TEST REPORT

Test Report No. : UL-RPT-RP11241886JD07A V3.0

Manufacturer	:	Apple Inc.
Model No.	:	A1779
FCC ID	:	BCG-E3086A
Technology	:	*Bluetooth* – Basic Rate & EDR (ePA)
Test Standard(s)	:	FCC Parts 15.209(a) & 15.247

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2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 3.0 supersedes all previous versions.

Date of Issue: 03 August 2016

Checked by:

Steven White
Service Lead, Radio Laboratory

Company Signatory:

Sarah Williams
Senior Engineer, Radio Laboratory
UL VS LTD

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

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1. Customer Information

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:	06 June 2016 to 07 July 2016

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
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

Note(s):

1. There are two vendors of the WiFi/Bluetooth radio modules, Vendor 1 and Vendor 2.
2. The WiFi/Bluetooth radio modules have the same mechanical outline (e.g. the same packaging dimension and pin layout), use the same on-board antenna matching circuit, have an identical antenna structure and are built and tested to conform to the same specification and to operate within the same tolerances.

   Baseline testing was performed on the two vendors to determine the worst case.

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:	A1779
Test Sample Serial Number:	C7CRR00BHCPX *(Radiated sample)*
Test Sample IMEI:	358640070063996
Hardware Version:	REV 1.0
Firmware Version:	9.44.11.27
Test Utility Software:	wl 1.359 RC65.0
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample Serial Number:	*C7CRR00GHCPX (Radiated sample)*
Test Sample IMEI:	358640070066106
Hardware Version:	REV 1.0
Firmware Version:	9.44.11.27
Test Utility Software:	wl 1.359 RC65.0
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample Serial Number:	C7CRG02QH6DH *(Conducted sample #1 with RF port)*
Test Sample IMEI:	358640070529822
Hardware Version:	REV 1.0
Firmware Version:	9.44.11.27
Test Utility Software:	wl 1.359 RC65.0
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample Serial Number:	C7CRR02BHCPX *(Conducted sample #2 with RF port)*
Test Sample IMEI:	358640070098109
Hardware Version:	REV 1.0
Firmware Version:	9.44.11.27
Test Utility Software:	wl 1.359 RC65.0
FCC ID:	BCG-E3086A

3.2. Description of EUT

The Equipment Under Test was a mobile phone, with GSM/GPRS/EGPRS/UMTS/LTE/TD-SCDMA and CDMA Technologies. It also supports IEEE 802.11 a/b/g/n/ac, Bluetooth®, GPS and NFC. 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:	*Bluetooth*		
Power Supply Requirement:	Nominal	3.8 VDC	
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:	12.0 dBm		
Antenna Gain:	-1.8 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:	Apple
Brand Name:	Test Laptop
Model Name or Number:	MacBook Pro
Serial Number:	C2QH700QDY20

Description:	USB Power Adapter
Brand Name:	Apple
Model Name or Number:	A1357
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 on bottom, middle and top channels in Basic Rate (DH5 packets) or EDR (2DH5 or 3DH5 packets)
- Continuously transmitting whilst hopping across all channels in Basic Rate (DH5 packets) or EDR (2DH5 or 3DH5 packets)

4.2. Configuration and Peripherals

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

- A test laptop with a third party test application was provided by the customer and was used to place the EUT into *Bluetooth* test mode. The application was used to enable continuous transmission in different modes, set transmit power settings and change channels as required.
- The EUT was powered by a bench DC power supply whilst being connected to the test laptop via a USB diagnostic cable for all conducted tests.
- 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.
- The customer supplied instructions to control the EUT in a document titled “AA1500_BT_ePA_Hopping_V2.0.docx” dated 27-06-16 which is stored on the company server.
- The EUT was placed in three orthogonal orientations X, Y and Z to determine the worst case orientation for radiated spurious emissions. The worst case orientation was Z.
- The worst-case radiated emission among all accessories is determined by the manufacturer to be with the headset connected. The compliance lab performed final testing only with the headset

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:	Sandeep Bharat	**Test Date:**	08 June 2016
Test Sample Serial Number:	C7CRG02QH6DH		

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

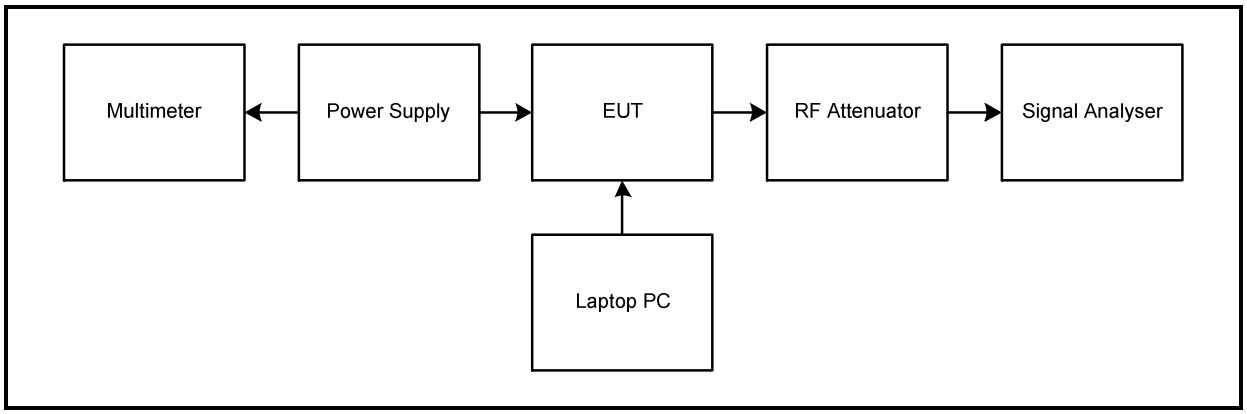
Environmental Conditions:

Temperature (℃):	25
Relative Humidity (%):	44

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.

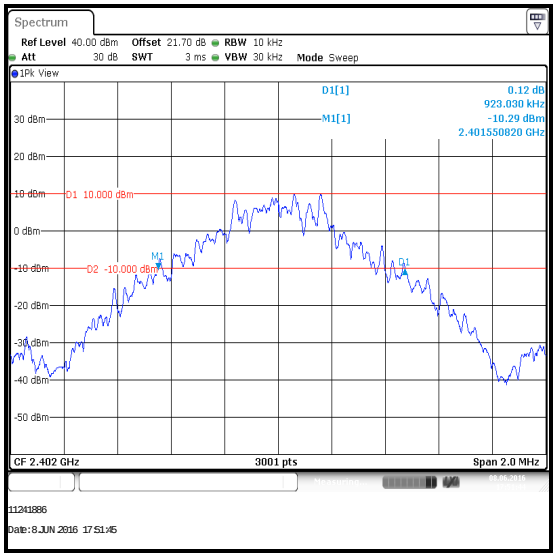
Test setup:



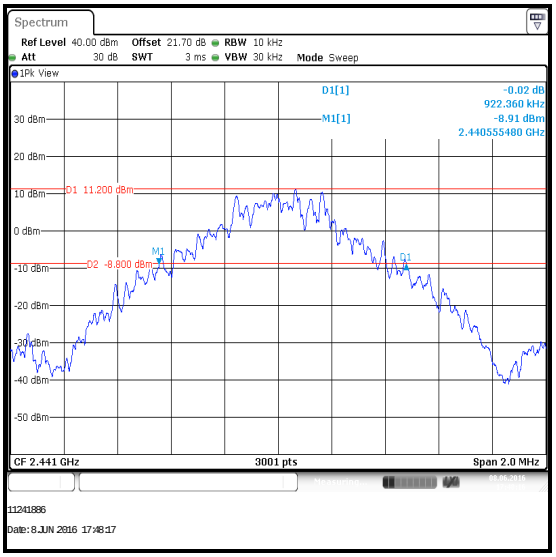
Transmitter 20 dB Bandwidth (continued)

Results: DH5

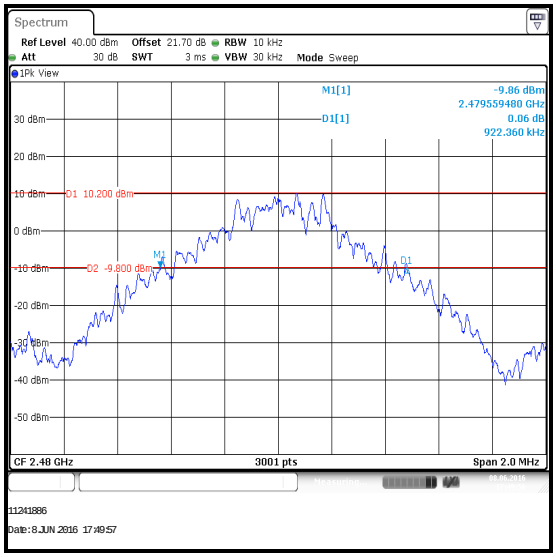
Channel	20 dB Bandwidth (kHz)
Bottom	923.030
Middle	922.360
Top	922.360



