RF TEST REPORT

Report No.:	20230817G10789X-W3
Product Name:	Passage People Counter
Model No.:	VS350-915M, NF350-915M, VS350-9M, NF350-9M, VS350, NF350
FCC ID:	2AYHY-VS350
Applicant:	Xiamen Milesight IoT Co., Ltd.
Address:	Building C09, Software Park Phase III, Xiamen 361024, Fujian, China
Dates of Testing:	08/23/2023 - 08/28/2023
Issued by:	CCIC Southern Testing Co., Ltd.
Lab Location:	Electronic Testing Building, No. 43 Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China. **Tel**：86 755 26627338 **Fax**：86 755 26627238

Test Report

Product .....:	Passage People Counter
Brand Name.....:	Milesight
Trade Name .....:	Milesight
Applicant.....:	Xiamen Milesight IoT Co., Ltd.
Applicant Address.....:	Building C09, Software Park Phase III, Xiamen 361024, Fujian, China
Manufacturer .....:	Xiamen Milesight IoT Co., Ltd.
Manufacturer Address .....:	Building C09, Software Park Phase III, Xiamen 361024, Fujian, China
Test Standards.....:	47 CFR Part 15 Subpart C 15.247 ANSI C63.10-2013
Test Result.....:	Pass

Tested by .....: Kim Li 2023.09.04

Kim Li, Test Engineer

Reviewed by .....: Chris You 2023.09.04

Chris You, Senior Engineer

Approved by .....: Yang Fan 2023.09.04

Yang Fan, Manager

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Change History		
Issue	Date	Reason for change
1.0	2023.09.04	First edition

1. General Information

1.1. EUT Description

Product Name	Passage People Counter
Frequency Range	LoRaWAN: 902MHz~928MHz
Channel Number	902.3~914.9MHz: 64 915.2~927.6MHz: 63
Data Rate	SF12, SF11, SF10, SF9, SF8, SF7, SF6, SF5
Modulation Type	LoRa
Antenna Type	PCB Antenna
Antenna Gain	2.29dBi
Power supply	2*Lithium Battery (3.6V, 2700mAh)

Note 1: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

Note 2: The antenna gain, RF Cable loss and all the information provided by manufacturer and our lab not responsible for the accuracy of the antenna gain/cable loss information.

Note 3: Model No.: VS350-915M, NF350-915M, VS350-9M, NF350-9M, VS350, NF350 Electrically the same inside the device, with only difference being model name.

1.2. Test Standards and Results

The purpose of the report is to conduct testing according to the following FCC certification standards:

No.	Identity	Document Title
1	47 CFR Part 15 Subpart C	Radio Frequency Devices
2	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
3	KDB 558074 D01 15.247 Meas Guidance v05r02	Cuidance for Compliance Measurement on Digital Transmission Systems, Frequency Hopping Spread Spectrum Systems, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules

Test detailed items/section required by FCC rules and results are as below:

No.	Section in CFR 47	Description	Result
1	15.203 15.247(b)(4)	Antenna Requirement	PASS
2	15.247 (a)(1)(i)	Number of Hopping Frequency	PASS
3	15.247 (b)(2)	Peak Output Power	PASS
4	15.247 (a)(1)(i)	20dB Emission Bandwidth	PASS
5	15.247 (a)(1)	Carrier Frequency Separation	PASS
6	15.247 (a)(1)(i)	Time of Occupancy (Dwell time)	PASS
7	15.247(d)	Conducted Band Edge and Spurious Emission	PASS
8	15.207	AC Power Line Conducted Emission	N/A[Note 3]
9	15.205 15.209 15.247(d)	Radiated Band Edges and Spurious Emission	PASS

Note 1: The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10-2013.

Note 2: These RF tests were performed according to the method of measurements prescribed in KDB 558074 D01 15.247 Meas Guidance v05r02.

Note 3: Not applicable, EUT is battery powered equipment.

1.3. Carrier Frequency and channel List

LoRaWAN_902.3~914.9MHz					
Channel	Frequency(MHz)	Channel	Frequency(MHz)	Channel	Frequency(MHz)
0	**902.3**	29	908.1	46	911.5
1	902.5	30	908.3	47	911.7
2	902.7	31	908.5	48	911.9
3	902.9	**32**	**908.7**	49	912.1
...	...	...	...	...	...
...	...	...	...	...	...
...	...	...	...	...	...
15	905.3	42	910.7	60	914.3
16	905.5	43	910.9	61	914.5
17	905.7	44	911.1	62	914.7
18	905.9	45	911.3	**63**	**914.9**
Note 1: F(MHz) = 902.3 + 0.2*n (0 ≤ n ≤ 63).					
Note 2: Channel 0, 32 and 63 selected for LoRaWAN as Lowest, Middle and Highest channel.					

LoRaWAN_915.2~927.6MHz					
Channel	Frequency(MHz)	Channel	Frequency(MHz)	Channel	Frequency(MHz)
0	**915.2**	29	921.0	46	924.4
1	915.4	30	921.2	47	924.6
2	915.6	31	921.4	48	924.8
3	915.8	**32**	**921.6**	49	925.0
...	...	...	...	...	...
...	...	...	...	...	...
...	...	...	...	...	...
15	918.2	42	923.6	60	927.2
16	918.4	43	923.8	61	927.4
17	918.6	44	924.0	**62**	**927.6**
18	918.8	45	924.2	/	/
Note 1: F(MHz) = 915.2 + 0.2*n (0 ≤ n ≤ 62).					
Note 2: Channel 0, 32 and 62 selected for LoRaWAN as Lowest, Middle and Highest channel.					

1.4. Test environment and mode

During the measurement, the environmental conditions were within the listed ranges:

Operating Environment	
Temperature	15°C - 35°C
Humidity	30% -60%
Atmospheric Pressure	86kPa-106kPa
Test mode:	
Non-hopping mode:	Keep the EUT in continuous transmitting mode with worst case data rate.
Hopping mode:	Keep the EUT in hopping mode.

1.5. Table for Supporting Units

No.	Equipment	Brand Name	Model Name	Manufacturer	Serial No.	Note
1	Laptop	HP	TPN-Q221	HP	5CD14347QB	FCC DOC

1.6. EUT Operation Test Setup

For RF test items, an engineering test program was provided and enable to make EUT transmitting.

1.7. Facilities and Accreditations

FCC-Registration No.: 406086

CCIC Southern Testing Co., Ltd EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Designation Number: CN1283, valid time is until Sep 30, 2023.

ISED Registration: 11185A-1

CCIC Southern Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A-1 on Aug. 04, 2016, valid time is until Sep 30, 2023.

A2LA Code: 5721.01

CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025.

2. Test Requirement

2.1. Antenna requirement

2.1.1. Applicable Standard

And according to FCC 47 CFR Section 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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, 15.221, or § 15.236. 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.

And according to FCC 47 CFR Section 15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2.1.2. Antenna Information

Antenna Category: PCB Antenna.

1. The PCB Antenna is permanently connected to the EUT, can't be removed.

Antenna General Information:

No.	EUT	Operating frequency range	Ant. Type	Ant. Gain
1	Passage People Counter	902-928MHz	PCB Antenna	2.29dBi

2.1.3. Result: Comply

Please refer to the EUT photos.

2.2. Number of Hopping Frequency

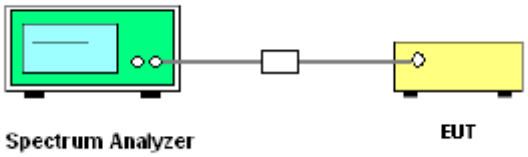
2.2.1. Limit of Number of Hopping Frequency

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.2.3. Test Setup



2.2.4. Test Procedure

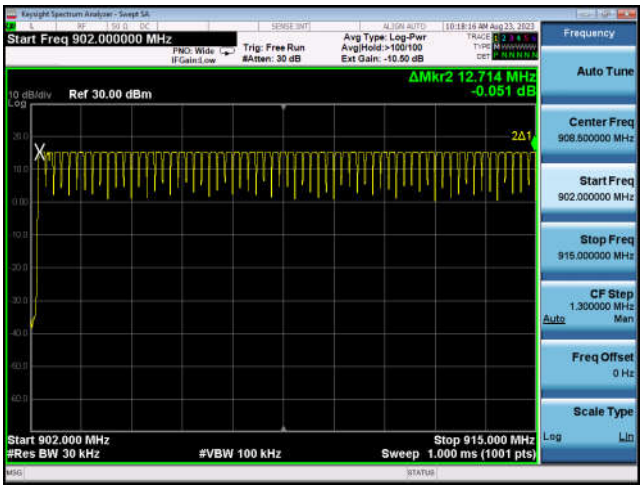
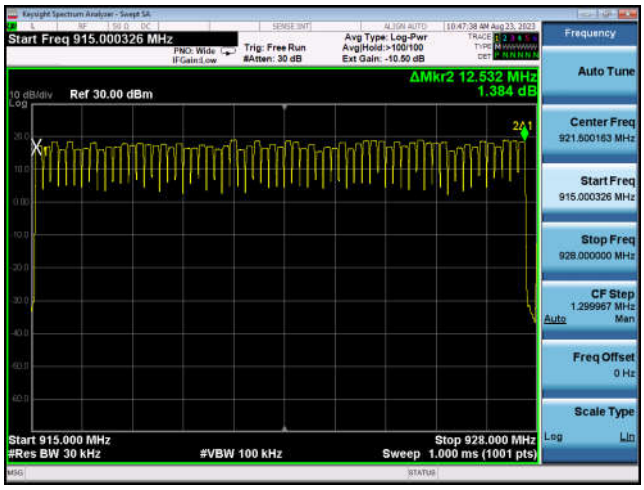
1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 7.8.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:

   Span: The frequency band of operation / RBW: Set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, Whichever is smaller / VBW ≥ RBW / Sweep: Auto / Detector function: Peak / Trace: Max hold / Allow the trace to stabilize.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement results in the test report.

