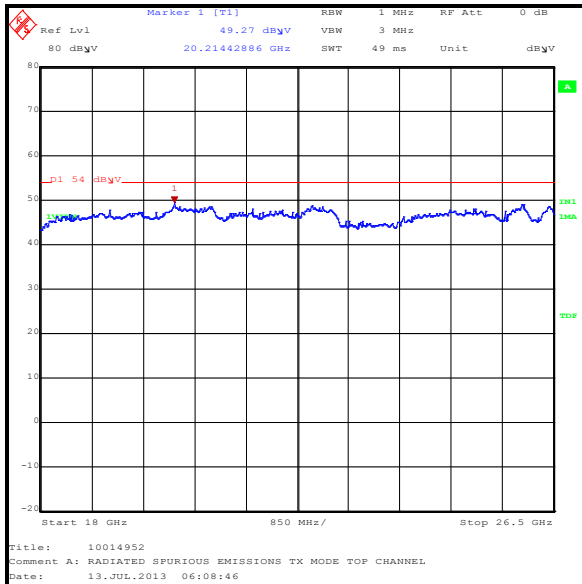
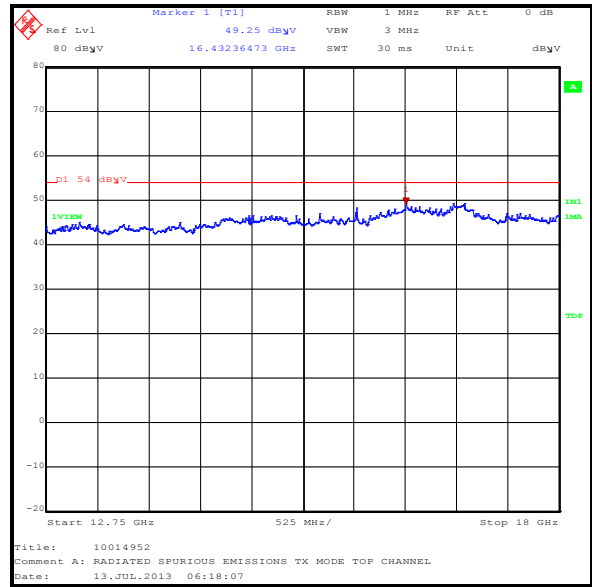
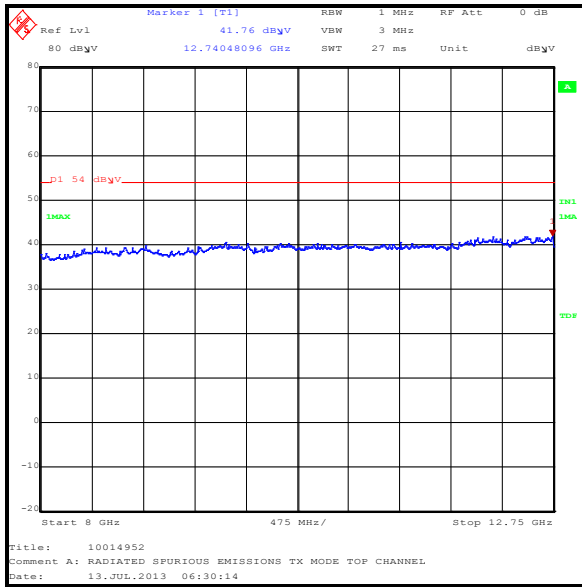
Peak detector



Average detector



### Transmitter Radiated Emissions (continued)



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

<b>Asset No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval (Months)</b>
M1656	Thermometer/ Hygrometer Station	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	04 Nov 2013	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	04 Nov 2013	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	14 Aug 2013	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	10 May 2014	12
A1975	High Pass Filter	AtlanTecRF	AFH-03000	090424010	19 Apr 2014	12
A1818	Antenna	EMCO	3115	00075692	04 Nov 2013	12
A253	Antenna	Flann Microwave	12240-20	128	04 Nov 2013	12
A254	Antenna	Flann Microwave	14240-20	139	04 Nov 2013	12
A255	Antenna	Flann Microwave	16240-20	519	04 Nov 2013	12
A256	Antenna	Flann Microwave	18240-20	400	04 Nov 2013	12
A436	Antenna	Flann Microwave	20240-20	330	04 Nov 2013	12

