



# TEST REPORT

**Test Report No. : UL-RPT-RP-13063166-416-FCC**

**Applicant** : Disruptive Technologies Research AS  
**Model No.** : Sensor US with Range Extender  
**FCC ID** : 2ATFX-100541  
**Technology** : 902 – 928 MHz  
**Test Standard(s)** : FCC Parts 15.209(a) & 15.249

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 Boosts.
4. Test Report Version 1.0
5. Result of the tested sample: **PASS**

Prepared by: Sercan Usta  
Title: Laboratory Engineer  
Date: 24 April 2020

Approved by: Ajit Phadtare  
Title: Lead Test Engineer  
Date: 24 April 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.

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## **1. Customer Information**

### **1.1. Applicant Information**

<b>Company Name:</b>	Disruptive Technologies Research AS
<b>Company Address:</b>	Ytrebygdsveien 215, 5258 Blomsterdalen, Bergen, Norway
<b>Contact Person:</b>	Bengt Johannes Lundberg
<b>Contact E-Mail:</b>	bengt.lundberg@disruptive-technologies.com
<b>Contact Phone No.:</b>	+47 91633887

### **1.2. Manufacturer Information**

<b>Company Name:</b>	Zollner Elektronik AG
<b>Company Address:</b>	Manfred-Zollner-Straße 1, 93499 Zandt, Germany
<b>Contact Person:</b>	Thomas Glasschröder (QA Manager)
<b>Contact E-Mail:</b>	thomas_glasschroeder@zollner.de
<b>Contact Phone No.:</b>	+49 9944-201-7146

## **2. Summary of Testing**

### **2.1. General Information**

#### **Applied Standards**

<b>Specification Reference:</b>	47CFR15.249
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.249
<b>Specification Reference:</b>	47CFR15.209
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.209
<b>Test Firm Registration:</b>	399704

#### **Location**

<b>Location of Testing:</b>	UL International Germany GmbH Hedelfinger Str. 61 70327 Stuttgart Germany
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#### **Date information**

<b>Order Date:</b>	30 September 2019
<b>EUT arrived:</b>	09 December 2019 to 10 February 2020
<b>Test Dates:</b>	11 February 2020 to 03 March 2020
<b>EUT returned:</b>	-/-

## **2.2. Summary of Test Results**

Clause	Measurement	Complied	Did not comply	Not performed	Not applicable
Part 15.207	Transmitter AC Conducted Emissions <sup>(1)</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Part 2.1049	Transmitter 20 dB Bandwidth	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.35(c)	Transmitter Duty Cycle	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.249(a)(c)	Transmitter Fundamental Field Strength	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.249(a)(d)(e)/ 15.209(a)	Transmitter Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.249(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### **Note:**

1. Not Applicable as EUT operates using a non-rechargeable battery power.

## **2.3. Methods and Procedures**

<b>Reference:</b>	ANSI C63.10-2013
<b>Title:</b>	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
<b>Reference:</b>	KDB 414788 D01 Radiated Test Site v01r01, July 12, 2018
<b>Title:</b>	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)**

<b>Brand Name:</b>	Disruptive Technologies
<b>Model Name or Number:</b>	Sensor US with Range Extender
<b>Test Sample Serial Number:</b>	UD9 [XID: bjr0qtdntbig00f92u6g] (Radiated sample)
<b>Hardware Version Number:</b>	100644
<b>Software Version Number:</b>	cc13xx_firmware/1.2.28
<b>FCC ID:</b>	2ATFX-100541

<b>Brand Name:</b>	Disruptive Technologies
<b>Model Name or Number:</b>	Sensor US with Range Extender
<b>Test Sample Serial Number:</b>	UD10 [XID: bjr2d78pismg008i21v0] (Radiated sample)
<b>Hardware Version Number:</b>	100644
<b>Software Version Number:</b>	cc13xx_firmware/1.2.28
<b>FCC ID:</b>	2ATFX-100541

<b>Brand Name:</b>	Disruptive Technologies
<b>Model Name or Number:</b>	Sensor US with Range Extender
<b>Test Sample Serial Number:</b>	UD19 [XID: bjr2bf0pismg008i21d0] (Radiated sample)
<b>Hardware Version Number:</b>	100644
<b>Software Version Number:</b>	cc13xx_firmware/1.2.28
<b>FCC ID:</b>	2ATFX-100541

#### **3.2. Description of EUT**

The equipment under test was a combination of Wireless IoT Sensor (Sensor US) coupled wirelessly (glued on flexible PCB) to Range Extender; supporting 902-928 MHz communications through a Cloud Connector gateway.

The Wireless IoT Sensor (Sensor US) was powered via a non-rechargeable battery.

#### **3.3. Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.

**3.4. Additional Information Related to Testing**

<b>Tested Technology:</b>	902-928 MHz (Boost Mode)	
<b>Power Supply Requirement:</b>	Nominal	3 V DC, 0.1 mA (Internal battery)
<b>Type of Unit:</b>	Transceiver	
<b>Channel Spacing:</b>	Fixed frequency	
<b>Modulation:</b>	Frequency Shift Keying (FSK)	
<b>Data Rate (kbps):</b>	25	
<b>Sensor US Power Amplifier Power Settings:</b>	+ 6 dBm	
<b>Sensor US Internal integrated Antenna Gain:</b>	-27.0 dBi	
<b>Sensor US Internal Integrated Antenna Type:</b>	Integrated PCB Antenna	
<b>Sensor US Internal Integrated Antenna Details :</b>	Model No. PN 100132-1 "DT Sensor antenna, 1st segment" and PN 100134-1 "DT Sensor antenna, 3rd segment"   Manufacturer: DISRUPTIVE TECHNOLOGIES	
<b>Range Extender Antenna Gain:</b>	+18.0 dBi	
<b>Range Extender Antenna Type:</b>	Integrated PCB Antenna	
<b>Range Extender Antenna Details :</b>	PN 100644 "Sensor Range Extender PCB (EU & US)"   Manufacturer: DISRUPTIVE TECHNOLOGIES	
<b>Combined Directivity Gain: (Sensor US Internal integrated Antenna + Range Extender Antenna Gain)</b>	+6 dBi	
<b>Measured Maximum Fundamental Field Strength:</b>	92.68 dBµV/m @ 3 m	
<b>Transmit Frequency Range:</b>	902.775 MHz to 927.225 MHz	
<b>Transmit Channels (Fixed Frequency) Tested:</b>	<b>Channel ID</b>	<b>Channel Frequency (MHz)</b>
	Bottom	902.775
	Middle	915.000
	Top	927.225



**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	RJ 45 Cable	Not stated	Not stated	Not stated

**B. Support Equipment (Manufacturer supplied)**

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Ethernet switch with power-over-ethernet (PoE) Injector	D-Link	DPE-101GI	SQ031HB003386
2	Switching Power Supply (PoE)	mimosa	POE16R-560	502-00005
3	POE/LAN Cable 5 m (M12x Coded to RJ45)	Not stated	1407473	Not stated
4	Laptop computer	Apple	MacBook Pro	C02T60V0GY25
5	Gateway with an 902-928 MHz RF-Technology, that relays communication between sensors and the cloud	Disruptive Technologies Research AS	Cloud Connector US	bjemb9tuvn3g0008o500

## **4. Operation and Monitoring of the EUT during Testing**

### **4.1. Operating Modes**

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

Transmitting Mode – Boost Mode Fixed Channel Frequency Mode

### **4.2. Configuration and Peripherals**

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

#### **EUT Configuration:**

The EUT was a combination of Sensor US wirelessly coupled (glued on) with a flexible PCB Range Extender.

#### **EUT Power Supply:**

- For all radiated measurements, the EUT was powered via the non-rechargeable internal battery of the Sensor US.

#### **Test Mode Activation:**

- The customer supplied a Gateway, "Cloud Connector US", supporting 902-928 MHz RF-Technology, from which test modes were activated wirelessly.
- This Gateway was powered via PoE injector & connected to the internet via a LAN cable.
- A wireless connection was established between this Gateway & EUT.
- The Test mode configuration files were installed on MacBook supplied by customer.
- For Boost Mode power amplifier inside the Sensor US was set to 6 dBm.

#### **Radiated Measurements:**

- The EUT radiated samples with fully charged internal battery were used for 20 dB bandwidth, field strength, band edge & spurious emissions measurements.
- The EUT radiated samples transmitting with the worst case (highest) operational duty cycle of 6.7 % were used for 20 dB bandwidth, field strength, band edge measurements.
- The EUT radiated samples transmitting with the maximum possible duty cycle in test mode of 7.2 %, were used for spurious emissions measurements. Therefore duty cycle correction factor was required for average measurements.
- Before starting final radiated 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 measurement.