Bottom Channel



Middle Channel

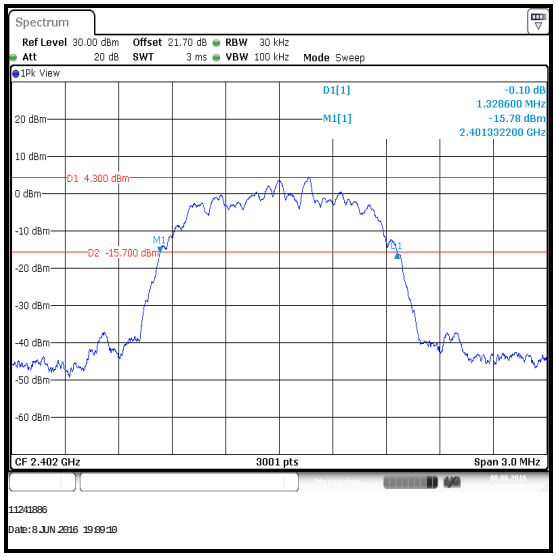


Top Channel

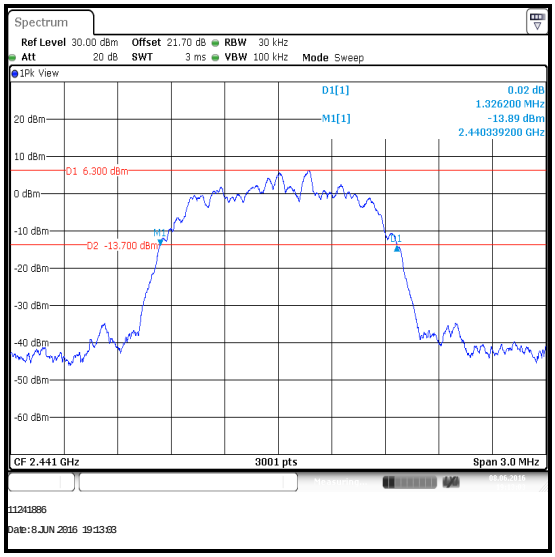
Transmitter 20 dB Bandwidth (continued)

Results: 2DH5

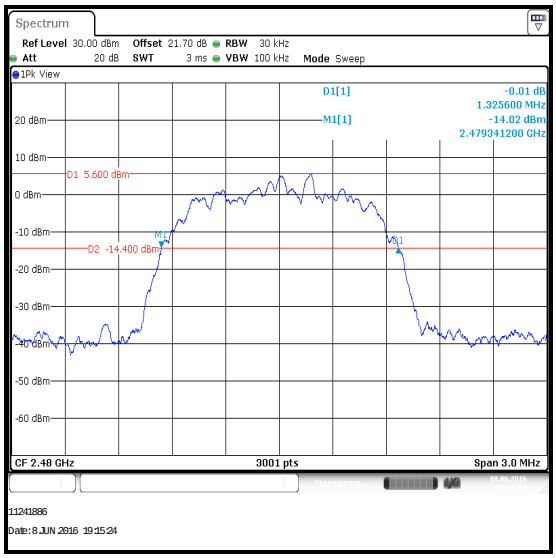
Channel	20 dB Bandwidth (kHz)
Bottom	1328.600
Middle	1326.200
Top	1325.600



Bottom Channel



Middle Channel

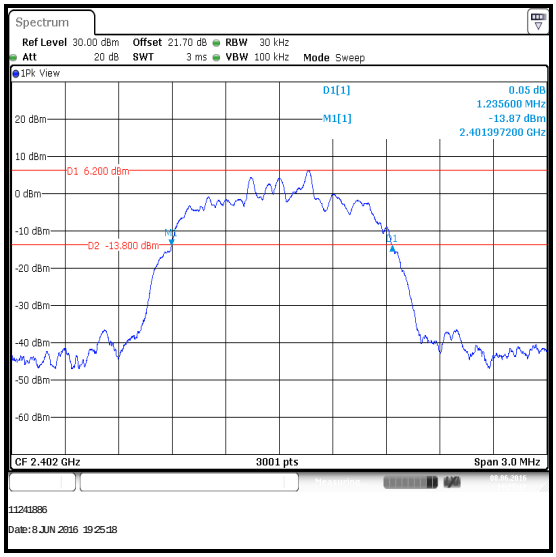


Top Channel

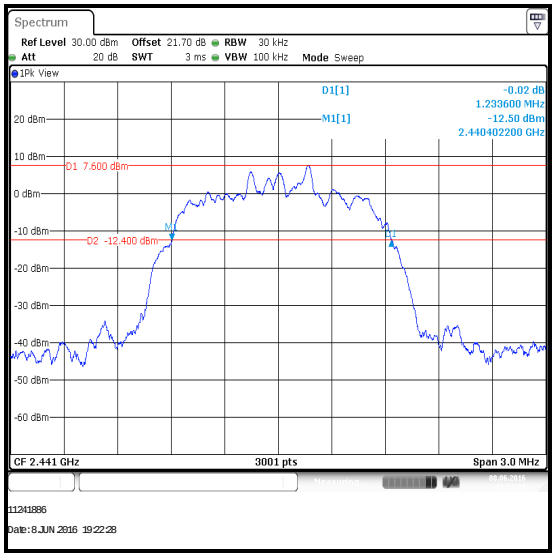
Transmitter 20 dB Bandwidth (continued)

Results: 3DH5

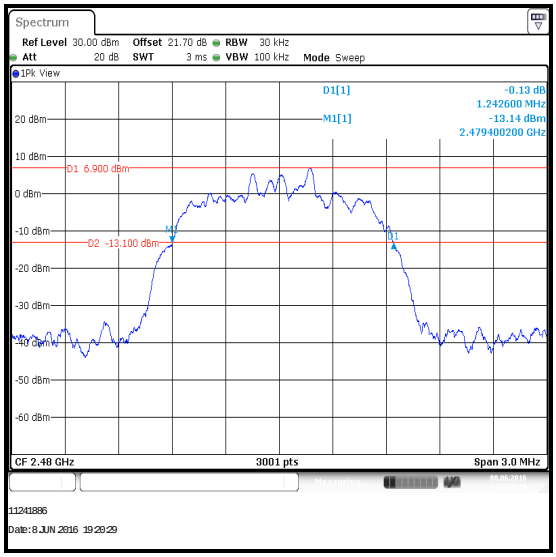
Channel	20 dB Bandwidth (kHz)
Bottom	1235.600
Middle	1233.600
Top	1242.600



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)
M2001	Thermohygrometer	Testo	608-H1	45041824	02 Apr 2017	12
M1883	Signal Analyser	Rohde & Schwarz	FSV30	103084	09 May 2017	12
A1999	Attenuator	Huber & Suhner	6820.17.B	07101	Calibrated before use	-
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	10 May 2019	36
S0576	DC Power Supply	Thurlby Thandar	PL330QMD	066701	Calibrated before use	-
M122	Digital Multimeter	Fluke	77	64910017	21 Apr 2017	12

5.2.2. Transmitter Carrier Frequency Separation

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Date:**	08 June 2016
Test Sample Serial Number:	C7CRG02QH6DH		

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

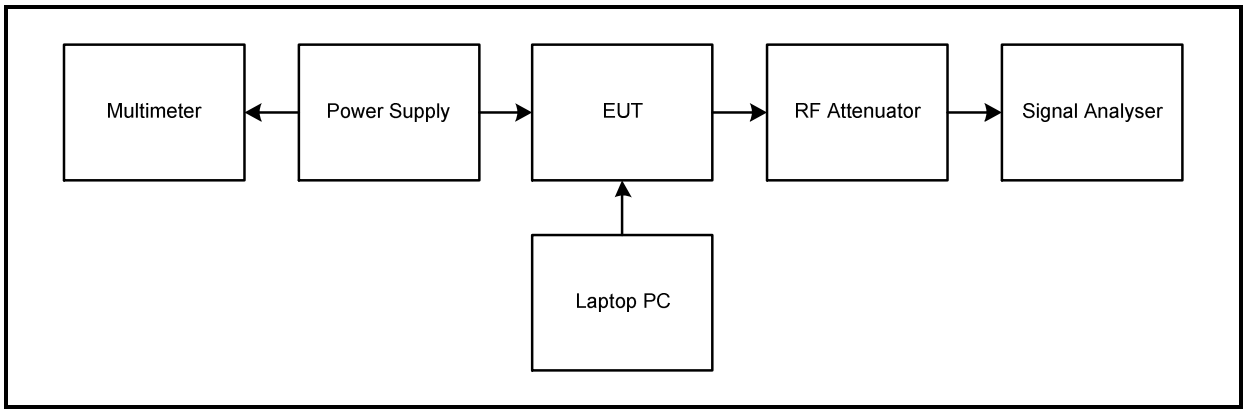
Environmental Conditions:

Temperature (℃):	25
Relative Humidity (%):	44

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.

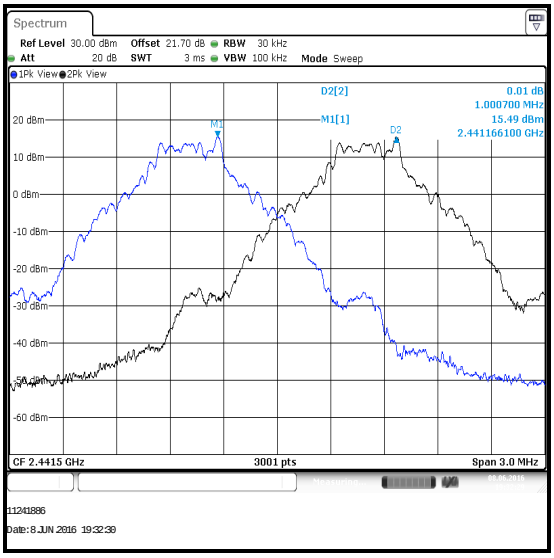
Test setup:



Transmitter Carrier Frequency Separation (continued)

