TEST REPORT

Test Report No. : UL-RPT-RP-12981910-616-FCC

Applicant	:	Endress+Hauser Conducta GmbH+Co.KG
Model No.	:	CML18
FCC ID	:	2AKGY-BT41PMMA01
Technology	:	Bluetooth – Low Energy
Test Standard(s)	:	FCC Parts 15.207, 15.209(a) & 15.247
		For details of applied tests refer to test result summary

1. This test report shall not be reproduced in full or partial, without the written approval of UL International Germany GmbH.
2. The results in this report apply only to the sample tested.
3. The test results in this report are traceable to the national or international standards.
4. Test Report Version 1.0
5. Result of the tested sample: **PASS**

Prepared by: Krume, Ivanov
Title: Laboratory Engineer
Date: 21 April 2020

Approved by: Ajit, Phadtare
Title: Lead Test Engineer
Date: 21 April 2020

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

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

UL INTERNATIONAL GERMANY GMBH
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Table of Contents

1. Customer Information

1.1.Applicant Information

Company Name:	Endress+Hauser Conducta GmbH+Co.KG
Company Address:	Dieselstr. 24, 70839 Gerlingen, GERMANY
Company Phone No.:	+49 7156 209 0
Company E-Mail:	info@endress.com
Contact Person:	Mr. Dirk Löffler
Contact E-Mail Address:	dirk.loeffler@endress.com
Contact Phone No.:	+49 7156 209 286

1.2.Manufacturer Information

Company Name:	Endress+Hauser Conducta GmbH+Co.KG
Company Address:	Dieselstr. 24, 70839 Gerlingen, GERMANY
Company Phone No.:	+49 7156 209 0
Company E-Mail:	info@endress.com
Contact Person:	Mr. Dirk Löffler
Contact E-Mail Address:	dirk.loeffler@endress.com
Contact Phone No.:	+49 7156 209 286

2. Summary of Testing

2.1. General Information

Applied Standards

Specification Reference:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.247
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
Test Firm Registration:	399704

Location

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

Date information

Order Date:	01 August 2019
EUT arrived:	25 October 2019
Test Dates:	14 November 2019 to 28 January 2020
EUT returned:	-/-

2.2. Summary of Test Results

Clause	Measurement	Complied	Did not comply	Not performed	Not applicable
Part 15.207	Transmitter AC Conducted Emissions	☒	☐	☐	☐
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	☒	☐	☐	☐
Part 15.247(e)	Transmitter Power Spectral Density(1)	☐	☐	☒	☐
Part 15.247(b)(3)	Transmitter Maximum Peak Output Power	☒	☐	☐	☐
Part 15.247(d)/15.209(a)	Transmitter Radiated Emissions	☒	☐	☐	☐
Part 15.247(d)/15.209(a)	Transmitter Band Edge Radiated Emissions	☒	☐	☐	☐

Note:

1. In accordance with KDB 558074 D01 section 8.4 referencing ANSI C63.10:2013, subclause 11.10.1, PSD is 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 to be equal to the measured total output power.

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 558074 D01 DTS Meas Guidance v05r02 April 2, 2019
Title:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
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:	Endress + Hauser
Model Name or Number:	CML18
Serial Number:	TM101 (radiated sample)
Hardware Version Number:	B0
Software Version Number:	01.00.51-0028
FCC ID:	2AKGY-BT41PMMA01

Brand Name:	Endress + Hauser
Model Name or Number:	CML18
Serial Number:	TM102 (conducted sample with RF SMA connector)
Hardware Version Number:	B0
Software Version Number:	01.00.51-0028
FCC ID:	2AKGY-BT41PMMA01

3.2. Description of EUT

The equipment under test was a multiparameter handheld device for pH/ORP, conductivity, oxygen and temperature measurement supporting Bluetooth Low Energy and 5W Wireless Power Transfer (WPT) passive charging.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Technology Tested:	Bluetooth Low Energy (Digital Transmission System)		
Type of Unit:	Transceiver		
Channel Spacing:	2 MHz		
Modulation:	GFSK		
Data Rate:	1 Mbps		
Power Supply Requirement(s):	Nominal	3.7 V DC (Internal Rechargeable Battery)	
Measured Maximum Conducted Output Power:	3.5 dBm		
Antenna Gain:	3.0 dBi		
Antenna Type:	Integral Monopole Antenna		
Transmit Frequency Range:	2402 MHz to 2480 MHz		
Transmit Channels Tested:	**Channel ID**	**RF Channel**	**Channel Frequency (MHz)**
	Bottom	0	2402
	Middle	19	2440
	Top	39	2480

3.5. Support Equipment

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

A. Support Equipment (In-house)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Test Laptop	Lenovo	L560	MP-16X73B 16/11

B. Support Equipment (Manufacturer supplied)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Programming USB Cable	Not marked or stated	Not marked or stated	Not marked or stated
2	Wireless Charging Pad	VARTA	Wireless Charger Tpe 57911	Not marked or stated
3	Type A to Micro USB Type B USB Cable | Length 0.5 m	Not marked or stated	Not marked or stated	Not marked or stated
4	AC to DC USB Power Adapter (Type A USB | Type C USB)	VARTA	Wall Charger Tpe 5791157958	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):
☒ Continuous transmissions at maximum power Bluetooth LE mode with modulation, maximum possible data length available and Pseudorandom Bit Sequence 9 (PRBS9)

4.2. Configuration and Peripherals

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

- The customer supplied a document containing the setup instructions “CML18 Test Mode Instruction v01.pdf".
- The EUT was configured into required Bluetooth LE TX test modes using the Software “nRFgo Studio” supplied by customer.
- All conducted test were performed with the EUT conducted sample with fully charged internal battery.
- All conducted measurements were carried out by using conducted samples with SMA (Female) RF Cable soldered on PCB by the customer. The SMA RF cable’s attenuation (maximum 0.5 dB@2.4GHz) was added to a reference level offset to each of the conducted plots.
- The EUT radiated sample was used for AC conducted emissions, radiated spurious emission & radiated band edge measurements.
- The radiated sample with discharged internal battery was used for AC conducted emissions measurements.
- The radiated sample with fully charged internal battery was used for radiated spurious emission & band edge measurements.
- Before starting final radiated spurious emission measurements “worst case verification” with the EUT in Standing-position & Laying-position was performed by Lab.
- The EUT in Laying-position was found to be the worst case therefore this report includes relevant results.
- EMC32 V10.1.0 Software was used for the Radiated spurious emission measurement.

5. Measurements, Examinations and Derived Results

5.1. General Comments

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

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

5.2. Test Results

5.2.1. Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	M. Asim Shahzad	**Test Date:**	28 January 2020
Test Sample Serial Number:	TM101 (radiated sample)		
Test Site Identification	SR 7/8		

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

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	33

Settings of the Instrument

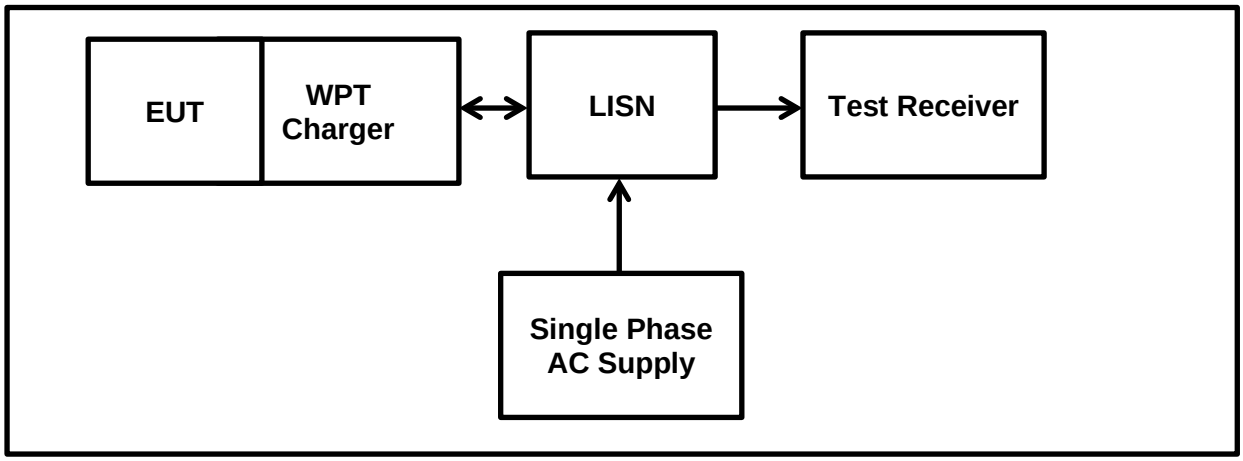
Detector	Quasi Peak/ Average Peak

Note(s):

1. Measurement software used: Toyo EMI Software; CE measurement software EP5/CE Ver 4.0.1.
2. In accordance with FCC KDB 174176 Q4, tests were performed with a 120 VAC 60 Hz single phase supply.
3. Measurements were performed in shielded room (SR7/ 8 Asset Number 1603671). The EUT was placed at a height of 80 cm above the reference ground plane and in a distance of 40 cm from the vertical ground plane at the edge of the table.
4. The wireless charging pad was connected to a 120 VAC 60 Hz single phase supply via a LISN. The EUT radiated sample with discharged battery was placed on wireless charging pad. This allowed EUT to draw maximum current during the tests.
5. The device was configured to Middle channel BT-LE test mode.
6. All other emissions shown on the pre-scan plot were investigated and found to be ambient or >15 dB below the applicable limit or below the measurement system noise floor.
7. The final measured value, for the given emission, in the table below incorporates the cable loss. Calculation: Level = test receiver reading + path loss (cable attenuation + correction LISN).

