



TEST REPORT

Test Report No. : UL-RPT-RP10407435JD01A V2.0

Manufacturer : Apple Inc.
Model No. A1601
FCC ID : BCGA1601
Technology : WLAN
Test Standard(s) : FCC Parts 15.207, 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 2.0 supersedes all previous versions.

Date of Issue: 14 September 2014

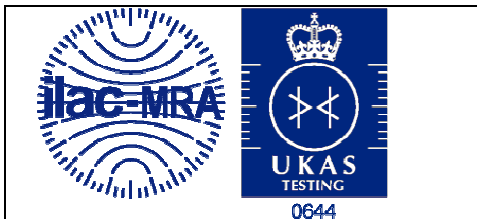
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This laboratory is accredited by UKAS.
The tests reported herein have been
performed in accordance with its' terms
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1. Customer Information

Company Name:	Apple Inc.
Address:	1 Infinite Loop Cupertino, CA 95014 U.S.A

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:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
Site Registration:	209735
Location of Testing:	, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	28 July 2014 to 12 September 2014

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.207	Transmitter AC Conducted Emissions	
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	
Part 15.35(c)	Transmitter Duty Cycle	Note 1
Part 15.247(e)	Transmitter Power Spectral Density	
Part 15.247(b)(3)	Transmitter Maximum Peak Output Power	
Part 15.247(d) & 15.209(a)	Transmitter Radiated Emissions	
Part 15.247(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	
Key to Results  = Complied  = Did not comply		

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

Reference:	ANSI C63.4 (2009)
Title:	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Reference:	ANSI C63.10 (2009)
Title:	American National Standard for Testing Unlicensed Wireless Devices
Reference:	KDB 558074 D01 DTS Meas Guidance v03r02 June 5, 2014
Title:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
Reference:	KDB 662911 D01 Multiple Transmitter Output v02r01 October 31, 2013
Title:	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

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:	Apple
Model Name or Number:	A1601
Test Sample IMEI:	352025060501666 (<i>Radiated Sample</i>)
Hardware Version Number:	REV 1.0
Software Version Number:	iOS 12A314 BB:3.08.08
FCC ID:	BCGA1601

Brand Name:	Apple
Model Name or Number:	A1601
Test Sample IMEI:	352025060506475 (<i>Conducted Sample</i>)
Hardware Version Number:	REV 1.0
Software Version Number:	iOS 12A314 BB:3.08.08
FCC ID:	BCGA1601

3.2. Description of EUT

The Equipment Under Test was a tablet with GSM/GPRS/EGPRS/UMTS and LTE. It also supports IEEE 802.11 a/b/g/n (MIMO 2x2) and Bluetooth®. The rechargeable battery is not user accessible.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Technology Tested:	WLAN (IEEE 802.11b,g,n) / Digital Transmission System	
Type of Unit:	Transceiver	
Modulation Type:	DBPSK, DQPSK, BPSK, QPSK, 16QAM & 64QAM	
Data Rates:	802.11b (SISO)	1, 2, 5.5 & 11 Mbps
	802.11g (SISO)	6, 9, 12, 18, 24, 36, 48 & 54 Mbps
	802.11n HT20 (SISO)	MCS0 to MCS7
	802.11n HT20 (MIMO)	MCS0 to MCS15 (CDD MCS0 to MCS7)
Power Supply Requirement(s):	Nominal	3.8 VDC
Maximum Conducted Output Power:	17.7 dBm	
Declared Antenna Gains:	Antenna 1	0.8 dBi
	Antenna 2	-1.9 dBi
Channel Spacing:	20 MHz	
Transmit Frequency Range:	2412 MHz to 2472 MHz	
Transmit Channels Tested:	Channel Number	Channel Frequency (MHz)
	1	2412
	6	2437
	11	2462
	12	2467
	13	2472

3.5. Support Equipment

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

Brand Name:	Dell
Description:	Laptop PC
Model Name or Number:	Latitude E5400
Serial Number:	00788

Brand Name:	Not stated
Description:	USB Diagnostic cable
Model Name or Number:	Not stated
Serial Number:	Not stated

Brand Name:	Apple
Description:	USB Cable
Model Name or Number:	A1480
Serial Number:	Not stated

Brand Name:	Apple
Description:	USB Charger
Model Name or Number:	A1399
Serial Number:	Not stated

Brand Name:	Apple
Description:	PHF
Model Name or Number:	Apple Ear Plugs
Serial Number:	Not stated

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.
- The customer declared the following data rates to be used for all measurements as:
 - o 802.11b – DBPSK / 1 Mbps
 - o 802.11g – BPSK / 6 Mbps
 - o 802.11n HT20 SISO – BPSK / 6.5 Mbps / MCS0
 - o 802.11n HT20 MIMO – BPSK / 6.5 Mbps / MCS0
- The EUT has two separate antennas which correspond to two separate antenna ports. Port 1 and Port 2 correspond to antenna 1 and antenna 2 respectively.
- For 802.11b and 802.11g the EUT transmits only from antenna 1, therefore conducted measurements were performed on Port 1 only.
- For 802.11n the EUT can transmit from both antennas, therefore conducted measurements were performed on both ports.
- Transmitter spurious emissions and AC conducted emissions tests were performed with the EUT transmitting with a data rate of 6.5 Mbps / MCS0 / MIMO. 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.
- Transmitter radiated spurious emissions and AC conducted emissions tests were performed with the AC Charger, USB cable and PHF connected to the EUT as this was found to be the worst case during pre-scans. All the accessories were individually connected and measurements made during the pre-scans to determine the worst case combination.
- The conducted sample with IMEI 352025060506475 was used for minimum 6 dB bandwidth, duty cycle, maximum output power and power spectral density tests.
- The radiated sample with IMEI 352025060501666 was used for all other tests.

4.3. Worst case Justification

Table of test reduction and modes covering other modes:

Mode	Covered by
802.11g CDD (2TX)	80211n HT20 MIMO (CDD 2TX)
802.11n HT20 STBC (2TX)	80211n HT20 MIMO (CDD 2TX)
802.11n HT20 SDM (2TX)	80211n HT20 MIMO (CDD 2TX)

5. Measurements, Examinations and Derived Results

5.1. General Comments

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

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

5.2. Test Results

5.2.1. Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Georgios Vrezas	Test Date:	31 July 2014
Test Sample IMEI:	352025060501666		

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

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	40

Results: Live / Quasi Peak

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.267	Live	26.7	61.2	34.5	Complied
0.758	Live	27.3	56.0	28.7	Complied
1.761	Live	25.8	56.0	30.2	Complied
4.781	Live	24.3	56.0	31.7	Complied
8.466	Live	20.0	60.0	40.0	Complied
27.416	Live	29.7	60.0	30.3	Complied

Results: Live / Average

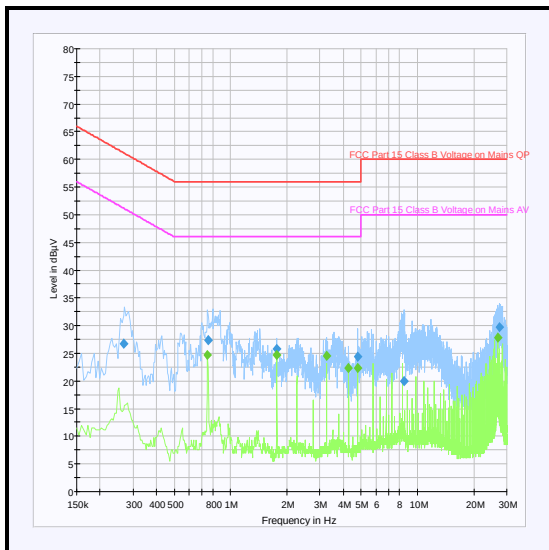
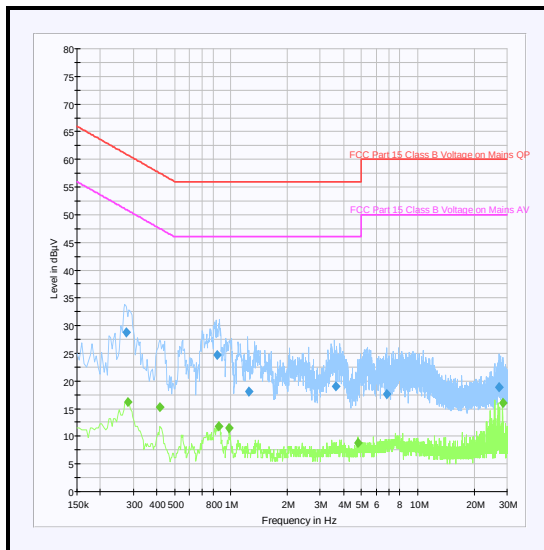
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.753	Live	24.7	46.0	21.3	Complied
1.761	Live	24.7	46.0	21.3	Complied
3.269	Live	24.6	46.0	21.4	Complied
4.277	Live	22.4	46.0	23.6	Complied
4.781	Live	22.3	46.0	23.7	Complied
26.916	Live	27.9	50.0	22.1	Complied

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

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.276	Neutral	28.8	60.9	32.1	Complied
0.848	Neutral	24.6	56.0	31.4	Complied
1.248	Neutral	18.1	56.0	37.9	Complied
3.624	Neutral	19.0	56.0	37.0	Complied
6.833	Neutral	17.6	60.0	42.4	Complied
27.168	Neutral	18.8	60.0	41.2	Complied

Results: Neutral / Average

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.281	Neutral	16.2	50.8	34.6	Complied
0.416	Neutral	15.2	47.5	32.3	Complied
0.857	Neutral	11.9	46.0	34.1	Complied
0.974	Neutral	11.5	46.0	34.5	Complied
4.781	Neutral	8.8	46.0	37.2	Complied
28.428	Neutral	16.0	50.0	34.0	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Live****Neutral**

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

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1625	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
A004	LISN	Rohde & Schwarz	ESH3-Z5	890604/027	18 Nov 2014	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	27 Feb 2015	12
M1263	Test Receiver	Rohde & Schwarz	ESIB 7	100265	14 Oct 2014	12

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

Test Engineer:	Georgios Vrezas	Test Date:	28 July 2014
Test Sample IMEI:	352025060506475		

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

Environmental Conditions:

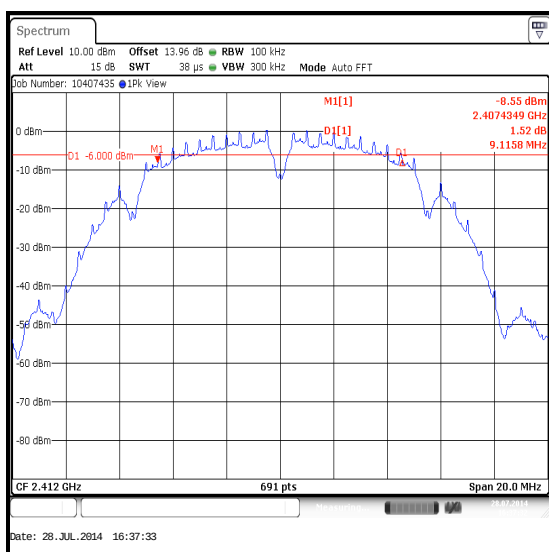
Temperature (°C):	26
Relative Humidity (%):	38

Note(s):

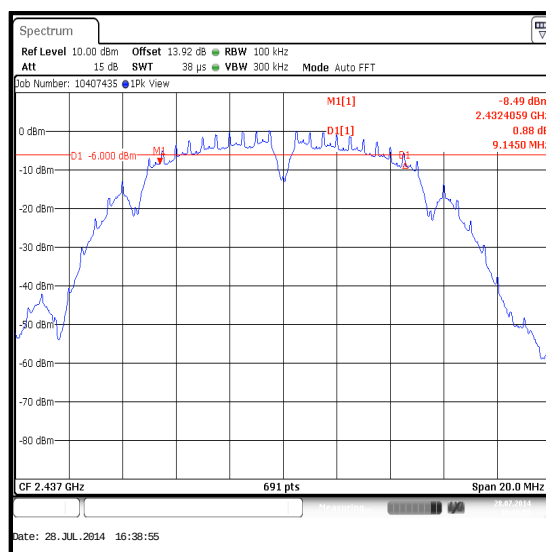
1. The customer declared the following data rates to be used for all measurements as:
 - o 802.11b – DBPSK / 1 Mbps
 - o 802.11g – DBPSK / 6 Mbps
 - o 802.11n SISO / HT20 – BPSK / 6.5 Mbps / MCS0 (GI = 800 ns)
 - o 802.11n MIMO / HT20 – BPSK / 6.5 Mbps / MCS0 (GI = 800 ns)
2. Final measurements were performed using the above configurations on the bottom, middle and top channels in accordance with KDB 558074 Section 8.1 Option 1 measurement procedure.
3. For 802.11b and 802.11g the EUT transmits only from antenna 1, therefore conducted measurements were performed on Port 1. For 802.11n the EUT can transmit from both antennas, therefore conducted measurements were performed on both ports.
4. The signal 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 / DBPSK / 1 Mbps**

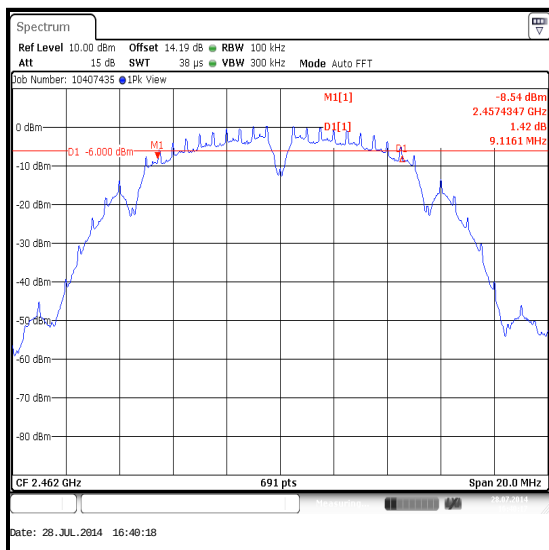
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
1	9116	≥500	8616	Complied
6	9145	≥500	8645	Complied
11	9116	≥500	8616	Complied
12	9116	≥500	8616	Complied
13	8623	≥500	8123	Complied



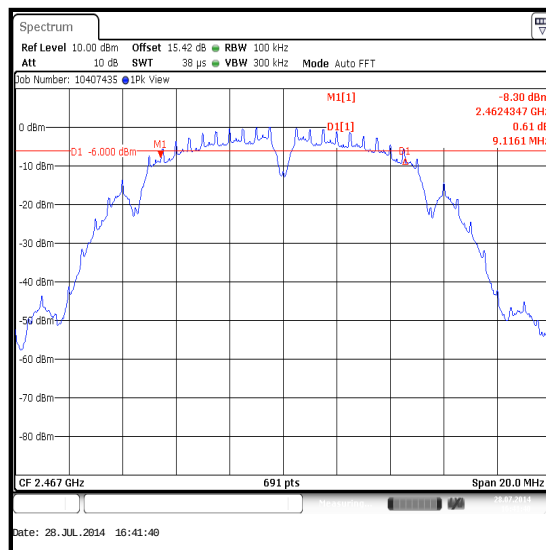
Channel 1



Channel 6



Channel 11

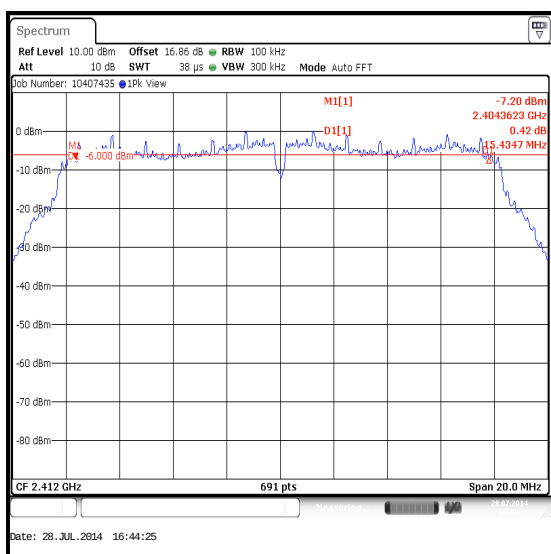
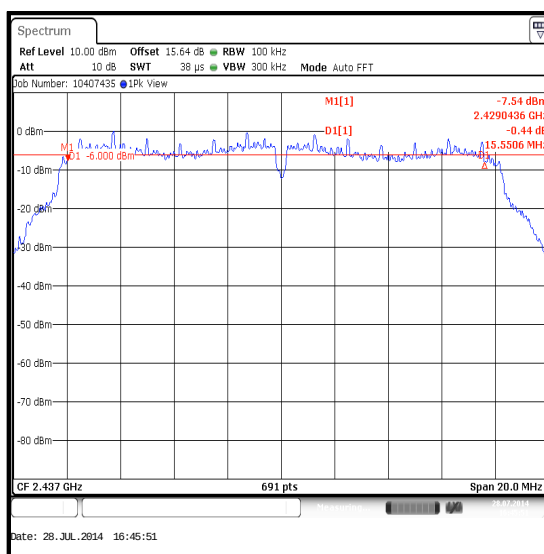
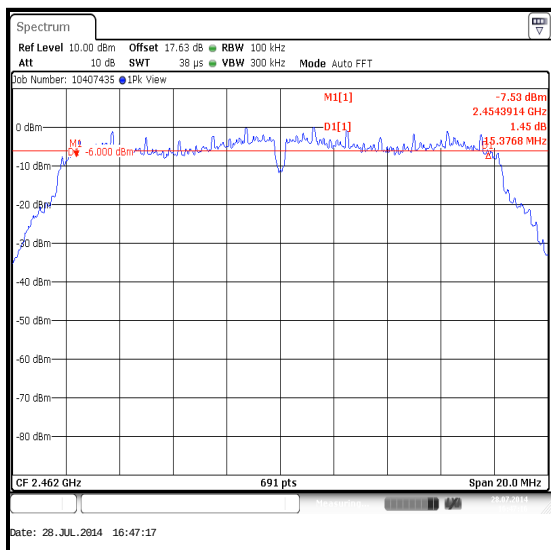
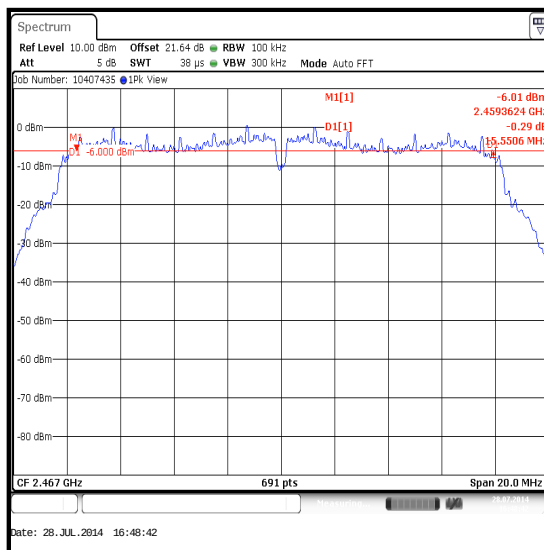


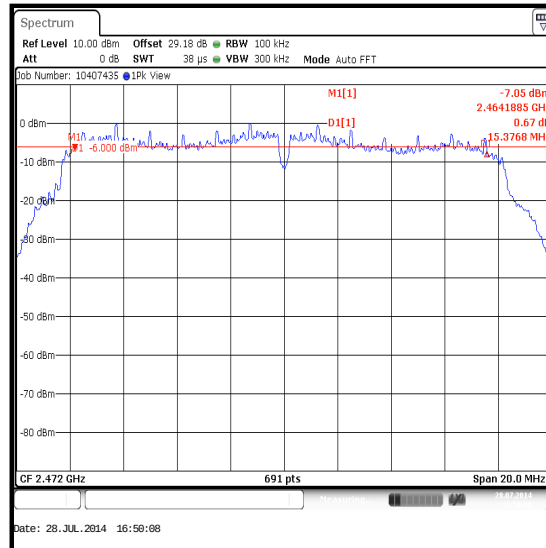
Channel 12

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11b / 20 MHz / DBPSK / 1 Mbps****Channel 13**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11g / 20 MHz / DBPSK / 6 Mbps**

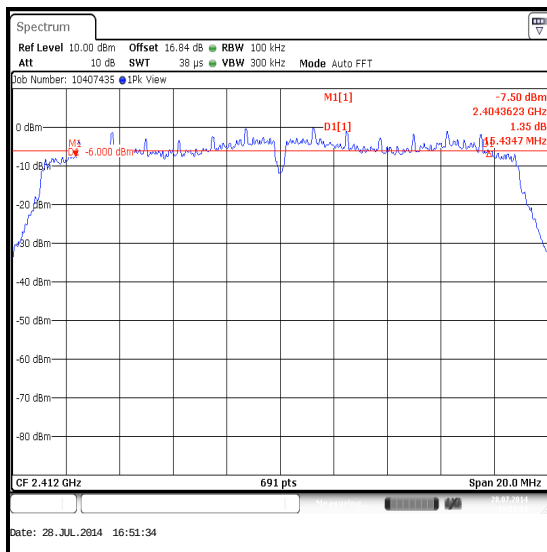
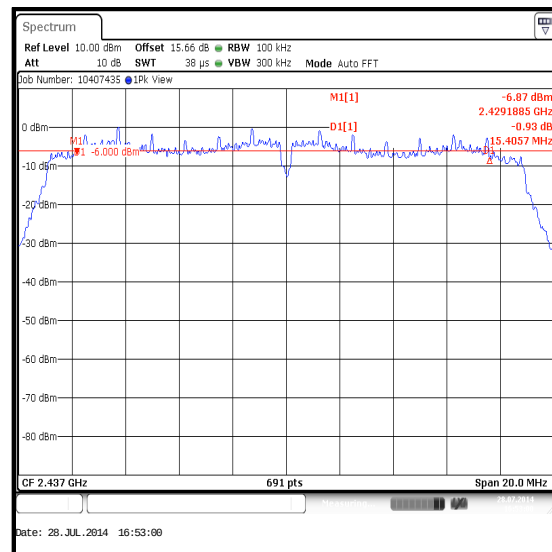
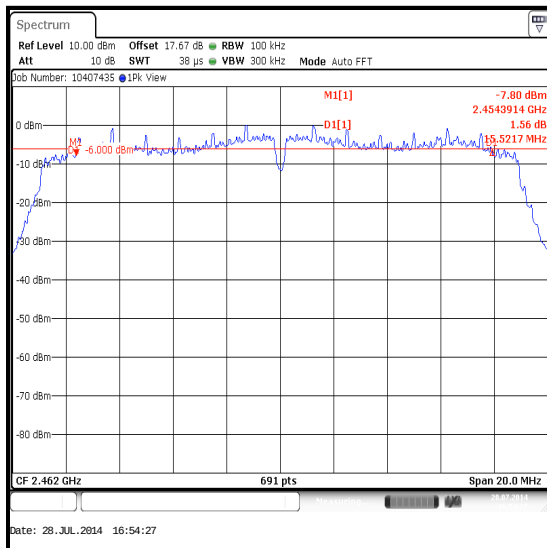
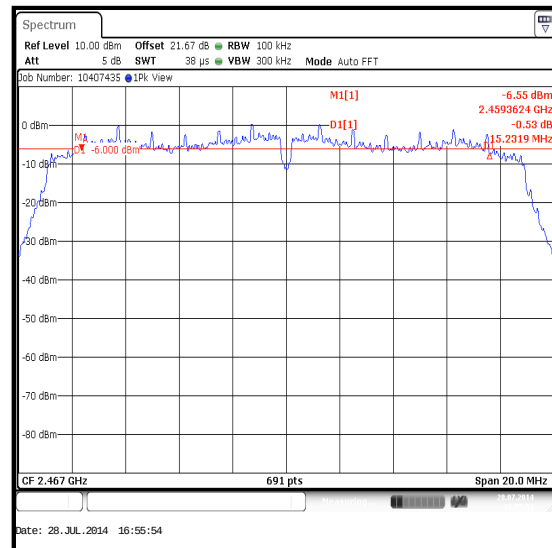
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
1	15435	≥500	14935	Complied
6	15551	≥500	15051	Complied
11	15377	≥500	14877	Complied
12	15551	≥500	15051	Complied
13	15377	≥500	14877	Complied

