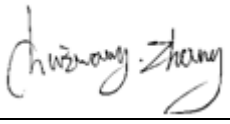
RF TEST REPORT

Report No.:	SET2023-01073
Product Name:	LoRaWAN Sensor Terminal
Model No.:	FST200-00HA, FST200-00HC
FCC ID:	2A8OE-FST200
Applicant:	Xiamen Four-Faith Communication Technology Co., Ltd.
Address:	11th Floor, A-06 Area, No.370, Chengyi Street, Jimei, Xiamen, Fujian, China.
Dates of Testing:	01/10/2023 - 02/16/2023
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 .....:	LoRaWAN Sensor Terminal
Trade Name .....:	Four-Faith
Applicant.....:	Xiamen Four-Faith Communication Technology Co., Ltd.
Applicant Address .....:	11th Floor, A-06 Area, No.370, Chengyi Street, Jimei, Xiamen, Fujian, China.
Manufacturer .....:	Xiamen Four-Faith Communication Technology Co., Ltd.
Manufacturer Address .....:	11th Floor, A-06 Area, No.370, Chengyi Street, Jimei, Xiamen, Fujian, China.
Test Standards.....:	47 CFR Part 15 Subpart C ANSI C63.10-2013
Test Result .....:	Pass

Tested by .....:		2023.02.17
	Chuiwang Zhang, Test Engineer	
Reviewed by .....:		2023.02.17
	Chris You, Senior Engineer	
Approved by .....:		2023.02.17
	Tao Hou, Manager	

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Change History		
Issue	Date	Reason for change
1.0	2023.02.17	First edition

1. General Information

1.1. EUT Description

Product Name	LoRaWAN Sensor Terminal
Model No.	FST200-00HA, FST200-00HC
Frequency Range	LoRa: 902MHz~928MHz
Channel Number	126
Data Rate	SF12, SF11, SF10, SF9, SF8, SF7, SF6, SF5
Modulation Type	LoRa
Antenna Type	Internal Antenna
Antenna Gain	1.03dBi
Power supply	FST200-00HA: Disposable Lithium Battery 3.6V/19000mAh FST200-00HC: DC 5~36V, Default 12V/0.5A(Adapter power supply)

Note 1: The difference between FST200-00HA and FST200-00HC is that the FST200-00HA powers the battery and the FST200-00HC powers the adapter.

Note 2: Both the FST200-00HA and FST200-00HC were tested, FST200-00HC was found to have the worst test results, only the worst cases are recorded in this report.

Note 3: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.2. Test Standards and Results

The objective of the report is to perform testing according to below standards for the EUT FCC ID Certification:

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

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(c)	Antenna Requirement	PASS
2	15.247(b)(3)	Peak Conducted Output Power	PASS
3	15.247(a)(2)	6dB and 99% Bandwidth	PASS
4	15.247(d)	Conducted Band Edges and Spurious Emission	PASS
5	15.247(e)	Power spectral density (PSD)	PASS
6	15.207	AC Power Line Conducted Emission	PASS
7	15.209 15.205 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.

1.3. Channel List

Operating frequency (Unit: MHz)					
902.5	906.7	910.9	**915.1**	919.3	923.5
902.7	906.9	911.1	915.3	919.5	923.7
902.9	907.1	911.3	915.5	919.7	923.9
903.1	907.3	911.5	915.7	919.9	924.1
903.3	907.5	911.7	915.9	920.1	924.3
903.5	907.7	911.9	916.1	920.3	924.5
903.7	907.9	912.1	916.3	920.5	924.7
903.9	908.1	912.3	916.5	920.7	924.9
904.1	908.3	912.5	916.7	920.9	925.1
904.3	908.5	912.7	916.9	921.1	925.3
904.5	908.7	912.9	917.1	921.3	925.5
904.7	908.9	913.1	917.3	921.5	925.7
904.9	909.1	913.3	917.5	921.7	925.9
905.1	909.3	913.5	917.7	921.9	926.1
905.3	909.5	913.7	917.9	922.1	926.3
905.5	909.7	913.9	918.1	922.3	926.5
905.7	909.9	914.1	918.3	922.5	926.7
905.9	910.1	914.3	918.5	922.7	926.9
906.1	910.3	914.5	918.7	922.9	927.1
906.3	910.5	914.7	918.9	923.1	927.3
906.5	910.7	914.9	919.1	923.3	**927.5**

Note 1: F(MHz) = 902.5 + 0.2*n (0 ≤ n ≤ 125).

Note 2: Frequency 902.5MHz, 915.1MHz and 927.5MHz selected for LoRa 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:	
Continuously transmitting mode	Keep the EUT in continuous transmitting with modulation

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Modulation Type	Data Rate	Channel
Peak Conducted Output Power Power Spectral Density 6dB and 99% Bandwidth Conducted and Spurious Emission Radiated and Spurious Emission	LoRa	SF12	L, M, H
Conducted Band Edge	LoRa	SF12	L, H

Table for Supporting Units

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

1.5. EUT Operation Test Setup

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

1.6. 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 April 19th, 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 Jun. 30th, 2023.

A2LA Code: 5721.01

CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025. The accreditation certificate number is 5721.01.

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2. Test Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

According to FCC 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.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

2.1.2. Antenna Information

Antenna Category: Internal Antenna

A internal Antenna was soldered to the antenna port of EUT via an adaptor cable, can't be removed.

Antenna General Information:

No.	EUT	Operating frequency range	Ant. Type	Ant. Gain
1	LoRaWAN Sensor Terminal	902-928MHz	Internal	1.03dBi

2.1.3. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

2.2. Maximum Conducted Output Power

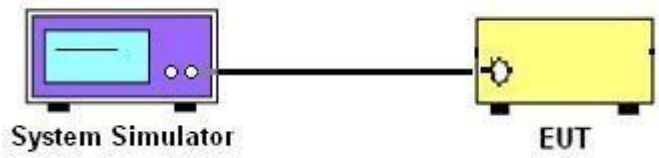
2.2.1. Limit of Peak Output Power

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

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 Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 11.9.1.1.
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:
   RBW ≥ DTS bandwidth / VBW ≥ 3*RBW / Sweep time: Auto couple / Detector mode: Peak / Trace mode: Max hold / Allow trace to fully stabilize / Use peak marker function to determine the peak amplitude level.
5. Record the measurement results in the test report.

2.2.5. Test Result of Peak Output Power

Test Frequency	Conducted Power(dBm)	Limit(dBm)	Result
902.5	14.454	30	Pass
915.1	14.476		Pass
927.5	14.110		Pass

Output Power: 902.5MHz	Output Power: 915.1MHz
	
Output Power: 927.5MHz	
	

2.3. 6dB and 99% Bandwidth

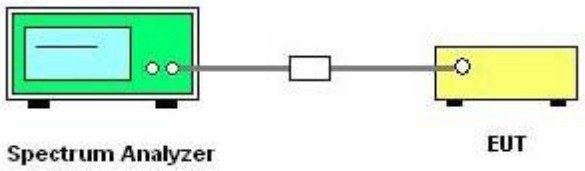
2.3.1. Limit of 6dB and 99% Bandwidth

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

2.3.2. Measuring Instruments

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

2.3.3. Test Setup



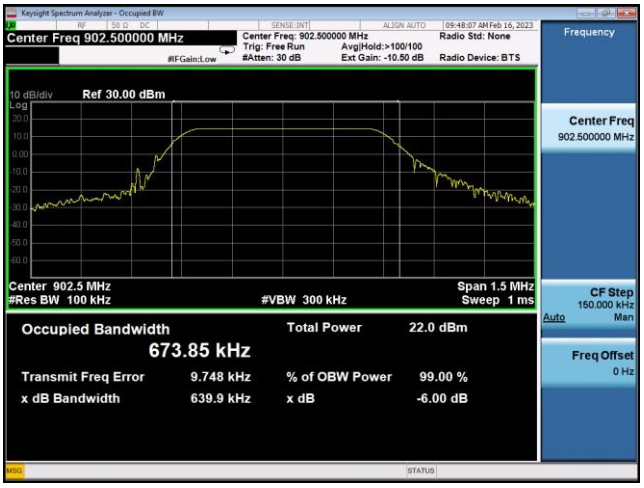
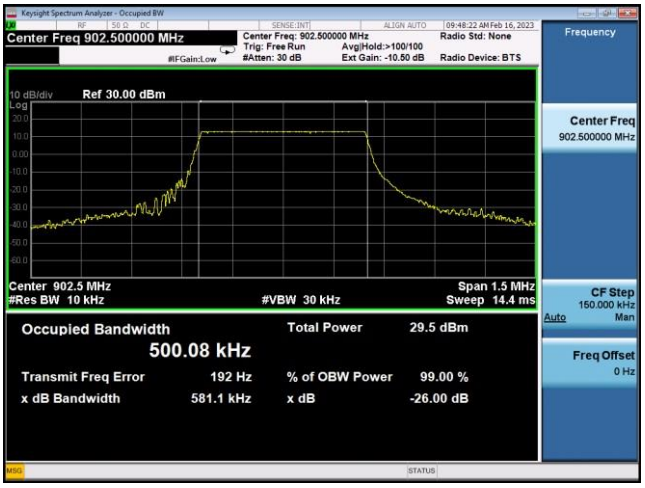
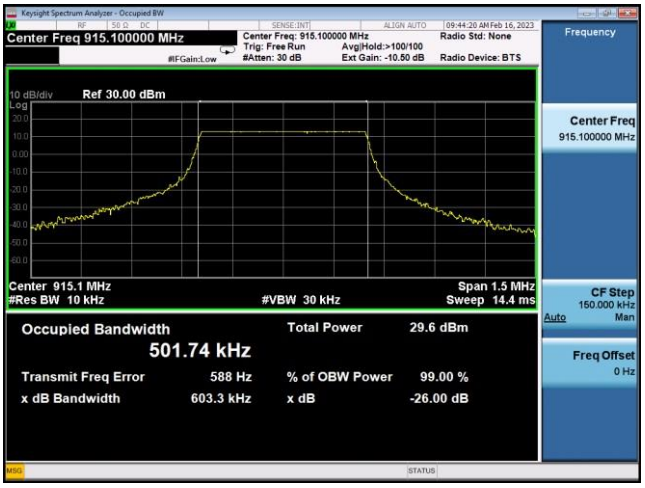
2.3.4. Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 11.8.
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 spectrum analyzer “Channel Bandwidth” function to easurement the 6dB EBW and 99% OBW.
5. For 6dB EBW Use the following spectrum analyzer settings:
   RBW: 100kHz / VBW: 300kHz / Detector: Peak / Trace mode: Max hold / Sweep time: Auto couple / Allow trace to fully stabilize.
6. For 99% OBW Use the following spectrum analyzer settings:
   Set RBW = approximately 1% EBW or 1.5 times to 5.0 times the OBW, VBW ≥ 3 × RBW.
7. Record the measurement results in the test report.

