TEST REPORT

Test Report No. : UL-RPT-RP-13262386-116-FCC

Applicant	:	ubisys technologies GmbH
Model No.	:	BLEND/Z M7B-Q95-B
FCC ID	:	2AWGH-M7B-Q95-B
Technology	:	ZigBee (IEEE 802.15.4)
Test Standard(s)	:	FCC Parts 15.207, 15.209 & 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-13262386-116-FCC Version 1.1, Issue Date 11 DECEMBER 2020 replaces
   Test Report No. UL-RPT-RP-13262386-116-FCC Version 1.0, Issue Date 03 NOVEMBER 2020, which is no longer valid.
5. Result of the tested sample: **PASS**

Prepared by: Krume, Ivanov
Title: Laboratory Engineer
Date: 11 December 2020

Approved by: Bernd, Woerl
Title: Operations Leader
Date: 11 December 2020

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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1. Customer Information

1.1. Applicant Information

Company Name:	ubisys technologies GmbH
Company Address:	Neumannstraße 10, 40223 Düsseldorf, Germany
Company Phone No.:	+49 211 54215500
Company E-Mail:	info@ubisys.de
Contact Person:	Dr. Arasch Honarbacht
Contact E-Mail Address:	info@ubisys.de
Contact Phone No.:	+49 211 54215500

1.2. Manufacturer Information

Company Name:	ubisys technologies GmbH
Company Address:	Neumannstraße 10, 40223 Düsseldorf, Germany
Company Phone No.:	+49 211 54215500
Company E-Mail:	info@ubisys.de
Contact Person:	Markus Proske
Contact E-Mail Address:	proske@ubisys.de
Contact Phone No.:	+49 211 54215531

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:	28 February 2020
EUT arrived:	14 May 2020
Test Dates:	26 May 2020 to 02 November 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 15.35(c)	Transmitter Duty Cycle(1)	☒	☐	☐	☐
Part 15.247(e)	Transmitter Power Spectral Density	☒	☐	☐	☐
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(s):

1. The measurement was performed to assist in the calculation of the level of average emissions.

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 15.247 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
Reference:	KDB 414788 D01 Radiated Test Site v01r01 July 12, 2018
Title:	TEST SITES FOR RADIATED EMISSION MEASUREMENTS

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:	ubisys
Model Name or Number:	BLEND/Z M7B-Q95-B
Test Sample Serial Number:	00-1F-EE-00-00-00-03-5A (Radiated /Conducted Sample)
Hardware Version Number:	B4
Software Version Number:	1.0.1.0
FCC ID:	2AWGH-M7B-Q95-B

Brand Name:	ubisys
Model Name or Number:	BLEND/Z M7B-Q95-B
Test Sample Serial Number:	00-1F-EE-00-00-00-03-5A (Radiated /Conducted Sample)
Hardware Version Number:	B4
Software Version Number:	1.0.1.0
FCC ID:	2AWGH-M7B-Q95-B

3.2. Description of EUT

The equipment under test was BLEND/Z M7B-Q95-B module, supporting Generic IEEE 802.15.4 (Zigbee/Thread/ RF4CE) & Bluetooth Low Energy operations in 2.4 - 2.4835 GHz ISM band.

The BLEND/Z M7B-Q95-B is a radio connectivity module for integration into home and building automation products, e.g. luminaries, thermostats, door-locks, sensors, switches, gateways, etc.

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:	ZigBee / IEEE 802.15.4 (Digital Transmission System)		
Type of Unit:	Transceiver		
Transmit Frequency Range:	2405 MHz to 2480 MHz		
Rated Power Levels:	10 dBm		
Channel Spacing:	5 MHz		
Modulation:	O-QPSK		
Data Rate:	250 Kbit/s		
Measured Maximum Conducted Output Power:	7.60 dBm		
Power Supply Requirement(s):	Nominal	1.8 – 3.3 VDC / 0.025A	
Transmit Channels Tested:	**Channel ID**	**RF Channel Number**	**Channel Frequency (MHz)**
	Bottom	11	2405
	Middle	18	2440
	Top	26	2480
Antenna Type:	PCB Chip Antenna		
Antenna Details:	JOHANSON Technology | P/N 2450AT43B100		
Antenna Gain:	1.3 dBi (Peak Gain)		

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	Hewlett Packard	HP Probook 650 G1	5CG6143YWB
2	Laboratory Power supply	Conrad Electronic	PS-2403D	N/A
3	Laboratory Power supply	Good Will Instruments Co. Ltd.	GPC-1850D	7662217

B. Support Equipment (Manufacturer supplied)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	DC Power Cable (Length 0.5 m)	N/A	N/A	N/A
2	FTDI USB Programming Cable (USB A to intern 3 wires | Length 1 m)	N/A	N/A	N/A

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):
☒ Transmitter Mode: Continuous transmissions with modulated carrier & maximum power (+10 dBm)

4.2. Configuration and Peripherals

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

EUT Power Supply:

- The EUT was powered by 3.3 V DC via laboratory DC power supply.

Test Mode Activation:

- The following documents containing the setup instructions were supplied by the customer
  - M7B-Q95B Test configuration 1.pdf
  - GP_P335_UM_16798_FCC_Certification_Guide_QPG6095__IoT_Controller_Zigbee_ Mode", Version 0.20
- The EUT programmed via FTDI USB Programming Cable and "RadioControlConsole_v3.1.0.0.msi" software application which was supplied by customer.
- The application was used to enable continuous transmission and to select the test channels as required. The transmitter test modes were configured to maximum power settings + 10 dBm.
- The EUT was transmitting continuously with duty cycle > 98 %, therefore no duty cycle correction was required for average measurements.

AC Conducted Line Measurements:

- The EUT was powered via 3.3 V DC using laboratory DC power supply, which in turn was connected to 120 VAC 60 Hz or 240 V AC / 60 Hz single phase supply via a LISN.

Conducted Measurements:

- All conducted measurements were carried out by using conducted sample with U.FL connector soldered on PCB by the customer.
- The U.FL (female) to SMA (female) to RF-Cable on the EUT's PCB with maximum attenuation of 0.5 dB at tested frequencies was added to a reference level offset to each of the conducted plots.

Radiated Measurements:

- The EUT radiated sample was used for AC conducted emissions, 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 Standing-position was found to be the worst case therefore this report includes relevant results.
- Radiated measurements above 30 MHz 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:	M. Asim Shahzad	**Test Date:**	10 June 2020
Test Sample Serial Number:	00-1F-EE-00-00-00-03-5A		
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):	20
Relative Humidity (%):	33

Settings of the Instrument

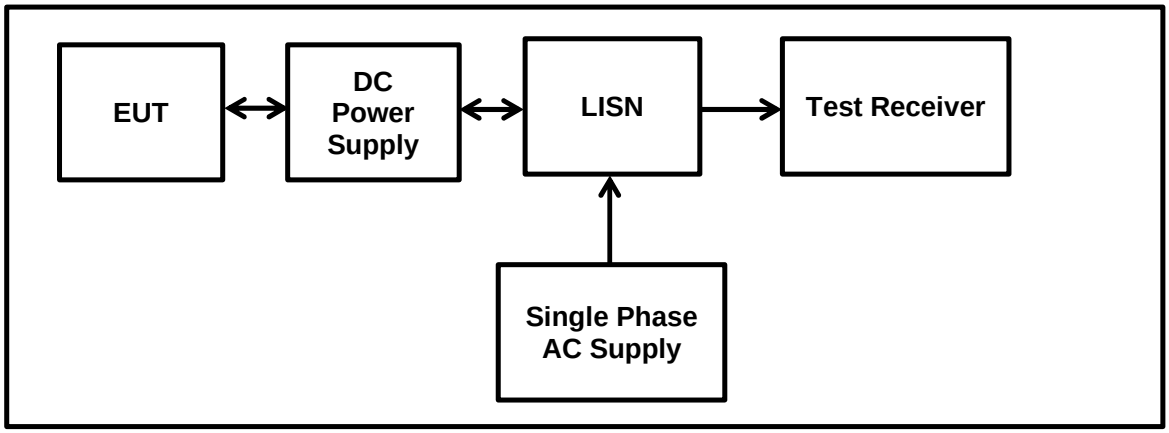
Detector	Quasi Peak/ Average Peak

Note(s):

1. 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.
2. Measurement software used: Toyo EMI Software; CE measurement software EP5/CE Ver 4.0.1.
3. The EUT was powered via 3.3 V DC using laboratory DC power supply, which in turn was connected to 120 VAC 60 Hz or 240 V AC / 60 Hz single phase supply via a LISN.
4. 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.
5. The EUT was configured on bottom channel with the power setting of 10 dBm.
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. 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:



Transmitter AC Conducted Spurious Emissions (continued)

