

Test Report

FCC Part15 Subpart C

Product Name : 915MHz LoRa Module
Model No. : LSD4RF-2F917N10
FCC ID : N8NLSD4RF2F917N10

Applicant : Lierda Science & Technology Group Co., Ltd.
Address : Building 1#, Lierda IOT park, No.1326 Wenyi Xi Rd,
Hangzhou,China

Date of Receipt : Nov. 29, 2016
Test Date : Nov. 29, 2016~ Dec. 08, 2016
Issued Date : Dec. 29, 2016
Report No. : 16B2198R-RF-US-P06V01
Report Version : V2.2

The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration of the equipment and evaluated measurement uncertainty herein.

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Test Report Certification

Issued Date : Dec. 29, 2016

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Product Name : 915MHz LoRa Module
Applicant : Lierda Science & Technology Group Co., Ltd.
Address : Building 1#, Lierda IOT park, No.1326 Wenyi Xi Rd,
Hangzhou,China
Manufacturer : Zhejiang Xianxin Science & Technology Co., Ltd
Address : ZHEN ZHU BAN DAO, QIANDAOHU TOWN, CHUN'AN
COUNTY, ZHEJIANG, CHINA
Model No. : LSD4RF-2F917N10
FCC ID : N8NLS4RF2F917N10
EUT Voltage : DC 2.4~3.6V
Brand Name : Lierda
Applicable Standard : FCC CFR Title 47 Part 15 Subpart C
ANSI C63.4:2014; ANSI C63.10:2013;
Test Result : Complied
Performed Location : Quietek Corporation - Suzhou EMC Laboratory
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FCC Registration Number: 800392

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Laboratory Information

We, **Quietek Corporation**, are an independent EMC and safety consultancy that was established the whole facility in our laboratories. The test facility has been accredited/accepted(audited or listed) by the following related bodies in compliance with ISO 17025, EN 45001 and specified testing scope:

Taiwan R.O.C.	:	BSMI, NCC, TAF
USA	:	FCC
Japan	:	VCCI
China	:	CNAS

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The address and introduction of Quietek Corporation's laboratories can be founded in our Web site : http://www.quietek.com/index_en.aspx

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History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
16B2198R-RF-US-P06V01	V1.0	Initial Issued Report	Dec. 09, 2016
16B2198R-RF-US-P06V01	V2.0	Modify the applicant's address	Dec. 14, 2016
16B2198R-RF-US-P06V01	V2.1	1, Modify the duty cycle plot. 2, P26, Modify the note 2. 3, Modify the applicant's address	Dec. 26, 2016
16B2198R-RF-US-P06V01	V2.2	1, Update conducted emission data.	Dec. 29, 2016

1. General Information

1.1. EUT Description

Product Name	915MHz LoRa Module
Brand Name	Lierda
Model No.	LSD4RF-2F917N10
EUT Voltage	DC 2.4~3.6V
Frequency Range	904~925MHz
Channel Number	20
Type of Modulation	LoRaTM\2-FSK\4-FSK\PSK\ASK\GFSK\OOK
Data Rate	0.2~37.5Kbps
Channel Control	Auto

1.2. Antenna information

Model No.	N/A					
Antenna manufacturer	N/A					
Antenna Delivery	☒	1*TX+1*RX	☐	2*TX+2*RX	☐	3*TX+3*RX
Antenna technology	☒	SISO				
	☐	MIMO	☐	Basic		
			☐	CDD		
			☐	Sectorized		
			☐	Beam-forming		
Antenna Type	☐	External	☐	Dipole		
☐			Sectorized			
	☒	Internal	☐	PIFA		
			☐	PCB		
			☒	helical antenna		
			☐	Ceramic Chip Antenna		
			☐	Metal plate type F antenna		
Antenna Technology	Ant Gain (dBi)		Directional Gain (dBi)			
			For Power	For PSD		
☒ SISO	2		2	2		

1.3. Mode of Operation

Test Modes List
Mode 1: Transmit

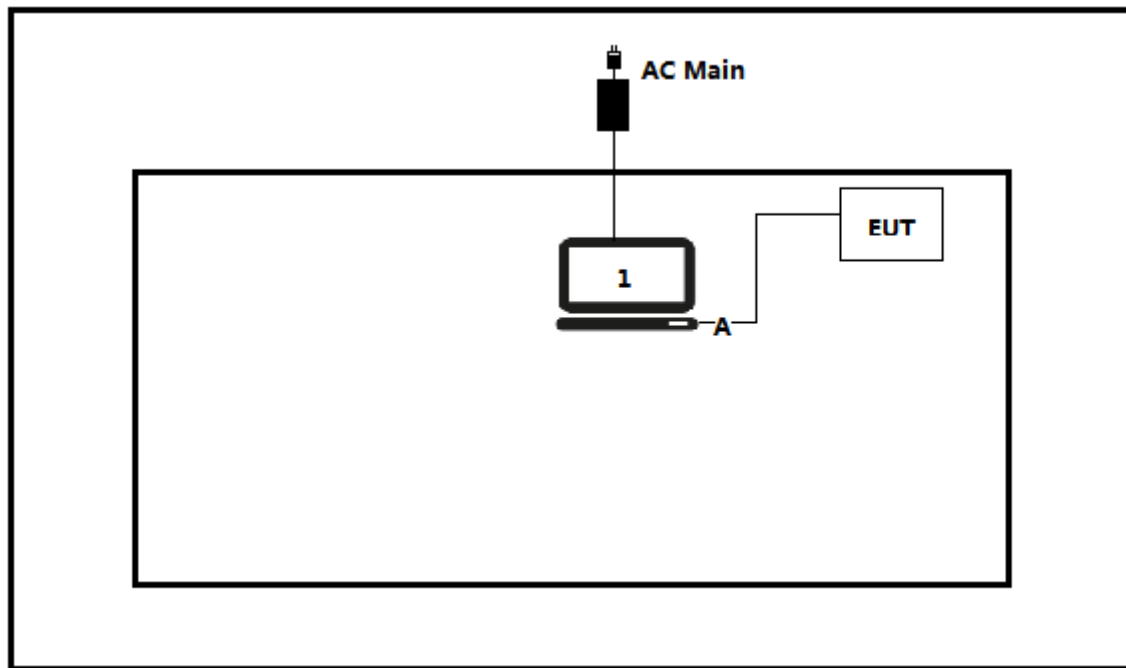
1.4. Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

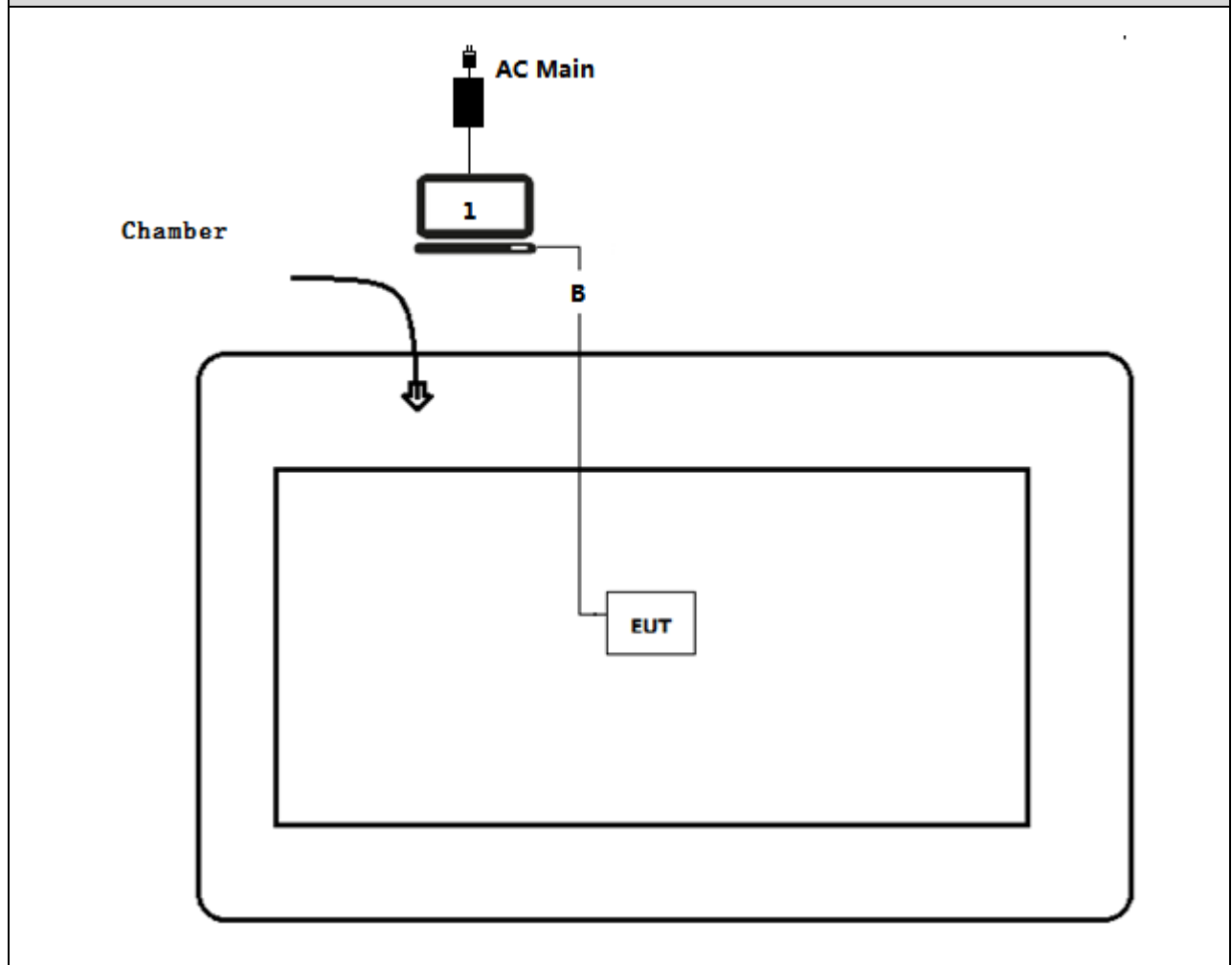
No.	Product	Manufacturer	Model No.	Serial No.	Power Cord
1	Notebook	Lenovo	Think pad x220	SUA0600195	Non-shielded

1.5. Configuration of Tested System

Test setup Diagram- AC Line Conducted Emission Test



Test setup Diagram- Radiated Emission



2. Technical Test

2.1. Summary of Test Result

Performed Test Item	Normative References	Limit	Result
AC Power Line Conducted Emission	FCC CFR Title 47 Part 15 Subpart C: 2015 Section 15.207	FCC 15.207	PASS
Emissions in restricted frequency bands	FCC CFR Title 47 Part 15 Subpart C: 2015 Section 15.209	FCC 15.209	PASS
Emissions in non-restricted frequency bands	FCC CFR Title 47 Part 15 Subpart C: 2015 Section 15.247(d)	$\geq 20\text{dBc}$	PASS
Occupied Bandwidth	FCC CFR Title 47 Part 15 Subpart C: 2015 Section 15.247(a)(2)	$\geq 500\text{kHz}$	PASS
Fundamental emission output power	FCC CFR Title 47 Part 15 Subpart C: 2015 Section 15.247(b)(3)	$\leq 30\text{dBm}$	PASS
Power Spectral Density	FCC CFR Title 47 Part 15 Subpart C: 2015 Section 15.247(e)	$\leq 8\text{dBm}/3\text{kHz}$	PASS
Antenna Requirement	FCC CFR Title 47 Part 15 Subpart C: 2015 Section 15.203	FCC 15.203	PASS