2.3.5. Test Results of 6dB and 99% Bandwidth

Test Frequency	6dB EBW(kHz)	Limit(kHz)	Result
902.5	639.9	≥ 500	Pass
915.1	643.3		Pass
927.5	639.3		Pass

Test Frequency	99% OBW(MHz)	Limit(kHz)	Result
902.5	500.08	N/A	Pass
915.1	501.74		Pass
927.5	499.76		Pass

6dB Bandwidth: 902.5MHz	99% Bandwidth: 902.5MHz
	
6dB Bandwidth: 915.1MHz	99% Bandwidth: 915.1MHz
	
6dB Bandwidth: 927.5MHz	99% Bandwidth: 927.5MHz
	

2.4. Power spectral density (PSD)

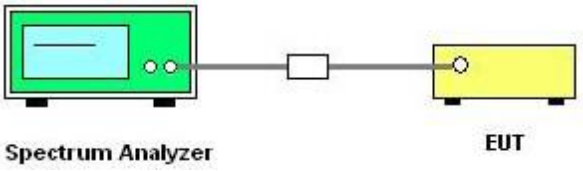
2.4.1. Limit of Power Spectral Density

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

2.4.2. Measuring Instruments

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

2.4.3. Test Setup



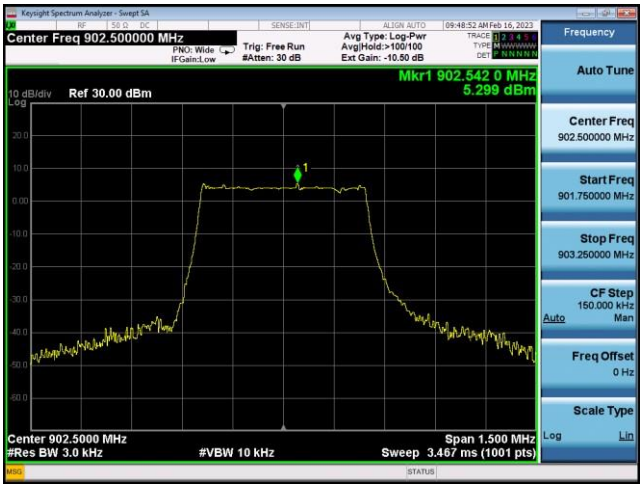
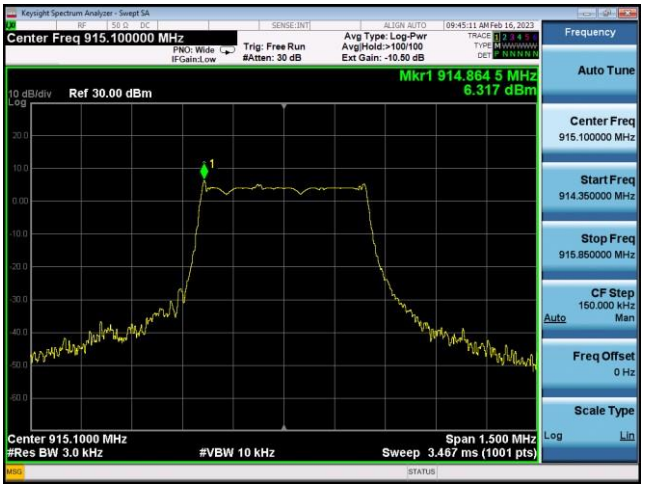
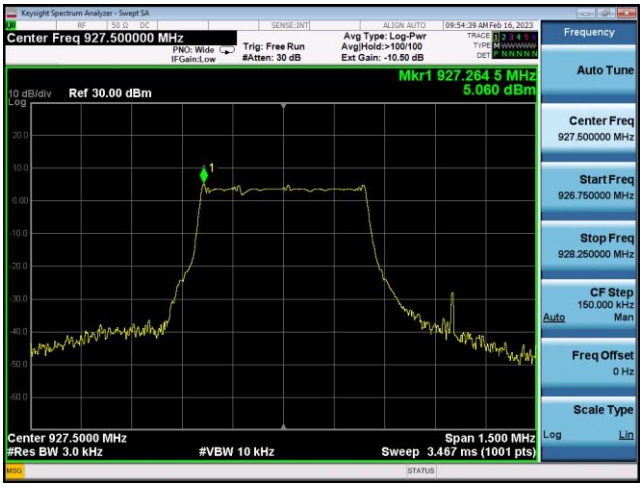
2.4.4. Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 11.10.2.
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 following spectrum analyzer settings:

   Set instrument center frequency to DTS channel center frequency / Set the span to 1.5 times the DTS bandwidth / RBW: 3kHz / VBW: 10kHz / 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. Record the measurement results in the test report.

2.4.5. Test Results of Power spectral density

Test Frequency	PSD(dBm/3kHz)	Limit(dBm/3kHz)	Result
902.5	5.299	8	Pass
915.1	6.317		Pass
927.5	5.060		Pass

Power spectral density: 902.5MHz	Power spectral density: 915.1MHz
	
Power spectral density: 927.5MHz	
	

2.5. Conducted Band Edges and Spurious Emissions

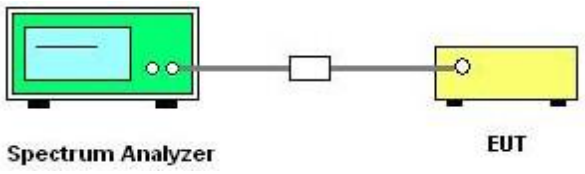
2.5.1. Limit of Conducted Band Edges and Spurious Emissions

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.

2.5.2. Measuring Instruments

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

2.5.3. Test Setup



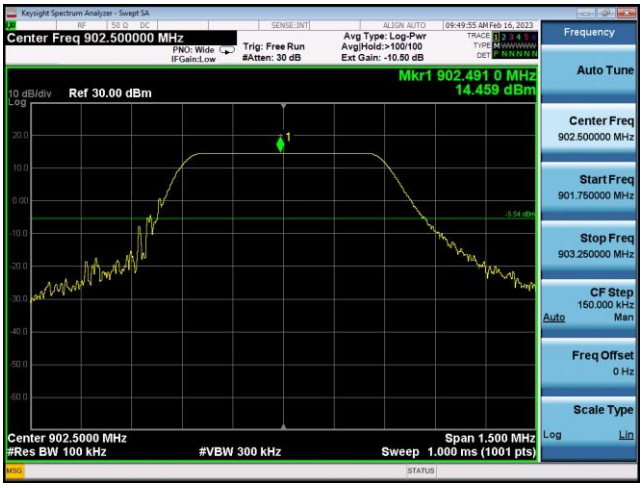
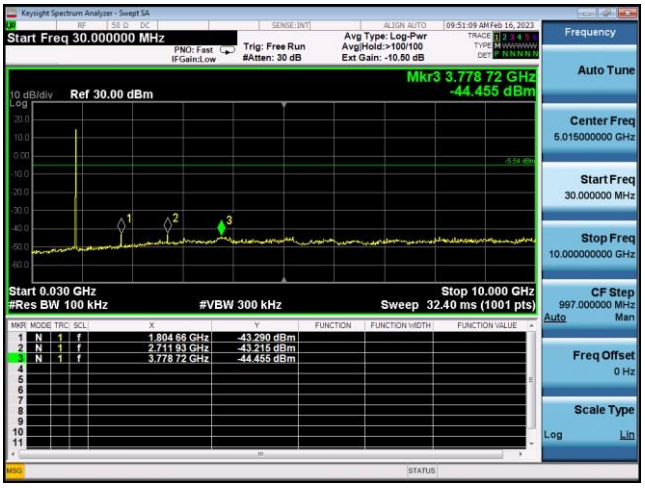
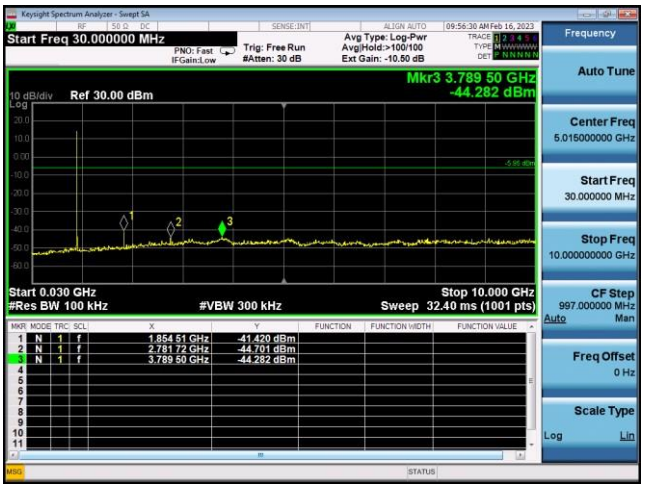
2.5.4. Test Procedure

