



FCC PART 15.247

TEST REPORT

For

Shenzhen Rakwireless Technology Co., Ltd.

RM1007, Hangsheng Technology Building, 4th South Gaoxing Avenue, Science and Technology Park, Nanshan District, Shenzhen, China

FCC ID: 2AF6B-RAK831

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Shenzhen Rakwireless Technology Co., Ltd.*'s product, model number: *RAK831* (FCC ID: *2AF6B-RAK831*) or the "EUT" in this report was a *LoRa WAN GATEWAY* which was measured approximately: 80 mm (L) * 50 mm (W) * 5.0 mm (H), rated with input voltage: DC 5.0V.

** All measurement and test data in this report was gathered from production sample serial number: 180322002 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2018-03-22.*

Objective

This report is prepared on behalf of *Shenzhen Rakwireless Technology Co., Ltd.* 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.

Related Submittal(s)/Grant(s)

No Related Submittal.

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.

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	±0.5dB
RF conducted test with spectrum	±1.5dB
AC Power Lines Conducted Emissions	±1.95dB
All emissions, radiated	±4.88dB
Temperature	±3°C
Humidity	±6%
Supply voltages	±0.4%

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 testing mode, which was provided by manufacturer.

For LoRa mode, Detailed Frequency as below:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	923.3	5	925.7
2	923.9	6	926.3
3	924.5	7	926.9
4	925.1	8	927.5

EUT was tested with Channel 1, 4 and 8.

Equipment Modifications

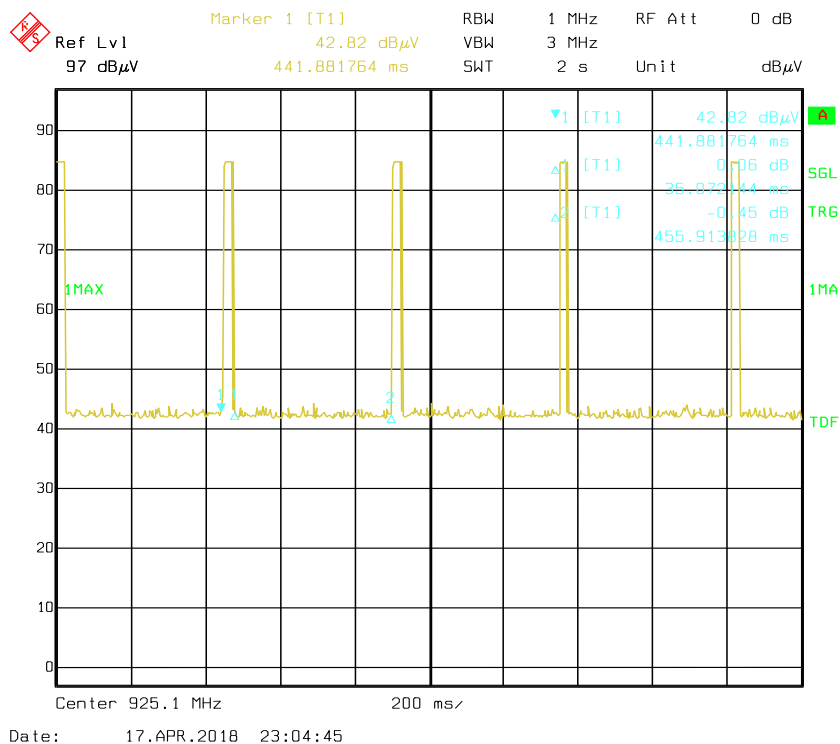
No modification was made to the EUT tested.

EUT Exercise Software

“VMware.exe” was used mode and power level is 9. SF=12

Duty cycle

LoRa Mode



Band	Duty Cycle (%)	T(us)	1/T(kHz)	VBW Setting	10log(1/x)
LoRa	7.68	35000	0.03	1kHz	11.15

Local Support Equipment List and Details

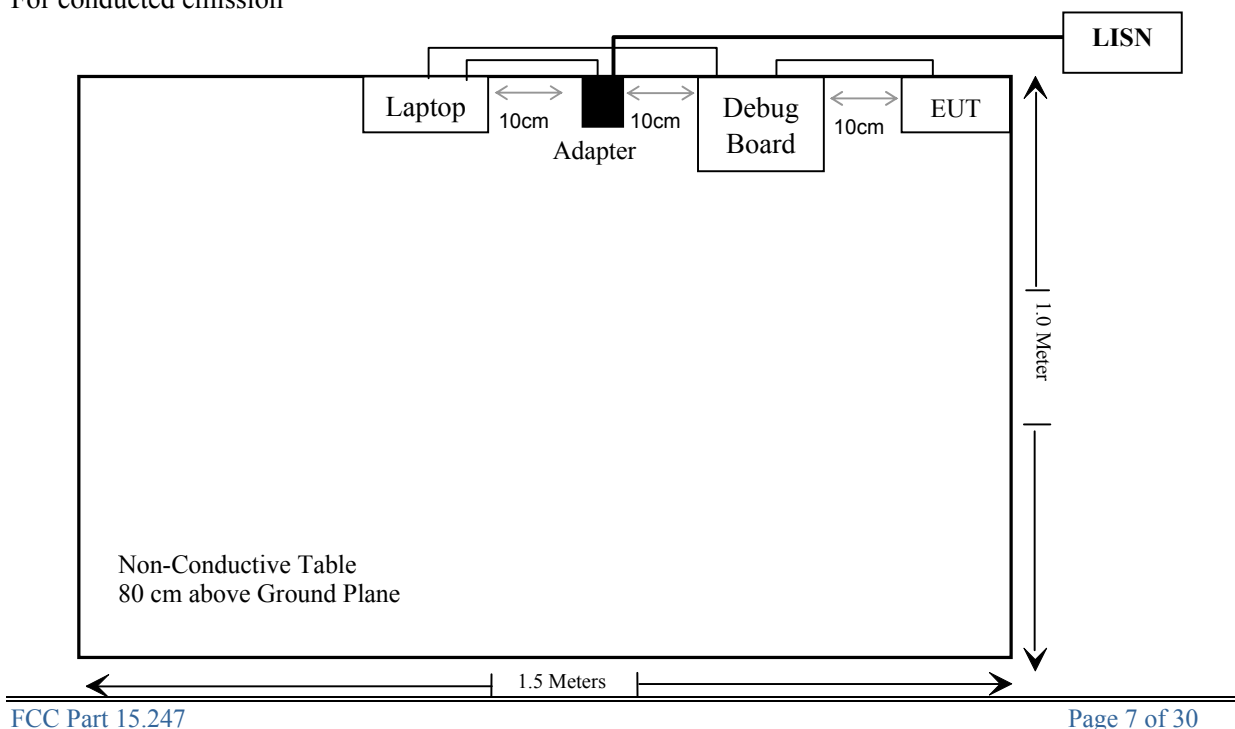
Manufacturer	Description	Model	Serial Number
DELL	Adapter	PA-1900-02D	N/A
Rakwireless	Debug board	FT2232HL	N/A
DELL	Laptop	E6410	N/A

