TESTING LABORATORY
CERTIFICATE#4323.01

FCC PART 15.247
TEST REPORT

For

Pycom Ltd

High Point 9 Sydenham Road, Guildford Surrey GU1 3RX, Surrey, United Kingdom

FCC ID: 2AJMTLOPY4R

Report Type:	Product Type:
Original Report	LoPy4 Module

Test Engineer:	Max Min
Report Number:	RSHA180625001-00D
Report Date:	2019-03-07
Reviewed By:	Oscar Ye RF Leader
Prepared By:	Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road,Kunshan,Jiangsu province,China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

TABLE OF CONTENTS

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Pycom Ltd
Tested Model	LoPy4 1.0
Product Type	LoPy4 Module
Dimension	55mm (L)* 20 mm (W)*10 mm(H)
Power Supply	DC 3.4-5.5V

**All measurement and test data in this report was gathered from production sample serial number: 20180625001. (Assigned by the BACL. The EUT supplied by the applicant was received on 2018-06-25)*

Objective

This report is prepared on behalf of Pycom Ltd in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions 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)

FCC Part 15.247 DTS, Part 15.247 DSS and Part 15.249 DXX submissions with FCC ID: 2AJMTLOPY4R.

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 FCC KDB558074 D01 DTS Meas Guidance v05r01.

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

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19 dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
Humidity		6%

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Channel List for LoRa mode:

The frequencies is F(MHz)=903.0+1.6*(n-64) (64<=n<=71). The lowest, middle, highest channel numbers of the EUT used and tested in this report are below.

Channel	Frequency (MHz)
64	903.0
68	909.4
71	914.2

Equipment Modifications

No modification was made to the EUT tested.

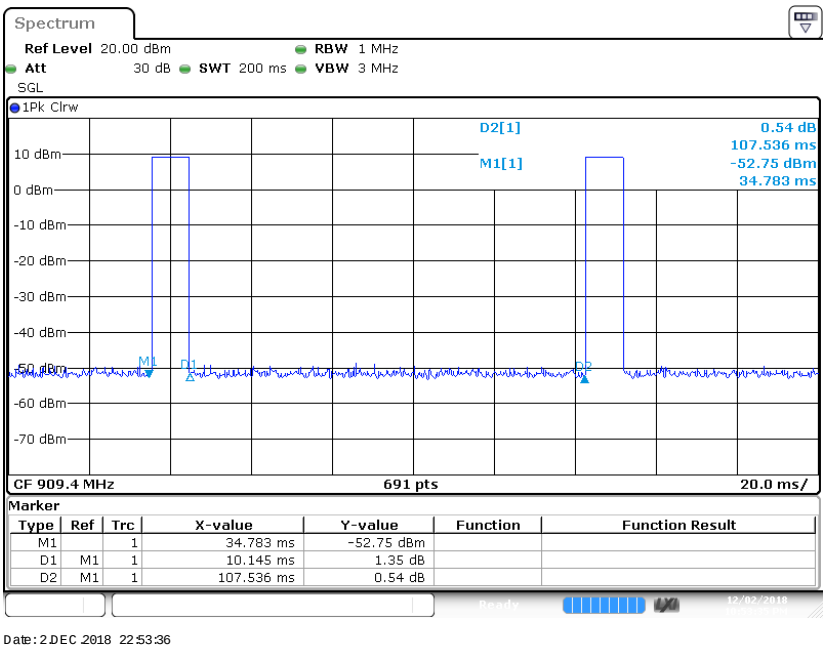
EUT Exercise Software

RF test tool: SecureCRT

Power Level: 20

Duty Cycle:

Middle Channel



Mode	Duty Cycle (%)	T(ms)	1/T(kHz)	10log(1/x)
LoRa	9.43	10.145	0.099	10.25

Note: "x" means the Duty Cycle.

Support Equipment List and Details

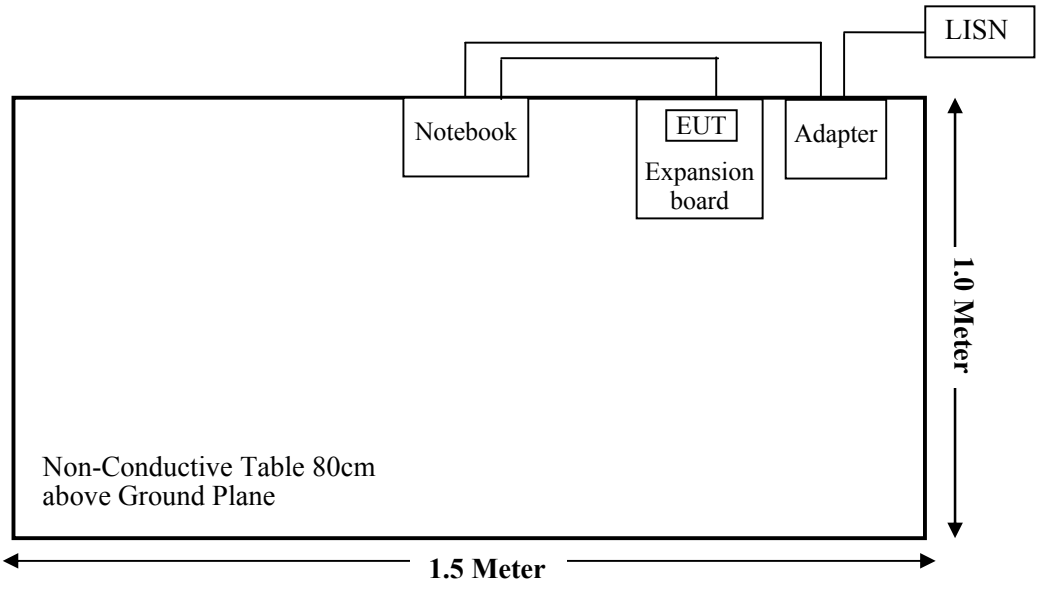
Manufacturer	Description	Model	Serial Number
DELL	Notebook	GX620	D65874152
DELL	Adapter	LA65NS0-00	DF263
Pycom Ltd	Expansion board	V3.0r	1811002240

External I/O Cable

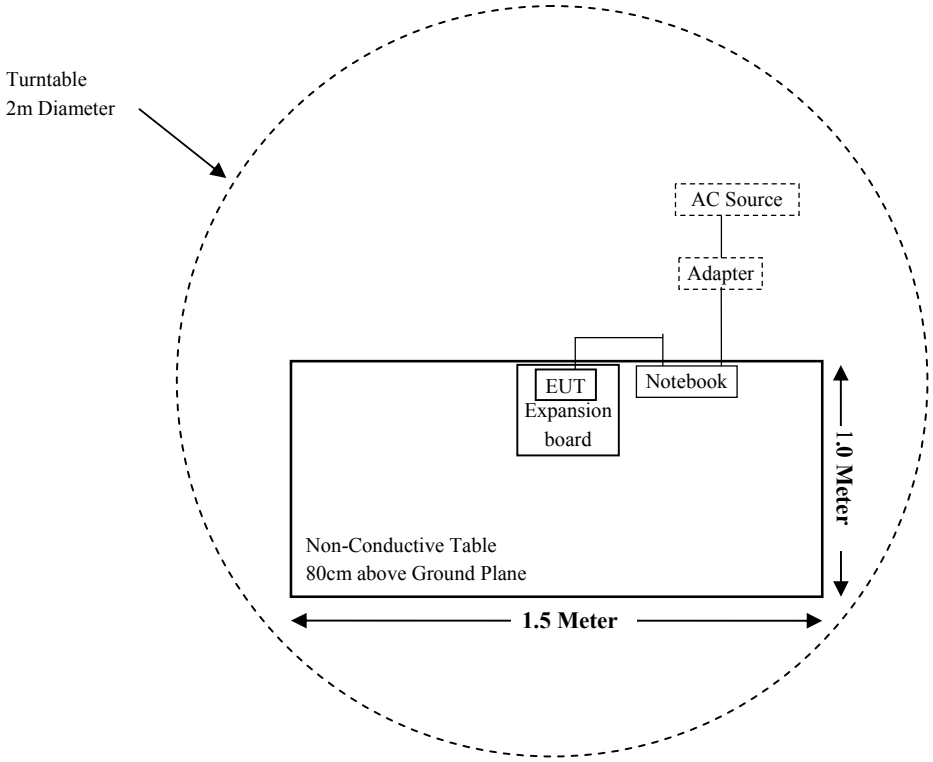
Cable Description	Length (m)	From Port	To
USB Cable	0.8	Expansion board	Notebook

