



TEST REPORT

Test Report No. : UL-RPT-RP-13524356-616-FCC

Applicant : Jifeline Networks B.V.
Model No. : J-ReX
FCC ID : 2AZLW-OB-CON-V10
Technology : WLAN (802.11 n)
Test Standard(s) : FCC Parts 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 1.2 supersede Version 1.1 with immediate effect**
Test Report No. UL-RPT-RP-13524356-616-FCC Version 1.2, Issue Date 25 JUNE 2021 replaces
Test Report No. UL-RPT-RP-13524356-616-FCC Version 1.1, Issue Date 25 JUNE 2021, which is no longer valid.
5. Result of the tested sample: **PASS**

Prepared by: Sercan, Usta
Title: Laboratory Engineer
Date: 25 June 2021

Approved by: Ajit, Phadtare
Title: Lead Test Engineer
Date: 25 June 2021



Deutsche
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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:	Jifeline BV
Company Address:	De Hoogjens 11, 4254XV Sleeuwijk, The Netherlands
Company Phone No.:	+31(0)85-4863727
Company E-Mail:	info@jifeline.com
Contact Person:	Femke van Wanrooij
Contact E-Mail Address:	femke@jifeline.com
Contact Phone No.:	+32(0)854863727

1.2. Manufacturer Information

Company Name:	Jifeline BV
Company Address:	De Hoogjens 11, 4254XV Sleeuwijk, The Netherlands
Company Phone No.:	+31(0)85-4863727
Company E-Mail:	info@jifeline.com
Contact Person:	Femke van Wanrooij
Contact E-Mail Address:	femke@jifeline.com
Contact Phone No.:	+32(0)854863727

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:	47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Section 15.209

Location

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

Date information

Order Date:	24 September 2020
EUT arrived:	18 December 2020
Test Dates:	09 February 2021 to 10 June 2021
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 ⁽¹⁾	☐	☐	☐	☒
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	☒	☐	☐	☐
Part 15.35(c)	Transmitter Duty Cycle ⁽²⁾	☒	☐	☐	☐
Part 15.247(e)	Transmitter Power Spectral Density	☒	☐	☐	☐
Part 15.247(b)(3)	Transmitter Maximum 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):

- Not applicable as the EUT will be powered via an automotive vehicle DC battery.
In accordance with Part 15.207(c) measurements to demonstrate compliance are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines or do not make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or do not connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines.
- The measurement was performed to determine the Duty Cycle Correction Factor to compute the corrected average values of the emissions that would have been measured had the test been performed at 100% Duty Cycle.

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

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:	Jifeline
Model Name or Number:	J-ReX
Test Sample Serial Number:	32520 (Radiated Sample)
Hardware Version Number:	10
Software Version Number:	100000050
FCC ID:	2AZLW-OB-CON-V10

Brand Name:	Jifeline
Model Name or Number:	J-ReX
Test Sample Serial Number:	KIM19005 (Conducted Sample)
Hardware Version Number:	10
Software Version Number:	100000050
FCC ID:	2AZLW-OB-CON-V10

3.2. Description of EUT

The equipment under test was an automotive remote diagnostics tool to connect the OBD diagnostics vehicle communication to an online cloud platform supporting WLAN 802.11n 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

Category of Equipment:	WLAN (IEEE 802.11n) / Digital Transmission System		
Type of Radio Device:	Transceiver		
Power Supply Requirement(s):	Nominal	12 - 24 V DC / 3 - 5 A	
Temperature Requirement(s):	Nominal	25 °C	
	Minimum	0 °C	
	Maximum	85 °C	
Relative Humidity	30%		
Supported Transmit Operating Mode(s):	IEEE 802.11n ^(Note 1)		
Data Rates:	802.11 n HT20	MCS0 to MCS7	
Modulation Types:	OFDM	BPSK, QPSK, 16QAM, 64QAM	
Nominal Channel Bandwidth:	20 MHz		
Maximum Conducted Output Power:	13.62 dBm		
Declared Antenna Gain:	0.0 dBi		
Antenna Type:	Single PCB Antenna Equipment		
Antenna Details:	Embedded on-board PCB antenna DPT DPT-Module-v1		
Transmit Frequency Range:	2412 MHz to 2462 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	1	2412
	Middle	6	2437
	Top	11	2462
(Note 1) As per applicant's declaration & in accordance with data sheet of the radio module's (Model: DPT-Module) FCC_Jifeline_wifi_module_datasheet_rev2.pdf Issue Date: June 26,2017 DPTECHNICS "The DPT-Module is a general purpose embedded system with integrated 2.4GHz 802.11n WiFi."			

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 with Putty	HP	HP Probook 650 G1	5CG614419V

B. Support Equipment (Manufacturer supplied)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	USB Programming Cable	N/A	N/A	N/A
2	DC Power Cable	N/A	N/A	N/A
3	OBD Cable	N/A	N/A	N/A
4	Car Battery	Yuasa	NP7-12L Type 12 V, 7.0 Ah	N/A

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes / Worst Case Identification

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

- ☒ Transmitter / Modulated Carrier Continuous Transmissions Mode WLAN 2.4 GHz, Worst Cases*:
802.11n HT20: MCS4 | Power Level (PWR) 14

*All supported data rates, modulation schemes & nominal channel bandwidths configurations were initially investigated to determine the above-mentioned worst-cases for highest power and widest bandwidth

4.2. Configuration and Peripherals

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

- The applicant supplied a document containing the setup instructions "DPT-Module V1 radio test firmware" Revision V1, issue date 16.11.2020

EUT Power Supply:

- The EUT Conducted Sample was powered by 3.3 V DC via laboratory DC power supply.
- The EUT Radiated Sample was powered by a fully charged automotive 12 V DC battery supplied by the customer..

Test Mode Activation:

- The EUT connected via USB cable to the test laptop.
- "The test modes were activated using terminal (Putty.exe) software tool supplied by applicant. The application was used to enable continuous transmission and to select the test channels as required.
- The EUTs were configured to continuous transmissions mode with power level (PWR) 14.
- As the EUT was transmitting continuously with a Duty Cycle of 88.69 %, a Duty Cycle Correction Factor of 0.52 dB was added to all average measurements.

Conducted Measurements:

- All conducted measurements were carried using conducted samples with SMA (Female) RF Cable soldered on PCB by the customer. The maximum attenuation of 0.5 dB at the tested frequencies was added to a reference level offset to each of the conducted plots.

Radiated Measurements:

- The radiated samples with integrated on chip antenna were used for radiated spurious emission 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 measurements below 30 MHz were performed with the EUT positioned on the turn table and rotating 360 degrees while the loop antenna height was set to 80 cm.
- 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.
- R&S® EMC32 V10.60.10 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 Minimum 6 dB Bandwidth

Test Summary:

Test Engineer:	Sercan Usta	Test Date:	01 March 2021
Test Sample Serial Number:	KIM19005 (Conducted 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 1

