



TEST REPORT

Test Report No. : UL-RPT-RP-13260875-516-FCC

Applicant : Danfoss Srl
Model No. : PR-OCTO
FCC ID : 2ATXJ-OCTO2020
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 1.1 supersede Version 1.0 with immediate effect**
Test Report No. UL-RPT-RP-13260875-516-FCC Version 1.1, Issue Date 09 APRIL 2021 replaces
Test Report No. UL-RPT-RP-13260875-516-FCC Version 1.0, Issue Date 06 APRIL 2021, which is no longer valid.
5. Result of the tested sample: **PASS**

Prepared by: Sercan, Usta
Title: Laboratory Engineer
Date: 09 April 2021

Approved by: Ajit, Phadtare
Title: Lead Test Engineer
Date: 09 April 2021



Deutsche
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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.

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1. Customer Information

1.1.Applicant Information

Company Name:	Danfoss A/S
Company Address:	Nordborgvej 81, DK-6430 Nordborg, Denmark
Company Phone No.:	+45 7488 2222
Company E-Mail:	info@danfoss.com
Contact Person:	Thomas Krogh Nielsen
Contact E-Mail Address:	tni@danfoss.com
Contact Phone No.:	-/-

1.2.Manufacturer Information

Company Name:	Danfoss A/S
Company Address:	Nordborgvej 81, DK-6430 Nordborg, Denmark
Company Phone No.:	+45 7488 2222
Company E-Mail:	info@danfoss.com
Contact Person:	Thomas Krogh Nielsen
Contact E-Mail Address:	tni@danfoss.com
Contact Phone No.:	-/-

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

Location

Location of Testing:	UL International Germany GmbH Hedelfinger Str. 61 70327 Stuttgart Germany
Test Firm Registration:	399704

Date information

Order Date:	27 February 2020
EUT arrived:	20 April 2020
Test Dates:	29 April 2020 to 11 August 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	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.35(c)	Transmitter Duty Cycle ⁽¹⁾	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(e)	Transmitter Power Spectral Density ⁽²⁾	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Part 15.247(b)(3)	Transmitter Maximum Peak Output Power	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(d)/15.209(a)	Transmitter Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(d)/15.209(a)	Transmitter Band Edge Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note(s):

1. The measurement was performed to assist in the calculation of the average measurements.
2. In accordance with ANSI C63.10-2013 Section 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 compliance measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC rules
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:	PR-OCTO
Model Name or Number:	PR-OCTO
Test Sample Serial Number:	EUT1 (Radiated Test Sample)
Hardware Version Number:	Rev. B (16 jan 2020)
Software Version Number:	V1.0
FCC ID:	2ATXJ-OCTO2020

Brand Name:	PR-OCTO
Model Name or Number:	PR-OCTO
Test Sample Serial Number:	EUT4 (Conducted Test Sample)
Hardware Version Number:	Rev. B (16 jan 2020)
Software Version Number:	V1.0
FCC ID:	2ATXJ-OCTO2020

3.2. Description of EUT

The equipment under test was a Model: PR-OCTO supporting WLAN 802.11 b,g,n & Bluetooth Low Energy operations in 2.4 - 2.4835 GHz ISM band.

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):	85 - 265 V/AC		
Maximum Conducted Output Power:	0.61 dBm		
Declared Antenna Gain:	4.9 dBi		
Antenna Type:	OnBoard Antenna		
Antenna Details:	Proant PRO-OB-440		
Transmit Frequency Range:	2402 MHz to 2480 MHz		
Transmit Channels Tested:	Channel ID	RF Channel	Channel Frequency (MHz)
	Bottom	37	2402
	Middle	17	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	HP	HP Probook 650 G1	5CG614419V

B. Support Equipment (Manufacturer supplied)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	USB extension cable (USB A to TTL UART 1m)	Not Marked or stated	Not Marked or stated	Not marked or stated
2	AC power cable (1m)	Not Marked or stated	Not Marked or stated	Not Marked or stated

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

- Continuously transmitting modulated carrier with combination of
 - BT-LE Test Mode :1 Mbps | PRBS9 | Power Settings : PWR 4

4.2. Configuration and Peripherals

EUT Power Supply:

- The EUT was powered by 120 V AC supply.

Test Mode Activation:

- All EUTs have attached programming-USB connector to connect it to the test laptop.
- The test modes were activated using the program “EspRFtestTool.exe” supplied by the customer.
- This application was used to enable continuous transmission and to select the technology, the power level and the test channels as required.
- The transmitter test modes were configured to power settings 4 (i.e. PWR 4).

AC Conducted Line Measurements:

- The EUT radiated sample was used for AC conducted emissions.
- The EUT was connected to either 120 VAC /60 Hz or 240 VAC/60 Hz single phase supply via a LISN.

Conducted Measurements:

- All conducted measurements were carried out by using conducted samples with SMA (Female) RF Cable soldered on PCB by the customer.
- The SMA (Female) RF cable’s attenuation (maximum 0.5 dB@2.4GHz) was added to a reference level offset to each of the conducted plots.

Radiated Measurements:

- The EUT radiated sample was used for radiated spurious emission & radiated 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.
- Radiated spurious emissions were performed with the EUT positioned on the turn table and rotating 360 degrees while the antenna height varies from 1 to 4 m over the measurement frequency range.
- EMC32 V10.1.0 Software was used for the Radiated spurious emission measurements.

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:	Devang Chauhan	Test Date:	10 August 2020
Test Sample Serial Number:	EUT1 (Radiated Test Sample)		
Test Site Identification	SR 7/8		

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

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	35

Settings of the Instrument

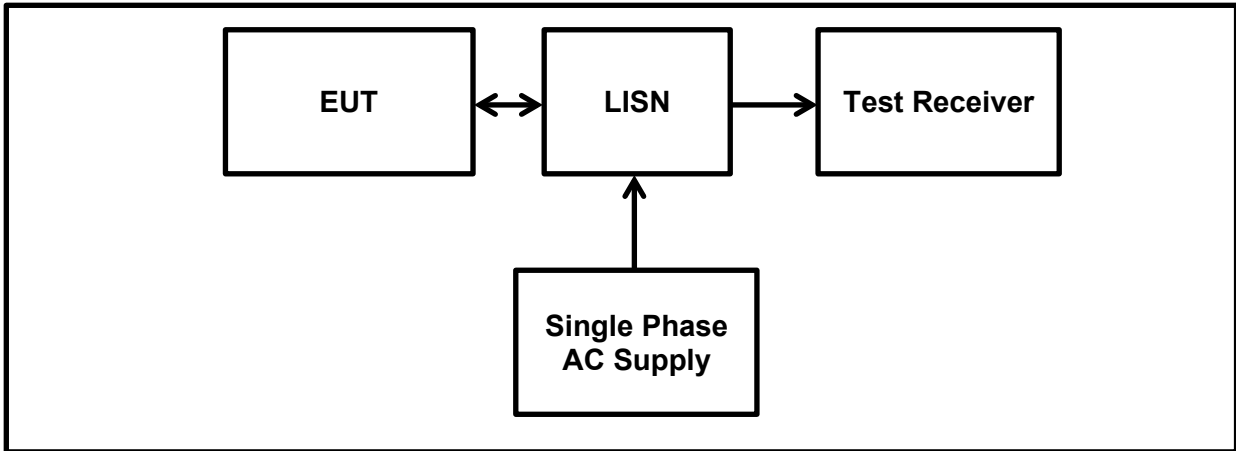
Detector	Quasi Peak/ Average Peak
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Note(s):

1. The EUT was plugged into a AC/DC Power Supply. The Power Supply was connected to 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 100-240 VAC~50/60 Hz power supply.
3. The EUT was configured on BT-LE Test mode: 1 Mbps | PRBS9 | Power Settings : PWR 44 | Middle Channel.
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.
5. The final measured value, for the given emission, in the table below incorporates the cable loss.
6. All other emissions shown on the pre-scan plot were investigated. Only the highest 6 emissions have been reported in the tables below in accordance with ANSI C63.10 section 6.2.5.
7. 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 at distance of 40 cm from the vertical ground plane at the edge of the table.
8. Measurement software used: Toyo EMI Software; CE measurement software EP5/CE Ver 4.0.1.

