

APPLICATION CERTIFICATION FCC Part 15C
On Behalf of
Qingdao Topscomm Communication Co., Ltd.

RF LoRa Module
Model No.: RF_LORA1276

FCC ID: 2AKOD-RFLORA1276

Prepared for : Qingdao Topscomm Communication Co., Ltd.
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Prepared by : ACCURATE TECHNOLOGY CO., LTD
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Report No. : ATE20162640
Date of Test : December 16, 2016
Date of Report : December 19, 2016

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Test Report Certification

Applicant : Qingdao Topscomm Communication Co., Ltd.
Manufacturer : Qingdao Topscomm Communication Co., Ltd.
EUT Description : RF LoRa Module
(A) MODEL NO.: RF_LORA1276
(B) POWER SUPPLY: DC 3.3V; 120mA

Measurement Procedure Used:

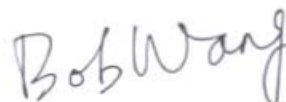
FCC Rules and Regulations Part 15 Subpart C Section 15.247:2016
ANSI C63.10: 2013


The EUT was tested according to DTS test procedure of Apr 08, 2016 KDB558074 D01 DTS Meas Guidance v03r05 for compliance to FCC 47CFR 15.247 requirements

The device described above is tested by ACCURATE TECHNOLOGY CO. LTD to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC Part 15 Subpart C Section 15.247 limits. The measurement results are contained in this test report and ACCURATE TECHNOLOGY CO. LTD is assumed full responsibility for the accuracy and completeness of these measurements. Also, this report shows that the Equipment Under Test (EUT) is to be technically compliant with the FCC requirements.

This report applies to above tested sample only. This report shall not be reproduced in part without written approval of ACCURATE TECHNOLOGY CO. LTD.

Date of Test :	December 16, 2016
Date of Report :	December 19, 2016

Prepared by : 
(Bob Wang, Engineer)

Approved & Authorized Signer : 
(Sean Liu, Manager)

1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	:	RF LoRa Module
Model Number	:	RF_LORA1276
Trade Mark	:	TOPSCOMM
Frequency	:	904MHz-926MHz
Number of Channels	:	15
Antenna Gain	:	3dBi
Type of Antenna	:	Integral Antenna
Power Supply	:	DC 3.3V; 120mA
Modulation Type	:	FSK, GFSK, MSK, GMSK, LoRa, OOK
Applicant	:	Qingdao Topscomm Communication Co., Ltd.
Address	:	Zone B, Floor 5, Building 6, No.288 Ningxia Road, Shinan district, Qingdao, Shandong, 266014, China
Manufacturer	:	Qingdao Topscomm Communication Co., Ltd.
Address	:	Zone B, Floor 5, Building 6, No.288 Ningxia Road, Shinan district, Qingdao, Shandong, 266014, China
Date of sample received	:	December 13, 2016
Date of Test	:	December 16, 2016

1.2.Carrier Frequency of Channels

channel	frequency
1	904
2	905
3	906
4	907
5	909
6	911
7	913
8	915
9	917
10	919
11	921
12	923
13	924
14	925
15	926

1.3.Accessory and Auxiliary Equipment

Notebook PC : Manufacturer: LENOVO
M/N: 4290-RT8
S/N: R9-FW93G 11/08

1.4. Description of Test Facility

EMC Lab : Accredited by TUV Rheinland Shenzhen

Listed by FCC
The Registration Number is 752051

Listed by Industry Canada
The Registration Number is 5077A-2

Accredited by China National Accreditation Committee
for Laboratories
The Certificate Registration Number is L3193

Name of Firm : ACCURATE TECHNOLOGY CO. LTD
Site Location : F1, Bldg. A, Changyuan New Material Port, Keyuan Rd.
Science & Industry Park, Nanshan, Shenzhen, Guangdong
P.R. China

1.5. Measurement Uncertainty

Conducted Emission Expanded Uncertainty = 2.23dB, k=2

Radiated emission expanded uncertainty = 3.08dB, k=2
(9kHz-30MHz)

Radiated emission expanded uncertainty = 4.42dB, k=2
(30MHz-1000MHz)

Radiated emission expanded uncertainty = 4.06dB, k=2
(Above 1GHz)

2. MEASURING DEVICE AND TEST EQUIPMENT

Table 1: List of Test and Measurement Equipment

Kind of equipment	Manufacturer	Type	S/N	Calibrated dates	Calibrated until
EMI Test Receiver	Rohde&Schwarz	ESCS30	100307	Jan. 9, 2016	Jan. 09, 2017
EMI Test Receiver	Rohde&Schwarz	ESPI3	101526/003	Jan. 9, 2016	Jan. 09, 2017
Spectrum Analyzer	Agilent	E7405A	MY45115511	Jan. 9, 2016	Jan. 09, 2017
Pre-Amplifier	Rohde&Schwarz	CBLU118354 0-01	3791	Jan. 9, 2016	Jan. 09, 2017
Loop Antenna	Schwarzbeck	FMZB1516	1516131	Jan. 14, 2016	Jan. 13, 2017
Bilog Antenna	Schwarzbeck	VULB9163	9163-323	Jan. 14, 2016	Jan. 13, 2017
Horn Antenna	Schwarzbeck	BBHA9120D	9120D-655	Jan. 14, 2016	Jan. 12, 2017
Horn Antenna	Schwarzbeck	BBHA9170	9170-359	Jan. 14, 2016	Jan. 13, 2017
LISN	Rohde&Schwarz	ESH3-Z5	100305	Jan. 9, 2016	Jan. 09, 2017
LISN	Schwarzbeck	NSLK8126	8126431	Jan. 9, 2016	Jan. 09, 2017
Highpass Filter	Wainwright Instruments	WHKX3.6/18 G-10SS	N/A	Jan. 9, 2016	Jan. 09, 2017
Band Reject Filter	Wainwright Instruments	WRCG2400/2 485-2375/2510 -60/11SS	N/A	Jan. 9, 2016	Jan. 09, 2017

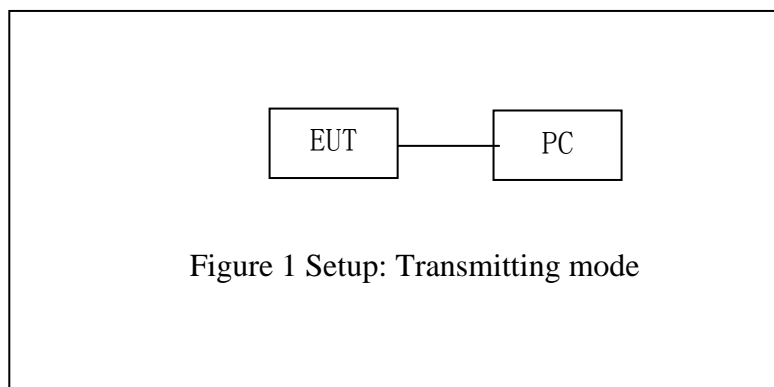
3. OPERATION OF EUT DURING TESTING

3.1.Operating Mode

The mode is used:

Low Channel: 904MHz
Middle Channel: 915MHz
High Channel: 926MHz

3.2.Configuration and peripherals



4. TEST PROCEDURES AND RESULTS

FCC Rules	Description of Test	Result
Section 15.207	Power Line Conducted Emission	N/A
Section 15.247(a)(2)	6dB Bandwidth Test	Compliant
Section 15.247(e)	Power Spectral Density Test	Compliant
Section 15.247(b)(3)	Maximum Peak Output Power Test	Compliant
Section 15.247(d)	Band Edge Compliance Test	Compliant
Section 15.247(d) Section 15.209	Radiated Spurious Emission Test	Compliant
Section 15.247(d)	Conducted Spurious Emission Test	Compliant
Section 15.203	Antenna Requirement	Compliant

5. POWER LINE CONDUCTED MEASUREMENT

5.1.Power Line Conducted Emission Measurement Limits

Frequency (MHz)	Limit dB(μ V)	
	Quasi-peak Level	Average Level
0.15 - 0.50	66.0 – 56.0 *	56.0 – 46.0 *
0.50 - 5.00	56.0	46.0
5.00 - 30.00	60.0	50.0
NOTE1: The lower limit shall apply at the transition frequencies. NOTE2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.50MHz.		

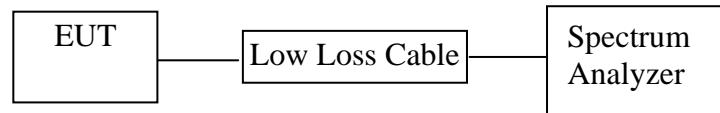
5.2.Power Line Conducted Emission Measurement Results

N/A.

Note: The power supply mode of the EUT is DC 3.3V, According to the FCC standard requirements, conducted emission is not applicable

6. 6DB BANDWIDTH MEASUREMENT

6.1. Block Diagram of Test Setup



6.2. The Requirement For Section 15.247(a)(2)

Section 15.247(a)(2): Systems using digital modulation techniques may operate in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

6.3. EUT Configuration on Measurement

The equipment are installed on the emission measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

6.4. Operating Condition of EUT

6.4.1. Setup the EUT and simulator as shown as Section 6.1.

6.4.2. Turn on the power of all equipment.

6.4.3. Let the EUT work in TX modes measure it. The transmit frequency are 904-926MHz. We select 904MHz, 915MHz, 926MHz TX frequency to transmit.

6.5. Test Procedure

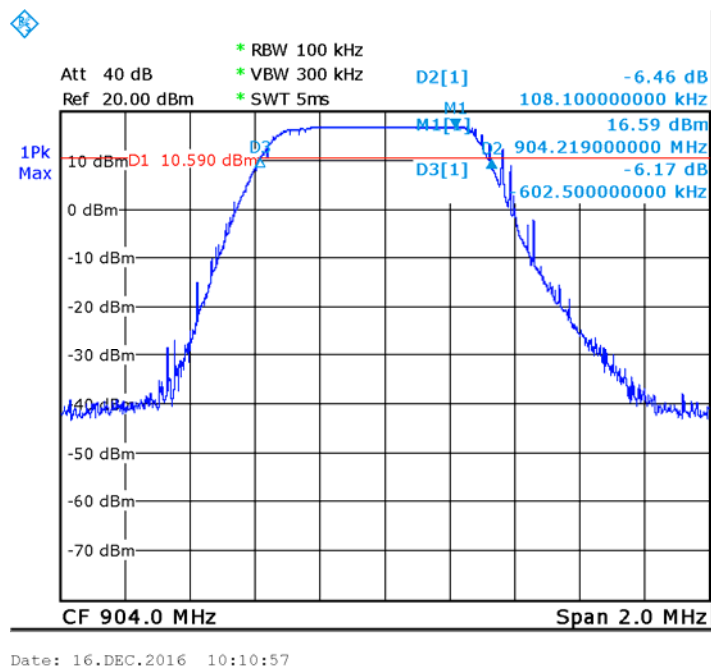
1. Set resolution bandwidth (RBW) = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with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

6.6. Test Result

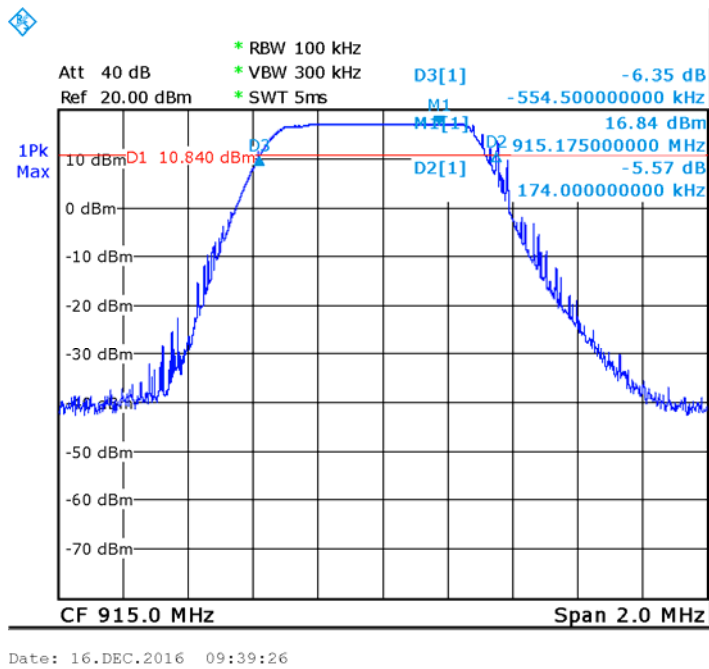
Channel	Frequency (MHz)	6dB Bandwidth (kHz)	Limit (MHz)
Low	904	710.6	> 0.5MHz
Middle	915	728.5	> 0.5MHz
High	926	690.6	> 0.5MHz

6dB Bandwidth

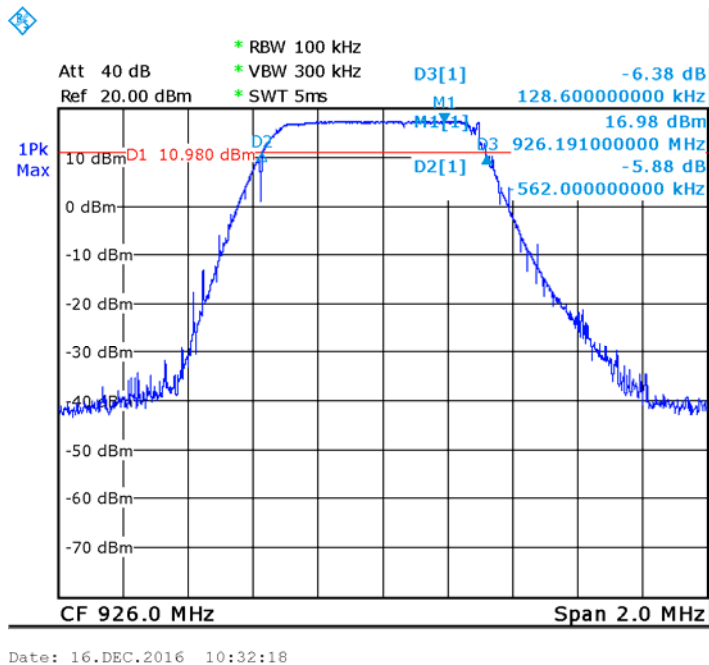
Low 904MHz



Middle 915MHz

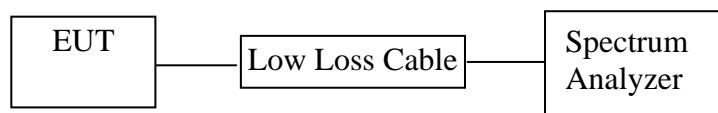


High 926MHz



7. MAXIMUM PEAK OUTPUT POWER

7.1. Block Diagram of Test Setup



7.2. The Requirement For Section 15.247(b)(3)

Section 15.247(b)(3): For systems using digital modulation in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands: 1 Watt.