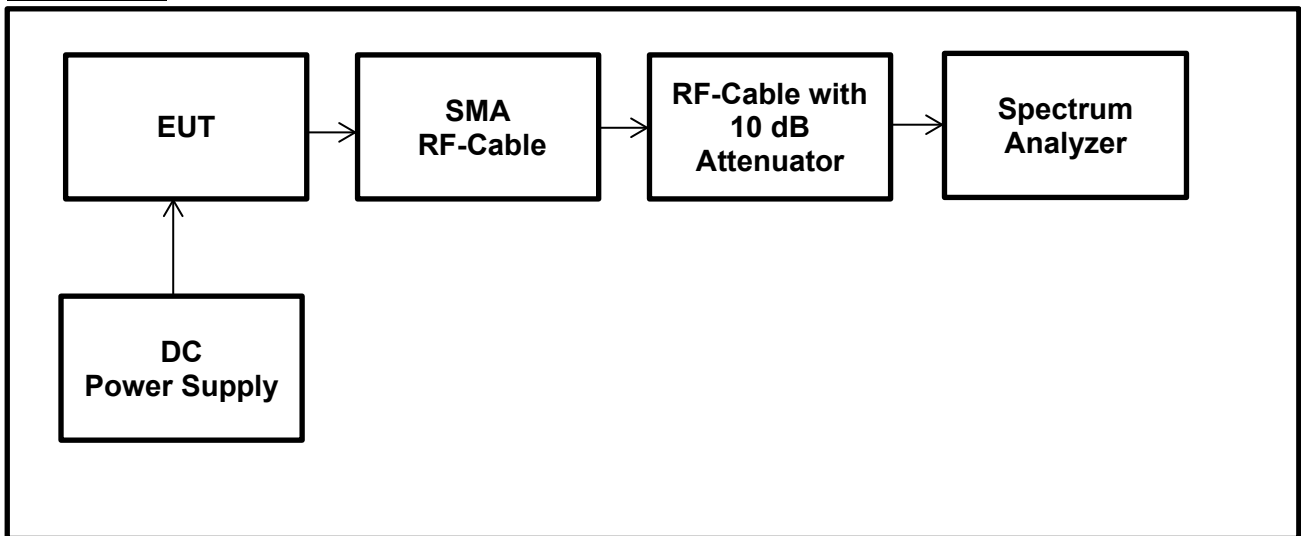
Environmental Conditions:

Temperature (°C):	27.1
Relative Humidity (%):	36.2

Note(s):

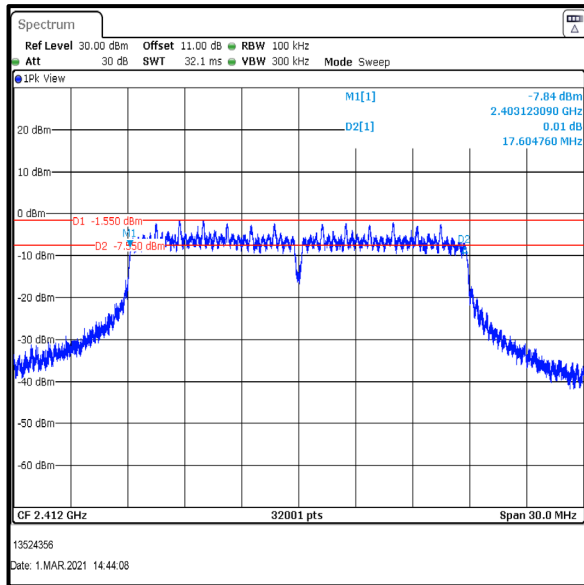
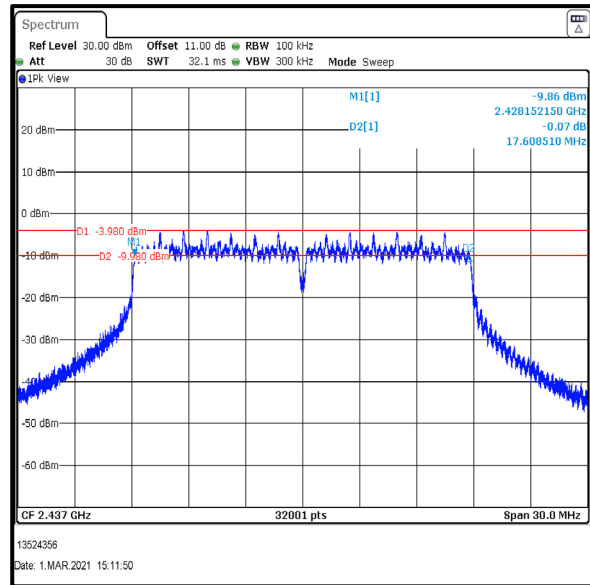
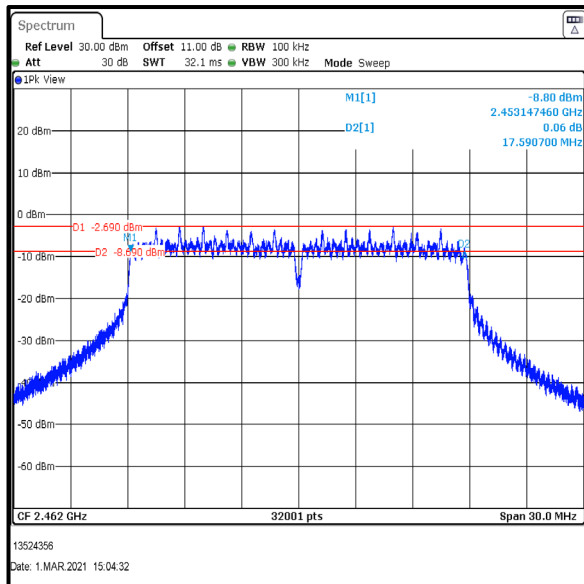
1. The measurements were performed using the above configurations on the bottom, middle and top channels in accordance FCC KDB 558074 Section 8.2 referencing ANSI C63.10 Section 11.8 (11.8.1 Option 1 measurement procedure).
2. The spectrum analyser resolution bandwidth was set to 100 kHz and video bandwidth 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 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.

Transmitter Minimum 6 dB Bandwidth (continue)**Test Setup:**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR 14**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	17604.76	≥ 500	17104.76	Complied
Middle	17608.51	≥ 500	17108.51	Complied
Top	17590.70	≥ 500	17090.70	Complied

**Bottom Channel****Middle Channel****Top Channel****Result: Pass**

5.2.2. Transmitter Duty Cycle**Test Summary:**

Test Engineer:	Sercan Usta	Test Date:	09 February 2021
Test Sample Serial Number:	KIM19005 (Conducted 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):	27.1
Relative Humidity (%):	36.2

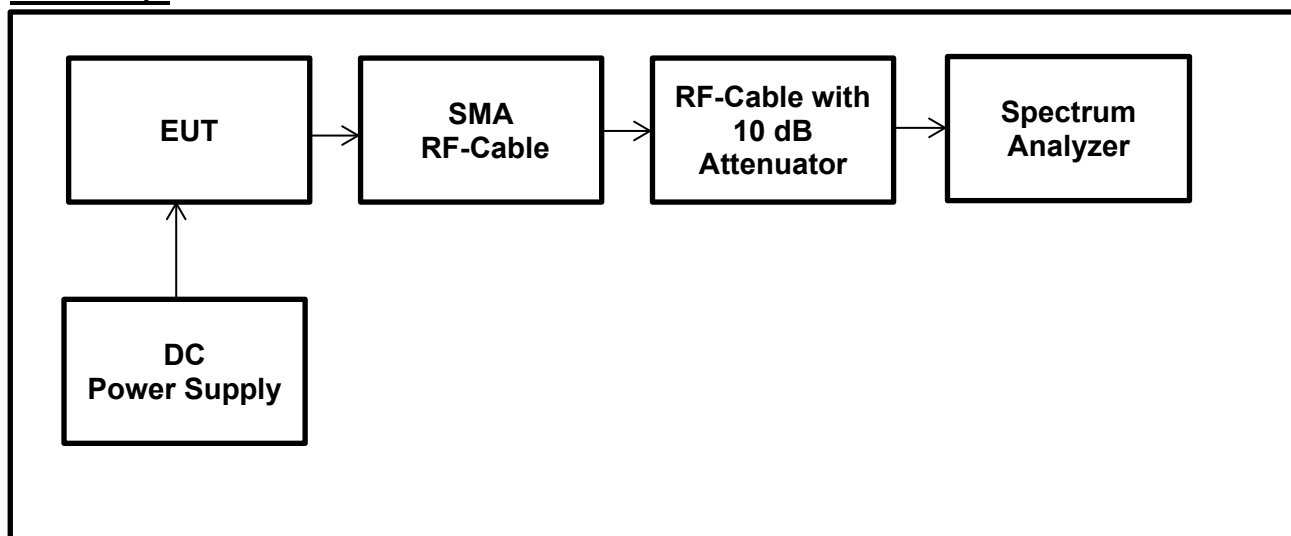
Note(s):