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-Shielding Detachable DC Power Cable	1.2	Laptop	Adapter
Un-Shielding Detachable AC Power Cable	1.5	LISN	Adapter
Un-Shielding Detachable USB Cable	1.0	Debug board	Laptop
Un-Shielding Detachable FFC Cable	0.2	EUT	Debug board

Block Diagram of Test Setup

For conducted emission



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i) & §1.1310 & §2.1091	Maximum Permissible exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§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

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2017-08-04	2018-08-04
Rohde & Schwarz	LISN	ENV216	3560.6650.12-101613-Yb	2017-12-21	2018-12-21
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2017-11-19	2018-05-17
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
N/A	Conducted Emission Cable	N/A	UF A210B-1-0720-504504	2017-11-12	2018-05-12
Radiated Emission Test					
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017-12-22	2020-12-21
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2017-04-24	2018-04-24
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2017-05-21	2018-05-21
HP	Amplifier	HP8447E	1937A01046	2017-11-19	2018-05-21
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2017-12-17	2020-12-16
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2018-01-11	2019-01-11
Ducommun technologies	RF Cable	UFA210A-1-4724-30050U	MFR64369 223410-001	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	104PEA	218124002	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	RG-214	1	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	RG-214	2	2017-11-22	2018-05-22
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
RF Conducted Test					
Agilent	P-Series Power Meter	N1912A	MY5000448	2018-01-02	2019-01-02
Agilent	Wideband Power Sensor	N1921A	MY54210016	2018-01-02	2019-01-02
WEINSCHL	10dB Attenuator	N/A	N/A	2017-11-22	2018-05-23
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2017-12-24	2018-12-24
Ducommun technologies	RF Cable	RG-214	3	2017-11-22	2018-05-22

* **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) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i) and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	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;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

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);

Calculated Data:

The worst case as below:

Frequency (MHz)	Antenna Gain		Max Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
	(dBi)	(numeric)	(dBm)	(mW)			
923.3-927.5	2.0	1.58	11	12.59	20	0.004	0.6

Result: The device meet FCC MPE at 20 cm distance

FCC §15.203 - ANTENNA REQUIREMENT

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 external antenna with a non-standard antenna jack which the maximum antenna gain is 2.0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

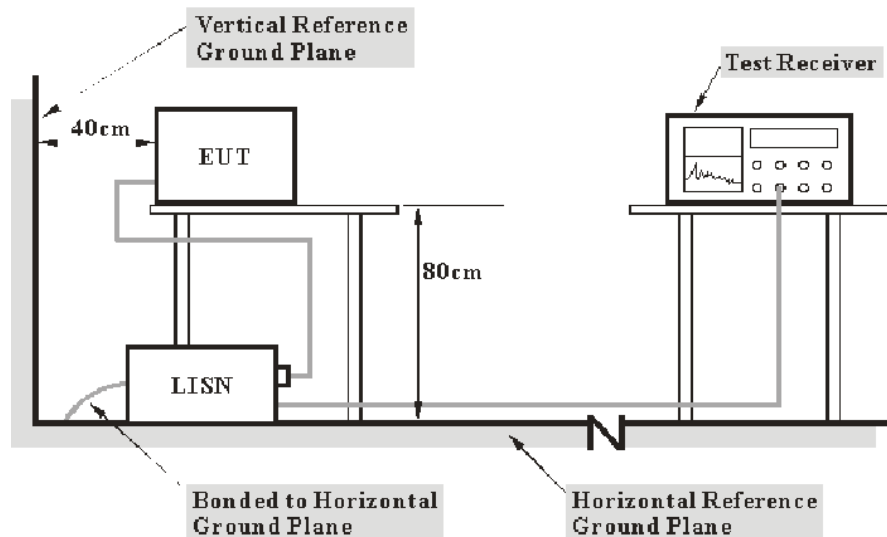
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

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

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

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207,

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{\text{lim}} + U_{\text{cisp}}r$$

In BACL, $U_{(Lm)}$ is less than $U_{\text{cisp}r}$, if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

