



RADIO TEST REPORT

ETSI EN 300 220-1 V3.1.1 (2017-02)

ETSI EN 300 220-2 V3.2.1 (2018-06)

Product: LoRa Module

Trade Mark: B&T 博安通



Model Name: Ra-08

Family Model: N/A

Report No.: S22021800205002

Prepared for

Shenzhen Ai-Thinker Technology Co., Ltd

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Prepared by

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TEST RESULT CERTIFICATION

Applicant's name : Shenzhen Ai-Thinker Technology Co., Ltd
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Manufacturer's Name : Shenzhen Ai-Thinker Technology Co., Ltd
Address : 410, Block C, Huafeng Smart Innovation Port, Gushu 2nd Road, Gushu Community, Xixiang Street, Baoan District, Shenzhen, China

Product description

Product name : LoRa Module

Trademark : B&T 博安通 , 

Model and/or type reference . . Ra-08

Family Model : N/A

Rating(s)..... : DC 3.3V form Uart

Standards..... : ETSI EN 300 220-1 V3.1.1 (2017-02)
ETSI EN 300 220-2 V3.2.1 (2018-06)

This device described above has been tested by Shenzhen NTEK, and the test results show that the equipment under test (EUT) is in compliance with the article 3.2 of Directive 2014/53/EU requirements. And it is applicable only to the tested sample identified in the report.

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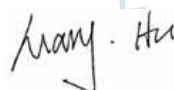
Date of Test..... :

Date (s) of performance of tests..... : Feb 18, 2022 ~ Apr 02, 2022

Date of Issue..... : Apr 02, 2022

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

Testing Engineer :



(Mary Hu)

Authorized Signatory :



(Alex Li)

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1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

ETSI EN 300 220-1 V3.1.1 (2017-02)

ETSI EN 300 220-2 V3.2.1 (2018-06)

Clause	Description of Test Item	Results(Pass/Fail)	N.T(Not Test)
Transmitter Parameters			
4.2.1	Operating frequency	Pass	
4.3.1	Effective Radiated Power	Pass	
4.3.2	Maximum Effective Radiated Power spectral density	Pass	
4.3.3	Duty Cycle	Pass	
4.3.4	Occupied Bandwidth	Pass	
4.3.5	Tx Out Of Band Emissions	Pass	
4.2.2	Unwanted emissions in the spurious domain	Pass	
4.3.6	Transient power	Pass	
4.3.7	Adjacent Channel Power		N.T
4.3.8	TX behaviour under Low Voltage Conditions	Pass	
4.3.9	Adaptive Power Control		N.T
4.4.1	RX sensitivity level		N.T
4.4.2	Blocking	Pass	

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

FCC Registered No.: 463705 IC Registered No.:9270A-1

CNAS Registration No.:L5516

1.2 MEASUREMENT UNCERTAINTY

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



No.	Item	Uncertainty
1	Conducted Emission Test	$\pm 1.38\text{dB}$
2	RF power,conducted	$\pm 0.16\text{dB}$
3	Spurious emissions,conducted	$\pm 0.21\text{dB}$
4	All emissions,radiated(<1G)	$\pm 4.68\text{dB}$
5	All emissions,radiated(>1G)	$\pm 4.89\text{dB}$
6	Temperature	$\pm 0.5^{\circ}\text{C}$
7	Humidity	$\pm 2\%$

Revision History

Report No.	Version	Description	Issued Date
S22021800205002	Rev.01	Initial issue of report	Apr 02, 2022

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	LoRa Module	
Brand Name	 , 	
Model Name.	Ra-08	
Family Model	N/A	
Model Difference	N/A	
Product Description	The EUT is LoRa Module	
	Operation Frequency Band:	Band H: 433.050 MHz to 434.790 MHz
	Modulation Type:	Lora
	Antenna Gain(Peak)	2dBi
	Antenna Designation:	Spring Antenna
	Power Rating	DC 3.3V form Uart
	Receiver Category	1
	Based on the application, features, or specification exhibited in User's Manual, the EUT is considered as an ITE/Computing Device. More details of EUT technical specification, please refer to the User's Manual.	
Channel List	Refer to below(Note 2)	
Adapter	N/A	
Battery	N/A	
Hardware Version	V1.1	
Software Version	V1.1.0	

Note:

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

2. Test Channel:

TX

Channel	Frequency (MHz)
01	433.96
--	--

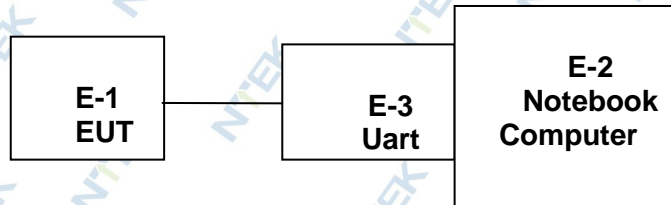
RX

Channel	Frequency (MHz)
01	433.96
--	--

Remark: The EUT can works in the whole band H: 433.050 MHz to 434.790 MHz . this report only recorded one channel result, And the use frequency of the EUT meets the standard requirements .



2.2 DESCRIPTION OF TEST CONDITIONS

1. Test setup



2.3 DESCRIPTION OF SUPPORT UNITS

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	Mfr/Brand	Model/Type No.	Series No.	Note
E-1	LoRa Module	 , 	Ra-08	N/A	EUT

Item	Shielded Type	Ferrite Core	Length	Note

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.

2.4 TEST CONDITIONS

	Normal Test Conditions	Extreme Test Conditions
Temperature	15°C - 35°C	-10°C ~ 70°C Note: (1)
Relative Humidity	20% - 75%	N/A
Supply Voltage	DC 3.3V	DC 2.7-3.6V

Note:

- (1) Tests at extreme temperatures shall be made in accordance with the procedures specified in EN 300220-1 V3.1.1 clause 4.3.4.1.1 at the upper and lower temperatures of the operational profile declared by the manufacturer.;
- (2) The lower extreme test voltages for equipment with power sources using batteries shall be as follows:
- for equipment with a battery indicator, the end point voltage as indicated;
 - for equipment without a battery indicator the following end point voltages shall be used:
 - for the Leclanché or the lithium type of battery:
0,85 multiplied by the nominal voltage of the battery;
 - for the nickel-cadmium type of battery:
0,9 multiplied the nominal voltage of the battery;
 - for other types of battery or equipment, the lower extreme test voltage for the discharged condition shall be declared by the equipment manufacturer..