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 11.11 and 11.13.
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:

   Reference level measurement: Set spectrum analyzer center frequency to DTS channel center frequency / Set the span to ≥1.5 times the DTS bandwidth / 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 PSD level and attenuate it by 20dB.

   Emission level measurement: Set the center frequency and span to encompass frequency range to be measured / 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.

2.5.5. Test Results of Conducted Band Edges and Spurious Emissions

Referecy Level: 902.5MHz	Conducted Spurious Emission: 902.5MHz
	
Referecy Level: 915.1MHz	Conducted Spurious Emission: 915.1MHz
	
Referecy Level: 927.5MHz	Conducted Spurious Emission: 927.5MHz
	

Conducted Band Edge: 902.5MHz	Conducted Band Edge: 927.5MHz
	

2.6. Radiated Band Edge and Spurious Emission

2.6.1. 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):

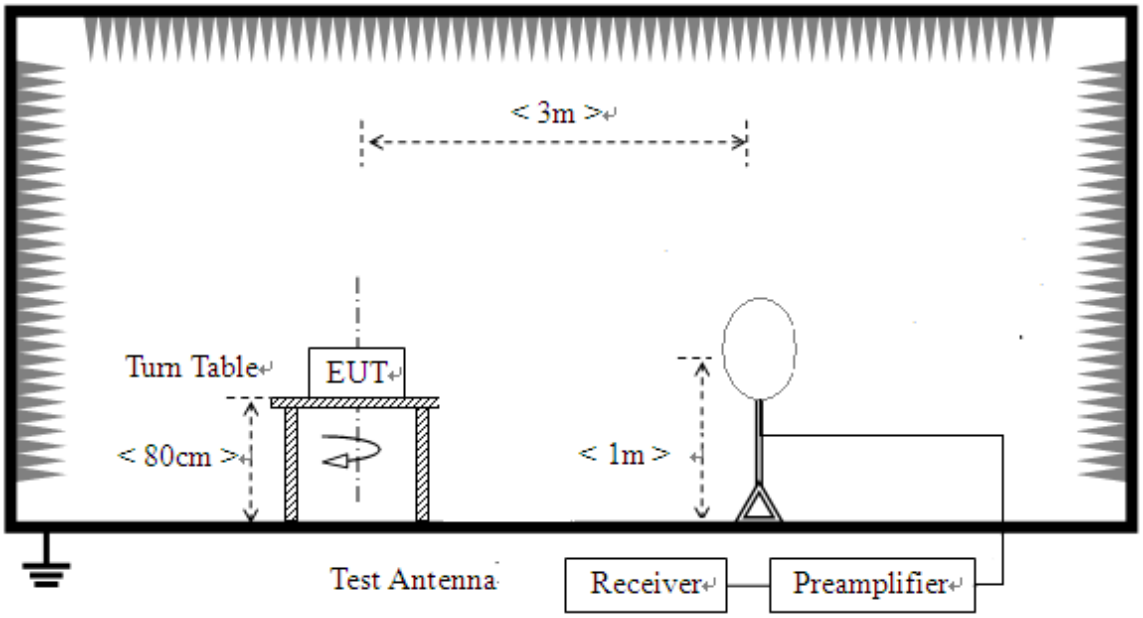
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	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.			

2.6.2. Measuring Instruments

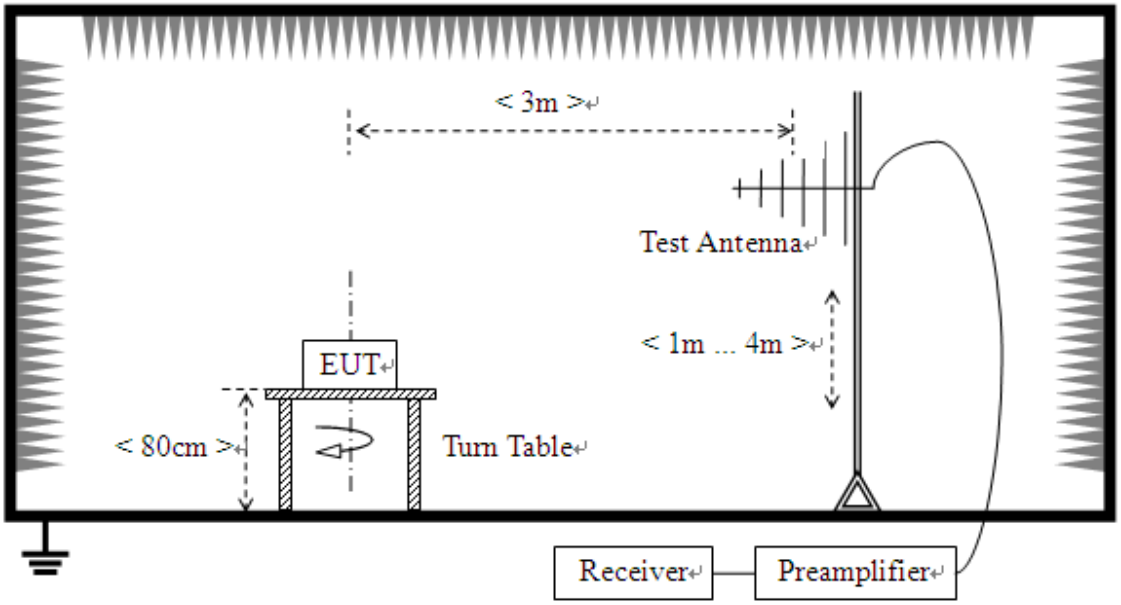
The measuring equipment is listed in the section 3 of this test report.

2.6.3. Test Setup

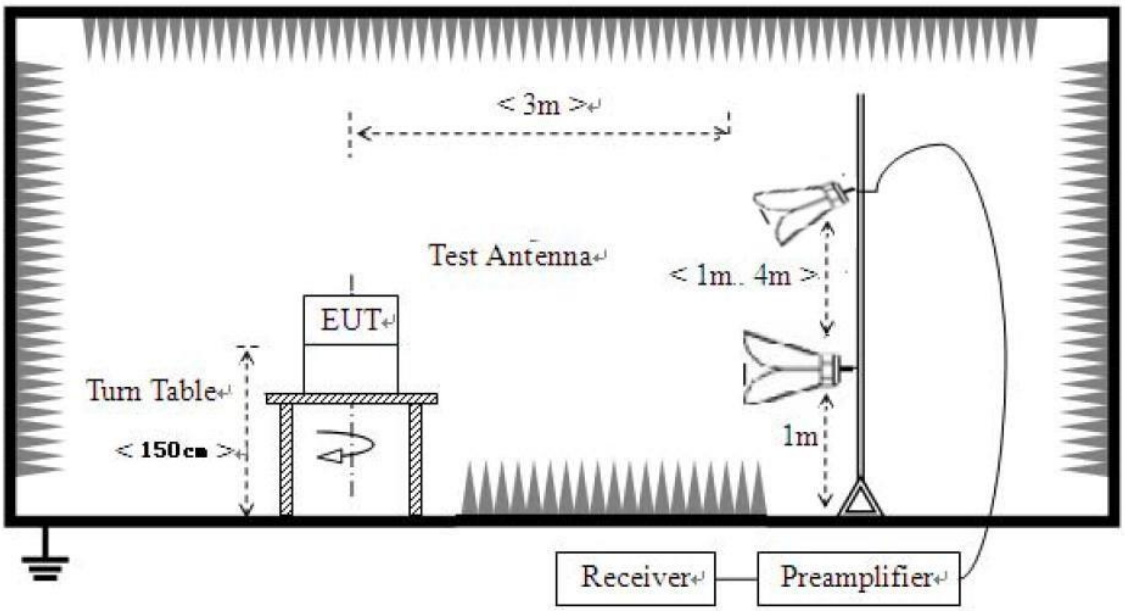
For radiated emissions from 9 kHz to 30 MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



2.6.4. Test Procedures

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.

