




TEST REPORT


Test Report No. : UL-RPT-RP10407435JD03A V2.0

Manufacturer : Apple Inc.
Model No. : A1601
FCC ID : BCGA1601
Technology : *Bluetooth* – Basic Rate & EDR
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

Checked by: 
Sarah Williams
Engineer, Radio Laboratory

Issued by : 
pp
John Newell
Quality Manager,
UL VS LTD



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UL VS LTD

Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG, UK
Telephone: +44 (0)1256 312000
Facsimile: +44 (0)1256 312001

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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:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	12 August 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)(1)	Transmitter 20 dB Bandwidth	
Part 15.247(a)(1)	Transmitter Carrier Frequency Separation	
Part 15.247(a)(1)(iii)	Transmitter Number of Hopping Frequencies and Average Time of Occupancy	
Part 15.247(b)(1)	Transmitter Maximum Peak Output Power	
Part 15.247(d) & 15.209(a)	Transmitter Radiated Emissions	
Part 15.247(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	
Key to Results		
 = Complied  = Did not comply		

2.3. Methods and Procedures

Reference:	ANSI C63.4 (2009)
Title:	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Reference:	ANSI C63.10 (2009)
Title:	American National Standard for Testing Unlicensed Wireless Devices

2.4. Deviations from the Test Specification

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

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Apple
Model Name or Number:	A1601
Test Sample IMEI:	352025060501666 (<i>Radiated Sample #1</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:	004400152020000 (<i>Radiated Sample #2</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

Tested Technology:	<i>Bluetooth</i>		
Power Supply Requirement:	Nominal	3.8 VDC	
Type of Unit:	Transceiver		
Channel Spacing:	1 MHz		
Mode:	Basic Rate	Enhanced Data Rate	
Modulation:	GFSK	$\pi/4$ -DQPSK	8DQPSK
Packet Type: (Maximum Payload)	DH5	2DH5	3DH5
Data Rate (Mbit/s):	1	2	3
Maximum Conducted Output Power:	12.7 dBm		
Antenna Gain:	0.8 dBi		
Transmit Frequency Range:	2402 MHz to 2480 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	0	2402
	Middle	39	2441
	Top	78	2480

3.5. Support Equipment

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

Description:	Laptop PC
Brand Name:	Dell
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 at maximum power on bottom, middle and top channels in Basic Rate (DH5 packets) or EDR (2DH5 or 3DH5 packets) as required.
- Continuously transmitting at maximum power in hopping mode on all channels in Basic Rate (DH5 packets) or EDR (2DH5 or 3DH5 packets) as required.

4.2. Configuration and Peripherals

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

- Controlled using a software application on the laptop PC supplied by the customer. The application was used to enable continuous transmission and to select the test channels as required.
- Both EDR/Basic rate modes were compared and tests were performed with the mode that presented the worst case result. For output power, bandwidth, band edge and channel separation, all modes were tested.
- Transmitter radiated spurious emissions tests were performed with the EUT transmitting in DH5 mode as this mode was found to transmit the highest power.
- 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.
- AC conducted emissions tests were performed with the EUT transmitting on the top channel using DH5 packet type. All ports were terminated, employing all available accessories.
- The conducted sample with IMEI 352025060506475 was used for 20 dB bandwidth, conducted output power and transmitter carrier frequency separation tests.
- The radiated samples with IMEI 352025060501666 & 004400152020000 were 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:**

Test Engineer:	Keith Tucker	Test Date:	19 August 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 (%):	43

Results: Live / Quasi Peak

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.267	Live	33.9	61.2	27.3	Complied
0.560	Live	25.9	56.0	30.1	Complied
0.834	Live	30.0	56.0	26.0	Complied
2.076	Live	21.8	56.0	34.2	Complied
5.595	Live	20.2	60.0	39.8	Complied
28.577	Live	32.2	60.0	27.8	Complied

Results: Live / Average

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.272	Live	21.1	51.1	30.0	Complied
0.546	Live	20.3	46.0	25.7	Complied
0.830	Live	25.1	46.0	20.9	Complied
2.193	Live	15.0	46.0	31.0	Complied
5.771	Live	14.6	50.0	35.4	Complied
28.424	Live	29.2	50.0	20.8	Complied

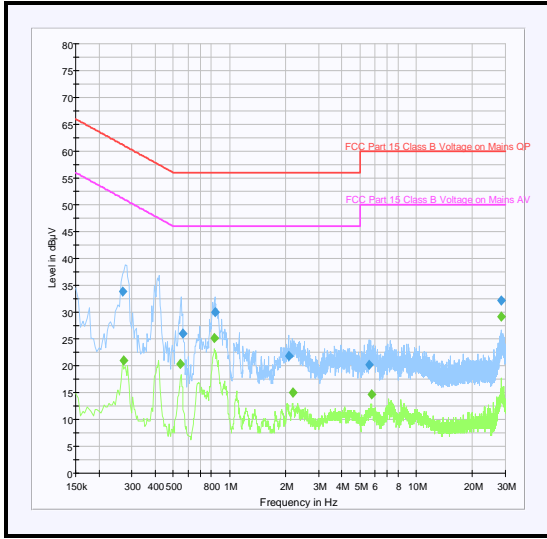
Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Quasi Peak**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.276	Neutral	34.6	60.9	26.3	Complied
0.425	Neutral	29.6	57.4	27.8	Complied
0.555	Neutral	26.9	56.0	29.1	Complied
0.834	Neutral	28.0	56.0	28.0	Complied
2.229	Neutral	18.0	56.0	38.0	Complied
28.716	Neutral	19.9	60.0	40.1	Complied

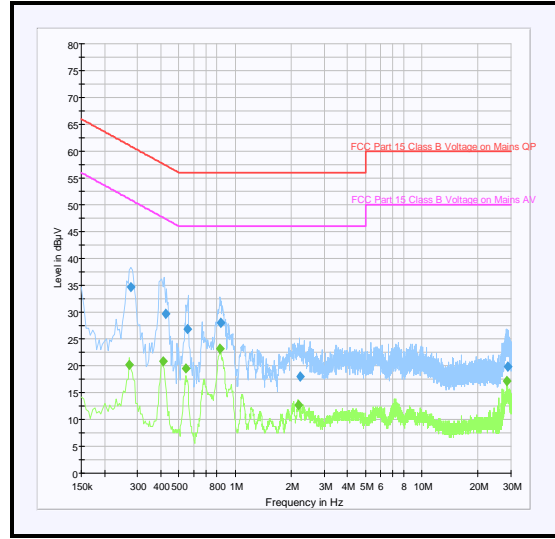
Results: Neutral / Average

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.272	Neutral	20.2	51.1	30.9	Complied
0.411	Neutral	20.8	47.6	26.8	Complied
0.546	Neutral	19.4	46.0	26.6	Complied
0.830	Neutral	23.2	46.0	22.8	Complied
2.184	Neutral	12.6	46.0	33.4	Complied
28.433	Neutral	17.2	50.0	32.8	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 20 dB Bandwidth**Test Summary:**

Test Engineer:	Georgios Vrezas	Test Dates:	13 August 2014 & 15 August 2014
Test Sample IMEI:	352025060506475		

FCC Reference:	Part 15.247(a)(1)
Test Method Used:	As detailed in ANSI C63.10 Section 6.9.1

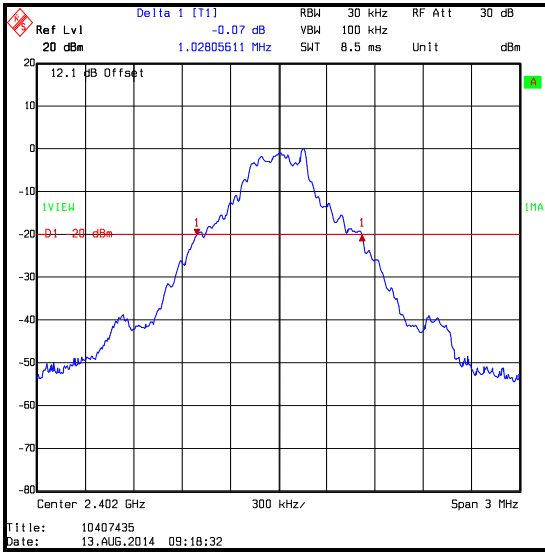
Environmental Conditions:

Temperature (°C):	24 to 25
Relative Humidity (%):	39 to 46

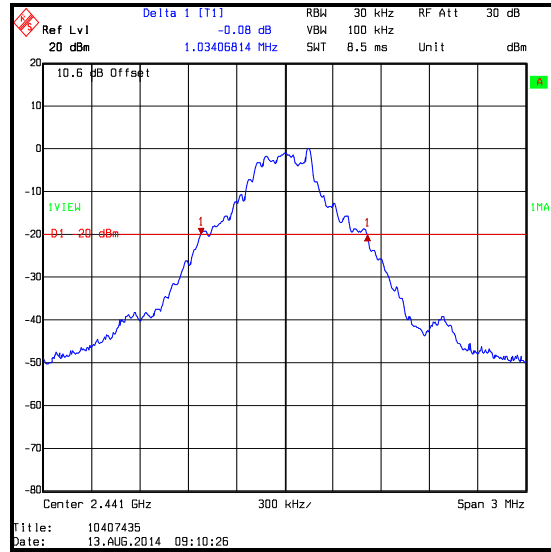
Transmitter 20 dB Bandwidth (continued)

Results DH5:

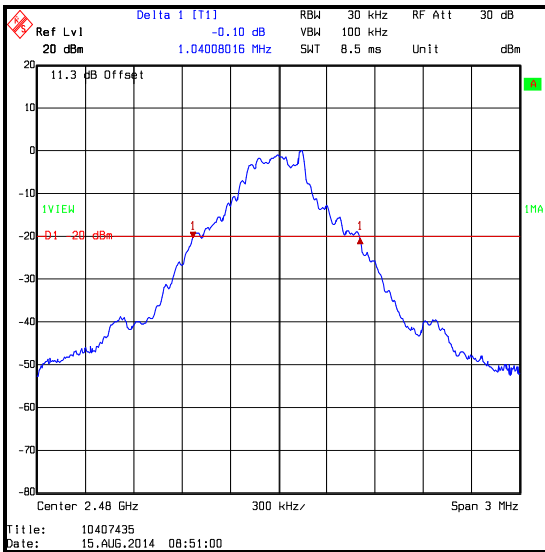
Channel	20 dB Bandwidth (kHz)
Bottom	1028.056
Middle	1034.068
Top	1040.080



Bottom Channel



Middle Channel

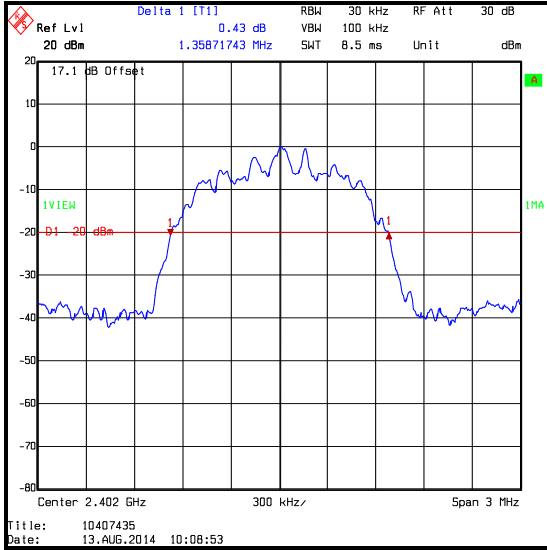


Top Channel

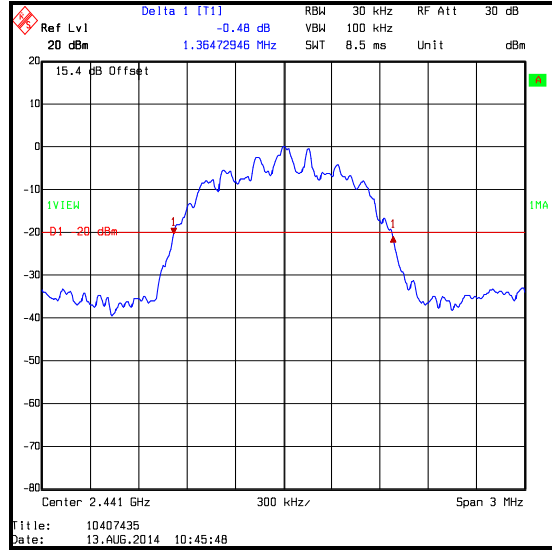
Transmitter 20 dB Bandwidth (continued)

Results 2DH5:

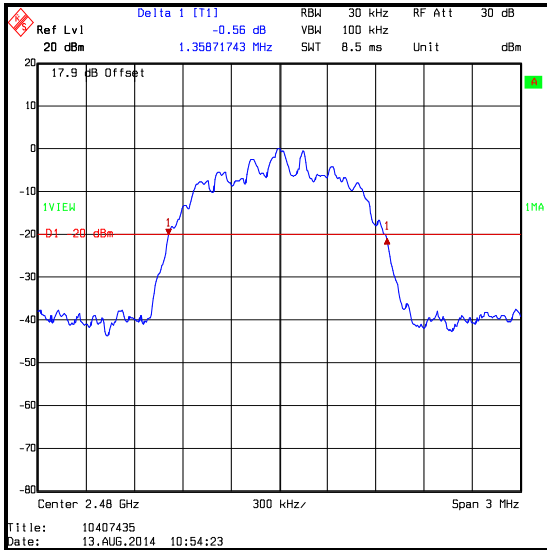
Channel	20 dB Bandwidth (kHz)
Bottom	1358.717
Middle	1364.729
Top	1358.717



Bottom Channel



Middle Channel

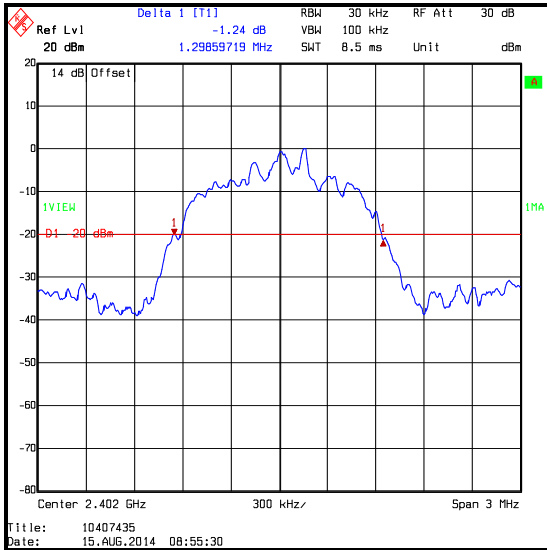


Top Channel

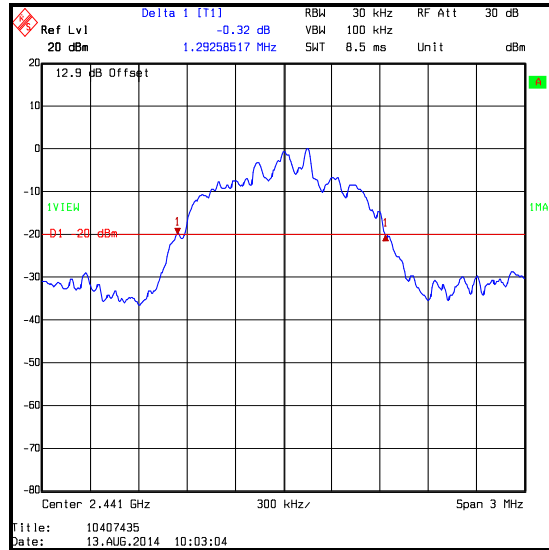
Transmitter 20 dB Bandwidth (continued)

Results 3DH5:

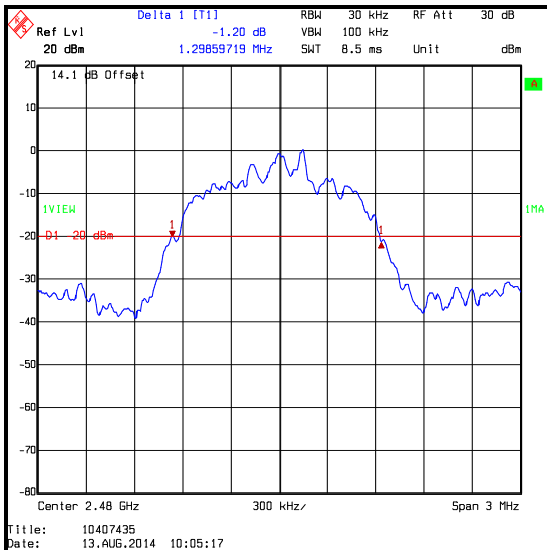
Channel	20 dB Bandwidth (kHz)
Bottom	1298.597
Middle	1292.585
Top	1298.597



Bottom Channel



Middle Channel



Top Channel

Transmitter 20 dB Bandwidth (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1658	Thermohygrometer	JM Handelpunkt	30.5015.13	None stated	14 Mar 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	30 Sept 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

5.2.3. Transmitter Carrier Frequency Separation

Test Summary:

Test Engineer:	Georgios Vrezas	Test Date:	13 August 2014
Test Sample IMEI:	352025060506475		

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

Environmental Conditions:

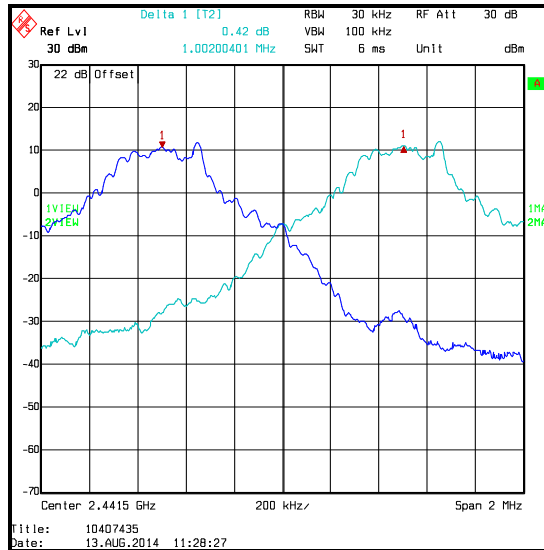
Temperature (°C):	24
Relative Humidity (%):	46

Note(s):

- The 20 dB bandwidth measured for the middle channel operating at 2441 MHz was used to calculate the limit.