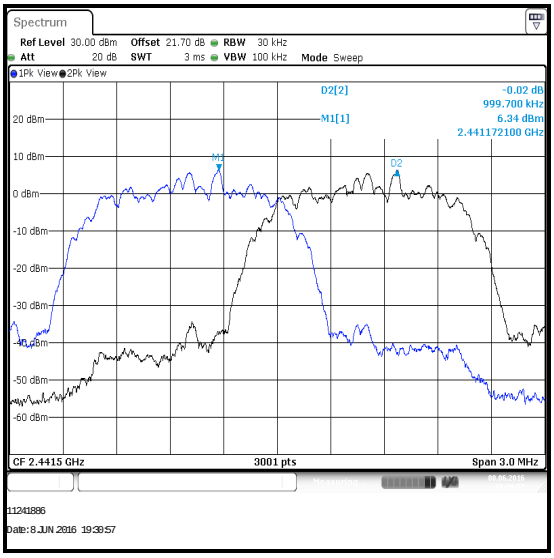
Results: DH5

Carrier Frequency Separation (kHz)	Limit ($^2/_3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
1000.700	614.907	385.793	Complied



Results: 2DH5

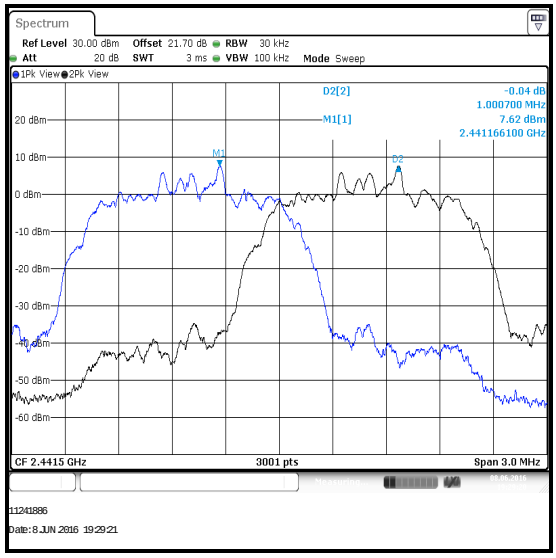
Carrier Frequency Separation (kHz)	Limit ($^2/_3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
999.700	884.133	115.567	Complied



Transmitter Carrier Frequency Separation (continued)

Results: 3DH5

Carrier Frequency Separation (kHz)	Limit ($^2/_3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
1000.700	822.400	178.300	Complied



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2001	Thermohygrometer	Testo	608-H1	45041824	02 Apr 2017	12
M1883	Signal Analyser	Rohde & Schwarz	FSV30	103084	09 May 2017	12
A1999	Attenuator	Huber & Suhner	6820.17.B	07101	Calibrated before use	-
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	10 May 2019	36
S0576	DC Power Supply	Thurlby Thandar	PL330QMD	066701	Calibrated before use	-
M122	Digital Multimeter	Fluke	77	64910017	21 Apr 2017	12

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

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Dates:**	08 June 2016 to 27 June 2016
Test Sample Serial Number:	C7CRG02QH6DH		

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

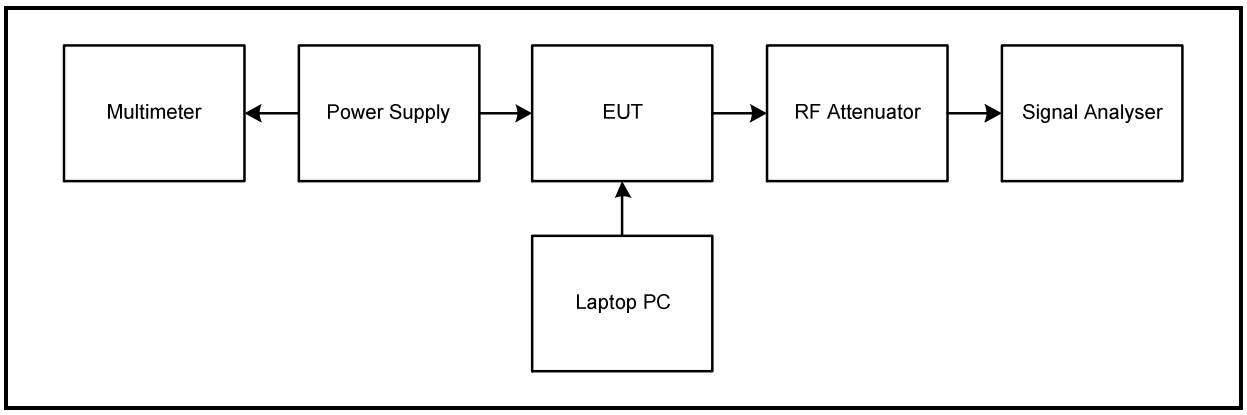
Environmental Conditions:

Temperature (℃):	23 to 25
Relative Humidity (%):	44 to 48

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 500 kHz and video bandwidth of 2 MHz. 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.

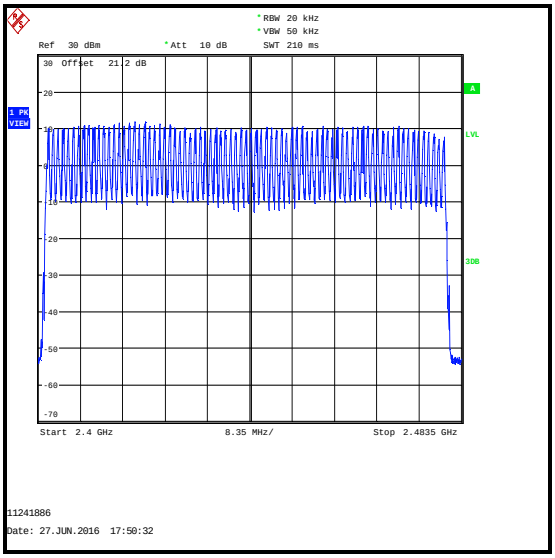
Test setup:



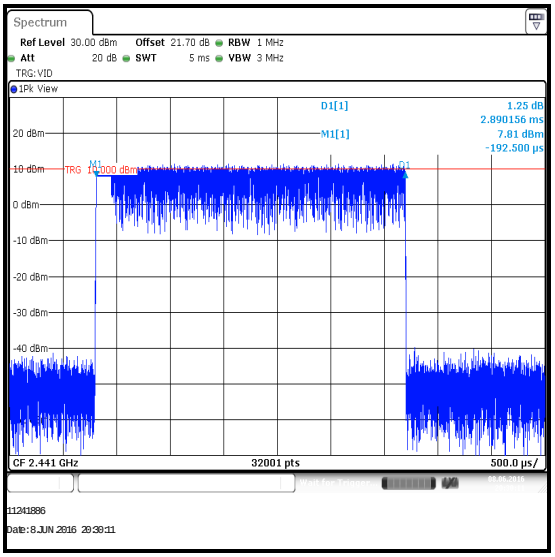
Transmitter Number of Hopping Frequencies and Average Time of Occupancy (continued)

Results:

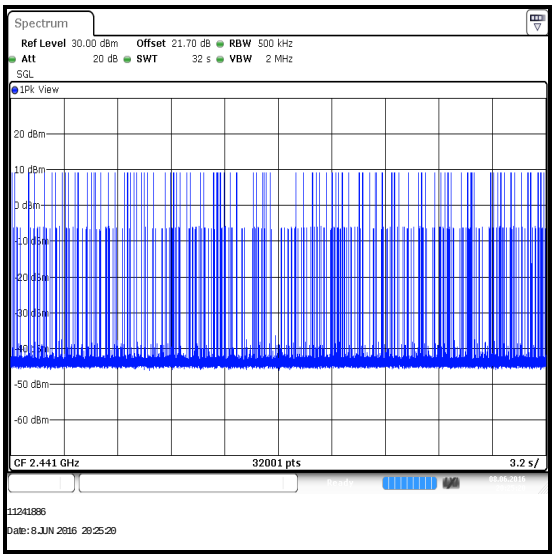
Emission Width (µs)	Number of Hops in 31.6 Seconds	Average Time of Occupancy (s)	Limit (s)	Margin (s)	Result
2890.156	94	0.272	0.4	0.128	Complied



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)
M2001	Thermohygrometer	Testo	608-H1	45041824	02 Apr 2017	12
M1883	Signal Analyser	Rohde & Schwarz	FSV30	103084	09 May 2017	12
A1999	Attenuator	Huber & Suhner	6820.17.B	07101	Calibrated before use	-
S0576	DC Power Supply	Thurlby Thandar	PL330QMD	066701	Calibrated before use	-
M122	Digital Multimeter	Fluke	77	64910017	21 Apr 2017	12
M2002	Thermohygrometer	Testo	608-H1	45041825	02 Apr 2017	12
S021	Power Supply Unit	Thurlby Thandar	CPX200	061034	Calibrated before use	-
M1642	Multimeter	Fluke	52II	18890119	25 Apr 2017	12
A2724	Directional Coupler	AAMCS	AAMCS-UDC-0.5G-18G-10dB-SF	000641	Calibrated before use	-
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	10 May 2019	36
A2521	Attenuator	AtlanTecRF	AN18-20	832797#2	Calibrated before use	-
M1794	Spectrum Analyser	Rohde & Schwarz	FSU26	100027	09 Feb 2018	24

5.2.4. Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Date:**	27 June 2016
Test Sample Serial Number:	C7CRR02BHCPX		