2.2.5. Test Results of Number of Hopping Frequency

LoRaWAN_902.3~914.9MHz				
Test Frequency	Test Range(MHz)	Number of Hopping Frequency	Limit	Result
Hopping	902~915	64	≥ 50	Pass

LoRaWAN_915.2~927.6MHz				
Test Frequency	Test Range(MHz)	Number of Hopping Frequency	Limit	Result
Hopping	915~928	63	≥ 50	Pass

Number Of Hopping Channels: 902~915MHz	Number Of Hopping Channels: 915~928MHz
	

2.3. Maximum Conducted Output Power

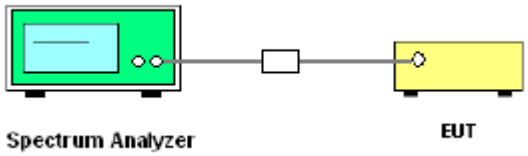
2.3.1. Limit of Maximum Conducted Output Power

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.3.3. Test Setup



2.3.4. Test Procedures

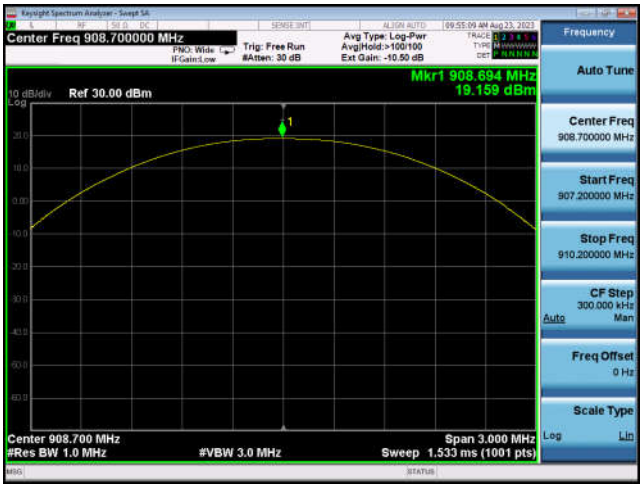
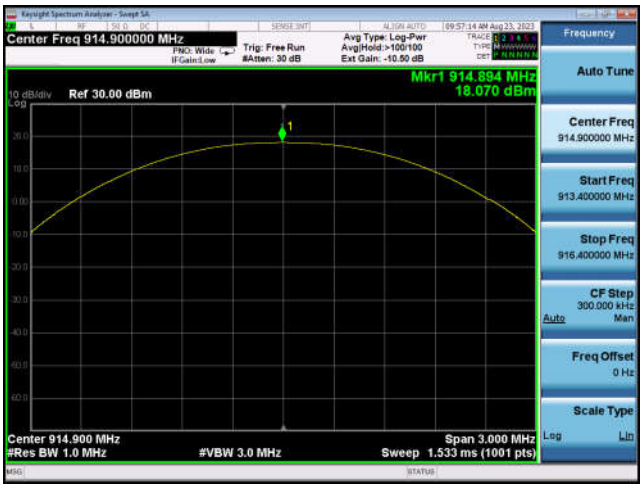
1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 7.8.5.
2. The RF output of EUT was connected to Spectrum analyzer by RF cable and attenuator. The pathloss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings:

   Set span to be Approximately five times the 20 dB bandwidth, centered on a hopping channel / RBW > 20 dB bandwidth of the emission being measured / VBW ≥ RBW / Sweep: Auto / Detector function: Peak / Trace: Max hold / Allow trace to stabilize / Use the marker-to-peak function to set the marker to the peak of the emission.
5. Record the measurement results in the test report.

2.3.5. Test Result of Maximum Conducted Output Power

LoRaWAN_902.3~914.9MHz			
Test Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Result
902.3	18.189	30.00	Pass
908.7	19.159	30.00	Pass
914.9	18.070	30.00	Pass

LoRaWAN_915.2~927.6MHz			
Test Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Result
915.2	18.168	30.00	Pass
921.6	18.265	30.00	Pass
927.6	18.696	30.00	Pass

Conducted Output Power: 902.3MHz	Conducted Output Power: 915.2MHz
	
Conducted Output Power: 908.7MHz	**Conducted Output Power: 921.6MHz**
	
Conducted Output Power: 914.9MHz	**Conducted Output Power: 927.6MHz**
	

2.4. 20dB Emission Bandwidth

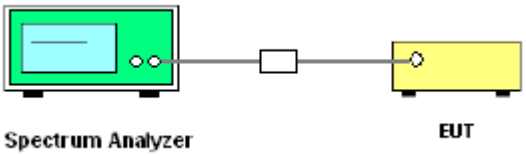
2.4.1. Definition

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.4.3. Test Setup



2.4.4. Test Procedure

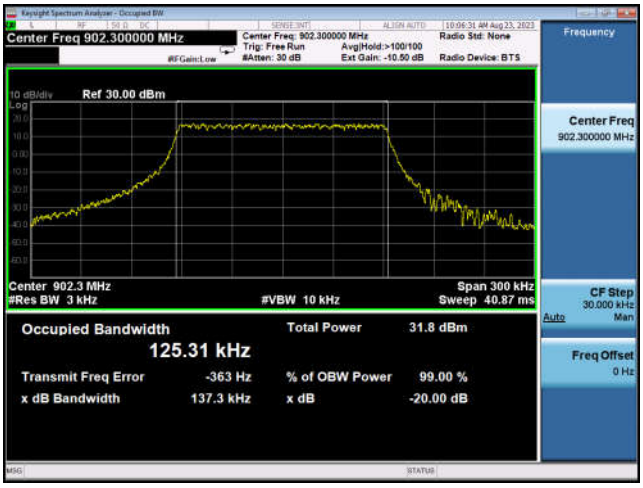
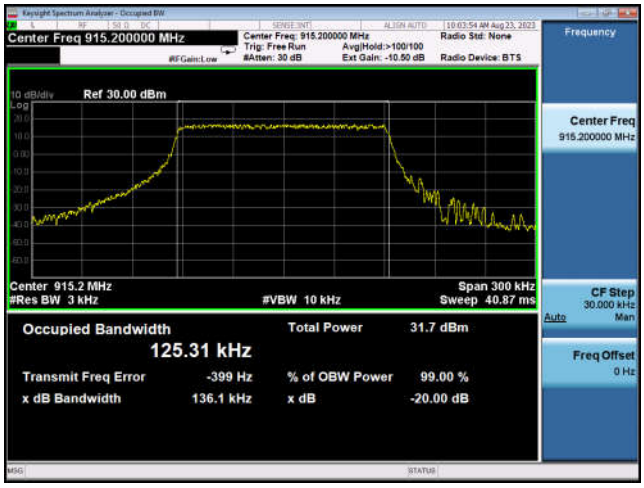
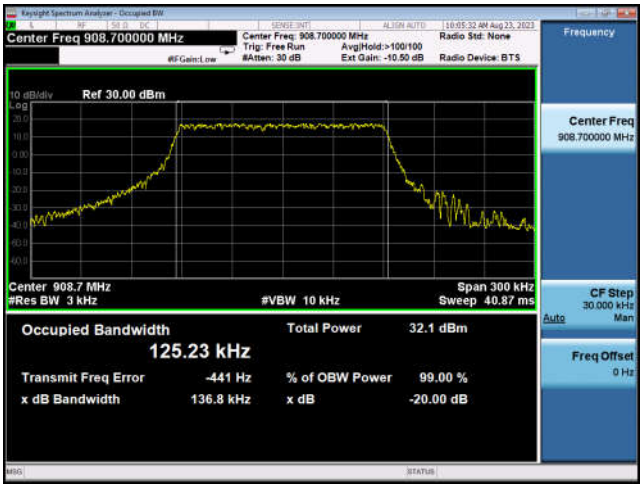
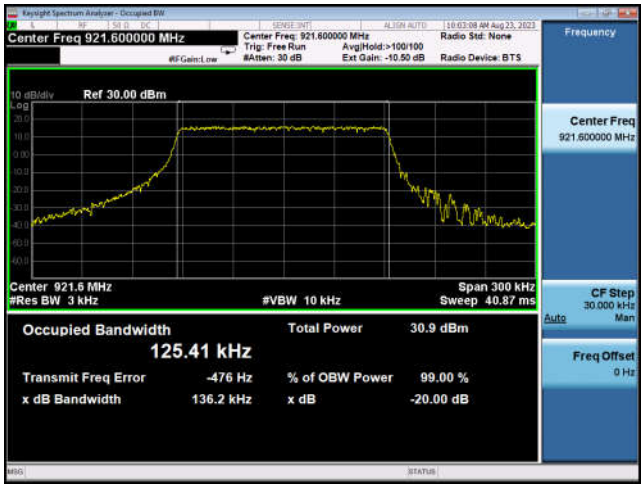
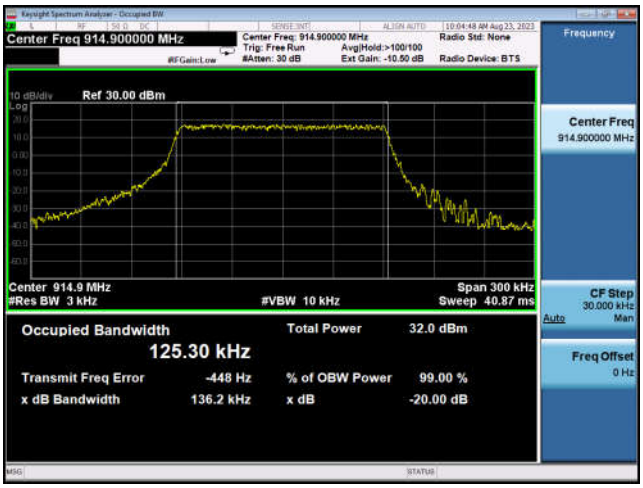
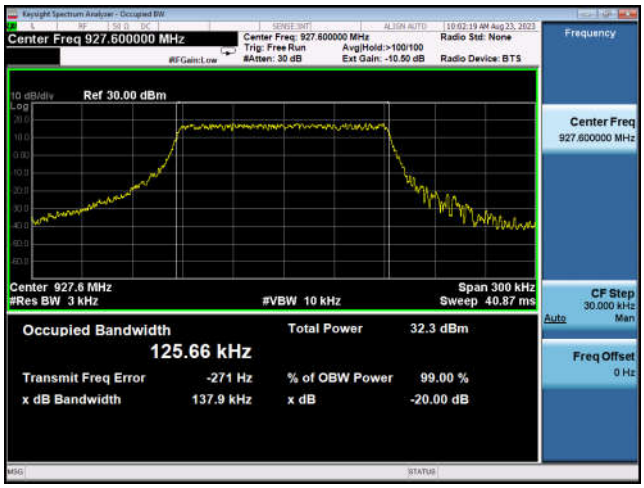
1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 7.8.7 or 6.9.2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the spectrum analyzer “Channel Bandwidth” function to easurement the 20dB EBW.
5. For 20dB EBW Use the following spectrum analyzer settings:

   Using the X dB bandwidth mode of the instrument's automatic bandwidth measurement function, X is set to 20 dB / The spectrum analyzer center frequency is set to the EUT channel center frequency / Set span to be approximately 2 to 5 times the EBW / RBW ≥ 1% to 5% of the EBW / VBW shall be approximately three times RBW / Sweep: Auto / Detector mode: Peak / Trace mode: Max hold.
6. Record the measurement results in the test report.

