

FCC EMC Test Report



Subject to
Supplier's Declaration of Conformity
Procedure

Product : LoRa Module

Trade Mark : B&T 博安通



Model Number : Ra-01

Prepared for

Shenzhen Ai-Thinker Technology Co., Ltd.
Room 701, Building B, Huafeng Industrial Park, Hangkong Road, Sanwei Community,
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Prepared by

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TEST RESULT CERTIFICATION

Applicant's Name: Shenzhen Ai-Thinker Technology Co., Ltd.
Address.....: Room 701, Building B, Huafeng Industrial Park, Hangkong Road,
Sanwei Community, Baoan District, Shenzhen, China

Manufacturer's Name.....: Shenzhen Ai-Thinker Technology Co., Ltd.
Address.....: Room 701, Building B, Huafeng Industrial Park, Hangkong Road,
Sanwei Community, Baoan District, Shenzhen, China

Product description

Product name.....: LoRa Module
Model and/or type reference ...: Ra-01
Standards.....: 47 CFR FCC part15 subpart B, 10-1-2019
ANSI C63.4:2014

This device described above has been tested by NTEK, and the test results show that the equipment under test (EUT) is in compliance with Part 15 of FCC Rules. And it is applicable only to the tested sample identified in the report.

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Date of Test

Date (s) of performance of tests: 11 Mar. 2020 ~ 20 Mar. 2020

Date of Issue: 20 Mar. 2020

Test Result.....: **Pass**

Testing Engineer :

Allen. Huang

(Allen Huang)

Technical Manager :

Sky. Zhang

(Sky Zhang)

Authorized Signatory :

Sam. Chen

(Sam Chen)

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1. TEST SUMMARY

Test procedures according to the technical standards:

EMC Emission				
Standard	Test Item	Limit	Judgment	Remark
FCC part15 subpart B, 10-1-2019 ANSI C63.4: 2014	Conducted Emission	Class B	PASS	
	Radiated Emission	Class B	PASS	

NOTE:

- (1) 'N/A' denotes test is not applicable in this Test Report
- (2) For client's request and manual description, the test will not be executed.

1.1 TEST FACILITY

Shenzhen NTEK Testing Technology Co., Ltd.

Add. : 1/F, Building E, Fenda Science Park, Sanwei Community, Xixiang Street Bao'an District, Shenzhen 518126 P.R. China

CNAS-Lab. : The Laboratory has been assessed and proved to be in compliance with CNAS-CL01:2006 (identical to ISO/IEC 17025:2005)
The Certificate Registration Number is L5516

IC-Registration : The Certificate Registration Number is CN0074

FCC- Accredited : Test Firm Registration Number: 463705
Designation Number: CN1184

A2LA-Lab. : The Certificate Registration Number is 4298.01
This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

Test Item	Measurement Frequency Range	K	U(dB)
AC Mains Conducted Emission	0.009kHz ~ 0.15MHz	2	2.66
AC Mains Conducted Emission	0.15MHz ~ 30MHz	2	2.80
Telecom Conducted Emission (Cat 3)	0.15MHz ~ 30MHz	2	2.40
Telecom Conducted Emission (Cat 5)	0.15MHz ~ 30MHz	2	2.58
Radiated Emission	30MHz ~ 1000MHz	2	2.64
Radiated Emission	1000MHz ~ 6000MHz	2	5.10
Radiated Emission	6000MHz ~ 18000MHz	2	2.52
Power Clamp	30MHz ~ 300MHz	2	2.20

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2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	LoRa Module		
Model Name	Ra-01		
Additional Model Number(s)	N/A		
Model Difference	N/A		
Product Description	The EUT is a LoRa Module.		
	Operating frequency:	525 MHz(Declaration by factory)	
	Connecting I/O port:	N/A	
	Based on the application, features, or specification exhibited in User's Manual. More details of EUT technical specification, please refer to the User's Manual.		
Power Source	DC Voltage		
Power Rating	DC 3.3V		

2.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

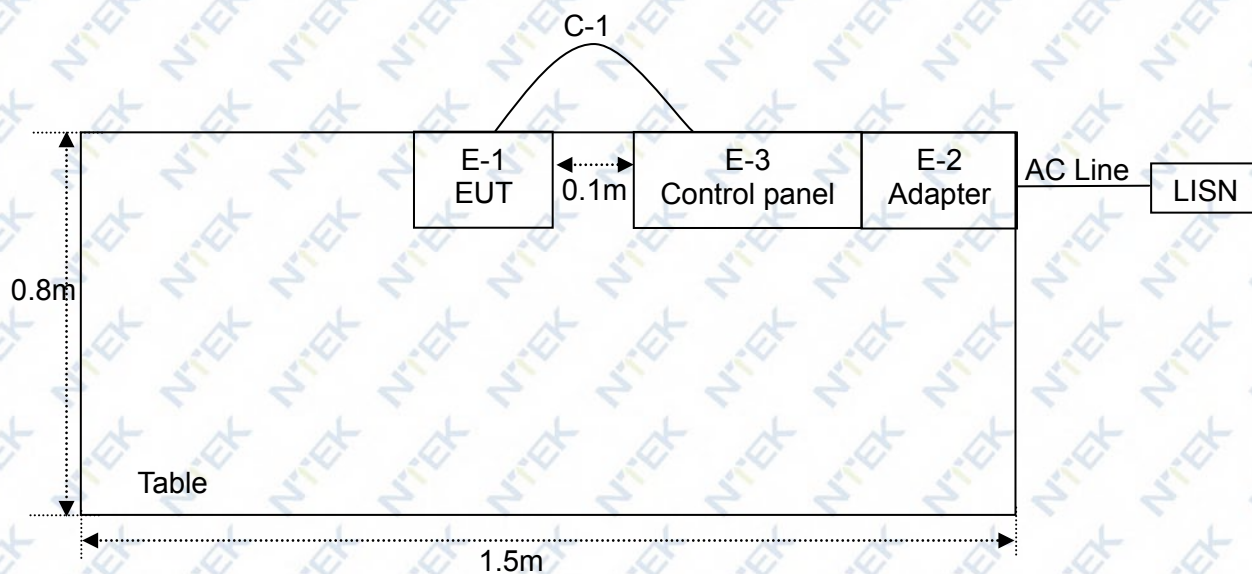
Pretest Mode	Description
Mode 1	Working

For Conducted Test	
Final Test Mode	Description
Mode 1	Working

For Radiated Test	
Final Test Mode	Description
Mode 1	Working



2.3 DESCRIPTION OF TEST SETUP

Mode CE : Working



2.4 DESCRIPTION TEST PERIPHERAL AND EUT PERIPHERAL

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Brand	Model/Type No.	Series No.	Note
E-1	LoRa Module	 B&T 博安通, 	Ra-01	N/A	EUT
E-2	Adapter	N/A	N/A	N/A	
E-3	Control panel	N/A	N/A	N/A	

Item	Shielded Type	Ferrite Core	Length	Note
C-1	NO	NO	20cm	

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.
- (3) "YES" means "shielded" "with core"; "NO" means "unshielded" "without core".