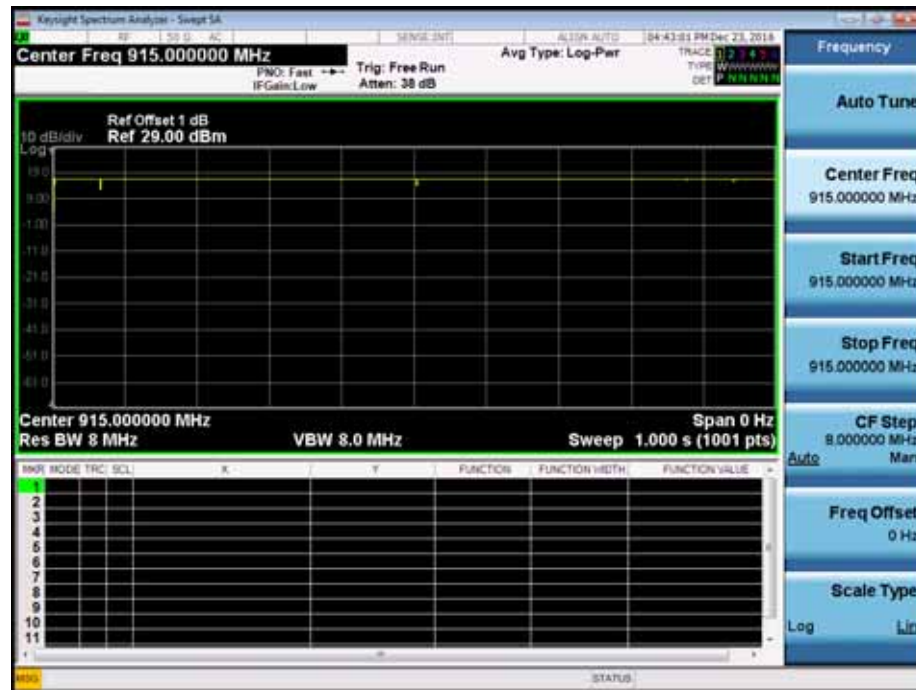
2.2. Test Frequency configuration:

Channel	Frequency	Channel	Frequency	Channel	Frequency
Low	904 MHz	Mid	915 MHz	High	925MHz

2.3. Duty Cycle

Test Mode	Tx On (ms)	Tx Off (ms)	VBW	Tx On + Tx Off (ms)	Duty Cycle
1	--	--	10Hz	--	100%

Frequency 915MHz



2.4. Test Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	21
Humidity (%RH)	25-75	50
Barometric pressure (mbar)	860-1060	950-1000

2.5. Measurement Uncertainty

Test Items	Uncertainty
AC Power Line Conducted Emission	$\pm 2.02\text{dB}$
Radiated Emission	Below 1GHz $\pm 3.8\text{ dB}$
	Above 1GHz $\pm 3.9\text{ dB}$
RF Antenna Port Conducted Emission	$\pm 1.27\text{dB}$
Radiated Emission Band Edge	$\pm 3.9\text{dB}$
Occupied Bandwidth	$\pm 1\text{kHz}$
Power Spectral Density	$\pm 1.27\text{dB}$

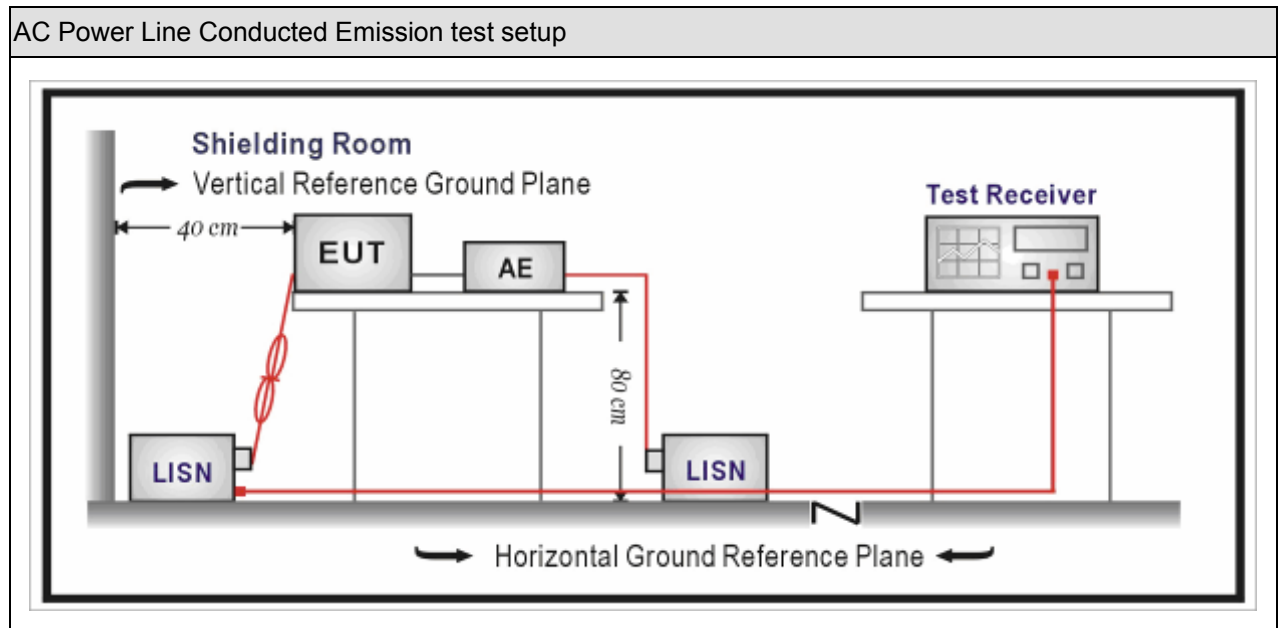
3. AC Power Line Conducted Emission

3.1. Test Equipment

AC Power Line Conducted Emission / TR-1					
Instrument	Manufacturer	Type No.	Serial No.	Cal. Date	Cal. Due Date
EMI Test Receiver	R&S	ESCI	100906	2016.03.05	2017.03.04
Two-Line V-Network	R&S	ENV 216	101189	2016.07.16	2017.07.15
Two-Line V-Network	R&S	ENV 216	101044	2016.09.04	2017.09.03
50ohm Coaxial Switch	Anritsu	MP59B	6200464462	N/A	N/A
50ohm Termination	SHX	TF2	07081402	2016.09.04	2016.09.03
Temperature/Humidity Meter	Zhichen	ZC1-2	TR1-TH	2016.01.05	2017.01.04

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

3.2. Test Setup



3.3. Limit

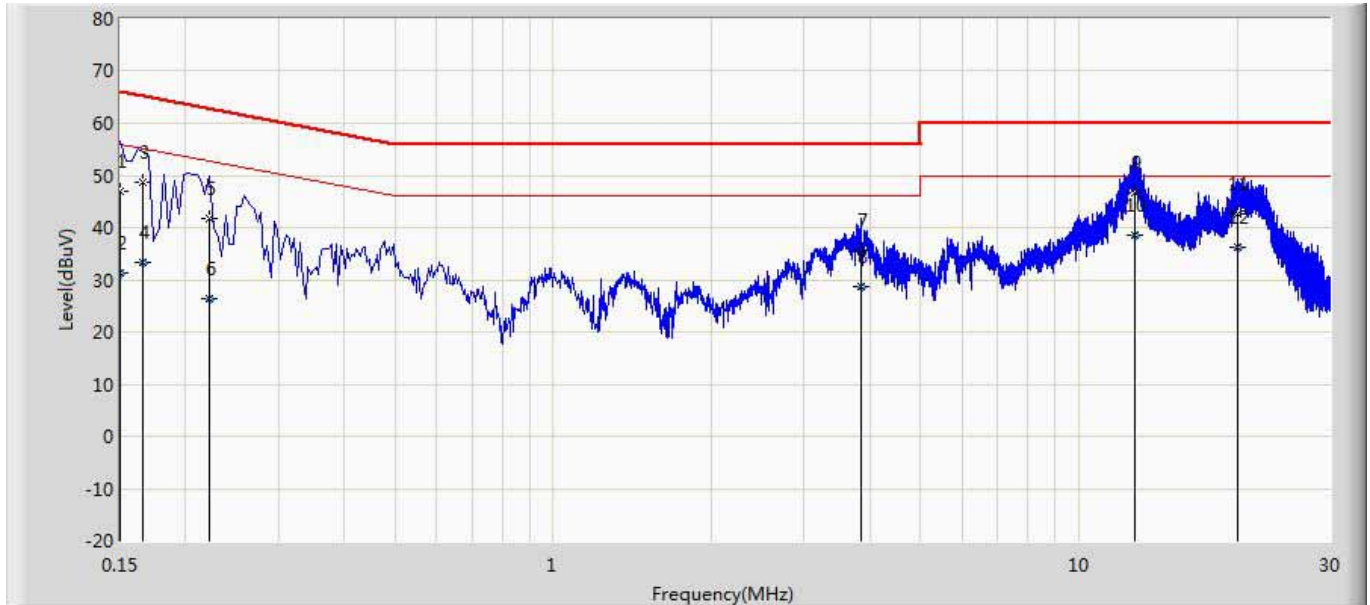
Frequency of Emission (MHz)	Conducted Limit	
	Quasi-peak (dB μ V)	Average (dB μ V)
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50
Note 1: The lower limit shall apply at the transition frequencies.		
Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.		

3.4. Test Procedure

Test Method			
	References Rule	Chapter	Item
☒	ANSI C63.10-2013	6.2	Standard test method for ac power-line conducted emissions from unlicensed wireless devices
☒	ANSI C63.4-2014	7	AC power-line conducted emission measurements

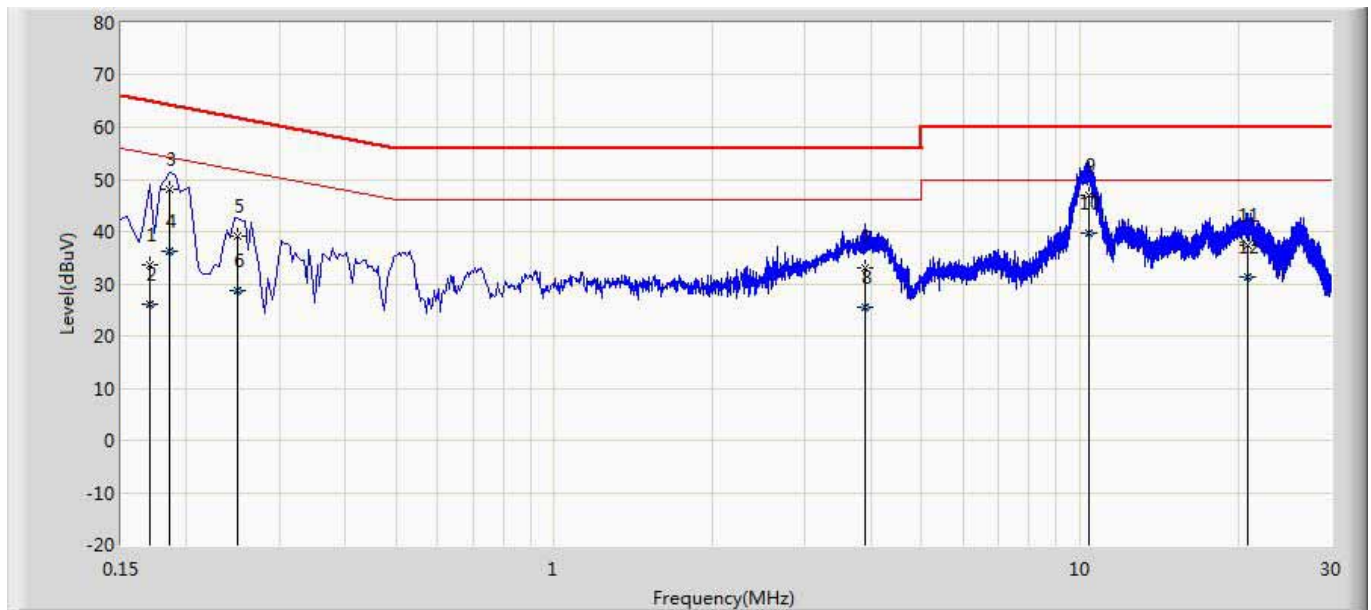
3.5. Test Result

Site: TR1	Time: 2016/12/06 - 14:51
Limit: FCC_Part15.107_CE_AC Power_ClassB	Margin: 0
Probe: ENV216_101044(0.009-30MHz)	Polarity: Line
EUT: 915MHz LoRa Module	Power: AC 120V/60HZ
Note: Mode 1	



