



# TEST REPORT

**Test Report No. :** UL-RPT-RP11624992JD07C V2.0

**Customer** : Apple Inc.

**Model No.** : A1842

**FCC ID** : BCGA1842

**Technology** : *Bluetooth* – Basic Rate & EDR (Low Power Mode)

**Test Standard(s)** : FCC Parts 15.209(a) & 15.247

**Test Laboratory** : UL VS LTD, Basingstoke, Hampshire, RG24 8AH, United Kingdom

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2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

**Date of Issue:** 22 August 2017

**Checked by:**

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Senior Test Engineer, Radio Laboratory

**Company Signatory:**

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Senior Test Engineer, Radio Laboratory  
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**Report Revision History**

<b>Version Number</b>	<b>Issue Date</b>	<b>Revision Details</b>	<b>Revised By</b>
1.0	01/08/2017	Initial Version	Ian Watch
2.0	22/08/2017	Changed Model No. to A1842 Changed description of EUT in Section 1.1	Ian Watch

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## **1. Attestation of Test Results**

### **1.1. Description of EUT**

The device is an interactive digital media player which plays content onto a screen through an HDMI port. It incorporates Wi-Fi and Bluetooth radios.

### **1.2. General Information**

<b>Specification Reference:</b>	47CFR15.247
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.247
<b>Specification Reference:</b>	47CFR15.209
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Section 15.209
<b>Test Dates:</b>	11 May 2017 to 04 July 2017

### **1.3. Summary of Test Results**

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

#### **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 (i.e. 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.

### **1.4. 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.

## **2. Summary of Testing**

### **2.1. Facilities and Accreditation**

The test site and measurement facilities used to collect data are located at Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom. The following table identifies which facilities were utilised for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

Site 1	
Site 2	
Site 17	X

UL VS LTD is accredited by UKAS. The tests reported herein have been performed in accordance with its terms of accreditation.

### **2.2. Methods and Procedures**

<b>Reference:</b>	ANSI C63.10-2013
<b>Title:</b>	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

## **2.3. Calibration and Uncertainty**

### **Measuring Instrument Calibration**

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.

### **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 measured (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
20 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±4.59 %
Carrier Frequency Separation	2.4 GHz to 2.4835 GHz	95%	±4.59 %
Average Time of Occupancy	2.4 GHz to 2.4835 GHz	95%	±3.53 ns
Conducted Maximum Peak Output Power	2.4 GHz to 2.4835 GHz	95%	±1.13 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 25 GHz	95%	±2.94 dB

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

## 2.4. Test and Measurement Equipment

### Test Equipment Used for Transmitter Conducted Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1883	Signal Analyser	Rohde & Schwarz	FSV30	103084	02 May 2018	12
A2520	Attenuator	AtlanTecRF	AN18-20	832797#1	Calibrated before use	-
G0614	Signal Generator	Rohde & Schwarz	SMB100A	177687	08 May 2020	36
M2002	Thermohygrometer	Testo	608-H1	45041825	22 Feb 2018	12

### Test Equipment Used for Transmitter Radiated Emissions Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Feb 2018	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	14 Apr 2018	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	11 Apr 2018	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	13 Apr 2018	12
A2903	Antenna	Schwarzbeck	VULB 9163	9163-944	22 Aug 2017	12
A2971	Low Pass Filter	AtlanTecRF	AFL-02000	15062902845	06 Mar 2018	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	03 Mar 2018	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	06 Mar 2018	12
A2891	Preamplifier	Schwarzbeck	BBV 9718	9718-306	11 Apr 2018	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	11 Apr 2018	12
A2893	Preamplifier	Schwarzbeck	BBV 9721	9721-021	11 Apr 2018	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	11 Apr 2018	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	11 Apr 2018	12

### Test Equipment Used for Transmitter Band Edge Radiated Emissions Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	JM Handelspunkt	608-H1	45046641	22 Feb 2018	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	14 Apr 2018	12
A2863	Amplifier	Hewlett Packard	8449B	3008A02100	11 Apr 2018	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	13 Apr 2018	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	03 Mar 2018	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	11 Apr 2018	12

### **3. Equipment Under Test (EUT)**

#### **3.1. Identification of Equipment Under Test (EUT)**

<b>Brand Name:</b>	Apple Inc.
<b>Model Name or Number:</b>	A1842
<b>Test Sample Serial Number:</b>	C07TK026J4C7 ( <i>Radiated sample #1</i> )
<b>Hardware Version:</b>	EVT
<b>Software Version:</b>	15J42500h
<b>FCC ID:</b>	BCGA1842

<b>Brand Name:</b>	Apple Inc.
<b>Model Name or Number:</b>	A1842
<b>Test Sample Serial Number:</b>	C07TK02MJ4C7 ( <i>Radiated sample #2</i> )
<b>Hardware Version:</b>	EVT
<b>Software Version:</b>	15J42500h
<b>FCC ID:</b>	BCGA1842

<b>Brand Name:</b>	Apple Inc.
<b>Model Name or Number:</b>	A1842
<b>Test Sample Serial Number:</b>	C07TK007J4C6 ( <i>Radiated sample #3</i> )
<b>Hardware Version:</b>	EVT
<b>Software Version:</b>	15J42500h
<b>FCC ID:</b>	BCGA1842

<b>Brand Name:</b>	Apple Inc.
<b>Model Name or Number:</b>	A1842
<b>Test Sample Serial Number:</b>	C07TK015J4CK ( <i>Conducted sample #1 with RF port</i> )
<b>Hardware Version:</b>	EVT
<b>Software Version:</b>	15J42500h
<b>FCC ID:</b>	BCGA1842

#### **3.2. Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.



**3.3. Additional Information Related to Testing**

Tested Technology:	Bluetooth		
Power Supply Requirement:	Nominal	120 VAC 60Hz	
Type of Unit:	Transceiver		
Channel Spacing:	1 MHz		
Mode:	Basic Rate	Enhanced Data Rate	
Modulation:	GFSK	$\pi/4$ -DQPSK	8DPSK
Packet Type: (Maximum Payload)	DH5	2DH5	3DH5
Data Rate (Mbps):	1	2	3
Maximum Conducted Output Power:	11.2 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

**3.4. Description of Available Antennas**

The radio utilizes an integrated antenna, with the following maximum gain:

Frequency Range (MHz)	Antenna Gain (dBi)
2400-2480	-0.10

### **3.5. Description of Test Setup**

#### **Support Equipment**

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

<b>Description:</b>	Goldeneye Adaptor
<b>Brand Name:</b>	Goldeneye
<b>Model Name or Number:</b>	X892
<b>Serial Number:</b>	Not marked or stated

<b>Description:</b>	USB to lightning cable
<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	Kanzi
<b>Serial Number:</b>	316D67

<b>Description:</b>	Laptop PC
<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	Macbook Pro
<b>Serial Number:</b>	C2QRC0BGQCT

<b>Description:</b>	HDMI Cable. Length 1.8 metres
<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated

<b>Description:</b>	Multi Media player adaptor
<b>Brand Name:</b>	Sumvision
<b>Model Name or Number:</b>	Cyclone Micro
<b>Serial Number:</b>	UL VS LTD Asset No. A1986

<b>Description:</b>	Power Cable. Length 1.8 metres.
<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated

<b>Description:</b>	Ethernet Cable. Length 2.0 metres.
<b>Brand Name:</b>	Not marked or stated
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated

**Support Equipment (continued)**

<b>Description:</b>	Ethernet Hub
<b>Brand Name:</b>	Netgear
<b>Model Name or Number:</b>	GS605
<b>Serial Number:</b>	1YG19430021A1

**Operating Modes**

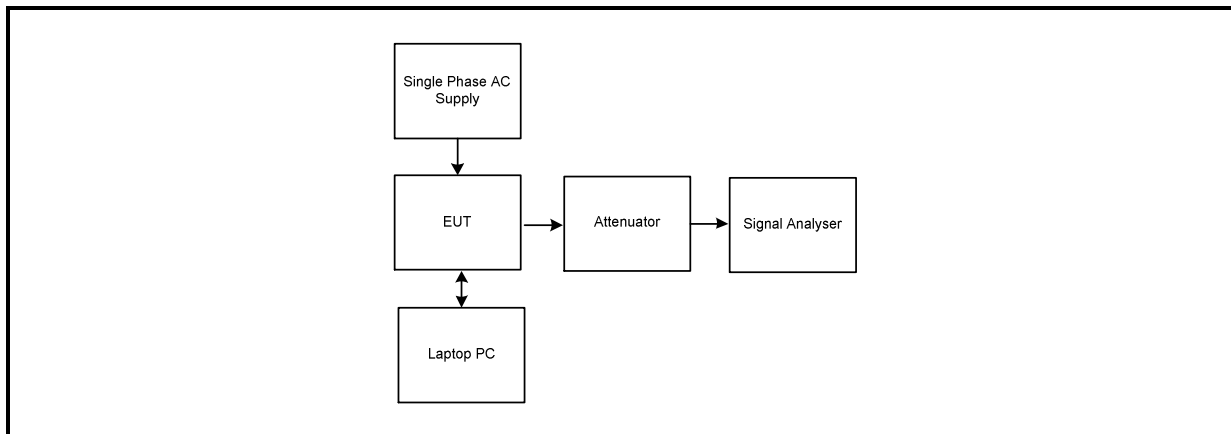
The EUT was tested in the following operating mode(s):

