



# TEST REPORT

**Test Report No. :** UL-RPT-RP12723241-116A V2.0

**Customer** : Onespan North America Inc.

**Model No.** : Digipass® 785

**FCC ID** : 2AH88-785

**Technology** : *Bluetooth* – Low Energy

**Test Standard(s)** : FCC Parts 15.207, 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:** 19 September 2019

**Checked by:**

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**Customer Information**

<b>Company Name:</b>	OneSpan North America Inc.
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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	16/09/2019	Initial Version	Ben Mercer
2.0	19/09/2019	Sections 1.2, 2.4 & 5.1 updated	Ben Mercer

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## 1. Attestation of Test Results








### 1.1. Description of EUT

The equipment under test was a FIDO (Fast IDentity Online) Authenticator for PCs and other mobile devices supporting USB or BLE (*Bluetooth* Low Energy).

### 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>	47CFR15.207 and 47CFR15.209
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Sections 15.207 & 15.209
<b>Site Registration:</b>	621311
<b>Location of Testing:</b>	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, G24 8AH, United Kingdom
<b>Test Dates:</b>	12 March 2019 to 17 September 2019

### 1.3. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	
Part 15.35(c)	Transmitter Duty Cycle	Note 1
Part 15.247(b)(3)	Transmitter Maximum Peak Output Power	
Part 15.247(e)	Transmitter Power Spectral Density	Note 2
Part 15.247(d)/15.209(a)	Transmitter Radiated Emissions	
Part 15.247(d)/15.209(a)	Transmitter Band Edge Radiated Emissions	
Part 15.207	Transmitter AC Conducted Emissions	
<b>Key to Results</b>		
 = Complied  = Did not comply		

#### Note(s):

- The measurement was performed to assist in the calculation of the level of the emissions. The EUT cannot transmit continuously and sweep triggering/signal gating cannot be implemented.
- In accordance with ANSI C63.10 Section 11.10.1, PSD measurements are not required if the maximum conducted output power is less than the PSD limit of 8 dBm / 3 kHz. The PSD level is therefore deemed be equal to the measured output power.

### 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	X
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
<b>Reference:</b>	KDB 558074 D01 15.247 Meas Guidance v05r02 April 2, 2019
<b>Title:</b>	Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules
<b>Reference:</b>	KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
<b>Title:</b>	AC Power-Line Conducted Emissions Frequently Asked Questions

## **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".

<b>Measurement Type</b>	<b>Range</b>	<b>Confidence Level (%)</b>	<b>Calculated Uncertainty</b>
Duty Cycle	2.4 GHz to 2.4835 GHz	95%	±1.14 %
Minimum 6 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±4.59 %
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%	±4.65 dB
Radiated Spurious Emissions	1 GHz to 25 GHz	95%	±2.94 dB
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±1.96 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 Conducted Tests**

<b>Asset No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval (Months)</b>
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100675	16 Jan 2020	12
G0628	Signal Generator	Rohde & Schwarz	SMBV100A	261847	01 Sep 2020	36
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	20 Apr 2020	24
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	20 Apr 2020	24
A2525	Attenuator	AtlanTecRF	AN18W5-10	832827#3	Calibrated before use	-
M2042	Thermohygrometer	Testo	608-H1	45124926	06 Jan 2020	12

### **Test Equipment Used for Transmitter Radiated Emissions Tests**

<b>Asset No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval (Months)</b>
M2003	Thermohygrometer	Testo	608-H1	45046641	06 Jan 2020	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	16 Feb 2020	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	10 Aug 2019	12
A2948	Pre Amplifier	Com-Power	PAM-118A	551087	12 Feb 2020	12
A2943	Attenuator	AtlanTecRF	AN18W5-06	208147#2	28 Feb 2020	12
A2889	Antenna	Schwarzbeck	BBHA 9120B	BBHA 9120 B653	12 Feb 2020	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	12 Feb 2020	12
A3142	Pre Amplifier	Schwarzbeck	BBV 9718 B	00020	12 Feb 2020	12
M2040	Thermohygrometer	Testo	608-H1	45124934	06 Jan 2020	12
K0001	3m RSE Chamber	Rainford	N/A	N/A	04 Oct 2019	12
M2044	Test Receiver	Rohde & Schwarz	ESU26	100122	01 Apr 2020	12
A3154	Pre Amplifier	Com-Power	PAM-103	18020012	14 Sep 2019	12
A553	Antenna	Chase	CBL6111A	1593	08 Oct 2019	12
A2895	Antenna	Schwarzbeck	BBHA 9170	9170-728	08 Feb 2020	12
A2896	Pre Amplifier	Schwarzbeck	BBV 9721	9721-023	08 Feb 2020	12
M2040	Thermohygrometer	Testo	608-H1	45124934	06 Jan 2020	12
A3198	Magnetic Loop Antenna	ETS-Lindgren	6502	00221887	27 Mar 2020	12

**Test and Measurement Equipment (continued)****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	Testo	608-H1	45046641	06 Jan 2020	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	16 Feb 2020	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	10 Aug 2019	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	20 Feb 2020	12
A2948	Pre Amplifier	Com-Power	PAM-118A	551087	12 Feb 2020	12
A2889	Antenna	Schwarzbeck	BBHA 9120B	BBHA 9120 B653	12 Feb 2020	12

**Test Equipment Used for Transmitter AC Conducted Emissions**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2037	Thermohygrometer	Testo	608-H1	45124925	06 Jan 2020	12
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	08 Aug 2020	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	10 Apr 2020	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	18 Dec 2019	12

**Test Measurement Software/Firmware Used:**

Name	Version	Release Date
Rohde & Schwarz EMC32	6.30.0	2008



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

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

<b>Brand Name:</b>	OneSpan
<b>Model Name or Number:</b>	Digipass® 785
<b>Test Sample Serial Number:</b>	Not marked or stated ( <i>Conducted Sample</i> )
<b>Hardware Version:</b>	1.3
<b>Software Version:</b>	Build FCC 2018/10/01
<b>FCC ID:</b>	2AH88-785

<b>Brand Name:</b>	OneSpan
<b>Model Name or Number:</b>	Digipass® 785
<b>Test Sample Serial Number:</b>	Not marked or stated ( <i>Radiated Sample</i> )
<b>Hardware Version:</b>	1.3
<b>Software Version:</b>	Build FCC 2018/10/01
<b>FCC ID:</b>	2AH88-785

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

No modifications were applied to the EUT during testing.