2.4.5. Test Results of 20dB Emission Bandwidth

LoRaWAN_902.3~914.9MHz			
Test Frequency (MHz)	20dB Emission Bandwidth (kHz)	Limit (kHz)	Result
902.3	137.3	< 250	Pass
908.7	136.8	< 250	Pass
914.9	136.2	< 250	Pass

LoRaWAN_915.2~927.6MHz			
Test Frequency (MHz)	20dB Emission Bandwidth (kHz)	Limit (kHz)	Result
915.2	136.1	< 250	Pass
921.6	136.2	< 250	Pass
927.6	137.9	< 250	Pass

20dB Emission Bandwidth: 902.3MHz	20dB Emission Bandwidth: 915.2MHz
	
20dB Emission Bandwidth: 908.7MHz	**20dB Emission Bandwidth: 921.6MHz**
	
20dB Emission Bandwidth: 914.9MHz	**20dB Emission Bandwidth: 927.6MHz**
	

2.5. Carried Frequency Separation

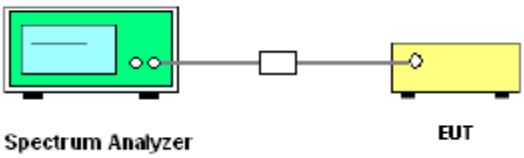
2.5.1. Limit of Carried Frequency Separation

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.5.3. Test Setup



2.5.4. Test Procedure

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 7.8.2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:

   Span: wide enough to capture the peaks of two adjacent channels /

   RBW: Start with the RBW set to approximately 30% of the channel spacing / VBW ≥ RBW /

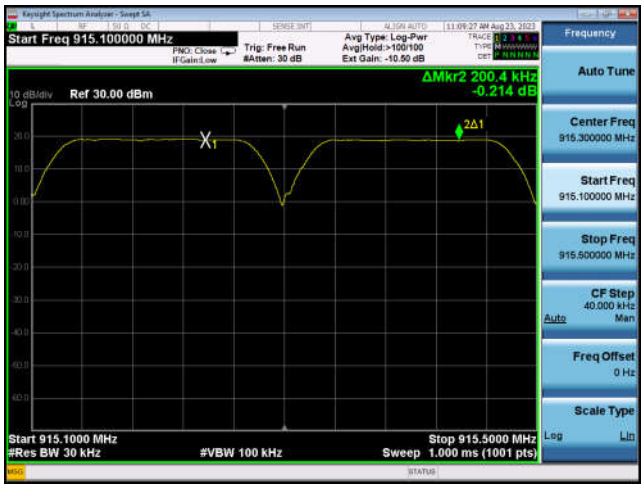
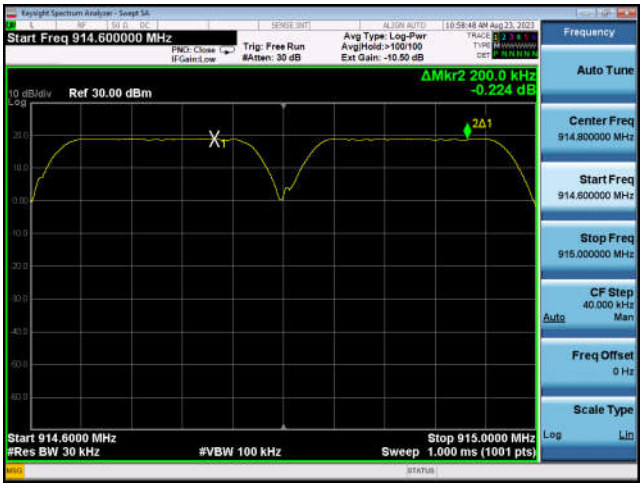
   Sweep: Auto / Detector function: Peak / Trace: Max hold / Allow the trace to stabilize /

   Use the marker-delta function to determine the separation between the peaks of the adjacent channels.
6. Record the measurement results in the test report.

2.5.5. Test Results of Carried Frequency Separation

LoRaWAN_902.3~914.9MHz				
Test Frequency (MHz)	Range (MHz~MHz)	Separation (kHz)	Limit (kHz)	Result
902.3	902.2~902.6	200.4	≥ 137.3	Pass
908.7	908.4~908.8	200.4	≥ 136.8	Pass
914.9	914.6~915.0	200.0	≥ 136.2	Pass

LoRaWAN_915.2~927.6MHz				
Test Frequency (MHz)	Range (MHz~MHz)	Separation (kHz)	Limit (kHz)	Result
915.2	915.1~915.5	200.4	≥ 136.1	Pass
921.6	921.3~921.7	200.4	≥ 136.2	Pass
927.6	927.3~927.7	200.4	≥ 137.9	Pass

Carried Frequency Separation: 902.2~902.6MHz	Carried Frequency Separation: 915.1~915.5MHz
	
Carried Frequency Separation: 908.4~908.8MHz	**Carried Frequency Separation: 921.3~921.7MHz**
	
Carried Frequency Separation: 914.6~915.0MHz	**Carried Frequency Separation: 927.5~927.9MHz**
	

2.6. Dwell time

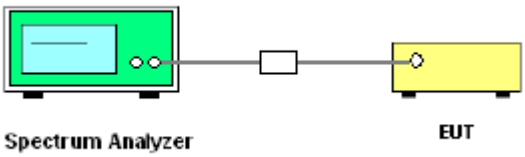
2.6.1. Limit of Dwell Time

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz

2.6.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.6.3. Test Setup



2.6.4. Test Procedure

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 7.8.4.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:

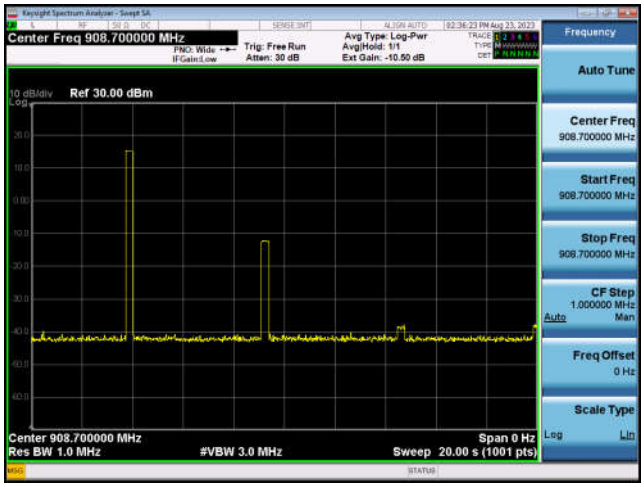
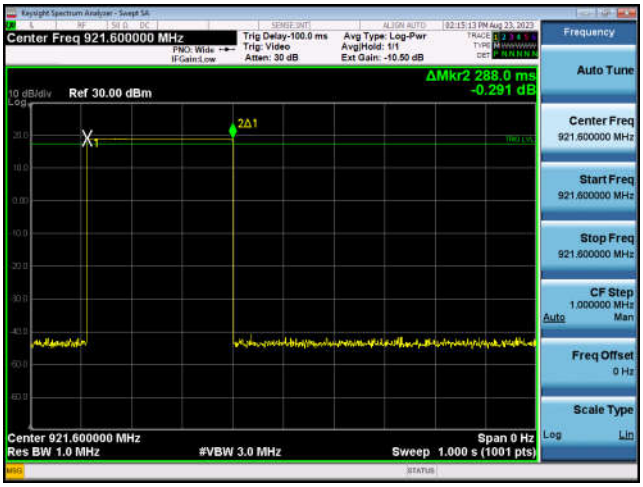
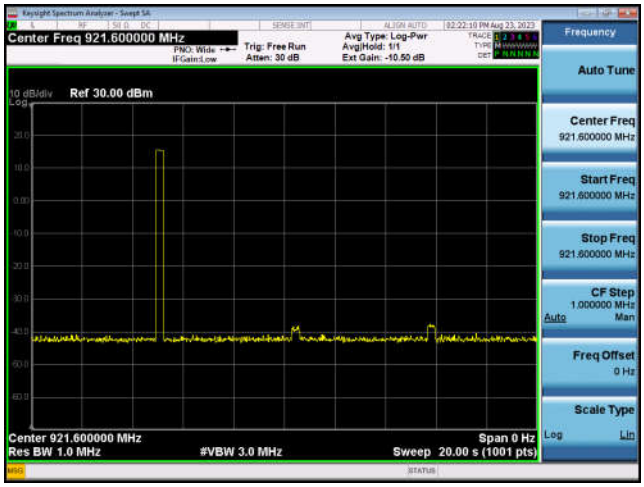
   Span: Zero span, centered on a hopping channel / RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel / VBW ≥ RBW / Sweep: As necessary to capture the entire dwell time per hopping channel / Detector function: Peak / Trace: Max hold.
6. Record the measurement results in the test report.

2.6.5. Test Results of Dwell Time

LoRaWAN_902.3~914.9MHz						
Test Frequency (MHz)	Pulse Time (ms)	Observation Time (s)	Hopping Number	Dwell Time (s)	Limit (s)	Result
908.7	288.0	20	1	0.2880	0.4	Pass

LoRaWAN_915.2~927.6MHz						
Test Frequency (MHz)	Pulse Time (ms)	Observation Time (s)	Hopping Number	Dwell Time (s)	Limit (s)	Result
921.6	288.0	20	1	0.2880	0.4	Pass

Note 1: Dwell Time = Pulse Time × Hopping Number.

Pulse Time: 908.7MHz	Observation Time: 908.7MHz
	
Pulse Time: 921.6MHz	Observation Time: 921.6MHz
	

2.7. Conducted Spurious Emissions

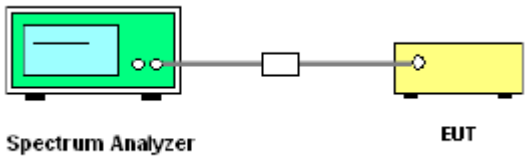
2.7.1. Limit of Conducted Spurious Emissions

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is perating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that.

2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.7.3. Test Setup



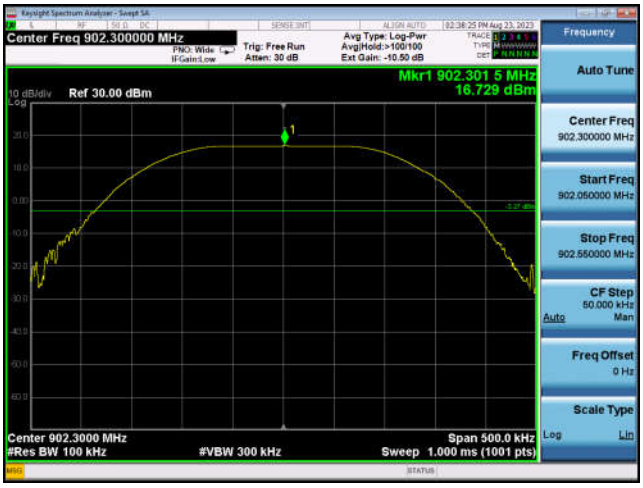
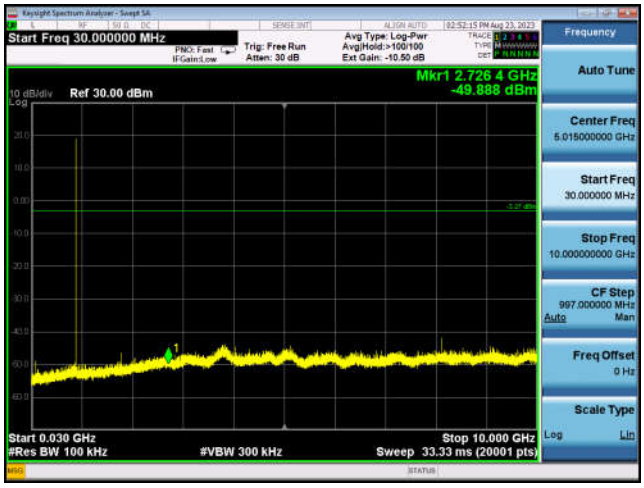
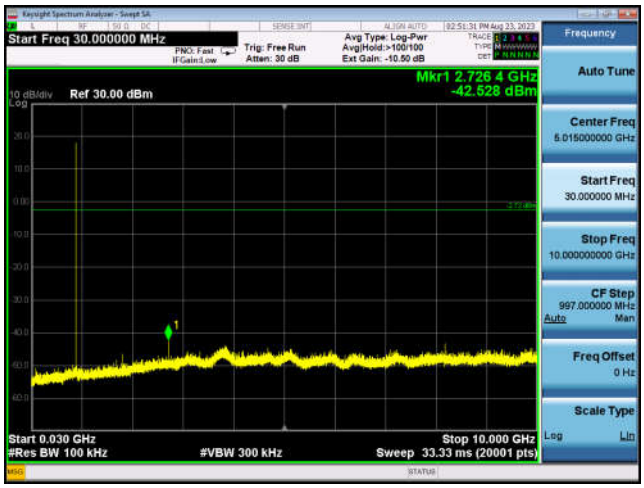
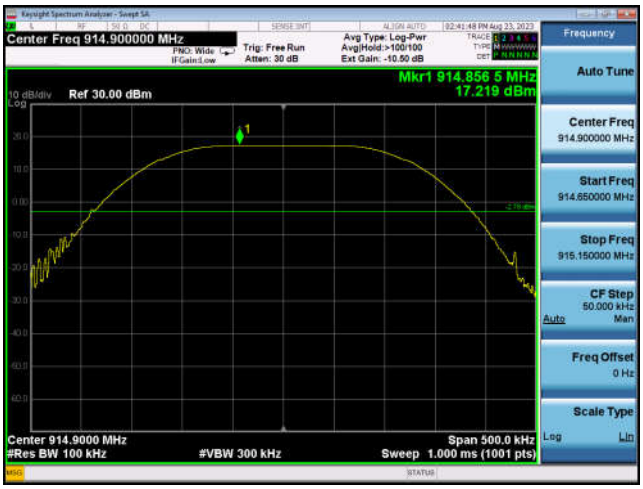
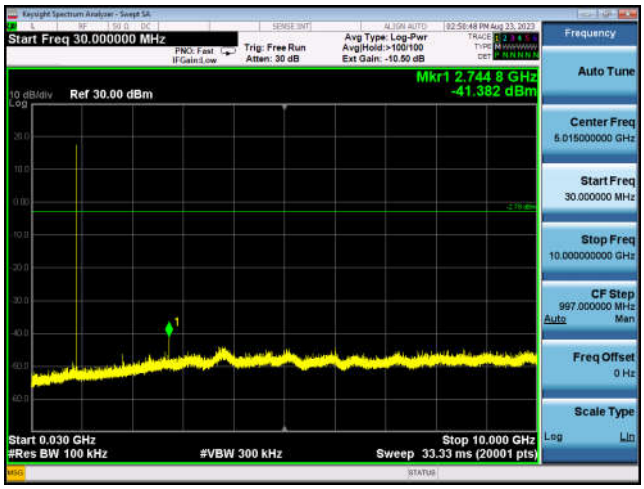
2.7.4. Test Procedure