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

<b>Test Engineer:</b>	Nick Steele	<b>Test Date:</b>	13 July 2013
<b>Test Sample IMEI:</b>	004402146858703		

<b>FCC Reference:</b>	Parts 15.247(d) & 15.209(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.9.2

**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	37

**Note(s):**

1. All configurations supported by the EUT were investigated on one channel. The data rates that produced the highest power and widest bandwidth were therefore deemed worst case :
  - 802.11b – DQPSK / 11 Mbps & DBPSK / 1 Mbps
  - 802.11g – BPSK / 6 Mbps
  - 802.11n HT20 – 16QAM / 43.3 Mbps / MCS4 (GI = 400 ns) & BPSK / 6.5 Mbps / MCS0 (GI = 800 ns)
2. Final measurements were performed with the above configurations.
3. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
4. For 802.11b the maximum peak conducted power was previously measured. In accordance with FCC KDB 558074 Section 11.1(a), the lower band edge measurement should be performed with a peak detector and the -20 dBc limit applied.
5. For 802.11g and 802.11n, the maximum conducted (average) output power was previously measured. In accordance with FCC KDB 558074 Section 11.1(b), the lower band edge measurement should be performed with a peak detector and the -30 dBc limit applied.
6. \* -20 dBc limit.
7. \*\* -30 dBc limit.

**Transmitter Band Edge Radiated Emissions (continued)****Results: Peak / 802.11b / 20 MHz / DBPSK / 1 Mbps**

<b>Frequency (MHz)</b>	<b>Level (dB<math>\mu</math>V/m)</b>	<b>Limit (dB<math>\mu</math>V/m)</b>	<b>Margin (dB)</b>	<b>Result</b>
2399.848	53.0	75.6*	22.6	Complied
2400	45.9	75.6*	29.7	Complied
2483.5	54.7	74.0	19.3	Complied
2487.157	55.6	74.0	18.4	Complied

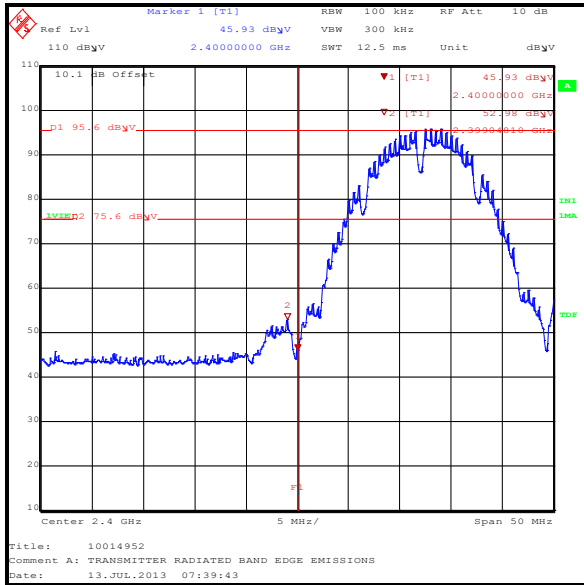
**Results: Average / 802.11b / 20 MHz / DBPSK / 1 Mbps**

<b>Frequency (MHz)</b>	<b>Level (dB<math>\mu</math>V/m)</b>	<b>Limit (dB<math>\mu</math>V/m)</b>	<b>Margin (dB)</b>	<b>Result</b>
2483.5	40.7	54.0	13.3	Complied
2487.558	41.4	54.0	12.6	Complied