**3.3. Additional Information Related to Testing**

<b>Technology Tested:</b>	<i>Bluetooth</i> Low Energy (Digital Transmission System)		
<b>Type of Unit:</b>	Transceiver		
<b>Channel Spacing:</b>	2 MHz		
<b>Modulation:</b>	GFSK		
<b>Data Rate: LE</b>	1 Mbps		
<b>Power Supply Requirement(s):</b>	Nominal	5.0 VDC	
<b>Maximum Conducted Output Power:</b>	-17.2 dBm		
<b>Transmit Frequency Range:</b>	2402 MHz to 2480 MHz		
<b>Transmit Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	Bottom	37	2402
	Middle	17	2440
	Top	39	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	-2.0

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

#### **Support Equipment**

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

<b>Description:</b>	AC Charger
<b>Brand Name:</b>	Flew Dual USB
<b>Model Name or Number:</b>	EY1606POFLO
<b>Serial Number:</b>	None stated

#### **Operating Modes**

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

- Transmitting at maximum power in *Bluetooth* LE mode with modulation, maximum possible data length available and Pseudorandom Bit Sequence 9.

#### **Configuration and Peripherals**

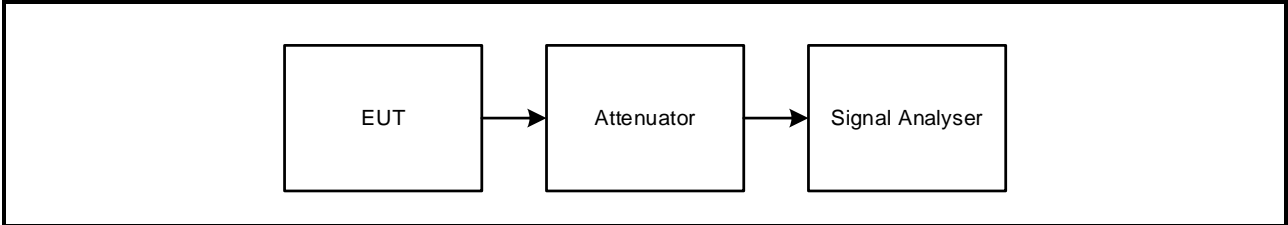
The EUT was tested in the following configuration(s):

- Controlled in test mode using test firmware on the EUT. The firmware was used to enable a continuous transmission and to select the test channels as required. The customer supplied a document containing the setup instructions 'DP785FIDO\_FCC\_Instructions\_V02.pdf' dated 12 March 2019.
- Powered by fully charged internal battery. The battery voltage was monitored throughout testing.
- For AC conducted emissions tests, the EUT was powered by its AC charger connected to a 120/240 VAC single phase mains supply.
- Radiated spurious emissions were performed with the EUT in the worst case position/orientation with respect to emissions. There were no ports to terminate.

**Test Setup Diagrams**

**Conducted Tests:**

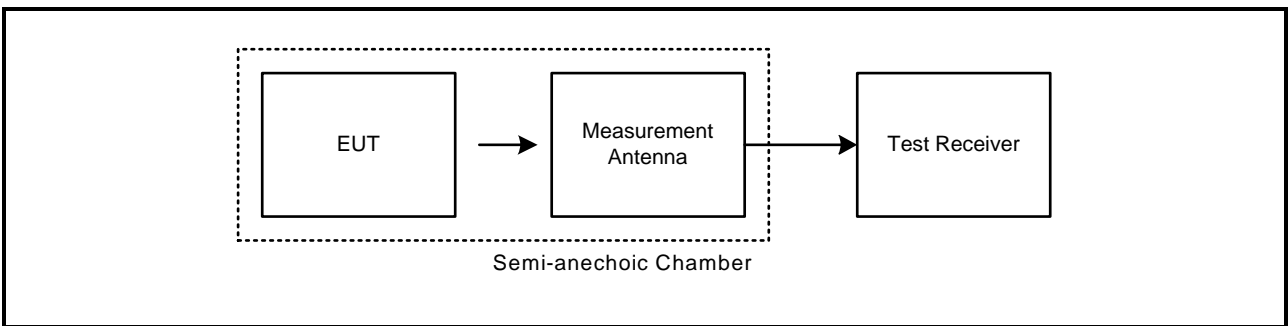
**Test Setup for Transmitter Minimum 6 dB Bandwidth, Duty Cycle & Maximum Peak Output Power**