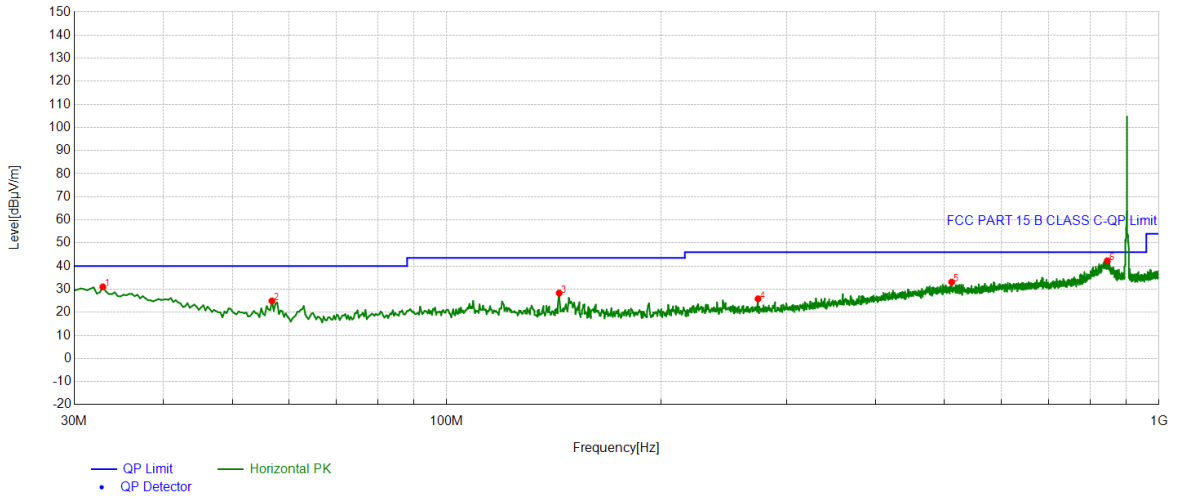
2.6.5. Test Results of Radiated Band Edge and Spurious Emission

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 915.1MHz channel is the worst mode, the worst case is recorded in this report.

NOTE 3: Antenna height and turntable angle are the worst positions, the worst case is recorded in this report.

For 30MHz to 1000MHz

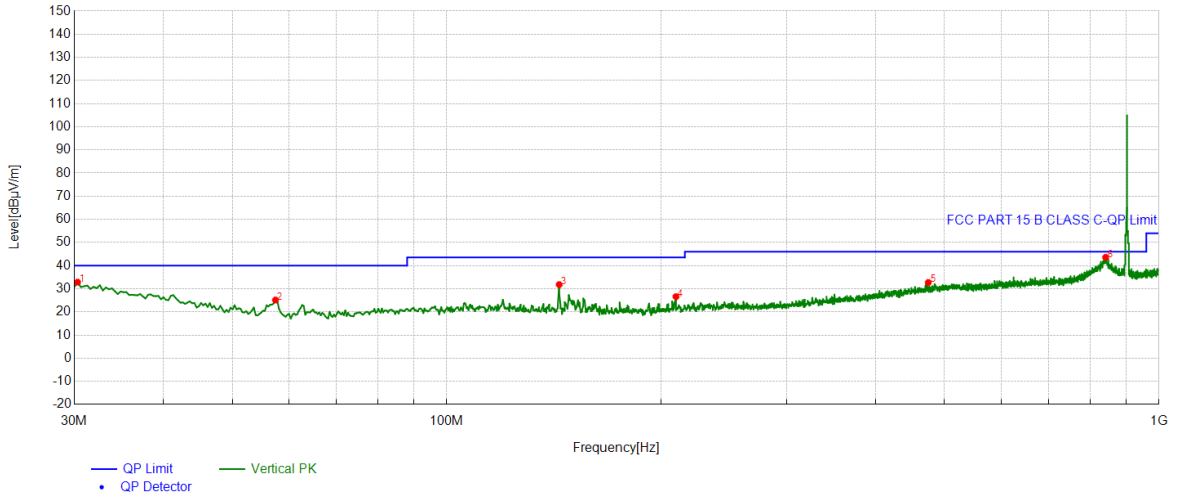


NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Height [cm]	Angle [°]	Polarity
1	32.91	30.98	18.00	40.00	9.02	PK	100	Horizontal
2	56.85	24.91	7.47	40.00	15.09	PK	100	Horizontal
3	143.85	28.32	10.16	43.50	15.18	PK	100	Horizontal
4	273.55	25.84	12.23	46.00	20.16	PK	100	Horizontal
5	511.60	33.09	19.85	46.00	12.91	PK	100	Horizontal
6	846.37	42.33	24.16	46.00	3.67	PK	100	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	30.32	32.86	19.11	40.00	7.14	PK	100	Vertical
2	57.49	25.13	7.19	40.00	14.87	PK	100	Vertical
3	143.85	31.81	10.16	43.50	11.69	PK	100	Vertical
4	209.83	26.59	10.91	43.50	16.91	PK	100	Vertical
5	474.41	32.71	18.90	46.00	13.29	PK	100	Vertical
6	841.51	43.59	24.10	46.00	2.41	PK	100	Vertical

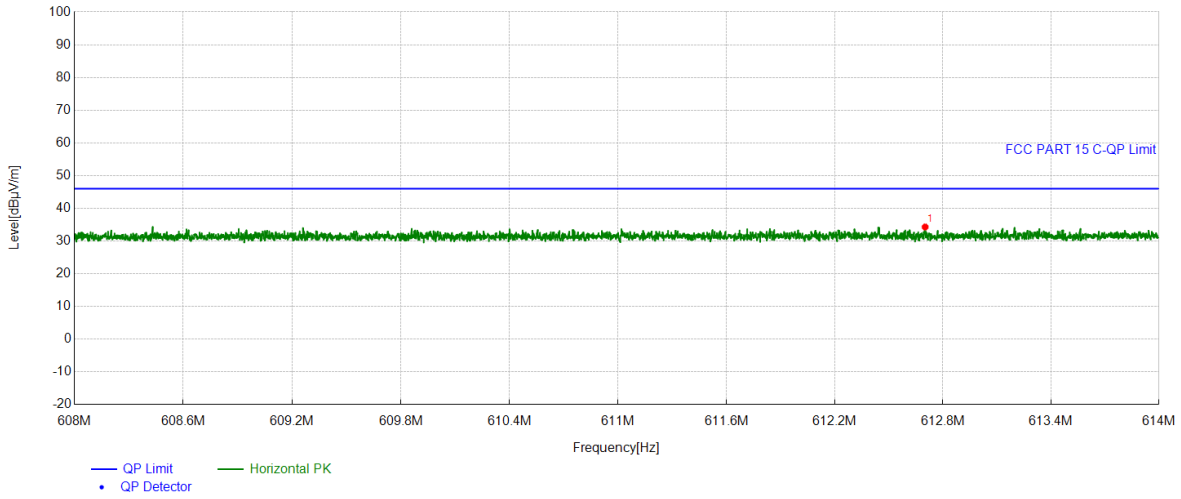
Test Result : Pass

Remark:

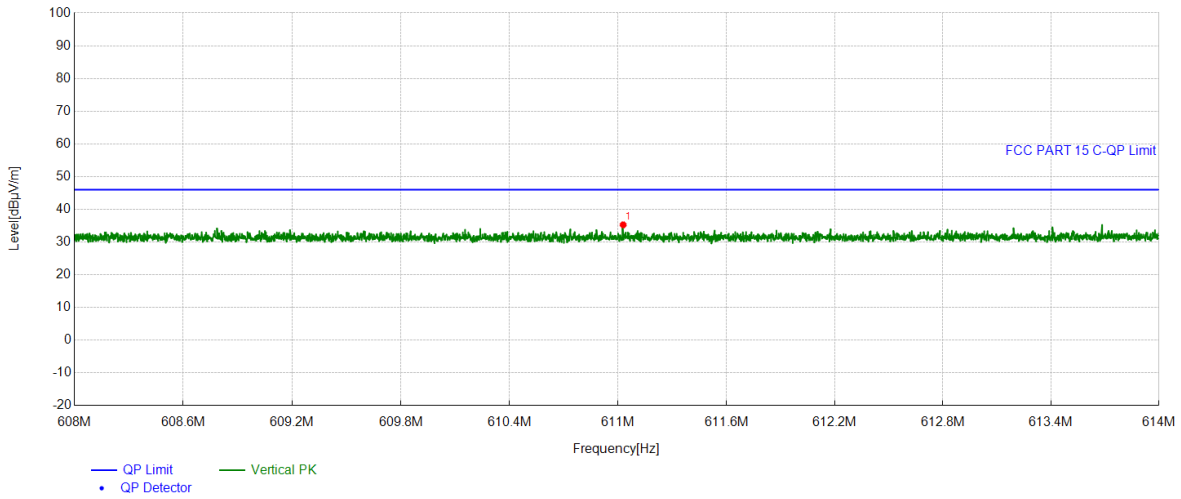
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value – Emission Level.
4. The other emission levels were very low against the limit.

