FCC RF Test Report

For

Ring LLC

Test Standards:	Part 15C Subpart C §15.247
Product Description:	Pathlight
Tested Model:	5LP1Y8
Additional Model No.:	N/A
Brand Name:	Ring
FCC ID:	2AEUPBHAPB001
ISED:	20271-BHAPB001
Classification	(DTS) Digital Transmission System
Report No.:	EC1811005F02
Tested Date:	2018-11-12 to 2018-12-25
Issued Date:	2018-12-25
Prepared By:	Tiny Yang/ Engineer
Approved By:	Bacon Wu / RF Manager

Hunan Ecloud Testing Technology Co., Ltd.

Building A1, Changsha E Center, No. 18 Xiangtai Avenue, Liuyang Economic and Technological Development Zone, Hunan, P.R.C

Tel.: +86-731-89634887 Fax.: +86-731-89634887

www.hn-ecloud.com

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2018.12.25	Valid	Original Report

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Summary of Test RESULT

FCC Rule	IC Rule	Description	Limit	Result	Remark
15.247(a)(2)	RSS-247 5.2(1)	6dB Bandwidth	≥ 0.5MHz	Pass	-
-	RSS-Gen 6.6	99% Bandwidth	-	Pass	-
15.247(b)(1)	RSS-247 A5.4(4)	Peak Output Power	≤ 30dBm	Pass	-
15.247(e)	RSS-247 5.2(2)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
15.247(d)	RSS-247 5.5	Conducted Band Edges and Spurious Emission	≤ 20dBc	Pass	-
15.247(d)	RSS-247 5.5	Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit -1.45 dB at 1805 MHz
15.203 & 15.247(b)	N/A	Antenna Requirement	N/A	Pass	-

1. Test Laboratory

1.1 Test facility

CNAS (accreditation number: L11138)

Hunan Ecloud Testing Technology Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (Designation number: CN1244 , Test Firm Registration Number: 793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

ISED(CAB identifier: CN0012)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

A2LA (Certificate Code: 4895.01)

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

2. General Description

2.1 Applicant

Ring LLC
1523 26th St, Santa Monica, CA 90404

2.2 Manufacturer

Guangdong Bestek Technology Co., Ltd
No.1, B Road, Longling industrial Zone, YuanCheng District, HeYuan City. China

2.3 General Description Of EUT

Product	Pathlight
Model No.	5LP1Y8
Additional No.	N/A
Difference Description	N/A
FCC ID	2AEUPBHAPB001
IC ID	20271-BHAPB001
Power Supply	6Vdc (4*D Batteries)
Modulation Technology	BLE / LoRa
Modulation Type	GFSK/ LoRa 500KHz DTS
Operating Frequency	2402MHz ~ 2480MHz - BLE 902.5MHz ~ 927.0MHz – DTS
Max. Output Power	16.364 dBm (43.29 mW)
Antenna Type	BLE: PCB Antenna type with 1dBi gain Lora: Monopole Antenna type with 3dBi gain
I/O Ports	Refer to user's manual

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

2.4 Modification of EUT

No modifications are made to the EUT during all test items.

2.5 ApplicaLora Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- ANSI C63.10-2013
- IC RSS-247 Issue 2
- IC RSS-Gen Issue 5
- FCC KDB Publication No. 558074 D01 15.247 Meas Guidance v05

Remark:

1. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, ICES-005 recorded in a separate test report.

3. Test Configuration of Equipment Under Test

3.1 Descriptions of Test Mode

The transmitter has a maximum peak conducted output power as follows:

Channel	Frequency	Lora RF Output Power
Low	902.5MHz	**16.185**
Middle	913.7MHz	**16.364**
High	927.0MHz	**16.355**

a. Radiated emission was performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

3.2 Test Mode

3.2.1 Antenna Port Conducted Measurement

Summary taLora of Test Cases	
Test Item	**Data Rate / Modulation**
	Lora 500KHz DTS
Conducted Test Cases	Mode 1: 902.5 MHz Mode 2: 913.7 MHz Mode 3: 927.0 MHz

3.2.2 Radiated Emission Test (Below 1GHz)

	Lora 500KHz DTS	
Radiated Test Cases	Transmitting	Mode 1: 902.5 MHz Mode 2: 913.7 MHz Mode 3: 927.0 MHz

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possiLora combinations between availaLora modulations, antenna ports (if EUT with antenna diversity architecture) and packet type.

2. All above modes were tested, but only the worst case test mode 1 was reported .

3.2.3 Radiated Emission Test (Above 1GHz)

	Lora 500KHz DTS	
Radiated Test Cases	Transmitting	Mode 1: 902.5 MHz Mode 2: 913.7 MHz Mode 3: 927.0 MHz

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possiLora combinations between availaLora modulations, antenna ports (if EUT with antenna diversity architecture) and packet type.

2. Following channel(s) was (were) selected for the final test as listed above

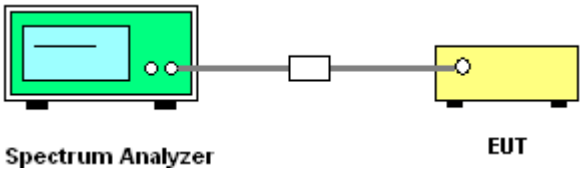
3.3 Support Equipment

Item	Equipment	Trade Name	Model Name	FCC ID	Data CaLora	Power Cord
1.	Notebook	Lenovo	E470C	FCC DoC	N/A	shielded caLora DC O/P 1.8 m unshielded AC I/P caLora1.2 m

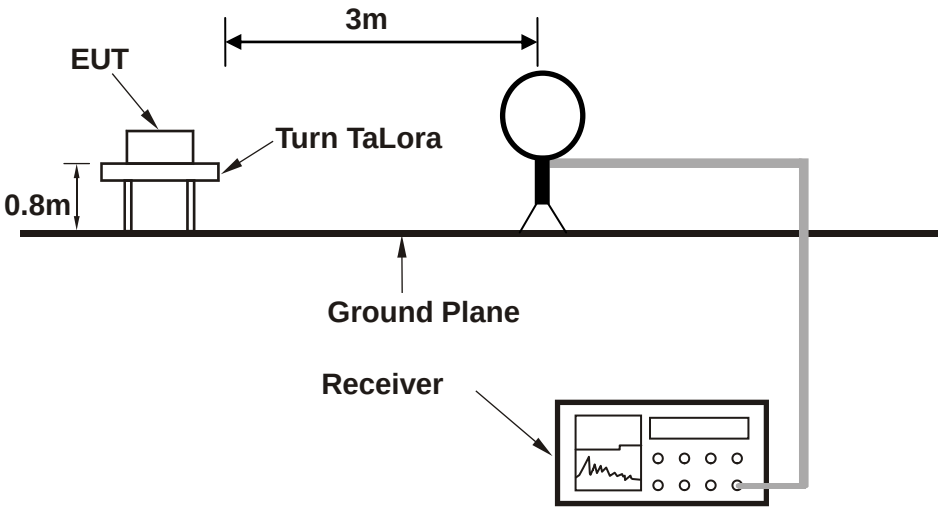
3.4 Test Setup

The software provided by client to enaLora the EUT under transmission condition continuously at specific channel frequencies individually.

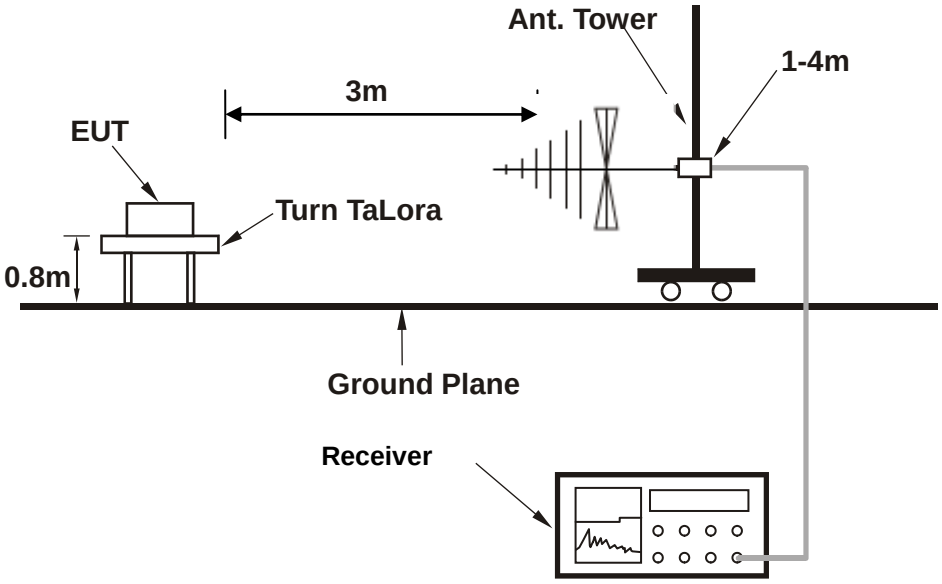
Setup diagram for Conducted Test



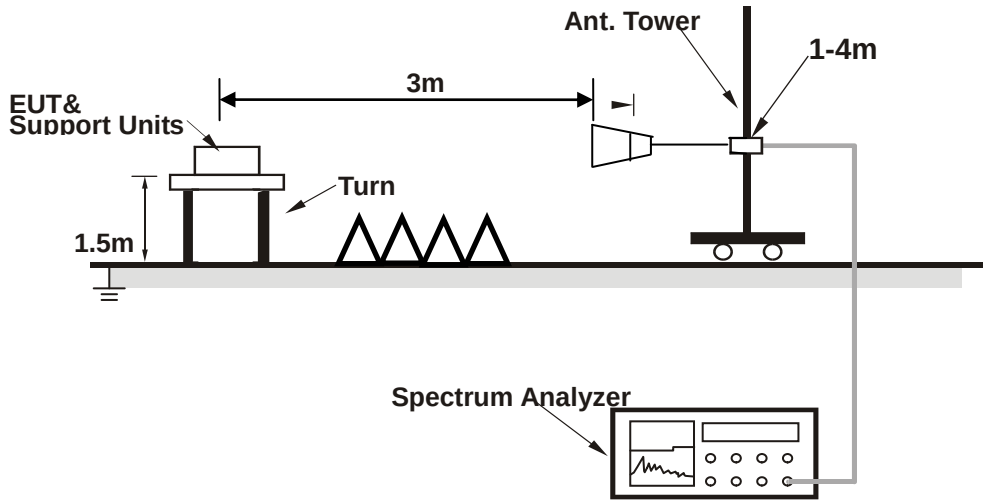
Setup diagram for Raidation(9KHz~30MHz) Test



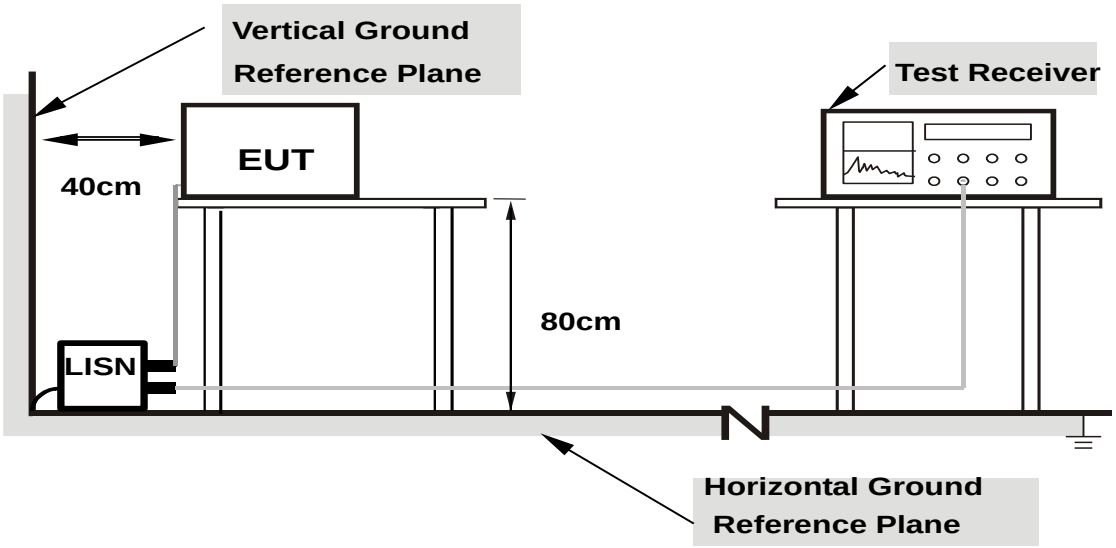
Setup diagram for Raidation(Below 1G) Test



Setup diagram for Raidation(Above1G) Test



Setup diagram for AC Conducted Emission Test



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

3.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF caLora loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF caLora loss and attenuator factor.