7.3. EUT Configuration on Measurement

The equipment is installed on the emission Measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

7.4. Operating Condition of EUT

7.4.1. Setup the EUT and simulator as shown as Section 7.1.

7.4.2. Turn on the power of all equipment.

7.4.3. Let the EUT work in TX modes measure it. The transmit frequency are 904-926MHz. We select 904MHz, 915MHz, 926MHz TX frequency to transmit.

7.5. Test Procedure

7.5.1. The transmitter output was connected to the spectrum analyzer through a low loss cable.

7.5.2. Test method is options 1 from KDB558074 D01 DTS Meas Guidance v03r05

7.5.3. Set RBW of spectrum analyzer to 1 MHz and VBW to 3 MHz.

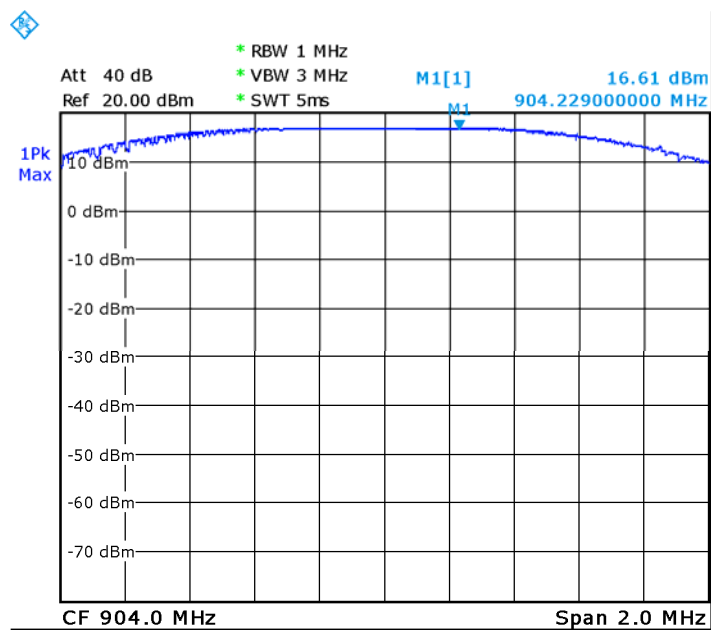
7.5.4. Measurement the maximum peak output power.

7.6.Test Result

Channel	Frequency (MHz)	peak output power (dBm)	peak output power (mW)	Limits dBm / W
Low	904MHz	16.61	45.81	30 dBm / 1 W
Middle	915MHz	16.82	48.08	30 dBm / 1 W
High	926MHz	17.00	50.12	30 dBm / 1 W

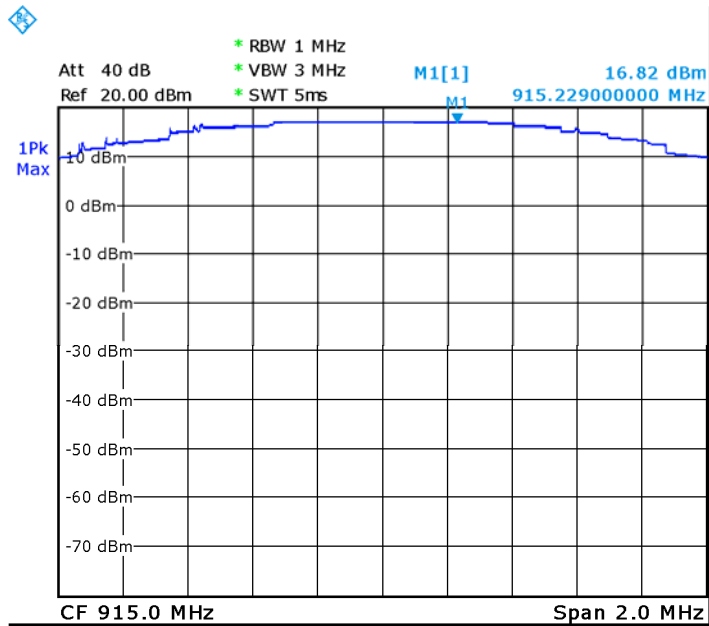
The spectrum analyzer plots are attached as below.

Low 904MHz



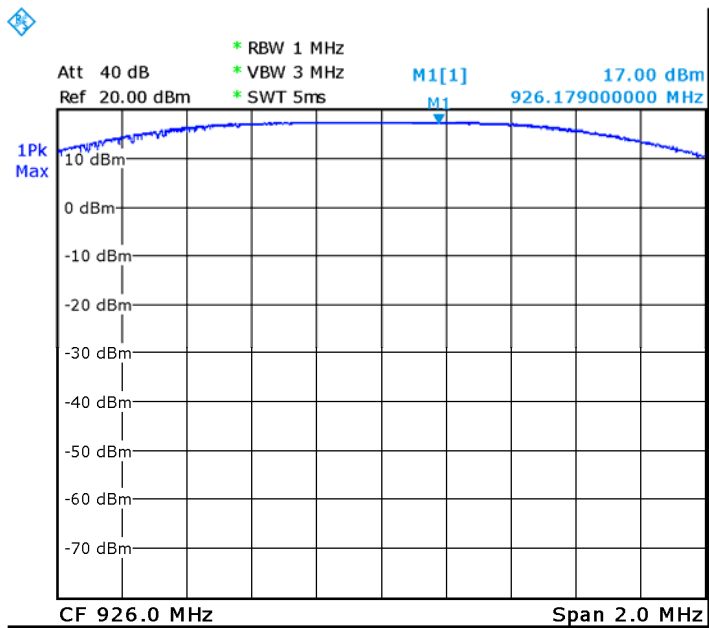
Date: 16.DEC.2016 10:12:37

Middle 915MHz



Date: 16.DEC.2016 05:12:23

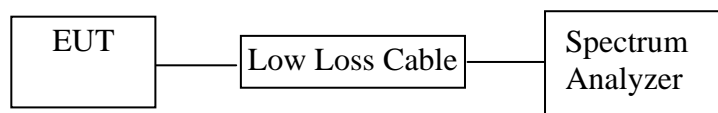
802.11b Channel High 926MHz



Date: 16.DEC.2016 10:37:53

8. POWER SPECTRAL DENSITY MEASUREMENT

8.1. Block Diagram of Test Setup



8.2. The Requirement For Section 15.247(e)

Section 15.247(e): 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.

8.3. EUT Configuration on Measurement

The equipment are installed on the emission Measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

8.4. Operating Condition of EUT

8.4.1. Setup the EUT and simulator as shown as Section 8.1.

8.4.2. Turn on the power of all equipment.

8.4.3. Let the EUT work in TX modes measure it. The transmit frequency are 904-926MHz. We select 904MHz, 915MHz, 926MHz TX frequency to transmit.

8.5. Test Procedure

8.5.1. The transmitter output was connected to the spectrum analyzer through a low loss cable.

8.5.2. Measurement Procedure PKPSD:

This procedure must be used if maximum peak conducted output power was used to demonstrate compliance to the fundamental output power limit, and is optional if the maximum (average) conducted output power was used to demonstrate compliance.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.

4. Set the VBW $\geq 3 \times$ RBW.
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.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

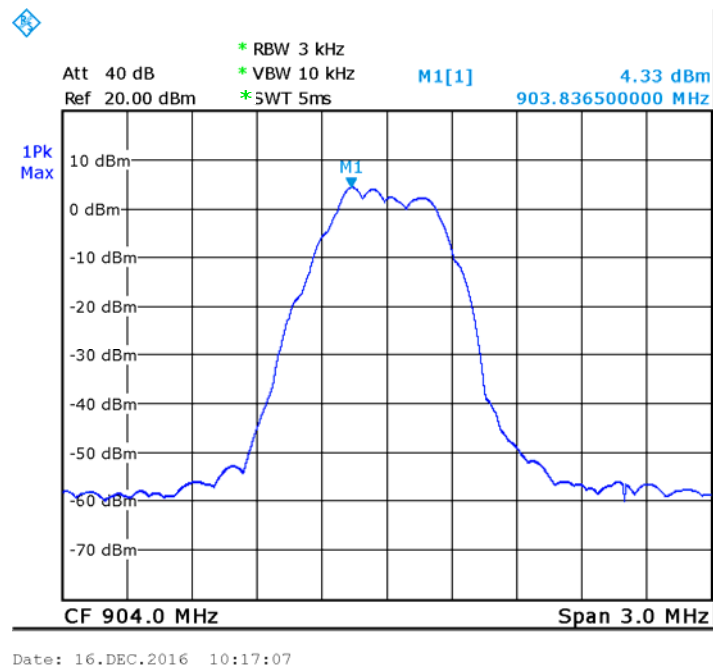
8.5.3.Measurement the maximum power spectral density.

8.6.Test Result

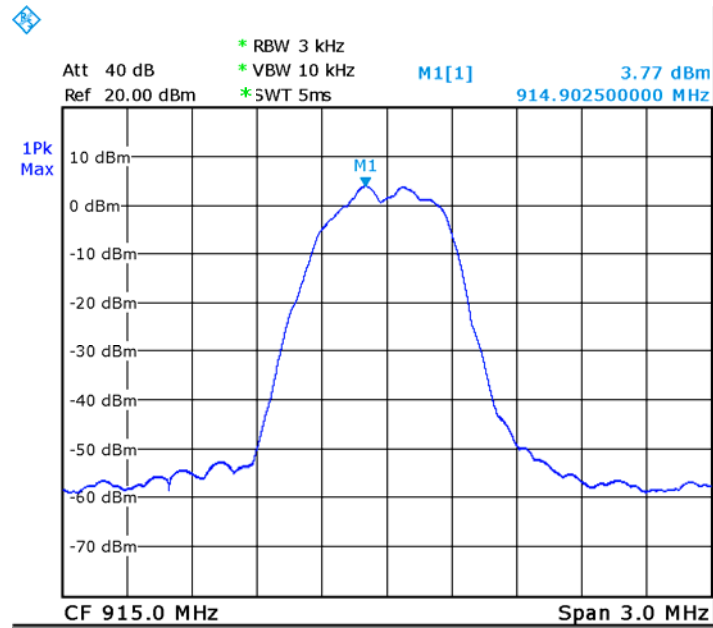
The test was performed with 802.11b			
Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limits (dBm)
Low	904MHz	4.33	8 dBm
Middle	915MHz	3.77	8 dBm
High	926MHz	3.78	8 dBm

The spectrum analyzer plots are attached as below.

Low 904MHz

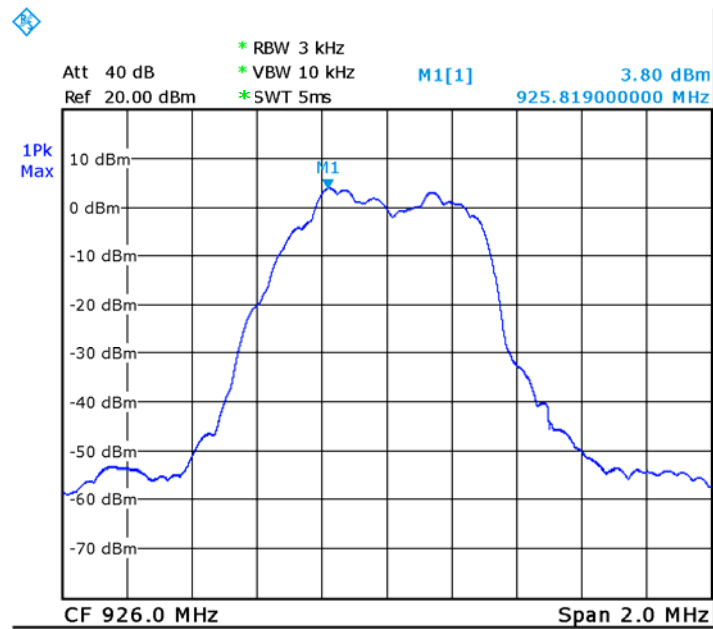


Middle 915MHz



Date: 16.DEC.2016 09:52:28

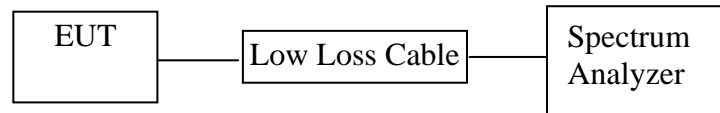
High 926MHz



Date: 16.DEC.2016 10:40:00

9. BAND EDGE COMPLIANCE TEST

9.1. Block Diagram of Test Setup



9.2. The Requirement For Section 15.247(d)

Section 15.247(d): 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

9.3. EUT Configuration on Measurement

The equipment are installed on the emission Measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

9.4. Operating Condition of EUT

9.4.1. Setup the EUT and simulator as shown as Section 9.1.

9.4.2. Turn on the power of all equipment.

9.4.3. Let the EUT work in TX modes measure it. The transmit frequency are 904-926MHz MHz. We select 904MHz, 926MHz TX frequency to transmit.