Block Diagram of Test Setup

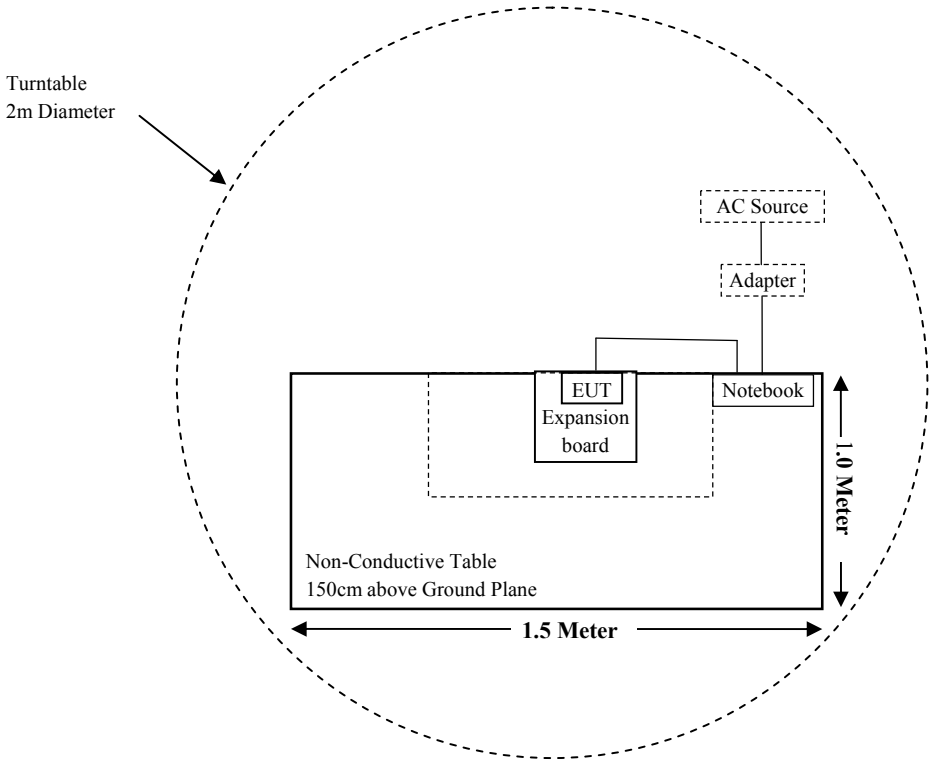
For Conducted Emissions:



For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1310 & §2.1091	MAXIMUM PERMISSIBLE EXPOSURE (MPE)	Compliant
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.247(d)	Spurious Emissions at Antenna Port	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
Radiated Emission Test（Chamber 1#）					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2018-11-30	2019-11-29
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sonoma Instrunent	Pre-amplifier	310N	171205	2018-08-15	2019-08-14
MICRO-TRONICS	Band Reject Filter	BRC50722	G013	2018-08-05	2019-08-04
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2018-08-15	2019-08-14
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2018-08-27	2019-08-26
ETS-LINDGREN	Horn Antenna	3115	6229	2016-12-12	2019-12-11
A.H.Systems, inc	Amplifier	2641-1	466	2018-09-11	2019-09-10
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2018-08-15	2019-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSV40	101116	2018-07-23	2019-07-22
Narda	Attenuator	10dB	010	2018-08-15	2019-08-14
Pycom Ltd	RF Cable	Pycom01	C01	Each Time	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	834115/007	2018-11-30	2019-11-29
Rohde & Schwarz	LISN	ENV216	3560655016	2018-11-30	2019-11-29
BACL	Auto test Software	BACL-EMC	CE001	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2018-01-10	2019-01-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2018-08-15	2019-08-14

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

FCC §1.1310 & §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart §2.1091 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/f²)	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/cm^2);
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);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Calculated Data:

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)	Ratio
		(dBi)	(numeric)	(dBm)	(mW)				
Wi-Fi	2412-2462	1.30	1.35	23.00	199.53	20	0.0536	1.00	0.0536
	2422-2452	1.30	1.35	20.00	100.00	20	0.0269	1.00	0.0269
BLE	2402-2480	1.30	1.35	3.00	2.00	20	0.0005	1.00	0.0005
BT 3.0	2402~2480	1.30	1.35	6.00	3.98	20	0.0011	1.00	0.0011
LoRa	902-928	0.87	1.22	20.00	100.00	20	0.0243	0.60	0.0405
Sigfox	902-928	0.87	1.22	20.00	100.00	20	0.0243	0.60	0.0405

Note:

Note: Wi-Fi/ BLE/ BT 3.0 & LoRa/ Sigfox can transmit simultaneously; the worst condition is Wi-Fi & LoRa, as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0536+0.0405=0.0941 < 1.0$$

Conclusion: The EUT meets exemption requirement- RF exposure evaluation greater than 20cm distance specified in § 2.1091. If the device built into a host as a portable usage, the additional RF exposure evaluation may be required as specified by§ 2.1093.

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 for LoRa, which is with a unique connector, and the antenna gain is 0.87 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna Model	Antenna Gain	Manufacture
WIESON GY115ZH017-001	0.87dBi	WIESON TECHNOLOGIES CO., LTD.

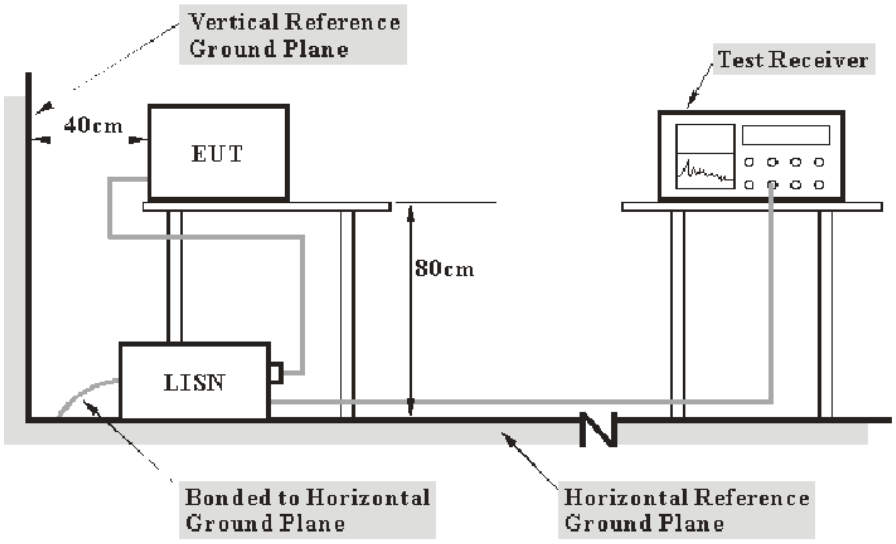
Result: Compliance.

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.