Offset = RF caLora loss + attenuator factor.

Following shows an offset computation example with caLora loss 5 dB and 10dB attenuator.

Offset(dB) = RF caLora loss(dB) + attenuator factor(dB).

= 5 + 10 = 15 (dB)

4. Test Result

4.1 6dB and 99% Bandwidth Measurement

4.1.1 Limit of 6dB and 99% Bandwidth

FCC §15.247 (a) (2)

IC RSS-247 5.2(1)

The minimum 6 dB bandwidth shall be at least 500 kHz.

4.1.2 Test Procedures

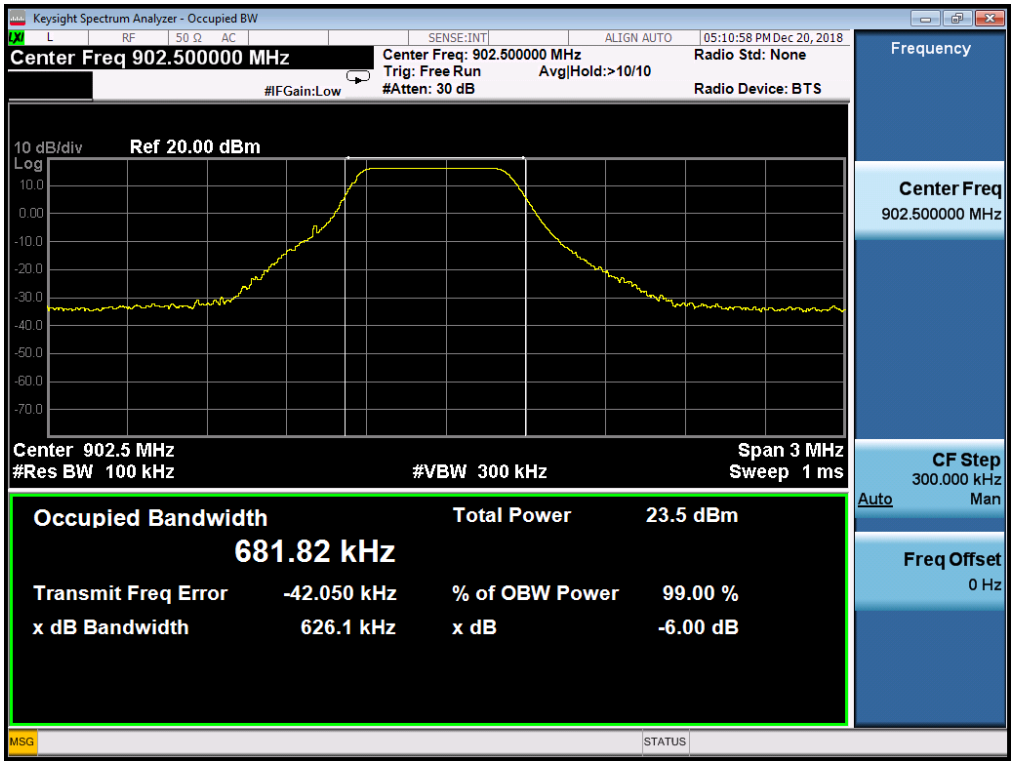
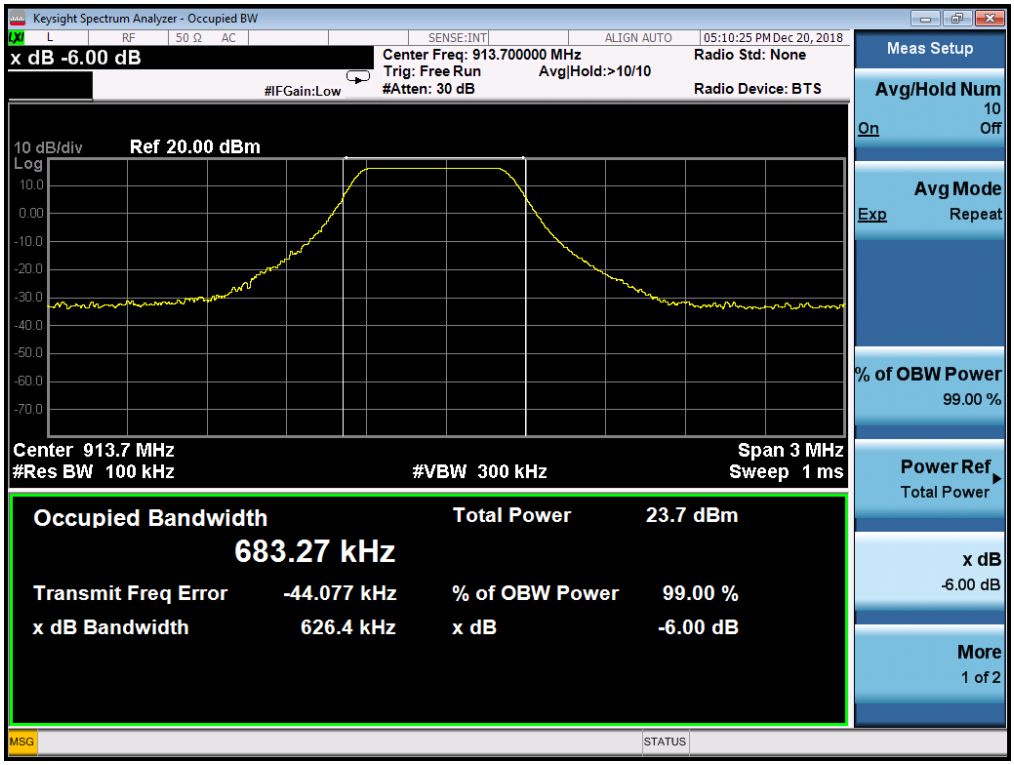
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Set to the maximum power setting and enaLora the EUT transmit continuously
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 30kHz and set the Video bandwidth (VBW) = 100kHz.

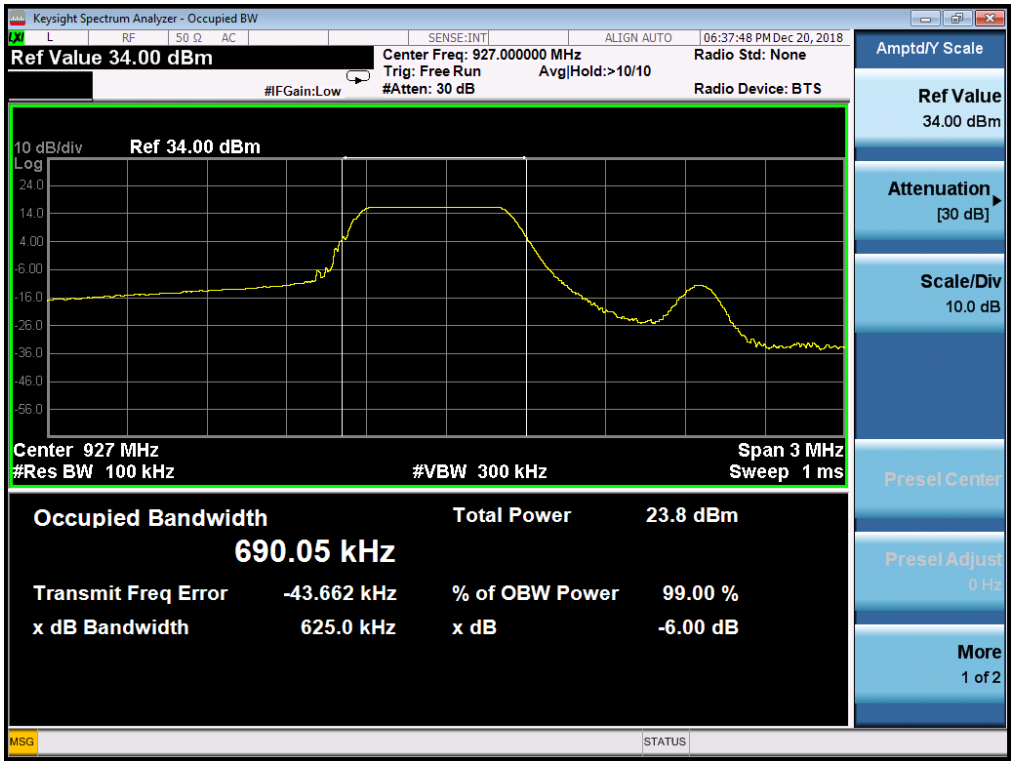
4.1.3 Test Result of 6dB and 99% Bandwidth

Test Mode :	Transmitting	**Temperature :**	24~26℃
Test Engineer :	Damon Zhang	**Relative Humidity :**	50~53%

Channel	**Frequency [MHz]**	**6dB Bandwidth [MHz]**	**99% OBW[MHz]**	**Limit 6dB OBW**	**Verdict**
LCH	902.5	0.6261	0.68182	⩾500KHz	PASS
MCH	913.7	0.6264	0.68327	⩾500KHz	PASS
HCH	927.0	0.6250	0.69005	⩾500KHz	PASS

6dB and 99% Bandwidth Plot

Graphs	
LCH	
MCH	

HCH	

Keysight Spectrum Analyzer - Occupied BW
Ref Value 34.00 dBm
Center Freq: 927.000000 MHz
Trig: Free Run
Avg|Hold:>10/10
#IFGain:Low
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
06:37:48 PM Dec 20, 2018
10 dB/div
Log
Ref 34.00 dBm
Center 927 MHz
#Res BW 100 kHz
#VBW 300 kHz
Span 3 MHz
Sweep 1 ms
Occupied Bandwidth
690.05 kHz
Total Power
23.8 dBm
Transmit Freq Error
-43.662 kHz
% of OBW Power
99.00 %
x dB Bandwidth
625.0 kHz
x dB
-6.00 dB
Amptd/Y Scale
Ref Value
34.00 dBm
Attenuation
[30 dB]
Scale/Div
10.0 dB
Presel Center
Presel Adjust
0 Hz
More
1 of 2
MSG
STATUS

4.2 Peak Output Power Measurement

4.2.1 Limit of Peak Output Power

FCC §15.247 (b)(3)

IC RSS-247 A5.4(4)