Results: DH5

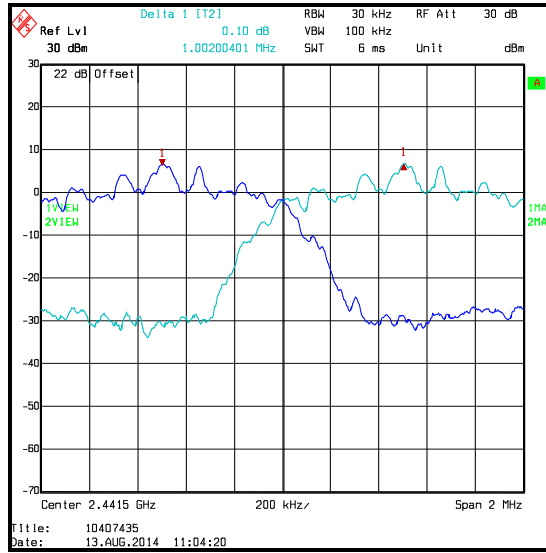
Carrier Frequency Separation (kHz)	Limit ($2/3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
1002.004	689.379	312.625	Complied



Transmitter Carrier Frequency Separation (continued)

Results: 2DH5

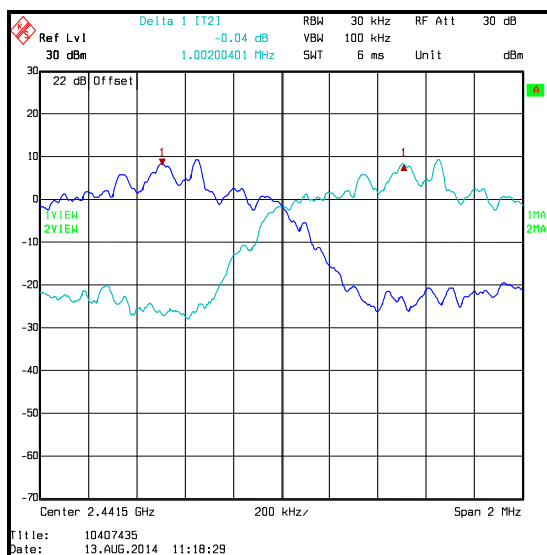
Carrier Frequency Separation (kHz)	Limit ($2/3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
1002.004	909.819	92.185	Complied



Transmitter Carrier Frequency Separation (continued)

Results: 3DH5

Carrier Frequency Separation (kHz)	Limit ($2/3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
1002.004	861.723	140.281	Complied



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	30 Sept 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
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	24 Apr 2015	12
M1009	RF Power Meter	Hewlett Packard	437B	3125U13706	04 Feb 2015	12
M1592	Power Sensor	Hewlett Packard	8487A	3318A02094	28 Aug 2014	12

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

Test Engineer:	Andrew Edwards	Test Date:	27 August 2014
Test Sample IMEI:	004400152020000		

FCC Reference:	Part 15.247(a)(1)(iii)
Test Method Used:	As detailed in ANSI C63.10 Section 7.7.3 & 7.7.4

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	49

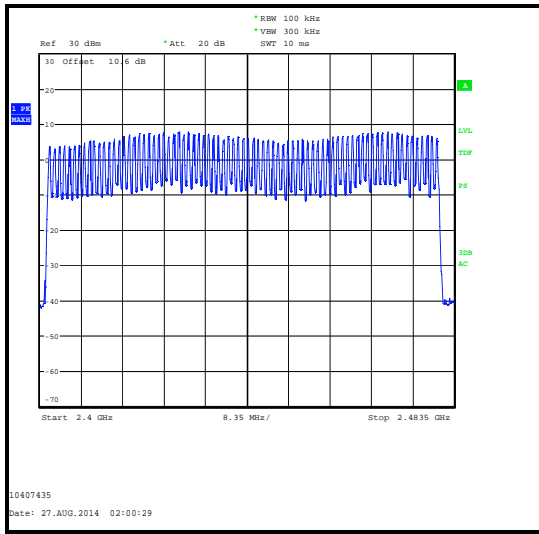
Note(s):

1. Tests were performed to identify the average time of occupancy in number of channels (79) x 0.4 seconds. The calculated period is 31.6 seconds.
2. The measurement was performed using a radiated sample in a fully anechoic chamber (Asset Number K0002) at a distance of 3 meters.

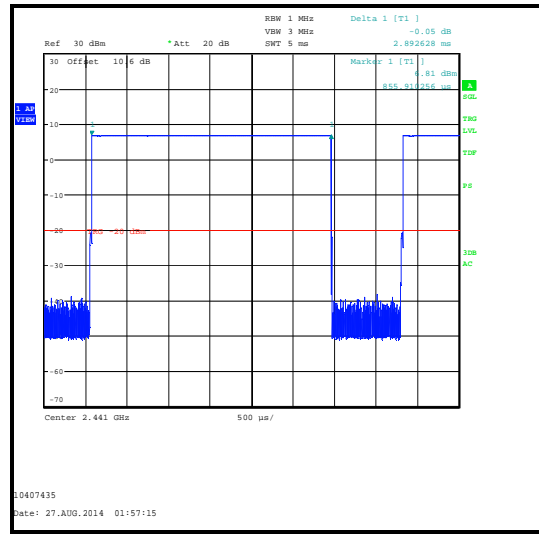
Results:

Emission Width (μs)	Number of Hops in 31.6 Seconds	Average Time of Occupancy (s)	Limit (s)	Margin (s)	Result
2892.628	88	0.255	0.4	0.145	Complied

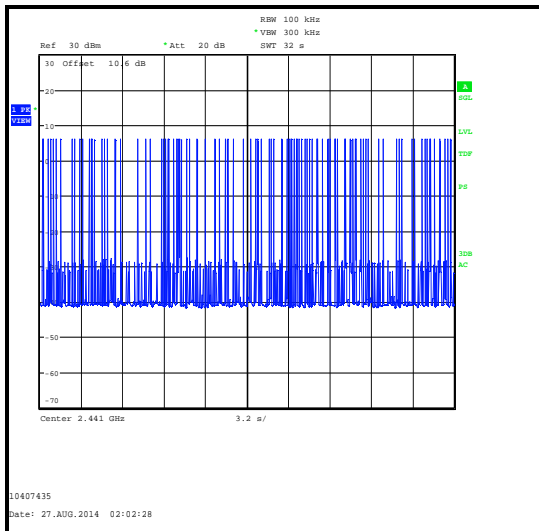
Transmitter Number of Hopping Frequencies and Average Time of Occupancy (continued)



Number of Hopping Frequencies



Emission Width



Number of Hopping Frequencies in 32 s

Transmitter Number of Hopping Frequencies and Average Time of Occupancy (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

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

Test Engineer:	Georgios Vrezas	Test Date:	15 August 2014
Test Sample IMEI:	352025060506475		

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

Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	39

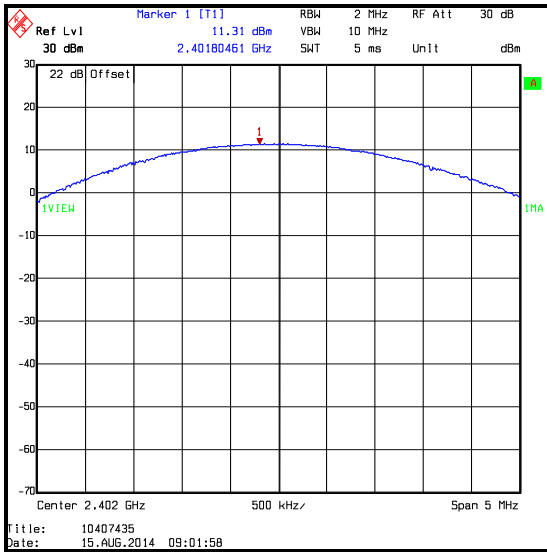
Results: DH5

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	11.3	21.0	9.7	Complied
Middle	12.7	21.0	8.3	Complied
Top	11.3	21.0	9.7	Complied

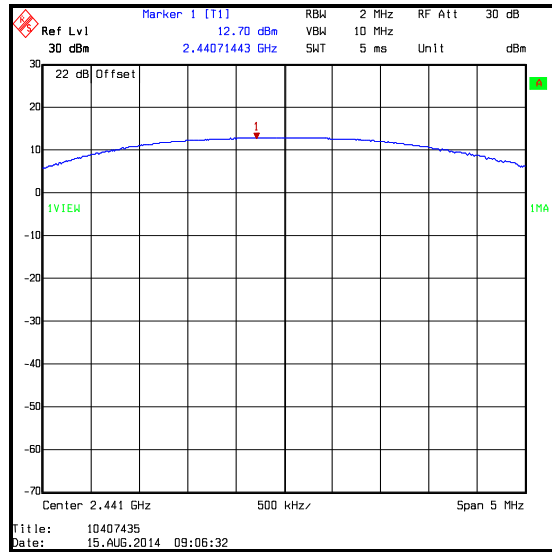
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.3	0.8	12.1	27.0	14.9	Complied
Middle	12.7	0.8	13.5	27.0	13.5	Complied
Top	11.3	0.8	12.1	27.0	14.9	Complied

Transmitter Maximum Peak Output Power (continued)

