


## FCC PART 15.247 TEST REPORT

For

**Xiamen Ursalink Technology Co., Ltd.**

4/F, NO.63-2 Wanghai Road, 2nd Software Park, Xiamen, China

**FCC ID: 2AOSV-EM500**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Environment Monitoring Sensor
<b>Report Number:</b> RXM200427055-00B	
<b>Report Date:</b> 2020-10-13	
<b>Reviewed By:</b> RF Engineer	Jacob Kong 
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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

Product	Environment Monitoring Sensor
Tested Model	EM500-UDL-915
Multiple Model	EM500-CO2-915, EM500-915
Model Differences	Refer to the DoS letter
Frequency Range	903~914.2 MHz
Maximum Conducted Peak Output Power	4.78dBm
Technique	DTS
Antenna Specification*	Internal Antenna: 1dBi (provided by the applicant)
Voltage Range	DC 3.6V from battery
Date of Test	2020-08-07 to 2020-09-28
Sample serial number	RXM200427055-RF-S1 for EM500-UDL-915 RXM200427055-RF-S2 for EM500-CO2-915 RXM200427055-RF-S3 for EM500-915 (Assigned by BACL, Shenzhen)
Received date	2020-04-27
Sample/EUT Status	Good condition

### Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1 °C
Humidity		±6%
Supply voltages		±0.4%

*Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.*

## Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in engineering mode.

#### Frequency List

Channel	Freq.(MHz)	Channel	Freq.(MHz)	Channel	Freq.(MHz)	Channel	Freq.(MHz)
64	903	65	904.6	66	906.2	67	907.8
68	909.4	69	911	70	912.6	71	914.2

Test at channel 64, 67, 71.

### Equipment Modifications

No modification was made to the EUT tested.

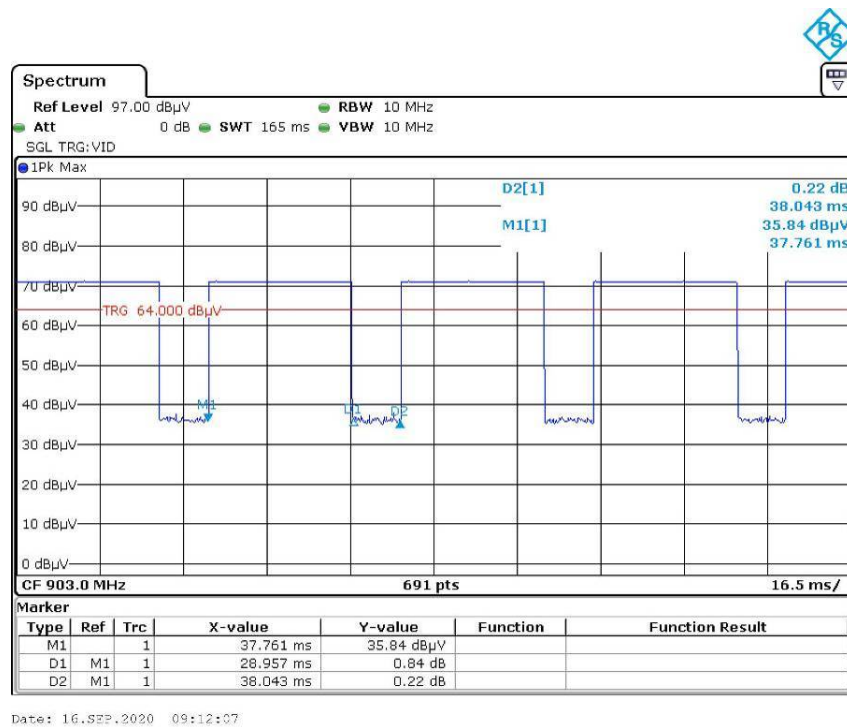
### EUT Exercise Software

“Ursalink Toolbox APP” was made to the EUT tested and the power level is 13.

### Equipment Modifications

No modification was made to the EUT tested.

## Duty cycle



Mode	T <sub>on</sub> (ms)	T <sub>on+off</sub> (ms)	Duty Cycle (%)
DTS	28.96	38.04	76.13

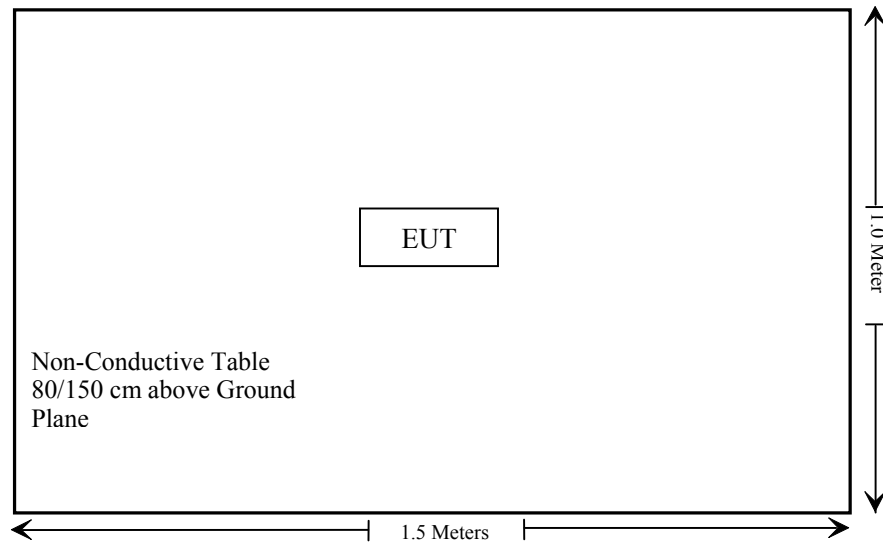
## Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	/	/	/

## External I/O Cable

Cable Description	Length (m)	From/Port	To
/	/	/	/

## Block Diagram of Test Setup



**SUMMARY OF TEST RESULTS**

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Not Applicable
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