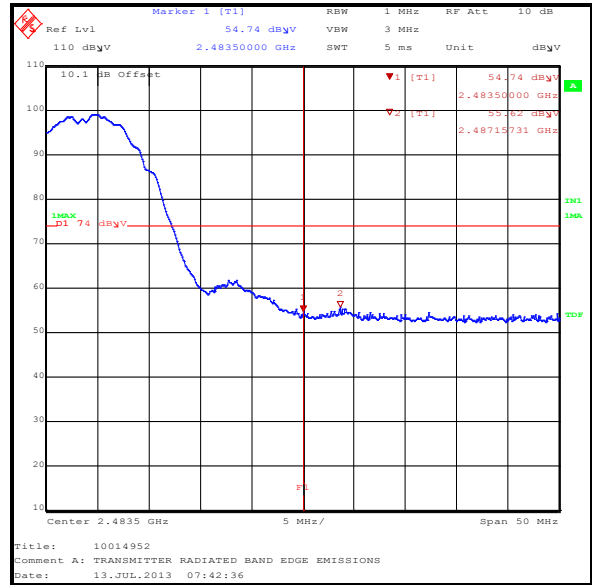


**Transmitter Band Edge Radiated Emissions (continued)**

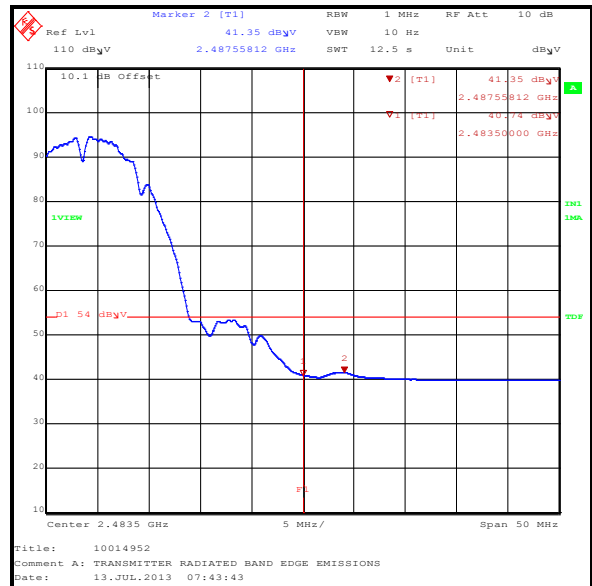
**Results: 802.11b / 20 MHz / DBPSK / 1 Mbps**



**Lower Band Edge Peak Measurement**



**Upper Band Edge Peak Measurement**



**Upper Band Edge Average Measurement**

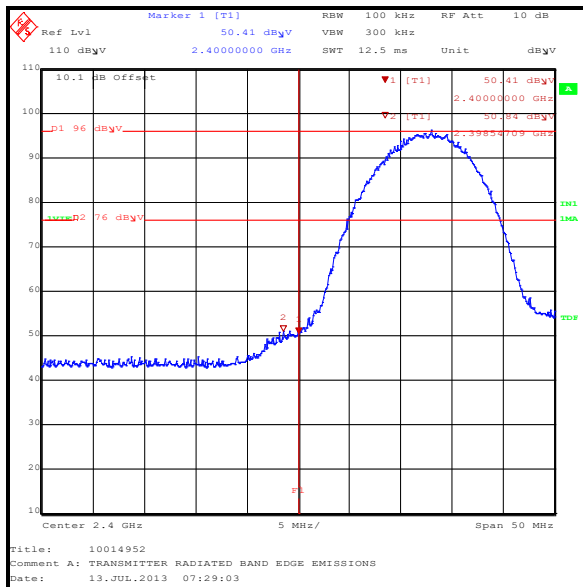
**Transmitter Band Edge Radiated Emissions (continued)**