9.5. Test Procedure

Conducted Band Edge:

9.5.1. The transmitter output was connected to the spectrum analyzer via a low loss cable.

9.5.2.Set RBW of spectrum analyzer to 100kHz and VBW to 300kHz.

Radiate Band Edge:

9.5.3.The EUT is placed on a turntable, which is 0.8m above the ground plane and worked at highest radiated power.

9.5.4.The turntable was rotated for 360 degrees to determine the position of maximum emission level.

9.5.5.EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.

9.5.6.Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:

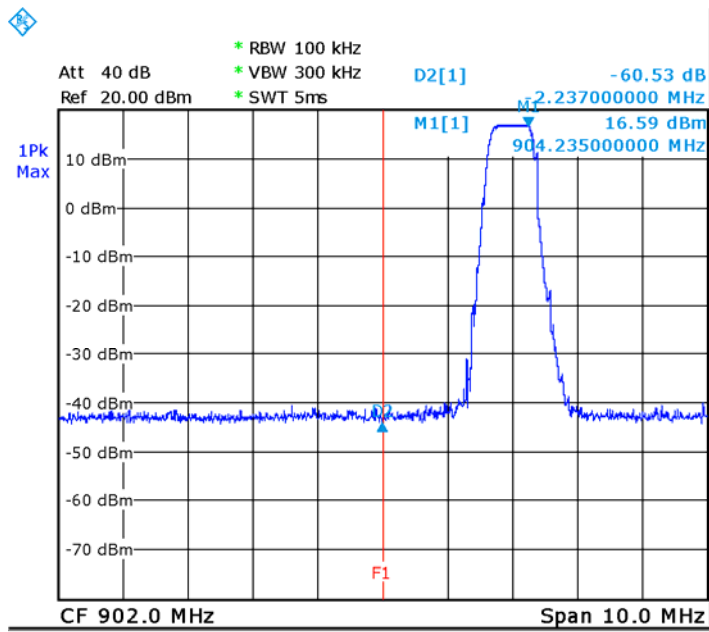
9.5.7.RBW=1MHz, VBW=1MHz

9.5.8.The band edges was measured and recorded.

9.6.Test Result

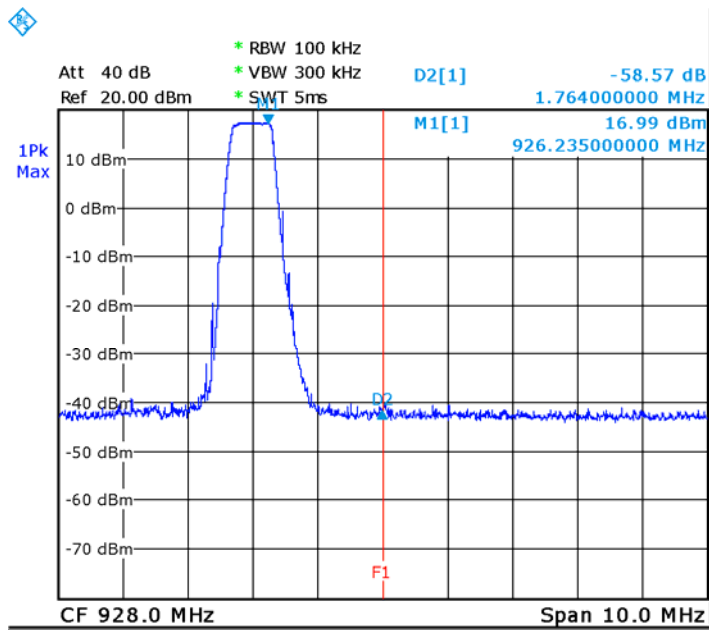
Frequency (MHz)	Result of Band Edge (dBc)	Limit of Band Edge (dBc)
904MHz	77.12	> 20dBc
926MHz	75.56	> 20dBc

Low 904MHz



Date: 16.DEC.2016 13:17:07

High 926MHz



Date: 16.DEC.2016 10:45:49

Radiated Band Edge Result

Note:

1. Emissions attenuated more than 20 dB below the permissible value are not reported.
2. The field strength is calculated by adding the antenna factor, high pass filter loss(if used) and cable loss, and subtracting the amplifier gain(if any)from the measured reading. The basic equation calculation is as follows:

Result = Reading + Corrected Factor

3. Display the measurement of peak values.

Test Procedure:

The EUT and its simulators are placed on a turntable, which is 1.5 meter high above ground(Above 1GHz). The turntable can rotate 360 degrees to determine the position of the maximum emission level. EUT is set 3.0 meters away from the receiving antenna, which is mounted on an antenna tower. The antenna can be moved up and down between 1.0 meter and 4 meters to find out the maximum emission level. Broadband antenna (calibrated bi-log antenna) is used as receiving antenna. Both horizontal and vertical polarizations of the antenna are set on measurement. In order to find the maximum emission levels, all of the EUT location must be manipulated according to ANSI C63.10:2013 on radiated emission measurement. The EUT was tested in 3 orthogonal planes.

Let the EUT work in TX modes then measure it.

We select 904MHz, 926MHz TX frequency to transmit.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

- 1.The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz.
- 2.The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
- 3.All modes of operation were investigated and the worst-case emissions are reported.



ACCURATE TECHNOLOGY CO., LTD.

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Fax:+86-0755-26503396

Job No.: YJZH #529

Standard: FCC PK

Test item: Radiation Test

Temp.(C)/Hum.(%) 25 C / 55 %

EUT: RF LoRa Module

Mode: TX 904M

Model: RF_LORA1276

Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Vertical

Power Source: DC 3.3V

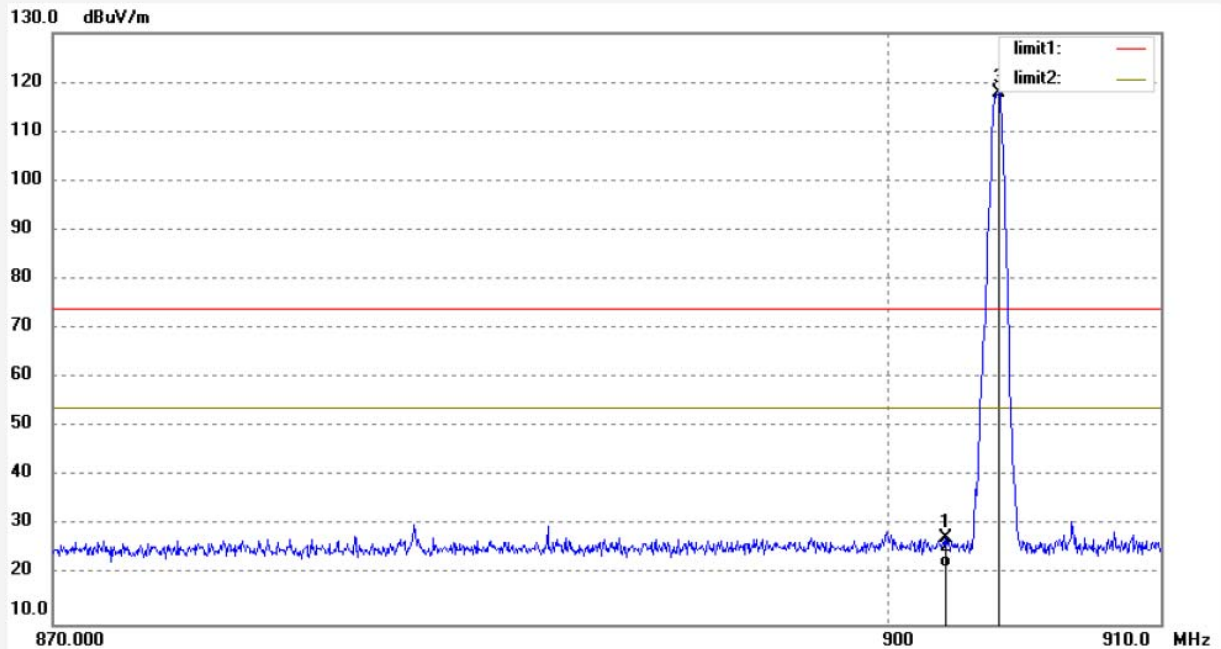
Date: 2016/12/16

Time: 18:13:41

Engineer Signature: YJZH

Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	902.0828	29.73	-2.26	27.47	74.00	-46.53	peak			
2	902.0828	23.73	-2.26	21.47	54.00	-32.53	AVG			
3	904.0000	120.09	-2.23	117.86			peak			



ACCURATE TECHNOLOGY CO., LTD.

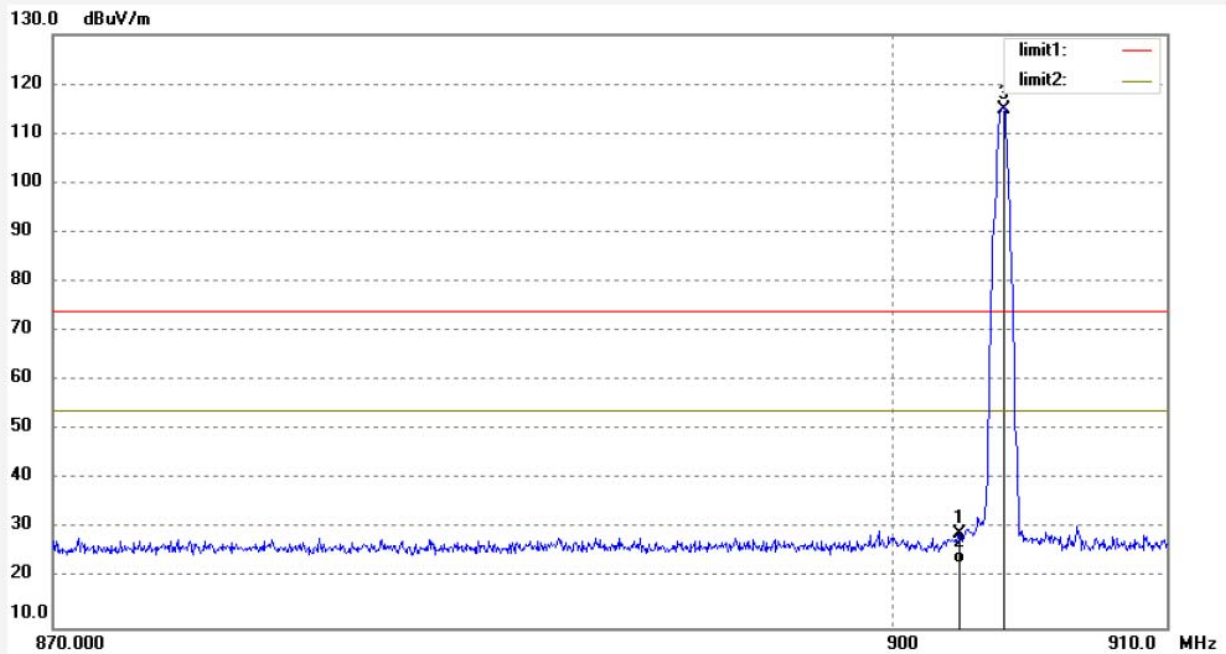
F1,Bldg,A,Changyuan New Material Port Keyuan Rd,
Science & Industry Park,Nanshan Shenzhen,P.R.China

Site: 1# Chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

Job No.: YJZH #530
Standard: FCC PK
Test item: Radiation Test
Temp.(C)/Hum.(%) 25 C / 55 %
EUT: RF LoRa Module
Mode: TX 904M
Model: RF_LORA1276
Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Horizontal
Power Source: DC 3.3V
Date: 2016/12/16
Time: 18:12:42
Engineer Signature: YJZH
Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	902.4080	31.40	-2.25	29.15	74.00	-44.85	peak			
2	902.4080	25.40	-2.25	23.15	54.00	-30.85	AVG			
3	904.0000	117.12	-2.23	114.89			peak			

