TEST REPORT

Test Report No. : UL-RPT-RP12700076-716A V2.0

Manufacturer	:	Ubisense
Model No.	:	UBIMOD31
FCC ID	:	SEAMOD31
Technology	:	Wide Band Transmitter
Test Standard(s)	:	FCC Parts 15.207, 15.209 & 15.250

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

Date of Issue: 24 June 2019

Checked by:

Ben Mercer
Senior Test Engineer, Radio Laboratory

Company Signatory:

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Senior Test Engineer, Radio Laboratory
UL VS LTD

ilac-MRA UKAS TESTING 0644

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

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1. Customer Information

Company Name:	Ubisense
Address:	St Andrew's House St Andrew's Road Chesterton, Cambridge CB4 1DL United Kingdom

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.250
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.250
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
Site Registration:	621311
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	22 February 2019 to 26 February 2019

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.207	Transmitter AC Conducted Emissions	✓
Part 15.250(a) & (b)	Transmitter -10 dB Bandwidth	✓
Part 15.250(a)	Transmitter Frequency Stability	✓
Parts 15.250(d)(4) & 15.209(a)	Transmitter Radiated Emissions Below 960 MHz	✓
Part 15.250(d)(1) & (2)	Transmitter Radiated Emissions Above 960 MHz	✓
Part 15.250(d)(3)	Transmitter Emission Peak Level	✓

Key to Results

✓ = Complied ✗ = Did not comply

2.3. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	UBISENSE
Model Name or Number:	UBIMOD31
Test Sample Serial Number:	0011CE0000000ED6 *(Radiated sample)*
Hardware Version Number:	ModeState1
Firmware Version Number:	Test Image
FCC ID:	SEAMOD31

Brand Name:	UBISENSE
Model Name or Number:	UBIMOD31
Test Sample Serial Number:	0011CE0000000ED7 *(Conducted sample)*
Hardware Version Number:	ModeState1
Firmware Version Number:	Test Image
FCC ID:	SEAMOD31

3.2. Description of EUT

The Equipment Under Test was a location-tracking tag containing a wide band transmitter operating in the 5925 MHz to 7250 MHz band. The unit has an integral antenna and is normally powered by host equipment from a nominal 5.0 VDC supply.

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:	Wide Band Transmitter	
Power Supply Requirement:	Nominal	5.0 VDC via 120 VAC 60 Hz
Type of Unit:	Transmitter	
Type of Equipment:	Module	
Modulation:	OOK of a 1 Mpps (pulse-per-second) pulse train	
Duty Cycle:	100%	
Transmit Frequency Range:	5925 to 7250 MHz	
Transmit Channel Tested:	**Channel ID**	**Channel Frequency (MHz)**
	Single	6500

3.5. Support Equipment

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

Description:	AC to DC Power Supply
Brand Name:	XP Power
Model Name or Number:	VER05US050-JA
Serial Number:	Not marked or stated

Description:	Power Cable. Length 1.8 m.
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

- Constantly transmitting at full power with a wide band modulated pulse train representing the maximum possible data payload.

4.2. Configuration and Peripherals

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

- The manufacturer pre-loaded test software/firmware prior to testing. This enabled the EUT to transmit in wide band test mode with a modulated pulse train. The customer supplied a document containing configuration instructions :'Instructions for FCC_IC Test Units.pdf'.
- For testing purposes the EUT was powered by 5 VDC via a 120 VAC 60 Hz XP power supply. The XP power supply was connected to the EUT via a multi pin connector.
- AC conducted emissions tests were performed with the XP power supply input connected to a 120 VAC 60 Hz single phase supply via a LISN. The XP power supply DC output was connected to the EUT via twin core cable and multi pin connector.
- Frequency stability measurements were performed using sample with serial number 0011CE0000000ED7. This sample was connected to a variable power supply in order to vary the voltage. This was monitored by a calibrated digital voltmeter throughout the test. All other measurements were performed using sample with serial number 0011CE0000000ED6.

5. Measurements, Examinations and Derived Results

5.1. General Comments

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

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

5.2. Test Results

5.2.1. Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Andrew Edwards	**Test Date:**	25 February 2019
Test Sample Serial Number:	0011CE0000000ED6		

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

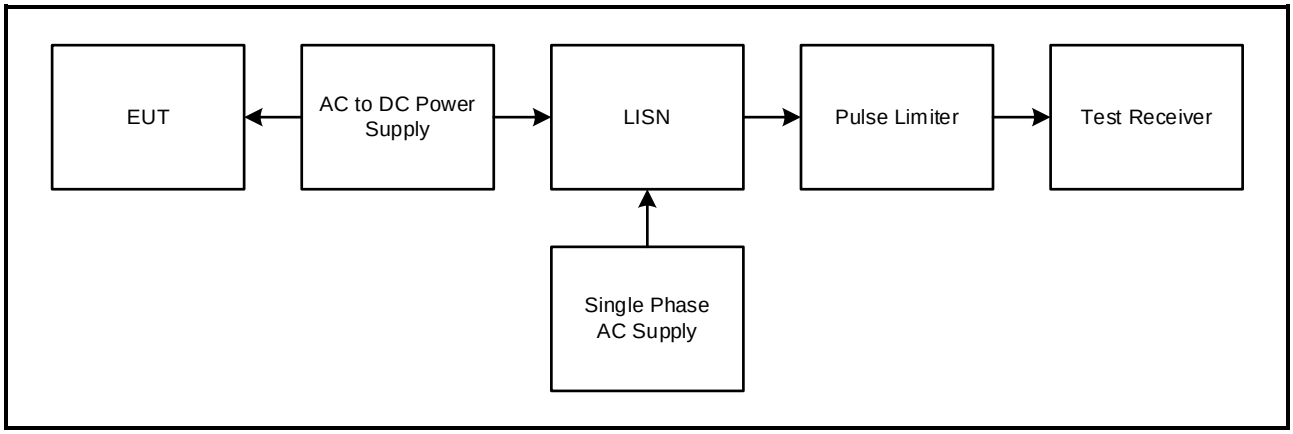
Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	36

Note(s):

1. The EUT was connected to the AC to DC power supply 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 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.

Test Setup Diagram for Transmitter AC Conducted Emissions



Transmitter AC Conducted Spurious Emissions (continued)

Results: Live / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.357	Live	45.1	58.8	13.7	Complied
0.551	Live	30.4	56.0	25.6	Complied
0.956	Live	29.9	56.0	26.1	Complied
1.325	Live	29.2	56.0	26.8	Complied
2.445	Live	28.9	56.0	27.1	Complied
2.958	Live	28.9	56.0	27.1	Complied

Results: Live / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.357	Live	31.6	48.8	17.2	Complied
0.569	Live	20.5	46.0	25.5	Complied
0.915	Live	20.3	46.0	25.7	Complied
1.482	Live	20.2	46.0	25.8	Complied
2.040	Live	19.3	46.0	26.7	Complied
3.444	Live	18.3	46.0	27.7	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

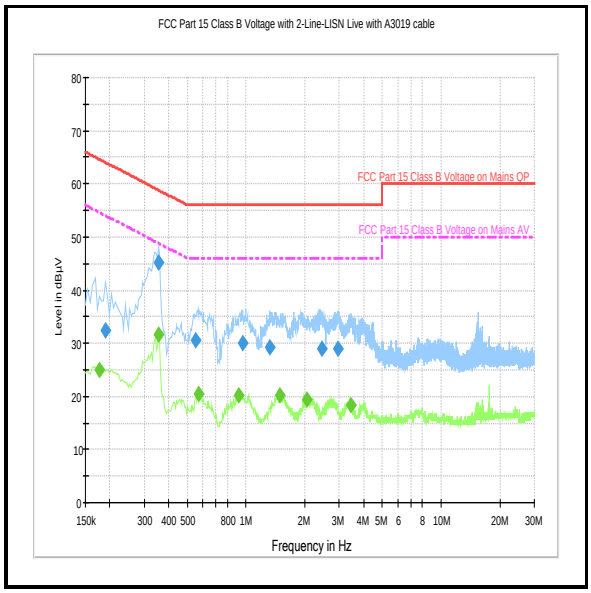
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.335	Neutral	39.0	59.3	20.3	Complied
0.380	Neutral	27.4	58.3	30.9	Complied
0.645	Neutral	26.3	56.0	29.7	Complied
0.947	Neutral	27.3	56.0	28.7	Complied
1.464	Neutral	25.6	56.0	30.4	Complied
2.319	Neutral	24.3	56.0	31.7	Complied