Note: The EUT only powered by battery

**TEST EQUIPMENT LIST**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>Radiated Emission Test</b>					
R&S	EMI Test Receiver	ESR3	102455	2020/08/04	2021/08/03
Sonoma instrument	Pre-amplifier	310 N	186238	2020/08/04	2021/08/03
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2020/08/04	2021/08/03
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulated Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2019/11/29	2020/11/28
<b>RF Conducted Test</b>					
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2020/04/03	2021/04/02
Agilent	USB Wideband Power Sensor	U2021XA	MY5425000 3	2020/08/04	2021/08/03
WEINSCHL	3dB Attenuator	Unknow	F-03-EM230	2019/11/29	2020/11/28
Unknown	RF Cable	Unknown	2301 276	2019/11/29	2020/11/28

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

**FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)****Applicable Standard**

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

**Limits for General Population/Uncontrolled Exposure**

<b>Limits for General Population/Uncontrolled Exposure</b>				
<b>Frequency Range (MHz)</b>	<b>Electric Field Strength (V/m)</b>	<b>Magnetic Field Strength (A/m)</b>	<b>Power Density (mW/cm<sup>2</sup>)</b>	<b>Averaging Time (Minutes)</b>
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

**Result****Calculated Formulary:**

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

<b>Frequency (MHz)</b>	<b>Antenna Gain</b>		<b>Tune up conducted power</b>		<b>Evaluation Distance (cm)</b>	<b>Power Density (mW/cm<sup>2</sup>)</b>	<b>MPE Limit (mW/cm<sup>2</sup>)</b>
	<b>(dBi)</b>	<b>(numeric)</b>	<b>(dBm)</b>	<b>(mW)</b>			
903	1	1.26	5	3.16	20	0.001	0.602

Note: To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

**Result: Pass**

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## **FCC §15.203 - ANTENNA REQUIREMENT**

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### **Applicable Standard**

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
  - b. Antenna must use a unique type of connector to attach to the EUT.
- Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

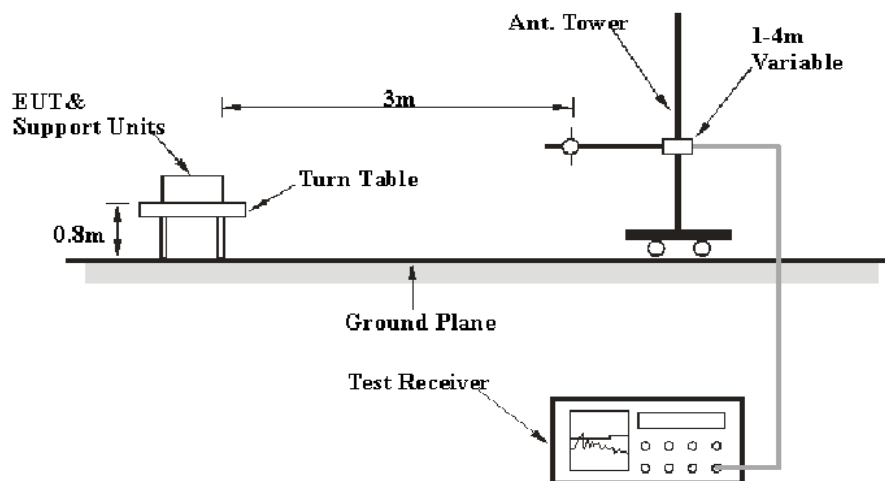
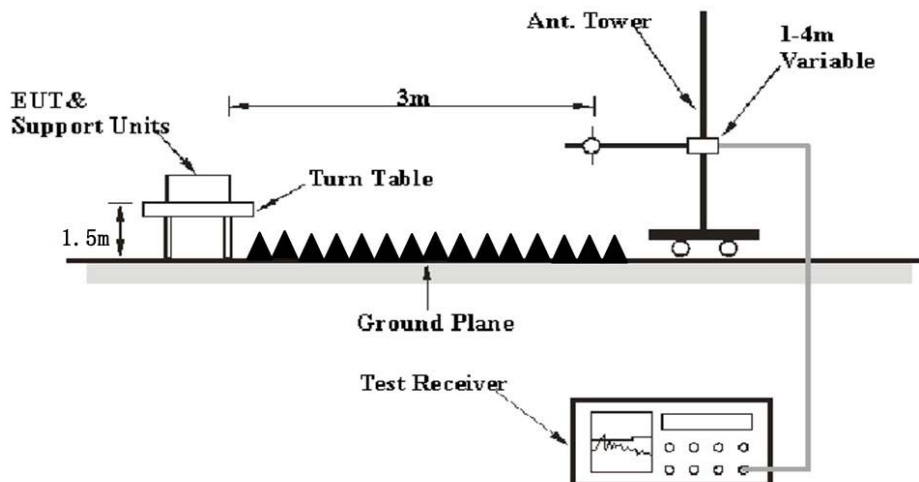
### **Antenna Connector Construction**

The EUT has an internal antenna arrangement and the antenna gain is 1dBi, fulfill the requirement of this section. Please refer to the EUT photos.

**Result: Pass**

**FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS****Applicable Standard**

FCC §15.247 (d); §15.209; §15.205;

**EUT Setup****Below 1 GHz:****Above 1GHz:**

The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

## EMI Test Receiver & Spectrum Analyzer Setup

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz <sup>Note 1</sup>	/	Average
	1MHz	> 1/T <sup>Note 2</sup>	/	Average