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 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:

Corrected Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)

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:

Margin (dB) = Limit (dBμV) – Corrected Amplitude (dBμV)

Test Results Summary

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

Test Data

Environmental Conditions

Temperature:	23.4 ℃
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

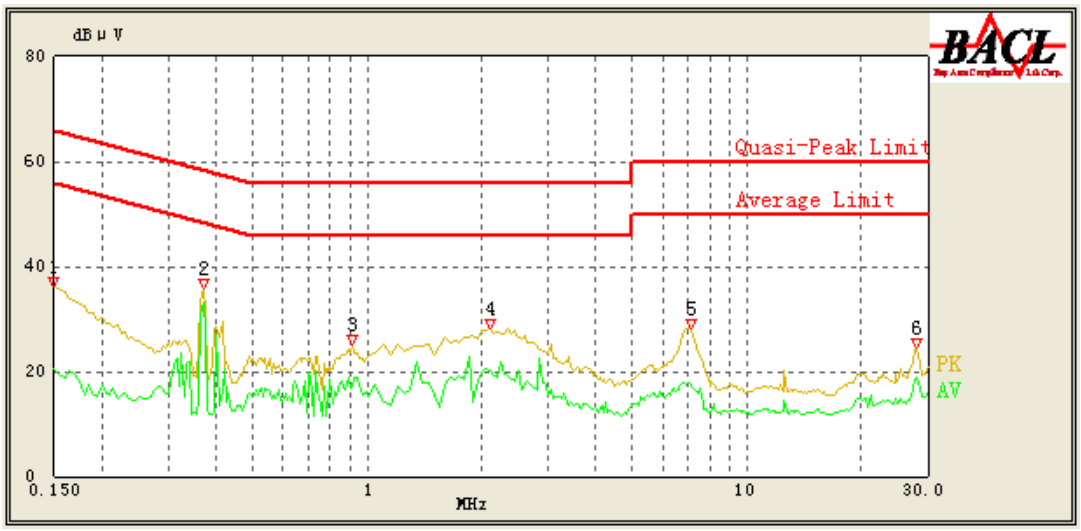
The testing was performed by Max Min on 2018-12-03.

EUT operation mode: Transmitting in middle channel. (Worst case)

AC 120V/60 Hz, Line

Frequency (MHz)	Corrected Amplitude (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	41.94	QP	9.000	L1	16.06	66.00	24.06	Compliance
0.150	30.80	AV	9.000	L1	16.06	56.00	25.20	Compliance
0.235	38.45	QP	9.000	L1	16.02	62.27	23.82	Compliance
0.235	19.83	AV	9.000	L1	16.02	52.27	32.44	Compliance
0.390	35.41	QP	9.000	L1	16.05	58.06	22.65	Compliance
0.390	31.64	AV	9.000	L1	16.05	48.06	16.42	Compliance
0.990	29.76	QP	9.000	L1	15.88	56.00	26.24	Compliance
0.985	23.16	AV	9.000	L1	15.88	46.00	22.84	Compliance
7.150	28.88	QP	9.000	L1	15.98	60.00	31.12	Compliance
7.100	21.71	AV	9.000	L1	15.98	50.00	28.29	Compliance
22.200	32.57	QP	9.000	L1	16.45	60.00	27.43	Compliance
22.300	25.65	AV	9.000	L1	16.45	50.00	24.35	Compliance

AC 120V/60 Hz, Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	36.03	QP	9.000	N	16.06	66.00	29.97	Compliance
0.150	20.39	AV	9.000	N	16.06	56.00	35.61	Compliance
0.370	35.74	QP	9.000	N	16.08	58.50	22.76	Compliance
0.370	33.18	AV	9.000	N	16.08	48.50	15.32	Compliance
0.910	25.07	QP	9.000	N	15.95	56.00	30.93	Compliance
0.910	17.21	AV	9.000	N	15.95	46.00	28.79	Compliance
2.100	28.04	QP	9.000	N	15.91	56.00	27.96	Compliance
2.100	20.02	AV	9.000	N	15.91	46.00	25.98	Compliance
7.100	28.20	QP	9.000	N	15.92	60.00	31.80	Compliance
7.150	17.56	AV	9.000	N	15.92	50.00	32.44	Compliance
27.900	24.44	QP	9.000	N	16.30	60.00	35.56	Compliance
27.950	18.89	AV	9.000	N	16.30	50.00	31.11	Compliance

Note:
1) Corrected Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)
2) Margin (dB) = Limit (dBµV) – Corrected Amplitude (dBµV)

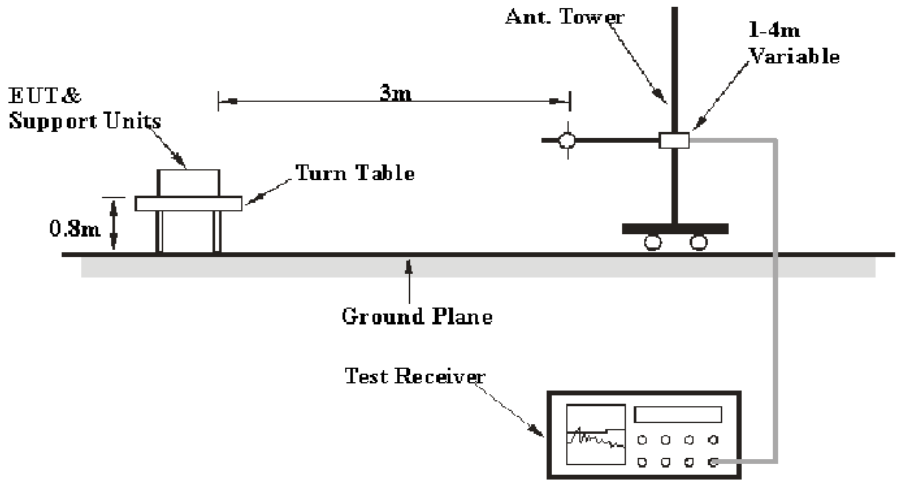
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

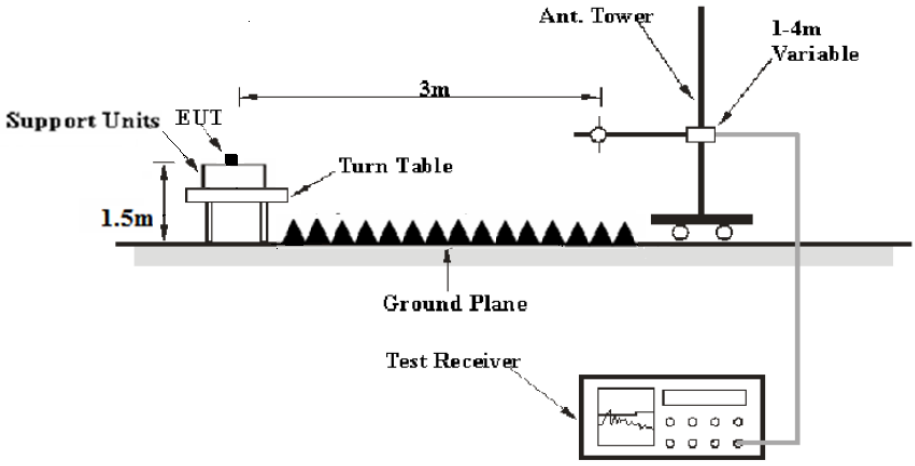
FCC §15.247 (d); §15.209; §15.205;

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 Setup

The system was investigated from 30 MHz to 10 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	Ave

Note: When duty cycle less than 98%, a correction factor shall be added to the average measurement results. Correction factor is 10*log (1/x), where "x" is the duty cycle.

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:

Corrected Amplitude (dBμV /m) = Meter Reading (dBμV) + Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB)

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:

Margin (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV /m)

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.