2.5 EQUIPMENTS LIST FOR ALL TEST ITEMS

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Spectrum Analyzer	Agilent	E4407B	MY45108040	2021.04.27	2022.04.26	1 year
2	Test Receiver	R&S	ESPI7	101318	2021.04.27	2022.04.26	1 year
3	Bilog Antenna	TESEQ	CBL6111D	31216	2021.03.29 2021.07.01	2022.03.28 2022.06.30	1 year
4	50Ω Coaxial Switch	Anritsu	MP59B	6200983705	2020.05.11	2023.05.10	3 year
5	Spectrum Analyzer	Agilent	N9020A	MY49100060	2021.07.01	2022.06.30	1 year
6	Horn Antenna	EM	EM-AH-10180	2011071402	2021.03.29 2021.07.01	2022.03.28 2022.06.30	1 year
7	Horn Ant	Schwarzbeck	BBHA 9170	9170-181	2021.04.27	2022.04.26	1 year
8	Amplifier	EMC	EMC051835SE	980246	2021.07.01	2022.06.30	1 year
9	Loop Antenna	ARA	PLA-2030/B	1029	2021.04.27	2022.04.26	1 year
10	Power Meter	Agilent	E4419B	MY45102538	2021.07.01	2022.06.30	1 year
11	ESG VETCTOR SIGNAL GENERATOR	Agilent	E4438C	MY45093347	2021.04.27	2022.04.26	1 year
12	Temperature & Humidity Chamber	GIANT FORCE	GTH-056P	GF-94454-1	2021.04.27	2022.04.26	1 year
13	Power Sensor	Agilent	E9301A	MY41495644	2021.07.01	2022.06.30	1 year

3. OPERATING FREQUENCY

3.1 LIMITS OF OPERATING FREQUENCY

Refer to chapter 4.2.1.2 of ETSI EN 300 220-2 V3.2.1 (2018-06)

The manufacturer may declare either one or more operating frequencies and operating channels. Operating channel(s) shall be entirely within operational frequency bands allowed by annex B or any NRI.

3.2 TEST PROCEDURE

Refer to chapter 5.1.1 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

3.3 CONFORMANCE

The information shown in Table 6 shall be recorded in the test report.

Table 6: Information Recorded in the Test Report for Operating Frequency test

Value	Notes
Operational Frequency band or bands	Band H: 433.050 MHz to 434.790 MHz
Nominal Operating Frequency or Frequencies	Refer to Channel list
Operating Channel width(s) - OCW	130KHz _{Note}

Note: The manufacturer declared the OCW=130kHz.

4. EFFECTIVE RADIATED POWER

4.1 LIMITS OF EFFECTIVE RADIATED POWER

Refer to chapter 4.3.1.2 of ETSI EN 300 220-2 V3.2.1 (2018-06)

The effective radiated power shall not be greater than the value allowed in annex B or in any NR for the chosen operational frequency band(s).

The limits please refer to ETSI EN 300 220-2 V3.2.1 Annex B:

Table B.1: EU wide harmonised national radio interfaces from 25 MHz to 1 000 MHz

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2017/1483/EU [2]
A	26,957 MHz to 27,283 MHz	10 mW e.r.p.	No requirement	The whole band		28
B	26,995 MHz, 27,045 MHz, 27,095 MHz, 27,145 MHz, 27,195 MHz	100 mW e.r.p.	$\leq 0,1\%$ duty cycle	10 kHz	Model control devices may operate without duty cycle restrictions.	29, 30, 31, 32, 33
C	40,660 MHz to 40,700 MHz	10 mW e.r.p.	No requirement	The whole band	Video applications excluded.	35
D	169,400 MHz to 169,475 MHz	500 mW e.r.p.	$\leq 1,0\%$ duty cycle For metering devices duty cycle limit is 10 %	50 kHz		37c
E	169,4000 MHz to 169,4875 MHz	10 mW	$\leq 0,1\%$ duty	The whole band		38
F	169,4875 MHz to 169,5875 MHz	10 mW	$\leq 0,001\%$ duty cycle Between 00.00 and 06.00 local time a duty cycle limit of 0,1 % may be used	The whole band	Equipment that concentrates or multiplexes individual equipment is excluded.	39b
G	169,5875 MHz to 169,8125 MHz	10 mW	$\leq 0,1\%$ duty cycle	The whole band		40
H	433,050 MHz to 434,790 MHz	10 mW	10 %	The whole band		44b, 45b

4.2 TEST PROCEDURE

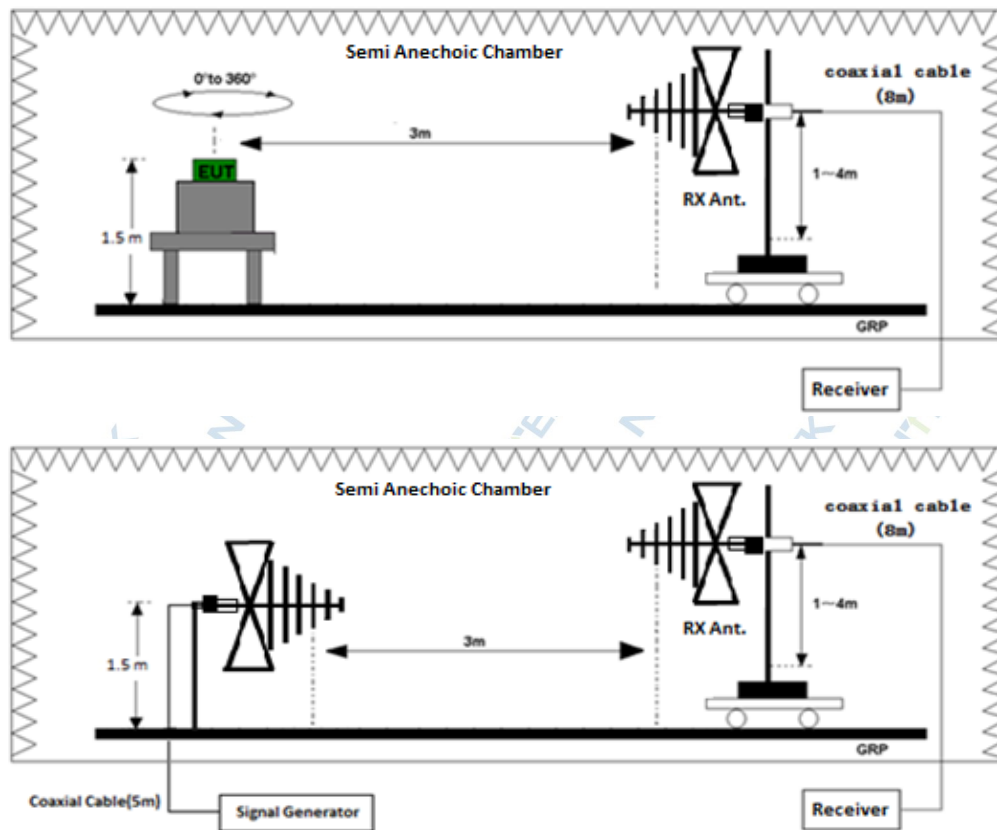
Refer to chapter 5.2.2.2 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input type="checkbox"/> Conducted measurement	<input checked="" type="checkbox"/> Radiated measurement

4.3 DEVIATION FROM TEST STANDARD

No deviation

4.4 TEST SETUP



4.5 TEST RESULTS

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	26°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	DC 3.3V
Test Mode:	TX Mode		

Band H:

Frequency	Ant	SG Level	Pcl	Ga	Correction	(ERP)	ERP	Limits	RESULT
(MHz)	H / V	(dBm)	(dB)	(dB)	(dBi)	(dBm)	(mW)	(mW)	
433.96	H	-6.18	2.38	12.34	2.15	1.63	1.46	25	PASS
	V	-7.27	2.38	12.34	2.15	0.54	1.13	25	PASS

Note: Pcl= cable loss

Ga= Antenna Gain

Peak EIRP(dBm)= SGLevel -Pcl +Ga

ERP(dBm)=EIRP-2.15

5. MAXIMUM EFFECTIVE RADIATED POWER SPECTRAL DENSITY

5.1 APPLICABILITY

Maximum e.r.p. power spectral density applies to transmitters using annex B bands I.
Maximum e.r.p. power spectral density applies to transmitters using DSSS or wideband techniques other than FHSS modulation, in annex C band W, AA or AC.

