TEST REPORT

Test Report No. : UL-RPT-RP11161473JD05A V2.0

Manufacturer	:	Apple Inc.
Model No.	:	A1706
FCC ID	:	BCGA1706
Technology	:	*Bluetooth* – Basic Rate & EDR
Test Standard(s)	:	FCC Parts 15.209(a) & 15.247

1. This test report shall not be reproduced in full or partial, without the written approval of UL VS LTD.
2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

Date of Issue: 27 September 2016

Checked by:

Sarah Williams
Engineer, Radio Laboratory

Company Signatory:

Steven White
Service Lead, Radio Laboratory
UL VS LTD

ilac-MRA UKAS TESTING 0644

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

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1. Customer Information

Company Name:	Apple
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:	47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 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:	23 August 2016 to 08 September 2016

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.247(a)(1)	Transmitter 20 dB Bandwidth	Complied
Part 15.247(a)(1)	Transmitter Carrier Frequency Separation	Complied
Part 15.247(a)(1)(iii)	Transmitter Number of Hopping Frequencies and Average Time of Occupancy	Complied
Part 15.247(b)(1)	Transmitter Maximum Peak Output Power	Complied
Part 15.247(d) & 15.209(a)	Transmitter Radiated Emissions	Complied
Part 15.247(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	Complied

2.3. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of 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:	A1706
Test Sample Serial Number:	C02S200EHH5Q *(Radiated sample)*
Hardware Version:	EVT
Software Version:	OS: 16B2272a BB: v234 c4096
FCC ID:	BCGA1706

Brand Name:	Apple
Model Name or Number:	A1706
Test Sample Serial Number:	C02S200FHH5Q *(Conducted sample with RF port)*
Hardware Version:	EVT
Software Version:	OS: 16A215 BB: v234 c4096
FCC ID:	BCGA1706

3.2. Description of EUT

The equipment under test was a Notebook PC with 2.4 GHz and 5 GHz wireless LAN and Bluetooth capabilities.

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:	*Bluetooth*		
Power Supply Requirement:	Nominal	120 VAC	
Type of Unit:	Transceiver		
Channel Spacing:	1 MHz		
Mode:	Basic Rate	Enhanced Data Rate	
Modulation:	GFSK	π/4-DQPSK	8DPSK
Packet Type: (Maximum Payload)	DH5	2DH5	3DH5
Data Rate (Mbps):	1	2	3
Maximum Conducted Output Power:	11.4 dBm		
Antenna Gain:	2.0 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:	Test Laptop
Brand Name:	Apple
Model Name or Number:	MacBook Pro
Serial Number:	C2QLQ03XF9F2

Description:	AC to DC Power adaptor
Brand Name:	Apple
Model Name or Number:	A1718
Serial Number:	Not marked or stated

Description:	USB-C Charge Cable (2 m)
Brand Name:	Apple
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Personal Hands Free (PHF)
Brand Name:	Apple
Model Name or Number:	Apple Ear Plugs
Serial Number:	Not marked or stated

Description:	USB-A to USB-C adaptor (x3)
Brand Name:	Apple
Model Name or Number:	A1632
Serial Number:	Not marked or stated

Description:	USB Hub
Brand Name:	Belkin
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

- 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):

- For the radiated tests, the EUT was controlled via a remote test laptop using the terminal application sending commands supplied by the customer. For conducted tests, the application was installed on the test unit. Channels, packet lengths and other settings were then set using this software application as required.
- The procedure to set up and control the EUT was supplied by the customer in a document titled “B40_BT_BTLE_COM_SOP_v1.1.docx” dated 22/08/2016 which is stored on the company server.
- The customer supplied an RF connector cable to facilitate a conducted RF link between the EUT and a spectrum analyser through suitable attenuation. This was taken into account for path loss calculations.
- 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.
- Radiated spurious emissions were performed with the EUT in the worst case orientation/position. Tests were performed with the EUT connected to its AC charger, PHF and a USB hub. The AC charger was powered by 120 VAC 60 Hz. All ports were terminated with suitable terminations.
- The EUT radiated sample serial number C02S200EHH5Q was used for radiated spurious emissions tests.
- The EUT conducted sample with serial number C02S200FHH5Q was used for all other tests.

5. Measurements, Examinations and Derived Results

5.1. General Comments

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

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

5.2. Test Results

5.2.1. Transmitter 20 dB Bandwidth

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	30 August 2016
Test Sample Serial Number:	C02S200FHH5Q		

FCC Reference:	Part 15.247(a)(1)
Test Method Used:	ANSI C63.10 Section 6.9.2

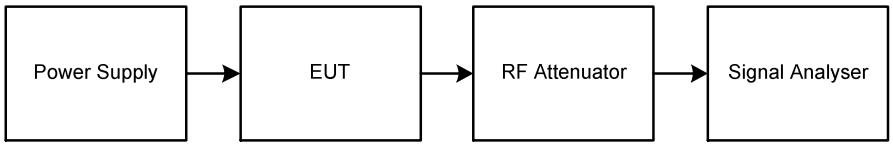
Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	57

Note(s):

1. The signal analyser resolution bandwidth was set between 1% & 5% of the occupied bandwidth and the video bandwidth set to 3 times the resolution bandwidth. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set between 2 and 5 times the bandwidth of the signal. Normal and delta markers were placed 20 dB down from the peak of the carrier. These results are documented in the table below.
2. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

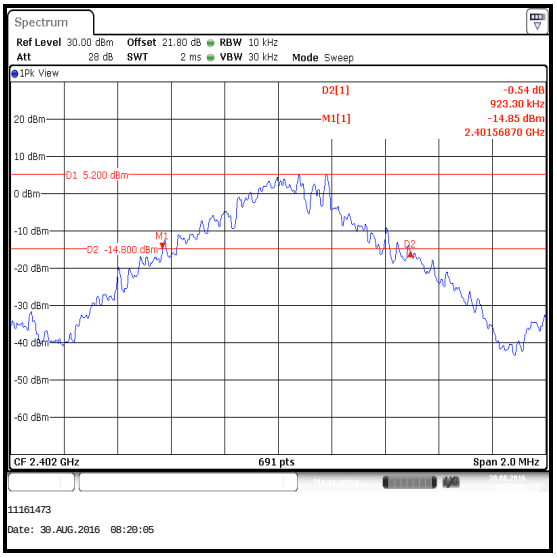
Test setup:



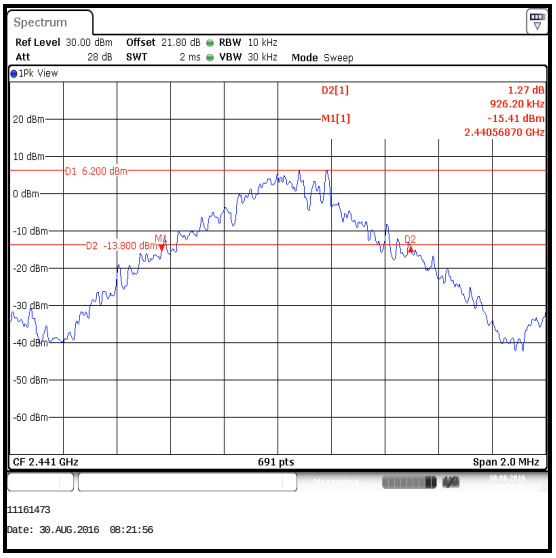
Transmitter 20 dB Bandwidth (continued)

Results DH5:

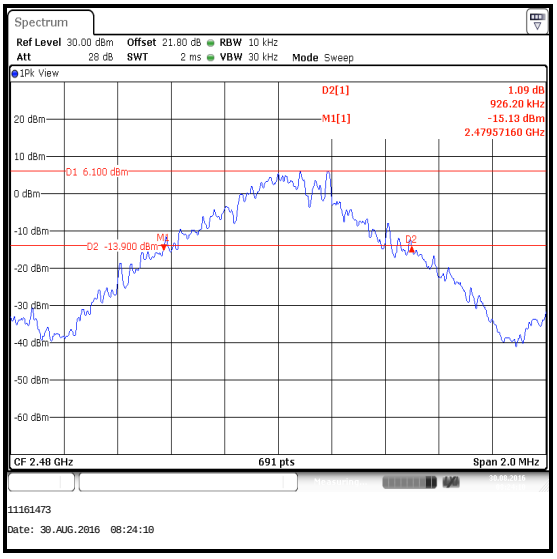
Channel	20 dB Bandwidth (kHz)
Bottom	923.300
Middle	926.200
Top	926.200



Bottom Channel



Middle Channel

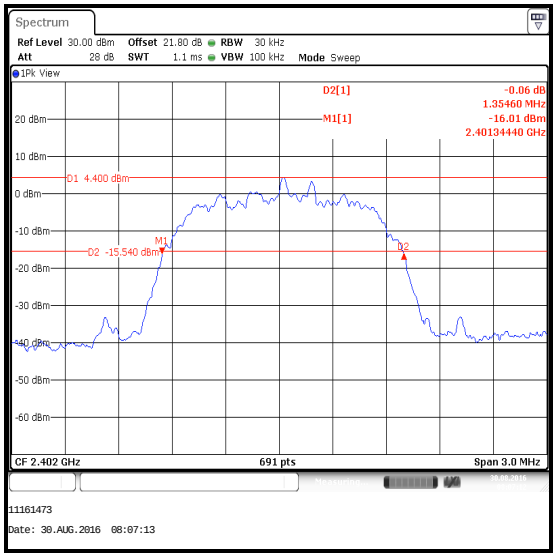


Top Channel

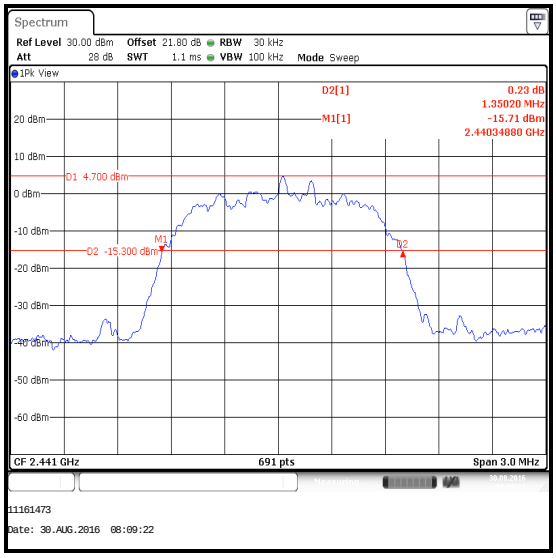
Transmitter 20 dB Bandwidth (continued)