## **5. Measurements, Examinations and Derived Results**

### **5.1. General Comments**

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on Boost 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 20 dB Bandwidth**

**Test Summary:**

<b>Test Engineer:</b>	Sercan Usta	<b>Test Date:</b>	11 February 2020
<b>Test Sample Serial Number:</b>	UD9 [XID: bjr0qtdntbig00f92u6g] (Radiated sample)		
<b>Test Site Identification</b>	SR 1/2		

<b>FCC Reference:</b>	Part 2.1049
<b>Test Method Used:</b>	ANSI C63.10 Section 6.9.2

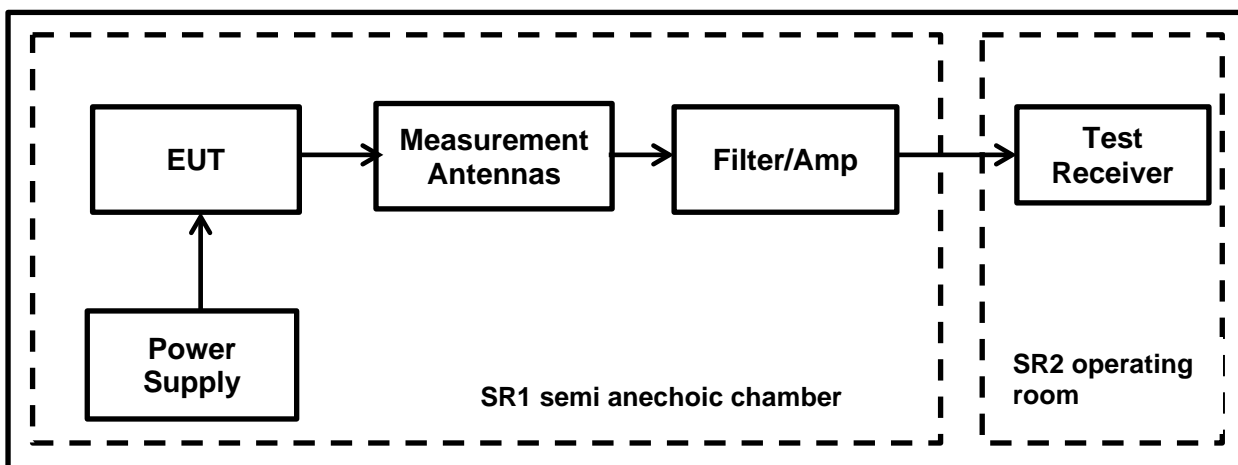
**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	34

**Notes:**

1. The test receiver resolution bandwidth was set to 5 kHz and video bandwidth 20 kHz. A Peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 500 kHz. Normal and delta markers were placed 20 dB down from the peak of the carrier. These results are documented in the table below.
2. Measurements were performed in a semi anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 meters. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 meter to 4 meters.
3. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.

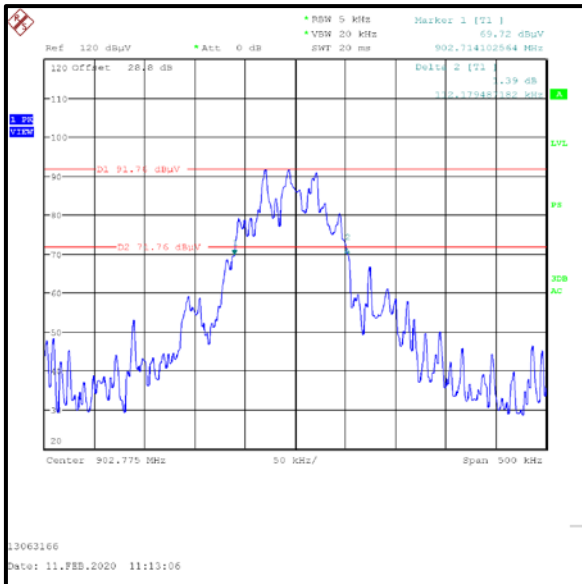
**Test Setup:**



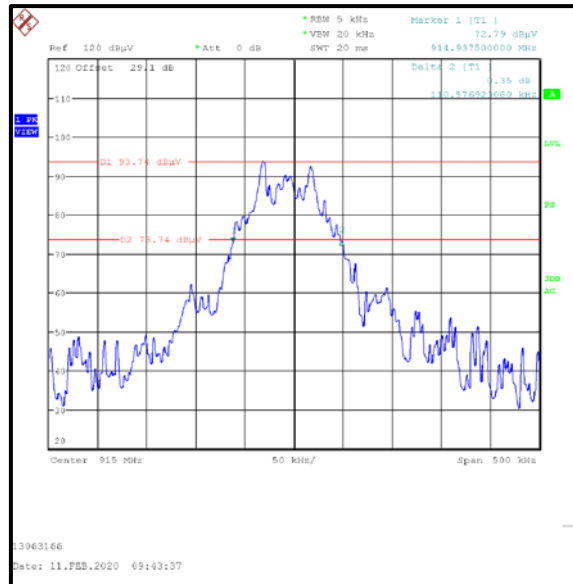
**Transmitter 20 dB Bandwidth (continued)**

**Results: Boost Mode**

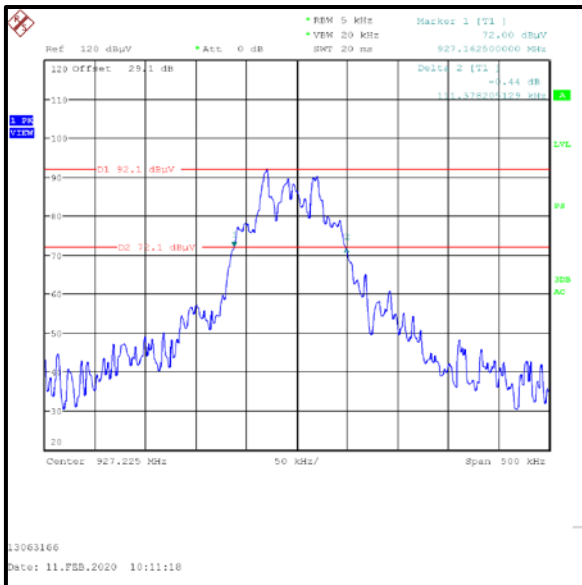
Channel	20 dB Bandwidth (kHz)
Bottom	112.179
Middle	110.577
Top	111.378



Bottom Channel



Middle Channel



Top Channel

Result: **Pass**

**5.2.2.Transmitter Duty Cycle**

**Test Summary:**

<b>Test Engineer:</b>	Sercan Usta	<b>Test Date:</b>	11 February 2020
<b>Test Sample Serial Number:</b>	UD9 [XID: bjr0qtdntbig00f92u6g] (Radiated sample) UD10 [XID: bjr2d78pismg008i21v0] (Radiated sample)		
<b>Test Site Identification</b>	SR 1/2		

<b>FCC Reference:</b>	Part 15.35(c)
<b>Test Method Used:</b>	ANSI C63.10 Section 7.5

**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	34

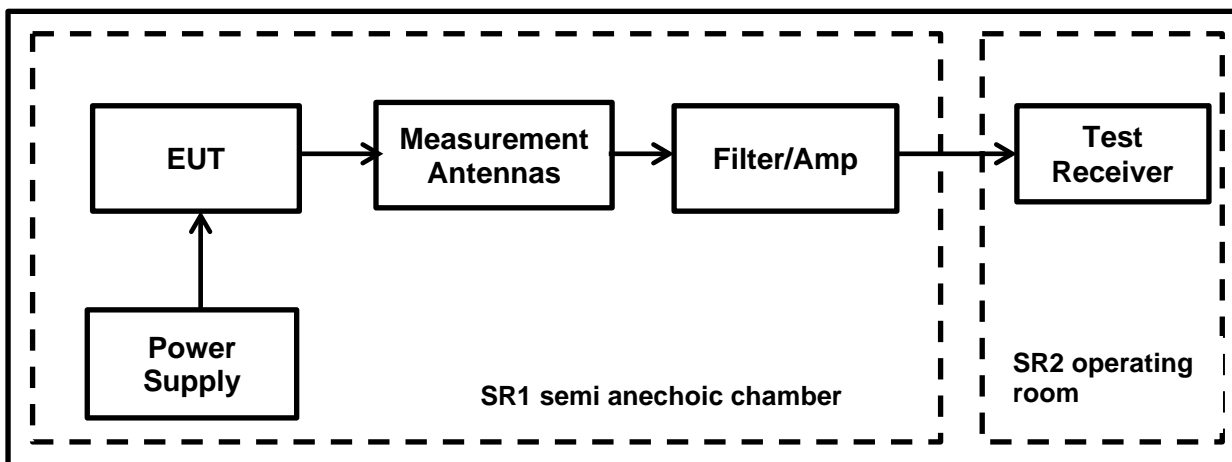
**Note(s):**

- In order to assist with the determination of the average level of fundamental and spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:  

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

$$Duty\ Cycle\ Correction\ Factor = 10\ log\ 1 / [On\ Time\ (T_{ON})] / [Period(T_{ON}+ T_{OFF})\ or\ 100ms\ whichever\ is\ the\ lesser]$$
- Measurements were performed in a semi anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 meters. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 meter to 4 meters.
- The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
- The measurements were performed both for the worst case (highest) operational duty cycle and for the maximum possible duty cycle in test mode of the EUT.
- The measured values of duty cycle & duty cycle correction factors are based on the maximum transmission time in any 100 msec period.