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

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

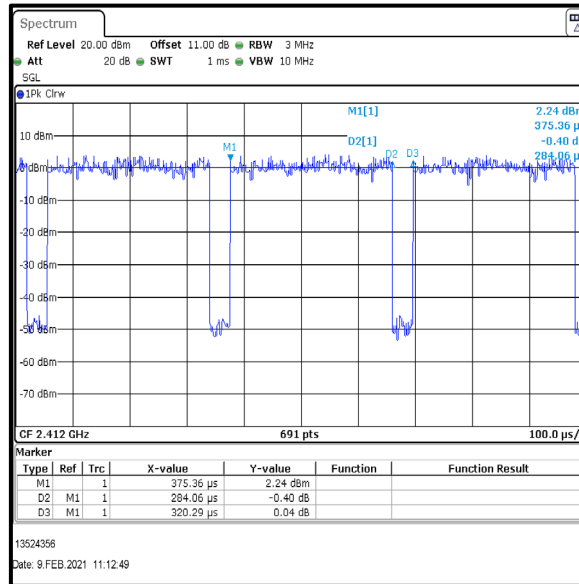
$$\text{Duty Cycle Correction Factor} = 10 \log 1 / [\text{On Time (T}_{\text{ON}})] / [\text{Period(T}_{\text{ON}} + \text{T}_{\text{OFF}}) \text{ or } 100\text{ms whichever is the lesser}]$$
- The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The 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: 802.11n / 20 MHz / MCS4 / PWR 14**

Pulse Duration (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
284.06	320.29	88.69	0.52

**Result: Pass**

5.2.3. Transmitter Power Spectral Density**Test Summary:**

Test Engineer:	Sercan Usta	Test Date:	10 June 2021
Test Sample Serial Number:	KIM19005 (Conducted Sample)		
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

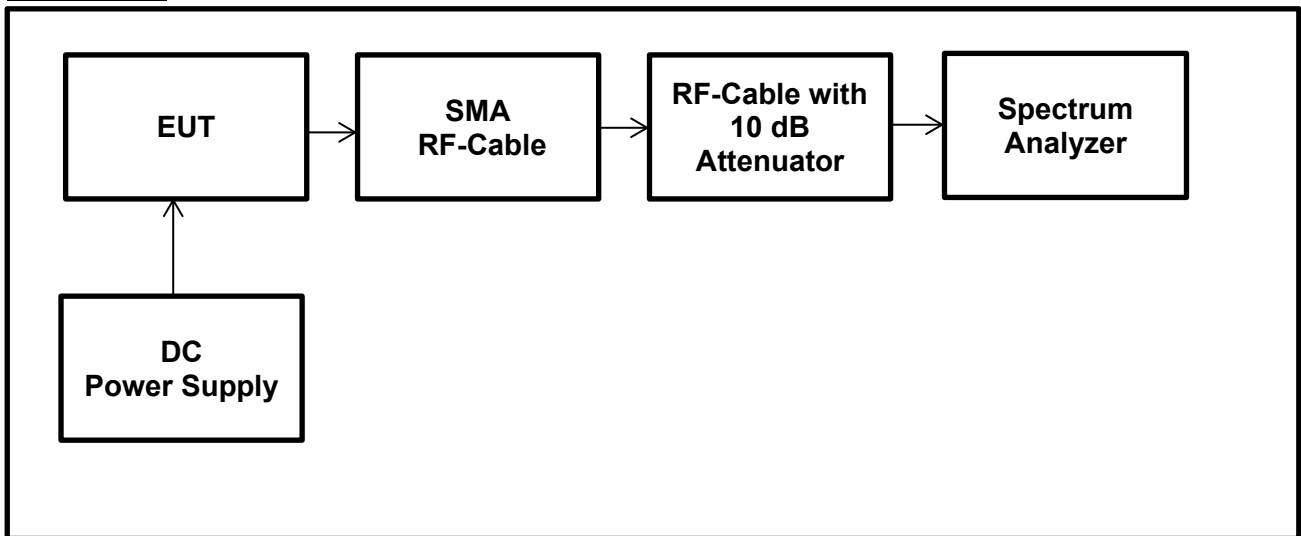
Environmental Conditions:

Temperature (°C):	27.1
Relative Humidity (%):	36.2

Note(s):

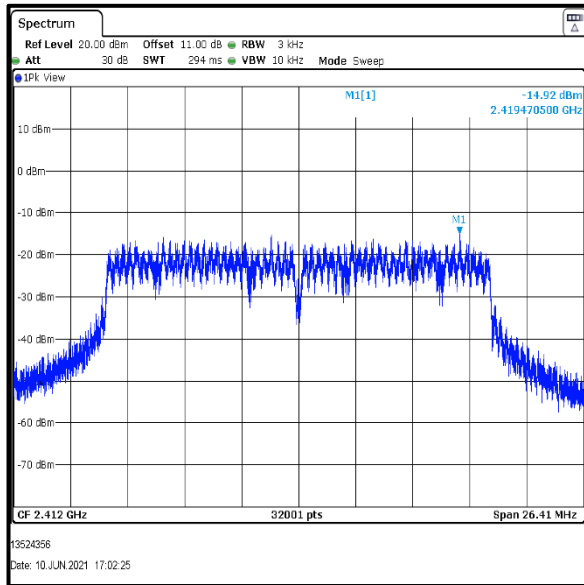
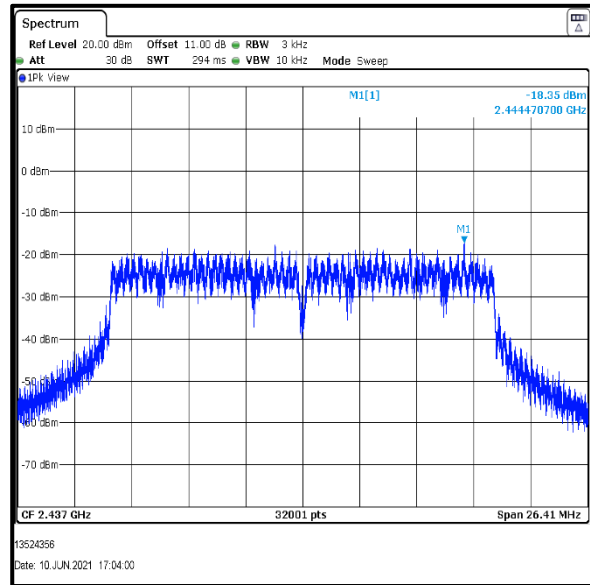
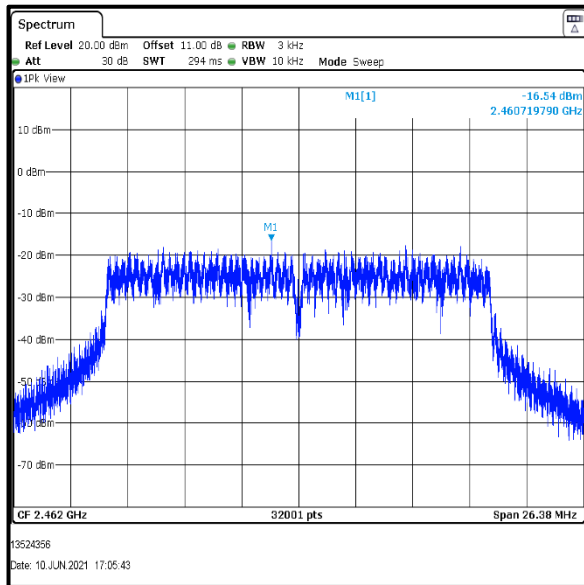
- Final measurements were performed using the below configurations on the bottom, middle and top channels.
- For 802.11n, the EUT was transmitting at < 98% duty cycle and testing was performed in accordance with ANSI C63.10 Section 11.10.2 Method PKPSD.
- The signal analyser resolution bandwidth was set to 3 kHz and video bandwidth 10 kHz. A Peak detector was used and sweep time was set to Auto. The span was set to 1.5 times the DTS bandwidth. The highest peak of the measured signal was recorded.
- 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.