2.5 MEASUREMENT INSTRUMENTS LIST

2.5.1 CONDUCTED TEST SITE

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	LISN	R&S	ENV216	101490	Aug. 28, 2019	Aug. 27, 2020	1 year
2	Low frequency cable	N/A	C-01	N/A	Jun. 06, 2017	Jun. 05, 2020	3 years
3	50Ω Switch	Anritsu	MP59B	6200983704	May 19, 2018	May 18, 2020	2 years
4	LISN	SCHWARZB ECK	NNLK 8129	8129245	May 13, 2019	May 12, 2020	1 year
5	EMI Test Receiver	R&S	ESCI	101160	May 13, 2019	May 12, 2020	1 year
6	LISN	R&S	ENV216	101313	May 13, 2019	May 12, 2020	1 year

2.5.2 RADIATED TEST SITE

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Antenna Mast	SKET	N/A	N/A	N/A	N/A	N/A
2	Test Cable	N/A	R-03	N/A	Jun. 28, 2019	Jun. 27, 2022	3 years
3	Test Cable	N/A	R-01	N/A	Aug. 06, 2019	Aug. 05, 2022	3 years
4	Pre-Amplifier	EMC	EMC051835S E	980246	Aug. 06, 2019	Aug. 05, 2020	1 year
5	Antenna Mast	EM	SC100	N/A	Apr. 26, 2017	Apr. 25, 2020	3 years
6	50Ω Switch	Anritsu	MP59B	6200983705	May 19, 2018	May 18, 2020	2 years
7	EMI Test Receiver	R&S	ESCI	101160	May 13, 2019	May 12, 2020	1 year
8	Spectrum Analyzer	Agilent	E4440A	MY41000130	May 13, 2019	May 12, 2020	1 year
9	Bilog Antenna	TESEQ	CBL6111D	31216	Apr. 15, 2019	Apr. 14, 2020	1 year
10	Broadband Horn Antenna	EM	EM-AH-10180	2011071402	Apr. 15, 2019	Apr. 14, 2020	1 year

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION (Frequency Range 150kHz-30MHz)

FREQUENCY (MHz)	<input type="checkbox"/> Class A (dB μ V)		<input checked="" type="checkbox"/> Class B (dB μ V)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 -0.5	79.00	66.00	66 - 56 *	56 - 46 *
0.50 -5.0	73.00	60.00	56.00	46.00
5.0 -30.0	73.00	60.00	60.00	50.00

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

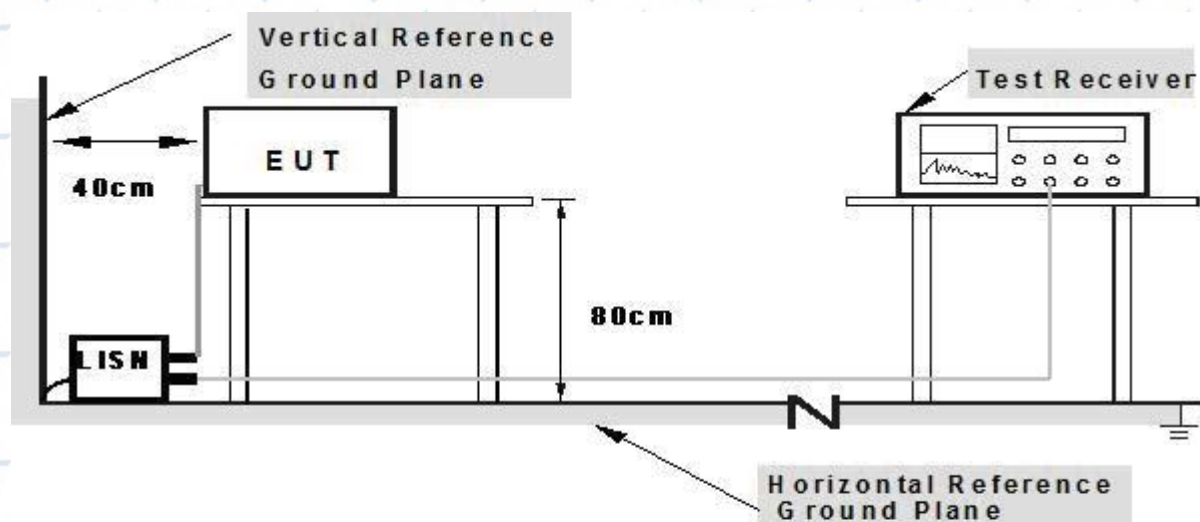
The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

3.1.2 TEST PROCEDURE

- The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of The cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN at least 80 cm from nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.1.3 TEST SETUP



Note: 1.Support units were connected to second LISN.

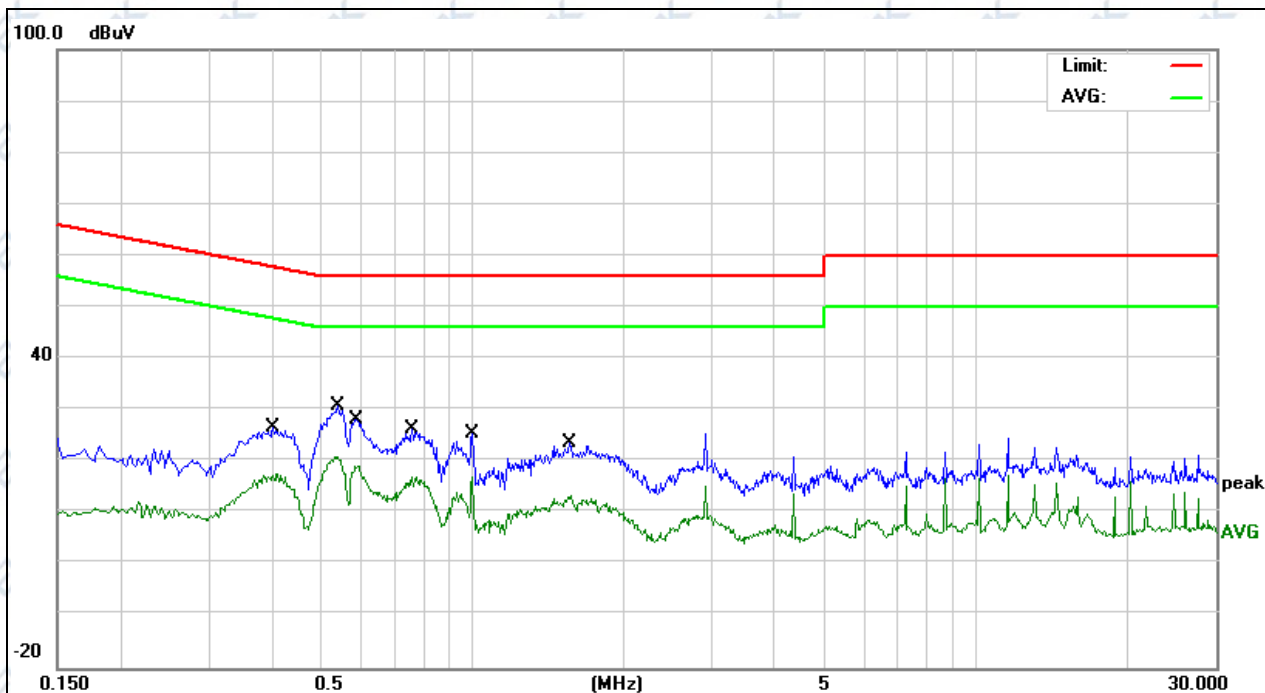
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.1.4 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