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 7.8.8.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings:

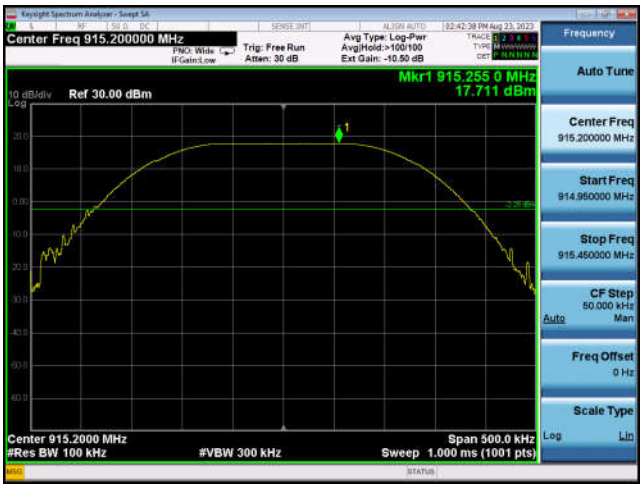
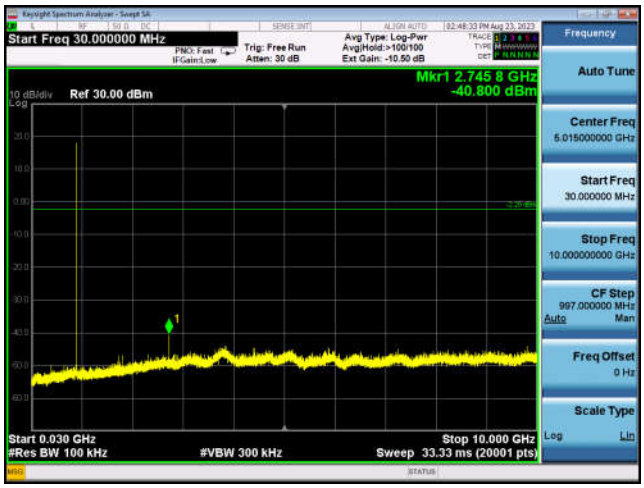
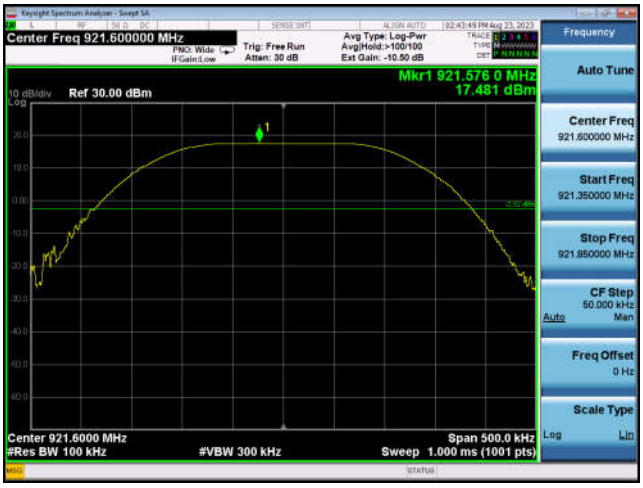
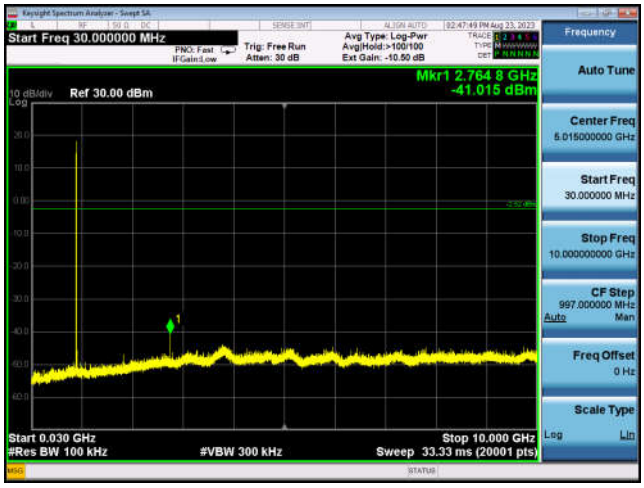
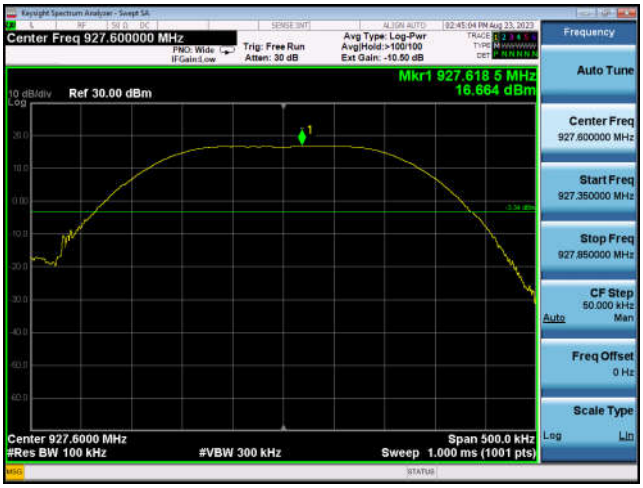
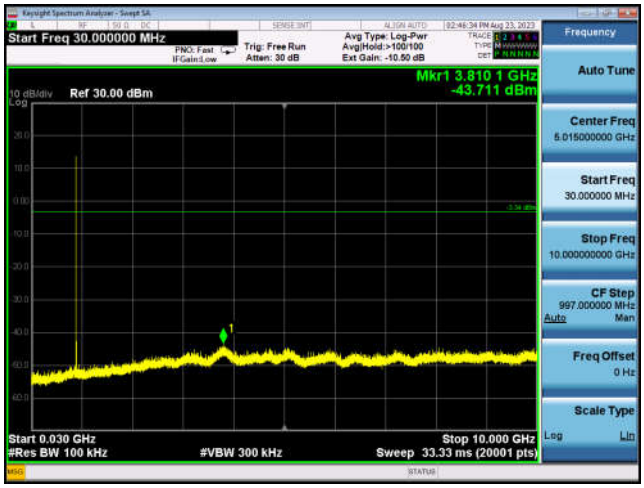
   Set the frequency range to 30MHz~10GHz / RBW: 100kHz / VBW: 300kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum amplitude level.
5. Record the measurement results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

2.7.5. Test Results of Conducted Spurious Emissions

LoRaWAN_902.3~914.9MHz:

Referecy Level: 902.3MHz	Conducted Spurious Emission: 902.3MHz
	
Referecy Level: 908.7MHz	Conducted Spurious Emission: 908.7MHz
	
Referecy Level: 914.9MHz	Conducted Spurious Emission: 914.9MHz
	

LoRaWAN_915.2~927.6MHz:

Referecy Level: 915.2MHz	Conducted Spurious Emission: 915.2MHz
	
Referecy Level: 921.6MHz	Conducted Spurious Emission: 921.6MHz
	
Referecy Level: 927.6MHz	Conducted Spurious Emission: 927.6MHz
	

2.8. Conducted Band Edge

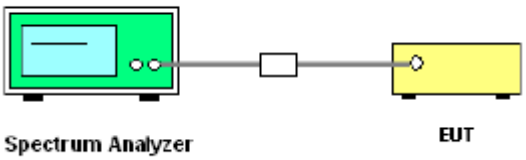
2.8.1. Limit of Conducted Band Edge

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is perating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that.

2.8.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.8.3. Test Setup



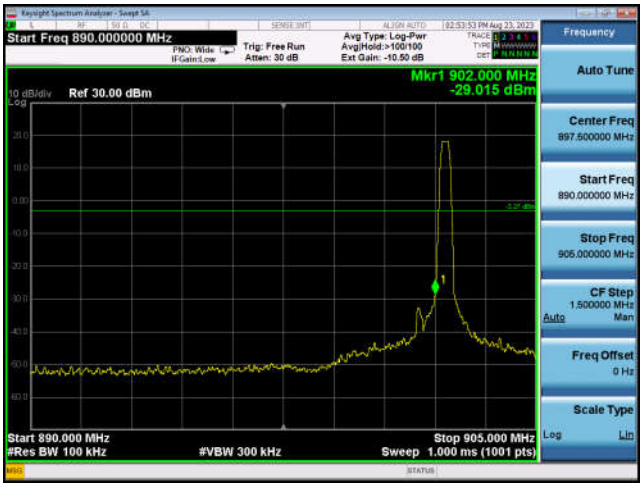
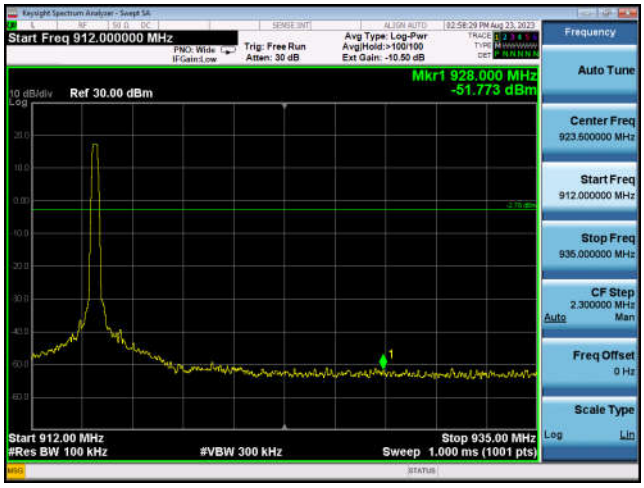
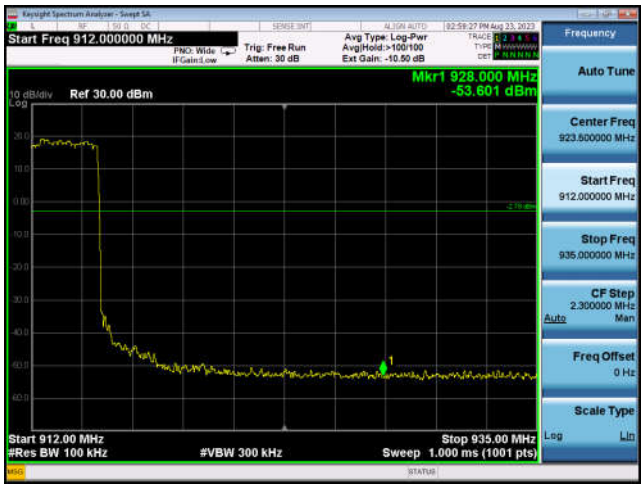
2.8.1. Test Procedure