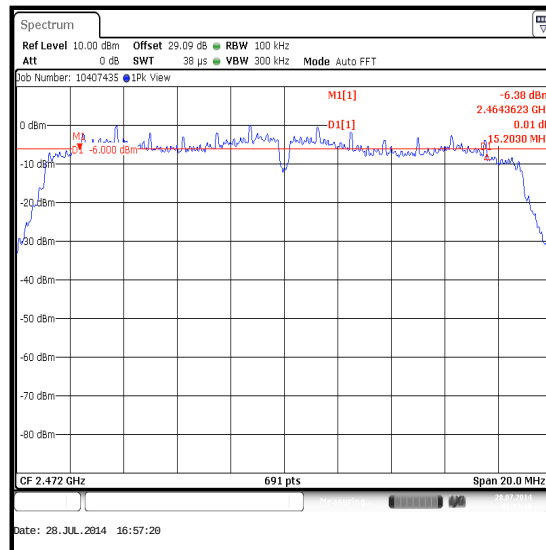
**Channel 1****Channel 6****Channel 11****Channel 12**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11g / 20 MHz / DBPSK / 6 Mbps****Channel 13**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 1**

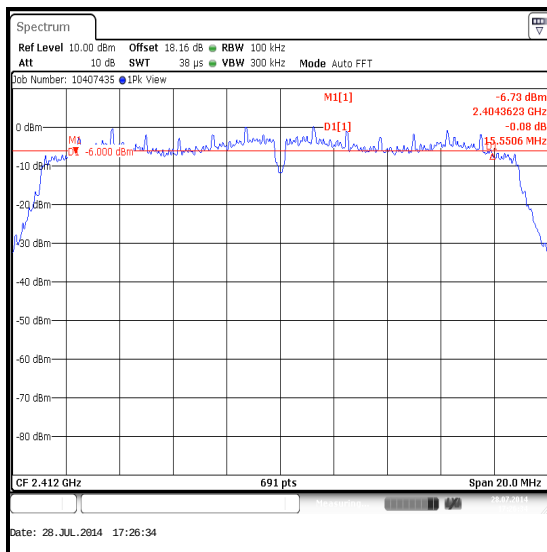
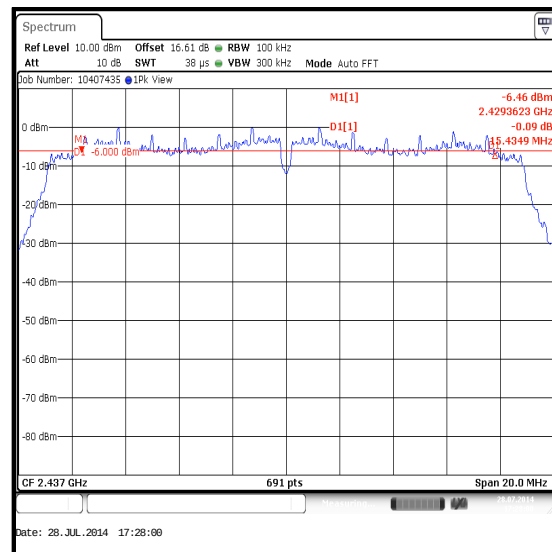
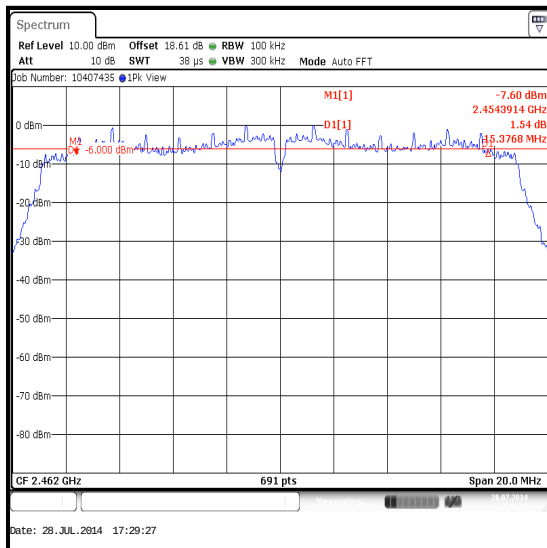
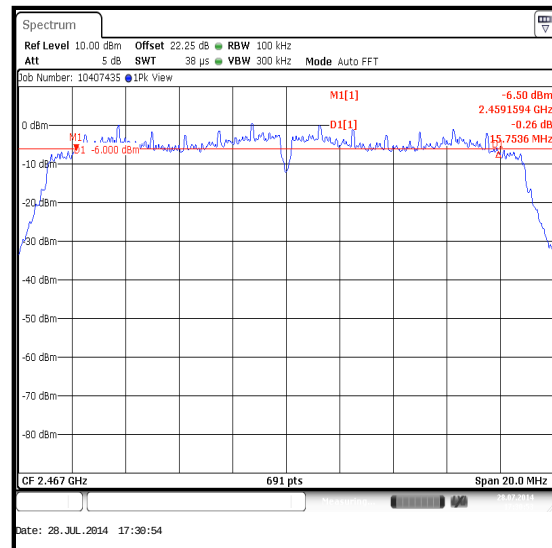
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
1	15435	≥500	14935	Complied
6	15406	≥500	14906	Complied
11	15522	≥500	15022	Complied
12	15232	≥500	14732	Complied
13	15203	≥500	14703	Complied

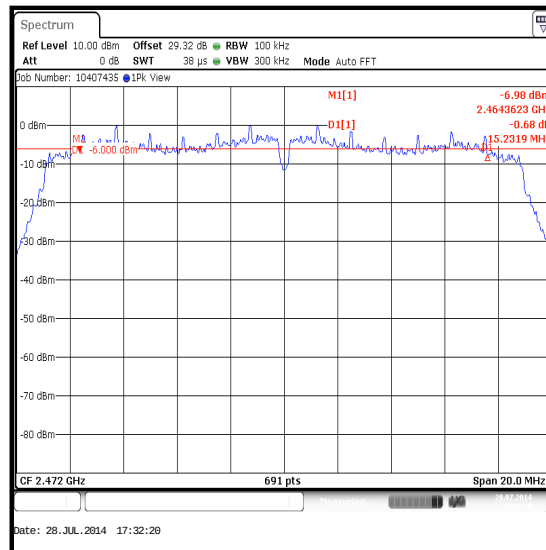
**Channel 1****Channel 6****Channel 11****Channel 12**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 1****Channel 13**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 2**

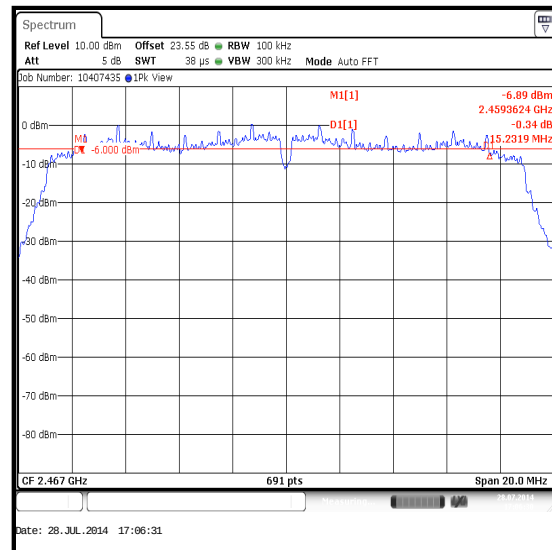
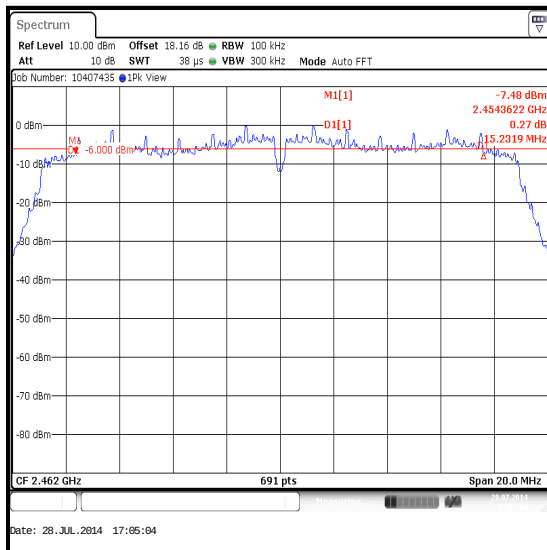
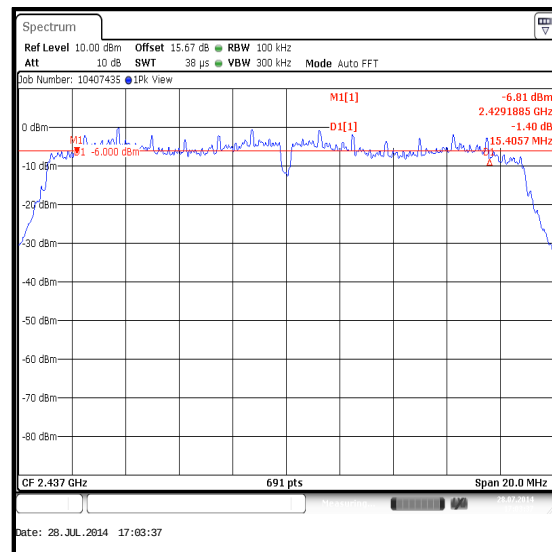
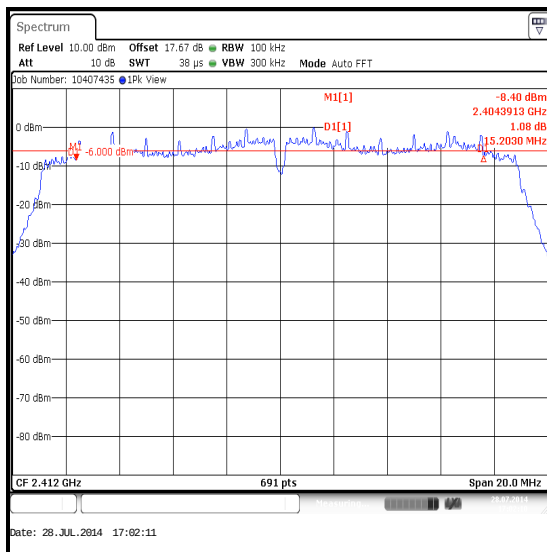
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
1	15551	≥500	15051	Complied
6	15435	≥500	14935	Complied
11	15377	≥500	14877	Complied
12	15754	≥500	15254	Complied
13	15232	≥500	14732	Complied

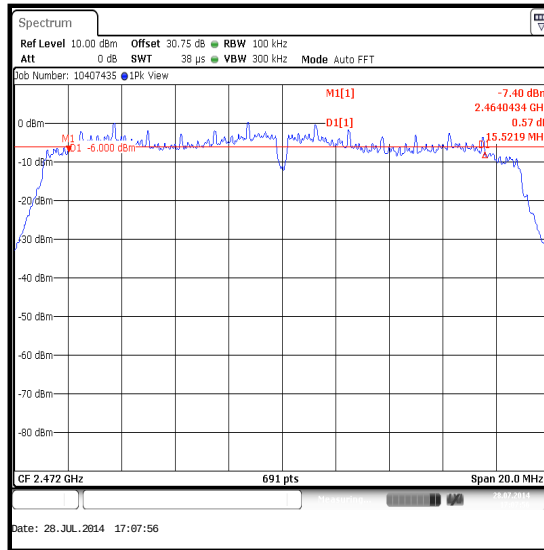
**Channel 1****Channel 6****Channel 11****Channel 12**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 2****Channel 13**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 1**

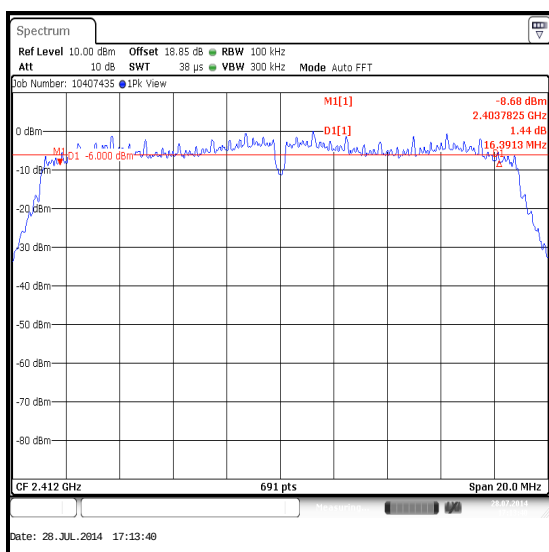
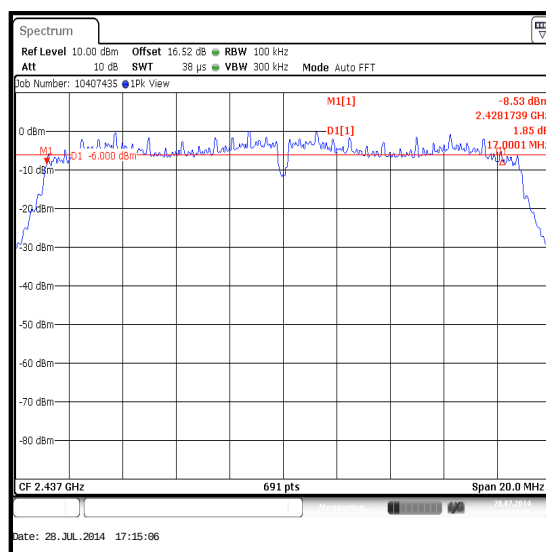
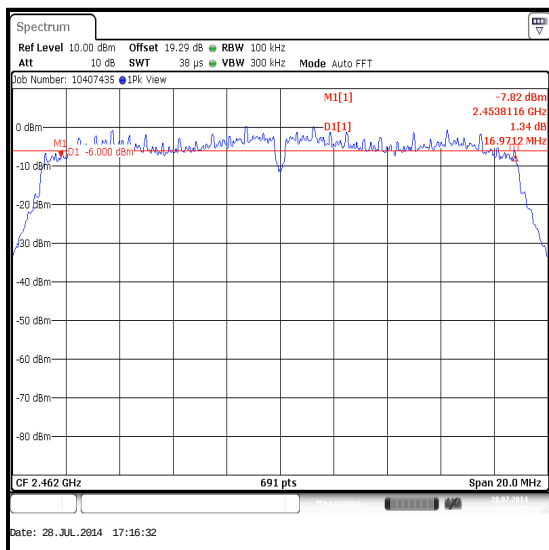
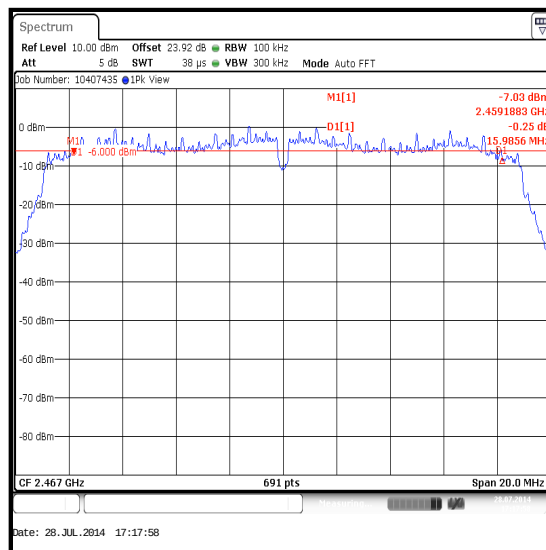
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
1	15203	≥500	14703	Complied
6	15406	≥500	14906	Complied
11	15232	≥500	14732	Complied
12	15232	≥500	14732	Complied
13	15522	≥500	15022	Complied

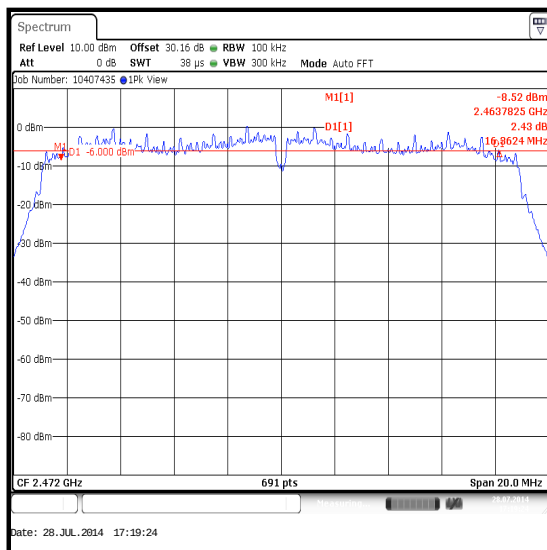


Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 1****Channel 13**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 2**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
1	16391	≥500	15891	Complied
6	17000	≥500	16500	Complied
11	16971	≥500	16471	Complied
12	15986	≥500	15486	Complied
13	16362	≥500	15862	Complied

**Channel 1****Channel 6****Channel 11****Channel 12**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 2****Channel 13****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1658	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
L1128	Signal Analyser	Rohde & Schwarz	FSV13	101835	25 Apr 2015	12
A1998	Attenuator	Huber & Suhner	6820.17.B	07101	Calibrated before use	-
S0558	DC Power Supply	TTI	EL 303R	395825	Calibrated before use	-
M1251	Multimeter	Fluke	175	89170179	19 May 2015	12

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

Test Engineer:	Georgios Vrezas	Test Date:	28 July 2014
Test Sample IMEI:	352025060506475		

FCC Reference:	Part 15.35(c)
Test Method Used:	As detailed in FCC KDB 558074 Section 6.0

Environmental Conditions:

Temperature (°C):	26
Relative Humidity (%):	38

Note(s):

1. 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:

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

$$802.11g / 20 \text{ MHz} / 6 \text{ Mbps duty cycle } 10 \log (1 / (2.055/2.098)) = 0.1 \text{ dB}$$

$$802.11n / HT20 / MCS0 / SISO / \text{Port 1 duty cycle: } 10 \log (1 / (1.897/1.941)) = 0.1 \text{ dB}$$

$$802.11n / HT20 / MCS0 / SISO / \text{Port 2 duty cycle: } 10 \log (1 / (1.891/1.947)) = 0.1 \text{ dB}$$

$$802.11n / HT20 / MCS0 / MIMO / \text{Port 1 duty cycle: } 10 \log (1 / (1.894/1.950)) = 0.1 \text{ dB}$$

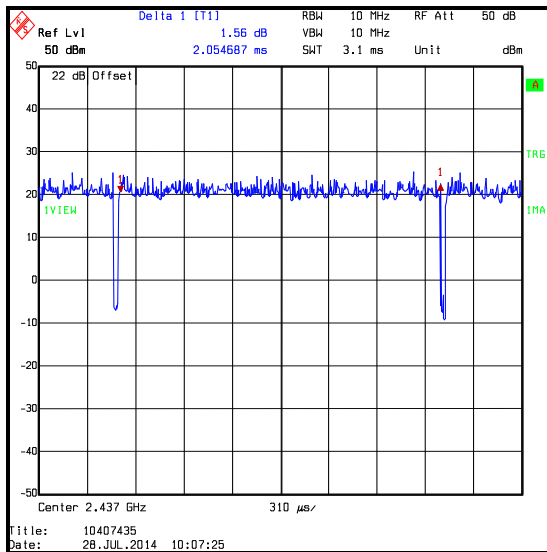
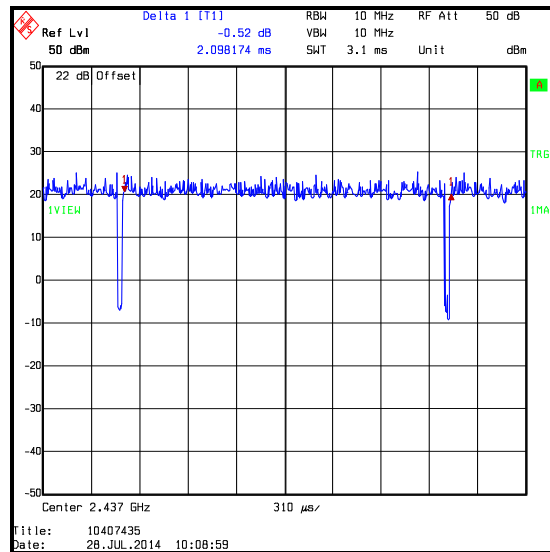
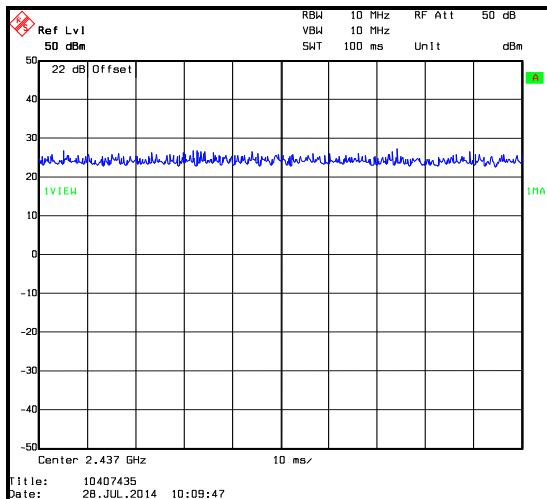
$$802.11n / HT20 / MCS0 / MIMO / \text{Port 2 duty cycle: } 10 \log (1 / (1.891/1.936)) = 0.1 \text{ dB}$$