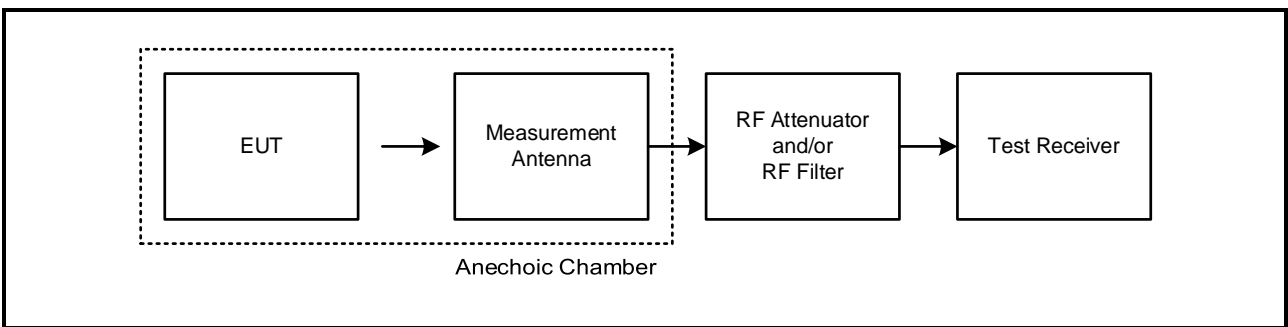
**Radiated Tests:**

**Test Setup for Transmitter Radiated Emissions**

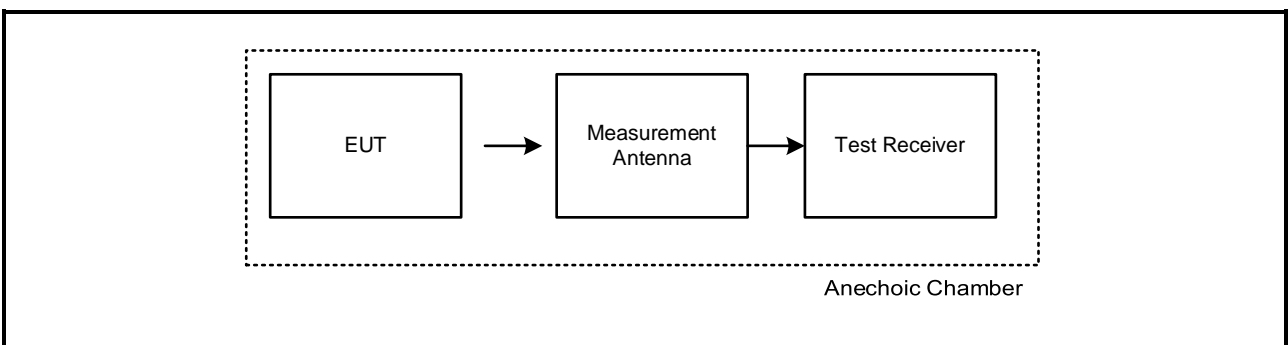
**Radiated Measurements < 1GHz**



**Radiated Measurements > 1GHz to 18 GHz**

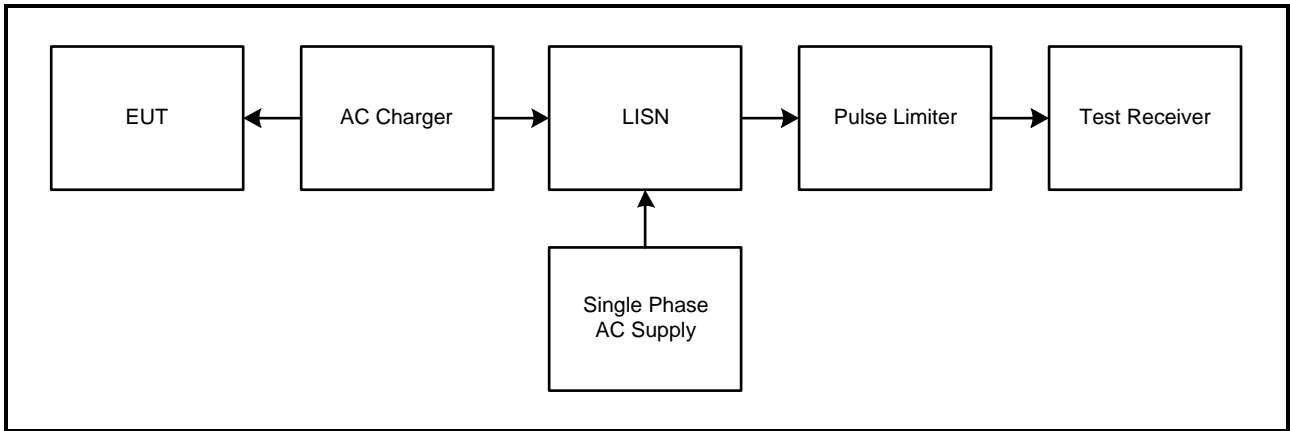


**Radiated Measurements > 18 GHz to 25 GHz**



**Test Setup Diagrams (continued)**

**Test Setup for Transmitter AC Conducted Emissions**



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

### **4.1. Transmitter Minimum 6 dB Bandwidth**

#### **Test Summary:**

<b>Test Engineer:</b>	Victor Carmon	<b>Test Date:</b>	18 March 2019
<b>Test Sample Serial Number:</b>	Not marked or stated		

<b>FCC Reference:</b>	Part 15.247(a)(2)
<b>Test Method Used:</b>	FCC KDB 558074 Section 8.2 referencing ANSI C63.10 Section 11.8.1

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	20
<b>Relative Humidity (%):</b>	36

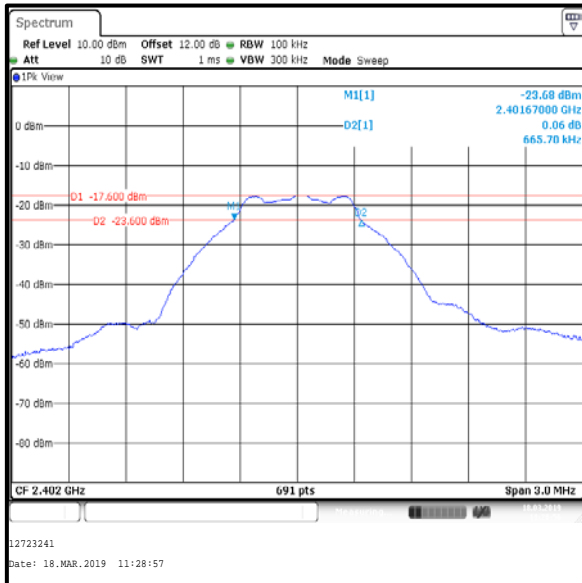
#### **Note(s):**

1. 6 dB DTS bandwidth tests were performed using a signal analyser in accordance with ANSI C63.10 Section 11.8.1 Option 1 measurement procedure. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The DTS bandwidth was measured at 6 dB down from the peak of the signal.
2. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

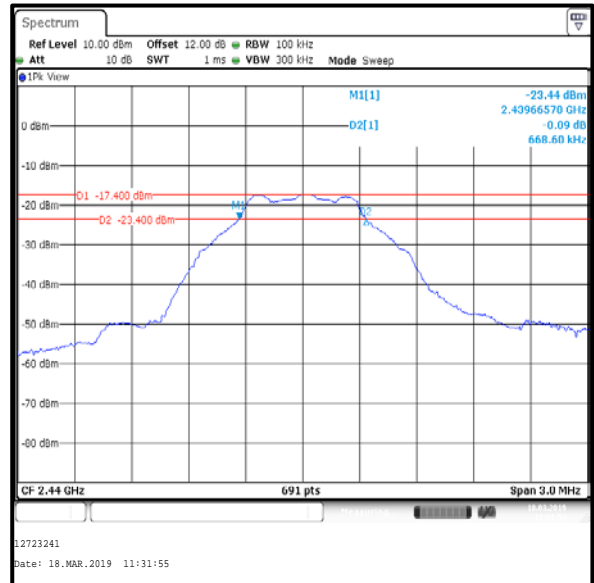
**Transmitter Minimum 6 dB Bandwidth (continued)**