Transmitter Power Spectral Density (continued)**Test Setup:**

Transmitter Power Spectral Density (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR 14**

Channel	Peak Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-14.92	8.0	22.92	Complied
Middle	-18.35	8.0	26.35	Complied
Top	-16.54	8.0	24.54	Complied

**Bottom Channel****Middle Channel****Top Channel****Result: Pass**

5.2.4. Transmitter Maximum Output Power**Test Summary:**

Test Engineer:	Sercan Usta	Test Date:	24 February 2021
Test Sample Serial Number:	KIM19005 (Conducted Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(b)(3)
Test Method Used:	FCC KDB 558074 Section 8.3.1.3 referencing ANSI C63.10 Sections 11.9.1.3

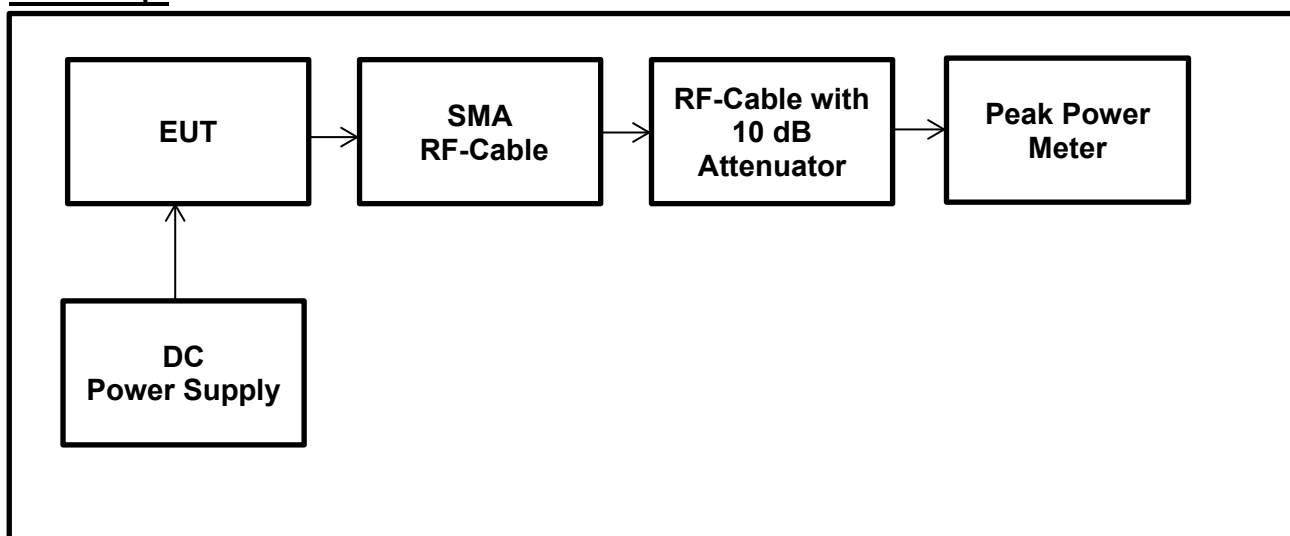
Environmental Conditions:

Temperature (°C):	27.1
Relative Humidity (%):	36.2

Note(s):

- Final measurements were performed using the below configurations on the bottom, middle and top channels.
- For 802.11n, the EUT was transmitting at <98% duty cycle and testing was performed in accordance with ANSI C63.10 Sections 11.9.1.3 Method PKPM1. The broadband peak RF power meter (VBW ≥ EUT's DTS Bandwidth) was used to measure the signal power.
- 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 RF power meter with maximum attenuation of 0.5 dB at the tested frequencies including the 10 dB attenuator at the input of RF power meter.

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

Test Setup:

Transmitter Maximum Output Power (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR 14**

Channel	Conducted Peak Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	13.62	30.0	16.38	Complied
Middle	11.50	30.0	18.50	Complied
Top	12.52	30.0	17.48	Complied

De Facto EIRP Limit Comparison

Channel	Conducted Power Peak (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	13.62	0.0	13.62	36.0	22.38	Complied
Middle	11.50	0.0	11.50	36.0	24.50	Complied
Top	12.52	0.0	12.52	36.0	23.48	Complied

Result: Pass

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

Test Engineer:	Sercan Usta	Test Date:	03 March 2021
Test Sample Serial Number:	32520 (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:

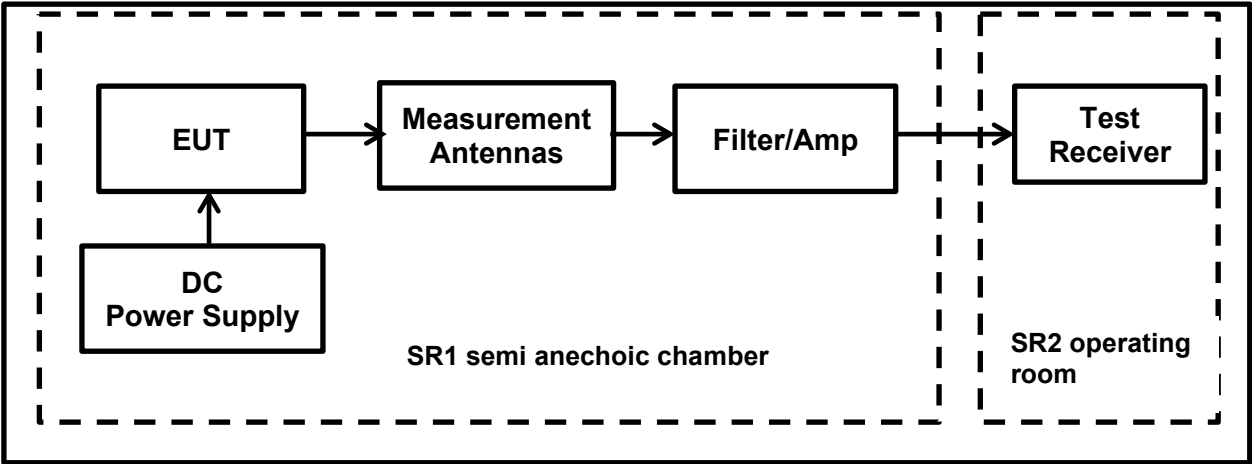
Temperature (°C):	23.3
Relative Humidity (%):	39.6

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 limits are specified at a test distance of 30 meters & 300 metres. However, as specified by FCC Section 15.31 (f)(2), measurements may be performed at a closer distance and the measured level corrected to the specified measurement distance by using the square of an inverse linear distance extrapolation factor.
3. Therefore, the limit values are extrapolated to a measurement distance of 3 m was measured.
 - 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.
4. 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.
5. 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 Top Channel only.
6. 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: 300 Hz /VBW: 1 kHz
 - Frequency range: 150 kHz – 30 MHz: RBW: 10 kHz /VBW: 30 kHz
 - Detector: Max-Peak detector
 - Trace Mode: Max Hold
7. All emissions shown on the pre-scans were investigated and are reported in result table. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
8. All other emissions shown on the pre-scans were investigated and found to be > 20 dB below the applicable limits.