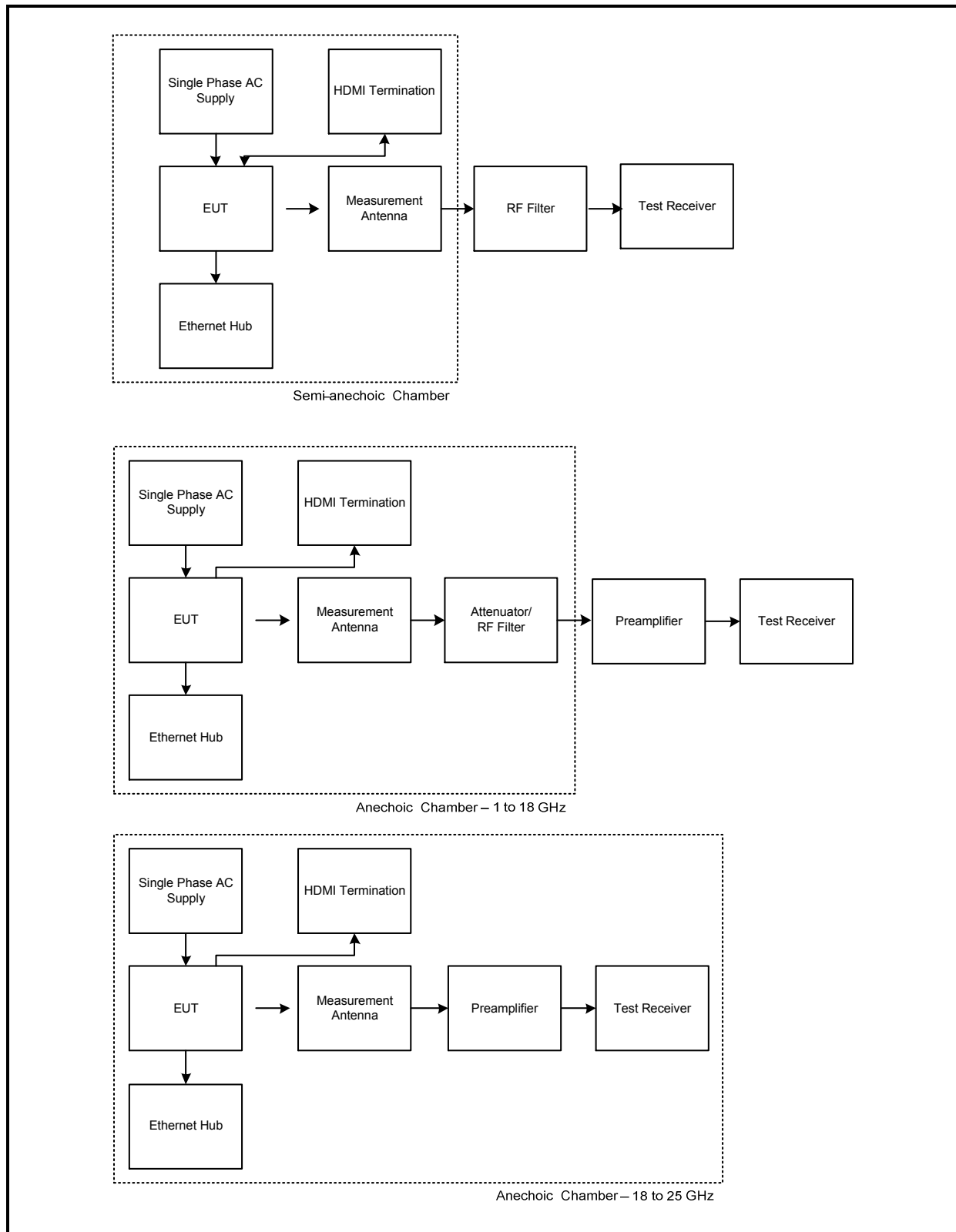
- Continuously transmitting at maximum power on bottom, middle and top channels in Basic Rate (DH5 packets) or EDR (2DH5 or 3DH5 packets) as required.
- Continuously transmitting at maximum power in hopping mode on all channels in Basic Rate (DH5 packets) or EDR (2DH5 or 3DH5 packets) as required.

**Configuration and Peripherals**

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

- Controlled in test mode using a software application on the laptop PC supplied by the customer. The application was used to enable a continuous transmission and to select the test channels as required. The customer supplied a document containing the setup instructions 'EUT\_setup\_v3.2.docx'. The laptop PC was connected to the EUT via a Goldeneye adaptor and USB to lightning cable.
- Transmitter maximum output power, radiated spurious emissions and band edge tests were performed with the EUT configured in iPA mode (Low Power). All other tests were performed with the EUT configured in ePA mode (High Power).
- Transmitter radiated spurious emissions tests were performed with the EUT transmitting in DH5 mode as this mode was found to transmit the highest power.
- During radiated emissions tests, the HDMI port was terminated into a Cyclone multimedia player adaptor. Once placed in test mode, the Goldeneye adaptor and USB to lightning cable were removed and replaced with an Ethernet cable terminated into an Ethernet hub.
- The EUT was powered from a 120 VAC 60 Hz single phase mains supply.

**Test Setup Diagrams****Conducted Tests:****Test Setup for Transmitter 20 dB Bandwidth, Carrier Frequency Separation, Number of Hopping Frequencies, Average Time of Occupancy & Maximum Peak Output Power**

**Radiated Tests:****Test Setup for Transmitter Radiated Emissions**

## **4. Antenna Port Test Results**

### **4.1. Transmitter 20 dB Bandwidth**

#### **Test Summary:**

<b>Test Engineer:</b>	Stefan Ho	<b>Test Date:</b>	19 June 2017
<b>Test Sample Serial Number:</b>	C07TK015J4CK		

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

#### **Environmental Conditions:**

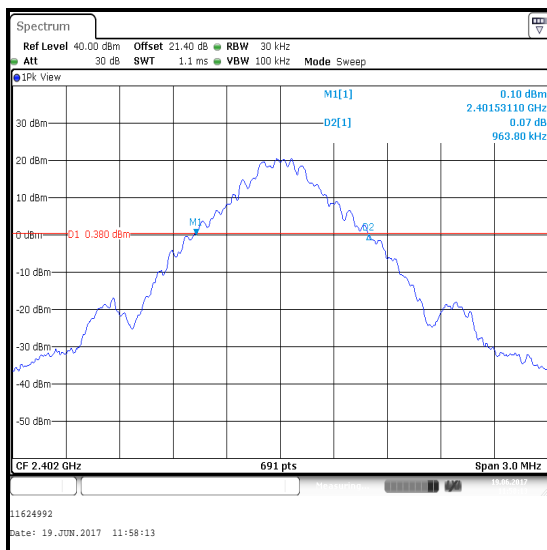
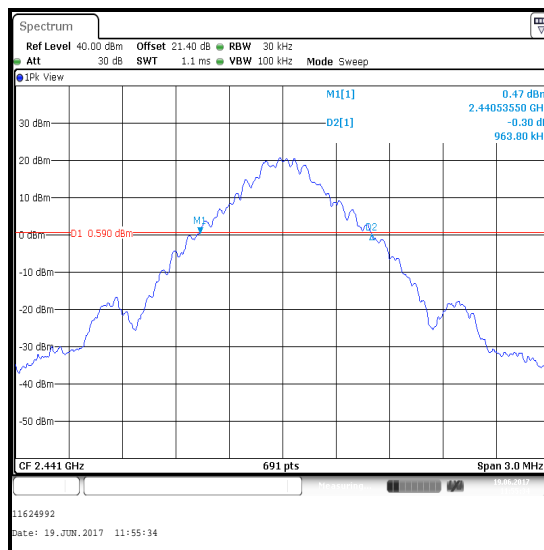
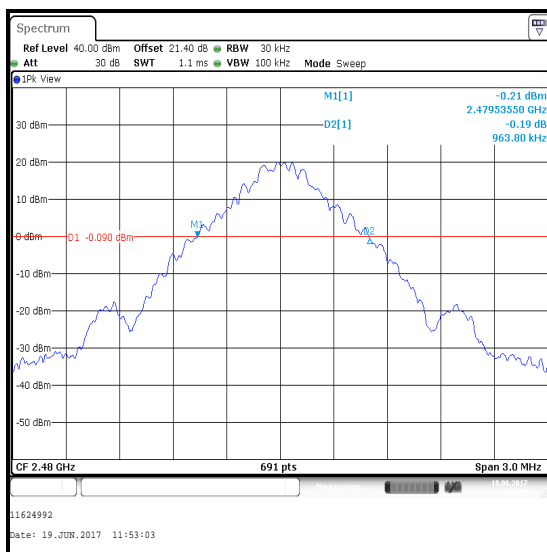
<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	50

#### **Note(s):**

1. The signal analyser 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.
2. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