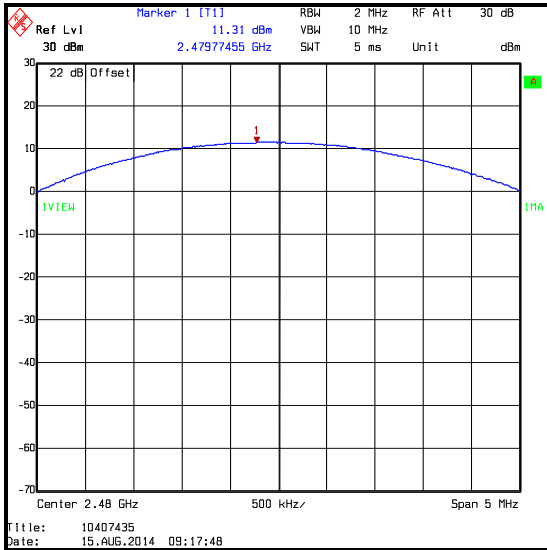
Results: DH5



Bottom Channel



Middle Channel



Top Channel

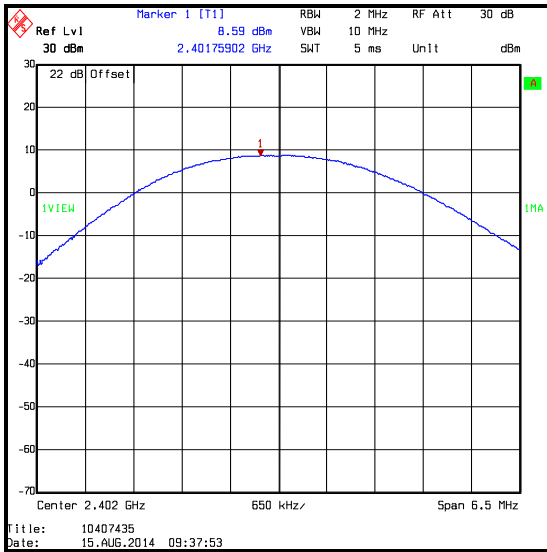
Transmitter Maximum Peak Output Power (continued)**Results: 2DH5**

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	8.6	21.0	12.4	Complied
Middle	10.1	21.0	10.9	Complied
Top	6.4	21.0	14.7	Complied

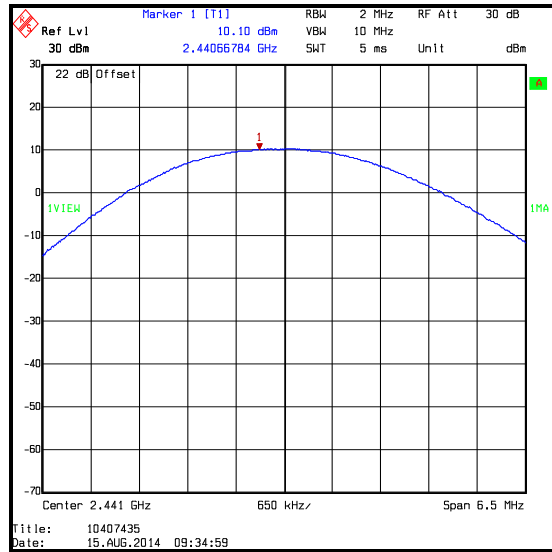
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	8.6	0.8	9.4	27.0	17.6	Complied
Middle	10.1	0.8	10.9	27.0	16.1	Complied
Top	6.4	0.8	7.2	27.0	19.8	Complied

Transmitter Maximum Peak Output Power (continued)

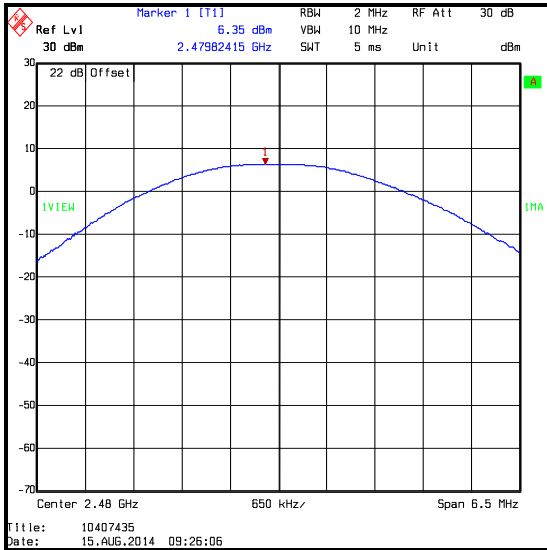
Results: 2DH5



Bottom Channel



Middle Channel



Top Channel

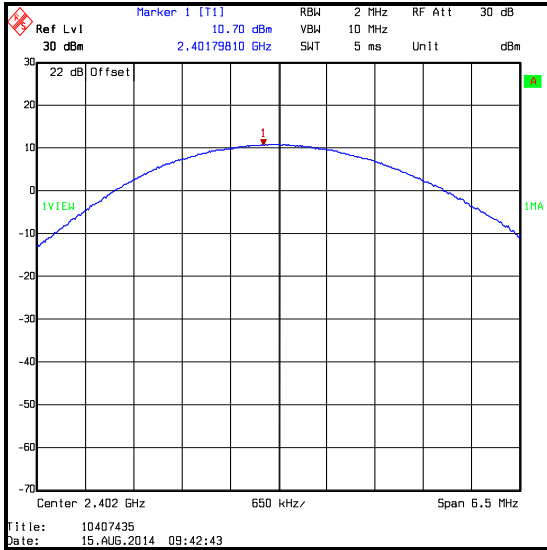
Transmitter Maximum Peak Output Power (continued)**Results: 3DH5**

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	10.7	21.0	10.3	Complied
Middle	11.4	21.0	9.6	Complied
Top	10.3	21.0	10.7	Complied

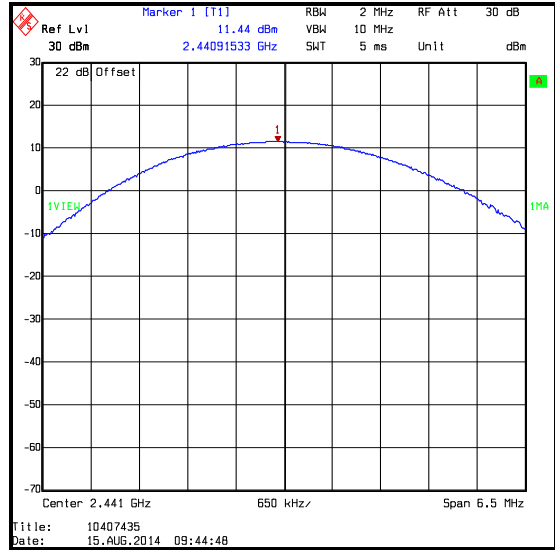
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	10.7	0.8	11.5	27.0	15.5	Complied
Middle	11.4	0.8	12.2	27.0	14.8	Complied
Top	10.3	0.8	11.1	27.0	15.9	Complied

Transmitter Maximum Peak Output Power (continued)

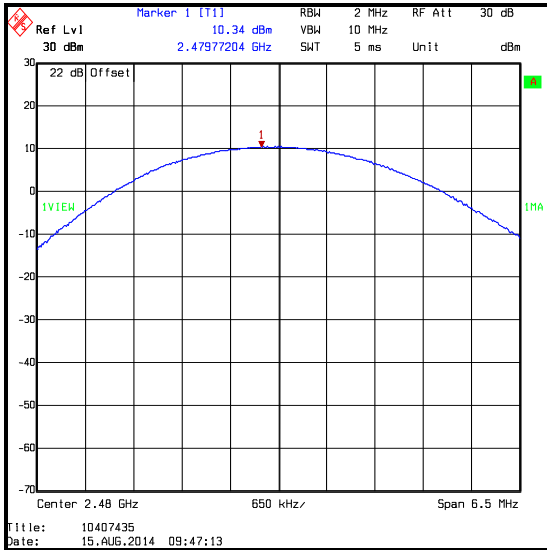
Results: 3DH5



Bottom Channel



Middle Channel



Top Channel

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1658	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	30 Sept 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
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	24 Apr 2015	12
M1009	RF Power Meter	Hewlett Packard	437B	3125U13706	04 Feb 2015	12
M1592	Power Sensor	Hewlett Packard	8487A	3318A02094	28 Aug 2014	12

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

Test Engineer:	Georgios Vrezas	Test Date:	12 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 6.5 referencing ANSI C63.4
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

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

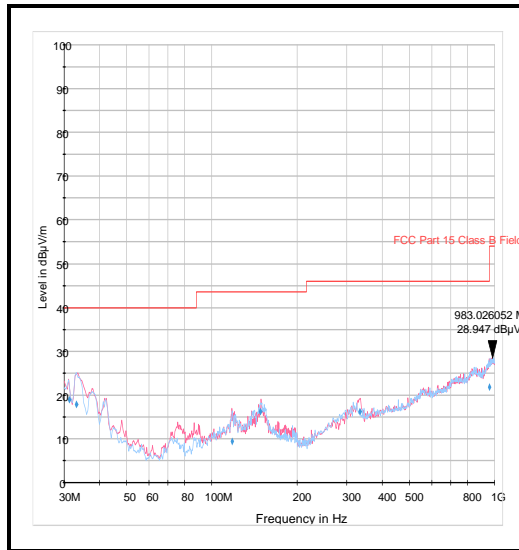
Note(s):

1. Transmitter radiated spurious emissions tests were performed with the EUT transmitting in DH5 mode as this was found to transmit the highest power and therefore deemed worst case.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the top channel only.
4. All 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.
5. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Results: Quasi-Peak / DH5

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
983.026	Vertical	28.9	54.0	25.1	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 & Andrew Edwards	Test Date:	18 August 2014 & 27 August 2014
Test Sample IMEI:	352025060501666 & 004400152020000		