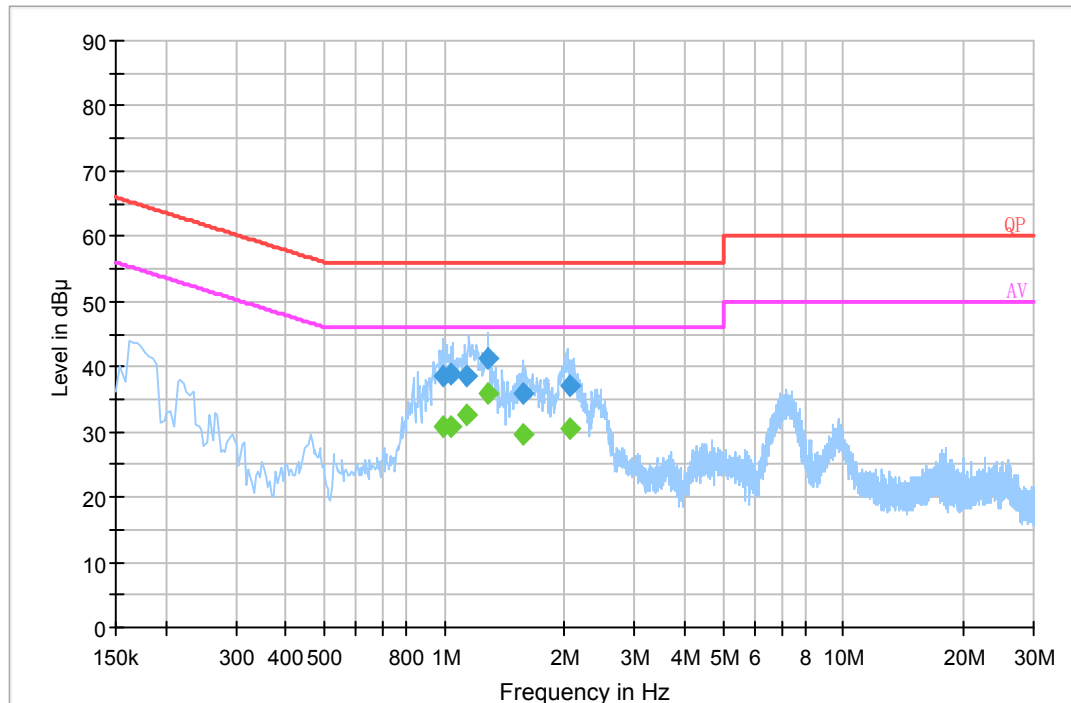
Test Data

Environmental Conditions

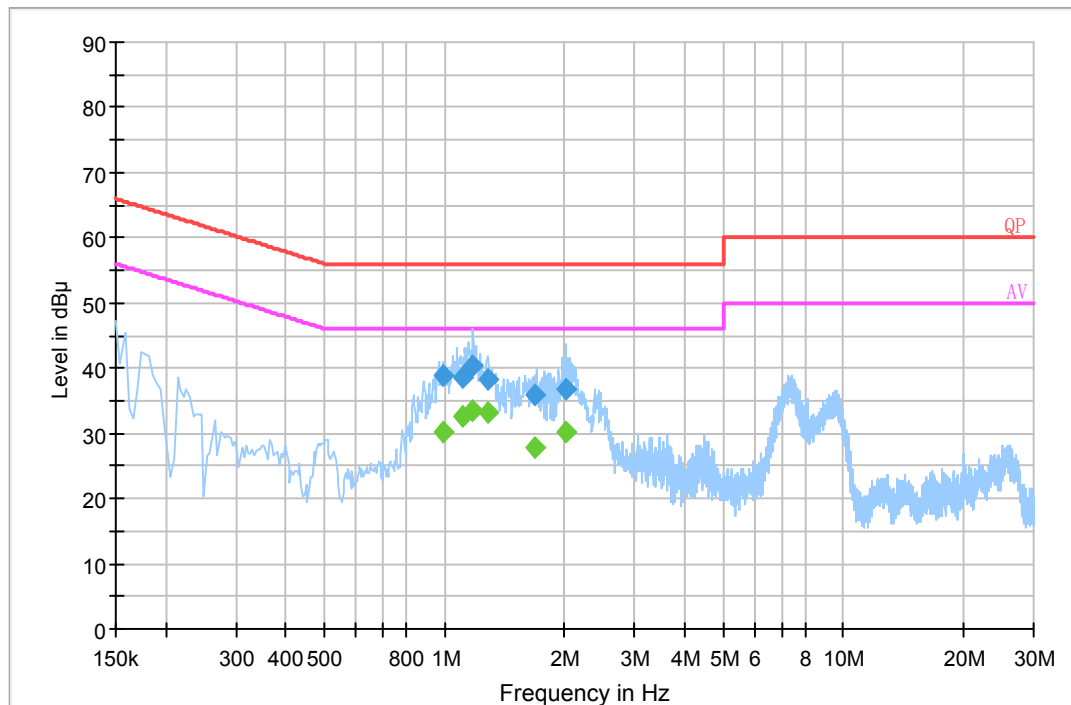
Temperature:	24 °C
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-04-18.

EUT operation mode: Transmitting

AC 120V/60 Hz, Line

Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.991090	38.5	20.0	56.0	17.5	QP
1.042250	38.7	20.0	56.0	17.3	QP
1.136690	38.6	20.0	56.0	17.4	QP
1.286710	41.3	20.0	56.0	14.7	QP
1.574510	35.8	20.0	56.0	20.2	QP
2.051550	37.1	20.0	56.0	18.9	QP
0.991090	30.9	20.0	46.0	15.1	Ave.
1.042250	30.7	20.0	46.0	15.3	Ave.
1.136690	32.6	20.0	46.0	13.4	Ave.
1.286710	35.9	20.0	46.0	10.1	Ave.
1.574510	29.5	20.0	46.0	16.5	Ave.
2.051550	30.4	20.0	46.0	15.6	Ave.