2. For 802.11b, the duty cycle was measured to be greater than 98%.

Transmitter Duty Cycle (continued)**Results: 802.11g / 20 MHz / 6 Mbps**

Pulse Duration (ms)	Duty Cycle (dB)
2.055	0.1

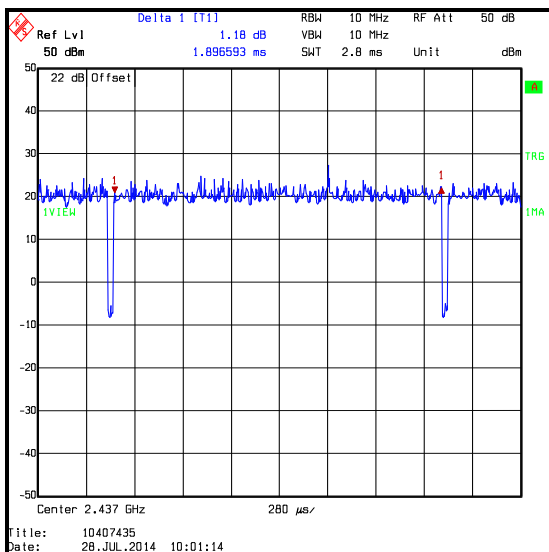
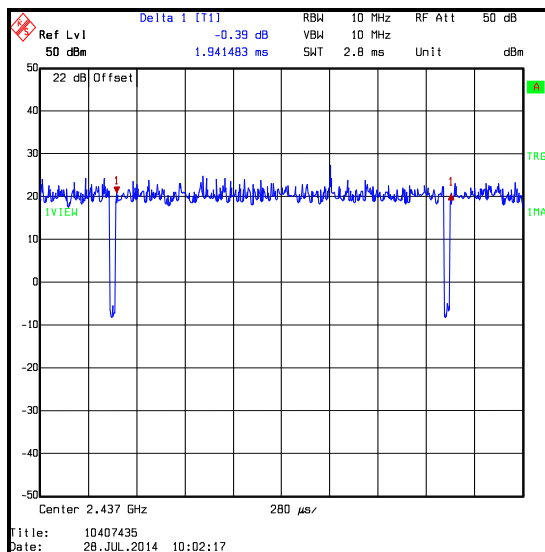
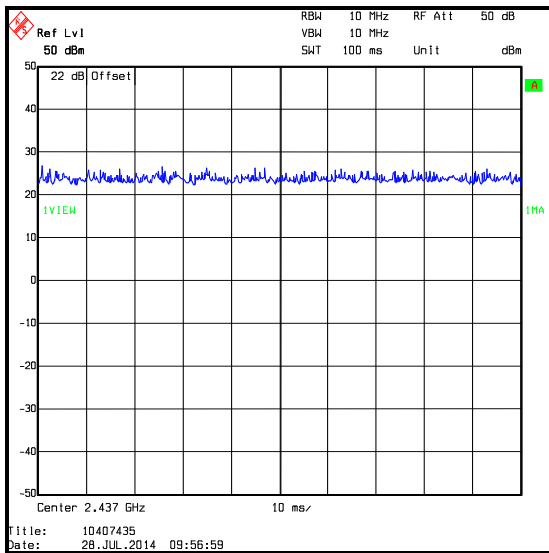
Period (ms)
2.098

**TX on time****TX on + off time / period****100 ms**

Transmitter Duty Cycle (continued)**Results: 802.11n / HT20 / MCS0 / SISO / Port 1**

Pulse Duration (ms)	Duty Cycle (dB)
1.897	0.1

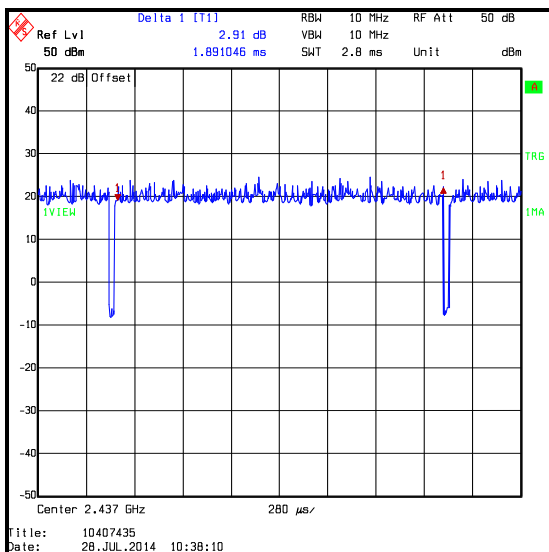
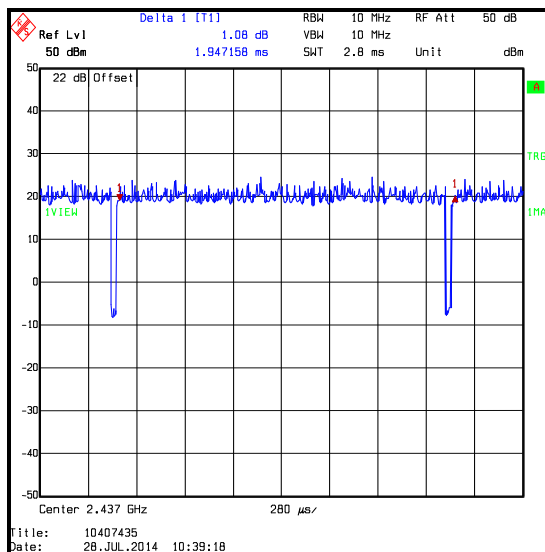
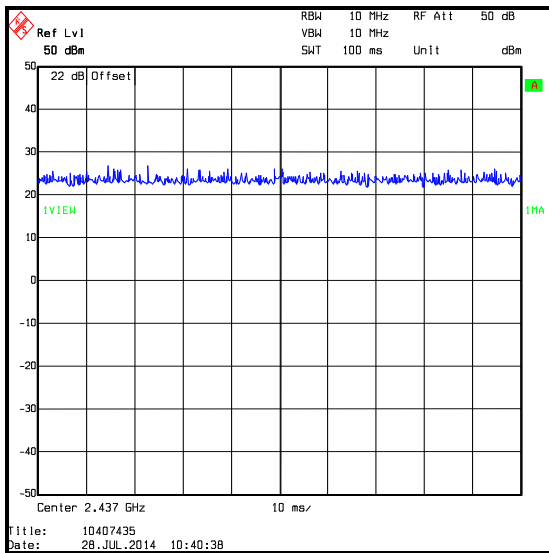
Period (ms)
1.941

**TX on time****TX on + off time / period****100 ms**

Transmitter Duty Cycle (continued)**Results: 802.11n / HT20 / MCS0 / SISO / Port 2**

Pulse Duration (ms)	Duty Cycle (dB)
1.891	0.1

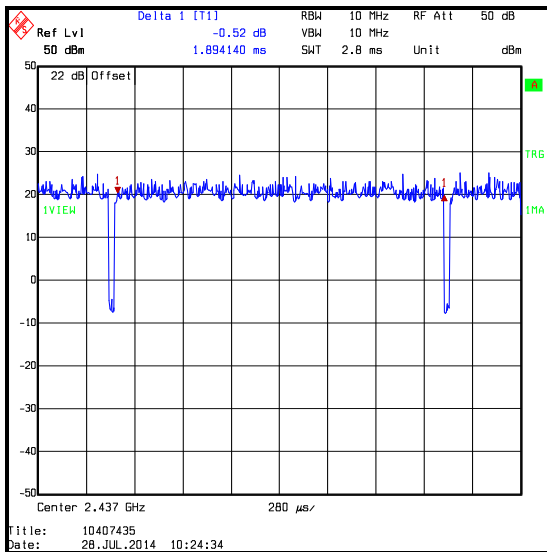
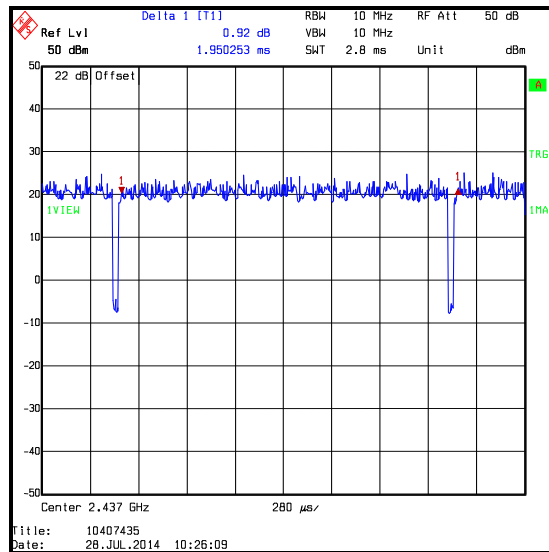
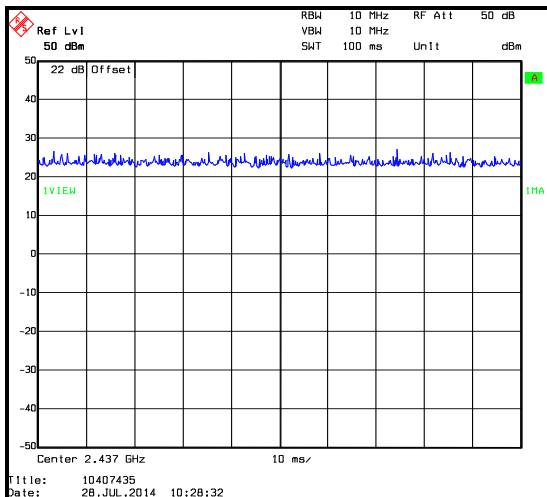
Period (ms)
1.947

**TX on time****TX on + off time / period****100 ms**

Transmitter Duty Cycle (continued)**Results: 802.11n / HT20 / MCS0 / MIMO / Port 1**

Pulse Duration (ms)	Duty Cycle (dB)
1.894	0.1

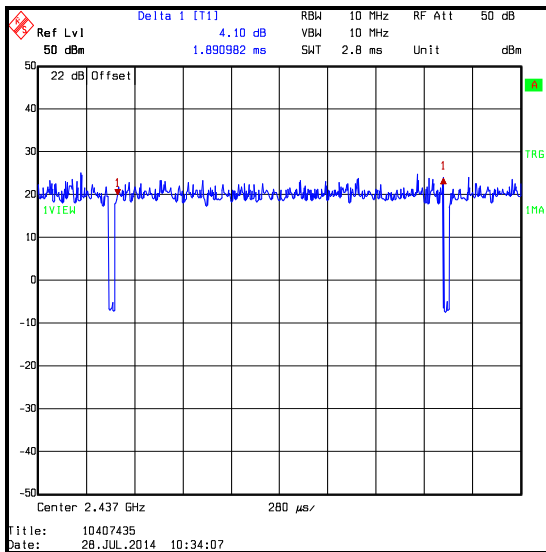
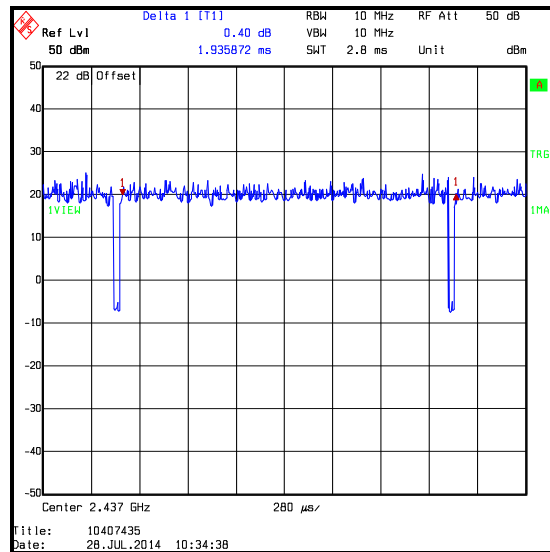
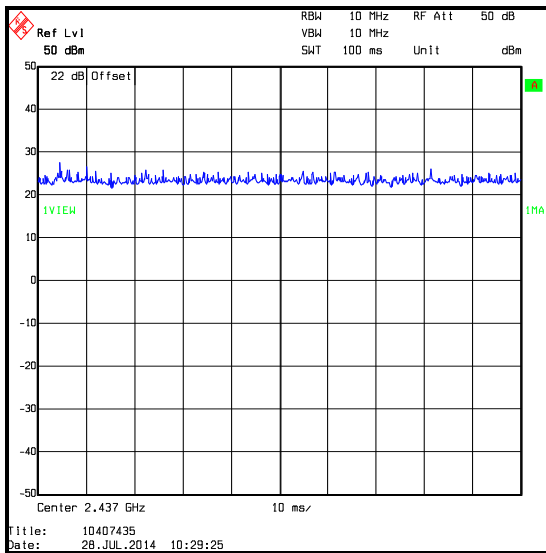
Period (ms)
1.950

**TX on time****TX on + off time / period****100 ms**

Transmitter Duty Cycle (continued)**Results: 802.11n / HT20 / MCS0 / MIMO / Port 2**

Pulse Duration (ms)	Duty Cycle (dB)
1.891	0.1

Period (ms)
1.936

**TX on time****TX on + off time / period****100 ms**

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1658	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	19 Aug 2014	12
A1998	Attenuator	Huber & Suhner	6820.17.B	07101	Calibrated before use	-
S0558	DC Power Supply	TTI	EL 303R	395825	Calibrated before use	-
M1251	Multimeter	Fluke	175	89170179	19 May 2015	12

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

Test Engineer:	Georgios Vrezas	Test Date:	28 July 2014
Test Sample IMEI:	352025060506475		

FCC Reference:	Part 15.247(e)
Test Method Used:	As detailed in FCC KDB 558074 Sections 10.3 &10.5

Environmental Conditions:

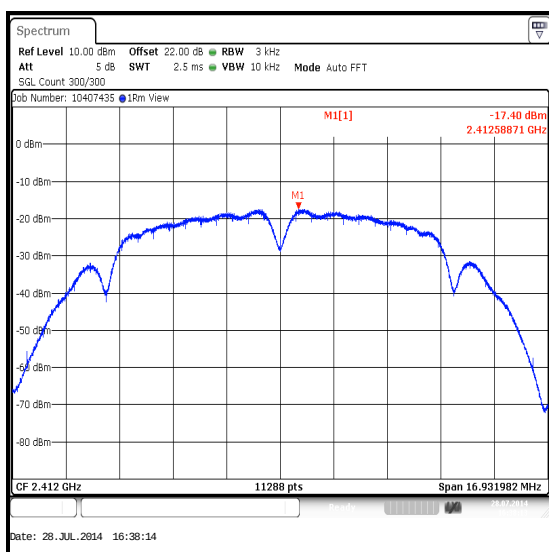
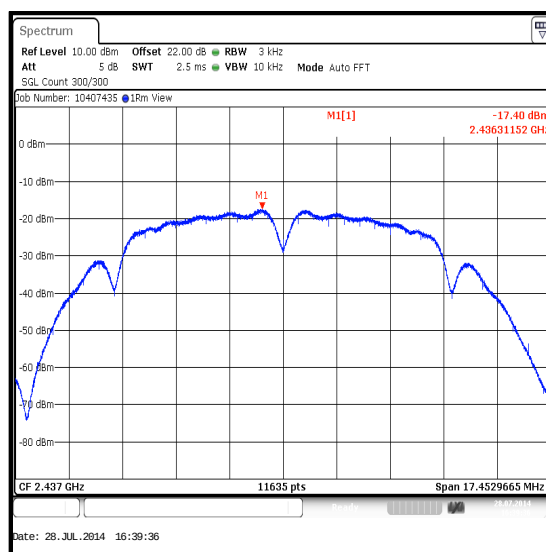
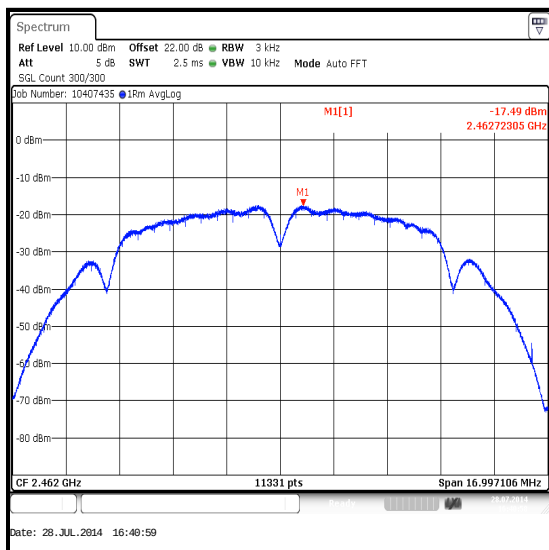
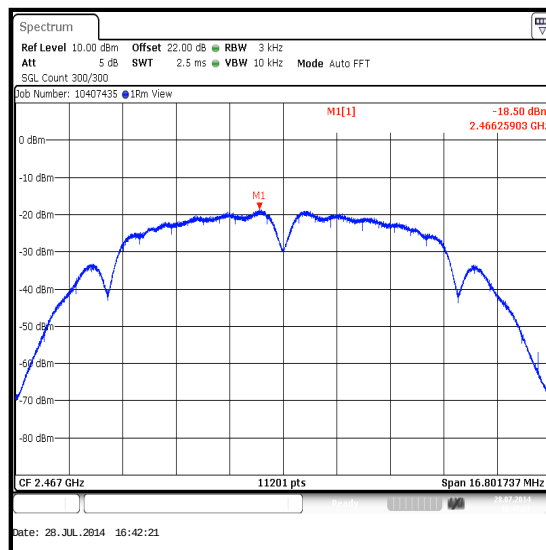
Temperature (°C):	26
Relative Humidity (%):	38

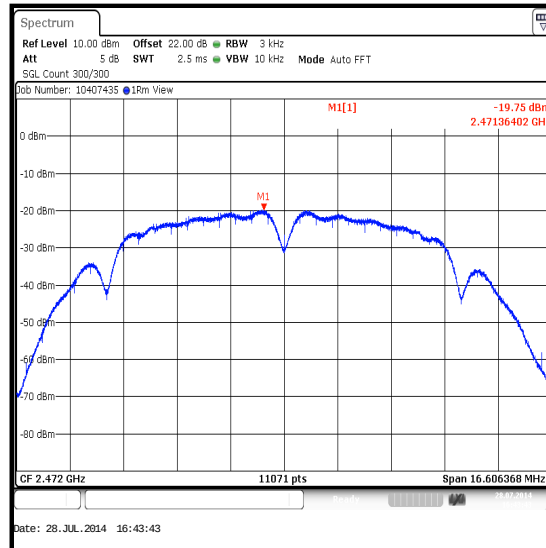
Note(s):

1. The customer declared the following data rates to be used for all measurements as:
 - o 802.11b – DBPSK / 1 Mbps
 - o 802.11g – DBPSK / 6 Mbps
 - o 802.11n SISO / HT20 – BPSK / 6.5 Mbps / MCS0 (GI = 800 ns)
 - o 802.11n MIMO / HT20 – BPSK / 6.5 Mbps / MCS0 (GI = 800 ns)
2. Final measurements were performed using the above configurations on the bottom, middle and top channels.
3. For 802.11b and 802.11g the EUT transmits only from antenna 1, therefore conducted measurements were performed on port 1. For 802.11n the EUT can transmit from both antennas, therefore conducted measurements were performed on both ports.
4. For 802.11b, the EUT was transmitting at 100% duty cycle and testing was performed in accordance with KDB 558074 Section 10.3 measurement procedure Method AVGPDS-1.
5. For 802.11g and 802.11n, the EUT was transmitting at <98% duty cycle and testing was performed in accordance with KDB 558074 Section 10.5 measurement procedure Method AVGPDS-2. 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.
6. For 802.11n MIMO, PSD was measured on both ports and then combined using the *measure and sum spectral maxima across the outputs* technique, stated in FCC KDB 662911 D01 Section E)2)b).
7. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

Transmitter Power Spectral Density (continued)**Results: 802.11b / 20 MHz / DBPSK / 1 Mbps**

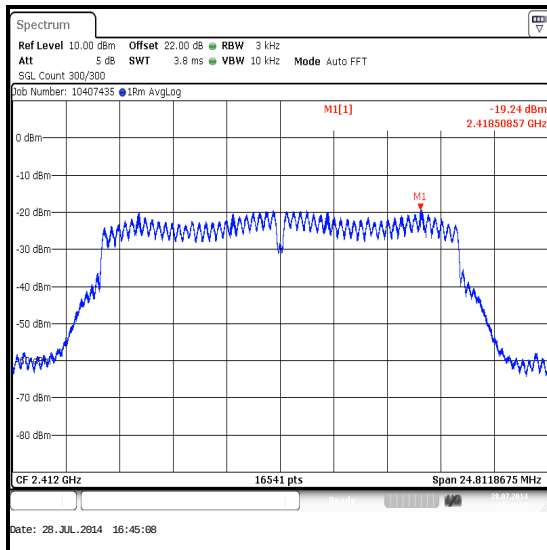
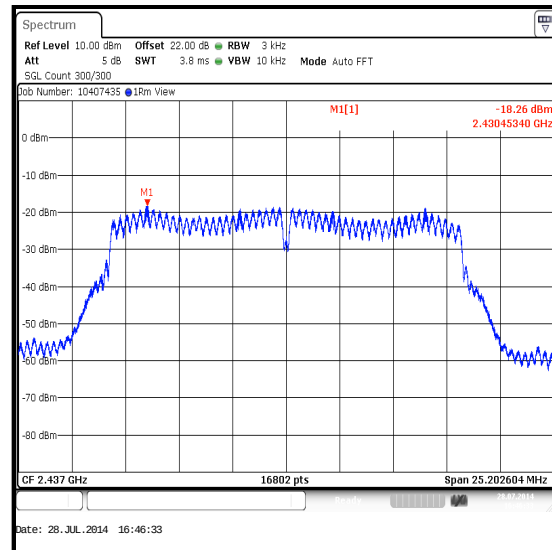
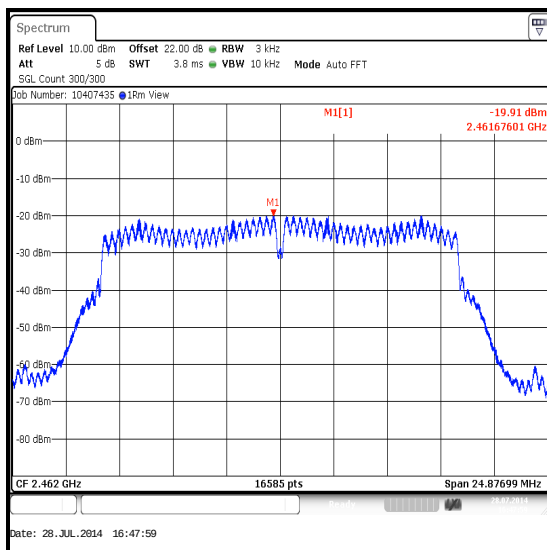
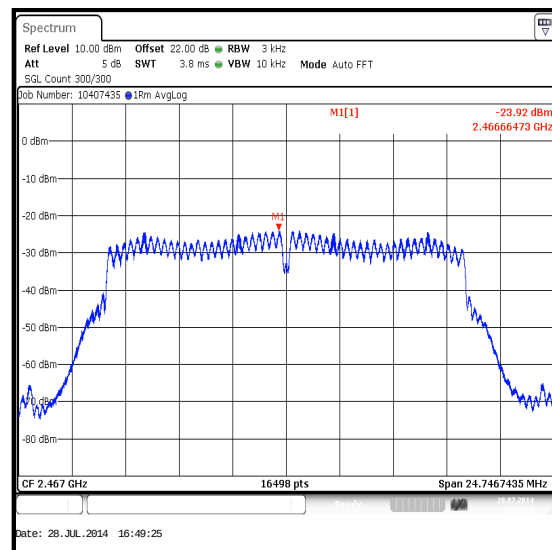
Channel	Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
1	-17.4	8.0	25.4	Complied
6	-17.4	8.0	25.4	Complied
11	-17.5	8.0	25.5	Complied
12	-18.5	8.0	26.5	Complied
13	-19.8	8.0	27.8	Complied