3.1.5 TEST RESULTS

EUT:	LoRa Module	Model Name:	Ra-01
Temperature:	24°C	Relative Humidity:	49%
Pressure:	1010hPa	Test Date:	2020-03-17
Test Mode:	Working	Phase:	L
Test Voltage:	DC 3.3V by Control panel and Adapter AC 120V/60Hz		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.4020	16.89	9.74	26.63	57.81	-31.18	QP	
2		0.4020	8.00	9.74	17.74	47.81	-30.07	AVG	
3		0.5420	21.11	9.74	30.85	56.00	-25.15	QP	
4	*	0.5420	11.24	9.74	20.98	46.00	-25.02	AVG	
5		0.5899	18.51	9.74	28.25	56.00	-27.75	QP	
6		0.5899	9.56	9.74	19.30	46.00	-26.70	AVG	
7		0.7620	16.63	9.74	26.37	56.00	-29.63	QP	
8		0.7620	7.27	9.74	17.01	46.00	-28.99	AVG	
9		1.0020	15.78	9.74	25.52	56.00	-30.48	QP	
10		1.0020	7.29	9.74	17.03	46.00	-28.97	AVG	
11		1.5660	14.01	9.77	23.78	56.00	-32.22	QP	
12		1.5660	3.56	9.77	13.33	46.00	-32.67	AVG	

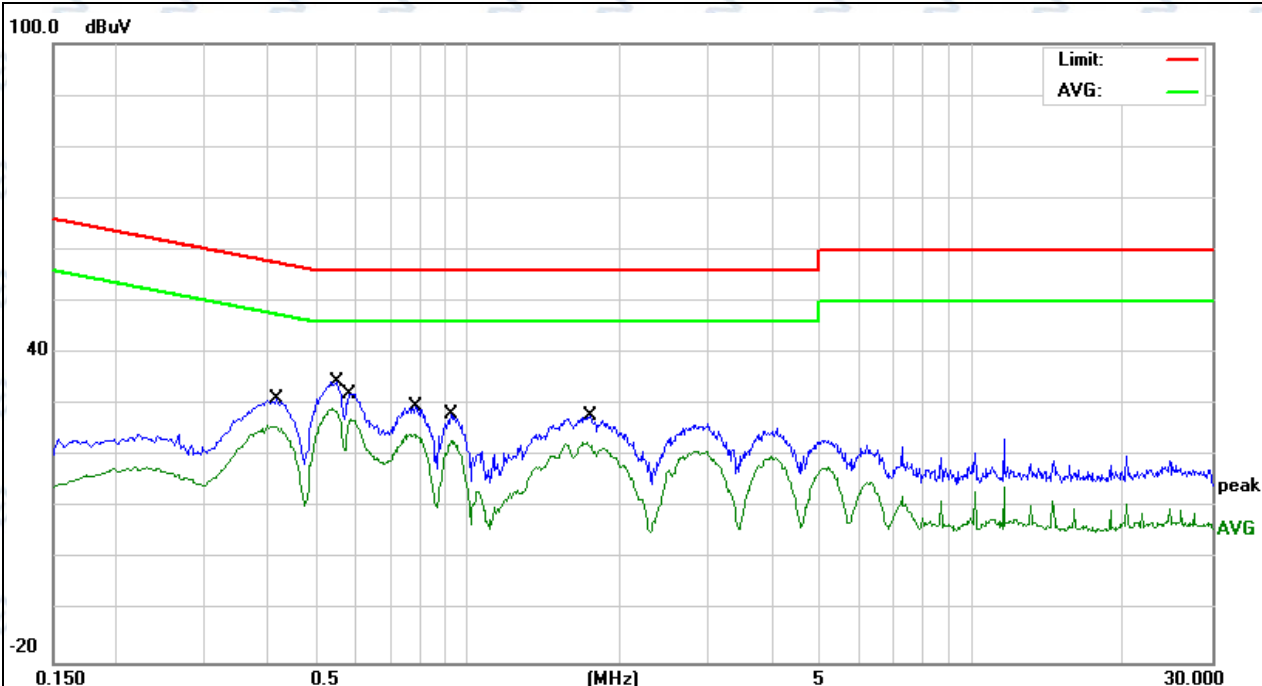
Remark:

Correct Factor = Insertion Loss + Cable Loss

Measurement Level = Reading Level + Correct Factor

Over Level = Measurement Level - Limit

EUT:	LoRa Module	Model Name:	Ra-01
Temperature:	24℃	Relative Humidity:	49%
Pressure:	1010hPa	Test Date:	2020-03-17
Test Mode:	Working	Phase:	N
Test Voltage:	DC 3.3V by Control panel and Adapter AC 120V/60Hz		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.4178	21.54	9.75	31.29	57.49	-26.20	QP	
2		0.4178	16.36	9.75	26.11	47.49	-21.38	AVG	
3		0.5500	24.84	9.75	34.59	56.00	-21.41	QP	
4	*	0.5500	19.65	9.75	29.40	46.00	-16.60	AVG	
5		0.5818	22.38	9.75	32.13	56.00	-23.87	QP	
6		0.5818	17.48	9.75	27.23	46.00	-18.77	AVG	
7		0.7860	19.89	9.75	29.64	56.00	-26.36	QP	
8		0.7860	14.64	9.75	24.39	46.00	-21.61	AVG	
9		0.9260	18.32	9.75	28.07	56.00	-27.93	QP	
10		0.9260	13.38	9.75	23.13	46.00	-22.87	AVG	
11		1.7500	17.94	9.78	27.72	56.00	-28.28	QP	
12		1.7500	12.86	9.78	22.64	46.00	-23.36	AVG	