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 7.8.6 ro 6.10.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings:

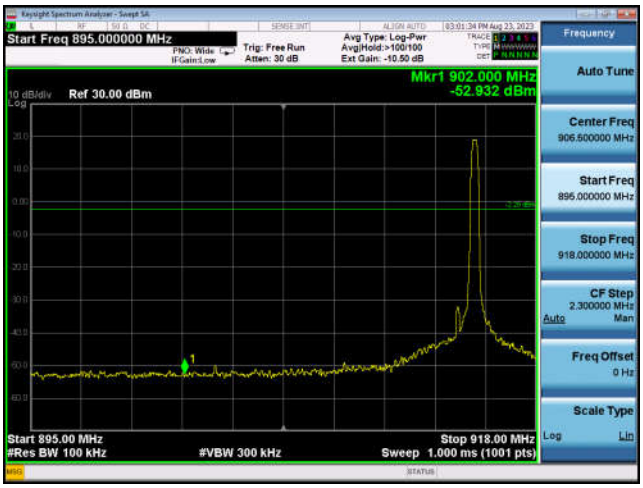
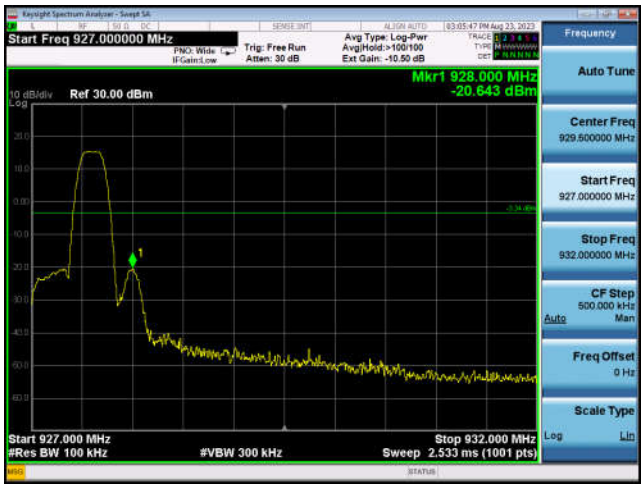
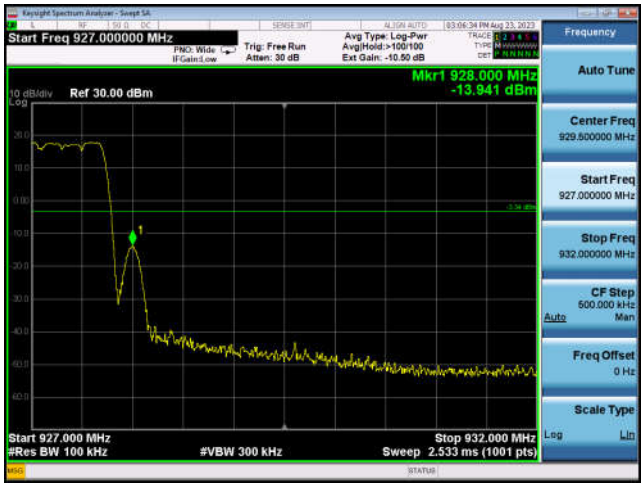
   Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation / RBW: 100kHz / VBW: 300kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum power level.
5. Enable hopping function of the EUT and then repeat step 3 and 4.
6. Record the measurement results in the test report.
7. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

2.8.2. Test Results of Conducted Band Edge

LoRaWAN_902.3~914.9MHz:

Conducted Band Edge: 902.3MHz_No-Hopping	Conducted Band Edge: 914.9MHz_No-Hopping
	
Conducted Band Edge: 902.3MHz_Hopping	Conducted Band Edge: 914.9MHz_Hopping
	

LoRaWAN_915.2~927.6MHz:

Conducted Band Edge: 915.2MHz_No-Hopping	Conducted Band Edge: 927.6MHz_No-Hopping
	
Conducted Band Edge: 915.2MHz_Hopping	Conducted Band Edge: 927.6MHz_Hopping
	

2.9. Radiated Band Edges and Spurious Emission

2.9.1. Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level. If the transmitter uses an RMS average conducted power limit, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the estricted bands, as defi ned in §15.205(a), must also comply with the radiated emission limits specifi ed in §15.209(a).

§15.209(a) Radiated emission limits:

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

Restricted bands of operation refer to §15.205 (a):

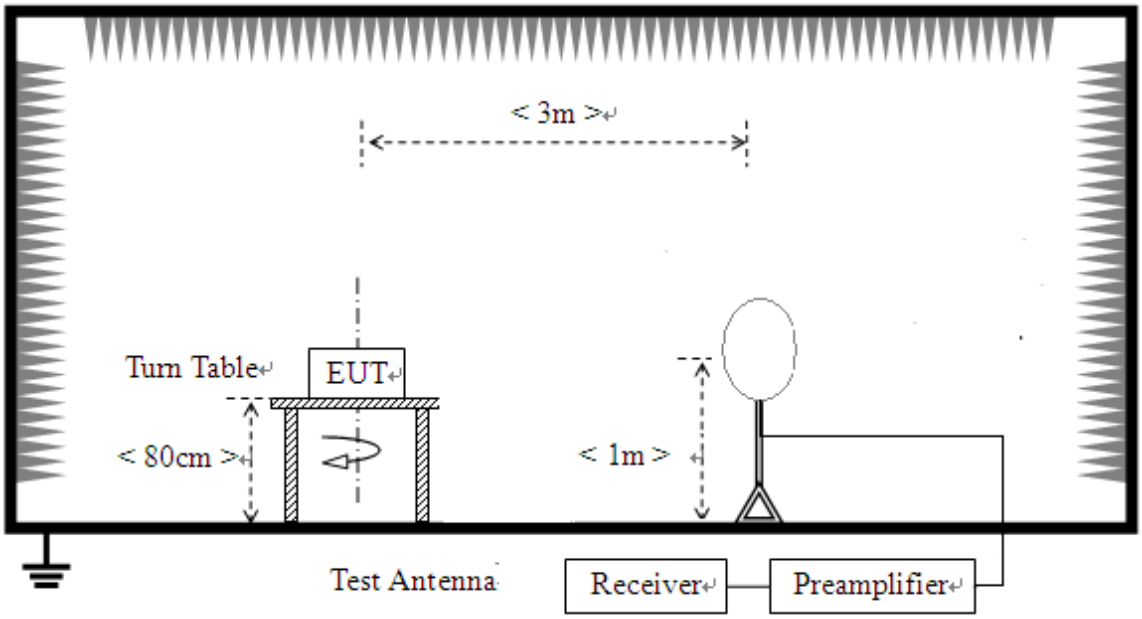
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41	/	/	/
Note: [1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz. [2]Above 38.6.			

2.9.2. Measuring Instruments

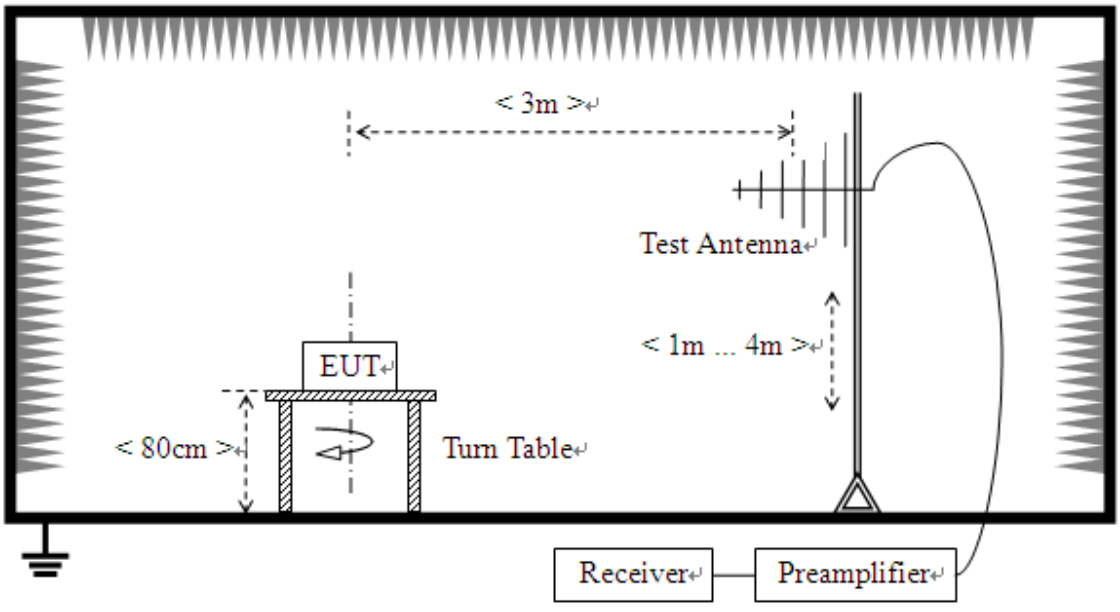
The measuring equipment is listed in the section 3 of this test report.

2.9.3. Test Setup

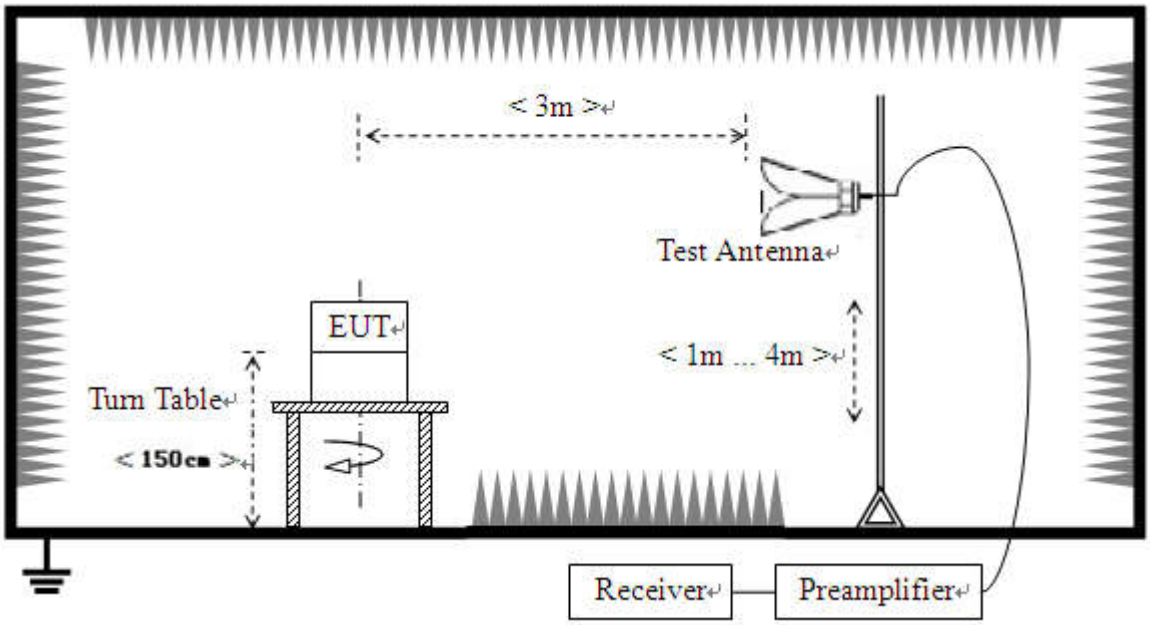
For radiated emissions from 9kHz to 30MHz



For radiated emissions from 30MHz to1GHz



For radiated emissions above 1GHz



2.9.4. Test Procedure

1. The EUT was placed on the top of a rotating table 0.8m for below 1GHz and 1.5m for above 1GHz above the ground at a 3 meters semi-anechoic chamber.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on thetop of a variable height antenna tower.
3. Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported.Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then

reported in a data sheet.