**Results:**

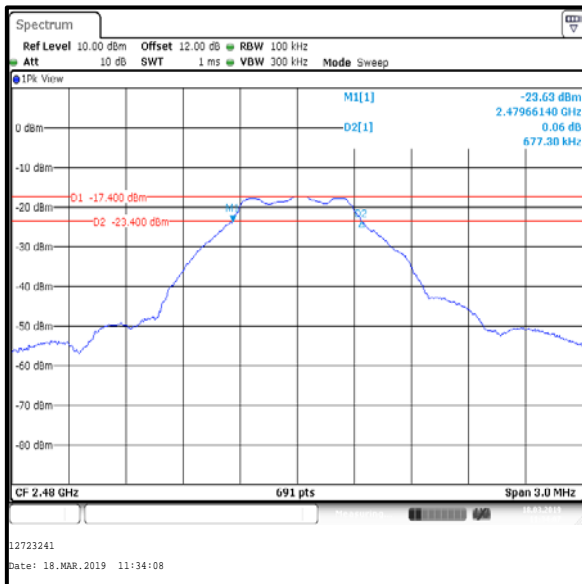
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	665.700	≥500	165.700	Complied
Middle	668.600	≥500	168.600	Complied
Top	677.300	≥500	177.300	Complied



**Bottom Channel**



**Middle Channel**



**Top Channel**

## 4.2. Transmitter Duty Cycle

### Test Summary:

<b>Test Engineer:</b>	Victor Carmon	<b>Test Date:</b>	18 March 2019
<b>Test Sample Serial Number:</b>	Not marked or stated		

<b>FCC Reference:</b>	Part 15.35(c)
<b>Test Method Used:</b>	FCC KDB 558074 Section 6 referencing ANSI C63.10 Section 11.6

### Environmental Conditions:

<b>Temperature (°C):</b>	20
<b>Relative Humidity (%):</b>	36

### Note(s):

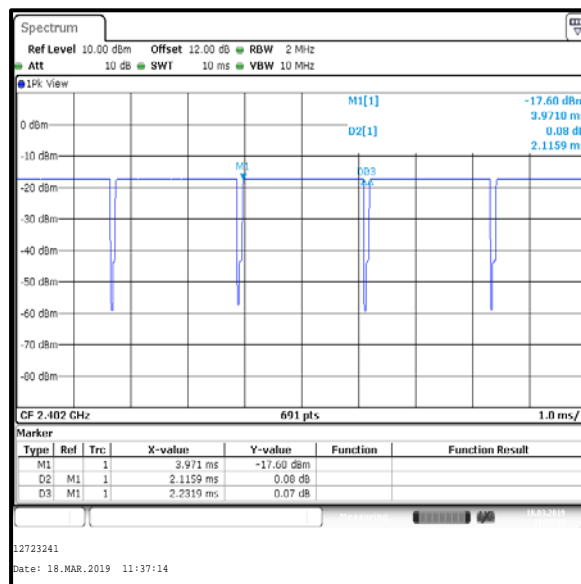
- In order to assist with the determination of the average level of spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

$$10 \log (1 / (\text{On Time} / [\text{Period or } 100 \text{ ms whichever is the lesser}])).$$

$$LE1M \text{ duty cycle: } 10 \log (1 / (2116 \mu\text{s} / 2232 \mu\text{s})) = 0.2 \text{ dB}$$

### Results:

Pulse Duration (µs)	Period (µs)	Duty Cycle (dB)
2116	2232	0.2





### **4.3. Transmitter Maximum Peak Output Power**

#### **Test Summary:**

<b>Test Engineer:</b>	Victor Carmon	<b>Test Date:</b>	18 March 2019
<b>Test Sample Serial Number:</b>	Not marked or stated		

<b>FCC Reference:</b>	Part 15.247(b)(3)
<b>Test Method Used:</b>	FCC KDB 558074 Section 8.3.1.1 referencing ANSI C63.10 Section 11.9.1.1 and Notes below

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	20
<b>Relative Humidity (%):</b>	36

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

1. Conducted power tests were performed using a signal analyser in accordance with ANSI C63.10 Section 11.9.1.1 with the RBW  $\geq$  DTS bandwidth procedure.
2. The signal analyser resolution bandwidth was set to 2 MHz 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 6 MHz. A marker was placed at the peak of the signal and the results recorded in the tables below.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.
4. The conducted power was added to the declared antenna gain to obtain the EIRP.

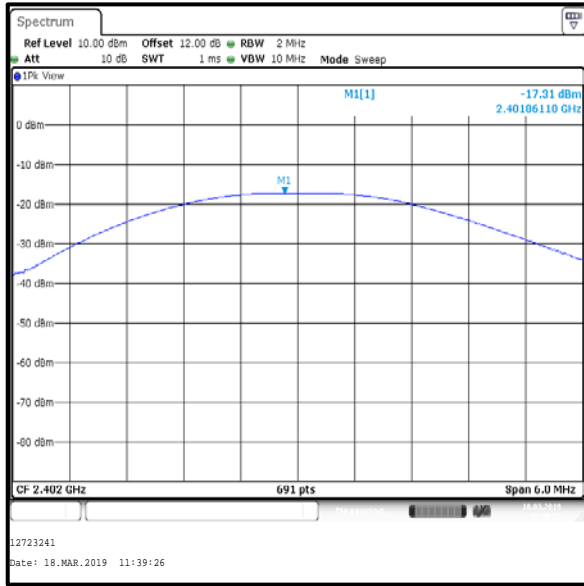
**Transmitter Maximum Peak Output Power (continued)****Results:**

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	-17.3	30.0	47.3	Complied
Middle	-17.2	30.0	47.2	Complied
Top	-17.2	30.0	47.2	Complied

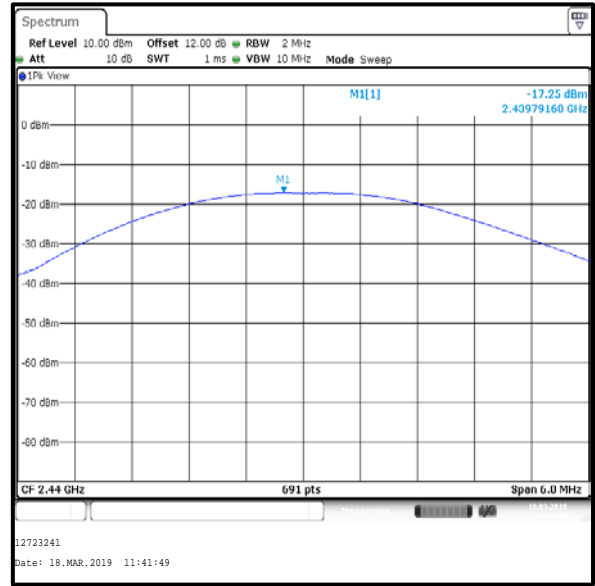
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	-17.3	-2.0	-19.3	36.0	55.3	Complied
Middle	-17.2	-2.0	-19.2	36.0	55.2	Complied
Top	-17.2	-2.0	-19.2	36.0	55.2	Complied