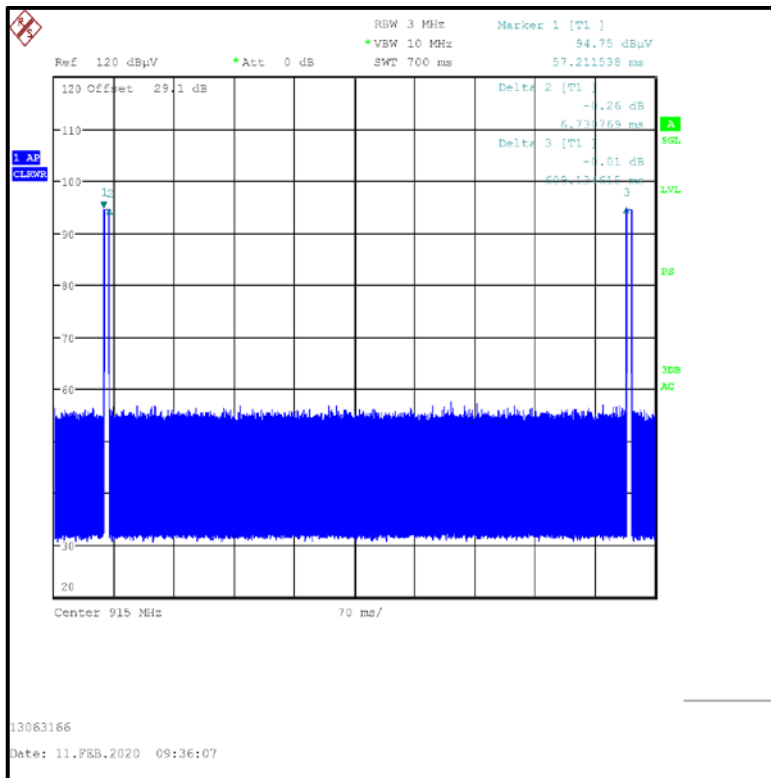
**Test Setup:**



**Transmitter Duty Cycle (continued)**

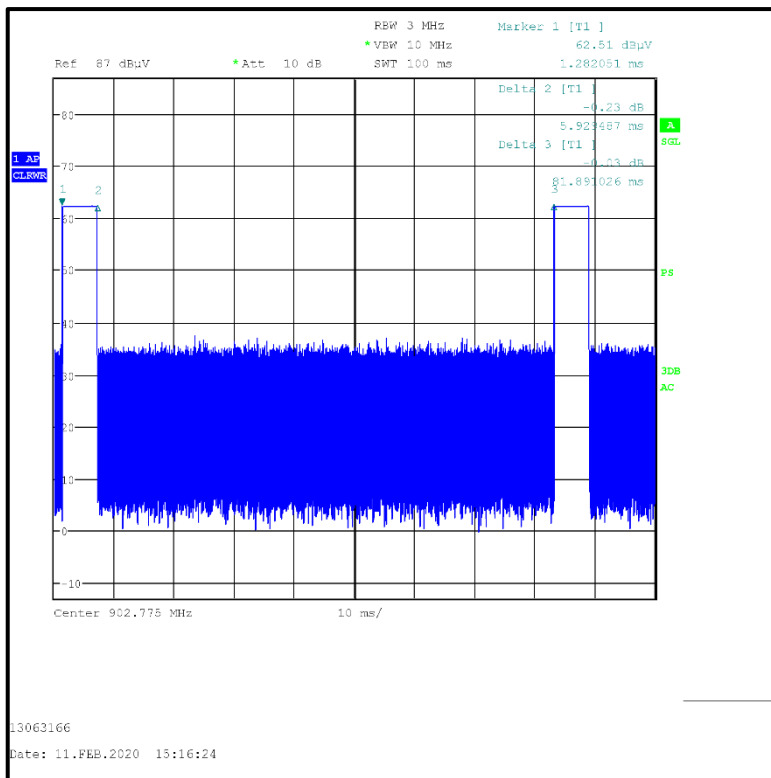
**Results: Boost Mode / Worst Case (Highest) Operational Duty Cycle**

Pulse On Time (T <sub>ON</sub> ) (ms)	Pulse Period (T <sub>ON</sub> + T <sub>OFF</sub> ) (ms) <sup>Note 1</sup>	Worst Case (Highest) Operational Duty Cycle (%)	Worst Case (Highest) Operational Duty Cycle Correction Factor (dB)
6.731	100	6.731	11.72



**Results: Boost Mode / Test Mode Maximum Possible Duty Cycle**

Pulse On Time (T <sub>ON</sub> ) (ms)	Pulse Period (T <sub>ON</sub> + T <sub>OFF</sub> ) (ms)	Test Mode Maximum Possible Duty Cycle (%)	Test Mode Maximum Possible Duty Cycle Correction Factor (dB)
5.929	81.891	7.24	11.40





**5.2.3. Transmitter Fundamental Field Strength**

**Test Summary:**

<b>Test Engineer:</b>	Sercan Usta	<b>Test Date:</b>	11 February 2020
<b>Test Sample Serial Number:</b>	UD9 [XID: bjr0qtdntbig00f92u6g] (Radiated sample)		
<b>Test Site Identification</b>	SR 1/2		

<b>FCC Reference:</b>	Part 15.249(a)
<b>Test Method Used:</b>	ANSI C63.10 Section 6.5

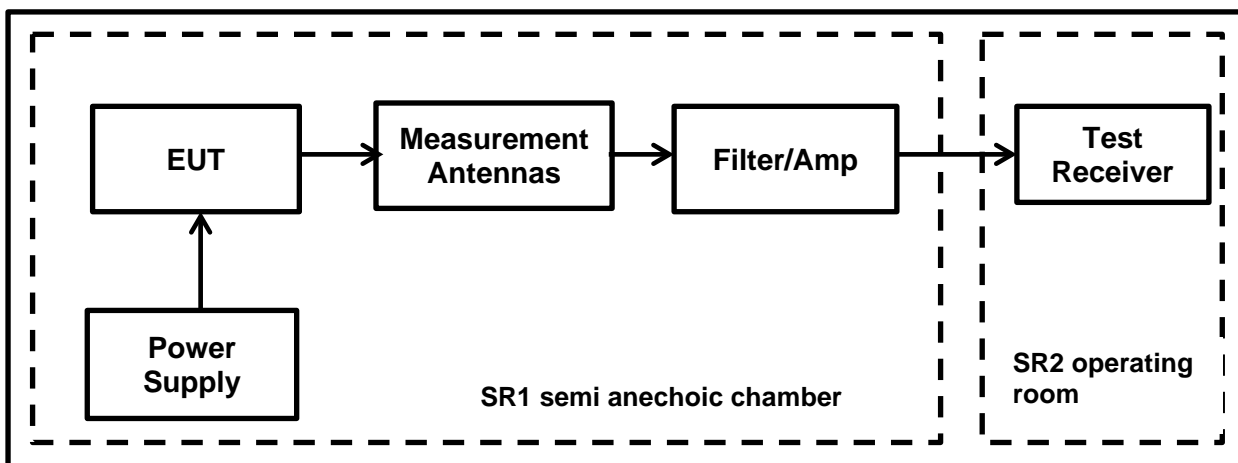
**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	34

**Notes:**

1. The test receiver resolution bandwidth was set to 120 kHz > (20 dB bandwidth) and video bandwidth of 1 MHz. A quasi peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 1 MHz. A marker was placed at the peak of the signal and the results recorded in the tables below.
2. Measurements were performed in a semi anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 meters. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 meter to 4 meters.
3. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.