Transmitter AC Conducted Spurious Emissions (continued)

Test setup:



Transmitter AC Conducted Spurious Emissions (continued)**Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Middle Channel****Results: Live / Quasi Peak / 120 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.1607	Live	45.60	65.40	19.80	Complied
0.2235	Live	56.50	62.70	6.20	Complied
0.3313	Live	43.30	59.40	16.10	Complied
0.5234	Live	31.30	56.00	24.70	Complied
1.0160	Live	22.80	56.00	33.20	Complied
2.3989	Live	20.60	56.00	35.40	Complied

Results: Live / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.1607	Live	32.60	55.40	22.80	Complied
0.2235	Live	40.10	52.70	12.60	Complied
0.3313	Live	28.40	49.40	21.00	Complied
0.5234	Live	20.90	46.00	25.10	Complied
1.0160	Live	17.50	46.00	28.50	Complied
2.3989	Live	15.90	46.00	30.10	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.1505	Neutral	47.10	66.00	18.90	Complied
0.2231	Neutral	56.60	62.70	6.10	Complied
0.3285	Neutral	43.50	59.50	16.00	Complied
0.4410	Neutral	34.20	57.00	22.80	Complied
1.2698	Neutral	22.30	56.00	33.70	Complied
2.7319	Neutral	17.80	56.00	38.20	Complied

Transmitter AC Conducted Spurious Emissions (continued)

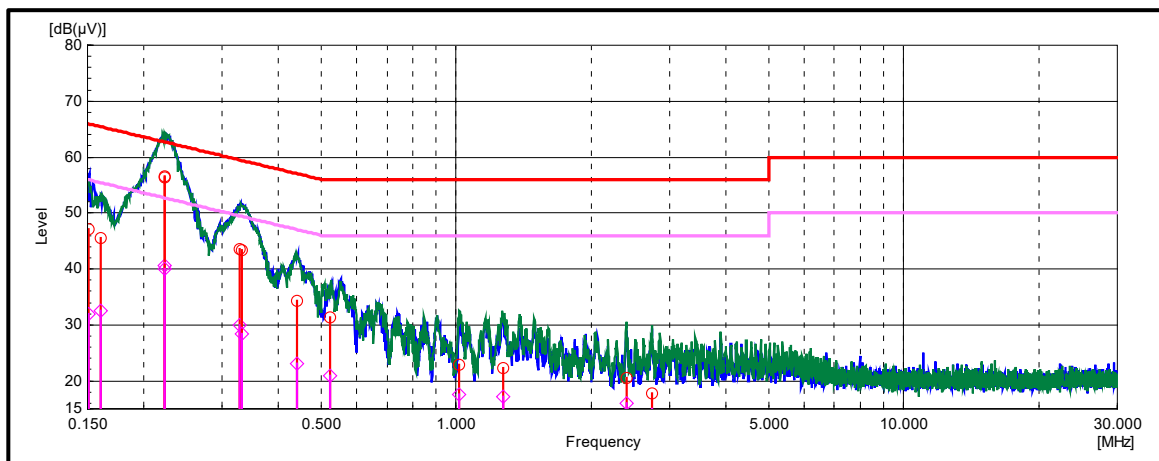
Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Middle Channel

Results: Neutral / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.1505	Neutral	32.00	56.00	24.00	Complied
0.2231	Neutral	40.60	52.70	12.10	Complied
0.3285	Neutral	29.90	49.50	19.60	Complied
0.4410	Neutral	23.00	47.00	24.00	Complied
1.2698	Neutral	17.20	46.00	28.80	Complied
2.7319	Neutral	13.30	46.00	32.70	Complied

Result: Pass

Plot: Live and Neutral Line / 120 VAC 60 Hz



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

Transmitter AC Conducted Spurious Emissions (continued)**Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Middle Channel****Results: Live / Quasi Peak / 240 VAC 60 Hz**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.1665	Live	43.10	65.10	22.00	Complied
0.2220	Live	53.70	62.70	9.00	Complied
0.3352	Live	45.50	59.30	13.80	Complied
0.4490	Live	37.70	56.90	19.20	Complied
1.1396	Live	26.40	56.00	29.60	Complied
2.6188	Live	20.70	56.00	35.30	Complied

Results: Live / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.1665	Live	30.60	55.10	24.50	Complied
0.2220	Live	38.70	52.70	14.00	Complied
0.3352	Live	30.50	49.30	18.80	Complied
0.4490	Live	22.80	46.90	24.10	Complied
1.1396	Live	21.60	46.00	24.40	Complied
2.6188	Live	16.40	46.00	29.60	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.2228	Neutral	53.80	62.70	8.90	Complied
0.3348	Neutral	46.00	59.30	13.30	Complied
0.4486	Neutral	38.20	56.90	18.70	Complied
0.5596	Neutral	30.10	56.00	25.90	Complied
1.1394	Neutral	25.20	56.00	30.80	Complied
1.8211	Neutral	21.70	56.00	34.30	Complied

Transmitter AC Conducted Spurious Emissions (continued)

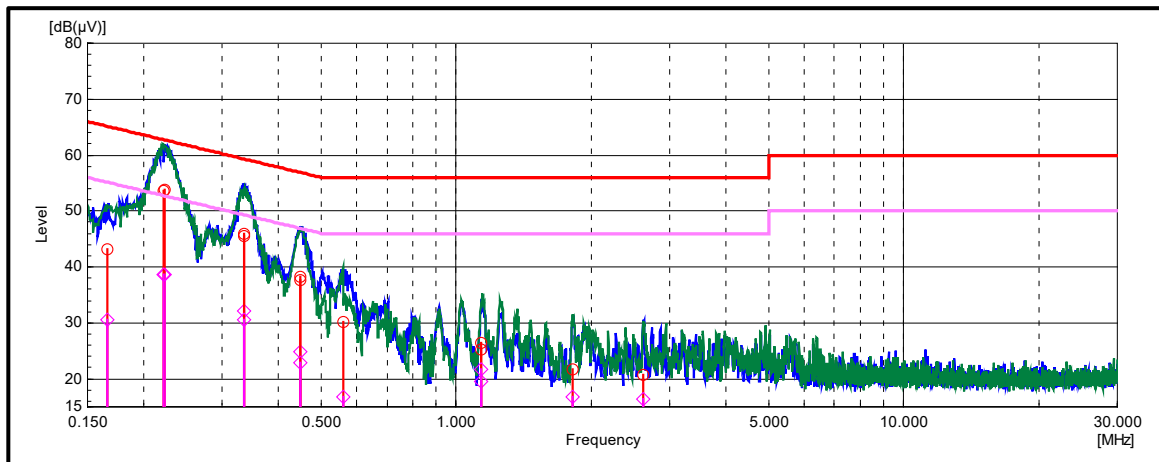
Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Middle Channel

Results: Neutral / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.2228	Neutral	38.70	52.70	14.00	Complied
0.3348	Neutral	32.10	49.30	17.20	Complied
0.4486	Neutral	24.80	46.90	22.10	Complied
0.5596	Neutral	16.70	46.00	29.30	Complied
1.1394	Neutral	19.60	46.00	26.40	Complied
1.8211	Neutral	16.80	46.00	29.20	Complied

Result: Pass

Plot: Live and Neutral Line / 240 VAC 60 Hz



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

5.2.2. Transmitter 6 dB Bandwidth

Test Summary:

Test Engineer:	Sercan Usta	Test Date:	11 August 2020
Test Sample Serial Number:	EUT4 (Conducted Test Sample)		
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 2

Environmental Conditions:

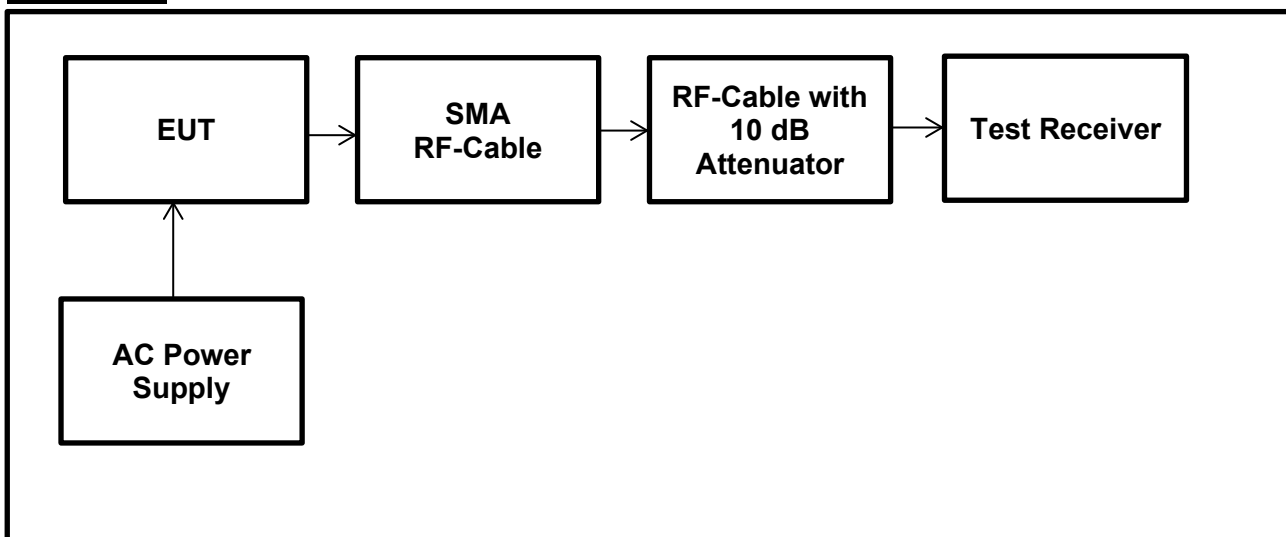
Temperature (°C):	22
Relative Humidity (%):	42

Note(s):

1. The measurements were performed using the above configurations on the bottom, middle and top channels in accordance FCC KDB 558074 Section 8.2 referencing ANSI C63.10 Section 11.8 (11.8.1 Option 2 measurement procedure).
2. The spectrum 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.
3. The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values take into consideration the external attenuation correction factors.
 - o The SMA (Female) RF Cable soldered on PCB with maximum attenuation of 0.5 dB at the tested frequencies.
 - o The RF cable from the EUT to Analyzer with maximum attenuation of 0.5 dB at the tested frequencies including the 10 dB attenuator at the input of Spectrum Analyzer

Therefore, total a reference level offset 11.0 dB was added to each of the at the tested frequencies conducted plots.