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

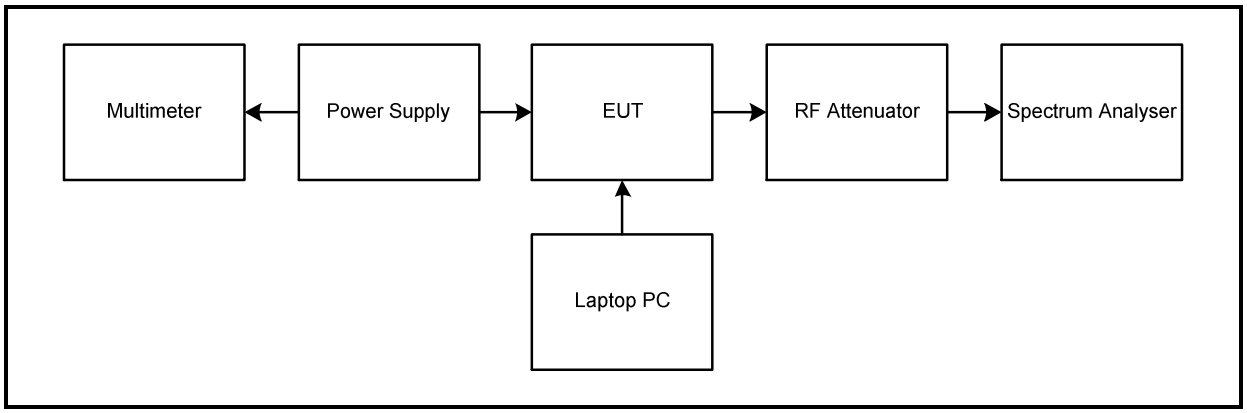
Environmental Conditions:

Temperature (℃):	23
Relative Humidity (%):	48

Note(s):

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

Test setup:



Transmitter Maximum Peak Output Power (continued)

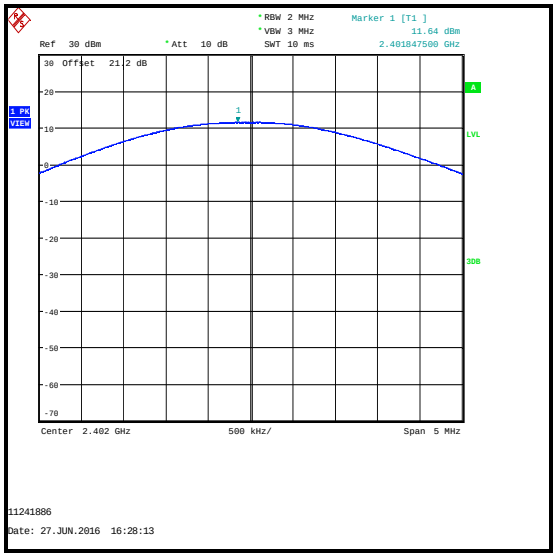
Results: DH5

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	11.6	30.0	18.4	Complied
Middle	11.6	30.0	18.4	Complied
Top	11.3	30.0	18.7	Complied

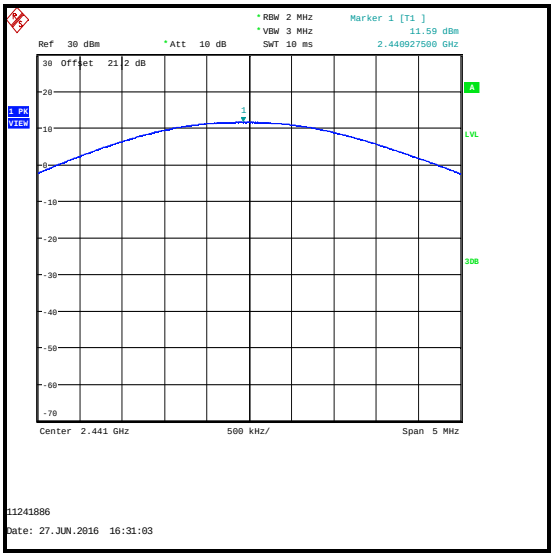
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.6	-1.8	9.8	36.0	26.2	Complied
Middle	11.6	-1.8	9.8	36.0	26.2	Complied
Top	11.3	-1.8	9.5	36.0	26.5	Complied

Transmitter Maximum Peak Output Power (continued)

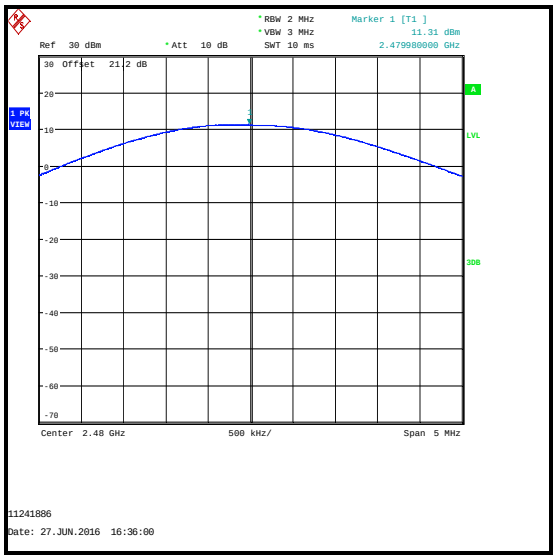
Results: DH5



Bottom Channel



Middle Channel



Top Channel

Transmitter Maximum Peak Output Power (continued)

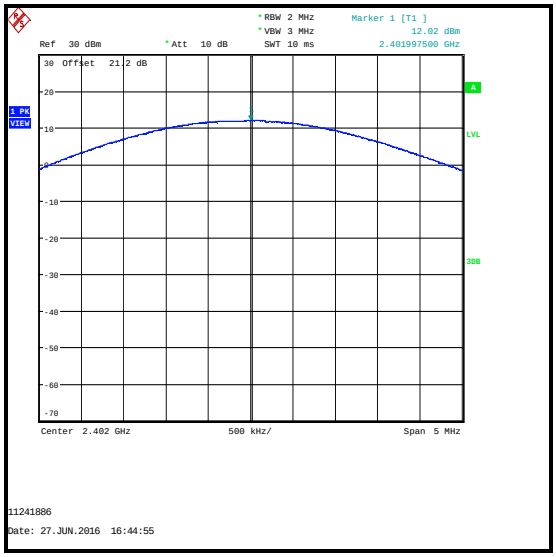
Results: 2DH5

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	12.0	21.0	9.0	Complied
Middle	12.0	21.0	9.0	Complied
Top	11.5	21.0	9.5	Complied

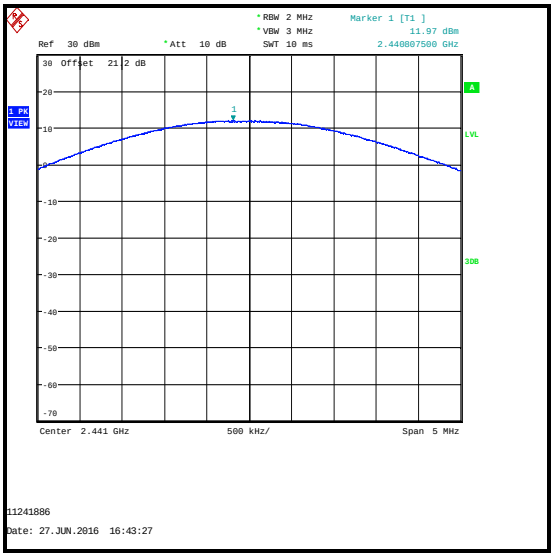
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	12.0	-1.8	10.2	27.0	16.8	Complied
Middle	12.0	-1.8	10.2	27.0	16.8	Complied
Top	11.5	-1.8	9.7	27.0	17.3	Complied

Transmitter Maximum Peak Output Power (continued)

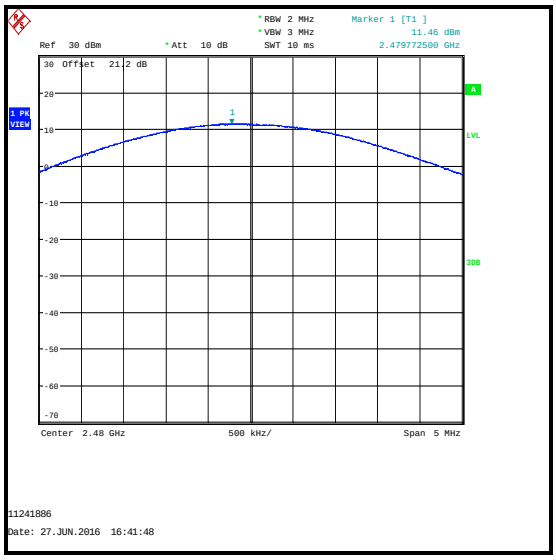
Results: 2DH5



Bottom Channel



Middle Channel



Top Channel

Transmitter Maximum Peak Output Power (continued)

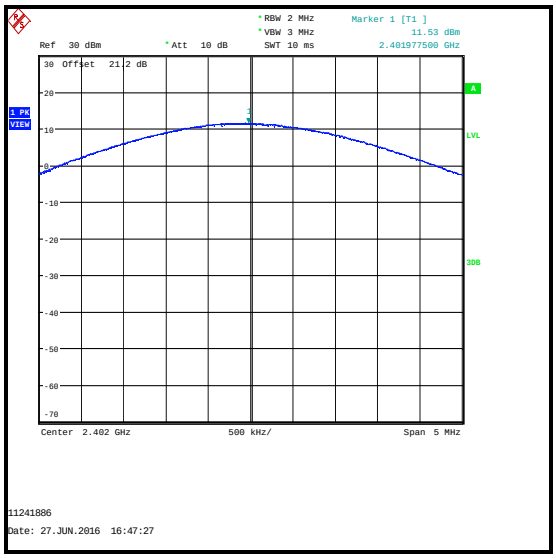
Results: 3DH5

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	11.5	21.0	9.5	Complied
Middle	11.3	21.0	9.7	Complied
Top	11.6	21.0	9.4	Complied