Note 1: when duty cycle is no less than 98%

Note 2: when duty cycle is less than 98%

## Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

## Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

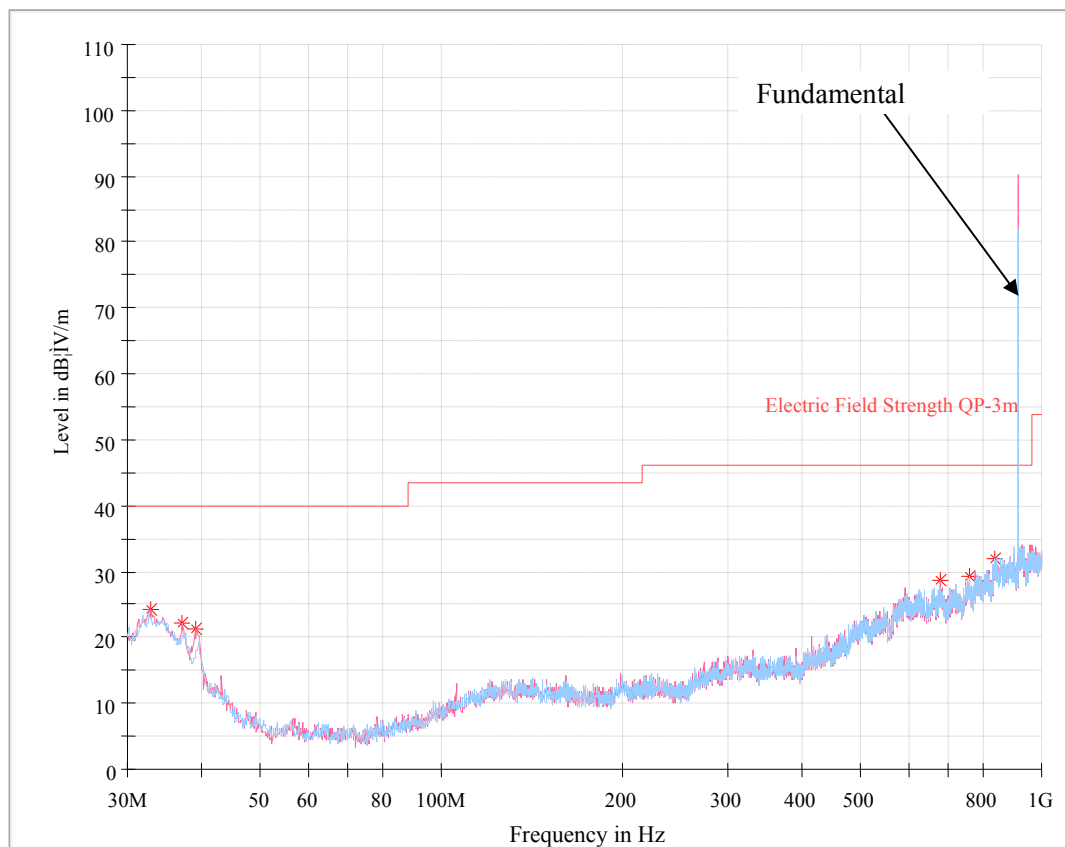
## Test Data

### Environmental Conditions

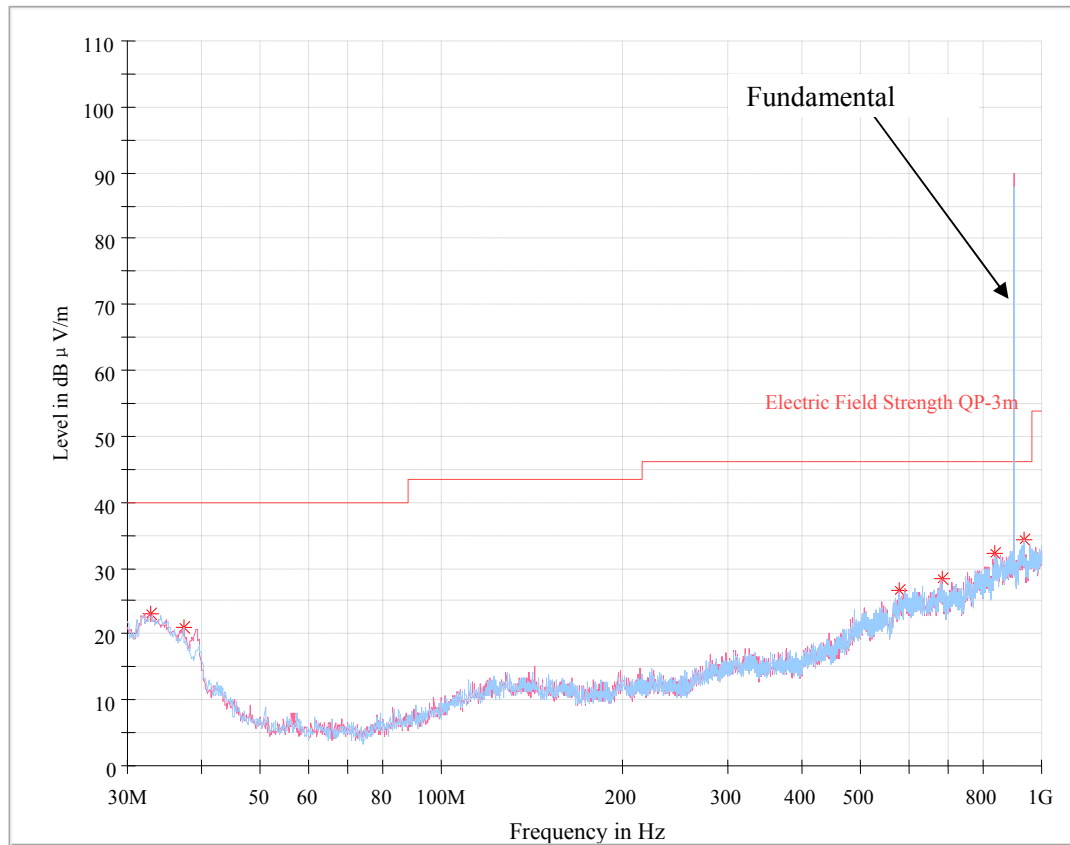
<b>Temperature:</b>	28~29.2 °C
<b>Relative Humidity:</b>	52~58 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Harris He from 2020-08-07 to 2020-09-22 for below 1GHz and Lohan Liang on 2020-09-16 for above 1GHz.*