Remark:

Correct Factor = Insertion Loss + Cable Loss

Measurement Level = Reading Level + Correct Factor

Over Level = Measurement Level - Limit

3.2 RADIATED EMISSION MEASUREMENT

3.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT

FREQUENCY (MHz)	<input type="checkbox"/> Class A (at 3m)	<input checked="" type="checkbox"/> Class B (at 3m)
	dB μ V/m	dB μ V/m
30 ~ 88	49.5	40.0
88 ~ 216	53.9	43.5
216 ~ 960	56.9	46.0
Above 960	60.0	54.0

Notes:

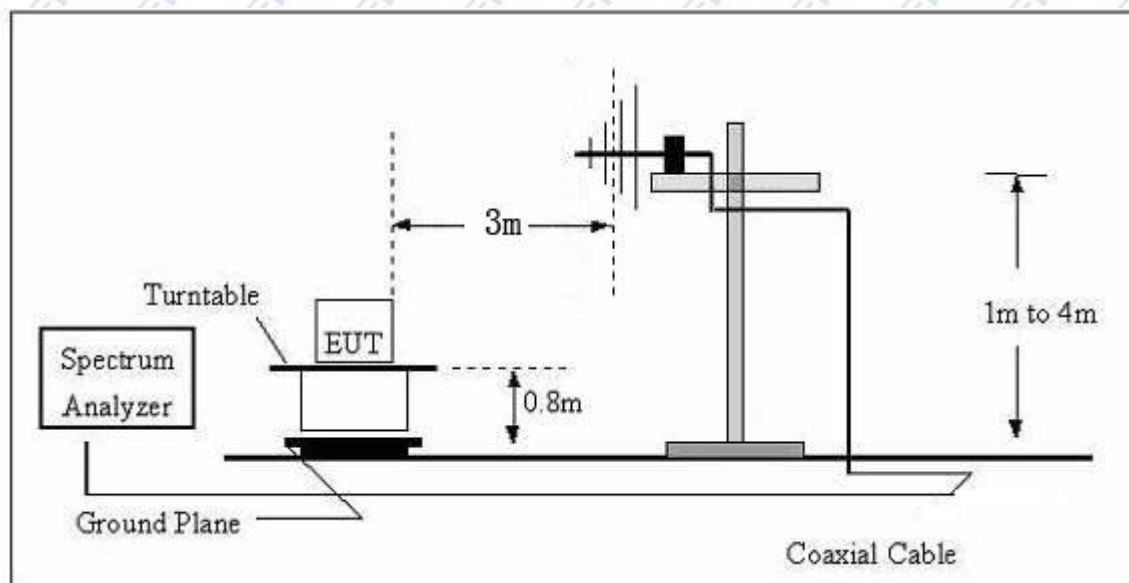
- (1) The limit for radiated test was performed according to as following: FCC PART 15B.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dB μ V/m)=20log Emission level (uV/m).

3.2.2 TEST PROCEDURE

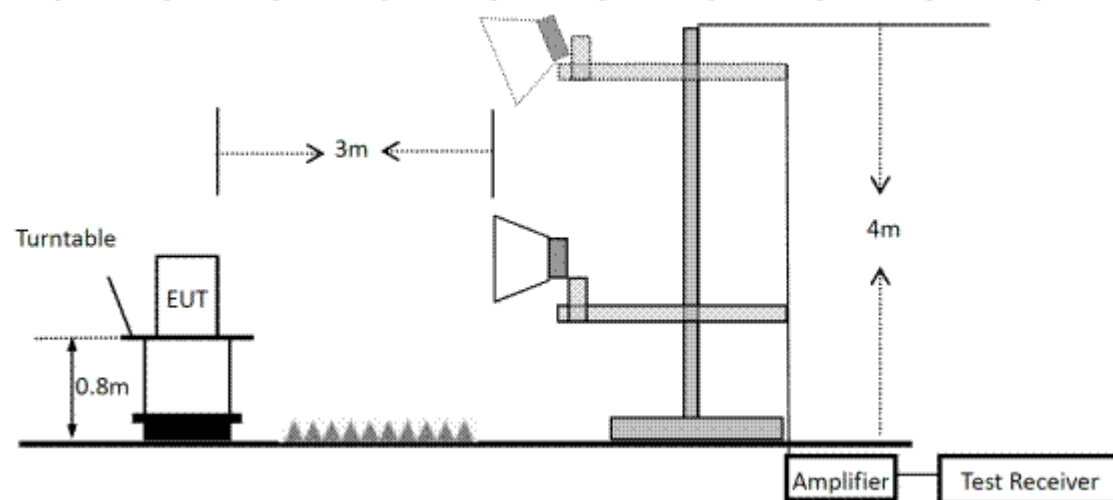
- a. The measuring distance of at 3m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- b. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The height of the equipment or of the substitution antenna shall be 0.8 m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked And then Quasi Peak detector mode re-measured, above 1G Average detector mode will be instead.
- e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP(AV) Limits and then no additional QP Mode measurement performed.
- f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.2.3 TEST SETUP