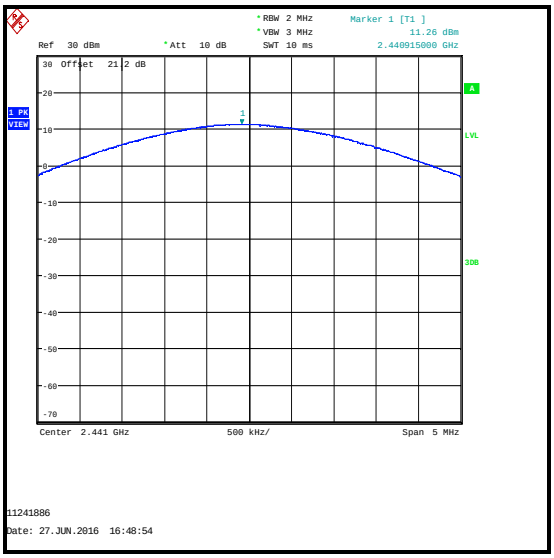
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.5	-1.8	9.7	27.0	17.3	Complied
Middle	11.3	-1.8	9.5	27.0	17.5	Complied
Top	11.6	-1.8	9.8	27.0	17.2	Complied

Transmitter Maximum Peak Output Power (continued)

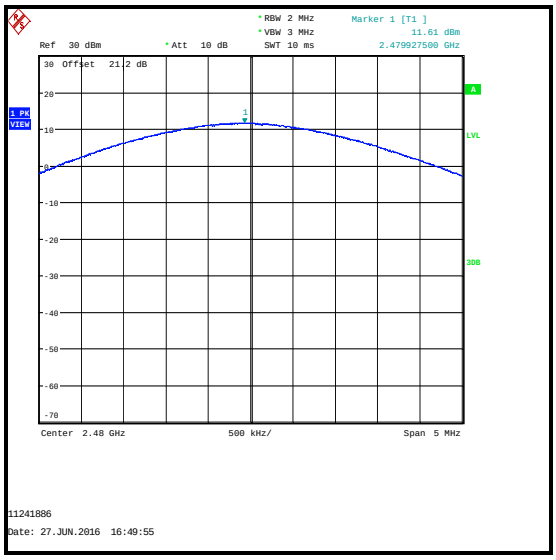
Results: 3DH5



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)
M2002	Thermohygrometer	Testo	608-H1	45041825	02 Apr 2017	12
S021	Power Supply Unit	Thurlby Thandar	CPX200	061034	Calibrated before use	-
M1642	Multimeter	Fluke	52II	18890119	25 Apr 2017	12
A2724	Directional Coupler	AAMCS	AAMCS-UDC-0.5G-18G-10dB-SF	000641	Calibrated before use	-
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	10 May 2019	36
A2521	Attenuator	AtlanTecRF	AN18-20	832797#2	Calibrated before use	-
M1794	Spectrum Analyser	Rohde & Schwarz	FSU26	100027	09 Feb 2018	24

5.2.5. Transmitter Radiated Emissions

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	17 June 2016
Test Sample Serial Number:	C7CRR00BHCPX		

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:

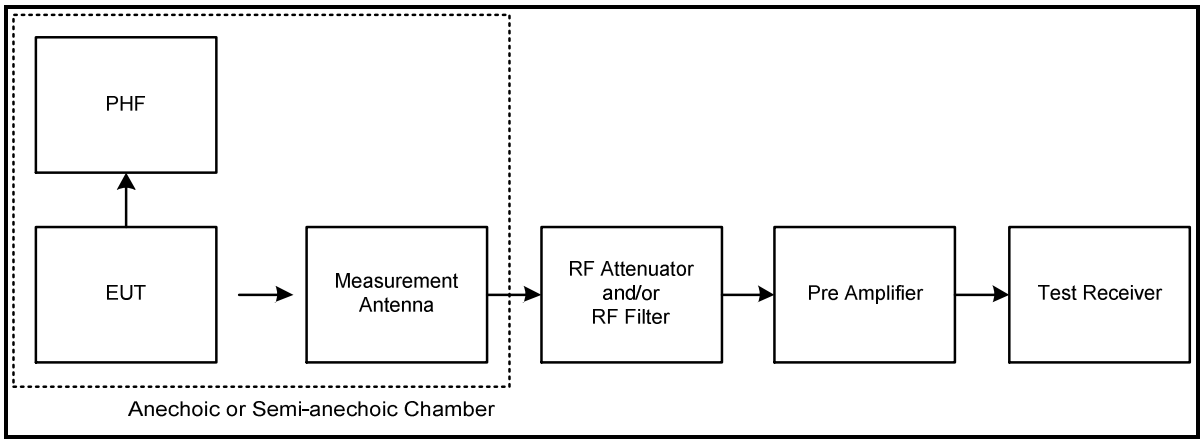
Temperature (℃):	27
Relative Humidity (%):	43

Note(s):

1. Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 2DH5 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. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak and average noise floor readings of the measuring receiver were recorded as shown in the tables below.
5. 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.
6. 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. The sweep time was set to auto. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
7. Final measurements were performed on the marker frequencies and the results entered into the table below. The test receiver resolution bandwidth was set to 120 kHz, using a CISPR quasi-peak detector and span big enough to see the whole emission.

Transmitter Radiated Emissions (continued)

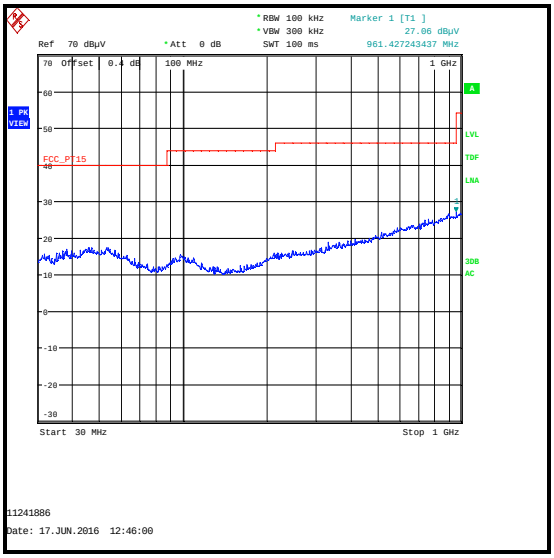
Test setup for radiated measurements:



Transmitter Radiated Emissions (continued)

Results: Quasi-Peak

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
961.427	Horizontal	27.1	47.0	19.9	Complied



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineers:	Nick Steele & David Doyle	**Test Dates:**	17 June 2016 to 18 June 2016
Test Sample Serial Number:	C7CRR00BHCPX		

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 (℃):	24 to 27
Relative Humidity (%):	42 to 43

Note(s):

1. Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 2DH5 mode as this was found to transmit the highest power and therefore deemed worst case.
2. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak and average noise floor readings of the measuring receiver were recorded as shown in the tables below.
3. The emission shown on the 1 GHz to 4 GHz plot is the EUT fundamental at 2441 MHz.
4. 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.
5. Measurements above 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 1.5 metres above the test chamber floor in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
6. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. The sweep time was set to auto. Peak and average measurements were performed with their own appropriate detectors during the pre-scan measurements.

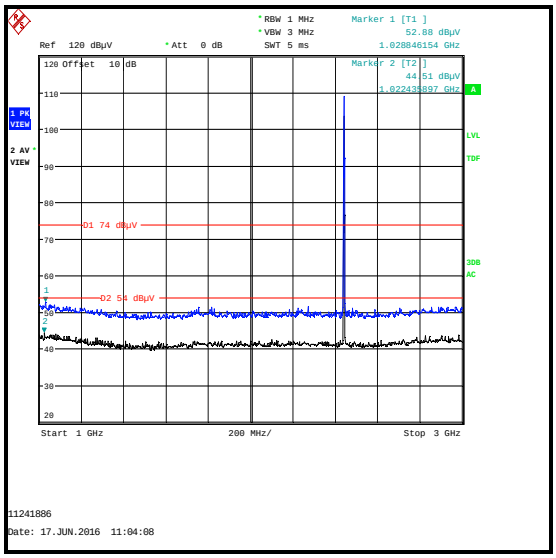
Results: Peak

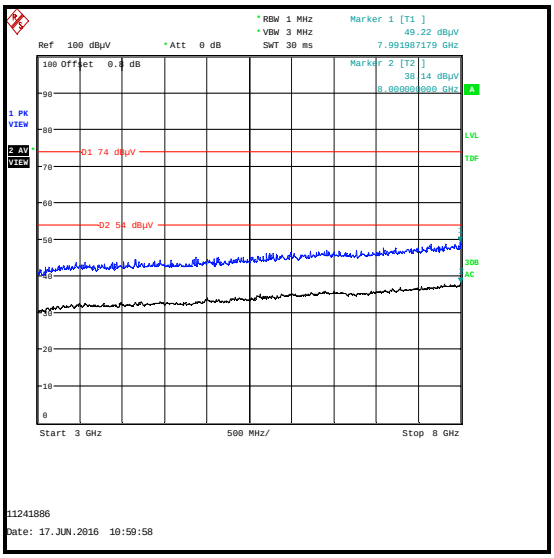
Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
17967.948	Horizontal	53.0	74.0	21.0	Complied