5.2 LIMITS OF MAXIMUM EFFECTIVE RADIATED POWER SPECTRAL DENSITY

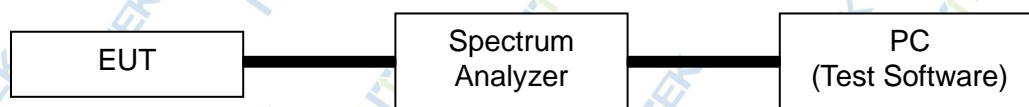
The Maximum e.r.p. power spectral density shall not be greater than the value allowed in annex B or any NRI for the chosen operational frequency band(s).

5.3 TEST PROCEDURES

Refer to chapter 5.3.4 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

5.4 TEST SETUP



5.5 TEST RESULTS

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	26°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	N/A
Test Mode:	N/A		

The Maximum e.r.p. spectral density shall not be required for EUT operating in Band H.

6. DUTY CYCLE

6.1 APPLICABILITY

Duty cycle applies to all transmitters except EUT with polite spectrum access (described in EN 300220-2 V3.2.1 clause 4.5) where permitted in annex B, table B.1 or annex C, table C.1 or any NRI

6.2 LIMITS OF DUTY CYCLE

The limits please refer to ETSI EN 300 220-2 V3.2.1 Annex B:

Table B.1: EU wide harmonised national radio interfaces from 25 MHz to 1 000 MHz

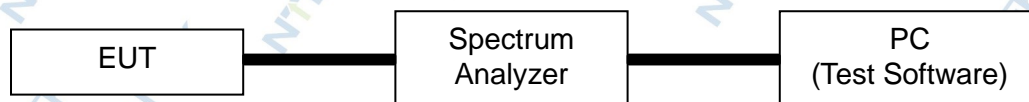
Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2017/1483/EU [2]
A	26,957 MHz to 27,283 MHz	10 mW e.r.p.	No requirement	The whole band		28
B	26,995 MHz, 27,045 MHz, 27,095 MHz, 27,145 MHz, 27,195 MHz	100 mW e.r.p.	$\leq 0,1 \%$ duty cycle	10 kHz	Model control devices may operate without duty cycle restrictions.	29, 30, 31, 32, 33
C	40,660 MHz to 40,700 MHz	10 mW e.r.p.	No requirement	The whole band	Video applications excluded.	35
D	169,400 MHz to 169,475 MHz	500 mW e.r.p.	$\leq 1,0 \%$ duty cycle For metering devices duty cycle limit is 10 %	50 kHz		37c
E	169,4000 MHz to 169,4875 MHz	10 mW	$\leq 0,1 \%$ duty	The whole band		38
F	169,4875 MHz to 169,5875 MHz	10 mW	$\leq 0,001 \%$ duty cycle Between 00.00 and 06.00 local time a duty cycle limit of 0,1 % may be used	The whole band	Equipment that concentrates or multiplexes individual equipment is excluded.	39b
G	169,5875 MHz to 169,8125 MHz	10 mW	$\leq 0,1 \%$ duty cycle	The whole band		40
H	433,050 MHz to 434,790 MHz	10 mW	10 %	The whole band		44b, 45b

6.3 TEST PROCEDURE

Refer to chapter 5.4 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

6.4 TEST SETUP



6.5 TEST RESULTS

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	26°C	Relative Humidity:	53 %
Pressure:	1012 hPa	Test Voltage:	DC 3.3V
Test Mode:	TX-Band H		

Duty Cycle	Limit	Result
0.235%	10%	Complies

The duty cycle is simply the on time divided by the period:

$T_{ON}=14.7\text{ms}$,

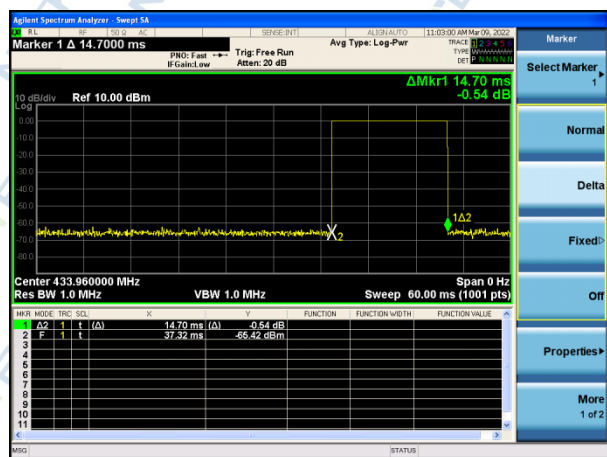
$T_{ON(Total)}=14.7\text{ms}\times 1=14.7\text{ms}$,

T_p = one hour=3600000ms, N means the number of times a product is transmit in one hour.

Duty Cycle= $T_{ON(Total)}\times N/T_p=14.7\times 1000/3600000=408\%$,

Note: The client declared keystrokes not more than 1000 times per hour.

Test Plot



7.OCCUPIED BANDWIDTH

7.1 APPLICABILITY

Maximum occupied bandwidth applies to all transmitters.

7.2 LIMITS OF OCCUPIED BANDWIDTH

The occupied bandwidth of the EUT according to ETSI EN 300 220-1 [1], clause 5.6.2 shall comply with the limits in annex B or any NRI for the chosen operational frequency band(s).

The limits please refer to ETSI EN 300 220-2 V3.2.1 Annex B:

Table B.1: EU wide harmonised national radio interfaces from 25 MHz to 1 000 MHz

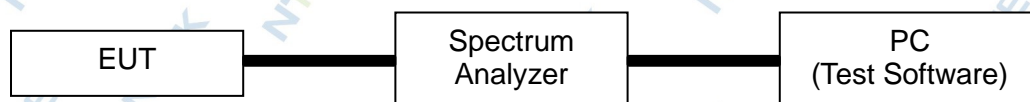
Operational Frequency Band		Maximum effective radiated power, e.r.p.	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)	Maximum occupied bandwidth	Other usage restrictions	Band number from EC Decision 2017/1483/EU [2]
A	26,957 MHz to 27,283 MHz	10 mW e.r.p.	No requirement	The whole band		28
B	26,995 MHz, 27,045 MHz, 27,095 MHz, 27,145 MHz, 27,195 MHz	100 mW e.r.p.	$\leq 0,1 \%$ duty cycle	10 kHz	Model control devices may operate without duty cycle restrictions.	29, 30, 31, 32, 33
C	40,660 MHz to 40,700 MHz	10 mW e.r.p.	No requirement	The whole band	Video applications excluded.	35
D	169,400 MHz to 169,475 MHz	500 mW e.r.p.	$\leq 1,0 \%$ duty cycle For metering devices duty cycle limit is 10 %	50 kHz		37c
E	169,4000 MHz to 169,4875 MHz	10 mW	$\leq 0,1 \%$ duty	The whole band		38
F	169,4875 MHz to 169,5875 MHz	10 mW	$\leq 0,001 \%$ duty cycle Between 00.00 and 06.00 local time a duty cycle limit of 0,1 % may be used	The whole band	Equipment that concentrates or multiplexes individual equipment is excluded.	39b
G	169,5875 MHz to 169,8125 MHz	10 mW	$\leq 0,1 \%$ duty cycle	The whole band		40
H	433,050 MHz to 434,790 MHz	10 mW	10 %	The whole band		44b, 45b