Transmitter AC Conducted Spurious Emissions (continued)

Test setup:



Calculation of final measurement result:

Final value = Test Receiver reading + Path loss (Cable attenuation + Internal attenuation from LISN)

Transmitter AC Conducted Spurious Emissions (continued)

Results: 120 VAC 60 Hz / Live / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.15200	Live	45.7	65.9	20.2	Complied
0.26673	Live	42.4	61.2	18.8	Complied
0.40100	Live	30.7	57.8	27.1	Complied
0.68557	Live	36.9	56	19.1	Complied
0.95731	Live	34.3	56	21.7	Complied
1.50621	Live	31.9	56	24.1	Complied

Results: 120 VAC 60 Hz / Live / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.15200	Live	31.1	55.9	24.8	Complied
0.26673	Live	31.9	51.2	19.3	Complied
0.40100	Live	27.2	47.8	20.6	Complied
0.68557	Live	30.5	46	15.5	Complied
0.95731	Live	26.1	46	19.9	Complied
1.50621	Live	22.7	46	23.3	Complied

Results: 120 VAC 60 Hz / Neutral / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.15351	Neutral	43.1	65.8	22.7	Complied
0.26723	Neutral	42.3	61.2	18.9	Complied
0.40301	Neutral	28.5	57.8	29.3	Complied
0.68657	Neutral	35.3	56	20.7	Complied
0.93747	Neutral	32.3	56	23.7	Complied
1.36513	Neutral	29.9	56	26.1	Complied

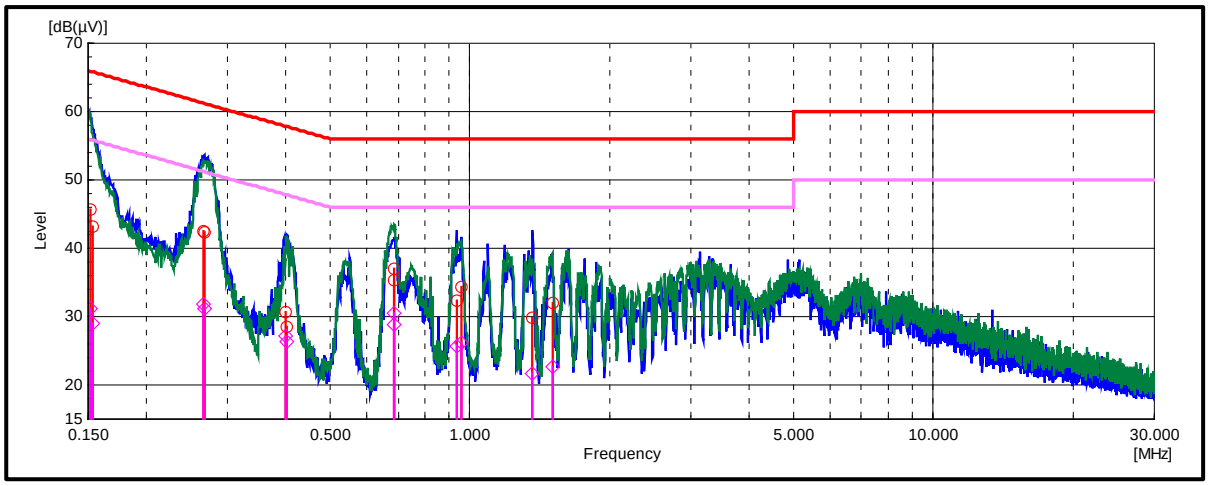
Results: 120 VAC 60 Hz / Neutral / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.15351	Neutral	28.9	55.8	26.9	Complied
0.26723	Neutral	31.2	51.2	20	Complied
0.40301	Neutral	26.3	47.8	21.5	Complied
0.68657	Neutral	28.8	46	17.2	Complied
0.93747	Neutral	25.6	46	20.4	Complied
1.36513	Neutral	21.7	46	24.3	Complied

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: 120 VAC 60 Hz / Live and Neutral Line



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

5.2.2. Transmitter Minimum 6 dB Bandwidth

Test Summary:

Test Engineer:	Abdoufataou Salifou	**Test Date:**	14 November 2019
Test Sample Serial Number:	TM102 (conducted sample with RF SMA connector)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(a)(2)
Test Method Used:	FCC KDB 558074 Section 8.2 referencing ANSI C63.10:2013 Section 11.8.1 Option 1

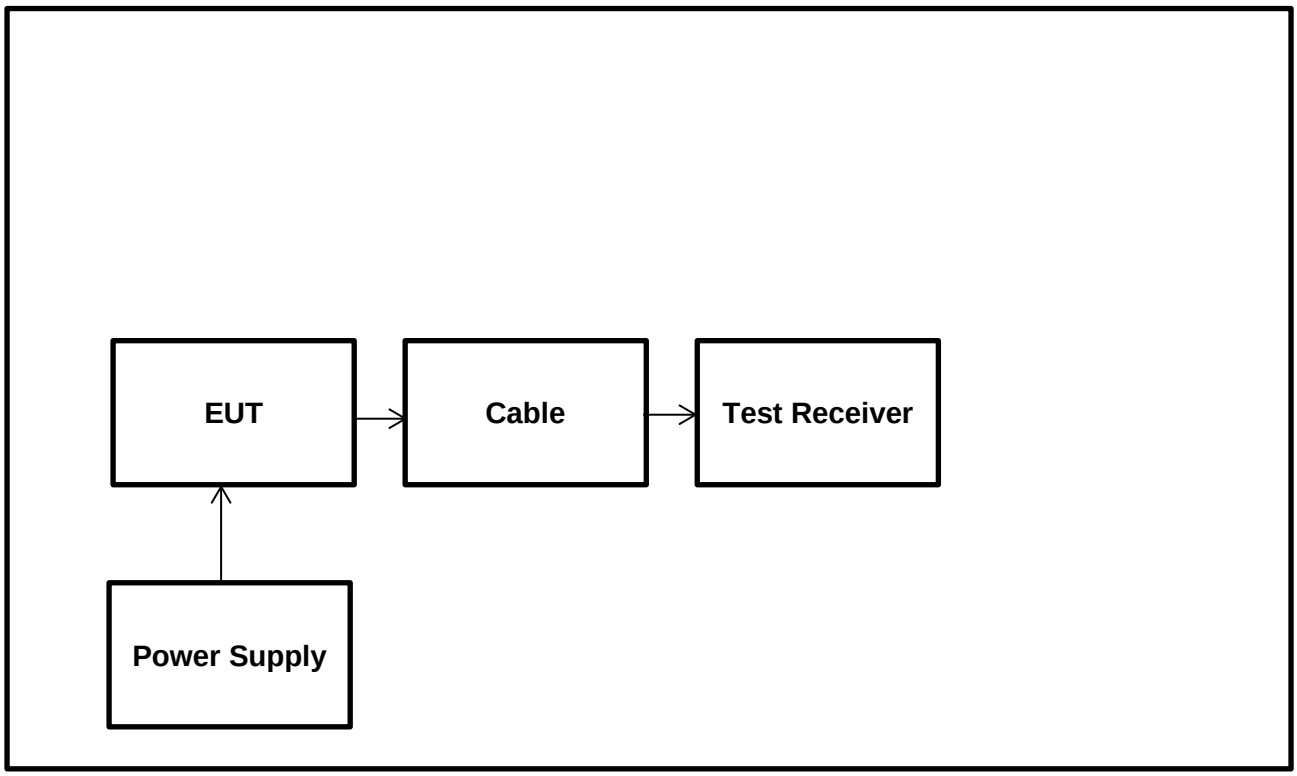
Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	38

Notes:

1. 6 dB DTS bandwidth tests were performed using a spectrum analyser in accordance with FCC KDB 558074 Section 8.2 referencing ANSI C63.10 Section 11.8 (11.8.1 Option 1 measurement procedure).
2. The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors. The RF cable attenuation (maximum 0.5 dB@2.4GHz) from the EUT to Analyzer including the 10 dB attenuation at the Spectrum Analyzer input was added as a reference level offset (10.5 dB) to each of the conducted plots.
3. The SMA (Female) RF Cable soldered on PCB with maximum attenuation of 0.5 dB@2.4GHz has to be corrected manually from plot values; this does make any difference to the measurement.

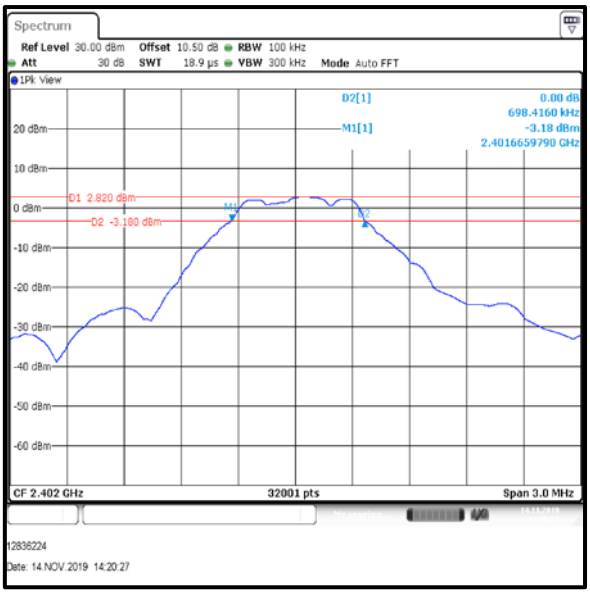
Test Setup:



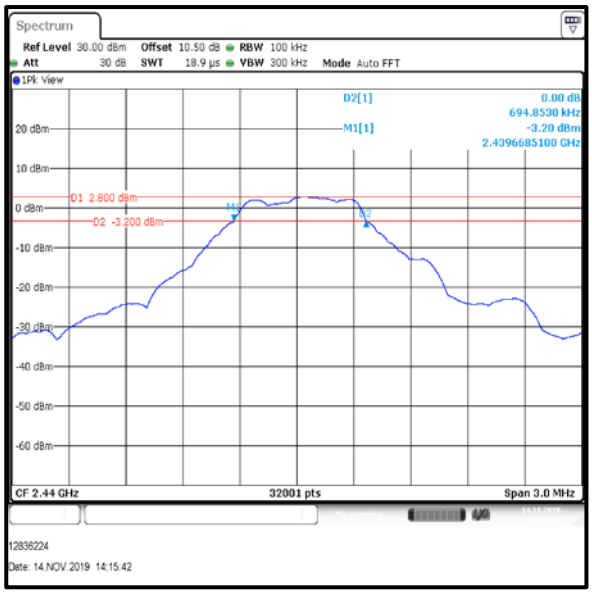
Transmitter Minimum 6 dB Bandwidth (continued)