Job No.: YJZH #531

Standard: FCC PK

Test item: Radiation Test

Temp.(C)/Hum.(%) 25 C / 55 %

EUT: RF LoRa Module

Mode: TX 926M

Model: RF_LORA1276

Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Horizontal

Power Source: DC 3.3V

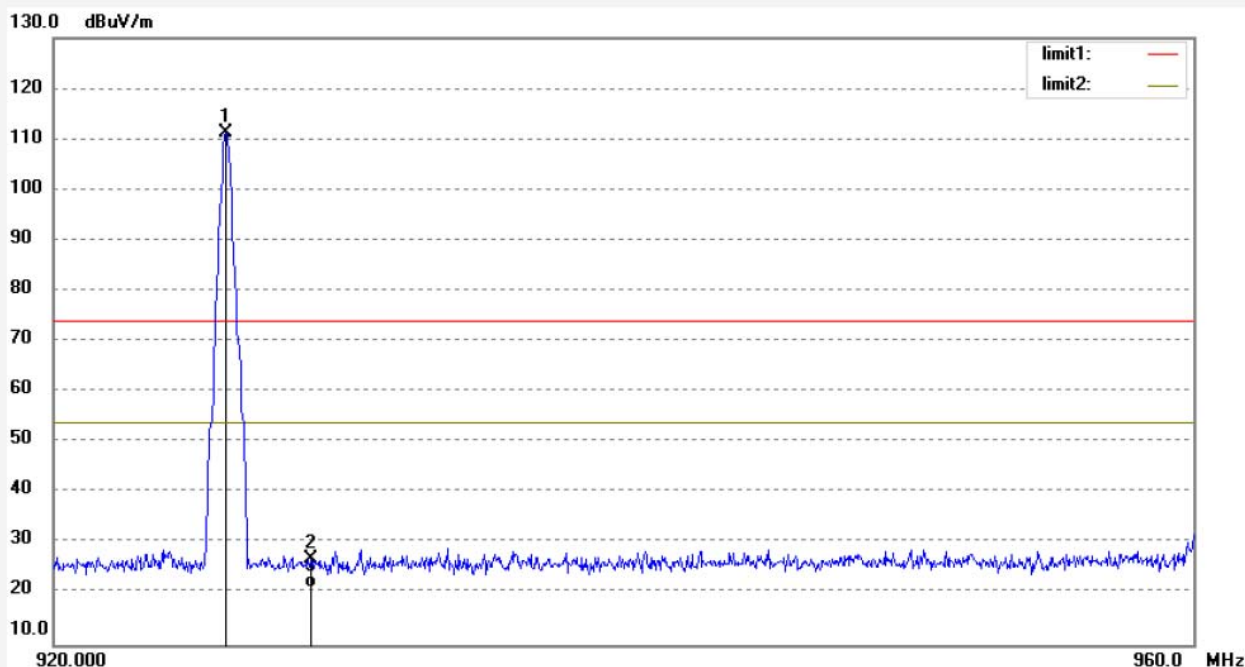
Date: 2016/12/16

Time: 18:05:45

Engineer Signature: YJZH

Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	926.0000	113.20	-1.87	111.33			peak			
2	928.8700	28.81	-1.84	26.97	74.00	-47.03	peak			
3	928.8700	23.01	-1.84	21.17	54.00	-32.83	AVG			



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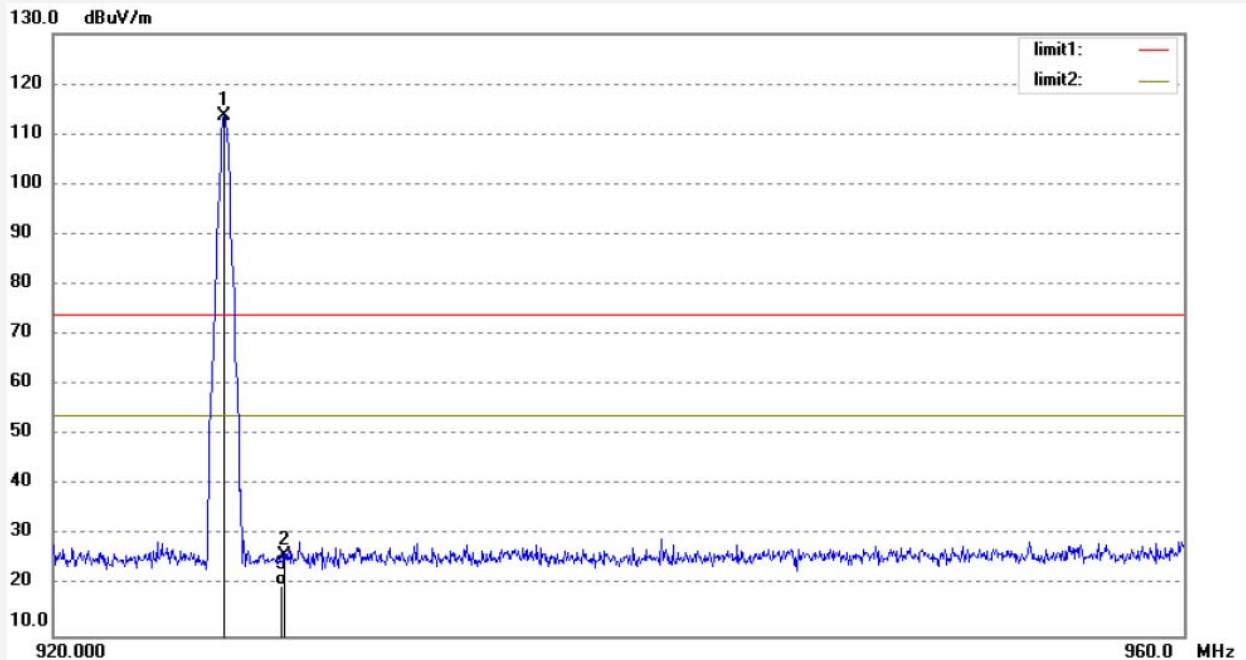
F1,Bldg,A,Changyuan New Material Port Keyuan Rd,
Science & Industry Park,Nanshan Shenzhen,P.R.China

Site: 1# Chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

Job No.: YJZH #532
Standard: FCC PK
Test item: Radiation Test
Temp.(C)/Hum.(%) 25 C / 55 %
EUT: RF LoRa Module
Mode: TX 926M
Model: RF_LORA1276
Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Vertical
Power Source: DC 3.3V
Date: 2016/12/16
Time: 18:04:33
Engineer Signature: YJZH
Distance: 3m

Note: Report NO.:ATE20162640

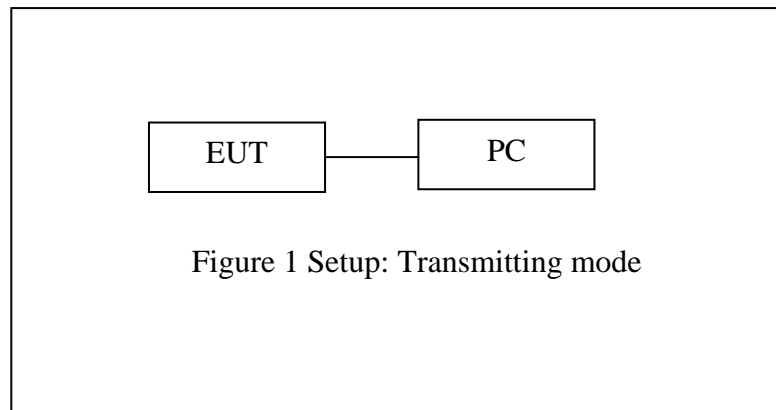


No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	926.0000	115.57	-1.87	113.70			peak			
2	928.0000	28.01	-1.85	26.16	74.00	-47.84	peak			
3	928.0000	22.01	-1.85	20.16	54.00	-33.84	AVG			

10.RADIATED SPURIOUS EMISSION TEST

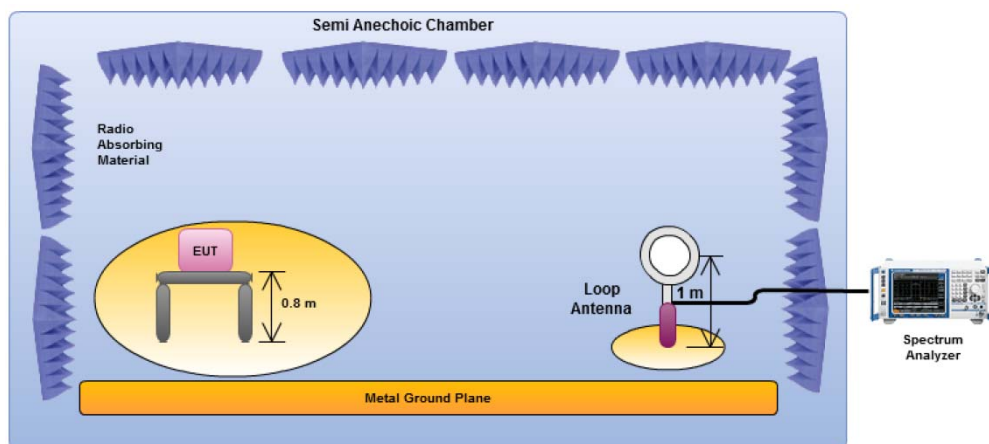
10.1.Block Diagram of Test Setup

10.1.1.Block diagram of connection between the EUT and peripherals



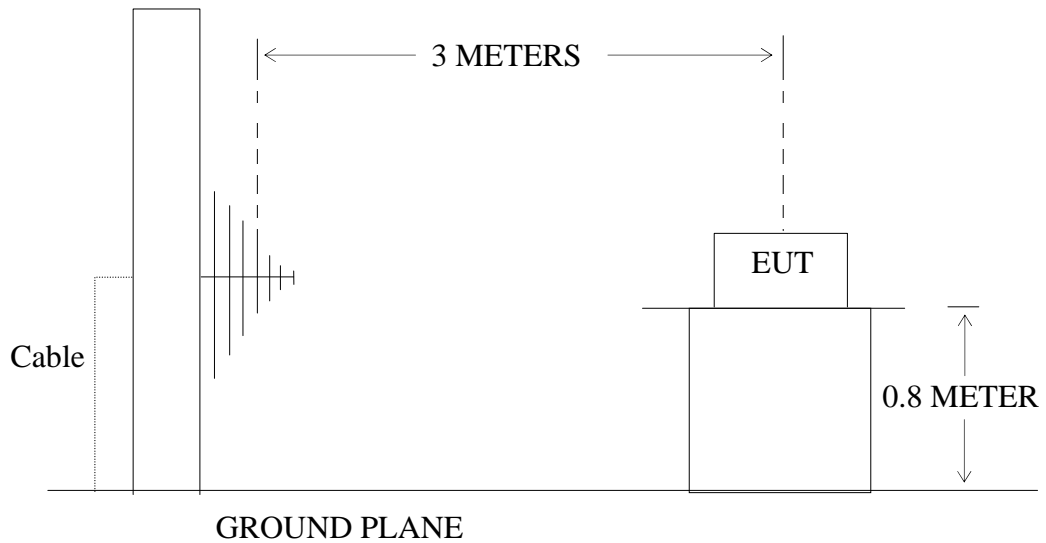
10.1.2.Semi-Anechoic Chamber Test Setup Diagram

Below 30MHz



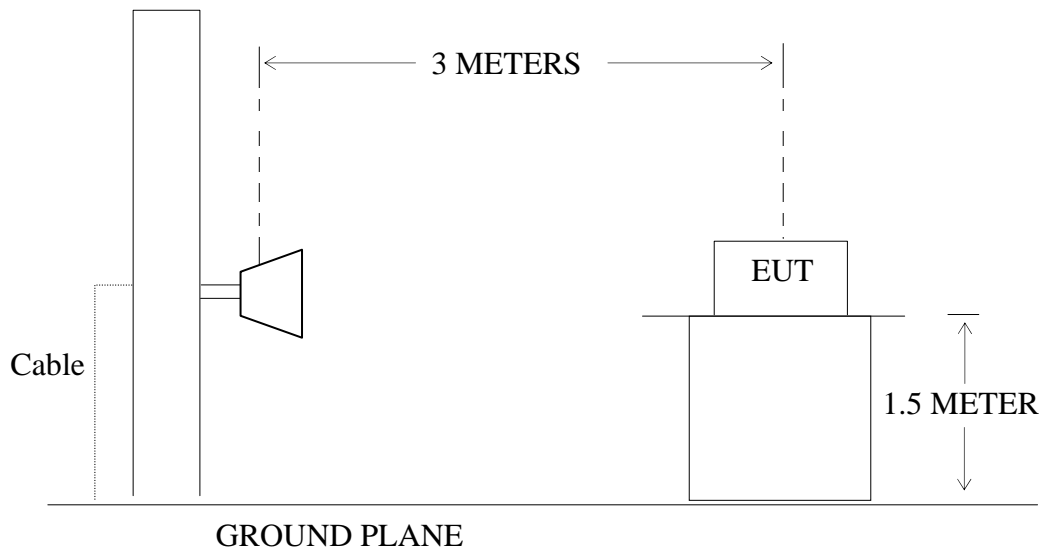
30-1GHz

ANTENNA ELEVATION VARIES FROM 1 TO 4 METERS



Above 1GHz

ANTENNA ELEVATION VARIES FROM 1 TO 4 METERS



10.2.The Limit For Section 15.247(d)

Section 15.247(d): 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 Section 15.209(a) is not required. In addition, radiated

emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

10.3.Restricted bands of operation

10.3.1.FCC Part 15.205 Restricted bands of operation

(a) Except as shown in paragraph (d) of this section, Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(²)
13.36-13.41			

¹Until February 1, 1999, this restricted band shall be 0.490-0.510

²Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emission appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000MHz, Compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

10.4.Configuration of EUT on Measurement

The equipment are installed on Radiated Emission Measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

10.5. Operating Condition of EUT

10.5.1. Setup the EUT and simulator as shown as Section 10.1.

10.5.2. Turn on the power of all equipment.

10.5.3. Let the EUT work in TX modes measure it. The transmit frequency are 904-926MHz. We select 904MHz, 915MHz, 926MHz TX frequency to transmit.

10.6. Test Procedure

The EUT and its simulators are placed on a turntable, which is 0.8 meter high above ground (Below 1GHz). The EUT and its simulators are placed on a turntable, which is 1.5 meter high above ground (Above 1GHz). The turntable can rotate 360 degrees to determine the position of the maximum emission level. EUT is set 3.0 meters away from the receiving antenna, which is mounted on an antenna tower. The antenna can be moved up and down between 1.0 meter and 4 meters to find out the maximum emission level. Broadband antenna (calibrated bi-log antenna) is used as receiving antenna. Both horizontal and vertical polarizations of the antenna are set on measurement. In order to find the maximum emission levels, all of the EUT location must be manipulated according to ANSI C63.10:2013 on radiated emission measurement. The EUT was tested in 3 orthogonal planes.

The frequency range from 30MHz to 10000MHz is checked.

Result = Reading + Corrected Factor

Where Corrected Factor = Antenna Factor + Cable Loss – Amplifier Gain

During the radiated emission test, the spectrum analyzer was set with the following configurations:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

10.7. The Field Strength of Radiation Emission Measurement Results

Note: 1. Emissions attenuated more than 20 dB below the permissible value are not reported.