7.3 TEST PROCEDURE

Refer to chapter 5.3.5 of ETSI EN 300 220 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

7.4 TEST SETUP

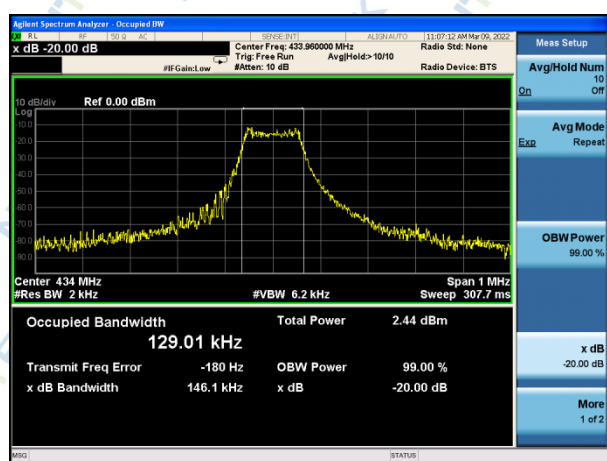


7.5 TEST RESULTS

EUT :	LoRa Module	Model Name:	Ra-08
Temperature :	26°C	Relative Humidity:	60 %
Pressure :	1012 hPa	Test Voltage :	DC 3.3V
Test Mode :	TX		

Band	CHANNEL	CHANNEL FREQUENCY (MHz)	99%OCCUPIED BANDWIDTH	Measured frequencies		Limit	PASS /FAIL
			(KHz)	FL (MHz)	FH (MHz)		
H	01	433.96	129.01	433.706	434.213	Flow>433,040MHz Fhigh<434,790MHz	PASS

Test Plot



8. TX OUT OF BAND EMISSIONS

8.1 APPLICABILITY

TX Out of Band Emissions applies to all transmitters with OCW > 25 kHz.

8.2 LIMITS OF TX OUT OF BAND EMISSIONS

The EUT shall comply with reference limits defined in ETSI EN 300 220-1 [1], clause 5.8.2.

The EUT emissions level in OOB domains for the Operating Channel and the Operational Frequency Band shall be less or equal to Table 15 spectrum mask.

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW _{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \leq f_{\text{low_OFB}} - 400 \text{ kHz}$	10 kHz	-36 dBm
	$F_{\text{low_OFB}} - 400 \text{ kHz} \leq f \leq f_{\text{low_OFB}} - 200 \text{ kHz}$	1 kHz	-36 dBm
	$f_{\text{low}} - 200 \text{ kHz} \leq f < f_{\text{low_OFB}}$	1 kHz	See Figure 6
	$f = f_{\text{low_OFB}}$	1 kHz	0 dBm
	$f = f_{\text{high_OFB}}$	1 kHz	0 dBm
	$F_{\text{high_OFB}} < f \leq f_{\text{high_OFB}} + 200 \text{ kHz}$	1 kHz	See Figure 6
	$F_{\text{high_OFB}} + 200 \text{ kHz} \leq f \leq f_{\text{high_OFB}} + 400 \text{ kHz}$	1 kHz	-36 dBm
	$F_{\text{high_OFB}} + 400 \text{ kHz} \leq f$	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c - 2.5 \times \text{OCW}$	1 kHz	-36 dBm
	$f_c - 2.5 \times \text{OCW} \leq f \leq f_c - 0.5 \times \text{OCW}$	1 kHz	See Figure 5
	$f = f_c - 0.5 \times \text{OCW}$	1 kHz	0 dBm
	$f = f_c + 0.5 \times \text{OCW}$	1 kHz	0 dBm
	$f_c + 0.5 \times \text{OCW} \leq f \leq f_c + 2.5 \times \text{OCW}$	1 kHz	See Figure 5
	$f = f_c + 2.5 \times \text{OCW}$	1 kHz	-36 dBm

NOTE: f is the measurement frequency.
 f_c is the Operating Frequency.
 $F_{\text{low_OFB}}$ is the lower edge of the Operational Frequency Band.
 $F_{\text{high_OFB}}$ is the upper edge of the Operational Frequency Band.
OCW is the operating channel bandwidth.

8.3 TEST PROCEDURES

Refer to chapter 5.8 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

8.4 TEST SETUP



These measurements only were performed at normal test conditions. The measurement shall be performed only on the lowest and the highest frequency within the ststed frequency range. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator. Controlling software has been activated to set the EUT on specific status.

8.5 TEST RESULTS

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	26°C	Relative Humidity:	53 %
Pressure:	1012 hPa	Test Voltage:	DC 3.3V
Test Mode:	TX		