### Transmitter Maximum Peak Output Power (continued)

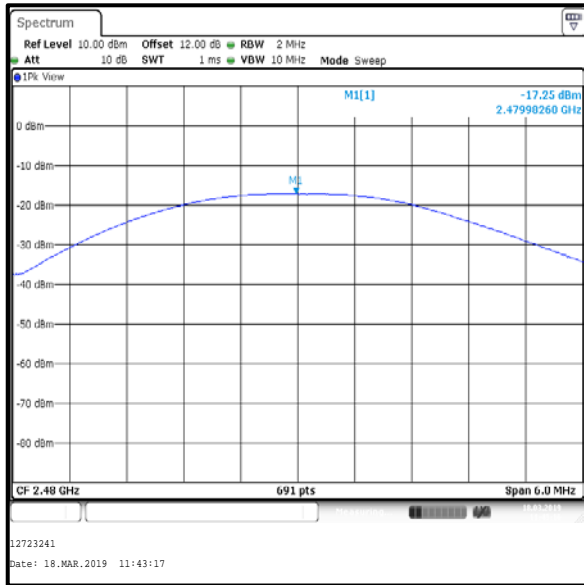
#### Results:



Bottom Channel



Middle Channel



Top Channel

## **5. Radiated Test Results**

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

#### **Test Summary:**

<b>Test Engineers:</b>	David Doyle & Andrew Edwards	<b>Test Dates:</b>	12 March 2019 & 17 September 2019
<b>Test Sample Serial Number:</b>	Not marked or stated		

<b>FCC Reference:</b>	Parts 15.247(d) & 15.209(a)
<b>Test Method Used:</b>	ANSI C63.10 Sections 6.3, 6.4 and 6.5
<b>Frequency Range</b>	490 kHz to 1000 MHz

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	21 to 24
<b>Relative Humidity (%):</b>	41 to 46

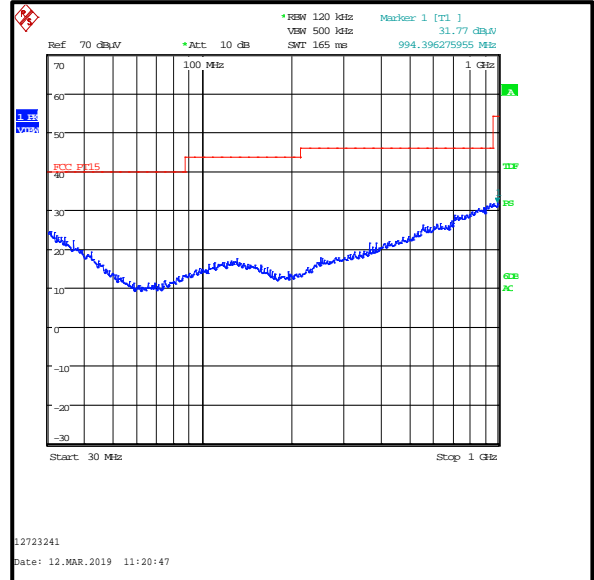
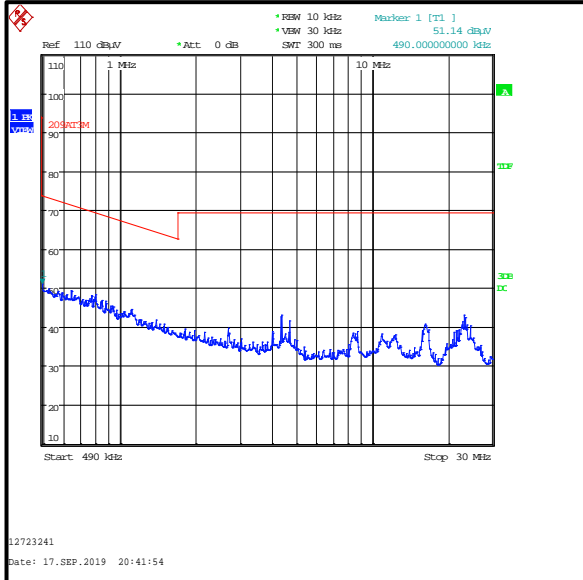
#### **Note(s):**

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The 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.
3. All 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. Therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
4. Measurements below 30 MHz were performed in a semi-anechoic chamber (Asset Number K0001) at 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. The limit was extrapolated to 3 metres in accordance with ANSI C63.10 Section 6.4.4.2. Correlation data between the semi-anechoic chamber and an open-field test site is available upon request.
5. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 10 kHz and video bandwidth 30 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
6. Measurements between 30 MHz and 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
7. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth 500 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.

**Transmitter Radiated Emissions (continued)**

**Results: Peak / Middle Channel**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
994.396	Horizontal	31.8	54.0	22.2	Complied



**5.2. Transmitter Radiated Emissions >1 GHz****Test Summary:**

<b>Test Engineer:</b>	David Doyle	<b>Test Date:</b>	12 March 2019
<b>Test Sample Serial Number:</b>	Not marked or stated		

<b>FCC Reference:</b>	Parts 15.247(d) & 15.209(a)
<b>Test Method Used:</b>	FCC KDB 558074 Sections 8.1 c)3), 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.6, 11.11 & 11.12
<b>Frequency Range</b>	1 GHz to 25 GHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	36

**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 emission shown on the 1 GHz to 3 GHz plot is the EUT fundamental.
3. 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.
4. 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.
5. 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 respective detectors during the pre-scan measurements.
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 not necessary to perform an average measurement.