**Transmitter 20 dB Bandwidth (continued)****Results DH5:**

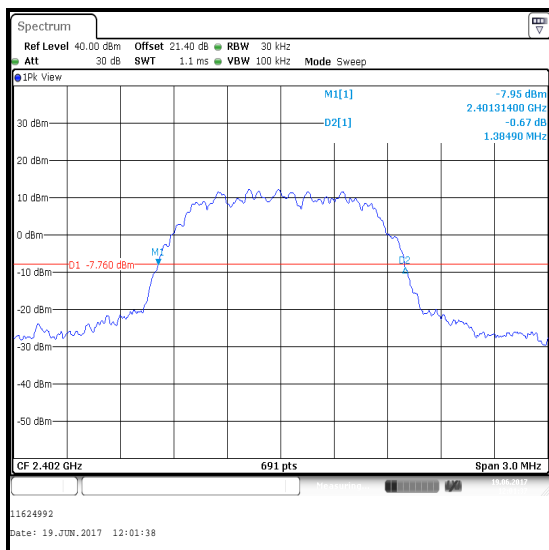
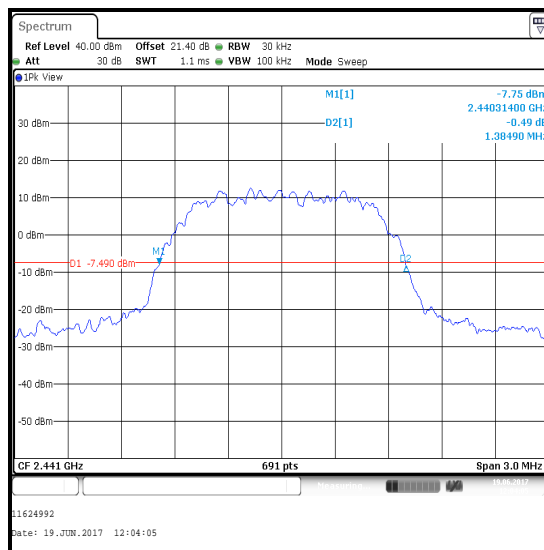
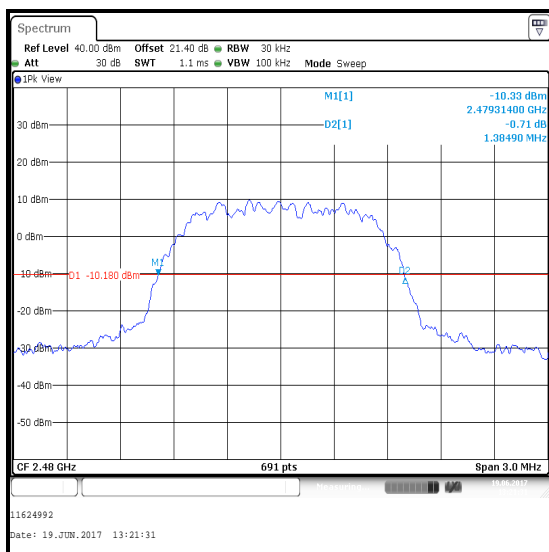
Channel	20 dB Bandwidth (kHz)
Bottom	963.800
Middle	963.800
Top	963.800

**Bottom Channel****Middle Channel****Top Channel**



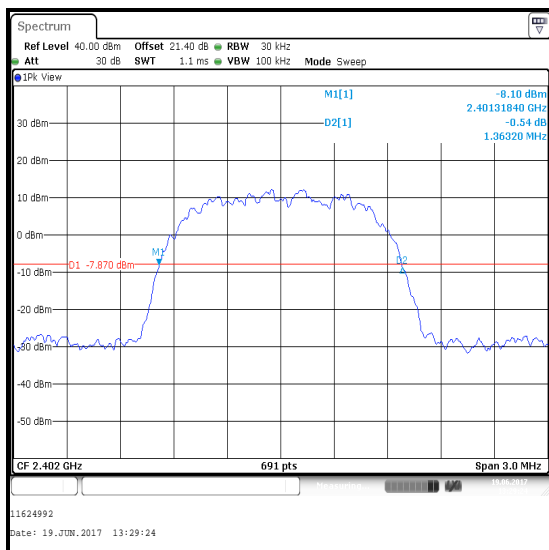
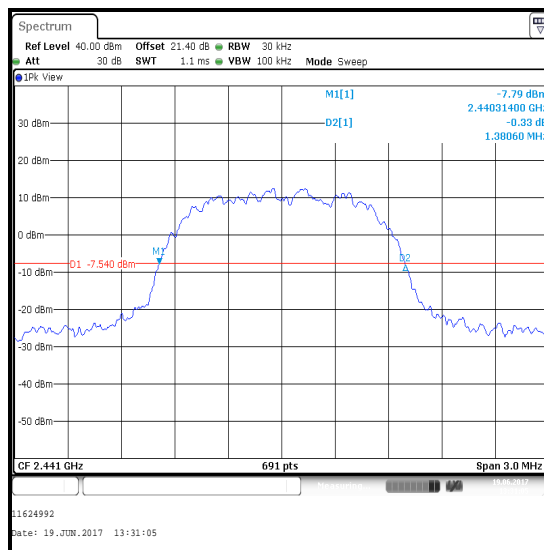
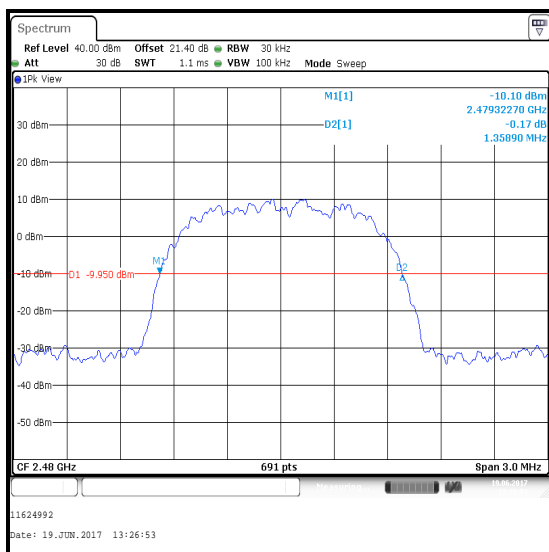
**Transmitter 20 dB Bandwidth (continued)****Results 2DH5:**

Channel	20 dB Bandwidth (kHz)
Bottom	1384.900
Middle	1384.900
Top	1384.900

**Bottom Channel****Middle Channel****Top Channel**

**Transmitter 20 dB Bandwidth (continued)****Results 3DH5:**

Channel	20 dB Bandwidth (kHz)
Bottom	1363.200
Middle	1380.600
Top	1358.900

**Bottom Channel****Middle Channel****Top Channel**

**4.2. Transmitter Carrier Frequency Separation****Test Summary:**

<b>Test Engineer:</b>	Stefan Ho	<b>Test Date:</b>	19 June 2017
<b>Test Sample Serial Number:</b>	C07TK015J4CK		

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

**Environmental Conditions:**

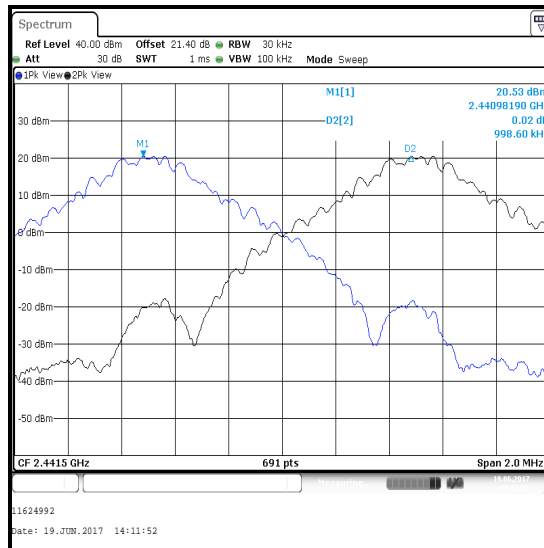
<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	50

**Note(s):**

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

**Transmitter Carrier Frequency Separation (continued)****Results: DH5**

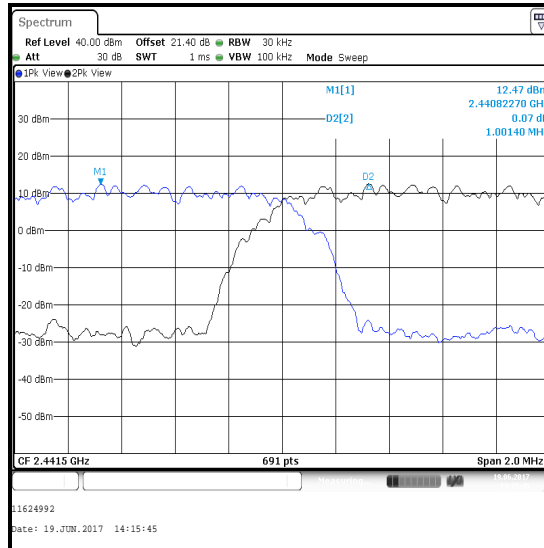
Carrier Frequency Separation (kHz)	Limit ( $2/3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
998.600	642.533	356.067	Complied