7. For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T(Duty cycle < 98%) or 10Hz(Duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
4. All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

2.9.5. Test Results of Radiated Band Edge and Spurious Emission

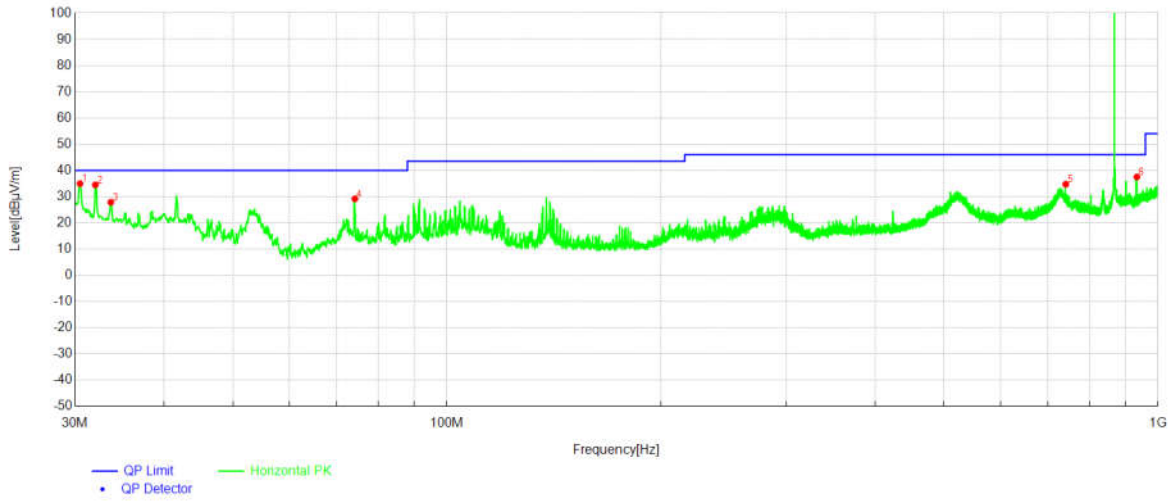
Note 1: For 9 kHz to 30MHz, The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Note 2: For 30MHz to 1GHz, All of the EUT Configure mode were tested and found 902.3MHz channel is the worst mode, the worst case is recorded in this report.

Note 3: For 1GHz to 10GHz, All of the EUT Configure mode were tested and found 902.3MHz and 927.6MHz channel is the worst mode, the worst case is recorded in this report.

Note 4: Antenna height and turntable angle are the worst positions, the worst case is recorded in this report.

For 30MHz to 1000MHz

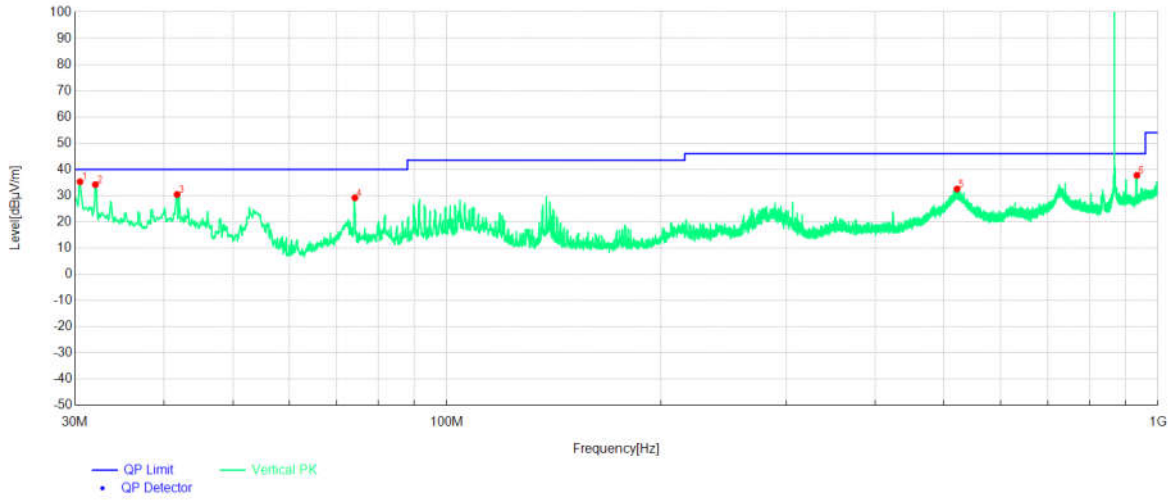


NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Height [cm]	Angle [°]	Polarity
1	30.49	34.96	19.04	40.00	5.04	110	60	Horizontal
2	32.04	34.49	18.37	40.00	5.51	110	230	Horizontal
3	33.69	27.84	17.66	40.00	12.16	110	40	Horizontal
4	74.24	29.16	8.80	40.00	10.84	110	320	Horizontal
5	741.57	34.73	22.77	46.00	11.27	110	260	Horizontal
6	933.65	37.50	25.10	46.00	8.50	110	150	Horizontal

Test Result: Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.



NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Height [cm]	Angle [°]	Polarity
1	30.49	35.29	19.04	40.00	4.71	110	270	Vertical
2	32.04	34.19	18.37	40.00	5.81	110	90	Vertical
3	41.74	30.42	14.16	40.00	9.58	110	50	Vertical
4	74.24	29.18	8.80	40.00	10.82	110	30	Vertical
5	521.45	32.50	19.88	46.00	13.50	110	30	Vertical
6	933.65	37.75	25.10	46.00	8.25	110	280	Vertical

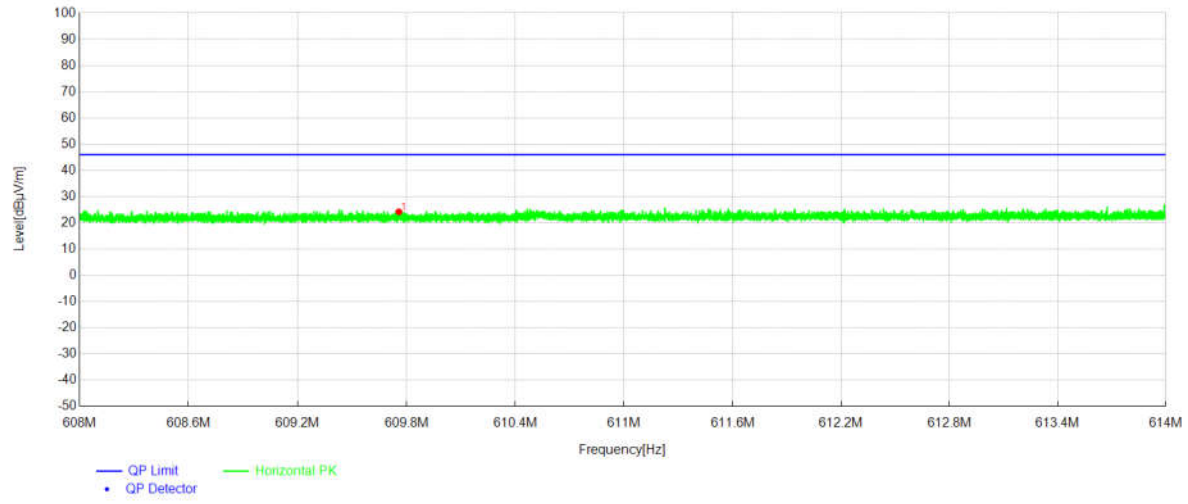
Test Result: Pass

Remark:

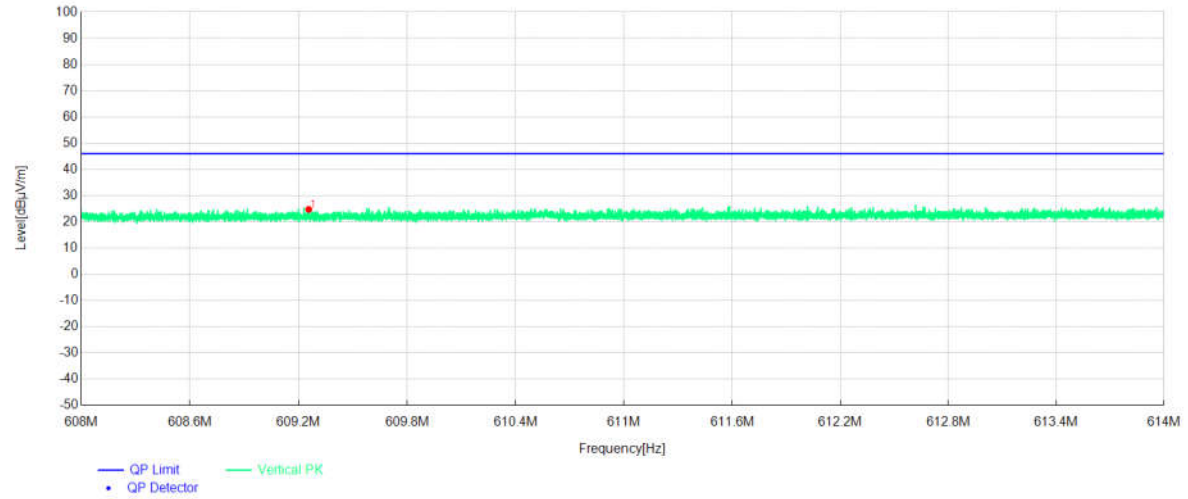
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

Restricted-band band-edge: 608MHz~614MHz

LoRa_902.3MHz: Horizontal



LoRa_902.3MHz: Vertical



NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Height [cm]	Angle [°]	Polarity
1	609.76	24.21	20.70	46.00	21.79	100	210	Horizontal
2	609.26	24.76	20.70	46.00	21.24	100	120	Vertical