Restricted-band band-edge

902.5MHz: Horizontal



902.5MHz: Vertical



NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Height [cm]	Angle [°]	Polarity
1	612.70	34.30	20.79	46.00	11.70	100	210	Horizontal
2	611.03	35.26	20.73	46.00	10.74	100	150	Vertical

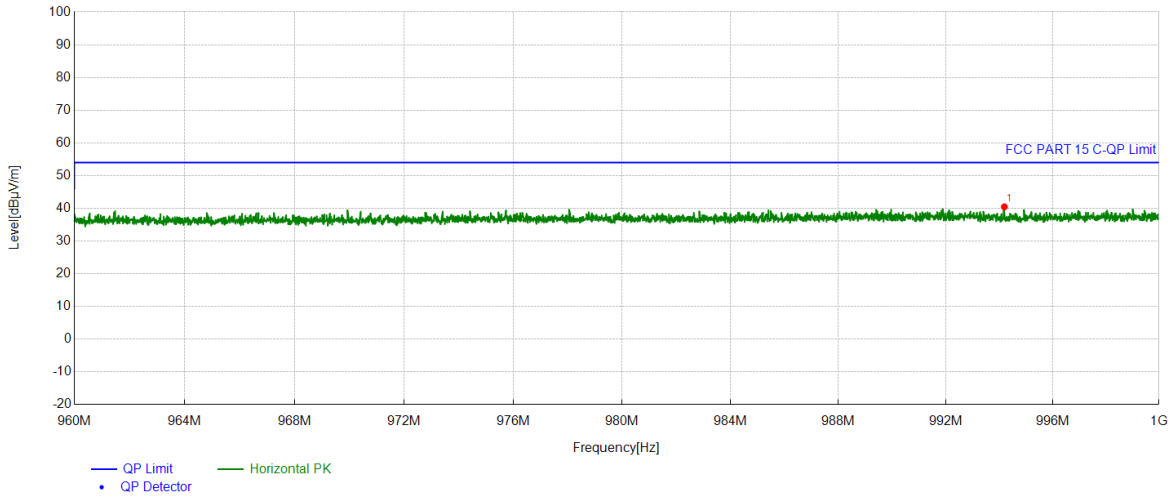
Test Result : Pass

Remark:

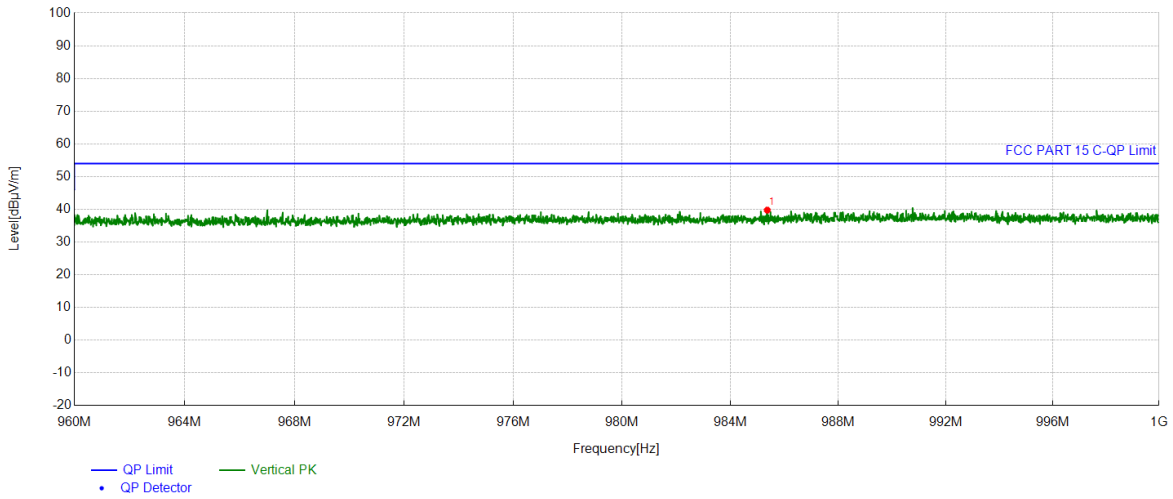
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value – Emission Level.
4. The other emission levels were very low against the limit.

Restricted-band band-edge

927.5MHz: Horizontal



927.5MHz: Vertical



NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Height [cm]	Angle [°]	Polarity
1	994.20	40.45	25.77	54.00	13.55	100	280	Horizontal
2	985.37	39.75	25.77	54.00	14.25	100	330	Vertical

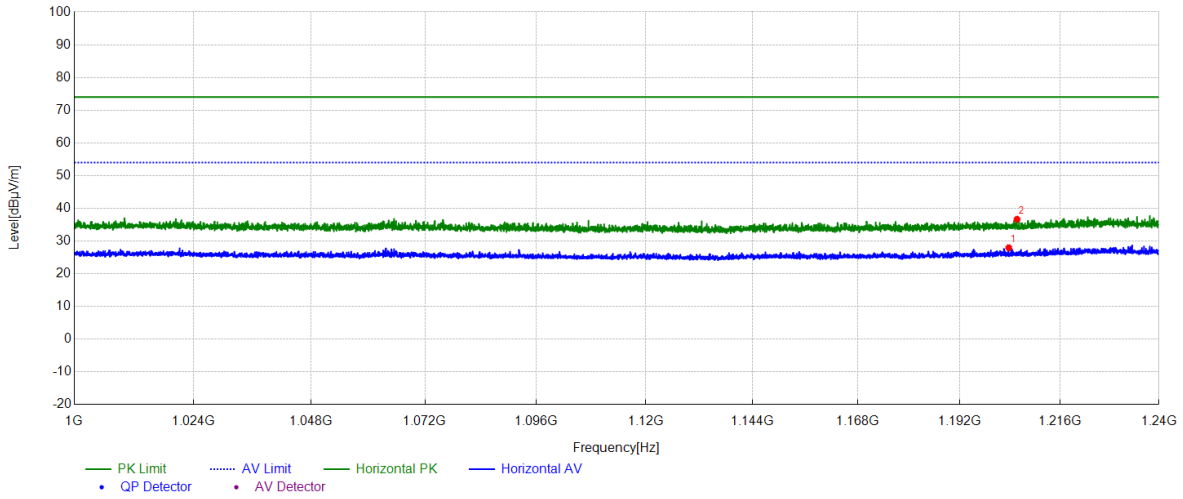
Test Result : Pass

Remark:

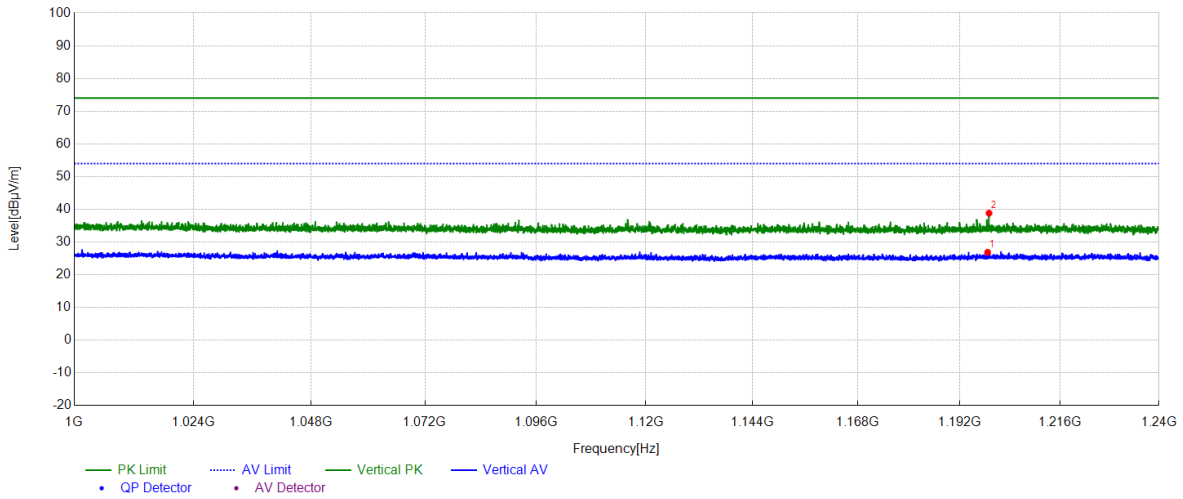
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value – Emission Level.
4. The other emission levels were very low against the limit.