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

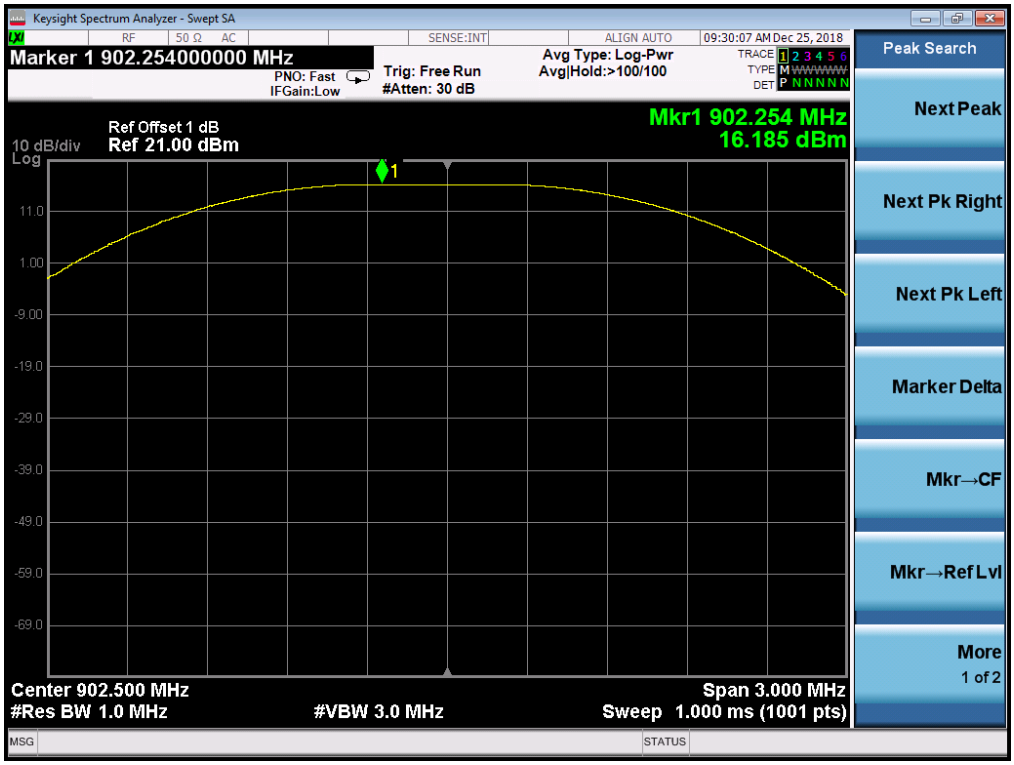
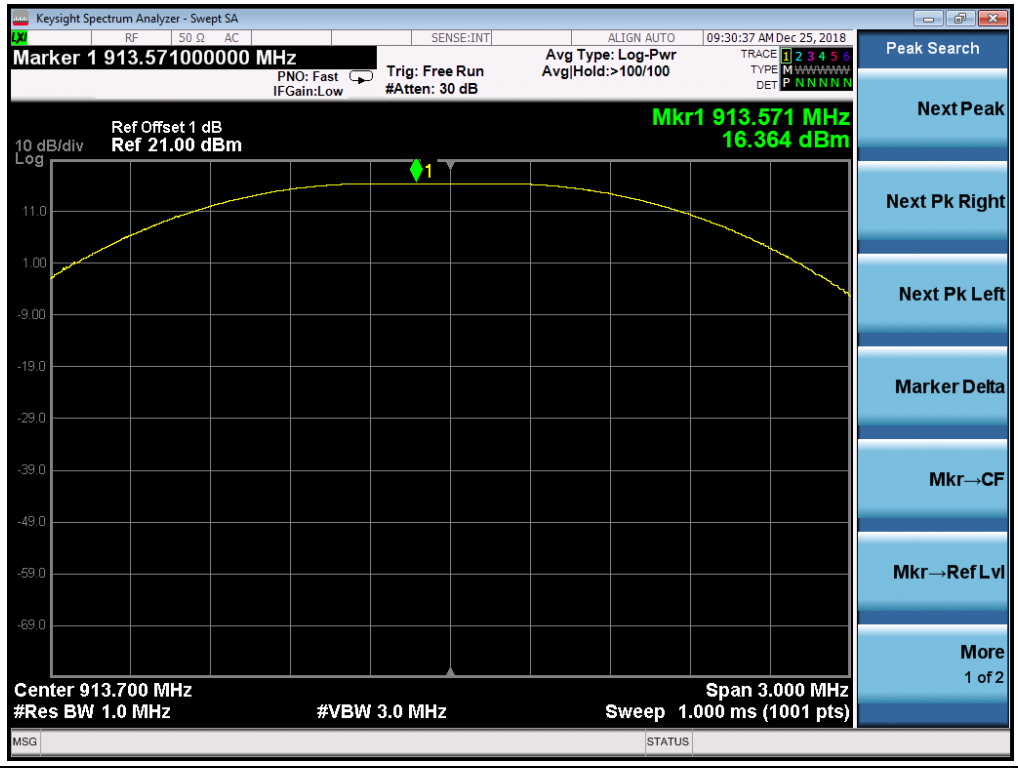
4.2.2 Test Procedures

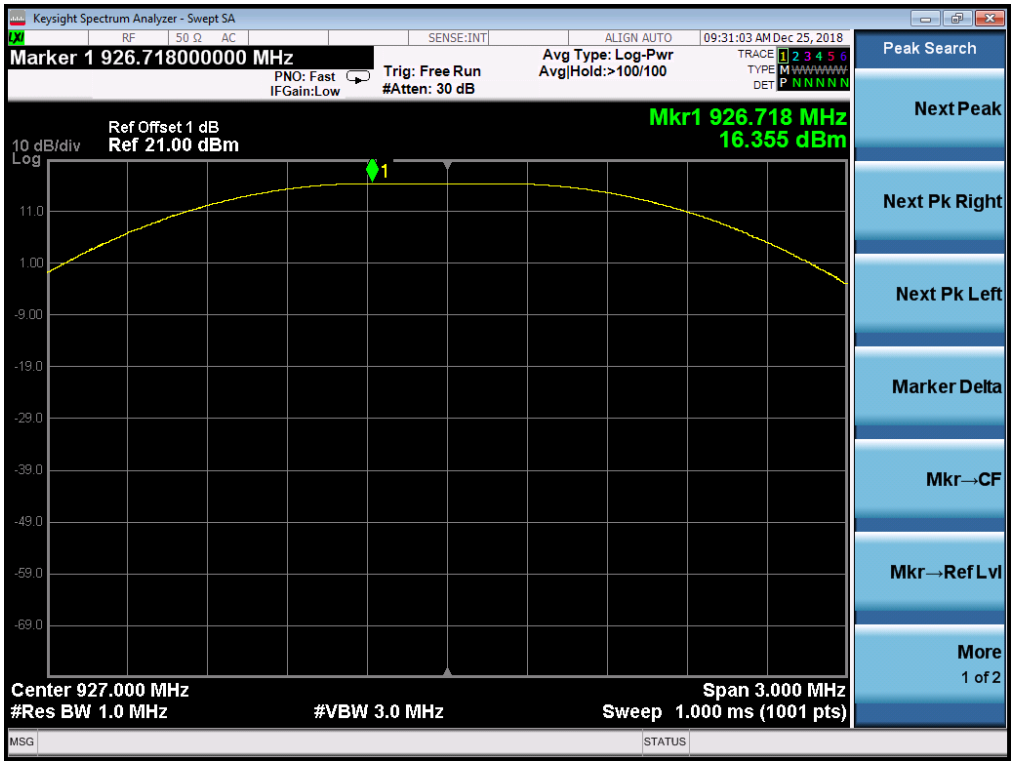
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to spectrum analyzer.
3. Set to the maximum power setting and enaLora the EUT transmit continuously
4. Set the RBW≥DTS Bandwidth,VBW≥3*RBW,Span≥3*RBW,Detector=Peak,Sweep time=auto couple,Trace mode=max hold.
5. Allow trace to fully stabilize, Use peak marker function to determine the peak amplitude level.
6. Measure the conducted output power

4.2.3 Test Result of Peak Output Power

Test Mode :	Transmitting	**Temperature :**	24~26℃
Test Engineer :	Damon Zhang	**Relative Humidity :**	50~53%
Channel	**Frequency**	**Conduct Peak Power[dBm]**	Verdict
LCH	902.5	**16.185**	PASS
MCH	913.7	**16.364**	PASS
HCH	927.0	**16.355**	PASS

Peak Output Power Plot

Graphs	
LCH	
MCH	

HCH	

Keysight Spectrum Analyzer - Swept SA
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
09:31:03 AM Dec 25, 2018
Marker 1 926.718000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 1 dB
10 dB/div
Log
Ref 21.00 dBm
Mkr1 926.718 MHz
16.355 dBm
11.0
1.00
-9.00
-19.0
-29.0
-39.0
-49.0
-59.0
-69.0
Center 927.000 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 3.000 MHz
Sweep 1.000 ms (1001 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

4.3 Power Spectral Density Measurement

4.3.1 Limits of Power Spectral Density

FCC § 15.247(e)

IC RSS-247 5.2(2)