### Transmitter Carrier Frequency Separation (continued)

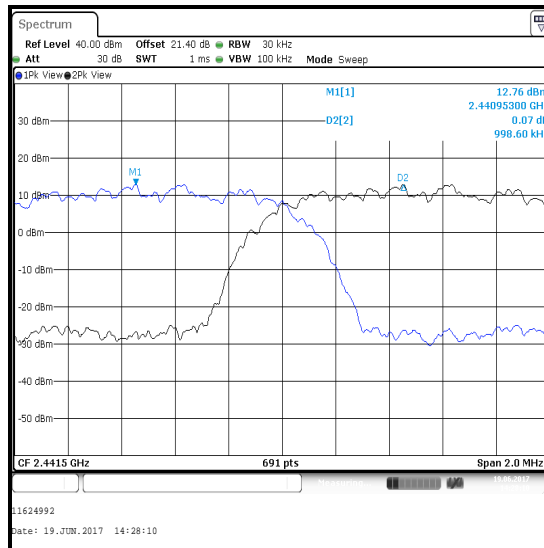
### Results: 2DH5

Carrier Frequency Separation (kHz)	Limit ( $2/3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
1001.400	923.267	78.133	Complied



**Transmitter Carrier Frequency Separation (continued)****Results: 3DH5**

Carrier Frequency Separation (kHz)	Limit ( $2/3$ of 20 dB BW) (kHz)	Margin (kHz)	Result
998.600	920.400	78.200	Complied



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

<b>Test Engineer:</b>	Stefan Ho	<b>Test Date:</b>	19 June 2017
<b>Test Sample Serial Number:</b>	C07TK015J4CK		

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

**Environmental Conditions:**

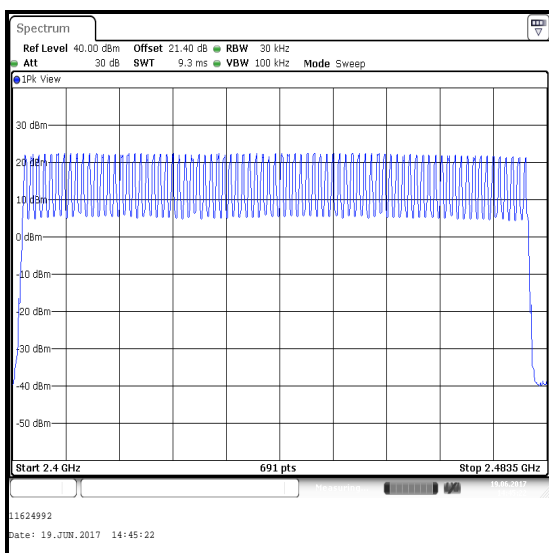
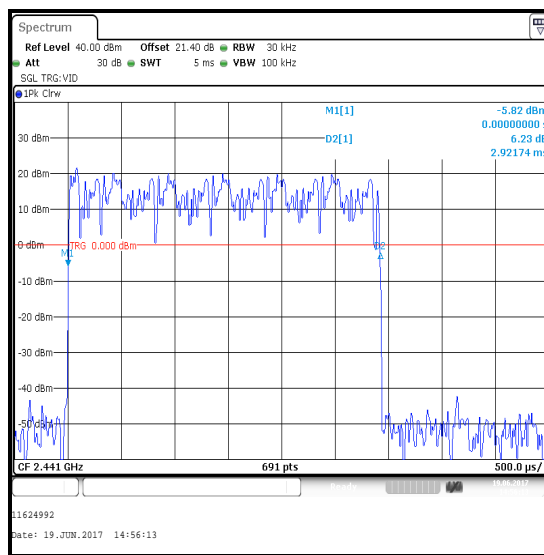
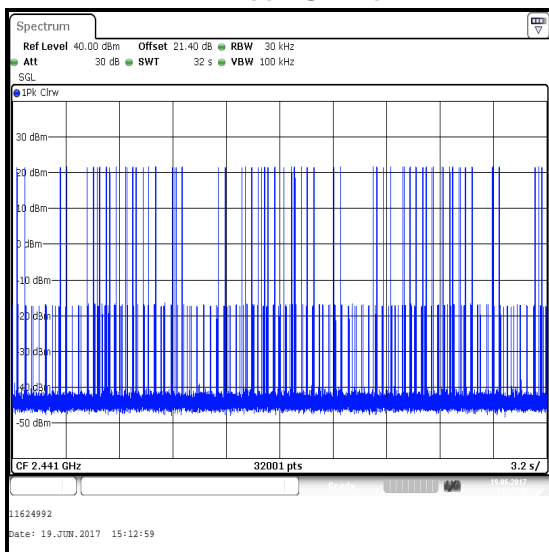
<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	50

**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 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 83.5 MHz.
3. The signal analyser was set up for the Emission Width measurement as follows: the resolution bandwidth was set to 30 kHz and video bandwidth of 100 kHz. A peak detector was used and sweep time was set to auto with a span of zero Hz. The test receiver was set to trigger at 0.5 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 30 kHz and video bandwidth of 100 kHz. A peak detector was used and sweep time was set to 32 seconds. The EUT was set to transmit in a hopping frequency mode with zero span. The total number of hopping frequencies was recorded in the table below.
5. The signal analyser 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)****Results:**

Emission Width ( $\mu$ s)	Number of Hops in 31.6 Seconds	Average Time of Occupancy (s)	Limit (s)	Margin (s)	Result
2921.740	105	0.307	0.4	0.093	Complied

**Number of Hopping Frequencies****Emission Width****Number of Hopping Frequencies in 32 s**



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

<b>Test Engineer:</b>	Stefan Ho	<b>Test Date:</b>	20 June 2017
<b>Test Sample Serial Number:</b>	C07TK015J4CK		

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

**Environmental Conditions:**

<b>Temperature (°C):</b>	21
<b>Relative Humidity (%):</b>	45

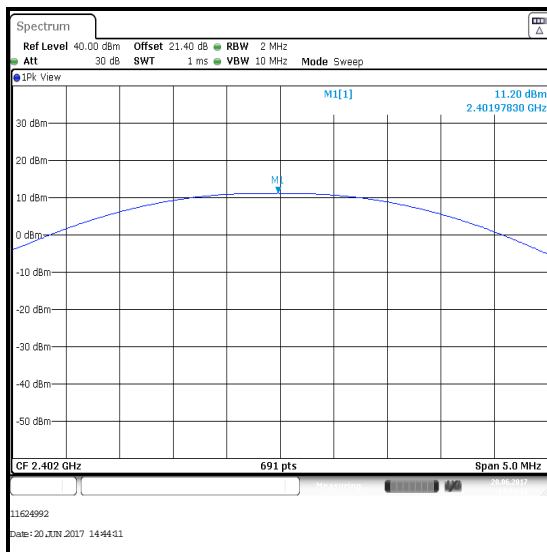
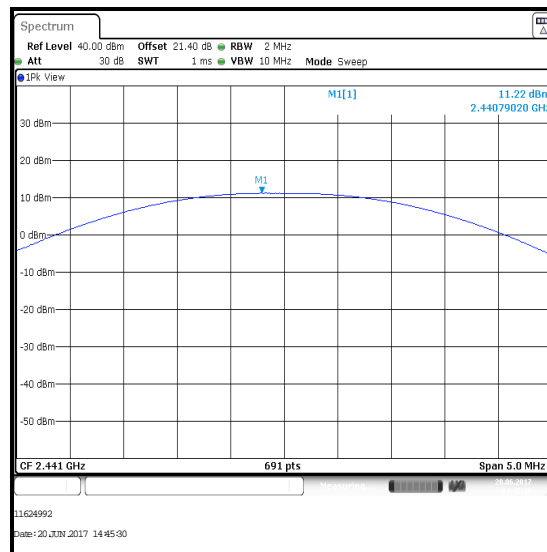
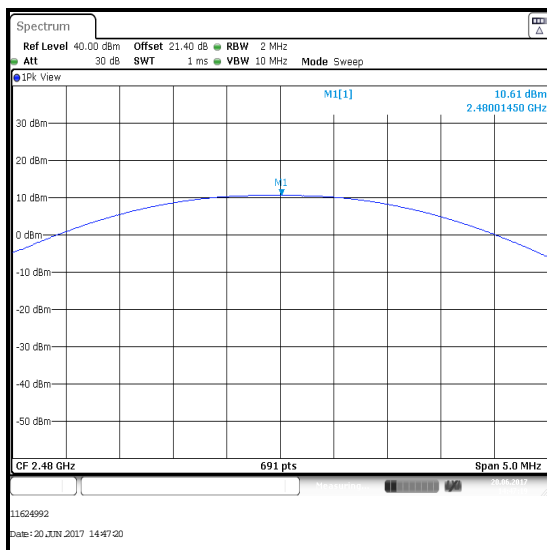
**Note(s):**

1. The signal analyser resolution bandwidth was set to 2 MHz (>20 dB bandwidth) and video bandwidth of 10 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 5.0 MHz (approximately five times the 20 dB bandwidth). A marker was placed at the peak of the signal and the results recorded in the tables below.
2. The declared antenna gain was added to the conducted peak power to obtain the EIRP.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF offset level was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

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

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	11.2	30.0	18.8	Complied
Middle	11.2	30.0	18.8	Complied
Top	10.6	30.0	19.4	Complied