Results 2DH5:

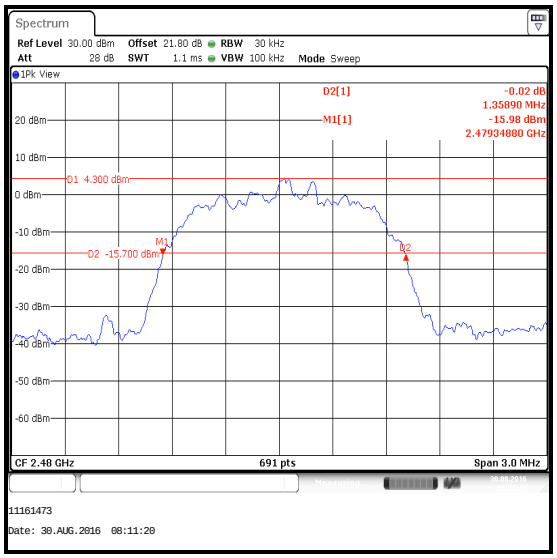
Channel	20 dB Bandwidth (kHz)
Bottom	1354.600
Middle	1350.200
Top	1358.900



Bottom Channel



Middle Channel

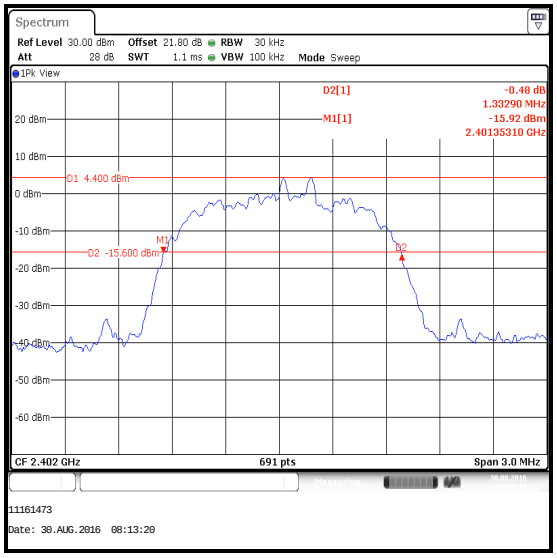


Top Channel

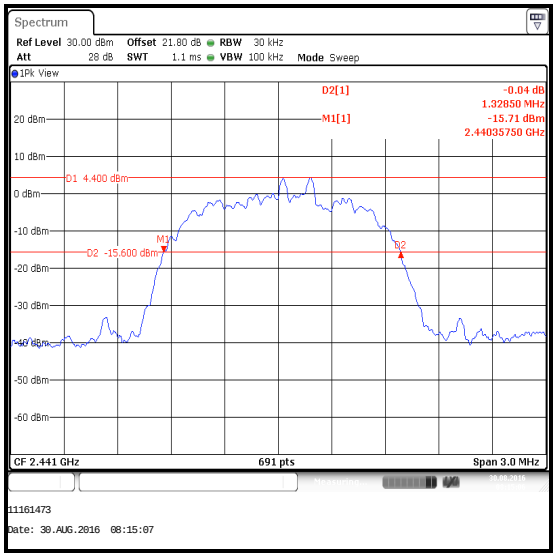
Transmitter 20 dB Bandwidth (continued)

Results 3DH5:

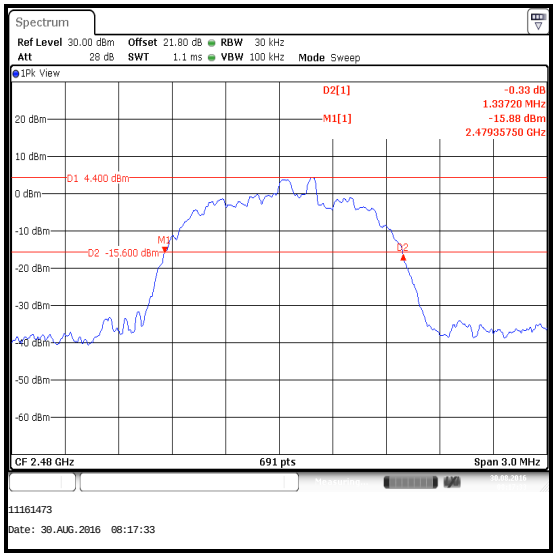
Channel	20 dB Bandwidth (kHz)
Bottom	1332.900
Middle	1328.500
Top	1337.200



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)
M2002	Thermohygrometer	Testo	608-H1	45041825	02 Apr 2017	12
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100975	02 Mar 2017	12
A2526	Attenuator	AtlanTecRF	AN18W5-20	832828#1	Calibrated before use	-
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	11 Apr 2018	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	15 Apr 2018	24
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	10 May 2019	36

5.2.2. Transmitter Carrier Frequency Separation

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	30 August 2016
Test Sample Serial Number:	C02S200FHH5Q		

FCC Reference:	Part 15.247(a)(1)
Test Method Used:	ANSI C63.10 Section 7.8.2

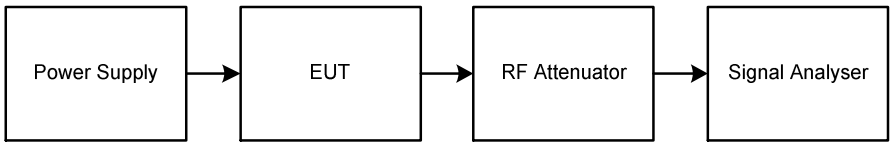
Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	57

Note(s):

1. The 20 dB bandwidth measured for the middle channel operating at 2441 MHz was used to calculate the limit.
2. The signal analyser centre frequency was set at the mid frequency of channels 39 and 40. The resolution bandwidth was set to 30 kHz and video bandwidth of 100 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 3 MHz. A marker was placed on each of the corresponding peaks of the adjacent channels, with the frequency difference recorded in the tables below for each mode of operation.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

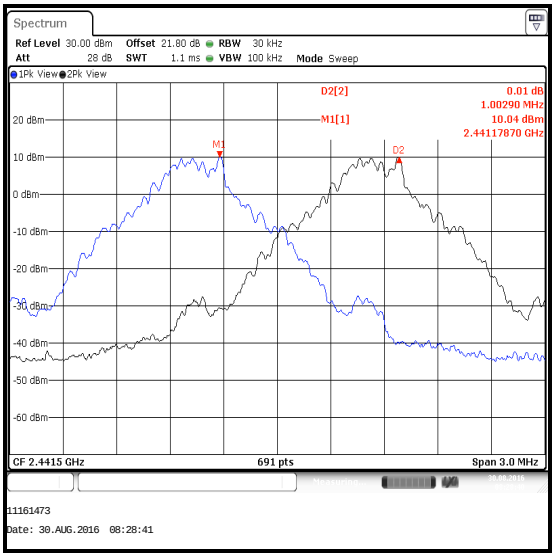
Test setup:



Transmitter Carrier Frequency Separation (continued)

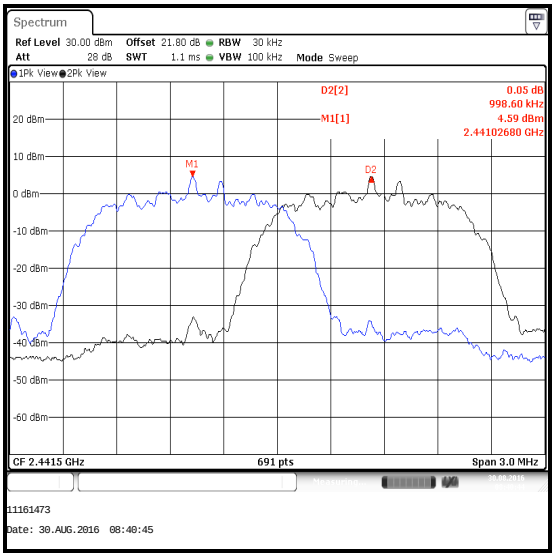
Results: DH5

Carrier Frequency Separation (kHz)	Limit ($^2/_3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
1002.900	617.467	385.433	Complied



Results: 2DH5

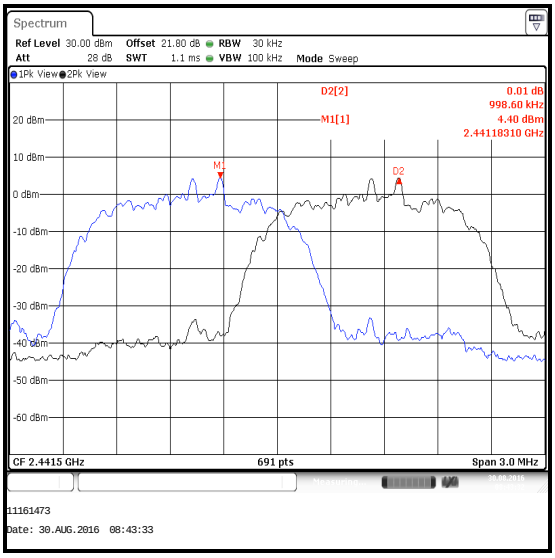
Carrier Frequency Separation (kHz)	Limit ($^2/_3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
998.600	900.133	98.467	Complied



