TEST REPORT

Test Report No. : UL-RPT-RP-11829235-1416-FCC

Applicant	:	Visteon Electronics Germany GmbH
Model No.	:	MFA2
FCC ID	:	2AA98-DBMFA2C5
Technology	:	*Bluetooth* – Basic Rate & EDR
Test Standard(s)	:	FCC Parts 15.209(a) & 15.247
		For details of applied tests refer to test result summary

1. This test report shall not be reproduced in full or partial, without the written approval of UL International Germany GmbH.
2. The results in this report apply only to the sample tested.
3. The test results in this report are traceable to the national or international standards.
4. Test Report Version 1.5 – Supersede Version 1.4
5. Result of the tested sample: **PASS**

Prepared by: Abdoufataou, Salifou
Title: Laboratory Engineer
Date: 22.01.2018

Approved by: Jakob, Reschke
Title: Test Engineer
Date: 25.05.2018

DAkkS Deutsche Akkreditierungsstelle D-PL-19381-02-00

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

UL INTERNATIONAL GERMANY GMBH
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STU.CTECHLab@ul.com

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1. Customer Information

1.1. Applicant Information

Company Name:	Visteon Electronics Germany GmbH
Company Address:	Visteonstrasse 4-10 50170 Kerpen Germany
Contact Person:	Dr.-Ing. Dennis Prill
Contact E-Mail Address:	dprill@visteon.com
Contact Phone No.:	+49 721 4766 1026

1.2. Manufacturer Information

Company Name:	Visteon Electronics Germany GmbH
Company Address:	Visteonstrasse 4-10 50170 Kerpen Germany
Contact Person:	Dr.-Ing. Dennis Prill
Contact E-Mail Address:	dprill@visteon.com
Contact Phone No.:	+49 721 4766 1026

2. Summary of Testing

2.1. General Information

Applied Standards

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) - Sections 15.207 and 15.209
Test Firm Registration:	399704

Location

Location of Testing:	UL International Germany GmbH Hedelfinger Str. 61 70327 Stuttgart Germany

Date information

Order Date:	21 June 2017
EUT arrived:	28 September 2017
Test Dates:	21 November 2017 to 18 January 2018
EUT returned:	-/-

2.2. Summary of Test Results

Clause	Measurement	Complied	Did not comply	Not performed	Not applicable
Part 15.207	Transmitter AC Conducted Emissions (1)	☐	☐	☐	☒
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	☒	☐	☐	☐

Note(s):

1. Device is an in car/vehicle device. No connection to AC mains. Due to this fact Part 15.207 (Transmitter AC conducted measurements) is not applicable.

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)

Sample Identification	Sample for all other measurements except spurious emission
Brand Name:	Visteon
Model Name or Number:	MFA2
Serial Number:	WAAY000385
Hardware Version Number:	VPJMKF-10849
Software Version Number:	12.3.7
FCC ID:	2AA98-DBMFA2C5

Sample Identification	Sample for Spurious emission measurement
Brand Name:	Visteon
Model Name or Number:	MFA2
Serial Number:	WAAZ000551
Hardware Version Number:	VPJMKF-10849
Software Version Number:	13.0.5
FCC ID:	2AA98-DBMFA2C5

3.2. Description of EUT

The equipment under test (EUT) was an infotainment system that supports Bluetooth and WLAN functionality for use within different vehicles. The Bluetooth functionality is the subject of this test report. The EUT has an external antenna as detailed above in section 3.5 below

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	13.5 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:	8.9 dBm		
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. Additional Antenna Information

Antenna Gain:	2.0 dBi
Antenna Type:	Patch-Antenna (external antenna)
Manufacturer	Rosenberger
Part Number	A 177 905 29 02

3.6. Support Equipment

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

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Laptop PC with software application CANoe 10.0	DELL	LATITUDE E5530	18X75S1
2	Power supply wires (Length 2 metres)	Not marked or stated	Not marked or stated	Not marked or stated
3	CAN Box	Vector Informatik GmbH	VN1630A CAN/LIN Interface	Not marked or stated
4	USB-Adapter	Not marked or stated	Not marked or stated	Not marked or stated
5	USB cable (Length 2 metres)	Not marked or stated	Not marked or stated	Not marked or stated
6	Laboratory Power Supply	Conrad Electronic Germany	PS -2403D	Not marked or stated
7	USB stick	Kingston	DTR3.0 G2	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) and EDR (2DH5 or 3DH5 packets) as required.
☒ Continuously transmitting at maximum power in hopping mode on all channels in Basic Rate (DH5 packets) and EDR (2DH5 or 3DH5 packets) as required.

4.2. Configuration and Peripherals

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

- The EUT was placed into *Bluetooth* test mode by using a canoe application on the laptop PC along with instructions provided by the customer. The document containing the configuration instruction was named “BluetoothTX test setup.pdf”. The customer had installed the application onto the EUT. Once in *Bluetooth* test mode, a link was established to a *Bluetooth* tester which was then used to control the EUT.
- 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.
- A conducted spurious emission was initially performed at the EUT antenna port.
- The cabinet radiated spurious emissions were performed with the EUT in normal position at the center of a table in 3 m Semi- Anechoic chamber at a distance of 3 m to receiving measurement antennas whilst the device in operation. The RF Port of the device was terminated with a 50 Ohms load for cabinet radiation and with antenna for the radiated band edge compliance.
- Transmitter radiated spurious emissions tests were performed with the EUT transmitting in DH5 mode as this mode was found to transmit the highest power.
- The settings of the channel and the data rates were controlled by the Bluetooth tester listed in section 7 of this report.
- The EUT was powered by 13.5 V DC power supply.
- The EMC32 V10.1.0 software was used for the measurement.

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 DAkkS 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:	Abdoufataou Salifou	**Test Date:**	21 November 2017
Test Sample Serial Number:	WAAY000385		
Test Site Identification	SR 9		

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

Environmental Conditions:

Temperature (°C):	23.1
Relative Humidity (%):	33

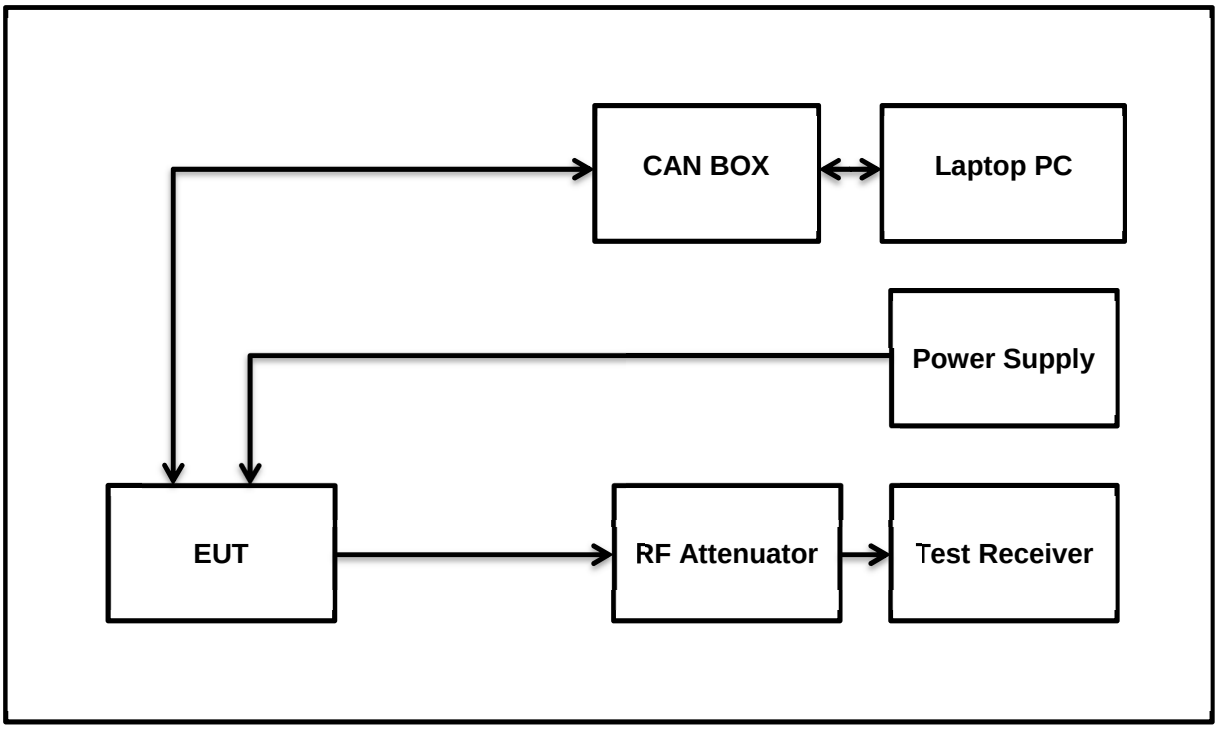
Settings of the Instrument

RBW/VBW	30 KHz / 100 KHz
Span	3 MHz
Sweep time	Auto
Detector	Peak

Note(s):

1. The test receiver resolution bandwidth was set to 30 kHz and video bandwidth 100 kHz. A Peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 3.0 MHz. 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 test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable.

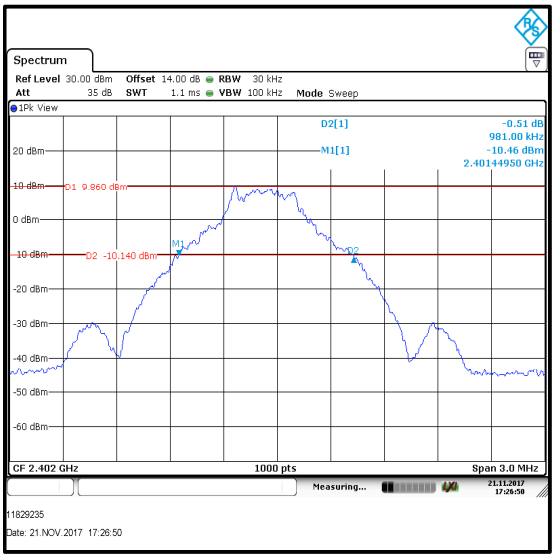
Transmitter 20 dB Bandwidth (continued)
Test Setup:



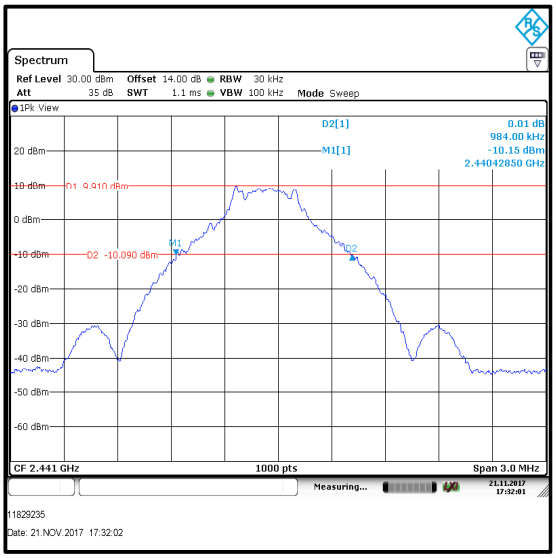
Transmitter 20 dB Bandwidth (continued)

Results DH5:

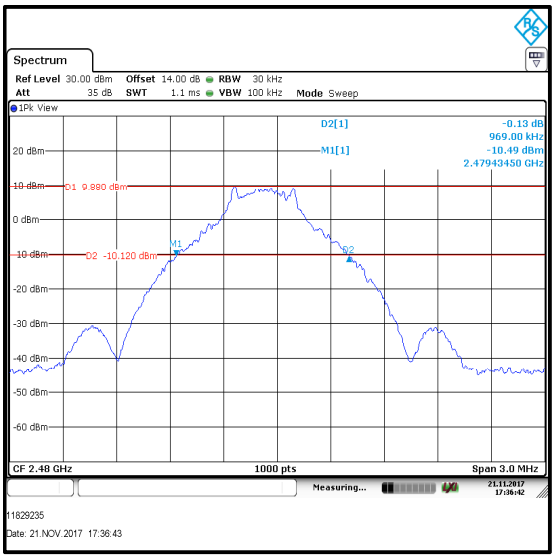
Channel	20 dB Bandwidth (kHz)
Bottom	981.000
Middle	984.000
Top	969.000