Results: Neutral / Average / 120 VAC 60 Hz

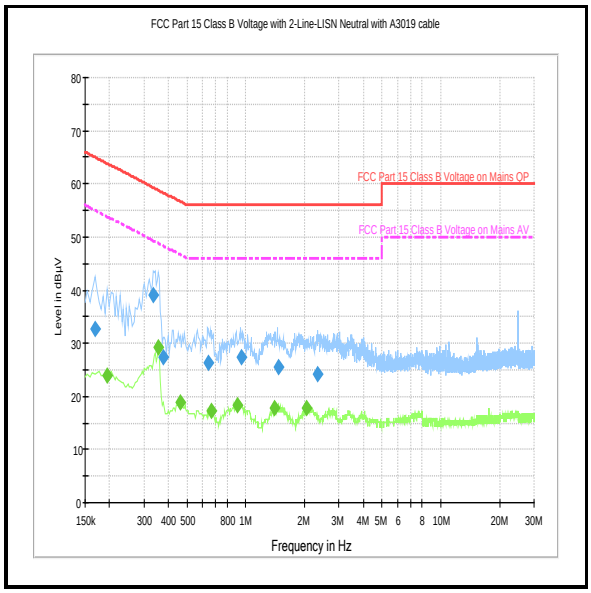
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.357	Neutral	29.1	48.8	19.7	Complied
0.461	Neutral	18.9	46.7	27.8	Complied
0.668	Neutral	17.2	46.0	28.8	Complied
0.911	Neutral	18.3	46.0	27.7	Complied
1.401	Neutral	17.7	46.0	28.3	Complied
2.054	Neutral	17.7	46.0	28.3	Complied

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 (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.344	Live	46.1	59.1	13.0	Complied
0.407	Live	37.2	57.7	20.5	Complied
0.582	Live	35.6	56.0	20.4	Complied
0.695	Live	35.6	56.0	20.4	Complied
1.514	Live	35.3	56.0	20.7	Complied
2.423	Live	32.2	56.0	23.8	Complied

Results: Live / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.344	Live	29.1	49.1	20.0	Complied
0.443	Live	23.0	47.0	24.0	Complied
0.560	Live	22.1	46.0	23.9	Complied
0.704	Live	22.0	46.0	24.0	Complied
1.496	Live	21.8	46.0	24.2	Complied
2.414	Live	20.7	46.0	25.3	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz

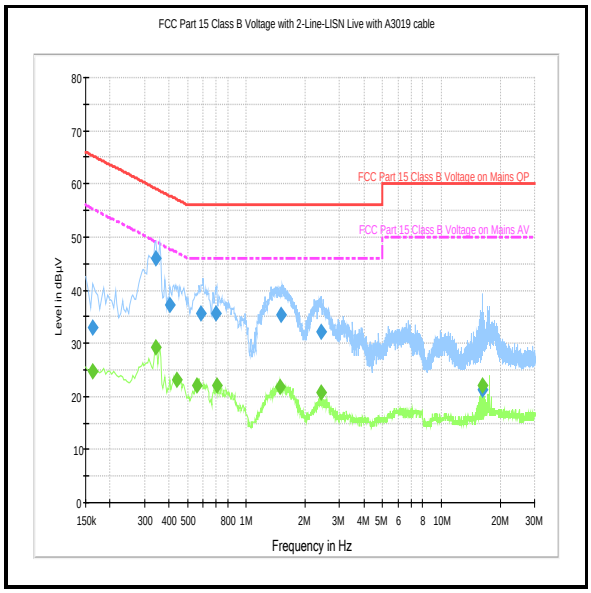
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.326	Neutral	37.2	59.6	22.4	Complied
0.362	Neutral	41.6	58.7	17.1	Complied
0.578	Neutral	31.8	56.0	24.2	Complied
0.704	Neutral	31.2	56.0	24.8	Complied
1.428	Neutral	29.6	56.0	26.4	Complied
2.265	Neutral	25.3	56.0	30.7	Complied

Results: Neutral / Average / 240 VAC 60 Hz

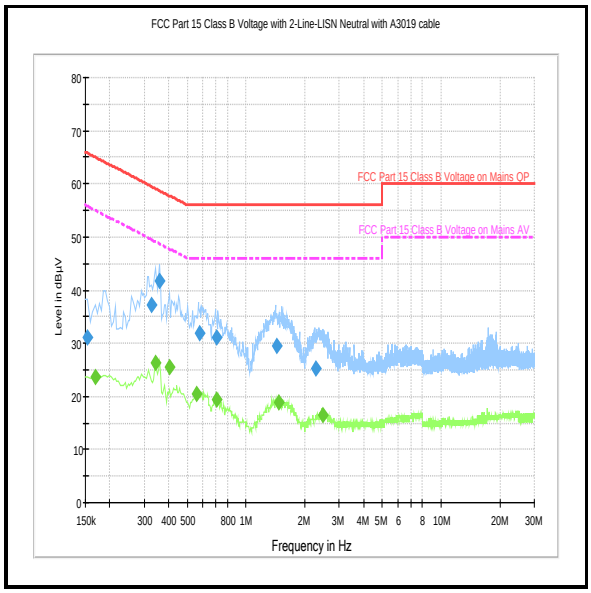
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.344	Neutral	26.3	49.1	22.8	Complied
0.407	Neutral	25.5	47.7	22.2	Complied
0.560	Neutral	20.4	46.0	25.6	Complied
0.704	Neutral	19.4	46.0	26.6	Complied
1.473	Neutral	18.8	46.0	27.2	Complied
2.463	Neutral	16.5	46.0	29.5	Complied

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.

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2037	Thermohygrometer	Testo	608-H1	45124925	06 Jan 2020	12
M1273	Test Receiver	Rohde & Schwarz	ESIB26	100275	18 Dec 2019	12
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	23 Aug 2019	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	06 Apr 2019	12

Test Measurement Software/Firmware Used

Name	Version	Release Date
Rohde & Schwarz EMC32	6.30.0	2018

5.2.2. Transmitter -10 dB Bandwidth

Test Summary:

Test Engineer:	Andrew Edwards	**Test Date:**	22 February 2019
Test Sample Serial Number:	0011CE0000000ED6		

FCC Reference:	Part 15.250(a) & (b)
Test Method Used:	Part 15.250(e)(4) & ANSI C63.10 Section 10.1

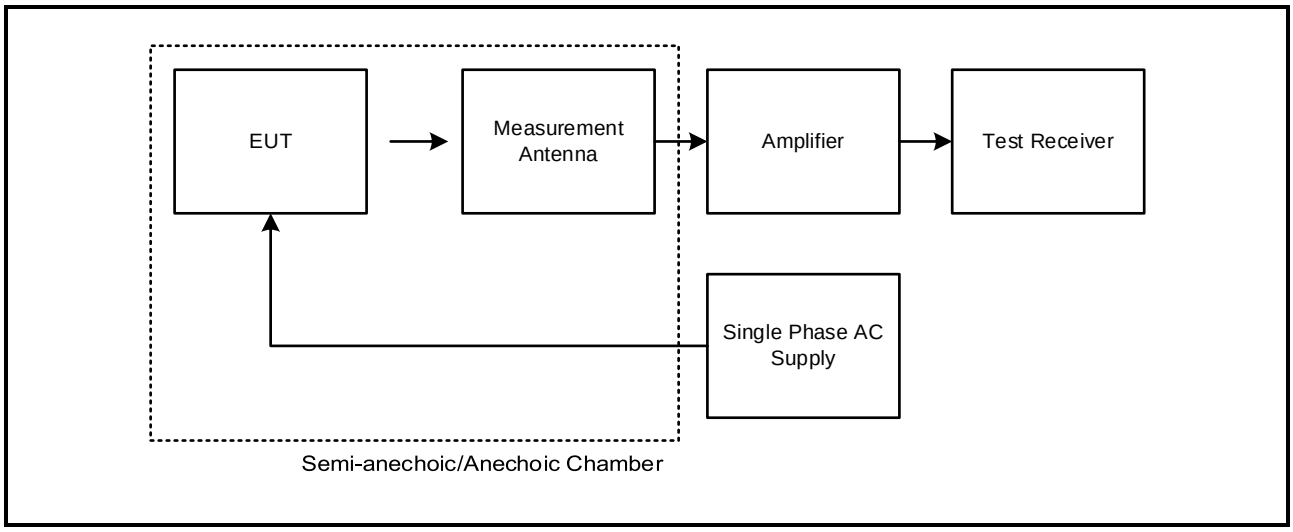
Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	41