AC 120V/60 Hz, Neutral

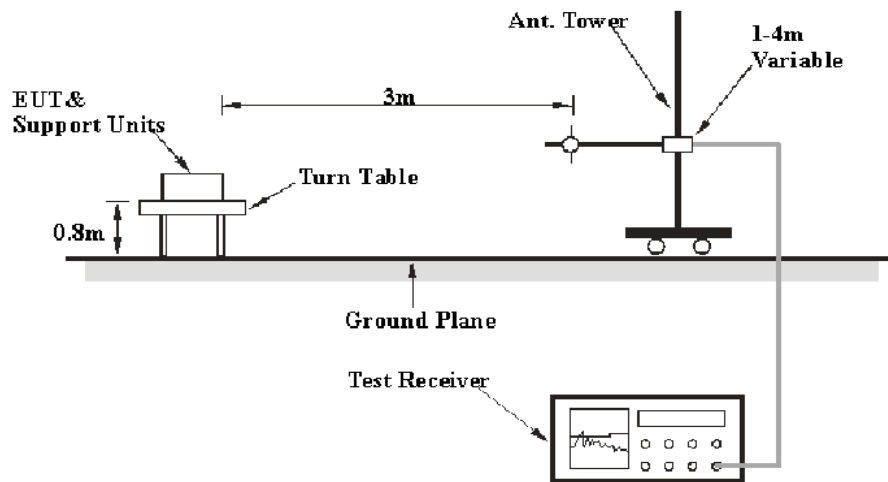
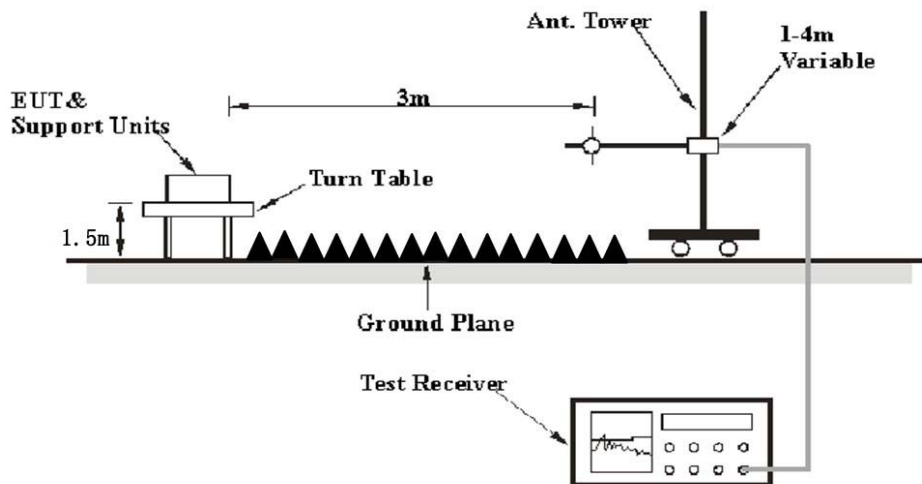
Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.991030	38.9	20.0	56.0	17.1	QP
1.113170	38.6	20.0	56.0	17.4	QP
1.172330	40.4	20.0	56.0	15.6	QP
1.282710	38.3	20.0	56.0	17.7	QP
1.684470	36.0	20.0	56.0	20	QP
2.027670	36.7	20.0	56.0	19.3	QP
0.991030	30.2	20.0	46.0	15.8	Ave.
1.113170	32.6	20.0	46.0	13.4	Ave.
1.172330	33.6	20.0	46.0	12.4	Ave.
1.282710	33.2	20.0	46.0	12.8	Ave.
1.684470	27.9	20.0	46.0	18.1	Ave.
2.027670	30.3	20.0	46.0	15.7	Ave.

Note:

- 1) Correction Factor = LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
- 2) Corrected Amplitude = Reading + Correction Factor
- 3) Margin = Limit – Corrected Amplitude

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

The system was investigated from 30 MHz to 10 GHz.

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	Measurements
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz ^{Note 1}	/	Average
	1MHz	> 1/T ^{Note 2}	/	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 Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(L_m)} \leq L_{\text{lim}} + U_{\text{cispr}}$$

In BACL, $U_{(L_m)}$ is less than U_{cispr} , if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

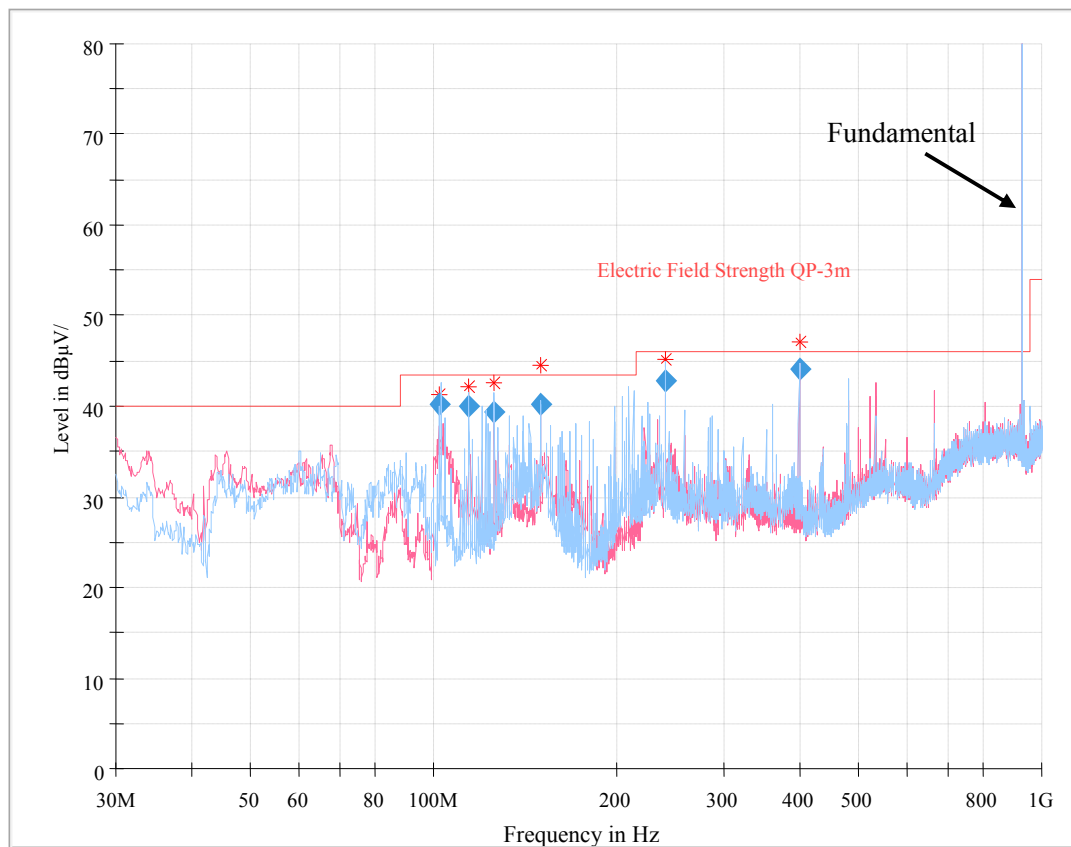
Test Data**Environmental Conditions**

Temperature:	24 °C
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-04-17.

Test range 30MHz – 10GHz, please refer to the following tables and plots.