Bottom Channel



Middle Channel



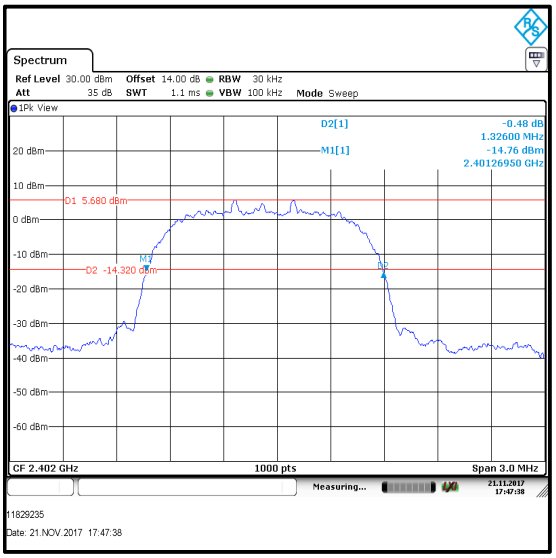
Top Channel

Result: Pass

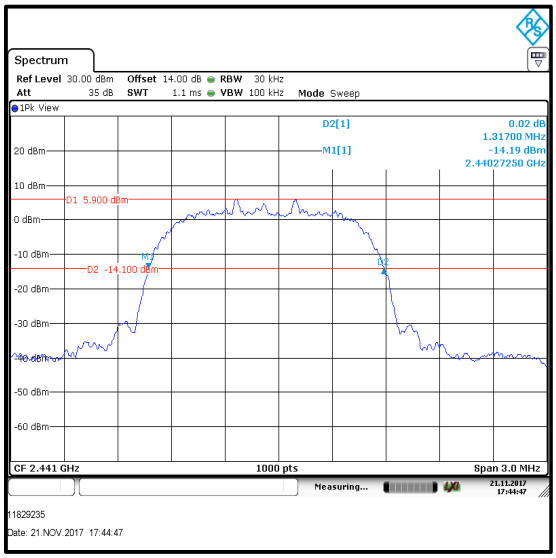
Transmitter 20 dB Bandwidth (continued)

Results 2DH5:

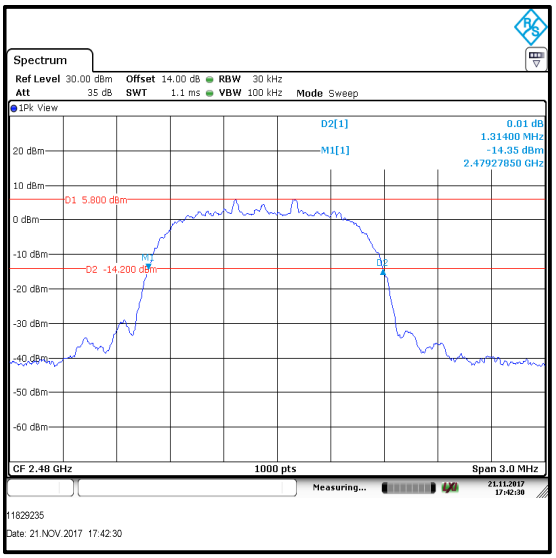
Channel	20 dB Bandwidth (kHz)
Bottom	1326.000
Middle	1317.000
Top	1314.000



Bottom Channel



Middle Channel



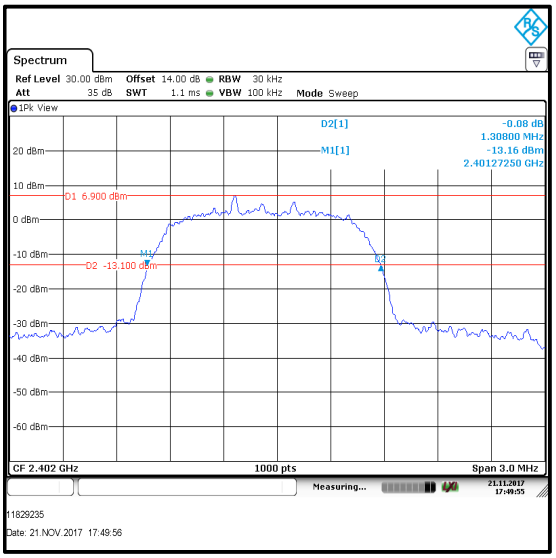
Top Channel

Result: Pass

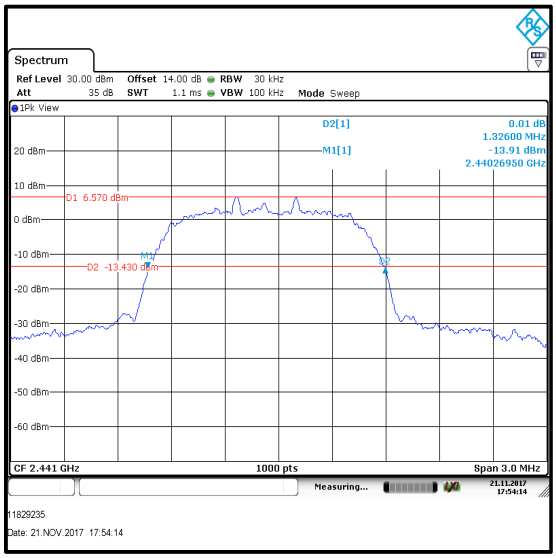
Transmitter 20 dB Bandwidth (continued)

Results 3DH5:

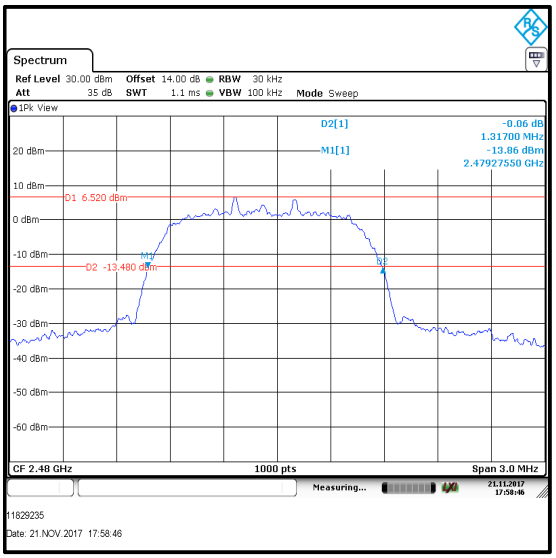
Channel	20 dB Bandwidth (kHz)
Bottom	1308.000
Middle	1326.000
Top	1317.000



Bottom Channel



Middle Channel



Top Channel

Result: Pass

5.2.2. Transmitter Carrier Frequency Separation

Test Summary:

Test Engineer:	Abdoufataou Salifou	**Test Date:**	21 November 2017
Test Sample Serial Number:	WAAY000385		
Test Site Identification	SR 9		

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

Environmental Conditions:

Temperature (°C):	23.1
Relative Humidity (%):	34

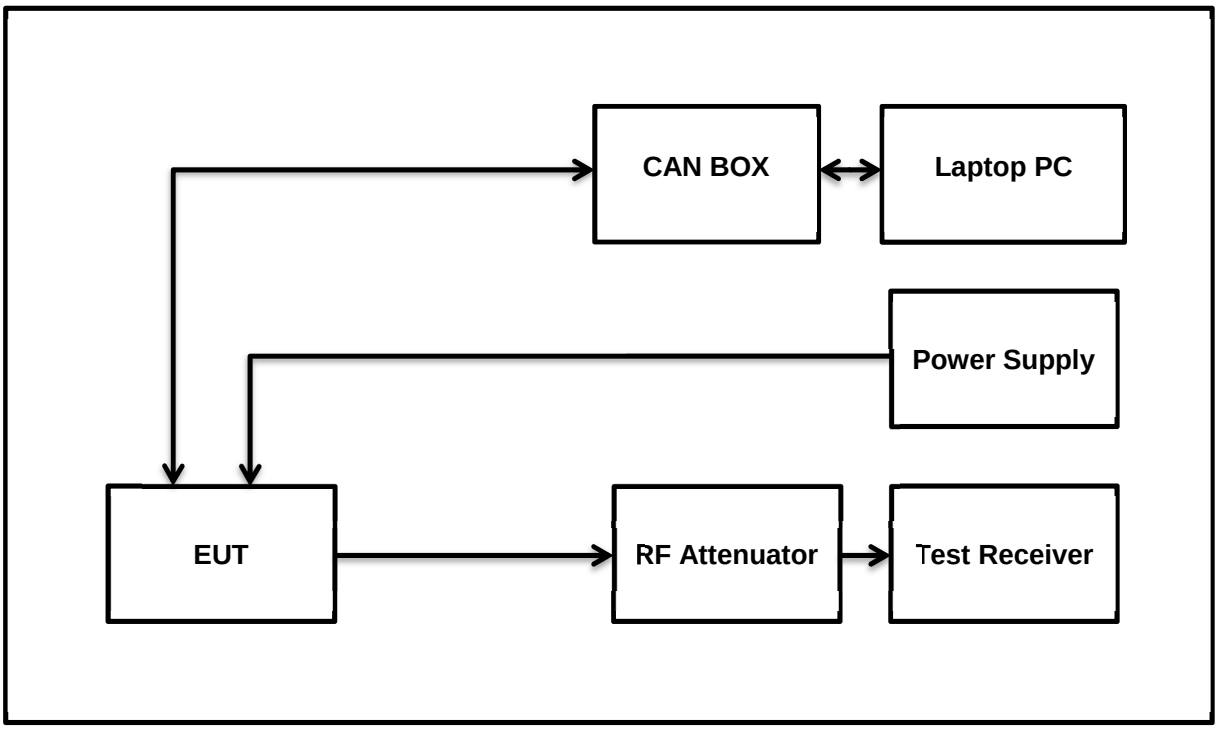
Settings of the Instrument

RBW/VBW	30 KHz / 100 KHz
Span	3 MHz
Sweep time	Auto
Detector	Peak

Note(s):

1. The 20 dB bandwidth measured for the middle channel operating at 2441 MHz was used to calculate the limit.
2. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable.

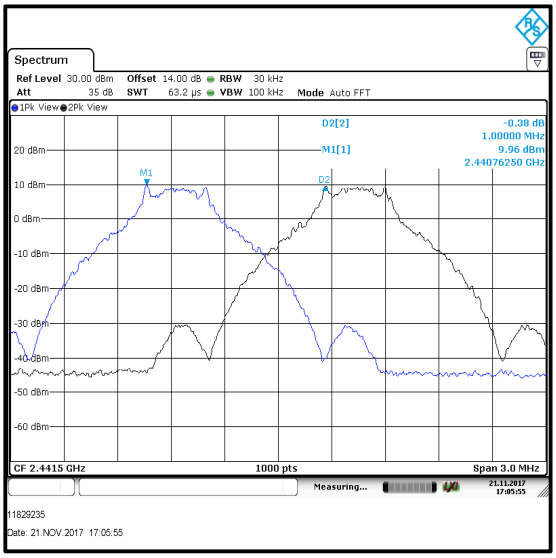
Test Setup:



Transmitter Carrier Frequency Separation (continued)

Results: DH5

Carrier Frequency Separation (kHz)	Limit ($^2/_3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
1000.000	656.000	344.000	Complied

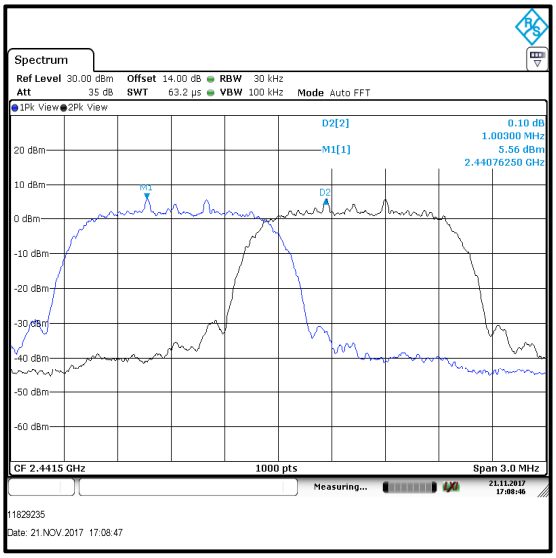


Result: Pass

Transmitter Carrier Frequency Separation (continued)

Results: 2DH5

Carrier Frequency Separation (kHz)	Limit ($^2/_3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
1003.000	878.000	125.000	Complied

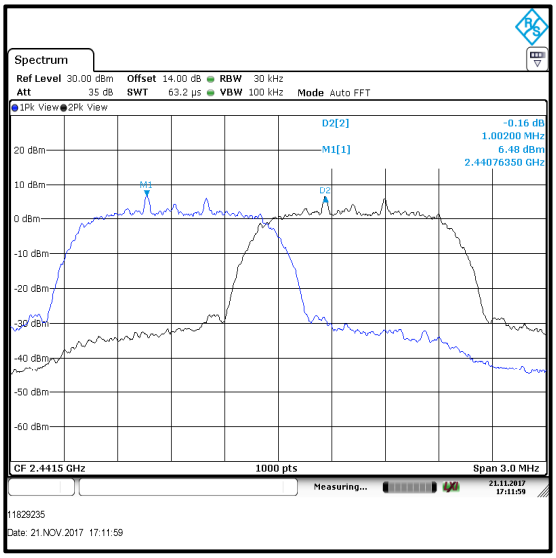


Result: Pass

Transmitter Carrier Frequency Separation (continued)