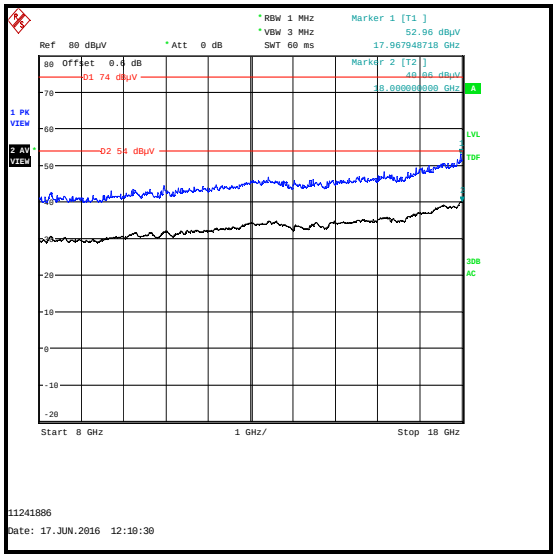
Results: Average

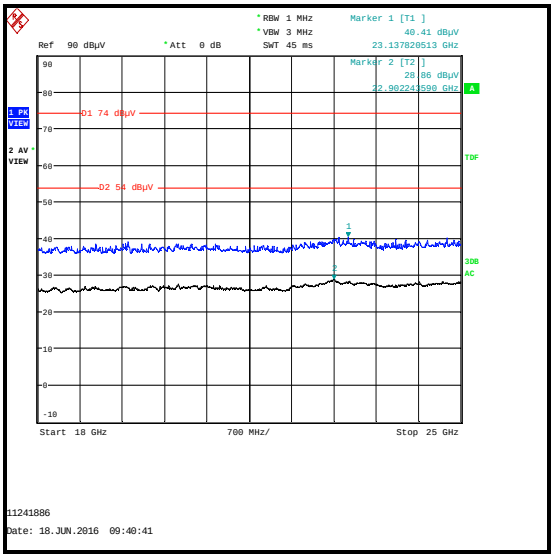
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
1022.439	Horizontal	44.5	54.0	9.5	Complied

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	JM Handelspunkt	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	19 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	07 Apr 2017	12
A2863	Pre Amplifier	Agilent	8449B	3008A02100	07 Jan 2017	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	06 May 2017	12
A2891	Pre Amplifier	Schwarzbeck	BBV 9718	9718-306	07 Apr 2017	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	07 Apr 2017	12
A2893	Pre Amplifier	Schwarzbeck	BBV 9721	9721-021	07 Apr 2017	12
S0582	Power Supply	Schwarzbeck	PS9721	00005	Calibrated before use	-
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	19 May 2017	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	19 May 2017	12
M1818	Multimeter	Fluke	79 Series II	71811580	27 Apr 2017	12

5.2.6. Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Dates:**	05 July 2016 to 06 July 2016
Test Sample Serial Number:	C7CRR00BHCPX		

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

Environmental Conditions:

Temperature (℃):	23 to 25
Relative Humidity (%):	42 to 50

Note(s):

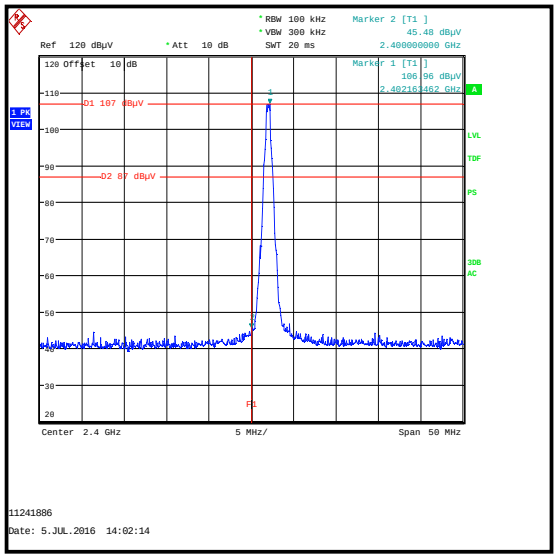
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The lower band edge falls within a non-restricted band. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, 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)

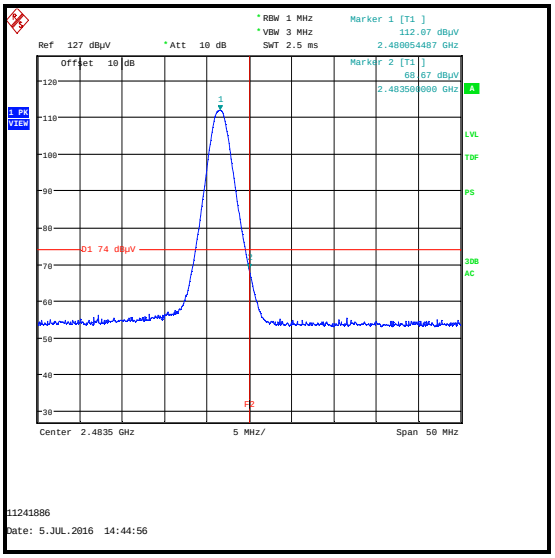
Results: Static Mode / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2400.0	Horizontal	45.5	87.0*	41.5	Complied
2483.5	Horizontal	68.7	74.0	5.3	Complied

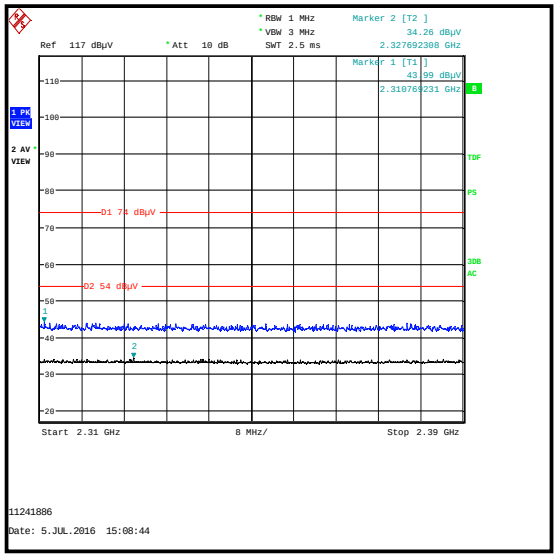
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Horizontal	49.4	54.0	4.6	Complied



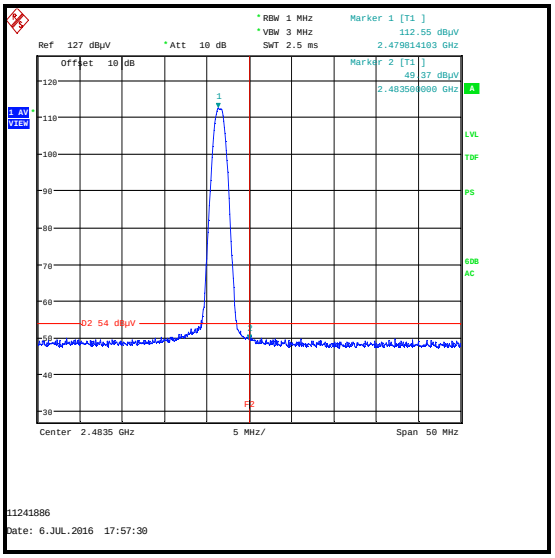
Lower Band Edge Peak Static



Upper Band Edge Peak Static



2310 MHz to 2390 MHz Restricted Band Plot



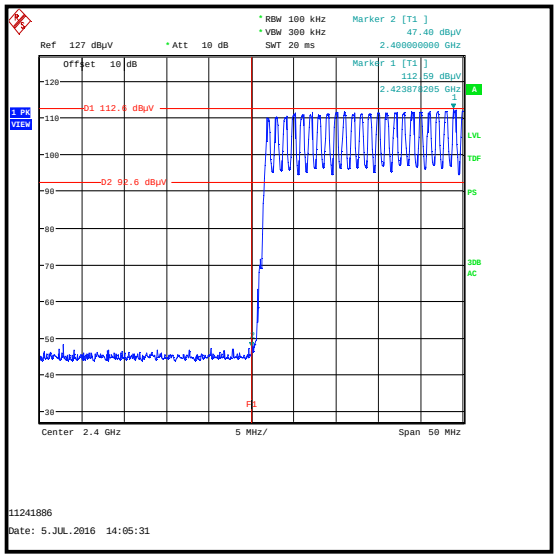
Upper Band Edge Average Static

Transmitter Band Edge Radiated Emissions (continued)

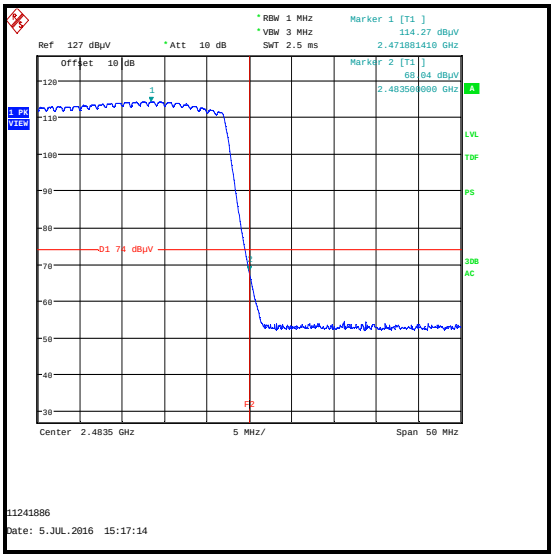
Results: Hopping Mode / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2400.0	Horizontal	47.4	92.6	45.2	Complied
2483.5	Horizontal	68.0	74.0	6.0	Complied

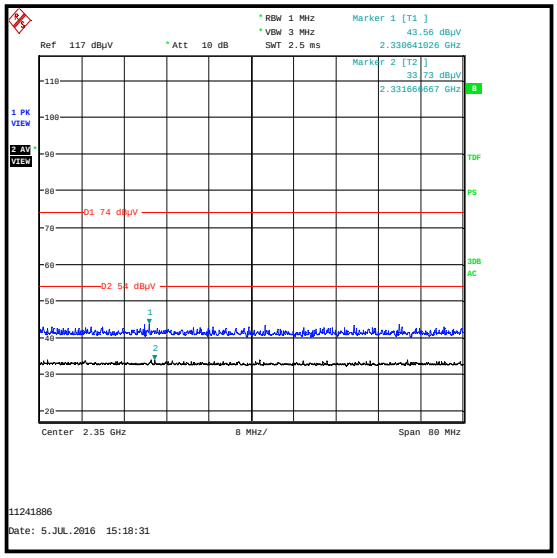
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Horizontal	48.0	54.0	6.0	Complied