(A) Radiated Emission Test Set-Up Frequency Below 1 GHz



(B) Radiated Emission Test Set-Up Frequency Above 1GHz

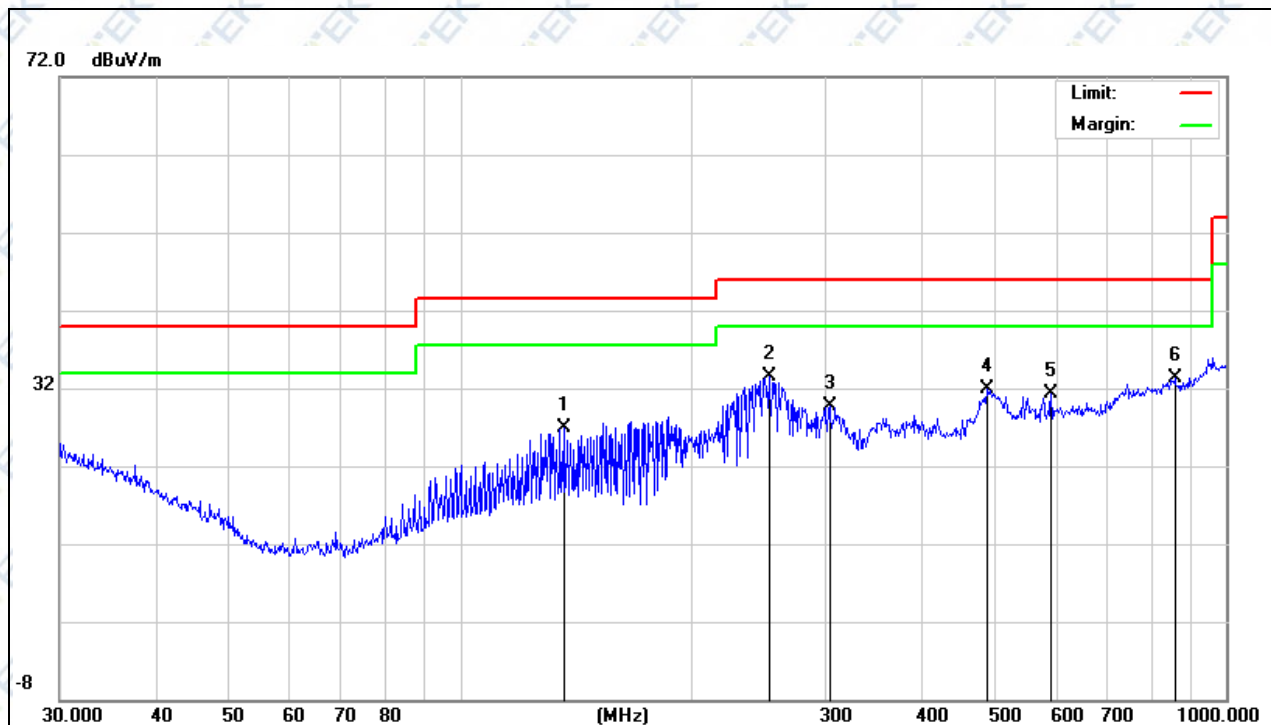


3.2.4 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of **2.3** Unless otherwise a special operating condition is specified in the follows during the testing.

3.2.5 TEST RESULTS(30-1000MHz)

EUT:	LoRa Module	Model Name:	Ra-01
Temperature:	26℃	Relative Humidity:	57%
Pressure:	1010hPa	Test Date:	2020-03-17
Test Mode:	Working	Polarization:	Horizontal
Test Power:	DC 3.3V by Control panel and Adapter AC 120V/60Hz		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		136.4598	14.48	12.47	26.95	43.50	-16.55	QP		
2	*	252.9482	19.73	13.70	33.43	46.00	-12.57	QP		
3		303.5437	14.79	15.00	29.79	46.00	-16.21	QP		
4		487.3151	12.18	19.66	31.84	46.00	-14.16	QP		
5		590.9737	9.95	21.43	31.38	46.00	-14.62	QP		
6		857.0247	7.21	26.05	33.26	46.00	-12.74	QP		

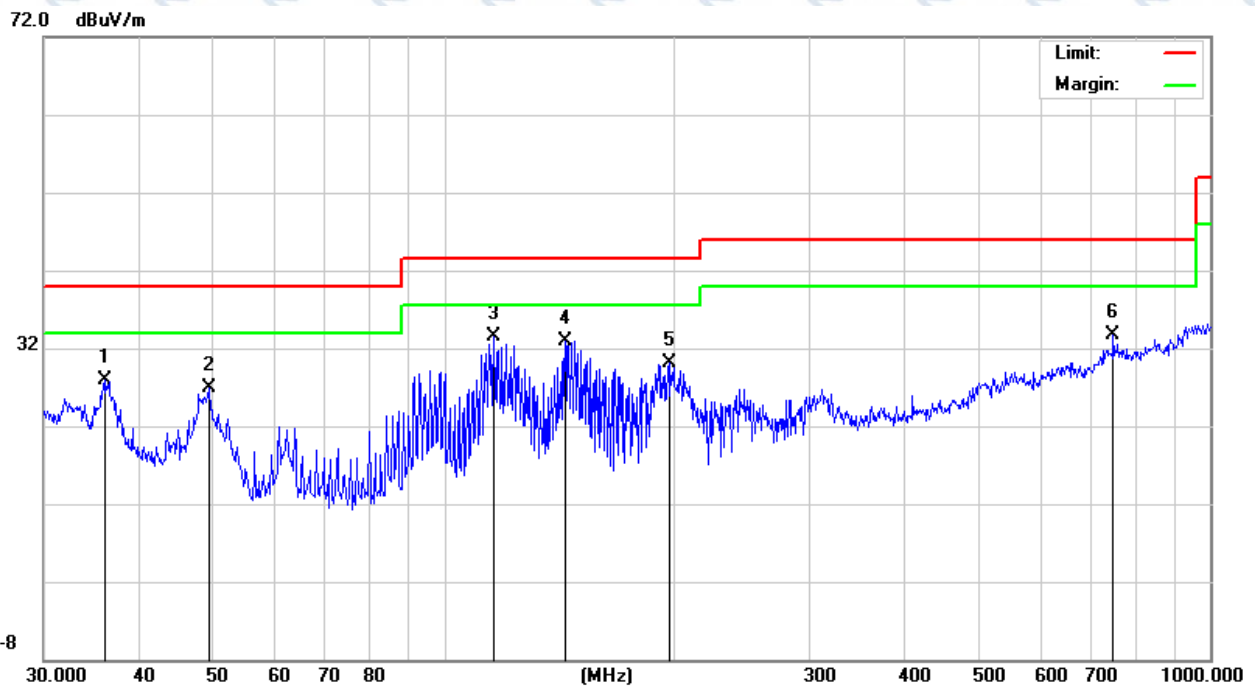
Remark:

Correct Factor = Antenna Factor + Cable Loss – Pre-Amplifier gain

Measurement Level = Reading Level + Correct Factor

Over Level = Measurement Level - Limit

EUT:	LoRa Module	Model Name:	Ra-01
Temperature:	26℃	Relative Humidity:	57%
Pressure:	1010hPa	Test Date:	2020-03-17
Test Mode:	Working	Polarization:	Vertical
Test Power:	DC 3.3V by Control panel and Adapter AC 120V/60Hz		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		36.1272	12.03	15.95	27.98	40.00	-12.02	QP		
2		49.3594	17.14	9.69	26.83	40.00	-13.17	QP		
3	*	116.1321	21.03	12.42	33.45	43.50	-10.05	QP		
4		143.8295	20.75	12.13	32.88	43.50	-10.62	QP		
5		197.2001	21.20	8.90	30.10	43.50	-13.40	QP		
6		747.4825	8.74	24.97	33.71	46.00	-12.29	QP		

Remark:

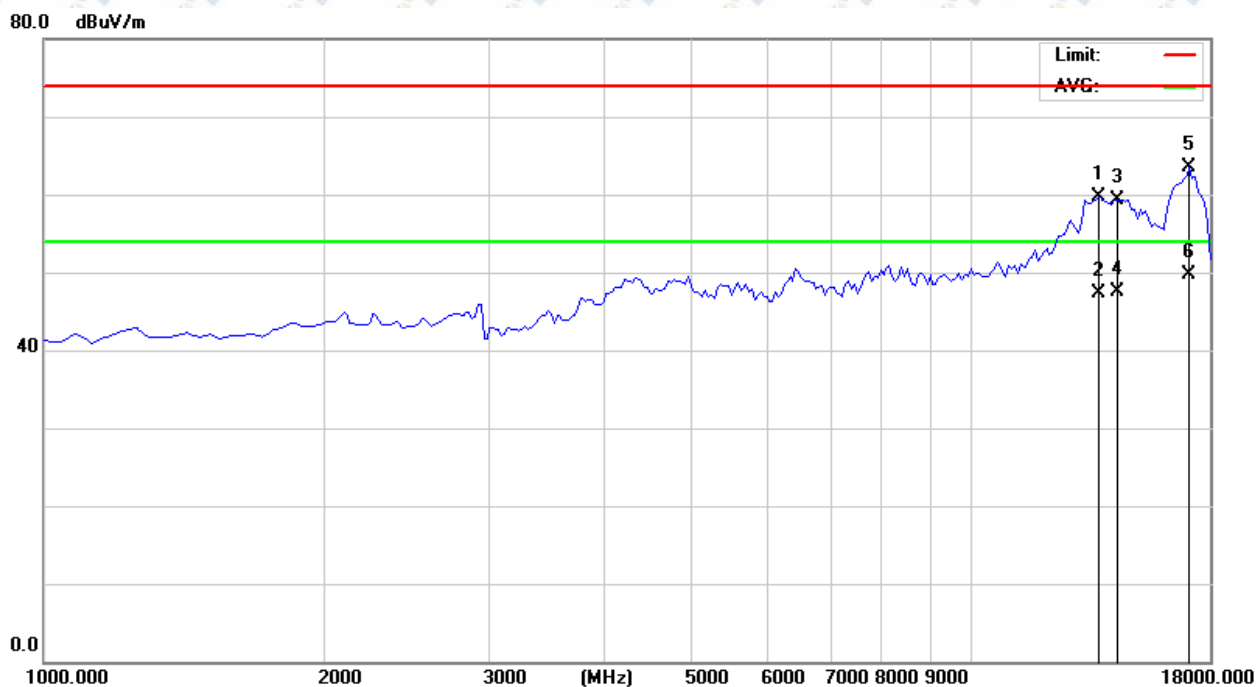
Correct Factor = Antenna Factor + Cable Loss – Pre-Amplifier gain

Measurement Level = Reading Level + Correct Factor

Over Level = Measurement Level - Limit

3.2.6 TEST RESULTS(Above 1000MHz)

EUT:	LoRa Module	Model Name:	Ra-01
Temperature:	24℃	Relative Humidity:	51%
Pressure:	1010hPa	Test Date:	2020-03-18
Test Mode:	Working	Polarization:	Horizontal
Test Power:	DC 3.3V by Control panel and Adapter AC 120V/60Hz		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		13750.00	35.39	24.27	59.66	74.00	-14.34	peak		
2		13750.00	23.13	24.27	47.40	54.00	-6.60	AVG		
3		14345.00	35.16	24.24	59.40	74.00	-14.60	peak		
4		14345.00	23.26	24.24	47.50	54.00	-6.50	AVG		
5		17150.00	35.16	28.30	63.46	74.00	-10.54	peak		
6	*	17150.00	21.40	28.30	49.70	54.00	-4.30	AVG		

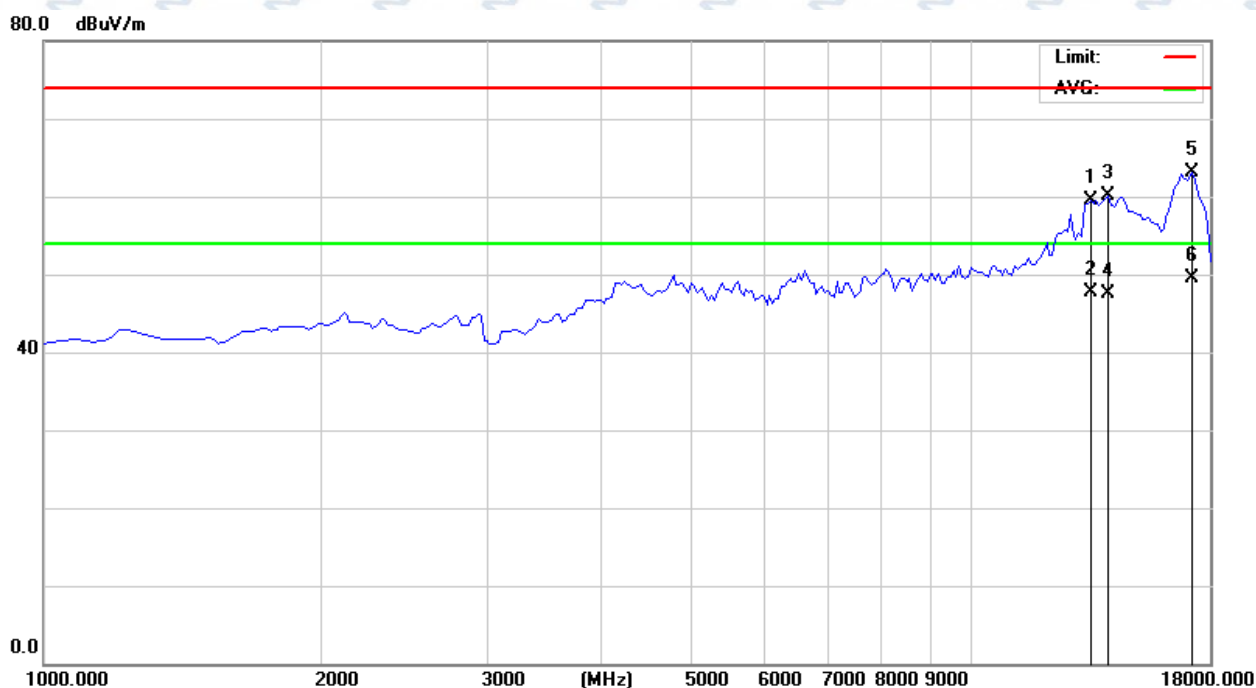
Remark:

Correct Factor = Antenna Factor + Cable Loss – Pre-Amplifier gain

Measurement Level = Reading Level + Correct Factor

Over Level = Measurement Level - Limit

EUT:	LoRa Module	Model Name:	Ra-01
Temperature:	24℃	Relative Humidity:	51%
Pressure:	1010hPa	Test Date:	2020-03-18
Test Mode:	Working	Polarization:	Vertical
Test Power:	DC 3.3V by Control panel and Adapter AC 120V/60Hz		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree	Comment
1		13452.50	35.51	23.99	59.50	74.00	-14.50	peak		
2		13452.50	23.71	23.99	47.70	54.00	-6.30	AVG		
3		14005.00	36.00	24.03	60.03	74.00	-13.97	peak		
4		14005.00	23.57	24.03	47.60	54.00	-6.40	AVG		
5		17320.00	34.56	28.59	63.15	74.00	-10.85	peak		
6	*	17320.00	21.01	28.59	49.60	54.00	-4.40	AVG		

Remark:

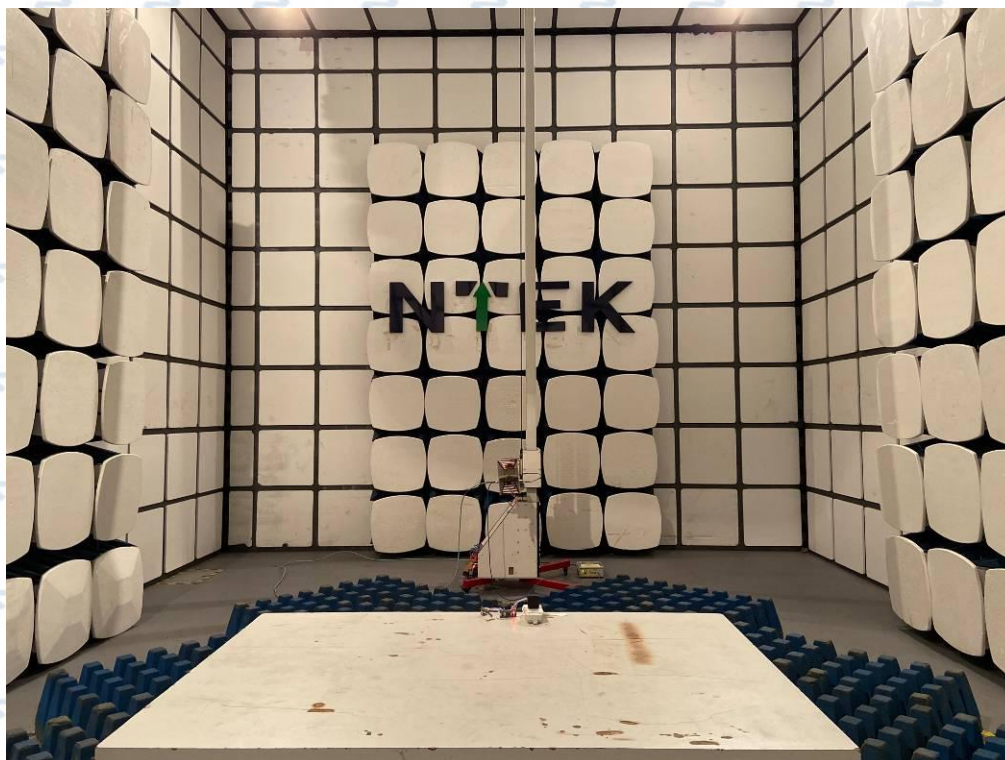
Correct Factor = Antenna Factor + Cable Loss – Pre-Amplifier gain