Results: 120 VAC 60 Hz / Live / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.1605	Live	16.8	65.4	48.6	Complied
0.1805	Live	16.8	64.5	47.7	Complied
0.2396	Live	16.4	62.1	45.7	Complied
0.2867	Live	14.6	60.6	46.0	Complied
8.1222	Live	9.0	60.0	51.0	Complied
13.5130	Live	8.6	60.0	51.4	Complied

Results: 120 VAC 60 Hz / Live / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.1605	Live	11.2	55.4	44.2	Complied
0.1805	Live	11.6	54.5	42.9	Complied
0.2396	Live	11.2	52.1	40.9	Complied
0.2867	Live	9.8	50.6	40.8	Complied
8.1222	Live	5.3	50.0	44.7	Complied
13.5130	Live	4.5	50.0	45.5	Complied

Results: 120 VAC 60 Hz / Neutral / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.1565	Neutral	16.8	65.6	48.8	Complied
0.1845	Neutral	16.8	64.3	47.5	Complied
0.2527	Neutral	16.3	61.7	45.4	Complied
0.2767	Neutral	15.1	60.9	45.8	Complied
7.9599	Neutral	10.5	60.0	49.5	Complied
16.078	Neutral	9.1	60.0	50.9	Complied

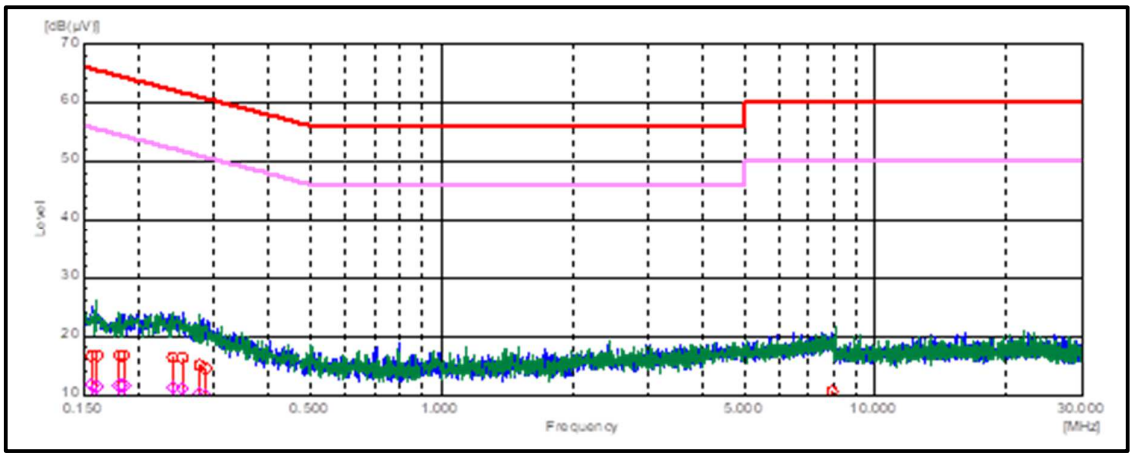
Results: 120 VAC 60 Hz / Neutral / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.1565	Neutral	11.6	55.6	44.0	Complied
0.1845	Neutral	11.6	54.3	42.7	Complied
0.2527	Neutral	11.1	51.7	40.6	Complied
0.2767	Neutral	10.3	50.9	40.6	Complied
7.9599	Neutral	6.0	50.0	44.0	Complied
16.078	Neutral	4.5	50.0	45.5	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.

Transmitter AC Conducted Spurious Emissions (continued)

Results: 240 VAC 60 Hz / Live / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.1590	Live	16.6	65.5	48.9	Complied
0.1996	Live	16.6	63.6	47.0	Complied
0.2436	Live	16.3	62	45.7	Complied
0.3353	Live	12.9	59.3	46.4	Complied
7.7705	Live	10.5	60.0	49.5	Complied
13.5931	Live	8.6	60.0	51.4	Complied

Results: 240 VAC 60 Hz / Live / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.1590	Live	11.2	55.5	44.3	Complied
0.1996	Live	11.6	53.6	42.0	Complied
0.2436	Live	11.1	52	40.9	Complied
0.3353	Live	7.8	49.3	41.5	Complied
7.7705	Live	6.0	50.0	44.0	Complied
13.5931	Live	4.5	50.0	45.5	Complied

Results: 240 VAC 60 Hz / Neutral / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.1620	Neutral	16.6	65.4	48.8	Complied
0.1805	Neutral	16.6	64.5	47.9	Complied
0.2386	Neutral	16.4	62.1	45.7	Complied
0.3168	Neutral	13.5	59.8	46.3	Complied
7.7074	Neutral	10.5	60.0	49.5	Complied
10.349	Neutral	9.0	60.0	51.0	Complied

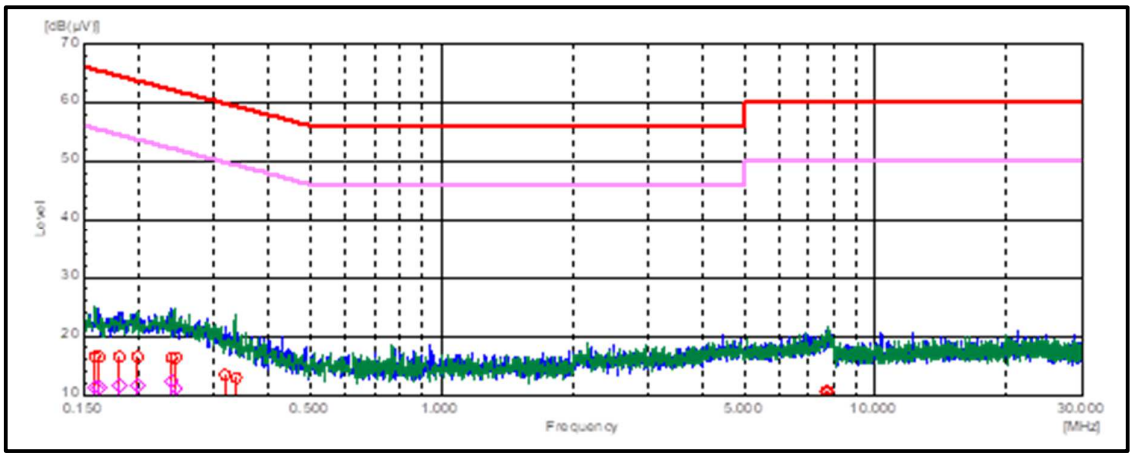
Results: 240 VAC 60 Hz / Neutral / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.1620	Neutral	11.2	55.4	44.2	Complied
0.1805	Neutral	11.6	54.5	42.9	Complied
0.2386	Neutral	12.3	52.1	39.8	Complied
0.3168	Neutral	8.3	49.8	41.5	Complied
7.7074	Neutral	6.0	50.0	44.0	Complied
10.349	Neutral	4.4	50.0	45.6	Complied

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: 240 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:	Krume Ivanov	**Test Date:**	03 June 2020
Test Sample Serial Number:	00-1F-EE-00-00-00-03-5A		
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 Section 11.8.1 Option 1

Environmental Conditions:

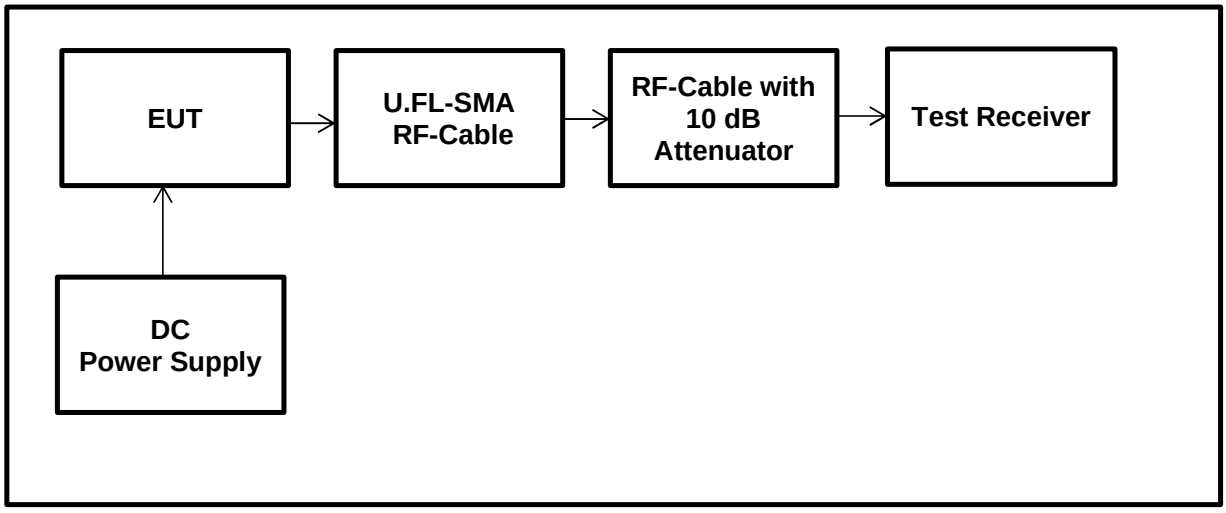
Temperature (°C):	27
Relative Humidity (%):	39

Notes:

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 1 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.
   - The U.FL (female) to SMA (female) to RF-Cable on the EUT's PCB with maximum attenuation of 0.5 dB at tested frequencies
   - The RF cable attenuation maximum 0.4 dB@2.4GHz from the EUT to spectrum analyser including the 10 dB attenuation at the spectrum analyser

   Therefore, a reference level offset of 10.90 dB was set on the spectrum analyser.