OCW=130kHz

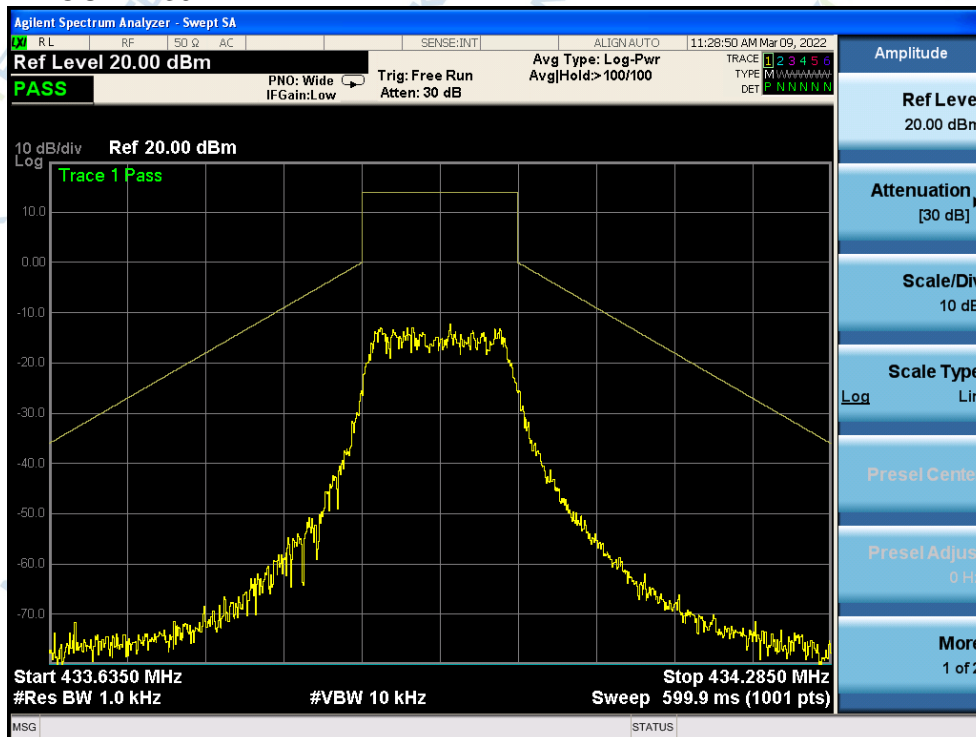


Figure 5 Out Of Band Domain for Operating Channel with reference BW

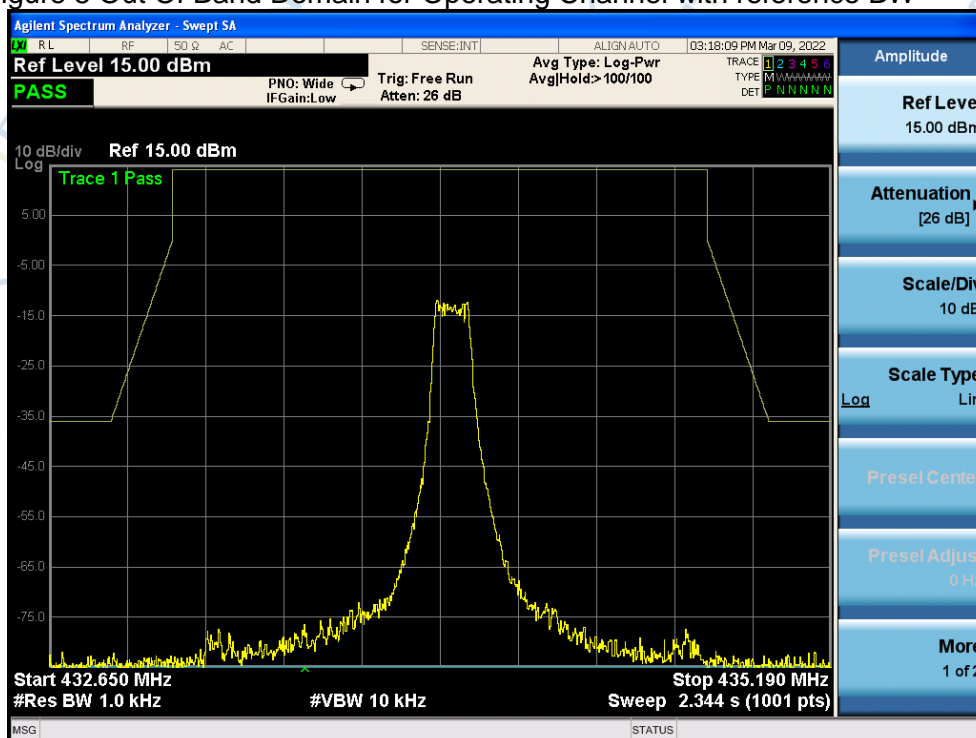


Figure 6 Out Of Band Domain for Operational Frequency Band with reference BW

9. UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

9.1 APPLICABILITY

This items applies to all equipment.

9.2 LIMITS OF UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

Refer to chapter 5.9.2 of ETSI EN 300 220-1 V3.1.1

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

Frequency State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

9.3 MEASURING INSTRUMENTS AND SETTING

Operating Mode	Frequency Range	RBW _{REF} (see note 2)
Transmit mode	$9 \text{ kHz} \leq f < 150 \text{ kHz}$	1 kHz
	$150 \text{ kHz} \leq f < 30 \text{ MHz}$	10 kHz
	$30 \text{ MHz} \leq f < f_c - m$	100 kHz
	$f_c - m \leq f < f_c - n$	10 kHz
	$f_c - n \leq f < f_c - p$	1 kHz
	$f_c + p < f \leq f_c + n$	1 kHz
	$f_c + n < f \leq f_c + m$	10 kHz
	$f_c + m < f \leq 1 \text{ GHz}$	100 kHz
	$1 \text{ GHz} < f \leq 6 \text{ GHz}$	1 MHz

NOTE 1: f is the measurement frequency.
 f_c is the Operating Frequency.
m is 10 x OCW or 500 kHz, whichever is the greater.
n is 4 x OCW or 100 kHz, whichever is the greater.
p is 2,5 x OCW.

NOTE 2: If the value of RBW used for measurement is different from RBW_{REF}, use bandwidth correction from clause 4.3.10.1.

Table 22: Spurious Radiations radiated Measurement Frequency Range

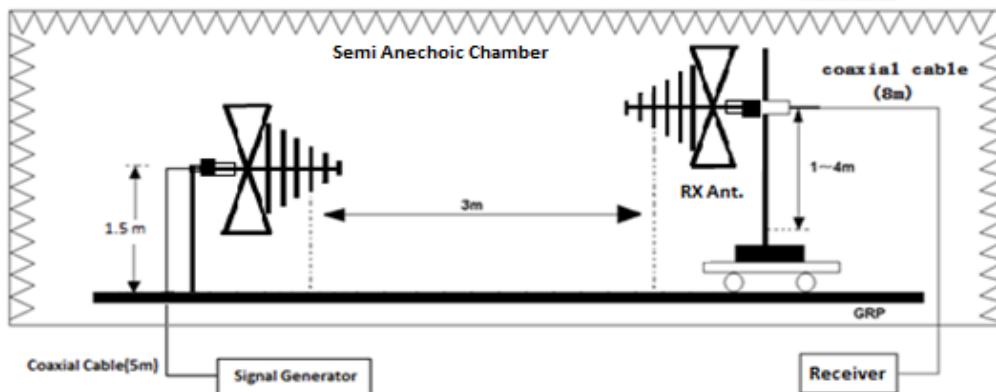
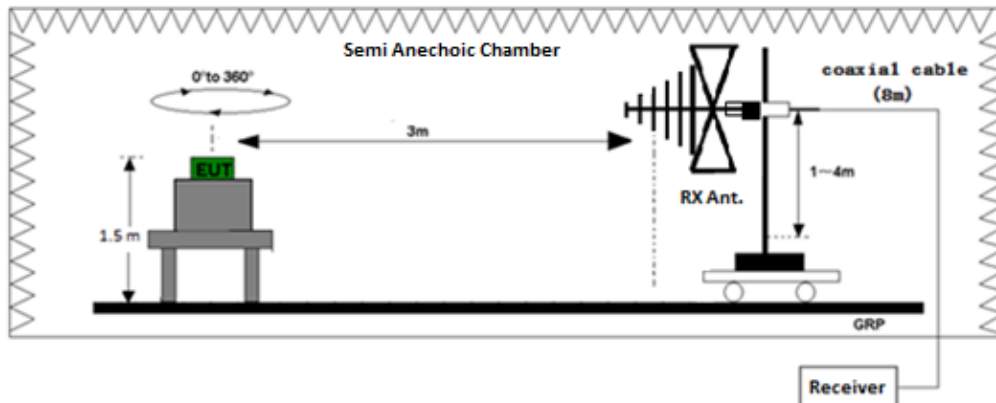
Frequency Range
25 MHz to 6 GHz
NOTE: The measurements need only to be performed over the frequency range 4 GHz to 6 GHz if emissions are detected within 10 dB of the specified limit between 1,5 GHz and 4 GHz.