2. *: Denotes restricted band of operation.

3. The fundamental radiated emissions were reduced by Band Reject Filter in the attached plots.

4. The EUT is tested radiation emission at each test mode in three axes. The worst emissions are reported in all test mode and channels.

Below 1G



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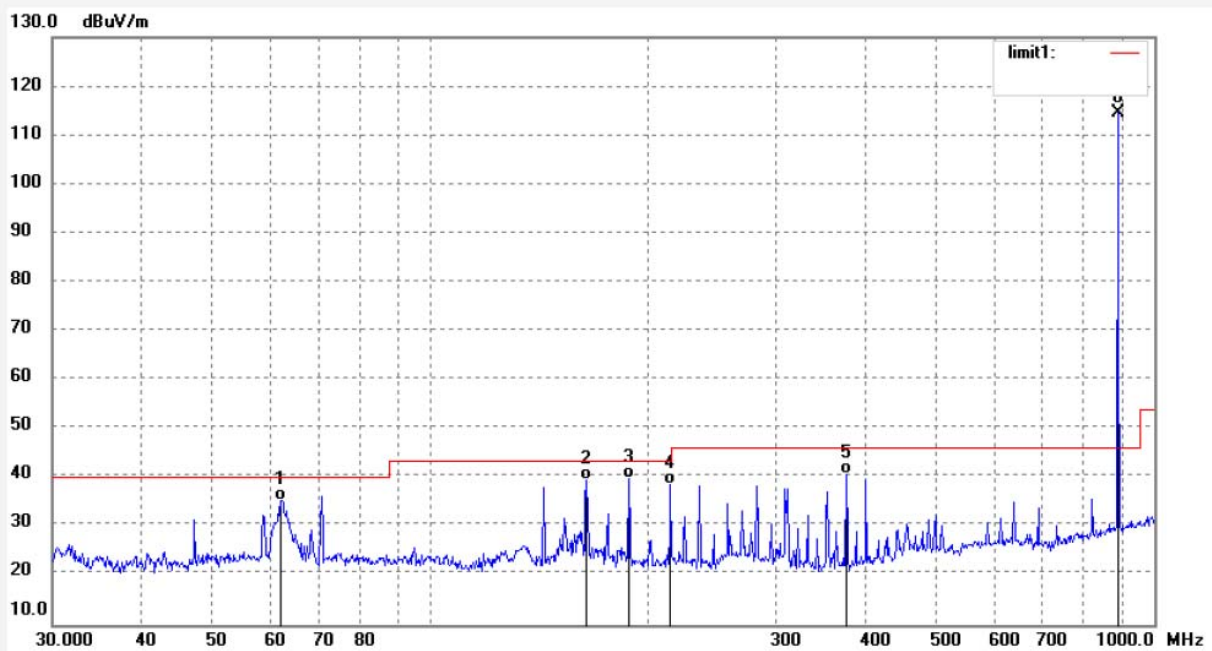
F1,Bldg,A,Changyuan New Material Port Keyuan Rd,
Science & Industry Park,Nanshan Shenzhen,P.R.China

Site: 1# Chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

Job No.: YJZH #519
Standard: FCC Class B 3M Radiated
Test item: Radiation Test
Temp.(C)/Hum.(%) 25 C / 55 %
EUT: RF LoRa Module
Mode: TX 904M
Model: RF_LORA1276
Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Horizontal
Power Source: DC 3.3V
Date: 2016/12/15
Time: 17:48:13
Engineer Signature: YJZH
Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	62.0852	57.23	-21.84	35.39	40.00	-4.61	QP			
2	164.3129	60.56	-20.91	39.65	43.50	-3.85	QP			
3	187.7831	59.49	-19.60	39.89	43.50	-3.61	QP			
4	214.6063	57.20	-18.42	38.78	43.50	-4.72	QP			
5	375.2022	53.92	-13.29	40.63	46.00	-5.37	QP			
6	904.0000	116.98	-2.46	114.52			peak			



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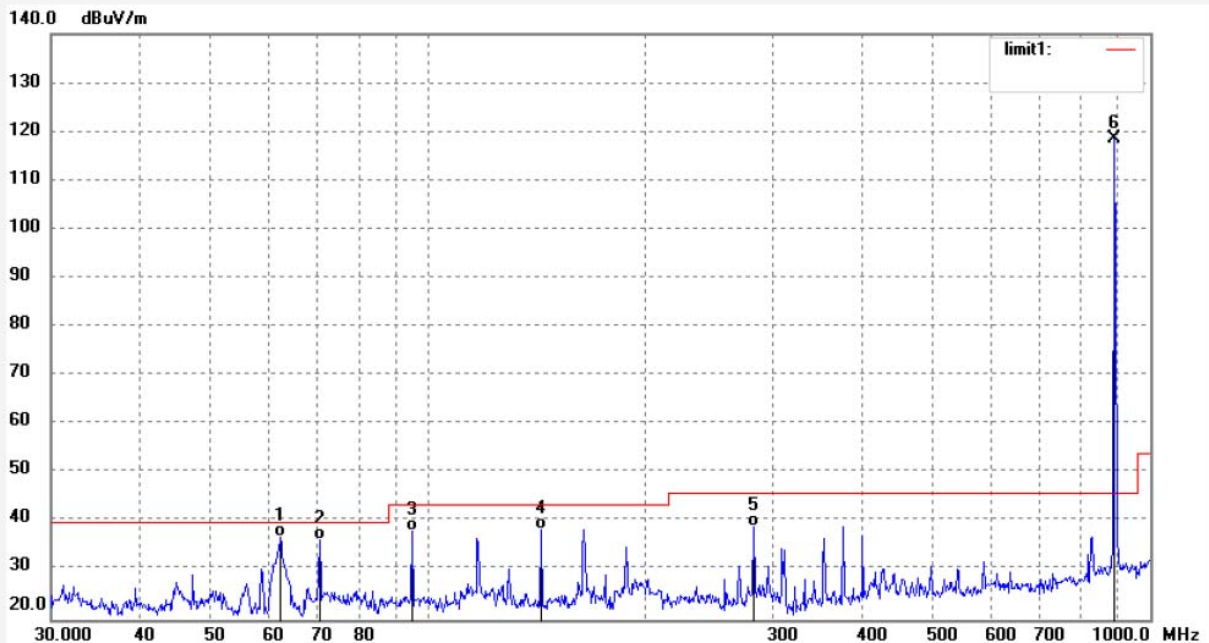
F1,Bldg,A,Changyuan New Material Port Keyuan Rd,
Science & Industry Park,Nanshan Shenzhen,P.R.China

Site: 1# Chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

Job No.: YJZH #520
Standard: FCC Class B 3M Radiated
Test item: Radiation Test
Temp.(C)/Hum.(%) 25 C / 55 %
EUT: RF LoRa Module
Mode: TX 904M
Model: RF_LORA1276
Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Vertical
Power Source: DC 3.3V
Date: 2016/12/15
Time: 17:47:25
Engineer Signature: YJZH
Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	62.3038	58.72	-21.85	36.87	40.00	-3.13	QP			
2	70.7047	58.41	-22.12	36.29	40.00	-3.71	QP			
3	94.9788	60.20	-21.92	38.28	43.50	-5.22	QP			
4	143.2717	60.65	-22.34	38.31	43.50	-5.19	QP			
5	282.2701	55.45	-16.51	38.94	46.00	-7.06	QP			
6	904.0000	121.06	-2.42	118.64			peak			



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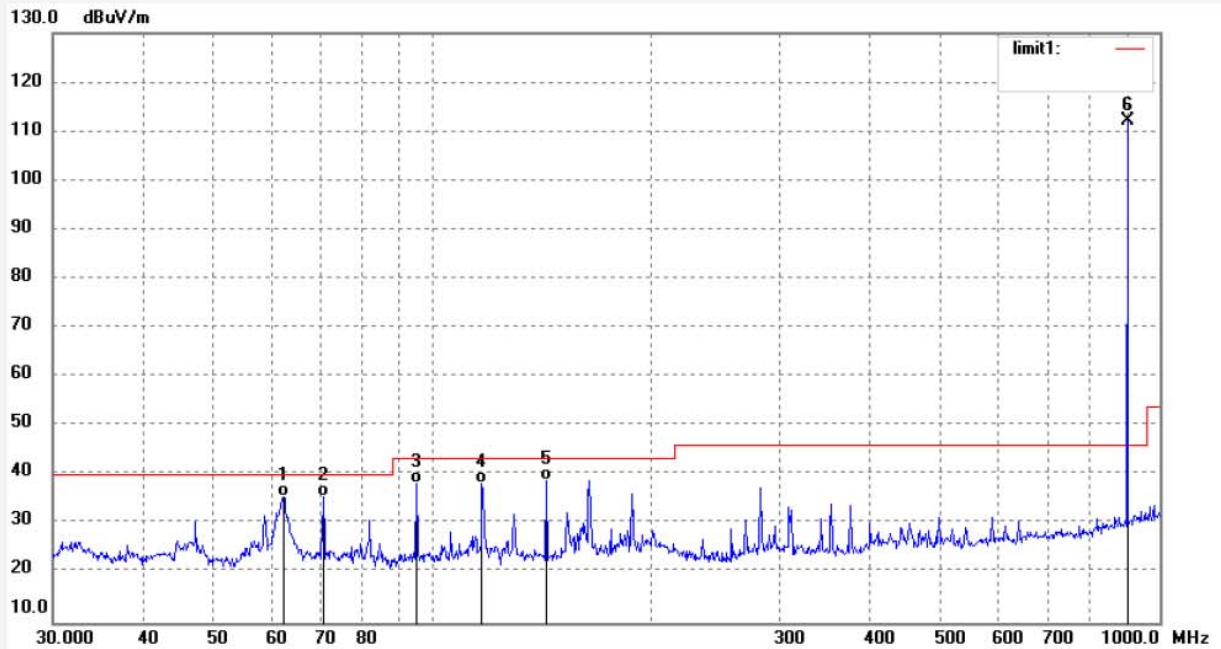
F1,Bldg,A,Changyuan New Material Port Keyuan Rd,
Science & Industry Park,Nanshan Shenzhen,P.R.China

Site: 1# Chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

Job No.: YJZH #517
Standard: FCC Class B 3M Radiated
Test item: Radiation Test
Temp.(C)/Hum.(%) 25 C / 55 %
EUT: RF LoRa Module
Mode: TX 915M
Model: RF_LORA1276
Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Vertical
Power Source: DC 3.3V
Date: 2016/12/15
Time: 17:51:54
Engineer Signature: YJZH
Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	62.3038	57.47	-21.85	35.62	40.00	-4.38	QP			
2	70.7047	57.73	-22.12	35.61	40.00	-4.39	QP			
3	94.9788	60.29	-21.92	38.37	43.50	-5.13	QP			
4	116.8572	60.32	-21.90	38.42	43.50	-5.08	QP			
5	143.2717	61.41	-22.34	39.07	43.50	-4.43	QP			
6	915.0000	114.33	-2.24	112.09			peak			



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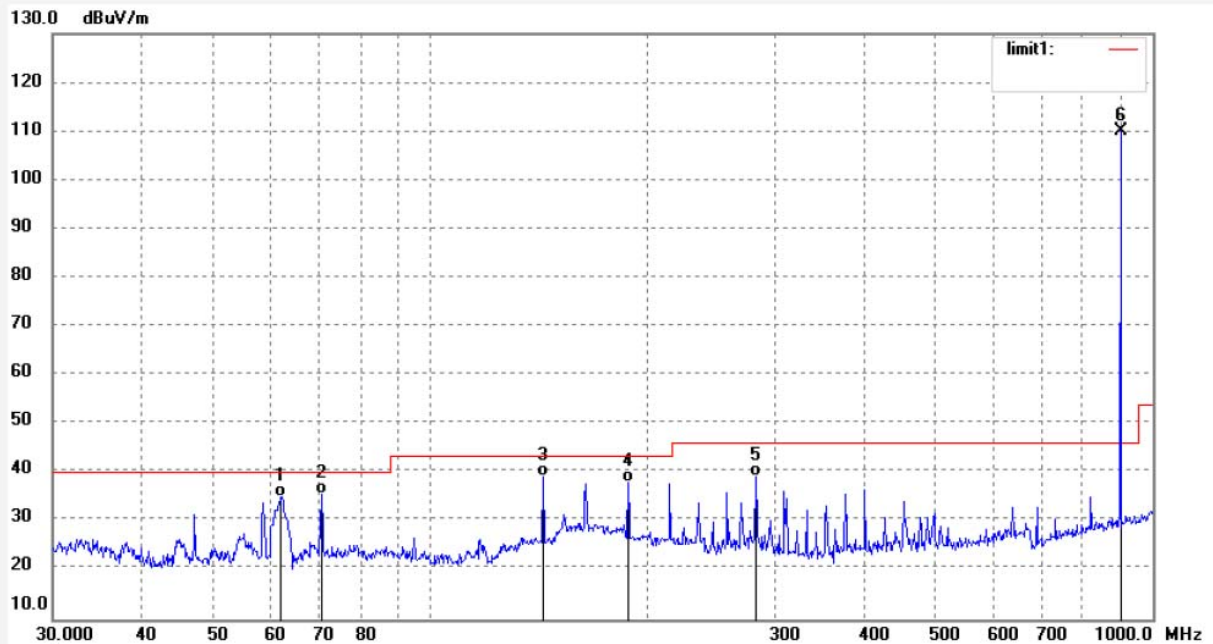
F1,Bldg,A,Changyuan New Material Port Keyuan Rd,
Science & Industry Park,Nanshan Shenzhen,P.R.China