Note(s):

1. The -10 dB bandwidth was measured using a peak detector in a 1 MHz resolution bandwidth and a video bandwidth greater than or equal to the resolution bandwidth. Markers were placed on the lower and upper -10 dB points and the frequencies recorded.
2. The -10 dB Bandwidth was calculated in accordance with ANSI C63.10 section 10.1

Test Setup Diagram for Transmitter -10 dB Bandwidth



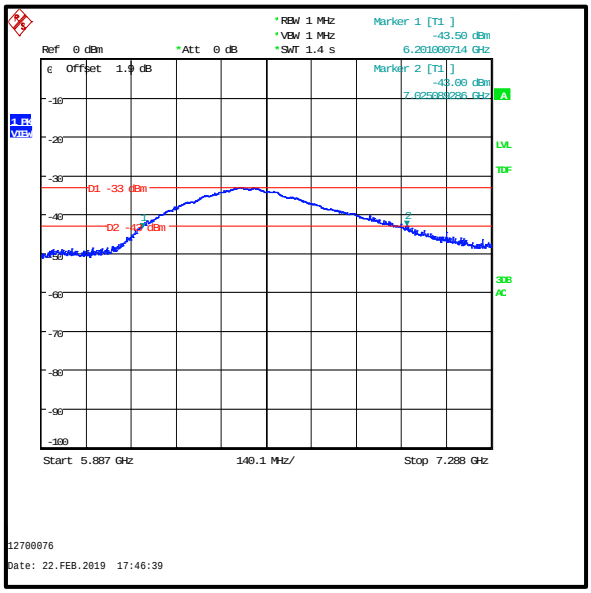
Transmitter -10 dB Bandwidth (continued)

Results: 15.250(a)

Lower -10 dB Frequency (MHz)	Upper -10 dB Frequency (MHz)	Lower Limit (MHz)	Upper Limit (MHz)	Result
6201.001	7025.089	5925	7250	Complied

Results: 15.250(b)

-10 dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)	Result
824.088	>50	774.088	Complied



Test Equipment Used:

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 EMC	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
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	12 Feb 2020	12

5.2.3. Transmitter Frequency Stability (Temperature Variation)

Test Summary:

Test Engineer:	Stefan Ho	**Test Dates:**	26 February 2019
Test Sample Serial Number:	0011CE0000000ED7		

FCC Reference:	Part 15.250(a)
Test Method Used:	Part 15.250(e)(4) and Notes below

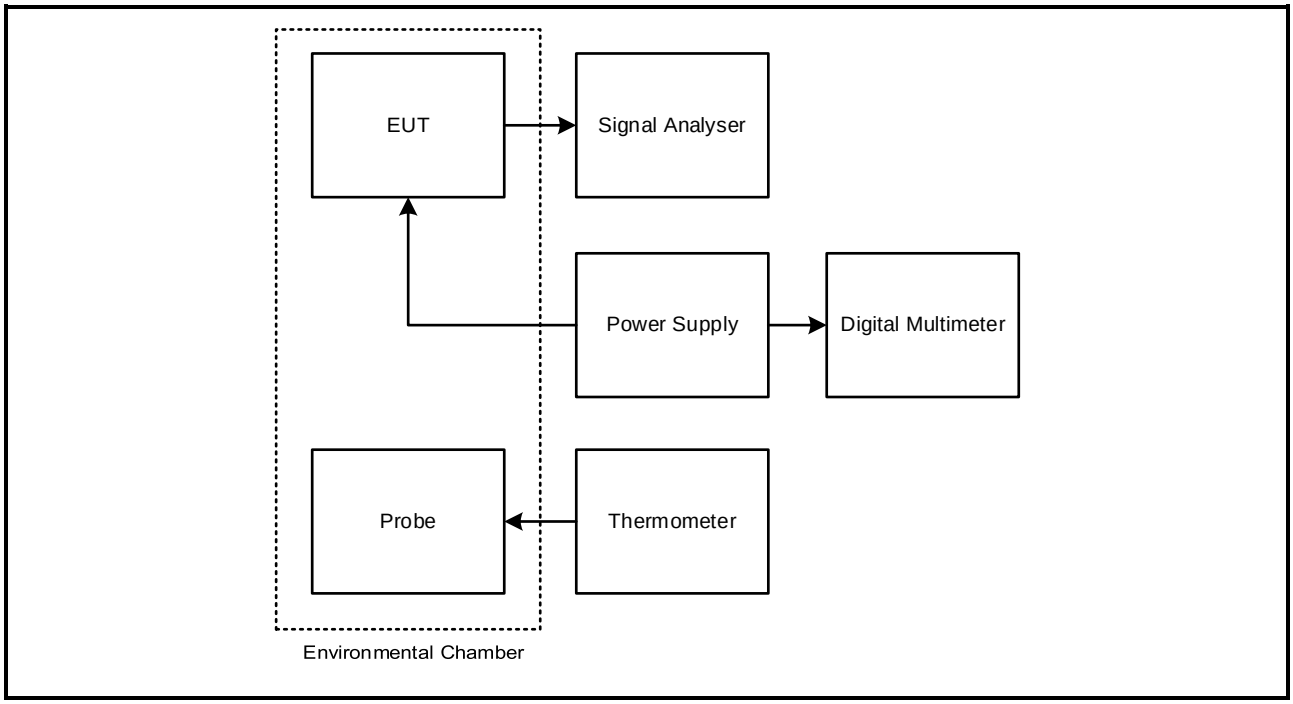
Environmental Conditions:

Ambient Temperature (°C):	21
Ambient Relative Humidity (%):	33

Note(s):

1. The -10 dB bandwidth was measured using a peak detector in a 1 MHz resolution bandwidth and a video bandwidth greater than or equal to the resolution bandwidth. -10 dB points were measured at the manufacturer's stated minimum and maximum temperatures of -40°C and +85°C. Markers were placed on the lower and upper -10 dB points and the results recorded in the table below.
2. A sufficient stabilisation period was allowed at each temperature level and temperature was monitored throughout the test with a calibrated digital thermometer.
3. 5.0 VDC was the nominal voltage used throughout the test.
4. Result plots are archived on the UL VS LTD IT server and available for inspection if required.

Test Setup Diagram for Transmitter Frequency Stability (Temperature Variation)



Transmitter Frequency Stability (Temperature Variation) (continued)

Results:

Temperature	Lower -10 dB Frequency (MHz)	Upper -10 dB Frequency (MHz)	Lower Limit (MHz)	Upper Limit (MHz)	Result
-40^{0}C	6197.900	7008.300	5925	7250	Complied
21^{0}C	6197.900	6964.900	5925	7250	Complied
85^{0}C	6190.600	6928.870	5925	7250	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	19 Mar 2019	12
A2524	Attenuator	AtlanTecRF	AN18W5-10	832827#2	Calibrated before use	-
M1815	Environmental Chamber	Votsch	VT4002	521/83083	Calibrated before use	-
M2053	Thermometer	Fluke	52II	4232071WS	16 Aug 2019	12
M2002	Thermohygrometer	Testo	608-H1	45041825	06 Jan 2020	12
S0577	DC power supply	TTI	CPX400S	436670	Calibrated before use	
M1818	Multimeter	Fluke	79 Series III	71811580	19 Apr 2019	12

5.2.4. Transmitter Frequency Stability (Voltage Variation)

Test Summary:

Test Engineer:	Stefan Ho	**Test Date:**	26 February 2019
Test Sample Serial Number:	0011CE0000000ED7		

FCC Reference:	Part 15.250(a)
Test Method Used:	Parts 15.250(e)(4) and Notes below