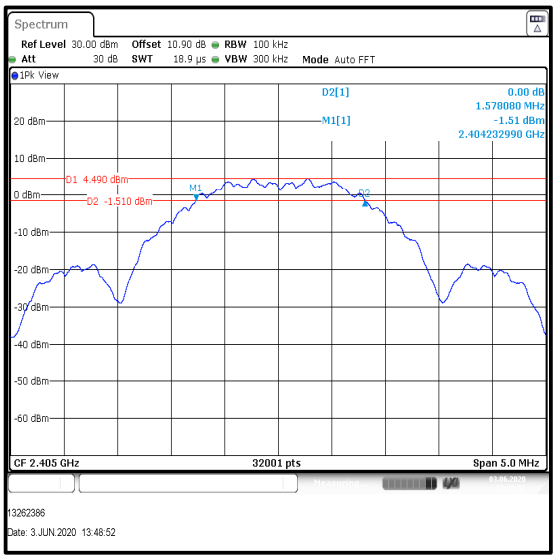
Test Setup:



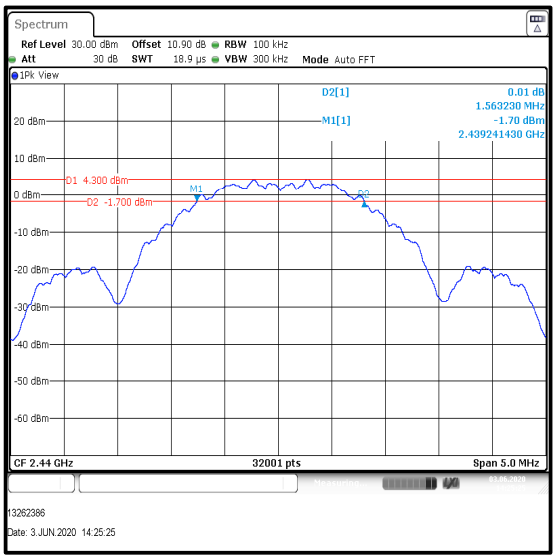
Transmitter Minimum 6 dB Bandwidth (continued)

Results: ZigBee / PWR 10 dBm

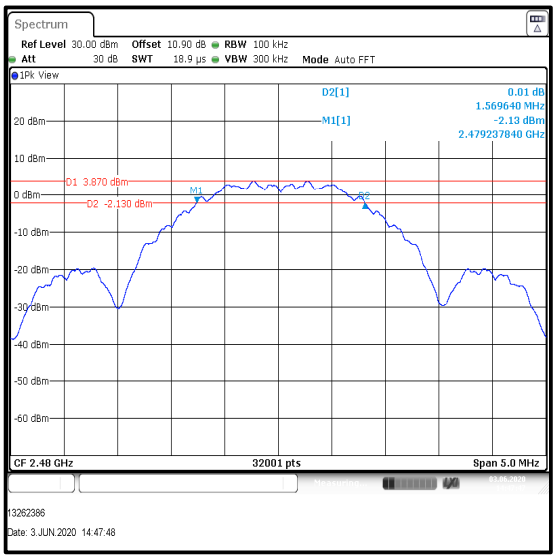
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	1578.080	≥500	1078.080	Complied
Middle	1563.230	≥500	1063.230	Complied
Top	1569.640	≥500	1069.640	Complied



Bottom Channel



Middle Channel



Top Channel

Result: Pass

5.2.3. Transmitter Duty Cycle

Test Summary:

Test Engineer:	Krume Ivanov	**Test Date:**	03 June 2020
Test Sample Serial Number:	00-1F-EE-00-00-00-03-5A		
Test Site Identification	SR 9		

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

Environmental Conditions:

Temperature (°C):	27
Relative Humidity (%):	39

Note:

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

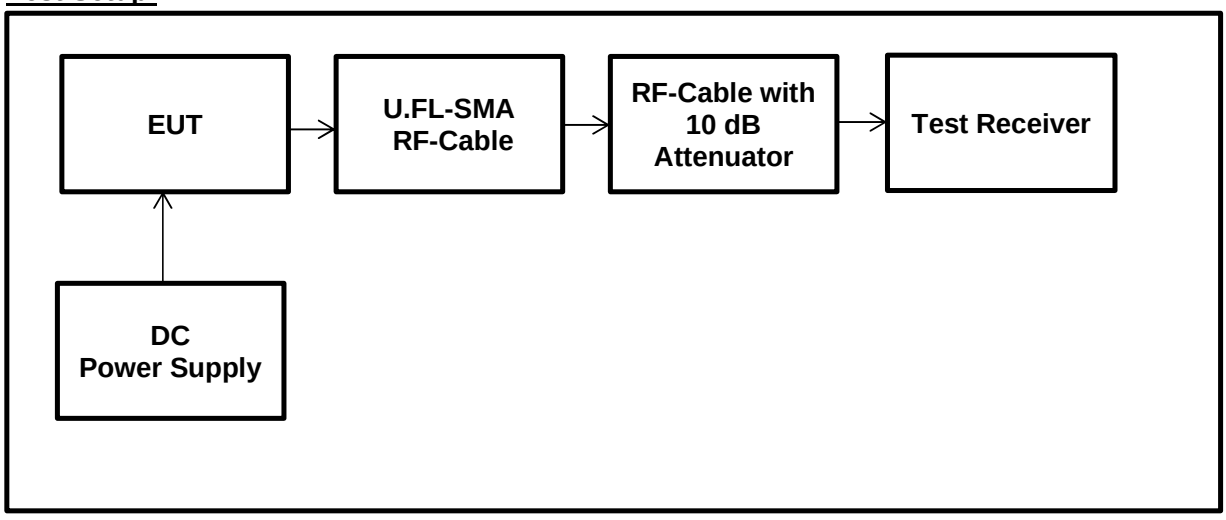
   Duty Cycle (%) = 100 X [On Time (T_{ON})] / [Period (T_{ON}+ T_{OFF}) or 100 ms whichever is the lesser]

   Duty Cycle Correction Factor= 10 log 1 / [On Time (T_{ON})] / [Period (T_{ON}+ T_{OFF}) or 100 ms whichever is the lesser]

2. 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 U.FL (female) to SMA (female) to RF-Cable on the EUT's PCB with maximum attenuation of 0.5 dB at tested frequencies
   - The RF cable attenuation maximum 0.4 dB@2.4GHz from the EUT to spectrum analyser including the 10 dB attenuation at the spectrum analyser

   Therefore, a reference level offset of 10.90 dB was set on the spectrum analyser.

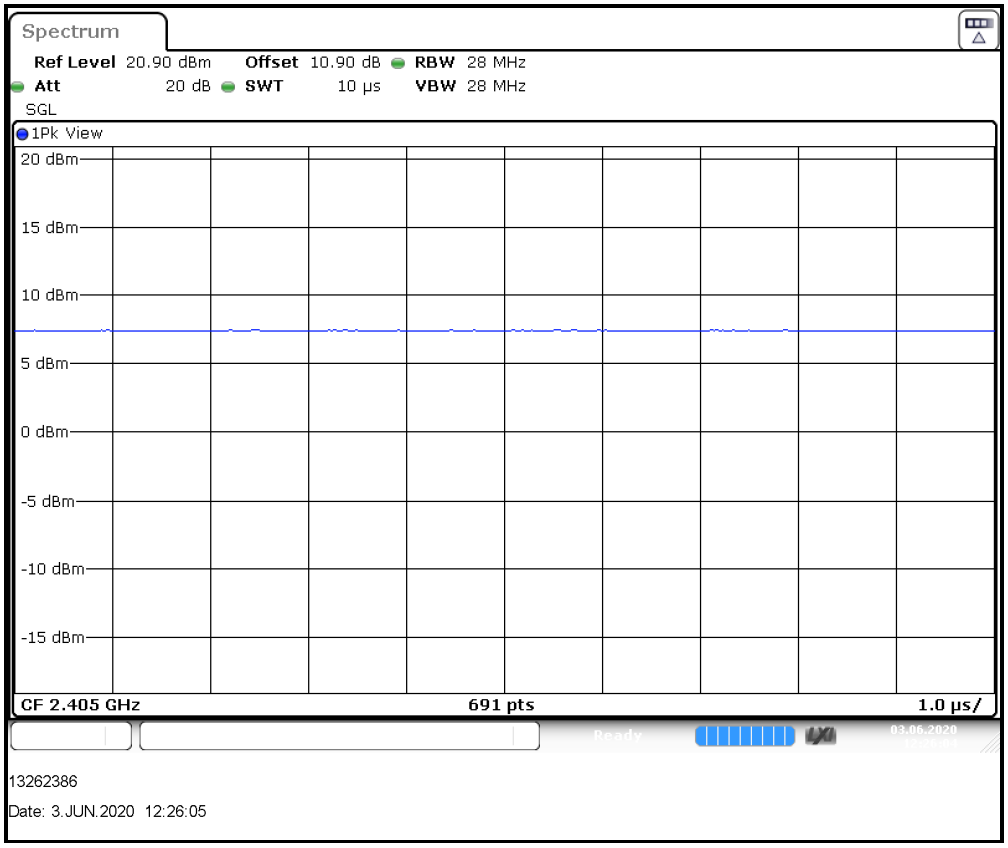
Test Setup:



Transmitter Duty Cycle (continued)

Results: ZigBee / PWR 10 dBm

Pulse Duration (µs)	Period (µs)	Duty Cycle Correction (dB)
10	10	0.0



5.2.4. Transmitter Power Spectral Density

Test Summary:

Test Engineer:	Krume Ivanov	**Test Date:**	03 June 2020
Test Sample Serial Number:	00-1F-EE-00-00-00-03-5A		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(e)
Test Method Used:	FCC KDB 558074 Section 8.4 referencing ANSI C63.10 Sections 11.10.2

Environmental Conditions:

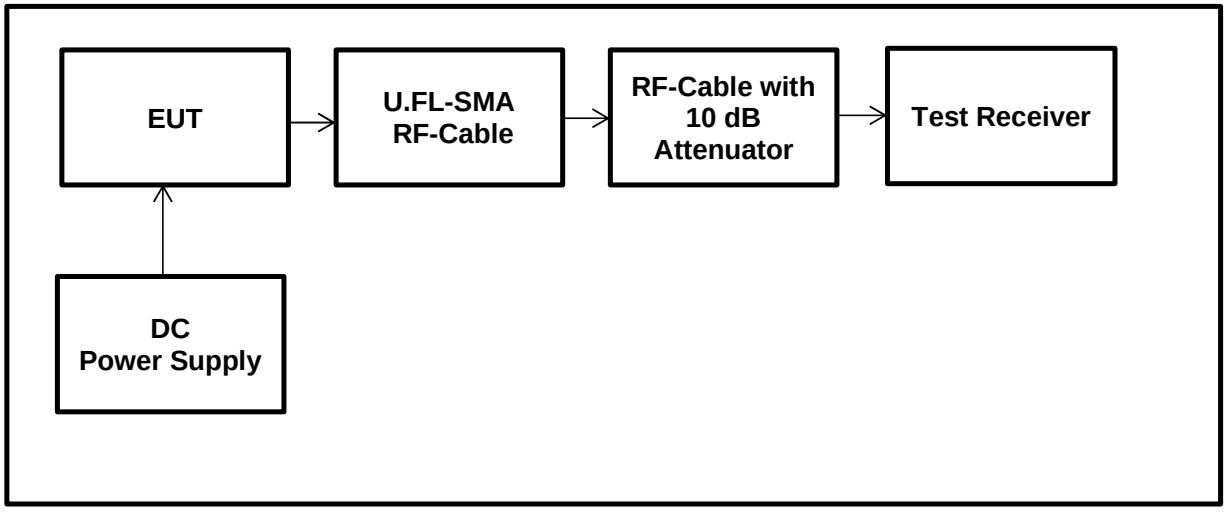
Temperature (°C):	27
Relative Humidity (%):	39

Notes:

1. Final measurements were performed using the above configurations on the bottom, middle and top channels.
2. The EUT was transmitting continuously with duty cycle > 98 % and testing was performed in accordance with ANSI C63.10 Section 11.10.2 Method PKPSD (peak PSD). The signal analyser resolution bandwidth was set to 3 kHz and video bandwidth 10 kHz. A peak detector was used and sweep time was set on auto couple. The span was set to 1.5 times the DTS bandwidth. The highest peak of the measured signal was recorded.
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.
   - The U.FL (female) to SMA (female) to RF-Cable on the EUT's PCB with maximum attenuation of 0.5 dB at tested frequencies
   - The RF cable attenuation maximum 0.4 dB@2.4GHz from the EUT to spectrum analyser including the 10 dB attenuation at the spectrum analyser

   Therefore, a reference level offset of 10.90 dB was set on the spectrum analyser.

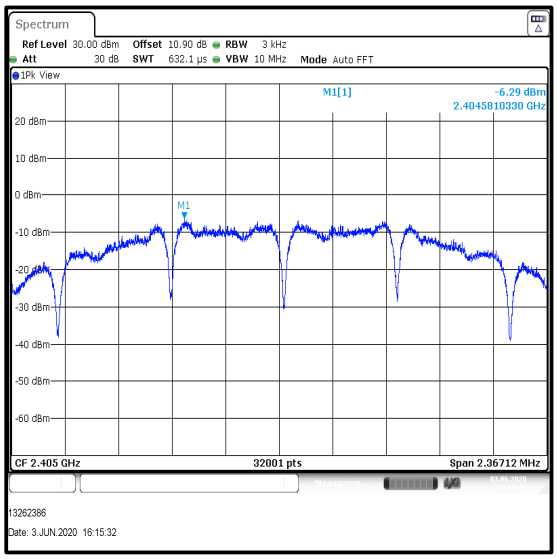
Test Setup:



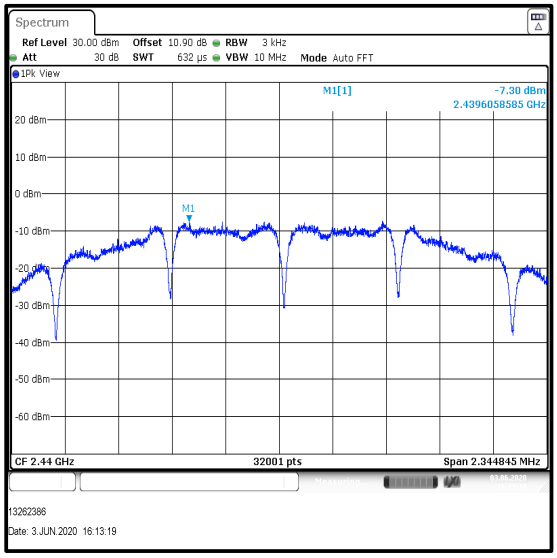
Transmitter Power Spectral Density (continued)

Results: ZigBee / PWR 10 dBm

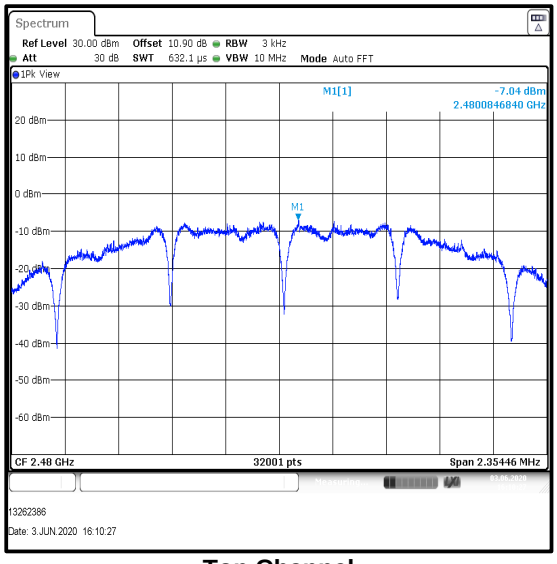
Channel	Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-6.29	8.0	14.29	Complied
Middle	-7.30	8.0	15.30	Complied
Top	-7.04	8.0	15.04	Complied



Bottom Channel



Middle Channel



Top Channel

Result: Pass

5.2.5. Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	Krume Ivanov	**Test Date:**	03 June 2020
Test Sample Serial Number:	00-1F-EE-00-00-00-03-5A		
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 (%):	39

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. Final measurements were performed using the below configurations on the bottom, middle and top channels.