Worst case at Low channel:



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
102.051125	40.15	242.0	H	0.0	-8.2	43.50	3.35
114.009125	39.99	275.0	H	171.0	-7.0	43.50	3.51
126.009500	39.42	313.0	H	175.0	-5.8	43.50	4.08
150.033500	40.30	222.0	H	0.0	-4.5	43.50	3.20
240.004000	42.71	116.0	H	135.0	-3.2	46.00	3.29
398.977125	44.02	107.0	H	170.0	-0.3	46.00	1.98

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel (923.3 MHz)									
923.30	62.50	QP	123	2.4	H	33.80	96.30	/	/
923.30	63.40	QP	151	1.8	V	33.80	97.20	/	/
901.99	15.27	QP	350	1.3	H	34.50	49.77	76.30	26.53
901.99	15.40	QP	198	1.4	V	34.50	49.90	77.20	27.30
1846.60	48.59	PK	123	1.2	H	-5.22	43.37	74	30.63
1846.60	43.02	Ave.	123	1.2	H	-5.22	37.80	54	16.20
1846.60	46.35	PK	355	1.6	V	-5.22	41.13	74	32.87
1846.60	41.47	Ave.	355	1.6	V	-5.22	36.25	54	17.75
Middle Channel(925.1MHz)									
925.10	62.10	QP	27	1.7	H	33.80	95.90	/	/
925.10	63.30	QP	138	1.5	V	33.80	97.10	/	/
1850.20	49.03	PK	165	1.7	H	-5.17	43.86	74	30.14
1850.20	44.29	Ave.	165	1.7	H	-5.17	39.12	54	14.88
1850.20	47.21	PK	43	1.4	V	-5.17	42.04	74	31.96
1850.20	42.64	Ave.	43	1.4	V	-5.17	37.47	54	16.53
High Channel(927.5 MHz)									
927.50	62.40	QP	248	2.4	H	33.80	96.20	/	/
927.50	62.90	QP	212	1	V	33.80	96.70	/	/
928.01	15.27	QP	108	1.8	H	34.50	62.90	76.20	13.30
928.01	15.40	QP	68	1.3	V	34.50	63.80	76.70	12.90
1855.00	49.11	PK	135	1.4	H	-5.17	43.94	74	30.06
1855.00	44.18	Ave.	135	1.4	H	-5.17	39.01	54	14.99
1855.00	47.32	PK	243	2.3	V	-5.17	42.15	74	31.85
1855.00	42.53	Ave.	243	2.3	V	-5.17	37.36	54	16.64

Note:

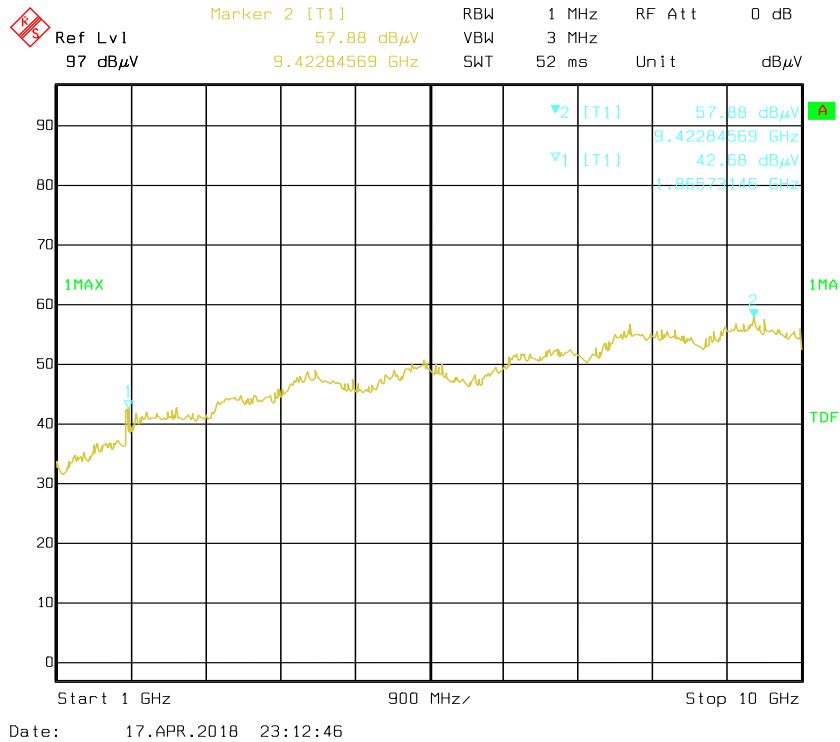
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