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

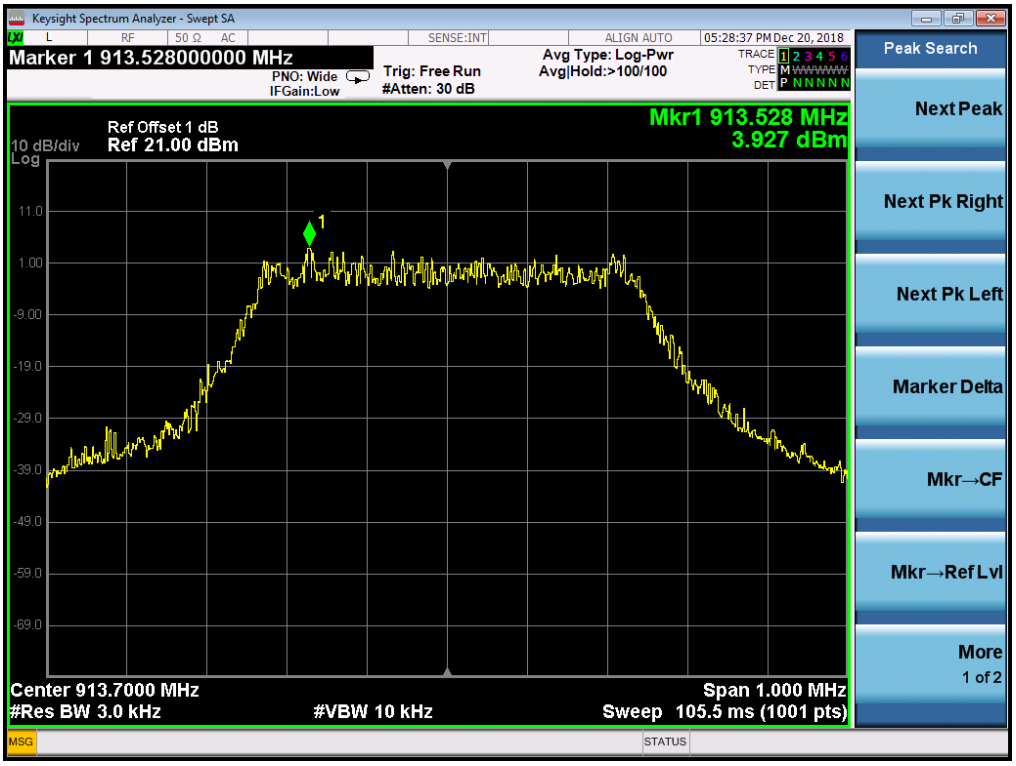
4.3.2 Test Procedure

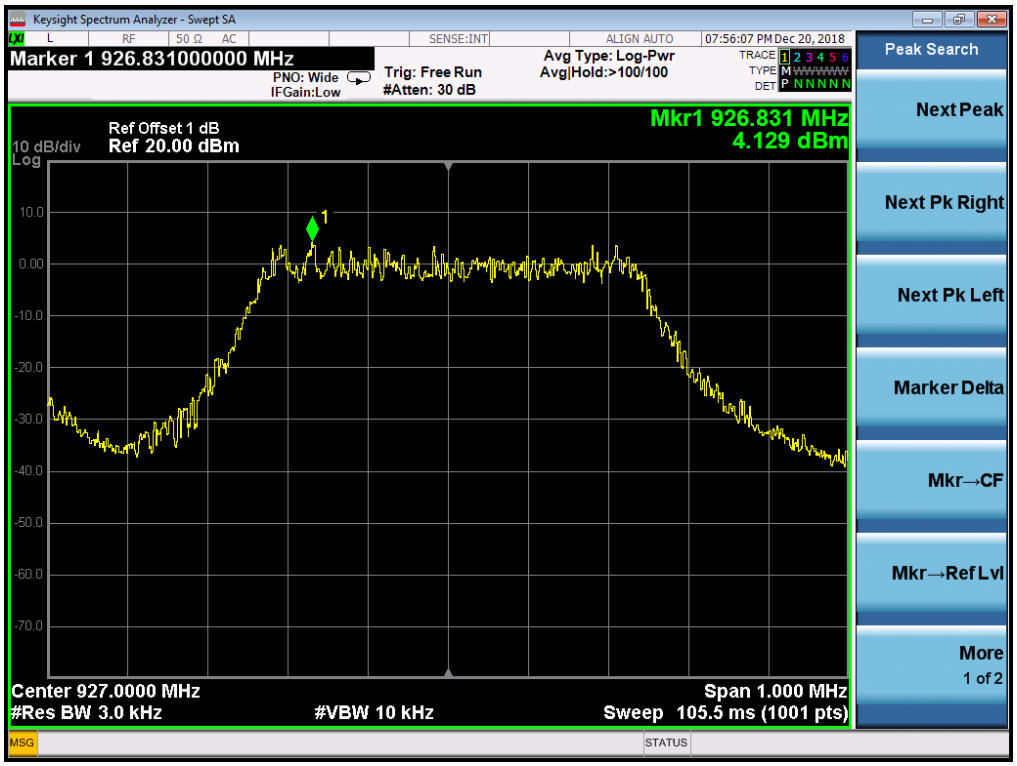
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
4. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
5. Measure and record the results in the test report.
6. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

4.3.3 Test Result of Power Spectral Density

Test Mode :	Transmitting	**Temperature :**	24~26℃
Test Engineer :	Damon Zhang	**Relative Humidity :**	50~53%
Channel	**Frequency**	**PSD [dBm]**	Verdict
LCH	902.5	**3.671**	PASS
MCH	913.7	**3.927**	PASS
HCH	927.0	**4.129**	PASS

Power Spectral Density Plot

Graphs	
LCH	
MCH	

HCH	

Keysight Spectrum Analyzer - Swept SA
Marker 1 926.831000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
07:56:07 PM Dec 20, 2018
Ref Offset 1 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 926.831 MHz
4.129 dBm
Center 927.0000 MHz
#Res BW 3.0 kHz
#VBW 10 kHz
Span 1.000 MHz
Sweep 105.5 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

4.4 Conducted Band Edges and Spurious Emission Measurement

4.4.1 Limit of Conducted Band Edges and Spurious Emission

FCC §15.247 (d)

IC RSS-247 5.5

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

4.4.2 Test Procedures

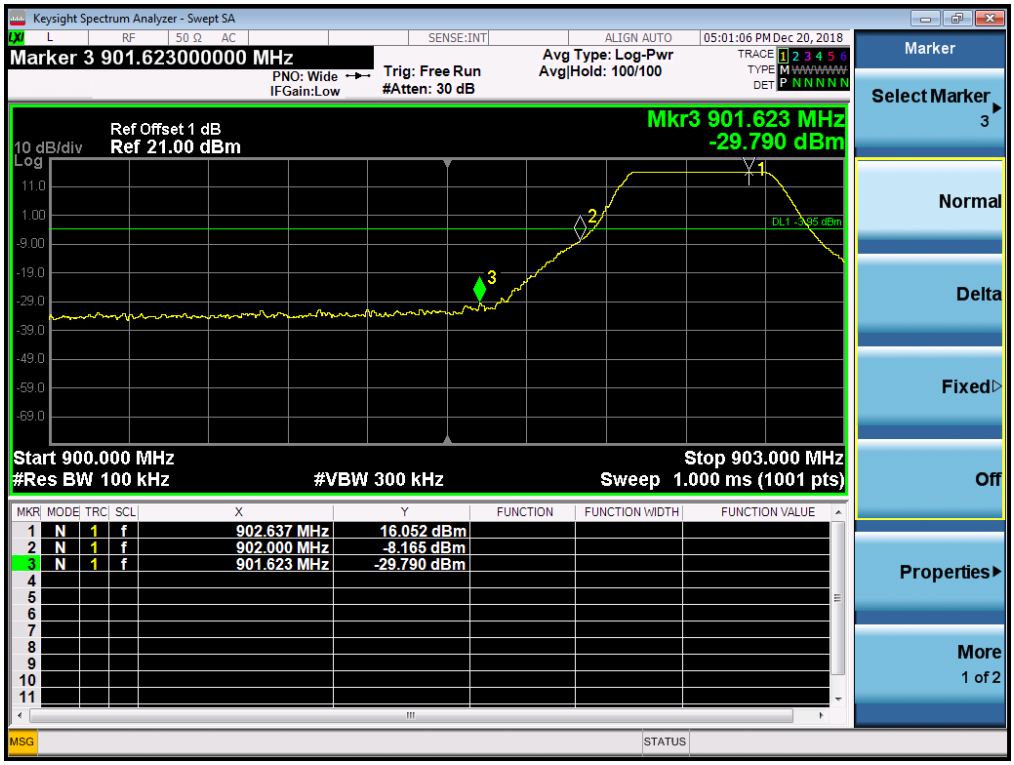
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

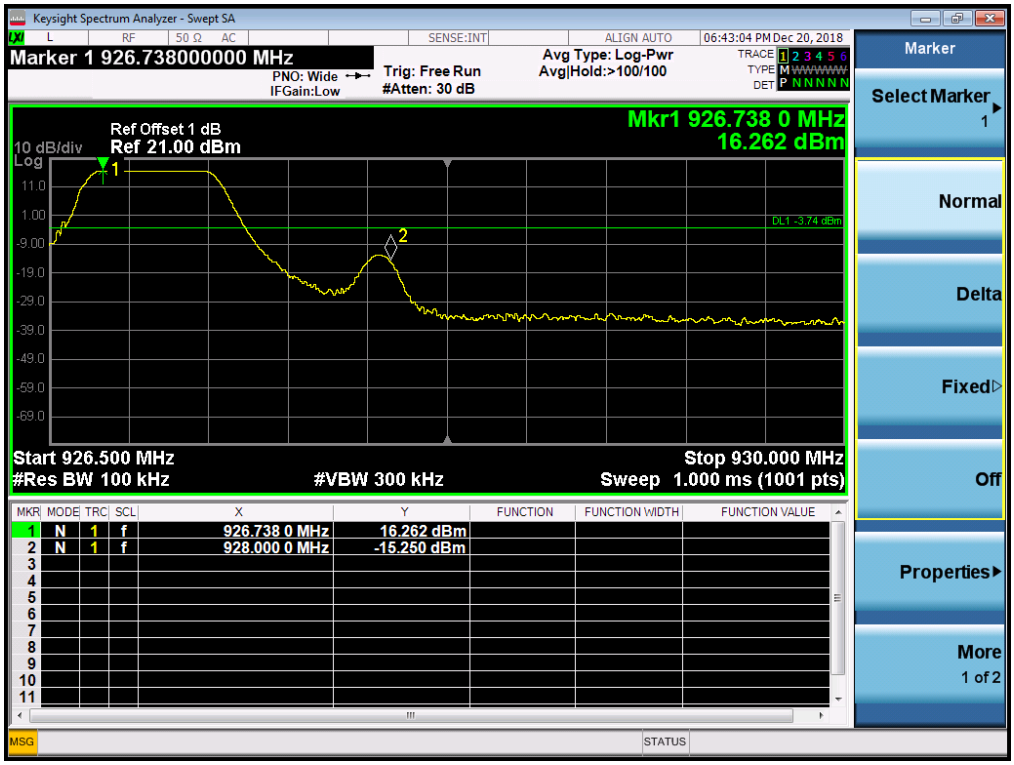
4.4.3 Test Result of Conducted Band Edges

Test Mode :	Transmitting	Temperature :	24~26℃
Test Engineer :	Damon Zhang	Relative Humidity :	50~53%

Channel	Frequency	Carrier Power[dBm]	Max.Spurious Level [dBm]	Limit [dBm]	Verdict
LCH	902.5	16.052	-8.165	-3.95	PASS
HCH	927.0	16.262	-15.250	-3.74	PASS

Conducted Band Edges Plot

Graphs	
LCH	

HCH	

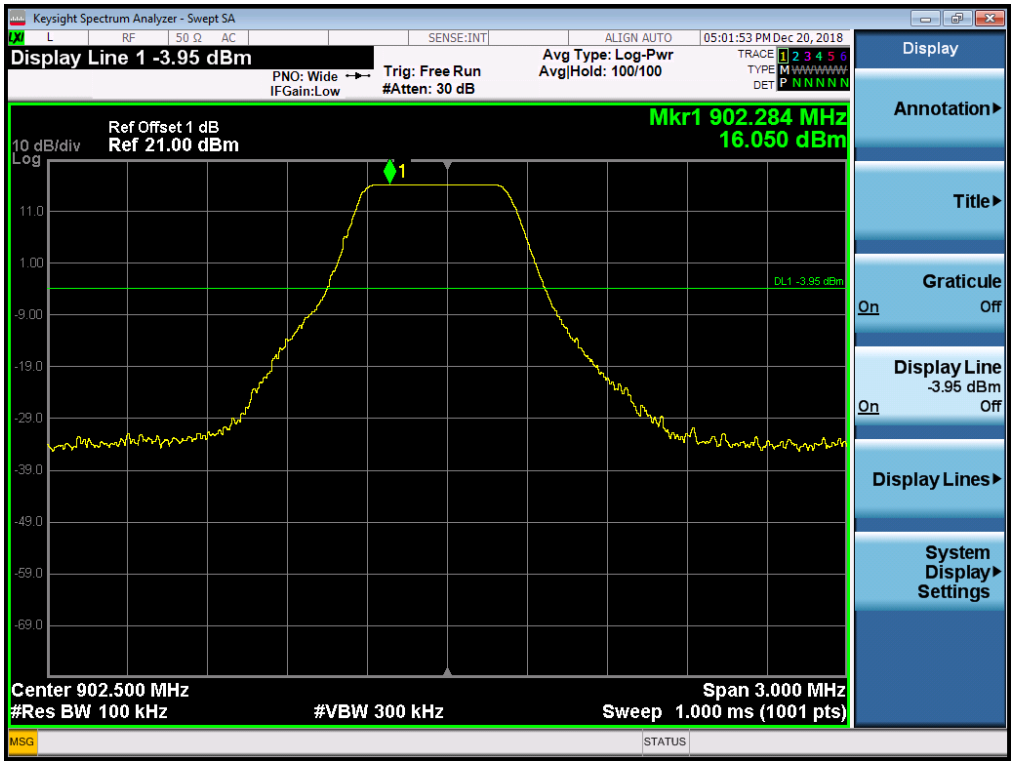
Keysight Spectrum Analyzer - Swept SA
Marker 1 926.738000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
06:43:04 PM Dec 20, 2018
Ref Offset 1 dB
10 dB/div
Log
Ref 21.00 dBm
Mkr1 926.738 0 MHz
16.262 dBm
DL1 -3.74 dBm
Start 926.500 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 930.000 MHz
Sweep 1.000 ms (1001 pts)
1 N 1 f 926.738 0 MHz 16.262 dBm
2 N 1 f 928.000 0 MHz -15.250 dBm
Marker
Select Marker
Normal
Delta
Fixed
Off
Properties
More
1 of 2
MSG
STATUS