No	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1		0.150	47.098	37.497	-18.902	66.000	9.601	QP
2		0.150	31.396	21.795	-24.604	56.000	9.601	AV
3		0.166	48.790	39.190	-16.369	65.158	9.600	QP
4		0.166	33.237	23.637	-21.921	55.158	9.600	AV
5		0.222	41.834	32.231	-20.910	62.744	9.602	QP
6		0.222	26.420	16.817	-26.324	52.744	9.602	AV
7		3.862	35.540	25.810	-20.460	56.000	9.729	QP
8		3.862	28.600	18.870	-17.400	46.000	9.729	AV
9		12.758	46.793	36.914	-13.207	60.000	9.880	QP
10	*	12.758	38.512	28.633	-11.488	50.000	9.880	AV
11		20.026	42.704	32.738	-17.296	60.000	9.966	QP
12		20.026	36.133	26.167	-13.867	50.000	9.966	AV

Site: TR1	Time: 2016/12/06 - 14:55
Limit: FCC_Part15.107_CE_AC Power_ClassB	Margin: 0
Probe: ENV216_101044(0.009-30MHz)	Polarity: Neutral
EUT: 915MHz LoRa Module	Power: AC 120V/60HZ
Note: Mode 1	



No	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1		0.170	33.525	23.905	-31.436	64.960	9.620	QP
2		0.170	26.049	16.430	-28.911	54.960	9.620	AV
3		0.186	48.037	38.417	-16.177	64.213	9.620	QP
4		0.186	36.146	26.526	-18.068	54.213	9.620	AV
5		0.250	39.069	29.448	-22.688	61.757	9.620	QP
6		0.250	28.758	19.138	-22.999	51.757	9.620	AV
7		3.898	33.132	23.391	-22.868	56.000	9.741	QP
8		3.898	25.430	15.689	-20.570	46.000	9.741	AV
9		10.430	46.893	37.042	-13.107	60.000	9.851	QP
10	*	10.430	39.778	29.927	-10.222	50.000	9.851	AV
11		20.874	37.535	27.607	-22.465	60.000	9.928	QP
12		20.874	31.391	21.463	-18.609	50.000	9.928	AV

4. Emissions in restricted frequency bands

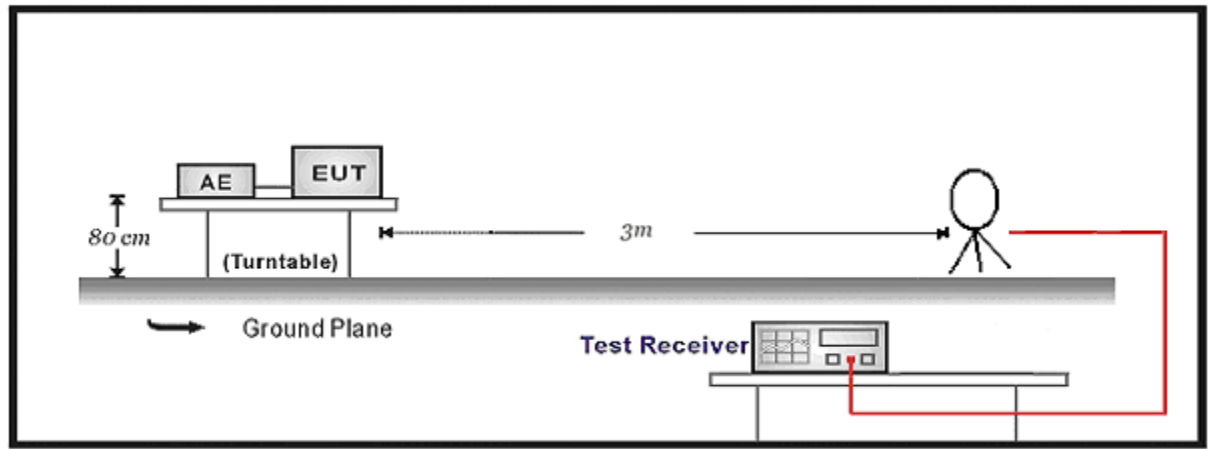
4.1. Test Equipment

Radiated Emission(Below 1GHz) / AC-2					
Instrument	Manufacturer	Type No.	Serial No.	Cal. Date	Cal. Due Date
EMI Test Receiver	R&S	ESCI	100573	2016.03.05	2017.03.04
Loop Antenna	R&S	HFH2-Z2	833799/003	2016.11.07	2017.11.06
Bilog Antenna	Teseq GmbH	CBL6112D	27611	2016.08.10	2017.08.09
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC2-C	2016.02.28	2017.02.27
Temperature/Humidity Meter	Zhichen	ZC1-2	AC2-TH	2016.01.05	2017.01.04
Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.					

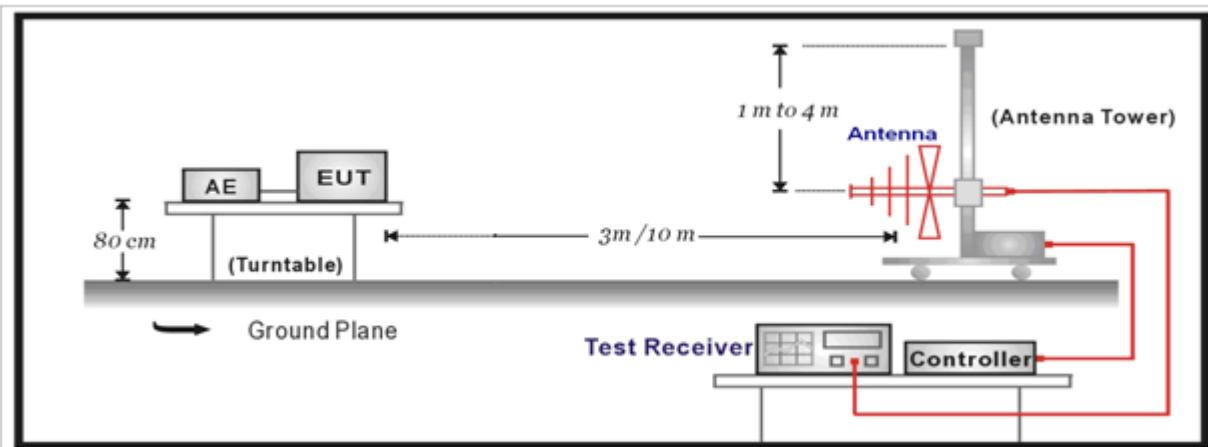
Radiated Emission(Above 1GHz) / AC-5					
Instrument	Manufacturer	Type No.	Serial No.	Cal. Date	Cal. Due Date
Spectrum Analyzer	Agilent	E4446A	MY45300103	2016.01.04	2017.01.03
Preamplifier	Miteq	NSP1800-25	1364185	2016.05.03	2017.05.02
Preamplifier	QuieTek	AP-040G	CHM-0906001	2016.05.06	2017.05.05
DRG Horn	ETS-Lindgren	3117	00123988	2016.01.22	2017.01.20
Broad-Band Horn Antenna	Schwarzbeck	BBHA9170	294	2016.11.25	2017.11.23
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C1	2016.03.02	2017.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C2	2016.03.02	2017.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 102	AC5-C3	2016.03.02	2017.03.01
EMI Receiver	Agilent	N9038A	MY51210196	2016.06.10	2017.06.09
Temperature/Humidity Meter	Zhichen	ZC1-2	AC5-TH	2016.01.04	2017.01.03
Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.					

4.2. Test Setup

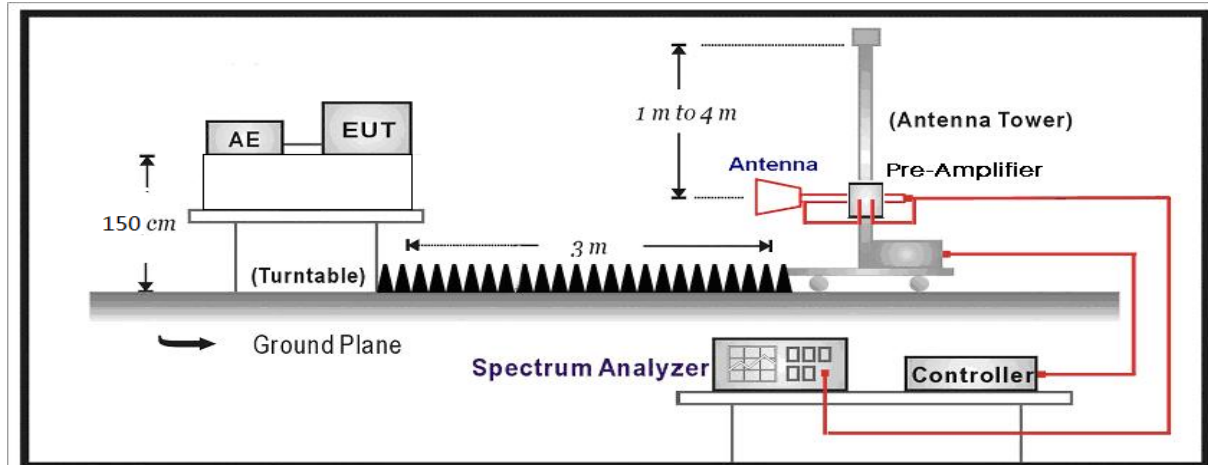
Below 30MHz Test Setup:



30MHz-1GHz Test Setup:



Above 1GHz Test Setup:



4.3. Limit

Restricted Bands of operation			
Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (GHz)
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
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
8.81425 – 8.81475	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	
13.36 – 13.41			

Restricted Band Emissions Limit			
Frequency (MHz)	Field strength (μ V/m)	Field strength (dB μ V/m)	Measurement distance (m)
0.009 - 0.49	2400/F(kHz)	48.5 – 13.8	300 _(Note 1)
0.49 - 1.705	24000/F(kHz)	33.8 - 23	30 _(Note 1)
1.705 - 30	30	29.5	30 _(Note 1)
30 - 88	100	40	3 _(Note 2)
88 - 216	150	43.5	3 _(Note 2)
216 - 960	200	46	3 _(Note 2)
Above 960	500	54	3 _(Note 2)

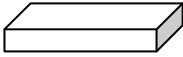
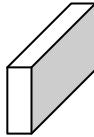
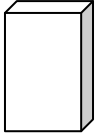
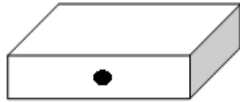
Note 1: At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