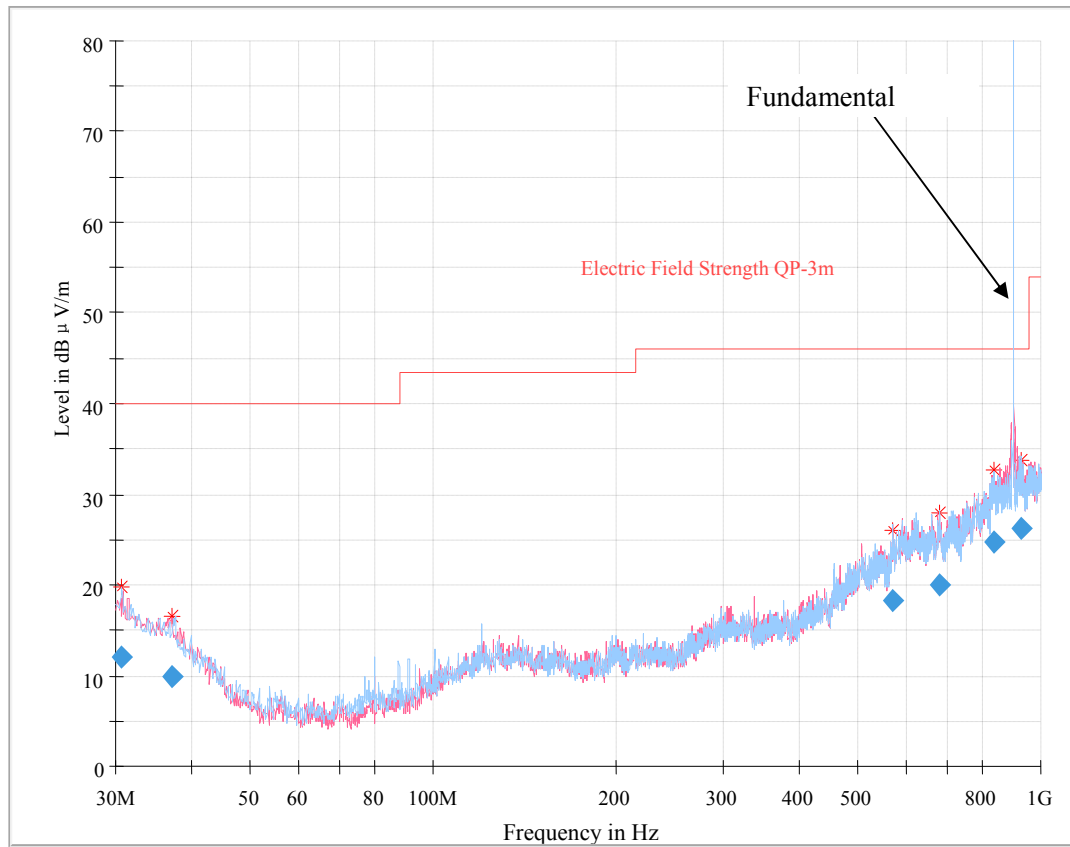
*EUT operation mode: Transmitting (Low channel)*

**30 MHz~1 GHz:****RXM200427055-RF-S1 for EM500-UDL-915****Critical\_Freqs**

Frequency (MHz)	MaxPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
32.910000	24.33	40.00	15.67	100.0	V	218.0	-9.4
37.032500	22.08	40.00	17.92	200.0	V	220.0	-11.9
39.093750	21.19	40.00	18.81	100.0	V	167.0	-13.2
678.566250	28.56	46.00	17.44	200.0	V	125.0	-1.4
758.470000	29.37	46.00	16.63	100.0	H	0.0	0.0
835.221250	32.01	46.00	13.99	300.0	H	69.0	2.7

**RXM200427055-RF-S2 for EM500-CO2-915****Critical\_Freqs**

Frequency (MHz)	MaxPeak (dB μV/m)	Limit (dB μV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
32.910000	23.18	40.00	16.82	200.0	V	161.0	-9.4
37.153750	21.11	40.00	18.89	200.0	H	289.0	-11.9
580.596250	26.53	46.00	19.47	400.0	V	22.0	-2.6
680.748750	28.29	46.00	17.71	300.0	V	0.0	-1.4
836.918750	32.35	46.00	13.65	200.0	V	191.0	2.7
934.646250	34.23	46.00	11.77	300.0	H	240.0	4.8

**RXM200427055-RF-S3 for EM500- 915****Final Result**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.621000	11.99	40.00	28.01	129.0	H	319.0	-8.0
37.164500	9.85	40.00	30.15	394.0	H	190.0	-12.0
570.297000	18.21	46.00	27.79	269.0	V	29.0	-3.1
682.722750	20.05	46.00	25.95	358.0	H	43.0	-1.4
836.682625	24.65	46.00	21.35	400.0	H	186.0	2.7
928.923500	26.13	46.00	19.87	400.0	V	355.0	4.7

**1 GHz - 10 GHz:**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
903 MHz									
2709.00	49.35	PK	46	1.7	H	1.09	50.44	74	23.56
2709.00	45.45	Ave.	46	1.7	H	1.09	46.54	54	7.46
3612.00	53.38	PK	230	2.1	H	4.03	57.41	74	16.59
3612.00	47.16	Ave.	230	2.1	H	4.03	51.19	54	2.81
907.8 MHz									
2723.40	54.19	PK	73	1.4	H	1.19	55.38	74	18.62
2723.40	49.99	Ave.	73	1.4	H	1.19	51.18	54	2.82
3631.20	54.84	PK	349	1.3	H	4.03	58.87	74	15.13
3631.20	49.23	Ave.	333	1.6	H	4.03	53.26	54	0.74
914.2 MHz									
2742.60	49.44	PK	220	1.2	H	1.19	50.63	74	23.37
2742.60	45.29	Ave.	220	1.2	H	1.19	46.48	54	7.52
3656.80	52.01	PK	217	1.2	H	3.06	55.07	74	18.93
3656.80	45.05	Ave.	217	1.2	H	3.06	48.11	54	5.89