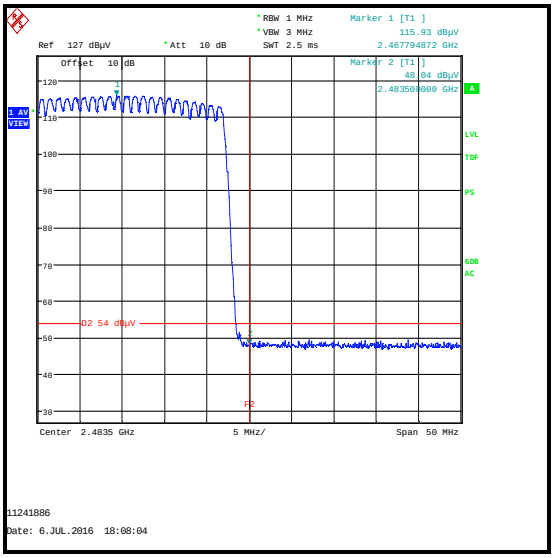
Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



2310 MHz to 2390 MHz Restricted Band Plot



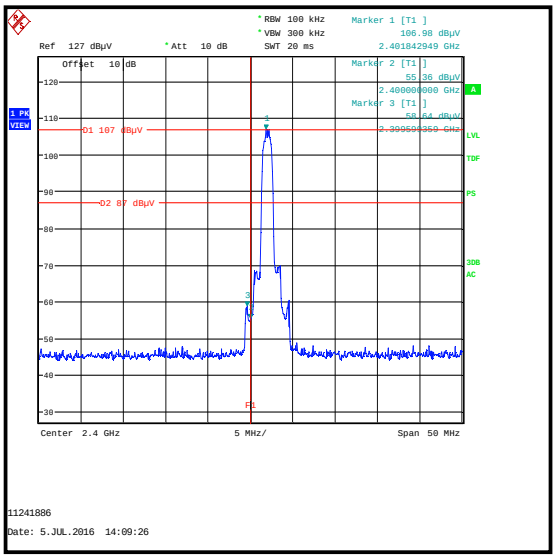
Upper Band Edge Average Hopping

Transmitter Band Edge Radiated Emissions (continued)

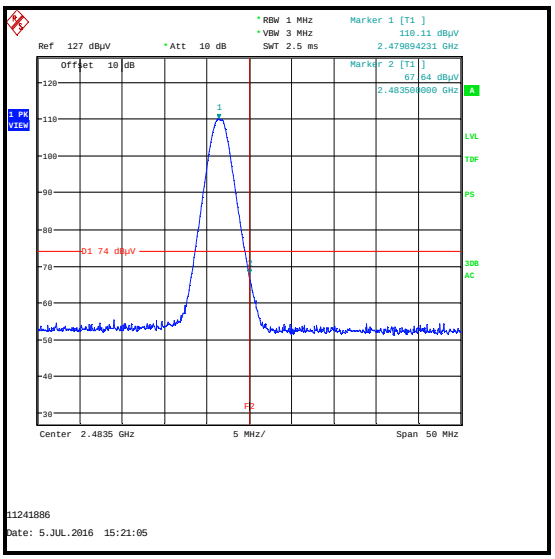
Results: Static Mode / 2DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2399.6	Horizontal	58.6	87.0*	28.4	Complied
2400.0	Horizontal	55.4	87.0*	31.6	Complied
2483.5	Horizontal	67.6	74.0	6.4	Complied

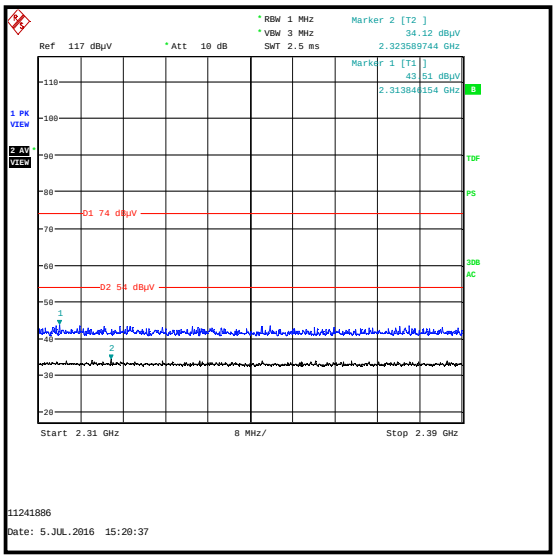
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Horizontal	49.5	54.0	4.5	Complied



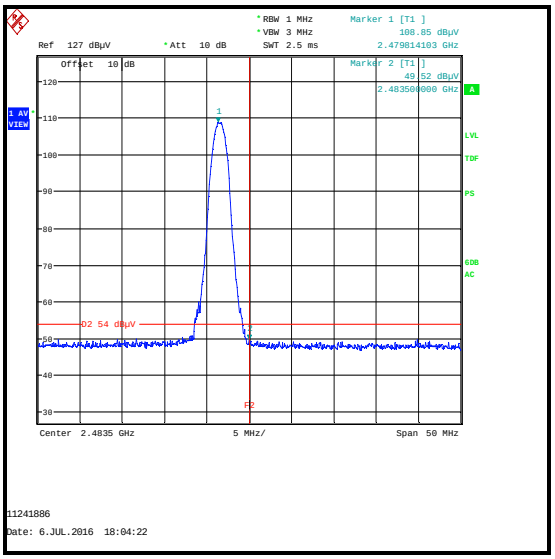
Lower Band Edge Peak Static



Upper Band Edge Peak Static



2310 MHz to 2390 MHz Restricted Band Plot



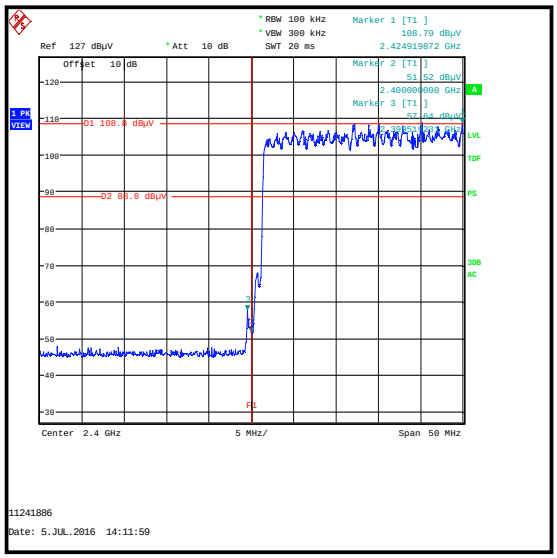
Upper Band Edge Average Static

Transmitter Band Edge Radiated Emissions (continued)

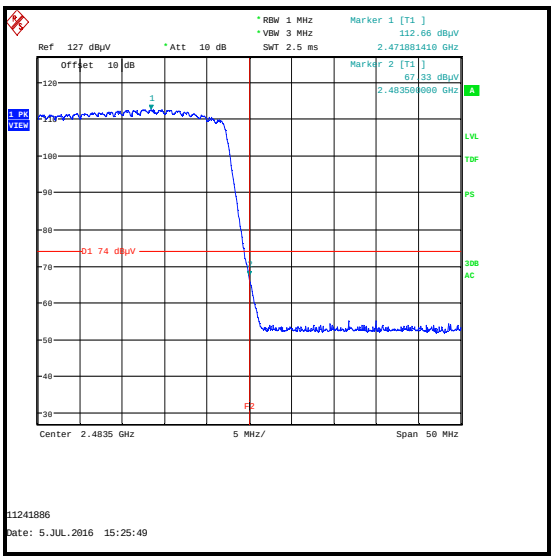
Results: Hopping Mode / 2DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2399.5	Horizontal	57.6	88.8*	31.2	Complied
2400.0	Horizontal	51.5	88.8*	37.3	Complied
2483.5	Horizontal	67.3	74.0	6.7	Complied

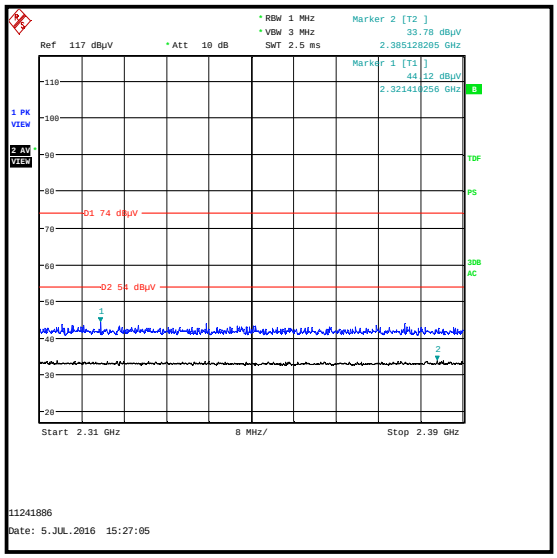
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Horizontal	48.0	54.0	6.0	Complied



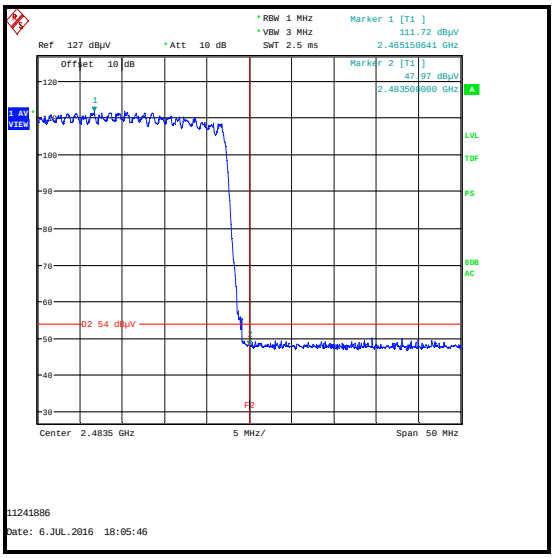
Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