Site: 1# Chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

Job No.: YJZH #518
Standard: FCC Class B 3M Radiated
Test item: Radiation Test
Temp.(C)/Hum.(%) 25 C / 55 %
EUT: RF LoRa Module
Mode: TX 915M
Model: RF_LORA1276
Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Horizontal
Power Source: DC 3.3V
Date: 2016/12/15
Time: 17:50:58
Engineer Signature: YJZH
Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	62.0852	56.95	-21.84	35.11	40.00	-4.89	QP			
2	70.7047	57.90	-22.12	35.78	40.00	-4.22	QP			
3	143.2717	61.46	-22.34	39.12	43.50	-4.38	QP			
4	187.7831	57.69	-19.60	38.09	43.50	-5.41	QP			
5	282.2701	55.65	-16.51	39.14	46.00	-6.86	QP			
6	915.0000	112.29	-2.24	110.05			peak			



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Site: 1# Chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

Job No.: YJZH #521

Standard: FCC Class B 3M Radiated

Test item: Radiation Test

Temp.(C)/Hum.(%) 25 C / 55 %

EUT: RF LoRa Module

Mode: TX 926M

Model: RF_LORA1276

Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Vertical

Power Source: DC 3.3V

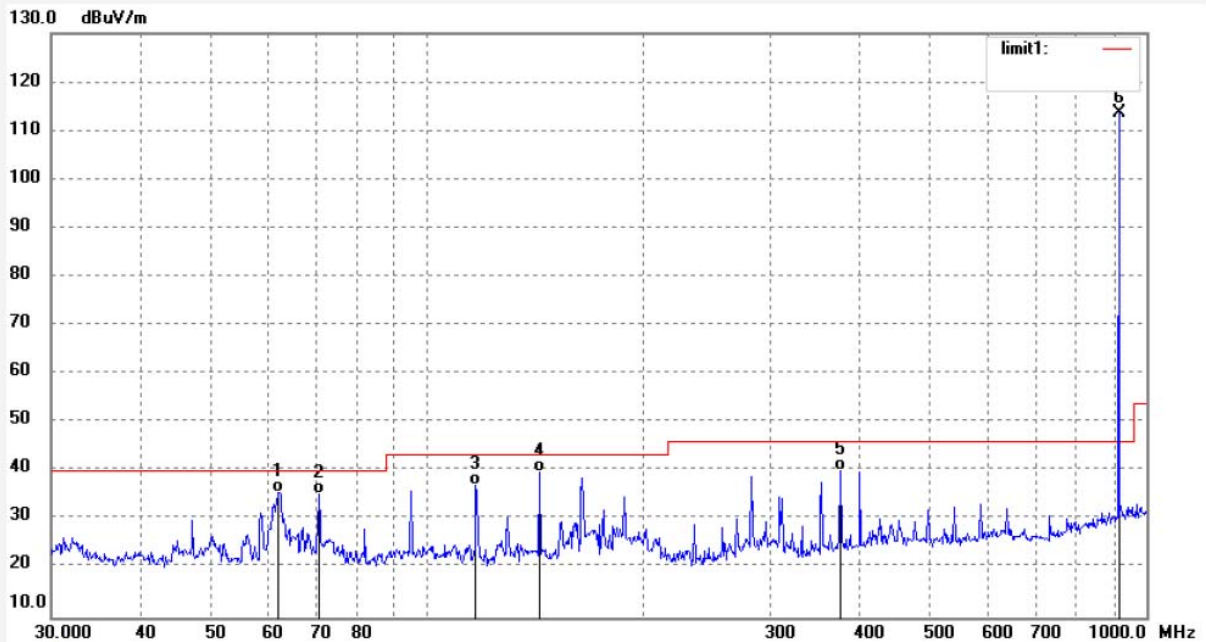
Date: 2016/12/15

Time: 17:44:48

Engineer Signature: YJZH

Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	62.0852	57.41	-21.84	35.57	40.00	-4.43	QP			
2	70.7047	57.52	-22.12	35.40	40.00	-4.60	QP			
3	116.8573	59.15	-21.90	37.25	43.50	-6.25	QP			
4	143.2717	62.29	-22.34	39.95	43.50	-3.55	QP			
5	375.2022	53.40	-13.29	40.11	46.00	-5.89	QP			
6	926.0000	115.74	-2.03	113.71			peak			

Job No.: YJZH #522

Standard: FCC Class B 3M Radiated

Test item: Radiation Test

Temp.(C)/Hum.(%) 25 C / 55 %

EUT: RF LoRa Module

Mode: TX 926M

Model: RF_LORA1276

Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Horizontal

Power Source: DC 3.3V

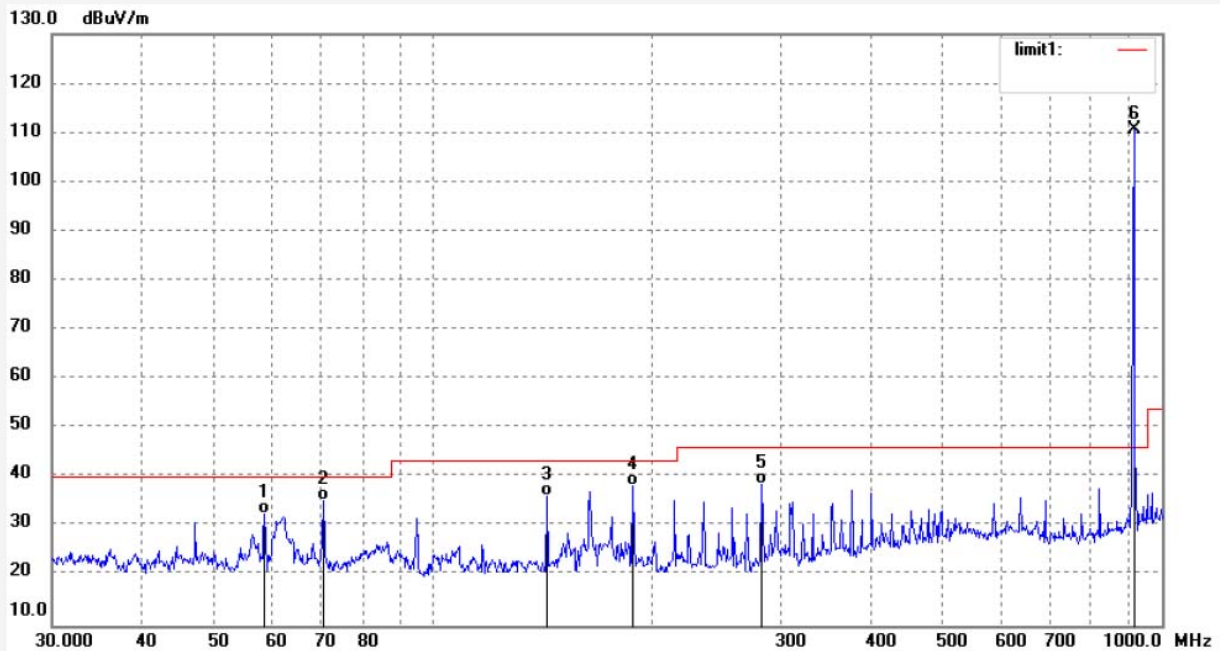
Date: 2016/12/15

Time: 17:43:55

Engineer Signature: YJZH

Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	58.6912	54.52	-21.75	32.77	40.00	-7.23	QP			
2	70.7047	57.39	-22.12	35.27	40.00	-4.73	QP			
3	143.2717	58.54	-22.34	36.20	43.50	-7.30	QP			
4	187.7831	57.97	-19.60	38.37	43.50	-5.13	QP			
5	282.2701	55.24	-16.51	38.73	46.00	-7.27	QP			
6	926.0000	112.65	-2.03	110.62			peak			

Above 1G



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Site: 1# Chamber

Tel:+86-0755-26503290

Fax:+86-0755-26503396

Job No.: YJZH #512

Standard: FCC PK

Test item: Radiation Test

Temp.(C)/Hum.(%) 25 C / 55 %

EUT: RF LoRa Module

Mode: TX 904M

Model: RF_LORA1276

Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Vertical

Power Source: DC 3.3V

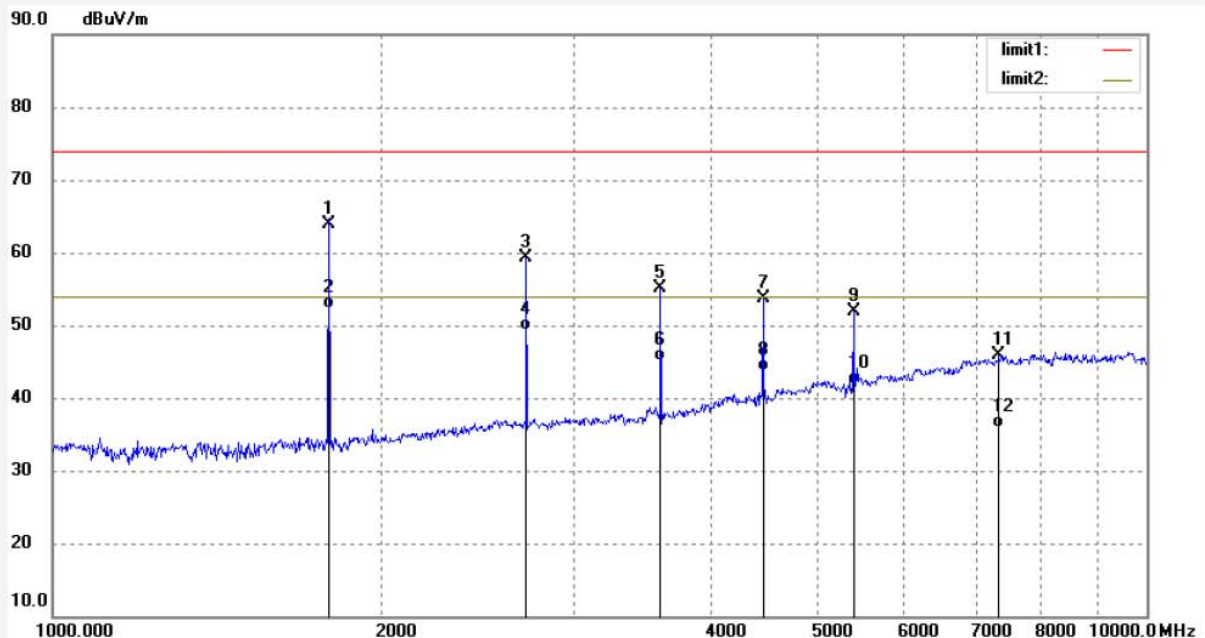
Date: 2016/12/15

Time: 18:05:42

Engineer Signature: YJZH

Distance: 3m

Note: Report NO.:ATE20162640

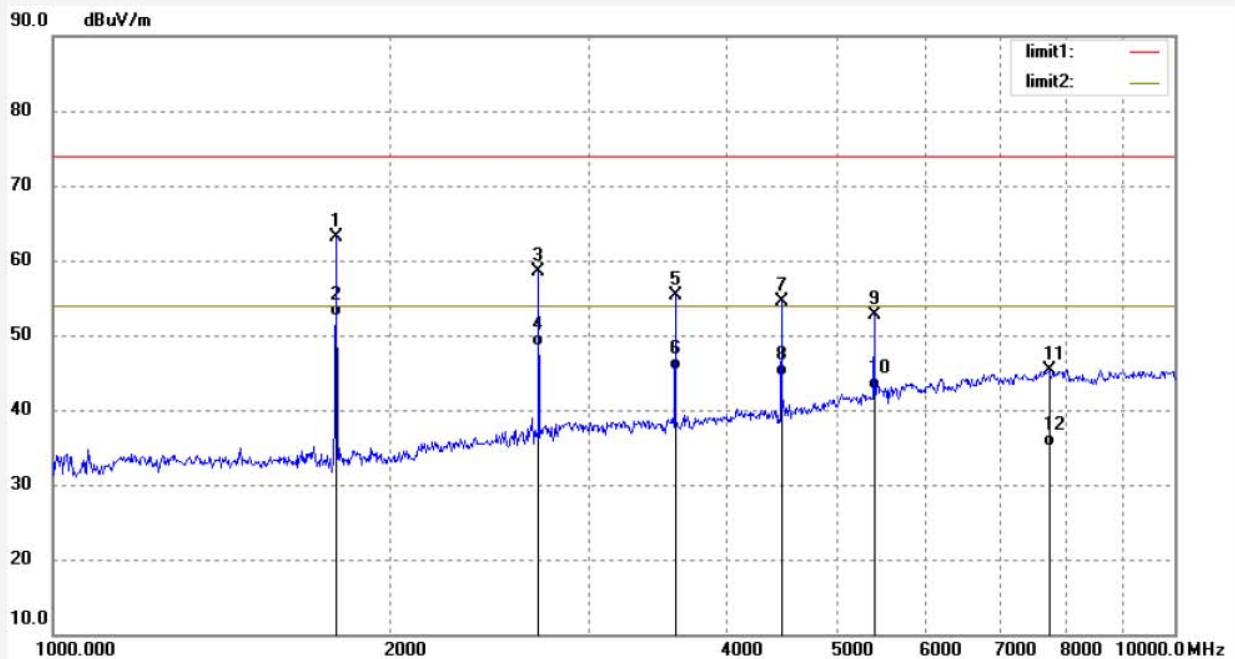


No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	1808.005	72.90	-8.95	63.95	74.00	-10.05	peak			
2	1808.005	61.20	-8.95	52.25	54.00	-1.75	AVG			
3	2712.007	64.10	-4.71	59.39	74.00	-14.61	peak			
4	2712.007	54.09	-4.71	49.38	54.00	-4.62	AVG			
5	3616.003	56.75	-1.56	55.19	74.00	-18.81	peak			
6	3616.003	46.74	-1.56	45.18	54.00	-8.82	AVG			
7	4520.007	54.10	-0.35	53.75	74.00	-20.25	peak			
8	4520.007	44.08	-0.35	43.73	54.00	-10.27	AVG			
9	5424.008	49.56	2.33	51.89	74.00	-22.11	peak			
10	5424.008	39.55	2.33	41.88	54.00	-12.12	AVG			
11	7329.180	39.92	6.07	45.99	74.00	-28.01	peak			
12	7329.180	29.93	6.07	36.00	54.00	-18.00	AVG			