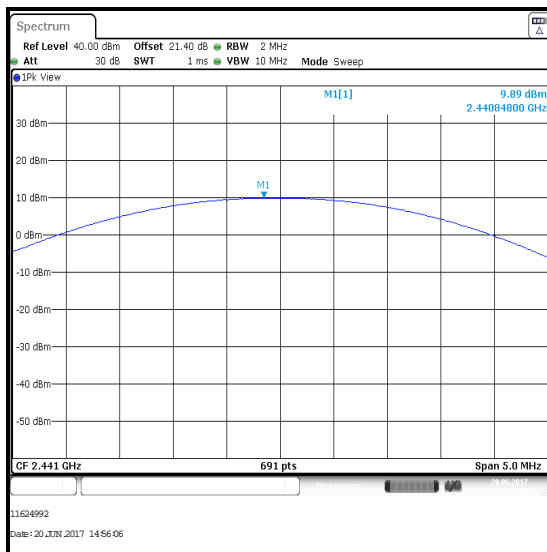
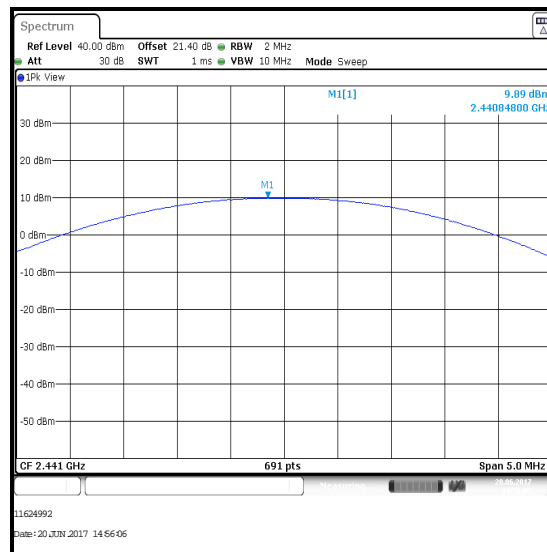
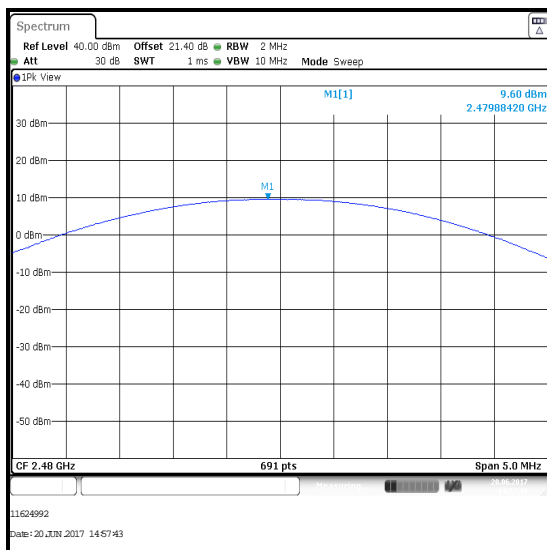
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.2	-0.1	11.1	36.0	24.9	Complied
Middle	11.2	-0.1	11.1	36.0	24.9	Complied
Top	10.6	-0.1	10.5	36.0	25.5	Complied

**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	9.9	21.0	11.1	Complied
Middle	9.9	21.0	11.1	Complied
Top	9.6	21.0	11.4	Complied

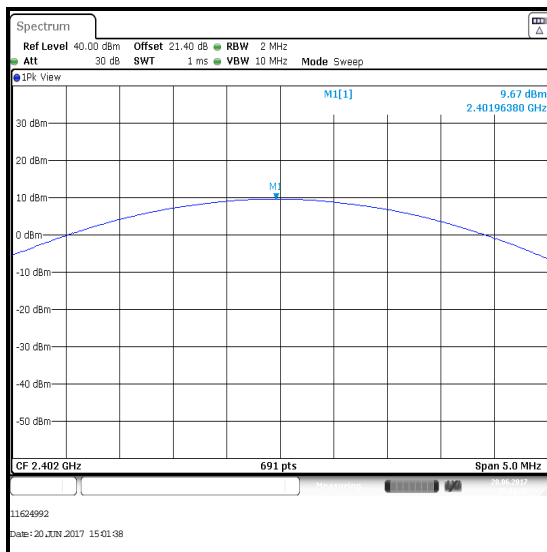
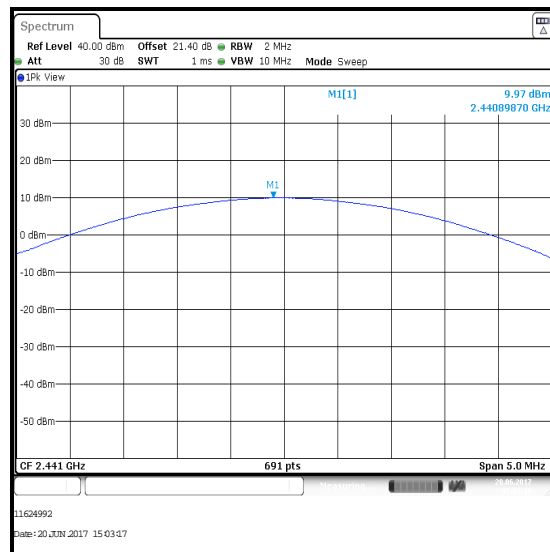
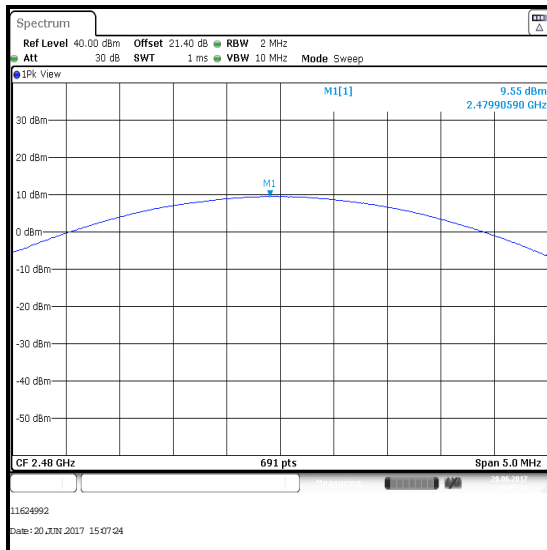
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	9.9	-0.1	9.8	27.0	17.2	Complied
Middle	9.9	-0.1	9.8	27.0	17.2	Complied
Top	9.6	-0.1	9.5	27.0	17.5	Complied

**Transmitter Maximum Peak Output Power (continued)****Results: 2DH5****Bottom Channel****Middle Channel****Top Channel**

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

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	9.7	21.0	11.3	Complied
Middle	10.0	21.0	11.0	Complied
Top	9.6	21.0	11.4	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	9.7	-0.1	9.6	27.0	17.4	Complied
Middle	10.0	-0.1	9.9	27.0	17.1	Complied
Top	9.6	-0.1	9.5	27.0	17.5	Complied

**Transmitter Maximum Peak Output Power (continued)****Results: 3DH5****Bottom Channel****Middle Channel****Top Channel**

## **5. Radiated Test Results**

### **5.1. Transmitter Radiated Emissions <1 GHz**

#### **Test Summary:**

<b>Test Engineers:</b>	Doug Freegard & Andrew Edwards	<b>Test Date:</b>	03 July 2017
<b>Test Sample Serial Number:</b>	C07TK007J4C6		

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

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	24
<b>Relative Humidity (%):</b>	44

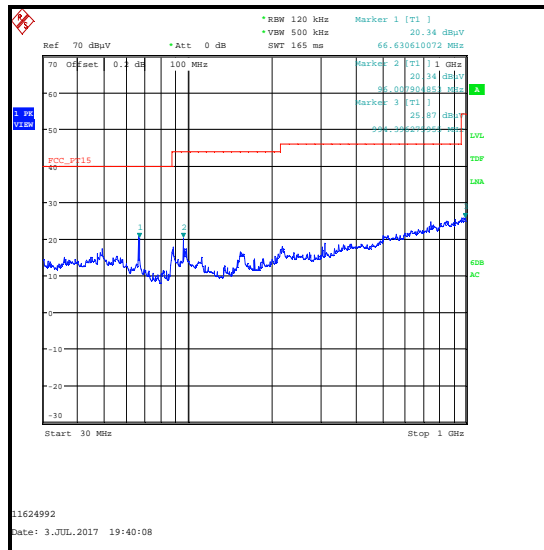
#### **Note(s):**

1. Transmitter radiated spurious emissions tests were performed with the EUT transmitting in DH5 mode as this was found to transmit the highest power and therefore deemed worst case.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the middle channel only.
4. All emissions shown on the pre-scan plot were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement system noise floor. Therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
5. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number 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.