**Test Setup:**



**Transmitter Fundamental Field Strength (continued)****Results: Boost Mode / Bottom Channel**

Frequency (MHz)	Antenna Polarization	Quasi Peak Level (dB $\mu$ V/m)	Quasi Peak Limit (dB $\mu$ V/m)	Margin (dB)	Result
902.775	Horizontal	92.68	94.00	1.32	Complied

**Results: Boost Mode / Middle Channel**

Frequency (MHz)	Antenna Polarization	Quasi Peak Level (dB $\mu$ V/m)	Quasi Peak Limit (dB $\mu$ V/m)	Margin (dB)	Result
915.000	Horizontal	92.27	94.00	1.73	Complied

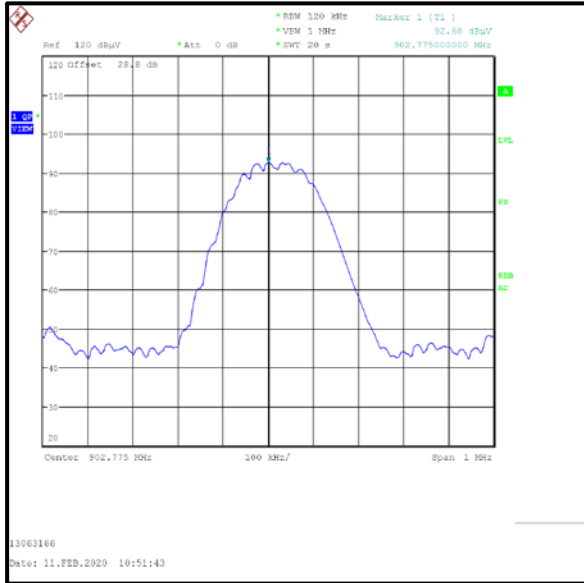
**Results: Boost Mode / Top Channel**

Frequency (MHz)	Antenna Polarization	Quasi Peak Level (dB $\mu$ V/m)	Quasi Peak Limit (dB $\mu$ V/m)	Margin (dB)	Result
927.225	Horizontal	90.94	94.00	3.06	Complied

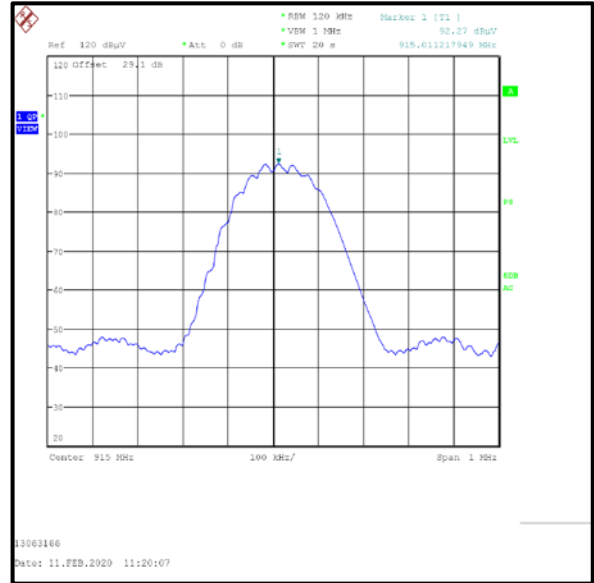
**Result: Pass**

### Transmitter Fundamental Field Strength (continued)

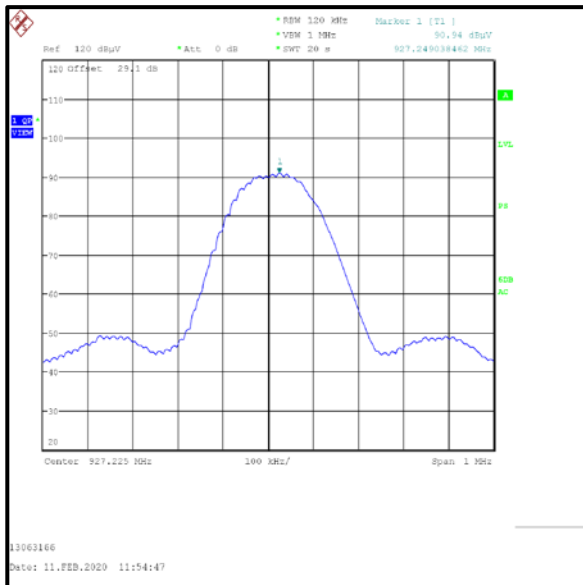
#### Results: Boost Mode



Bottom Channel



Middle Channel



Top Channel

Result: **Pass**

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

<b>Test Engineer:</b>	Sercan Usta	<b>Test Date:</b>	11 February 2020
<b>Test Sample Serial Number:</b>	UD10 [XID: bjr2d78pismg008i21v0] (Radiated sample)		
<b>Test Site Identification</b>	SR 1/2		

<b>FCC Reference:</b>	Parts 15.249(a)(d)(e) & 15.209(a)
<b>Test Method Used:</b>	ANSI C63.10:2013 Sections 6.3 and 6.4
<b>Frequency Range</b>	9 kHz to 30 MHz

**Environmental Conditions:**

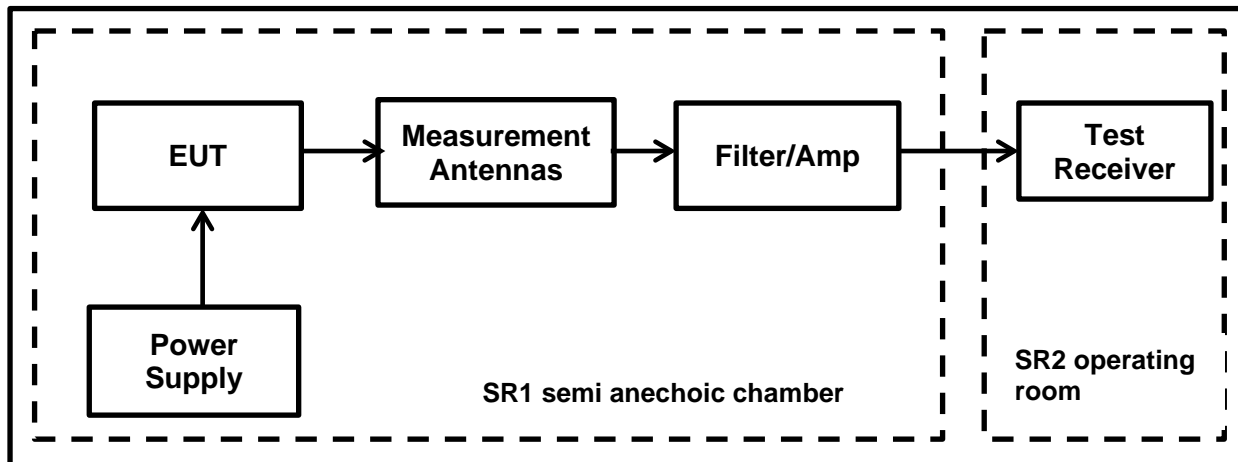
<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	34

**Note(s):**

1. In accordance with FCC KDB 414788, an alternative test site may be used for the measurement below 30 MHz (The OATS / SAC comparison data is available upon request). Therefore the result from the semi-anechoic chamber tests is shown in this section of the test report.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. The preliminary scans showed similar emission levels below 30 MHz, for fixed frequency mode for each channel. Therefore final radiated emissions measurements were performed with the EUT on the top channel only.
4. All other emissions shown on the pre-scan plot were investigated and represent system noise floor.
5. Measurements below 30 MHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 meters. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by searching the loop antenna polarizations set at height of 1 meter.
6. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 10 kHz and video bandwidth 30 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.

**Transmitter Radiated Emissions (continued)**

**Test Setup:**

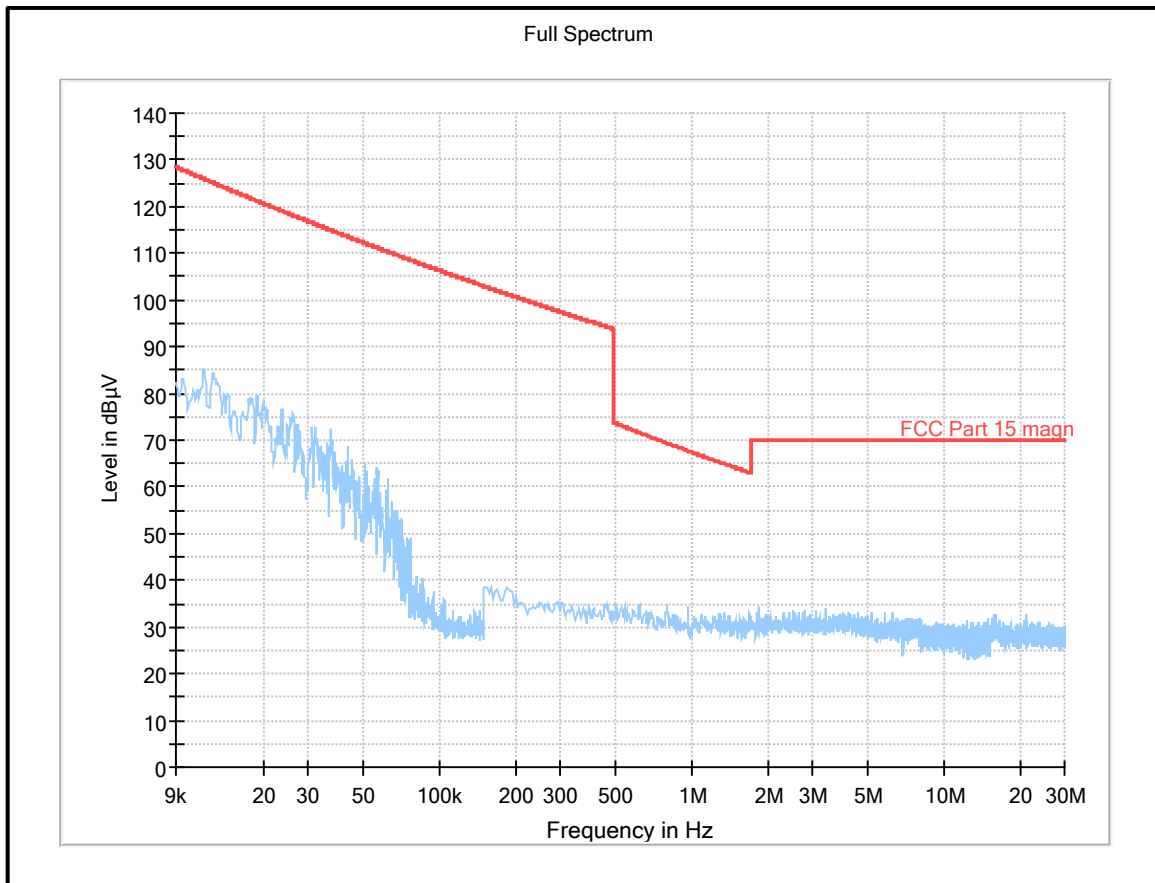


**Transmitter Radiated Emissions (continued)**

**Results: Boost Mode / Top Channel**

Frequency (MHz)	Antenna Polarization	Quasi Peak Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
No spurious emissions found					