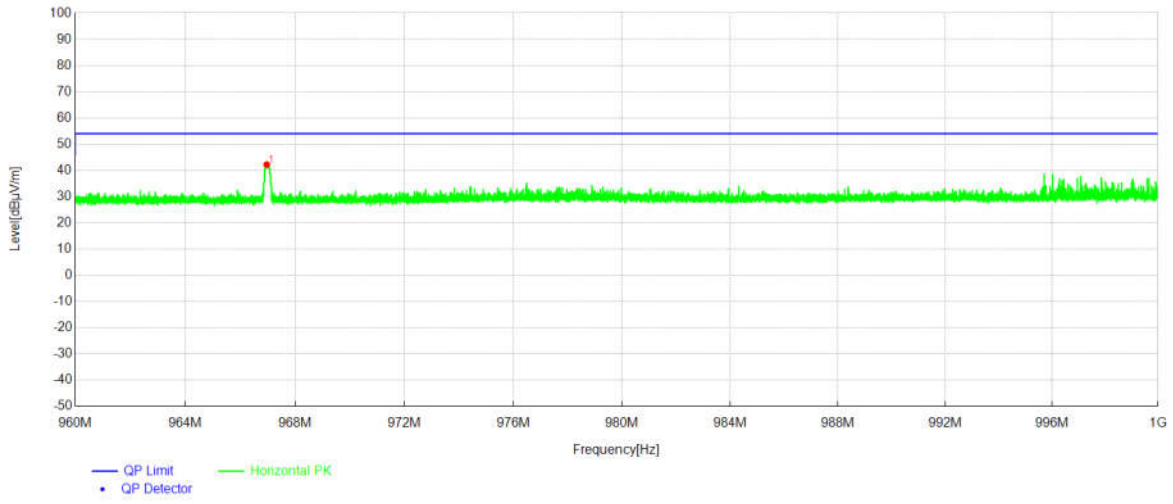
Test Result: Pass

Remark:

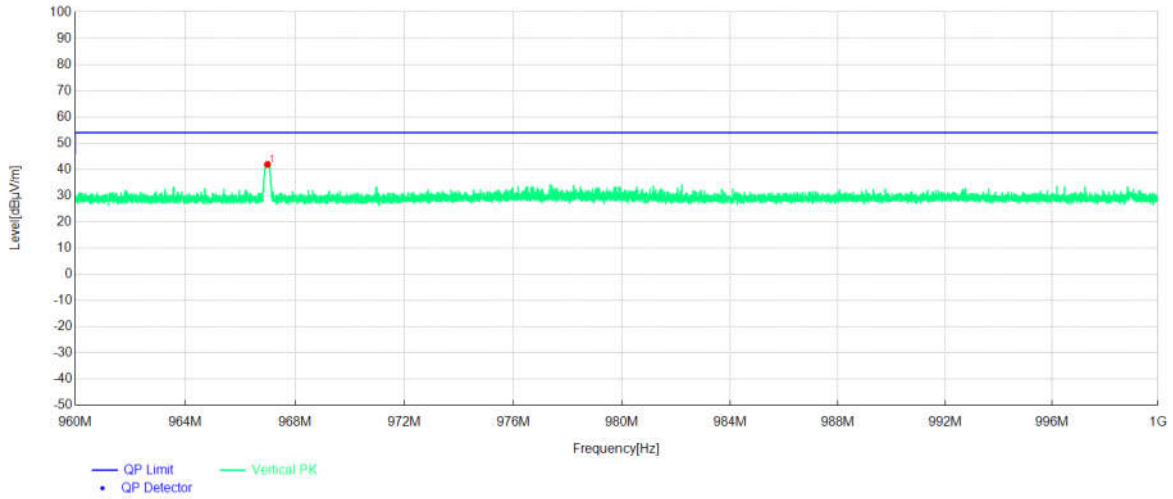
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

Restricted-band band-edge: 960MHz~1000MHz

LoRa_927.6MHz: Horizontal



LoRa_927.6MHz: Vertical



NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Height [cm]	Angle [°]	Polarity
1	966.96	42.19	25.45	54.00	11.81	100	360	Horizontal
2	966.99	41.91	25.45	54.00	12.09	100	80	Vertical

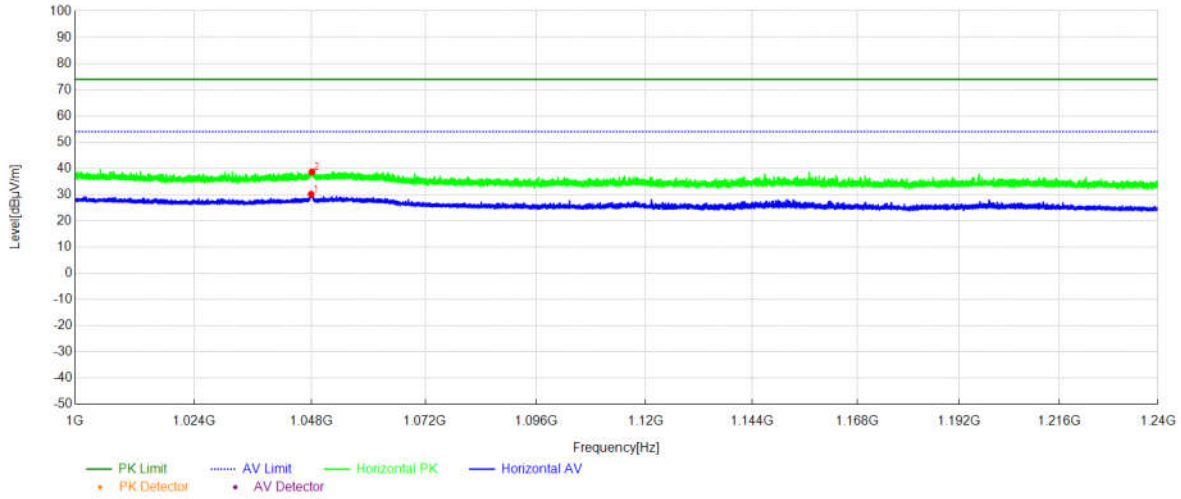
Test Result: Pass

Remark:

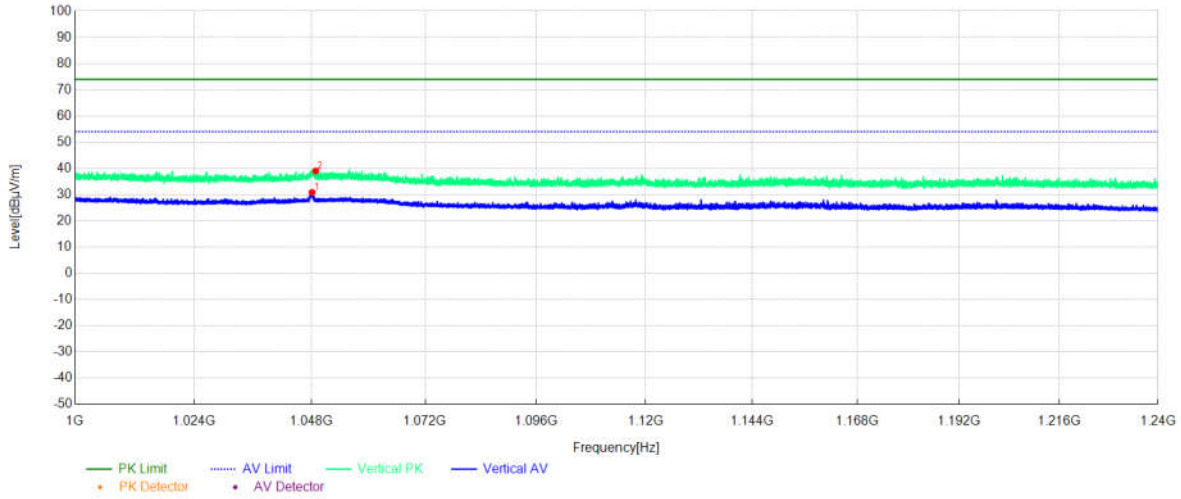
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

Restricted-band band-edge: 1000MHz~1240MHz

LoRa_927.6MHz: Horizontal



LoRa_927.6MHz: Vertical



NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1048.17	38.67	-12.66	74.00	35.33	PK	150	130	Horizontal
2	1048.00	30.18	-12.66	54.00	23.82	AV	150	270	Horizontal
3	1048.94	39.03	-12.66	74.00	34.97	PK	150	240	Vertical
4	1048.20	30.87	-12.66	54.00	23.13	AV	150	60	Vertical

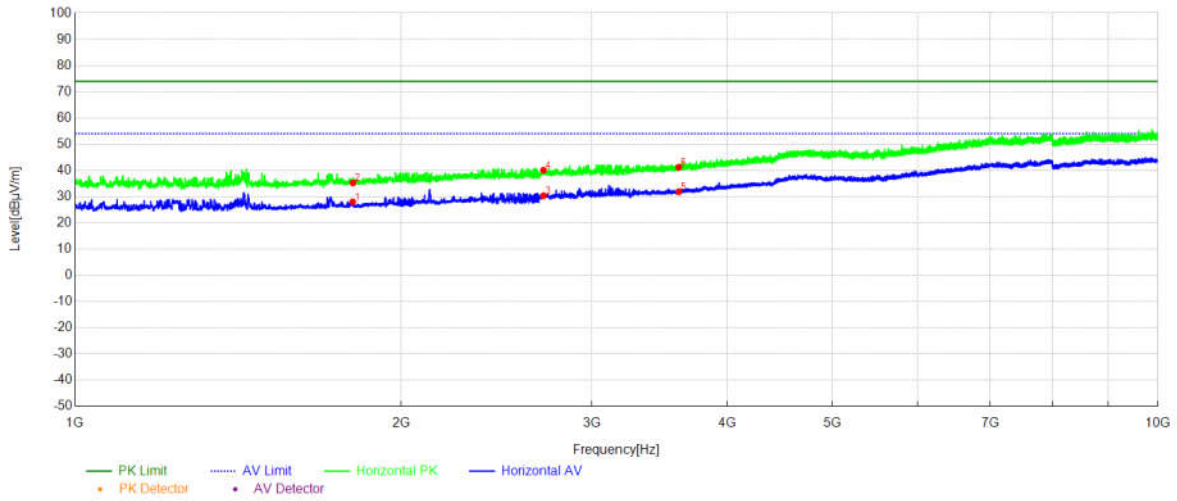
Test Result: Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

For 1GHz to 10GHz:

LoRa_902.3MHz



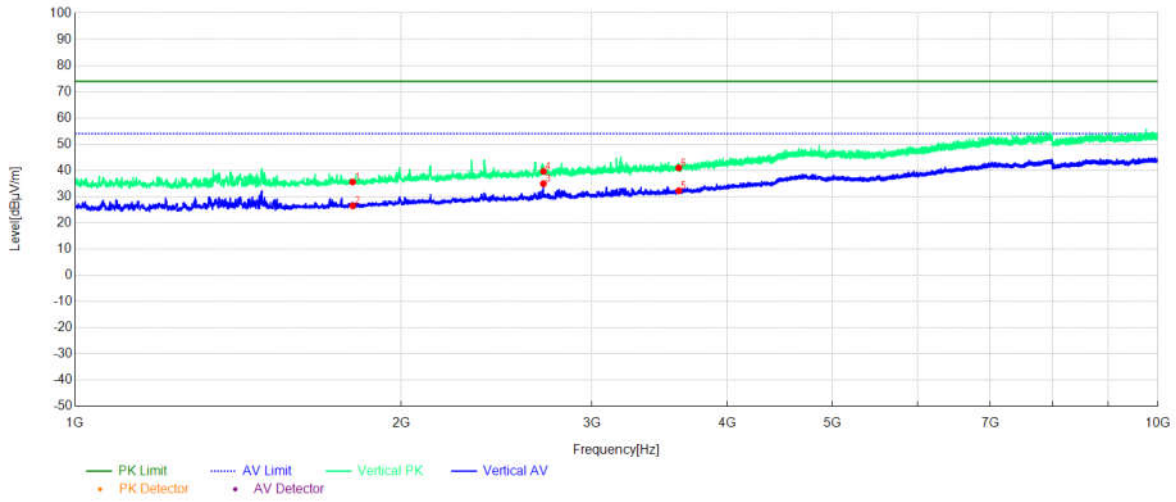
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1804.6	27.99	-11.42	54.00	26.01	AV	140	187	Horizontal
2	1805.5	35.23	-11.42	74.00	38.77	PK	140	319	Horizontal
3	2707.4	30.32	-7.98	54.00	23.68	AV	140	28	Horizontal
4	2707.4	40.09	-7.98	74.00	33.91	PK	140	329	Horizontal
5	3609.3	31.85	-5.18	54.00	22.15	AV	140	0	Horizontal
6	3609.3	41.18	-5.18	74.00	32.82	PK	140	108	Horizontal