**Transmitter Radiated Emissions (continued)****Results: Peak / DH5**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
994.396	Vertical	25.9	54.0	28.1	Complied



## 5.2. Transmitter Radiated Emissions >1 GHz

### Test Summary:

Test Engineers:	Alan Withers & David Doyle	Test Dates:	11 May 2017 & 04 July 2017
Test Sample Serial Number:	C07TK026J4C7		

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 to 24
Relative Humidity (%):	39 to 44

### Note(s):

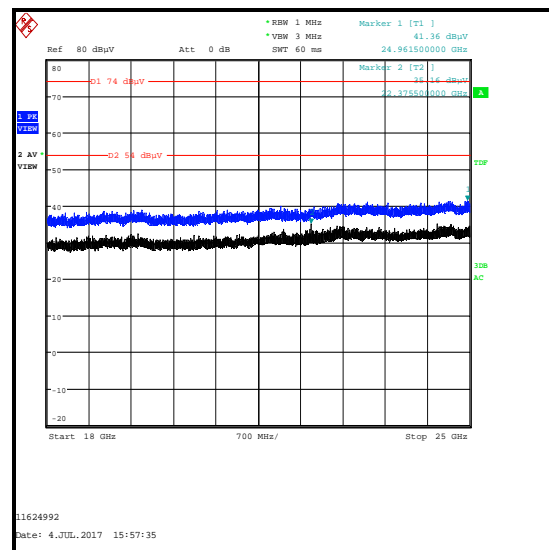
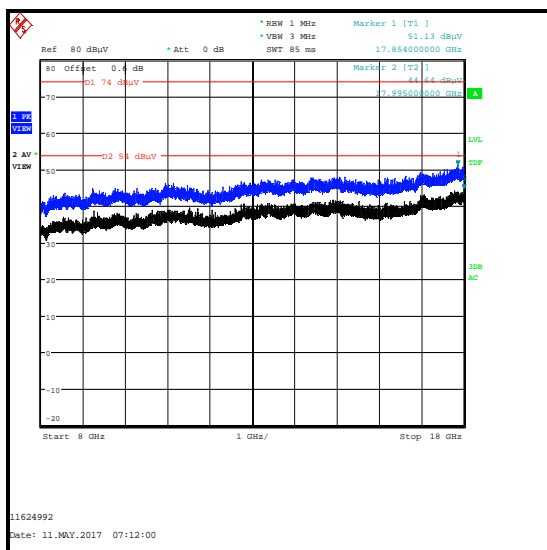
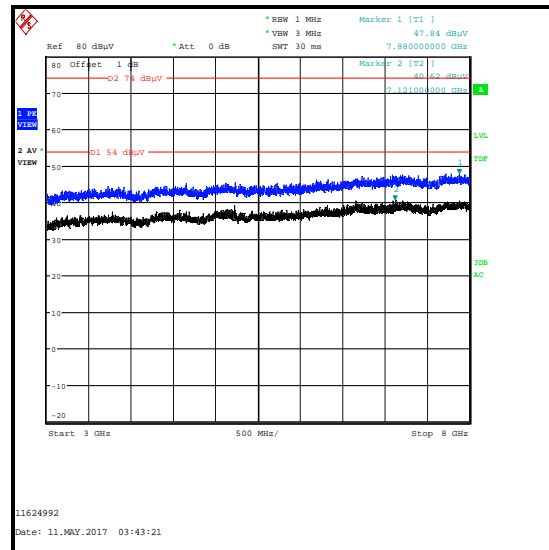
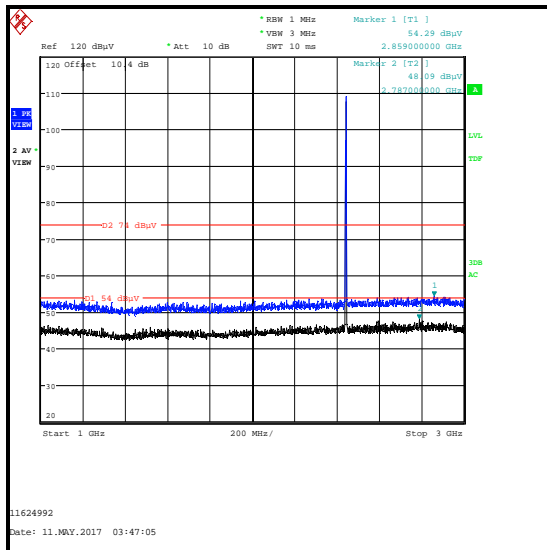
1. Transmitter radiated spurious emissions tests were performed with the EUT transmitting in DH5 mode as this was found to transmit the highest power and therefore deemed worst case.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. The emission shown on the 1 GHz to 4 GHz plot is the EUT fundamental at 2441 MHz.
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. 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.
6. Pre-scans above 1 GHz were performed in a fully 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. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.
7. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. The sweep time was set to auto. Peak and average measurements were performed with their own appropriate detectors during the pre-scan measurements.

### Results: Peak / Middle Channel / DH5

Frequency (MHz)	Antenna Polarity	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)	Result
2859.000	Vertical	54.3	74.0	19.7	Complied

### Results: Average / Middle Channel / DH5

Frequency (MHz)	Antenna Polarity	Average Level (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)	Result
2787.000	Vertical	48.1	54.0	5.9	Complied

**Transmitter Radiated Emissions (continued)**

### **5.3. Transmitter Band Edge Radiated Emissions**

#### **Test Summary:**

<b>Test Engineer:</b>	John Ferdinand	<b>Test Date:</b>	17 May 2017
<b>Test Sample Serial Number:</b>	C07TK02MJ4C7		

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

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	24
<b>Relative Humidity (%):</b>	48

#### **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 is adjacent to 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 is adjacent to 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 (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400.000	Horizontal	47.5	86.0*	38.5	Complied
2483.500	Horizontal	51.3	74.0	22.7	Complied
2492.394	Horizontal	52.5	74.0	21.5	Complied

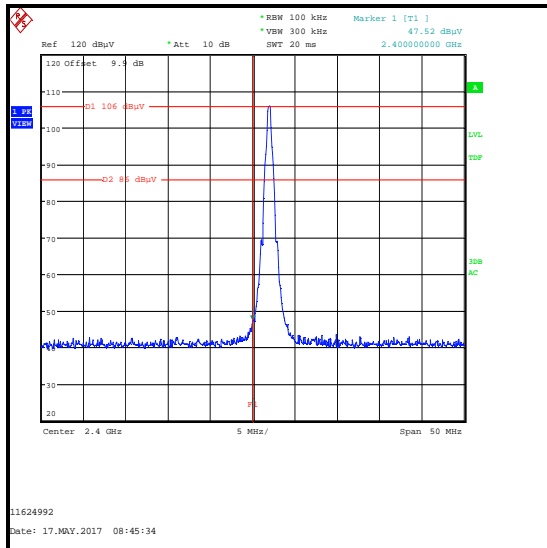
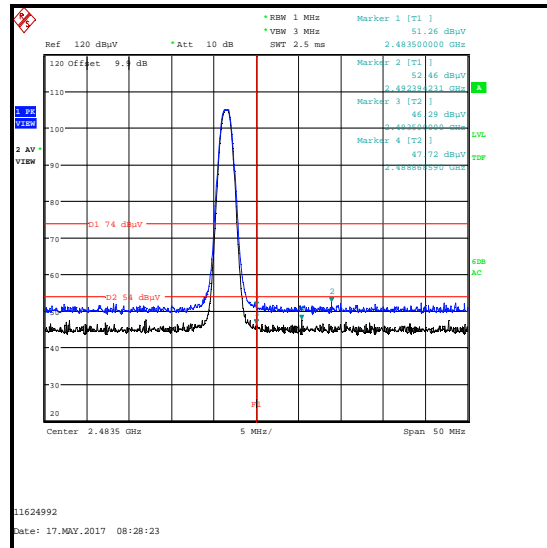
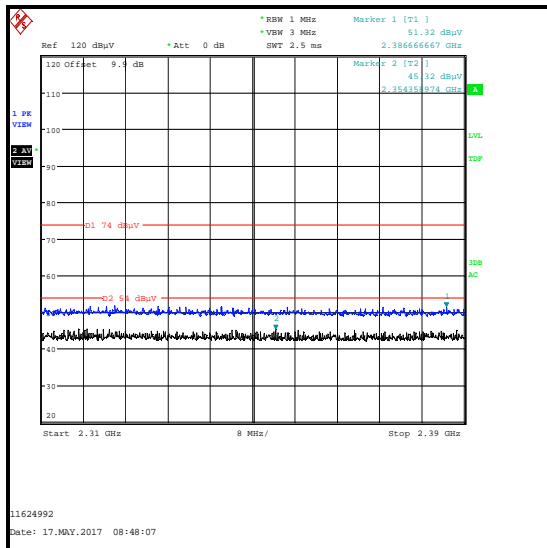
Frequency (MHz)	Antenna Polarity	Average Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.500	Horizontal	46.3	54.0	7.7	Complied
2488.869	Horizontal	47.7	54.0	6.3	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2386.667	Horizontal	51.3	74.0	22.7	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2354.359	Horizontal	45.3	54.0	8.7	Complied

**Transmitter Band Edge Radiated Emissions (continued)****Results: Static Mode / DH5****Lower Band Edge****Upper Band Edge****2310 MHz to 2390 MHz Restricted Band**

**Transmitter Band Edge Radiated Emissions (continued)****Results: Hopping Mode / DH5**

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400.000	Horizontal	41.8	85.6*	43.8	Complied
2483.500	Horizontal	50.9	74.0	23.1	Complied
2484.702	Horizontal	51.9	74.0	22.1	Complied