**Results: Peak / 802.11b / 20 MHz / DQPSK / 11 Mbps**

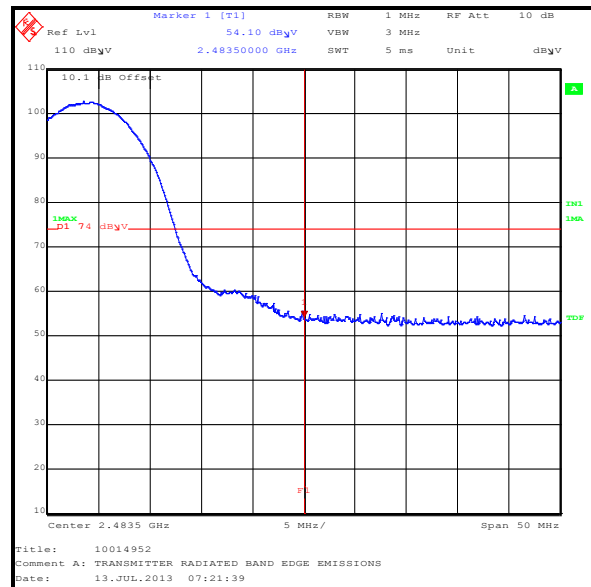
Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2398.547	50.8	76.0*	25.2	Complied
2400	50.4	76.0*	25.6	Complied
2483.5	54.1	74.0	19.9	Complied

**Results: Average / 802.11b / 20 MHz / DQPSK / 11 Mbps**

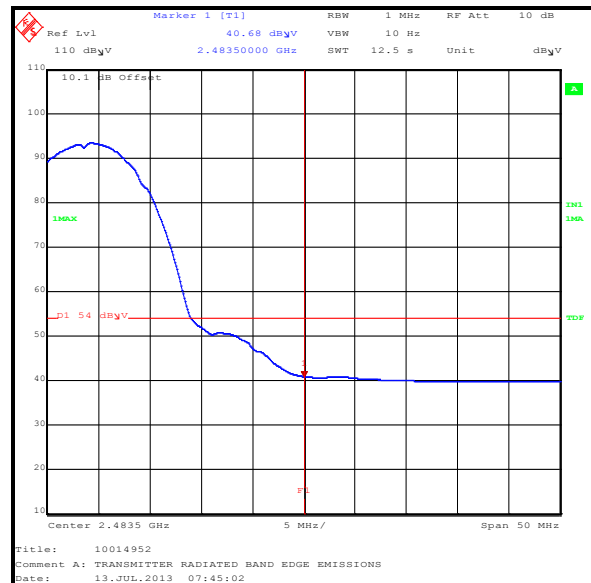
Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.5	40.7	54.0	13.3	Complied



**Lower Band Edge Peak Measurement**



**Upper Band Edge Peak Measurement**



**Upper Band Edge Average Measurement**

**Transmitter Band Edge Radiated Emissions (continued)****Results: Peak / 802.11g / 20 MHz / BPSK / 6 Mbps**

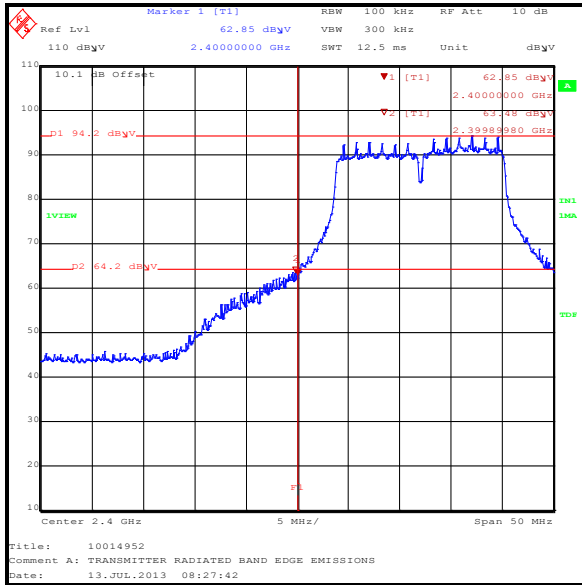
Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2399.900	63.5	64.2**	0.7	Complied
2400	62.9	64.2**	1.3	Complied
2483.5	68.9	74.0	5.1	Complied
2483.851	69.9	74.0	4.1	Complied