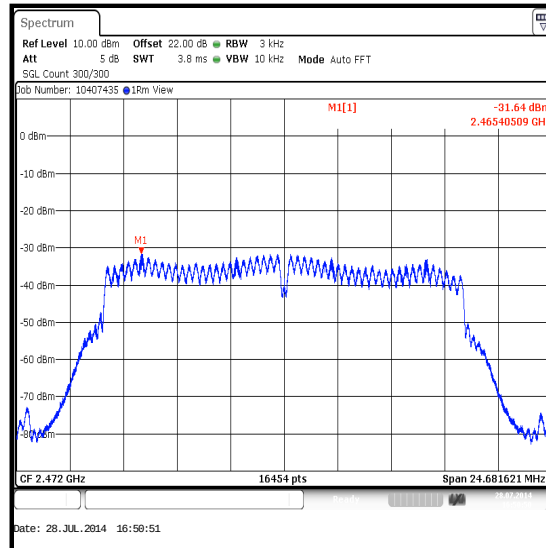
**Channel 1****Channel 6****Channel 11****Channel 12**

Transmitter Power Spectral Density (continued)**Results: 802.11b / 20 MHz / DBPSK / 1 Mbps****Channel 13**

Transmitter Power Spectral Density (continued)**Results: 802.11g / 20 MHz / BPSK / 6 Mbps**

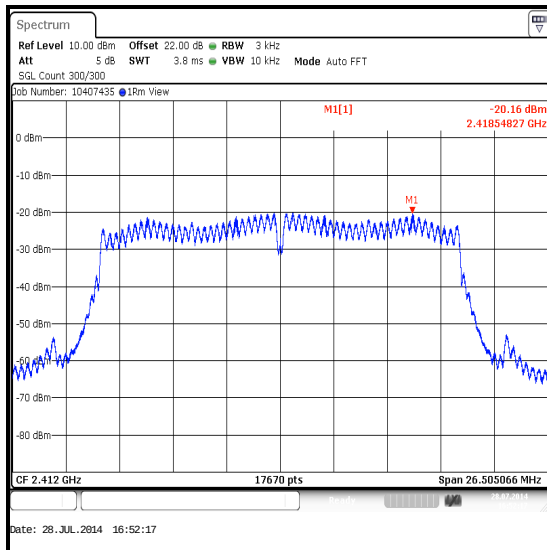
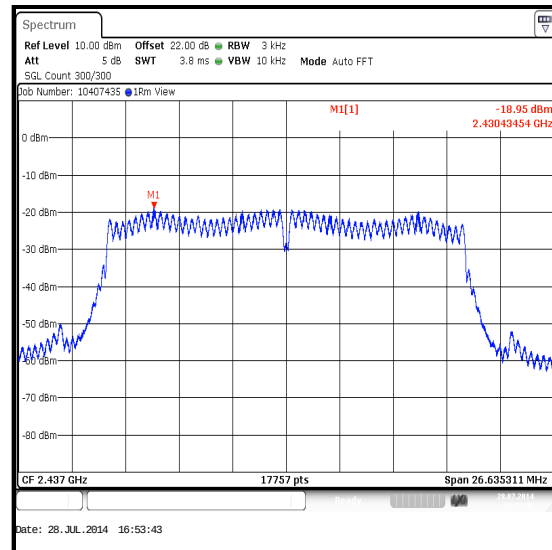
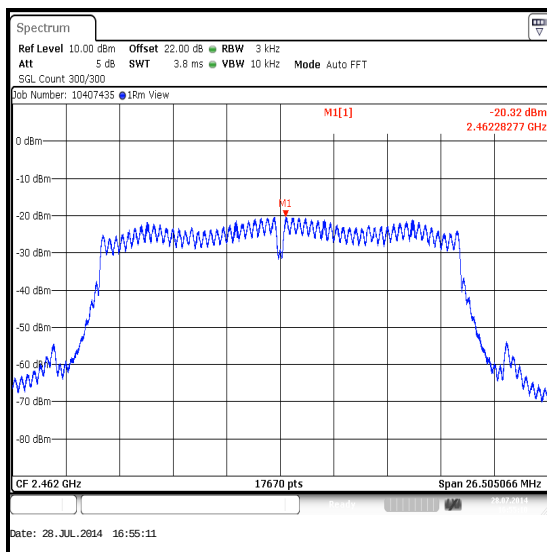
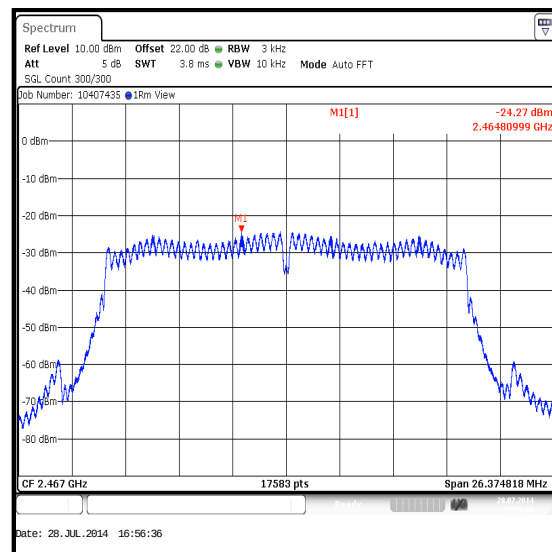
Channel	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
1	-19.2	0.1	-19.1	8.0	27.1	Complied
6	-18.3	0.1	-18.2	8.0	26.2	Complied
11	-19.9	0.1	-19.8	8.0	27.8	Complied
12	-23.9	0.1	-23.8	8.0	31.8	Complied
13	-31.6	0.1	-31.5	8.0	39.5	Complied

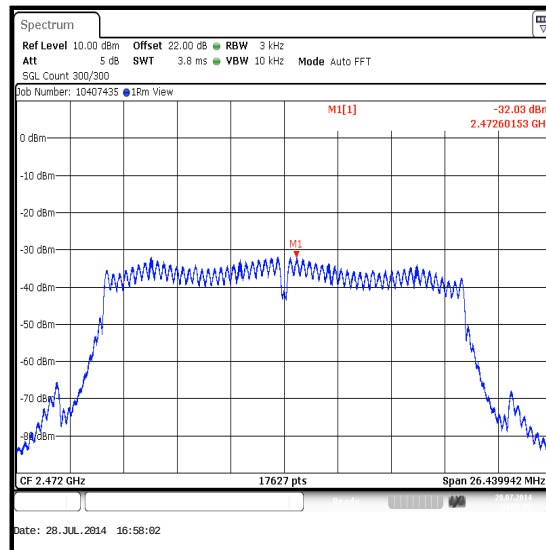
**Channel 1****Channel 6****Channel 11****Channel 12**

Transmitter Power Spectral Density (continued)**Results: 802.11g / 20 MHz / BPSK / 6 Mbps****Channel 13**

Transmitter Power Spectral Density (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 1**

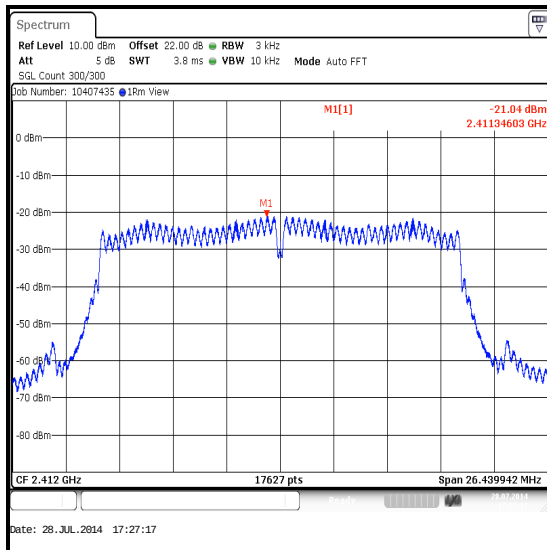
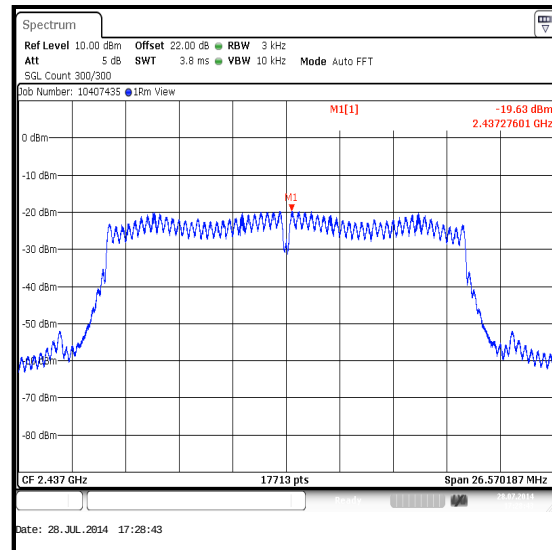
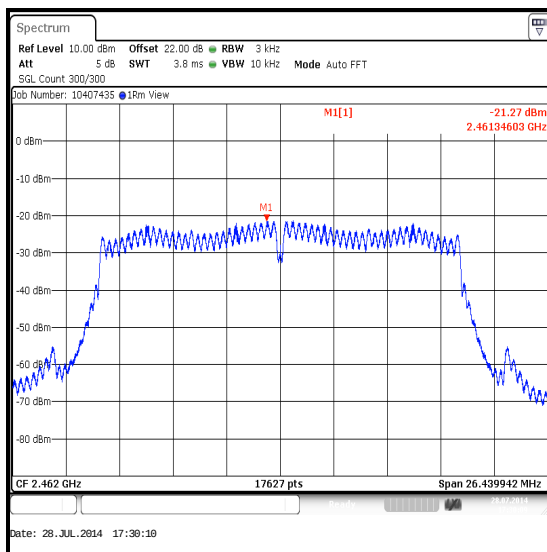
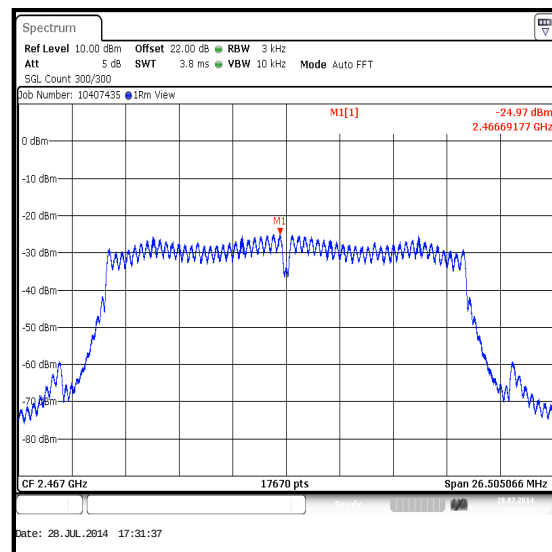
Channel	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
1	-20.2	0.1	-20.1	8.0	28.1	Complied
6	-19.0	0.1	-18.9	8.0	26.9	Complied
11	-20.3	0.1	-20.2	8.0	28.2	Complied
12	-24.3	0.1	-24.2	8.0	32.2	Complied
13	-32.0	0.1	-31.9	8.0	39.9	Complied

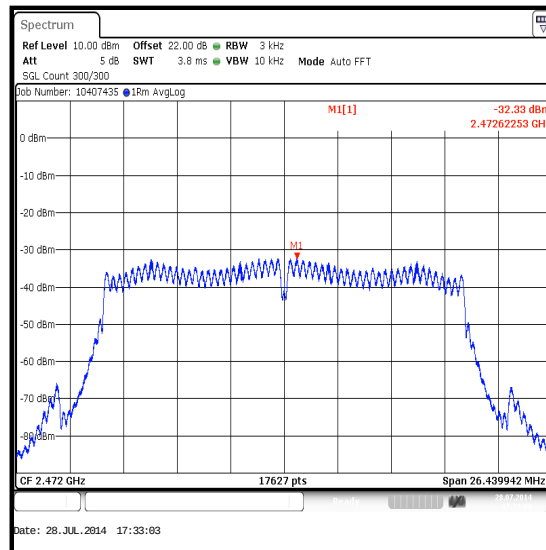
**Channel 1****Channel 6****Channel 11****Channel 12**

Transmitter Power Spectral Density (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 1****Channel 13**

Transmitter Power Spectral Density (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 2**

Channel	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
1	-21.0	0.1	-20.9	8.0	28.9	Complied
6	-19.6	0.1	-19.5	8.0	27.5	Complied
11	-21.3	0.1	-21.2	8.0	29.2	Complied
12	-25.0	0.1	-24.9	8.0	32.9	Complied
13	-32.3	0.1	-32.2	8.0	40.2	Complied

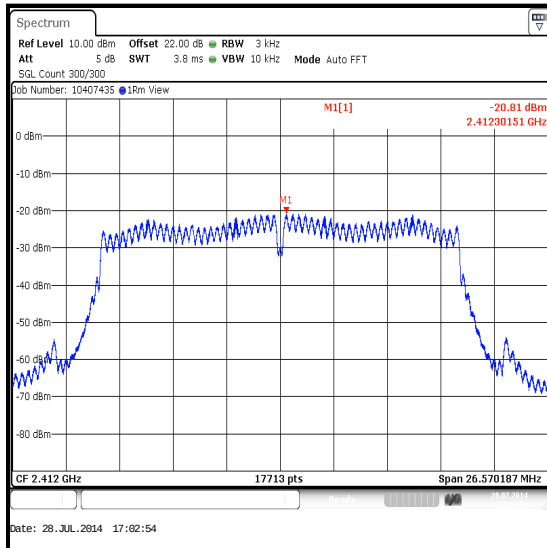
**Channel 1****Channel 6****Channel 11****Channel 12**

Transmitter Power Spectral Density (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 2****Channel 13**

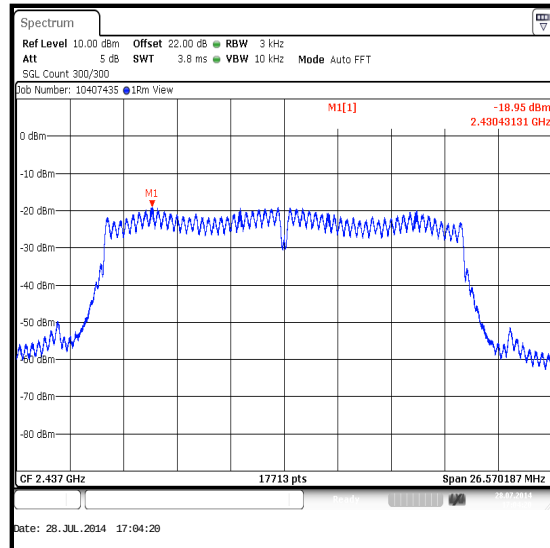
Transmitter Power Spectral Density (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO**

Channel	Port 1			Port 2		
	PSD (dBm / 3 kHz)	Duty Cycle Correction (dB)	Corrected PSD (dBm / 3 kHz)	PSD (dBm / 3 kHz)	Duty Cycle Correction (dB)	Corrected PSD (dBm / 3 kHz)
1	-20.8	0.1	-20.7	-21.8	0.1	-21.7
6	-19.0	0.1	-18.9	-19.2	0.1	-19.1
11	-21.0	0.1	-20.9	-21.8	0.1	-21.7
12	-26.5	0.1	-26.4	-27.0	0.1	-26.9
13	-33.6	0.1	-33.5	-32.9	0.1	-32.8

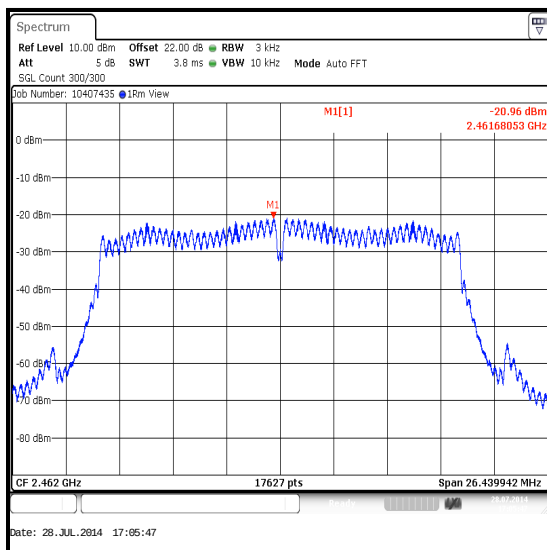
Channel	Corrected PSD at Port 1 (dBm / 3 kHz)	Corrected PSD at Port 2 (dBm / 3 kHz)	Combined PSD (dBm / 3 kHz)	PSD Limit (dBm / 3 kHz)	Margin (dB)	Result
1	-20.7	-21.7	-18.2	8.0	26.2	Complied
6	-18.9	-19.1	-16.0	8.0	24.0	Complied
11	-20.9	-21.7	-18.3	8.0	26.3	Complied
12	-26.4	-26.9	-23.6	8.0	31.6	Complied
13	-33.5	-32.8	-30.1	8.0	38.1	Complied

Transmitter Power Spectral Density (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 1**

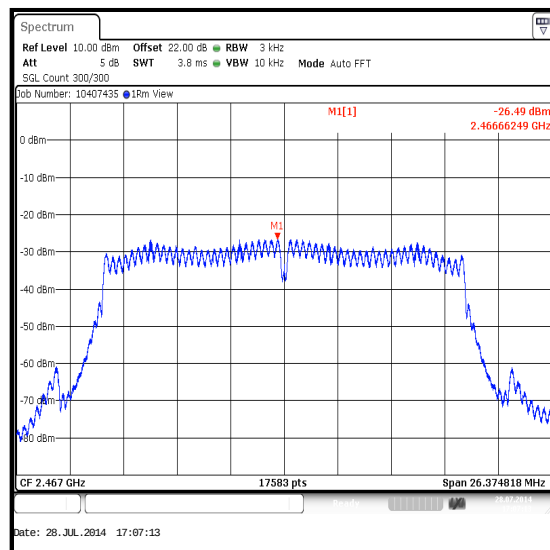
Channel 1



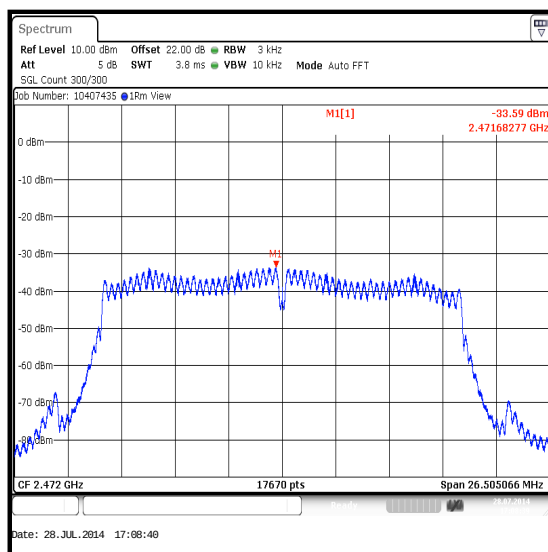
Channel 6

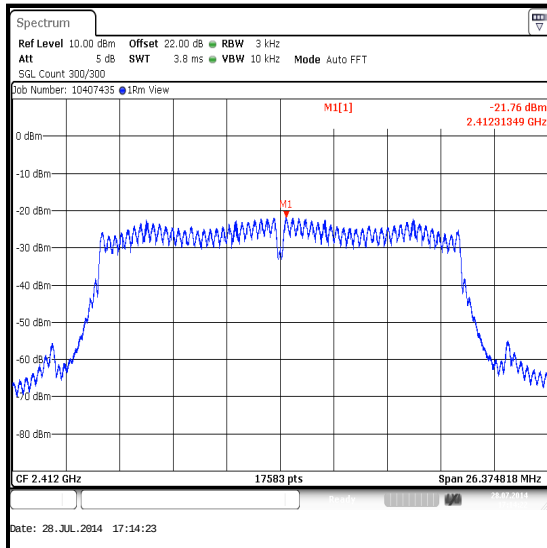
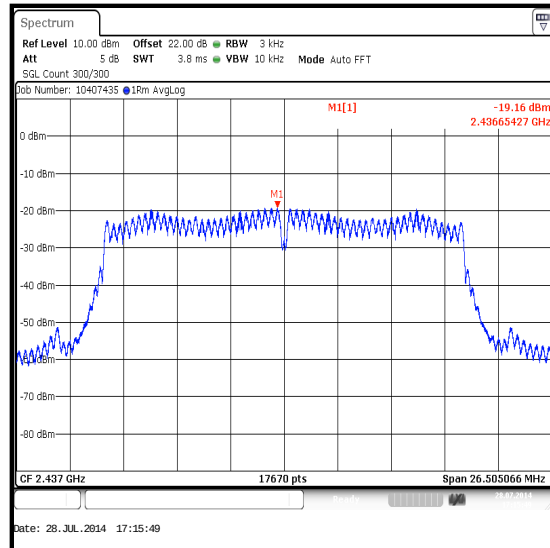
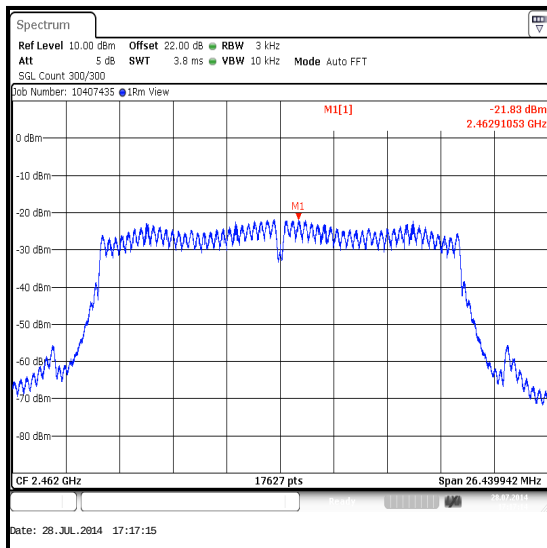
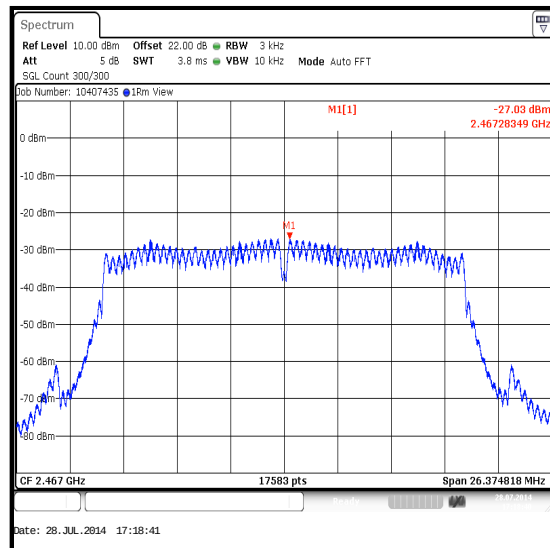