**Radiated Transmitter spurious emission from 9 kHz – 30 MHz for the top channel**



*Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.*

**Result: Pass**

**Transmitter Radiated Emissions (continued)**

**Test Summary:**

<b>Test Engineer:</b>	Sercan Usta	<b>Test Date:</b>	11 February 2019
<b>Test Sample Serial Number:</b>	UD10 [XID: bjr2d78pismg008i21v0] (Radiated sample)		
<b>Test Site Identification</b>	SR 1/2		

<b>FCC Reference:</b>	Parts 15.249(a)(d)(e) & 15.209(a)
<b>Test Method Used:</b>	ANSI C63.10:2013 Sections 6.3 and 6.5
<b>Frequency Range</b>	30 MHz to 1000 MHz

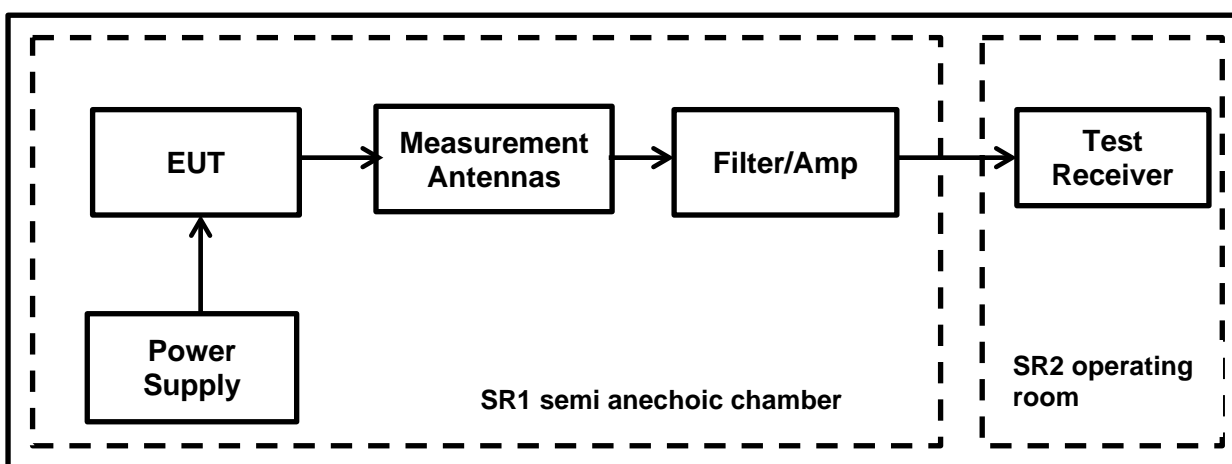
**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	34

**Note(s):**

1. The emissions shown at frequencies between approximately 903 to 927 MHz on the 30 MHz to 1 GHz plots are the EUT fundamental for the given channel.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. No spurious emissions were detected above the noise floor of the measuring receiver.
4. Measurements below 1 GHz were performed in a semi anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 meters. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 meter to 4 meters.
5. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. The sweep time was set to auto. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.