Results:

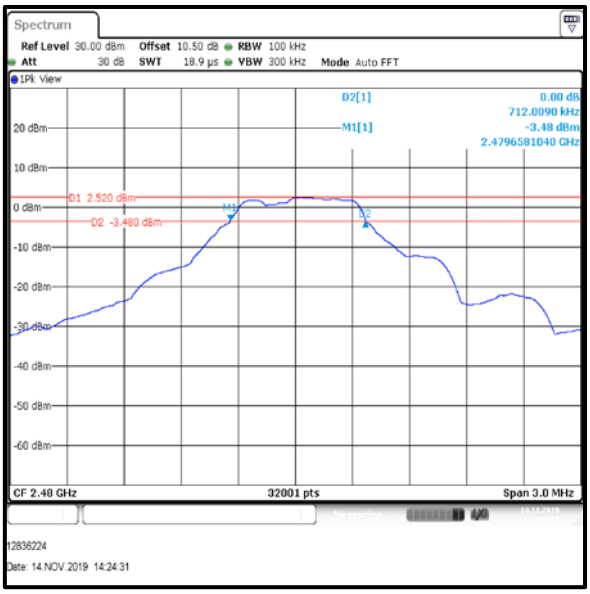
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	698.416	≥500	198.416	Complied
Middle	694.853	≥500	194.853	Complied
Top	712.009	≥500	212.009	Complied



Bottom Channel



Middle Channel



Top Channel

[6 dB Bandwidth plots are without 0.5 dB Attenuation correction for SMA (Female) RF Cable soldered on PCB; this does make any difference to the measurement]

Result: Pass

5.2.3.Transmitter Duty Cycle

Test Summary:

Test Engineer:	Abdoufataou Salifou	**Test Date:**	14 November 2019
Test Sample Serial Number:	TM102 (conducted sample with RF SMA connector)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.35(c)
Test Method Used:	FCC KDB 558074 Section 6.0

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	38

Note:

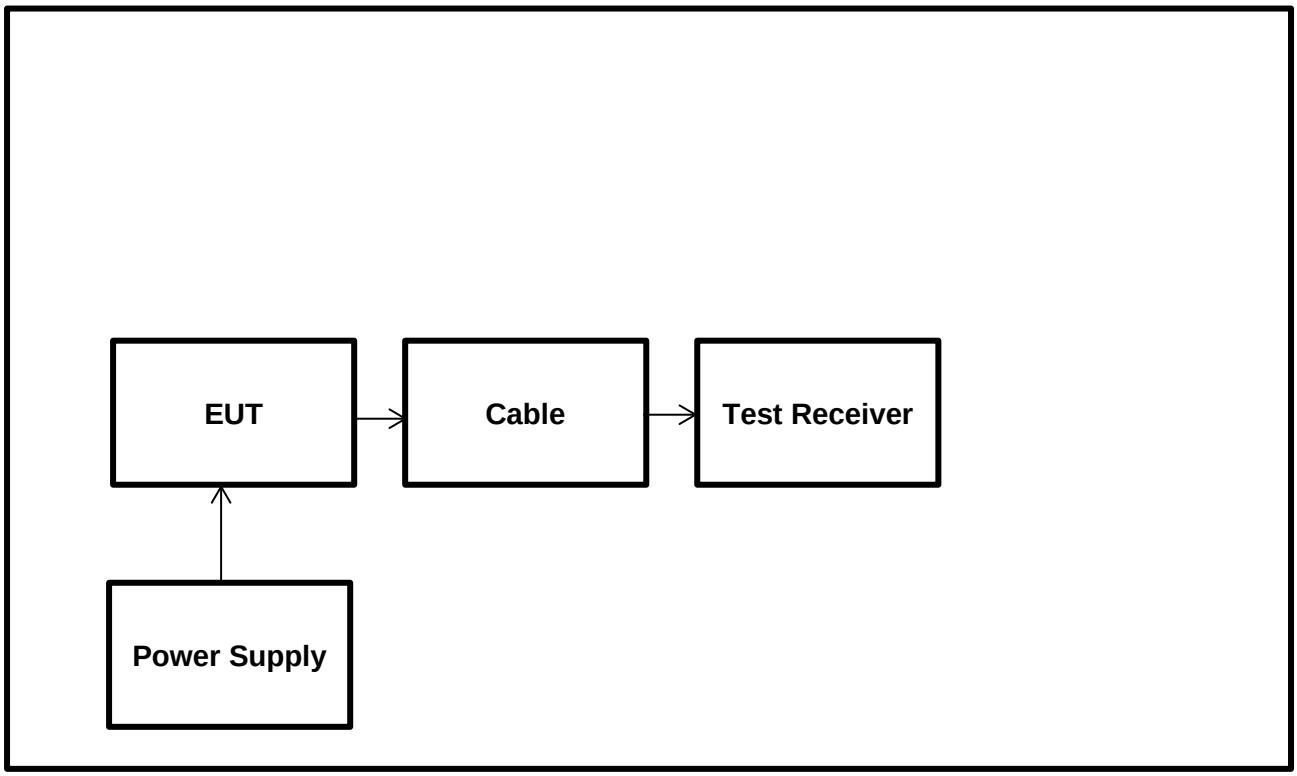
1. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

   10 log (1 / (On Time / [Period or 100 ms whichever is the lesser]).

   BLE duty cycle: 10 log (1 / (423.19 µs/ 626.09µs)) = 1.7 dB

2. The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors. The RF cable attenuation (maximum 0.5 dB@2.4GHz) from the EUT to Analyzer including the 10 dB attenuation at the Spectrum Analyzer input was added as a reference level offset (10.5 dB) to each of the conducted plots.
3. The SMA (Female) RF Cable soldered on PCB with maximum attenuation of 0.5 dB@2.4GHz has to be corrected manually from plot values; this does make any difference to the measurement.

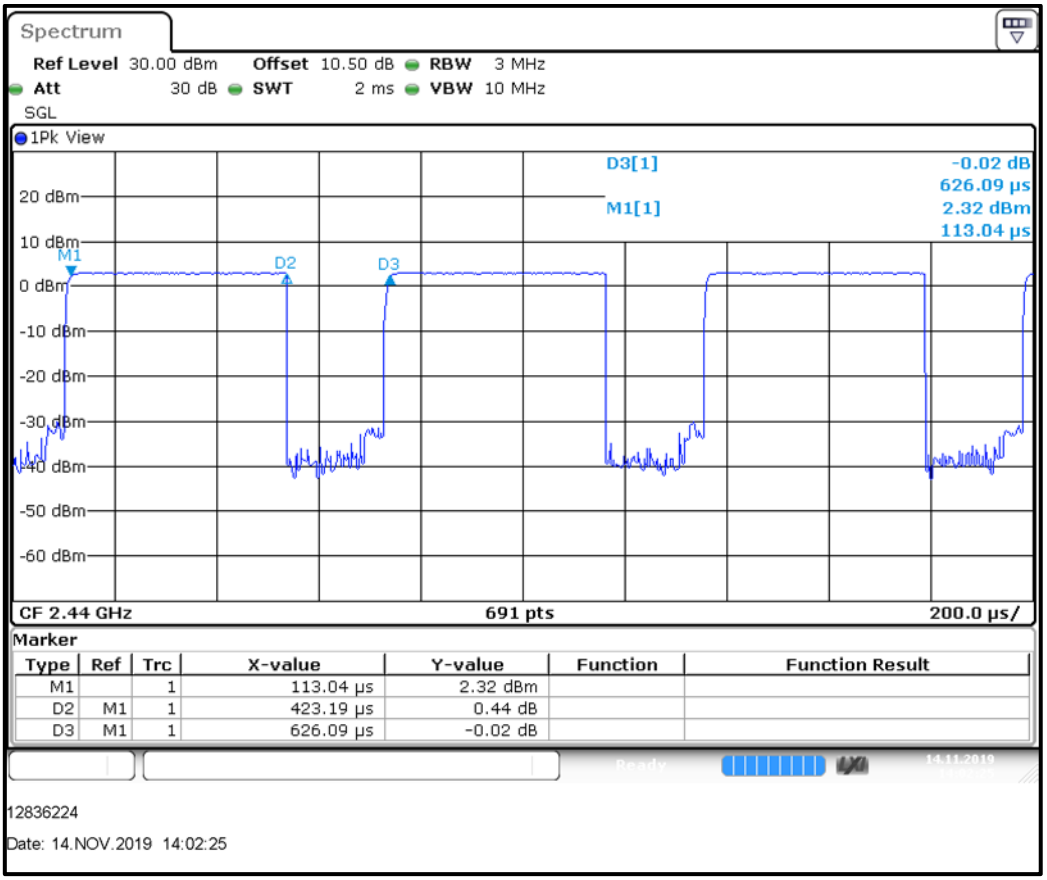
Test Setup:



Transmitter Duty Cycle (continued)

Results:

Pulse On Time (T_{ON}) (ms)	Pulse Period (T_{ON} +T_{OFF}) (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
0.423	0.626	67.6	1.7



[Duty cycle plot is without 0.5 dB Attenuation correction for SMA (Female) RF Cable soldered on PCB; this does make any difference to the measurement]

5.2.4. Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	Abdoufataou Salifou	**Test Date:**	14 November 2019
Test Sample Serial Number:	TM102 (conducted sample with RF SMA connector)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(b)(3)
Test Method Used:	FCC KDB 558074 Section 8.3.1.1 referencing ANSI C63.10 Section 11.9.1.1