2. The spectrum 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.

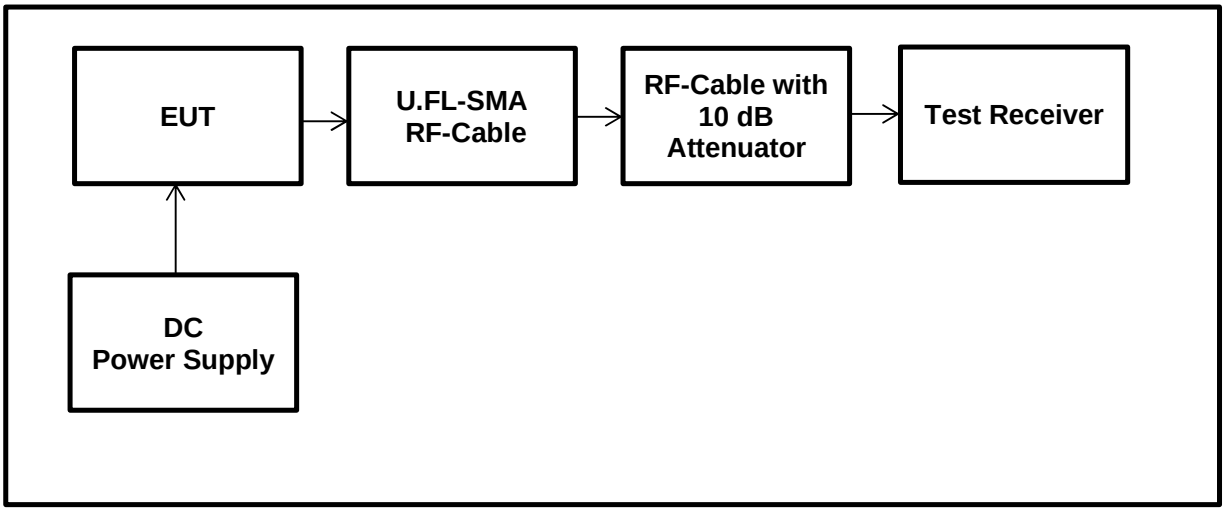
3. The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values take into consideration the external attenuation correction factors.
   - The U.FL (female) to SMA (female) to RF-Cable on the EUT's PCB with maximum attenuation of 0.5 dB at tested frequencies
   - The RF cable attenuation maximum 0.4 dB@2.4GHz from the EUT to spectrum analyser including the 10 dB attenuation at the spectrum analyser

   Therefore, a reference level offset of 10.90 dB was set on the spectrum analyser.

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

Transmitter Maximum Peak Output Power (continued)

Test Setup:



Transmitter Maximum Peak Output Power (continued)

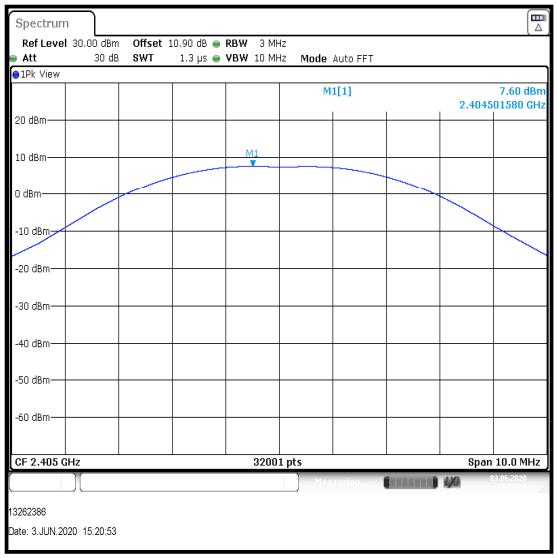
Results: ZigBee / PWR 10 dBm

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	7.60	30.0	22.40	Complied
Middle	7.21	30.0	22.79	Complied
Top	6.86	30.0	23.14	Complied

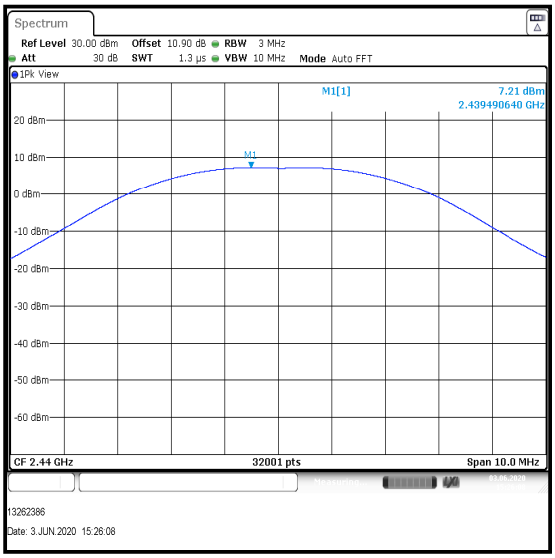
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	7.60	1.3	8.90	36.0	27.10	Complied
Middle	7.21	1.3	8.51	36.0	27.49	Complied
Top	6.86	1.3	8.16	36.0	27.84	Complied

Transmitter Maximum Peak Output Power (continued)

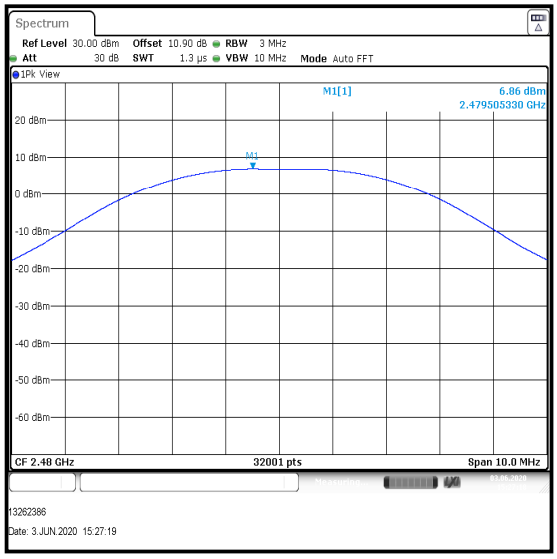
Results: ZigBee / PWR 10 dBm



Bottom Channel



Middle Channel



Top Channel

Result: Pass

5.2.6. Transmitter Radiated Emissions

Test Summary:

Test Engineer:	Sercan Usta	**Test Date:**	27 May 2020
Test Sample Serial Number:	00-1F-EE-00-00-00-03-5A		
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 Sections 6.3 and 6.5
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

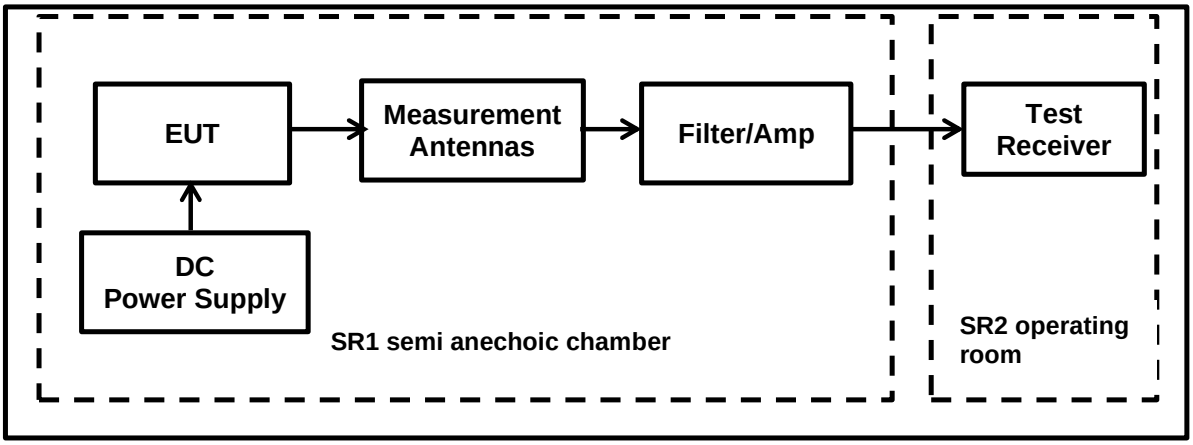
Temperature (°C):	24
Relative Humidity (%):	37

Note(s):

1. 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.
2. 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.
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 below the noise floor of the measurement system.