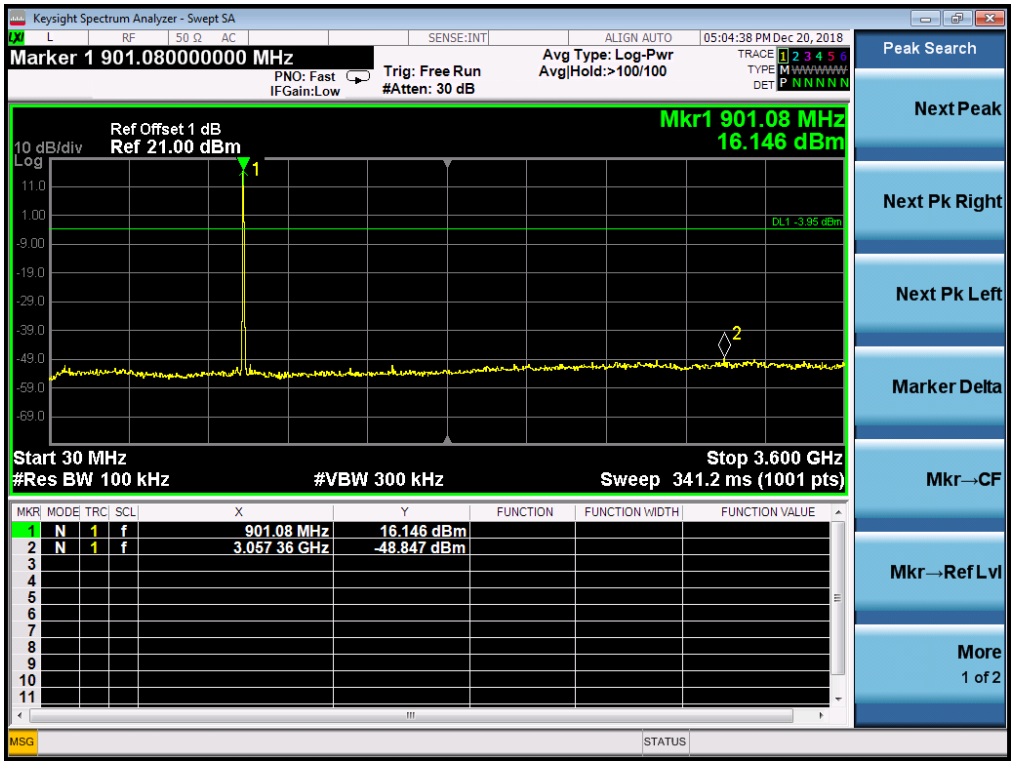
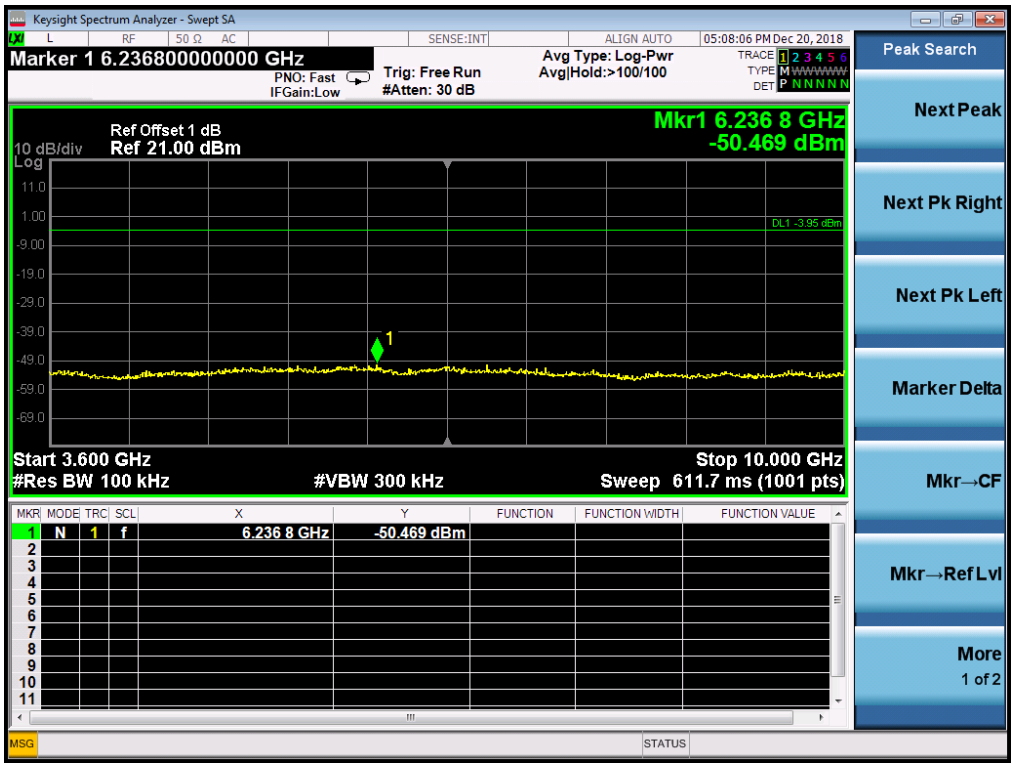
4.4.4 Test Result of Conducted Spurious Emission

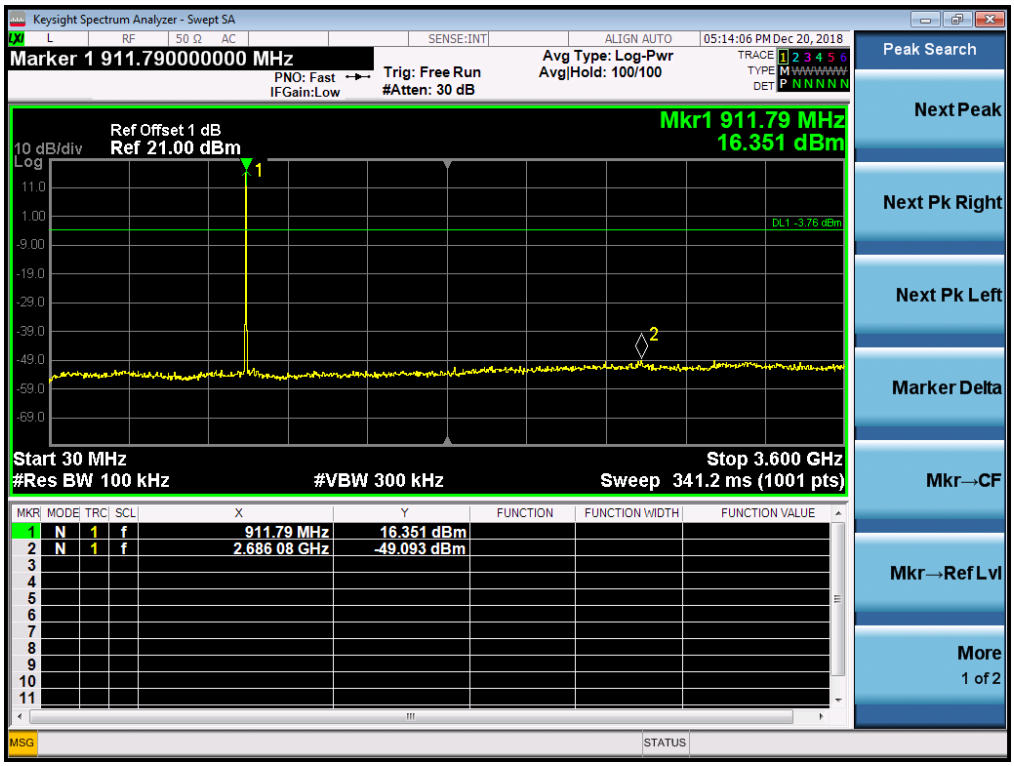
Test Mode :	Transmitting	Temperature :	24~26℃
Test Engineer :	Damon Zhang	Relative Humidity :	50~53%

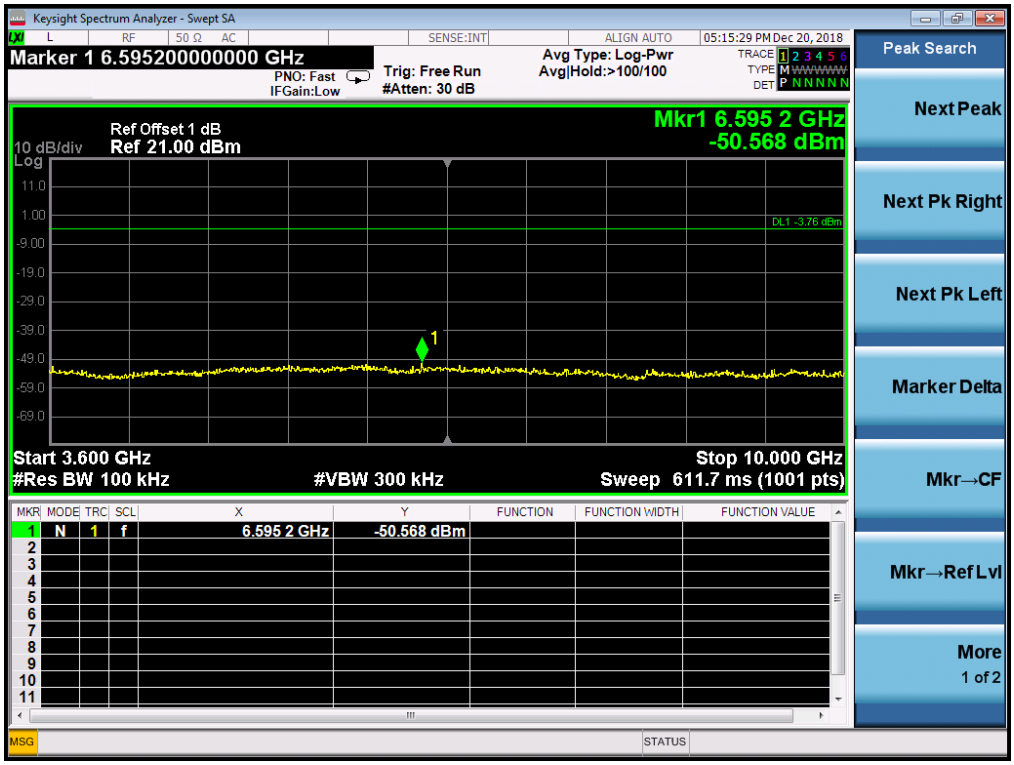
Channel	Frequency	Pref [dBm]	Puw[dBm]	Verdict
LCH	902.5	-3.95	<Limit	PASS
MCH	913.7	-3.76	<Limit	PASS
HCH	927.0	-3.70	<Limit	PASS