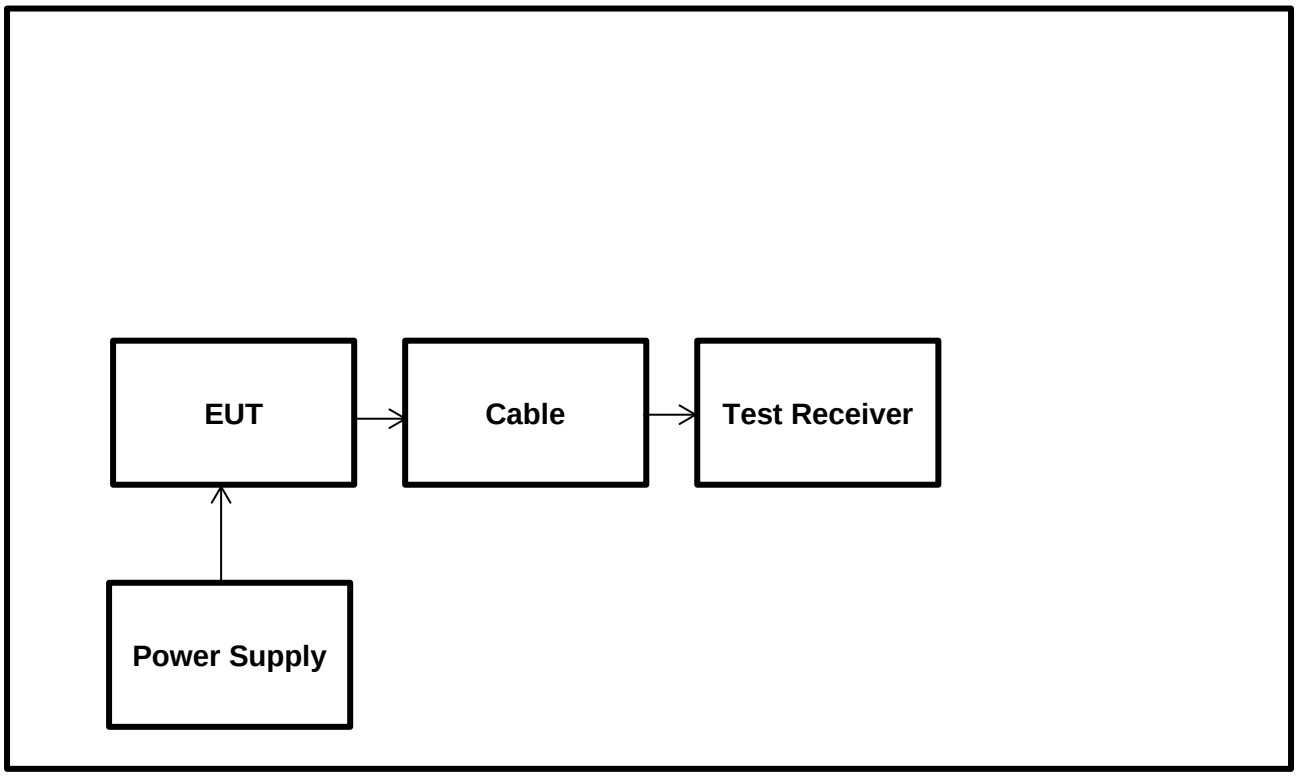
Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	38

Notes:

1. Conducted power tests were performed using a spectrum analyser in accordance with FCC KDB 558074 Section 8.3.1.1 referencing ANSI C63.10 Section 11.9.1.1 with the RBW ≥ *DTS bandwidth* procedure.
2. The signal analyser resolution bandwidth was set to 3 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 10 MHz. A marker was placed at the peak of the signal and the results recorded in the table below.
3. The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors. The RF cable attenuation (maximum 0.5 dB@2.4GHz) from the EUT to Analyzer including the 10 dB attenuation at the Spectrum Analyzer input was added as a reference level offset (10.5 dB) to each of the conducted plots.
4. The SMA (Female) RF Cable soldered on PCB with maximum attenuation of 0.5 dB@2.4GHz has been corrected manually from plot values; this does make any difference to the measurement.
5. The declared antenna gain was was added to the measured conducted power to obtain the EIRP.

Test setup



Transmitter Maximum Peak Output Power (continued)

Results:

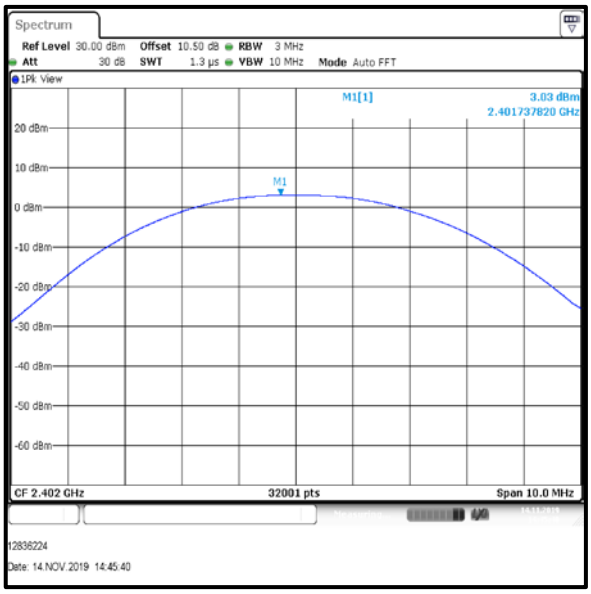
Channel	Plot Conducted Peak Power (dBm)	SMA (Female) RF Cable Attenuation Correction (dB)	Corrected Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	3.03	0.5	3.53	30.0	26.47	Complied
Middle	2.97	0.5	3.47	30.0	26.53	Complied
Top	2.66	0.5	3.16	30.0	26.84	Complied

Channel	Corrected Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	3.53	3.0	6.53	36.0	29.47	Complied
Middle	3.47	3.0	6.47	36.0	29.53	Complied
Top	3.16	3.0	6.16	36.0	29.84	Complied

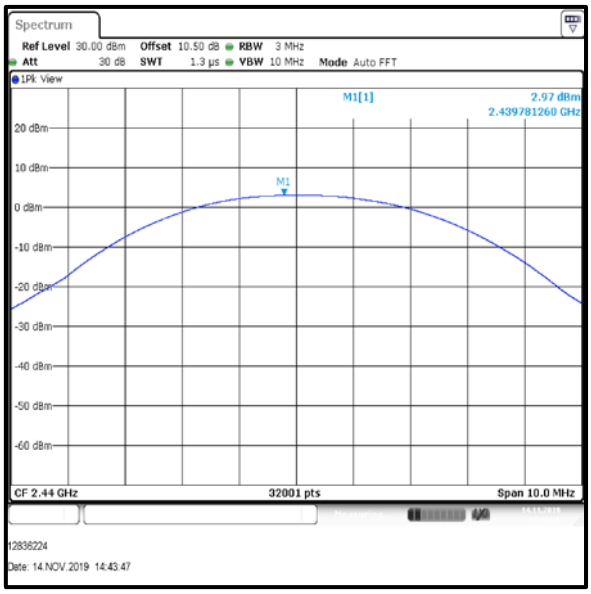
Result: Pass

Transmitter Maximum Peak Output Power (continued)

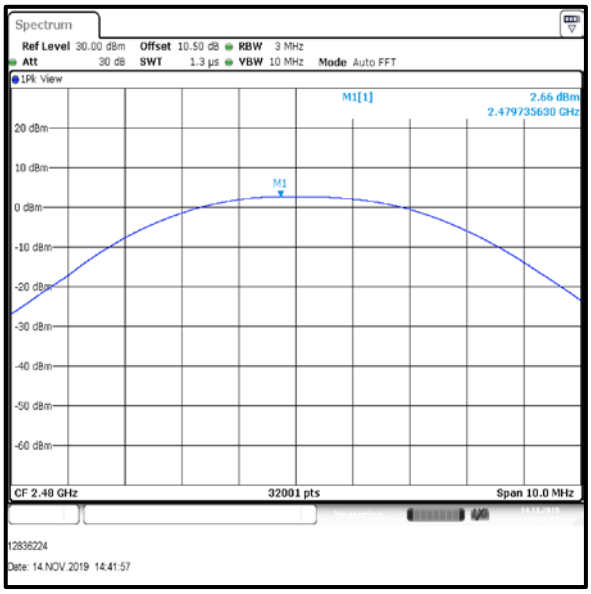
Plots



Bottom Channel



Middle Channel



Top Channel

[Conducted Peak Power plots are without 0.5 dB Attenuation correction fror SMA (Female) RF Cable soldered on PCB.
Refer result tables for final corrected values.]

5.2.5. Transmitter Radiated Emissions

Test Summary:

Test Engineer:	Sercan Usta	**Test Date:**	02 January 2020
Test Sample Serial Number:	TM101 (radiated sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	FCC KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 11.11 and 11.12 ANSI C63.10:2013 Sections 6.3 and 6.4
Frequency Range	9 kHz to 30 MHz

Environmental Conditions:

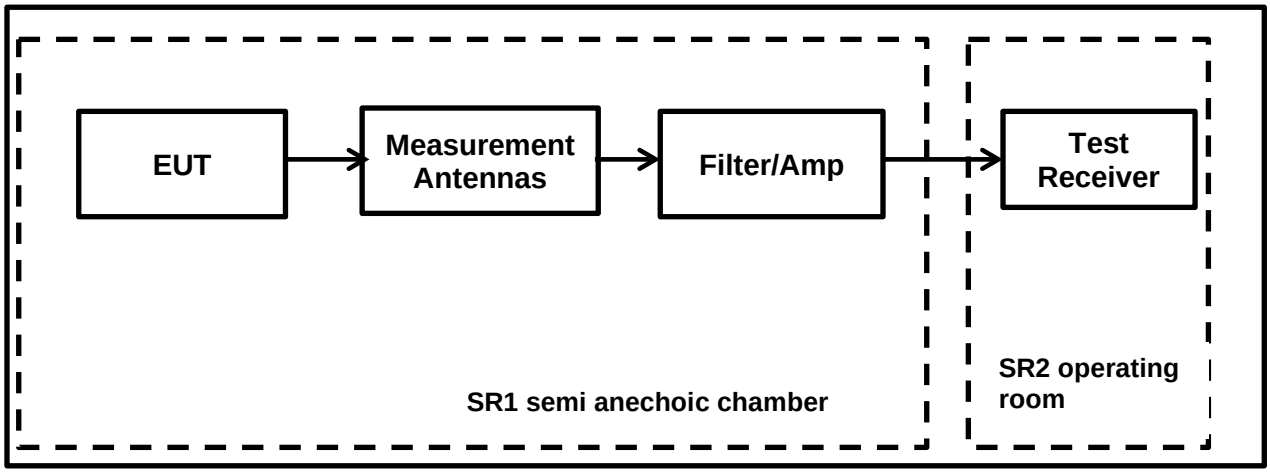
Temperature (°C):	20
Relative Humidity (%):	45

Note(s):

1. In accordance with FCC KDB 414788, an alternative test site may be used for the measurement below 30 MHz (The OATS / SAC comparison data is available upon request). Therefore the result from the semi-anechoic chamber tests is shown in this section of the test report.
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 30 MHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the Bottom Channel only.
4. All emissions shown on the pre-scan plots were investigated and found to be below system noise floor.
5. Measurements below 30 MHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 meters. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable.
6. 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.
7. Final measurements were performed on the marker frequencies and the results entered into the table below. As there was no critical spurious found, no re-measurement with quasi-peak detector necessary.