Note 2: At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

4.4. Test Procedure

Test Method				
	References Rule		Chapter	Description
☐	ANSI C63.10		11.11	Emissions in non-restricted frequency bands
	☐	ANSI C63.10	11.11.2	Reference level measurement
	☐	ANSI C63.10	11.11.3	Emission level measurement
☒	ANSI C63.10		11.12	Emissions in restricted frequency bands
	☒	ANSI C63.10	11.12.1	Radiated emission measurements
	☒	ANSI C63.10	11.12.2.7	Radiated spurious emission test
	☒	ANSI C63.10	6.4	Radiated emissions from unlicensed wireless devices below 30 MHz
		ANSI C63.10	6.5	Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz
		ANSI C63.10	6.6	Radiated emissions from unlicensed wireless devices above 1 GHz
	☐	ANSI C63.10	11.12.2.3	Quasi-peak measurement procedure
		ANSI C63.10	11.12.2.4	Peak power measurement procedure
		ANSI C63.10	11.12.2.5	Average power measurement procedures
	☐	ANSI C63.10	11.12.2.5.1	Trace averaging with continuous EUT transmission at full power
		ANSI C63.10	11.12.2.5.2	Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction
		☒ ANSI C63.10	11.12.2.5.3	Reduced VBW averaging across ON and OFF times of the EUT transmissions with max hold

4.5. EUT test Axis definition

Item	Emissions in restricted frequency bands			
Device Category	☐	Fixed position use		
	☒	Mobile position use		
Test mode	Mode 1			
Test method	☒	Radiated		
		X Axis	Y Axis	Z Axis
				
		Worst Axis ☐	Worst Axis ☐	Worst Axis ☒
	☐	Conducted		
	☐	Chain 1		
				
	☐	Chain 1	Chain 2	
				
	☐	Chain 1	Chain 2	Chain 3
				

4.6. Test Result

Product Name	:	915MHz LoRa Module	Power	:	AC 120V/60HZ
Test Mode	:	Mode 1	Test Site	:	AC-5
Test Date	:	2016.12.08			

CH	Antenna Polarity	Frequency (MHz)	Reading Level (dB μ V)	Factor (dB)	Measured Level (dB μ V/m)	Limit (dB μ V/m)	Over Limit (dB)	Detector
Low	H	1810.0	59.3	-14.5	44.8	54(note3)	-9.2	PK
	H	2710.0	54.6	-11.3	43.3	54(note3)	-10.7	PK
	H	3616.0	50.6	-10.0	40.6	54(note3)	-13.4	PK
	H	7232.5	53.2	-5.5	47.7	54(note3)	-6.3	PK
	H	8136.0	49.6	-4.3	45.3	54(note3)	-8.7	PK
	H	9040.0	46.8	-3.4	43.4	54(note3)	-10.6	PK
	V	1792.0	59.2	-14.6	44.6	54(note3)	-9.4	PK
	V	2710.0	55.3	-11.3	44.0	54(note3)	-10.0	PK
	V	3616.0	51.2	-9.9	41.3	54(note3)	-12.7	PK
	V	7232.5	56.4	-5.5	50.9	54(note3)	-3.1	PK
	V	8137.0	55.3	-4.3	51.0	54(note3)	-3.0	PK
	V	9041.5	52.0	-3.4	48.6	54(note3)	-5.4	PK
Mid	H	1828.0	58.2	-14.3	43.9	54(note3)	-10.1	PK
	H	2746.0	53.4	-10.8	42.6	54(note3)	-11.4	PK
	H	3660.0	50.8	-9.8	41.0	54(note3)	-13.0	PK
	H	6405.0	50.3	-6.8	43.5	54(note3)	-10.5	PK
	H	7318.0	54.3	-5.4	48.9	54(note3)	-5.1	PK
	H	8235.0	48.3	-4.2	44.1	54(note3)	-9.9	PK
	V	9150.0	46.6	-3.2	43.4	54(note3)	-10.6	PK
	V	1832.5	56.8	-14.2	42.6	54(note3)	-11.4	PK
	V	2746.0	54.4	-10.9	43.5	54(note3)	-10.5	PK
	V	3660.0	51.4	-9.8	41.6	54(note3)	-12.4	PK
	V	6404.5	53.1	-6.8	46.3	54(note3)	-7.7	PK
	V	7318.0	57.1	-5.4	51.7	54(note3)	-2.3	PK

High	H	1850.5	59.3	-14.0	45.3	54(note3)	-8.7	PK
	H	2773.0	53.9	-10.9	43.0	54(note3)	-11.0	PK
	H	3700.0	51.4	-9.9	41.5	54(note3)	-12.5	PK
	H	6475.0	49.7	-6.7	43.0	54(note3)	-11.0	PK
	H	7399.0	54.2	-5.1	49.1	54(note3)	-4.9	PK
	H	8325.0	47.5	-3.9	43.6	54(note3)	-10.4	PK
	V	9250.0	47.1	-2.8	44.3	54(note3)	-9.7	PK
	V	1850.5	57.6	-13.9	43.7	54(note3)	-10.3	PK
	V	2773.0	55.3	-10.8	44.5	54(note3)	-9.5	PK
	V	3700.0	51.5	-9.9	41.6	54(note3)	-12.4	PK
	V	6476.5	52.5	-6.6	45.9	54(note3)	-8.1	PK
	V	7399.0	58.3	-5.2	53.1	54(note3)	-0.9	PK

Note: 1. Measure Level = Reading Level + Factor.

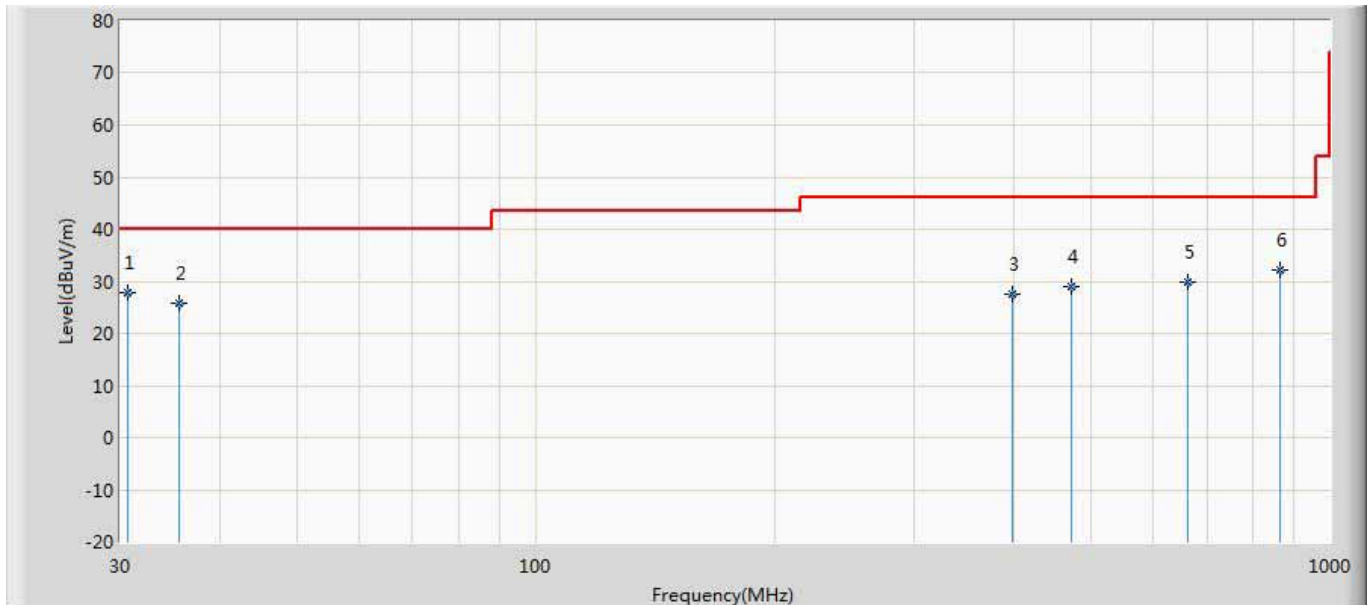
Note: 2. The test frequency range, 9kHz~30MHz, the worst case are at least 20dB below the limits, therefore no data appear in the report.

Note: 3. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.

Note: 4. The VBW setting for average testing, see Clause 2.3.

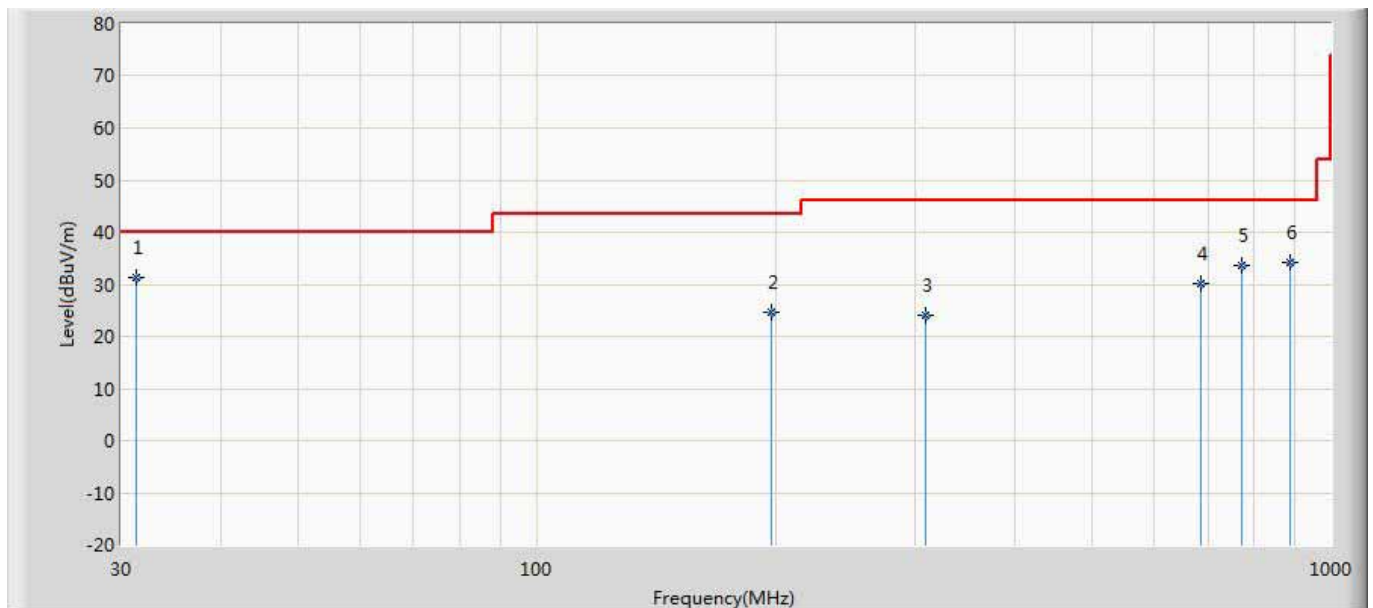
The worst case of Radiated Emission below 1GHz:

Engineer: Scott	
Site: AC3	Time: 2016/12/08 - 13:21
Limit: FCC_Part15.109_RE(3m)_ClassB	Margin: 0
Probe: AC3_3m (30-1000MHz)	Polarity: Horizontal
EUT: 915MHz LoRa Module	Power: AC 120V/60HZ
Note: Mode 1	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	30.606	27.916	0.300	-12.084	40.000	27.616	QP
2		35.577	25.806	0.100	-14.194	40.000	25.706	QP
3		399.085	27.591	2.300	-18.409	46.000	25.291	QP
4		472.199	29.009	3.000	-16.991	46.000	26.009	QP
5		662.925	29.990	0.500	-16.010	46.000	29.491	QP
6		865.898	32.063	0.200	-13.937	46.000	31.863	QP