Restricted-band band-edge

927.5MHz: Horizontal



927.5MHz: Vertical



Suspected List									
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1203.61	27.96	-13.16	54.00	26.04	AV	150	340	Horizontal
2	1205.58	36.67	-13.16	74.00	37.33	PK	150	320	Horizontal
3	1198.57	26.86	-13.16	54.00	27.14	AV	150	70	Vertical
4	1198.90	38.83	-13.16	74.00	35.17	PK	150	40	Vertical

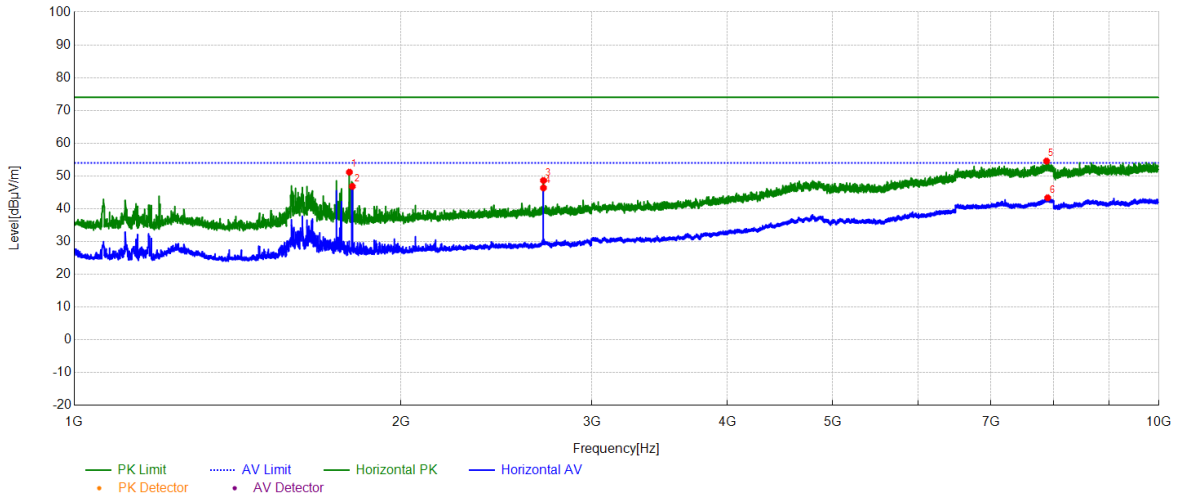
Test Result : Pass

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_902.5MHz



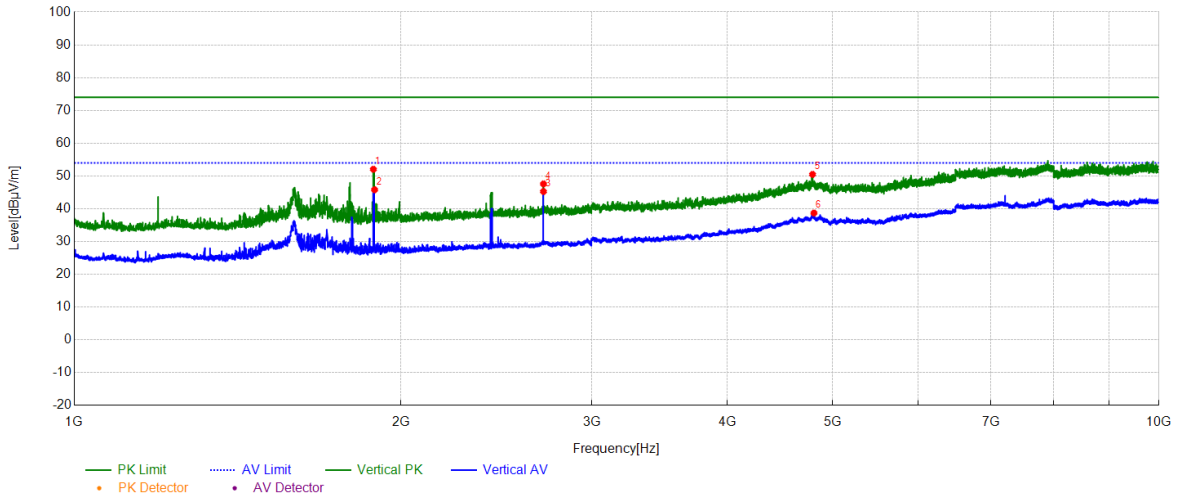
Suspected List									
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1793.3	51.16	-11.47	74.00	22.84	PK	150	294	Horizontal
2	1804.5	46.82	-11.42	54.00	7.18	AV	150	198	Horizontal
3	2707.5	48.63	-7.98	74.00	25.37	PK	150	216	Horizontal
4	2707.5	46.37	-7.98	54.00	7.63	AV	150	213	Horizontal
5	7877.1	54.54	7.31	74.00	19.46	PK	150	251	Horizontal
6	7896.0	43.34	7.46	54.00	10.66	AV	150	206	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_902.5MHz



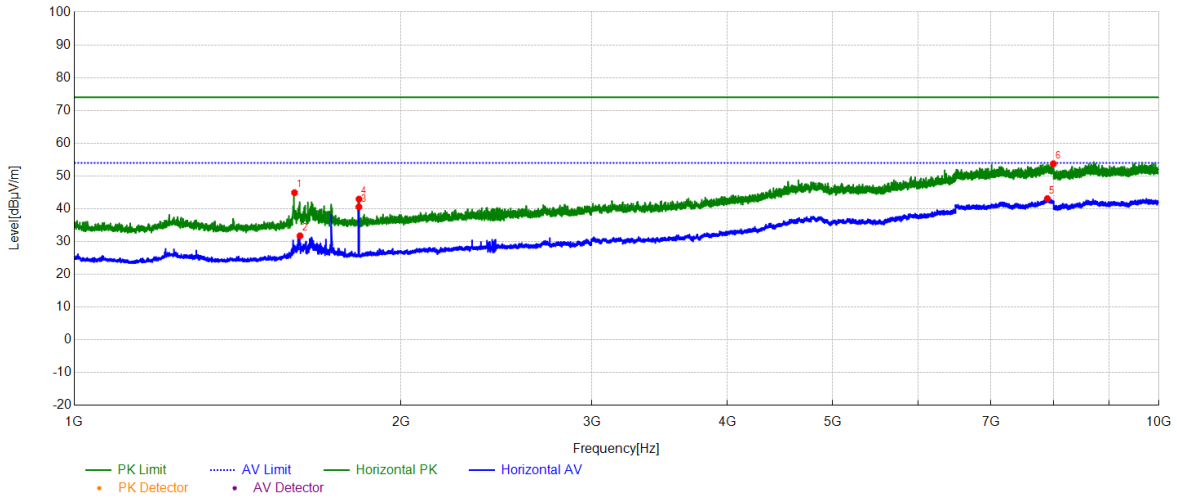
Suspected List									
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1886.9	52.04	-11.18	74.00	21.96	PK	150	5	Vertical
2	1891.7	45.80	-11.16	54.00	8.20	AV	150	69	Vertical
3	2707.5	45.26	-7.98	54.00	8.74	AV	150	162	Vertical
4	2707.5	47.58	-7.98	74.00	26.42	PK	150	155	Vertical
5	4793.0	50.48	1.22	74.00	23.52	PK	150	200	Vertical
6	4807.7	38.70	1.25	54.00	15.30	AV	150	200	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_915.1MHz



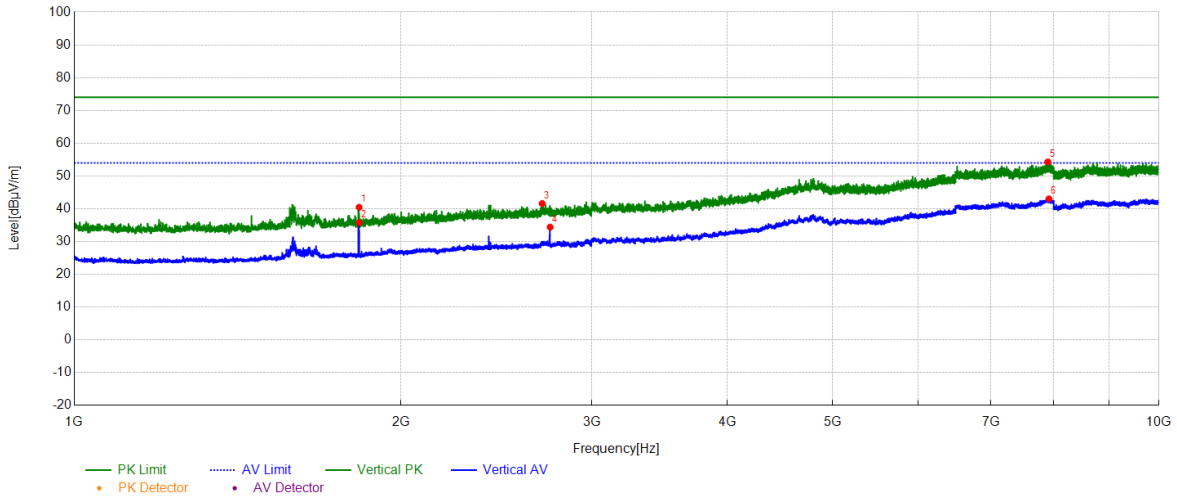
Suspected List									
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1596.1	44.91	-12.17	74.00	29.09	PK	150	150	Horizontal
2	1614.9	31.74	-12.11	54.00	22.26	AV	150	230	Horizontal
3	1829.7	40.56	-11.35	54.00	13.44	AV	150	210	Horizontal
4	1830.1	42.95	-11.35	74.00	31.05	PK	150	150	Horizontal
5	7890.4	43.11	7.42	54.00	10.89	AV	150	150	Horizontal
6	7991.3	53.71	7.04	74.00	20.29	PK	150	360	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_915.1MHz