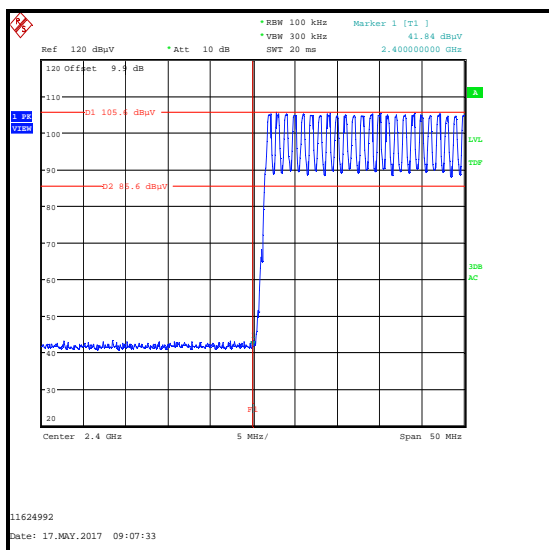
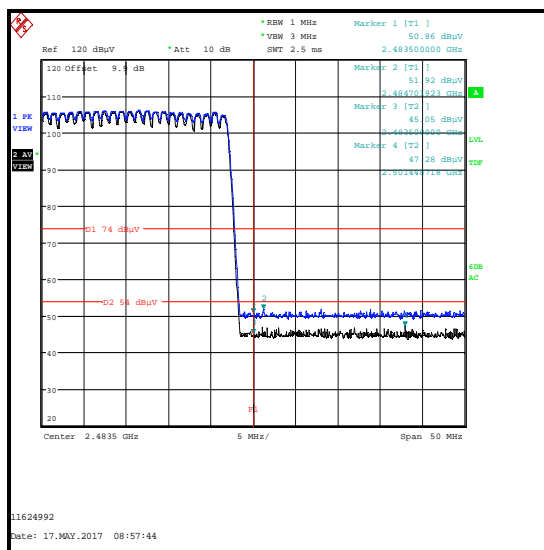
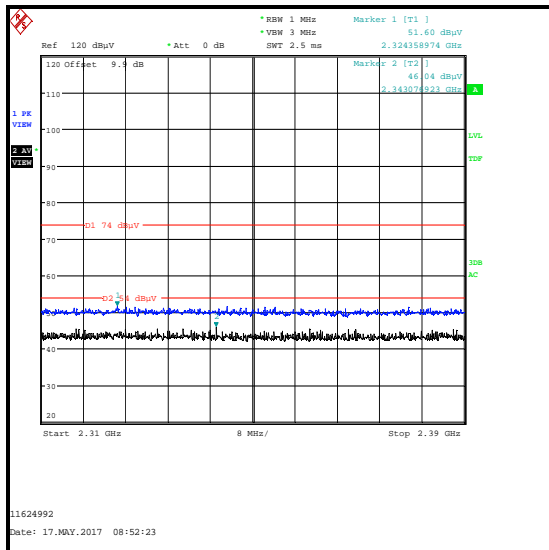
Frequency (MHz)	Antenna Polarity	Average Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.500	Horizontal	45.1	54.0	8.9	Complied
2501.449	Horizontal	47.3	54.0	6.7	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2324.359	Horizontal	51.6	74.0	22.4	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2343.077	Horizontal	46.0	54.0	8.0	Complied

**Transmitter Band Edge Radiated Emissions (continued)****Results: Hopping Mode / DH5****Lower Band Edge****Upper Band Edge****2310 MHz to 2390 MHz Restricted Band**



**Transmitter Band Edge Radiated Emissions (continued)****Results: Static Mode / 2DH5**

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2399.519	Horizontal	55.6	83.5*	27.9	Complied
2400.000	Horizontal	53.3	83.5*	30.2	Complied
2483.500	Horizontal	50.2	74.0	23.8	Complied

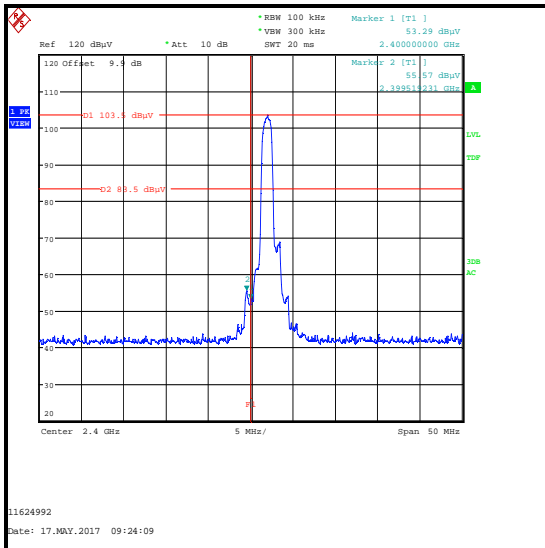
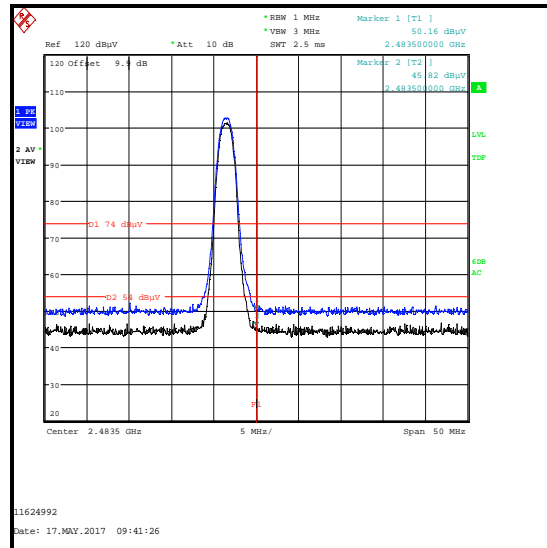
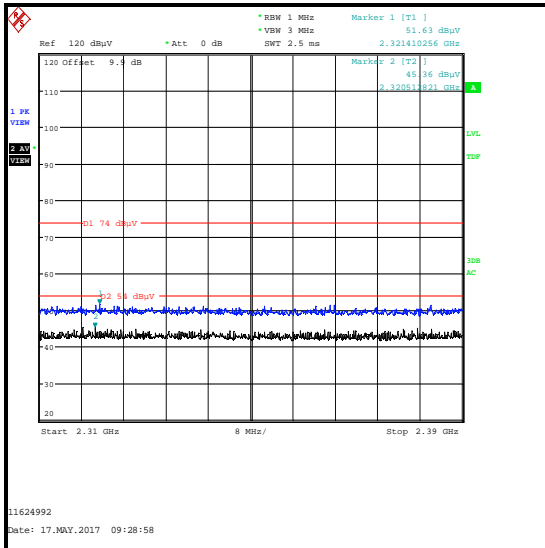
Frequency (MHz)	Antenna Polarity	Average Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.500	Horizontal	45.8	54.0	8.2	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2321.410	Horizontal	51.6	74.0	22.4	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2320.513	Horizontal	45.4	54.0	8.6	Complied

**Transmitter Band Edge Radiated Emissions (continued)****Results: Static Mode / 2DH5****Lower Band Edge****Upper Band Edge****2310 MHz to 2390 MHz Restricted Band**

**Transmitter Band Edge Radiated Emissions (continued)****Results: Hopping Mode / 2DH5**

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400.000	Horizontal	43.1	82.7*	39.6	Complied
2483.500	Horizontal	50.3	74.0	23.7	Complied
2489.670	Horizontal	51.8	74.0	22.2	Complied

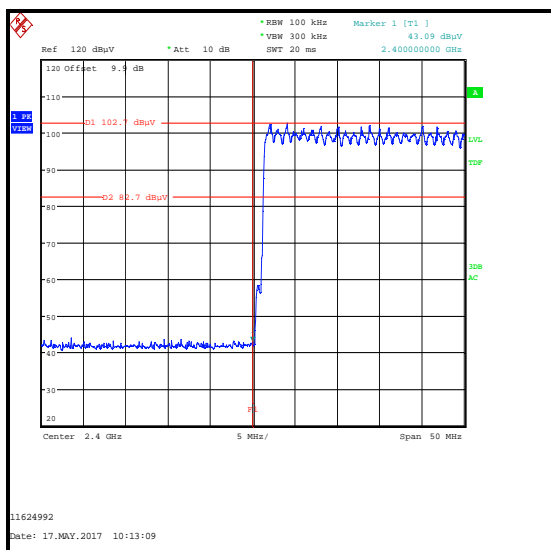
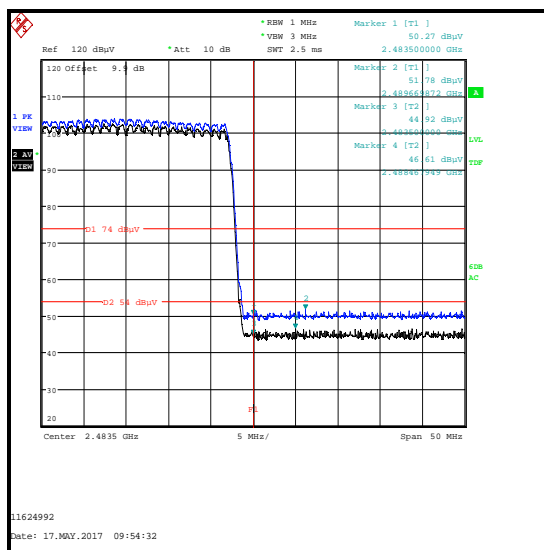
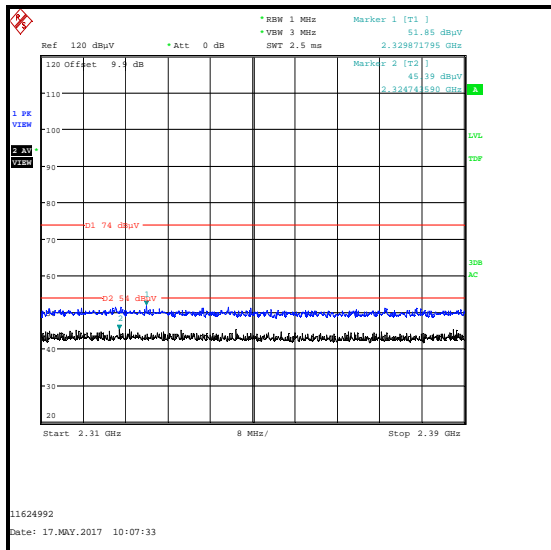
Frequency (MHz)	Antenna Polarity	Average Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.500	Horizontal	44.9	54.0	9.1	Complied
2488.468	Horizontal	46.6	54.0	7.4	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2329.872	Horizontal	51.9	74.0	22.1	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2324.744	Horizontal	45.4	54.0	8.6	Complied