**Results: Average / 802.11g / 20 MHz / BPSK / 6 Mbps**

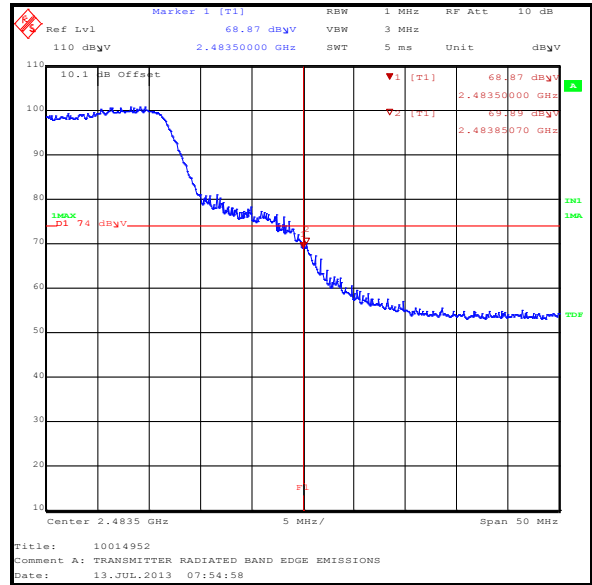
Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.5	46.0	54.0	8.0	Complied

### Transmitter Band Edge Radiated Emissions (continued)

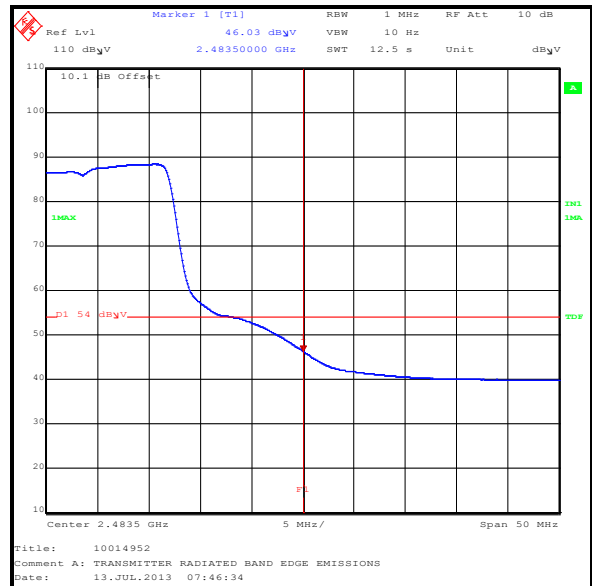
Results: 802.11g / 20 MHz / BPSK / 6 Mbps



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Upper Band Edge Average Measurement

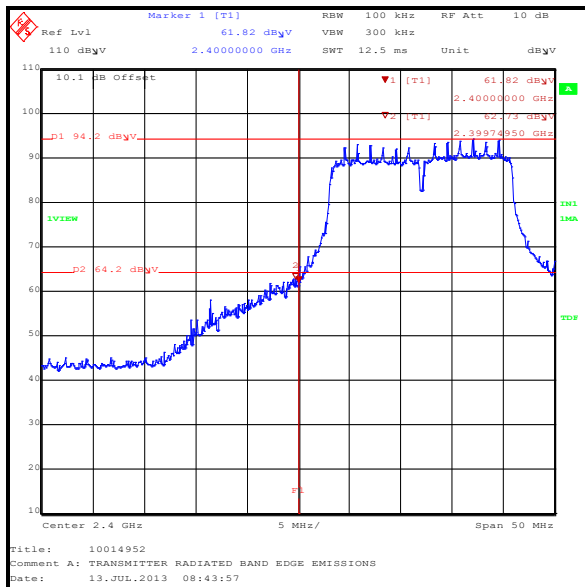
**Transmitter Band Edge Radiated Emissions (continued)**