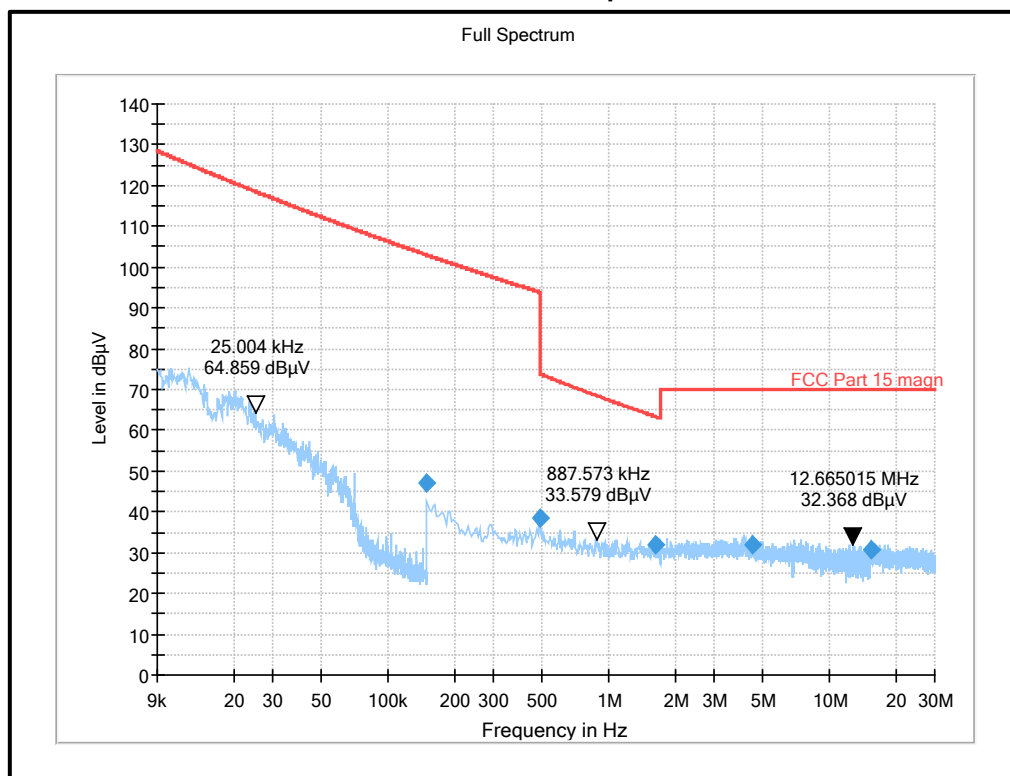
Transmitter Radiated Emissions (continued)

Test Setup:



Transmitter Radiated Emissions (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR14 / Top Channel**

Frequency (MHz)	Loop Antenna Orientation	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
0.150	0 ° to EUT	47.00	102.96	55.96	Complied
0.490	0 ° to EUT	38.68	73.79	35.11	Complied
1.618	0 ° to EUT	32.02	63.39	31.37	Complied
4.453	0 ° to EUT	32.13	70.00	37.87	Complied
15.581	90 ° to EUT	30.84	70.00	39.16	Complied

Plot: 9 kHz – 30 MHz: Top channel**Result: Pass**

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

Test Engineer:	Sercan Usta	Test Date:	03 March 2021
Test Sample Serial Number:	32520 (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:

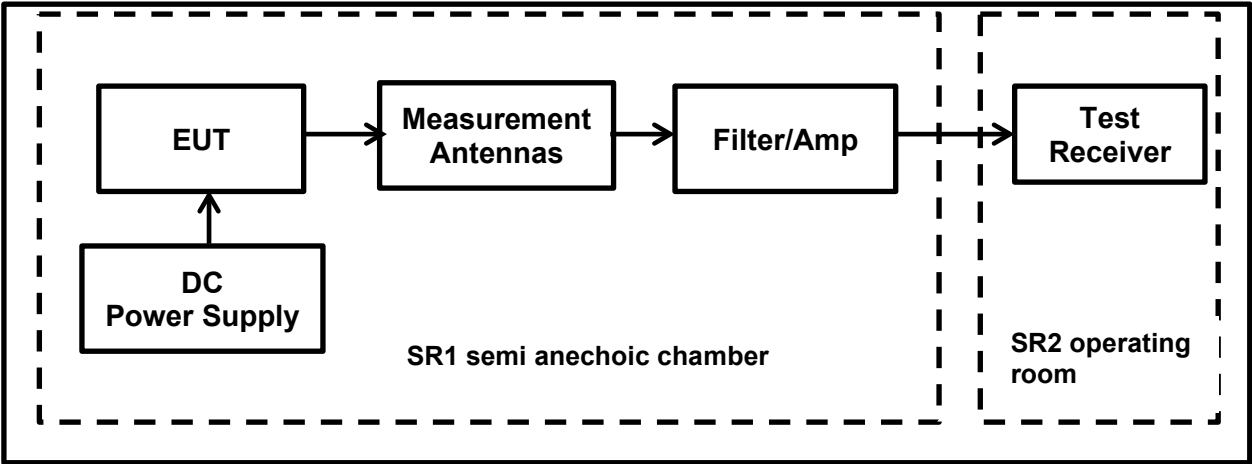
Temperature (°C):	23.3
Relative Humidity (%):	39.6

Note(s):

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 Top 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 are reported in result table. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
5. All other emissions shown on the pre-scans were investigated and found to be > 20 dB below the applicable limits.

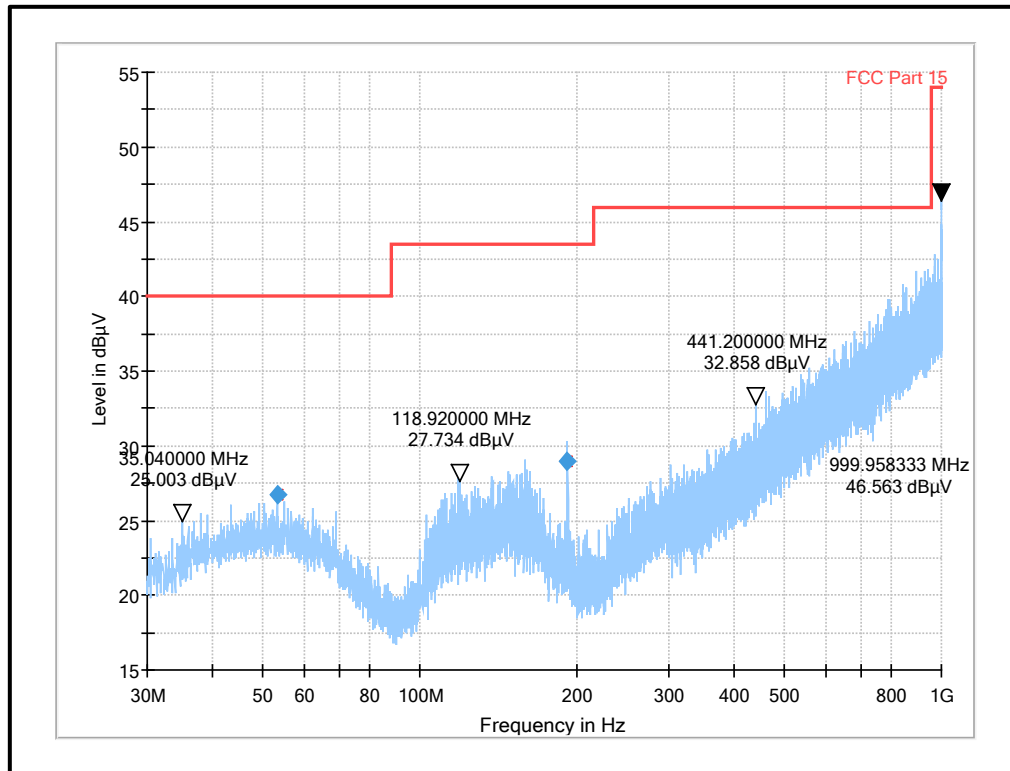
Transmitter Radiated Emissions (continued)

Test Setup:



Transmitter Radiated Emissions (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR14 / Top Channel**

Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
53.175	Vertical	26.72	40.00	13.28	Complied
192.000	Horizontal	29.02	43.50	14.48	Complied