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

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Margin (dB)	Result
4804.021	Horizontal	50.5*	54.0	3.5	Complied

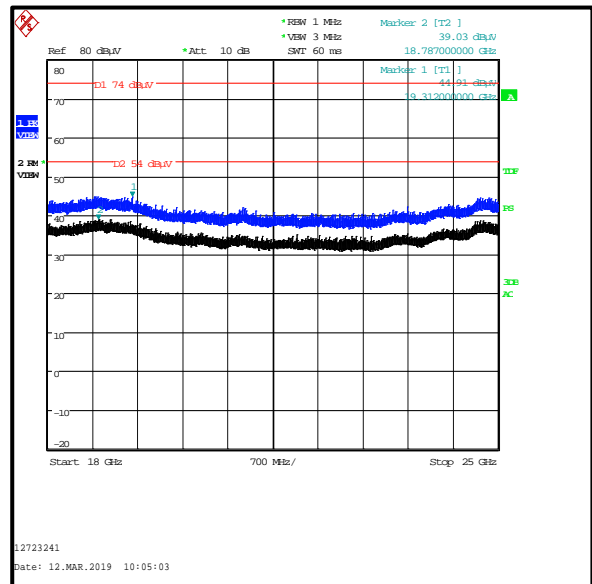
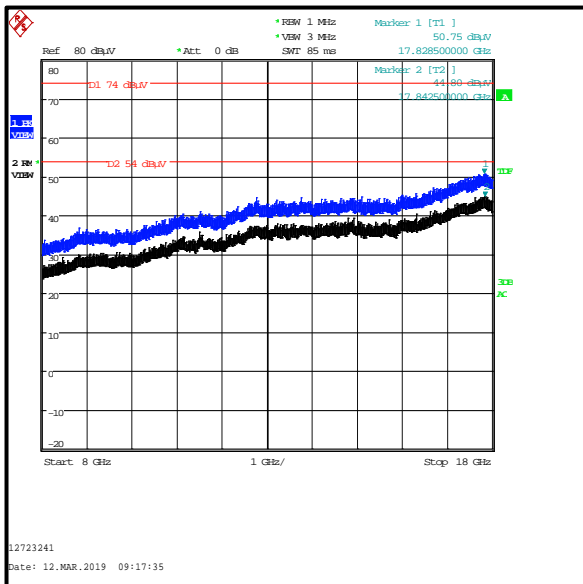
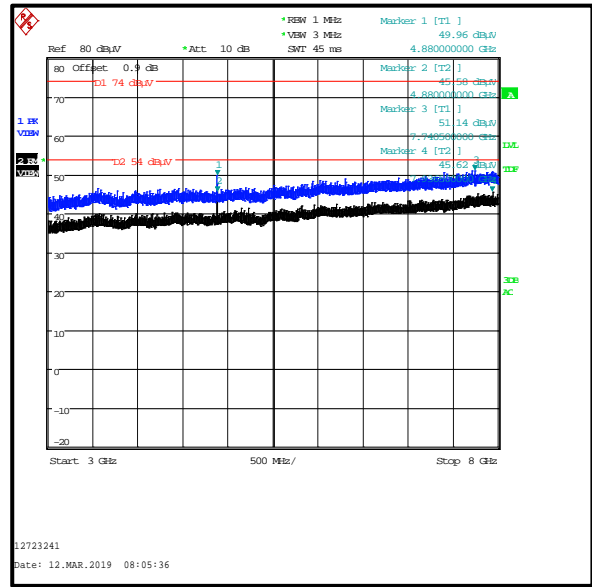
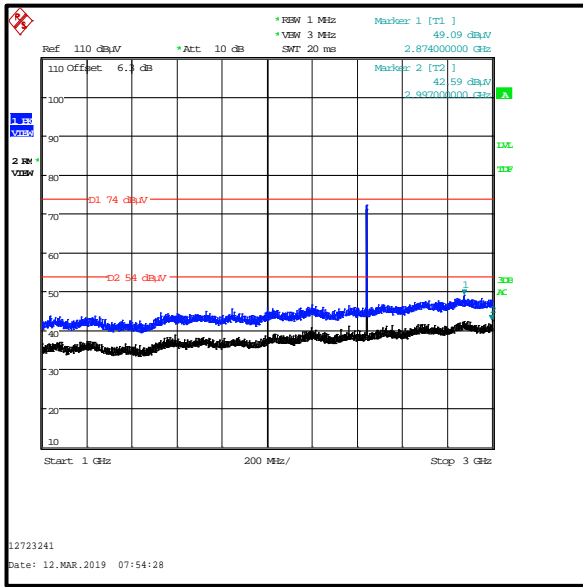
**Results: Peak / Middle Channel**

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Margin (dB)	Result
4879.900	Horizontal	51.4*	54.0	2.6	Complied

**Results: Peak / Top Channel**

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Margin (dB)	Result
4959.964	Horizontal	51.1*	54.0	2.9	Complied

**Transmitter Radiated Emissions (continued)**



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



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

#### **Test Summary:**

<b>Test Engineer:</b>	David Doyle	<b>Test Date:</b>	12 March 2019
<b>Test Sample Serial Number:</b>	Not marked or stated		

<b>FCC Reference:</b>	Parts 15.247(d) & 15.209(a)
<b>Test Method Used:</b>	KDB 558074 Section 8.7 referencing ANSI C63.10 Sections 11.11, 11.12 & 11.13

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	36

#### **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 maximum peak conducted output power was previously measured. In accordance with ANSI C63.10 Section 11.11.1(a), the lower band edge measurement was performed with a peak detector and the -20 dBc limit applied.
3. As the lower band edge is adjacent to a non-restricted band, only peak measurements are required. In accordance with ANSI C63.10 Section 11.11.1, the test method in Section 11.11.3 was followed: 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. As the maximum peak conducted output power was measured using a peak detector in accordance with ANSI C63.10 Section 11.9.1.1 an out-of-band limit line was placed 20 dB (ANSI C63.10 Section 11.11.1(a)) below the peak level. A marker was placed on the band edge spot frequencies. Marker frequency and levels were recorded.
4. As the upper band edge is adjacent to a restricted band, both peak and average measurements were recorded by placing a marker at the edge of the band. For peak measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. For average measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. An RMS detector was used, sweep time was set to auto and trace mode was trace averaging over 300 sweeps. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent restricted band of operation (where a higher level emission was present). Marker frequencies and levels were recorded.
5. 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 peak and RMS detectors respectively. Markers were placed on the highest point on each trace.
6. \* -20 dBc limit.