Test Data

Environmental Conditions

Temperature:	22.0-23.4 ℃
Relative Humidity:	48-50 %
ATM Pressure:	101.0-101.3 kPa

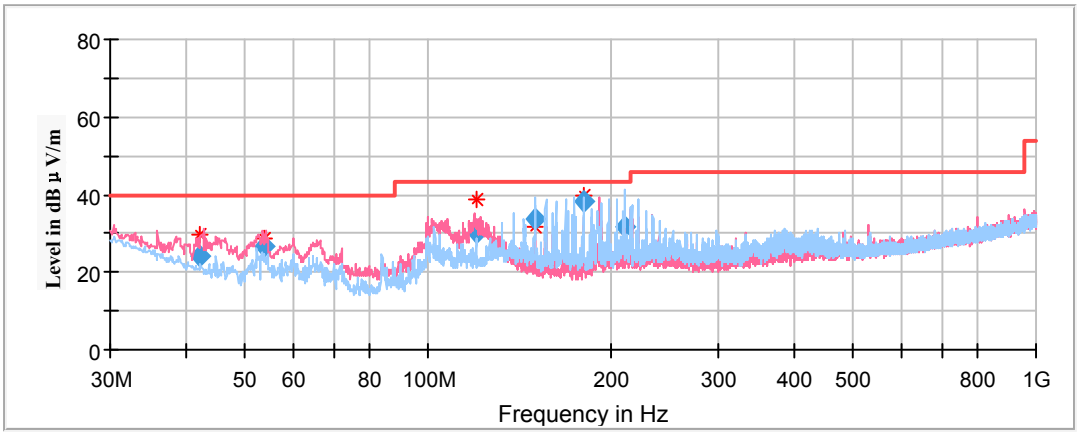
Radiated Emission Test was performed by Max Min on 2018-12-23.

EUT operation mode: Transmitting

Spurious Emission Test:

30MHz-1GHz:

*Pre-Scan with X,Y and Z axes of orientation,, the worst case **low channel in X-axis of orientation** was recorded*



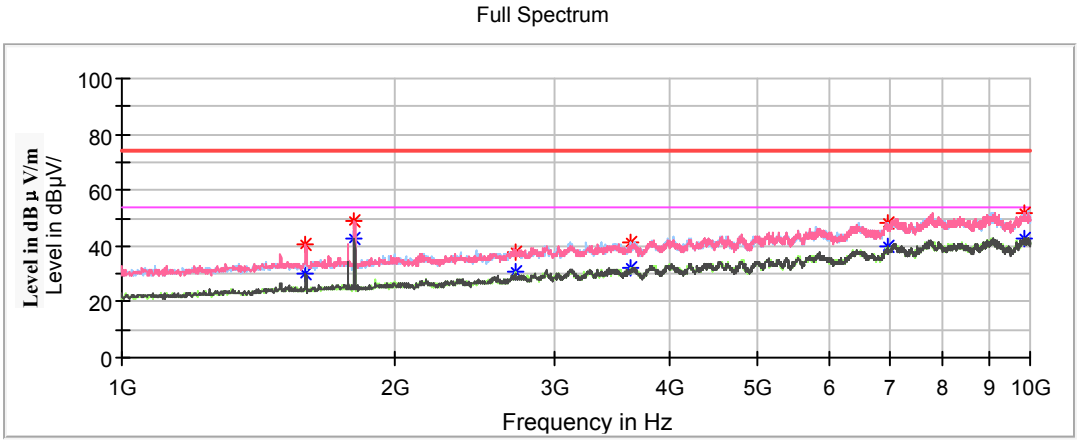
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	Quasi-peak (dBµV/m)	Height (cm)	Polar (H/V)				
42.153800	24.15	101.0	V	347.0	-12.2	40.00	15.85
53.586050	26.70	101.0	V	330.0	-17.7	40.00	13.30
120.016250	30.42	101.0	V	289.0	-11.2	40.00	9.58
150.216850	33.52	199.0	H	262.0	-12.3	43.50	9.98
180.216450	38.46	100.0	H	87.0	-13.6	46.00	7.54
210.246000	31.57	100.0	H	98.0	-12.3	46.00	14.43

1GHz-10GHz

*Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded.*

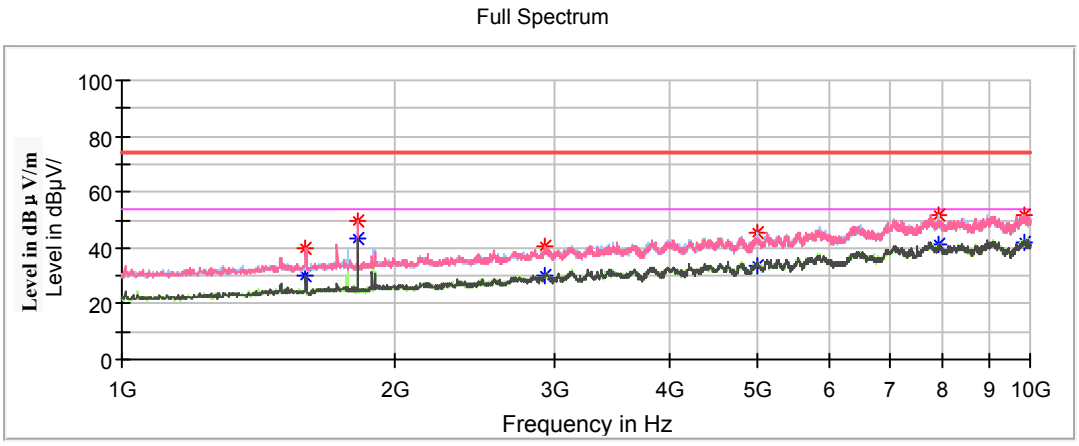
Note:
1. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB) + Attenuator(dB)
   Corrected Amplitude (dBμV /m) = Corrected Factor (dB/m) + Reading (dBμV)
   Margin (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV /m)

Low Channel: 903.0MHz



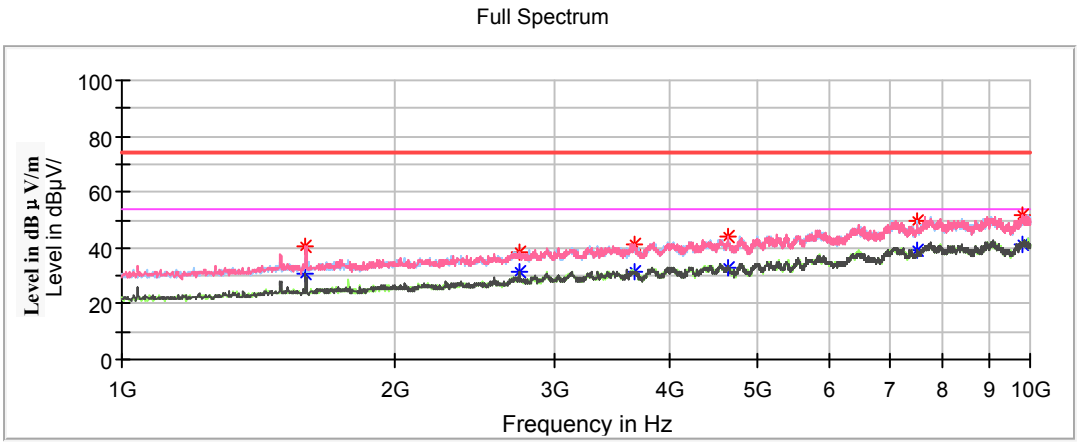
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
1594.000000	40.23	---	250.0	V	166.0	-7.2	74.00	33.77
1594.000000	---	29.94	250.0	V	166.0	-7.2	54.00	24.06
1806.000000	49.09	---	250.0	V	136.0	-6.5	74.00	24.91
1806.000000	---	42.38	250.0	V	136.0	-6.5	54.00	11.62
2709.000000	38.09	---	100.0	V	154.0	-3.2	74.00	35.91
2709.000000	---	30.76	100.0	V	154.0	-3.2	54.00	23.24
3637.000000	41.58	---	200.0	H	184.0	-0.4	74.00	32.42
3637.000000	---	32.46	200.0	H	184.0	-0.4	54.00	21.54
6965.200000	48.14	---	250.0	V	2.0	8.1	74.00	25.86
6965.200000	---	39.93	250.0	V	2.0	8.1	54.00	14.07
9857.800000	---	42.92	150.0	V	196.0	12.3	54.00	11.08
9857.800000	51.64	---	150.0	V	196.0	12.3	74.00	22.36