Engineer: Scott	
Site: AC3	Time: 2016/12/08 - 13:21
Limit: FCC_Part15.109_RE(3m)_ClassB	Margin: 0
Probe: AC3_3m (30-1000MHz)	Polarity: Vertical
EUT: 915MHz LoRa Module	Power: AC 120V/60HZ
Note: Mode 1	



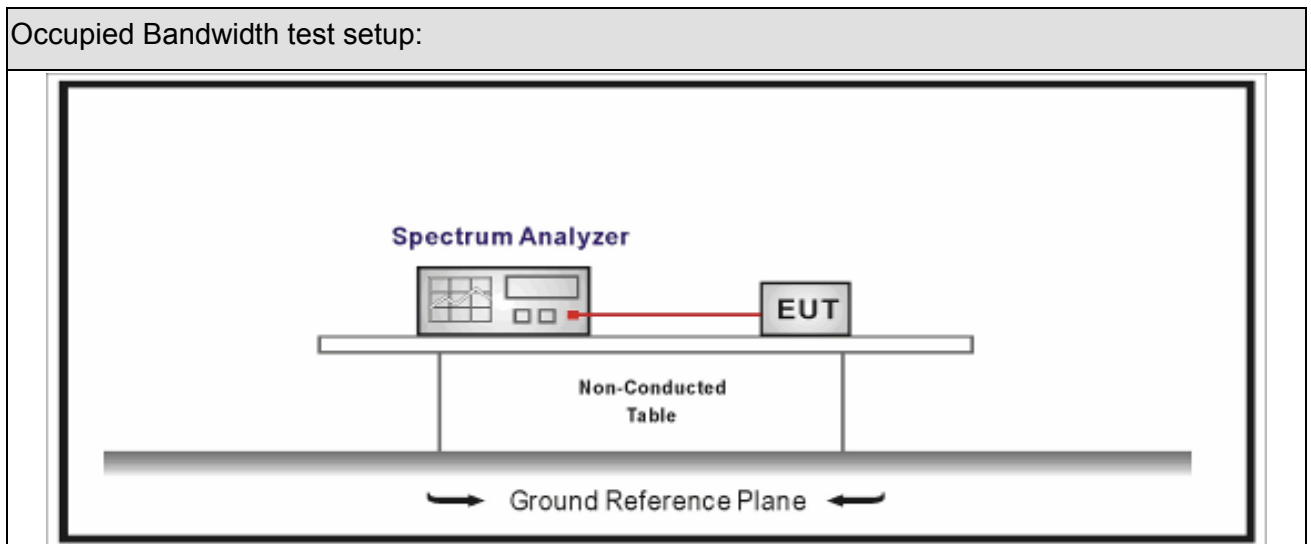
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	31.334	31.273	7.600	-8.727	40.000	23.674	QP
2		197.689	24.747	2.700	-18.753	43.500	22.048	QP
3		308.996	24.034	-1.300	-21.966	46.000	25.334	QP
4		684.629	30.093	1.200	-15.907	46.000	28.893	QP
5		772.171	33.746	1.400	-12.254	46.000	32.347	QP
6		888.208	34.193	0.900	-11.807	46.000	33.293	QP

5. Emissions in non-restricted frequency bands

5.1. Test Equipment

Occupied Bandwidth / TR-8					
Instrument	Manufacturer	Type No.	Serial No.	Cal. Date	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.02.04	2017.02.03
EXA Spectrum Analyzer	Keysight	N9010A	MY55370495	2016.04.09	2017.04.08
MXA Signal Analyzer	Keysight	N9020A	MY56060147	2016.04.09	2017.04.08
Temperature/Humidity Meter	zhichen	ZC1-2	TR8-TH	2016.04.10	2017.04.09
Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.					

5.2. Test Setup



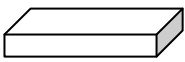
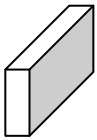
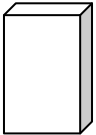
5.3. Limit

Un-Restricted Band Emissions Limit	
RF Output power (Detection methods)	Limit(dB)
RF Output power(Average detector)	30c(Note1)
RF Output power(PK detector)	20c(Note2)
Note 1: If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc). Note 2: If the maximum peak conducted output power procedure was used, then the peak output power 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 (i.e., 20 dBc).	

5.4. Test Procedure

Test Method				
	References Rule		Chapter	Description
☒	ANSI C63.10		11.11	Emissions in non-restricted frequency bands
	☒	ANSI C63.10	11.11.2	Reference level measurement
	☒	ANSI C63.10	11.11.3	Emission level measurement
☐	ANSI C63.10		11.12	Emissions in restricted frequency bands
	☐	ANSI C63.10	11.12.1	Radiated emission measurements
	☐	ANSI C63.10	11.12.2.7	Radiated spurious emission test
☐	ANSI C63.10		6.4	Radiated emissions from unlicensed wireless devices below 30 MHz
☐	ANSI C63.10		6.5	Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz
☒	ANSI C63.10		6.6	Radiated emissions from unlicensed wireless devices above 1 GHz
	☒	ANSI C63.10	11.12.2	Antenna-port conducted measurements
	☐	ANSI C63.10	11.12.2.3	Quasi-peak measurement procedure
		☒	ANSI C63.10	Peak power measurement procedure
		☐	ANSI C63.10	Average power measurement procedures
	☐	☐	ANSI C63.10	11.12.2.5.1 Trace averaging with continuous EUT transmission at full power
		☐	ANSI C63.10	11.12.2.5.2 Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction
		☐	ANSI C63.10	11.12.2.5.3 Reduced VBW averaging across ON and OFF times of the EUT transmissions with max hold

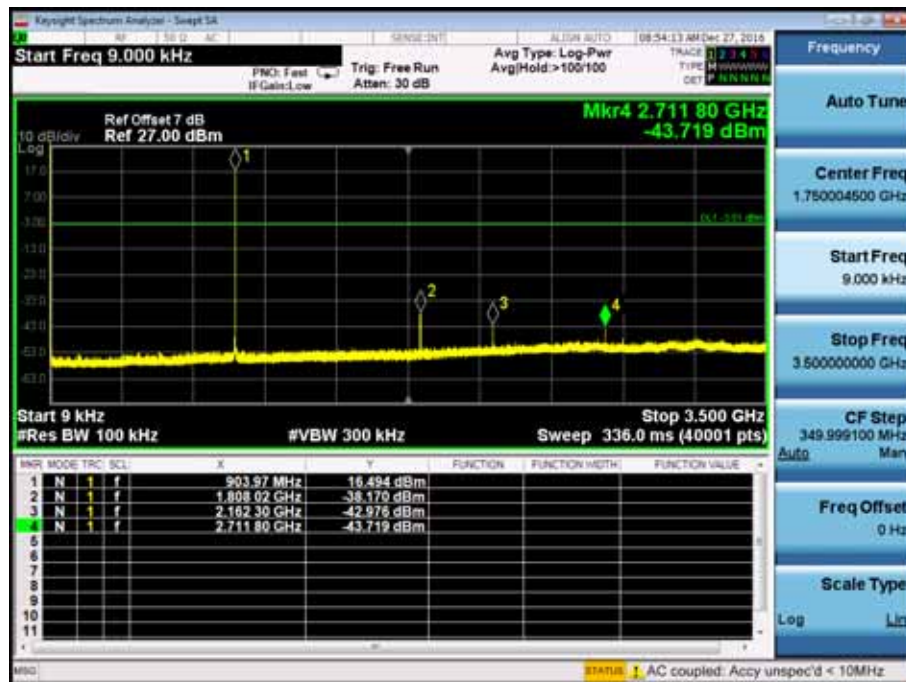
5.5. EUT test Axis definition

Item	Emissions in non-restricted frequency bands			
Device Category	☐	Fixed position use		
	☒	Mobile position use		
Test mode	Mode 1 ~ Mode 4			
Test method	☐	Radiated		
		X Axis	Y Axis	Z Axis
				
		Worst Axis ☐	Worst Axis ☐	Worst Axis ☐
	☒	Conducted		
	☒	Chain 0		
				
	☐	Chain 0	Chain 1	
				
	☐	Chain 0	Chain 1	Chain 2
				

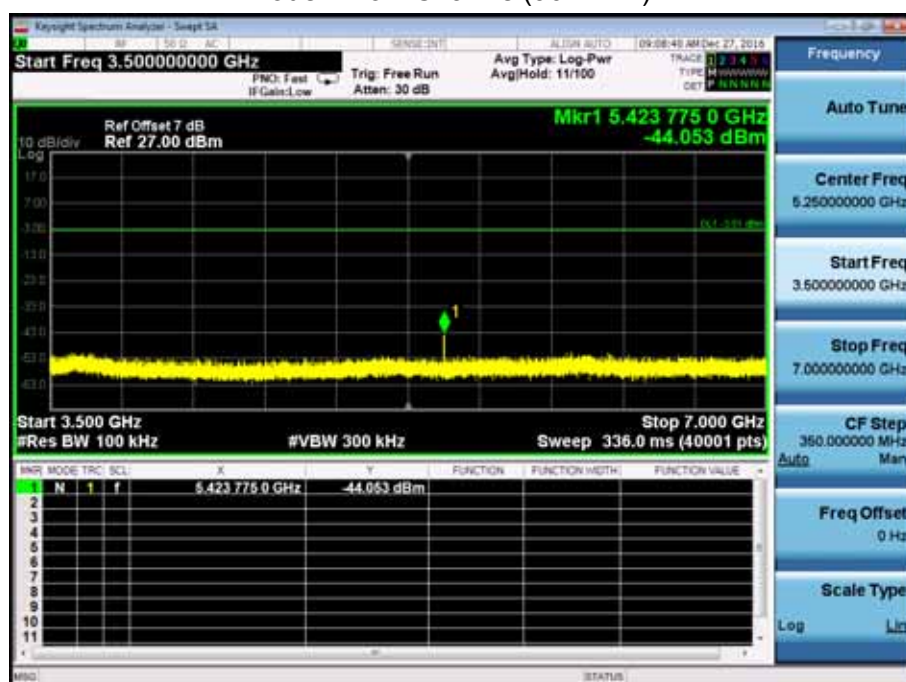
5.6. Test Result

Product Name	: 915MHz LoRa Module	Power	: AC 120V/60HZ
Test Mode	: Mode1	Test Site	: TR8
Test Date	: 2016.12.08		