Transmitter Radiated Emissions (continued)

Test Setup:

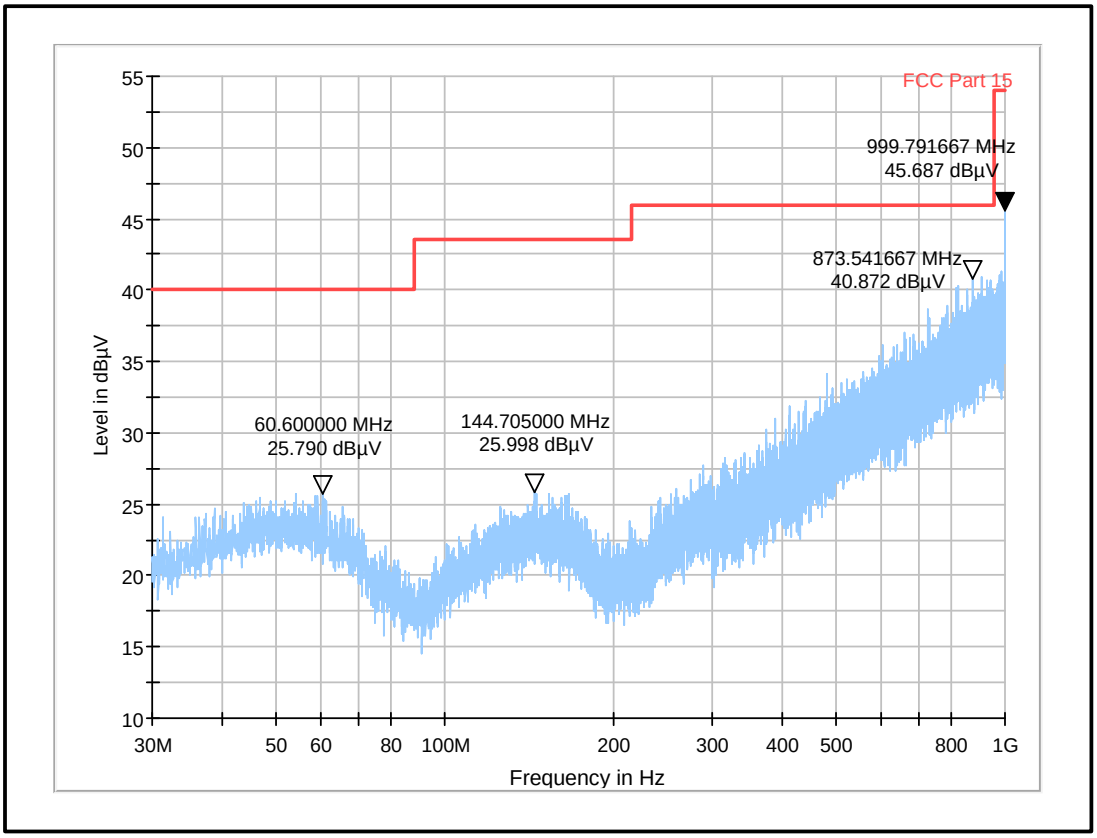


Transmitter Radiated Emissions (continued)

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 & Krume Ivanov	**Test Date:**	26 May 2020 & 02 November 2020
Test Sample Serial Number:	00-1F-EE-00-00-00-03-5A		
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 Sections 6.3 and 6.6
Frequency Range	1 GHz to 26 GHz

Environmental Conditions:

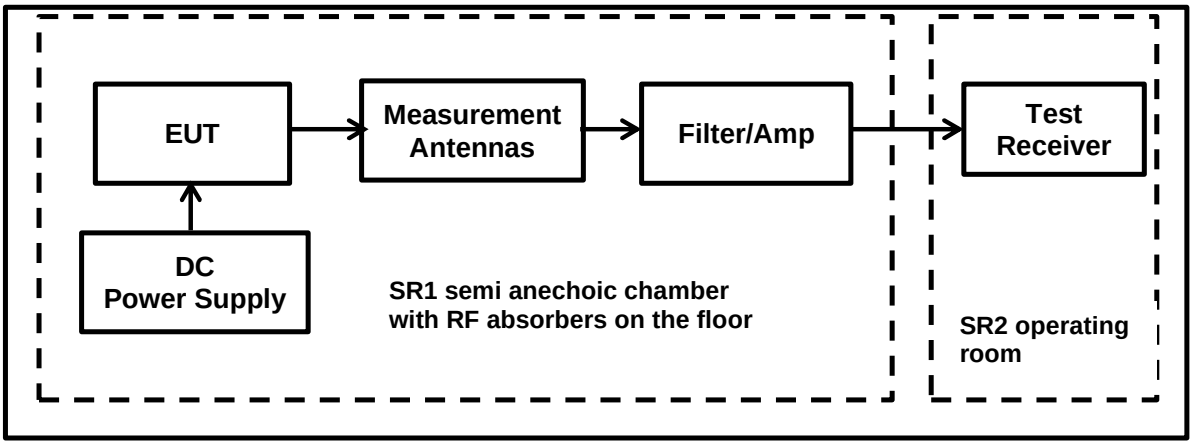
Temperature (°C):	23 & 22
Relative Humidity (%):	39 & 60

Note(s):

1. The emission shown approximately at 2.4-2.4835 GHz on the 1 GHz to 18 GHz plot is the EUT fundamental.
2. 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.
3. 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 m 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.
4. 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.
5. All emissions shown on the pre-scan plots were investigated and found to be below system noise floor.
6. 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.
7. For frequency range between 18 GHz to 26 GHz, no critical emission was found so only the measurement receiver noise floor level has been measured and recorded in the table
8. The EUT was transmitting continuously with duty cycle > 98 %, therefore no duty cycle correction was required.
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:



Transmitter Radiated Emissions (continued)

Results: 1 GHz – 18 GHz

Results: Bottom Channel

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

Results: Middle Channel

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

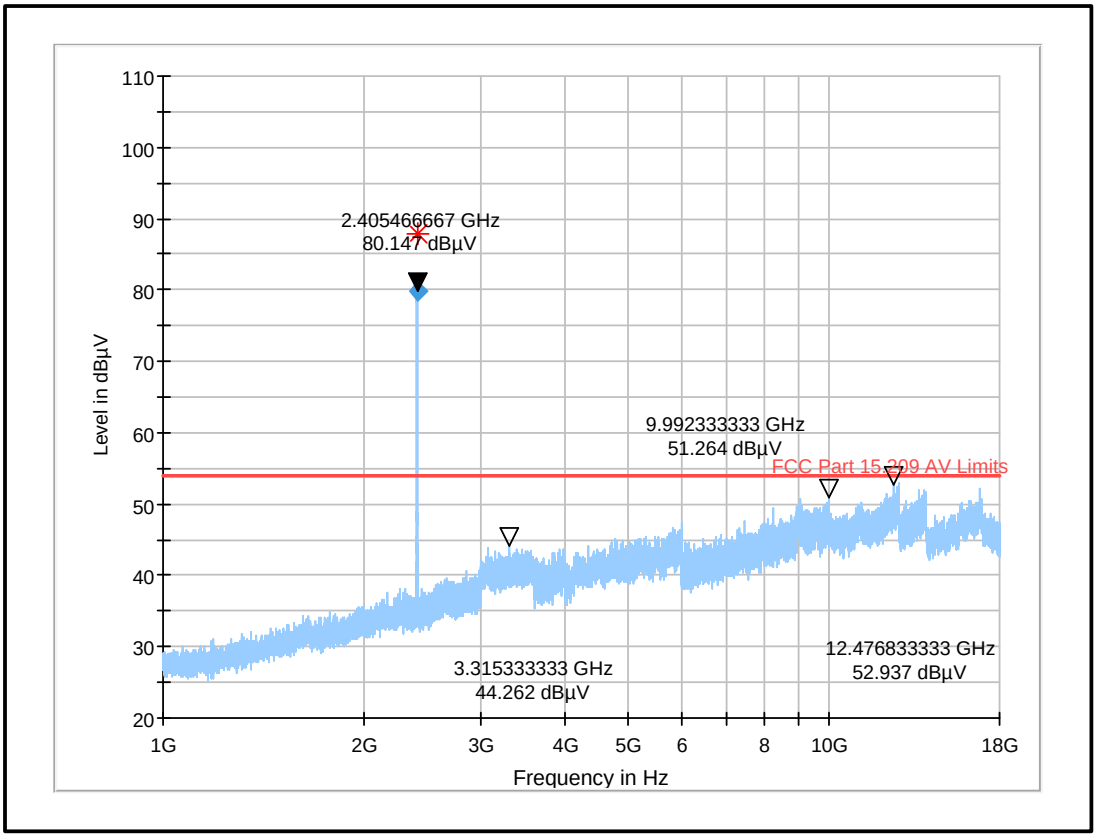
Results: Top Channel

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

Result: Pass

Transmitter Radiated Emissions (continued)