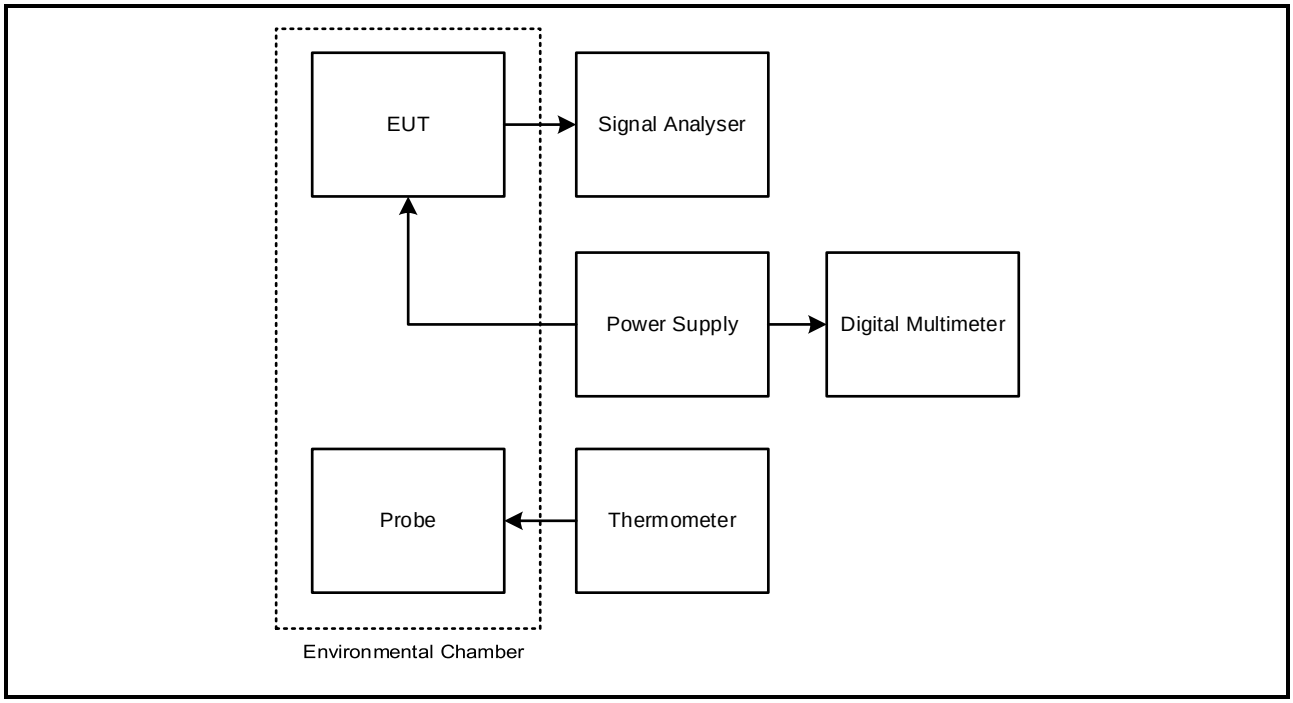
Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	33

Note(s):

1. The -10 dB bandwidth was measured using a peak detector in a 1 MHz resolution bandwidth and a video bandwidth greater than or equal to the resolution bandwidth. -10 dB points were measured at the manufacturer's stated minimum, nominal and maximum voltages. Markers were placed on the lower and upper -10 dB points and the results recorded in the table below.
2. Voltage was monitored throughout the test with a calibrated digital voltmeter.
3. Result plots are archived on the UL VS LTD IT server and available for inspection if required.

Test Setup Diagram for Transmitter Frequency Stability (Voltage Variation)



Transmitter Frequency Stability (Voltage Variation) (continued)

Results:

Voltage (DC)	Lower -10 dB Frequency (MHz)	Upper -10 dB Frequency (MHz)	Lower Limit (MHz)	Upper Limit (MHz)	Result
2.30	6197.900	6964.900	5925	7250	Complied
5.00	6197.900	6964.900	5925	7250	Complied
5.25	6197.900	6957.600	5925	7250	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	19 Mar 2019	12
A2524	Attenuator	AtlanTecRF	AN18W5-10	832827#2	Calibrated before use	-
S0577	DC power supply	TTI	CPX400S	436670	Calibrated before use	-
M1818	Multimeter	Fluke	79 Series III	71811580	19 Apr 2019	12
M2002	Thermohygrometer	Testo	608-H1	45041825	06 Jan 2020	12

5.2.5. Transmitter Radiated Emissions Below 960 MHz

Test Summary:

Test Engineer:	Andrew Edwards	**Test Date:**	22 February 2019
Test Sample Serial Number:	0011CE0000000ED6		

FCC Reference:	Parts 15.250(d)(4) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.5
Frequency Range	30 MHz to 960 MHz

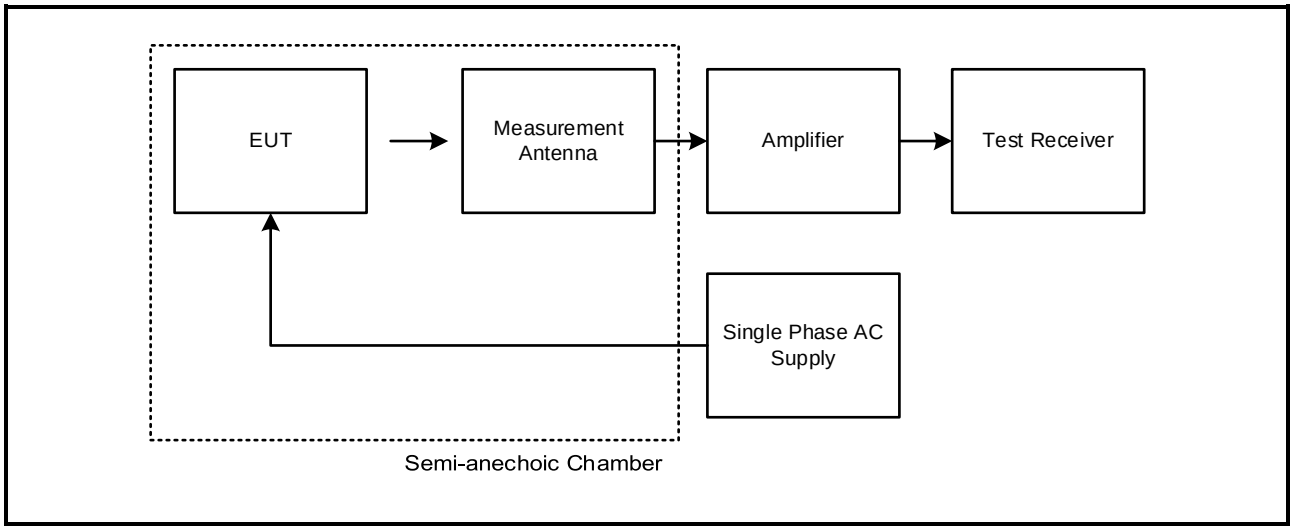
Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	42

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. 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 in the table below.
3. 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.
4. 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. The sweep time was set to auto. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.

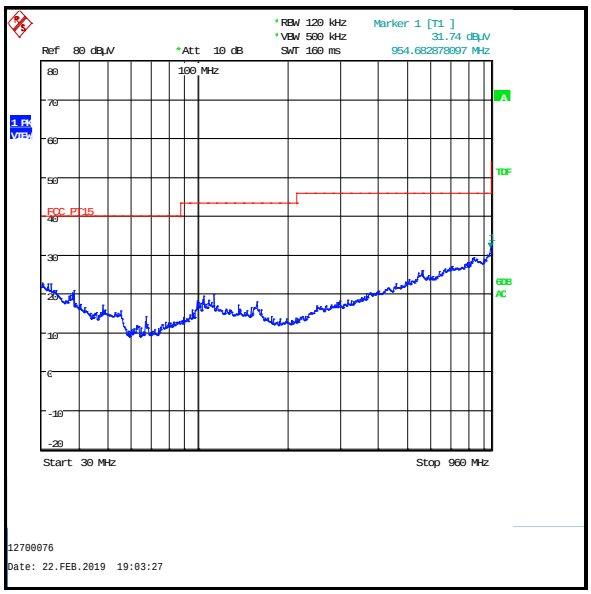
Test Setup Diagram for Transmitter Radiated Emissions Below 960 MHz



Transmitter Radiated Emissions Below 960 MHz (continued)

Results: Peak

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
954.683	Vertical	31.7	46.0	14.3	Complied



Test Equipment Used:

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 EMC	N/A	N/A	16 Feb 2020	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	10 Aug 2019	12
A3167	Pre–Amplifier	COM-POWER	PAM-103	18020010	11 Feb 2020	12
A3161	Antenna	Teseq	CBL6111D	50859	17 Dec 2019	12
A3113	Attenuator	AtlanTecRF	AN18-06	219706#3	17 Dec 2019	12

5.2.6. Transmitter Radiated Emissions Above 960 MHz

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	22 February 2019 & 26 February 2019
Test Sample Serial Number:	0011CE0000000ED6		

FCC Reference:	Part 15.250(d)(1)(2)
Test Method Used:	Part 15.250(e)(1) & ANSI C63.10 Sections 6.3, 6.6 & 10.3
Frequency Range	960 MHz to 40 GHz

Environmental Conditions:

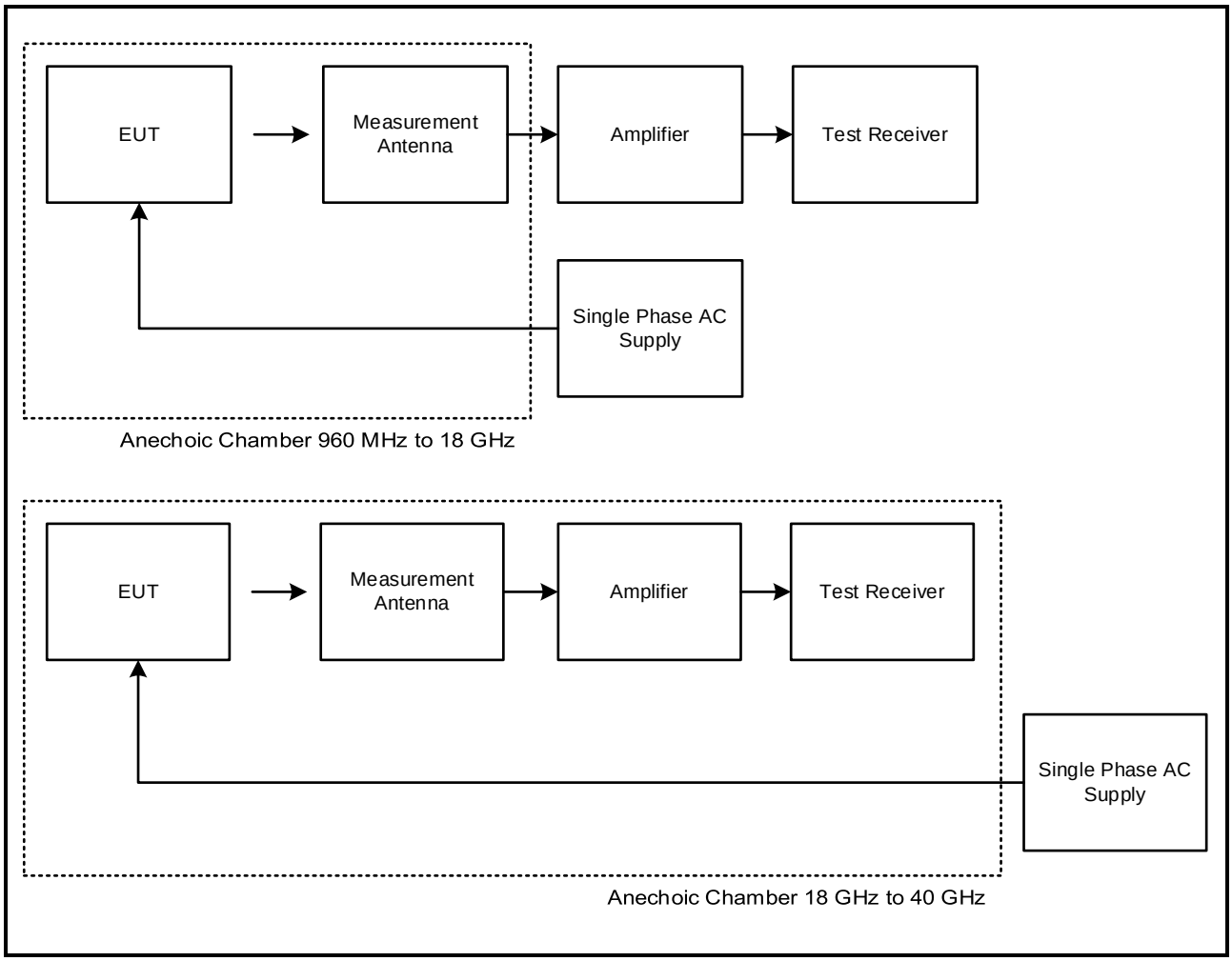
Temperature (°C):	23 to 24
Relative Humidity (%):	35 to 45

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 5.887 GHz to 7.288 GHz plot at approximately 6509 MHz is the EUT fundamental.
3. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest noise floor reading of the measuring receiver was recorded in the table below.
4. In certain frequency ranges it was not possible to perform the measurements at the required distance due to the level of the measurement system noise floor compared with the limit. Therefore the test distance was reduced and a correction offset was applied to the measurements.
5. Pre-scans below 1 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 2 metres. The EUT was placed at a height of 80 cm above the test chamber floor in the centre of the chamber turntable. The measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.
6. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Numbers K0002 and K0017) at a distance between 0.15 to 3 metres (the test distance for each range is stated in Appendix 1 of this test report). 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. Final measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
7. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 1 MHz. The sweep time was set in accordance with FCC Part 15.250(e)(1).
8. Due to limitations of the test receiver it was necessary to overlap the start and stop frequencies of pre-scan measurement ranges to satisfy the sweep point requirement in FCC Part 15.250(e)(1). Pre-scan measurements < 1 GHz were performed between 799 MHz to 1 GHz; a frequency line has been placed at 960 MHz to indicate the actual measurement start frequency. Appendix 1 of this report details the frequency range, sweep points and sweep time used.

Transmitter Radiated Emissions Above 960 MHz (continued)

Test Setup Diagrams Radiated Emissions Above 960 MHz



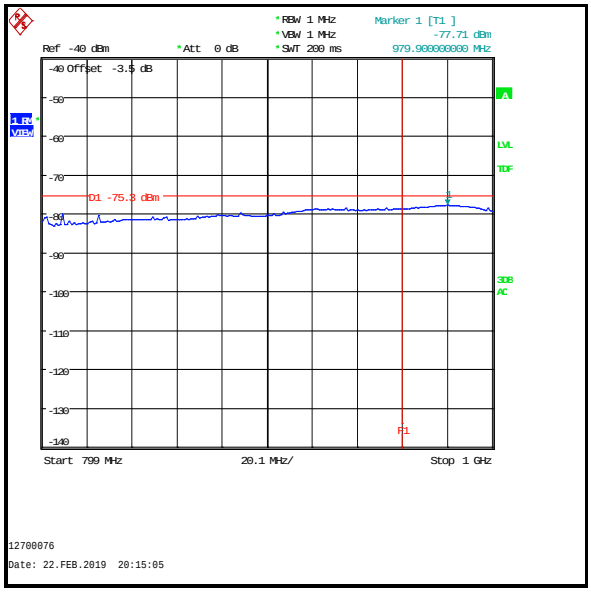
Transmitter Radiated Emissions Above 960 MHz (continued)

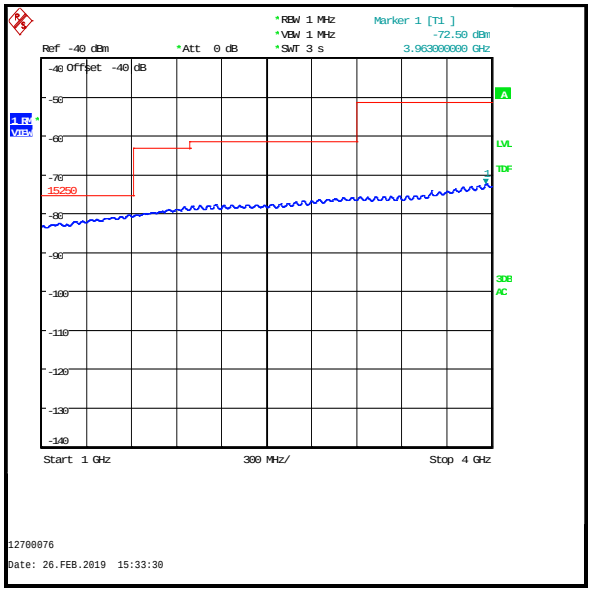
Results: Part 15.250(d)(1)