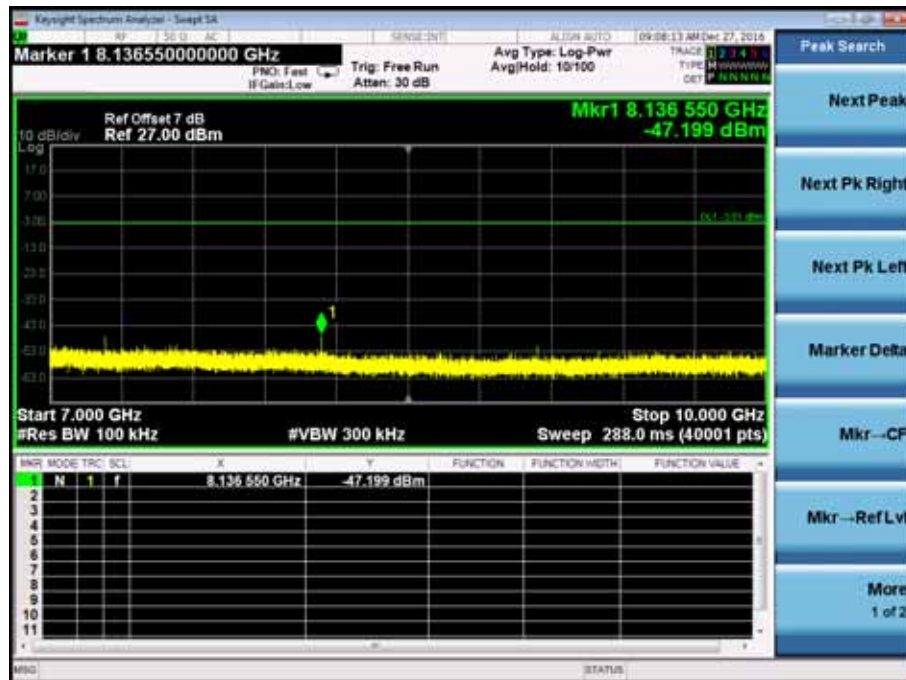
Mode 1 Low Channel(904MHz)-1



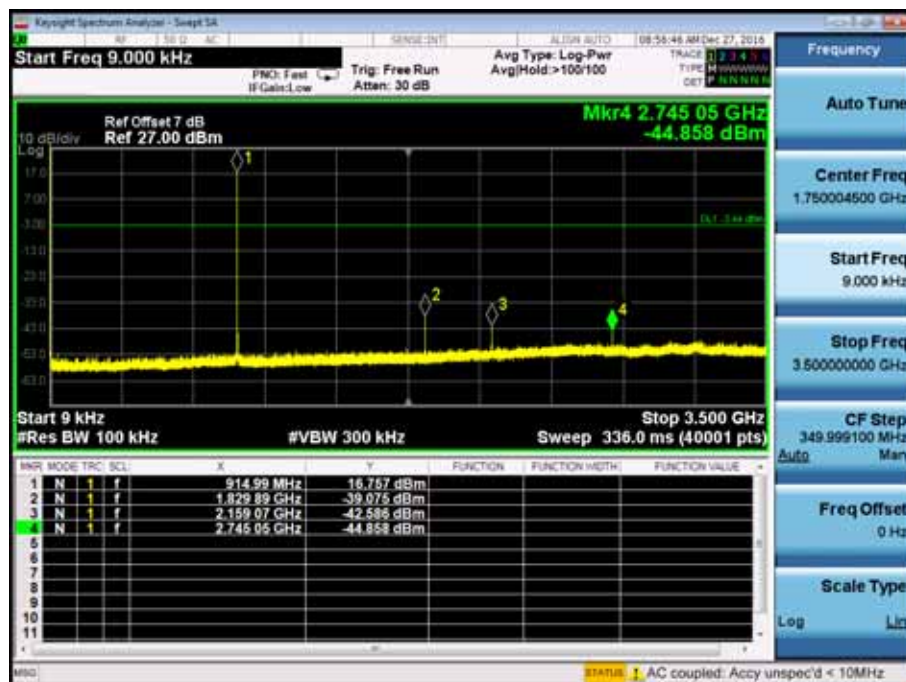
Mode 1 Low Channel(904MHz)-2



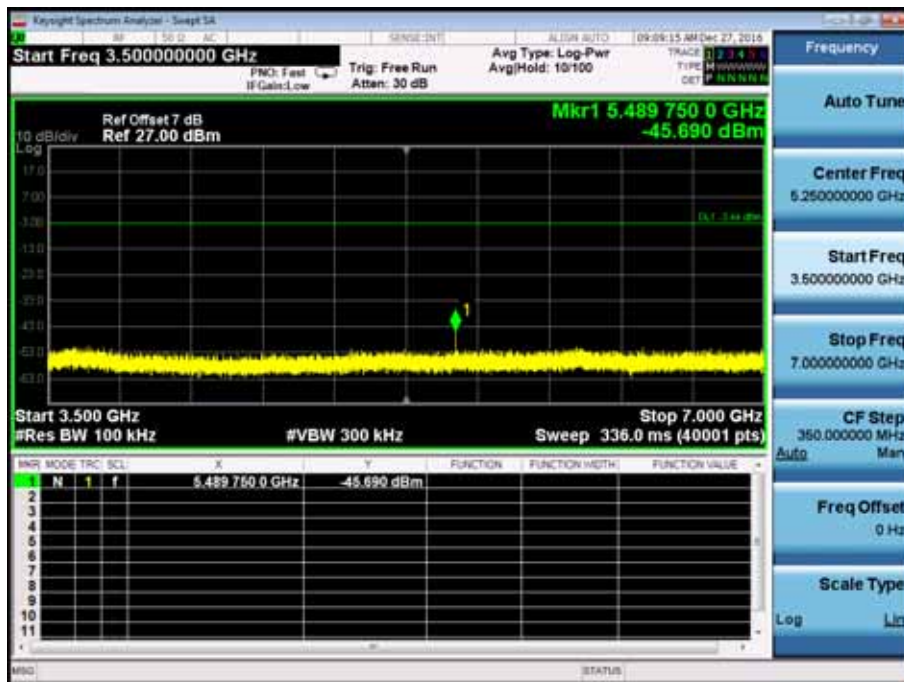
Mode 1 Low Channel(904MHz)-3



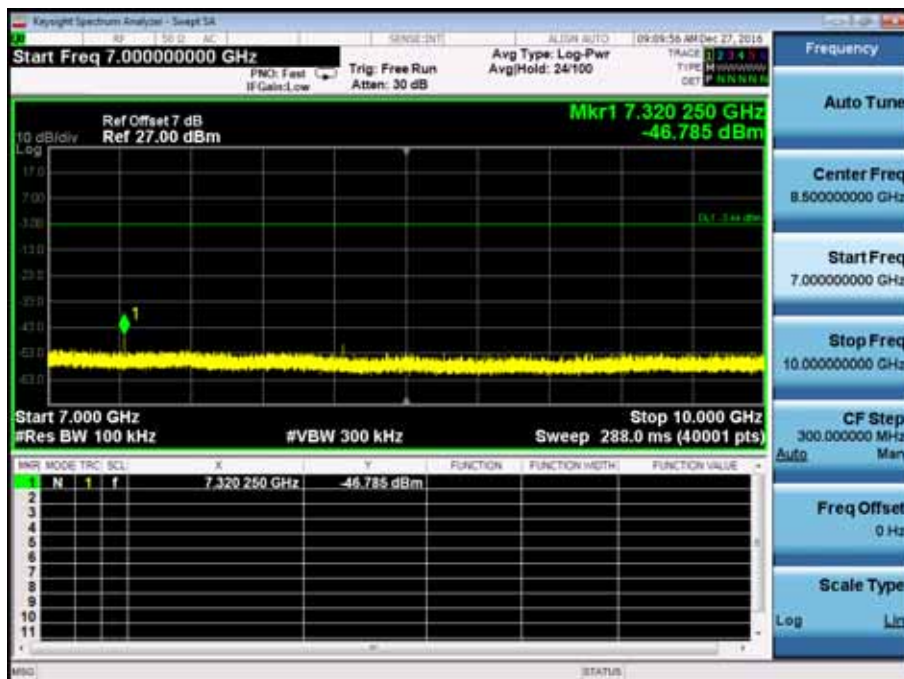
Mode 1 Mid Channel(915MHz)-1



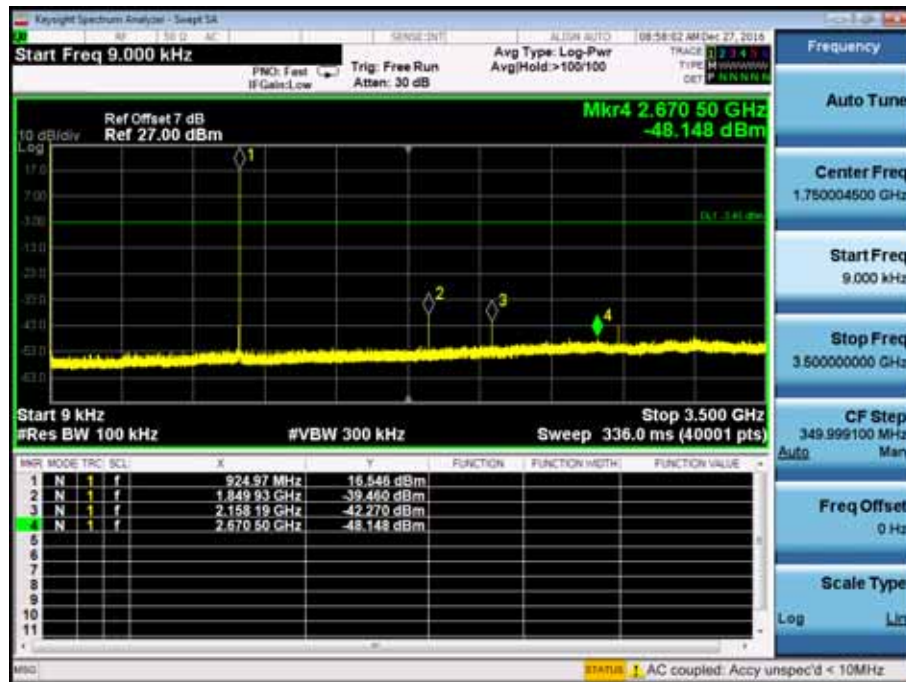
Mode 1 Mid Channel(915MHz)-2



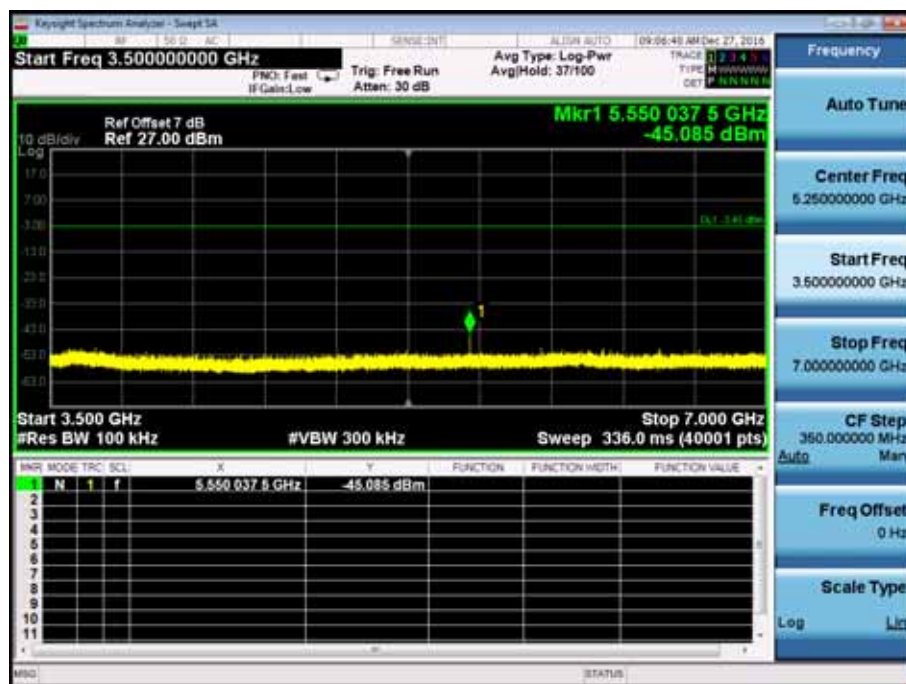
Mode 1 Mid Channel(915MHz)-3



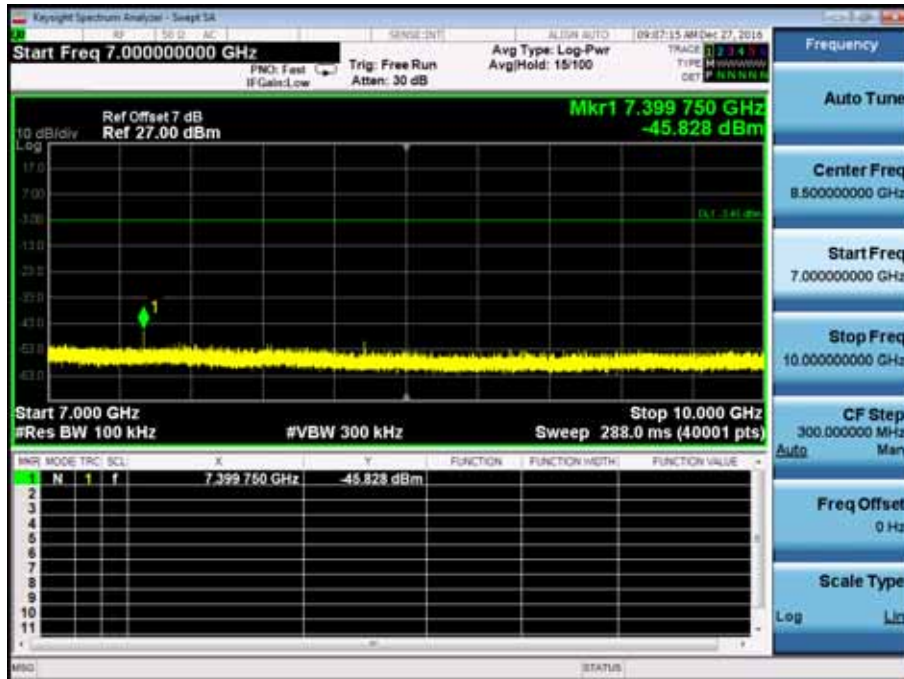
Mode 1 High Channel(925MHz)-1



Mode 1 Mid Channel(915MHz)-2



Mode 1 Mid Channel(915MHz)-3

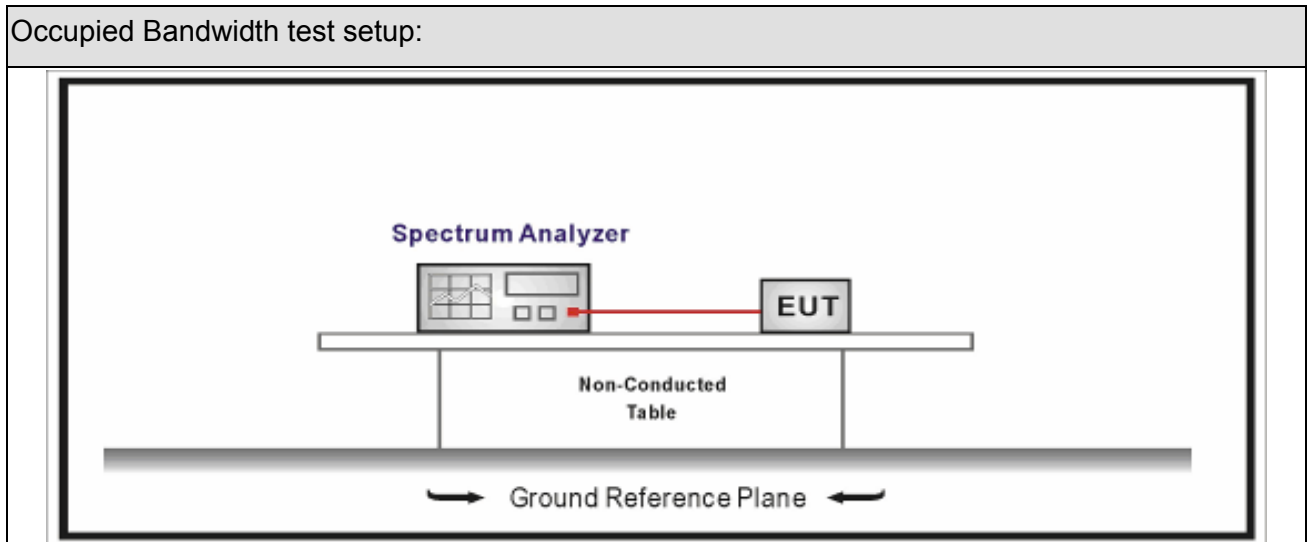


6. Occupied Bandwidth

6.1. Test Equipment

Occupied Bandwidth / TR-8					
Instrument	Manufacturer	Type No.	Serial No.	Cal. Date	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.02.04	2017.02.03
EXA Spectrum Analyzer	Keysight	N9010A	MY55370495	2016.04.09	2017.04.08
MXA Signal Analyzer	Keysight	N9020A	MY56060147	2016.04.09	2017.04.08
Temperature/Humidity Meter	zhichen	ZC1-2	TR8-TH	2016.04.10	2017.04.09
Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.					

6.2. Test Setup



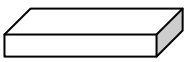
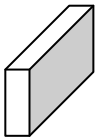
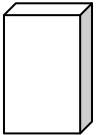
6.3. Limit

Occupied Bandwidth
Systems using digital modulation techniques operate in the 2400-2483.5 MHz. The minimum 6 dB bandwidth shall be at least 500 kHz

6.4. Test Procedure

Test Method				
	Reference Rule		Chapter	Description
☒	ANSI C63.10		11.8	DTS bandwidth
	☐	ANSI C63.10	11.8.1	Option 1
	☒	ANSI C63.10	11.8.2	Option 2

6.5. EUT test definition

Item	Occupied Bandwidth			
Device Category	☐	Fixed position use		
	☒	Mobile position use		
Test mode	Mode 1			
Test method	☐	Radiated		
		X Axis	Y Axis	Z Axis
				
		Worst Axis ☐	Worst Axis ☐	Worst Axis ☐
	☒	Conducted		
	☒	Chain 0		
				
	☐	Chain 0	Chain 1	
				
	☐	Chain 0	Chain 1	Chain 2
				