Middle Channel: 909.4MHz



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1594.000000	---	30.25	250.0	V	164.0	-7.2	54.00	23.75
1594.000000	40.03	---	250.0	V	164.0	-7.2	74.00	33.97
1818.800000	---	43.45	250.0	V	154.0	-6.4	54.00	10.55
1818.800000	49.91	---	250.0	V	154.0	-6.4	74.00	24.09
2728.200000	---	29.94	150.0	V	295.0	-2.0	54.00	24.06
2728.200000	40.69	---	150.0	V	295.0	-2.0	74.00	33.31
5001.400000	---	33.54	200.0	H	105.0	2.1	54.00	20.46
5001.400000	45.18	---	200.0	H	105.0	2.1	74.00	28.82
7942.600000	---	41.08	100.0	H	337.0	10.6	54.00	12.92
7942.600000	51.51	---	100.0	H	337.0	10.6	74.00	22.49
9857.800000	---	42.21	200.0	V	1.0	12.3	54.00	11.79
9857.800000	52.02	---	200.0	V	1.0	12.3	74.00	21.98

High Channel: 914.2MHz



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1592.200000	---	30.76	250.0	V	175.0	-7.2	54.00	23.24
1592.200000	40.71	---	250.0	V	175.0	-7.2	74.00	33.29
2742.600000	---	31.33	150.0	V	251.0	-3.0	54.00	22.67
2742.600000	38.13	---	150.0	V	251.0	-3.0	74.00	35.87
3658.600000	---	31.27	200.0	V	128.0	-0.3	54.00	22.73
3658.600000	41.02	---	200.0	V	128.0	-0.3	74.00	32.98
4648.600000	---	32.99	250.0	V	210.0	1.6	54.00	21.01
4648.600000	43.92	---	250.0	V	210.0	1.6	74.00	30.08
7508.800000	---	39.03	100.0	H	292.0	9.8	54.00	14.97
7508.800000	49.58	---	100.0	H	292.0	9.8	74.00	24.42
9811.000000	---	40.94	250.0	V	317.0	12.1	54.00	13.06
9811.000000	51.71	---	250.0	V	317.0	12.1	74.00	22.29

Fundamental Test & Restricted Bands Emissions Test:

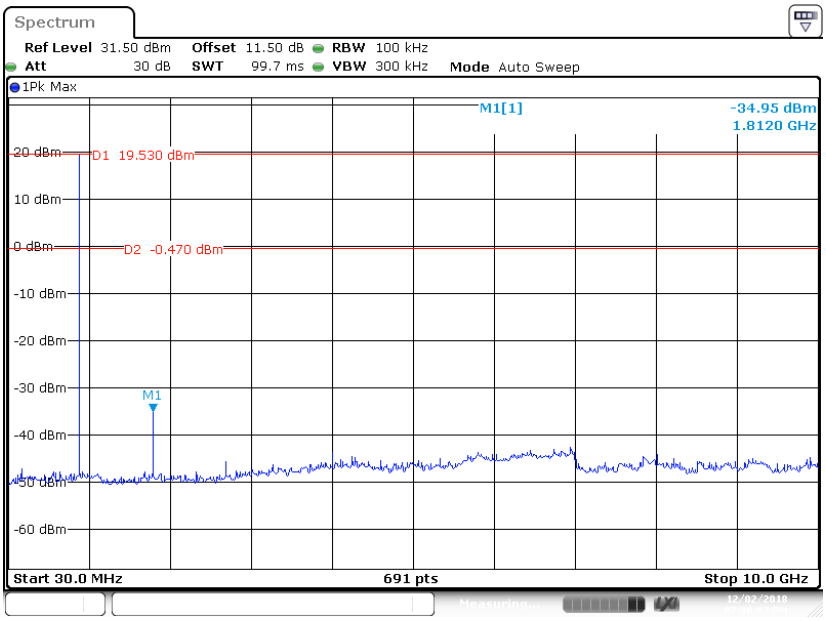
*(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded.)*

Note:
1. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
   Corrected Amplitude = Corrected Factor + Reading
   Margin = Limit - Corrected. Amplitude

Frequency (MHz)	Corrected Amplitude (dBµV /m)	Detector (PK/QP/Ave.)	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
			Height (cm)	Polar (H/V)				
903.00MHz								
903.00	114.11	PK	150	V	330	0.22	/	/
903.00	111.56	PK	150	H	330	0.22	/	/
902.00	36.97	QP	150	V	328	0.20	46	9.03
902.00	35.86	QP	150	H	328	0.20	46	10.14
909.40MHz								
909.40	114.09	PK	150	V	357	0.36	/	/
909.40	111.53	PK	150	H	357	0.36	/	/
914.20MHz								
914.20	114.13	PK	100	V	7	0.46	/	/
914.20	111.61	PK	100	H	7	0.46	/	/
928.00	34.61	QP	150	V	313	0.75	46	11.39
928.00	33.26	QP	150	H	313	0.75	46	12.74

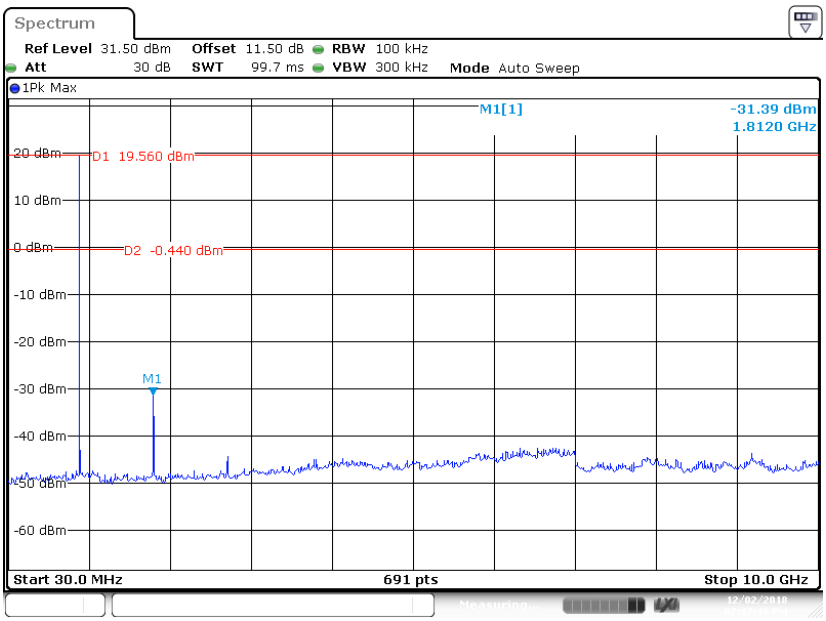
Conducted Spurious Emissions at Antenna Port:

Low Channel



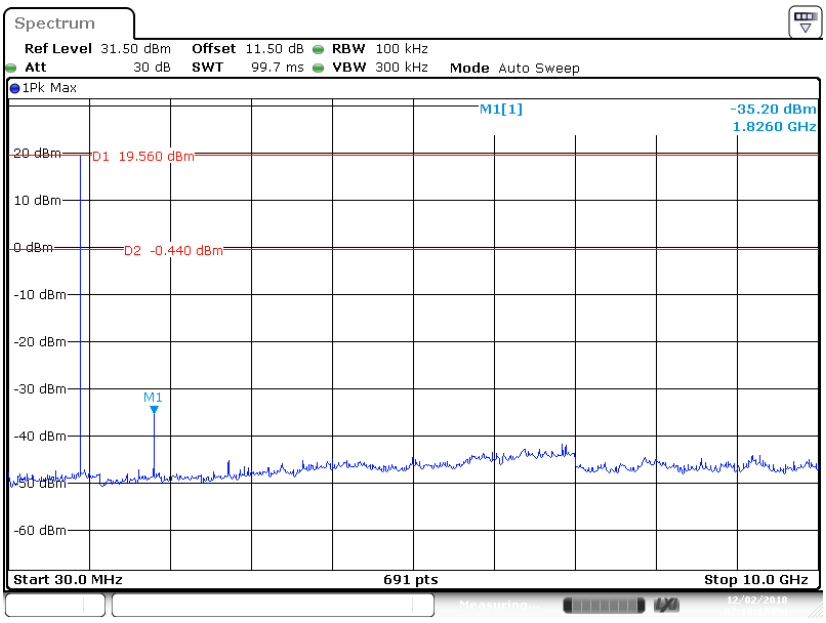
Date: 2.DEC.2018 19:16:03

Middle Channel



Date: 2.DEC.2018 19:17:19

High Channel



Date: 2.DEC.2018 19:18:17

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

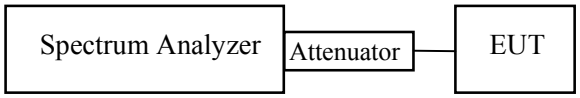
Applicable Standard

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

According to ANSI C63.10-2013 sub-clause 11.8.1

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3xRBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.



Test Data

Environmental Conditions

Temperature:	24.2℃
Relative Humidity:	51 %
ATM Pressure:	101.2 kPa

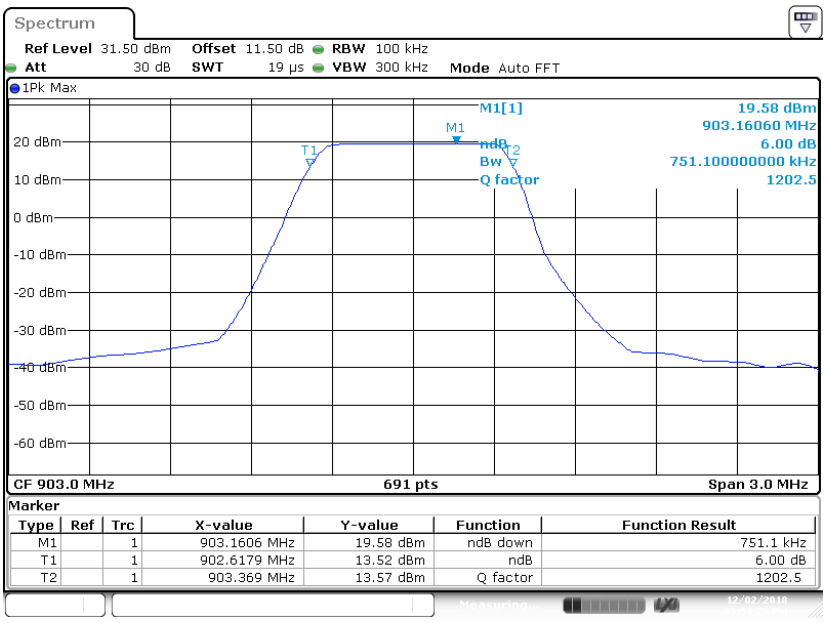
The testing was performed by Max Min on 2018-12-02.

Test Result: Pass.

EUT operation mode: Transmitting

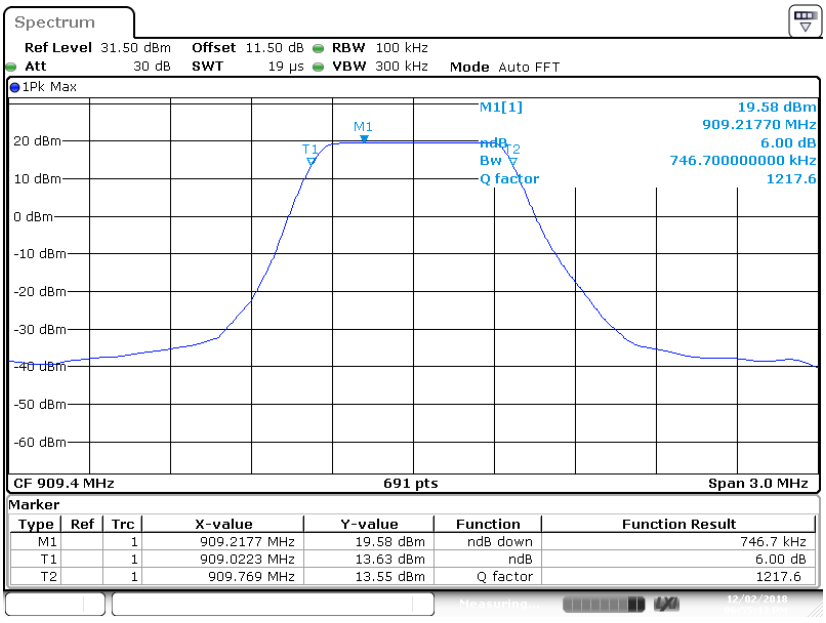
Channel	Frequency (MHz)	6 dB Emission Bandwidth (kHz)	Limit (MHz)
Low	903.00	0.751	≥0.5
Middle	909.40	0.747	≥0.5
High	914.20	0.751	≥0.5

Low Channel



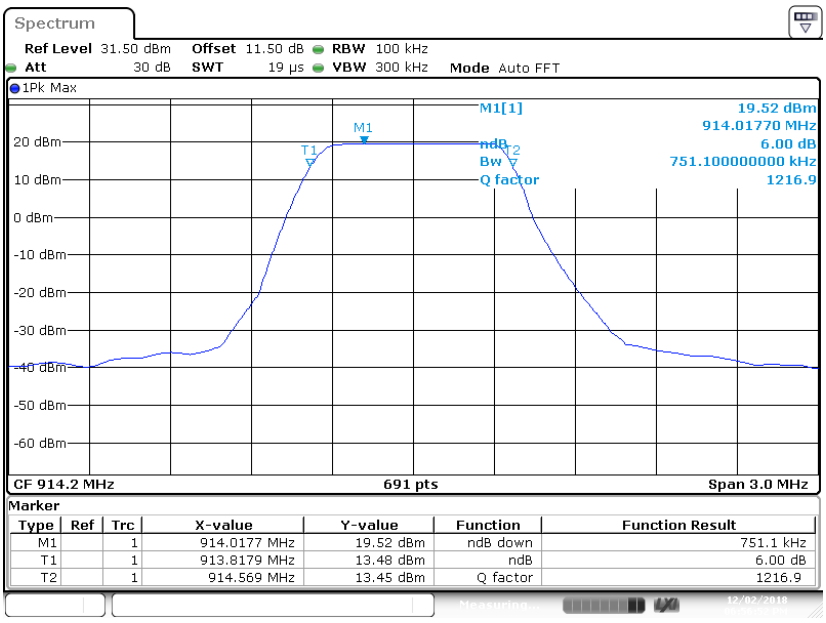
Date: 2.DEC.2018 18:59:26

Middle Channel



Date: 2.DEC.2018 18:55:13

High Channel



Date: 2.DEC.2018 18:56:52

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

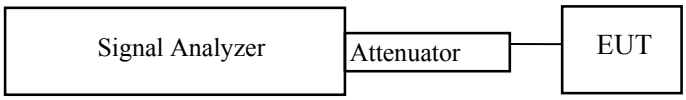
Applicable Standard

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

According to ANSI C63.10-2013 sub-clause 11.9.1.3

1. Set the RBW ≥ DTS bandwidth.
2. Set VBW ≥ 3 x RBW.
3. Set span ≥ 3 x RBW
4. Sweep time = auto couple.
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.