9.4 TEST PROCEDURES

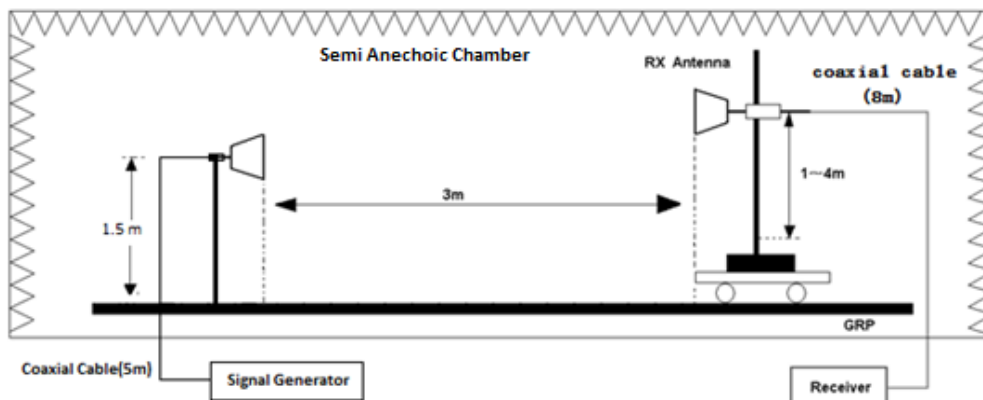
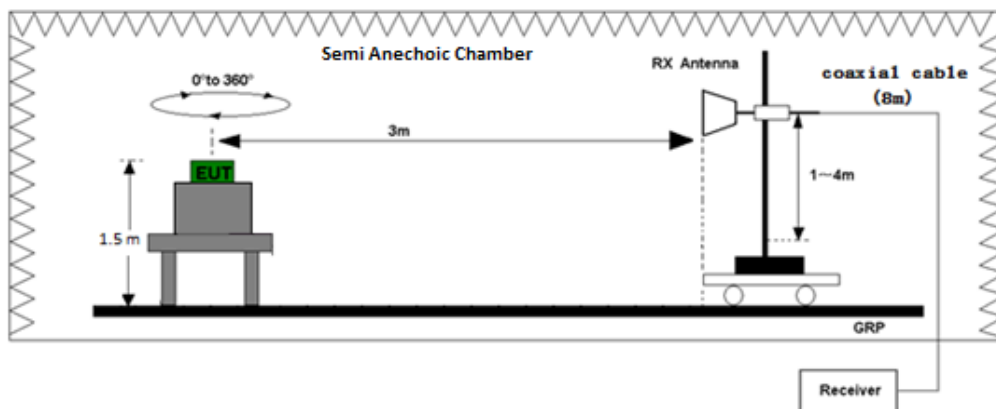
Refer to chapter 5.9.3.3.2 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input type="checkbox"/> Conducted measurement	<input checked="" type="checkbox"/> Radiated measurement

9.5 TEST SETUP LAYOUT



Test set-up of radiated disturbance (30MHz-1GHz)



Test set-up of radiated disturbance (above 1GHz)

9.6 EUT OPERATION DURING TEST

The EUT was programmed to be in continuously transmitting mode.

9.7 TEST RESULTS

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	24 °C	Relative Humidity:	54%
Pressure:	1010 hPa	Test Power:	DC 3.3V
Test Mode:	TX		

BELOW 1 GHz WORST- CASE DATA (30 MHz ~ 1GHz)

Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
	(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)	
V	103.8054	-80.19	11.09	-69.10	-54.00	-15.10	peak
V	139.3608	-78.53	12.43	-66.10	-36.00	-30.10	peak
V	187.0954	-76.87	9.47	-67.40	-54.00	-13.40	peak
V	386.6338	-81.09	17.19	-63.90	-36.00	-27.90	peak
V	494.1983	-82.51	20.11	-62.40	-54.00	-8.40	peak
V	584.7894	-88.30	21.70	-66.60	-54.00	-12.60	peak
H	102.3597	-74.78	11.08	-63.70	-54.00	-9.70	peak
H	144.8418	-70.85	12.05	-58.80	-36.00	-22.80	peak
H	186.4404	-76.24	9.54	-66.70	-54.00	-12.70	peak
H	208.5800	-76.70	9.90	-66.80	-54.00	-12.80	peak
H	530.1014	-85.20	20.90	-64.30	-54.00	-10.30	peak
H	614.2142	-85.51	22.01	-63.50	-54.00	-9.50	peak

Remark:

Emission Level= Meter Reading+ Factor, Margin= Emission Level - Limit

ABOVE 1 GHz WORST- CASE DATA (1GHz ~ 6GHz)

Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
	(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)	
V	1998.750	-36.00	-10.07	-46.07	-30.00	-16.07	peak
V	2233.750	-41.84	-9.01	-50.85	-30.00	-20.85	peak
V	3320.625	-43.42	-6.33	-49.75	-30.00	-19.75	peak
V	4613.125	-43.82	-2.26	-46.08	-30.00	-16.08	peak
V	4965.625	-44.44	-1.26	-45.70	-30.00	-15.70	peak
V	6375.625	-45.14	2.69	-42.45	-30.00	-12.45	peak
H	1998.750	-36.58	-9.69	-46.27	-30.00	-16.27	peak
H	2880.000	-42.59	-8.68	-51.27	-30.00	-21.27	peak
H	3761.250	-43.54	-6.05	-49.59	-30.00	-19.59	peak
H	4789.375	-44.60	-1.52	-46.12	-30.00	-16.12	peak
H	5758.750	-44.56	-0.57	-45.13	-30.00	-15.13	peak
H	6816.250	-45.14	6.41	-38.73	-30.00	-8.73	peak

Remark:

Emission Level= Meter Reading+ Factor, Margin= Emission Level - Limit

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	24 °C	Relative Humidity:	54%
Pressure:	1010 hPa	Test Power:	DC 3.3V
Test Mode:	RX		

BELOW 1 GHz WORST- CASE DATA (30 MHz ~ 1GHz)

Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Remark
	(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)	
V	96.0986	-81.92	10.17	-71.75	-57.00	-14.75	peak
V	191.7450	-78.45	9.05	-69.40	-57.00	-12.40	peak
V	210.0482	-77.73	9.93	-67.80	-57.00	-10.80	peak
V	227.6904	-77.74	10.84	-66.90	-57.00	-9.90	peak
V	494.1983	-87.41	20.11	-67.30	-57.00	-10.30	peak
V	537.5891	-87.84	21.44	-66.40	-57.00	-9.40	peak
H	107.1337	-80.74	11.14	-69.60	-57.00	-12.60	peak
H	191.7450	-77.45	9.05	-68.40	-57.00	-11.40	peak
H	387.9920	-87.74	17.24	-70.50	-57.00	-13.50	peak
H	508.2581	-89.95	20.65	-69.30	-57.00	-12.30	peak
H	574.6258	-90.12	21.92	-68.20	-57.00	-11.20	peak
H	654.2318	-87.45	22.65	-64.80	-57.00	-7.80	peak

Remark:

Emission Level= Meter Reading+ Factor, Margin= Emission Level - Limit

ABOVE 1 GHz WORST- CASE DATA (1GHz ~ 6GHz)

Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Remark
	(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)	
V	1793.125	-61.48	3.69	-57.79	-47.00	-10.79	peak
V	2065.715	-65.51	8.20	-57.31	-47.00	-10.31	peak
V	2586.250	-66.17	9.23	-56.94	-47.00	-9.94	peak
V	2938.750	-66.65	8.82	-57.83	-47.00	-10.83	peak
V	8255.625	-70.72	16.02	-54.70	-47.00	-7.70	peak
V	10781.875	-70.92	14.32	-56.60	-47.00	-9.60	peak
H	2065.715	-65.96	8.66	-57.30	-47.00	-10.30	peak
H	2880.000	-67.48	8.62	-58.86	-47.00	-11.86	peak
H	4231.250	-68.56	7.87	-60.69	-47.00	-13.69	peak
H	6757.500	-73.13	14.13	-59.00	-47.00	-12.00	peak
H	10341.250	-74.81	19.92	-54.89	-47.00	-7.89	peak
H	11457.500	-67.79	13.79	-54.00	-47.00	-7.00	peak

Remark:

Emission Level= Meter Reading+ Factor, Margin= Emission Level - Limit

10 TRANSIENT POWER

10.1 APPLICABILITY

Transient power applies to all transmitters.