Transmitter Carrier Frequency Separation (continued)

Results: 3DH5

Carrier Frequency Separation (kHz)	Limit ($^2/_3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
998.600	885.667	112.933	Complied



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	Testo	608-H1	45041825	02 Apr 2017	12
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100975	02 Mar 2017	12
A2526	Attenuator	AtlanTecRF	AN18W5-20	832828#1	Calibrated before use	-
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	11 Apr 2018	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	15 Apr 2018	24
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	10 May 2019	36

5.2.3. Transmitter Number of Hopping Frequencies and Average Time of Occupancy

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	30 August 2016
Test Sample Serial Number:	C02S200FHH5Q		

FCC Reference:	Part 15.247(a)(1)(iii)
Test Method Used:	ANSI C63.10 Sections 7.8.3 & 7.8.4

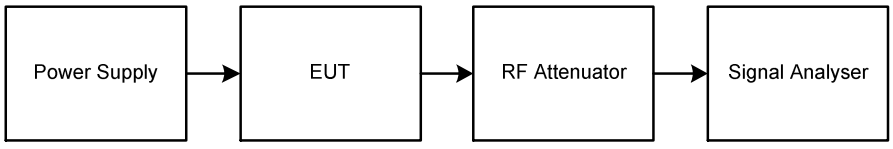
Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	57

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 signal analyser was set up for the Number of Hopping Frequencies measurement as follows: the resolution bandwidth was set to 20 kHz and video bandwidth to 50 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 83.5 MHz.
3. The signal analyser was set up for the Emission Width measurement as follows: the resolution bandwidth was set to 1 MHz and video bandwidth of 3 MHz. A peak detector was used and sweep time was set to auto with a span of zero Hz. The signal analyser was set to trigger at 1 ms, with a marker placed at the start of the emission and a delta marked place at the end of the emission. The emission width is recorded in the table below.
4. The signal analyser was set up for the Number of Hopping Frequencies in 32 seconds measurement as follows: the resolution bandwidth was set to 100 kHz and video bandwidth of 300 kHz. A peak detector was used and sweep time was set to 32 seconds. The EUT was set to transmit in a hopping frequency mode with zero span. The total number of hopping frequencies were recorded in the table below.
5. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

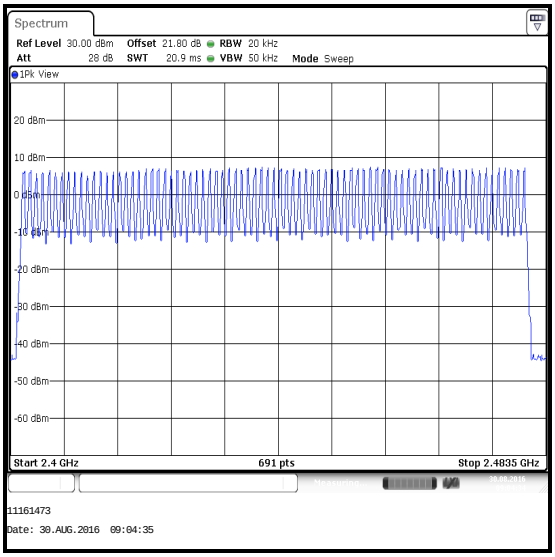
Test setup:



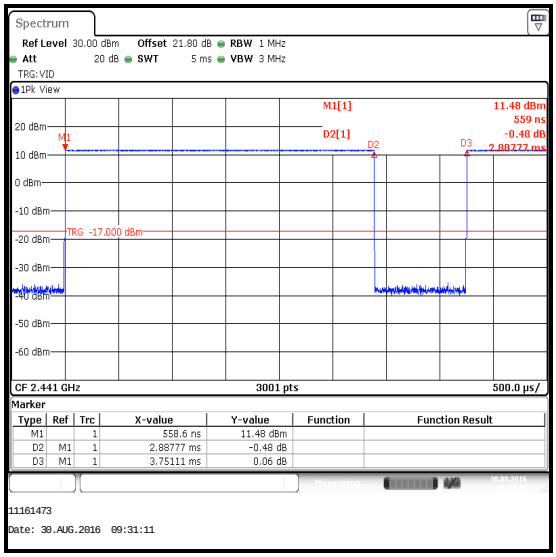
Transmitter Number of Hopping Frequencies and Average Time of Occupancy (continued)

Results:

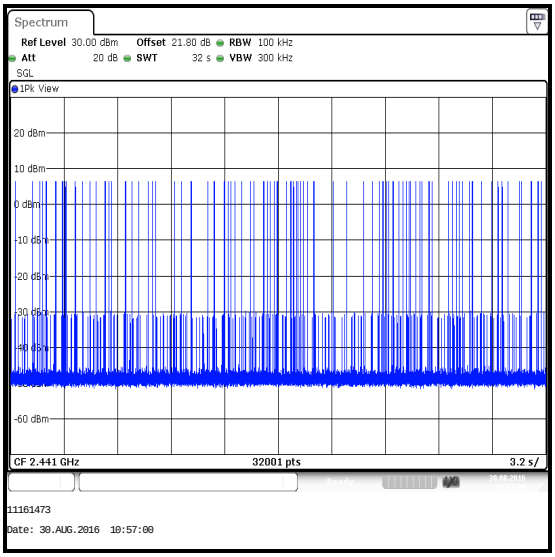
Emission Width (µs)	Number of Hops in 31.6 Seconds	Average Time of Occupancy (s)	Limit (s)	Margin (s)	Result
2887.770	105	0.303	0.4	0.097	Complied



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)
M2002	Thermohygrometer	Testo	608-H1	45041825	02 Apr 2017	12
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100975	02 Mar 2017	12
A2526	Attenuator	AtlanTecRF	AN18W5-20	832828#1	Calibrated before use	-
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	11 Apr 2018	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	15 Apr 2018	24
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	10 May 2019	36

5.2.4. Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	23 August 2016
Test Sample Serial Number:	C02S200FHH5Q		

FCC Reference:	Part 15.247(b)(1)
Test Method Used:	ANSI C63.10 Section 7.8.5

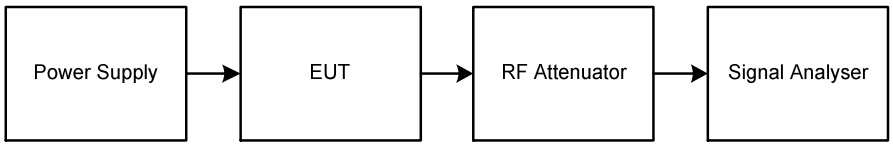
Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	57

Note(s):

1. The signal analyser resolution bandwidth was set to 2 MHz (20 dB bandwidth) and video bandwidth of 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 5 MHz (approximately five times the 20 dB bandwidth). A marker was placed at the peak of the signal and the results recorded in the tables below.
2. The declared antenna gain was added to the conducted peak power to obtain the EIRP.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF offset level was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

Test setup:



Transmitter Maximum Peak Output Power (continued)

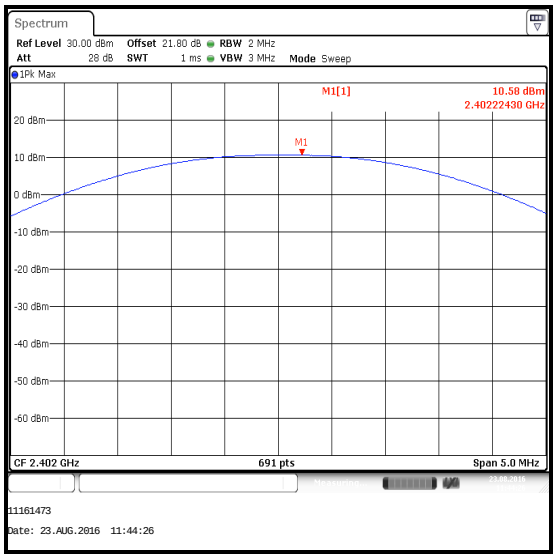
Results: DH5

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	10.6	30.0	19.4	Complied
Middle	11.4	30.0	18.6	Complied
Top	11.4	30.0	18.6	Complied

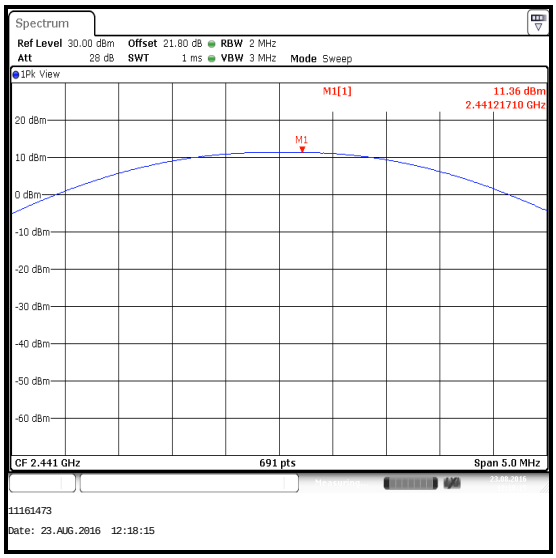
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	10.6	2.0	12.6	36.0	23.4	Complied
Middle	11.4	2.0	13.4	36.0	22.6	Complied
Top	11.4	2.0	13.4	36.0	22.6	Complied

Transmitter Maximum Peak Output Power (continued)