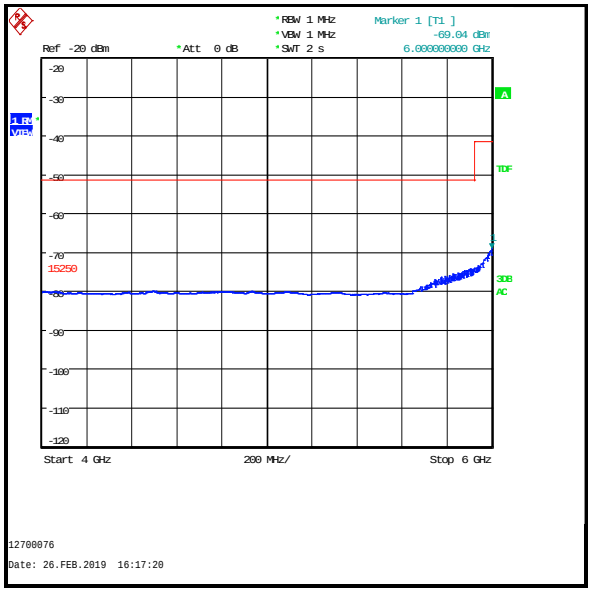
Frequency (MHz)	Antenna Polarity	RMS Level (dBm)	Limit (dBm)	Margin (dB)	Result
6509.444	Vertical	-42.0	-41.3	0.7	Complied

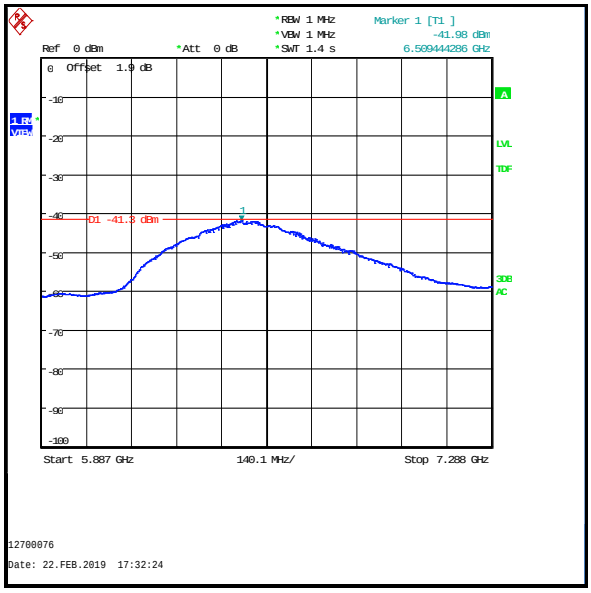
Results: Part 15.250(d)(2)

Frequency (MHz)	Antenna Polarity	RMS Level (dBm)	Limit (dBm)	Margin (dB)	Result
1239.525	Vertical	-91.3	-85.3	6.0	Complied
1586.200	Vertical	-89.3	-85.3	4.0	Complied

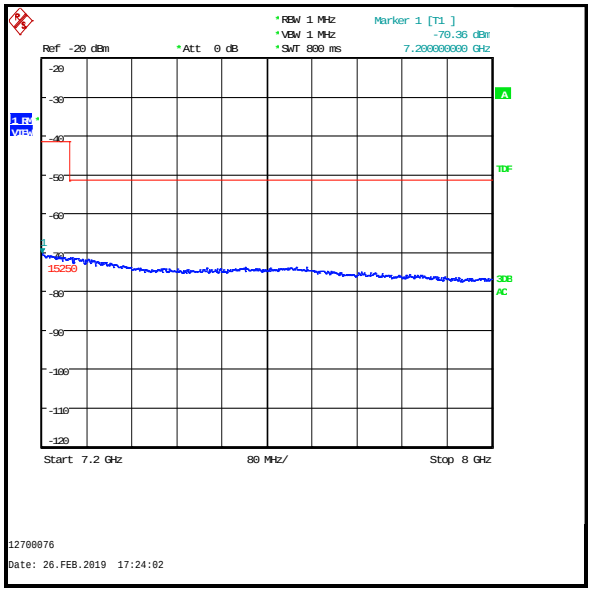


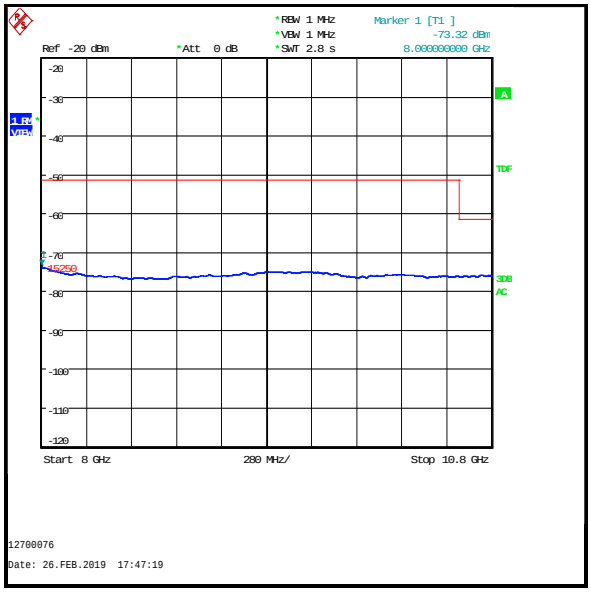


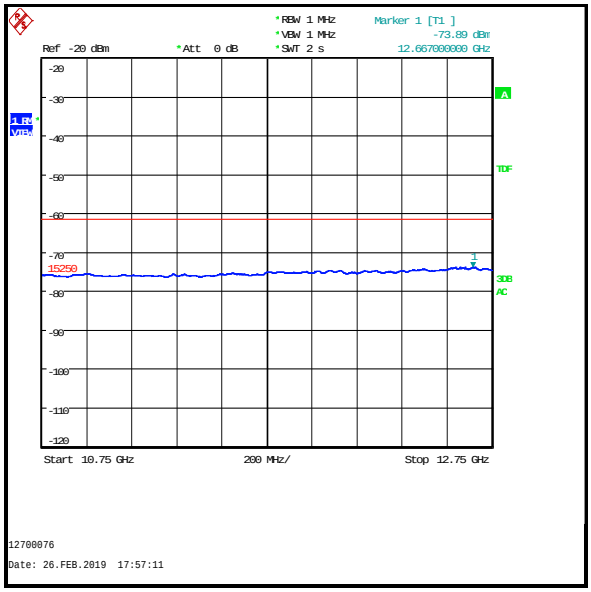


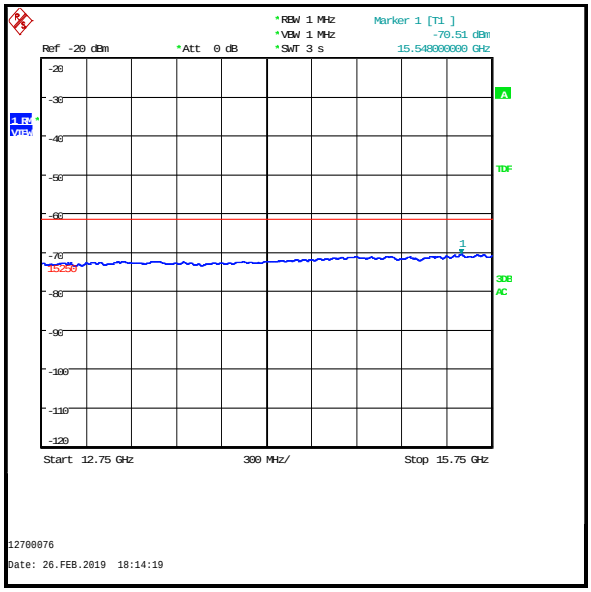


Transmitter Radiated Emissions Above 960 MHz (continued)