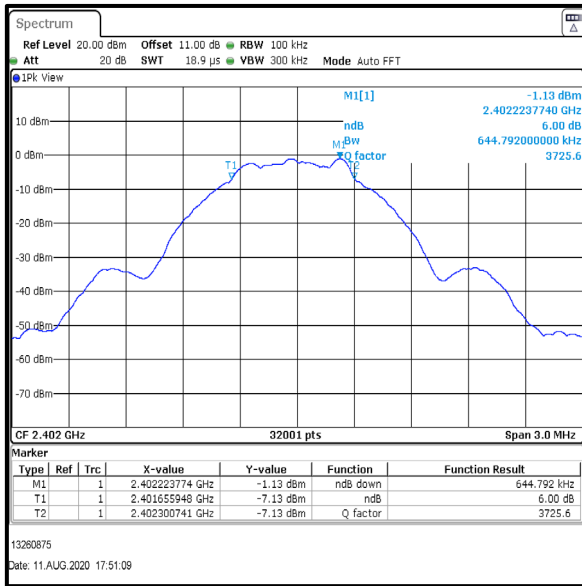
Test Setup:



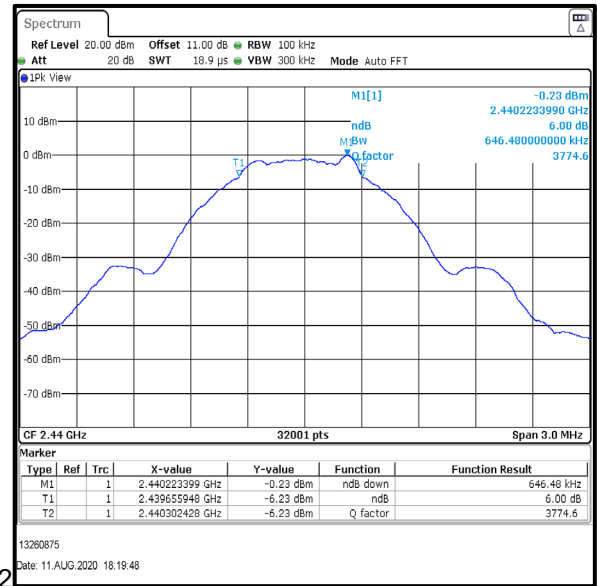
Transmitter Minimum 6 dB Bandwidth (continued)

Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4

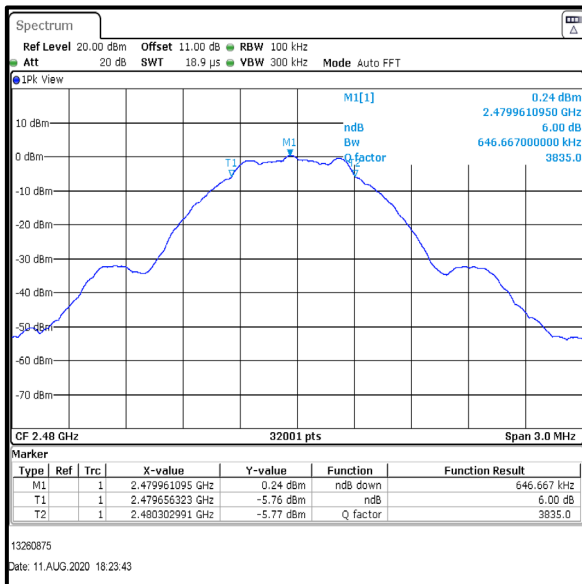
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	644.792	≥ 500	144.792	Complied
Middle	646.480	≥ 500	146.480	Complied
Top	646.667	≥ 500	146.667	Complied



Bottom Channel



Middle Channel



Top Channel

Result: **Pass**



5.2.3. Transmitter Duty Cycle

Test Summary:

Test Engineer:	Sercan Usta	Test Date:	11 August 2020
Test Sample Serial Number:	EUT4 (Conducted Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.35(c)
Test Method Used:	FCC KDB 558074 Section 6.0 referencing ANSI C63.10 Section 11.6

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	42

Note:

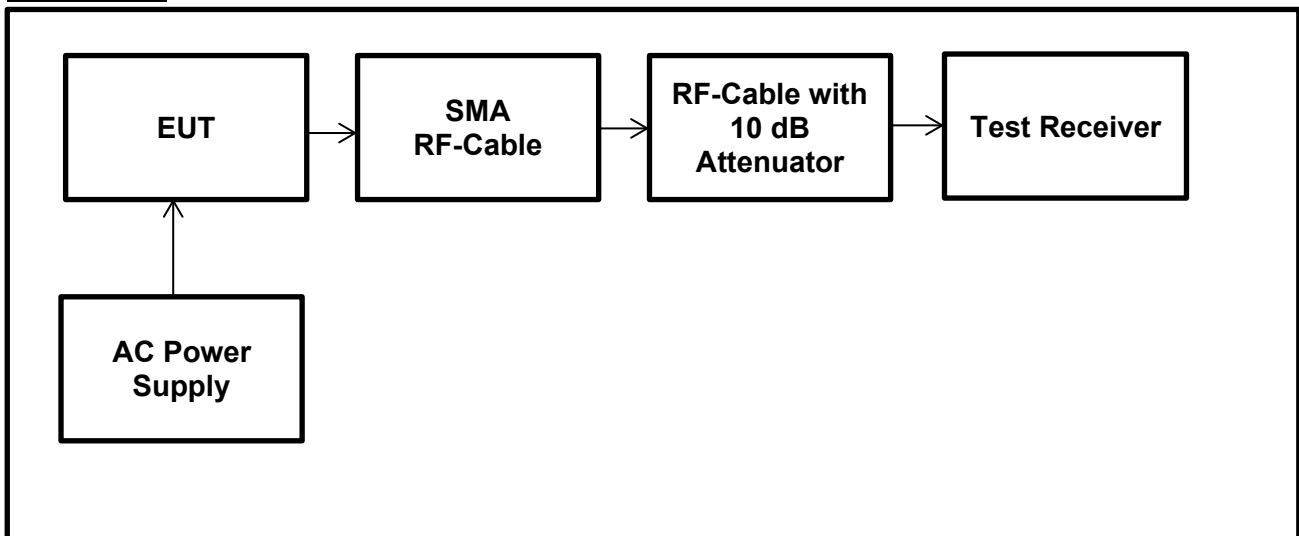
- The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

$$\text{Duty Cycle (\%)} = 100 \times [\text{On Time } (T_{ON})] / [\text{Period}(T_{ON} + T_{OFF}) \text{ or } 100\text{ms whichever is the lesser}]$$

$$\text{Duty Cycle Correction Factor} = 10 \log 1 / [\text{On Time } (T_{ON})] / [\text{Period}(T_{ON} + T_{OFF}) \text{ or } 100\text{ms whichever is the lesser}]$$
- The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values take into consideration the external attenuation correction factors.
 - The SMA (Female) RF Cable soldered on PCB with maximum attenuation of 0.5 dB at the tested frequencies.
 - The RF cable from the EUT to Analyzer with maximum attenuation of 0.5 dB at the tested frequencies including the 10 dB attenuator at the input of Spectrum Analyzer

Therefore, total a reference level offset 11.0 dB was added to each of the at the tested frequencies conducted plots.

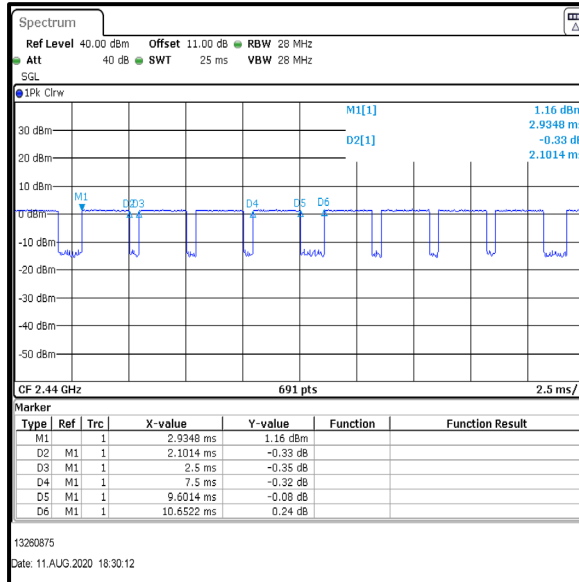
Test Setup:



Transmitter Duty Cycle (continued)

Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4

Pulse On Time (T _{ON}) (ms)	Pulse Period (T _{ON} +T _{OFF}) (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
8.4056	10.6522	78.9	1.03



5.2.4. Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	Sercan Usta	Test Date:	11 August 2020
Test Sample Serial Number:	EUT4 (Conducted Test Sample)		
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):	27
Relative Humidity (%):	37

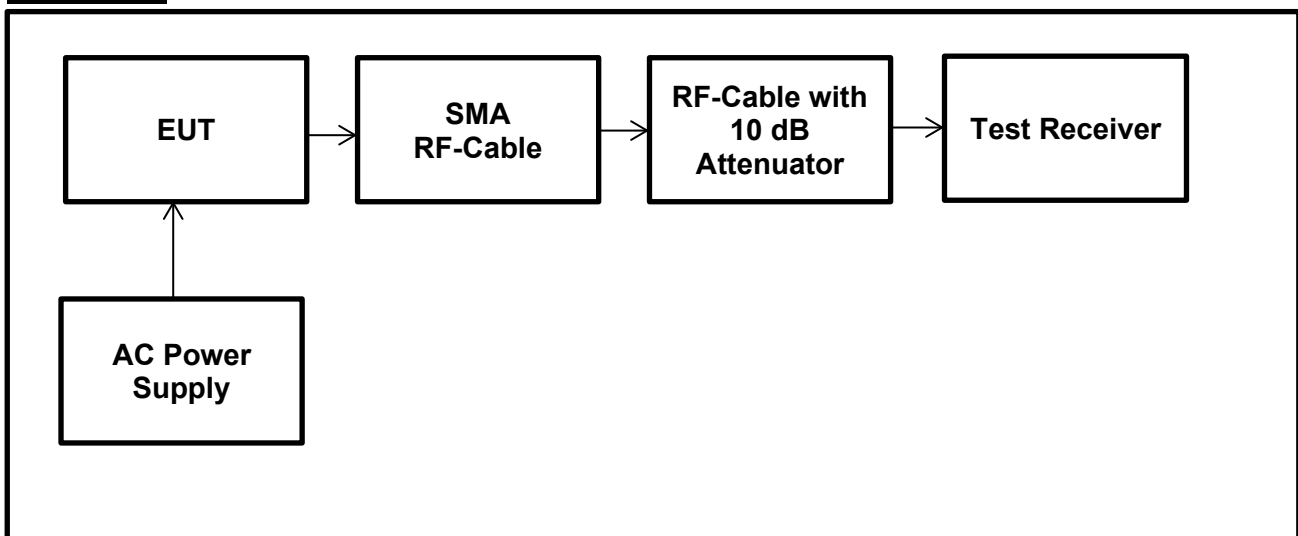
Notes:

1. Conducted power tests were performed using a spectrum analyser in accordance with FCC KDB 558074 Section 8.3.1.1 with the RBW ≥ DTS bandwidth referencing ANSI C63.10 Section 11.9.1.1.
2. The signal analyser resolution bandwidth was set to 1 MHz and video bandwidth of 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 3 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 take into consideration the external attenuation correction factors.
 - o The SMA (Female) RF Cable soldered on PCB with maximum attenuation of 0.5 dB at the tested frequencies.
 - o The RF cable from the EUT to Analyzer with maximum attenuation of 0.5 dB at the tested frequencies including the 10 dB attenuator at the input of Spectrum Analyzer

Therefore, total a reference level offset 11.0 dB was added to each of the at the tested frequencies conducted plots.

4. The declared antenna gain was added to conducted power to obtain the EIRP.

Test Setup:



Transmitter Maximum Peak Output Power (continued)**Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4**

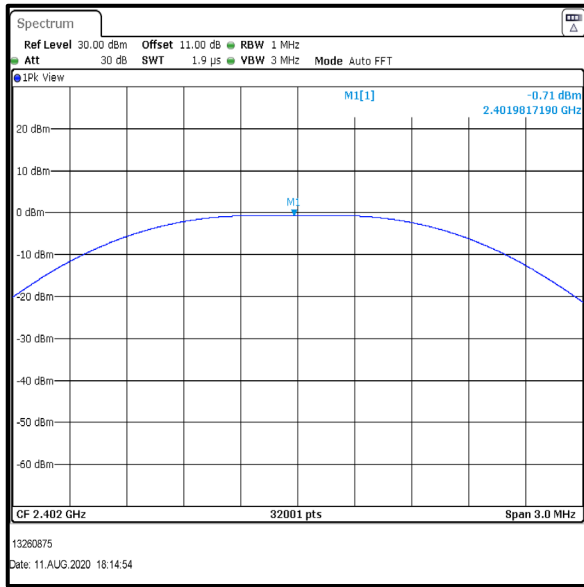
Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	-0.71	30.00	30.71	Complied
Middle	0.10	30.00	29.90	Complied
Top	0.61	30.00	29.39	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	-0.71	4.9	4.19	36.00	31.81	Complied
Middle	0.10	4.9	5.00	36.00	31.00	Complied
Top	0.61	4.9	5.51	36.00	30.49	Complied

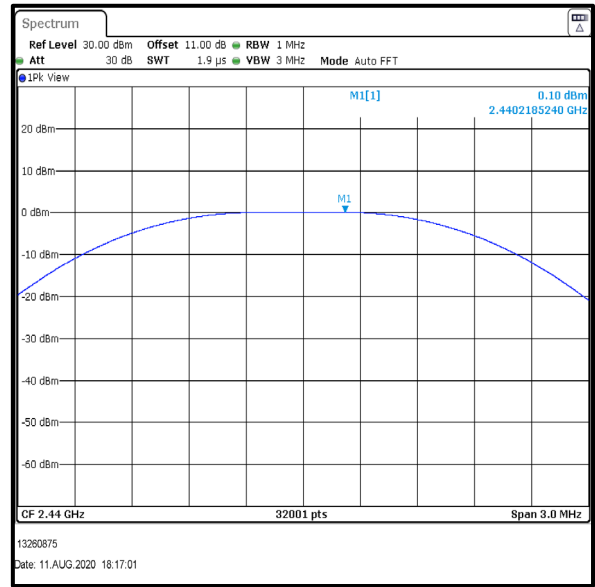
Result: Pass

Transmitter Maximum Peak Output Power (continued)

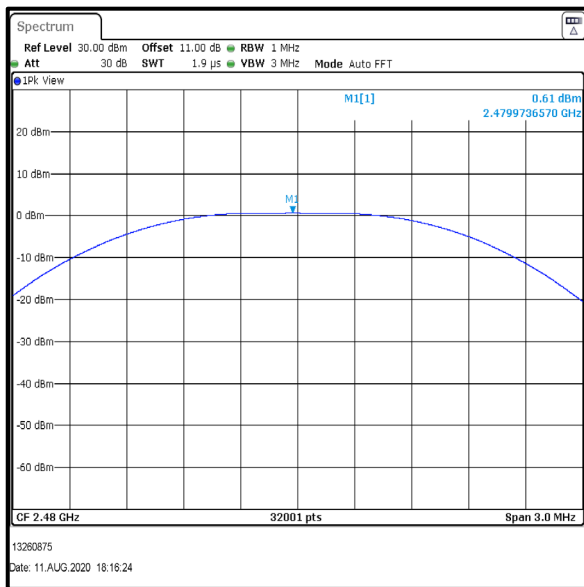
Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4



Bottom Channel



Middle Channel



Top Channel

5.2.5. Transmitter Radiated Emissions**Test Summary:**

Test Engineer:	Sercan Usta	Test Date:	08 June 2020
Test Sample Serial Number:	EUT1 (Radiated Test 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:

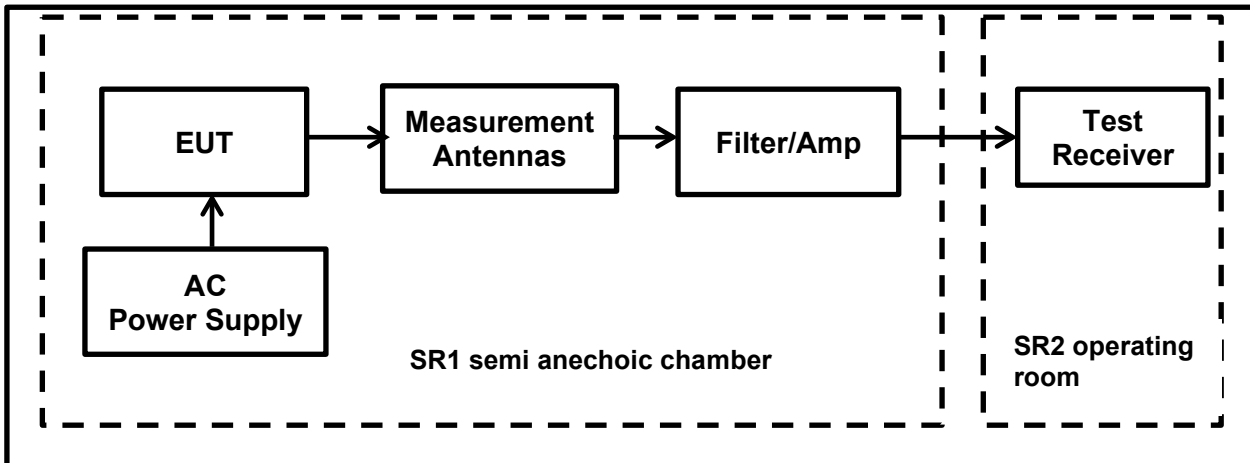
Temperature (°C):	22
Relative Humidity (%):	50

Notes:

- In accordance with FCC KDB 414788 D01 Radiated Test Site & ANSI C63.10 clause 5.2 an alternative test site that can demonstrate equivalence to a open area test site may be used. Therefore, the measurement was performed in a Semi Anechoic Chamber. (The OATS / SAC comparison data is available upon request).
- The limits are specified at a test distances of 30 and 300 metres. However, as specified in FCC Section 15.31 (f)(2) & ANSI C63.10 clause 6.4.3, measurements may be performed at a closer distance and the measured level extrapolated to the specified measurement distance using the method described in clauses 6.4.4, specifically sub-clause 6.4.4.1 which specifies that the measured level shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 40 dB/decade.
Therefore, measurements were performed at a measurement distance of 3 m.
- Therefore, the limit values are extrapolated to a measurement distance of 3 m.
 - 9 kHz- 490 kHz: limits extrapolated from 300 m to 3 m by adding 80 dB at 40 dB /decade.
 - 490 kHz-1705 kHz: limits extrapolated from 30 m to 3 m by adding 40 dB at 40 dB /decade.
- Measurements below 30 MHz 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. The measurement loop antenna height was 80 cm.
- The preliminary scans showed similar emission levels below 30 MHz, for each channel & modes of operation. Therefore, final radiated emissions measurements were performed with the EUT set to the middle channel only.
- All emissions shown on the pre-scan plots were investigated and found to be below system noise floor.
- Pre-scans were performed and markers placed on the highest measured levels. The test receiver was set to:
 - Frequency range: 9 kHz-150 kHz : RBW: 1 kHz /VBW: 3 kHz
 - Frequency range: 150 kHz – 30 MHz: RBW: 10 kHz /VBW: 30 kHz
 - Detector: Max-Peak detector
 - Trace Mode: Max Hold