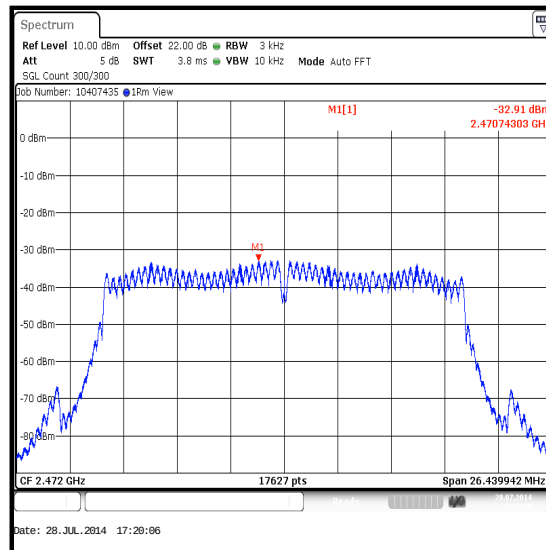
Channel 11



Channel 12

Transmitter Power Spectral Density (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 1****Channel 13**

Transmitter Power Spectral Density (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 2****Channel 1****Channel 6****Channel 11****Channel 12**

Transmitter Power Spectral Density (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 2****Channel 13****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1658	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
L1128	Signal Analyser	Rohde & Schwarz	FSV13	101835	25 Apr 2015	12
A1998	Attenuator	Huber & Suhner	6820.17.B	07101	Calibrated before use	-
S0558	DC Power Supply	TTI	EL 303R	395825	Calibrated before use	-
M1251	Multimeter	Fluke	175	89170179	19 May 2015	12
G0608	Signal Generator	Rohde & Schwarz	SMIQ 06B	838341/033	14 Feb 2015	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	08 Apr 2016	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	23 Apr 2016	24

5.2.5. Transmitter Maximum (Average) Output Power**Test Summary:**

Test Engineer:	Georgios Vrezas	Test Date:	28 July 2014
Test Sample IMEI:	352025060506475		

FCC Reference:	Part 15.247(b)(3)
Test Method Used:	As detailed in FCC KDB 558074 Sections 9.2.2.2 & 9.2.2.4

Environmental Conditions:

Temperature (°C):	26
Relative Humidity (%):	38

Transmitter Maximum (Average) Output Power (continued)**Note(s):**

1. The customer declared the following data rates to be used for all measurements as:
 - o 802.11b – DBPSK / 1 Mbps
 - o 802.11g – DBPSK / 6 Mbps
 - o 802.11n SISO / HT20 – BPSK / 6.5 Mbps / MCS0 (GI = 800 ns)
 - o 802.11n MIMO / HT20 – BPSK / 6.5 Mbps / MCS0 (GI = 800 ns)
2. Final measurements were performed using the above configurations on the bottom, middle and top channels. The power has been integrated over the 99% occupied bandwidth. Plots for the occupied bandwidth are archived on the company server and available for inspection upon request.
3. For 802.11b and 802.11g the EUT transmits only from antenna 1, therefore conducted measurements were performed on port 1. For 802.11n the EUT can transmit from both antennas, therefore conducted measurements were performed on both ports.
4. For 802.11b, the EUT was transmitting at 100% duty cycle and testing was performed in accordance with KDB 558074 Section 9.2.2.2 measurement procedure AVGSA-1.
5. For 802.11g and 802.11n, the EUT was transmitting at <98% duty cycle and testing was performed in accordance with KDB 558074 Section 9.2.2.4 measurement procedure AVGSA-2. 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.
6. For 802.11n MIMO, power was measured on both ports and then combined using the measure-and-sum technique stated in FCC KDB 662911 D01 Section E1).
7. As the data streams are correlated for 802.11n MIMO, the directional antenna gain has been calculated in accordance with Section F2)e(ii):

$$\text{Directional Gain} = 10 \log \left[\frac{\sum_{j=1}^{N_{SS}} \left(\sum_{k=1}^{N_{ANT}} g_{j,k} \right)^2}{N_{ANT}} \right]$$

$$\text{For } N_{SS} = 1, N_{ANT} = 2, g_{1,1} = 10^{\frac{G_{ANTENNA 1}}{20}} = 10^{\frac{0.8}{20}} \text{ and } g_{1,2} = 10^{\frac{G_{ANTENNA 2}}{20}} = 10^{\frac{-1.9}{20}}.$$

the equation above gives the following result:

$$\text{Directional Gain} = 10 \log \left[\frac{\left(10^{\frac{0.8}{20}} + 10^{\frac{-1.9}{20}} \right)^2}{2} \right] = 2.6 \text{ dBi}$$

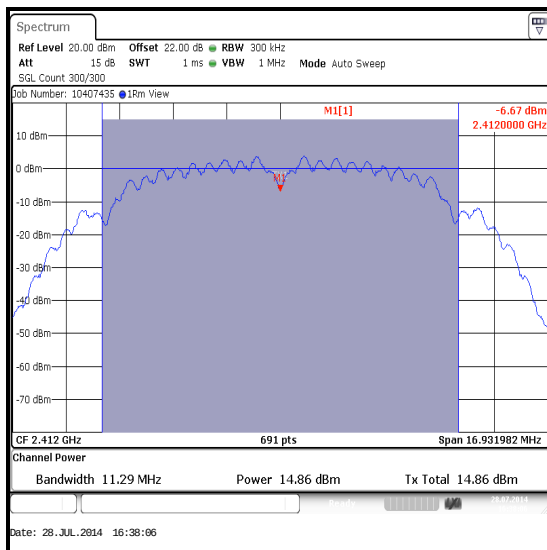
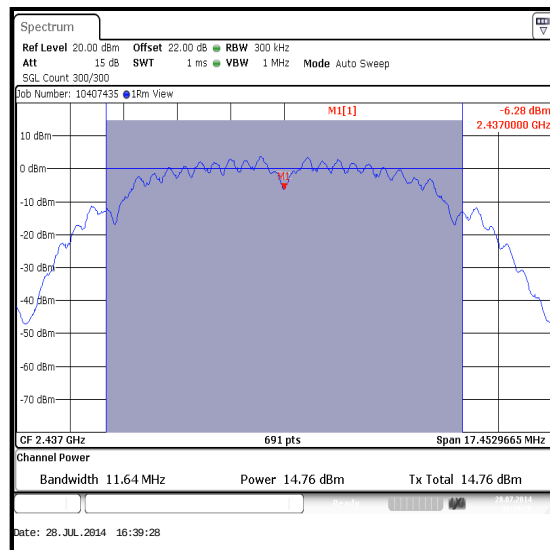
8. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

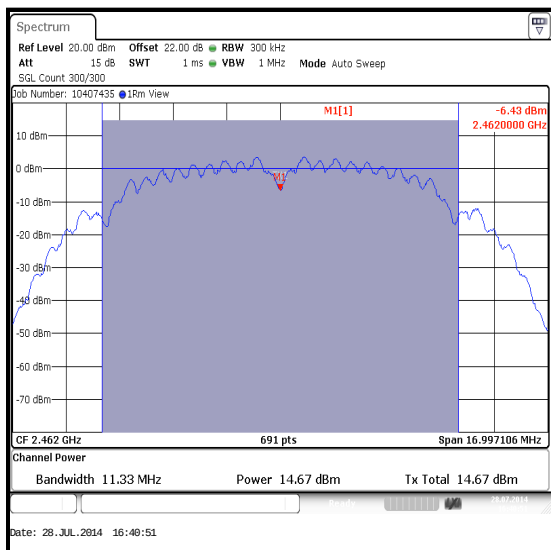
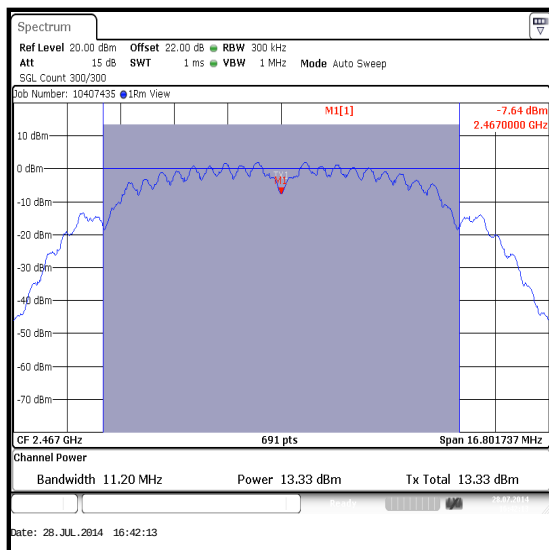
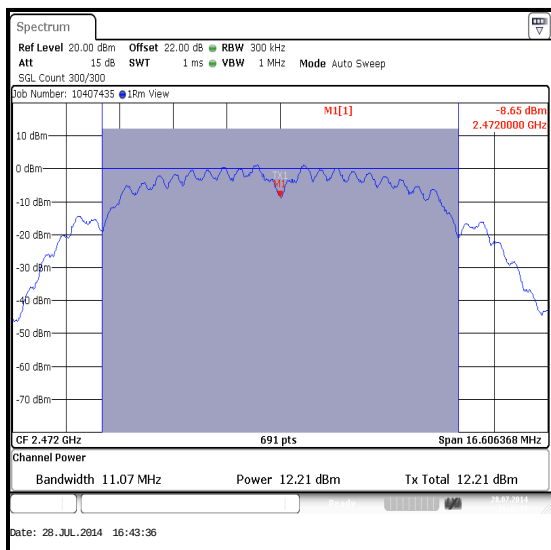
Transmitter Maximum (Average) Output Power (continued)**Results: 802.11b / 20 MHz / DBPSK / 1 Mbps****Conducted Power Limit Comparison**

Channel	Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
1	14.9	30.0	15.1	Complied
6	14.8	30.0	15.2	Complied
11	14.7	30.0	15.3	Complied
12	13.3	30.0	16.7	Complied
13	12.2	30.0	17.8	Complied

De Facto EIRP Limit Comparison

Channel	Conducted Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
1	14.9	0.8	15.7	36.0	20.3	Complied
6	14.8	0.8	15.6	36.0	20.4	Complied
11	14.7	0.8	15.5	36.0	20.5	Complied
12	13.3	0.8	14.1	36.0	21.9	Complied
13	12.2	0.8	13.0	36.0	23.0	Complied

**Channel 1****Channel 6**

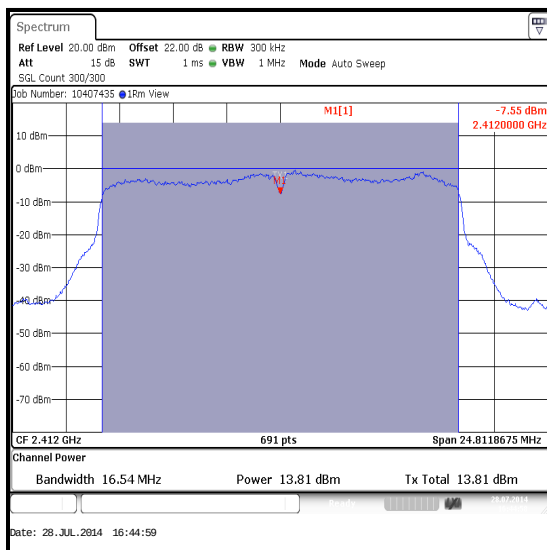
Transmitter Maximum (Average) Output Power (continued)**Results: 802.11b / 20 MHz / DBPSK / 1 Mbps****Channel 11****Channel 12****Channel 13**

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

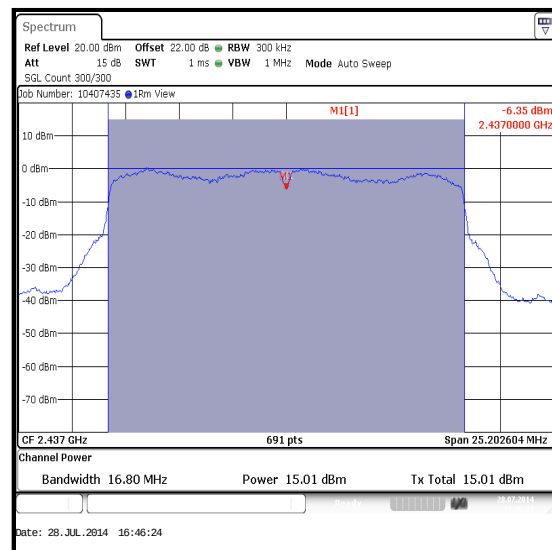
Channel	Conducted Power (dBm)	Duty Cycle Correction (dB)	Corrected Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
1	13.8	0.1	13.9	30.0	16.1	Complied
6	15.0	0.1	15.1	30.0	14.9	Complied
11	13.5	0.1	13.6	30.0	16.4	Complied
12	9.4	0.1	9.5	30.0	20.5	Complied
13	1.7	0.1	1.8	30.0	28.2	Complied

De Facto EIRP Limit Comparison

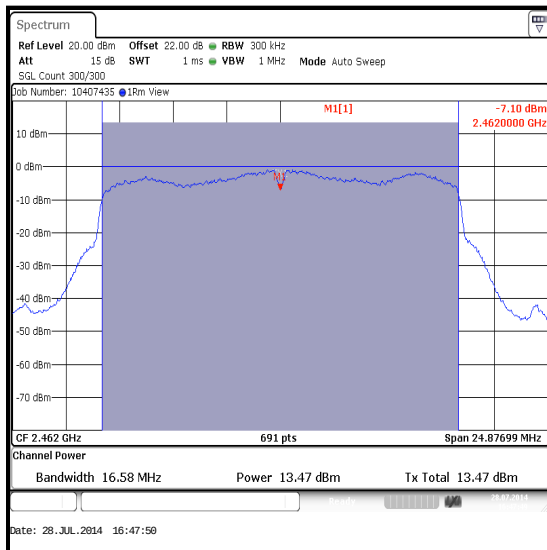
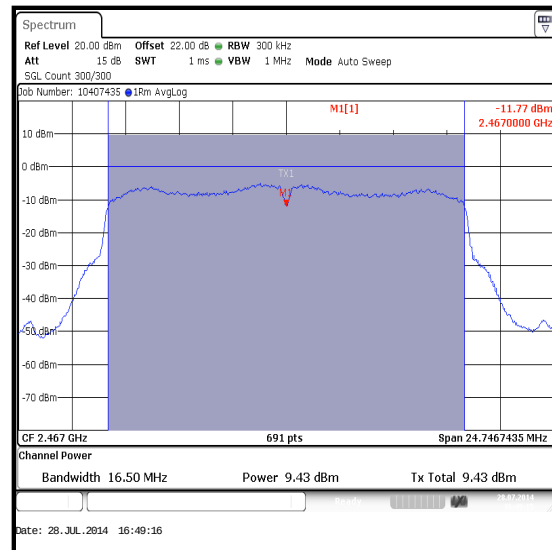
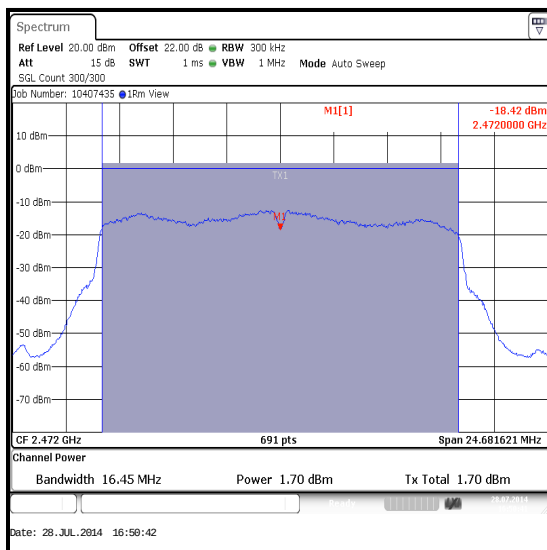
Channel	Corrected Conducted Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
1	13.9	0.8	14.7	36.0	21.3	Complied
6	15.1	0.8	15.9	36.0	20.1	Complied
11	13.6	0.8	14.4	36.0	21.6	Complied
12	9.5	0.8	10.3	36.0	25.7	Complied
13	1.8	0.8	2.6	36.0	33.4	Complied



Channel 1



Channel 6

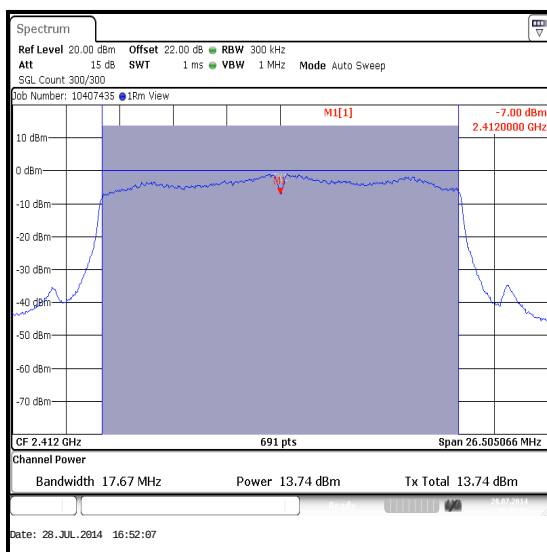
Transmitter Maximum (Average) Output Power (continued)**Results: 802.11g / 20 MHz / BPSK / 6 Mbps****Channel 11****Channel 12****Channel 13**

Transmitter Maximum (Average) Output Power (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 1****Conducted Power Limit Comparison**

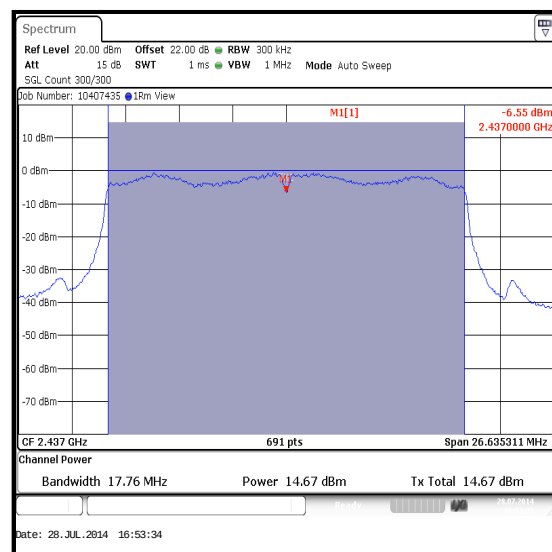
Channel	Conducted Power (dBm)	Duty Cycle Correction (dB)	Corrected Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
1	13.7	0.1	13.8	30.0	16.2	Complied
6	14.7	0.1	14.8	30.0	15.2	Complied
11	13.2	0.1	13.3	30.0	16.7	Complied
12	9.1	0.1	9.2	30.0	20.8	Complied
13	1.7	0.1	1.8	30.0	28.2	Complied

De Facto EIRP Limit Comparison

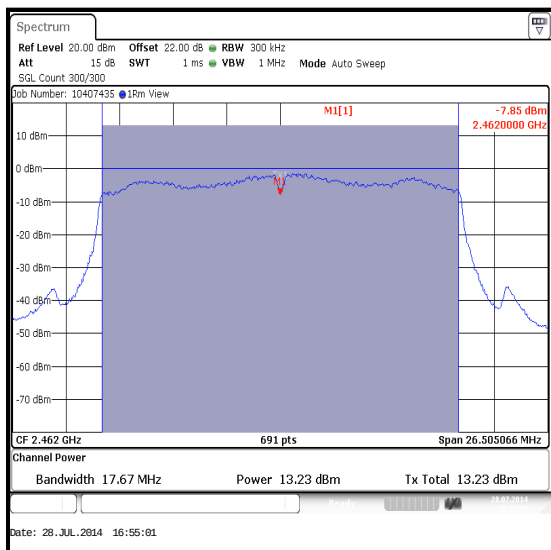
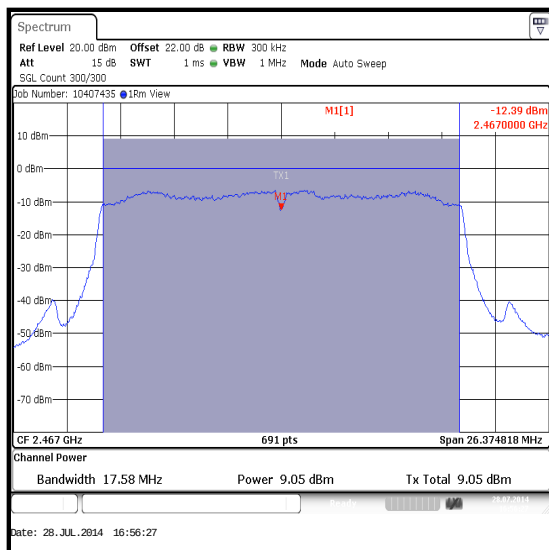
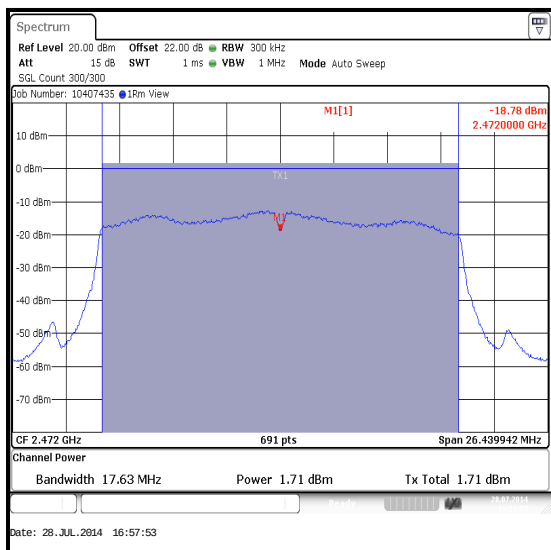
Channel	Corrected Conducted Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
1	13.8	0.8	14.6	36.0	21.4	Complied
6	14.8	0.8	15.6	36.0	20.4	Complied
11	13.3	0.8	14.1	36.0	21.9	Complied
12	9.2	0.8	10.0	36.0	26.0	Complied
13	1.8	0.8	2.6	36.0	33.4	Complied