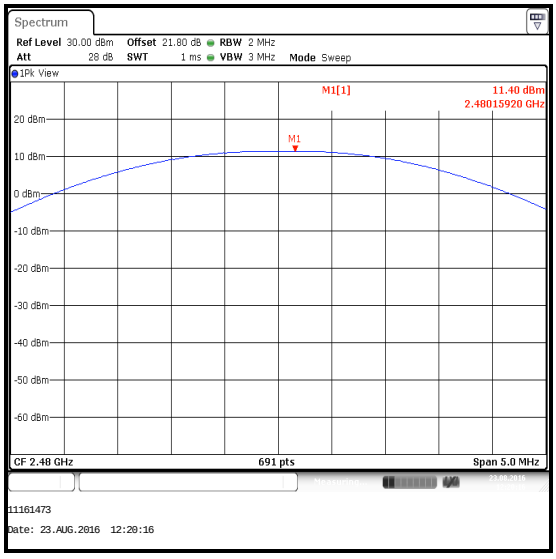
Results: DH5



Bottom Channel



Middle Channel



Top Channel

Transmitter Maximum Peak Output Power (continued)

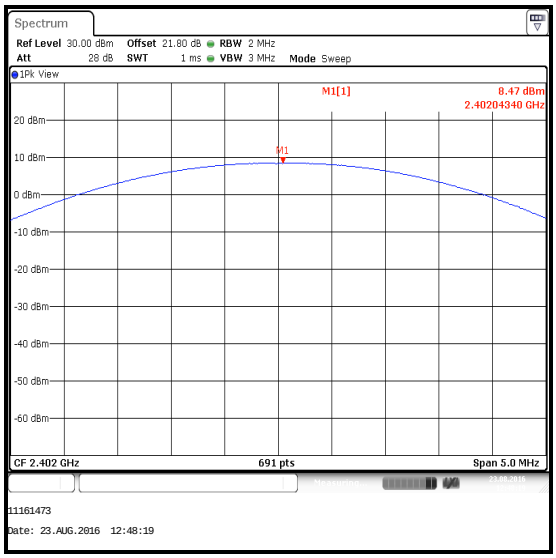
Results: 2DH5

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	8.5	21.0	12.5	Complied
Middle	8.5	21.0	12.5	Complied
Top	8.5	21.0	12.5	Complied

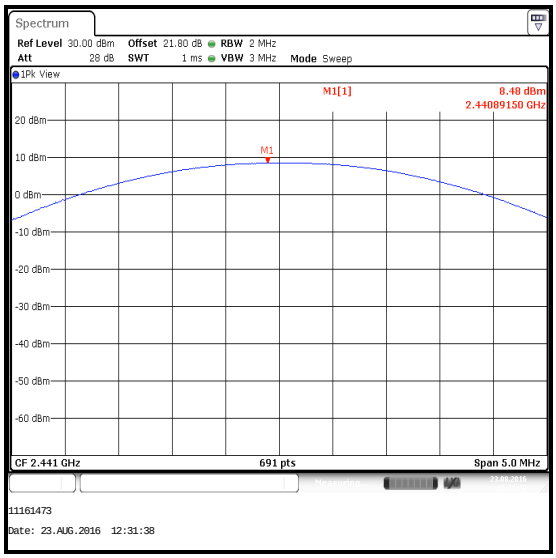
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	8.5	2.0	10.5	27.0	16.5	Complied
Middle	8.5	2.0	10.5	27.0	16.5	Complied
Top	8.5	2.0	10.5	27.0	16.5	Complied

Transmitter Maximum Peak Output Power (continued)

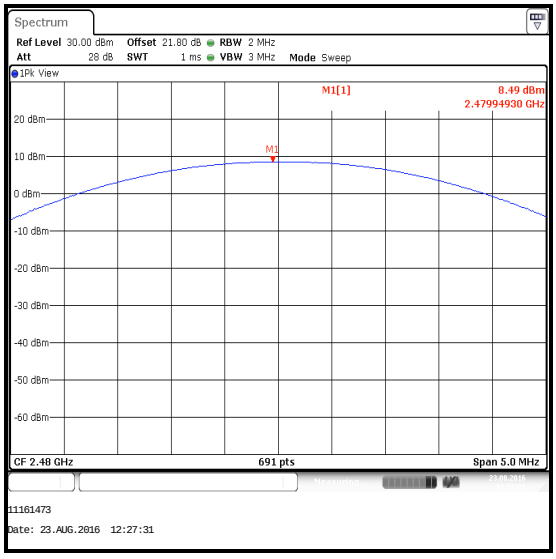
Results: 2DH5



Bottom Channel



Middle Channel



Top Channel

Transmitter Maximum Peak Output Power (continued)

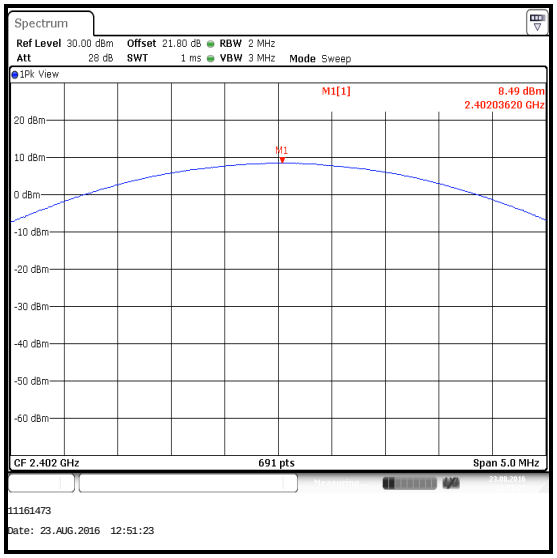
Results: 3DH5

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	8.5	21.0	12.5	Complied
Middle	8.5	21.0	12.5	Complied
Top	8.5	21.0	12.5	Complied

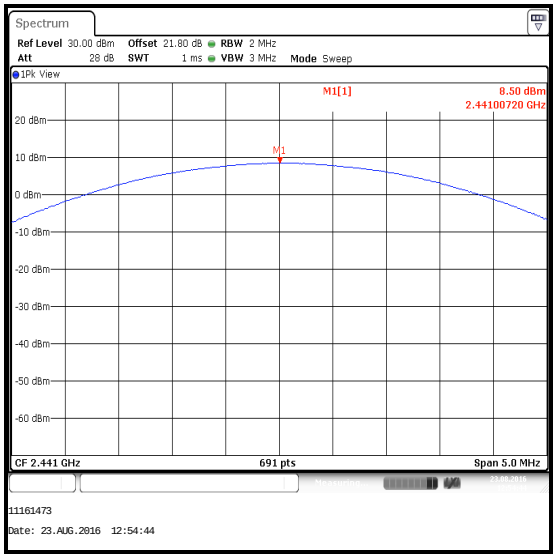
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	8.5	2.0	10.5	27.0	16.5	Complied
Middle	8.5	2.0	10.5	27.0	16.5	Complied
Top	8.5	2.0	10.5	27.0	16.5	Complied

Transmitter Maximum Peak Output Power (continued)

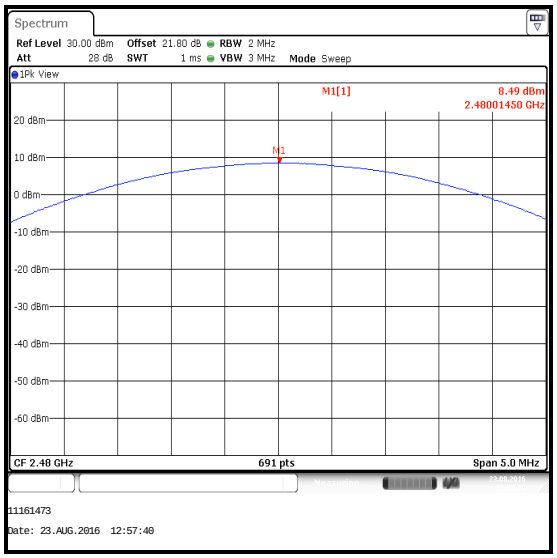
Results: 3DH5



Bottom Channel



Middle Channel



Top Channel

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	Testo	608-H1	45041825	02 Apr 2017	12
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100975	02 Mar 2017	12
A2526	Attenuator	AtlanTecRF	AN18W5-20	832828#1	Calibrated before use	-
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	11 Apr 2018	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	15 Apr 2018	24
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	10 May 2019	36

5.2.5. Transmitter Radiated Emissions

Test Summary:

Test Engineers:	Stuart Martin & Shahbaz Qureshi	**Test Dates:**	05 September 2016 & 08 September 2016
Test Sample Serial Number:	C02S200EHH5Q		

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

Environmental Conditions:

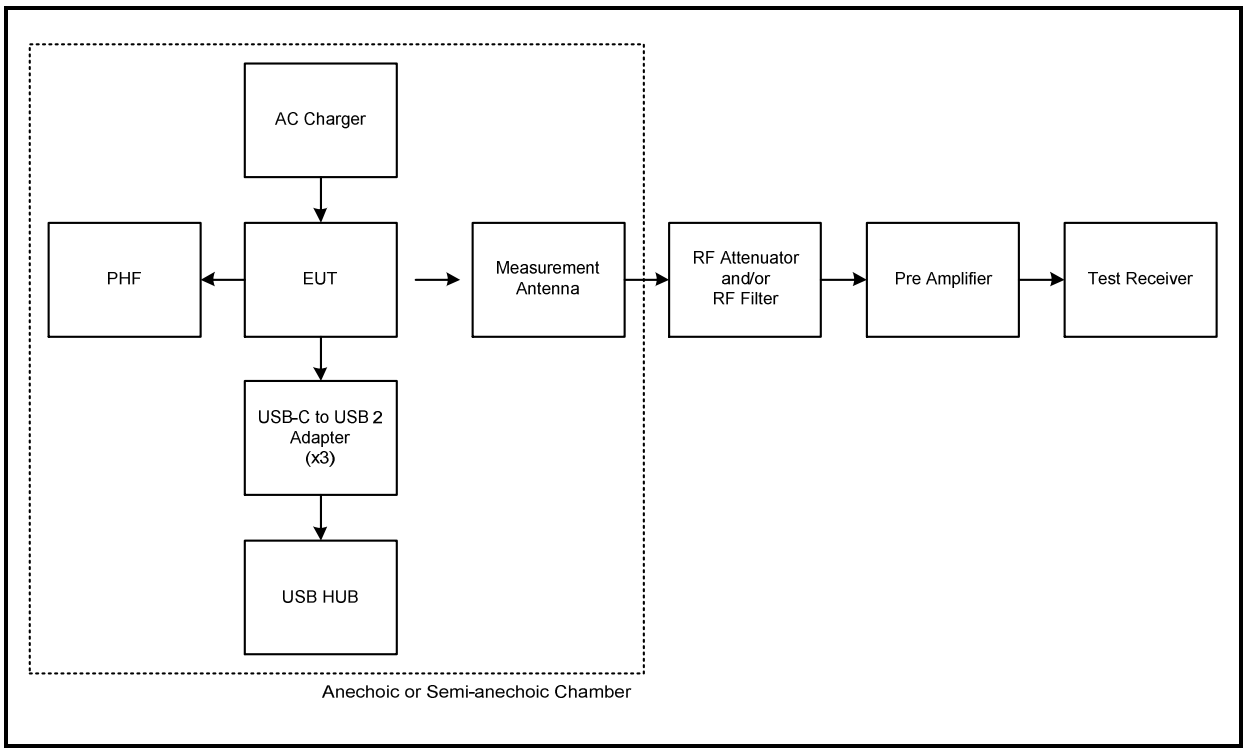
Temperature (°C):	25 to 26
Relative Humidity (%):	42 to 48

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 middle 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. Middle channel results are recorded in this report and are representative of bottom and top channel results which are held on the UL IT server and available for inspection on request.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) 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. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
8. Final measurements were performed on the marker frequencies. The test receiver resolution bandwidth was set to 120 kHz, using a CISPR quasi-peak detector and span big enough to see the whole emission.

Transmitter Radiated Emissions (continued)

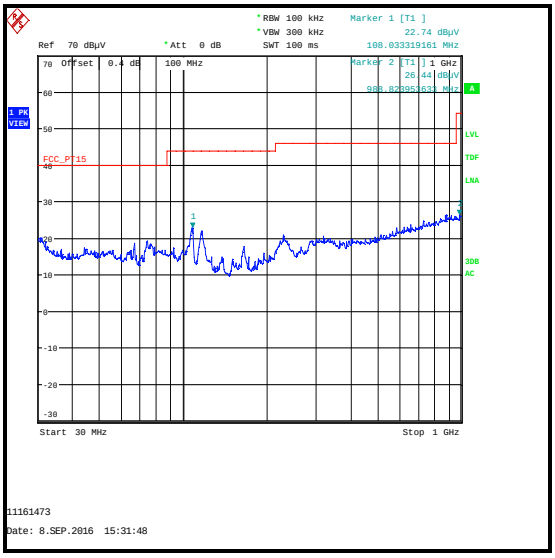
Test setup for radiated measurements:



Transmitter Radiated Emissions (continued)

Results: Quasi-Peak / DH5

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
988.824	Vertical	26.4	54.0	27.6	Complied



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	17 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	07 Apr 2017	12
A2175	Low Pass Filter	AtlanTecRF	AFL-01000	800976	30 Apr 2017	12

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	David Doyle	**Test Dates:**	29 August 2016, 01 September 2016 & 02 September 2016
Test Sample Serial Number:	C02S200EHH5Q		

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

Environmental Conditions:

Temperature (°C):	24 to 27
Relative Humidity (%):	42 to 46

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 3 GHz plot is the EUT fundamental at 2441 MHz.
4. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak noise floor reading of the measuring receiver was recorded as shown in the tables below.
5. Middle channel results are recorded in this report and are representative of bottom and top channel results which are held on the UL IT server and available for inspection on request.
6. Measurements were performed in an anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres 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. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. The sweep time was set to auto. Peak and average measurements were performed with their own appropriate detectors during the pre-scan measurements.

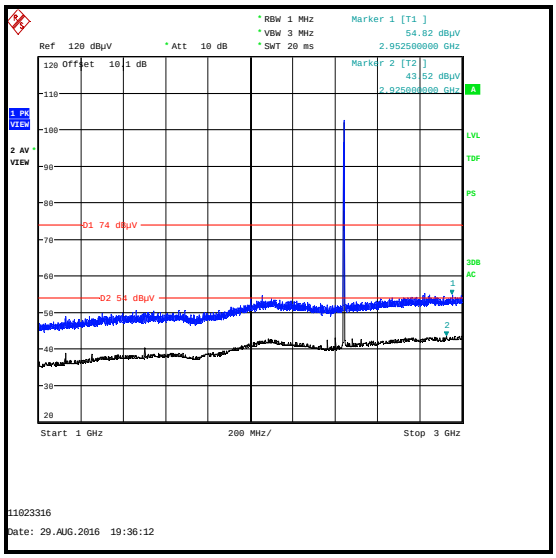
Results: DH5 / Peak

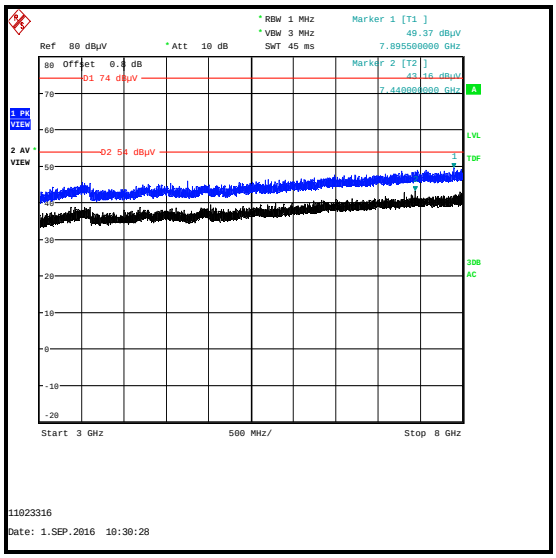
Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2952.500	Vertical	54.8	74.0	19.2	Complied

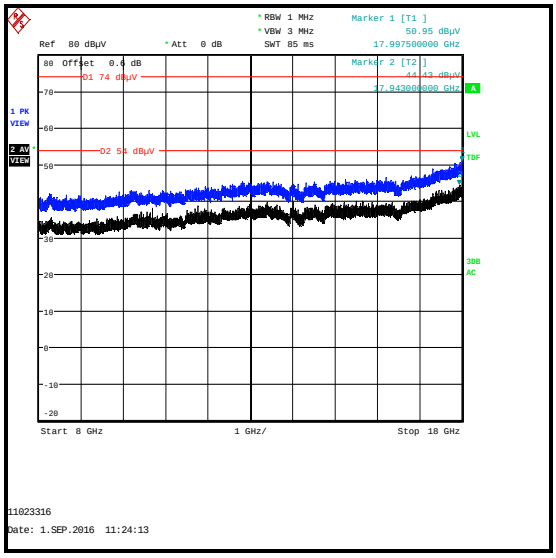
Results: DH5 / Average

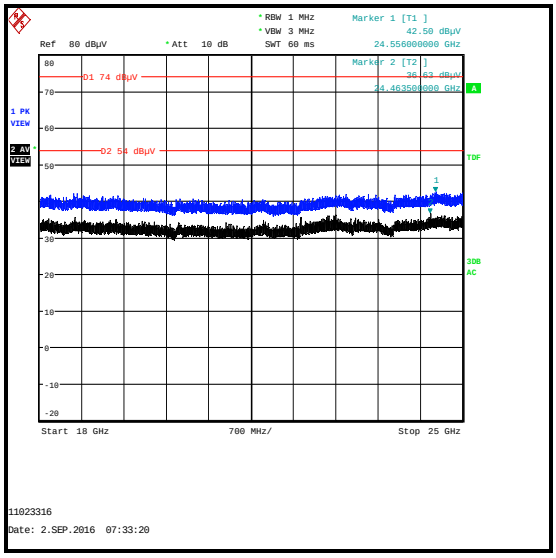
Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2952.000	Vertical	43.5	54.0	10.5	Complied

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)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	17 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B	07 Apr 2017	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	06 May 2017	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	07 Apr 2017	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	07 Jan 2017	12
A2891	Pre-Amplifier	Schwarzbeck	BBV 9718	9718-306	07 Apr 2017	12
A2893	Pre-Amplifier	Schwarzbeck	BBV 9721	9721-021	07 Apr 2017	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	19 May 2017	12
A2947	High Pass Filter	AtlanTecRF	AFH-07000	1601900001	01 Jun 2017	12
A2916	Attenuator	AtlanTecRF	AN185W-10	832827#1	19 May 2017	12

5.2.6. Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineers:	Mark Perry & David Doyle	**Test Dates:**	29 August 2016 & 01 September 2016
Test Sample Serial Number:	C02S200EHH5Q		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10 Section 6.10

Environmental Conditions:

Temperature (°C):	24 to 26
Relative Humidity (%):	42 to 44

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 lower band edge falls within a non-restricted band. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent band (where a higher level emission was present). Marker frequencies and levels were recorded.
3. The upper band edge falls within a restricted band. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. Peak and average measurements were performed with their respective detectors, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent band (where a higher level emission was present). Marker frequencies and levels were recorded.
4. There is a restricted band 10 MHz below the lower band edge. The test receiver was set up as follows: the RBW set to 1 MHz, the VBW set to 3 MHz, with the sweep time set to auto couple. Peak and average measurements were performed with their respective detectors. Markers were placed on the highest point on each trace.
5. * -20 dBc limit.