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):	22 to 23
Relative Humidity (%):	42 to 56

Note(s):

1. Transmitter radiated spurious emissions tests were performed with the EUT transmitting in DH5 mode as this was found to transmit the highest power and therefore deemed worst case.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. The emission shown on the 1 GHz to 4 GHz plot is the EUT fundamental at 2480 MHz.
4. All other emissions shown on the pre-scan plots were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement systems noise floor.
5. In accordance with ANSI C63.10 section 6.6.4.2 -Note 1, the peak level complied with the average limit; therefore average results were not required.
6. 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.
7. Sample with IMEI number 352025060501666 was used for pre-scans 1 to 4 and 12.75 to 25 GHz. Sample with IMEI number 004400152020000 was used for pre-scans 4 to 12.75 and all final measurements

Transmitter Radiated Emissions (continued)**Results: Bottom Channel / DH5**

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4804.029	Vertical	45.0	54.0	9.0	Complied

Results: Middle Channel / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4881.779	Vertical	43.0	54.0	11.0	Complied

Results: Middle Channel / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
7323.337	Vertical	59.6	74.0	14.4	Complied

Results: Middle Channel / DH5

Frequency (MHz)	Antenna Polarity	Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
7322.968	Vertical	50.4	54.0	3.6	Complied

Results: Top Channel / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4960.337	Vertical	43.5	54.0	10.5	Complied

Results: Top Channel / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
7439.471	Vertical	56.5	74.0	17.5	Complied

Transmitter Radiated Emissions (continued)**Results: Top Channel / DH5**

Frequency (MHz)	Antenna Polarity	Average Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
7439.904	Vertical	47.5	54.0	6.5	Complied

Results: Hopping / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4855.529	Vertical	44.2	54.0	9.8	Complied

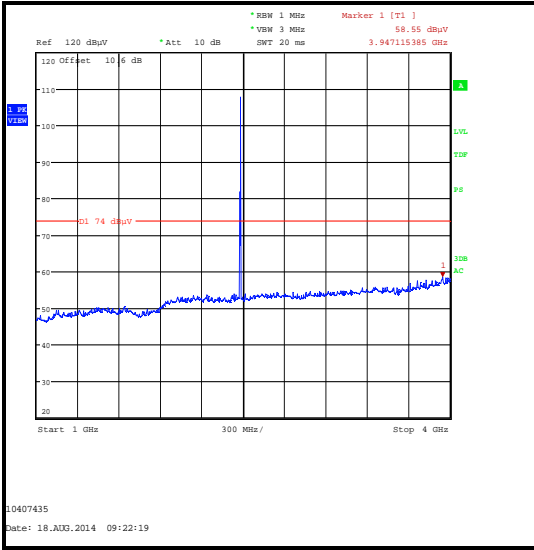
Results: Hopping / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Result
7344.683	Vertical	58.2	74.0	15.8	Complied

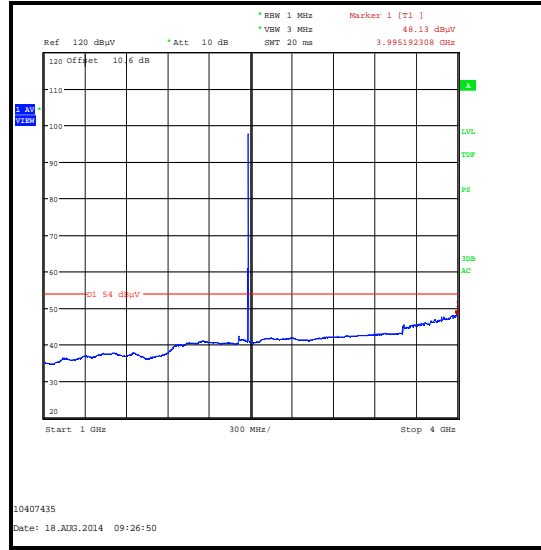
Results: Hopping / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Result
7358.814	Vertical	35.4	54.0	18.6	Complied

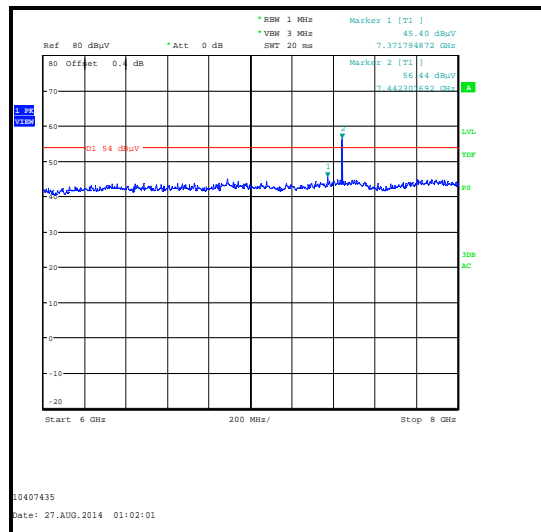
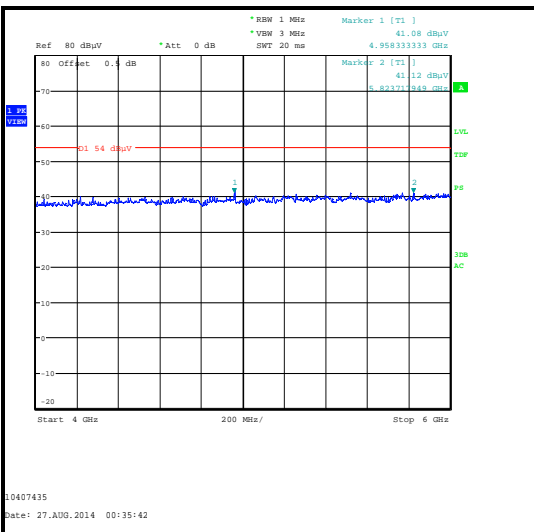
Transmitter Radiated Emissions (continued)



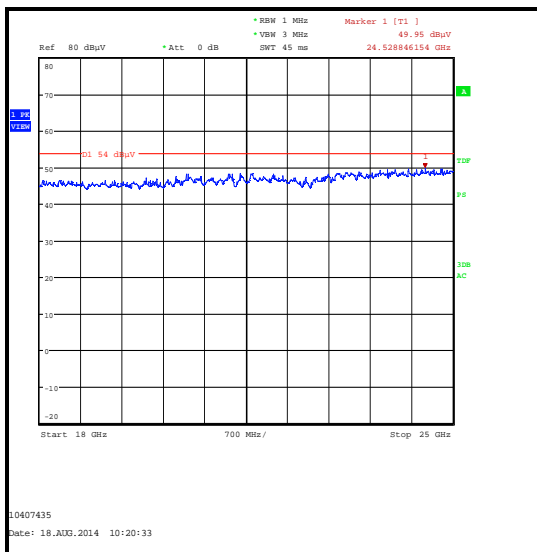
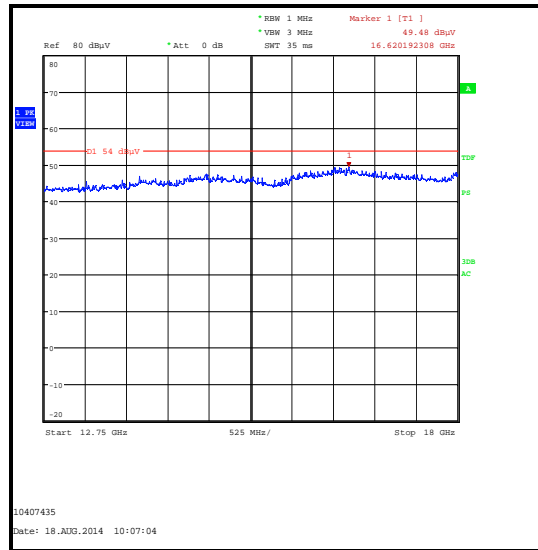
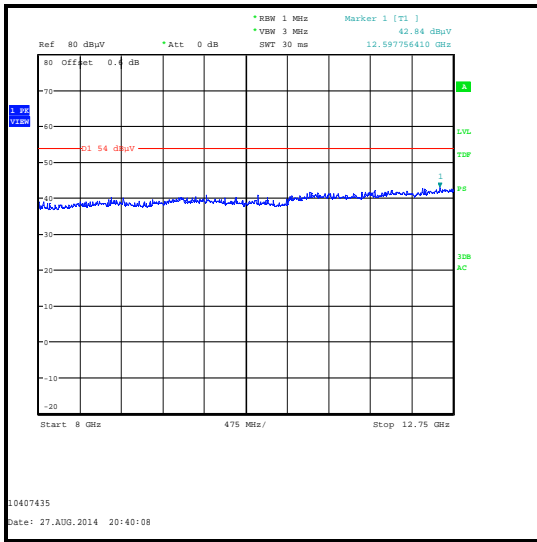
Peak detector



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 Handlungspunkt	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
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, Andrew Edwards & David Doyle	Test Dates:	13 August 2014 to 12 September 2014
Test Sample IMEIs:	352025060501666 & 004400152020000		

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

Environmental Conditions:

Temperature (°C):	21 to 22
Relative Humidity (%):	46 to 57

Note(s):

- The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
- * -20 dBc limit.
- **DH5 and 3 DH5 Static upper band edge average measurements were tested in accordance with ANSI C63.10 Sections 6.9.3 marker-delta method. An in-band field strength measurement was initially performed. A second measurement was performed using a reduced RBW of 500 kHz which is 1 % of the 50 MHz span. The amplitude delta between the peak of the fundamental emission and the emission level at the upper band edge was noted. The delta was subtracted from the initial in band field strength level to obtain the upper band edge level. Results plots can be found below.