Results: 3DH5

Carrier Frequency Separation (kHz)	Limit ($^2/_3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
1002.000	884.000	118.000	Complied



Result: Pass

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

Test Summary:

Test Engineer:	Abdoufataou Salifou	**Test Date:**	22 November 2017
Test Sample Serial Number:	WAAY000385		
Test Site Identification	SR 9		

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

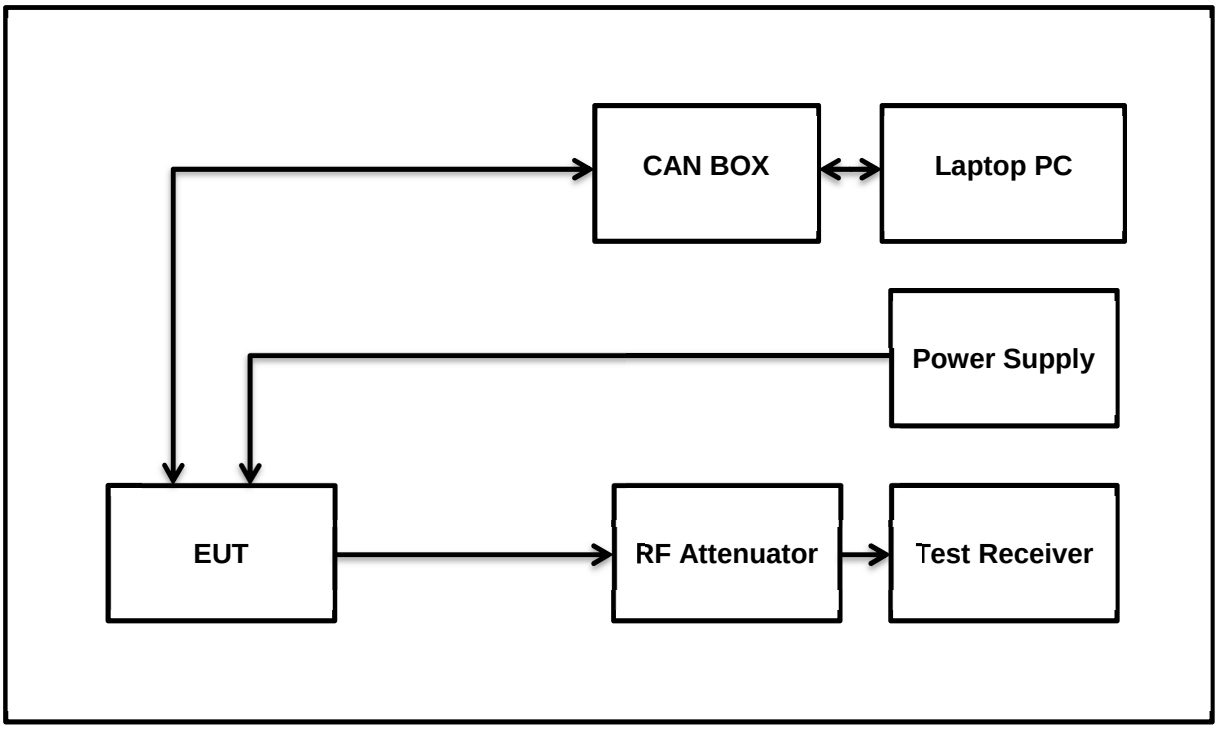
Environmental Conditions:

Temperature (°C):	22.5
Relative Humidity (%):	35

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 test receiver was set up for the Number of Hopping Frequencies measurement as follows: the resolution bandwidth was set to 300 kHz and video bandwidth of 1000 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 test receiver was set up for the Emission Width measurement as follows: the resolution bandwidth was set to 1000 kHz and video bandwidth of 3000 kHz. A peak detector was used and sweep time was set to auto with a span of zero Hz. The emission width is recorded in the table below
4. The test receiver 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.
5. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable.

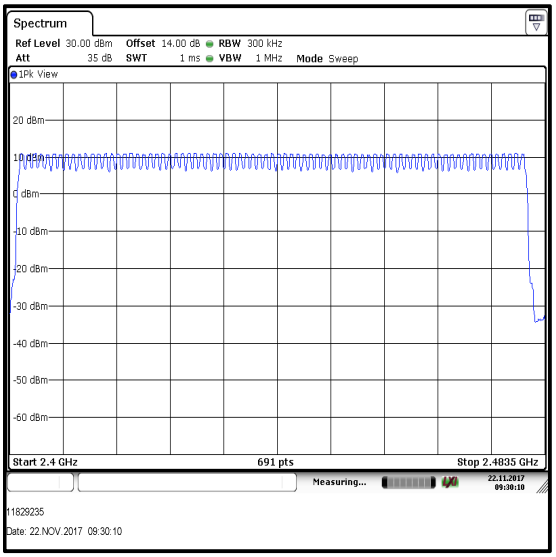
Transmitter Number of Hopping Frequencies and Average Time of Occupancy (continued)
Test Setup:



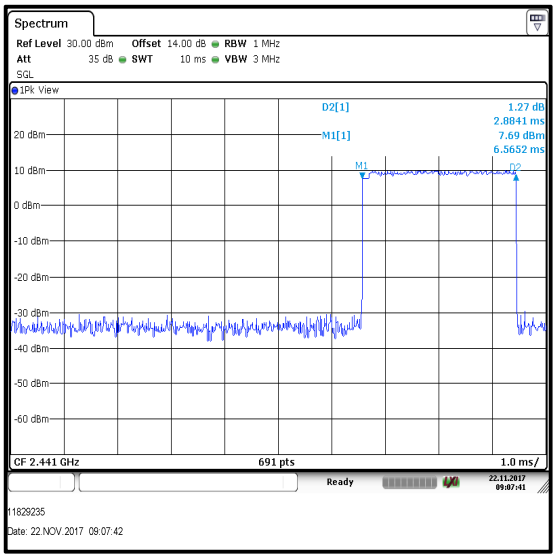
Transmitter Number of Hopping Frequencies and Average Time of Occupancy (continued)

Results:

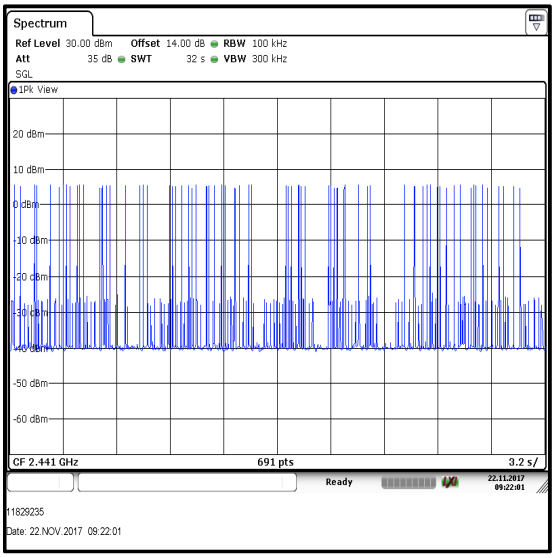
Emission Width (µs)	Number of Hops in 31.6 Seconds	Average Time of Occupancy (s)	Limit (s)	Margin (s)	Result
2884.1	79	0.228	0.4	0.172	Complied



Number of Hopping Frequencies



Emission Width



Number of Hopping Frequencies in 32 s

Result: Pass

5.2.4. Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	Abdoufataou Salifou	**Test Date:**	22 November 2017
Test Sample Serial Number:	WAAY000385		
Test Site Identification	SR 9		

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

Environmental Conditions:

Temperature (°C):	22.0
Relative Humidity (%):	34

Settings of the Instrument

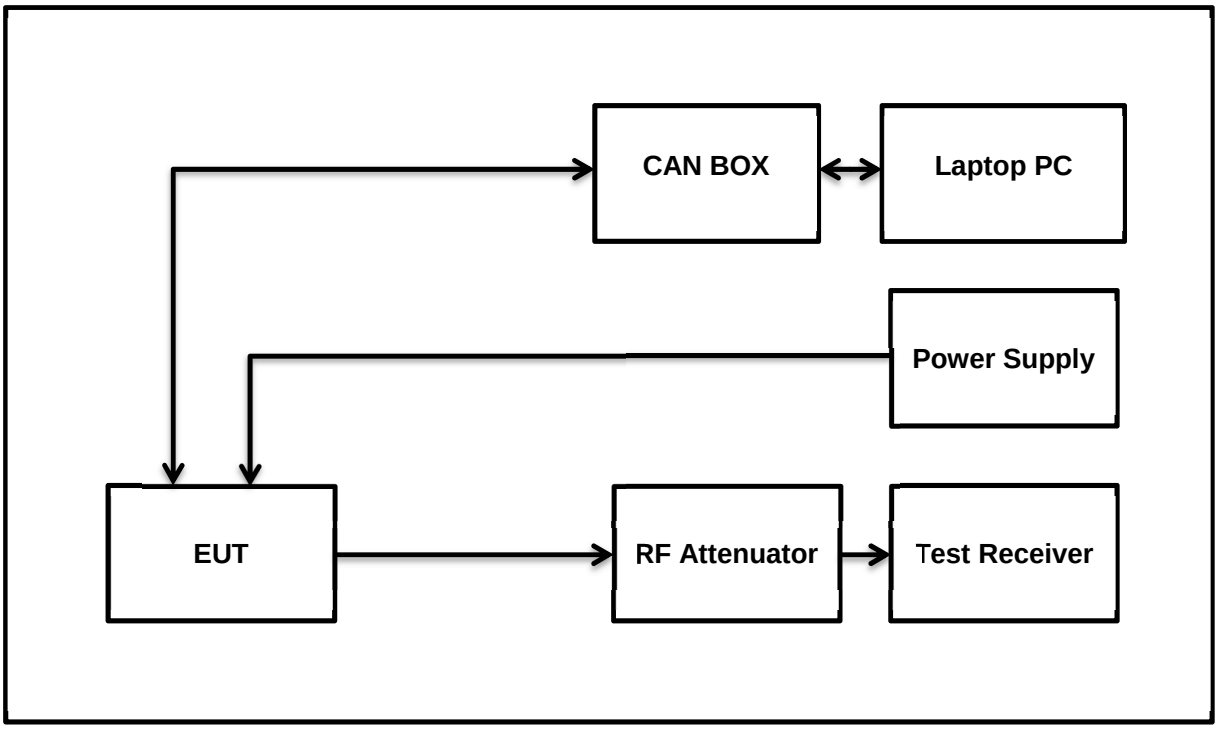
RBW/VBW	2 MHz / 5 MHz
Span	5 MHz
Sweep time	Auto
Detector	Peak

Note(s):

1. These tests were performed conducted as the EUT has an antenna port. Hence the measurement was done at this port.
2. The test receiver resolution bandwidth was set to 2 MHz (20 dB bandwidth) and video bandwidth of 5.0 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.
3. The declared antenna gain was added to the conducted peak power to obtain the EIRP.
4. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF offset level was entered on the test receiver to compensate for the loss of the attenuator and RF cable.