10.2 LIMITS OF TRANSIENT POWER

The EUT shall comply with reference limits defined in ETSI EN 300 220-1 [1], clause 5.10.2.

The transient power shall not exceed the values given in Table 23.

Table 23: Transmitter Transient Power limits

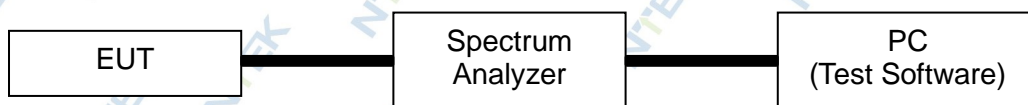
Absolute offset from centre frequency	RBW _{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

10.3 TEST PROCEDURES

Refer to chapter 5.10.3.2 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

10.4 TEST SETUP



10.5 TEST RESULT

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	26°C	Relative Humidity:	53 %
Pressure:	1012 hPa	Test Voltage:	DC 3.3V
Test Mode:	TX		

OCW=130kHz

Frequency	Center Frequency	RBW	Max Vaule	Limit	Results
	MHz	(kHz)	(dBm)	(dBm)	(P/F)
-0,5 x OCW - 3 kHz	433.892	1kHz	-29.147	0 dBm	PASS
0,5 x OCW + 3 kHz	434.028	1kHz	-29.068	0 dBm	PASS
-OCW	433.83	10kHz	-49.432	0 dBm	PASS
+OCW	434.09	10kHz	-48.225	0 dBm	PASS
-0,5 x OCW - 400 kHz	433.495	100kHz	-63.408	-27 dBm	PASS
0,5 x OCW + 400 kHz	434.425	100kHz	-64.818	-27 dBm	PASS
-0,5 x OCW -1 200 kHz	432.695	300kHz	-65.272	-27 dBm	PASS
0,5 x OCW +1 200 kHz	435.225	300kHz	-65.274	-27 dBm	PASS

11. ADJACENT CHANNEL POWER

11.1 APPLICABILITY

Adjacent channel power applies to all transmitters with OCW \leq 25 kHz.

11.2 LIMITS OF ADJACENT CHANNEL POWER

Where the Operating Channel Width is less than or equal to 25 kHz, the power in the adjacent channels shall not exceed the reference limits defined in ETSI EN 300 220-1 [1], clause 5.11.2.

Table 26: Adjacent channel power limits for transmitters with OCW \leq 25 kHz

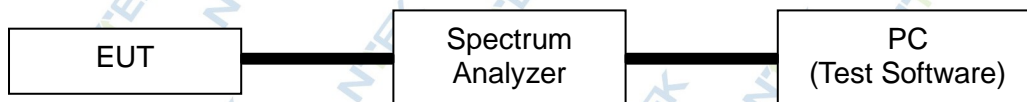
		Adjacent Channel power integrated over 0,7 x OCW	Alternate Adjacent Channel power integrated over 0,7 x OCW
OCW < 20 kHz	Normal test conditions	-20 dBm	-20 dBm
	Extreme test conditions	-15 dBm	-20 dBm
OCW \geq 20 kHz	Normal test conditions	-37 dBm	-40 dBm
	Extreme test conditions	-32 dBm	-37 dBm

11.3 TEST PROCEDURES

Refer to chapter 5.11.3.3 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

11.4 TEST SETUP



11.5 TEST RESULT

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	26°C	Relative Humidity:	53 %
Pressure:	1012 hPa	Test Voltage:	N/A
Test Mode:	N/A		

Note: Not applicable .

12. TX BEHAVIOUR UNDER LOW VOLTAGE CONDITIONS

12.1 APPLICABILITY

TX behaviour under low voltage condition applies to battery powered EUT.

12.2 LIMITS OF TX BEHAVIOUR UNDER LOW VOLTAGE CONDITIONS

The EUT shall comply with reference limits defined in ETSI EN 300 220-1 [1], clause 5.12.2.

The equipment shall either:

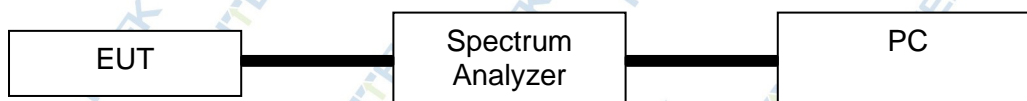
- a) remain in the Operating Channel OC without exceeding any applicable limits (e.g. Duty Cycle);
 - or
 - b) reduce its effective radiated power below the Spurious Emission limits without exceeding any applicable limits(e.g. Duty Cycle); or
 - c) shut down, (ceasing function);
- as the voltage falls below the manufacturers declared operating voltage.

12.3 TEST PROCEDURES

Refer to chapter 5.12.3.2 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

12.4 TEST SETUP



12.5 TEST RESULT

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	26 °C	Relative Humidity:	60 %
Pressure:	1010 hPa	Test Power:	N/A
Test Mode:	N/A		

Note: This item applies to battery powered EUT

13. ADAPTIVE POWER CONTROL

13.1 APPLICABILITY

Adaptive power control applies to all EUT with adaptive power control using annex C band AF.

13.2 LIMITS OF ADAPTIVE POWER CONTROL

The EUT shall comply with reference limits defined in ETSI EN 300 220-1 [1], clause 5.13.2.

The peak power measured when active APC function at its minimum setting shall not exceed the value shown in Table 29.

Table 29: APC power limit

Parameter	Limit
Transmitted e.r.p.	+7 dBm

13.3 TEST PROCEDURES

Refer to chapter 5.12.3.2 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

13.4 TEST SETUP

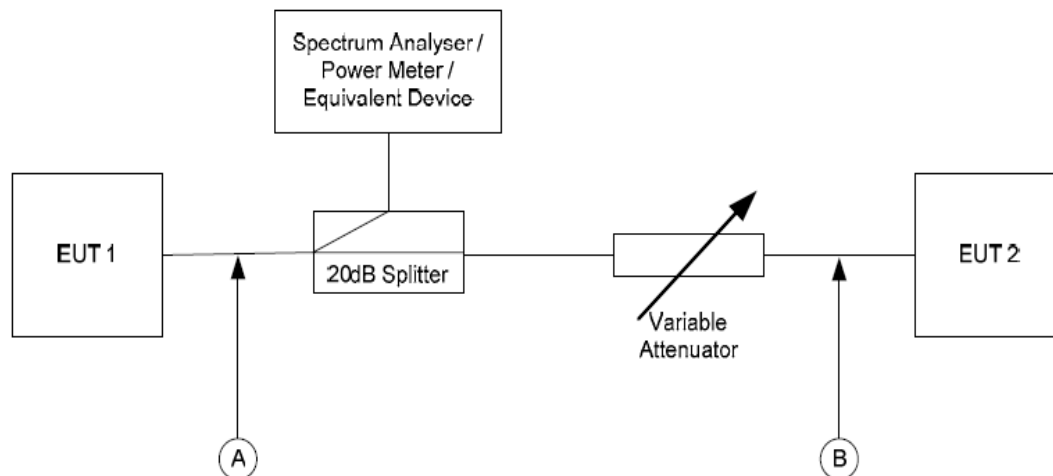


Figure 8: APC Measurement Setup

The EUTs shall be set to communicate with each other for at least the APC settling time.