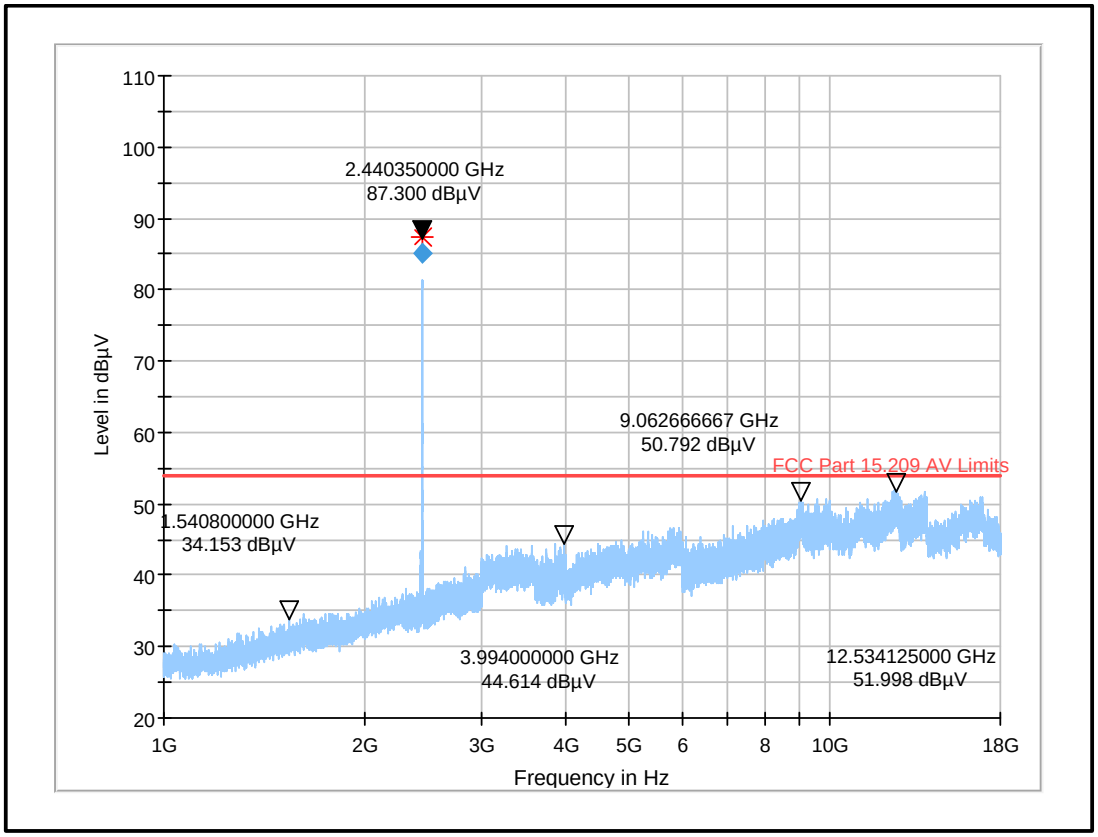
Plot: 1 GHz – 18 GHz: Bottom Channel



Result: Pass

Transmitter Radiated Emissions (continued)

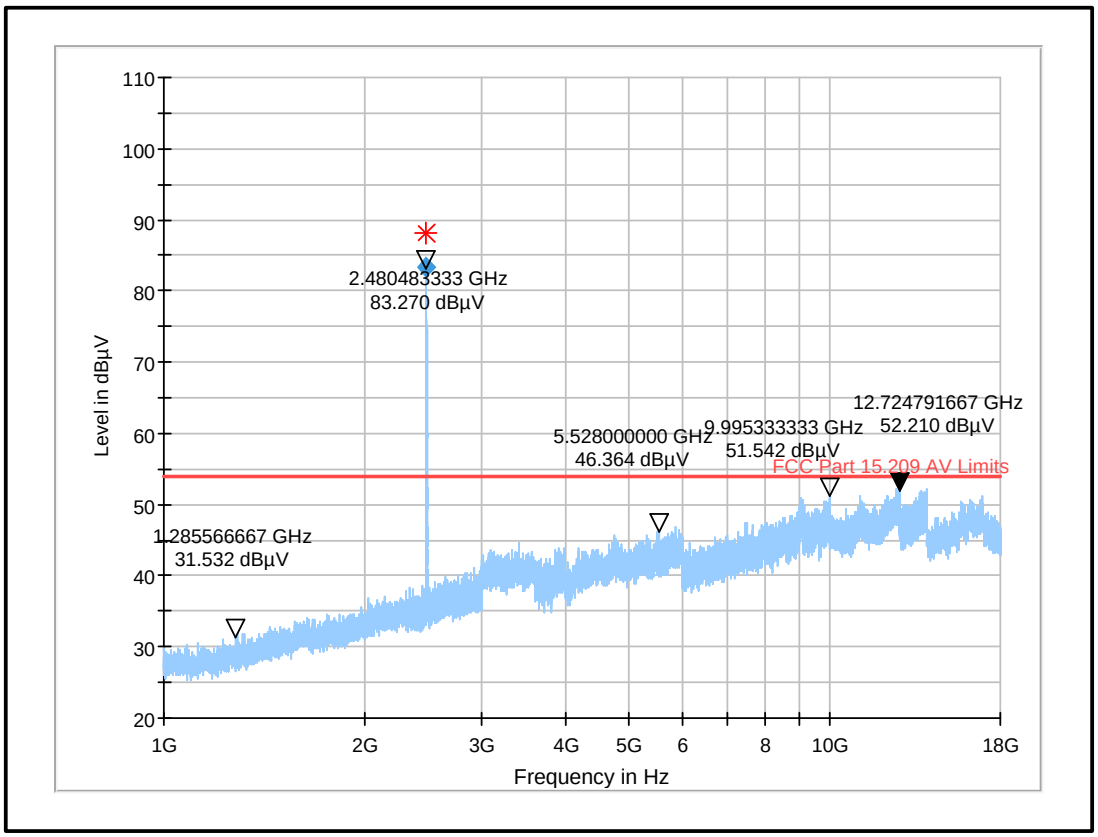
Plot: 1 GHz – 18 GHz: Middle channel



Result: Pass

Transmitter Radiated Emissions (continued)

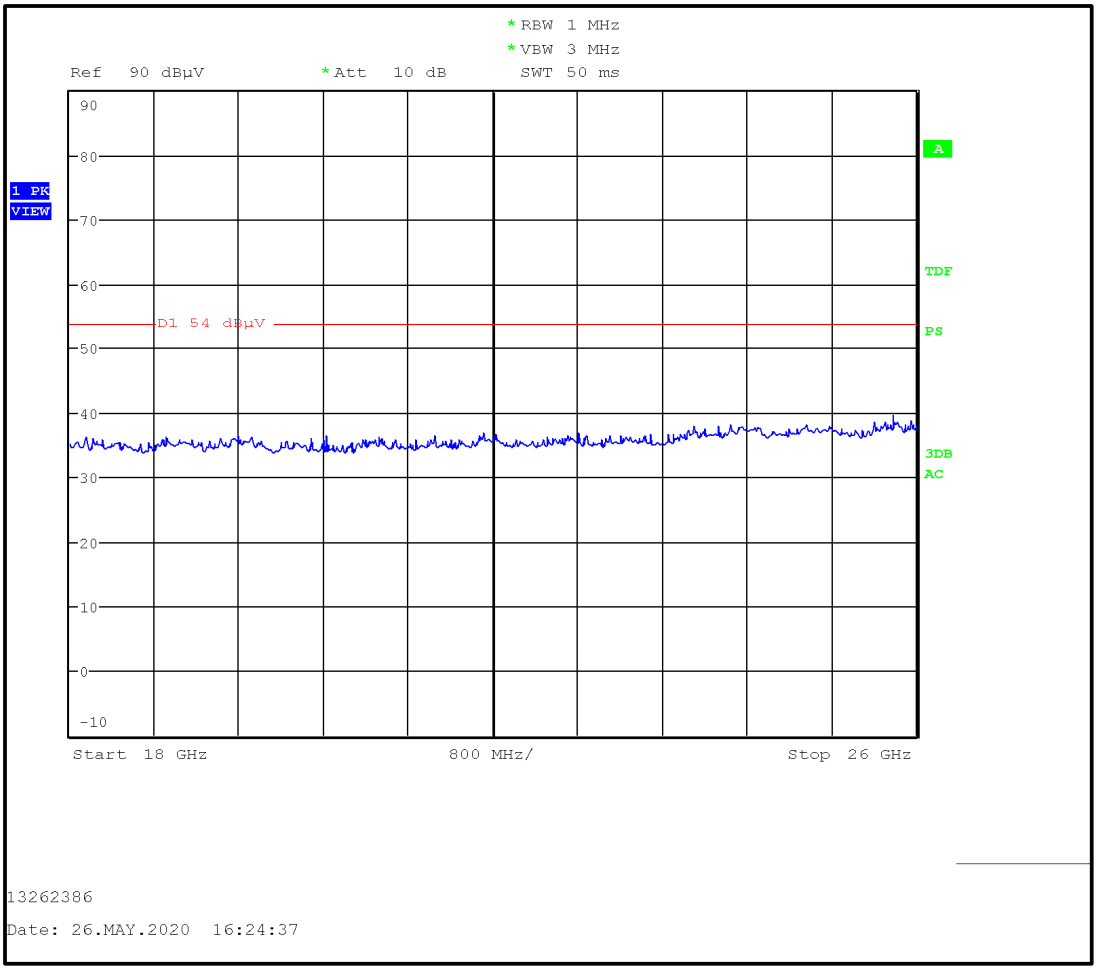
Plot: 1 GHz – 18 GHz: Top channel



Result: Pass

Transmitter Radiated Emissions (continued)