Transmitter Band Edge Radiated Emissions (continued)

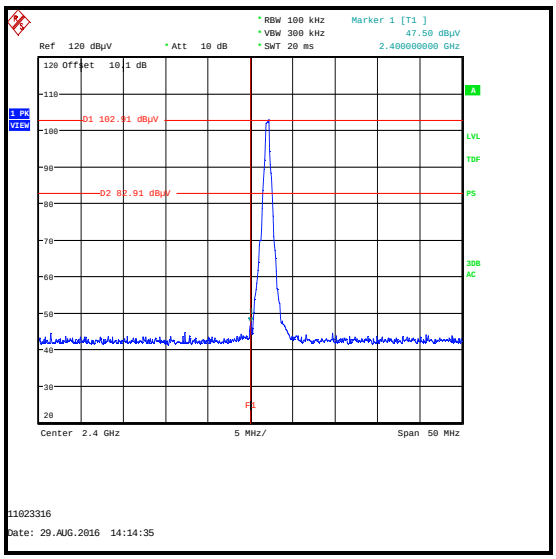
Results: Static Mode / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2349.359	Vertical	53.0	74.0	21.0	Complied
2400.0	Vertical	47.5	82.9*	35.4	Complied
2483.5	Vertical	60.3	74.0	13.7	Complied

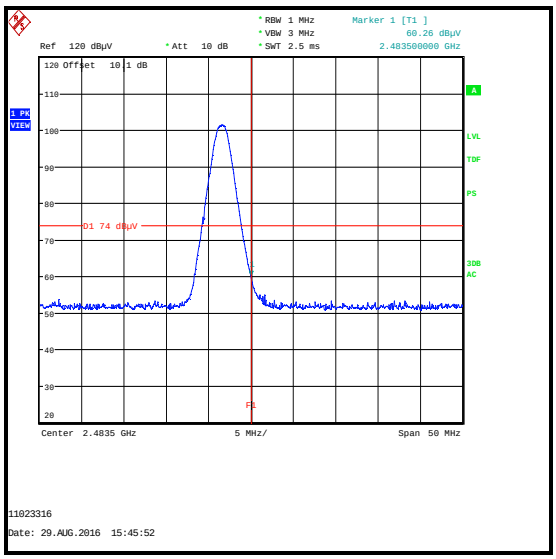
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2370.769	Vertical	43.2	54.0	10.8	Complied
2483.5	Vertical	44.6	54.0	9.4	Complied
2484.221	Vertical	45.4	54.0	8.6	Complied

Transmitter Band Edge Radiated Emissions (continued)

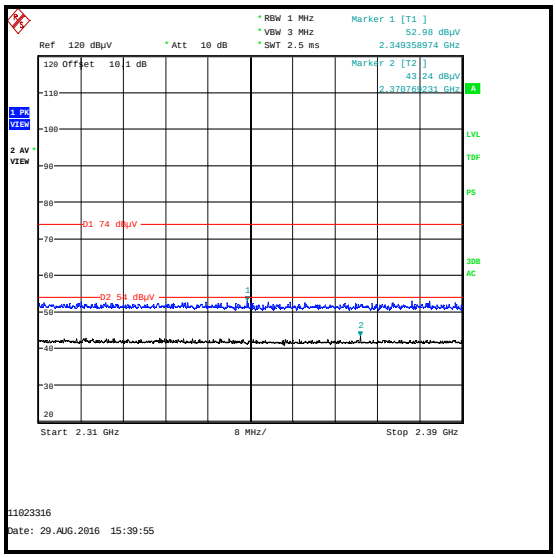
Results: Static Mode / DH5



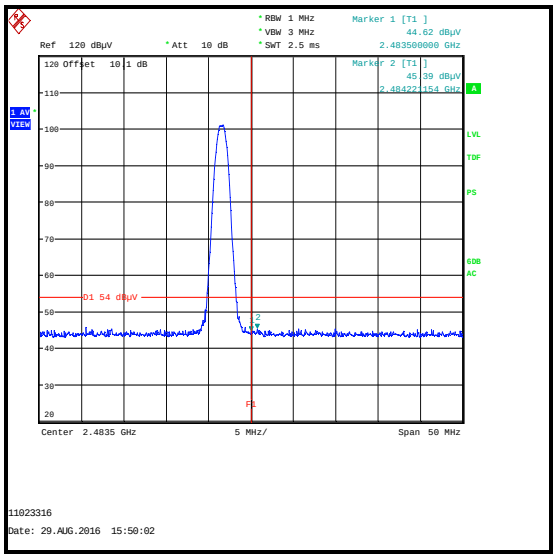
Lower Band Edge Peak Static



Upper Band Edge Peak Static



2310 MHz to 2390 MHz Restricted Band Plot



Upper Band Edge Average Static

Transmitter Band Edge Radiated Emissions (continued)

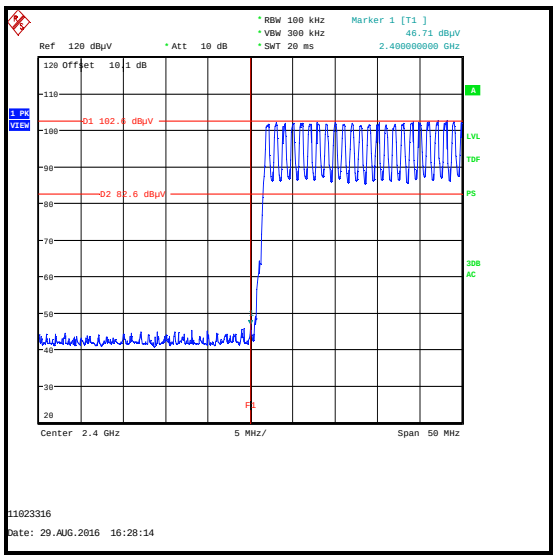
Results: Hopping Mode / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2346.026	Vertical	53.5	74.0	20.5	Complied
2400.0	Vertical	46.7	82.6*	35.9	Complied
2483.5	Vertical	59.5	74.0	14.5	Complied

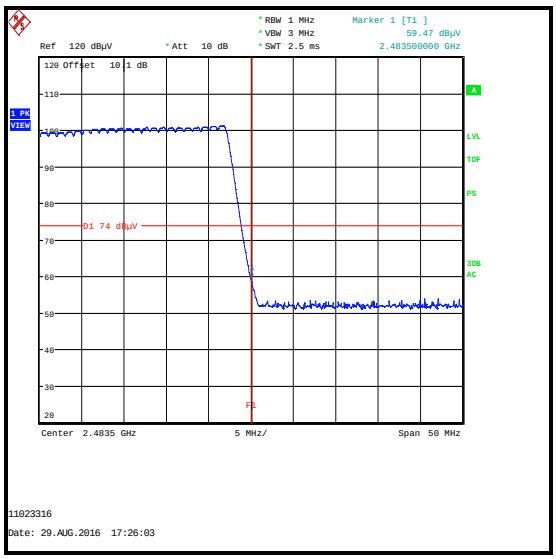
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2367.051	Vertical	44.4	54.0	9.6	Complied
2483.5	Vertical	44.6	54.0	9.4	Complied

Transmitter Band Edge Radiated Emissions (continued)

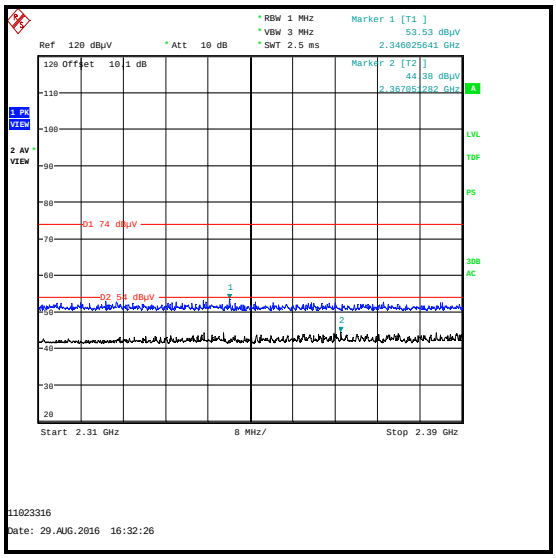
Results: Hopping Mode / DH5



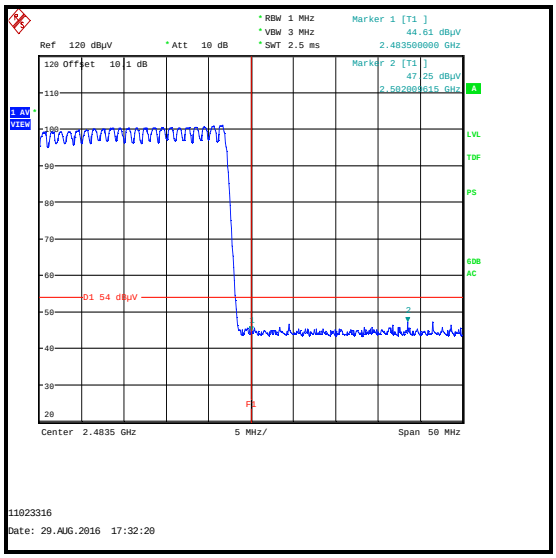
Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



2310 MHz to 2390 MHz Restricted Band Plot



Upper Band Edge Average Hopping

Transmitter Band Edge Radiated Emissions (continued)