**Results: Peak / 802.11n / 20 MHz / BPSK / 6.5 Mbps / MCS0**

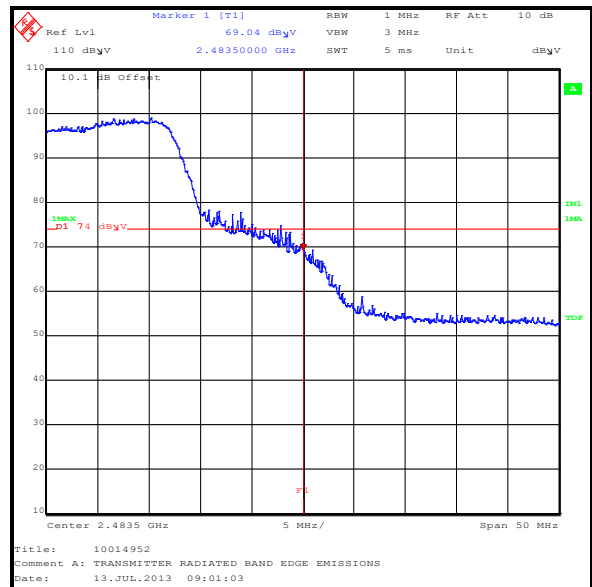
Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2399.750	62.7	64.2**	1.5	Complied
2400	61.8	64.2**	2.4	Complied
2483.5	69.0	74.0	5.0	Complied

**Results: Average / 802.11n / 20 MHz / BPSK / 6.5 Mbps / MCS0**

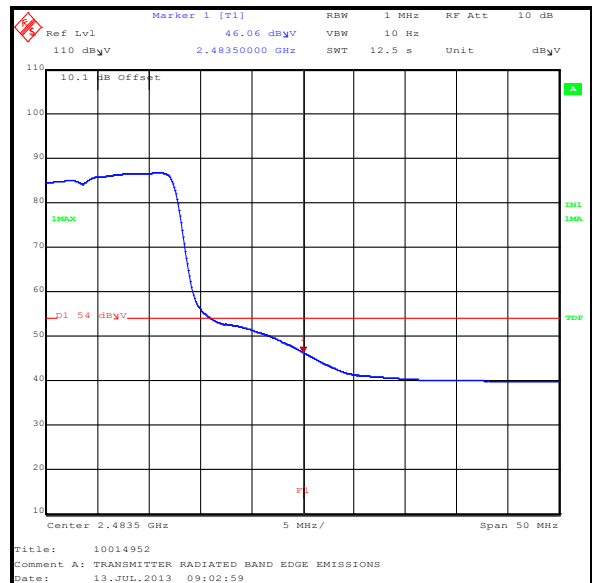
Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.5	46.1	54.0	7.9	Complied



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Upper Band Edge Average Measurement

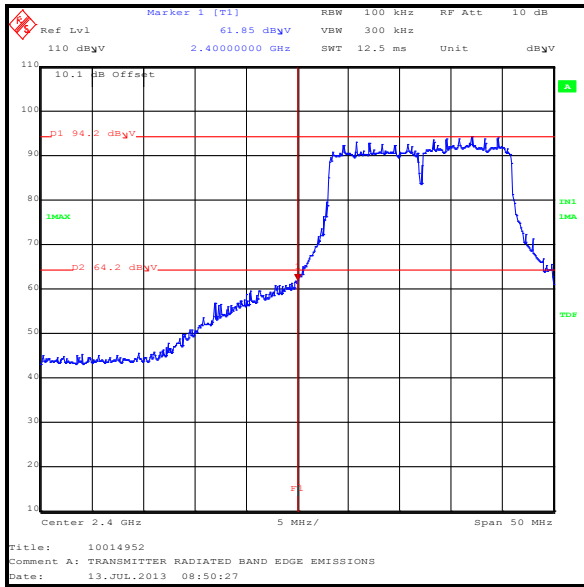
**Transmitter Band Edge Radiated Emissions (continued)**