The test equipment shall then be used to measure power for at least 60 seconds.

NOTE: The power measuring interval should be sufficiently long to capture transmissions from the EUT.

13.5 TEST RESULT

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	26 °C	Relative Humidity:	60 %
Pressure:	1010 hPa	Test Power:	N/A
Test Mode:	N/A		

Note: The equipment is not applicable for adaptive power control.

14. RX SENSITIVITY LEVEL

14.1 APPLICABILITY

Rx sensitivity requirement is applicable to all EUT employing polite spectrum access as set out in clause 4.5.1.

14.2 LIMITS OF RX SENSITIVITY LEVEL

Refer to chapter 4.4.1.2 of ETSI EN 300 220-2 V3.2.1& EN 300 220-1 V3.1.1, clause 5.14.2.

The sensitivity for receivers shall be below or equal to Table 32 level.

Table 32: Limits for Receiver sensitivity

$$S = 10 \log RB_{\text{kHz}} - 4 \text{ dB}\mu\text{V emf}; \text{ or}$$

$$S_p = 10 \log RB_{\text{kHz}} - 117 \text{ dBm}$$

where:

- S_p is the sensitivity in dBm.
- RB is the declared receiver bandwidth in kHz.

The receiver bandwidth RB shall be declared by the manufacturer. RB is the usually 3 dB receiver bandwidth selectivity.

For example, the sensitivity for a 25 kHz Operating Channel equipment with a 16 kHz bandwidth shall be better than +8 dBμV emf for a 50 Ω receiver input impedance. This corresponds to a receiver sensitivity of -105 dBm.

14.3 TEST PROCEDURES

Refer to chapter 5.14.3.3 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

14.4 TEST SETUP



14.5 TEST RESULTS

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	26°C	Relative Humidity:	53 %
Pressure:	1012 hPa	Test Voltage:	N/A
Test Mode:	N/A		

Note: The EUT has no function of polite spectrum access. So this test is not applicable.

15.BLOCKING

15.1 APPLICABILITY

Blocking applies to all receivers.

15.2 LIMITS OF BLOCKING

The blocking level shall be better or equal to category 2 reference limits level defined in ETSI EN 300 220-1 [1], clause 5.18.3.

Table 41: Blocking level parameters for RX category 2

Requirement	Limits
	Receiver category 2
Blocking at ± 2 MHz from OC edge fhigh and flow	≥ -69 dBm
Blocking at ± 10 MHz from OC edge fhigh and flow	≥ -44 dBm
Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -44 dBm

The blocking levels at the specified frequency offsets shall be equal to or greater than the limits Table 42, except at frequencies where spurious responses are found.

Table 42: Blocking level parameters for RX category 1.5

Requirement	Limits
	Receiver category 1.5
Blocking at ± 2 MHz from OC edge fhigh and flow	≥ -43 dBm
Blocking at ± 10 MHz from OC edge fhigh and flow	≥ -33 dBm
Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -33 dBm

The blocking levels at the specified frequency offsets shall be equal to or greater than the limits Table 43, except at frequencies where spurious responses are found.

Table 43: Blocking level parameters for RX category 1

Requirement	Limits
	Receiver category 1
Blocking at ± 2 MHz from Centre Frequency	≥ -20 dBm
Blocking at ± 10 MHz from Centre Frequency	≥ -20 dBm
Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -20 dBm

15.3 TEST PROCEDURES

Refer to chapter 5.18.6.3&5.18.6.4 of ETSI EN 300 220-1 V3.1.1 (2017-02)

Measurement	
<input checked="" type="checkbox"/> Conducted measurement	<input type="checkbox"/> Radiated measurement

15.4 TEST SETUP

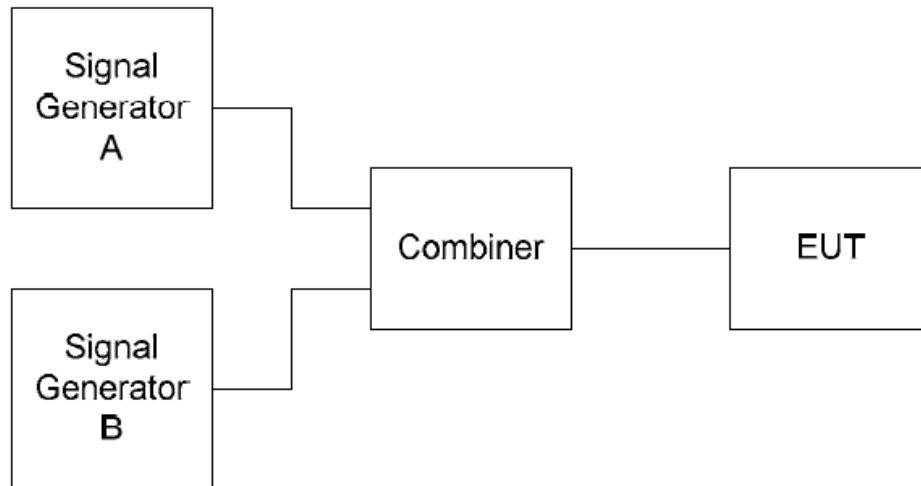


Figure 10: Blocking measurement arrangement

15.5 TEST RESULTS

EUT:	LoRa Module	Model Name:	Ra-08
Temperature:	26°C	Relative Humidity:	53 %
Pressure:	1012 hPa	Test Voltage:	DC 3.3V
Test Mode:	RX		

Flow= 433.895MHz; Fhigh=434.025MHz

Receiver category	Frequency offset	Test Frequency (MHz)	Receiver BW(kHz)	Measurement Vause(dB)	≥Limit(dB)
2	+2 MHz of Flow	435.8950	180	-36	-69
	-2 MHz of Flow	431.8950	180	-33	-69
	+2 MHz of Fhigh	436.0250	180	-37	-69
	-2 MHz of Fhigh	432.0250	180	-35	-69
	+10 MHz of Fhigh	444.0250	180	-26	-44
	-10 MHz of Fhigh	424.0250	180	-27	-44
	+10 MHz of Flow	443.8950	180	-28	-44
	-10 MHz of Flow	423.8950	180	-29	-44
	-21.698 MHz	412.2620	180	-30	-44
	+21.698MHz	455.6580	180	-23	-44

APPENDIX-PHOTOGRAPHS OF EUT CONSTRUCTIONAL DETAILS
Radiated Measurement Photos



END OF REPORT