Transmitter Maximum Peak Output Power (continued)

Test Setup:



Transmitter Maximum Peak Output Power (continued)

Results: DH5

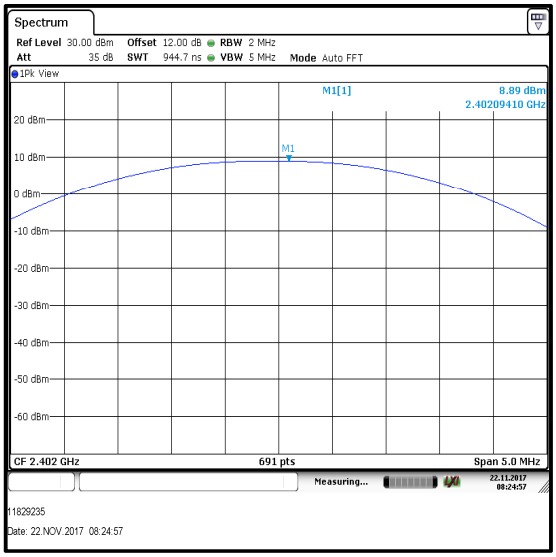
Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	8.9	30.0	21.1	Complied
Middle	8.8	30.0	21.2	Complied
Top	8.8	30.0	21.2	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	8.9	2.0	10.9	36.0	25.1	Complied
Middle	8.8	2.0	10.8	36.0	25.2	Complied
Top	8.8	2.0	10.8	36.0	25.2	Complied

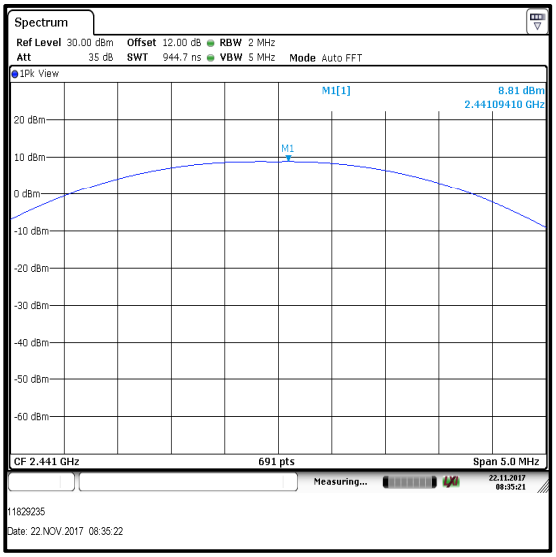
Result: Pass

Transmitter Maximum Peak Output Power (continued)

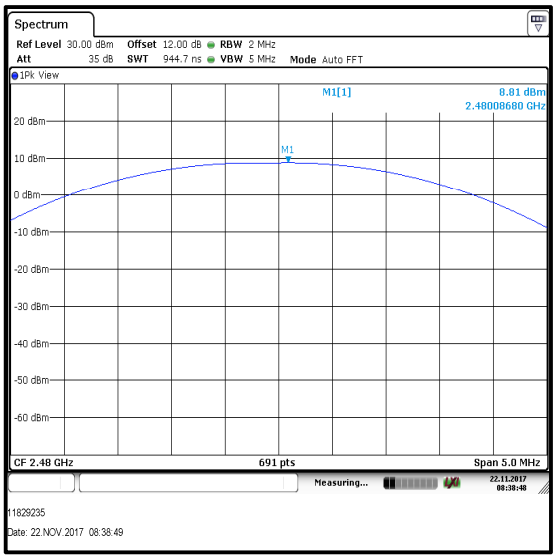
Results: DH5



Bottom Channel



Middle Channel



Top Channel

Transmitter Maximum Peak Output Power (continued)

Results: 2DH5

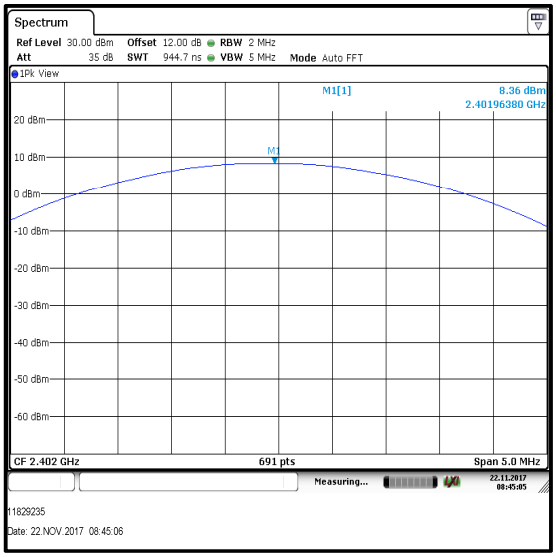
Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	8.4	21.0	12.6	Complied
Middle	7.8	21.0	13.2	Complied
Top	8.2	21.0	12.8	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	8.4	2.0	10.4	27.0	16.6	Complied
Middle	7.8	2.0	9.8	27.0	17.2	Complied
Top	8.2	2.0	10.2	27.0	16.8	Complied

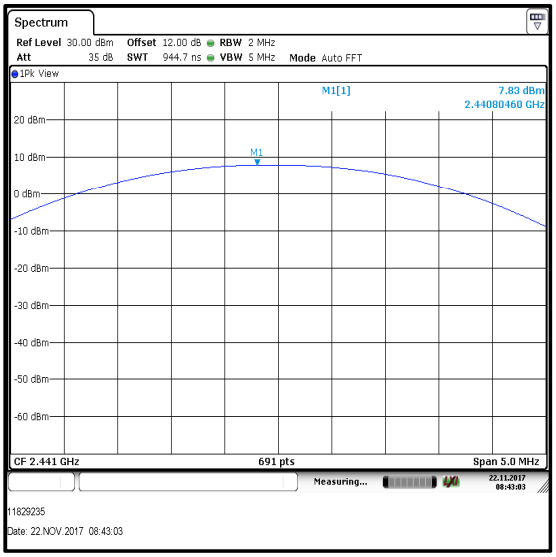
Result: Pass

Transmitter Maximum Peak Output Power (continued)

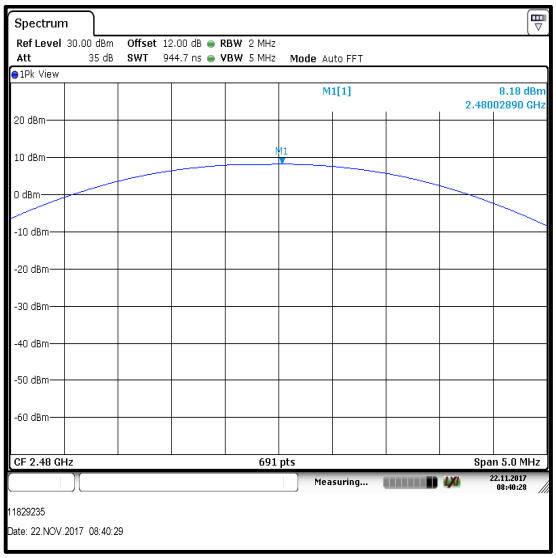
Results: 2DH5



Bottom Channel



Middle Channel



Top Channel

Transmitter Maximum Peak Output Power (continued)

Results: 3DH5

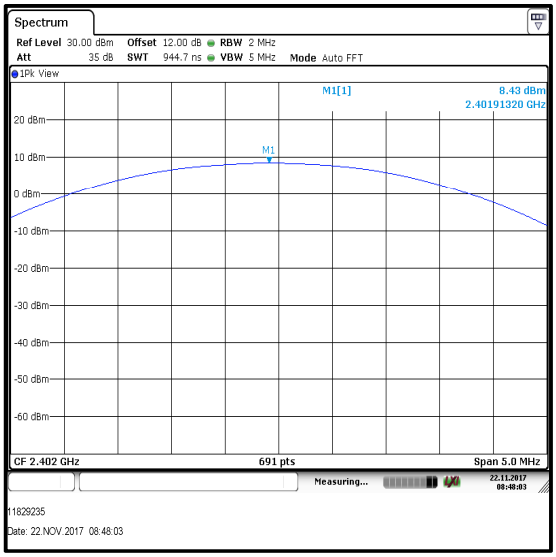
Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	8.4	21.0	12.6	Complied
Middle	8.5	21.0	12.5	Complied
Top	8.4	21.0	12.6	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	8.4	2.0	10.4	27.0	16.6	Complied
Middle	8.5	2.0	10.5	27.0	16.5	Complied
Top	8.4	2.0	10.4	27.0	16.6	Complied

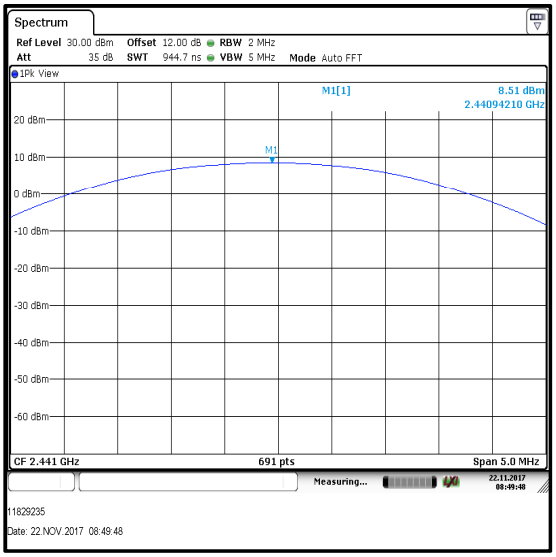
Result: Pass

Transmitter Maximum Peak Output Power (continued)

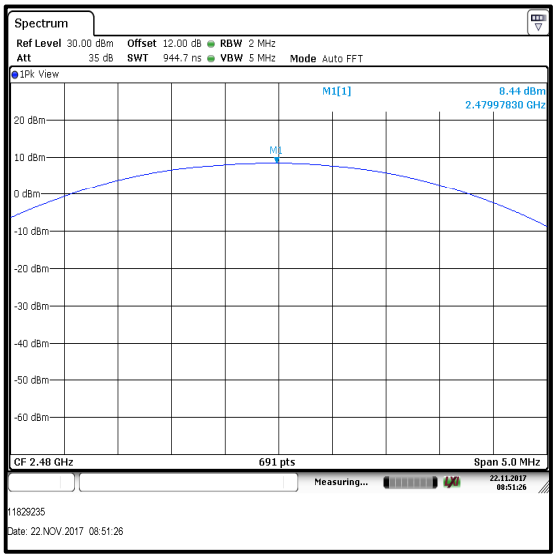
Results: 3DH5



Bottom Channel



Middle Channel



Top Channel

5.2.5. Transmitter Emissions (Conducted)

Test Summary:

Test Engineer:	Segun Adeniji	**Test Date:**	17 January 2018
Test Sample Serial Number:	WABU000551		
Test Site Identification	SR 9		

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):	24
Relative Humidity (%):	35

Settings of the Instrument

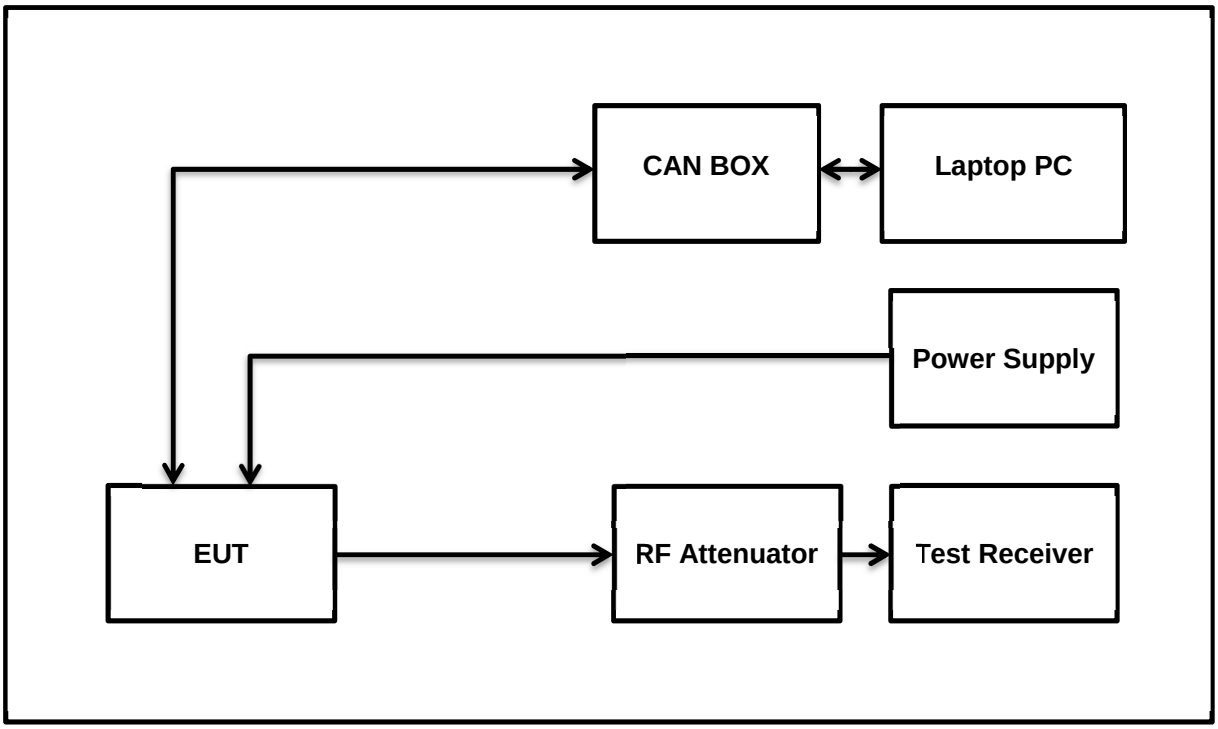
RBW/VBW	100 kHz / 300 kHz
Detector	Peak

Note(s):

1. Transmitter conducted 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. The measurement was done at the EUT antenna port. Also there was no difference seen in the spurious emission pre-scan result when the device was hoping or when fixed to any of the bottom, middle or top channel.
2. The final measured value, for the given emission, in the table below incorporates the attenuator value and cable loss.
3. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final emissions measurements were performed with the EUT set to the middle channel only.
4. All emissions shown on the pre-scan plot were investigated and found to be below the applicable limit or below the measurement system noise floor.
5. 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.
6. Since the EUT complied to the spurious emission limit with peak detector, therefore no quasi-peak measurement was necessary according to ANSI C63.10.