2310 MHz to 2390 MHz Restricted Band Plot



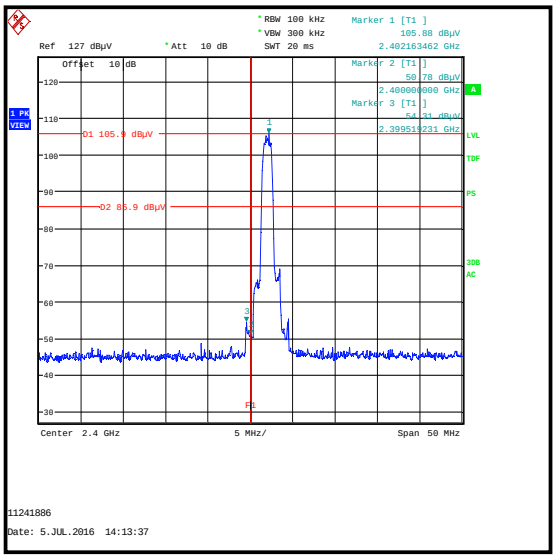
Upper Band Edge Average Hopping

Transmitter Band Edge Radiated Emissions (continued)

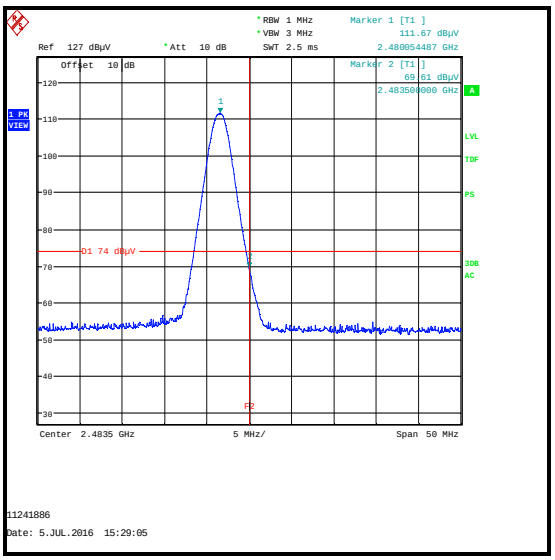
Results: Static Mode / 3DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2399.5	Horizontal	54.3	85.9*	31.6	Complied
2400.0	Horizontal	50.8	85.9*	35.1	Complied
2483.5	Horizontal	69.6	74.0	4.4	Complied

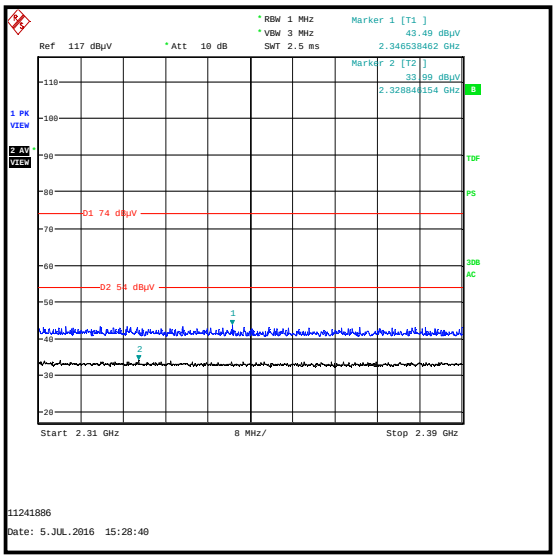
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Horizontal	49.4	54.0	4.6	Complied



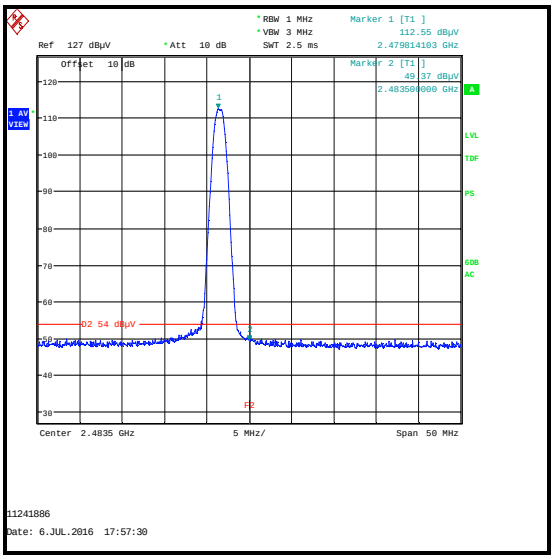
Lower Band Edge Peak Static



Upper Band Edge Peak Static



2310 MHz to 2390 MHz Restricted Band Plot



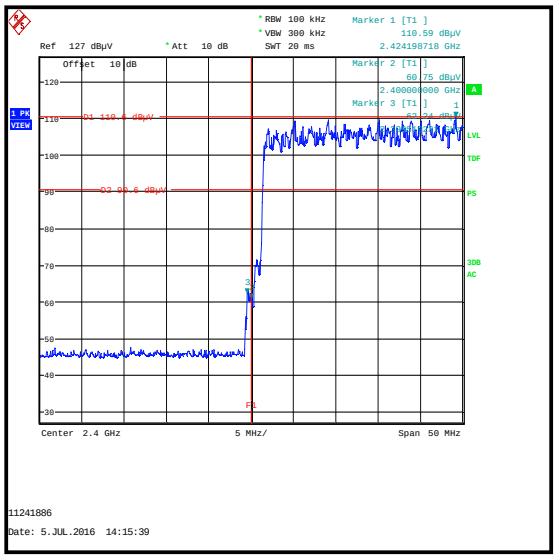
Upper Band Edge Average Static

Transmitter Band Edge Radiated Emissions (continued)

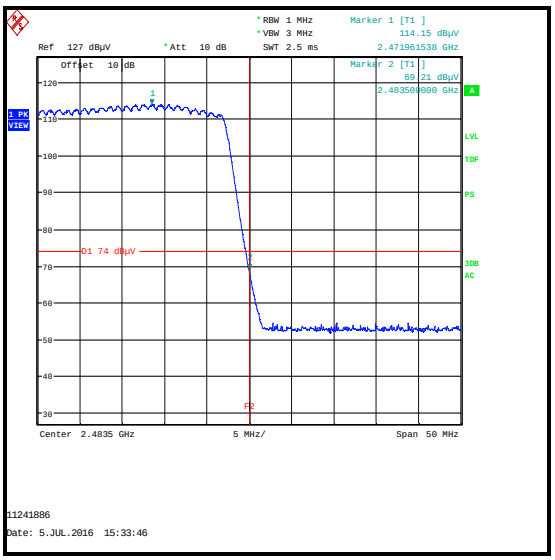
Results: Hopping Mode / 3DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2399.5	Horizontal	62.2	90.6*	28.4	Complied
2400.0	Horizontal	60.8	90.6*	29.8	Complied
2483.5	Horizontal	69.2	74.0	4.8	Complied

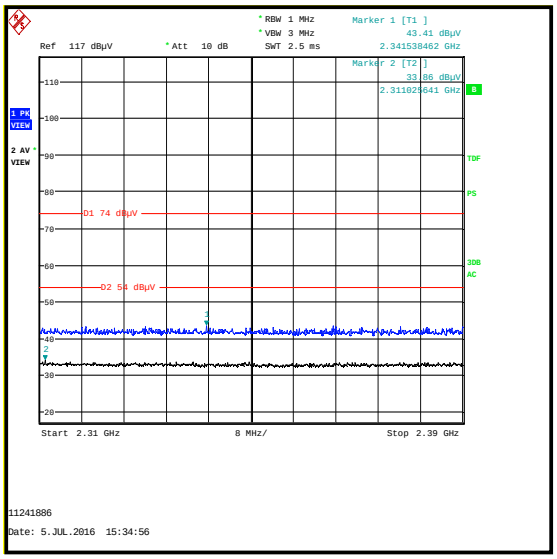
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Horizontal	50.7	54.0	3.3	Complied



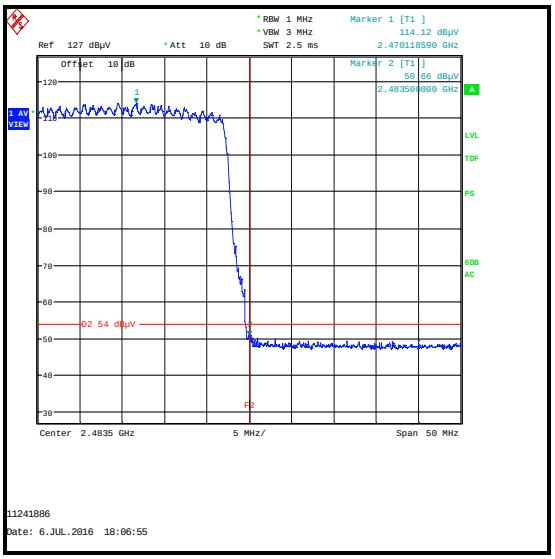
Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



2310 MHz to 2390 MHz Restricted Band Plot



Upper Band Edge Average Hopping

Transmitter Band Edge Radiated Emissions (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	02 Apr 2017	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	21 Dec 2016	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	19 Dec 2016	12
M1886	Test Receiver	Rohde & Schwarz	ESU26	100554	21 Mar 2017	12
A1818	Antenna	EMCO	3115	00075692	17 Dec 2016	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	26 Apr 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%	±3.52 %
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%	±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	-	-	Updates as requested by the TCB
3.0	-	-	Spurious emissions configuration details added to section 4.2

--- END OF REPORT ---