DH5: Initial fundamental; peak emission level using RBW/VBW of 1 MHz / 10 Hz = 91.7

Delta between fundamental and band edge using RBW/VBW of 500 kHz / 10 Hz = 52.6

DH5: Band edge level: 91.7 – 52.6 = 39.1 dB μ V/m

3DH5: Initial fundamental; peak emission level using RBW/VBW of 1 MHz / 10 Hz = 88.4

Delta between fundamental and band edge using RBW/VBW of 500 kHz / 10 Hz = 47.5

3DH5: Band edge level: 88.4 – 47.5 = 40.9 dB μ V/m

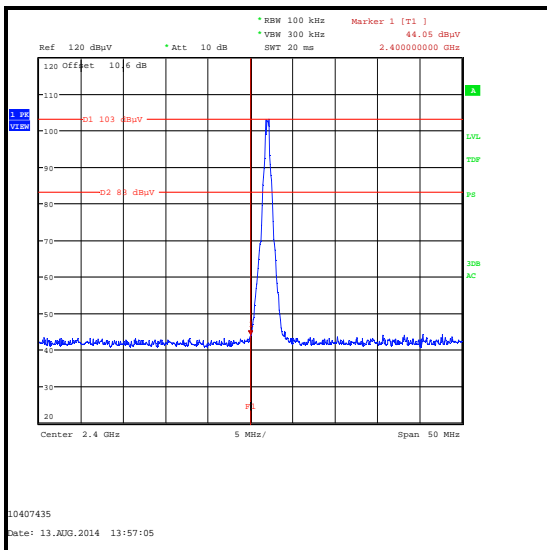
- Sample with IMEI number 352025060501666 was used for peak measurements. Sample with IMEI number 004400152020000 was used for pre-scans all upper band edge average measurements.

Transmitter Band Edge Radiated Emissions (continued)

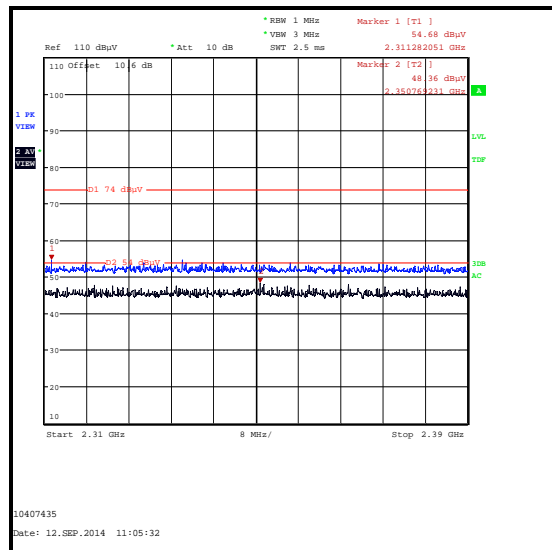
Results: Static Mode / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2311.282	Horizontal	54.7	74.0	19.3	Complied
2400.0	Horizontal	44.1	83.0*	38.9	Complied
2483.5	Horizontal	64.2	74.0	9.8	Complied

Frequency (MHz)	Antenna Polarity	Average Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2350.769	Horizontal	48.4	54.0	5.6	Complied
2483.5	Horizontal	39.1**	54.0	14.9	Complied



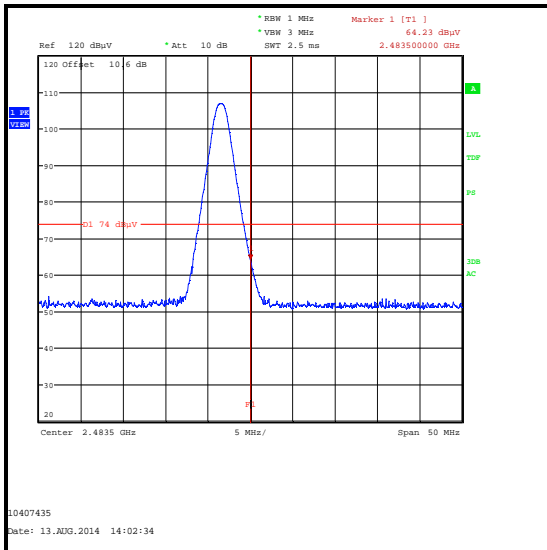
Lower Band Edge Peak Static



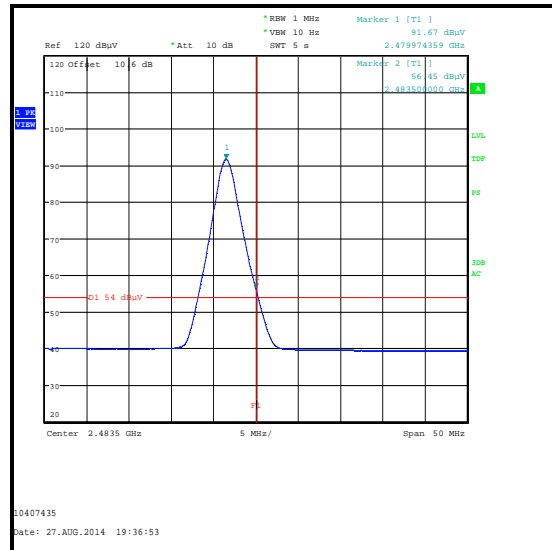
2310-2390 MHz Restricted Band Measurement

Transmitter Band Edge Radiated Emissions (continued)

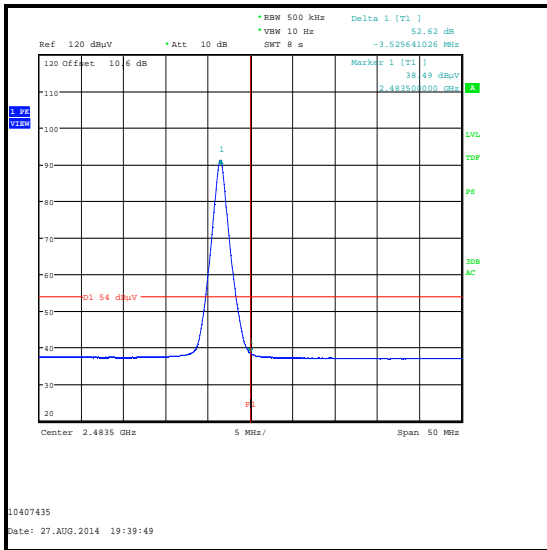
Results: Static Mode / DH5



Upper Band Edge Peak Static



Upper Band Edge Average Static



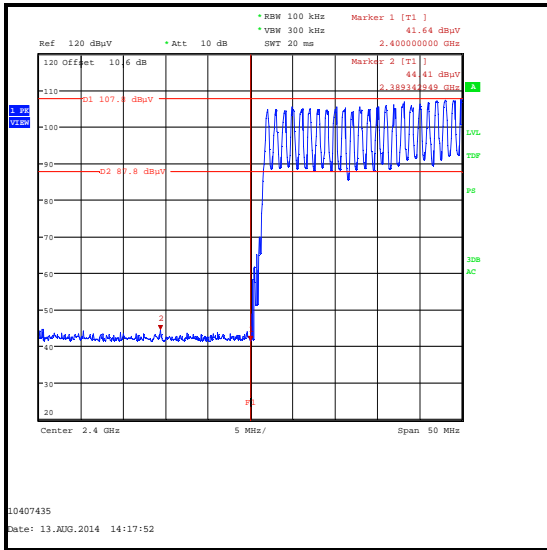
Upper Band Edge Average Static
(Marker-delta method)

Transmitter Band Edge Radiated Emissions (continued)

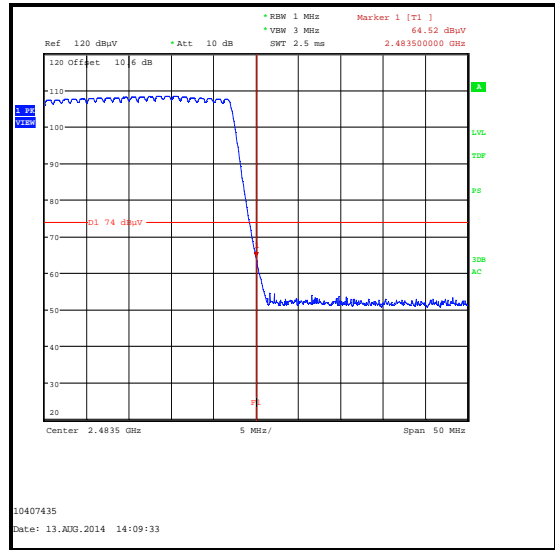
Results: Hopping Mode / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2389.343	Horizontal	44.4	87.8*	43.4	Complied
2400.0	Horizontal	41.6	87.8*	46.2	Complied
2483.5	Horizontal	64.5	74.0	9.5	Complied