Plot: 18 GHz – 26 GHz : Bottom Channel



Result: Pass

5.2.7. Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineer:	Krume Ivanov	**Test Date:**	02 November 2020
Test Sample Serial Number:	00-1F-EE-00-00-00-03-5A		
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 Section 6.10.4, 6.10.5 & Section 11.11, 11.2 ,11.13

Environmental Conditions:

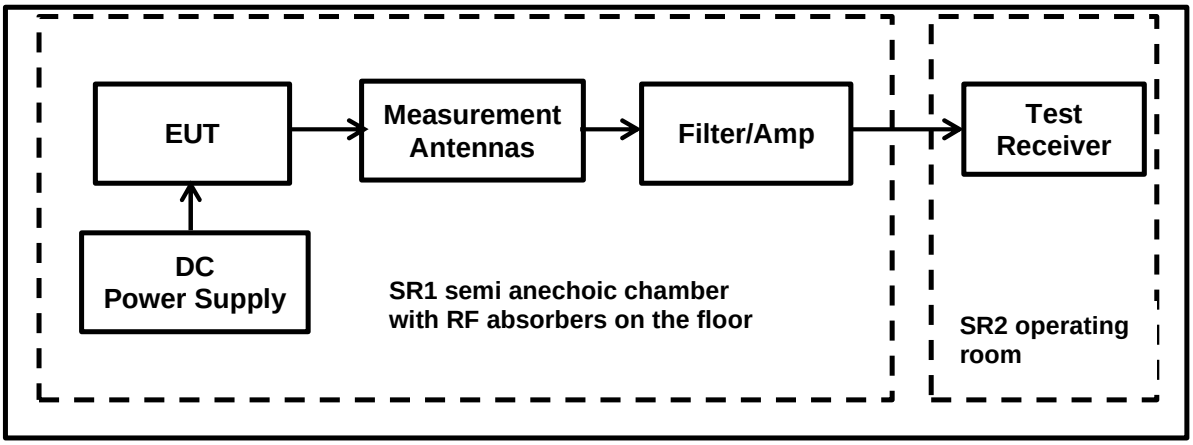
Temperature (°C):	22
Relative Humidity (%):	60

Note(s):

1. Measurements were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) with RF absorbers on the floor at a distance of 3 m.
2. 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 m 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.
3. 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.
4. 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.
5. 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.
6. 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.
7. The EUT was transmitting continuously with duty cycle > 98 %, therefore no duty cycle correction was required for average measurements.
8. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.

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
2399.95	44.62	62.69	18.07	Complied
2400.00	43.19	62.69	19.50	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
2385.00	48.70	74.0	25.30	Complied

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

Frequency (MHz)	Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
2389.10	36.95	54.0	17.05	Complied

Results: Upper Band Edge / Peak

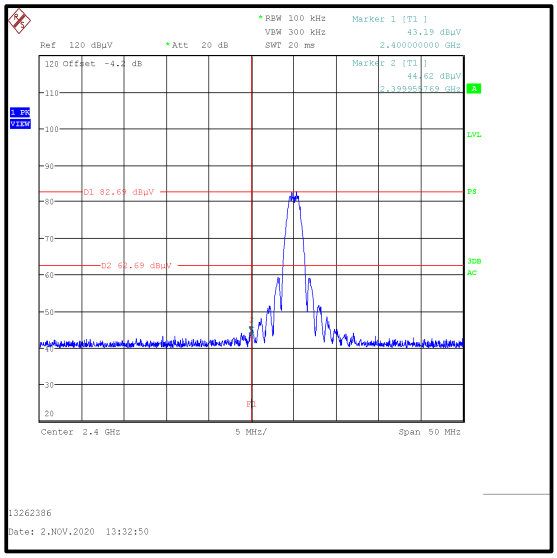
Frequency (MHz)	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
2483.35	58.19	74.0	15.81	Complied

Results: Upper Band Edge / Average

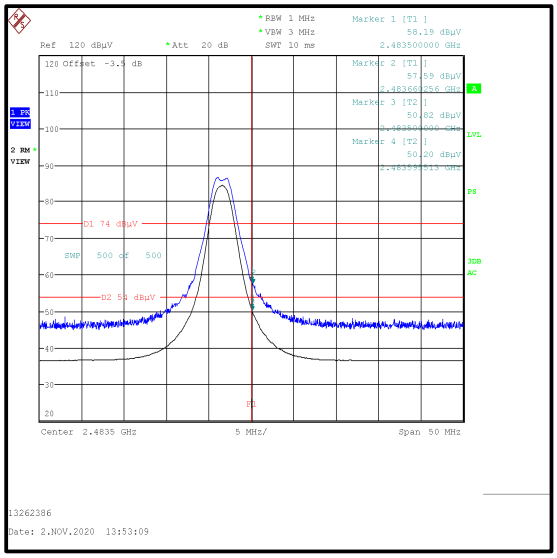
Frequency (MHz)	Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
2483.35	50.82	54.0	3.18	Complied

Result: Pass

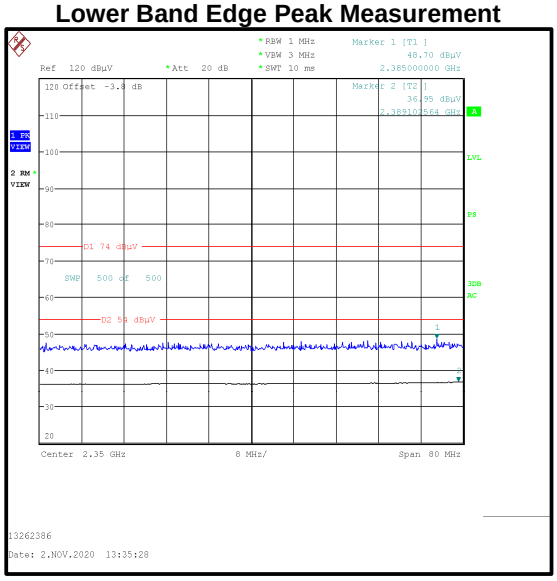
Transmitter Band Edge Radiated Emissions (continued)



Lower Band Edge Peak Measurement



Upper Band Edge Peak & 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
Conducted Maximum Peak Output Power	95%	±0.59 dB
Radiated Spurious Emissions	95%	±3.10 dB
Band Edge Radiated Emissions	95%	±3.10 dB
Transmitter Duty Cycle	95%	±3.4%
Minimum 6 dB Bandwidth	95%	±0.87 %
Spectral Power Density	95%	±0.59 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. Used equipment

Test site: SR 1/2

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
377	BONN Elektronik	Amplifier, Low Noise Pre	BLMA 0118-1A	025294B	08/07/2020	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	05/08/2020	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	07/07/2020	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	09/07/2019	12
349	Rohde & Schwarz	Receiver, EMI Test	ESIB7	836697/009	10/07/2019	12
351	Rohde & Schwarz	network, Artificial Mains	ESH3-Z5	862770/018	08/07/2019	12
616	Rohde & Schwarz	ISN	ENY81-CA6	101656	09/07/2019	12
327	SPS	AC/DC power distribution system	PAS 5000	A2464 00/1 0200	lab verification	n/a
-/-	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	16/07/2019	12
445	Huber & Suhner	RF Attenuator (10 dB)	6810.17.AC	--	lab verification	12
621	Ahlborn-Almemo	Temperatur-/ Feuchtemessgerät	MA2470-S2	H16080099	15/03/2019	12
637	Rohde & Schwarz	Spectrum Analyzer	FSV40	101587	11/07/2019	12
-/-	Huber & Suhner	RF Cable (up to 18 GHz)	-/-	-/-	lab verification	n/a
-/-	Testo	Thermo-Hygrometer	608-H1	07	lab verification	n/a
327	SPS	AC/DC power distribution system	PAS 5000	A2464 00/1 0200	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
Test Report Version 1.1 supersede Version 1.0 with immediate effect Test Report No. UL-RPT-RP-13262386-116-FCC Version 1.1, Issue Date 11 DECEMBER 2020 replaces Test Report No. UL-RPT-RP-13262386-116-FCC Version 1.0, Issue Date 03 NOVEMBER 2020, which is no longer valid.			
1.1	as below	as below	Current Version
	27, 28, 29	5.2.6	Emissions measurements below 30 MHz are not required and were removed
	42	7	Used equipment list: Loop antenna removed from the list