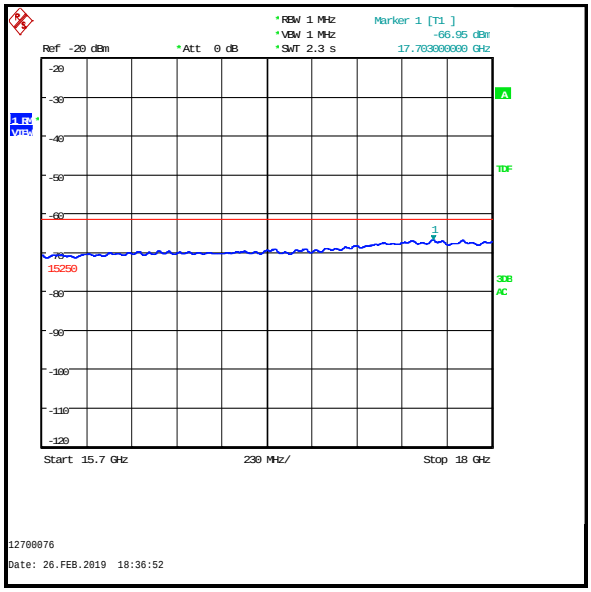


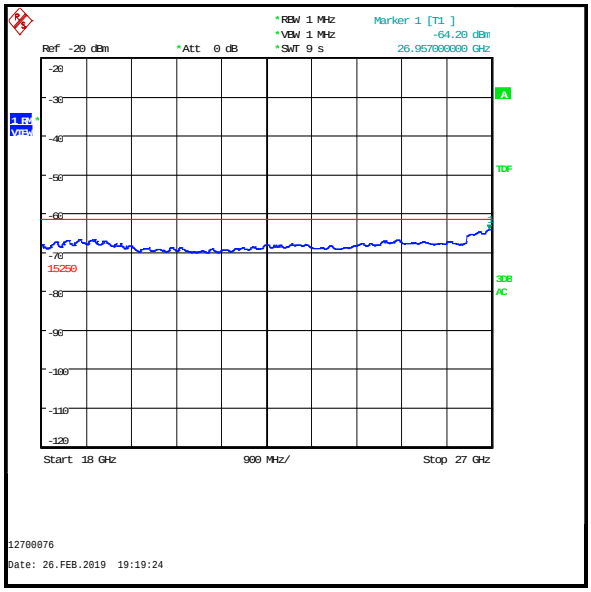


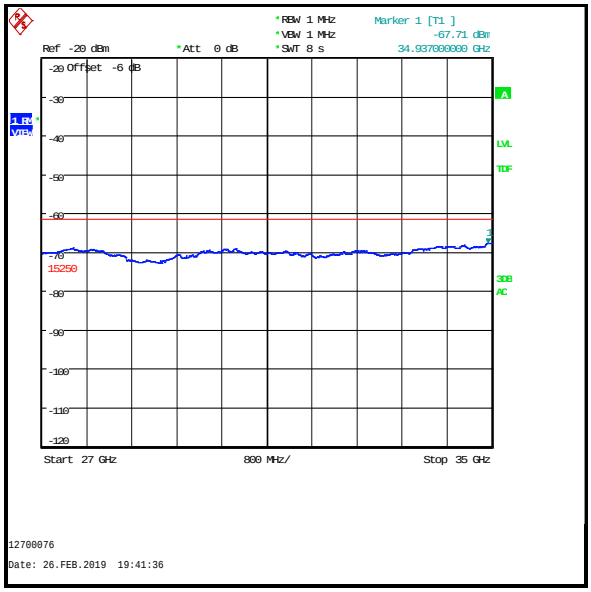


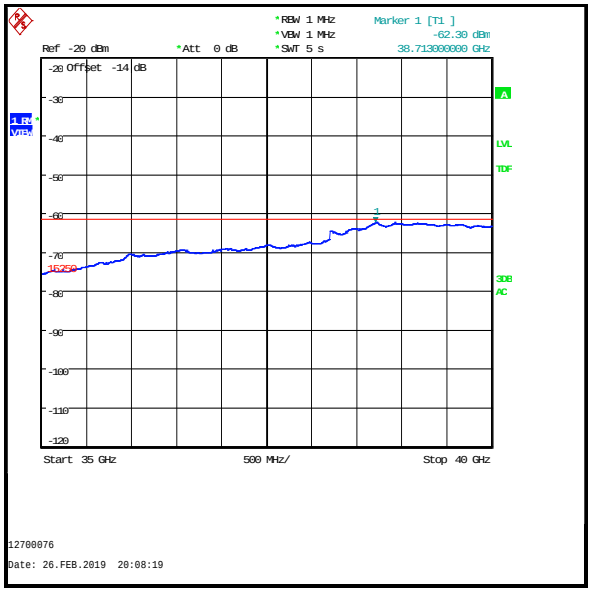


Transmitter Radiated Emissions Above 960 MHz (continued)

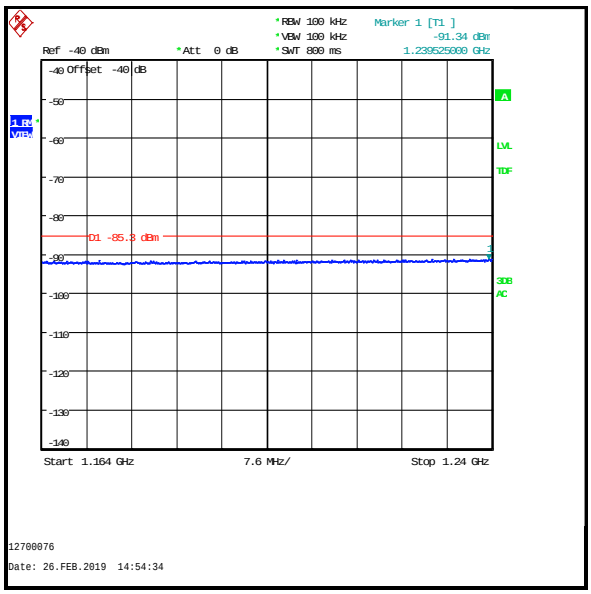




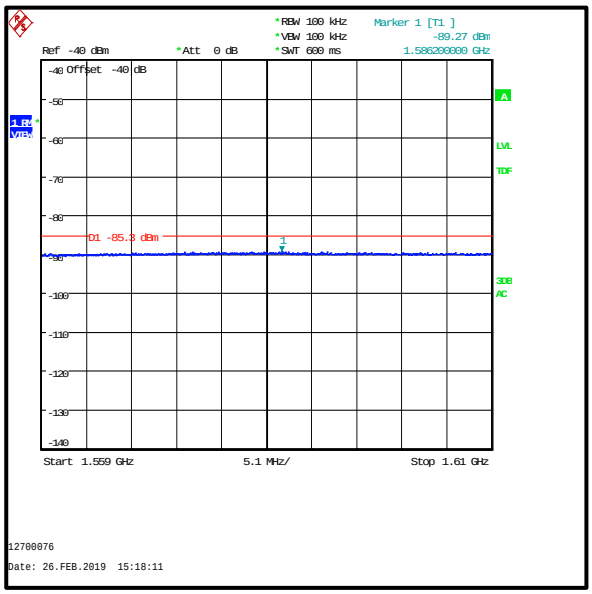




Transmitter Radiated Emissions Above 960 MHz (continued)



1164 to 1240 MHz
-85.3 dBm limit / 100 kHz resolution bandwidth



1559 to 1610 MHz
-85.3 dBm limit / 100 kHz resolution bandwidth

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

Transmitter Radiated Emissions Above 960 MHz (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2016	Thermohygrometer	Testo	608-H1	45046428	06 Jan 2020	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	08 Feb 2020	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	04 Dec 2019	12
A3056	Pre-Amplifier	COM-POWER	PAM-118A	18040040	08 Feb 2020	12
A2896	Pre-Amplifier	Schwarzbeck	BBV 9721	9721 - 023	08 Feb 2020	12
A1818	Antenna	EMCO	3115	00075692	08 Feb 2020	12
A253	Antenna	Flann Microwave	12240-20	128	08 Feb 2020	12
A254	Antenna	Flann Microwave	14240-20	139	08 Feb 2020	12
A255	Antenna	Flann Microwave	16240-20	519	08 Feb 2020	12
A256	Antenna	Flann Microwave	18240-20	400	08 Feb 2020	12
A2895	Antenna	Schwarzbeck	BBHA 9170	9170-728	08 Feb 2020	12
M2003	Thermohygrometer	Testo	608-H1	45046641	06 Jan 2020	12
K0017	3m RSE Chamber	Rainford EMC	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
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	12 Feb 2020	12
G0614	Signal Generator	Rohde & Schwarz	SMB100A	177687	08 May 2020	36
A3097	Antenna	Link Microtek	AM1-18HA	15275	30 Aug 2021	36
M1435	Power Meter	Hewlett Packard	437B	3125U14631	03 May 2019	12
M1011	Power Sensor	Hewlett Packard	8485D	2847A00141	05 Jul 2019	12
M1649	Reference Attenuator	Hewlett Packard	11708A	26584	02 Jul 2019	12
A2943	Attenuator	AtlanTecRF	AN18W5-06	208147#2	Calibrated Before Use	-