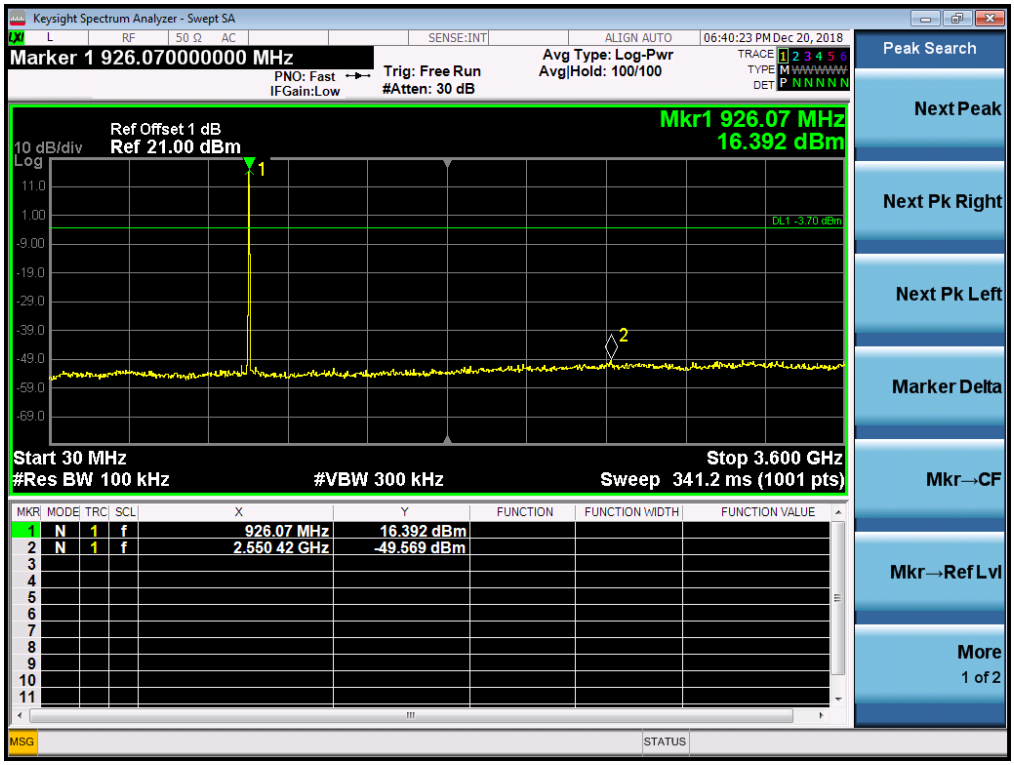
Conducted Band Edges and Spurious Emission Plot

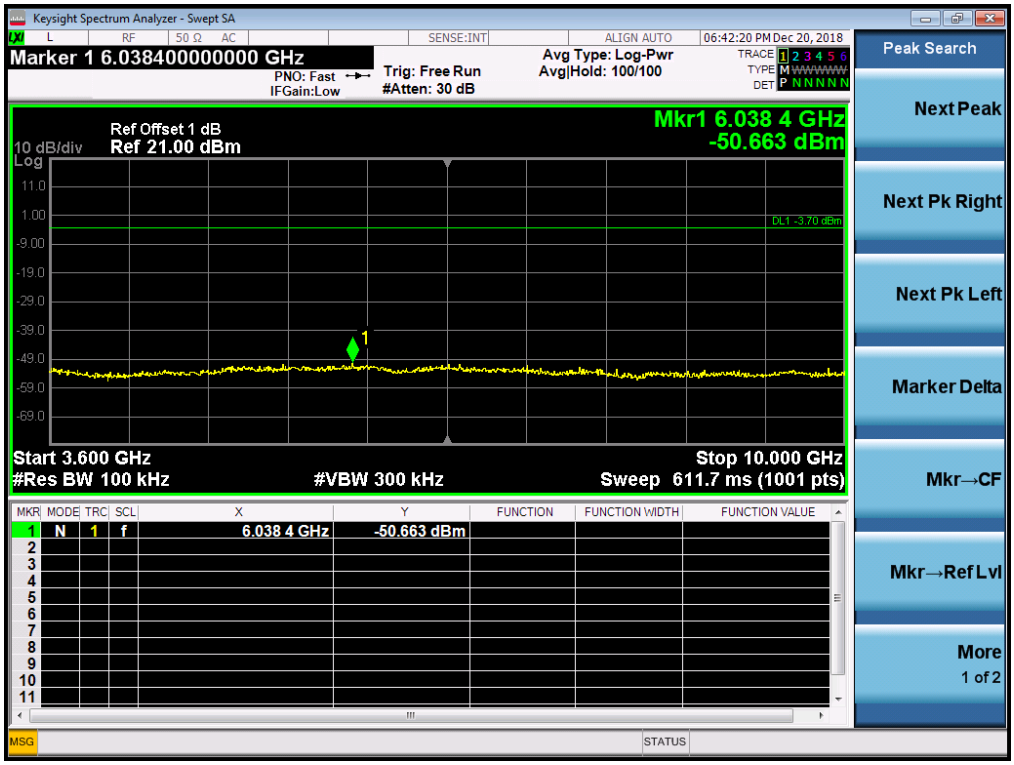
Lora_LCH_Graphs	
Pref/Lora/LCH	

Puw/Lora/LCH	 

LORA_MCH_Graphs	
Pref/LORA/MCH	
Puw/LORA/MCH	


Keysight Spectrum Analyzer - Swept SA
Marker 1 6.595200000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
05:15:29 PM Dec 20, 2018
Ref Offset 1 dB
10 dB/div
Log
Ref 21.00 dBm
Mkr1 6.595 2 GHz
-50.568 dBm
DL1 -3.76 dBm
Start 3.600 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 10.000 GHz
Sweep 611.7 ms (1001 pts)
1 N 1 f 6.595 2 GHz -50.568 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

LORA_HCH_Graphs	
Pref/LORA/HCH	
Puw/LORA/HCH	


Keysight Spectrum Analyzer - Swept SA
Marker 1 6.038400000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
06:42:20 PM Dec 20, 2018
Ref Offset 1 dB
10 dB/div
Log
Ref 21.00 dBm
Mkr1 6.038 4 GHz
-50.663 dBm
DL1 -3.70 dBm
Start 3.600 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 10.000 GHz
Sweep 611.7 ms (1001 pts)
1 N 1 f 6.038 4 GHz -50.663 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

4.5 Radiated Spurious Emission Measurement

4.5.1 Limit of Radiated Spurious Emission

FCC §15.247 (d)

IC RSS-247 5.5

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

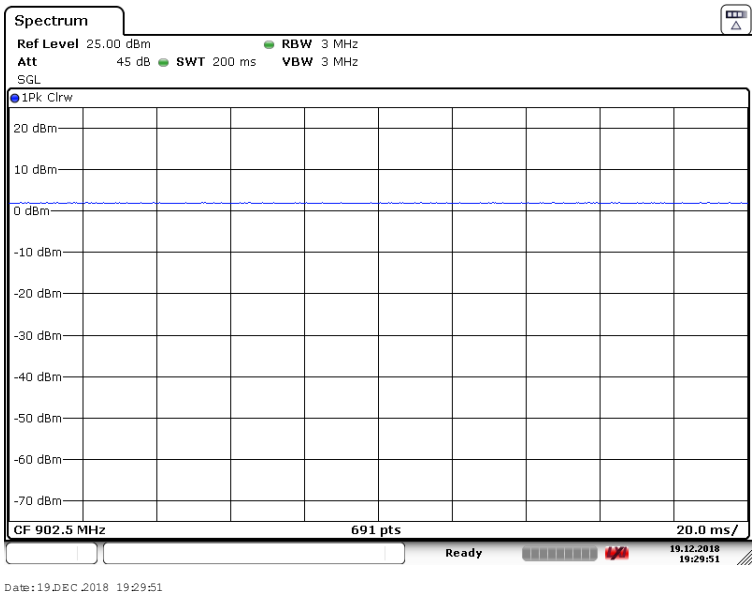
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

Note: The frequency range from 9KHz to 10th harmonic (25GHz) are checked, and no any emissions were found from 18GHz to 25GHz, So the radiated emissions from 18GHz to 25GHz were not record.

4.5.2 Test Procedures

1. The EUT was placed on a turntaLora with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The measurement distance is 3 meter.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntaLora (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enaLora the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement:
   VBW = 10 Hz, when duty cycle is no less than 98 percent.
   VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
Lora 500KHz DTS	1	/	/	10Hz



6. Corrected Reading: Antenna Factor + CaLora Loss + Read Level - Preamp Factor = Level

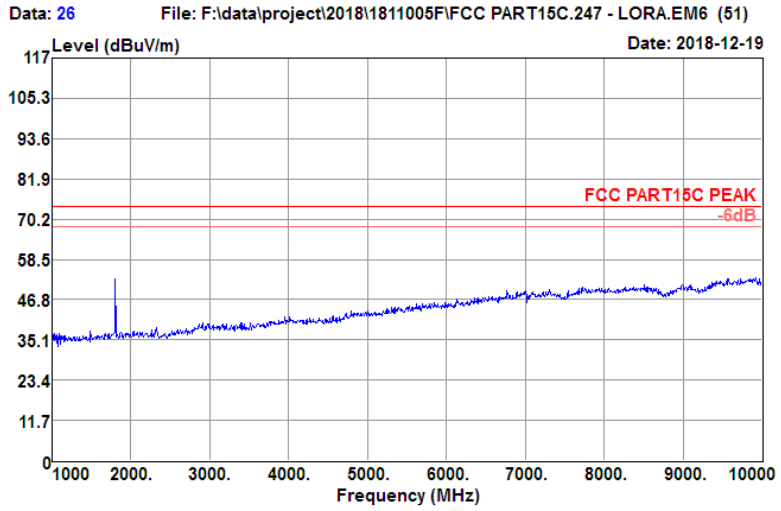
4.5.3 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

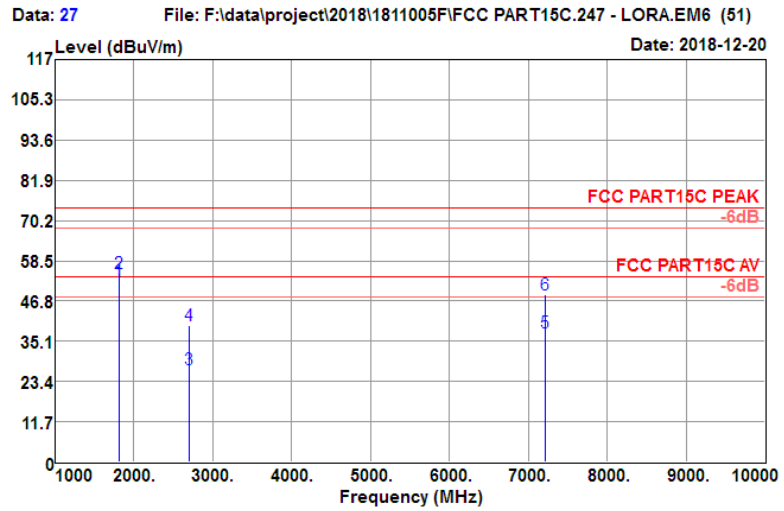
4.5.4 Test Result of Radiated Spurious Emission (1GHz ~ 10th Harmonic)

Low Channel Horizontal:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: HORIZONTAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 902.5MHz		