Plot: 30 MHz – 1GHz: Top channel**Result: Pass**

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

Test Engineer:	Sercan Usta	Test Date:	01 March 2021 to 03 March 2021
Test Sample Serial Number:	32520 (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:

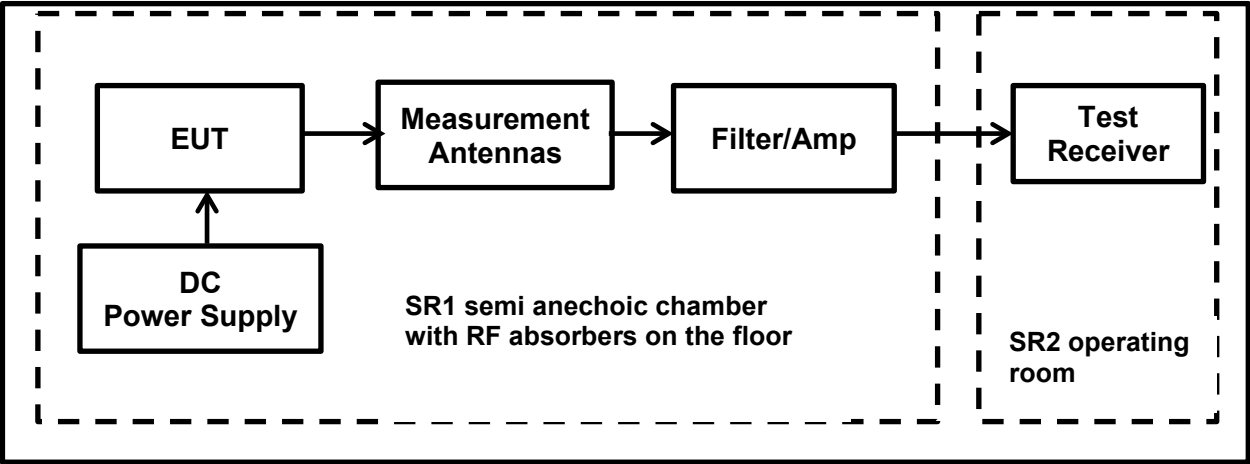
Temperature (°C):	23.3 to 24
Relative Humidity (%):	35 to 39.6

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. All emissions shown on the pre-scan plots were investigated and are reported in result table. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
5. All other emissions shown on the pre-scans were investigated and found to be below the noise floor of the measurement system.
6. *In accordance with ANSI C63.10 Section 6.6.4.3 (Note 1), if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
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 Top channel only.
8. For frequency range between 18 GHz and 25 GHz, no critical emissions were found. All emissions shown on the pre-scans were investigated and found to be below the noise floor of the measurement system.

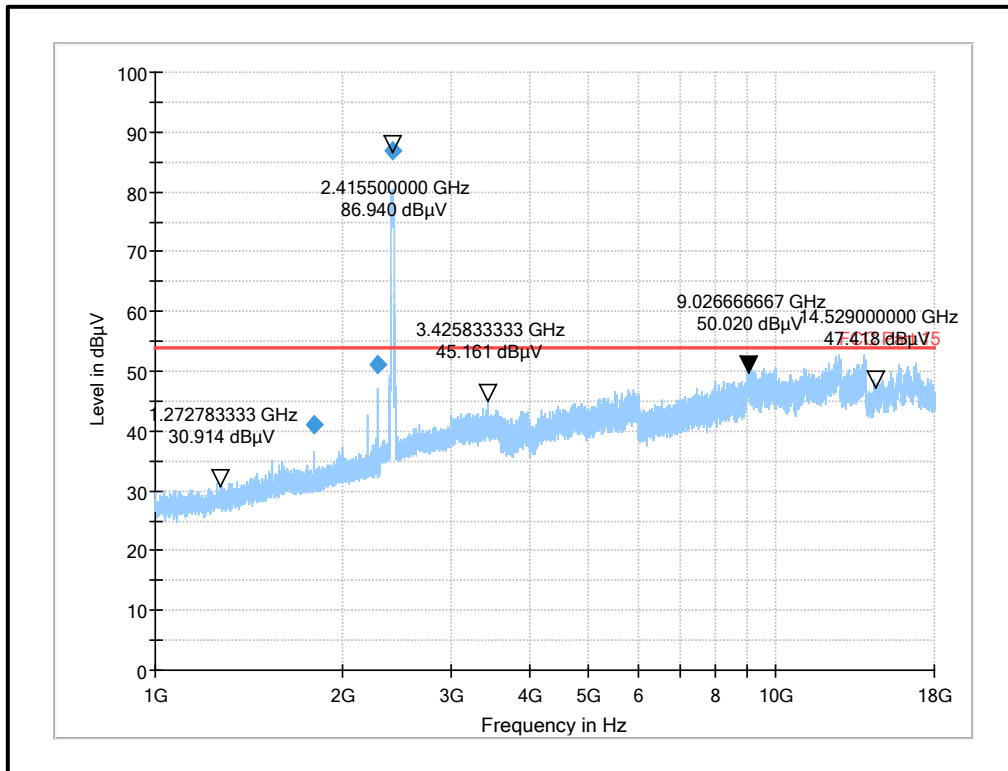
Transmitter Radiated Emissions (continued)

Test Setup:



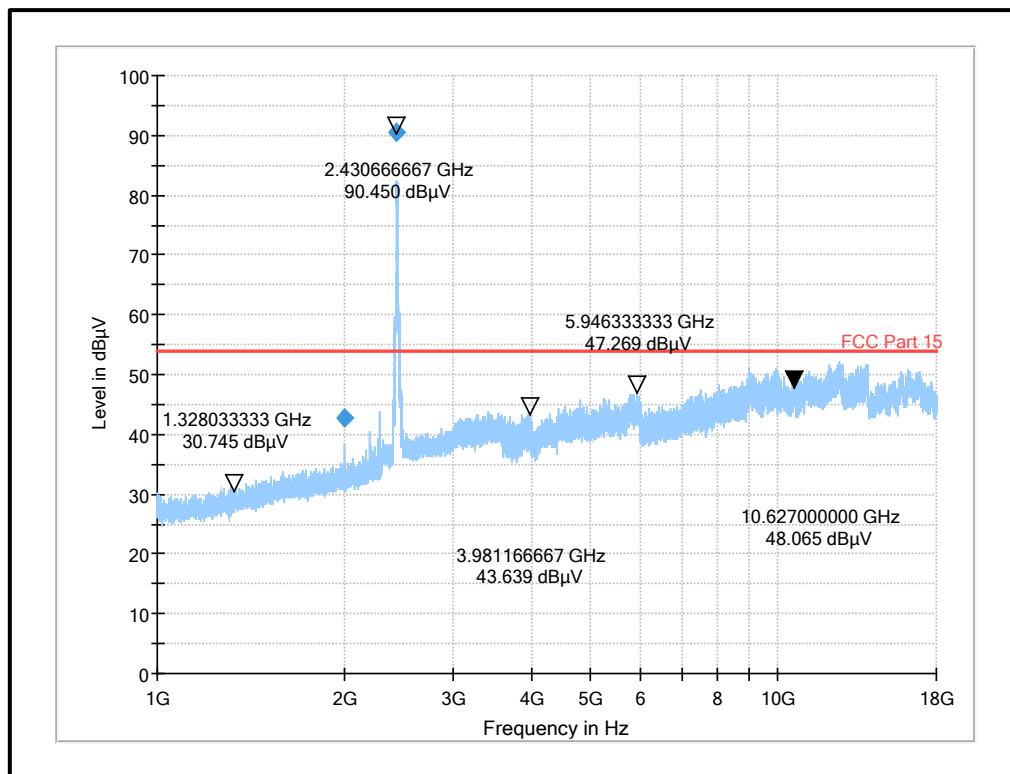
Transmitter Radiated Emissions (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR14 / Bottom Channel**

Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
1799.933	Horizontal	41.10	54.00	12.90	Complied*
2288.083	Horizontal	51.06	54.00	2.94	Complied*