**Transmitter Band Edge Radiated Emissions (continued)****Results: Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2376.683	Horizontal	40.8	58.4*	17.6	Complied
2400.000	Horizontal	39.0	58.4*	19.4	Complied
2483.500	Horizontal	49.7	74.0	24.3	Complied
2499.686	Horizontal	51.3	74.0	22.7	Complied

**Results: Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.500	Horizontal	38.6	54.0	15.4	Complied
2508.260	Horizontal	39.0	54.0	15.0	Complied

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

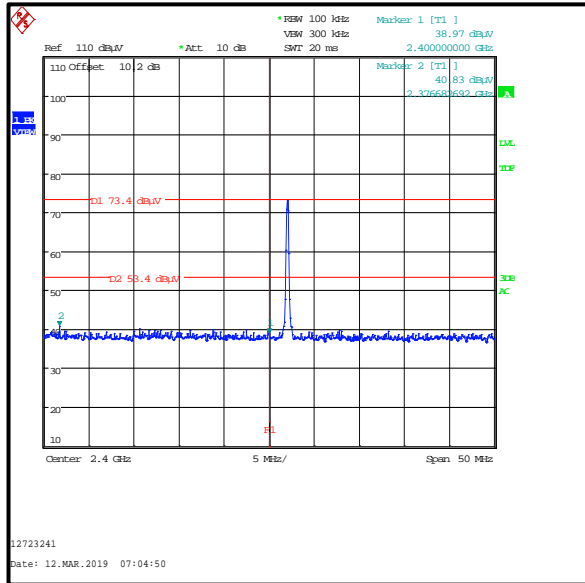
Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2342.051	Horizontal	52.7	74.0	21.3	Complied

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

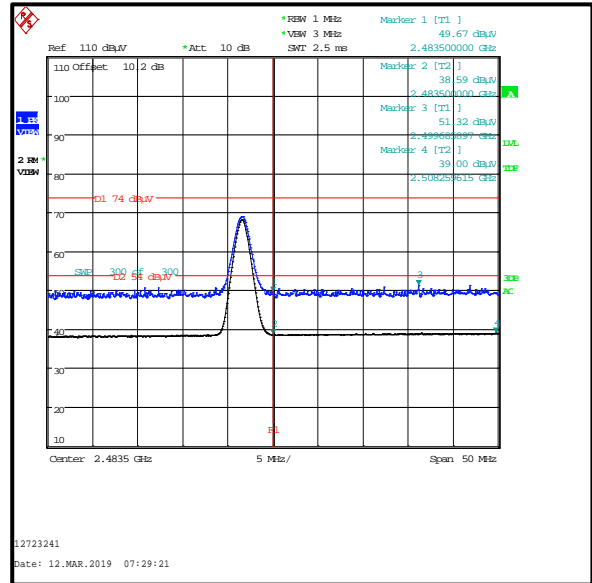
Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2362.692	Horizontal	38.2	54.0	15.8	Complied

### Transmitter Band Edge Radiated Emissions (continued)

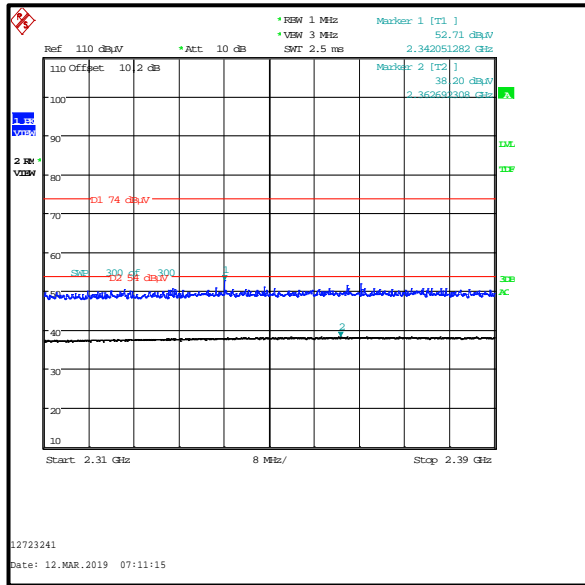
#### Results:



Lower Band Edge



Upper Band Edge



2310 MHz to 2390 MHz Restricted Band

## **6. AC Power Line Conducted Emissions Test Results**

### **6.1. Transmitter AC Conducted Spurious Emissions**

#### **Test Summary:**

<b>Test Engineer:</b>	Alison Johnston	<b>Test Date:</b>	13 September 2019
<b>Test Sample Serial Number:</b>	Not marked or stated		

<b>FCC Reference:</b>	Part 15.207
<b>Test Method Used:</b>	ANSI C63.10 Section 6.2 / FCC KDB 174176 and notes below

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	50

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

1. The EUT was connected to its AC charger, which was connected to a 120 VAC 60 Hz single phase supply via a LISN.
2. In accordance with FCC KDB 174176 Q4, tests were also performed with a 240 VAC 60 Hz single phase supply as this was within the voltage range marked on the EUT power supply.
3. A pulse limiter was fitted between the LISN and the test receiver.
4. Pre-scans were performed and markers placed on the highest live and neutral measured levels. Final measurements were performed on the marker frequencies and the results entered into the tables below.

**Transmitter AC Conducted Spurious Emissions (continued)****Results: Live / Quasi Peak / 120 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.582000	Live	34.4	56.0	21.6	Complied
0.739500	Live	34.9	56.0	21.2	Complied
2.220000	Live	34.6	56.0	21.4	Complied
2.751000	Live	35.1	56.0	20.9	Complied
3.282000	Live	35.8	56.0	20.2	Complied
4.339500	Live	40.0	56.0	16.0	Complied

**Results: Live / Average / 120 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.744000	Live	24.0	46.0	22.0	Complied
1.270500	Live	23.7	46.0	22.3	Complied
2.215500	Live	23.3	46.0	22.7	Complied
2.751000	Live	23.6	46.0	22.4	Complied
3.273000	Live	24.2	46.0	21.8	Complied
4.231500	Live	27.7	46.0	18.3	Complied

**Results: Neutral / Quasi Peak / 120 VAC 60 Hz**

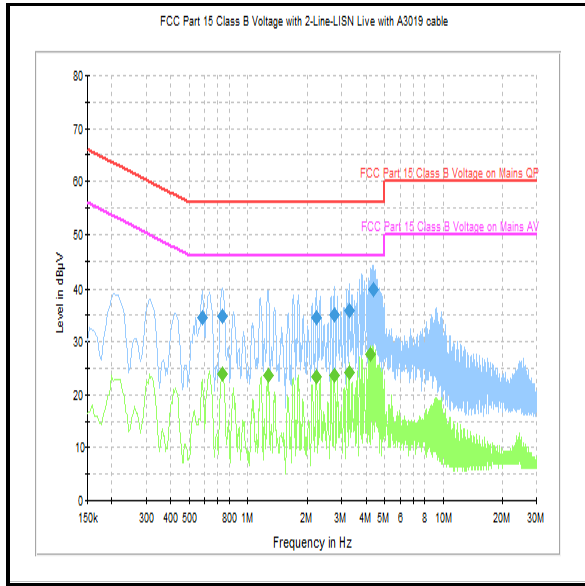
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.582000	Neutral	38.8	56.0	17.2	Complied
0.744000	Neutral	32.2	56.0	23.8	Complied
1.270500	Neutral	30.7	56.0	25.3	Complied
2.854500	Neutral	32.3	56.0	23.7	Complied
3.282000	Neutral	34.7	56.0	21.3	Complied
4.443000	Neutral	39.3	56.0	16.7	Complied