Transmitter Radiated Emissions (continued)

Test Setup:

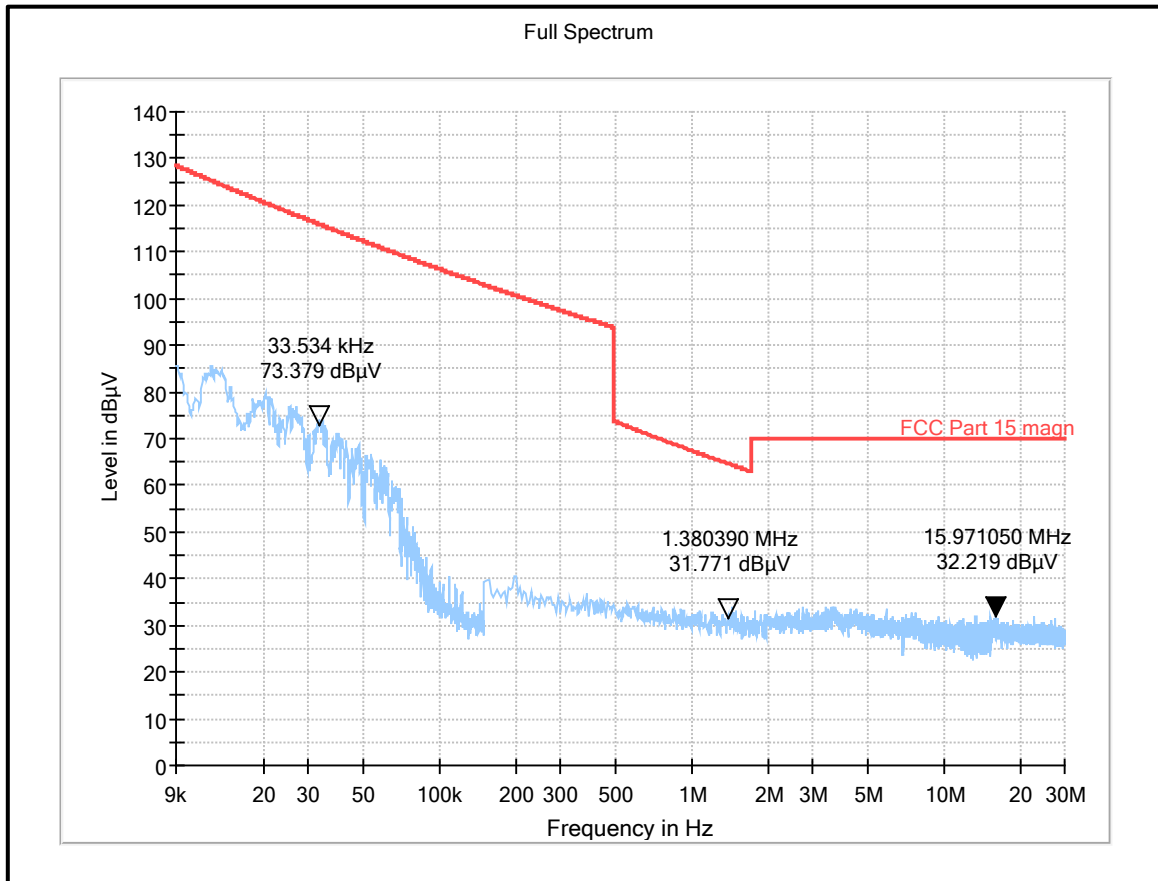


Transmitter Radiated Emissions (continued)

Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4

Frequency (MHz)	Loop Antenna Orientation	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
No critical spurious emissions were detected					

Plot: 9 kHz – 30 MHz: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Middle Channel



Result: Pass

Transmitter Radiated Emissions (continued)**Test Summary:**

Test Engineer:	Sercan Usta	Test Date:	08 June 2020
Test Sample Serial Number:	EUT1 (Radiated Test 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:

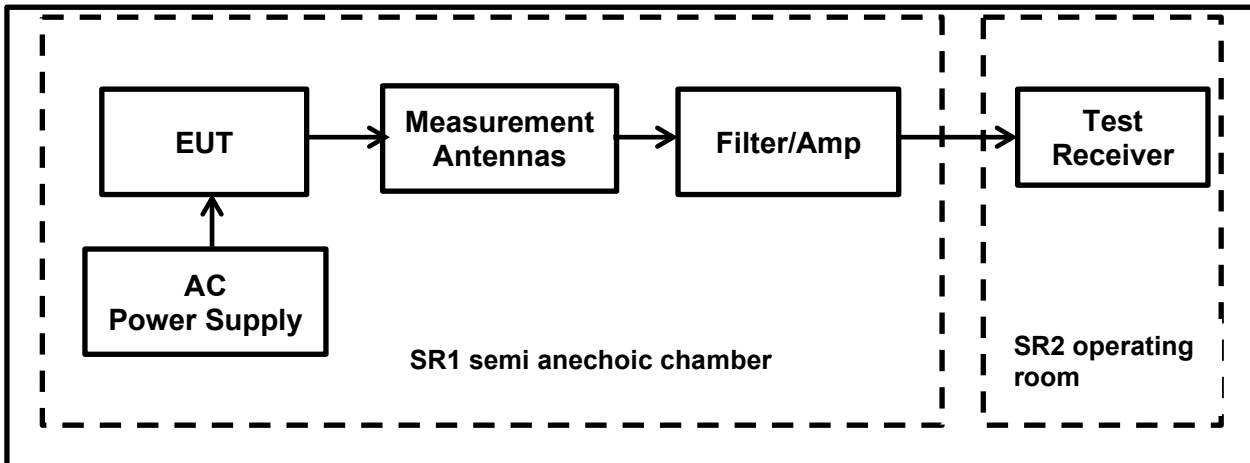
Temperature (°C):	23
Relative Humidity (%):	44

Notes:

1. 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.
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. 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.
4. All emissions shown on the pre-scans were investigated and found to be > 20 dB below the applicable limits.

Transmitter Radiated Emissions (continued)

Test Setup:

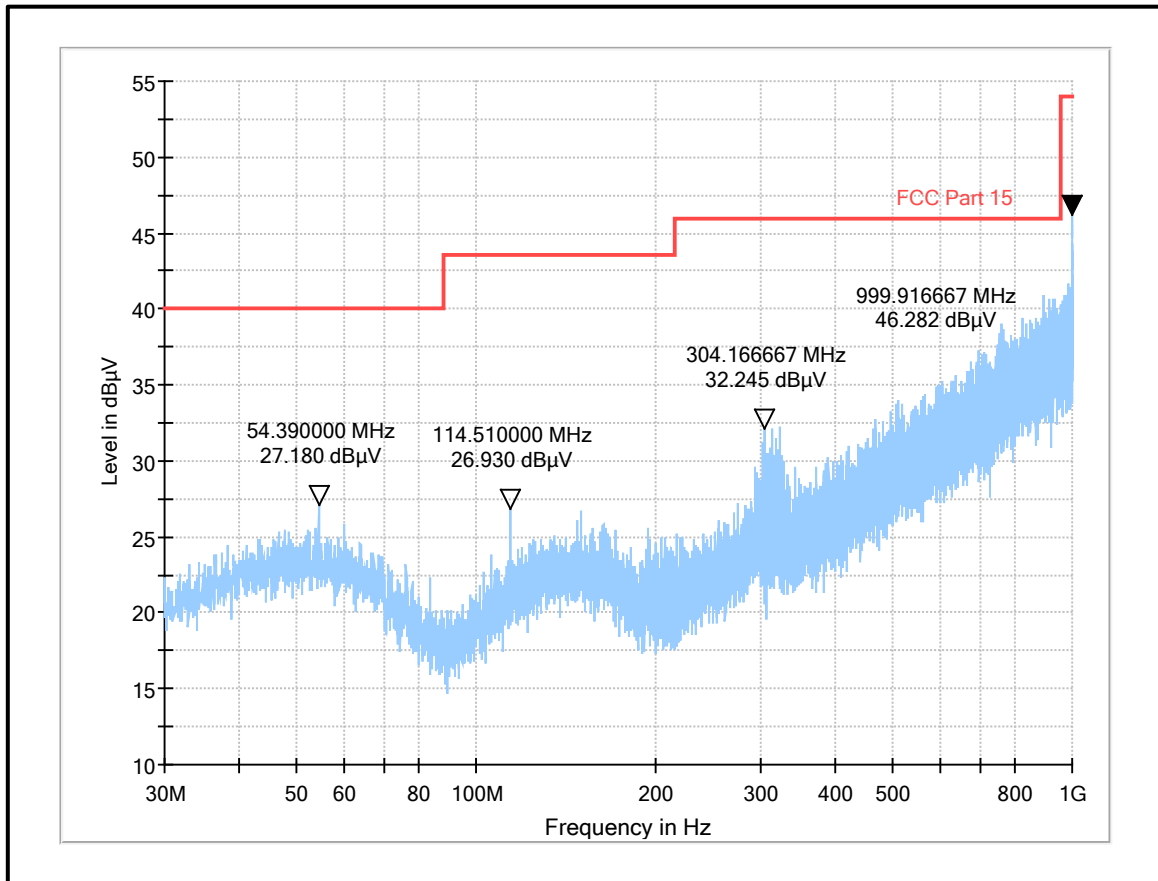


Transmitter Radiated Emissions (continued)

Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4

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

Plot: 30 MHz-1 GHz: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Middle Channel