Job No.: YJZH #513
Standard: FCC PK
Test item: Radiation Test
Temp.(C)/Hum.(%) 25 C / 55 %
EUT: RF LoRa Module
Mode: TX 904M
Model: RF_LORA1276
Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Horizontal
Power Source: DC 3.3V
Date: 2016/12/15
Time: 18:07:02
Engineer Signature: YJZH
Distance: 3m

Note: Report NO.:ATE20162640

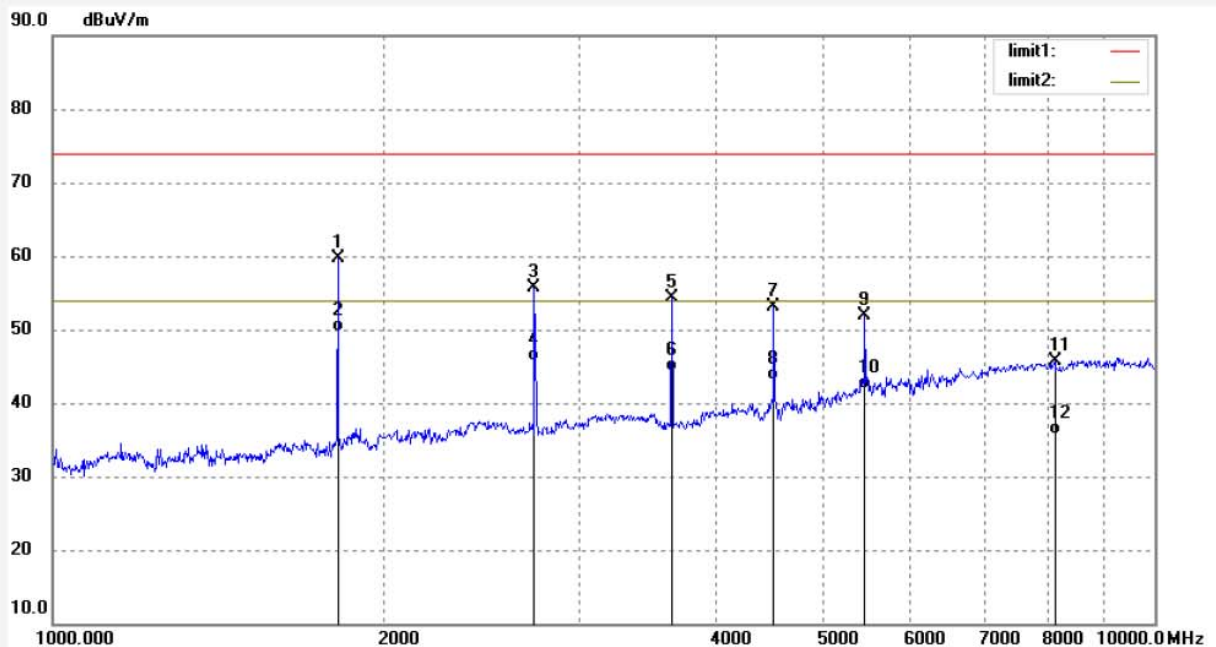


No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	1808.005	72.00	-8.95	63.05	74.00	-10.95	peak			
2	1808.005	61.50	-8.95	52.55	54.00	-1.45	AVG			
3	2712.007	63.26	-4.71	58.55	74.00	-15.45	peak			
4	2712.007	53.25	-4.71	48.54	54.00	-5.46	AVG			
5	3616.002	56.82	-1.57	55.25	74.00	-18.75	peak			
6	3616.002	46.81	-1.57	45.24	54.00	-8.76	AVG			
7	4520.007	54.84	-0.35	54.49	74.00	-19.51	peak			
8	4520.007	44.85	-0.35	44.50	54.00	-9.50	AVG			
9	5424.008	50.33	2.33	52.66	74.00	-21.34	peak			
10	5424.008	40.33	2.33	42.66	54.00	-11.34	AVG			
11	7730.677	38.48	6.82	45.30	74.00	-28.70	peak			
12	7730.677	28.35	6.82	35.17	54.00	-18.83	AVG			

Job No.: YJZH #510
Standard: FCC PK
Test item: Radiation Test
Temp.(C)/Hum.(%) 25 C / 55 %
EUT: RF LoRa Module
Mode: TX 915M
Model: RF_LORA1276
Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Horizontal
Power Source: DC 3.3V
Date: 2016/12/15
Time: 17:59:35
Engineer Signature: YJZH
Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	1830.028	68.57	-8.85	59.72	74.00	-14.28	peak			
2	1830.028	58.50	-8.85	49.65	54.00	-4.35	AVG			
3	2745.003	60.37	-4.58	55.79	74.00	-18.21	peak			
4	2745.003	50.37	-4.58	45.79	54.00	-8.21	AVG			
5	3660.001	55.77	-1.47	54.30	74.00	-19.70	peak			
6	3660.001	45.76	-1.47	44.29	54.00	-9.71	AVG			
7	4575.003	53.44	-0.24	53.20	74.00	-20.80	peak			
8	4575.003	43.44	-0.24	43.20	54.00	-10.80	AVG			
9	5490.001	49.45	2.40	51.85	74.00	-22.15	peak			
10	5490.001	39.50	2.40	41.90	54.00	-12.10	AVG			
11	8116.440	38.27	7.40	45.67	74.00	-28.33	peak			
12	8116.440	28.28	7.40	35.68	54.00	-18.32	AVG			



ACCURATE TECHNOLOGY CO., LTD.

F1,Bldg,A,Changyuan New Material Port Keyuan Rd,
Science & Industry Park,Nanshan Shenzhen,P.R.China

Site: 1# Chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

Job No.: YJZH #511

Standard: FCC PK

Test item: Radiation Test

Temp.(C)/Hum.(%) 25 C / 55 %

EUT: RF LoRa Module

Mode: TX 915M

Model: RF_LORA1276

Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Vertical

Power Source: DC 3.3V

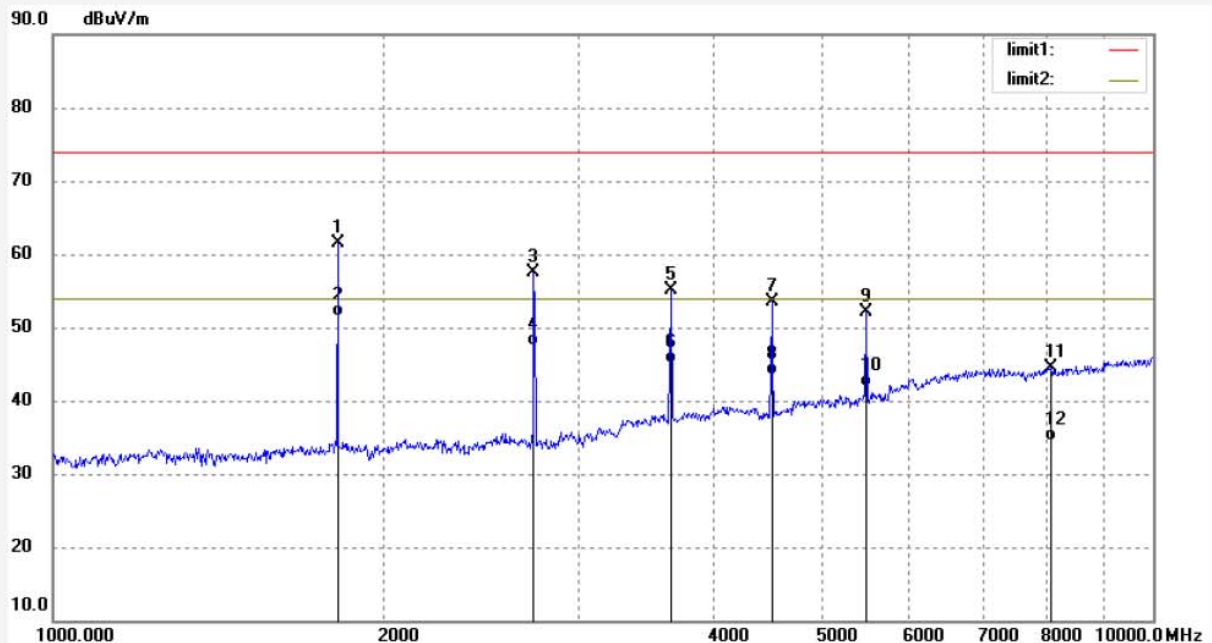
Date: 2016/12/15

Time: 18:00:51

Engineer Signature: YJZH

Distance: 3m

Note: Report NO.:ATE20162640

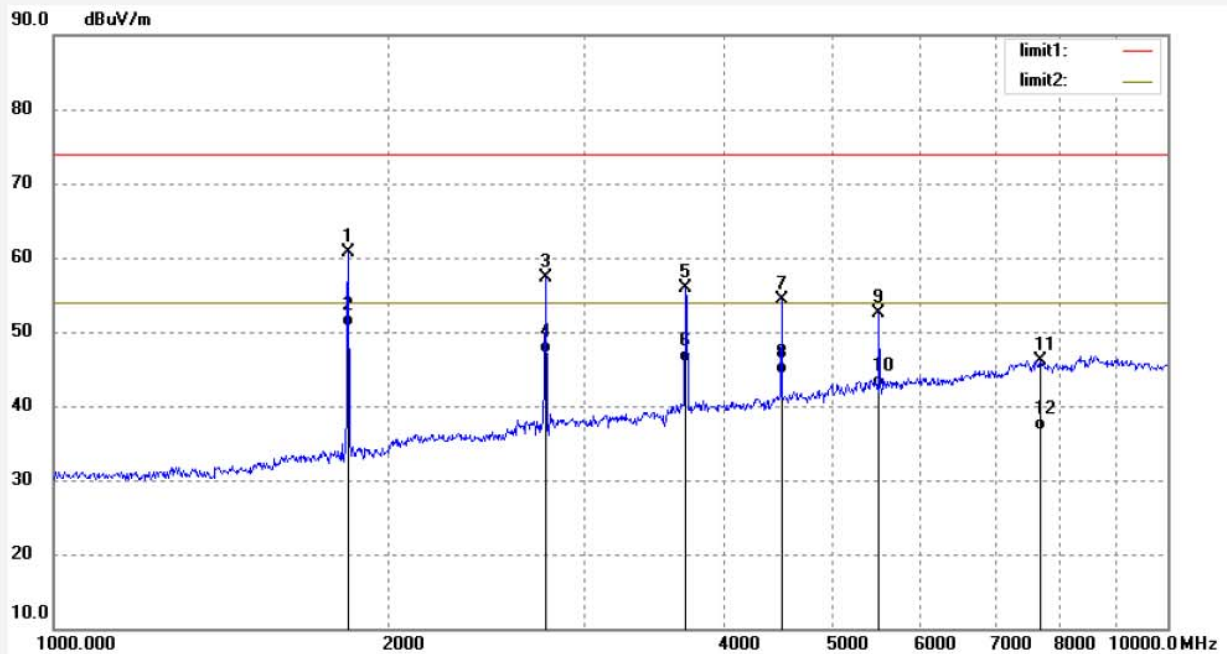


No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	1830.008	70.39	-8.85	61.54	74.00	-12.46	peak			
2	1830.008	60.29	-8.85	51.44	54.00	-2.56	AVG			
3	2745.003	62.00	-4.58	57.42	74.00	-16.58	peak			
4	2745.003	52.01	-4.58	47.43	54.00	-6.57	AVG			
5	3660.001	56.54	-1.47	55.07	74.00	-18.93	peak			
6	3660.001	46.53	-1.47	45.06	54.00	-8.94	AVG			
7	4575.008	53.85	-0.29	53.56	74.00	-20.44	peak			
8	4575.008	43.87	-0.29	43.58	54.00	-10.42	AVG			
9	5490.000	49.58	2.43	52.01	74.00	-21.99	peak			
10	5490.000	39.57	2.43	42.00	54.00	-12.00	AVG			
11	8078.886	37.06	7.38	44.44	74.00	-29.56	peak			
12	8078.886	27.04	7.38	34.42	54.00	-19.58	AVG			

Job No.: YJZH #514
Standard: FCC PK
Test item: Radiation Test
Temp.(C)/Hum.(%) 25 C / 55 %
EUT: RF LoRa Module
Mode: TX 926M
Model: RF_LORA1276
Manufacturer: QingDao Topscomm Communication Co.,Ltd.

Polarization: Horizontal
Power Source: DC 3.3V
Date: 2016/12/15
Time: 18:09:02
Engineer Signature: YJZH
Distance: 3m

Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	1852.003	69.39	-8.75	60.64	74.00	-13.36	peak			
2	1852.003	59.40	-8.75	50.65	54.00	-3.35	AVG			
3	2778.005	61.64	-4.42	57.22	74.00	-16.78	peak			
4	2778.005	51.54	-4.42	47.12	54.00	-6.88	AVG			
5	3704.006	57.17	-1.36	55.81	74.00	-18.19	peak			
6	3704.006	47.20	-1.36	45.84	54.00	-8.16	AVG			
7	4630.008	54.61	-0.29	54.32	74.00	-19.68	peak			
8	4630.008	44.60	-0.29	44.31	54.00	-9.69	AVG			
9	5556.006	50.03	2.47	52.50	74.00	-21.50	peak			
10	5556.006	40.10	2.47	42.57	54.00	-11.43	AVG			
11	7694.908	39.44	6.75	46.19	74.00	-27.81	peak			
12	7694.908	30.00	6.75	36.75	54.00	-17.25	AVG			



ACCURATE TECHNOLOGY CO., LTD.