Channel 1



Channel 6

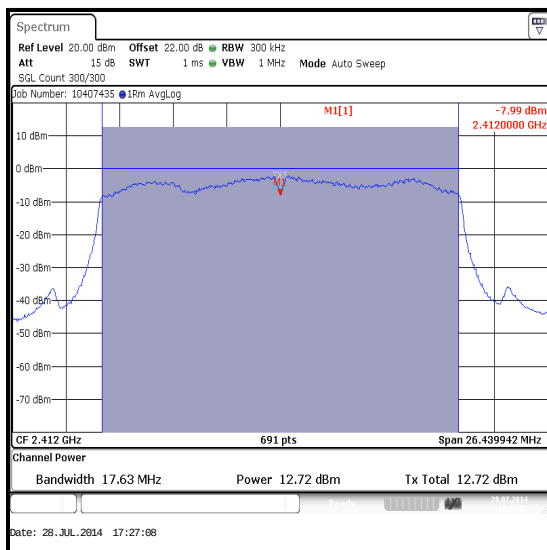
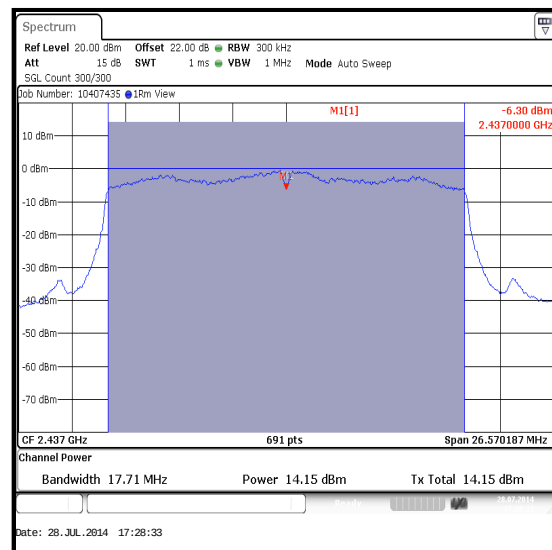
Transmitter Maximum (Average) Output Power (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 1****Channel 11****Channel 12****Channel 13**

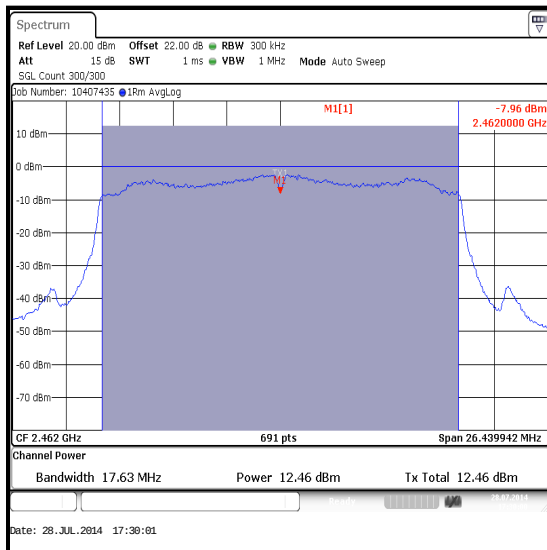
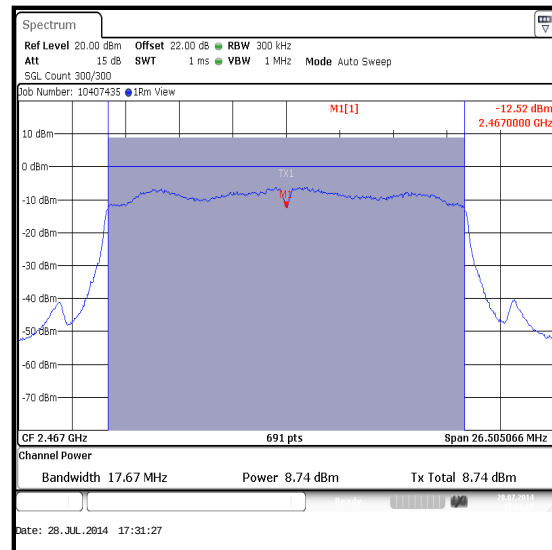
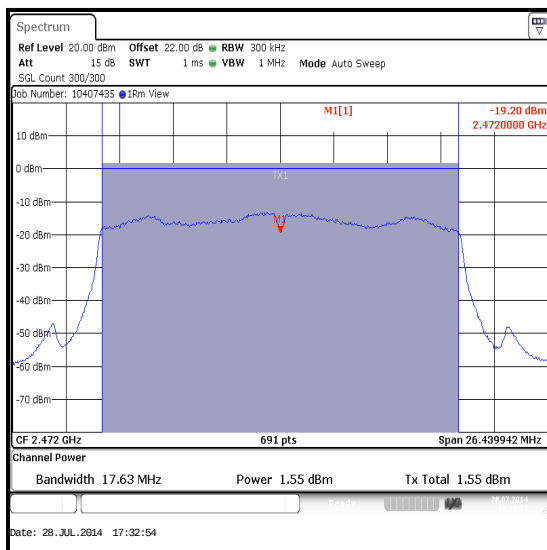
Transmitter Maximum (Average) Output Power (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 2****Conducted Power Limit Comparison**

Channel	Conducted Power (dBm)	Duty Cycle Correction (dB)	Corrected Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
1	12.7	0.1	12.8	30.0	17.2	Complied
6	14.2	0.1	14.3	30.0	15.7	Complied
11	12.5	0.1	12.6	30.0	17.4	Complied
12	8.7	0.1	8.8	30.0	21.2	Complied
13	1.6	0.1	1.7	30.0	28.3	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
1	12.8	-1.9	10.9	36.0	25.1	Complied
6	14.3	-1.9	12.4	36.0	23.6	Complied
11	12.6	-1.9	10.7	36.0	25.3	Complied
12	8.8	-1.9	6.9	36.0	29.1	Complied
13	1.7	-1.9	-0.2	36.0	36.2	Complied

**Channel 1****Channel 6**

Transmitter Maximum (Average) Output Power (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / SISO / Port 2****Channel 11****Channel 12****Channel 13**

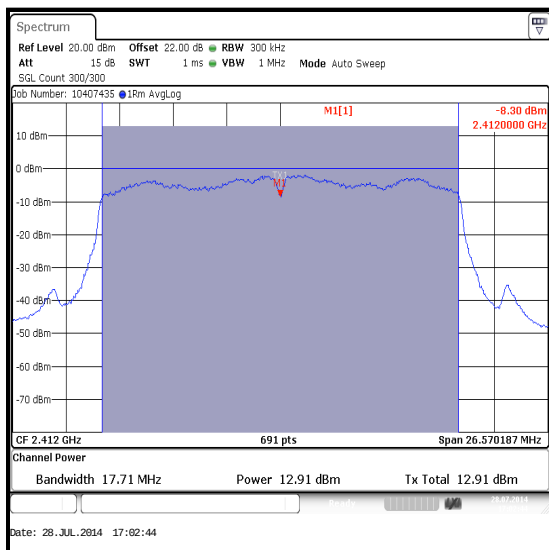
Transmitter Maximum (Average) Output Power (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO****Conducted Power Limit Comparison**

Channel	Port 1			Port 2		
	Conducted Power (dBm)	Duty Cycle Correction (dB)	Corrected Conducted Power (dBm)	Conducted Power (dBm)	Duty Cycle Correction (dB)	Corrected Conducted Power (dBm)
1	12.9	0.1	13.0	12.0	0.1	12.1
6	14.7	0.1	14.8	14.5	0.1	14.6
11	12.6	0.1	12.7	12.1	0.1	12.2
12	7.5	0.1	7.6	7.1	0.1	7.2
13	0.0	0.1	0.1	1.1	0.1	1.2

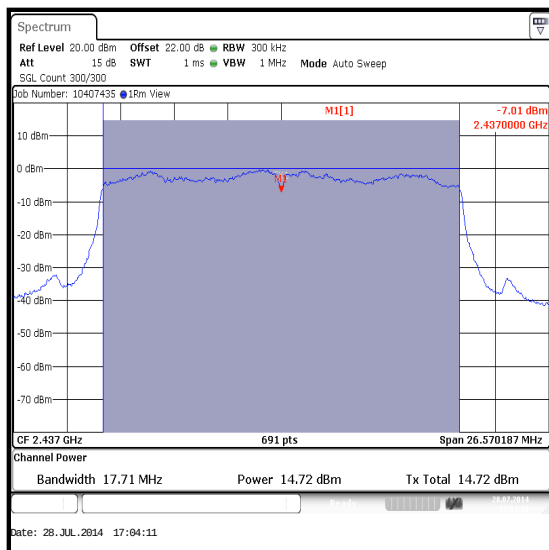
Channel	Corrected Conducted Power Port 1 (dBm)	Corrected Conducted Power Port 2 (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
1	13.0	12.1	15.6	30.0	14.4	Complied
6	14.8	14.6	17.7	30.0	12.3	Complied
11	12.7	12.2	15.5	30.0	14.5	Complied
12	7.6	7.2	10.4	30.0	19.6	Complied
13	0.1	1.2	3.7	30.0	26.3	Complied

De Facto EIRP Limit Comparison

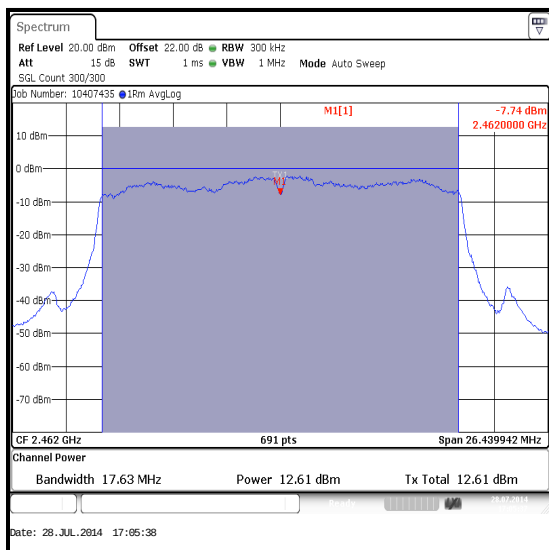
Channel	Combined Conducted Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
1	15.6	2.6	18.2	36.0	17.8	Complied
6	17.7	2.6	20.3	36.0	15.7	Complied
11	15.5	2.6	18.1	36.0	17.9	Complied
12	10.4	2.6	13.0	36.0	23.0	Complied
13	3.7	2.6	6.3	36.0	29.7	Complied

Transmitter Maximum (Average) Output Power (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 1**

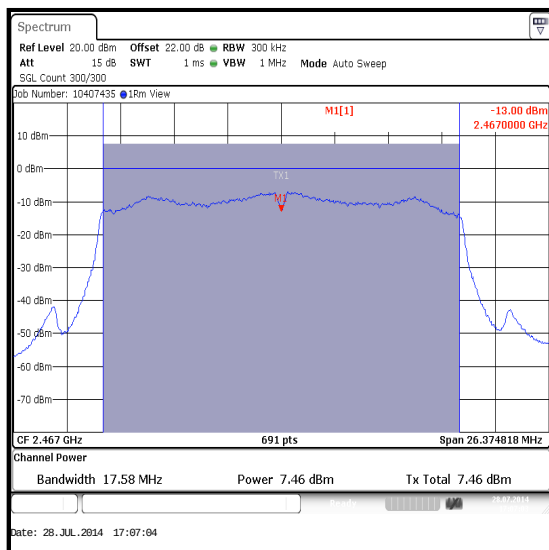
Channel 1



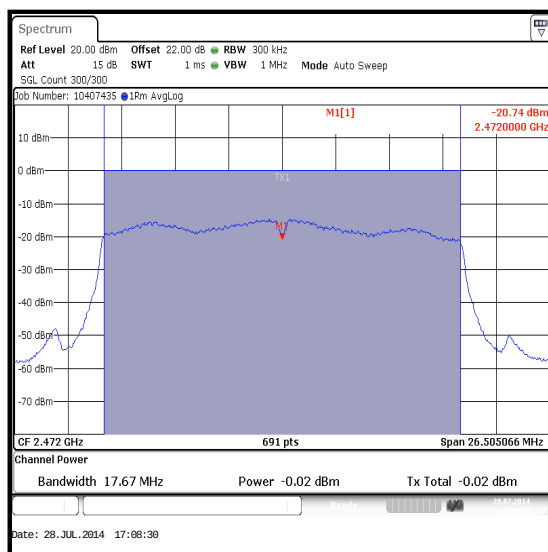
Channel 6

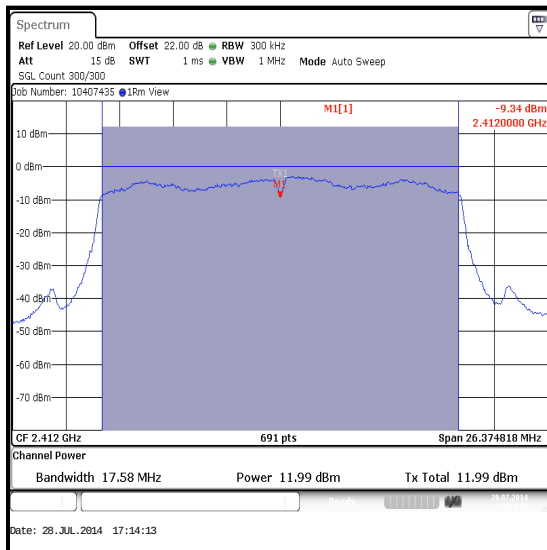


Channel 11

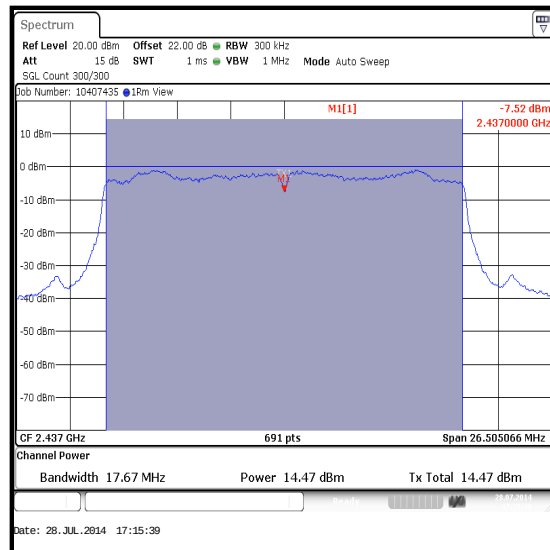


Channel 12

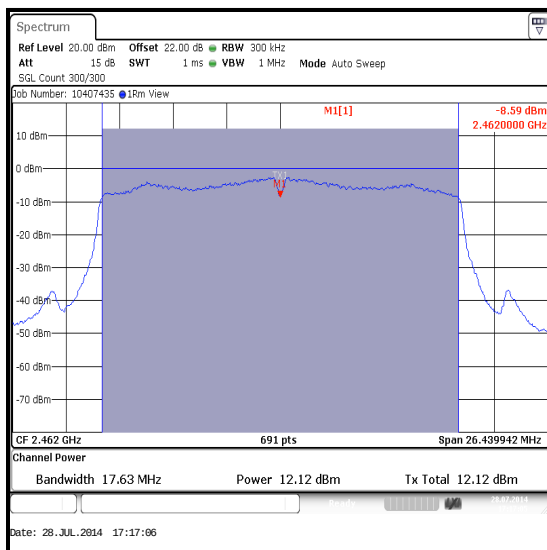
Transmitter Maximum (Average) Output Power (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 1****Channel 13**

Transmitter Maximum (Average) Output Power (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 2**

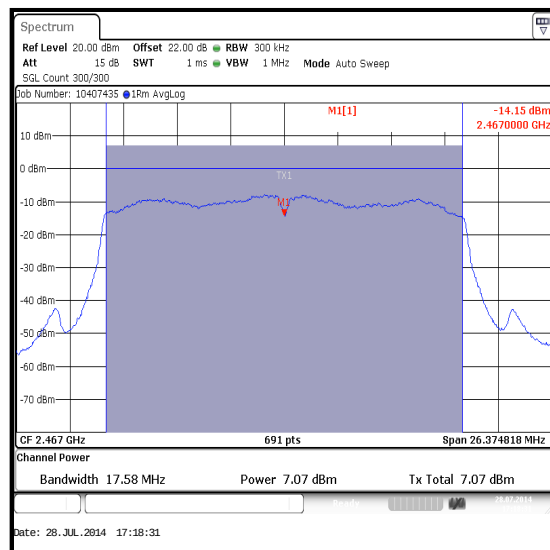
Channel 1



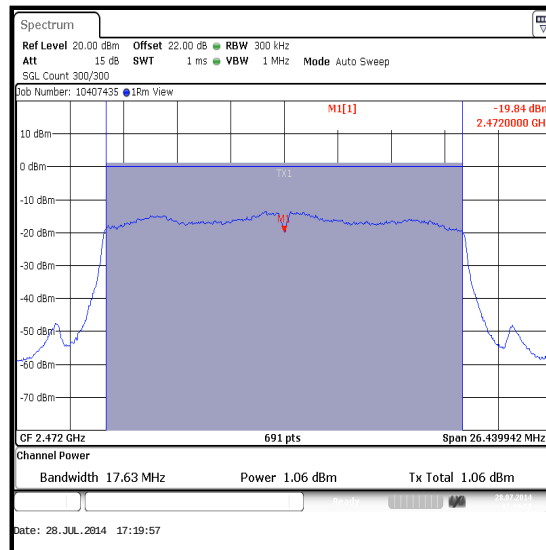
Channel 6



Channel 11



Channel 12

Transmitter Maximum (Average) Output Power (continued)**Results: 802.11n / HT20 / BPSK / MCS0 / MIMO / Port 2****Channel 13****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1658	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
S0558	DC Power Supply	TTI	EL 303R	395825	Calibrated before use	-
L1128	Signal Analyser	Rohde & Schwarz	FSV13	101835	25 Apr 2015	12
M1251	Multimeter	Fluke	175	89170179	19 May 2015	12
A1998	Attenuator	Huber & Suhner	6820.17.B	07101	Calibrated before use	-
G0608	Signal Generator	Rohde & Schwarz	SMIQ 06B	838341/033	14 Feb 2015	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	08 Apr 2016	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	23 Apr 2016	24

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

Test Engineer:	Georgios Vrezas	Test Date:	30 July 2014
Test Sample IMEI:	352025060501666		

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

Environmental Conditions:

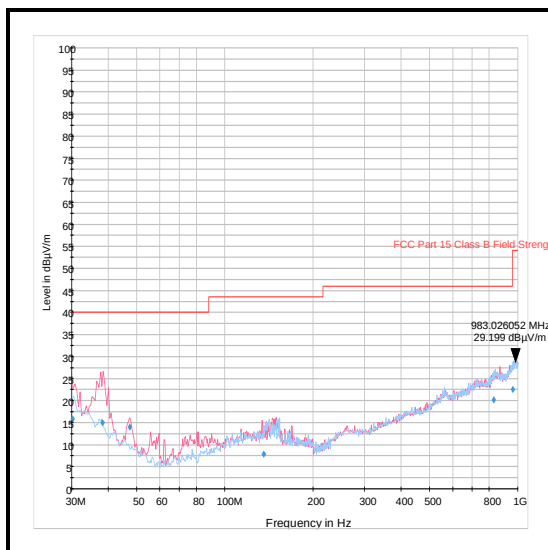
Temperature (°C):	25
Relative Humidity (%):	32

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 channel 11 only.
3. All 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. Therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
4. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Results: Top Channel / 802.11n / HT20 / BPSK / MCS0 / MIMO

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
983.026	Vertical	29.2	54.0	24.8	Complied

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12
G0543	Amplifier	Sonoma	310N	230801	19 Aug 2014	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	15 Feb 2015	12
A490	Antenna	Chase	CBL6111A	1590	29 Apr 2015	12

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

Test Engineer:	Georgios Vrezas	Test Date:	01 August 2014
Test Sample IMEI:	352025060501666		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
Frequency Range	1 GHz to 25 GHz

Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	41

Note(s):

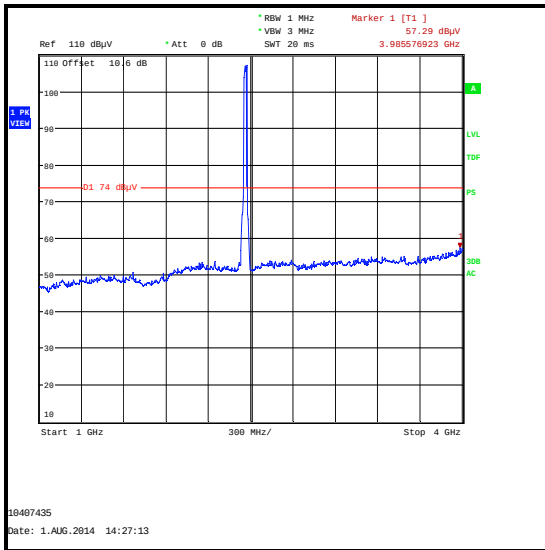
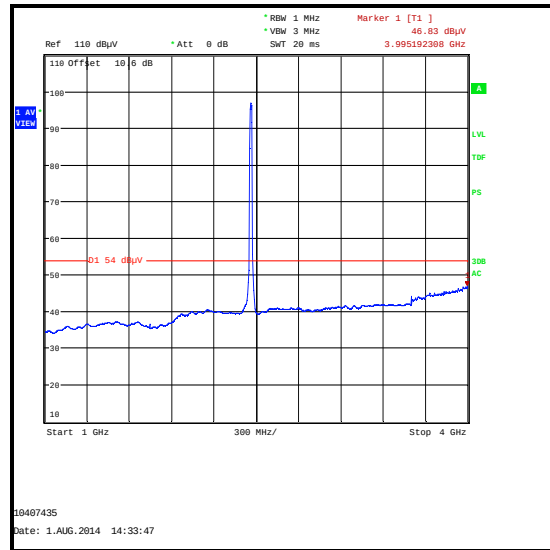
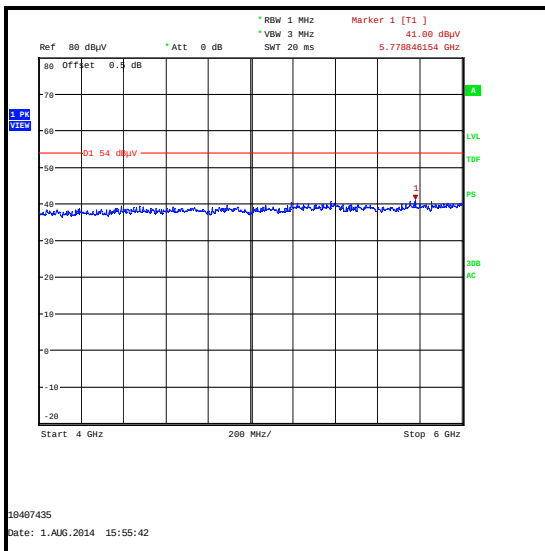
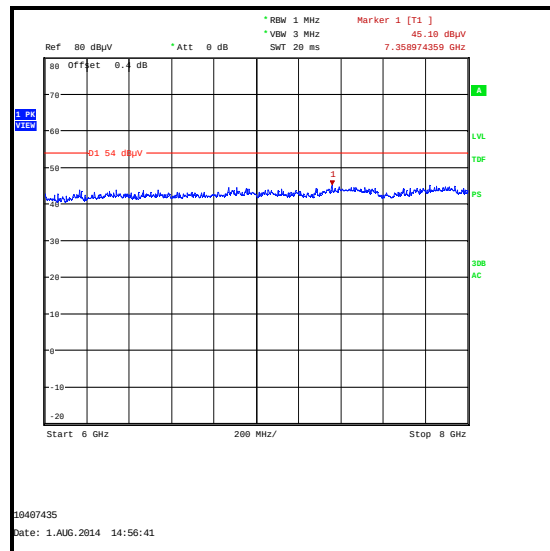
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak and average noise floor readings of the measuring receiver 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.