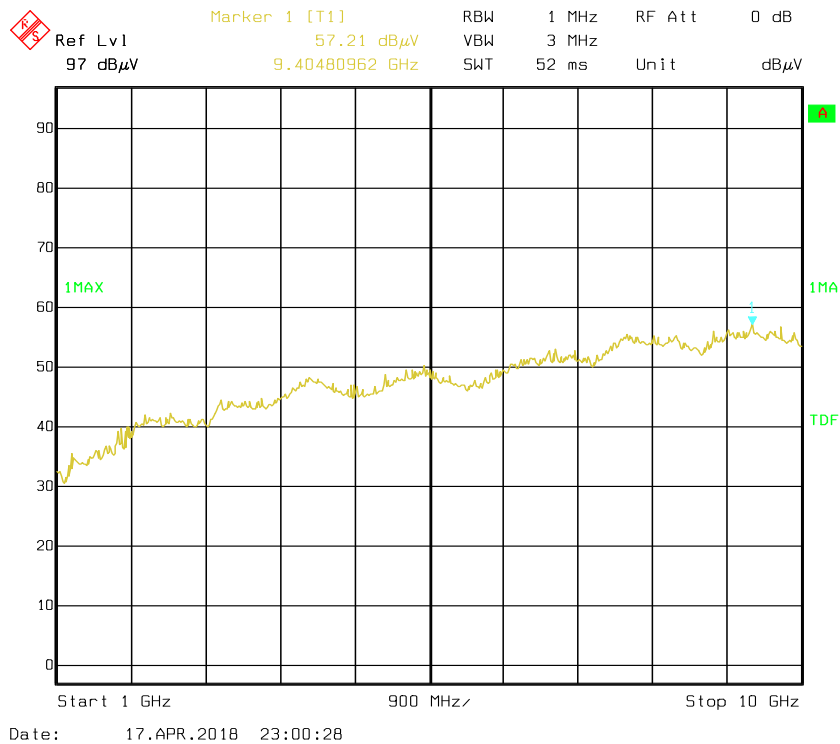
Margin = Limit - Corrected. Amplitude

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

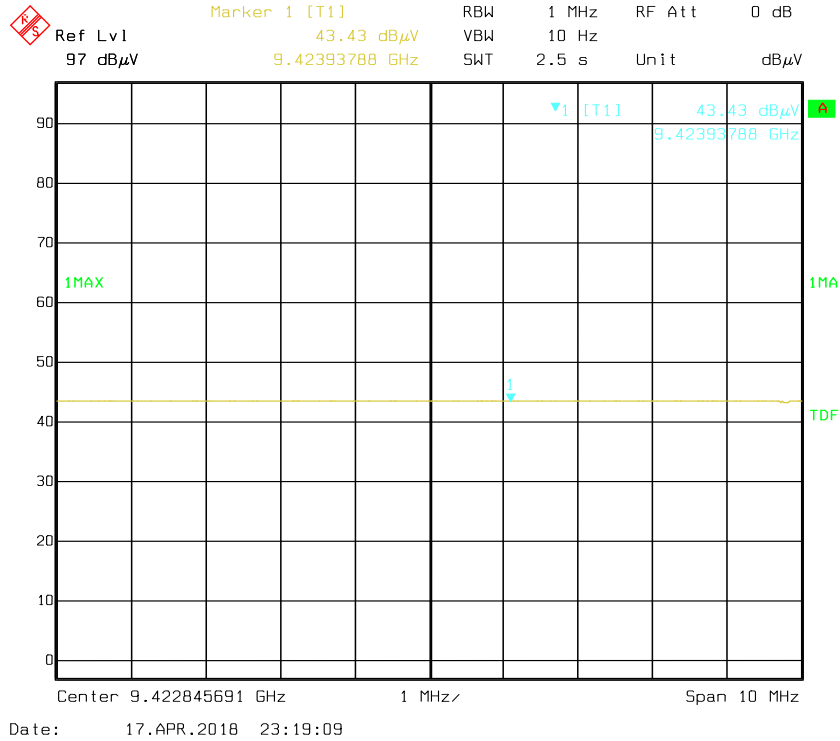
Pre-scan with High channel for Peak Horizontal



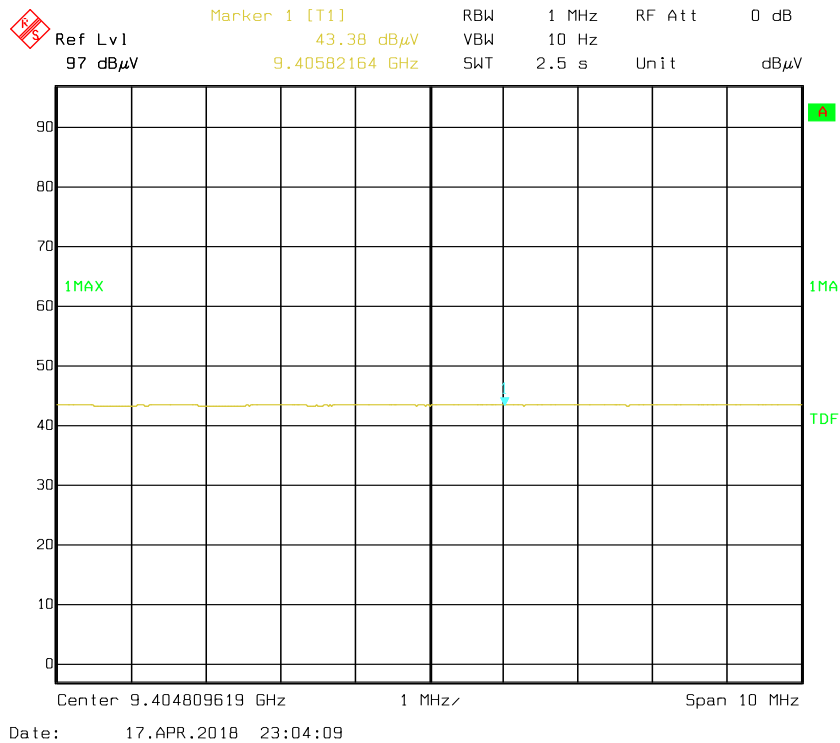
Vertical



Pre-scan for Average Horizontal



Vertical



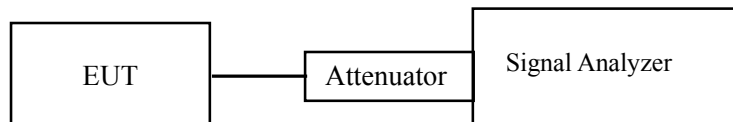
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

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:	25 °C
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-04-13.

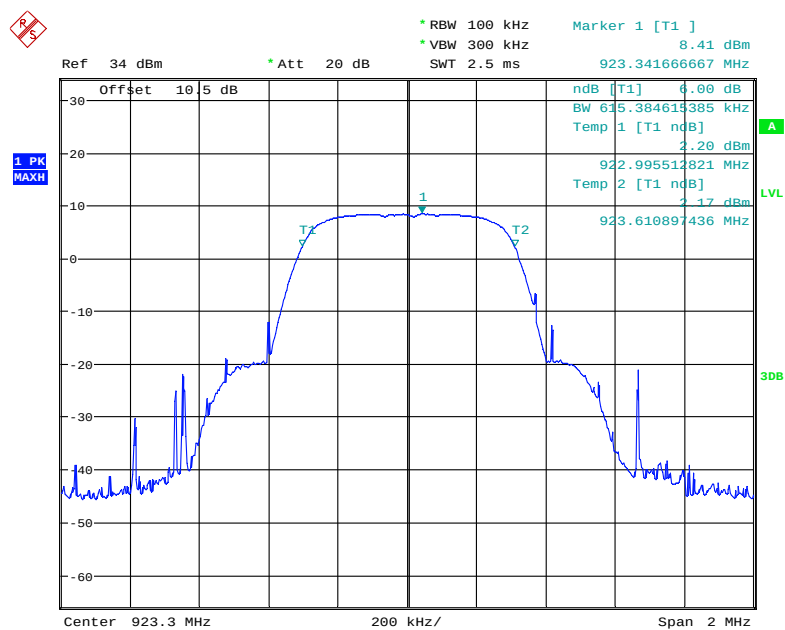
Test Result: Pass.

Please refer to the following table and plots.