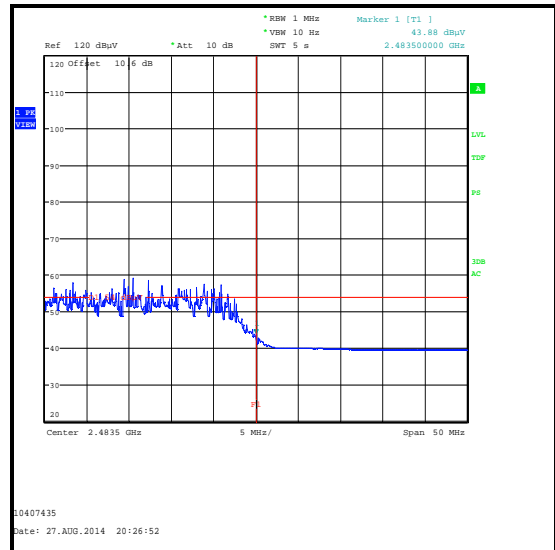
Frequency (MHz)	Antenna Polarity	Average Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2483.5	Horizontal	43.9	54.0	10.1	Complied



Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



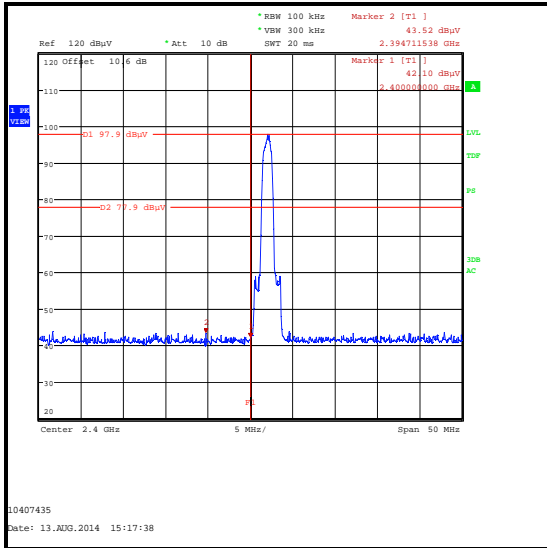
Upper Band Edge Average Hopping

Transmitter Band Edge Radiated Emissions (continued)

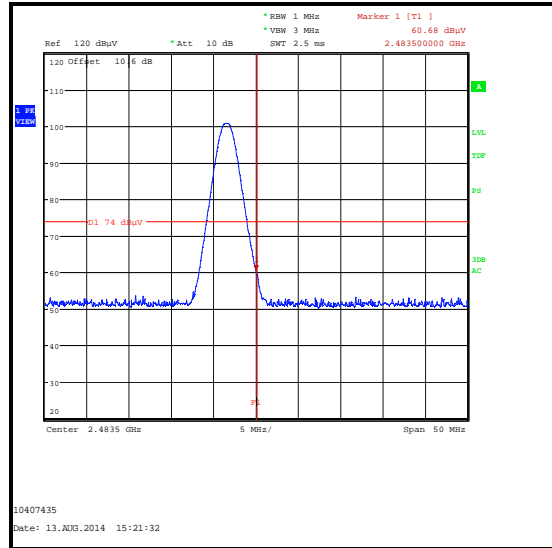
Results: Static Mode / 2DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2311.282	Horizontal	54.7	74.0	19.3	Complied
2394.712	Horizontal	43.5	77.9*	34.4	Complied
2400.0	Horizontal	42.1	77.9*	35.8	Complied
2483.5	Horizontal	60.7	74.0	13.3	Complied

Frequency (MHz)	Antenna Polarity	Average Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2350.769	Horizontal	48.4	54.0	5.6	Complied
2483.5	Horizontal	51.0	54.0	3.0	Complied



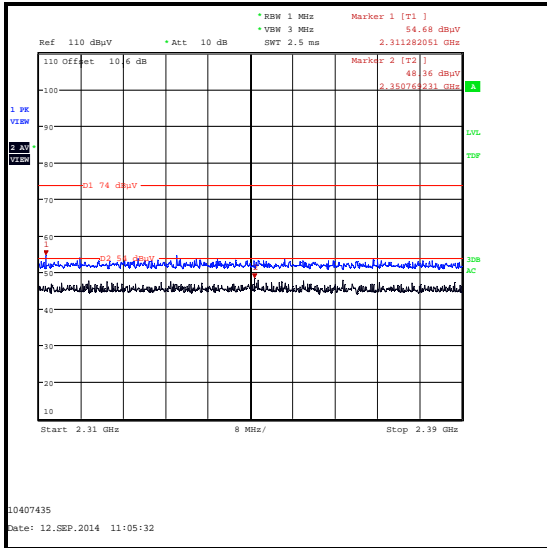
Lower Band Edge Peak Static



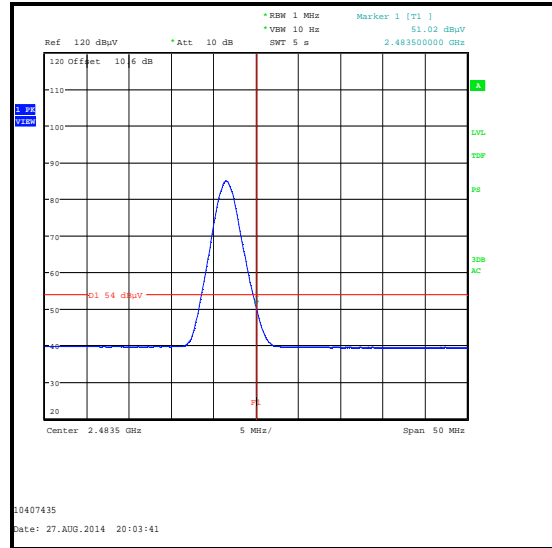
Upper Band Edge Peak Static

Transmitter Band Edge Radiated Emissions (continued)

Results: Static Mode / 2DH5



2310-2390 MHz Restricted Band Measurement



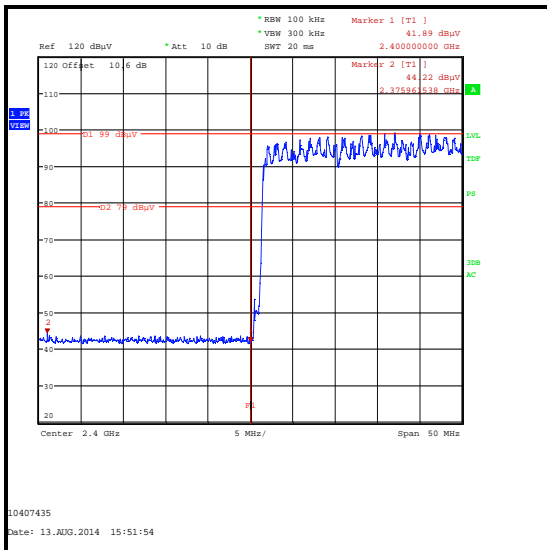
Upper Band Edge Average Static

Transmitter Band Edge Radiated Emissions (continued)

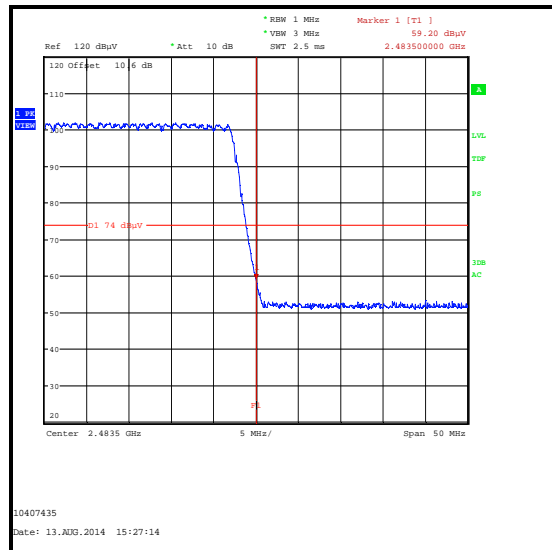
Results: Hopping Mode / 2DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2375.962	Horizontal	44.2	79.0*	34.8	Complied
2400.0	Horizontal	41.9	79.0*	37.1	Complied
2483.5	Horizontal	59.2	74.0	14.8	Complied

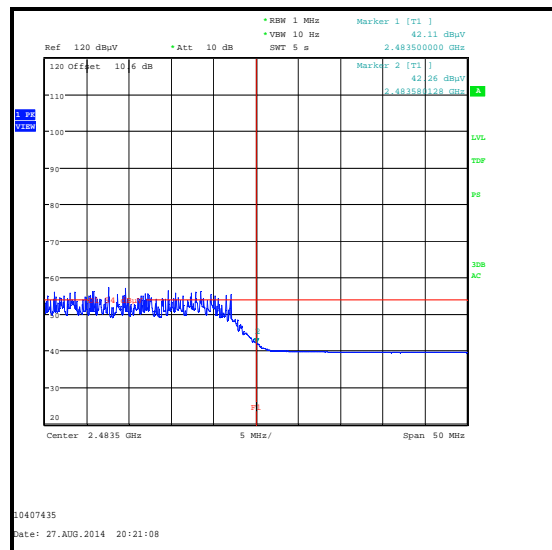
Frequency (MHz)	Antenna Polarity	Average Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	Horizontal	42.1	54.0	11.9	Complied
2483.580	Horizontal	42.3	54.0	11.7	Complied



Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



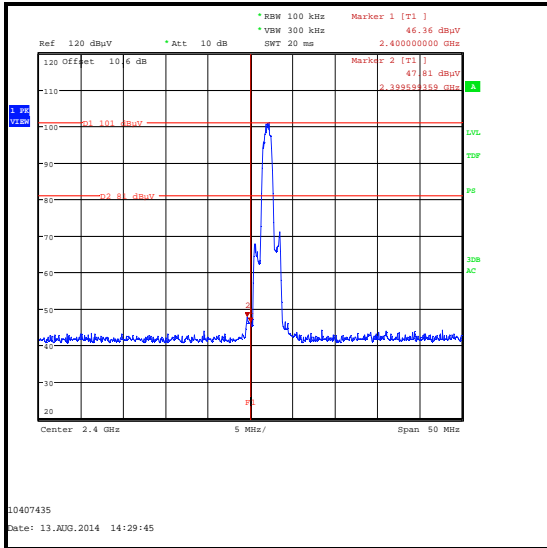
Upper Band Edge Average Hopping

Transmitter Band Edge Radiated Emissions (continued)

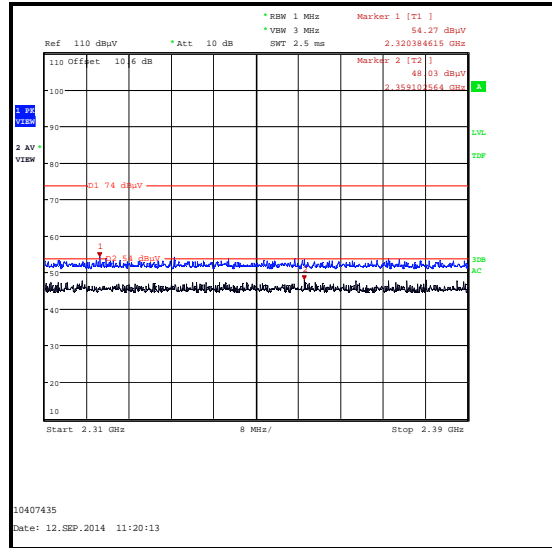
Results: Static Mode / 3DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2320.385	Horizontal	54.3	74.0	19.7	Complied
2399.599	Horizontal	47.8	81.0*	33.2	Complied
2400.0	Horizontal	46.4	81.0*	34.6	Complied
2483.5	Horizontal	64.6	74.0	9.4	Complied

Frequency (MHz)	Antenna Polarity	Average Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
2359.103	Horizontal	48.0	54.0	6.0	Complied
2483.5	Horizontal	40.9**	54.0	13.1	Complied



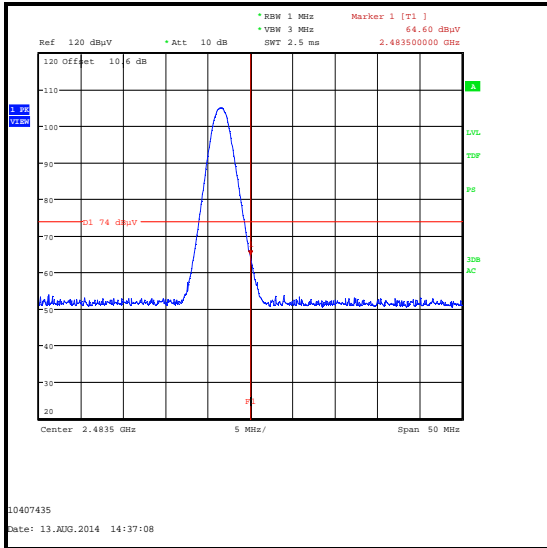
Lower Band Edge Peak Static



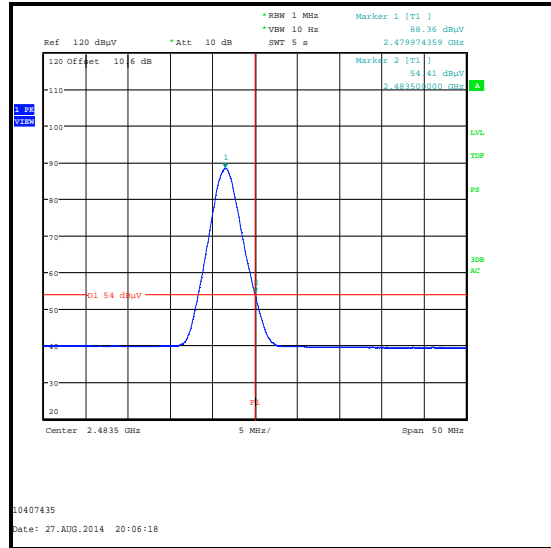
2310-2390 MHz Restricted Band Measurement

Transmitter Band Edge Radiated Emissions (continued)

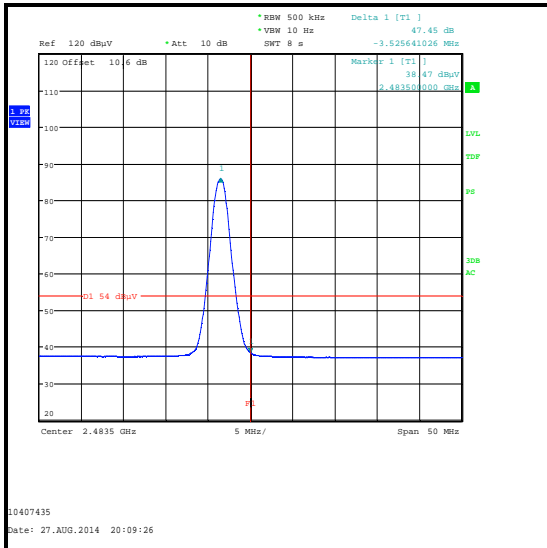
Results: Static Mode / 3DH5



Upper Band Edge Peak Static



Upper Band Edge Average Static



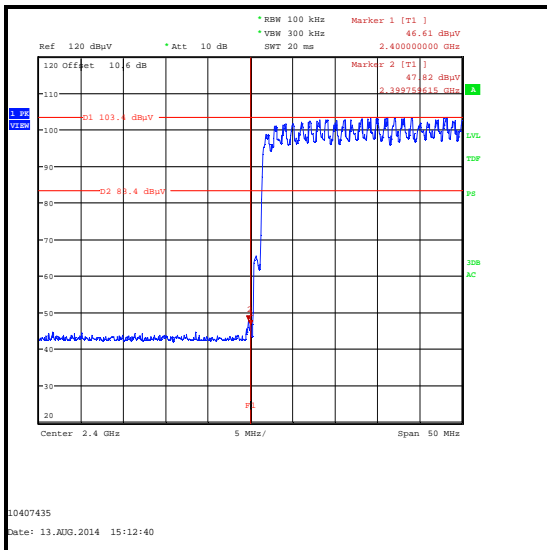
Upper Band Edge Average Static
(Marker-delta method)

Transmitter Band Edge Radiated Emissions (continued)

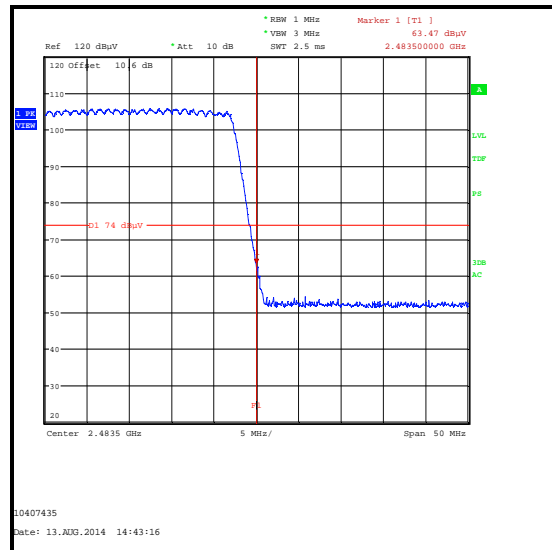
Results: Hopping Mode / 3DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2399.760	Horizontal	47.8	83.4*	35.6	Complied
2400.0	Horizontal	46.6	83.4*	36.8	Complied
2483.5	Horizontal	63.5	74.0	10.5	Complied

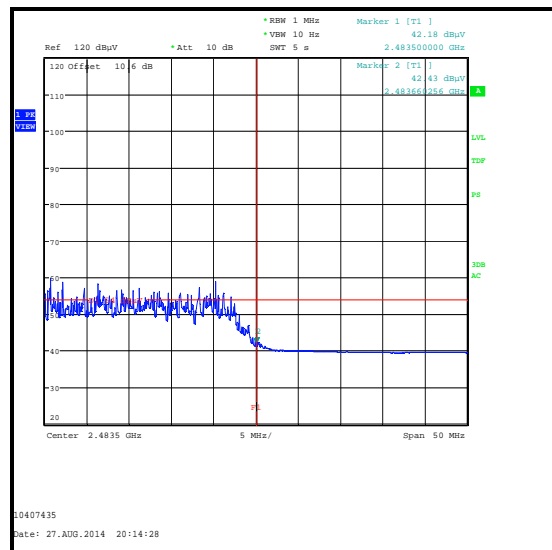
Frequency (MHz)	Antenna Polarity	Average Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	Horizontal	42.2	54.0	11.8	Complied
2483.660	Horizontal	42.4	54.0	11.6	Complied



Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



Upper Band Edge Average Hopping

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 Handelpunkt	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
Maximum Peak Output Power	2.4 GHz to 2.4835 GHz	95%	±1.13 dB
Carrier Frequency Separation	2.4 GHz to 2.4835 GHz	95%	±0.92 ppm
Average Time of Occupancy	2.4 GHz to 2.4835 GHz	95%	±0.3 ns
20 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±3.92 %
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 26.5 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 ---