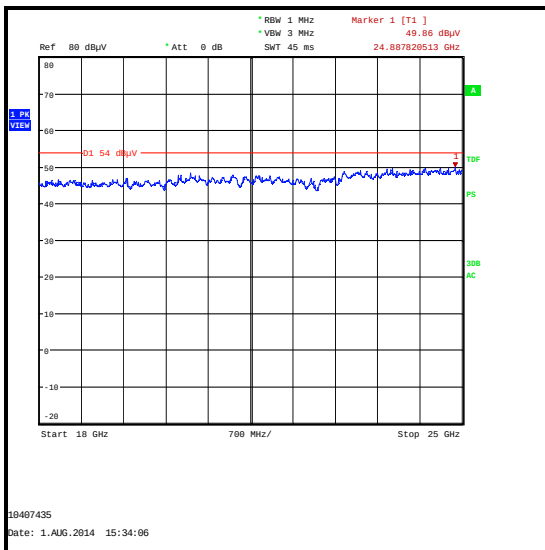
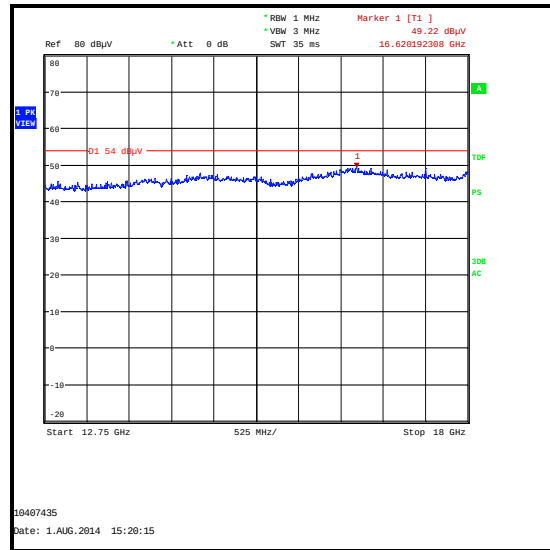
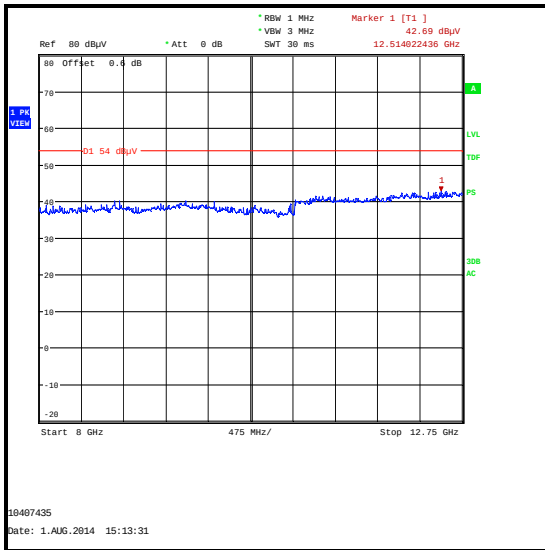
Results: Peak

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Result
3985.577	Horizontal	57.3	74.0	16.7	Complied

Results: Average

Frequency (MHz)	Antenna Polarity	Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
3995.192	Horizontal	46.8	54.0	7.2	Complied

Transmitter Radiated Emissions (continued)*Peak detector**Average detector*

Transmitter Radiated Emissions (continued)

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	13 May 2015	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	18 May 2015	12
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12
A253	Antenna	Flann Microwave	12240-20	128	14 Nov 2014	12
A254	Antenna	Flann Microwave	14240-20	139	14 Nov 2014	12
A255	Antenna	Flann Microwave	16240-20	519	14 Nov 2014	12
A256	Antenna	Flann Microwave	18240-20	400	14 Nov 2014	12
A436	Antenna	Flann Microwave	20240-20	330	14 Nov 2014	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	02 May 2015	12
A1975	High Pass Filter	AtlanTecRF	AFH-03000	090424010	12 Apr 2015	12

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

Test Engineers:	Georgios Vrezas & David Doyle	Test Dates:	01 August 2014 & 12 September 2014
Test Sample IMEI:	352025060501666		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	As detailed in ANSI C63.10 Section 6.9.2 & FCC KDB 558074 Section 11

Environmental Conditions:

Temperature (°C):	23 to 24
Relative Humidity (%):	40 to 51

Note(s):

- The customer declared the following data rates to be used for all measurements as:
 - o 802.11b – DBPSK / 1 Mbps
 - o 802.11g – BPSK / 6 Mbps
 - o 802.11n HT20 SISO – BPSK / 6.5 Mbps / MCS0
 - o 802.11n HT20 MIMO – BPSK / 6.5 Mbps / MCS0
- Final measurements were performed with the above configurations.
- For 802.11n HT20 SISO, the EUT was transmitting from Port 1 only as this Port emits the highest output power level and was therefore deemed to be worst case. For 802.11n MIMO, the EUT was transmitting from both ports.
- The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
- 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.
- * -30 dBc limit.

Results: Lower Band Edge / Peak / 802.11b / 20 MHz / DBPSK / 1 Mbps / Channel 1

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2328.590	54.2	74.0	19.8	Complied
2397.997	51.9	72.5*	20.6	Complied
2400	47.1	72.5*	25.4	Complied

Results: Lower Band Edge / Average / 802.11b / 20 MHz / DBPSK / 1 Mbps / Channel 1

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2377.821	48.0	54.0	6.0	Complied

Transmitter Band Edge Radiated Emissions (continued)**Results: Upper Band Edge / Peak / 802.11b / 20 MHz / DBPSK / 1 Mbps / Channel 11**

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	56.2	74.0	17.8	Complied
2484.061	56.7	74.0	17.3	Complied

Results: Upper Band Edge / Average / 802.11b / 20 MHz / DBPSK / 1 Mbps / Channel 11

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	44.3	54.0	9.7	Complied

Results: Upper Band Edge / Peak / 802.11b / 20 MHz / DBPSK / 1 Mbps / Channel 12

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	57.9	74.0	16.1	Complied

Results: Upper Band Edge / Average / 802.11b / 20 MHz / DBPSK / 1 Mbps / Channel 12

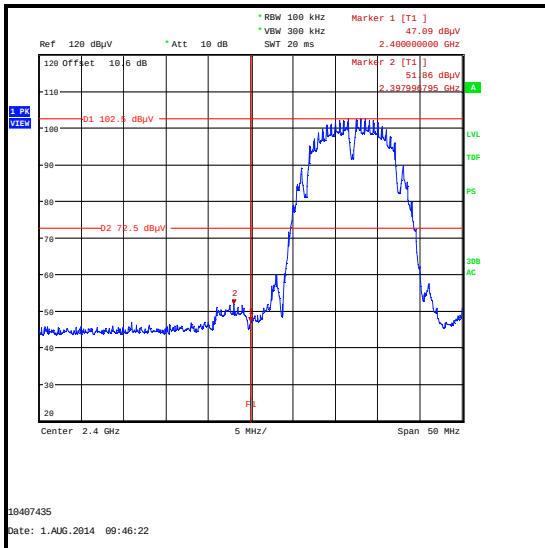
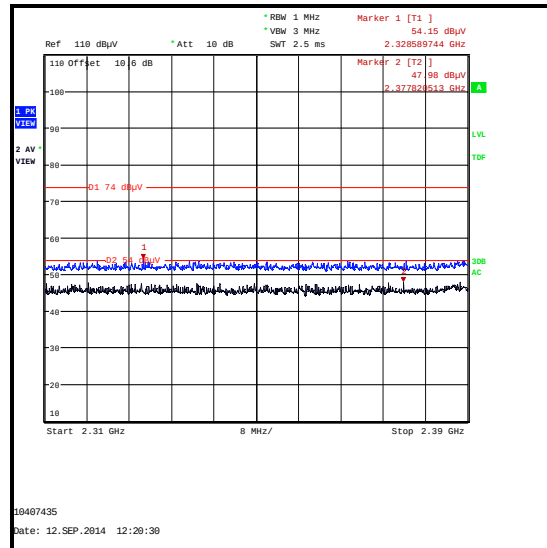
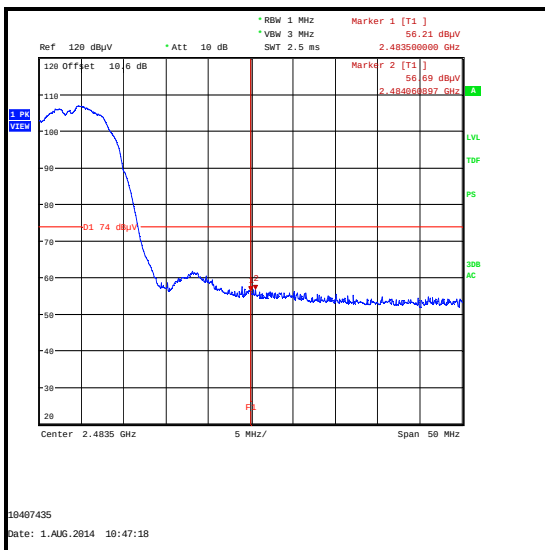
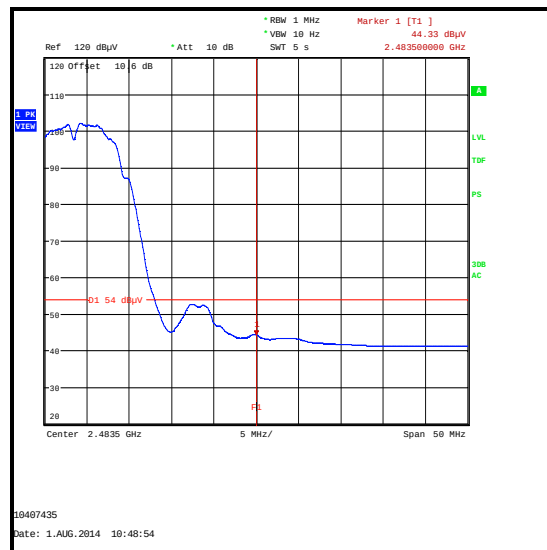
Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	46.7	54.0	7.3	Complied

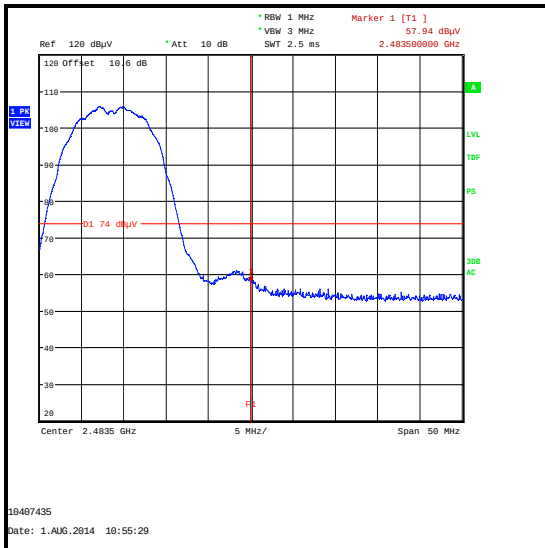
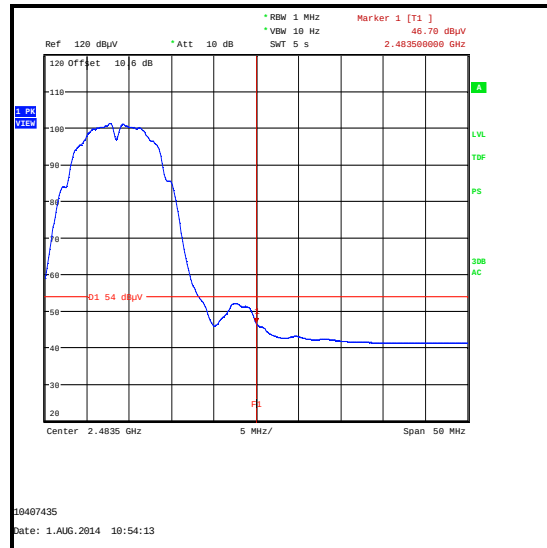
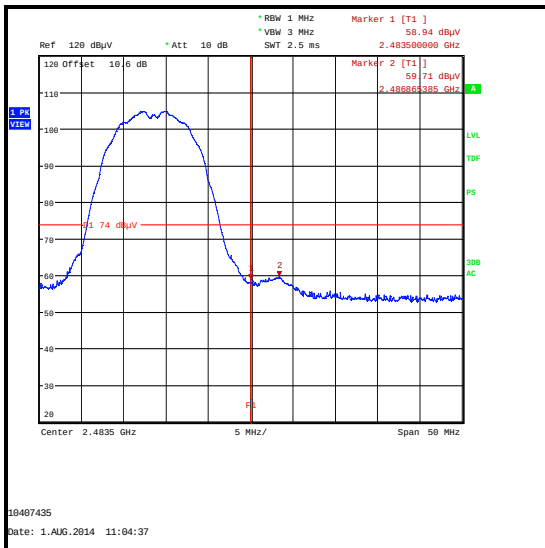
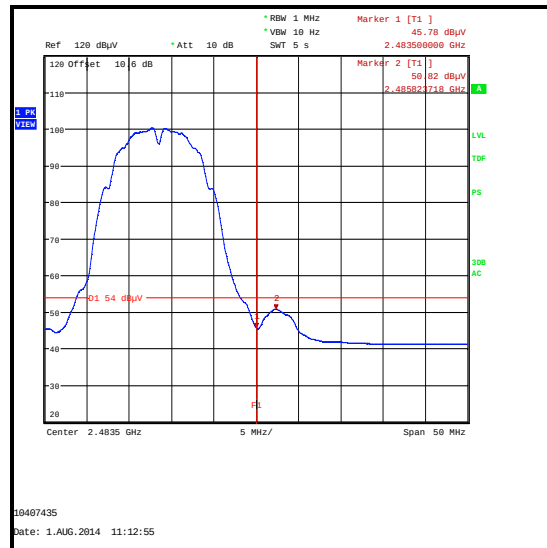
Results: Upper Band Edge / Peak / 802.11b / 20 MHz / DBPSK / 1 Mbps / Channel 13

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	58.9	74.0	15.1	Complied
2486.865	59.7	74.0	14.3	Complied

Results: Upper Band Edge / Average / 802.11b / 20 MHz / DBPSK / 1 Mbps / Channel 13

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	45.8	54.0	8.2	Complied
2485.824	50.8	54.0	3.2	Complied

Transmitter Band Edge Radiated Emissions (continued)**Results: 802.11b / 20 MHz / DBPSK / 1 Mbps****Lower Band Edge Peak Measurement Channel 1****2310-2390 MHz Restricted Band Measurement****Upper Band Edge Peak Measurement Channel 11****Upper Band Edge Average Measurement Channel 11**

Transmitter Band Edge Radiated Emissions (continued)**Results: 802.11b / 20 MHz / DBPSK / 1 Mbps****Upper Band Edge Peak Measurement
Channel 12****Upper Band Edge Average Measurement
Channel 12****Upper Band Edge Peak Measurement
Channel 13****Upper Band Edge Average Measurement
Channel 13**

Transmitter Band Edge Radiated Emissions (continued)**Results: Lower Band Edge / Peak / 802.11g / 20 MHz / BPSK / 6 Mbps / Channel 1**

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2389.872	62.8	74.0	11.2	Complied
2398.958	61.6	69.4*	7.8	Complied
2400	59.8	69.4*	9.6	Complied

Results: Lower Band Edge / Average / 802.11g / 20 MHz / BPSK / 6 Mbps / Channel 1

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2389.744	50.0	54.0	4.0	Complied

Results: Upper Band Edge / Peak / 802.11g / 20 MHz / BPSK / 6 Mbps / Channel 11

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	70.2	74.0	3.8	Complied

Results: Upper Band Edge / Average / 802.11g / 20 MHz / BPSK / 6 Mbps / Channel 11

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	46.2	54.0	7.8	Complied

Results: Upper Band Edge / Peak / 802.11g / 20 MHz / BPSK / 6 Mbps / Channel 12

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	63.6	74.0	10.4	Complied
2484.381	64.1	74.0	9.9	Complied

Results: Upper Band Edge / Average / 802.11g / 20 MHz / BPSK / 6 Mbps / Channel 12

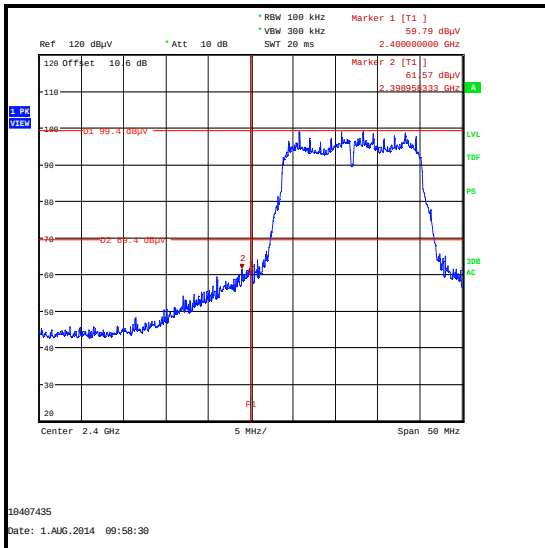
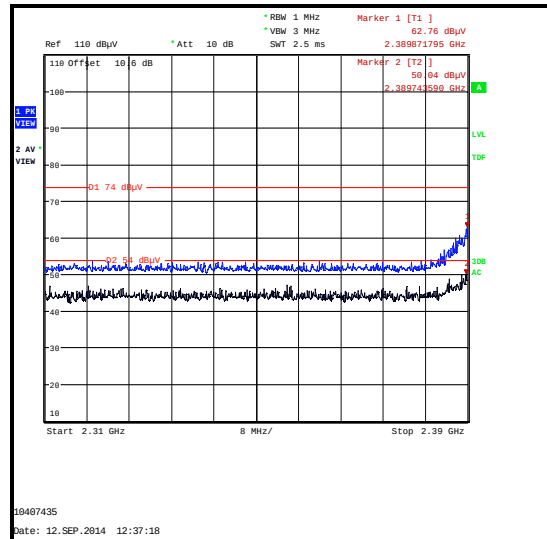
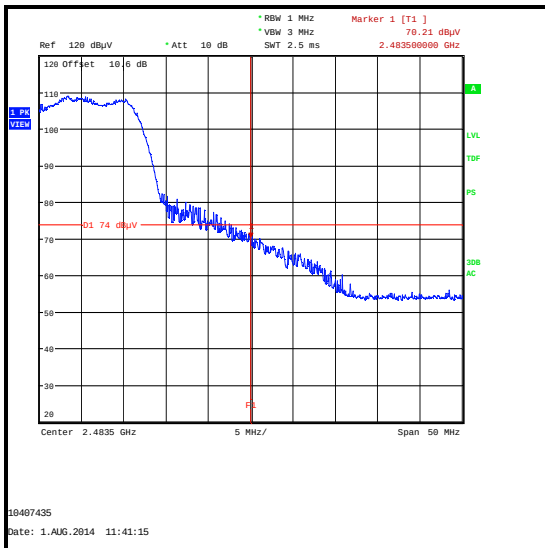
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2483.5	47.4	54.0	6.6	Complied

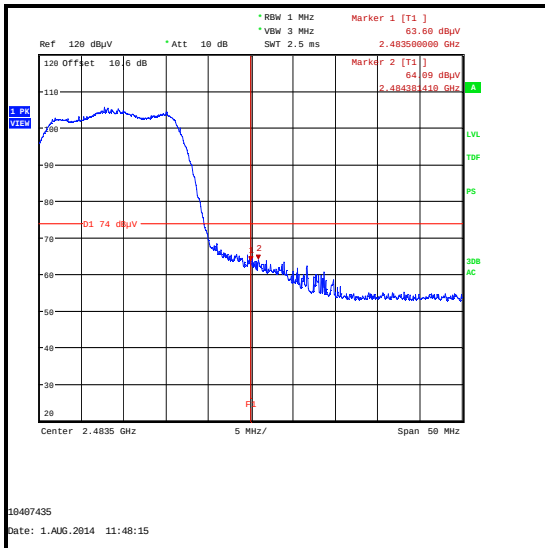
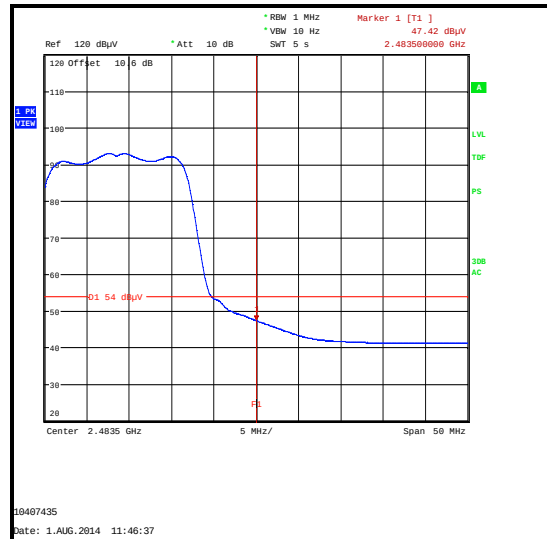
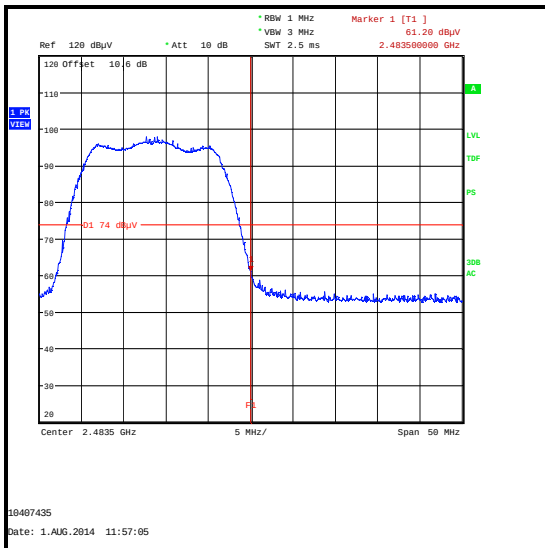
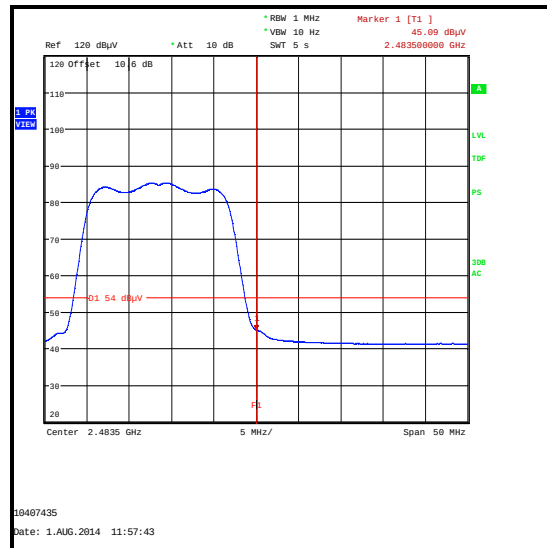
Results: Upper Band Edge / Peak / 802.11g / 20 MHz / BPSK / 6 Mbps / Channel 13