5.2.7. Transmitter Emissions Peak Level

Test Summary:

Test Engineer:	Andrew Edwards	**Test Date:**	22 February 2019
Test Sample Serial Number:	0011CE0000000ED6		

FCC Reference:	Part 15.250(d)(3)
Test Method Used:	Part 15.250(e)(2) & ANSI C63.10 Section 10.3.6

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	41

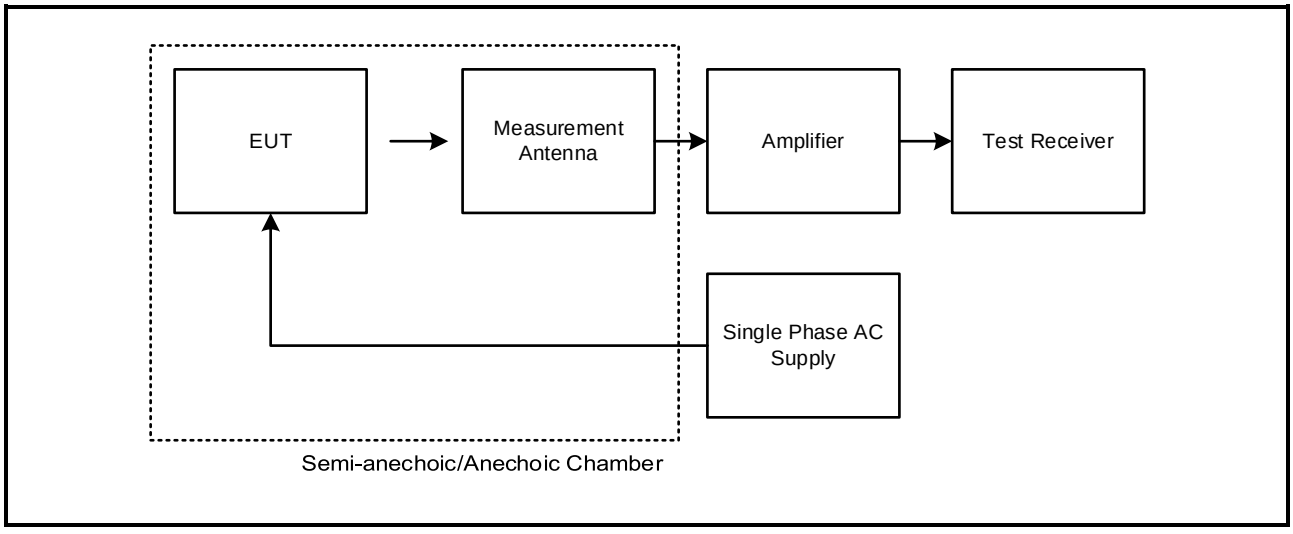
Note(s):

1. The test receiver was set to the maximum available resolution bandwidth of 10 MHz and video bandwidth of 10 MHz. The measurement span was set to 1401 MHz and a sweep time of 1.4s with 1401 sweep points were used. The test receiver was set to the centre frequency of the peak signal. A peak detector and max hold function were used.
2. The measurement was performed using a 10 MHz RBW and in accordance with Part 15.250(d)(3) the limit has been calculated as:

20 Log (RBW/50) dBm

*20*Log (10/50) = -14.0 dBm/10 MHz*

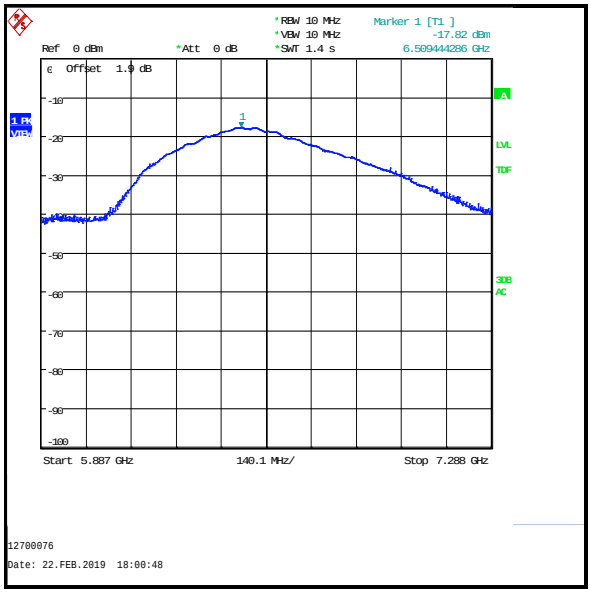
Test Setup Diagram for Transmitter Emissions Peak Level



Transmitter Emissions Peak Level (continued)

Results:

Frequency FM (MHz)	Antenna Polarity	Level (dBm/10 MHz)	Limit (dBm/10 MHz)	Margin (dB)	Result
6509.444	Vertical	-17.8	-14.0	3.8	Complied



Test Equipment Used:

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 EMC	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
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	12 Feb 2020	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	12 Feb 2020	12
G0614	Signal Generator	Rohde & Schwarz	SMB100A	177687	08 May 2020	36
A3097	Antenna	Link Microtek	AM1-18HA	15275	30 Aug 2021	36
M1435	Power Meter	Hewlett Packard	437B	3125U14631	03 May 2019	12
M1011	Power Sensor	Hewlett Packard	8485D	2847A00141	05 Jul 2019	12
M1649	Reference Attenuator	Hewlett Packard	11708A	26584	02 Jul 2019	12
A2943	Attenuator	AtlanTecRF	AN18W5-06	208147#2	Calibrated Before Use	-

6. Measurement Uncertainty

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

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

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

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

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±2.40 dB
Transmitter -10 dB Bandwidth	5.925 GHz to 7.250 GHz	95%	±4.59 %
Frequency Stability	5.925 GHz to 7.250 GHz	95%	±4.59 %
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±4.65 dB
Radiated Spurious Emissions	1 GHz to 40 GHz	95%	±2.54 dB
Transmitter Emissions Peak Level	5.925 GHz to 7.250 GHz	95%	±2.54 dB

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

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	**Clause**	**Details**
1.0	-	-	Initial Version
2.0	1, 6, 8	3.2, 3.4, 4.1, 4.2	Replaced references to ‘Ultra Wide Band’ with ‘Wide Band Transmitter’.

8. Appendix 1

In accordance with FCC 15.250(e)(1), the test receiver span, sweep time and sweep points must be set to achieve a 1 ms dwell time over each 1 MHz segment. The test receiver settings used during testing are detailed in the table below.

Using a 1 MHz Bandwidth

Frequency Range (GHz)	Span (MHz)	Sweep Points	Sweep Time (s)	Test Distance (m)
0.03 to 0.96	930 MHz	625	Auto coupled	3.0
0.799 to 1	201	201	0.2	2.0
1 to 4	3000	3001	3.0	1.0
4 to 6	2000	2001	2.0	1.0
5.887 to 7.288	1401	1401	1.4	3.0
7.2 to 8	800	801	0.8	1.0
8 to 10.8	2800	2801	2.8	1.0
10.75 to 12.75	2000	2001	2.0	1.0
12.75 to 15.75	3000	3001	3.0	1.0
15.7 to 18	2300	2301	2.3	1.0
18 to 27	9000	9001	9.0	1.0
27 to 35	8000	8001	8.0	0.5
35 to 40	5000	5001	5.0	0.2

Using a 100 kHz Bandwidth

Frequency Range (GHz)	Span (MHz)	Sweep Points	Sweep Time (s)	Test Distance (m)
1.164 to 1.24	76	801	0.8	1.0
1.559 to 1.61	51	601	0.6	1.0

--- END OF REPORT ---