Result: Pass

Transmitter Radiated Emissions (continued)**Test Summary:**

Test Engineer:	Sercan Usta	Test Date:	29 April 2020 & 8 June 2020
Test Sample Serial Number:	EUT1 (Radiated Test 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:

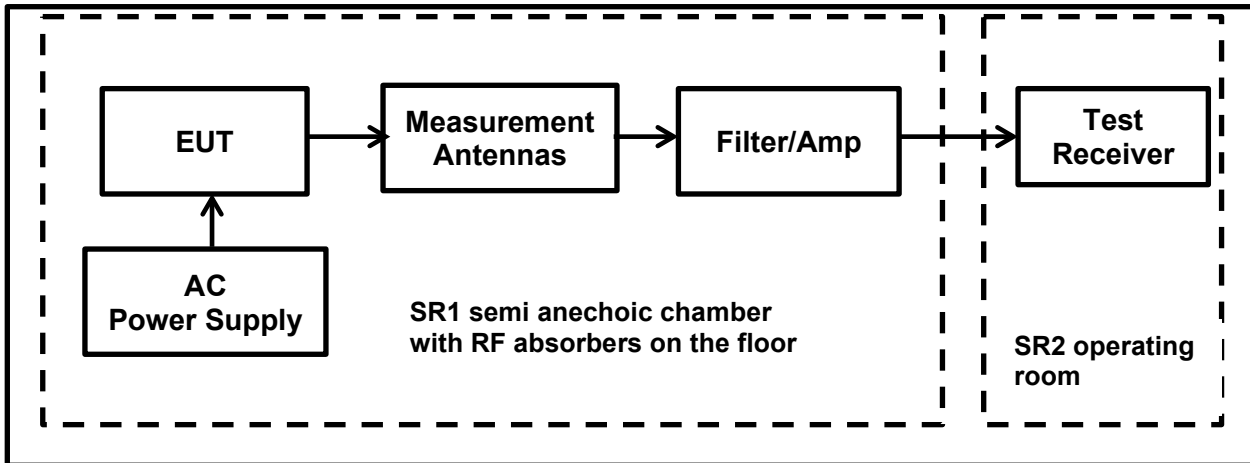
Temperature (°C):	24 & 23
Relative Humidity (%):	42 & 44

Note(s):

1. Pre-scans above 1 GHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) with RF absorbers on the floor at a distance of 3 m. The EUT was placed at a height of 1.5 m above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 m above the test chamber floor, in line with the EUT. Final measurements 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 m. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 m to 4 m.
2. 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.
3. The emissions shown at frequencies approximately 2.4 GHz to 2.4835 GHz on the 1 GHz to 18 GHz plots are the EUT fundamental for the tested channel.
4. No spurious emissions were detected.
5. The preliminary scans showed similar emission levels above 18 GHz, for each channel & modes of operation. Therefore, final radiated emissions measurements were performed with the EUT set to the middle channel only.
6. For frequency range between 18 GHz and 25 GHz, no critical emissions were found.

Transmitter Radiated Emissions (continued)

Test Setup:

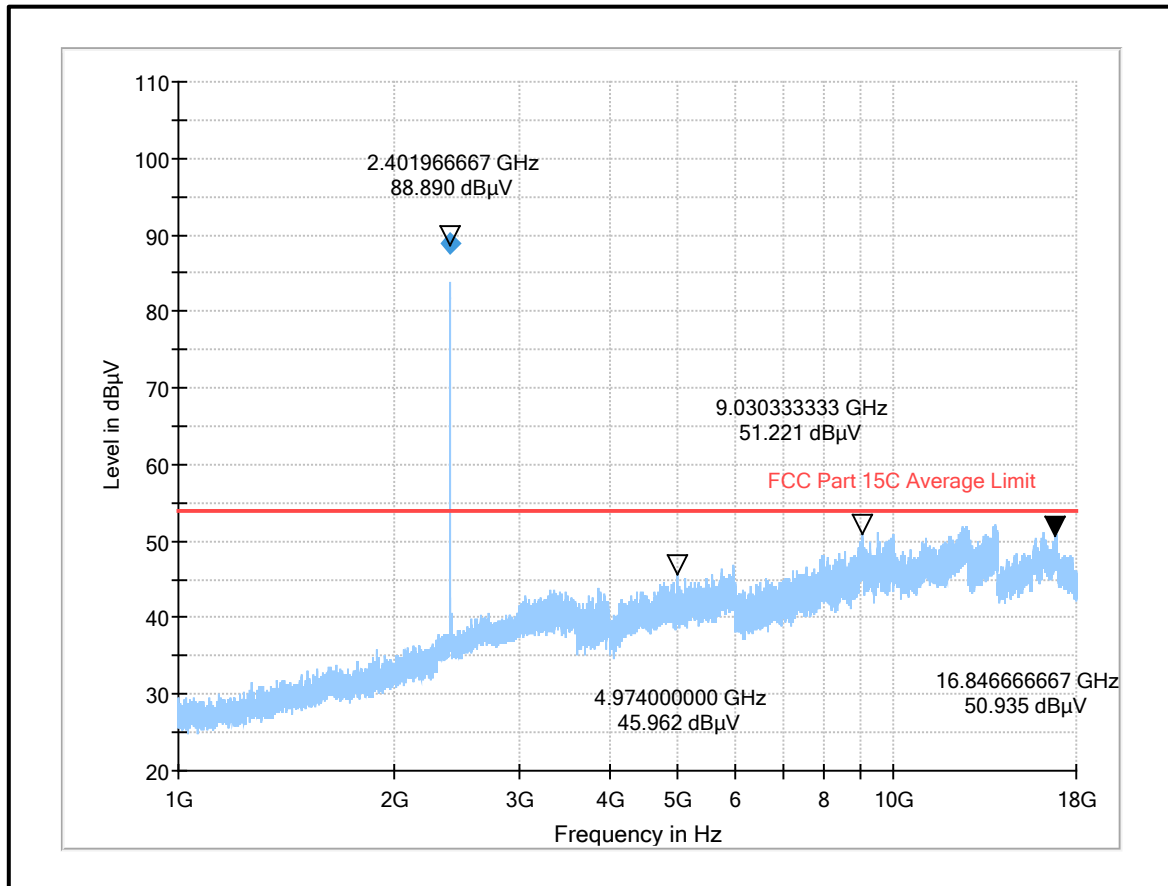


Transmitter Radiated Emissions (continued)

Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Bottom Channel

Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
No critical spurious emissions were detected					

Plot: 1 GHz – 18 GHz: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Bottom Channel



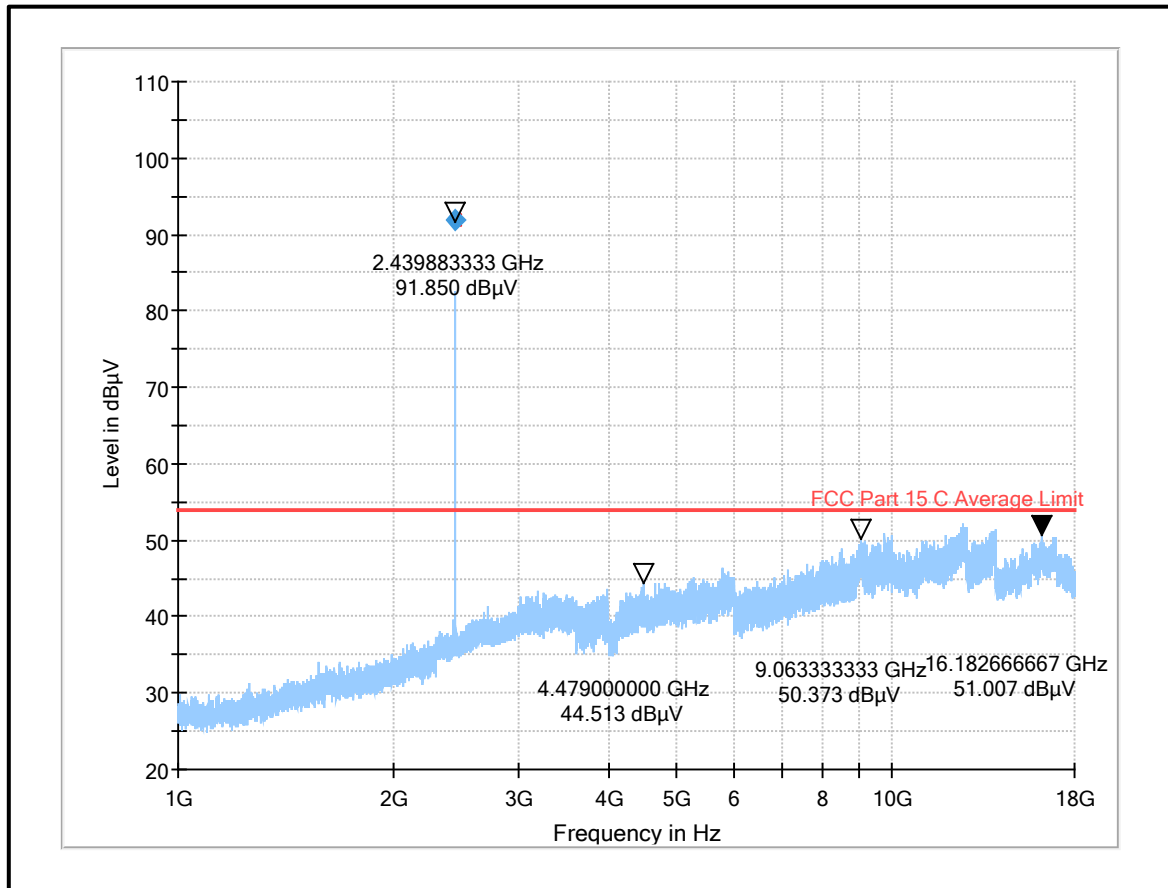
Result: Pass

Transmitter Radiated Emissions (continued)

Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Middle Channel

Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
No critical spurious emissions were detected					

Plot: 1 GHz – 18 GHz: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Middle Channel

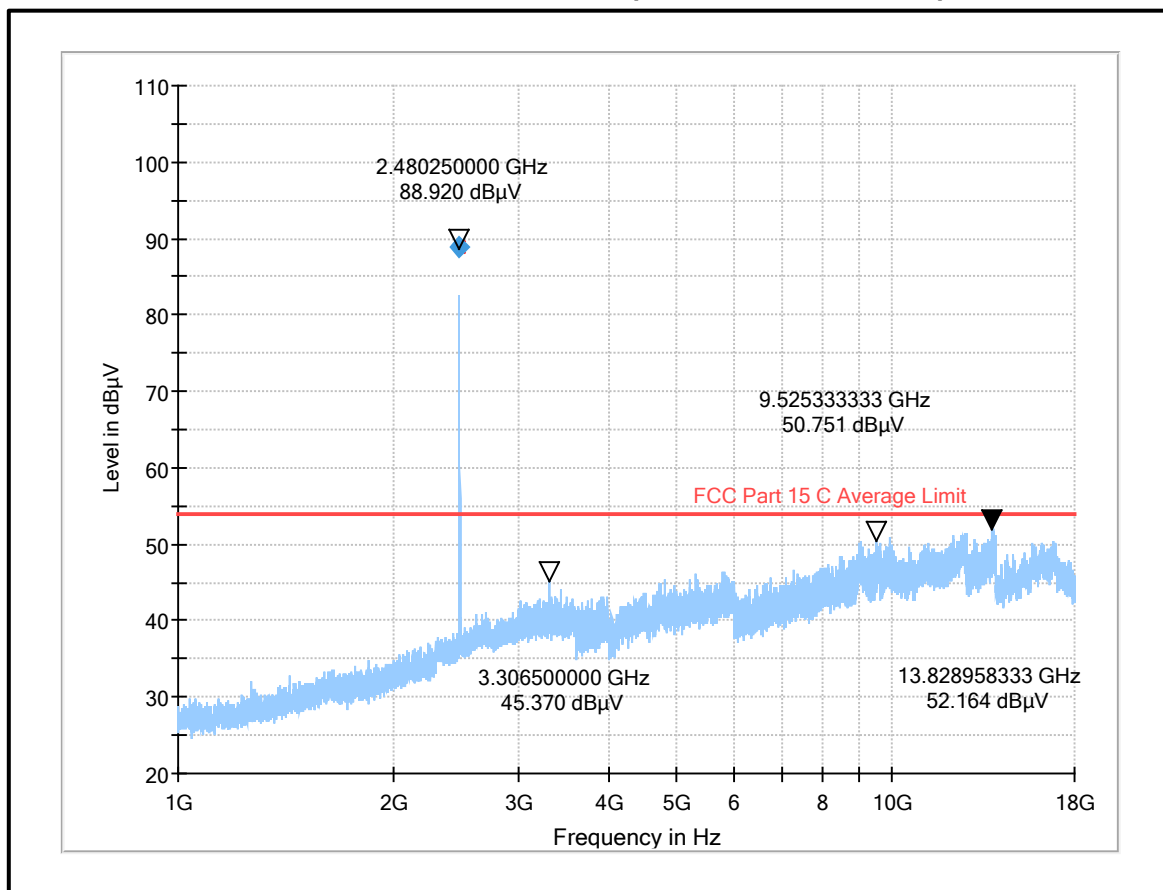


Result: Pass

Transmitter Radiated Emissions (continued)
Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Top Channel

Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
No critical spurious emissions were detected					

Plot: 1 GHz – 18 GHz: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Top Channel



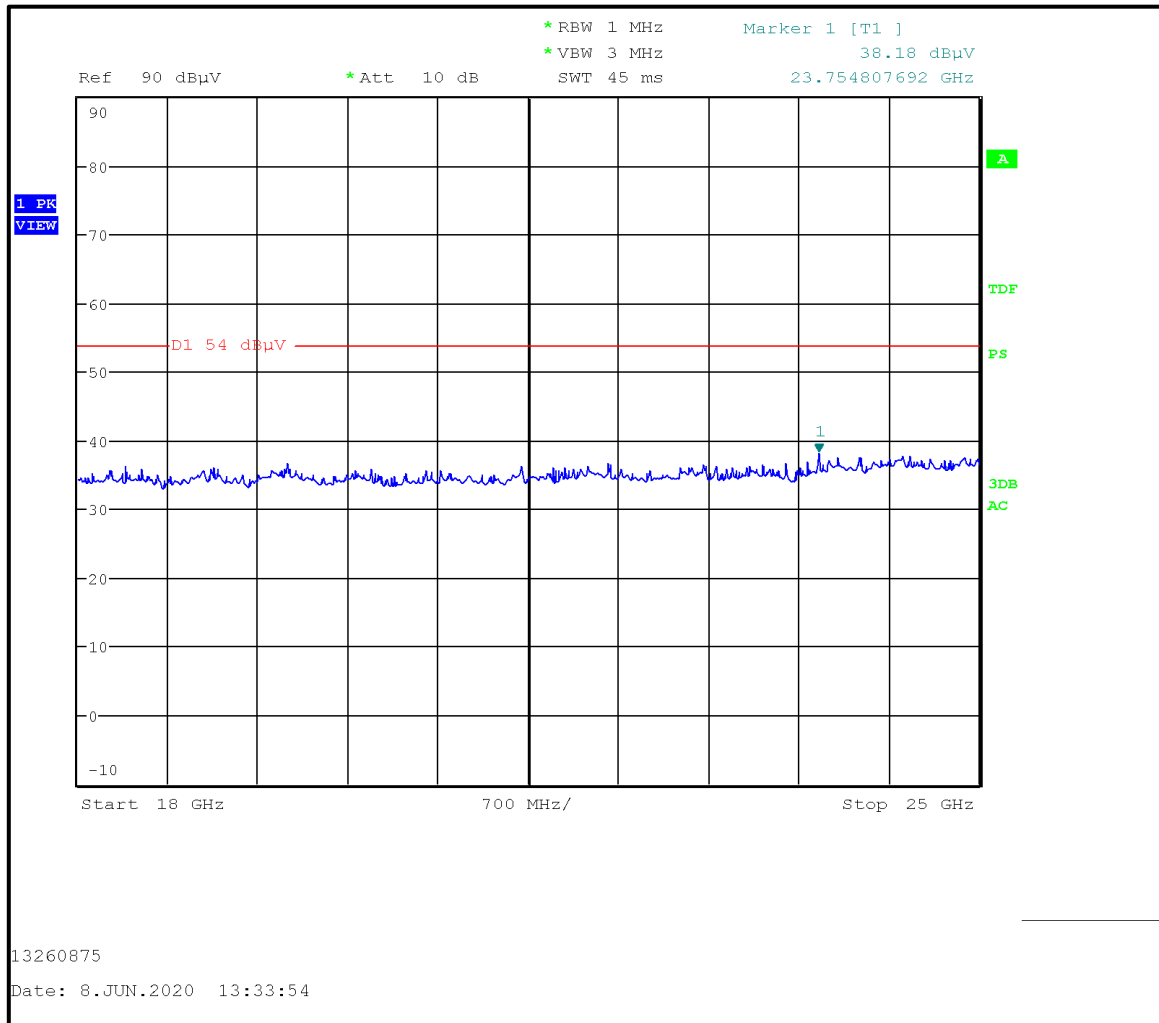
Result: **Pass**

Transmitter Radiated Emissions (continued)

Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Middle Channel

Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
No critical spurious emissions were detected					

Plot: 1 GHz – 18 GHz: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4 / Middle Channel



Result: Pass

5.2.6. Transmitter Band Edge Radiated Emissions**Test Summary:**

Test Engineer:	Sercan Usta	Test Date:	05 June 2020
Test Sample Serial Number:	EUT1 (Radiated Test Sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	DTS emissions in non-restricted frequency bands: FCC KDB 558074 Section 8.5 referencing ANSI C63.10:2013 Sections 11.11
	DTS emissions in restricted frequency bands: FCC KDB 558074 Section 8.6 referencing ANSI C63.10:2013 Sections 11.12
	ANSI C63.10:2013 Sections 6.10.4, 6.10.5

Environmental Conditions:

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

Note(s):