**Results: Peak / 802.11n / 20 MHz / 16QAM / 43.3 Mbps / MCS4**

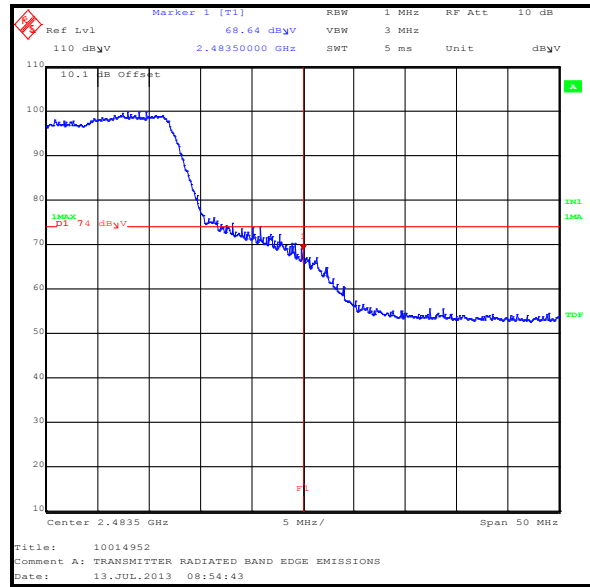
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2400	61.9	64.2**	2.3	Complied
2483.5	68.6	74.0	5.4	Complied

**Results: Average / 802.11n / 20 MHz / 16QAM / 43.3 Mbps / MCS4**

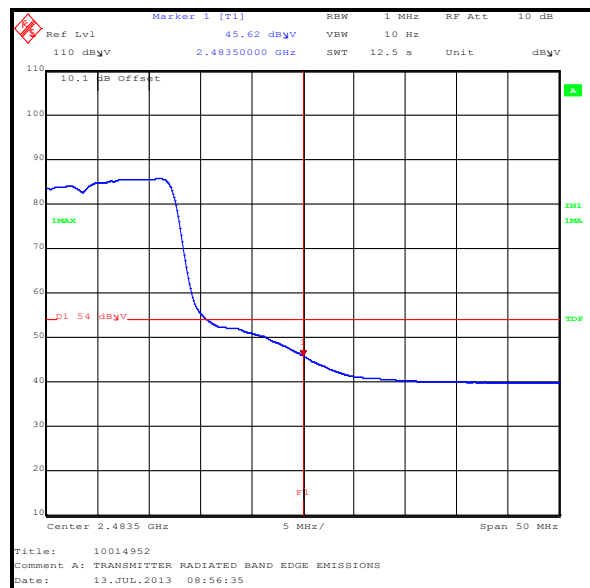
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	45.6	54.0	8.4	Complied



**Lower Band Edge Peak Measurement**



**Upper Band Edge Peak Measurement**



**Upper Band Edge Average Measurement**

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

<b>Asset No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval (Months)</b>
M1656	Thermometer / Hygrometer station	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	04 Nov 2013	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	04 Nov 2013	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	14 Aug 2013	12
A1396	Antenna	Huber & Suhner	6810.17.B	757987	10 May 2014	12
A1818	Attenuator	EMCO	3115	00075692	04 Nov 2013	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”.

<b>Measurement Type</b>	<b>Range</b>	<b>Confidence Level (%)</b>	<b>Calculated Uncertainty</b>
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±4.69 dB
Conducted Maximum 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
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 25 GHz	95%	±2.94 dB
Duty Cycle	2.4 GHz to 2.4835 GHz	95%	±0.3 ns

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**

<b>Version Number</b>	<b>Revision Details</b>		
	<b>Page No(s)</b>	<b>Clause</b>	<b>Details</b>
1.0	-	-	Initial Version
2.0	-	-	Update to section 3.4