6.6. Test Result

Product Name	: 915MHz LoRa Module	Power	: AC 120V/60HZ
Test Mode	: Mode1	Test Site	: TR8
Test Date	: 2016.12.08		

Mode	CH.	Test Freq. (MHz)	99% Occupied Bandwidth (KHz)	6dB Occupied Bandwidth (KHz)	Limit (kHz)	Result
1	Low	904	790.69	754.5	>500	Pass
1	Mid	915	787.66	743.4	>500	Pass
1	High	925	784.77	738.4	>500	Pass

Note : The worst case of Occupied Bandwidth as below in next page:

Mode 1 High Channel (925MHz)



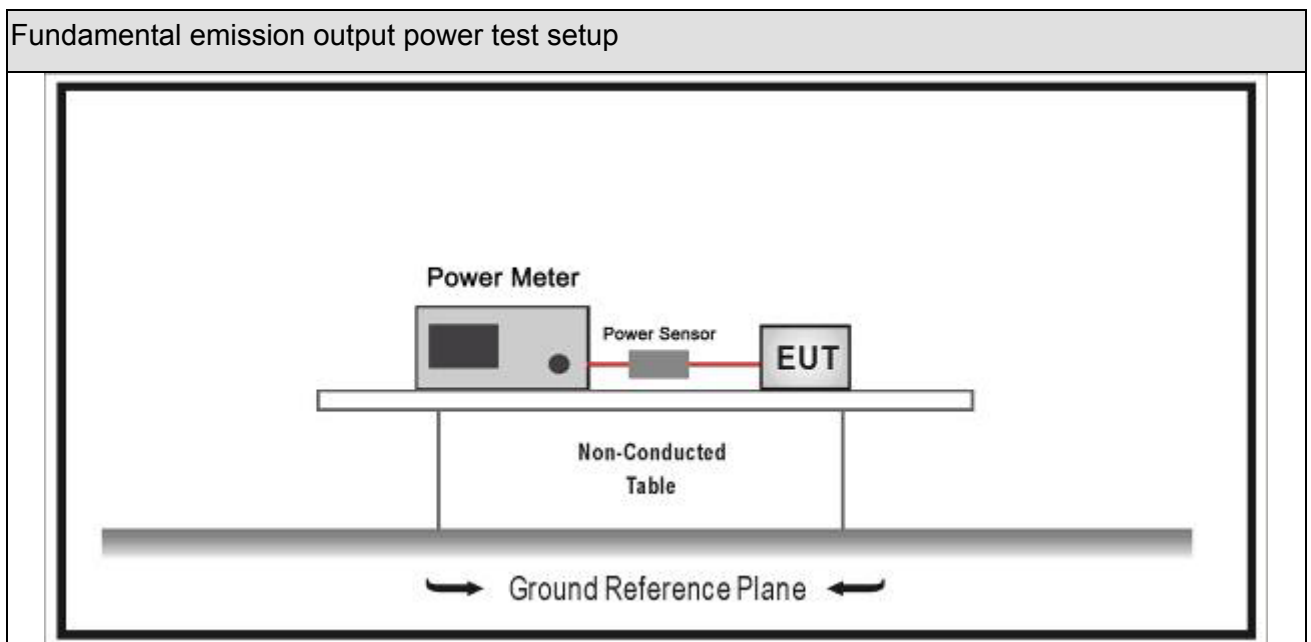
7. Fundamental emission output power

7.1. Test Equipment

Fundamental emission output power/ TR-8					
Instrument	Manufacturer	Type No.	Serial No.	Cal. Date	Cal. Due Date
Spectrum Analyzer	Agilent	E4446A	MY45300103	2016.01.04	2017.01.03
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.02.04	2017.02.03
Wideband Peak Power Meter	Anritsu	ML2495A	0905006	2016.10.14	2017.10.13
Power Sensor	Anritsu	MA2411B	0846014	2016.10.14	2017.10.13
Temperature/Humidity Meter	zhicheng	ZC1-2	TR8-TH	2016.04.10	2017.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

7.2. Test Setup



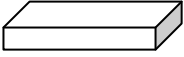
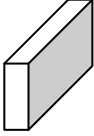
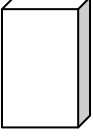
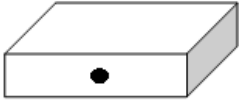
7.3. Limit

Fundamental emission output power Limit		
☒	$G_{TX} < 6\text{dBi}$	$P_{out} \leq 30\text{dBm}$
☐	$G_{TX} > 6\text{dBi}$	
☐	Non-Fix point-point	$P_{out} \leq 30 - (G_{TX} - 6)$
☐	Fix point-point	$P_{out} \leq 30 - [(G_{TX} - 6)]/3$
☐	Point-to-multipoint	$P_{out} \leq 30 - (G_{TX} - 6)$
☐	Overlap Beams	$P_{out} \leq 30 - [(G_{TX} - 6)]/3$
☐	Aggregate power transmitted simultaneously on all beams	$P_{out} \leq 30 - [(G_{TX} - 6)]/3$
☐	single directional beam	$P_{out} \leq 30 - [(G_{TX} - 6)]/3 + 8\text{dB}$
Note 1 : G_{TX} directional gain of transmitting antennas. Note 2 : P_{out} is maximum peak conducted output power .		