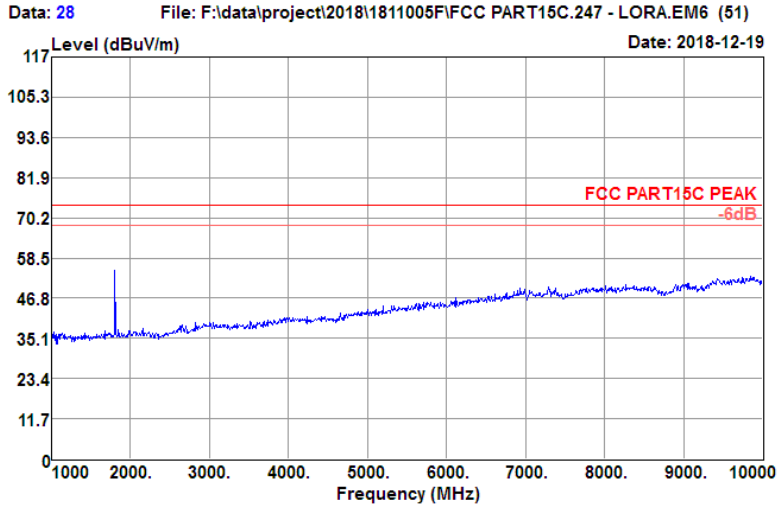
Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: HORIZONTAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 902.5MHz		



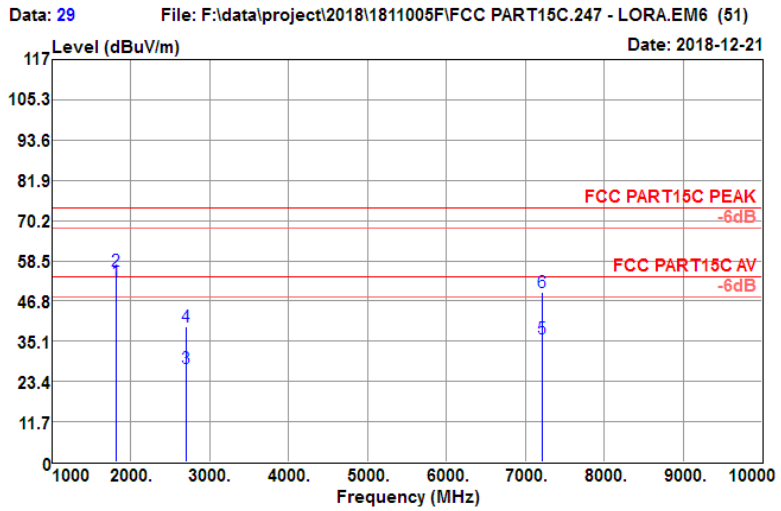
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1805.000	58.98	25.79	2.87	35.09	52.55	54.00	-1.45	Average
1805.000	61.27	25.79	2.87	35.09	54.84	74.00	-19.16	Peak
2707.500	32.24	27.94	3.70	36.92	26.96	54.00	-27.04	Average
2707.500	45.15	27.94	3.70	36.92	39.87	74.00	-34.13	Peak
7220.000	28.90	35.91	6.98	34.26	37.53	54.00	-16.47	Average
7220.000	40.15	35.91	6.98	34.26	48.78	74.00	-25.22	Peak

Low Channel Vertical:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: VERTICAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 902.5MHz		



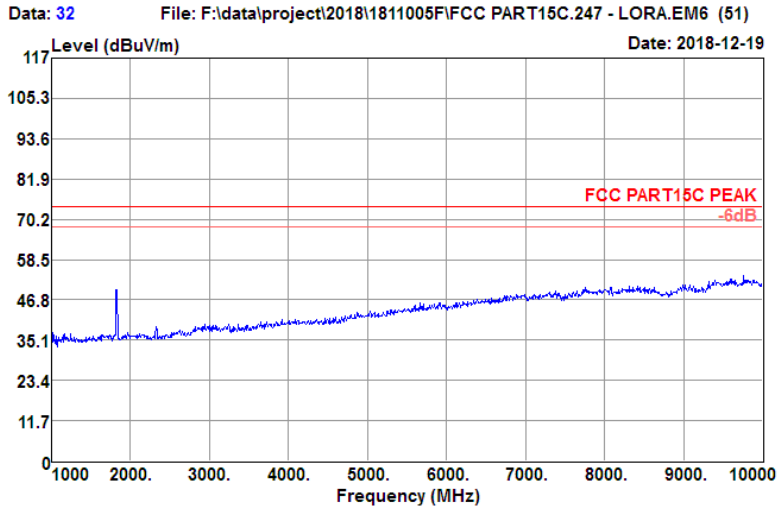
Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: VERTICAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 902.5MHz		



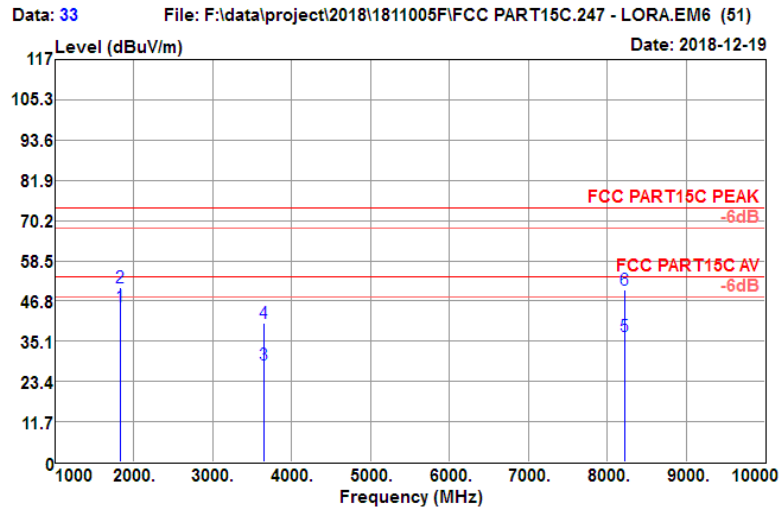
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1805.000	58.88	25.79	2.87	35.09	52.45	54.00	-1.55	Average
1805.000	62.14	25.79	2.87	35.09	55.71	74.00	-18.29	Peak
2707.500	32.71	27.94	3.70	36.92	27.43	54.00	-26.57	Average
2707.500	44.69	27.94	3.70	36.92	39.41	74.00	-34.59	Peak
7220.000	27.40	35.91	6.98	34.26	36.03	54.00	-17.97	Average
7220.000	40.60	35.91	6.98	34.26	49.23	74.00	-24.77	Peak

Middle Channel Horizontal:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: HORIZONTAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 913.7MHz		



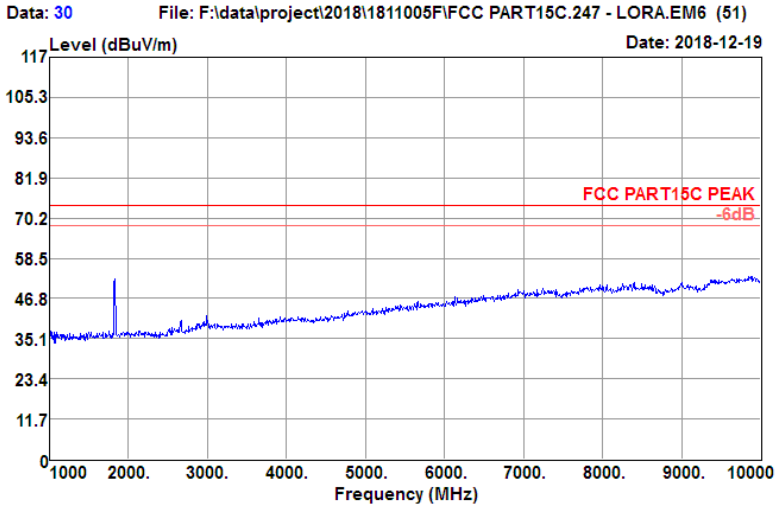
Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: HORIZONTAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 913.7MHz		



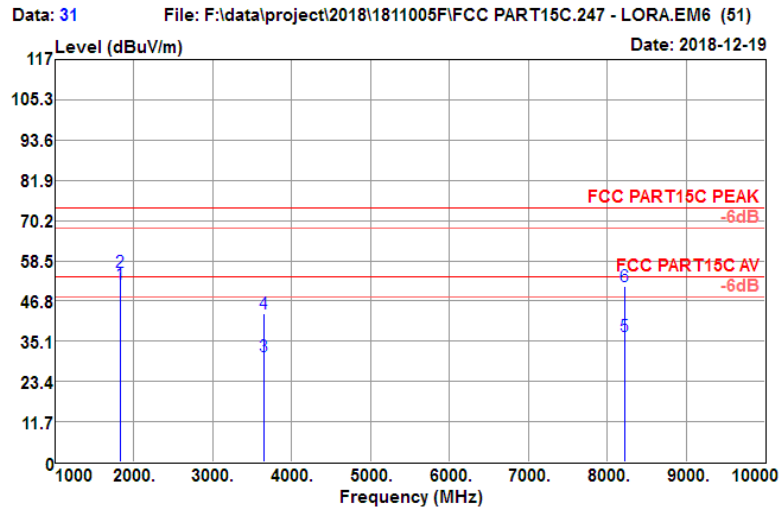
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1827.400	51.75	25.82	2.87	35.08	45.36	54.00	-8.64	Average
1827.400	57.15	25.82	2.87	35.08	50.76	74.00	-23.24	Peak
3654.000	31.13	29.09	4.88	36.94	28.16	54.00	-25.84	Average
3654.000	43.34	29.09	4.88	36.94	40.37	74.00	-33.63	Peak
8227.000	27.43	37.47	6.28	34.74	36.44	54.00	-17.56	Average
8227.000	40.93	37.47	6.28	34.74	49.94	74.00	-24.06	Peak

Middle Channel Vertical:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: VERTICAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 913.7MHz		



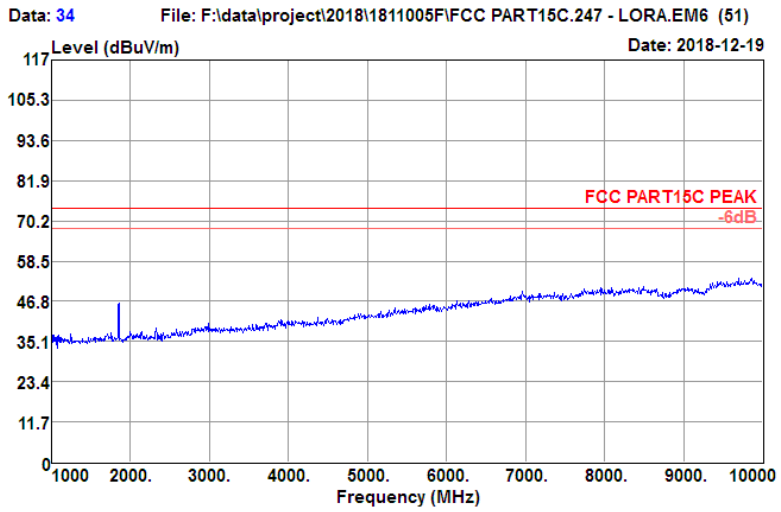
Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: VERTICAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 913.7MHz		