**Test Setup:**



**Transmitter Radiated Emissions (continued)**

**Results: Boost Mode / Bottom Channel**

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

**Results: Boost Mode / Middle Channel**

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

**Results: Boost Mode / Top Channel**

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

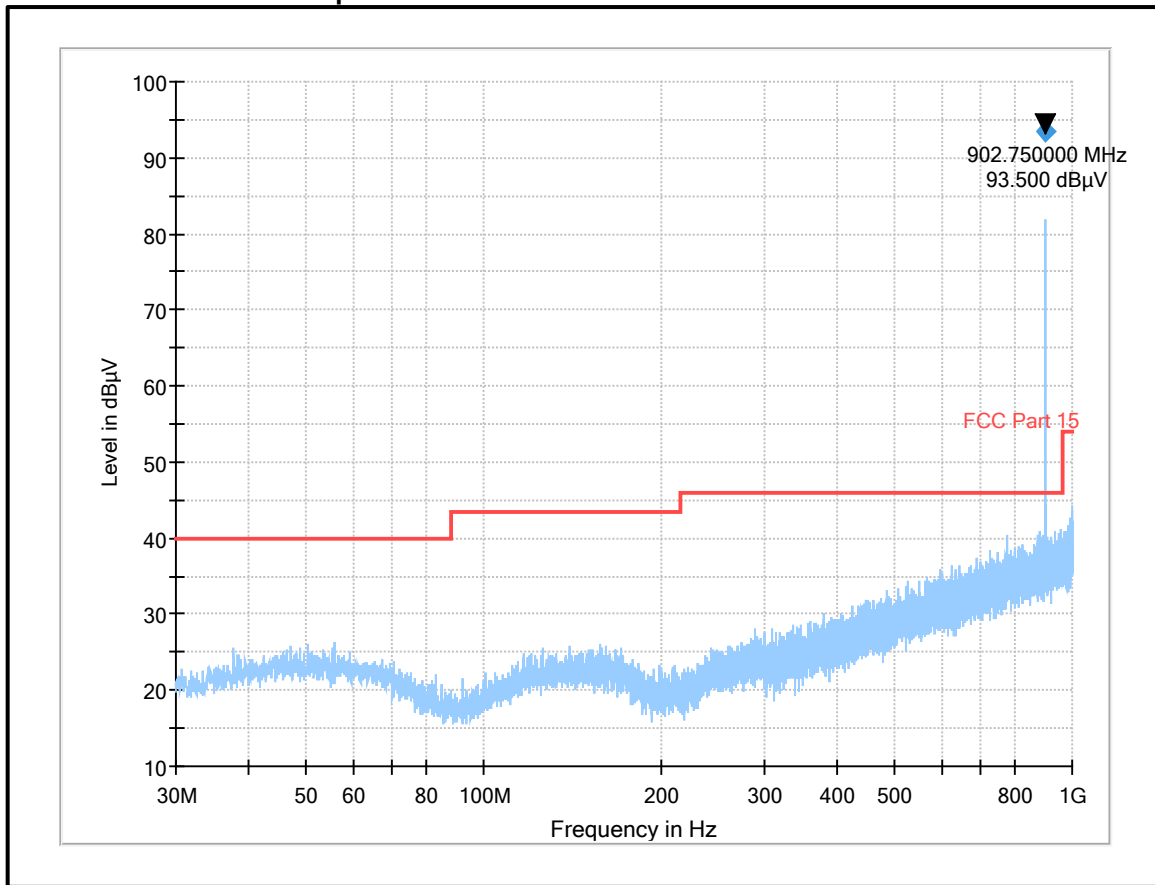
Result: **Pass**



**Transmitter Radiated Emissions (continued)**

**Boost Mode**

**Radiated Transmitter spurious emission from 30 MHz – 1 GHz for the bottom channel**

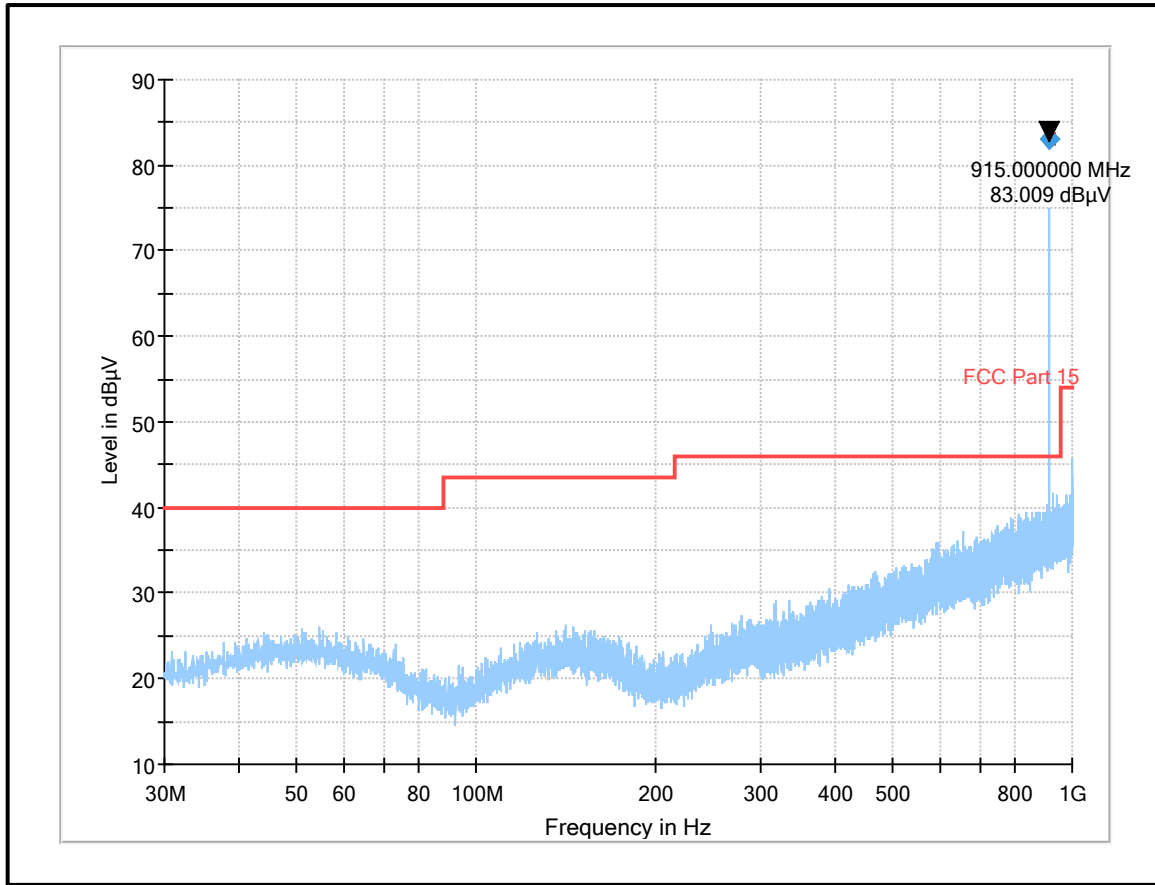


**Result: Pass**

**Transmitter Radiated Emissions (continued)**

**Boost Mode**

**Plot: Radiated Transmitter spurious emission from 30 MHz – 1 GHz for the middle channel**

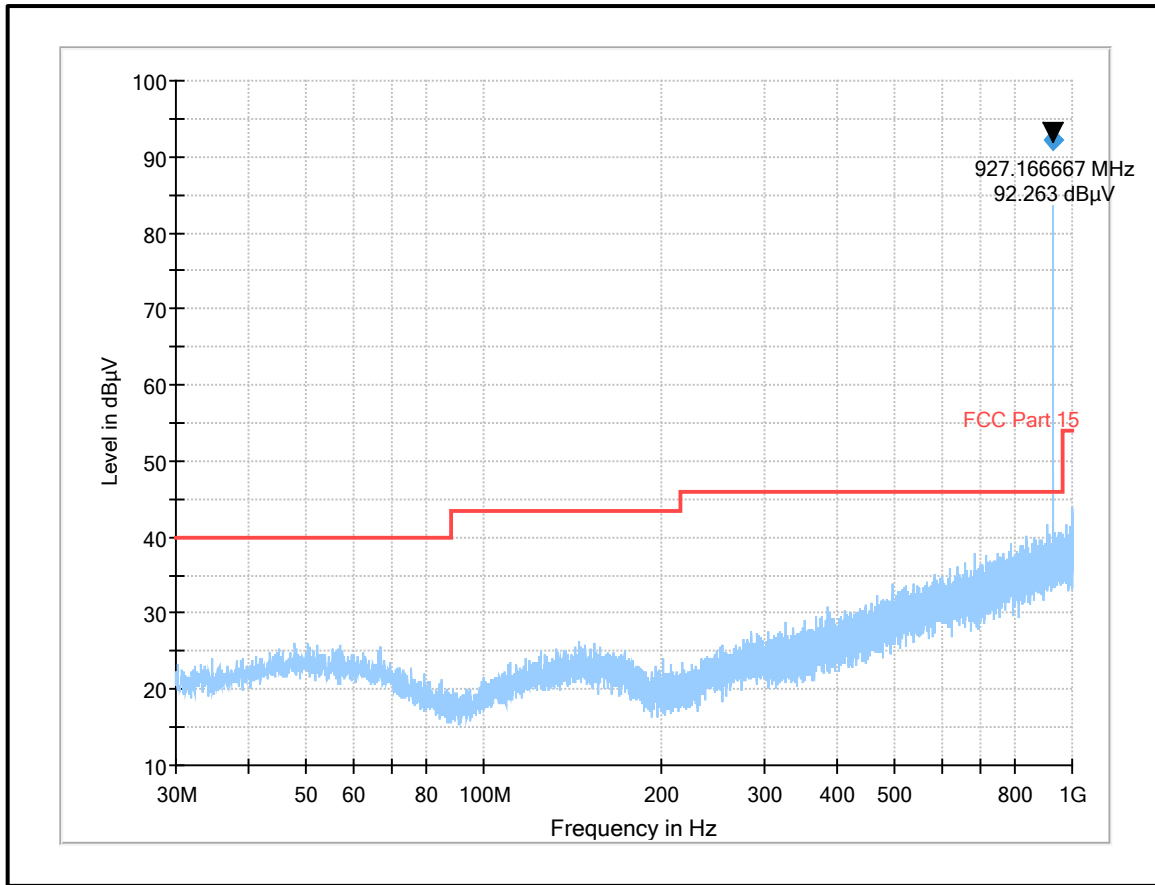


**Result: Pass**

**Transmitter Radiated Emissions (continued)**

**Boost Mode**

**Plot: Radiated Transmitter spurious emission from 30 MHz – 1 GHz for the top channel**



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

**Result: Pass**

**Transmitter Radiated Emissions (continued)**

**Test Summary:**

<b>Test Engineer:</b>	Sercan Usta	<b>Test Date:</b>	12 February 2020
<b>Test Sample Serial Number:</b>	UD19 [XID: bjr2bf0pismg008i21d0] (Radiated sample)		
<b>Test Site Identification</b>	SR 1/2		

<b>FCC Reference:</b>	Parts 15.249(a)(d)(e) & 15.209(a)
<b>Test Method Used:</b>	ANSI C63.10:2013 Sections 6.3 and 6.6
<b>Frequency Range</b>	1 GHz to 10 GHz

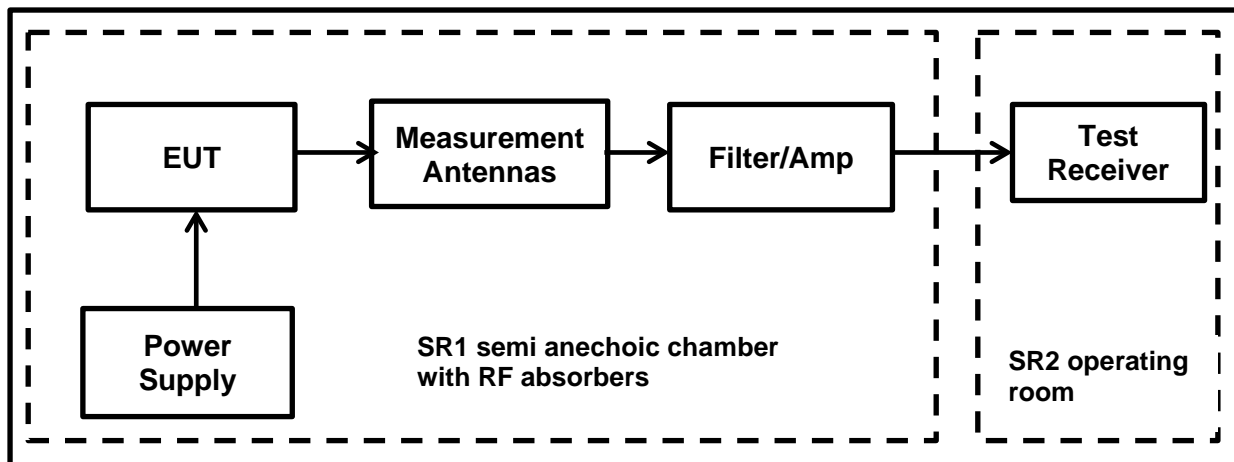
**Environmental Conditions:**

<b>Temperature (°C):</b>	21.6
<b>Relative Humidity (%):</b>	34

**Note(s):**

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. Pre-scan were performed against FCC Part 15.209 general radiated emissions limit.
3. Pre-scans above 1 GHz were performed in a semi anechoic chamber SR1/ 2 (Asset Number 1603665) with absorbers on the ground at a distance of 3 meters. The EUT was placed at a height of 1.5 me above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 meters 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 absorbers on the ground at a distance of 3 meters. 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 meter to 4 meters.
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. \*In accordance with ANSI C63.10 Section 6.6.4.3, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.