**Transmitter Band Edge Radiated Emissions (continued)****Results: Hopping Mode / 2DH5****Lower Band Edge****Upper Band Edge****2310 MHz to 2390 MHz Restricted Band**

**Transmitter Band Edge Radiated Emissions (continued)****Results: Static Mode / 3DH5**

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2399.599	Horizontal	56.0	83.5*	27.5	Complied
2400.000	Horizontal	52.6	83.5*	30.9	Complied
2483.500	Horizontal	50.9	74.0	23.1	Complied

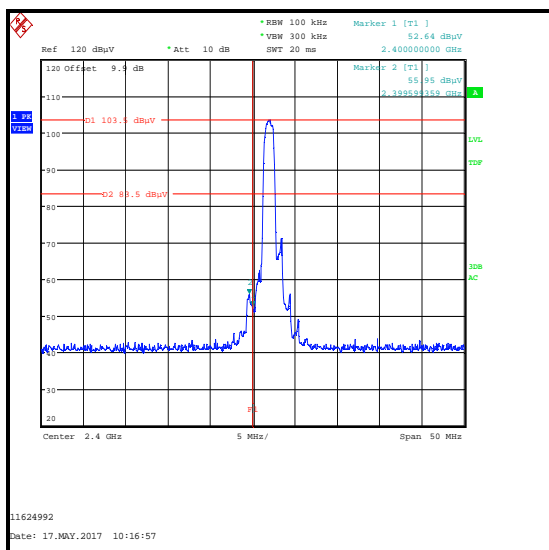
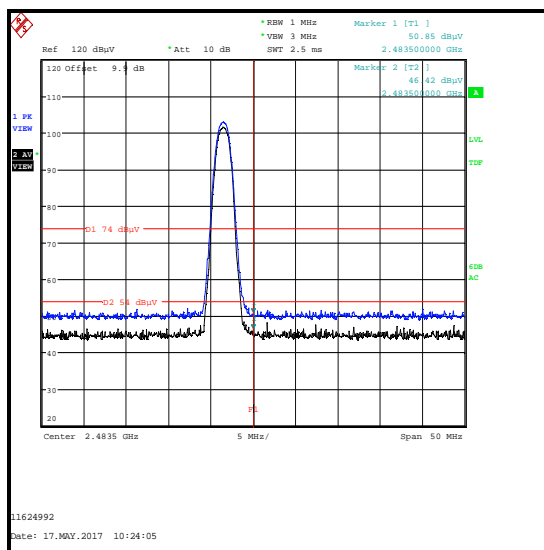
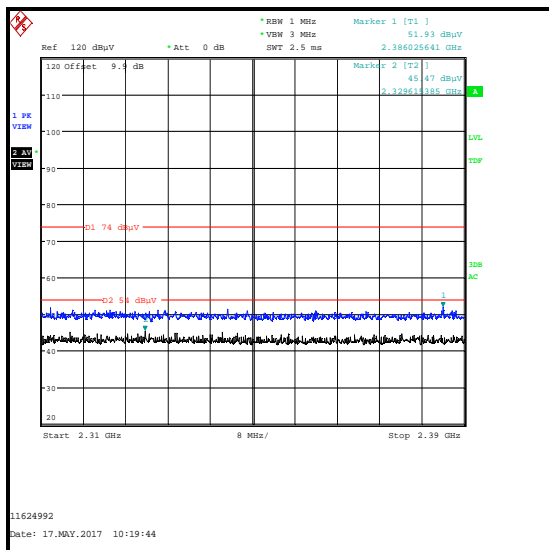
Frequency (MHz)	Antenna Polarity	Average Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.500	Horizontal	46.4	54.0	7.6	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2386.026	Horizontal	51.9	74.0	22.1	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2329.615	Horizontal	45.5	54.0	8.5	Complied

**Transmitter Band Edge Radiated Emissions (continued)****Results: Static Mode / 3DH5****Lower Band Edge****Upper Band Edge****2310 MHz to 2390 MHz Restricted Band**

**Transmitter Band Edge Radiated Emissions (continued)****Results: Hopping Mode / 3DH5**

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2399.760	Horizontal	48.9	84.2*	35.3	Complied
2400.000	Horizontal	44.7	84.2*	39.5	Complied
2483.500	Horizontal	50.2	74.0	23.8	Complied
2497.042	Horizontal	52.2	74.0	21.8	Complied

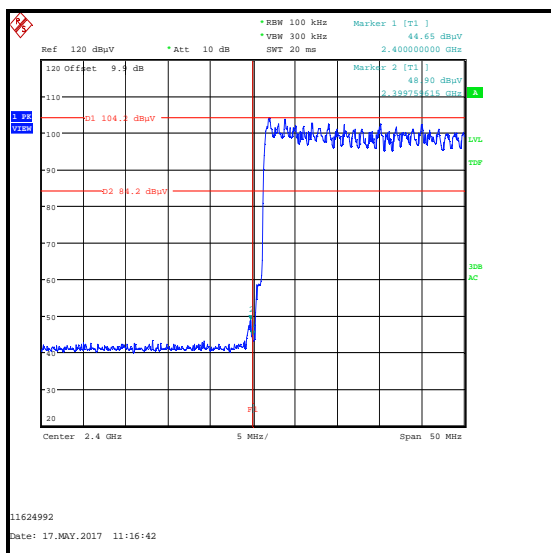
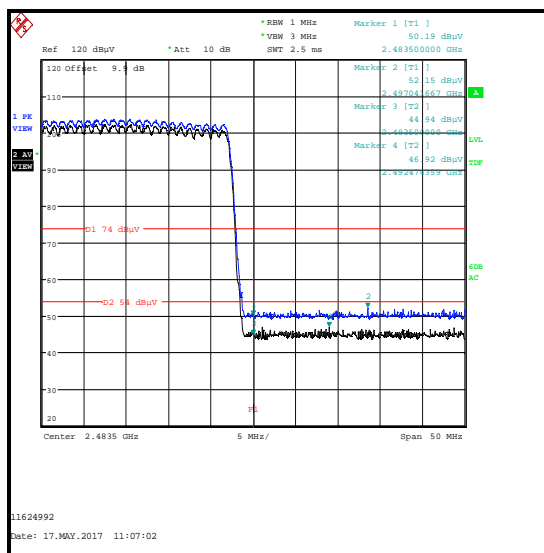
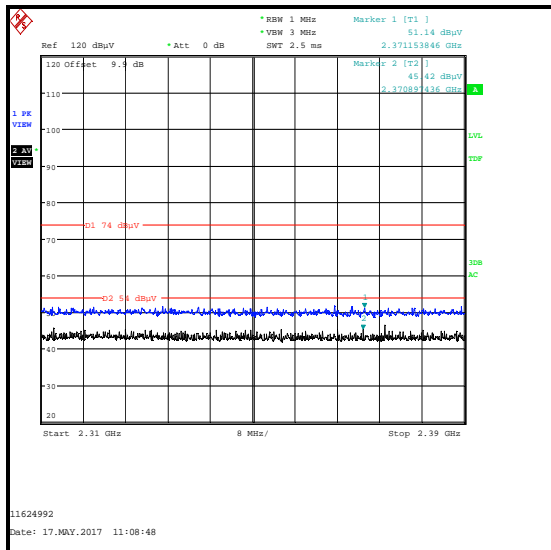
Frequency (MHz)	Antenna Polarity	Average Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.500	Horizontal	44.9	54.0	9.1	Complied
2492.474	Horizontal	46.9	54.0	7.1	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2371.154	Horizontal	51.1	74.0	22.9	Complied

**Results: 2310 MHz to 2390 MHz Restricted Band / Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2370.897	Horizontal	45.4	54.0	8.6	Complied

**Transmitter Band Edge Radiated Emissions (continued)****Results: Hopping Mode / 3DH5****Lower Band Edge****Upper Band Edge****2310 MHz to 2390 MHz Restricted Band****--- END OF REPORT ---**