Transmitter Radiated Emissions (continued)

Test Setup:

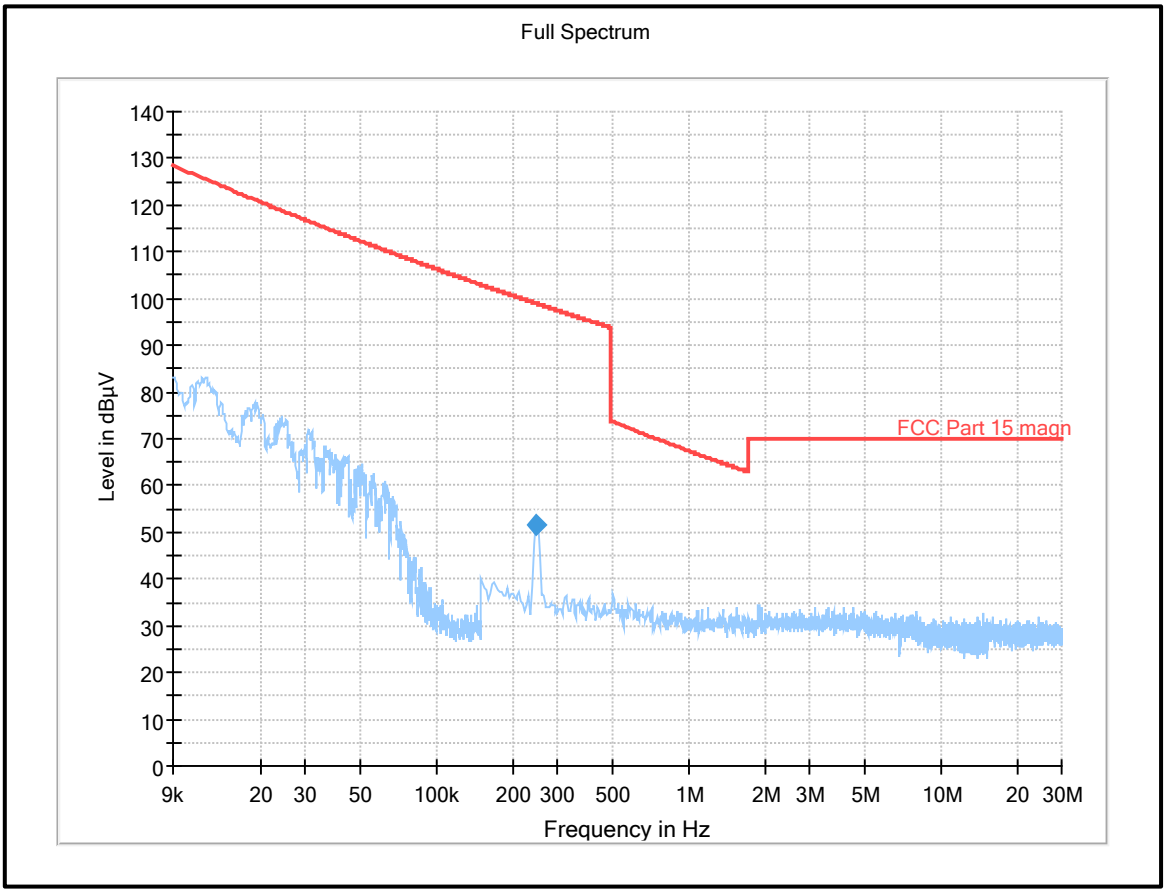


Transmitter Radiated Emissions (continued)

Results: Bottom Channel

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
No spurious emissions were detected					

Plot: 9 KHz - 30 MHz : Bottom Channel



Result: Pass

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Sercan Usta	**Test Date:**	02 January 2020
Test Sample Serial Number:	TM101 (radiated sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	FCC KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 11.11 and 11.12 ANSI C63.10:2013 Sections 6.3 and 6.5
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

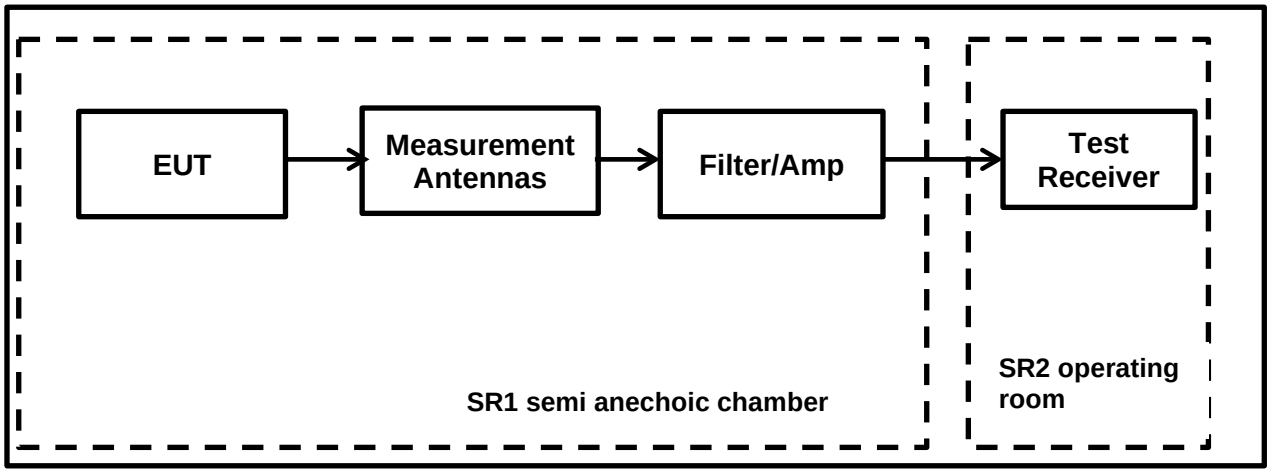
Temperature (°C):	20
Relative Humidity (%):	45

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 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 Bottom 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.
4. Measurements below 1 GHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 m. 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 m to 4 m.
5. 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. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
6. Final measurements were performed on the marker frequencies and the results entered into the table below. As there was no critical spurious found, no re-measurement with quasi-peak detector necessary.

Transmitter Radiated Emissions (continued)

Test Setup:

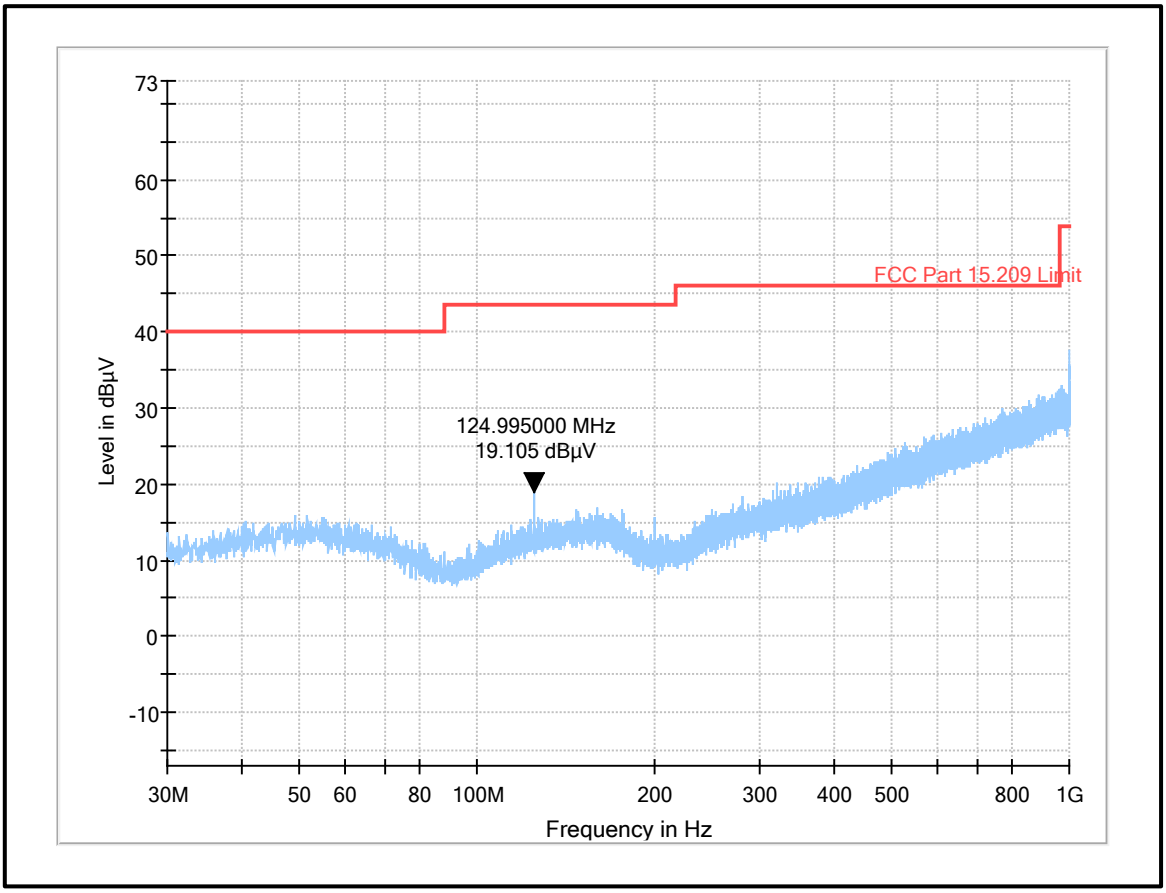


Transmitter Radiated Emissions (continued)