**Test Setup:**



**Transmitter Radiated Emissions (continued)****Results: Boost Mode / Peak Detector/ Bottom Channel**

Frequency (MHz)	Antenna Polarization	Peak Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Margin (dB)	Result
3118.500	Horizontal	46.78	54.00	7.22	Complied
3668.333	Vertical	47.34	54.00	6.66	Complied
4907.500	Vertical	51.59	54.00	2.41	Complied

**Results: Boost Mode / Peak Detector/ Middle Channel**

Frequency (MHz)	Antenna Polarization	Peak Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Margin (dB)	Result
3161.167	Vertical	46.06	54.00	7.94	Complied
3893.500	Horizontal	46.98	54.00	7.02	Complied
4474.500	Vertical	50.58	54.00	3.42	Complied

**Results: Boost Mode / Peak Detector/ Top Channel**

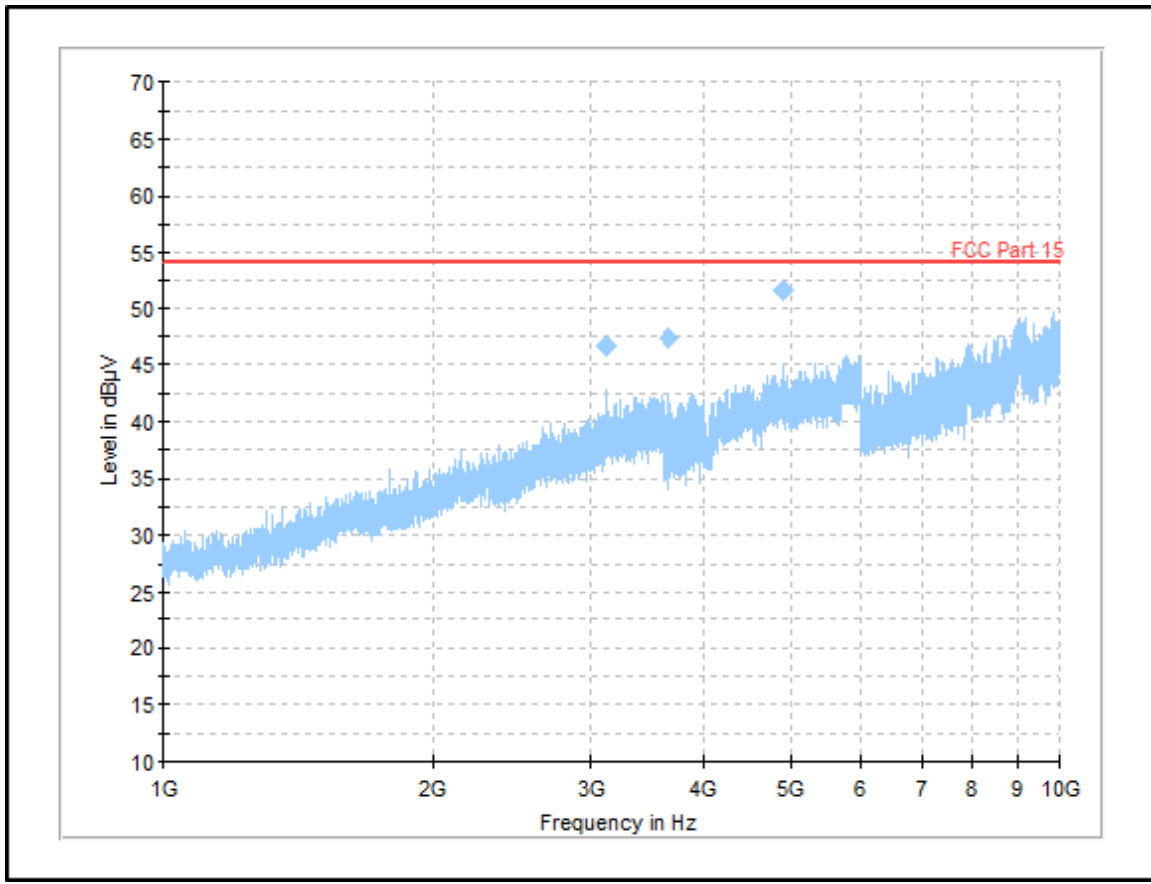
Frequency (MHz)	Antenna Polarization	Peak Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Margin (dB)	Result
3122.000	Vertical	46.37	54.00	7.63	Complied
3890.000	Horizontal	47.68	54.00	6.32	Complied