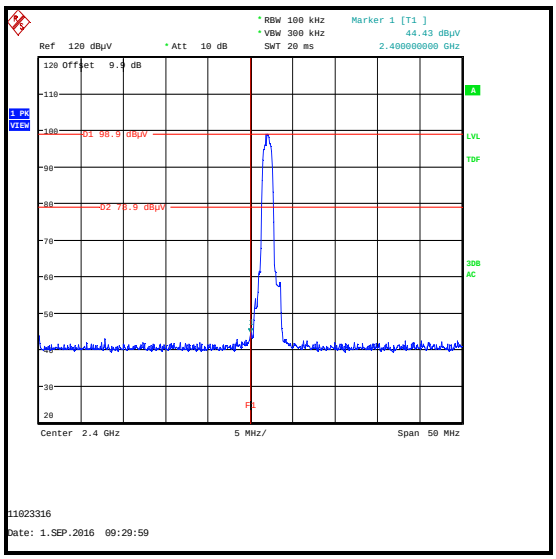
Results: Static Mode / 2DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2361.026	Vertical	52.9	74.0	21.1	Complied
2400.0	Vertical	44.4	78.9*	34.5	Complied
2483.5	Vertical	59.7	74.0	14.3	Complied

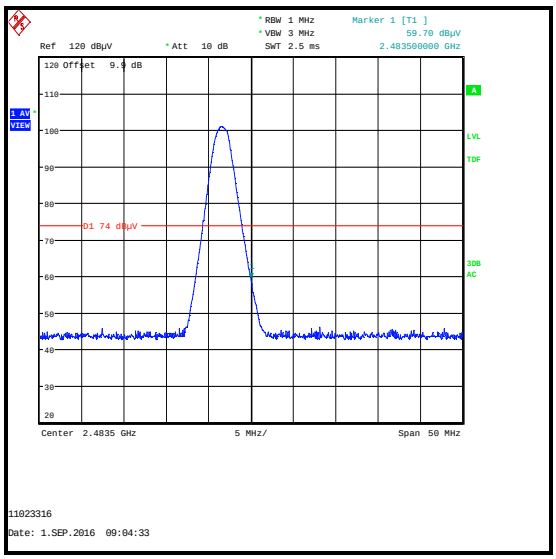
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2361.795	Vertical	47.9	54.0	6.1	Complied
2483.5	Vertical	46.2	54.0	7.8	Complied
2484.542	Vertical	47.1	54.0	6.9	Complied

Transmitter Band Edge Radiated Emissions (continued)

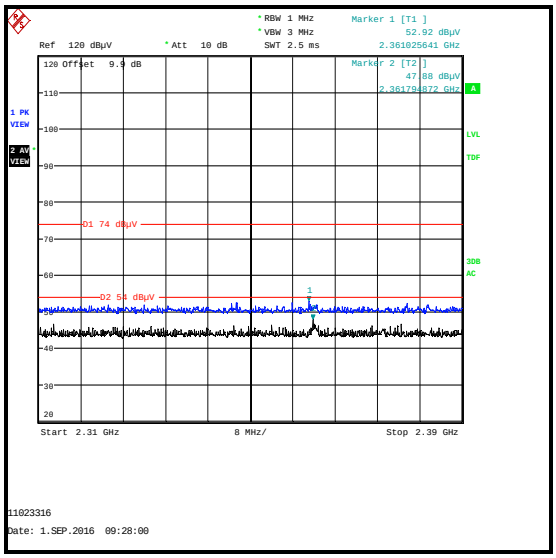
Results: Static Mode / 2DH5



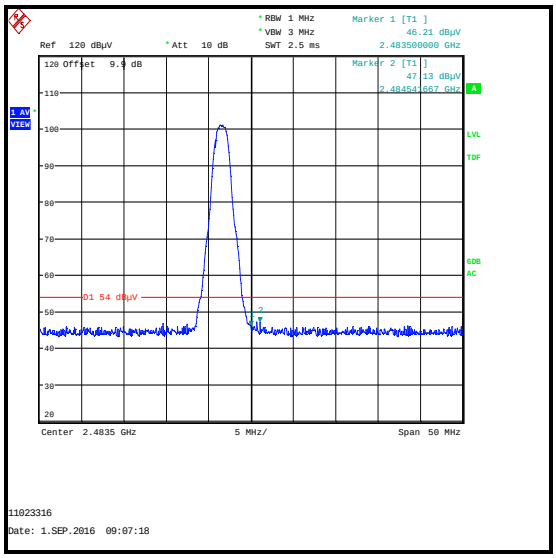
Lower Band Edge Peak Static



Upper Band Edge Peak Static



2310 MHz to 2390 MHz Restricted Band Plot



Upper Band Edge Average Static

Transmitter Band Edge Radiated Emissions (continued)

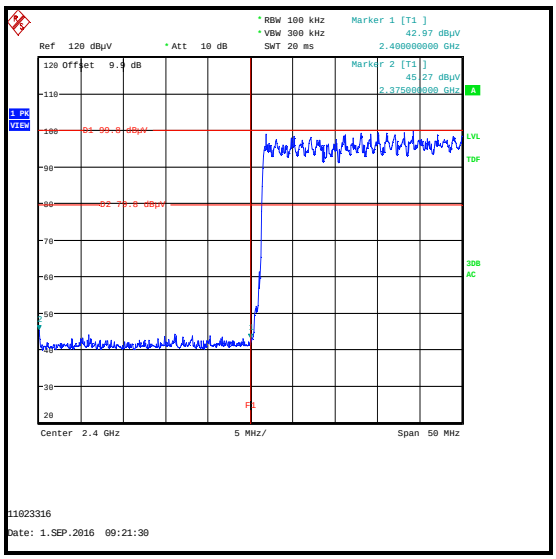
Results: Hopping Mode / 2DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2375.000	Vertical	45.3	74.0	28.7	Complied
2383.718	Vertical	53.5	74.0	20.5	Complied
2400.0	Vertical	43.0	79.8*	36.8	Complied
2483.5	Vertical	59.3	74.0	14.7	Complied

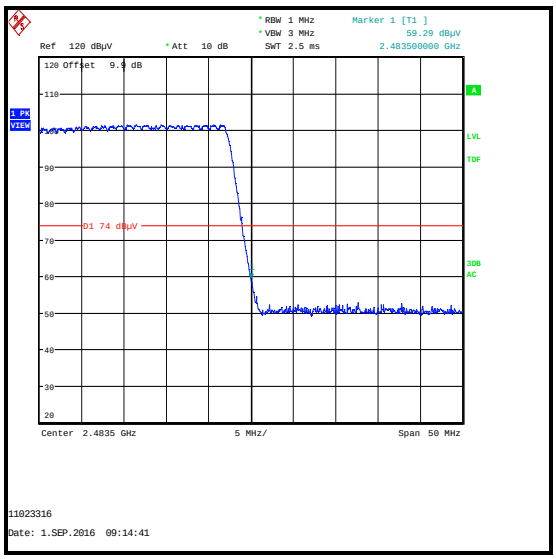
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2312.308	Vertical	47.3	54.0	6.7	Complied
2483.5	Vertical	46.8	54.0	7.2	Complied
2485.263	Vertical	48.2	54.0	5.8	Complied

Transmitter Band Edge Radiated Emissions (continued)

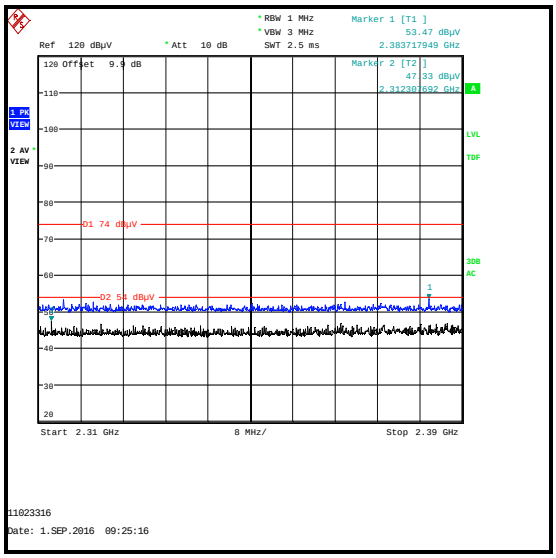
Results: Hopping Mode / 2DH5



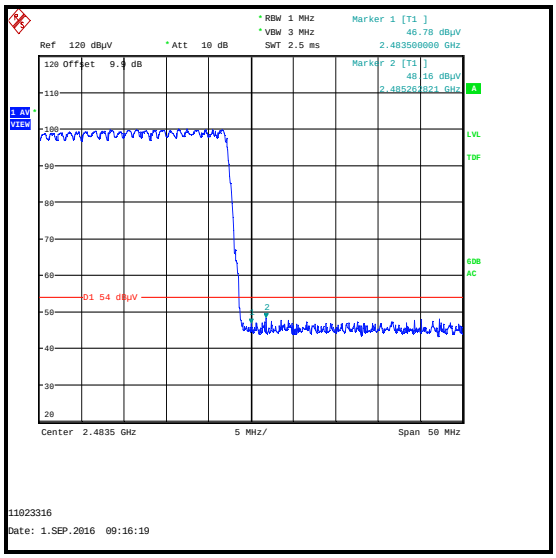
Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



2310 MHz to 2390 MHz Restricted Band Plot



Upper Band Edge Average Hopping

Transmitter Band Edge Radiated Emissions (continued)