EUT operation mode: Transmitting

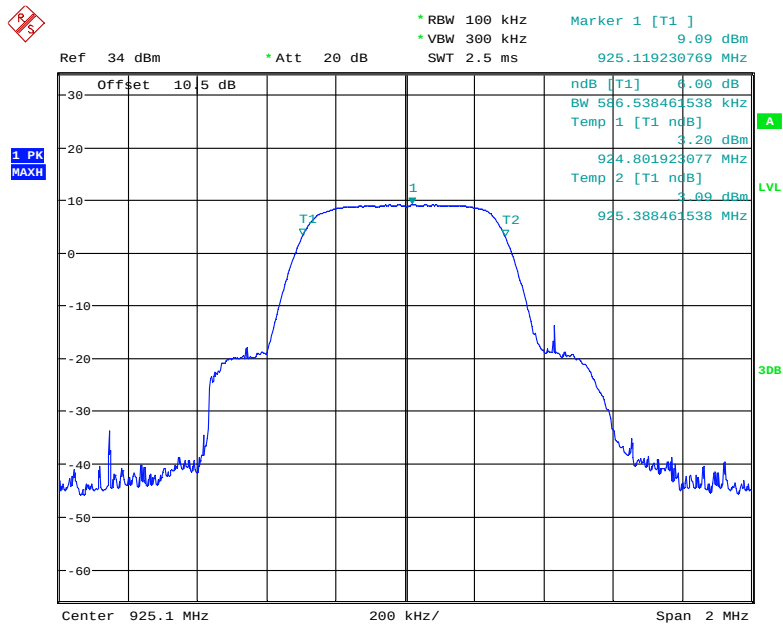
Channel	Frequency (MHz)	6 dB Emission Bandwidth (kHz)	Limit (kHz)
Low	923.3	615.38	≥ 500
Middle	925.1	586.54	≥ 500
High	927.5	586.54	≥ 500

Low Channel



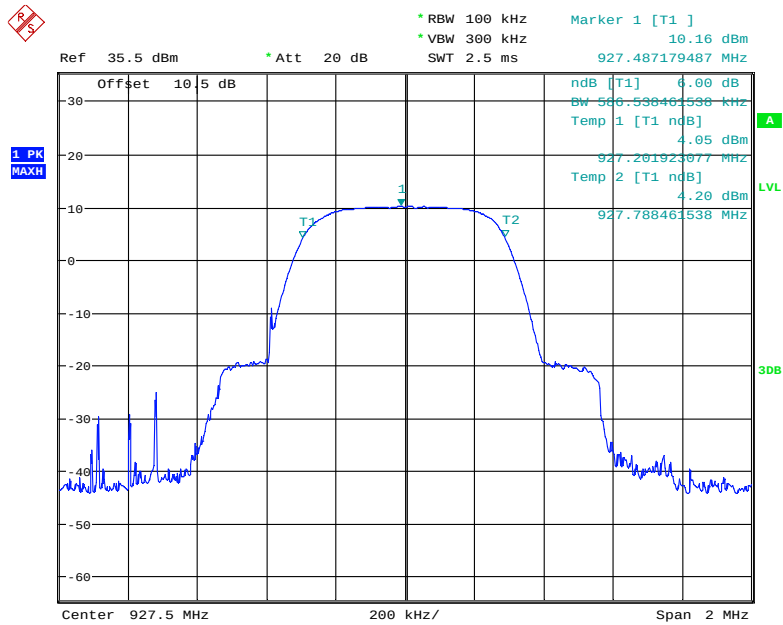
Date: 13.APR.2018 23:53:53

Middle Channel



Date: 13.APR.2018 23:39:59

High Channel



Date: 13.APR.2018 23:27:03

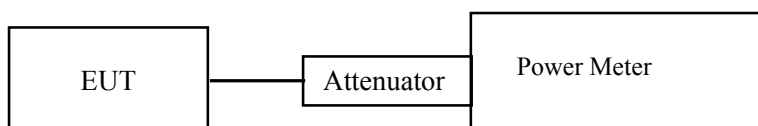
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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

Temperature:	25 °C
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-04-13.

EUT operation mode: Transmitting

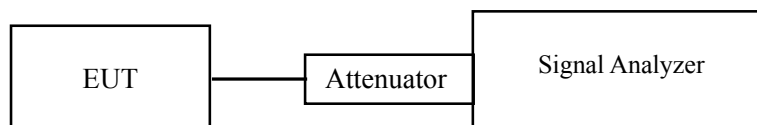
Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
Low	923.3	8.46	30
Middle	925.1	9.15	30
High	927.5	10.27	30

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**

Temperature:	25 °C
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-04-13.

EUT operation mode: Transmitting

Test Result: Compliance

Please refer to the following plots.

Ref 34 dBm * Att 20 dB * RBW 100 kHz * VBW 300 kHz Marker 1 [T1] -42.45 dBm
 SWT 20 ms 894.628205128 MHz

Offset 10.5 dB

1 PK MAXH

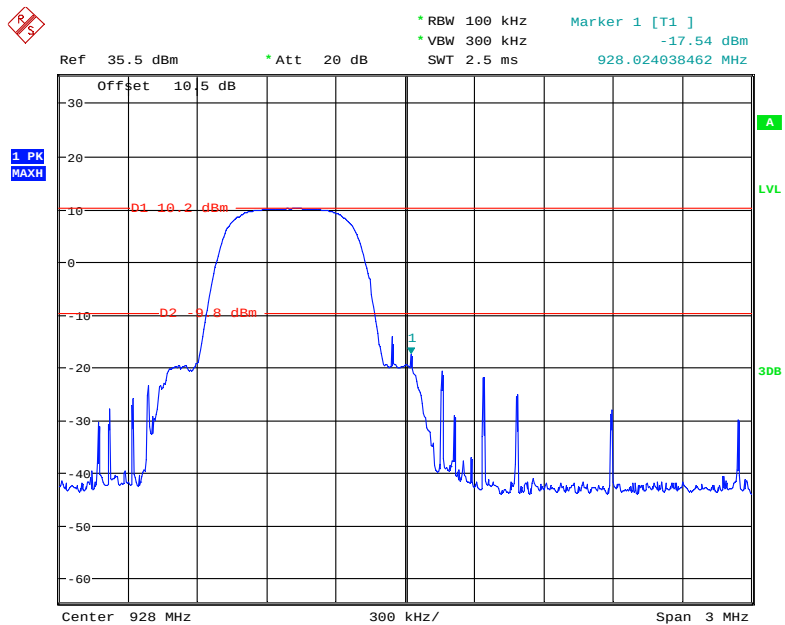
D1 -8.5 dBm

D2 -11.5 dBm

1

Center 902 MHz 5 MHz/ Span 50 MHz

Band Edge, Right Side



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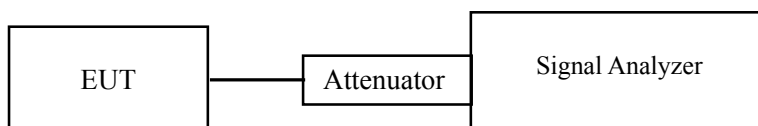
FCC §15.247(e) - POWER SPECTRAL DENSITY