**Result: Pass**

**Transmitter Radiated Emissions (continued)**

**Boost Mode**

**Plot: Radiated Transmitter spurious emission from 1 GHz – 10 GHz for the bottom channel**

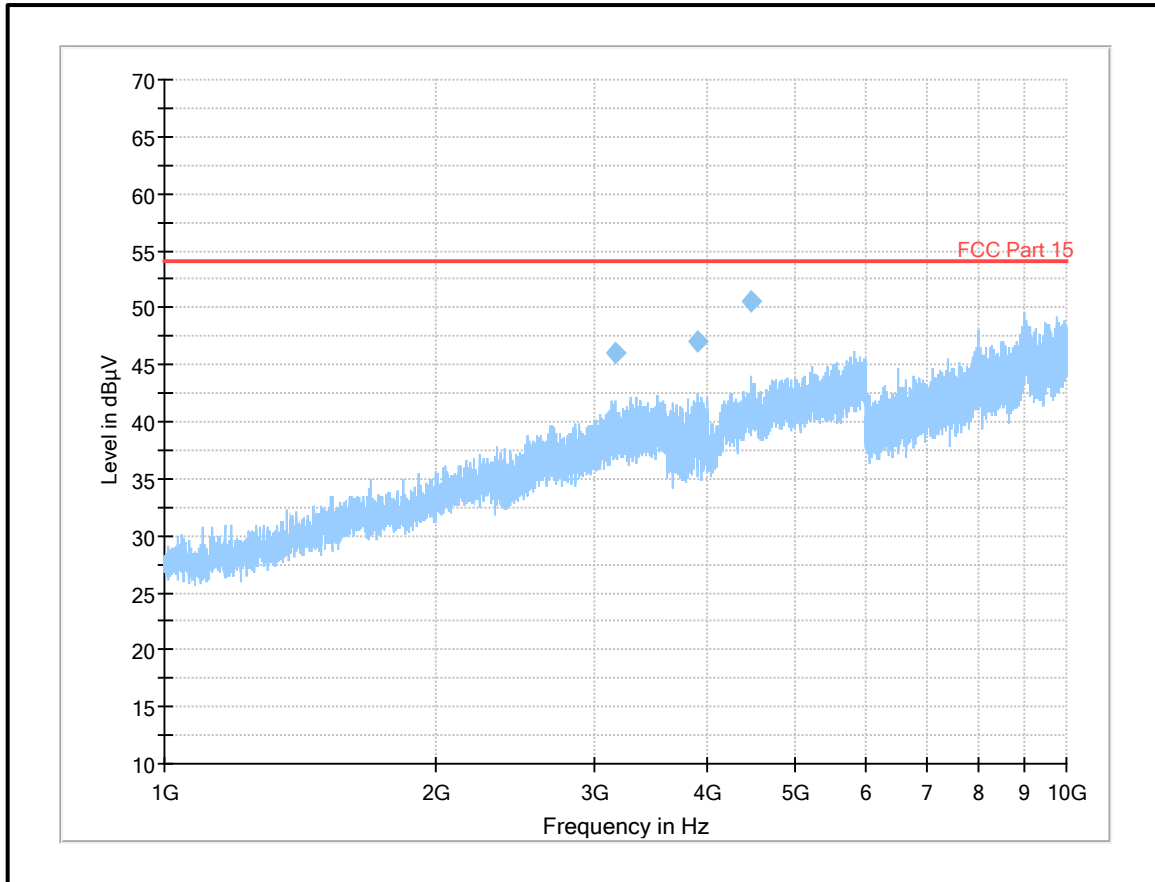


**Result: Pass**

**Transmitter Radiated Emissions (continued)**

**Boost Mode**

**Plot: Radiated Transmitter spurious emission from 1 GHz – 10 GHz for the middle channel**

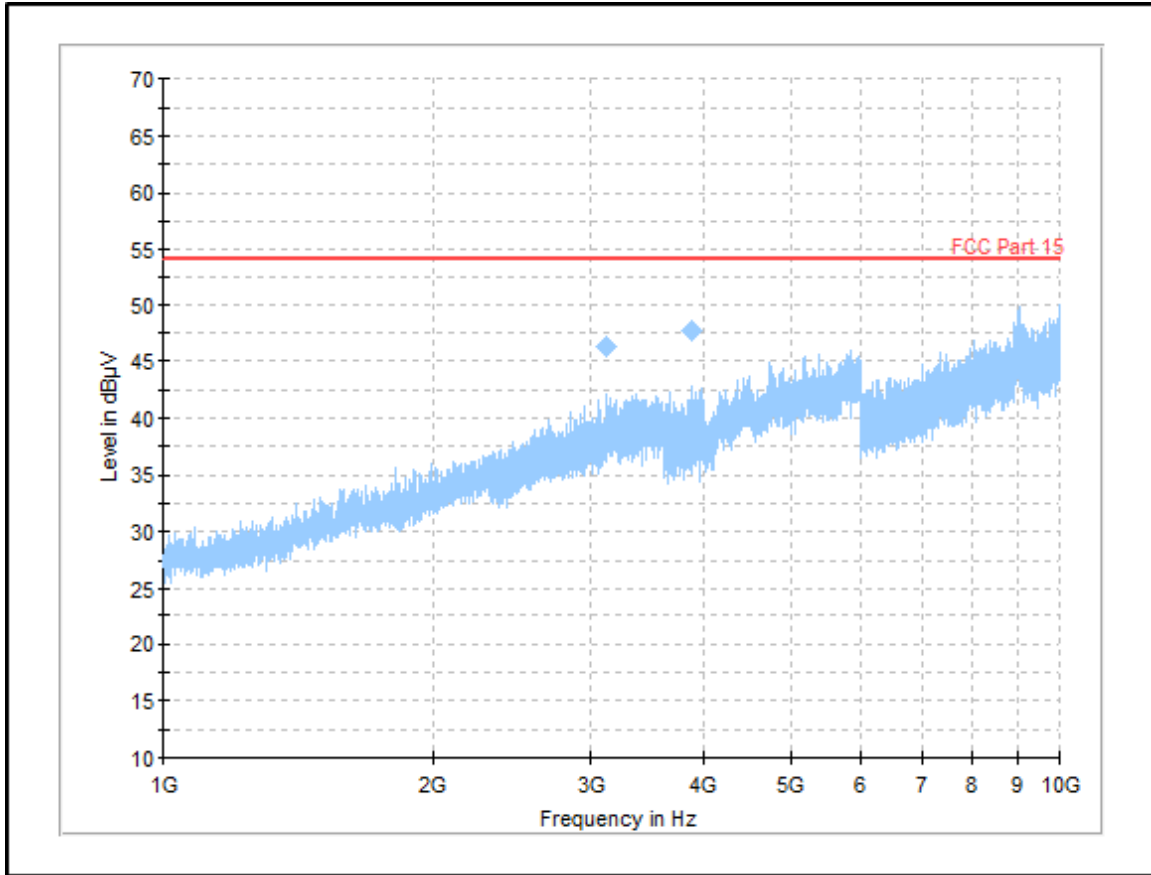


**Result: Pass**

**Transmitter Radiated Emissions (continued)**

**Boost Mode**

Plot: Radiated Transmitter spurious emission from 1 GHz – 10 GHz for the top channel



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

Result: **Pass**



**5.2.5. Transmitter Band Edge Radiated Emissions**

**Test Summary:**

<b>Test Engineer:</b>	Sercan Usta	<b>Test Date:</b>	3 March 2020
<b>Test Sample Serial Number:</b>	UD9 [XID: bjr0qtdntbig00f92u6g] (Radiated sample)		
<b>Test Site Identification</b>	SR 1/2		

<b>FCC Reference:</b>	Parts 15.249(d) & 15.209
<b>Test Method Used:</b>	ANSI C63.10 Section 6.10.4, 6.10.5

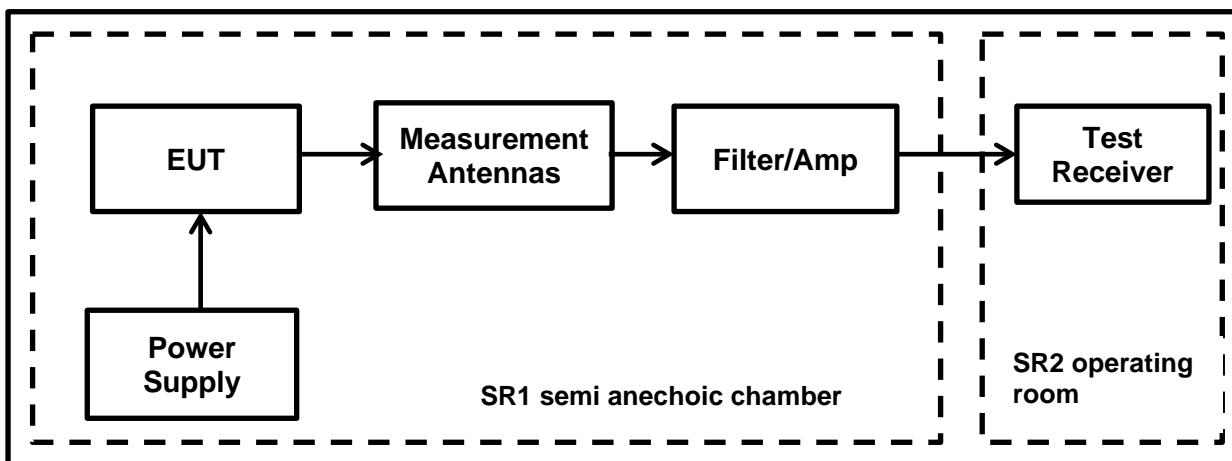
**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	34

**Notes:**

1. Measurements were performed in a semi anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 meters. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 meter to 4 meters.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. In accordance with FCC 15.249(d) emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in FCC 15.209, whichever is the lesser attenuation.
4. Of which lesser attenuation limit of 46.02 dB $\mu$ V/m@3 m in accordance to FCC 15.209 ; has been applied.
5. 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.

**Test Setup:**



**Transmitter Band Edge Radiated Emissions (continued)**

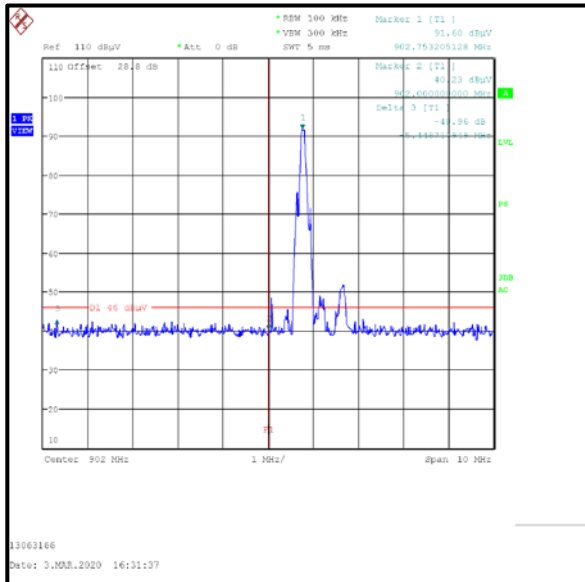
**Results: Boost Mode / Lower Band Edge / Peak**

Frequency (MHz)	Antenna Polarization	Peak Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
897.305	Horizontal	42.64	46.02	4.62	Complied
902.000	Horizontal	40.23	46.02	5.83	Complied

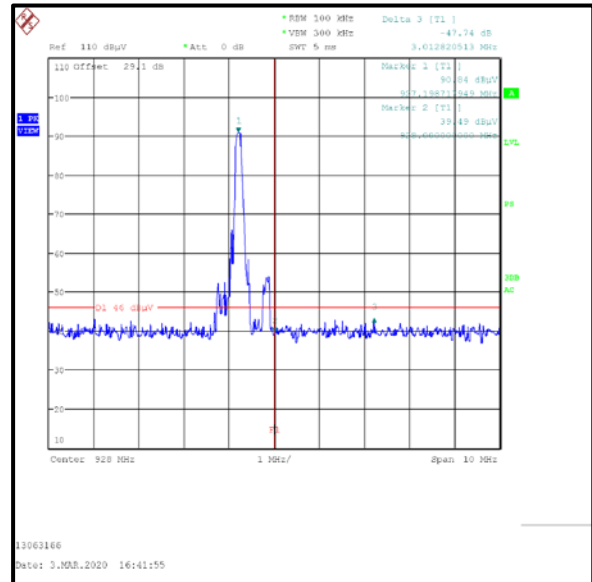
**Results: Boost Mode / Upper Band Edge / Peak**

Frequency (MHz)	Antenna Polarization	Peak Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
928.000	Horizontal	39.49	46.02	6.53	Complied
930.212	Horizontal	43.10	46.02	2.92	Complied

**Plots: Boost Mode**



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement

**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 Boosts.

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 Boost 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".

<b>Measurement Type</b>	<b>Confidence Level (%)</b>	<b>Calculated Uncertainty</b>
20 dB Bandwidth	95%	±0.87 %
Transmitter Duty Cycle	95%	±3.4%
Fundamental Field Strength	95%	±3.10 dB
Radiated Spurious Emissions	95%	±3.10 dB
Band Edge Radiated Emissions	95%	±3.10 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**

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

## **8. Report Revision History**

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

--- END OF REPORT ---