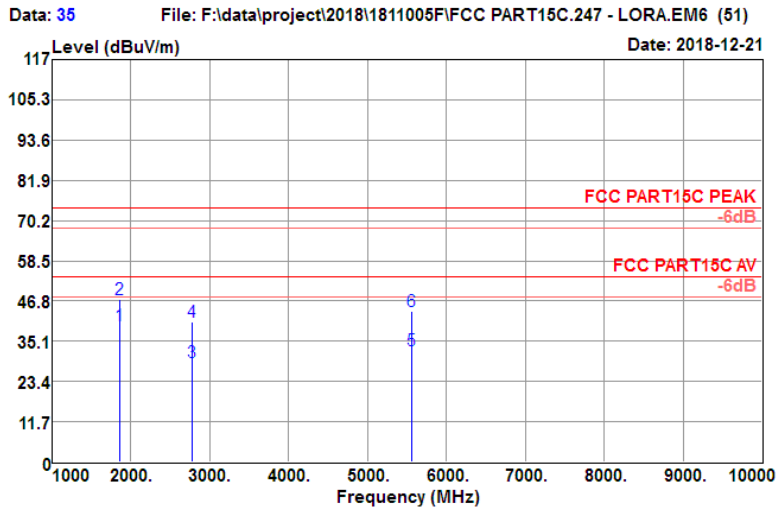
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1827.400	58.18	25.82	2.87	35.08	51.79	54.00	-2.21	Average
1827.400	61.45	25.82	2.87	35.08	55.06	74.00	-18.94	Peak
3654.800	33.56	29.09	4.88	36.94	30.59	54.00	-23.41	Average
3654.800	46.20	29.09	4.88	36.94	43.23	74.00	-30.77	Peak
8223.300	27.48	37.48	6.27	34.75	36.48	54.00	-17.52	Average
8223.300	42.18	37.48	6.27	34.75	51.18	74.00	-22.82	Peak

High Channel Horizontal:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: HORIZONTAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 927MHz		



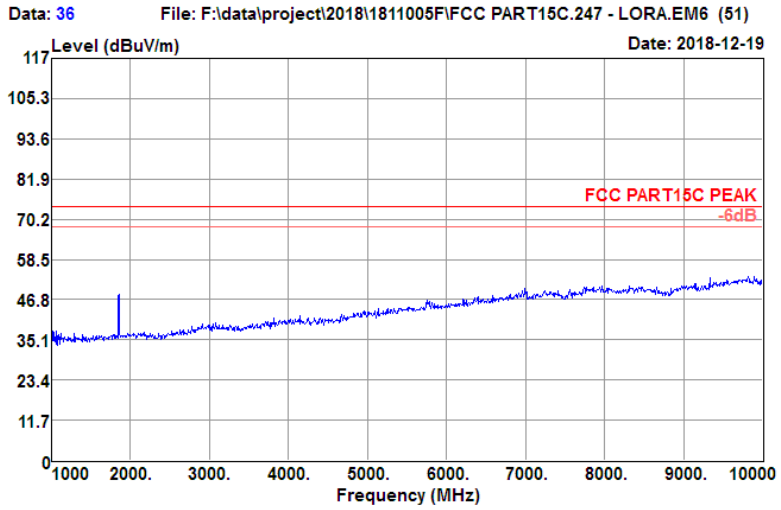
Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: HORIZONTAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 927MHz		



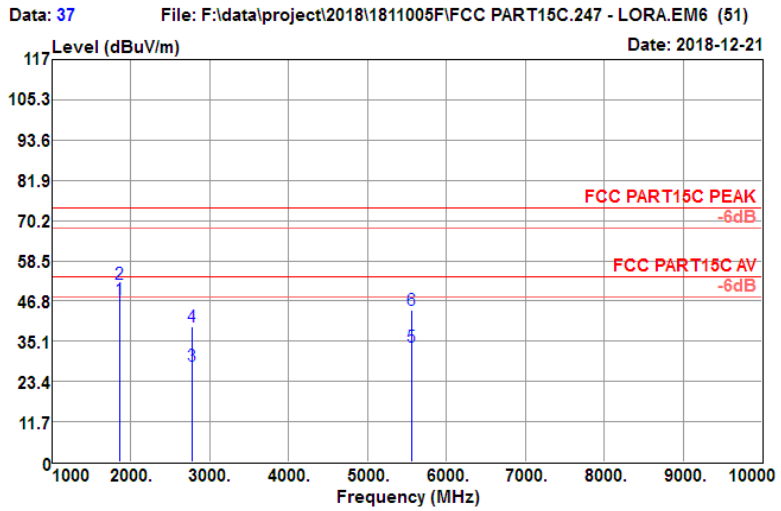
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1854.000	46.05	25.87	2.88	35.08	39.72	54.00	-14.28	Average
1854.000	53.78	25.87	2.88	35.08	47.45	74.00	-26.55	Peak
2781.000	34.21	28.13	3.69	37.11	28.92	54.00	-25.08	Average
2781.000	45.98	28.13	3.69	37.11	40.69	74.00	-33.31	Peak
5562.000	29.42	32.15	6.23	35.37	32.43	54.00	-21.57	Average
5562.000	40.77	32.15	6.23	35.37	43.78	74.00	-30.22	Peak

High Channel Vertical:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: VERTICAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 927MHz		



Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: VERTICAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 927MHz		

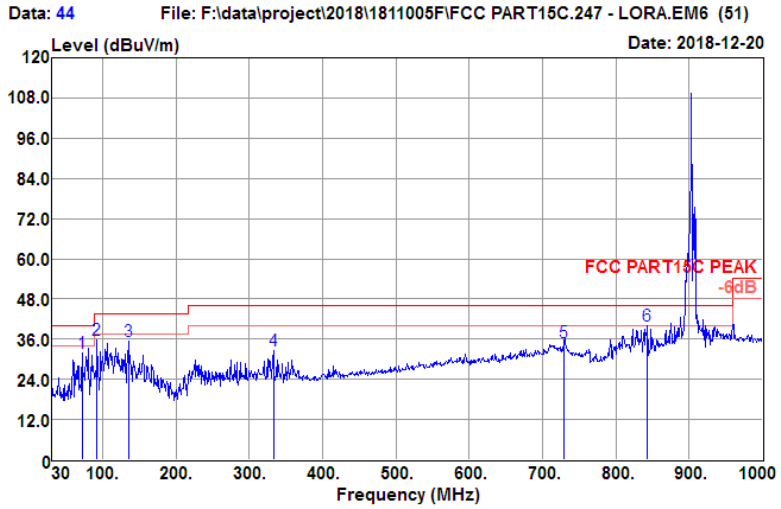


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1854.000	53.70	25.87	2.88	35.08	47.37	54.00	-6.63	Average
1854.000	58.19	25.87	2.88	35.08	51.86	74.00	-22.14	Peak
2781.000	33.32	28.13	3.69	37.11	28.03	54.00	-25.97	Average
2781.000	44.82	28.13	3.69	37.11	39.53	74.00	-34.47	Peak
5562.000	30.56	32.15	6.23	35.37	33.57	54.00	-20.43	Average
5562.000	41.29	32.15	6.23	35.37	44.30	74.00	-29.70	Peak

4.5.5 Test Result of Radiated Spurious Emission (30MHz ~ 1GHz)

Horizontal:

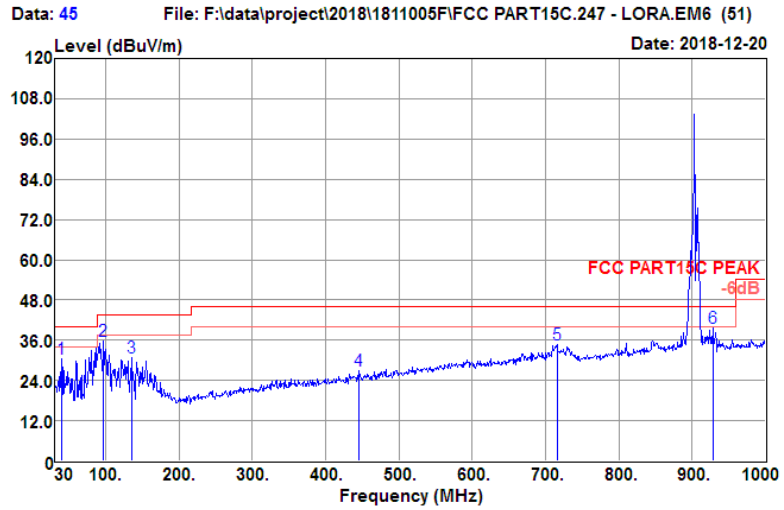
Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: HORIZONTAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 902.5MHz		



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
71.710	51.96	10.54	1.71	32.51	31.70	40.00	-8.30	QP
92.080	56.85	9.65	1.88	32.46	35.92	43.50	-7.58	QP
134.760	52.55	13.13	2.28	32.49	35.47	43.50	-8.03	QP
332.640	47.88	13.52	3.66	32.50	32.56	46.00	-13.44	QP
729.370	42.27	20.02	5.58	32.74	35.13	46.00	-10.87	QP
842.860	45.36	21.19	5.99	32.40	40.14	46.00	-5.86	QP

Vertical:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/60%
Tested by	: Damon	Power rating	: DC 6V
EUT	: Pathlight	Pol/Phase	: VERTICAL
Model No.	: 5LP1Y8		
Test Mode	: LORA 500KHz DTS 902.5MHz		



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB	
39.700	47.90	14.06	1.15	32.56	30.55	40.00	-9.45	QP
96.930	56.37	9.99	1.92	32.45	35.83	43.50	-7.67	QP
134.760	47.92	13.13	2.28	32.49	30.84	43.50	-12.66	QP
445.160	39.63	15.57	4.26	32.51	26.95	46.00	-19.05	QP
715.790	42.06	19.87	5.58	32.76	34.75	46.00	-11.25	QP
928.220	43.58	21.87	6.44	32.07	39.82	46.00	-6.18	QP

4.6 Antenna Requirements

4.6.1 Standard ApplicaLora

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsiLora 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 re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsiLora for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

4.6.2 Antenna Connected Construction

An embedded-in antenna design is used.

4.6.3 Antenna Gain

The antenna peak gain of EUT is 1dBi for BLE and 3dBi for Lora less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5. List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	Keysight	N9010A	MY56070788	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY56510025	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY57030005	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY56510018	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY56480002	2018-03-02	2019-03-01	Conducted
Thermal Chamber	Sanmtest	SMC-408-CD	2435	2018-07-05	2019-07-04	Conducted
Base Station	R&S	CMW 270	101231	2018-03-17	2019-03-16	Conducted
Signal Generator (Interferer)	Keysight	N5182B	MY56200384	2018-04-10	2019-04-09	Conducted
Signal Generator (Blocker)	Keysight	N5171B	MY56200661	2018-03-15	2019-03-14	Conducted

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV 40	101433	2018-03-14	2019-03-13	Radiation
Amplifier	Sonoma	310	363917	2018-03-06	2019-03-05	Radiation
Amplifier	Schwarzbeck	BBV 9718	327	2018-03-14	2019-03-13	Radiation
Amplifier	Narda	TTA1840-35-HG	2034380	2018-07-18	2019-07-17	Radiation
Broadband Antenna	Schwarzbeck	VULB 9168	9168-757	2017-03-03	2020-03-02	Radiation
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2017-03-03	2020-03-02	Radiation
Horn Antenna	COM-POWER	AH-1840	101117	2018-06-20	2021-06-19	Radiation
Test Software	Auidx	E3	6.111221a	N/A	N/A	Radiation
Filter	Micro-Tronics	BRM 50702	G266	N/A	N/A	Radiation

N/A: No Calibration Required

6. Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.64dB
Radiated emission	30MHz ~ 1GMHz	5.05dB
	1GHz ~ 18GHz	5.06 dB
	18GHz ~ 40GHz	3.65dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.