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:	25 °C
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

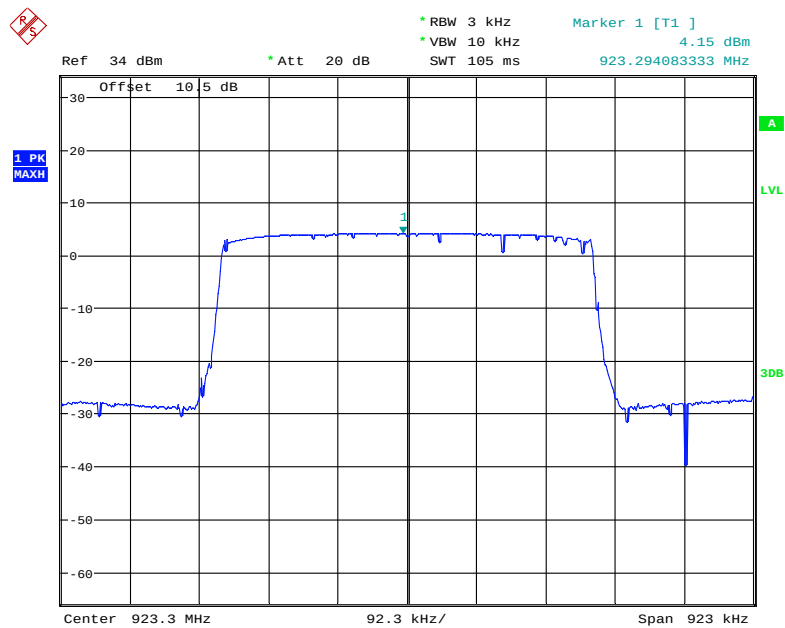
The testing was performed by Jacob Kong on 2018-04-13.

EUT operation mode: Transmitting

Test Result: Pass

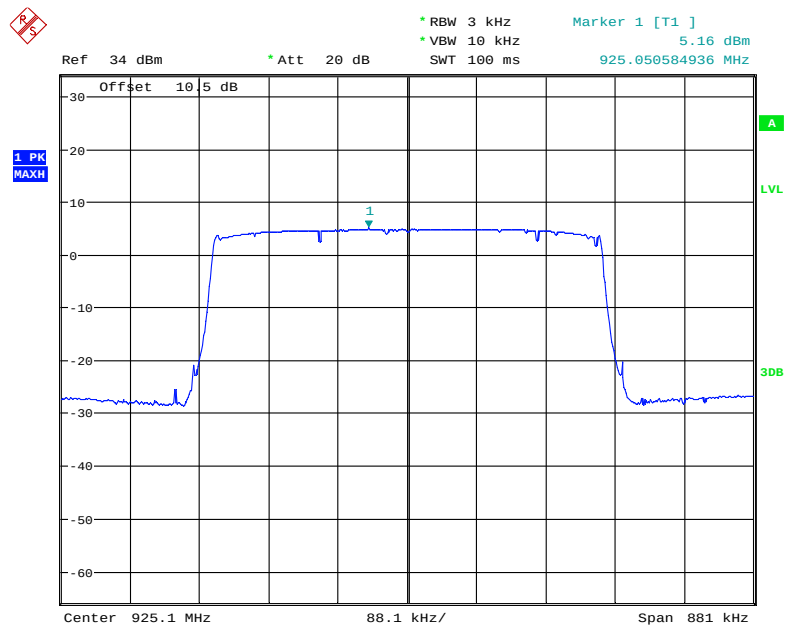
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
Low	923.3	4.15	≤ 8
Middle	925.1	5.16	≤ 8
High	927.5	6.07	≤ 8

Power Spectral Density, Low Channel



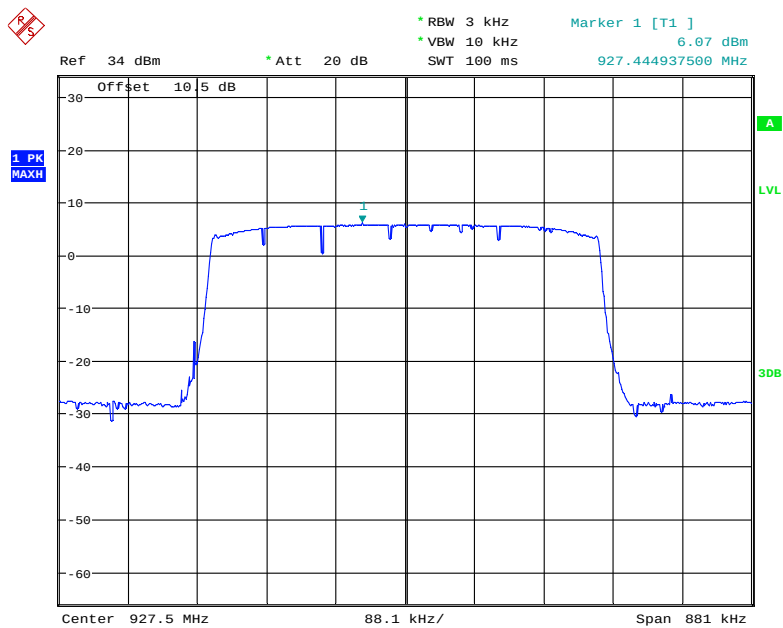
Date: 13.APR.2018 23:58:27

Power Spectral Density, Middle Channel



Date: 13.APR.2018 23:52:45

Power Spectral Density, High Channel



Date: 13.APR.2018 23:38:50

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