**Results: Neutral / Average / 120 VAC 60 Hz**

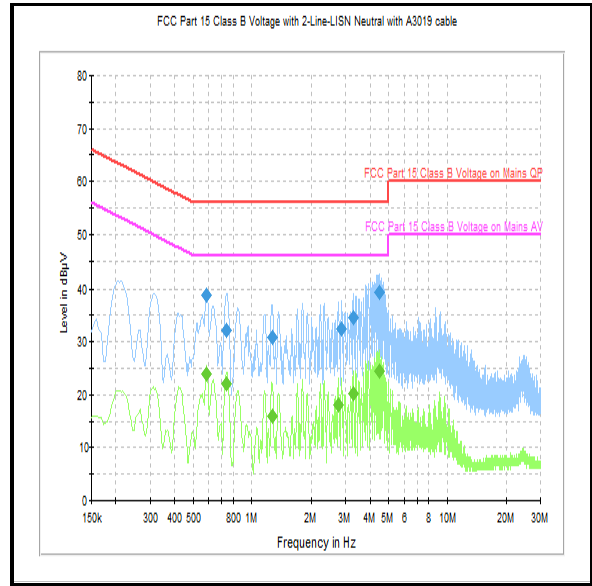
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.582000	Neutral	23.9	46.0	22.1	Complied
0.739500	Neutral	22.0	46.0	24.0	Complied
1.270500	Neutral	15.9	46.0	30.1	Complied
2.751000	Neutral	18.2	46.0	27.8	Complied
3.282000	Neutral	20.1	46.0	25.9	Complied
4.443000	Neutral	24.5	46.0	21.5	Complied

**Transmitter AC Conducted Spurious Emissions (continued)**

**Results: 120 VAC 60 Hz**



**Live**



**Neutral**

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

**Transmitter AC Conducted Spurious Emissions (continued)****Results: Live / Quasi Peak / 240 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.420000	Live	37.1	57.4	20.3	Complied
0.532500	Live	39.1	56.0	16.9	Complied
1.378500	Live	37.5	56.0	18.5	Complied
2.332500	Live	38.5	56.0	17.5	Complied
3.390000	Live	40.1	56.0	15.9	Complied
4.335000	Live	41.9	56.0	14.1	Complied

**Results: Live / Average / 240 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.420000	Live	18.2	47.4	29.2	Complied
0.532500	Live	20.2	46.0	25.8	Complied
1.374000	Live	19.9	46.0	26.1	Complied
2.431500	Live	18.3	46.0	27.7	Complied
3.282000	Live	20.3	46.0	25.7	Complied
4.447500	Live	22.5	46.0	23.5	Complied

**Results: Neutral / Quasi Peak / 240 VAC 60 Hz**

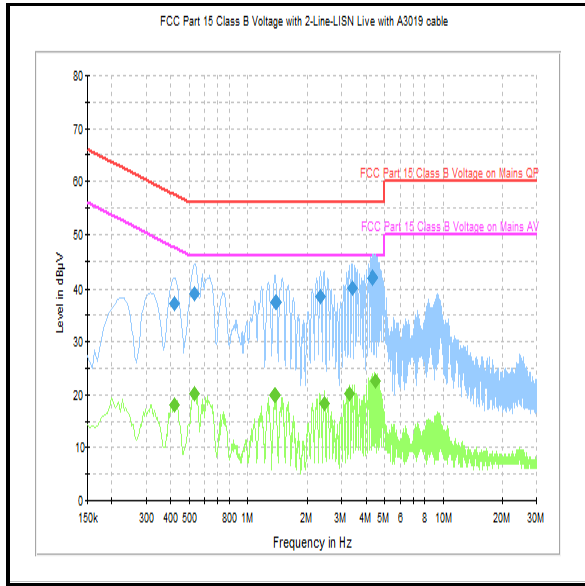
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.532500	Neutral	38.7	56.0	17.3	Complied
0.622500	Neutral	36.1	56.0	19.9	Complied
1.477500	Neutral	35.5	56.0	20.5	Complied
2.332500	Neutral	36.0	56.0	20.0	Complied
3.390000	Neutral	38.3	56.0	17.7	Complied
4.339500	Neutral	40.8	56.0	15.2	Complied

**Results: Neutral / Average / 240 VAC 60 Hz**

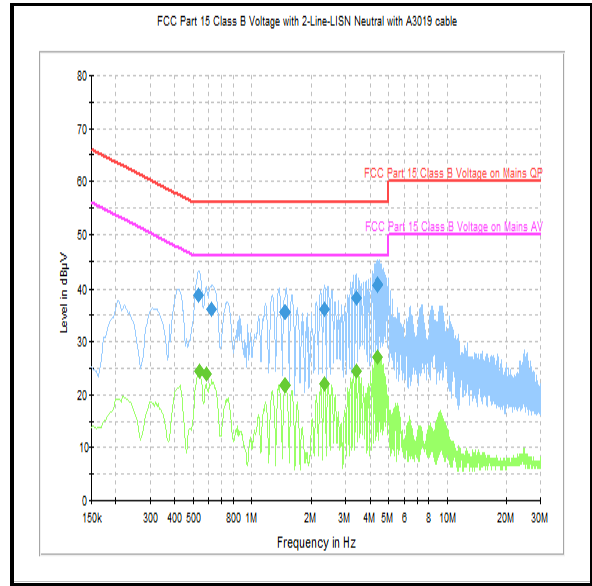
Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.537000	Neutral	24.5	46.0	21.5	Complied
0.582000	Neutral	24.0	46.0	22.0	Complied
1.477500	Neutral	21.8	46.0	24.2	Complied
2.332500	Neutral	21.9	46.0	24.1	Complied
3.390000	Neutral	24.4	46.0	21.6	Complied
4.339500	Neutral	27.1	46.0	18.9	Complied

**Transmitter AC Conducted Spurious Emissions (continued)**

**Results: 240 VAC 60 Hz**



**Live**



**Neutral**

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

**--- END OF REPORT ---**