**Note:**

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

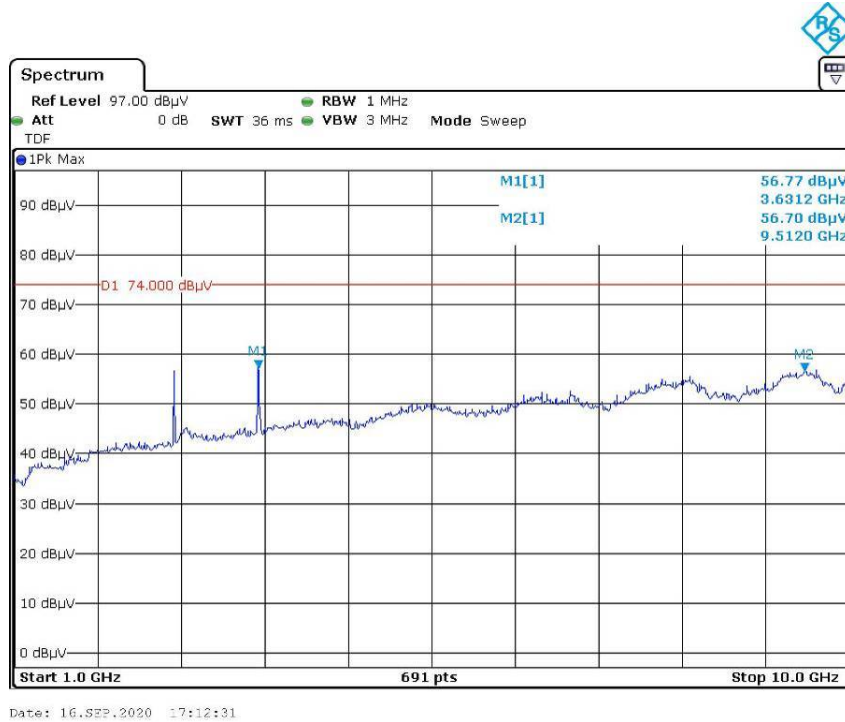
Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

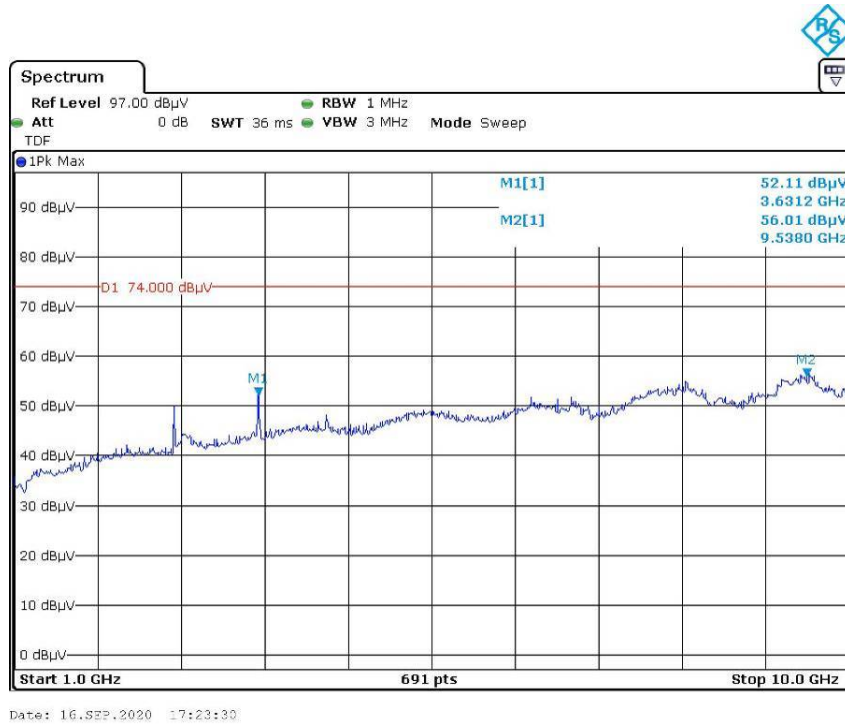
The other spurious emission which is 20dB to the limit was not recorded.