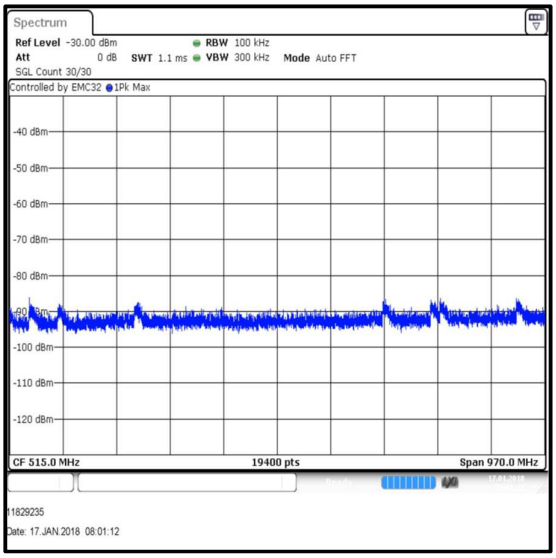
Transmitter Spurious Emissions (continued)

Test Setup:



Results: Peak / DH5

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Result
67.06	-85.1	-67.0	18.1	Complied
250.29	-88.2	-61.0	27.2	Complied



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

Result: Pass

Test Summary :

Test Engineer:	Segun Adeniji	**Test Date:**	17 January 2018
Test Sample Serial Number:	WABU000551		
Test Site Identification	SR 9		

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
Relative Humidity (%):	35

Settings of the Instrument

RBW/VBW	1 MHz / 3 MHz
Detector	Peak

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. The measurement was done at the EUT antenna port.
2. Initial pre-scan was performed from 30 MHz-26 GHz. The result for the measurement up to 1 GHz has already been presented in the preceding section.
3. The final measured value, for the given emission, in the table below incorporates the attenuator and cable loss.
4. During the initial pre-scan, it was discovered that the worst case spurious emission was found when the EUT was set to a particular channel on the middle channel compared to bottom channel, top channel or the hopping mode. Therefore the plots have only shown the middle channel results.
5. The emission shown on the 1 GHz to 4 GHz plot between 2.4 GHz and 2.48 GHz are the EUT fundamentals.
6. *In accordance with ANSI C63.10 Section 6.6.4.3 (Note 1), if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
7. All emissions including the carrier second harmonic shown on the pre-scans were investigated and found to be ambient, or > 20 dB below the average limit.
8. 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 / Bottom Channel / DH5

Frequency (MHz)	Level (dBm)	Average Limit (dBm)	Margin (dB)	Result
2483	-65.1	-53.0	12	Complied
4804	-69.4	-53.0	16.4	Complied
5326	-74.9	-53.0	21.9	Complied

Results: Peak / Middle Channel / DH5

Frequency (MHz)	Level (dBm)	Average Limit (dBm)	Margin (dB)	Result
2483	-64.5	-53.0	11.5	Complied
4882	-68.5	-53.0	15.5	Complied
5326	-75.5	-53.0	14.5	Complied

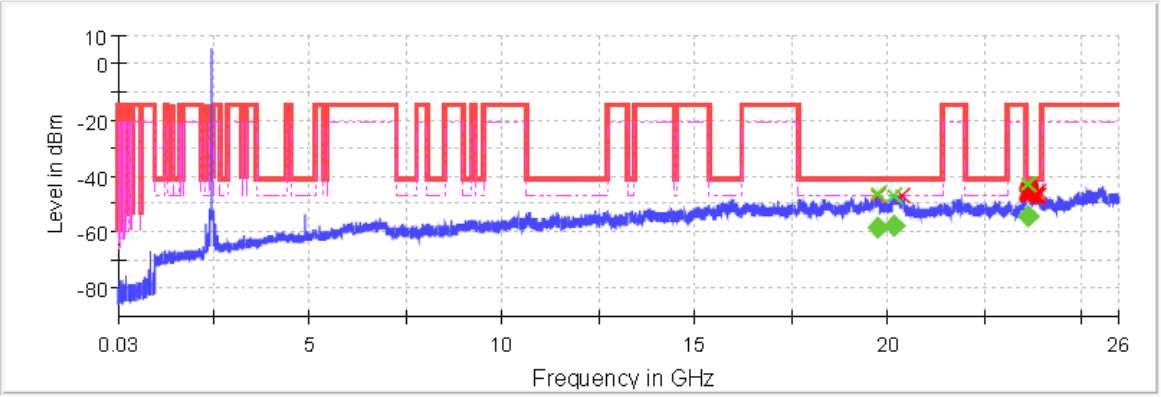
Results: Peak / Top Channel / DH5

Frequency (MHz)	Level (dBm)	Average Limit (dBm)	Margin (dB)	Result
2483	-64.5	-53.0	11.5	Complied
4960	-69.0	-53.0	16.0	Complied
5327	-77.2	-53.0	24.2	Complied

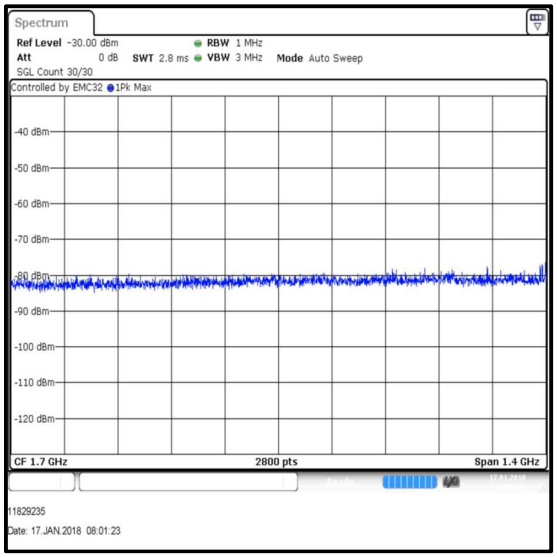
Results: Peak / Hopping Mode / DH5

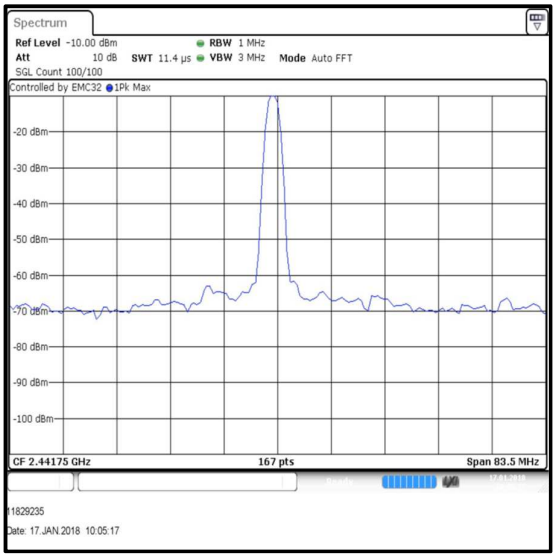
Frequency (MHz)	Level (dBm)	Average Limit (dBm)	Margin (dB)	Result
2483	-65.4	-53.0	12.4	Complied
5326	-79.1	-53.0	26.1	Complied

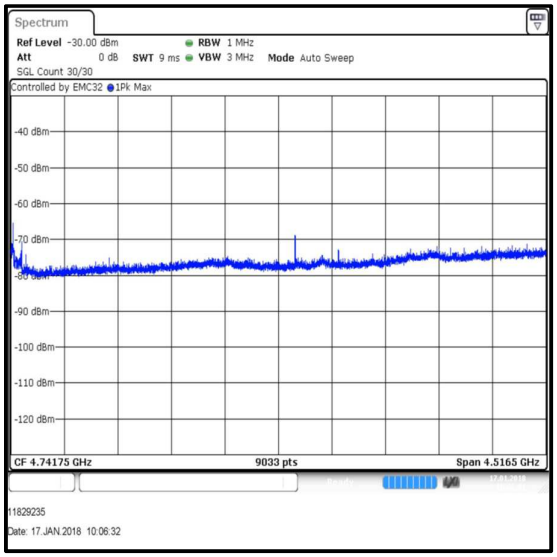
Result: Pass

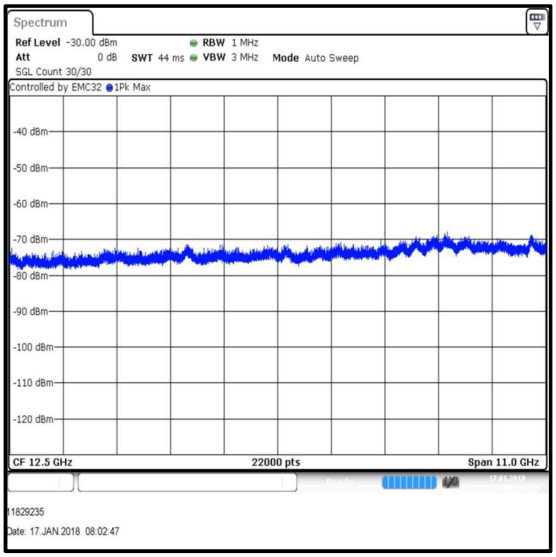


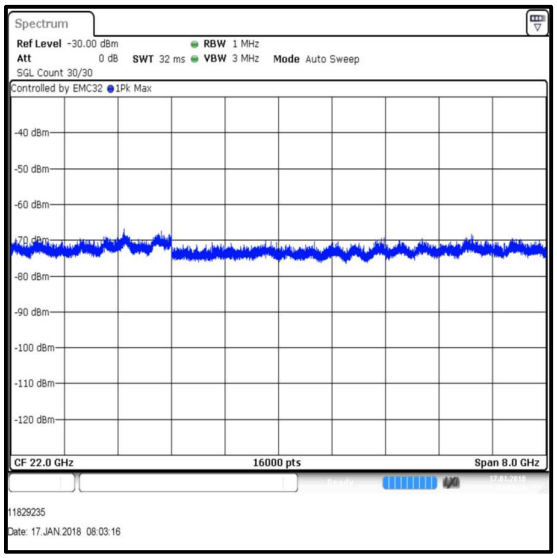
Initial Spurious emission pre-scan from 30 MHz- 26 GHz with Peak detector











Segmented scan plots with peak detector. Note that they are for indication purposes only therefore for final measurements, see accompanying tables.

5.2.6. Transmitter Radiated Emissions (Cabinet Radiation)

Test Summary:

Test Engineer:	Segun Adeniji	**Test Date:**	18 January 2018
Test Sample Serial Number:	WABU000551		
Test Site Identification	SR 1/2		

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):	24
Relative Humidity (%):	35

Settings of the Instrument

RBW/VBW	100 kHz / 300 kHz
Detector	Peak

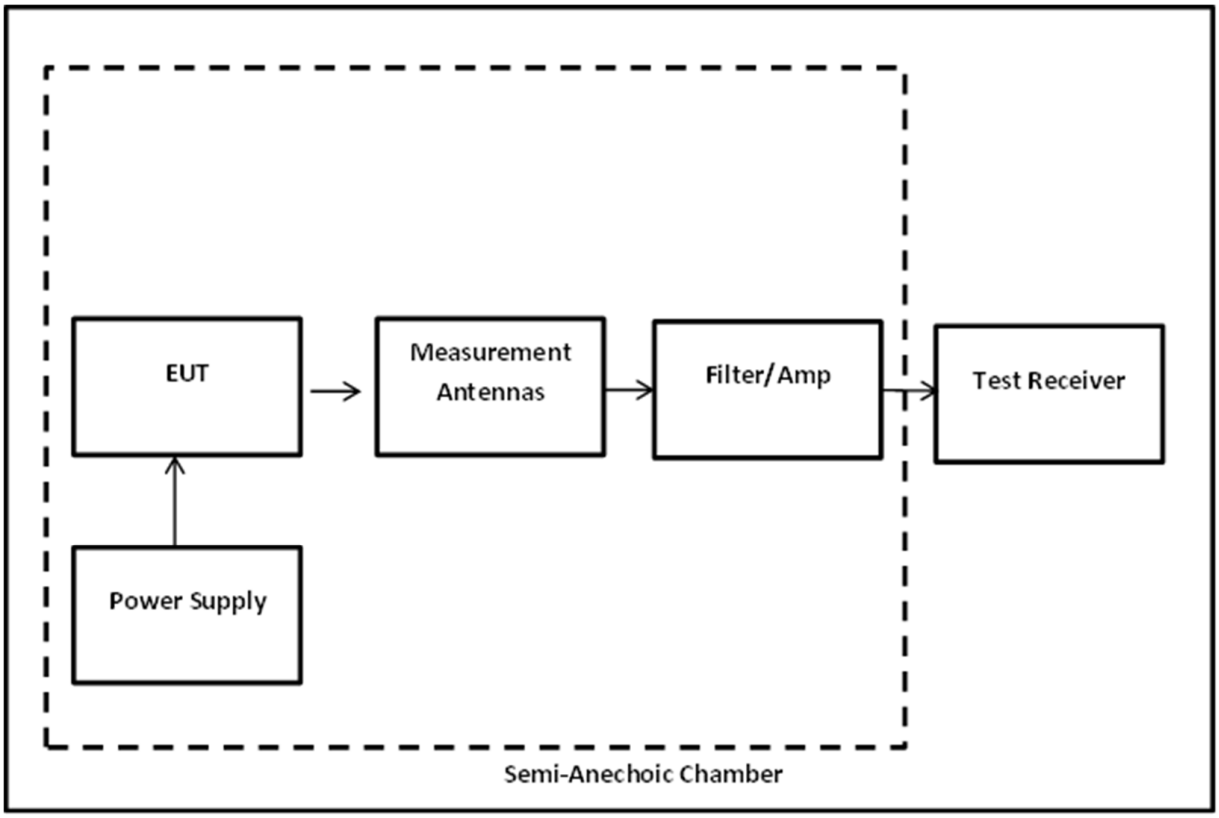
Note(s):

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 measurement was done with the EUT antenna port terminated with a 50 Ohms load.
3. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
4. 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. Also there was no difference seen in the spurious emission pre-scan result when the device was hoping or when fixed to any of the bottom, middle or top channel.
5. All emissions shown on the pre-scan plot were investigated and found to be below the measurement system noise floor.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber 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. 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.
8. Since the EUT complied to the spurious emission limit with peak detector, therefore no quasi-peak measurement was necessary according to ANSI C63.10.