Results: Bottom Channel

Frequency (MHz)	Antenna Polarization	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
No spurious emissions were detected					

Plot: 30 MHz – 1GHz : Bottom Channel



Result: Pass

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Sercan Usta	**Test Date:**	14 November 2019 & 02 January 2020
Test Sample Serial Number:	TM101 (radiated sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	FCC KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 11.11 and 11.12 ANSI C63.10:2013 Sections 6.3 and 6.6
Frequency Range	1 GHz to 25 GHz

Environmental Conditions:

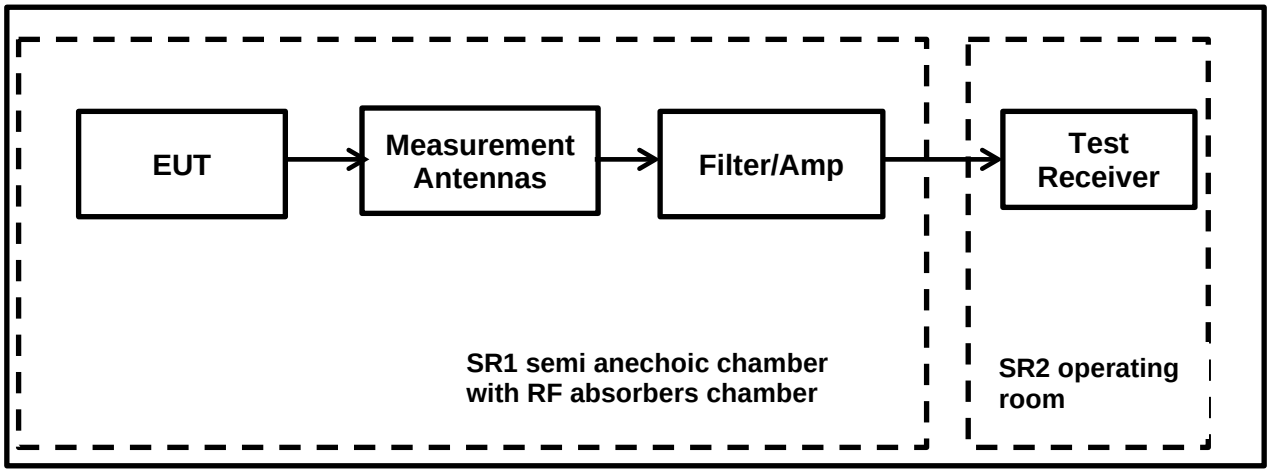
Temperature (°C):	20
Relative Humidity (%):	45

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 approximately at 2.4-2.4835 GHz on the 1 GHz to 18 GHz plot is the EUT fundamental.
3. Pre-scans above 1 GHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) with absorber on the floor at a distance of 3 meters.
4. The EUT was placed at a height of 1.5 m above the test chamber floor in the centre of the chamber turntable. For the pre-scans all measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. For the final measurements maximum emission levels were determined by height searching the measurement antenna over the range 1 m to 4 m.
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.
6. For frequency range between 18 GHz and 25 GHz, no critical emission was found so only the measurement receiver noise floor level has been measured and recorded in the table
7. The preliminary scans showed similar emission levels above 18 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the Bottom channel only.
8. **As the EUT had a duty cycle < 98 % a duty Cycle Correction factor of 1.7 dB was added to all average measurements.
9. *In accordance with ANSI C63.10 Section 6.6.4.3 (Note 1), if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.

Transmitter Radiated Emissions (continued)

Test Setup: Test Setup:



Transmitter Radiated Emissions (continued)

Results: 1 GHz – 18 GHz

Frequency (MHz)	Antenna Polarization	Peak Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
Bottom Channel					
2300.47	Horizontal	51.33	54.00*	2.67	Complied
2383.65	Vertical	51.11	54.00*	2.89	Complied
2414.45	Horizontal	52.23	54.00*	1.77	Complied
Middle Channel					
2413.98	Vertical	46.47	54.00*	7.53	Complied
2475.12	Horizontal	46.47	54.00*	7.53	Complied
Top Channel					
2508.83	Horizontal	53.55	54.00*	0.45	Complied
4960.33	Vertical	53.38	54.00*	0.62	Complied

Results: 1 GHz – 18 GHz / Peak

Frequency (MHz)	Antenna Polarization	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
Bottom Channel					
2355.07	Horizontal	59.11	74.00	14.89	Complied
4804.00	Vertical	58.17	74.00	15.83	Complied
Middle Channel					
4880.00	Vertical	58.07	74.00	15.93	Complied
Top Channel					
2508.83	Horizontal	56.13	74.00	17.87	Complied
2544.07	Vertical	57.42	74.00	16.58	Complied
4960.33	Vertical	57.25	74.00	16.75	Complied

Result: Pass

Transmitter Radiated Emissions (continued)

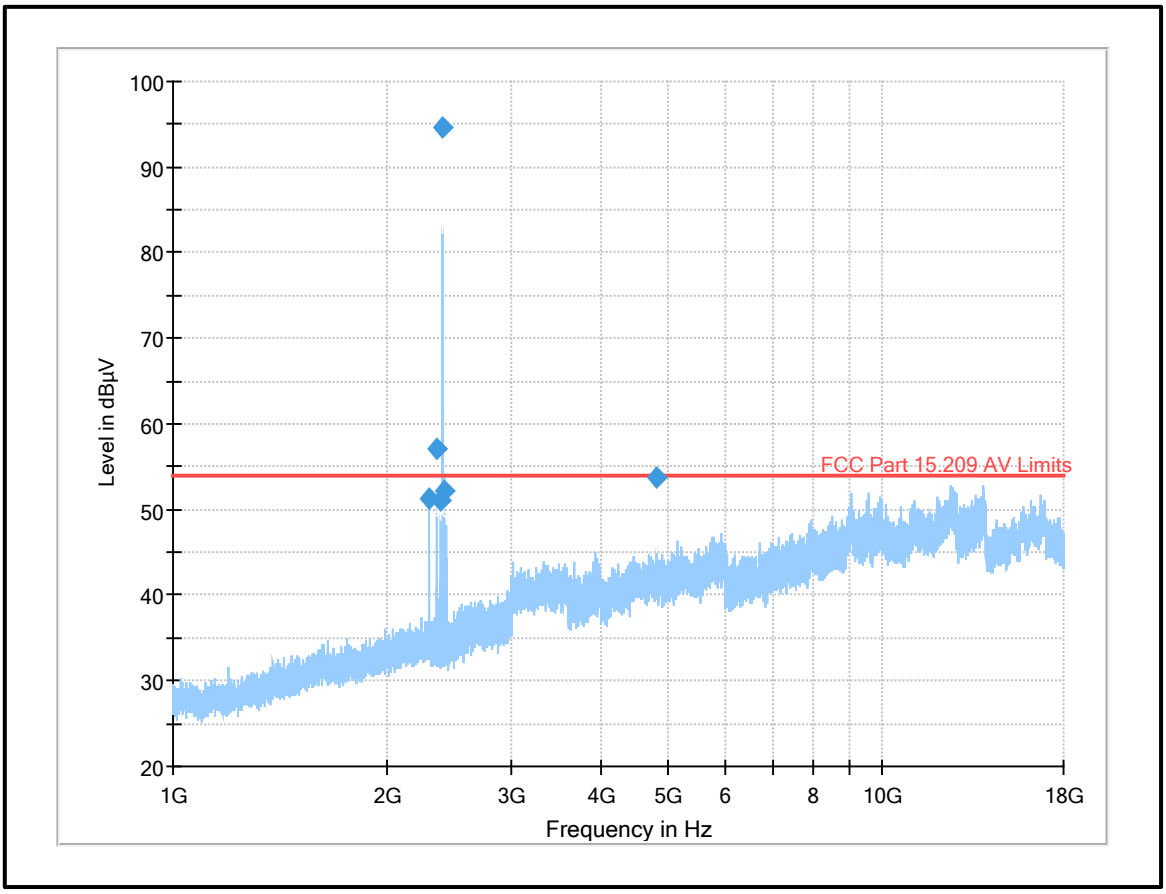
Results: 1 GHz – 18 GHz / Average

Frequency (MHz)	Antenna Polarization	Average Level (dBµV/m)	Duty Cycle Correction (dB)	Corrected Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
Bottom Channel							
2355.07	Horizontal	40.75	1.7	42.45**	54.00	11.55	Complied
4804.00	Vertical	45.78	1.7	47.48**	54.00	6.52	Complied
Middle Channel							
4880.00	Vertical	45.82	1.7	47.52**	54.00	6.48	Complied
Top Channel							
2508.83	Horizontal	33.98	1.7	35.68**	54.00	18.32	Complied
2544.07	Vertical	34.78	1.7	36.48**	54.00	17.52	Complied
4960.33	Vertical	44.32	1.7	46.02**	54.00	7.98	Complied

Result: Pass

Transmitter Radiated Emissions (continued)