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	61.2	74.0	12.8	Complied

Results: Upper Band Edge / Average / 802.11g / 20 MHz / BPSK / 6 Mbps / Channel 13

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	45.1	54.0	8.9	Complied

Transmitter Band Edge Radiated Emissions (continued)**Results: 802.11g / 20 MHz / BPSK / 6 Mbps****Lower Band Edge Peak Measurement
Channel 1****2310-2390 MHz Restricted Band Measurement****Upper Band Edge Peak Measurement
Channel 11****Upper Band Edge Average Measurement
Channel 11**

Transmitter Band Edge Radiated Emissions (continued)**Results: 802.11g / 20 MHz / BPSK / 6 Mbps****Upper Band Edge Peak Measurement
Channel 12****Upper Band Edge Average Measurement
Channel 12****Upper Band Edge Peak Measurement
Channel 13****Upper Band Edge Average Measurement
Channel 13**

Transmitter Band Edge Radiated Emissions (continued)**Results: Lower Band Edge / Peak / 802.11n HT20 / SISO – BPSK / MCS0 / Channel 1**

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2389.872	65.9	74.0	8.1	Complied
2399.199	61.5	69.4*	7.9	Complied
2400	60.8	69.4*	8.6	Complied

Results: Lower Band Edge / Average / 802.11n HT20 / SISO – BPSK / MCS0 / Channel 1

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2390.000	51.6	54.0	2.4	Complied

Results: Upper Band Edge / Peak / 802.11n HT20 / SISO – BPSK / MCS0 / Channel 11

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	69.7	74.0	4.3	Complied
2484.061	71.9	74.0	2.1	Complied

Results: Upper Band Edge / Average / 802.11n HT20 / SISO – BPSK / MCS0 / Channel 11

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	47.1	54.0	6.9	Complied

Results: Upper Band Edge / Peak / 802.11n HT20 / SISO – BPSK / MCS0 / Channel 12

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	64.6	74.0	9.4	Complied
2484.702	66.6	74.0	7.4	Complied

Results: Upper Band Edge / Average / 802.11n HT20 / SISO – BPSK / MCS0 / Channel 12

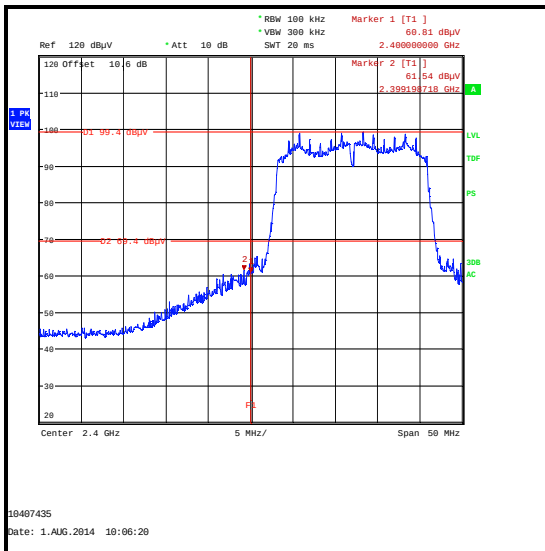
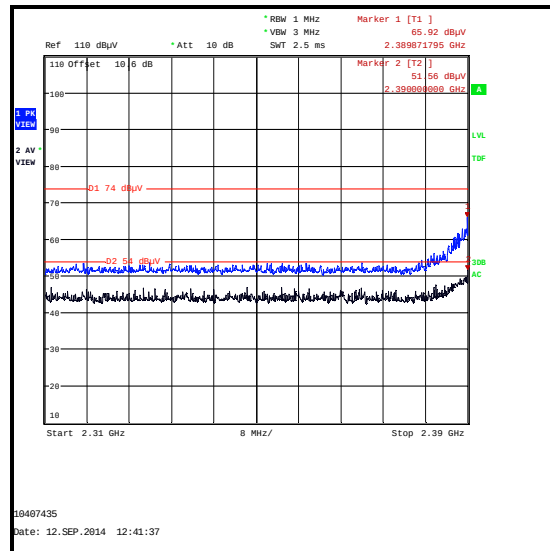
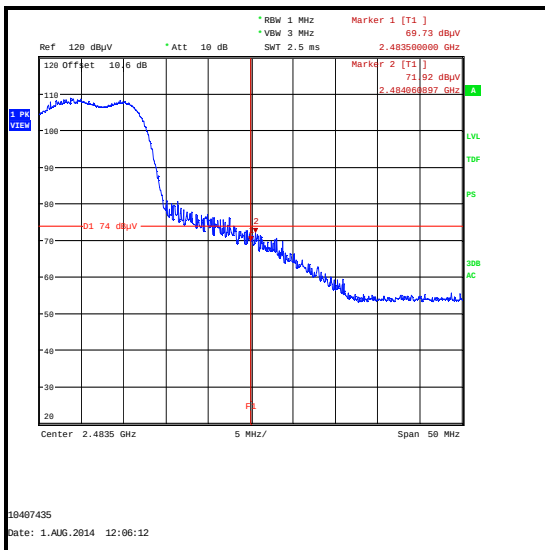
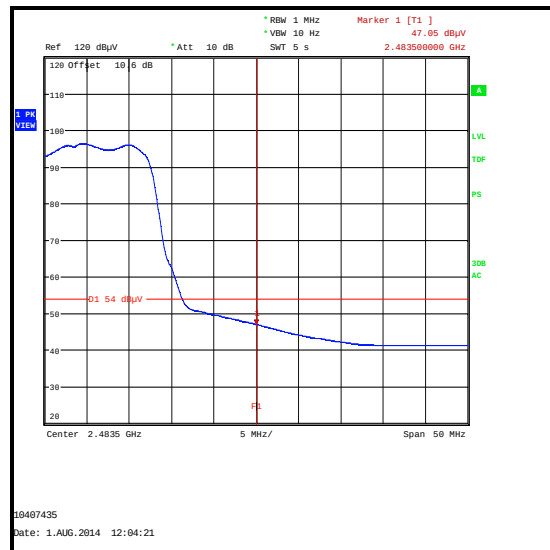
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2483.5	48.1	54.0	5.9	Complied

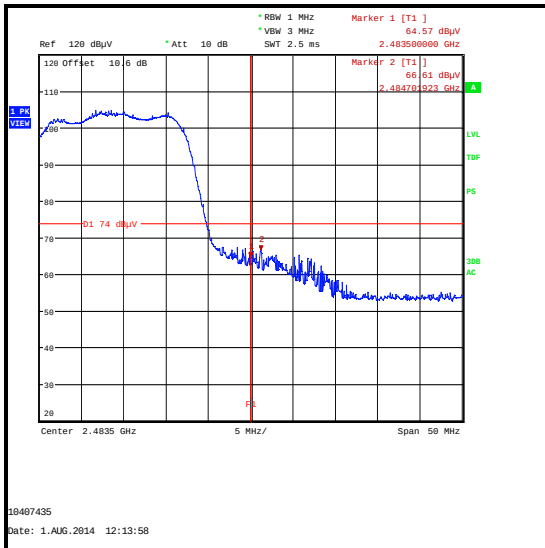
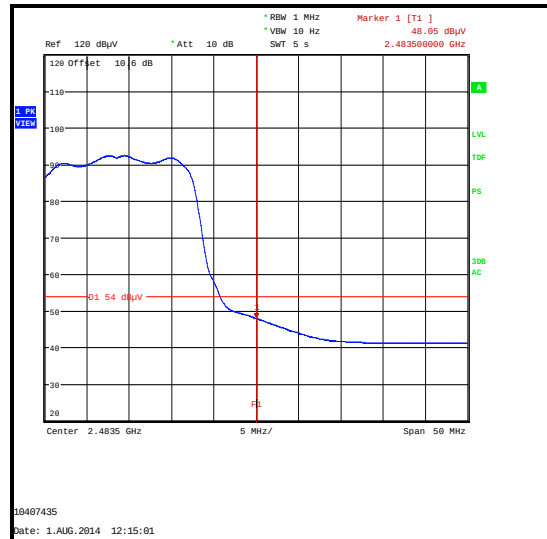
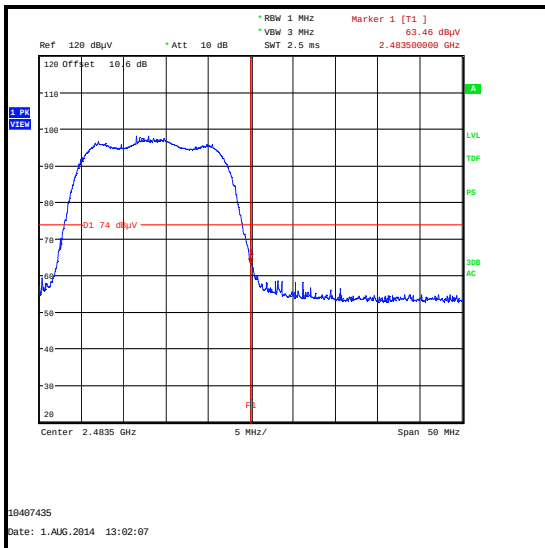
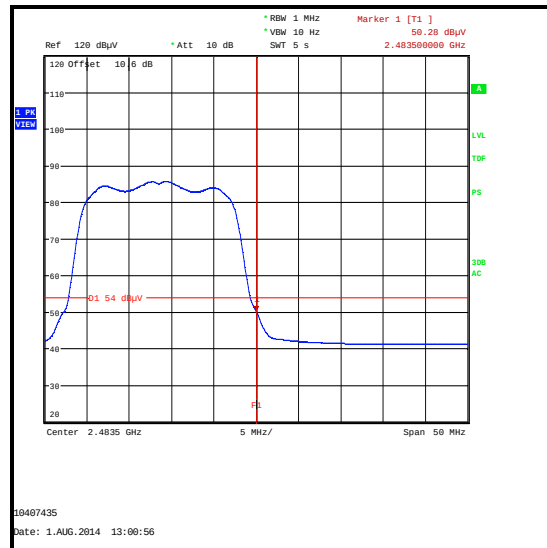
Results: Upper Band Edge / Peak / 802.11n HT20 / SISO – BPSK / MCS0 / Channel 13

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	63.5	74.0	10.5	Complied

Transmitter Band Edge Radiated Emissions (continued)**Results: Upper Band Edge / Average / 802.11n HT20 / SISO – BPSK / MCS0 / Channel 13**

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	50.3	54.0	3.7	Complied

Results: 802.11n / 20 MHz / BPSK / MCS0 / SISO**Lower Band Edge Peak Measurement Channel 1****2310-2390 MHz Restricted Band Measurement****Upper Band Edge Peak Measurement Channel 11****Upper Band Edge Average Measurement Channel 11**

Transmitter Band Edge Radiated Emissions (continued)**Results: 802.11n / 20 MHz / BPSK / MCS0 / SISO****Upper Band Edge Peak Measurement
Channel 12****Upper Band Edge Average Measurement
Channel 12****Upper Band Edge Peak Measurement
Channel 13****Upper Band Edge Average Measurement
Channel 13**

Transmitter Band Edge Radiated Emissions (continued)**Results: Lower Band Edge / Peak / 802.11n HT20 / MIMO – BPSK / MCS0 / Channel 1**

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2389.744	65.6	74.0	8.4	Complied
2399.840	61.5	70.8*	9.3	Complied
2400	61.0	70.8*	9.8	Complied

Results: Lower Band Edge / Average / 802.11n HT20 / MIMO – BPSK / MCS0 / Channel 1

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2390.000	49.9	54.0	4.1	Complied

Results: Upper Band Edge / Peak / 802.11n HT20 / MIMO – BPSK / MCS0 / Channel 11

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	69.0	74.0	5.0	Complied
2483.740	71.2	74.0	2.8	Complied

Results: Upper Band Edge / Average / 802.11n HT20 / MIMO – BPSK / MCS0 / Channel 11

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	48.0	54.0	6.0	Complied

Results: Upper Band Edge / Peak / 802.11n HT20 / MIMO – BPSK / MCS0 / Channel 12

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	68.9	74.0	5.1	Complied
2484.942	70.9	74.0	3.1	Complied

Results: Upper Band Edge / Average / 802.11n HT20 / MIMO – BPSK / MCS0 / Channel 12

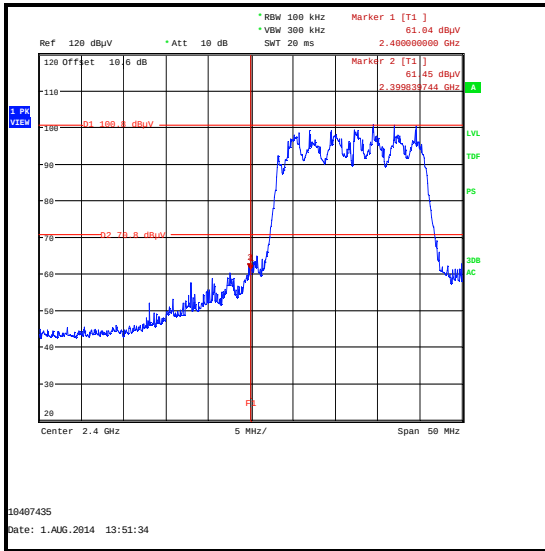
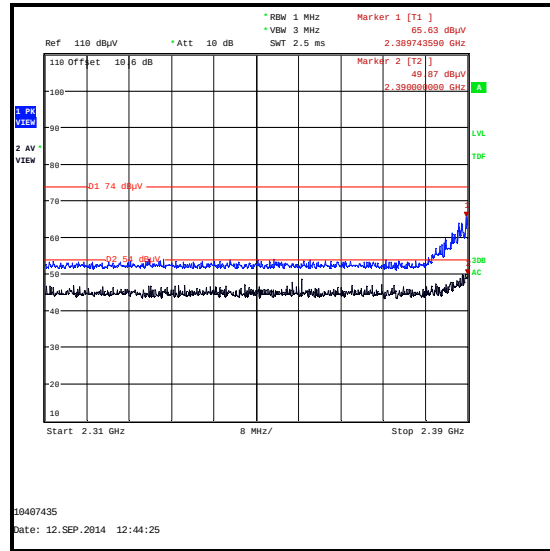
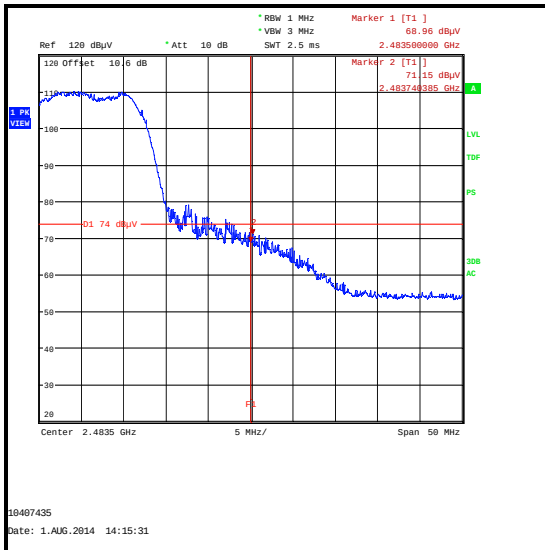
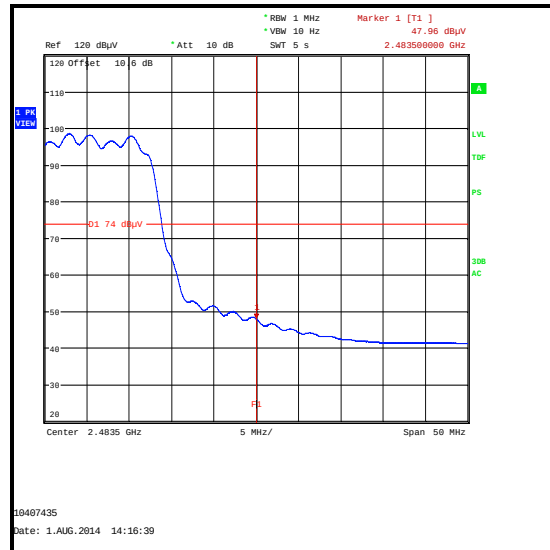
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	48.2	54.0	5.8	Complied

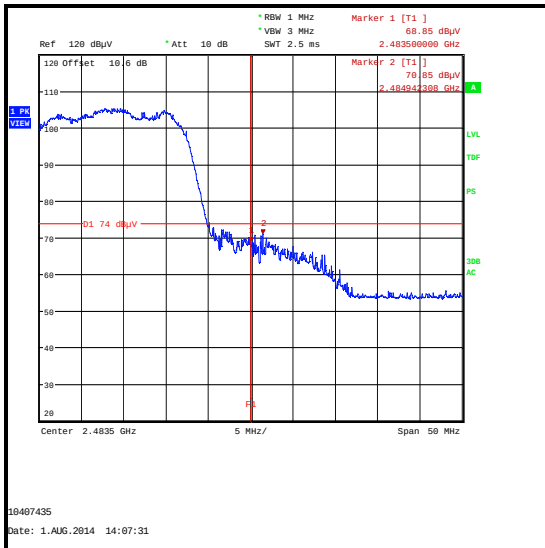
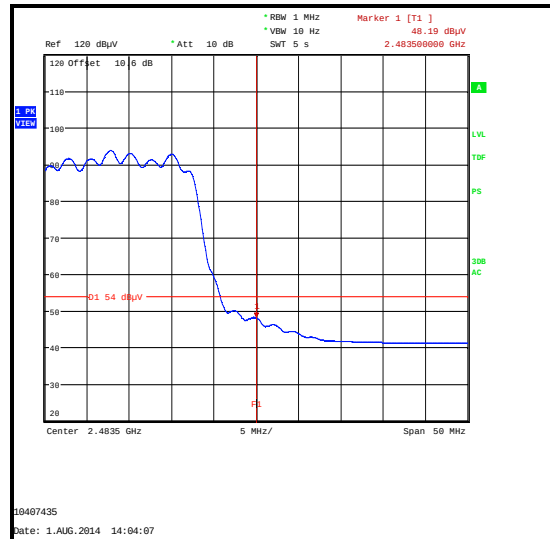
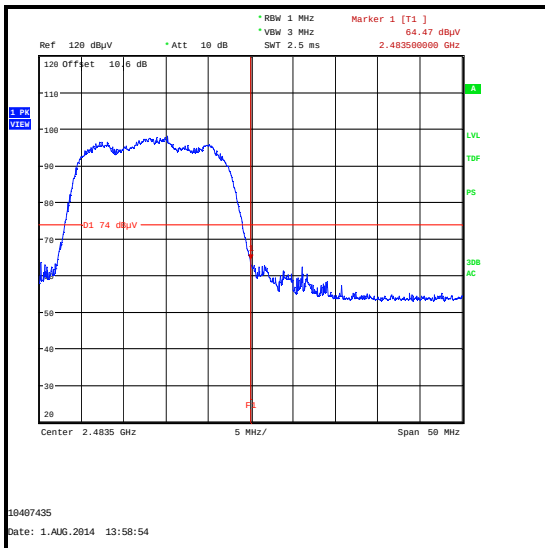
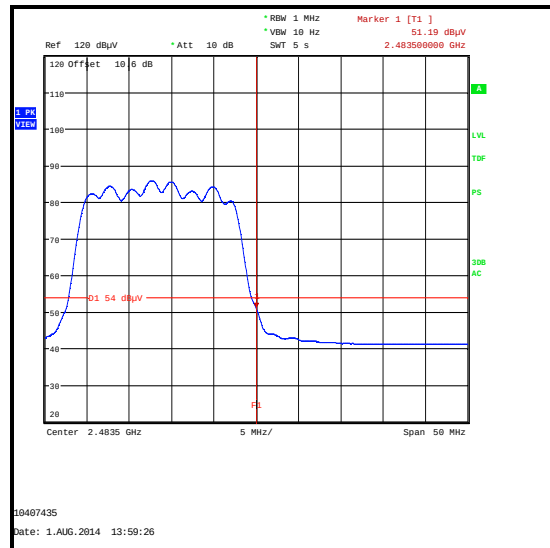
Results: Upper Band Edge / Peak / 802.11n HT20 / MIMO – BPSK / MCS0 / Channel 13

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	64.5	74.0	9.5	Complied

Transmitter Band Edge Radiated Emissions (continued)**Results: Upper Band Edge / Average / 802.11n HT20 / MIMO – BPSK / MCS0 / Channel 13**

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	51.2	54.0	2.8	Complied

Results: 802.11n / 20 MHz / BPSK / MCS0 / MIMO**Lower Band Edge Peak Measurement Channel 1****2310-2390 MHz Restricted Band Measurement****Upper Band Edge Peak Measurement Channel 11****Upper Band Edge Average Measurement Channel 11**

Transmitter Band Edge Radiated Emissions (continued)**Results: 802.11n / 20 MHz / BPSK / MCS0 / MIMO****Upper Band Edge Peak Measurement
Channel 12****Upper Band Edge Average Measurement
Channel 12****Upper Band Edge Peak Measurement
Channel 13****Upper Band Edge Average Measurement
Channel 13**

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	14 Mar 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	13 May 2015	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	18 May 2015	12
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	02 May 2015	12

6. Measurement Uncertainty

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

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

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

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

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±4.69 dB
Minimum 6 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±3.92 %
Duty Cycle	2.4 GHz to 2.4835 GHz	95%	±1.14 %
Spectral Power Density	2.4 GHz to 2.4835 GHz	95%	±1.13 dB
Conducted Maximum Output Power	2.4 GHz to 2.4835 GHz	95%	±1.13 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 25 GHz	95%	±2.94 dB

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

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
2.0	-	-	Admin updates & Band edge restricted band plots added

--- END OF REPORT ---