Transmitter Radiated Emissions (continued)

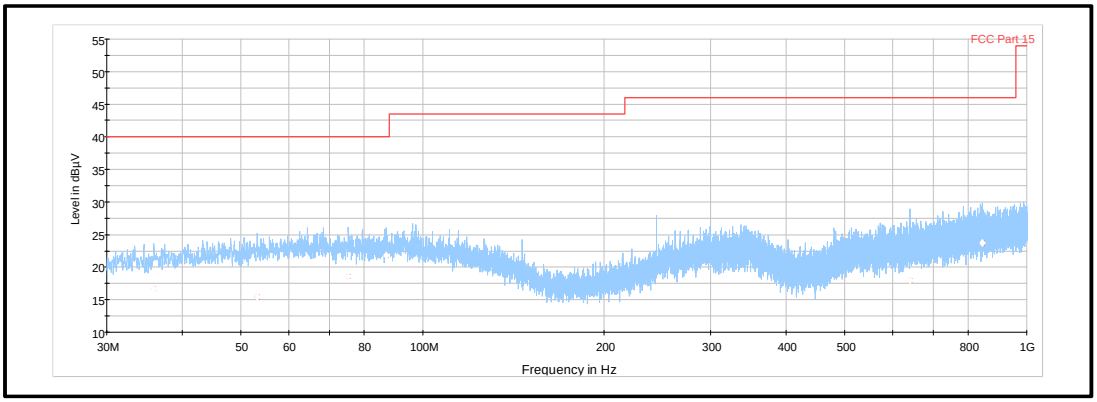
Test Setup:

Semi-anechoic chamber



Results: Peak / DH5

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
167.06	H	23.8	43.5	19.7	Complied
251.29	H	28.9	46.0	17.1	Complied



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

Result: Pass

Test Summary:

Test Engineer:	Segun Adeniji	**Test Date:**	08 December 2017
Test Sample Serial Number:	WABU000551		
Test Site Identification	SR 1/2		

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):	23
Relative Humidity (%):	32

Settings of the Instrument

RBW/VBW	1 MHz / 3 MHz
Detector	Peak

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 measurement was done with the EUT antenna port terminated with a 50 Ohms load.
3. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
4. The emission shown at around 2.4 GHz are the EUT fundamentals at their transmitting frequencies. The leakage was investigated to be coming from the EUT cabinet.
5. *In accordance with ANSI C63.10 Section 6.6.4.3 (Note 1), if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
6. 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 table below. The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.
7. All other emissions shown on the pre-scans were investigated and found to be ambient, or > 20 dB below the appropriate limit or below the noise floor of the measurement system.
8. Measurements were performed in a semi-anechoic chamber at a distance of 3 metres. The EUT was placed at a height of 1.5 m 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.
9. 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 / Bottom Channel / DH5

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
7338.0	H	47.3	54.0	6.7	Complied
9044.2	H	60.5	54.0	6.5	Complied
2021.3	H	50.4	54.0	3.6	Complied

Results: Peak / Middle Channel / DH5

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
7338.1	H	47.4	54.0	6.6	Complied
9044.3	H	60.7	54.0	6.7	Complied
2021.2	H	50.5	54.0	3.5	Complied

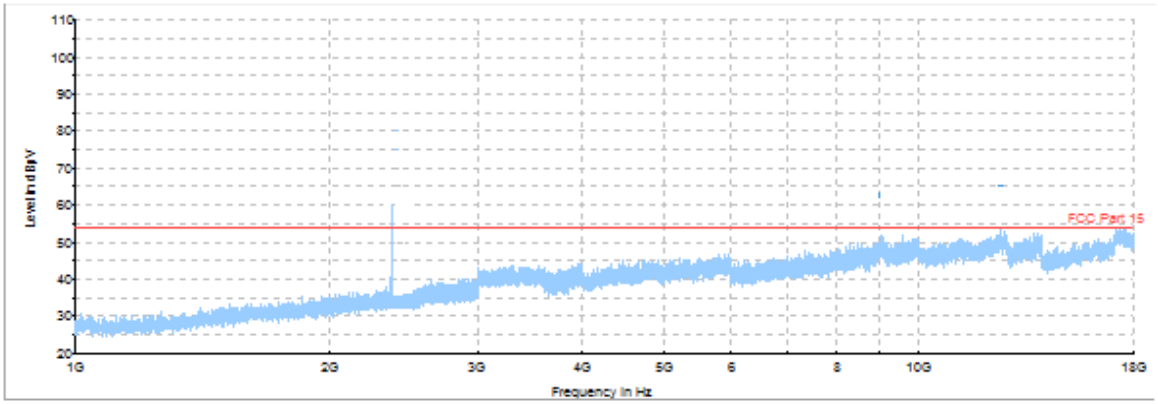
Results: Peak / Top Channel / DH5

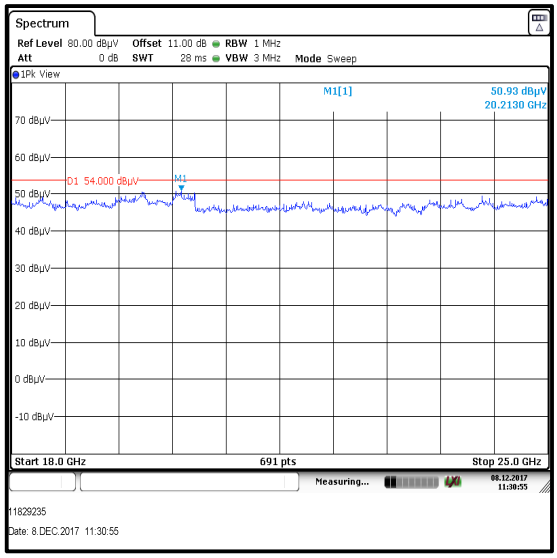
Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
7338.0	H	47.0	54.0	7.0	Complied
9044.2	H	60.1	54.0	6.1	Complied
2021.3	H	50.3	54.0	3.7	Complied

Results: Peak / Hopping Mode / DH5

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
7338.0	H	46.9	54.0	7.1	Complied
9044.3	H	61.0	54.0	7.0	Complied
2021.3	H	49.9	54.0	4.1	Complied

Result: Pass





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

5.2.7. Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineer:	Abdoufataou Salifou	**Test Date:**	01 December 2017
Test Sample Serial Number:	WAAY000385 with connected antenna		
Test Site Identification	SR 1/2		

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

Environmental Conditions:

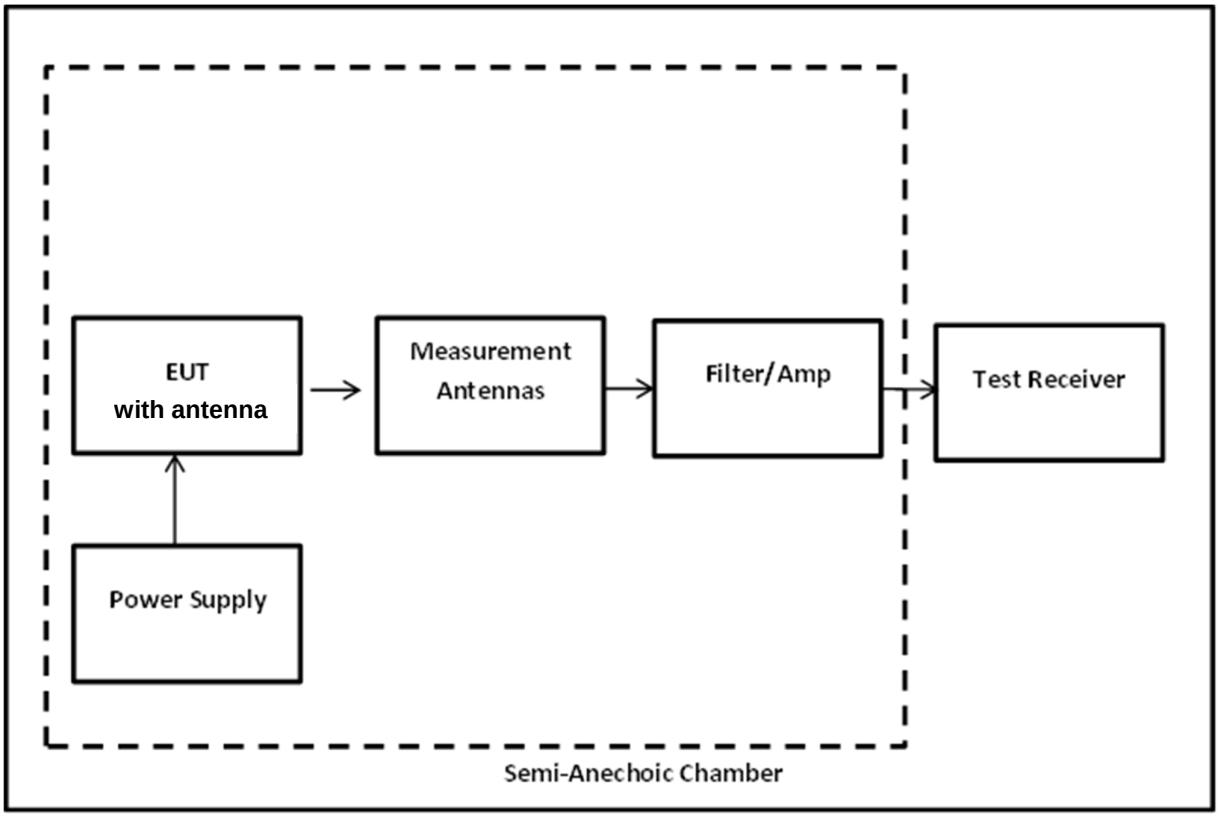
Temperature (°C):	22.6
Relative Humidity (%):	23

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. The restricted band plot for 2310 MHz to 2390 MHz can be found under the results for DH5 static as this mode had the highest output power and was therefore deemed worst case.
6. * -20 dBc limit.