Test Data

Environmental Conditions

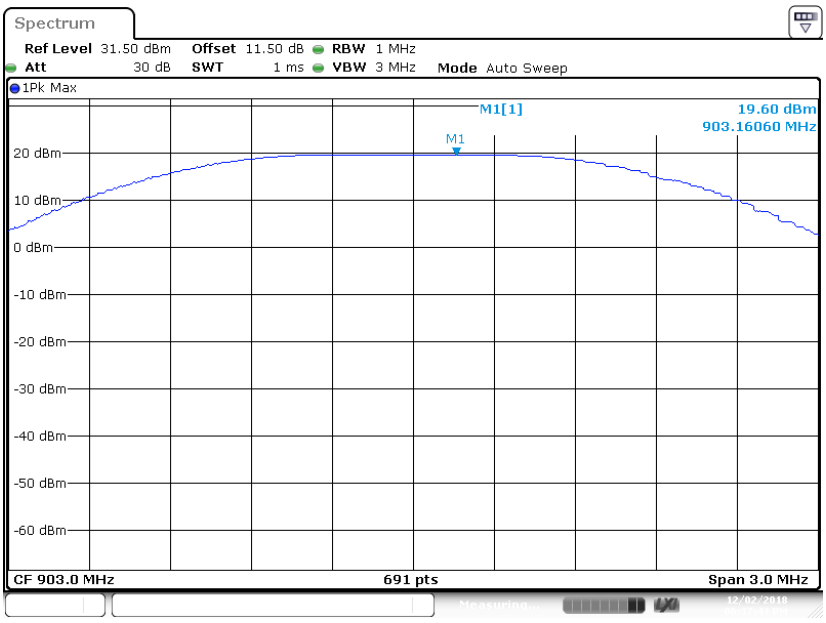
Temperature:	24.2℃
Relative Humidity:	51 %
ATM Pressure:	101.2 kPa

The testing was performed by Max Min on 2018-12-02.

EUT operation mode: Transmitting

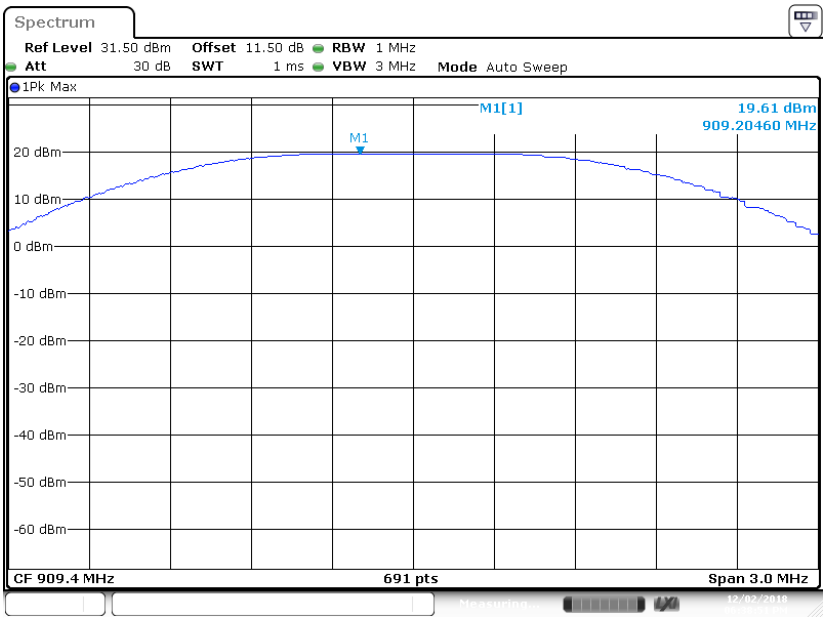
Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
Low	903.00	19.60	30	Pass
Middle	909.40	19.61	30	Pass
High	914.20	19.59	30	Pass

Low Channel



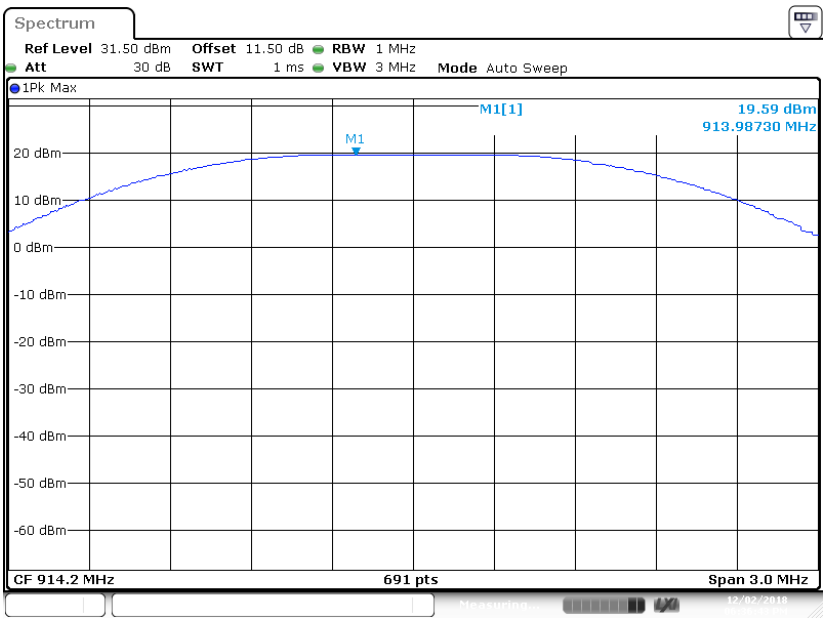
Date: 2.DEC.2018 18:37:43

Middle Channel



Date: 2.DEC.2018 18:38:52

High Channel



Date: 2.DEC.2018 18:36:43

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

According to ANSI C63.10-2013 clause 6.10.

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

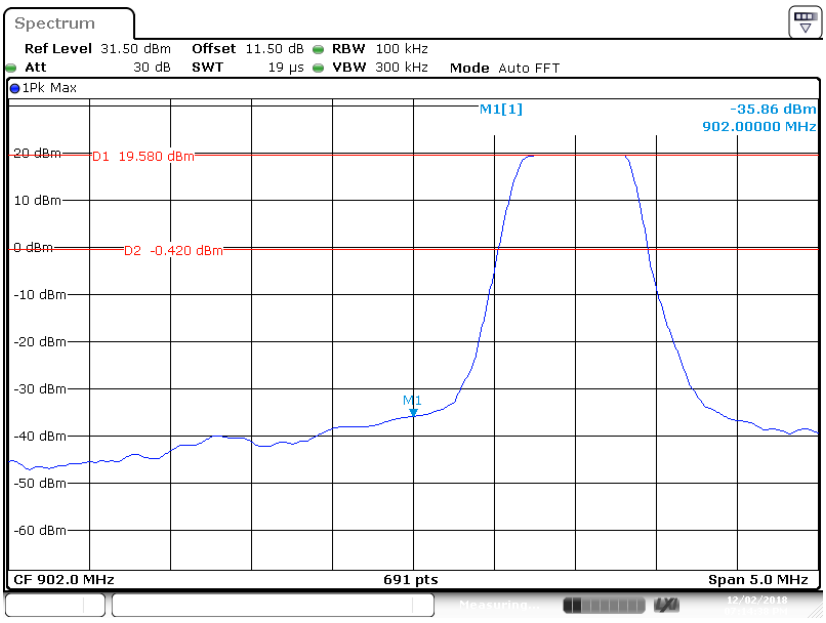
Temperature:	24.2℃
Relative Humidity:	51 %
ATM Pressure:	101.2 kPa

The testing was performed by Max Min on 2018-12-02.