Measurement Level = Reading Level + Correct Factor

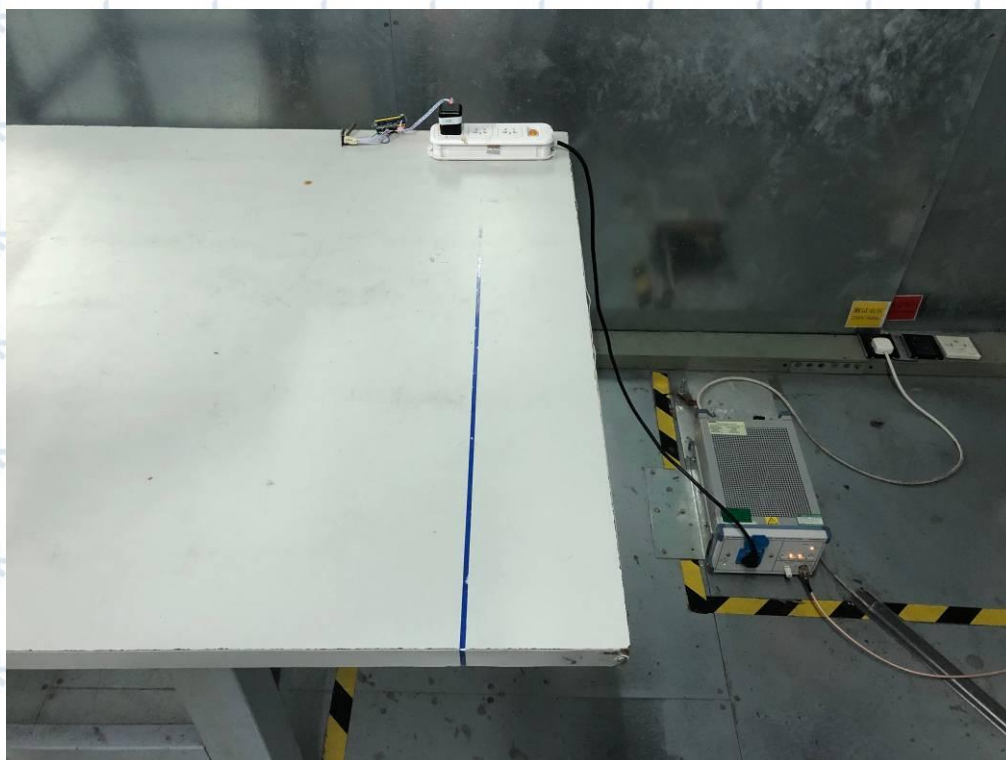
Over Level = Measurement Level - Limit

4. EUT TEST PHOTO

Radiated Measurement Photos



Conducted Measurement Photos



ATTACHMENT PHOTOGRAPHS OF EUT

Photo 1

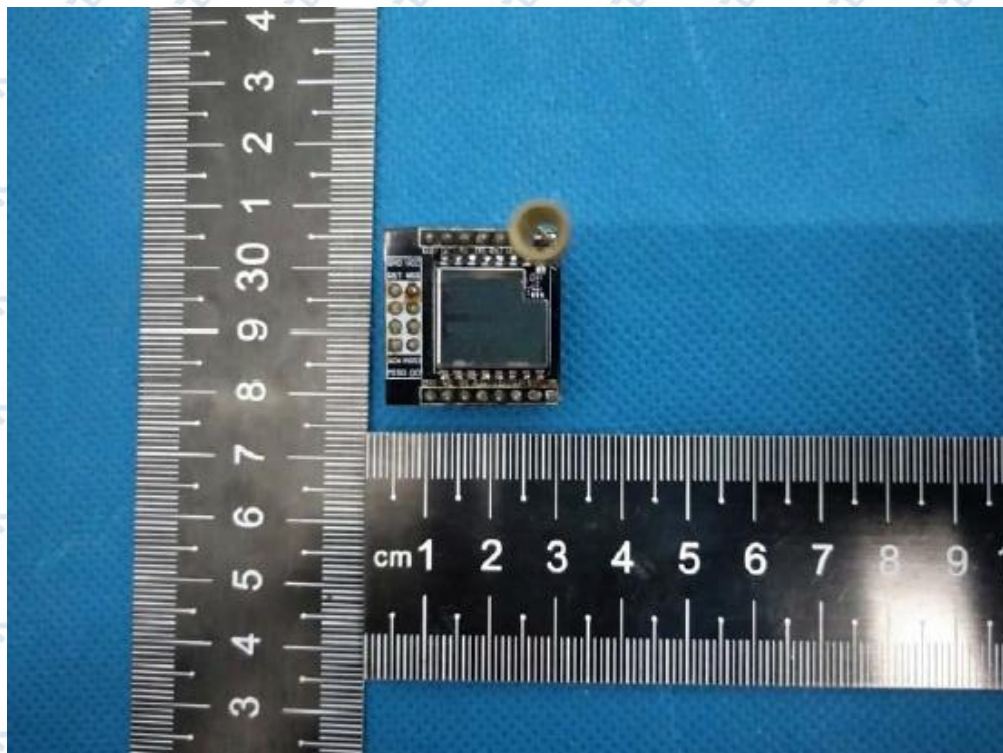


Photo 2

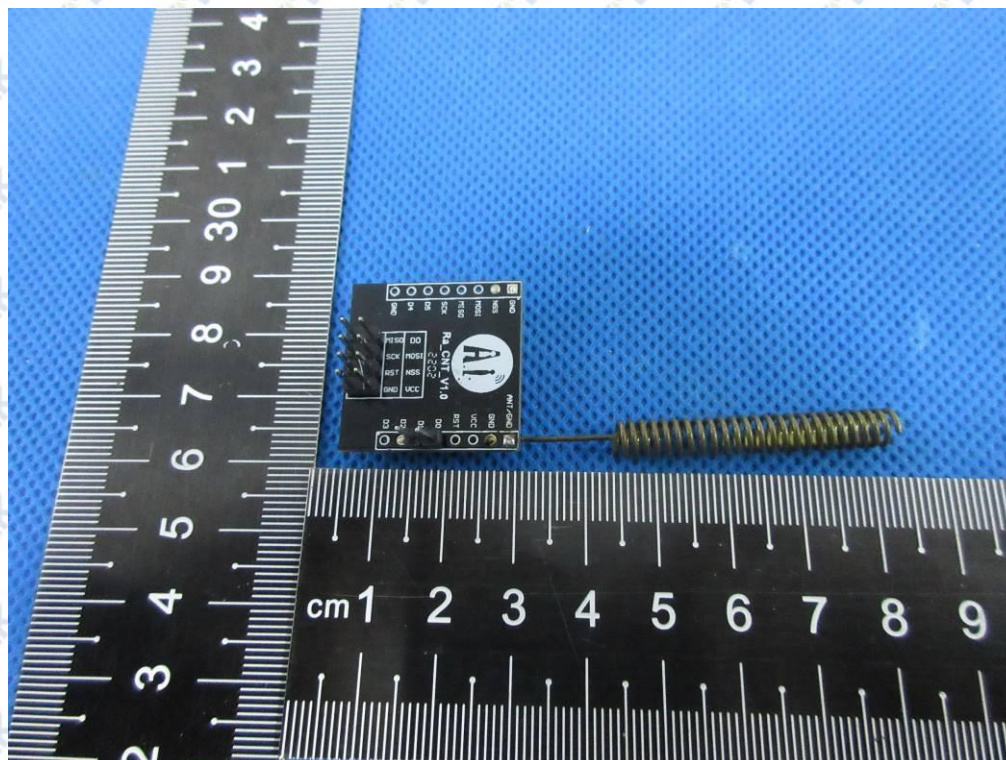
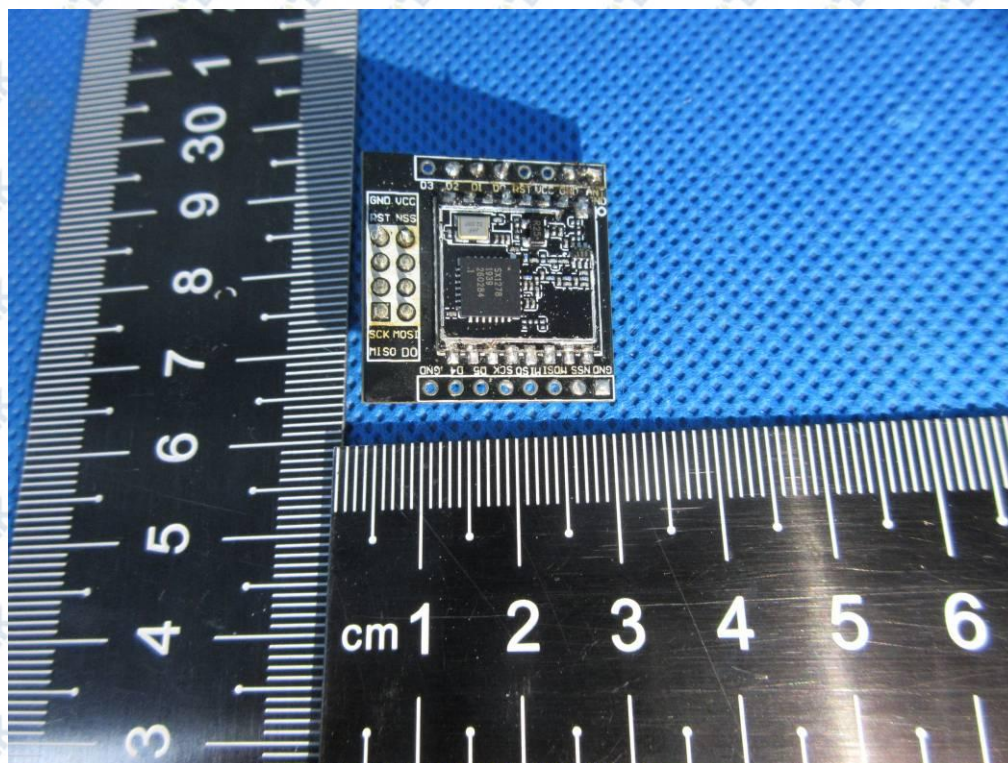


Photo 3



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