Transmitter Band Edge Radiated Emissions (continued)

Test setup:

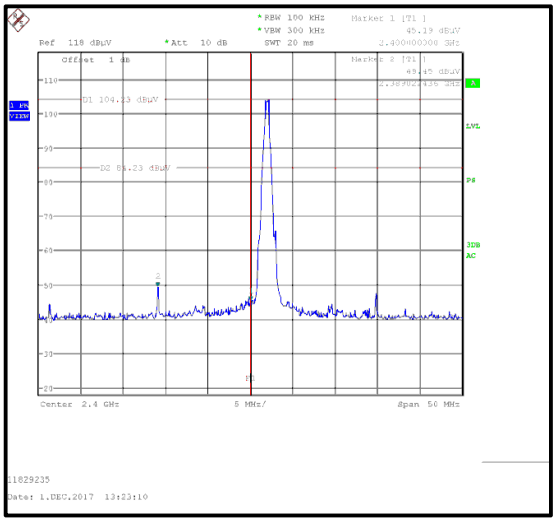


Transmitter Band Edge Radiated Emissions (continued)

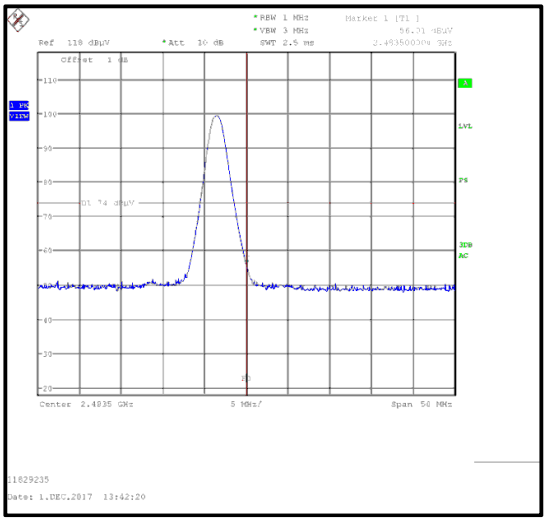
Results: Static Mode / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2389.0	Vertical	49.5	84.2	34.7	Complied
2389.487	Vertical	54.5	74.0	19.5	Complied
2400.0	Vertical	45.2	84.2	39.0	Complied
2483.5	Vertical	56.0	74.0	18.0	Complied

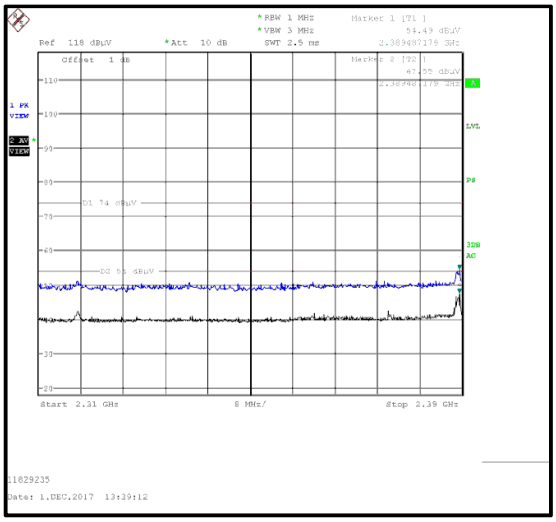
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2389.487	Vertical	47.6	54.0	6.4	Complied
2483.5	Vertical	53.1	54.0	0.9	Complied



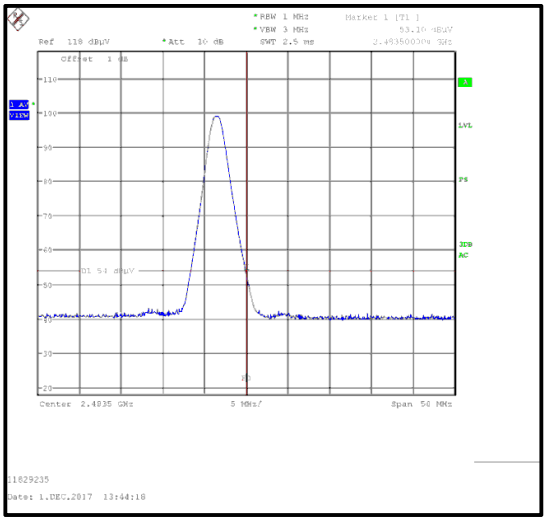
Lower Band Edge Peak Static



Upper Band Edge Peak Static



2310 MHz to 2390 MHz Restricted Band Plot



Upper Band Edge Average Static

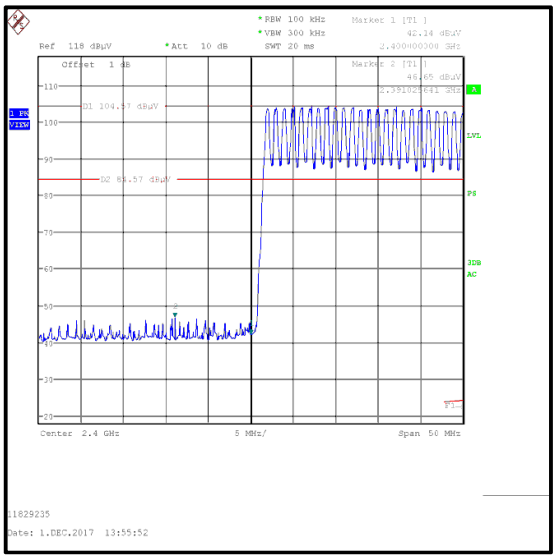
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

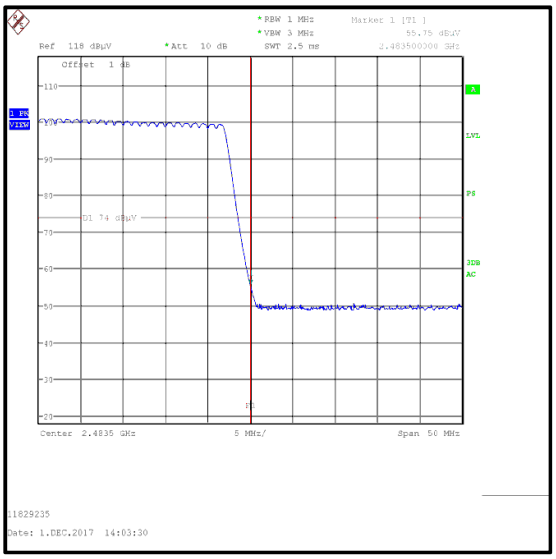
Results: Hopping Mode / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2391.0	Vertical	46.7	84.6	37.9	Complied
2400.0	Vertical	42.1	84.6	42.5	Complied
2483.5	Vertical	55.8	74.0	18.2	Complied

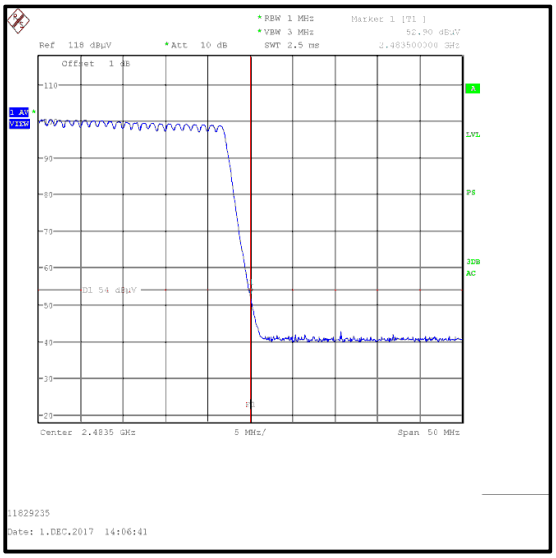
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Vertical	52.9	54.0	1.1	Complied



Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



Upper Band Edge Average Hopping

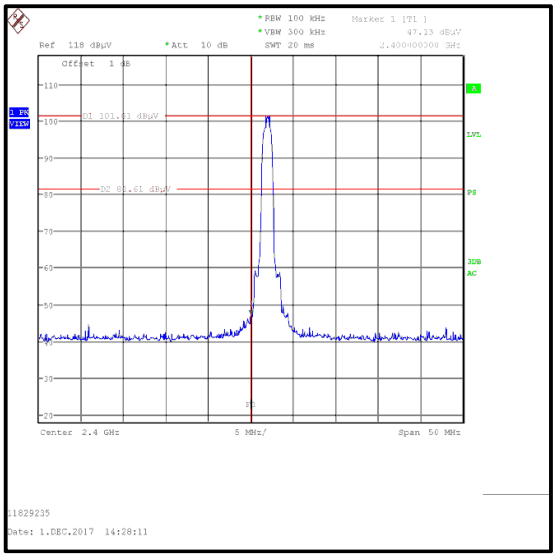
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

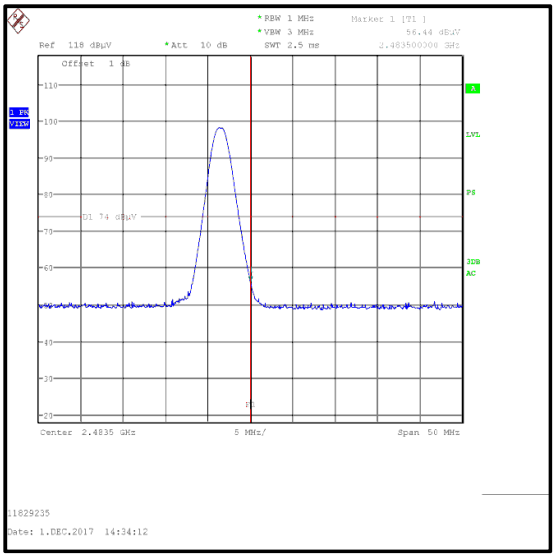
Results: Static Mode / 2DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2400.0	Vertical	47.1	81.6	34.6	Complied
2483.5	Vertical	56.4	74.0	17.6	Complied

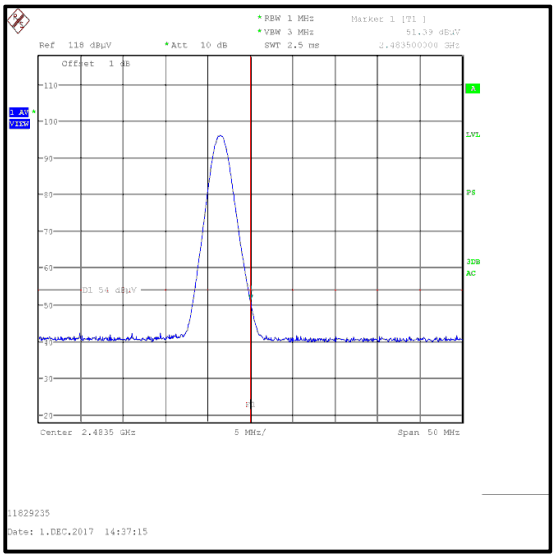
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Vertical	51.4	54.0	2.8	Complied



Lower Band Edge Peak Static



Upper Band Edge Peak Static



Upper Band Edge Average Static

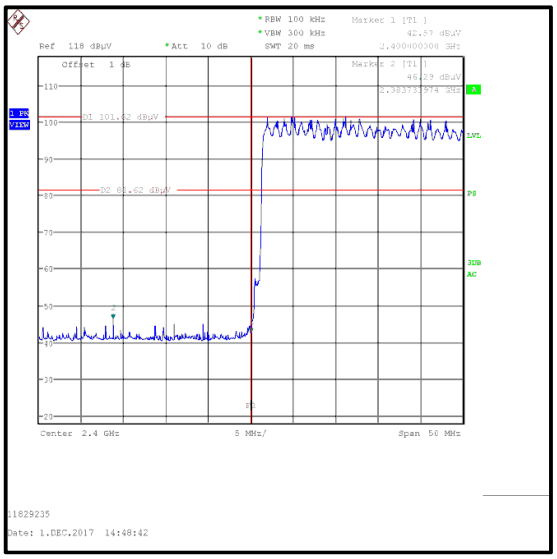
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

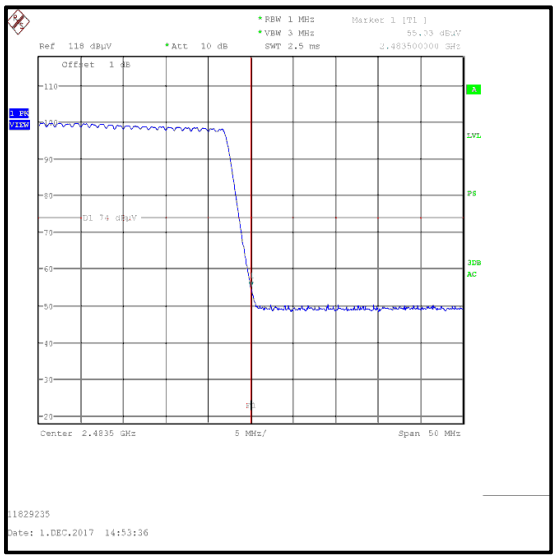
Results: Hopping Mode / 2DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2383.7	Vertical	46.3	81.6	35.3	Complied
2400.0	Vertical	42.6	81.6	39.0	Complied
2483.5	Vertical	55.0	74.0	19.0	Complied

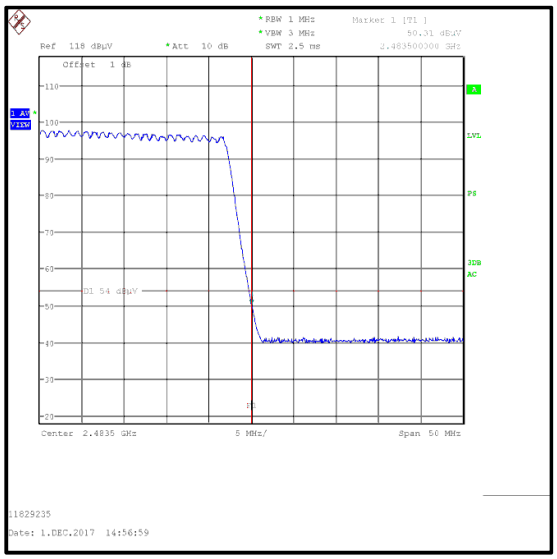
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Vertical	50.3	54.0	3.7	Complied



Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



Upper Band Edge Average Hopping

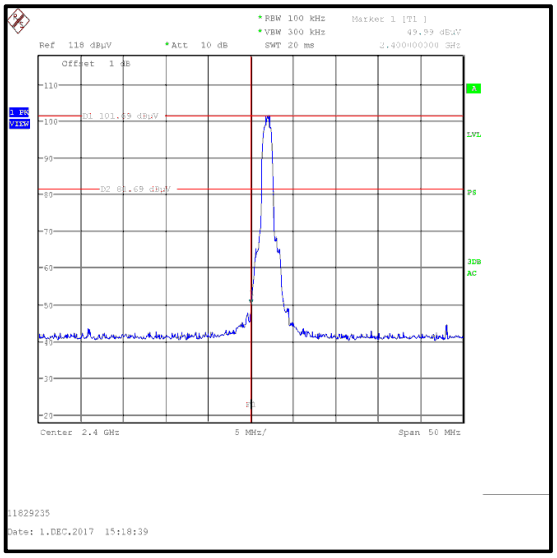
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

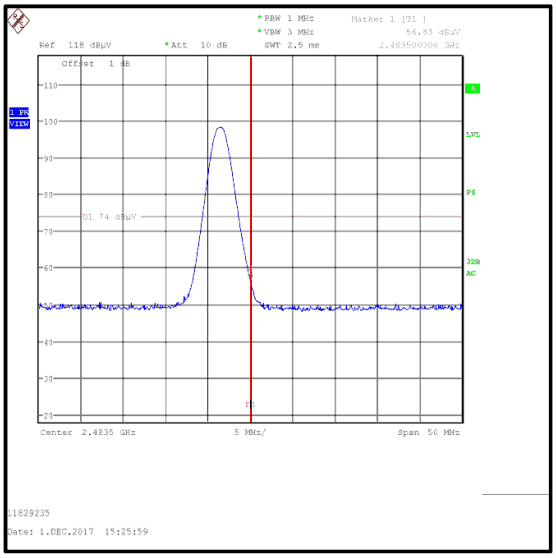
Results: Static Mode / 3DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2400.0	Vertical	50.0	81.7	31.7	Complied
2483.5	Vertical	56.8	74.0	17.2	Complied

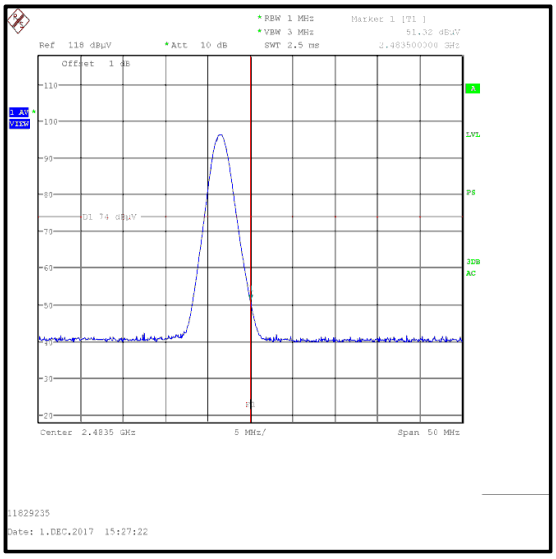
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Vertical	51.3	54.0	2.7	Complied



Lower Band Edge Peak Static



Upper Band Edge Peak Static



Upper Band Edge Average Static

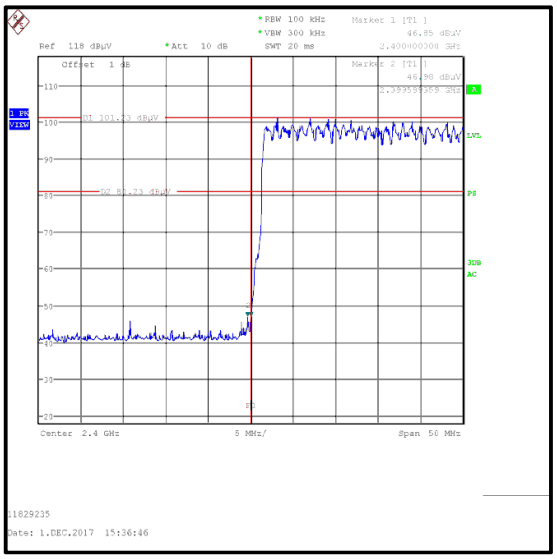
Result: Pass

Transmitter Band Edge Radiated Emissions (continued)

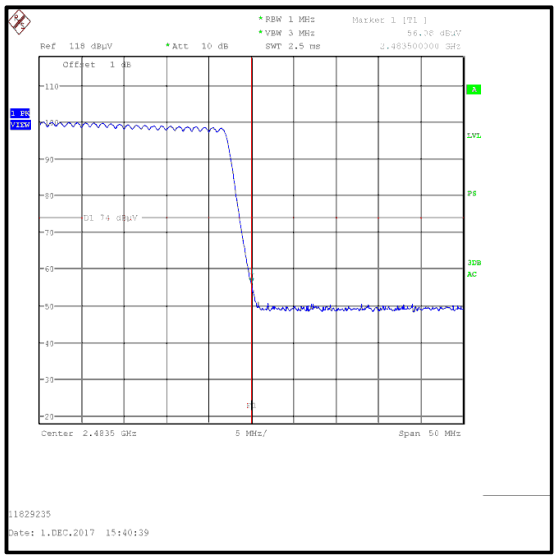
Results: Hopping Mode / 3DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2399.6	Vertical	47.0	81.2	34.2	Complied
2400.0	Vertical	46.9	81.2	34.3	Complied
2483.5	Vertical	56.0	74.0	18.0	Complied

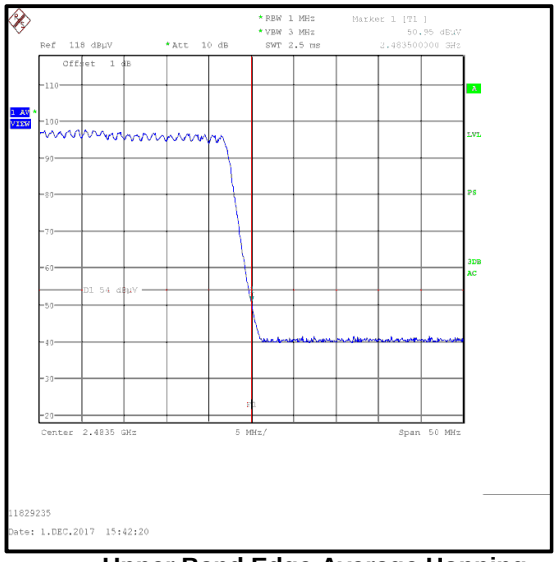
Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.5	Vertical	51.0	54.0	3.0	Complied



Lower Band Edge Peak Hopping



Upper Band Edge Peak Hopping



Upper Band Edge Average Hopping

Result: Pass

6. Measurement Uncertainty

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	Confidence Level (%)	Calculated Uncertainty
Conducted Maximum Peak Output Power	95%	±0.59 dB
Radiated Spurious Emissions	95%	±3.10 dB
Band Edge Radiated Emissions	95%	±3.10 dB
Carrier Frequency Separation	95%	±92 Hz
Average Time of Occupancy	95%	±3.53 ns
20 dB Bandwidth	95%	±0.87 %

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. Used equipment

Test site: SR 1/2

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
1	Rohde & Schwarz	Antenna, Loop	HFH2-Z2	831247/012	8/5/2016	36
103	EMCO	Antenna, Horn	3115	9008/3485	7/20/2016	36
104	EMCO	Antenna, Horn	3115	9008/3486	7/20/2016	36
156	Rohde & Schwarz	V-Network	ESH3-Z6	843864/004	7/12/2017	12
350	Rohde & Schwarz	Receiver, EMI Test	ESIB7	836697/014	7/13/2017	12
377	BONN Elektronik	Amplifier, Low Noise Pre	BLMA 0118-1A	025294B	7/11/2017	12
383	Rohde & Schwarz	Antenna, Rod	HFH2-Z1	890151/11	7/14/2017	24
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	055929	7/12/2017	12
424	EMCO	Antenna, Horn	EMCO 3116	00046537	7/28/2016	24
425	Agilent	Generator, CW Signal	E8247C	MY43320849	7/19/2016	24
426	Agilent	Spectrum Analyzer	E4446A	US44020316	7/20/2016	24
460	Deisl	Turntable	DT 4250 S		n/a	n/a
465	Schwarzbeck	Antenna, Trilog Broadband	VULB 9168	9168-240	8/8/2016	36
474	Agilent	Analyzer, ENA Network	E5071C	MY46100912	7/20/2016	24
495	Rohde & Schwarz	Antenna, Log.- Periodical	HL050	100296	7/20/2016	24
496	Rohde & Schwarz	Antenna, log. - periodical	HL050	100297	7/20/2016	24
497	Schwarzbeck	Antenna, Biconical	VHBB 9124	423	7/7/2016	36
499	Schwarzbeck	Antenna, log.-per	VUSLP 9111	317	8/2/2016	36
587	Maturo	antenna mast, tilting	TAM 4.0-E	011/7180311	n/a	n/a
588	Maturo	Controller	NCD	029/7180311	n/a	n/a
591	Rohde & Schwarz	Receiver	ESU 40	100244/040	7/12/2017	12
607	Schwarzbeck	Antenna broadband horn antenna	BBHA 9170	9170-561	7/28/2016	24
608	Rohde & Schwarz	Switch Matrix	OSP 120	101227	4/8/2014	60
363	Wainwright	Notch Filter GSM900	WW-NF9	100002	Lab verification	n/a
611	Wainwright Instruments	Band Reject Filter DL LTE	WRCGV8-	1	Lab verification	n/a
612	Wainwright Instruments	Band Reject Filter UL LTE	WRCGV8-	1	Lab verification	n/a
613	Wainwright Instruments	Band Reject Filter WLAN/ BT	WRCTF12-	1	Lab verification	n/a
614	Wainwright Instruments	Highpass Filter 3GHz	WHKX10-	1	Lab verification	n/a
615	Wainwright Instruments	Highpass Filter 1GHz	WHKX12-	3	Lab verification	n/a
620	Bonn Elektronik	pre-amplifier	BLNA 0110-01N	1510111	7/12/2017	24
624	Wainwright	6 GHz high-pass filter	WHKX10-5850-6500-18000-40SS	5	Lab verification	n/a
628	Maturo	Antenna mast	CAM 4.0-P	224/19590716	n/a	n/a
629	Maturo	Kippeinrichtung	KE 2.5-R-M	MAT002	n/a	n/a

Test site: SR 9

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
424	EMCO	Antenna, Horn	EMCO 3116	00046537	7/28/2016	24
472	Rohde & Schwarz	Generator, Vektorsignal	SMU200A	102409	7/11/2017	12
592	Rohde & Schwarz	Wideband Radio Communication tester	CMW 500	119593	8/15/2017	12
622	Rohde & Schwarz	Step Attenuator	RSC	101904	7/13/2017	12
625	Schwarzbeck	Antenna, H-field	HFSL 7101	109	Verification - only relative measurements	n/a
626	Rohde & Schwarz	Bluetooth Tester	CBT	100481	Signaling Only	24
635	Rohde & Schwarz	Signal generator	SMB100A	179875	7/11/2017	12
636	Rohde & Schwarz	switching unit	OSP120	101698	7/14/2017	12
637	Rohde & Schwarz	Spectrum Analyzer	FSV40	101587	7/11/2017	12
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	55929	7/21/2016	24
451	Rohde & Schwarz	Power Meter, Dual Channel	NRVD	101190	7/10/2017	12
427	Rohde & Schwarz	Probe, Power Sensor	NRV-Z5	1019	7/11/2017	12
195	SPS	Power Supply	TOE8842-24	51455	Verified by Multimeter	12
216	Agilent	Multimeter	34401A	US36017458	7/11/2017	24
378	ESPEC/ Thermotec	Climatic Chamber	PL-1FT	5100869	8/9/2016	36

Additional Control Equipment

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
626	Rohde & Schwarz	Bluetooth Tester	CBT	100481	Signaling Only	24

8. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
1.1	4	1	Applicant and Manufacturer changed (from Karlsruhe to Kerpen)
1.2	1,7	1,3.1	Model number changed
1.3	1,7	1.3.1	Model number changed
1.4	8	3.5	Added antenna information
1.5	4.2 43,44	9 5.2.7	Added clarification regarding antenna termination Added that antenna was used for Band Edge measurements

--- END OF REPORT ---