Plot: 1 GHz – 18 GHz: Bottom Channel**Result: Pass**

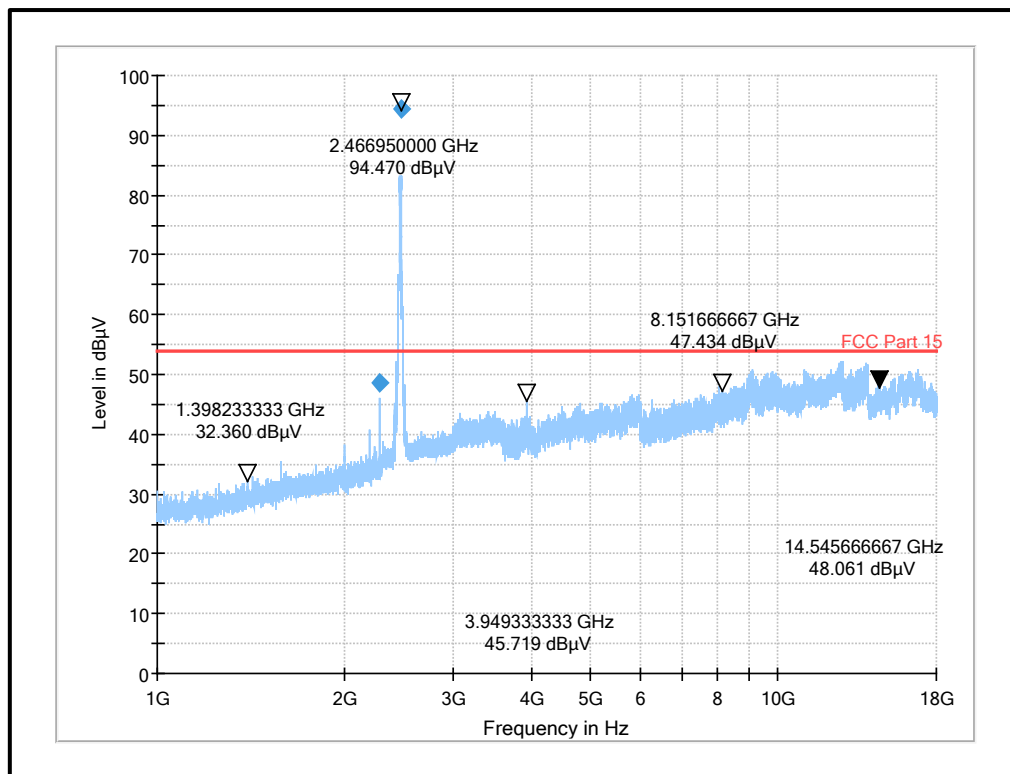
Transmitter Radiated Emissions (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR14 / Middle Channel**

Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
2000.133	Horizontal	42.85	54.00	11.15	Complied*

Plot: 1 GHz – 18 GHz: Middle channel**Result: Pass**

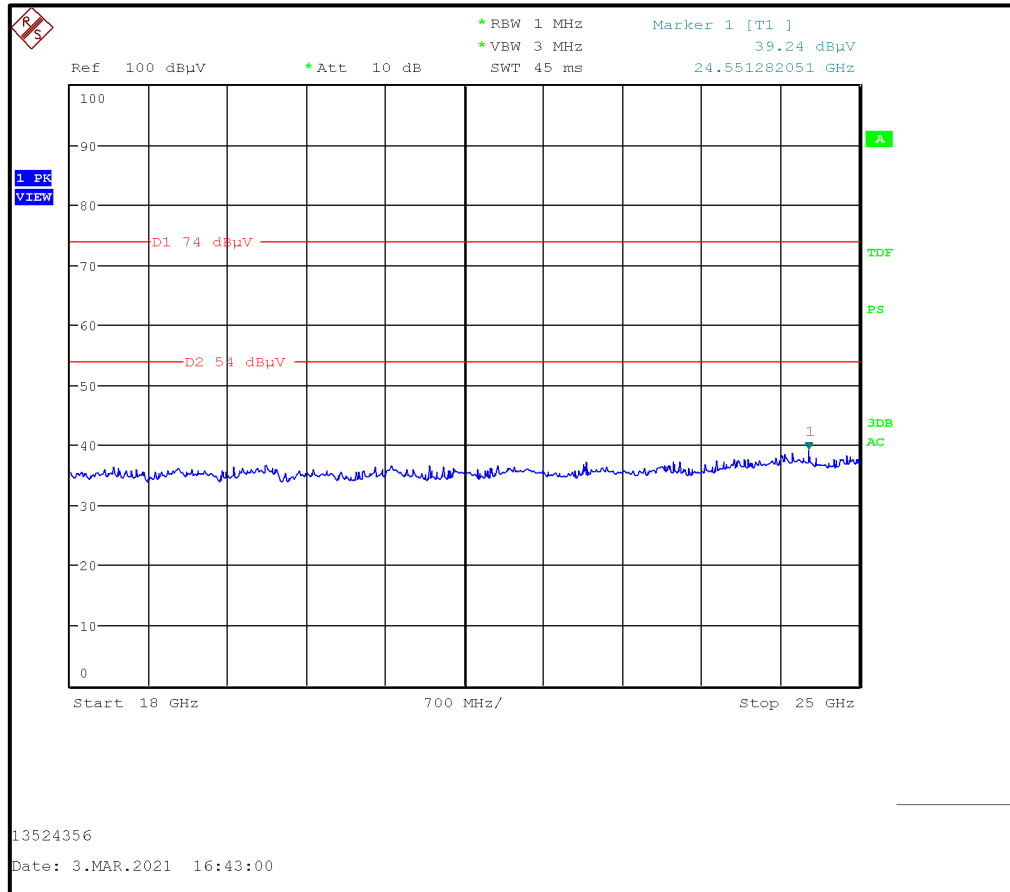
Transmitter Radiated Emissions (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR14 / Top Channel**

Frequency (MHz)	Antenna Polarization	MaxPeak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
2288.083	Horizontal	48.62	54.00	5.38	Complied*

Plot: 1 GHz – 18 GHz: Top channel**Result: Pass**

Transmitter Radiated Emissions (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR14 / Top Channel**

Frequency (MHz)	Antenna Polarization	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
All emissions were below the level of the measurement system noise floor.					

Plot: 18 GHz – 25 GHz : Top Channel**Result: Pass**

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

Test Engineer:	Sercan Usta	Test Date:	01 March 2021
Test Sample Serial Number:	32520 (Radiated 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:

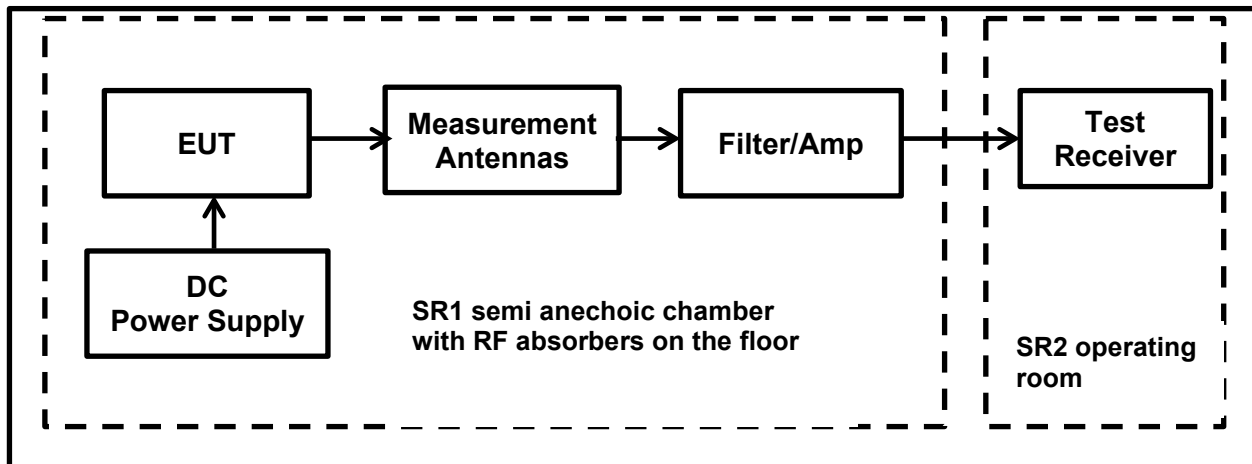
Temperature (°C):	23.3
Relative Humidity (%):	39.6

Note(s):

1. 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
2. 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.
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. The restricted band peak measurements were performed in accordance with ANSI C63.10 Section 11.12.2.4.
5. 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.
6. 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 trace averaged over 300 sweeps. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent restricted band of operation (where a higher level emission was present). Marker frequencies and levels were recorded.