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Site: 1# Chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

Job No.: YJZH #515

Standard: FCC PK

Test item: Radiation Test

Temp.(C)/Hum.(%) 25 C / 55 %

EUT: RF LoRa Module

Mode: TX 926M

Model: RF_LORA1276

Manufacturer: QingDao Topscmm Communication Co.,Ltd.

Polarization: Vertical

Power Source: DC 3.3V

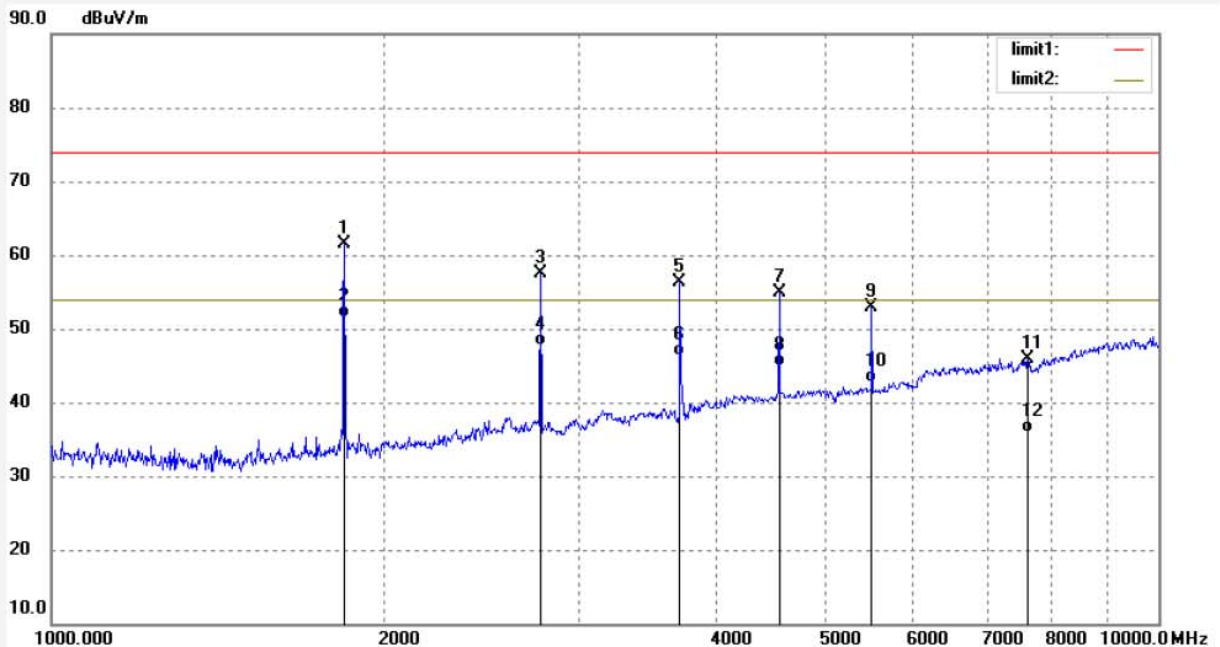
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Time: 18:10:57

Engineer Signature: YJZH

Distance: 3m

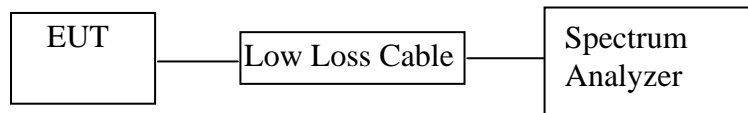
Note: Report NO.:ATE20162640



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	1852.003	70.25	-8.75	61.50	74.00	-12.50	peak			
2	1852.003	60.25	-8.75	51.50	54.00	-2.50	AVG			
3	2778.005	62.01	-4.42	57.59	74.00	-16.41	peak			
4	2778.005	52.11	-4.42	47.69	54.00	-6.31	AVG			
5	3704.006	57.76	-1.36	56.40	74.00	-17.60	peak			
6	3704.006	47.75	-1.36	46.39	54.00	-7.61	AVG			
7	4630.005	55.03	-0.11	54.92	74.00	-19.08	peak			
8	4630.005	45.05	-0.11	44.94	54.00	-9.06	AVG			
9	5556.006	50.38	2.47	52.85	74.00	-21.15	peak			
10	5556.006	40.30	2.47	42.77	54.00	-11.23	AVG			
11	7623.865	39.34	6.61	45.95	74.00	-28.05	peak			
12	7623.865	29.38	6.61	35.99	54.00	-18.01	AVG			

11.CONDUCTED SPURIOUS EMISSION COMPLIANCE TEST

11.1.Block Diagram of Test Setup



11.2.The Requirement For Section 15.247(d)

Section 15.247(d): 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

11.3.EUT Configuration on Measurement

The equipment is installed on the emission measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

11.4.Operating Condition of EUT

11.4.1.Setup the EUT and simulator as shown as Section 11.1.

11.4.2.Turn on the power of all equipment.

11.4.3.Let the EUT work in TX modes measure it. The transmit frequency are 904-926MHz. We select 904MHz, 915MHz, 926MHz TX frequency to transmit.

11.5.Test Procedure

11.5.1.The transmitter output was connected to the spectrum analyzer via a low loss cable.

11.5.2. Set RBW of spectrum analyzer to 100kHz and VBW to 300kHz.

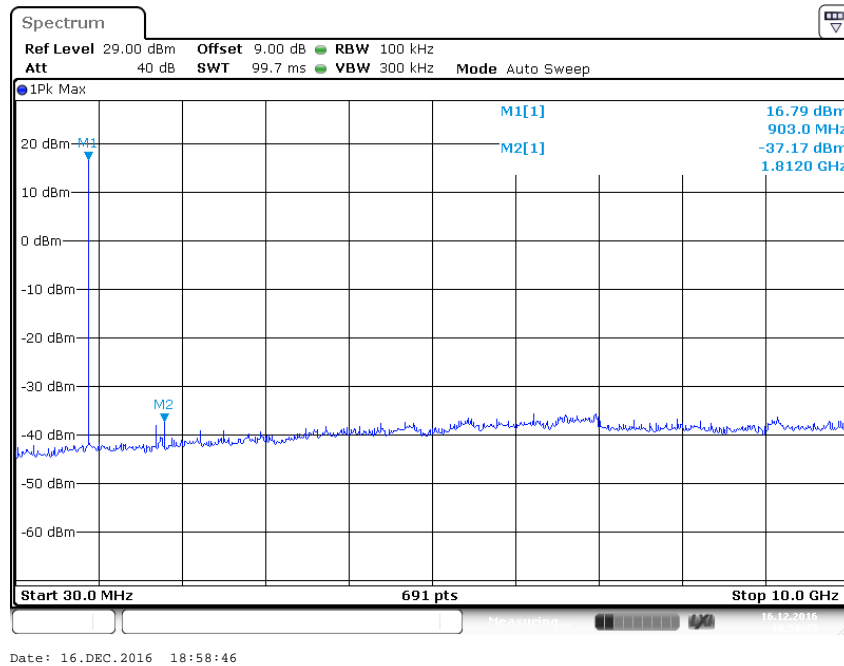
11.5.3. The Conducted Spurious Emission was measured and recorded.

11.6. Test Result

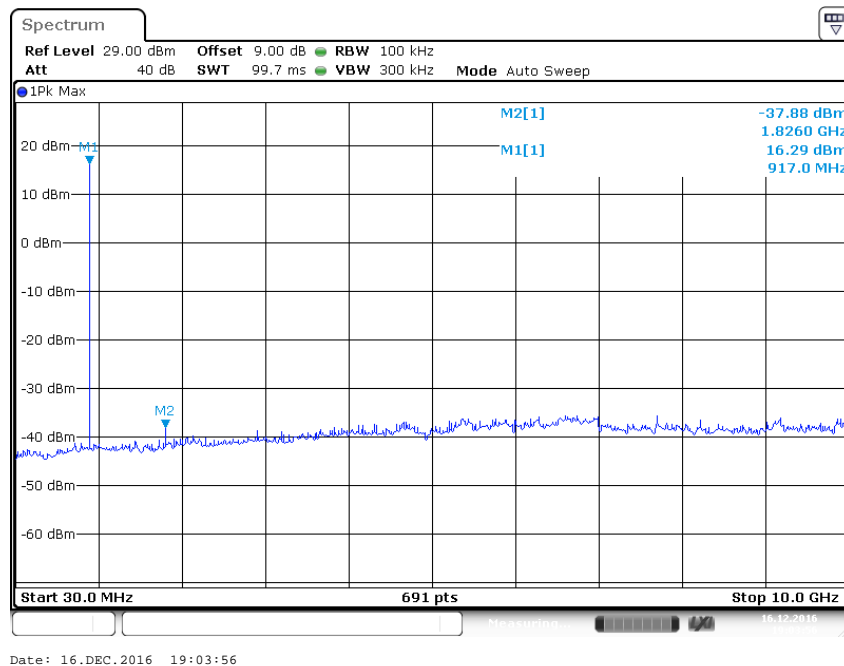
Pass.

The spectrum analyzer plots are attached as below.

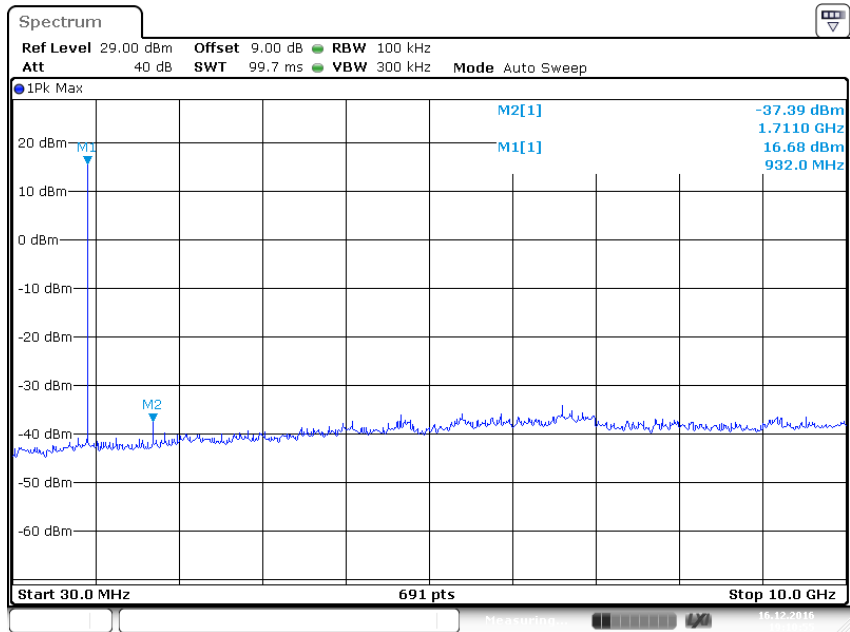
Low 904MHz



Middle 915MHz



High 926MHz



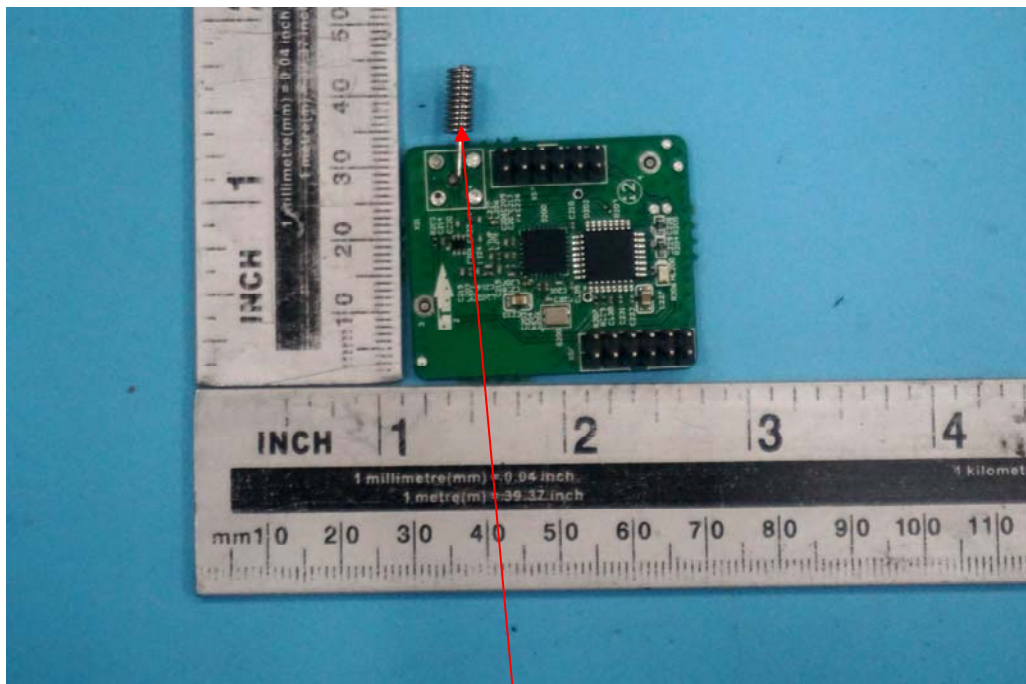
12.ANTENNA REQUIREMENT

12.1.The Requirement

According to Section 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.

12.2.Antenna Construction

Device is equipped with permanent attached antenna, which isn't displaced by other antenna. The Antenna gain of EUT is 3.0dBi. Therefore, the equipment complies with the antenna requirement of Section 15.203.



Antenna