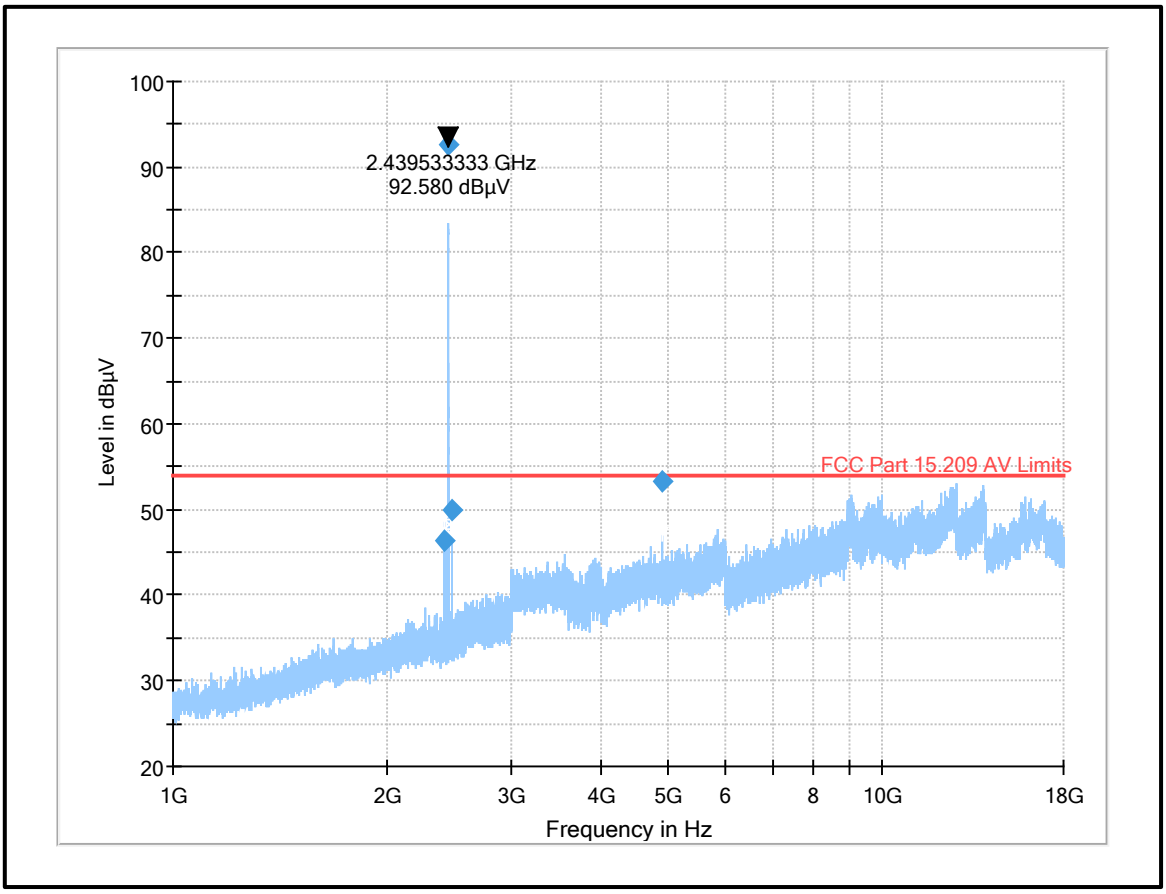
Plot: 1 GHz – 18GHz: Bottom Channel



Result: Pass

Transmitter Radiated Emissions (continued)

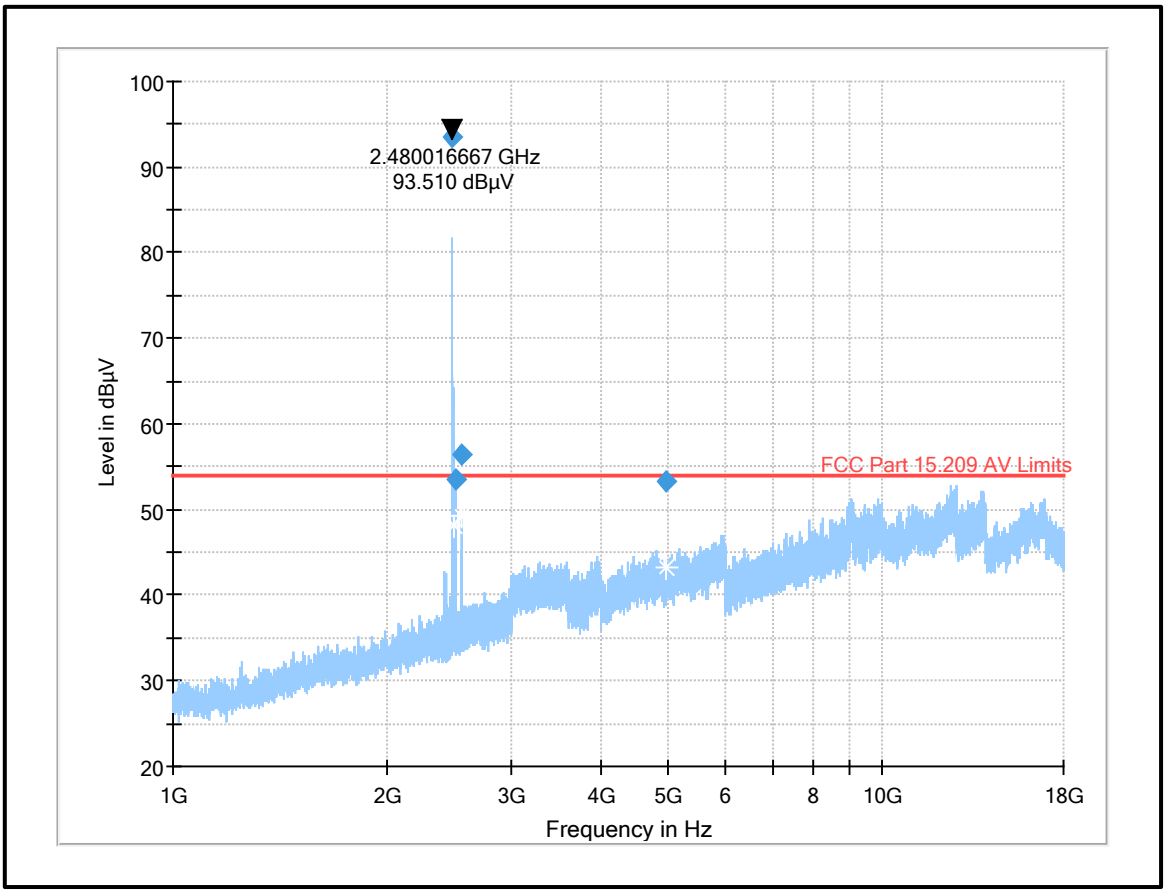
Plot: 1 GHz – 18GHz: Middle channel



Result: Pass

Transmitter Radiated Emissions (continued)

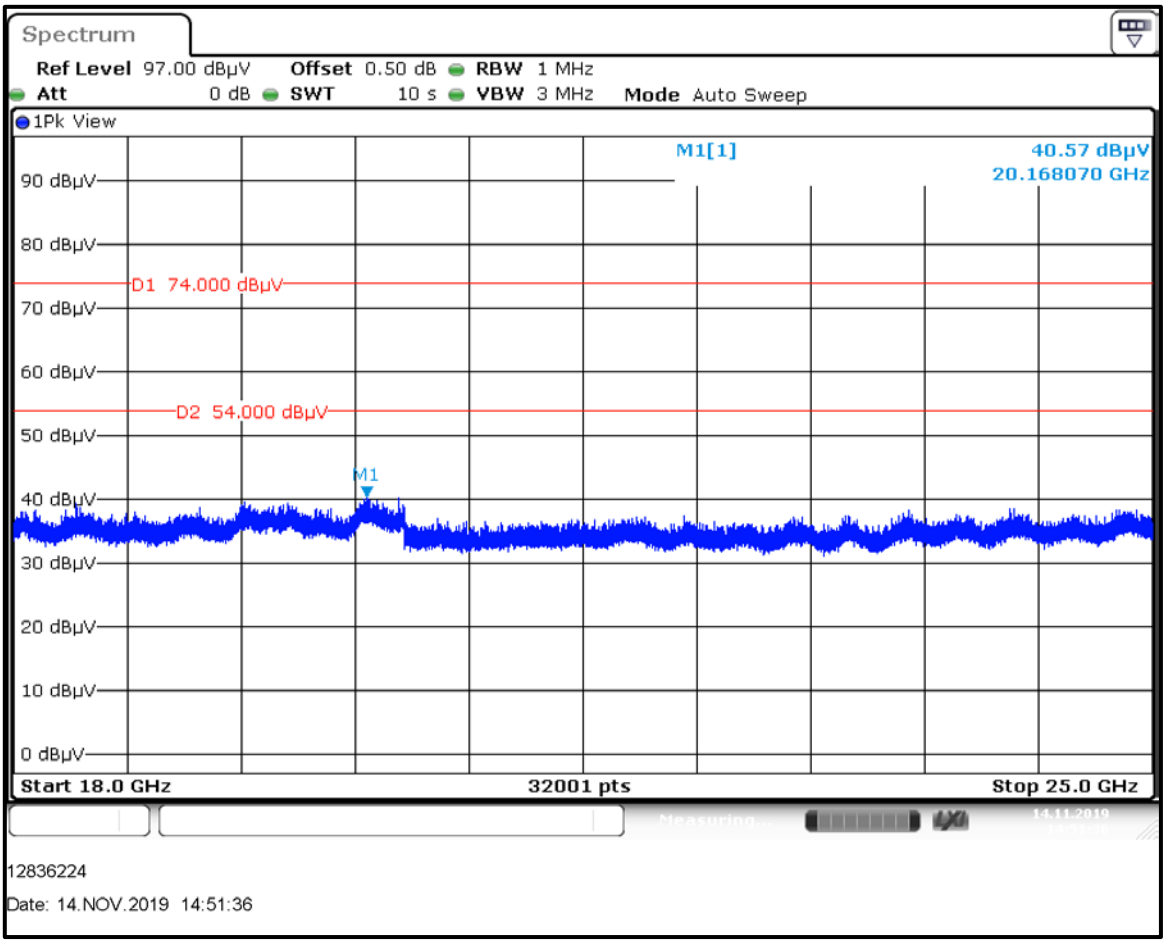
Plot: 1 GHz – 18GHz: Top channel



Result: Pass

Transmitter Radiated Emissions (continued)

Plot: 18 GHz – 25GHz : Bottom Channel



Result: Pass

5.2.6. Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineer:	Sercan Usta	**Test Date:**	20 December 2019
Test Sample Serial Number:	TM101 (radiated sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Part 15.247(d)
Test Method Used:	FCC KDB 558074 Sections 8.7 referencing ANSI C63.10:2013 Section 6.10.4, 6.10.5 & Section 11.11, 11.2 ,11.13

Environmental Conditions:

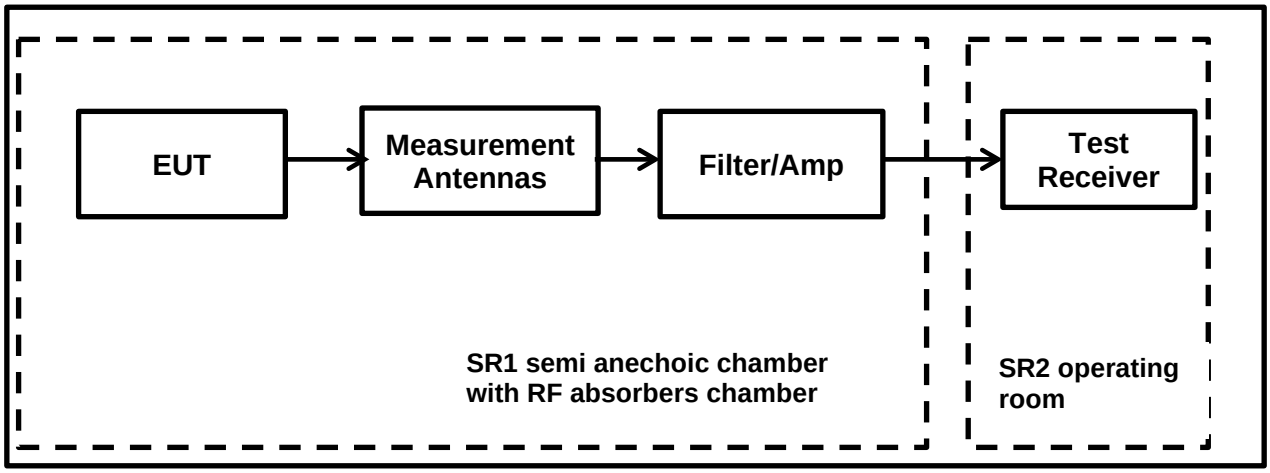
Temperature (°C):	20
Relative Humidity (%):	45

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. As the maximum peak conducted output power was previously measured. In accordance with FCC KDB 558074 Section 8.7 lower band edge measurement was performed with a peak detector and the -20 dBc limit applied.
3. As the lower band edge falls within a non-restricted band, only peak measurements are required. 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. Marker frequencies and levels were recorded.
4. As the upper band edge falls within 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. A RMS detector in linear power avergaging mode was used. 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 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 their respective detectors. Markers were placed on the highest point on each trace.
6. A Duty Cycle Correction factor of 1.7 dB was added to all average measurements.

Transmitter Band Edge Radiated Emissions (Continued)

Test Setup:



Transmitter Band Edge Radiated Emissions (Continued)

Results: Lower Band Edge / Peak

Frequency (MHz)	Peak Level (dBµV/m)	-20 dBc Limit (dBµV/m)	Margin (dB)	Result
2384.15	50.35	75.45	25.10	Complied

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

Frequency (MHz)	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
2355.25	59.35	74.0	14.65	Complied

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

Frequency (MHz)	Average Level (dBµV/m)	Duty Cycle Correction (dB)	Corrected Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
2384.10	35.69	1.7	37.39	54.0	16.61	Complied

Results: Upper Band Edge / Peak

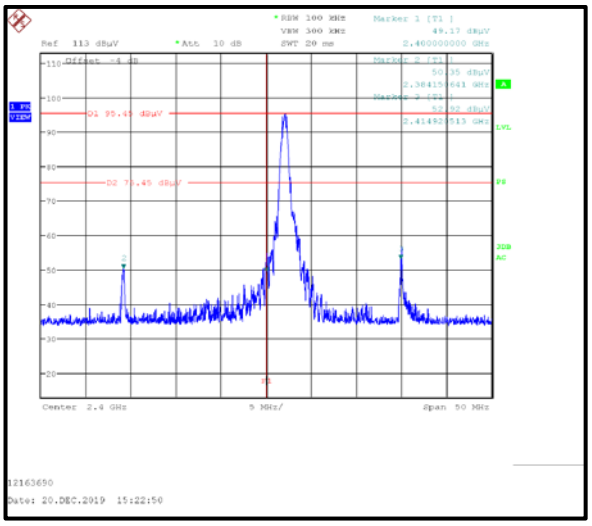
Frequency (MHz)	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
2483.50	66.98	74.0	7.02	Complied
2501.10	55.84	74.0	18.16	Complied

Results: Upper Band Edge / Average

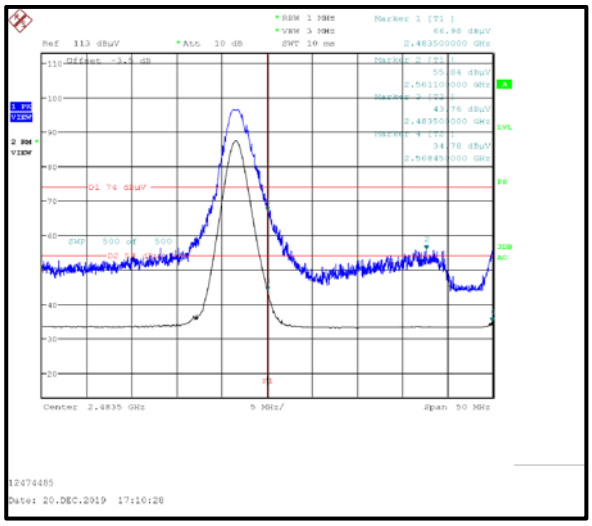
Frequency (MHz)	Average Level (dBµV/m)	Duty Cycle Correction (dB)	Corrected Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
2483.50	43.76	1.7	45.46	54.0	8.54	Complied
2508.45	34.78	1.7	36.48	54.0	17.52	Complied

Result: Pass

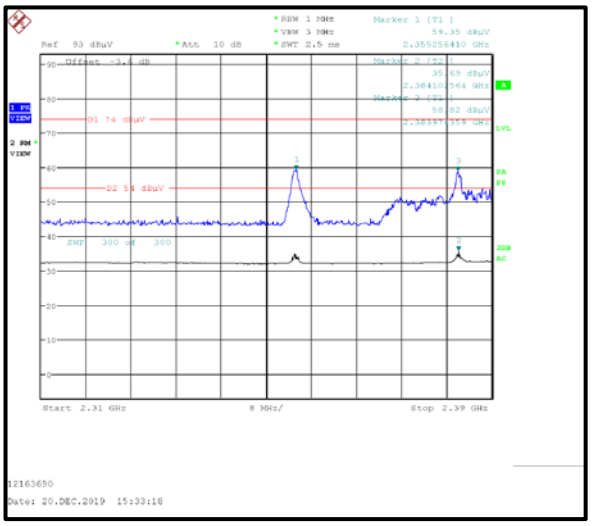
Transmitter Band Edge Radiated Emissions (continued)



Lower Band Edge Peak Measurement



Upper Band Edge Peak and Average Measurement



2310 MHz to 2390 MHz Restricted Band Plot

6. Measurement Uncertainty

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

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

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

Measurement Type	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	95%	±2.49 dB
Conducted Maximum Peak Output Power	95%	±0.59 dB
Transmitter Duty Cycle	95%	±3.4%
Radiated Spurious Emissions	95%	±3.10 dB
Band Edge Radiated Emissions	95%	±3.10 dB
Minimum 6 dB Bandwidth	95%	±0.87 %

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

7. Used equipment

Test site: SR 1/2

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
1	Rohde & Schwarz	Antenna, Loop	HFH2-Z2	831247/012	7/11/2019	36
377	BONN Elektronik	Amplifier, Low Noise Pre	BLMA 0118-1A	025294B	7/10/2019	12
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	55929	7/16/2019	12
460	Deisl	Turntable	DT 4250 S	n/a	n/a	n/a
465	Schwarzbeck	Antenna, Trilog Broadband	VULB 9168	9168-240	3/20/2019	24
496	Rohde & Schwarz	Antenna, log. - periodical	HL050	100297	2/19/2019	36
587	Maturo	antenna mast, tilting	TAM 4.0-E	011/7180311	n/a	n/a
588	Maturo	Controller	NCD	029/7180311	n/a	n/a
591	Rohde & Schwarz	Receiver	ESU 40	100244/040	7/9/2019	12
608	Rohde & Schwarz	Switch Matrix	OSP 120	101227	lab verification	n/a
628	Maturo	Antenna mast	CAM 4.0-P	224/19590716	n/a	n/a
629	Maturo	Kippeinrichtung	KE 2.5-R-M	MAT002	n/a	n/a
-/-	Testo	Thermo-Hygrometer	608-H1	01	lab verification	n/a
1603665	Siemens Matsushita Components	semi-anechoic chamber SR1/ 2		B83117-A1421-T161	n/a	n/a

Test site: SR 7/8

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
22	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/014	9/7/2019	12
23	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/013	9/7/2019	12
28	Rohde & Schwarz	Passive Probe	ESH2-Z3	none	11/7/2019	12
215	Rohde & Schwarz	Artificial Mains Network	ESH2-Z5	879675/002	5/7/2019	12
349	Rohde & Schwarz	Receiver, EMI Test	ESIB7	836697/009	10/7/2019	12
351	Rohde & Schwarz	network, Artificial Mains	ESH3-Z5	862770/018	8/7/2019	12
564	Teseq	Impedance stabilisation network (ISN)	ISN T800	26076	8/7/2019	24
616	Rohde & Schwarz	ISN	ENY81-CA6	101656	9/7/2019	12
-/-	Testo	Thermo-Hygrometer	608-H1	08	lab verification	n/a

Test site: SR 9

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	55929	7/16/2019	12
445	Huber & Suhner	RF Attenuator (10dB)	6810.17.AC	--	lab verification	12
621	Ahlborn-Almemo	Temperatur-/ Feuchtemessgerät	MA2470-S2	H16080099	3/15/2019	12
636	Rohde & Schwarz	switching unit	OSP120	101698	7/19/2019	12
637	Rohde & Schwarz	Spectrum Analyzer	FSV40	101587	7/11/2019	12
-/-	Testo	Thermo-Hygrometer	608-H1	07	lab verification	n/a
1603668	Siemens Matsushita Components	shielded room		B83117-B1422-T161	n/a	n/a

8. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	45	-	Initial Version