# Pre-scan Middle Channel Peak

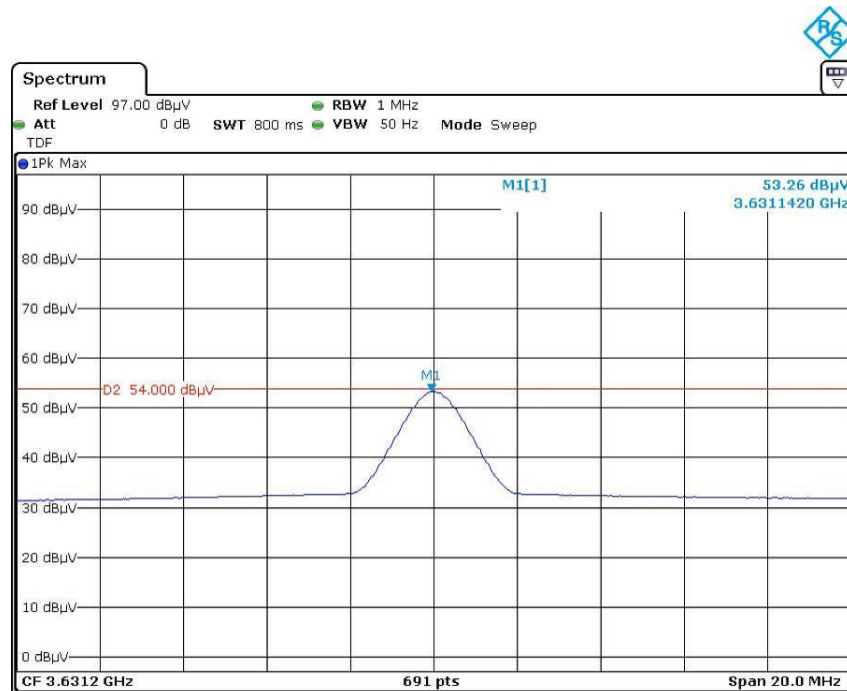
## Horizontal



## Vertical

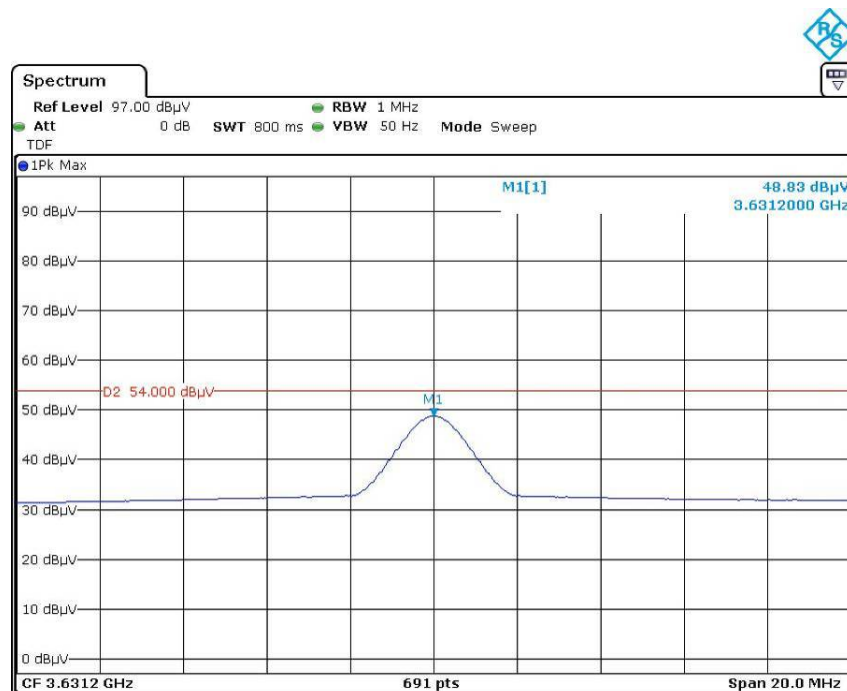


# Pre-scan for Average Horizontal



Date: 16.SEP.2020 17:18:11

# Vertical



Date: 16.SEP.2020 17:28:38

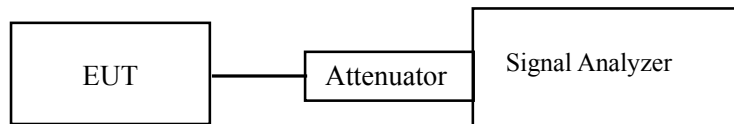
## FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

### Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



### Test Data

#### Environmental Conditions

Temperature:	24 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

*The testing was performed by Coco Liu on 2020-09-28.*

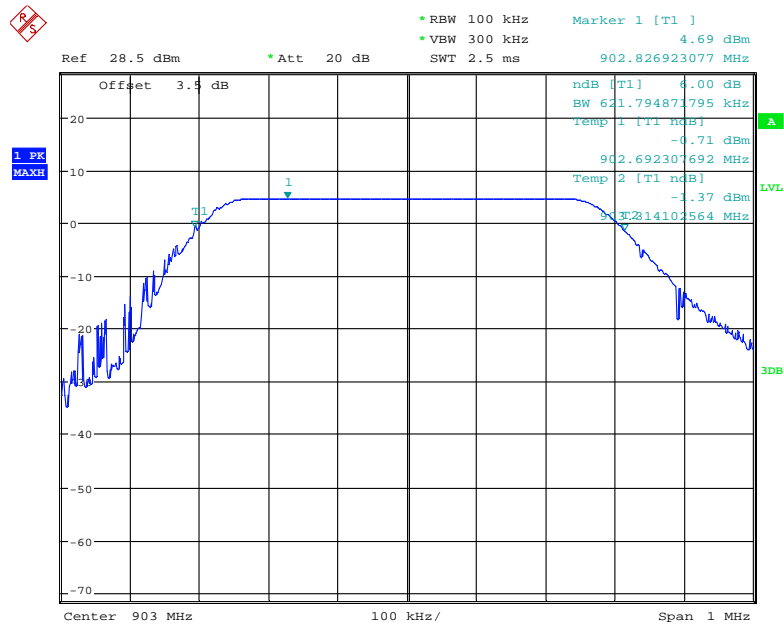
*EUT operation mode: Transmitting*

#### Test Result: Pass

*Please refer to the following table and plots.*

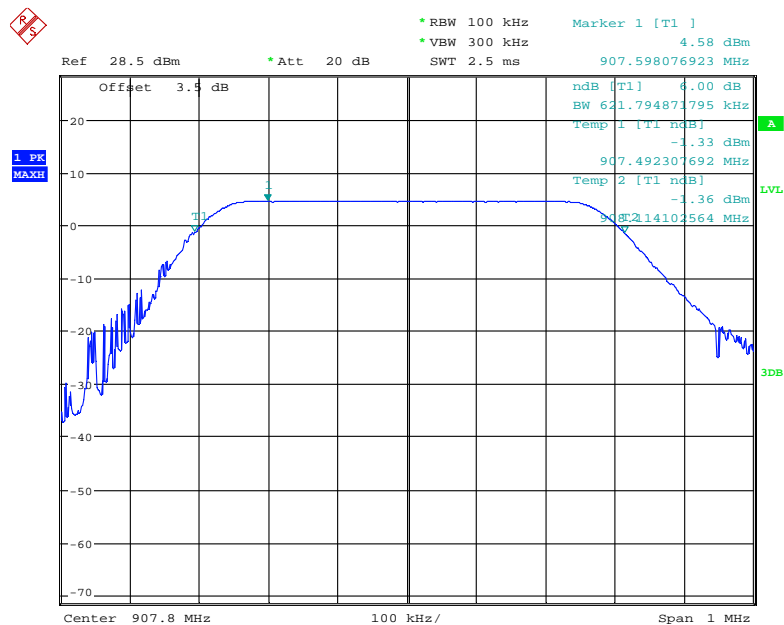
Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
Low	903	0.622	≥0.5
Middle	907.8	0.622	≥0.5
High	914.2	0.625	≥0.5