EUT operation mode: Transmitting

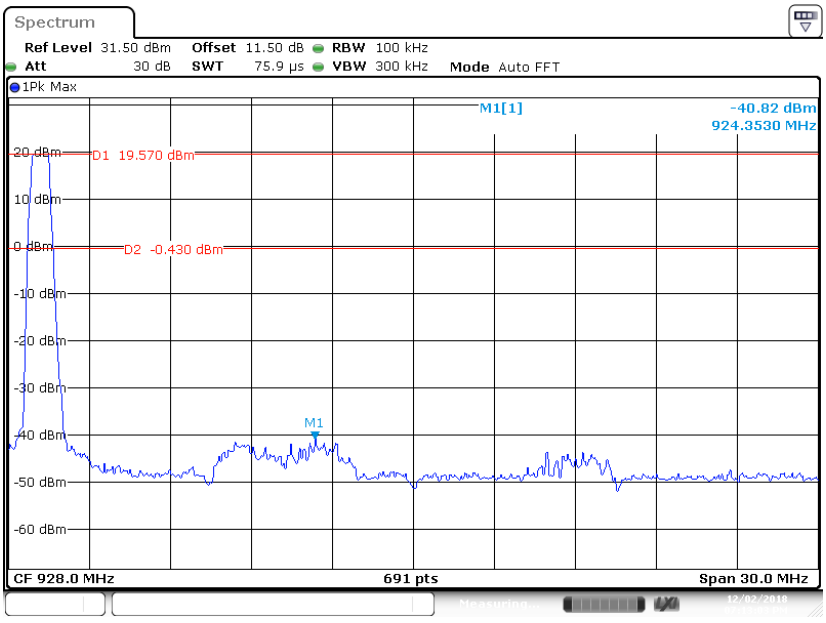
Test Result: *Compliance*

Left Side



Date: 2.DEC.2018 19:14:38

Right Side



Date: 2.DEC.2018 19:13:03

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

According to ANSI C63.10-2013 sub-clause 11.10.2

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: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×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:	24.2℃
Relative Humidity:	51 %
ATM Pressure:	101.2 kPa

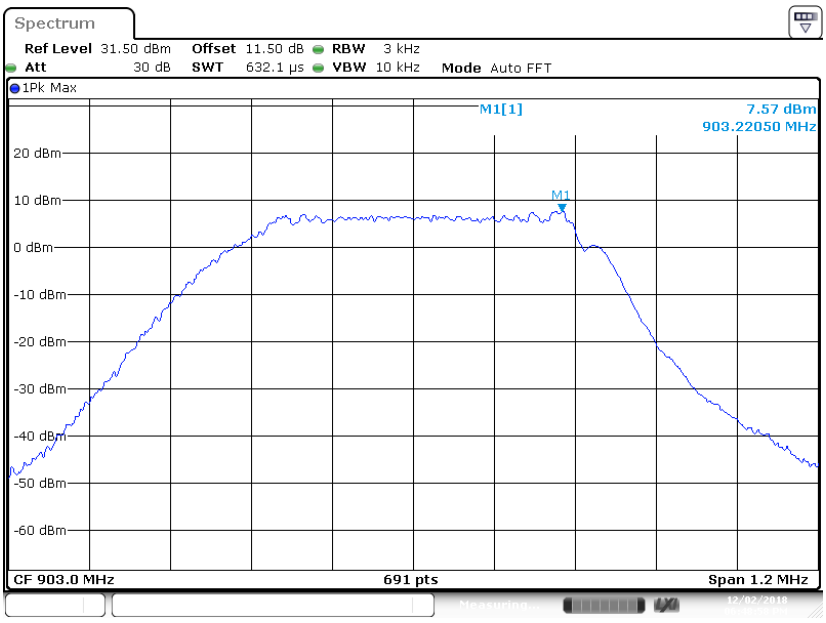
The testing was performed by Max Min on 2018-12-02.

EUT operation mode: Transmitting

Test Result: Pass

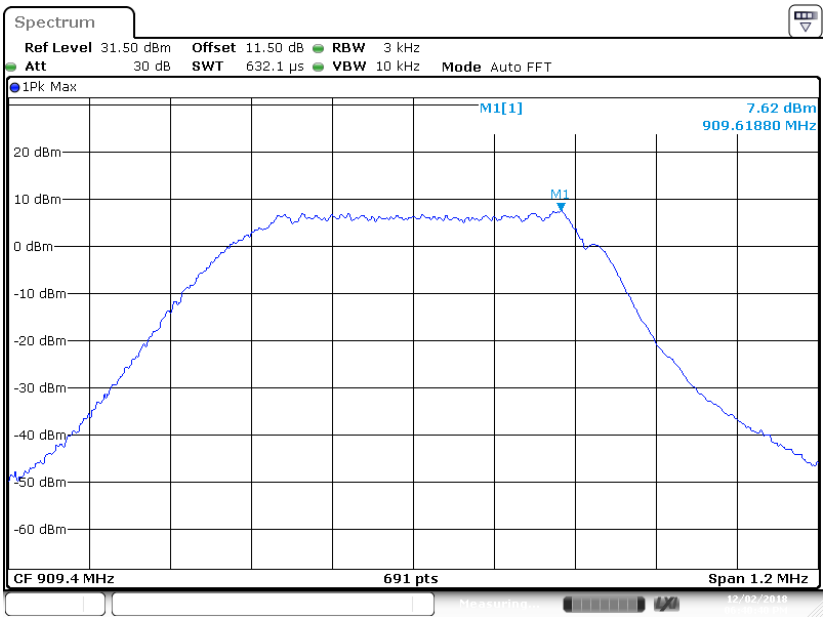
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
Low	903.00	7.57	≤8
Middle	909.40	7.62	≤8
High	914.20	7.57	≤8

Low Channel



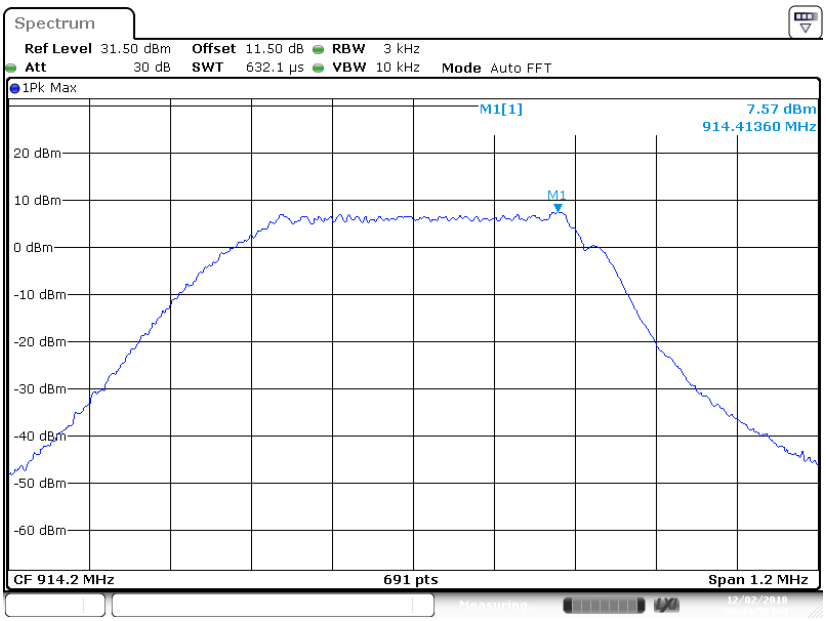
Date: 2.DEC.2018 18:48:59

Middle Channel



Date: 2.DEC.2018 18:40:40

High Channel



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