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 88.69 %, a Duty Cycle Correction Factor of 0.52 dB was added to all average measurements.

Test Setup:

Transmitter Band Edge Radiated Emissions (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR14****Results: Lower Band Edge / Peak**

Frequency (MHz)	Peak Level (dB μ V/m)	-20 dBc Limit (dB μ V/m)	Margin (dB)	Result
2399.839	47.13	60.01	12.88	Complied
2400.000	49.05	60.01	10.96	Complied

Results: 2310 to 2390 MHz Restricted Band / Peak

Frequency (MHz)	Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Result
2339.358	49.09	74.0	24.91	Complied

Results: 2310 to 2390 MHz Restricted Band / Average

Frequency (MHz)	Average Level (dB μ V/m)	Duty Cycle Correction Factor (dB)	Corrected Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
2338.076	37.01	0.52	37.53	54.0	16.47	Complied

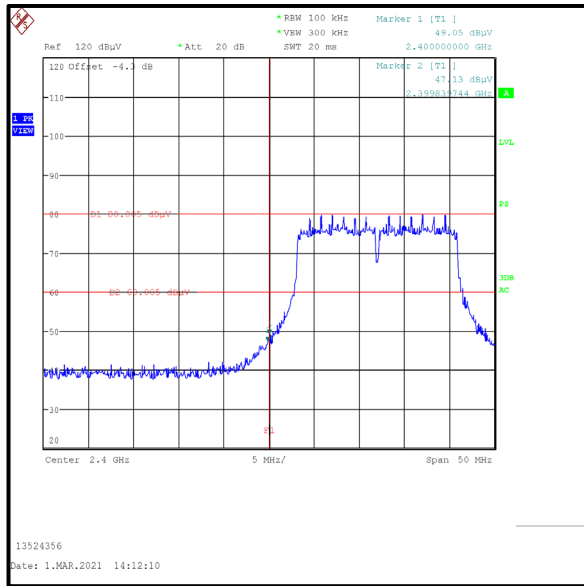
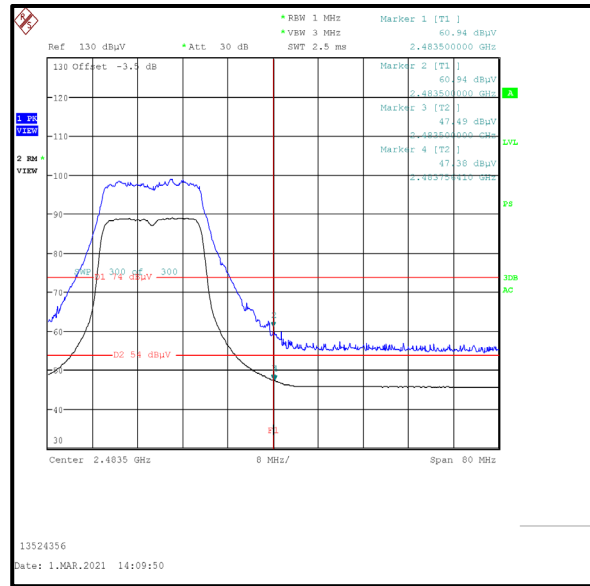
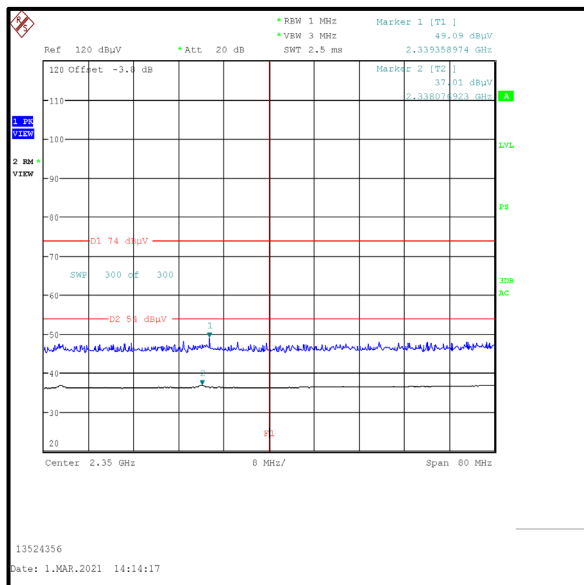
Results: Upper Band Edge / Peak

Frequency (MHz)	Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Result
2483.500	60.94	74.0	13.06	Complied

Results: Upper Band Edge / Average

Frequency (MHz)	Average Level (dB μ V/m)	Duty Cycle Correction Factor (dB)	Corrected Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
2483.500	47.49	0.52	48.01	54.0	5.99	Complied
2483.756	47.38	0.52	47.90	54.0	6.10	Complied

Result: Pass

Transmitter Band Edge Radiated Emissions (continued)**Results: 802.11n / 20 MHz / MCS4 / PWR14****Lower Band Edge Peak Measurement****Upper Band Edge Peak & Average Measurement****Restricted Band 2310 MHz to 2390 MHz**

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)
1	Rohde & Schwarz	Antenna, Loop	HFH2-Z2	831247/012	10/07/2020	36
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	09/07/2020	12
460	Deisel	Turntable	DT 4250 S	n/a	n/a	n/a
452	Schwarzbeck	Antenna, Trilog Broadband	VULB 9168	9168-240	02/09/2020	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	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	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 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
636	Rohde & Schwarz	Switching Unit Power Meter	OSP-B157W8	101698	07/07/2020	12
-/-	Testo	Thermo-Hygrometer	608-H1	07	lab verification	n/a
-/-	Huber & Suhner	RF Cable (upto 18GHz)	-/-	-/-	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-13524356-616-FCC Version 1.1, Issue Date 25 JUNE 2021 replaces Test Report No. UL-RPT-RP-13524356-616-FCC Version 1.0, Issue Date 16 JUNE 2021, which is no longer valid.			
1.1	as below	as below	Intermediate Version
	5	2.1	Test Dates corrected 09 February 2021 to 10 June 2021
	14	5.2.2	Test Dates corrected 09 February 2021
	27	5.2.5	Test Dates corrected 01 March 2021 to 03 March 2021
	33	5.2.6	Test Dates corrected 01 March 2021
	38	7	Test site: SR 1/2 Used equipment list corrected.
Test Report Version 1.2 supersede Version 1.1 with immediate effect Test Report No. UL-RPT-RP-13524356-616-FCC Version 1.2, Issue Date 25 JUNE 2021 replaces Test Report No. UL-RPT-RP-13524356-616-FCC Version 1.1, Issue Date 25 JUNE 2021, which is no longer valid.			
1.2	as below	as below	Current Version
	12	5.2.1	Test Setup diagram corrected to include Spectrum Analyzer reference
	14	5.2.2	Test Setup diagram corrected to include Spectrum Analyzer reference
	17	5.2.3	Test Setup diagram corrected to include Spectrum Analyzer reference
	19	5.2.4	Note 3 corrected to include RF power meter reference
	27	5.2.5	Temperature & Humidity values updated

--- END OF REPORT ---