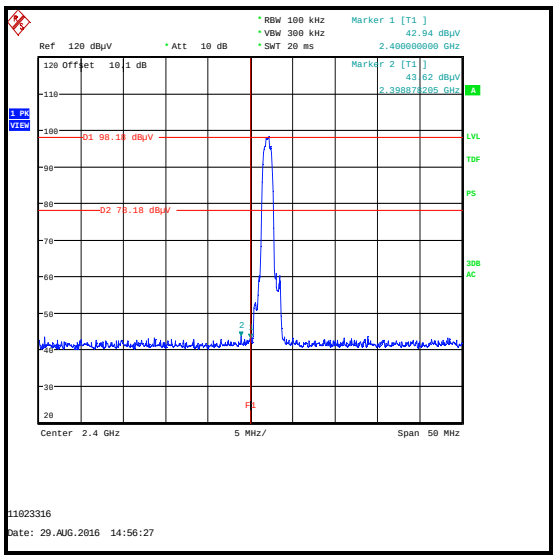
Results: Static Mode / 3DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2386.538	Vertical	52.7	74.0	21.3	Complied
2398.878	Vertical	43.6	78.2*	34.6	Complied
2400.0	Vertical	42.9	78.2*	35.3	Complied
2483.5	Vertical	60.7	74.0	13.3	Complied

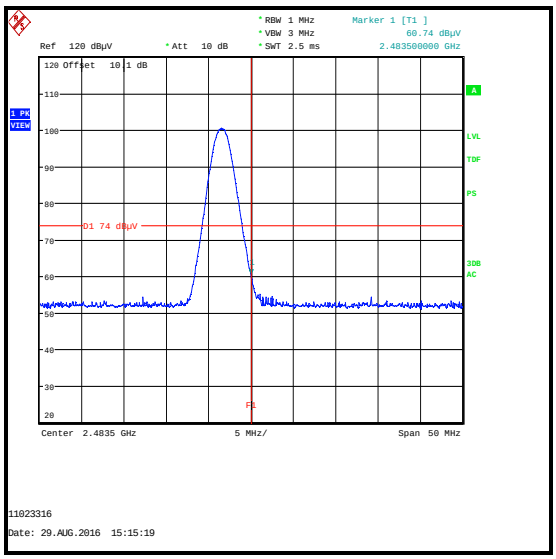
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2362.051	Vertical	44.1	54.0	9.9	Complied
2483.5	Vertical	44.0	54.0	10.0	Complied
2488.708	Vertical	45.8	54.0	8.2	Complied

Transmitter Band Edge Radiated Emissions (continued)

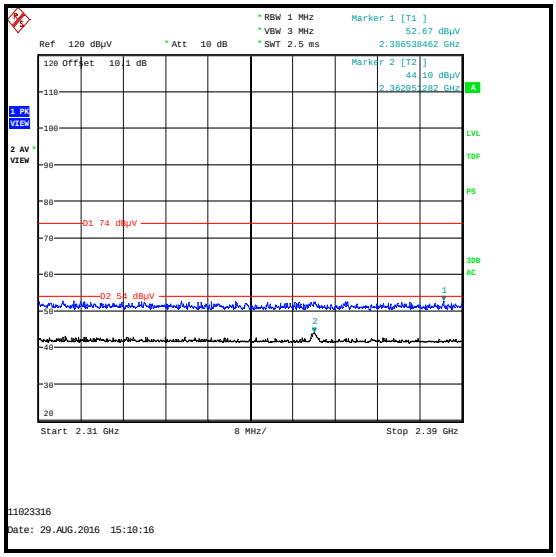
Results: Static Mode / 3DH5



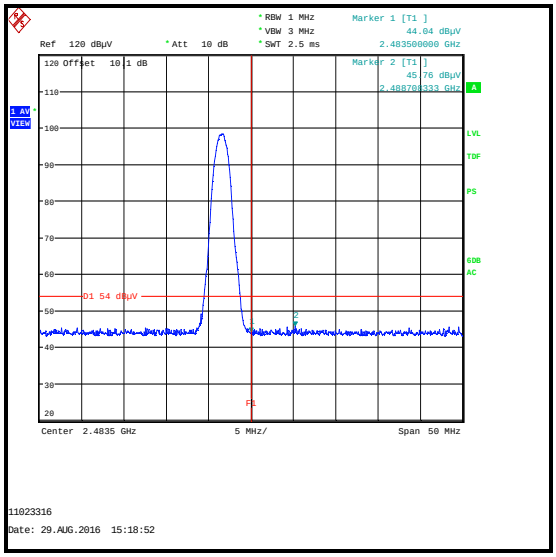
Lower Band Edge Peak Static



Upper Band Edge Peak Static



2310 MHz to 2390 MHz Restricted Band Plot



Upper Band Edge Average Static

Transmitter Band Edge Radiated Emissions (continued)

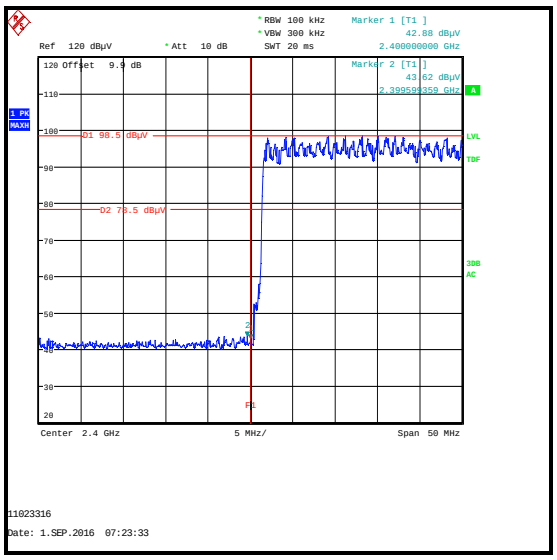
Results: Hopping Mode / 3DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2321.667	Vertical	52.1	74.0	21.9	Complied
2399.599	Vertical	43.6	78.5*	34.9	Complied
2400.0	Vertical	42.9	78.5*	35.6	Complied
2483.5	Vertical	58.9	74.0	15.1	Complied

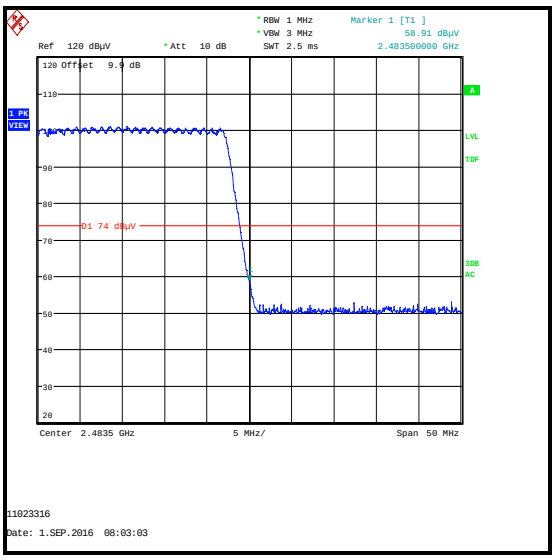
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2317.051	Vertical	46.5	54.0	7.5	Complied
2483.5	Vertical	45.3	54.0	8.7	Complied
2487.186	Vertical	47.6	54.0	6.4	Complied

Transmitter Band Edge Radiated Emissions (continued)

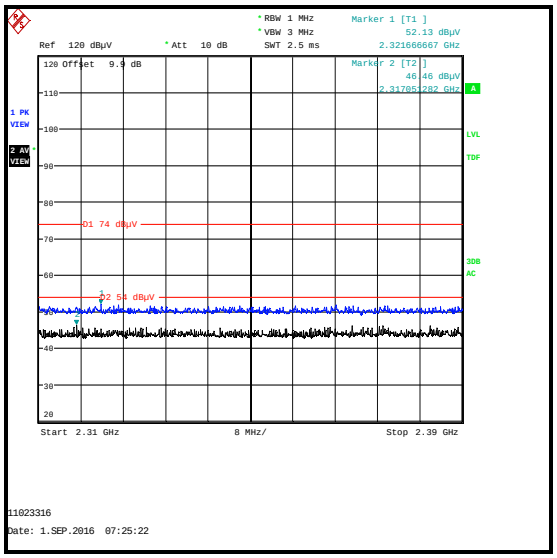
Results: Hopping Mode / 3DH5



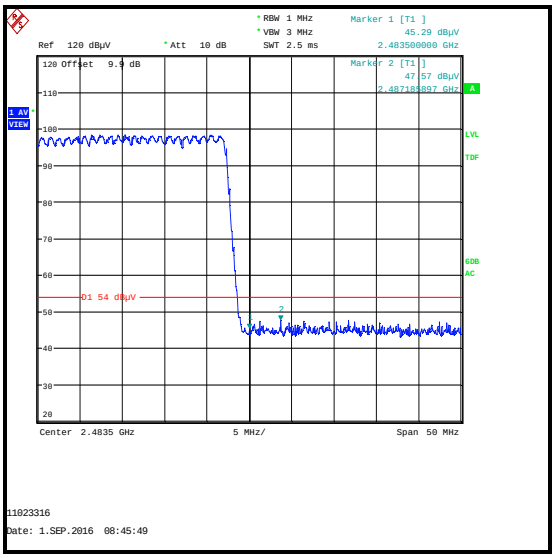
Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



2310 MHz to 2390 MHz Restricted Band Plot



Upper Band Edge Average Hopping

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	17 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	07 Jan 2017	12
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	07 Apr 2017	12
A2916	Attenuator	AtlanTecRF	AN185W-10	832827#1	19 May 2017	12

6. Measurement Uncertainty

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

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

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

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

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Conducted Maximum Peak Output Power	2.4 GHz to 2.4835 GHz	95%	±1.13 dB
Carrier Frequency Separation	2.4 GHz to 2.4835 GHz	95%	±4.59 %
Average Time of Occupancy	2.4 GHz to 2.4835 GHz	95%	±3.53 ns
20 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±4.59 %
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	-	-	Sections 3.1 & 3.5 updated

--- END OF REPORT ---