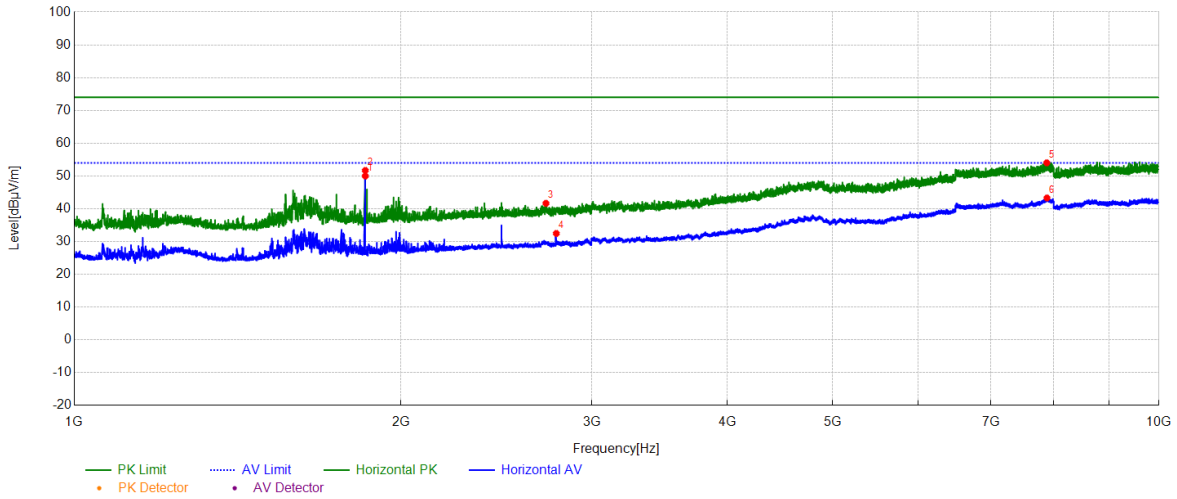
Suspected List									
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1830.5	40.45	-11.35	74.00	33.55	PK	150	160	Vertical
2	1830.5	35.75	-11.35	54.00	18.25	AV	150	60	Vertical
3	2699.9	41.60	-8.00	74.00	32.40	PK	150	60	Vertical
4	2745.9	34.38	-7.90	54.00	19.62	AV	150	120	Vertical
5	7897.4	54.28	7.48	74.00	19.72	PK	150	290	Vertical
6	7916.3	43.02	7.41	54.00	10.98	AV	150	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_927.5MHz



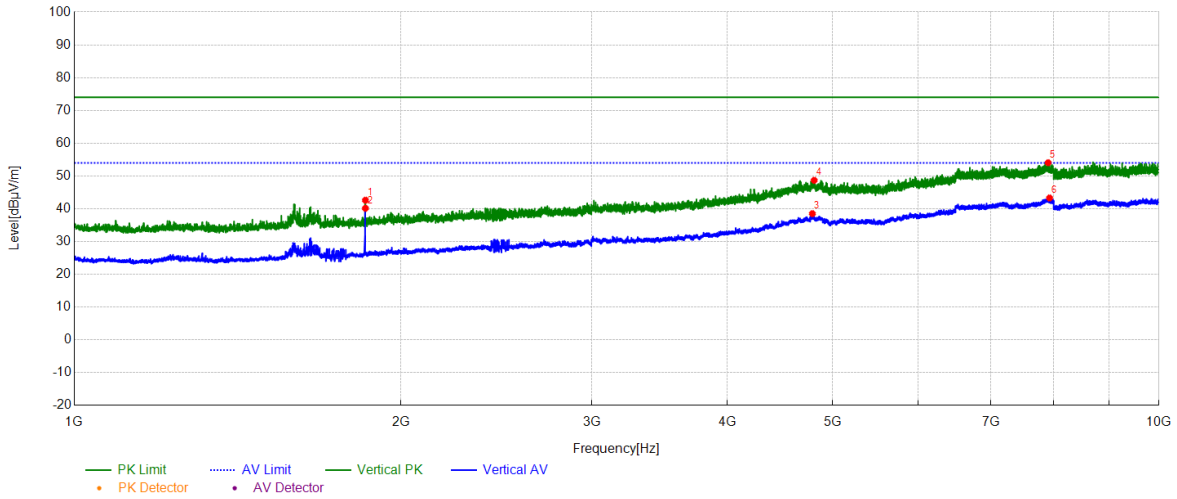
Suspected List									
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1854.9	49.99	-11.27	54.00	4.01	AV	150	179	Horizontal
2	1854.9	51.69	-11.27	74.00	22.31	PK	150	179	Horizontal
3	2721.9	41.66	-7.95	74.00	32.34	PK	150	165	Horizontal
4	2782.3	32.48	-7.82	54.00	21.52	AV	150	208	Horizontal
5	7880.6	54.01	7.34	74.00	19.99	PK	150	302	Horizontal
6	7883.4	43.29	7.37	54.00	10.71	AV	150	360	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_927.5MHz



Suspected List									
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1855.3	42.61	-11.27	74.00	31.39	PK	150	50	Vertical
2	1855.3	40.15	-11.27	54.00	13.85	AV	150	40	Vertical
3	4791.6	38.51	1.20	54.00	15.49	AV	150	190	Vertical
4	4809.8	48.67	1.24	74.00	25.33	PK	150	10	Vertical
5	7903.0	54.04	7.48	74.00	19.96	PK	150	80	Vertical
6	7927.5	43.29	7.36	54.00	10.71	AV	150	160	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.

2.7. AC Power Line Conducted Emission

2.7.1. Limit of AC Power Line Conducted Emission

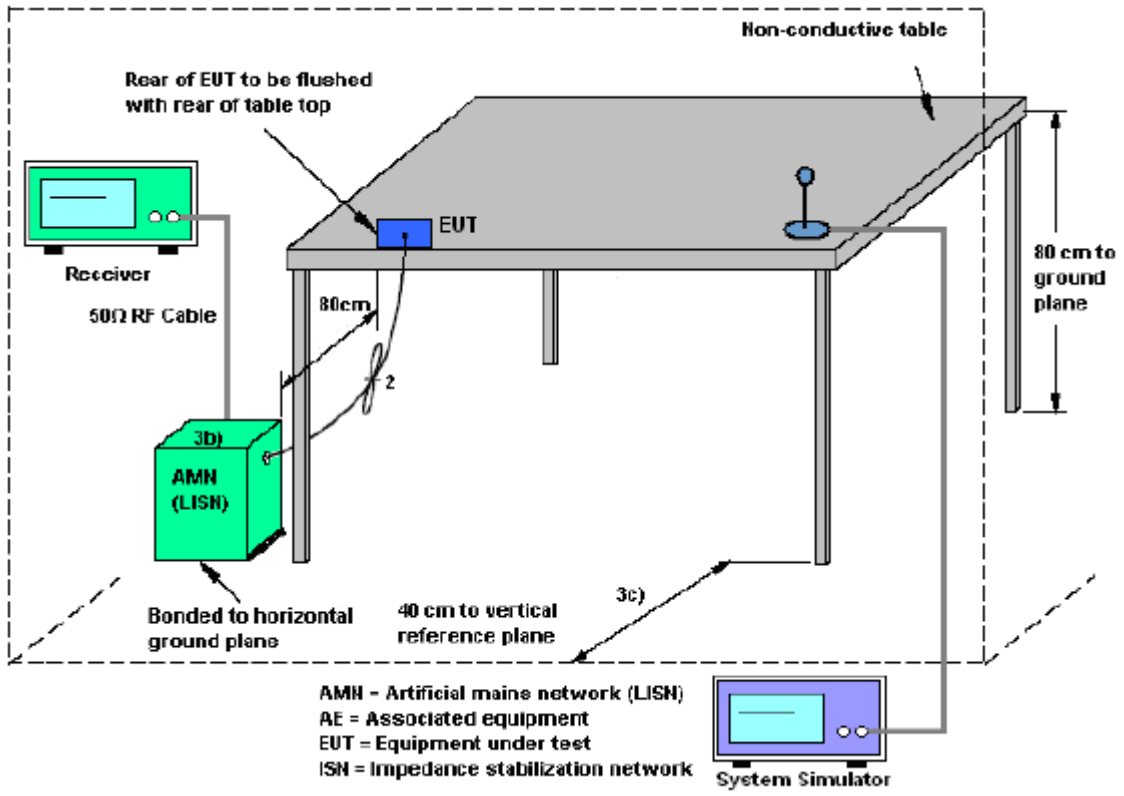
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