7.4. Test Procedure

Fundamental emission output power Test Method						
	References Rule			Chapter	Description	
☒	ANSI C63.10			11.9	Fundamental emission output power	
	☒	ANSI C63.10		11.9.1	Maximum peak conducted output power	
		☐	ANSI C63.10	11.9.1.1	RBW ≥ DTS bandwidth	
		☐	ANSI C63.10	11.9.1.2	Integrated band power method	
		☒	ANSI C63.10	11.9.1.3	PKPM1 Peak power meter method	
	☐	ANSI C63.10		11.9.2	Maximum conducted (average) output power	
		☐	ANSI C63.10		11.9.2.2	Measurement using a spectrum analyzer (SA)
			☐	ANSI C63.10	11.9.2.2.2	Method AVGSA-1(Duty cycle ≥ 98%)
			☐	ANSI C63.10	11.9.2.2.3	Method AVGSA-1A(Duty cycle ≥ 98%)
			☐	ANSI C63.10	11.9.2.2.4	Method AVGSA-2(Duty cycle ≤ 98%)
			☐	ANSI C63.10	11.9.2.2.5	Method AVGSA-2A(Duty cycle ≤ 98%)
			☐	ANSI C63.10	11.9.2.2.4	Method AVGSA-3
			☐	ANSI C63.10	11.9.2.2.5	Method AVGSA-3A
		☐	ANSI C63.10		11.9.2.3	Measurement using a power meter (PM)
			☐	ANSI C63.10	11.9.2.3.1	Method AVGPM
			☐	ANSI C63.10	11.9.2.3.2	Method AVGPM-G

7.5. EUT test definition

Item	Fundamental emission output power			
Device Category	☐	Fixed position use		
	☒	Mobile position use		
Test mode	Mode 1~4			
Test method	☐	Radiated		
		X Axis	Y Axis	Z Axis
				
		Worst Axis ☐	Worst Axis ☐	Worst Axis ☐
	☒	Conducted		
	☒	Chain 0		
				
	☐	Chain 0	Chain 1	
				
	☐	Chain 0	Chain 1	Chain 2
				

7.6. Test Result

Product Name	:	915MHz LoRa Module	Power	:	AC 120V/60HZ
Test Mode	:	Mode1	Test Site	:	TR8
Test Date	:	2016.12.09			

Mode	Channel	Test Frequency (MHz)	Peak Power Output (dBm)	Antenna Gain (dBi)	Limit (dBm)	Result
1	Low	904	14.82	2.0	30	Pass
1	Mid	915	14.71	2.0	30	Pass
1	High	925	14.69	2.0	30	Pass

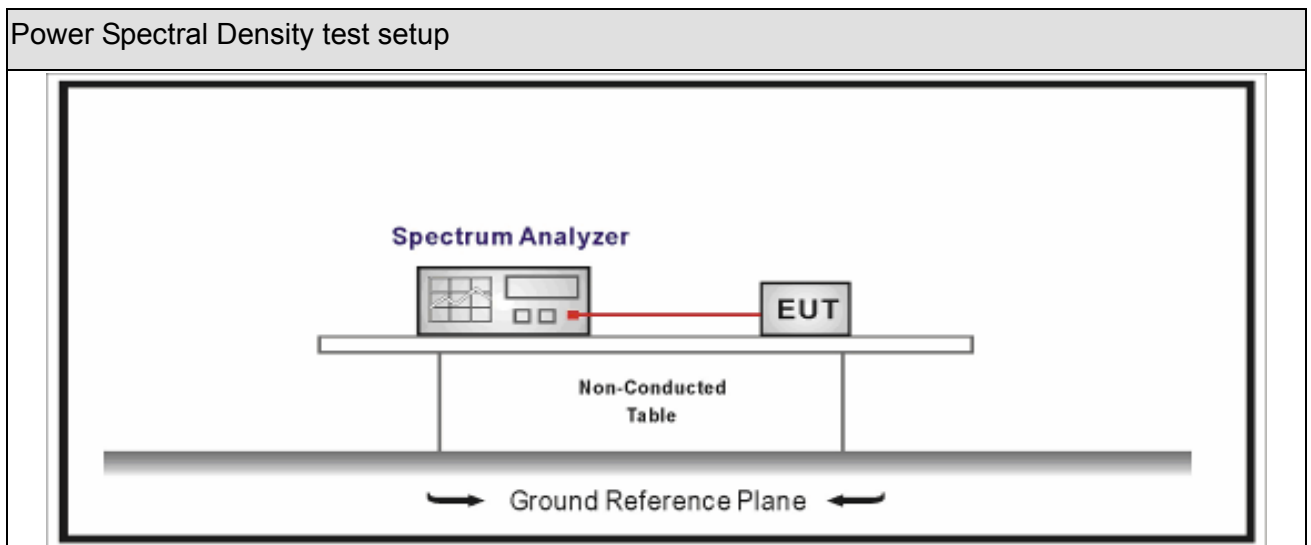
8. Power Spectral Density

8.1. Test Equipment

Power Spectral Density / TR-8					
Instrument	Manufacturer	Type No.	Serial No.	Cal. Date	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.02.04	2017.02.03
EXA Spectrum Analyzer	Keysight	N9010A	MY55370495	2016.04.09	2017.04.08
MXA Signal Analyzer	Keysight	N9020A	MY56060147	2016.04.09	2017.04.08
Temperature/Humidity Meter	zhichen	ZC1-2	TR8-TH	2016.04.10	2017.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

8.2. Test Setup



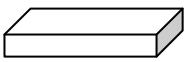
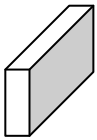
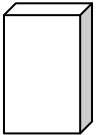
8.3. Limit

Power Spectral Density Limit
Power Spectral Density $\leq 8\text{dBm}/3\text{kHz}$

8.4. Test Procedure

Power Spectral Density Test Method				
	References Rule		Chapter	Description
☒	ANSI C63.10		11.10	Maximum power spectral density level in the fundamental emission
	☒	ANSI C63.10	11.10.2	Method PKPSD (peak PSD)
	☐	ANSI C63.10	11.10.3	Method AVGPSD-1(Duty cycle ≥ 98%)
	☐	ANSI C63.10	11.10.4	Method AVGPSD-1A(Duty cycle ≥ 98%)
	☐	ANSI C63.10	11.10.5	Method AVGPSD-2(Duty cycle < 98%)
	☐	ANSI C63.10	11.10.6	Method AVGPSD-2A(Duty cycle < 98%)
	☐	ANSI C63.10	11.10.7	Method AVGPSD-3
	☐	ANSI C63.10	11.10.8	Method AVGPSD-3A

8.5. EUT test definition

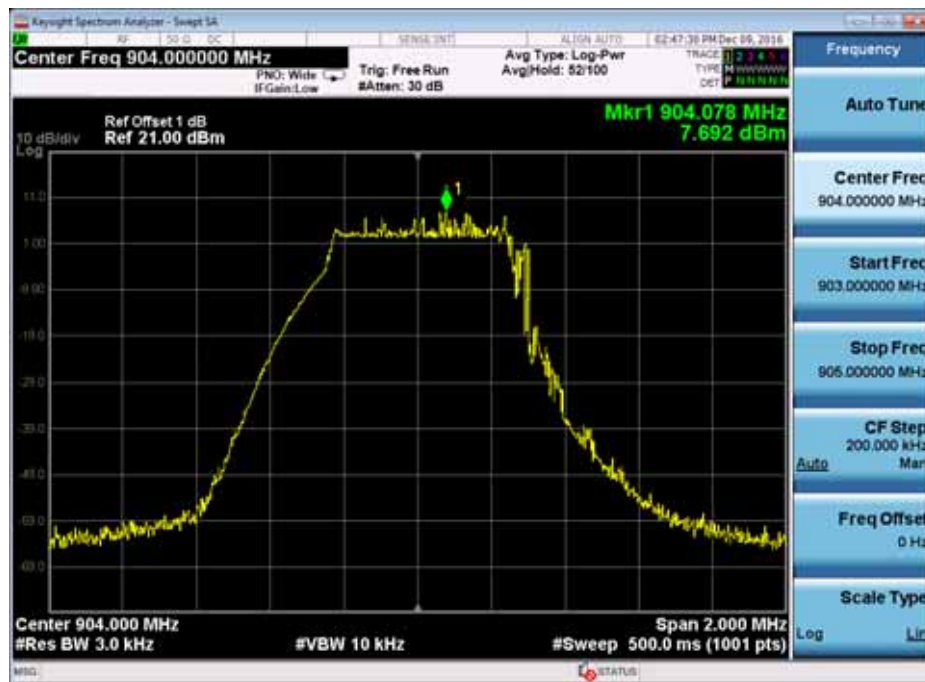
Item	Power Spectral Density Test Method			
Device Category	☐	Fixed position use		
	☒	Mobile position use		
Test mode	Mode 1			
Test method	☐	Radiated		
		X Axis	Y Axis	Z Axis
				
		Worst Axis ☐	Worst Axis ☐	Worst Axis ☐
	☒	Conducted		
	☒	Chain 0		
				
	☐	Chain 0	Chain 1	
				
	☐	Chain 0	Chain 1	Chain 2
				

8.6. Test Result

Product Name	: 915MHz LoRa Module	Power	: AC 120V/60HZ
Test Mode	: Mode1	Test Site	: TR8
Test Date	: 2016.12.08		

Mode	Channel	Test Frequency (MHz)	Measurement PSD (dBm/3kHz)	Directional Gain (dBi)	Limit (dBm/3kHz)	Result
1	Low	904	7.692	2.0	8.0	Pass
1	Mid	915	7.509	2.0	8.0	Pass
1	High	925	7.325	2.0	8.0	Pass

Mode 1 Low Channel (904MHz)



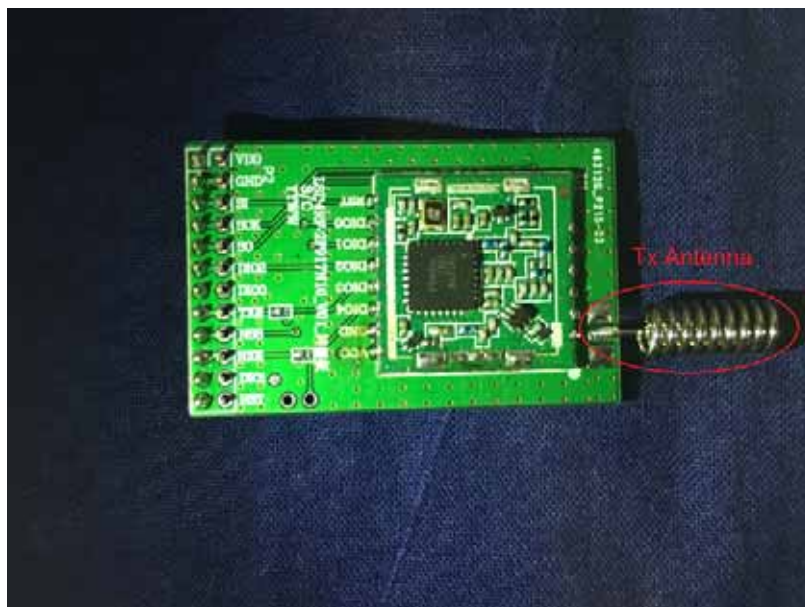
9. Antenna Requirement

9.1. Limit

Antenna Requirement Limit
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 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 §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 §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

9.2. Antenna Connector Construction

The EUT use permanently attached antennas and comply with FCC 15.203.



The End