### Low Channel



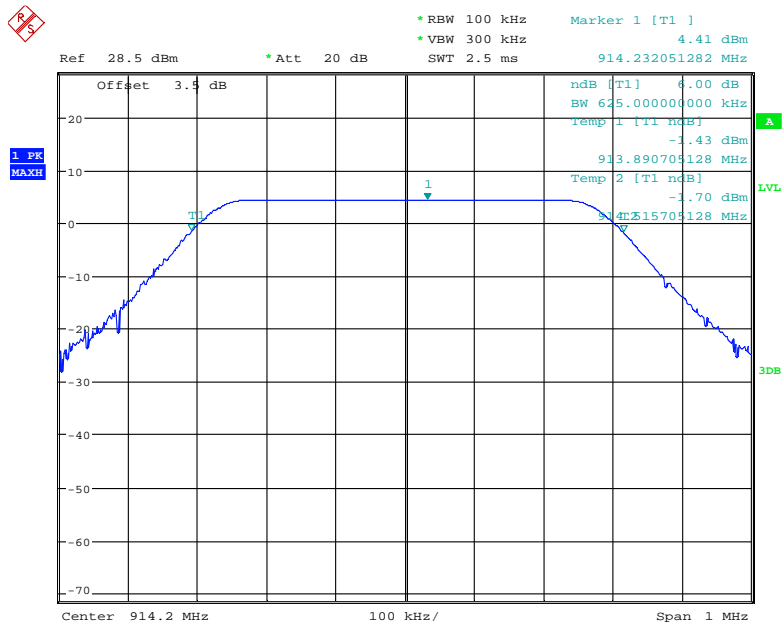
Date: 28.SEP.2020 13:27:49

### Middle Channel



Date: 28.SEP.2020 13:26:46

High Channel



Date: 28.SEP.2020 13:25:03

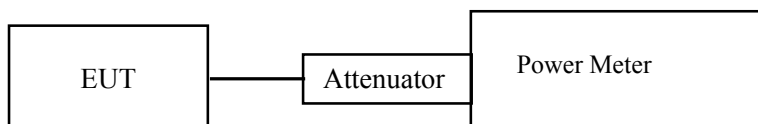
## FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

### Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

### Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



### Test Data

#### Environmental Conditions

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	53 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Coco Liu on 2020-09-28.*

*EUT operation mode: Transmitting*

#### Test Result: Pass

*Please refer to following table and plots.*

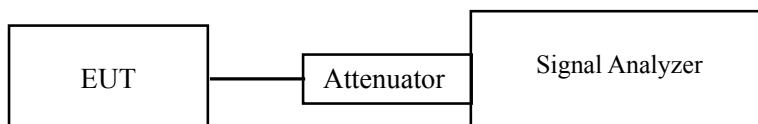
Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
Low	903	4.78	≤30	Pass
Middle	907.8	4.67	≤30	Pass
High	914.2	4.51	≤30	Pass

**FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE****Applicable Standard**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

**Test Procedure**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

**Test Data****Environmental Conditions**

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	53 %
<b>ATM Pressure:</b>	101.0 kPa

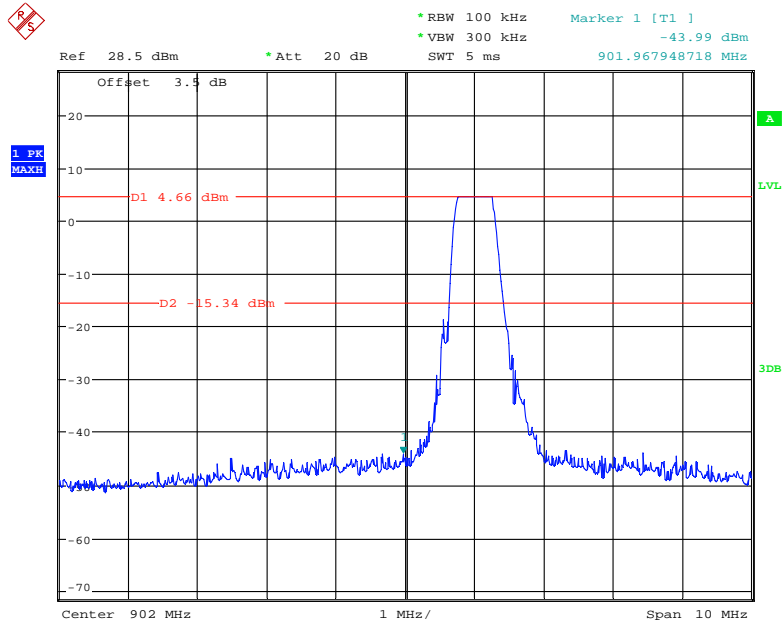
*The testing was performed by Coco Liu on 2020-09-28.*

*EUT operation mode: Transmitting*

**Test Result: Pass**

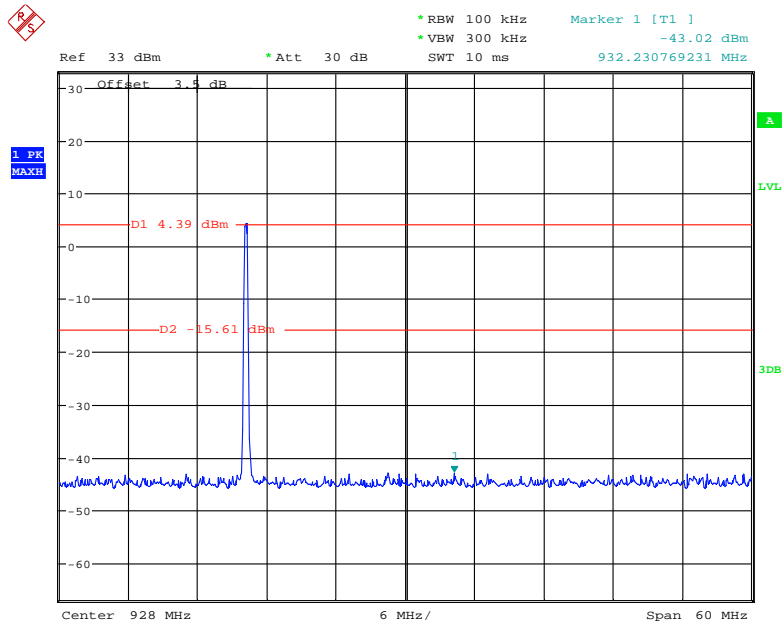
*Please refer to following table and plots.*