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

2.7.2. Measuring Instruments

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

2.7.3. Test Setup



2.7.4. Test Procedures

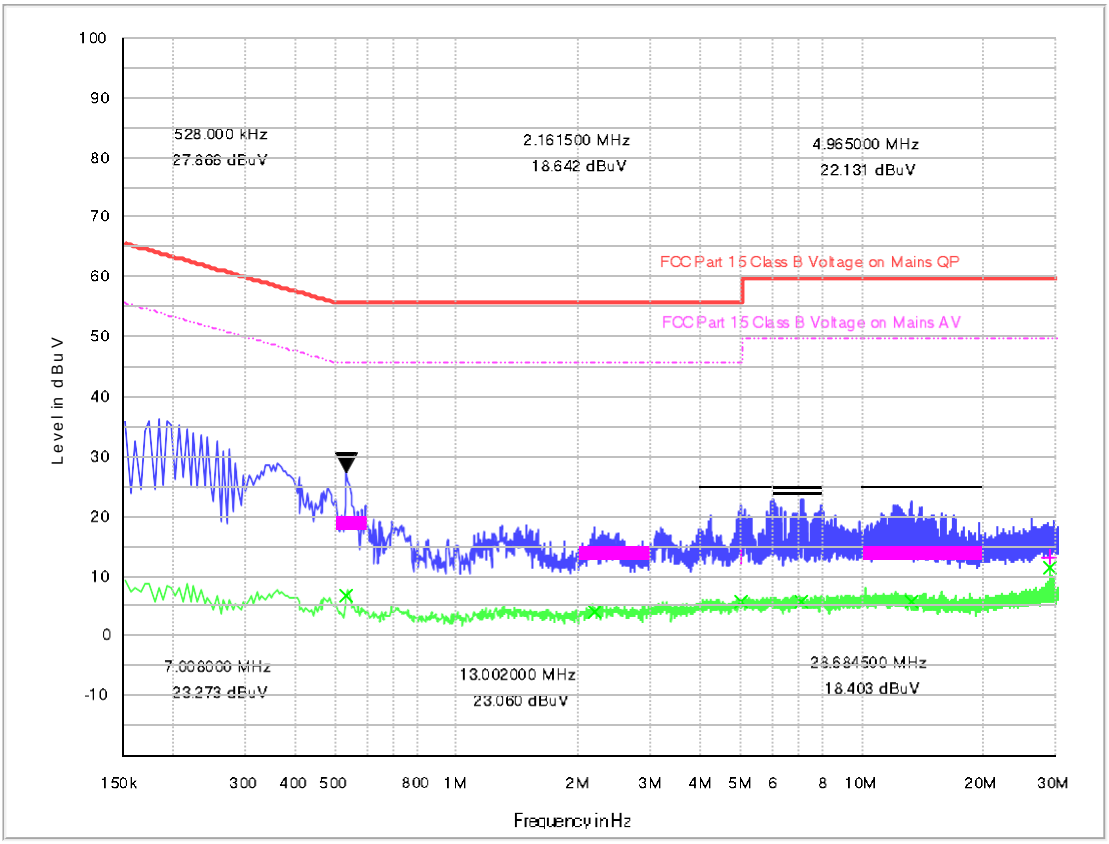
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
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.

2.7.5. Test Results of Conducted Emission

NOTE 1: The EUT configuration of the emission tests is LoRa Link + Charging from Adapter.

NOTE 2: All of the EUT Configure mode were tested and found 915.1MHz channel is the worst mode, the worst case is recorded in this report.

Line Phase



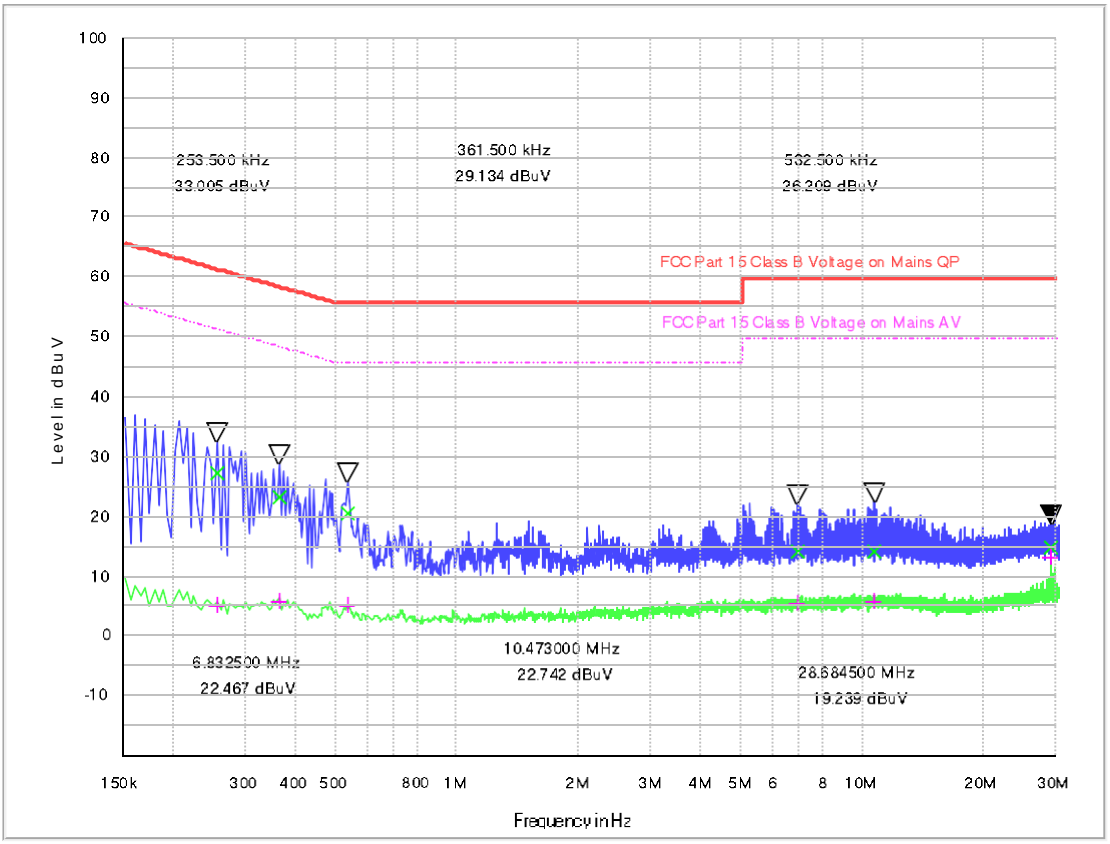
Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Cabel Loss (dB)	Corr.Factor (dB)	Margin - QPK (dB)	Limit - QPK (dB µ V)	Margin - AV (dB)	Limit - AV (dB µ V)
0.528000	20.20	7.16	0.2	10.2	35.80	56.0	38.84	46.0
2.161500	13.97	4.57	0.2	10.2	42.03	56.0	41.43	46.0
4.965000	13.40	6.01	0.3	10.3	42.60	56.0	39.99	46.0
7.008000	14.49	6.09	0.4	10.4	45.51	60.0	43.91	50.0
13.002000	15.23	6.22	0.9	10.9	44.77	60.0	43.78	50.0
28.684500	13.50	11.76	1.8	11.8	46.50	60.0	38.24	50.0

Test Result : Pass

Remark:

1. Correction factor = Cabel loss+ attenuation factor.
2. attenuation factor = 10dB.

Neutral Phase



Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Cabel Loss (dB)	Corr.Factor (dB)	Margin - QPK (dB)	Limit - QPK (dB µ V)	Margin - AV (dB)	Limit - AV (dB µ V)
0.253500	27.49	5.59	0.3	10.3	34.15	61.6	46.05	51.6
0.361500	23.59	6.21	0.3	10.3	35.10	58.7	42.48	48.7
0.532500	20.85	5.37	0.2	10.2	35.15	56.0	40.63	46.0
6.832500	14.49	5.93	0.3	10.3	45.51	60.0	44.07	50.0
10.473000	14.37	6.27	0.6	10.6	45.63	60.0	43.73	50.0
28.684500	15.27	13.54	2.0	12.0	44.73	60.0	36.46	50.0

Test Result : Pass

Remark:

1. Correction factor = Cabel loss+ attenuation factor.
2. attenuation factor = 10dB.

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	2022.07.21	2023.07.20
2	5M Anechoic Chamber	Albatross	SAC-5MAC 12.8x6.8x6.4m	A0304210	2019.03.25	2023.03.24
3	Loop Antenna	Schwarz beck	HFH2-Z2	A0304220	2022.05.02	2025.05.01
4	Broadband antenna (30MHz~1GHz)	R&S	HL562	A0304224	2020.06.19	2023.06.18
5	EMI Horn Ant. (1-	ETC	1209	A150402241	2021.01.02	2024.01.01
6	Horn antenna (18GHz~26.5GHz)	AR	AT4510	A0804450	2020.06.19	2023.06.18
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	2022.03.25	2023.03.24
10	Test Receiver	KEYSIGHT	N9038A	A141202036	2022.07.21	2023.07.20
11	LISN	ROHDE&SCHWARZ	ENV216	A140701847	2022.07.21	2023.07.20
12	Cable	MATCHING PAD	W7	/	2022.07.21	2023.07.20

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