Test Result: Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

LoRa_902.3MHz



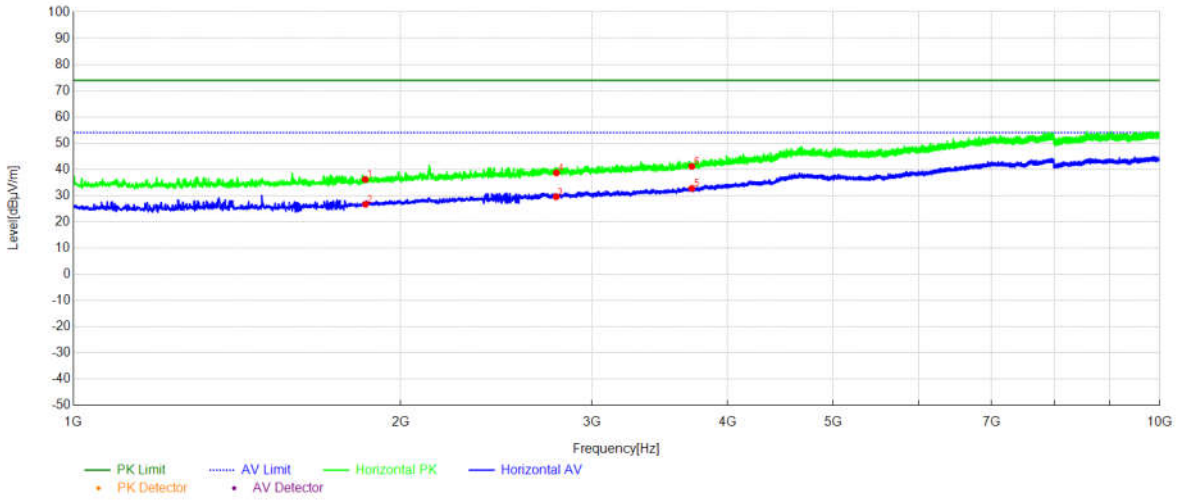
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1804.6	35.58	-11.42	74.00	38.42	PK	140	290	Vertical
2	1804.6	26.50	-11.42	54.00	27.50	AV	140	272	Vertical
3	2706.5	34.92	-7.98	54.00	19.08	AV	140	272	Vertical
4	2707.4	39.63	-7.98	74.00	34.37	PK	140	359	Vertical
5	3609.3	32.22	-5.18	54.00	21.78	AV	140	229	Vertical
6	3609.3	40.97	-5.18	74.00	33.03	PK	140	360	Vertical

Test Result: Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

LoRa_927.6MHz



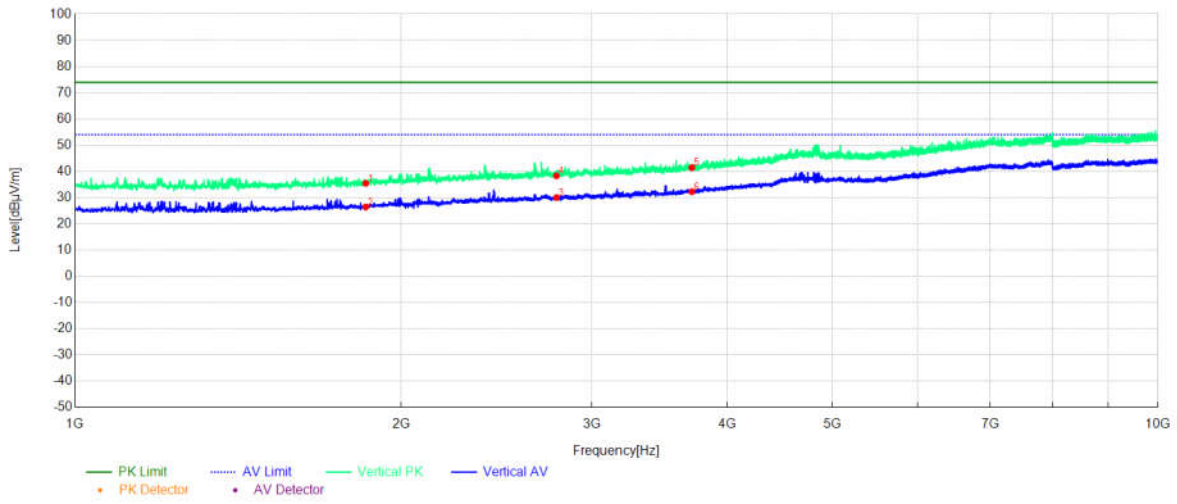
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1855.9	36.17	-11.27	74.00	37.83	PK	150	96	Horizontal
2	1856.8	26.69	-11.28	54.00	27.31	AV	150	72	Horizontal
3	2781.2	29.56	-7.82	54.00	24.44	AV	150	15	Horizontal
4	2783.0	38.68	-7.82	74.00	35.32	PK	150	200	Horizontal
5	3708.3	32.76	-4.80	54.00	21.24	AV	150	192	Horizontal
6	3708.3	41.13	-4.80	74.00	32.87	PK	150	25	Horizontal

Test Result: Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

LoRa_927.6MHz



NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1855.0	35.47	-11.27	74.00	38.53	PK	150	262	Vertical
2	1855.0	26.43	-11.27	54.00	27.57	AV	150	26	Vertical
3	2783.0	30.00	-7.82	54.00	24.00	AV	150	224	Vertical
4	2783.0	38.32	-7.82	74.00	35.68	PK	150	240	Vertical
5	3711.07	41.45	-4.80	74.00	32.55	PK	150	1	Vertical
6	3711.07	32.26	-4.80	54.00	21.74	AV	150	57	Vertical

Test Result: Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

2.10. AC Power Line Conducted Emission

2.10.1. Limit of AC Power Line Conducted Emission

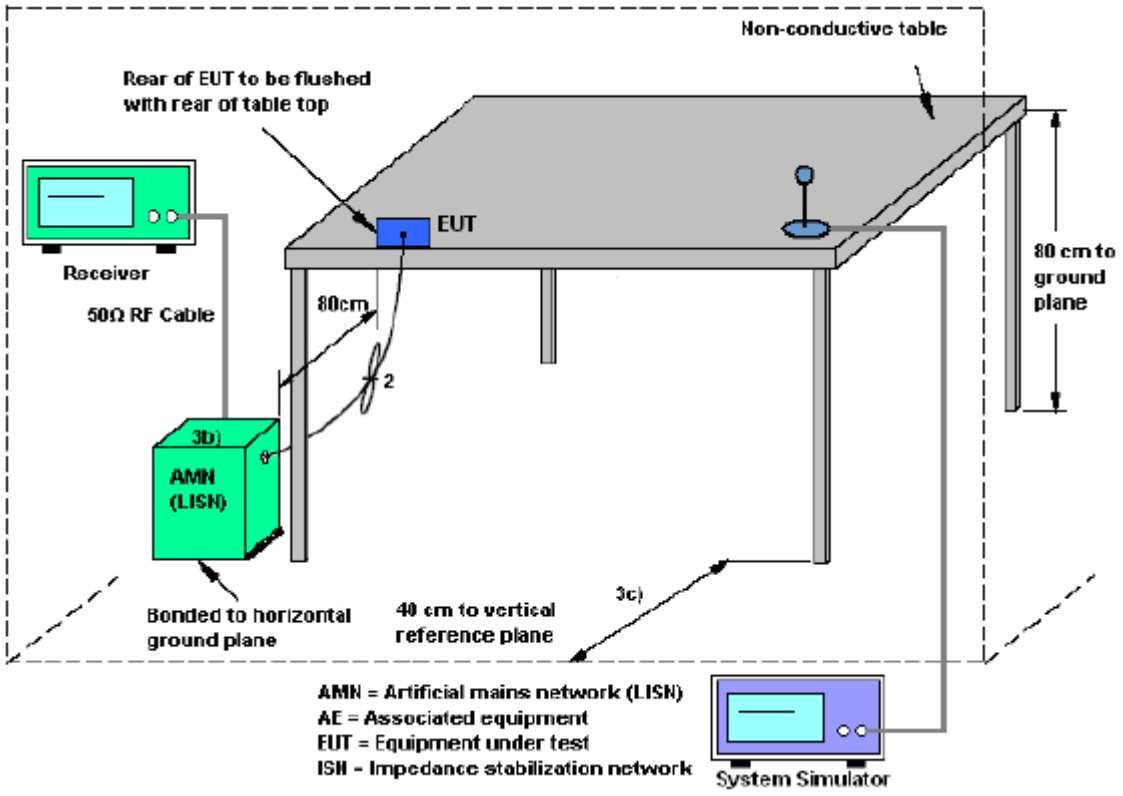
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

2.10.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.10.3. Test Setup



2.10.4. Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 micrometry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

2.10.5. Test Results of AC Power Line Conducted Emission

Note: Not applicable, EUT is battery powered equipment.

3. List of measuring equipment

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	EMI Test Receiver	ROHDE&SCHWARZ	ESW26	A180502935	2023.06.08	2024.06.07
2	5M Anechoic Chamber	Albatross	SAC-5MAC 12.8x6.8x6.4m	A0304210	2023.08.01	2026.07.31
3	Loop Antenna	Schwarz beck	HFH2-Z2	A0304220	2022.05.02	2025.05.01
4	Broadband antenna (30MHz~1GHz)	R&S	HL562	A0304224	2023.06.08	2026.06.07
5	EMI Horn Ant. (1-18G)	ETC	1209	A150402241	2021.01.02	2024.01.01
6	Horn antenna (18GHz~26.5GHz)	AR	AT4510	A0804450	2023.06.01	2026.05.31
7	Amplifier 30M~1GHz	MILMEGA	80RF1000-10004	A140101634	2022.12.13	2023.12.12
8	Amplifier 1G~18GHz	MILMEGA	AS0104R-800/400	A160302517	2022.12.13	2023.12.12
9	Spectrum Analyzer	KEYSIGHT	N9030A	A160702554	2023.02.20	2024.02.19
10	Test Receiver	KEYSIGHT	N9038A	A141202036	2023.06.12	2024.06.11
11	LISN	ROHDE&SCHWARZ	ENV216	A140701847	2023.08.21	2024.08.20
12	Cable	MATCHING PAD	W7	/	2023.08.21	2024.08.20

4. Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence . The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of AC Power Line Conducted Emission Measurement (150kHz~30MHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	2.8dB

Uncertainty of Radiated Emission Measurement (9kHz~30MHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	3.5dB

Uncertainty of Radiated Emission Measurement (30MHz~1GHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	3.91dB

Uncertainty of Radiated Emission Measurement (1GHz~18GHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	4.5dB

Uncertainty of Radiated Emission Measurement (18GHz~40GHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	4.9dB

Uncertainty of RF Conducted Measurement (9kHz~40GHz)

Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y))	1.3dB

END OF REPORT