### Left Side



Date: 28.SEP.2020 13:30:04

### Right Side



Date: 28.SEP.2020 18:10:08

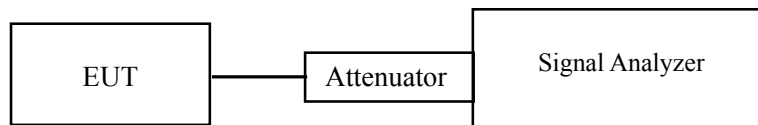
## FCC §15.247(e) - POWER SPECTRAL DENSITY

### Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to:  $3\text{ kHz} \leq \text{RBW} \leq 100\text{ kHz}$ .
3. Set the VBW  $\geq 3 \times \text{RBW}$ .
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



### Test Data

#### Environmental Conditions

Temperature:	24 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

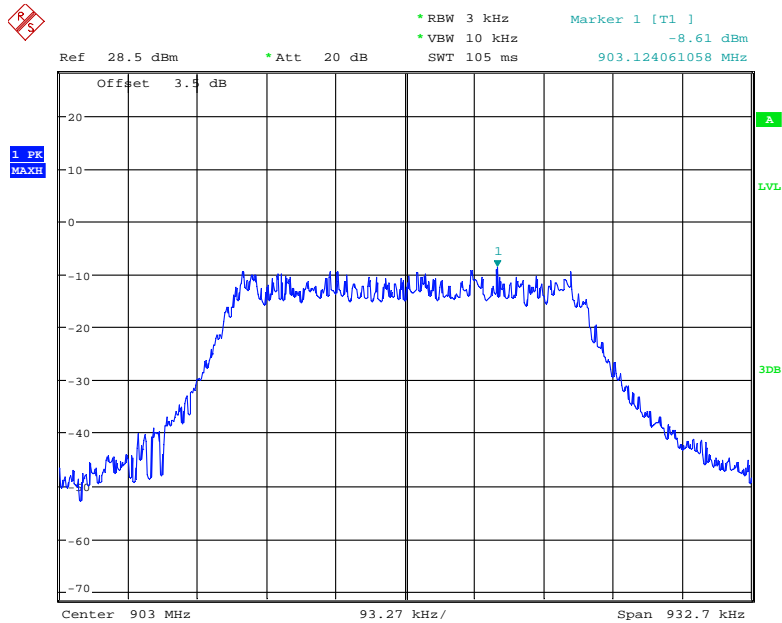
The testing was performed by Coco Liu on 2020-09-28.

EUT operation mode: Transmitting

#### Test Result: Pass

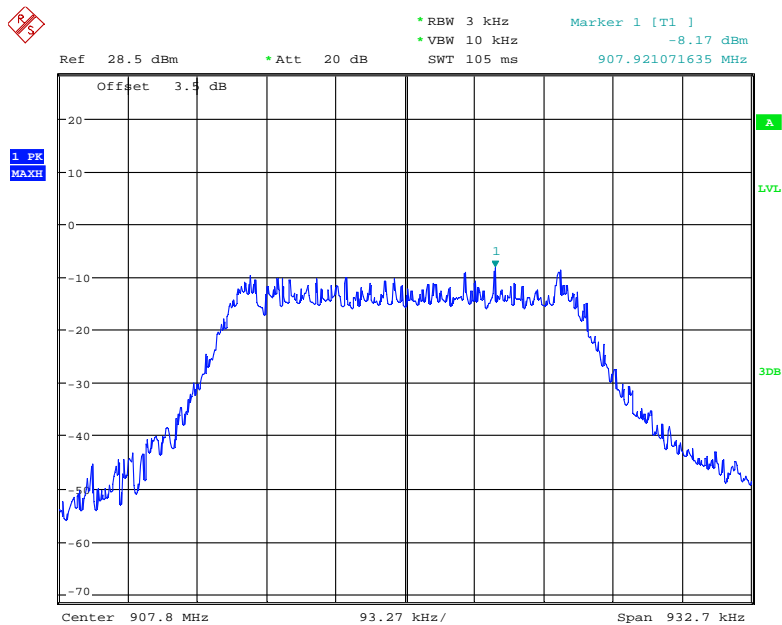
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
Low	903	-8.61	$\leq 8$
Middle	907.8	-8.17	$\leq 8$
High	914.2	-8.95	$\leq 8$

### Power Spectral Density, Low Channel



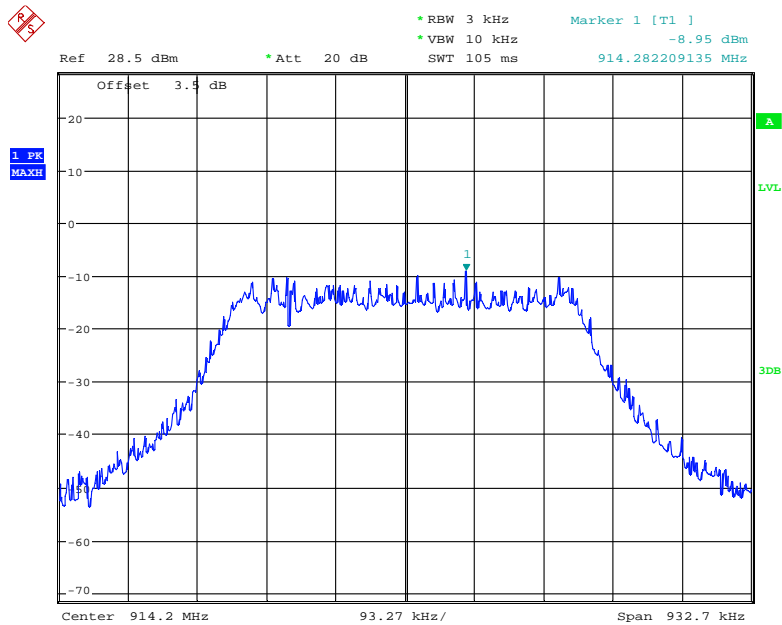
Date: 28.SEP.2020 13:41:38

### Power Spectral Density, Middle Channel



Date: 28.SEP.2020 13:40:32

Power Spectral Density, High Channel



Date: 28.SEP.2020 13:43:52

\*\*\*\*\* END OF REPORT \*\*\*\*\*