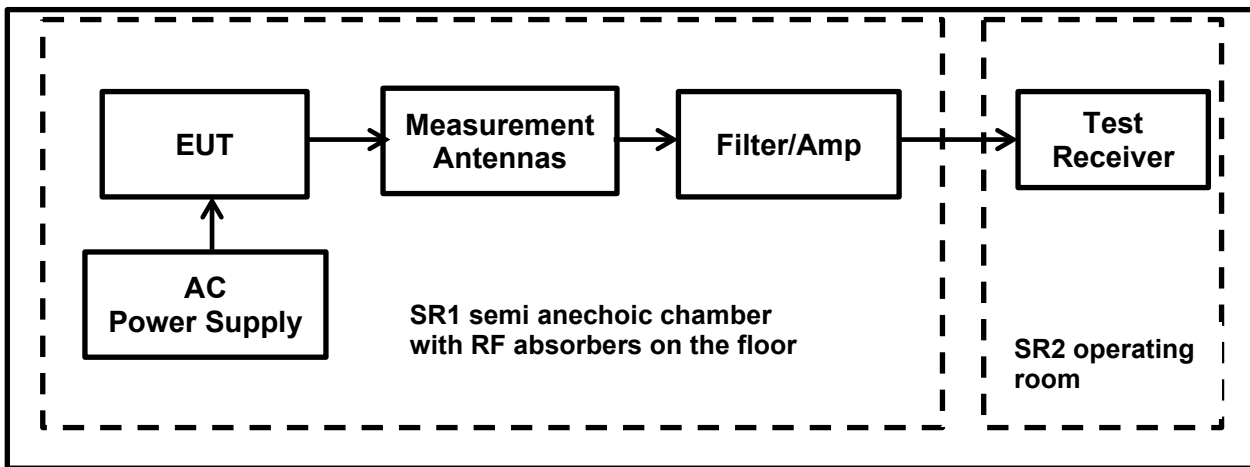
- The measurements were in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) with RF absorbers on the floor at a distance of 3 m. The EUT was placed at a height of 1.5 m above the test chamber floor in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 m to 4 m
- As the lower band edge falls within a non-restricted band, measurements were performed in accordance with FCC KDB 558074 Section 8.5 referencing ANSI C63.10 Section 11.11. As the maximum peak conducted output power was previously measured, in accordance with ANSI C63.10 Section 11.11.1(a) lower band edge measurement was performed with a peak detector and the -20 dBc limit applied.
- 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.
- The restricted band peak measurements were performed in accordance with ANSI C63.10 Section 11.12.2.4.
- As the EUT continuous transmission of the EUT ($D \geq 98\%$) cannot be achieved and the duty cycle is constant (duty cycle variations are less than $\pm 2\%$), the restricted band average measurements were performed in accordance with ANSI C63.10 Section 11.12.2.5.2.
- 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 averaging 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.

Transmitter Band Edge Radiated Emissions (continued)

Note(s):

7. 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.
8. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
9. **As the EUT was transmitting continuously with a Duty Cycle of 78.9 %, a Duty Cycle Correction Factor of 1.03 dB was added to all average measurements.

Test Setup:



Transmitter Band Edge Radiated Emissions (continued)

Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4

Results: Lower Band Edge / Peak

Frequency (MHz)	Peak Level (dBµV/m)	-20 dBc Limit (dBµV/m)	Margin (dB)	Result
2399.20	40.93	71.32	30.39	Complied
2400.00	37.51	71.32	33.81	Complied

Results: 2310 to 2390 MHz Restricted Band / Peak

Frequency (MHz)	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
2332.44	44.83	74.0	29.17	Complied

Results: 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
2390.00	33.04	1.03	34.07	54.0	19.93	Complied

Results: Upper Band Edge / Peak

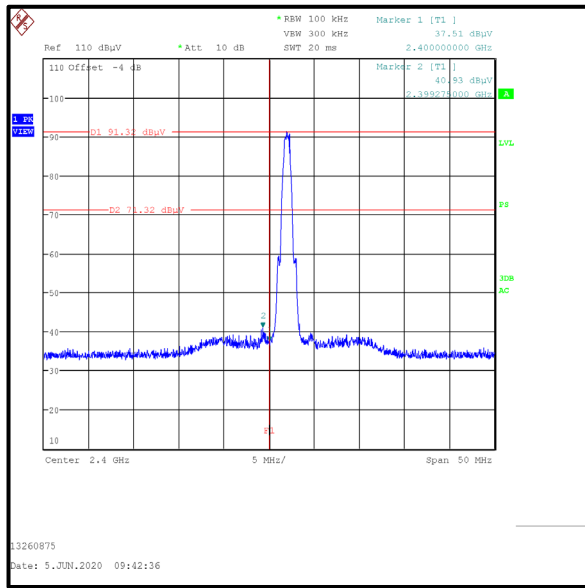
Frequency (MHz)	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
2483.50	48.59	74.0	25.41	Complied
2483.68	48.31	74.0	25.69	Complied

Results: Upper Band Edge / Average

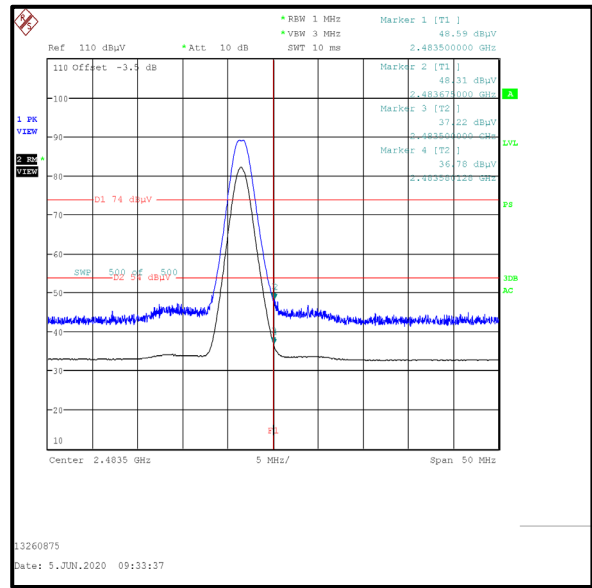
Frequency (MHz)	Average Level (dBµV/m)	Duty Cycle Correction (dB)	Corrected Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
2483.50	37.22	1.03	38.25	54.0	15.75	Complied
2483.58	36.78	1.03	37.81	54.0	16.19	Complied

Result: **Pass**

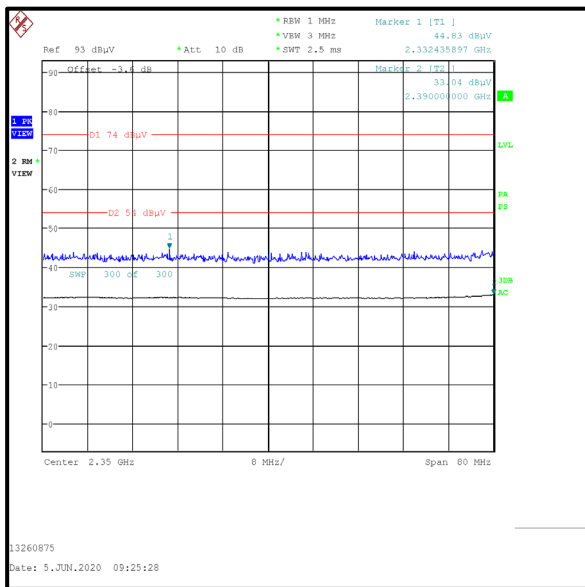
Transmitter Band Edge Radiated Emissions (continued)
Results: BT-LE Mode / 1 Mbps / PRBS9 / PWR 4



Lower Band Edge Peak Measurement



Upper Band Edge Peak & Average Measurement



2310 MHz to 2390 MHz Restricted Band

Result: Pass

6. Measurement Uncertainty

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

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

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

Measurement Type	Confidence Level (%)	Calculated Uncertainty
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	11/07/2019	36
377	BONN Elektronik	Amplifier, Low Noise Pre	BLMA 0118-1A	025294B	10/07/2019	12
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	55929	16/07/2019	12
460	Deisl	Turntable	DT 4250 S	n/a	n/a	n/a
465	Schwarzbeck	Antenna, Trilog Broadband	VULB 9168	9168-240	20/03/2019	24
496	Rohde & Schwarz	Antenna, log. - periodical	HL050	100297	19/02/2019	36
607	Schwarzbeck	Antenna broadband horn antenna	BBHA 9170	9170-561	15/10/2019	24
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	09/07/2019	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
328	SPS	AC/DC power distribution system	PAS 5000	A2464 00/2 0200	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)
23	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/013	07/07/2020	12
28	Rohde & Schwarz	Passive Probe	ESH2-Z3	none	11/07/2020	12
349	Rohde & Schwarz	Receiver, EMI Test	ESIB7	836697/009	09/07/2020	12
351	Rohde & Schwarz	network, Artificial Mains	ESH3-Z5	862770/018	07/07/2020	12
564	Teseq	Impedance stabilisation network (ISN)	ISN T800	26076	07/07/2020	24
616	Rohde & Schwarz	ISN	ENY81-CA6	101656	07/07/2020	12
-/	Testo	Thermo-Hygrometer	608-H1	08	lab verification	n/a
327	SPS	AC/DC power distribution system	PAS 5000	A2464 00/1 0200	lab verification	n/a

Test site: SR 9

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
445	Huber & Suhner	RF Attenuator (10dB)	6810.17.AC	--	lab verification	12
637	Rohde & Schwarz	Spectrum Analyzer	FSV40	101587	08/07/2020	12
-/	Testo	Thermo-Hygrometer	608-H1	07	lab verification	n/a
-/	Huber & Suhner	RF Cable (upto 18GHz)	-/	-/	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	-	-	Initial Version
<p>Test Report Version 1.1 supersede Version 1.0 with immediate effect Test Report No. UL-RPT-RP-13260875-516-FCC Version 1.1, Issue Date 09 APRIL 2021 replaces Test Report No. UL-RPT-RP-13260875-516-FCC Version 1.0, Issue Date 06 APRIL 2021, which is no longer valid.</p>			
1.1	as below	as below	Current Version
	6	2.2	Note 2 reference corrected to ANSI C63.10-2013 Section 11.10.1
	27	5.2.5	Note 4 corrected to all emissions were > 20 dB
	30	5.2.5	Note 4 & 6 corrected to no spurious emissions were detected
	36	5.2.6	Test Method Used section is updated Note 2 reference added to ANSI C63.10 Section 11.11.1(a) Note 4 new note inserted with reference to restricted band peak measurements Note 5 new note inserted with reference to restricted band average measurements