



FCC TEST REPORT

**Test report
On Behalf of
Hangzhou Roombanker Technology Co., Ltd.
For
Smart Linux Gateway
Model No: DSGW-091
FCC ID: 2AUXBDSGW-091**

Prepared for : Hangzhou Roombanker Technology Co., Ltd.
A#801 Wantong center, Hangzhou, China

Prepared By : Shenzhen Tongzhou Testing Co., Ltd
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Date of Test: 2022/10/8 ~ 2022/10/25
Date of Report: 2022/10/25
Report Number: TZ220903661-E4

The test report apply only to the specific sample(s) tested under stated test conditions
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.



TEST RESULT CERTIFICATION

Applicant's name : Hangzhou Roombanker Technology Co., Ltd.

Address..... : A#801 Wantong center, Hangzhou, China

Manufacture's Name : Hangzhou Roombanker Technology Co., Ltd.

Address..... : A#801 Wantong center, Hangzhou, China

Product description

Trade Mark..... : Dusun

Product name : Smart Linux Gateway

Model No..... : DSGW-091

Standards : FCC Rules and Regulations Part 15 Subpart C Section 15.247
ANSI C63.10: 2013

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Date of Test :

Date (s) of performance of tests..... : 2022/10/8 ~ 2022/10/25

Date of Issue..... : 2022/10/25

Test Result..... : PASS

Testing Engineer

:

Anna Hu

(Anna Hu)

Technical Manager

:

Hugo Chen

(Hugo Chen)

Authorized Signatory

:

Andy Zhang

(Andy Zhang)



Revision History

Revision	Issue Date	Revisions	Revised By
00	2022/10/25	Initial Issue	Andy Zhang



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1. GENERAL INFORMATION

1.1. Description of Device (EUT)

Product Name	: Smart Linux Gateway
Model Number	: DSGW-091
Model Difference Declaration	: N/A
Test Model	: DSGW-091
Power Supply	: Input: DC 5V,2A
Hardware version	: 5-1-9-009760
Software version	: V1.0
Sample ID	: TZ220903661-1#&TZ220903661-2#

LoRa

LoRa-Hybrid Mode

Frequency Range	: 902.3 – 914.9 MHz
Channel Number	: 64 Channels
Modulation Technology	: LORA

LoRa-DTS Mode

Frequency Range	: 923.3 – 927.5 MHz
Channel Number	: 8 Channels
Modulation Technology	: LORA
Antenna Type And Gain	: External Antenna / 2.44 dBi(Max)

Bluetooth

Bluetooth Version	: V5.2
Frequency Range	: 2402 – 2480 MHz
Channel Number	: 40 Channels for BLE (DTS)
Modulation Technology	: GFSK for BLE (DTS)
Data Rates	: BLE (DTS): 1Mbps
Antenna Type And Gain	: FPC Antenna / -0.09dBi(Max)

Zigbee

Frequency Range	: 2415 – 2480 MHz
Channel Number	: 14 Channels
Modulation Technology	: O-QPSK
Data Rates	: 250 kbps
Antenna Type And Gain	: PCB Antenna / 0.0dBi(Max)

Z-Wave

Frequency Range	: 908.4 – 916 MHz
Channel Number	: Channel 1: 908.4MHz / Channel 2: 916MHz
Modulation Technology	: FSK
Antenna Type And Gain	: FPC Antenna / -1.8dBi(Max)

Note 1: Antenna position refer to EUT Photos.

Note 2: the above information was supplied by the applicant.

Note3: LoRa supports Hybrid and DTS Mode, This Report is for DTS Mode.



1.2 EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - supplied by the lab

○	Adapter	Model:	MDY-10-EH
		Input:	100-240VAC 50/60Hz 0.7A
		Output:	DC 5.0V,3.0A; DC 9.0V,3.0A; DC 12.0V,2.25A; DC 20.0V,1.35A
		Lab. Code:	SZTZ-ZB-EMC-010

1.3 External I/O Cable

I/O Port Description	Quantity	Cable
DC port	1	N/A
RJ45 port	1	N/A

1.4. Description of Test Facility

FCC

Designation Number: CN1275

Test Firm Registration Number: 167722

Shenzhen Tongzhou Testing Co.,Ltd has been listed on the US Federal Communications Commission

list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA

Certificate Number: 5463.01

Shenzhen Tongzhou Testing Co.,Ltd has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

IC

ISED#: 22033

CAB identifier: CN0099

Shenzhen Tongzhou Testing Co.,Ltd has been listed by Innovation, Science and Economic Development Canada to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010



1.5. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the Shenzhen Tongzhou Testing Co.,Ltd quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1.6. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	±3.08dB	(1)
		30MHz~1000MHz	±4.42dB	(1)
		1GHz~40GHz	±4.06dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	±2.23dB	(1)

- (1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.7. Description of Test Modes

LoRa operates in the unlicensed Band at 902 – 928 MHz. All test modes were tested, only the result of the worst case was recorded in the report.

Mode of Operations	Test Frequency (MHz)	
Hybrid	923.3(LCH)	
	925.7(MCH)	
	927.5(HCH)	
For Radiated Emission		
Test Mode		TX Mode

Note: LCH means Low Channel; MCH means Middle Channel; HCH means High Channel

Worst-case mode and channel used for 9kHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be TX(LCH).



1.8. Frequency of Channels

LoRa-DTS

Channel	Frequency(MHz)
0	923.3
1	923.9
2	924.5
3	925.1
4	925.7
5	926.3
6	926.9
7	927.5



2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen Tongzhou Testing Co.,Ltd

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to FCC's request, Test Procedure KDB558074 D01 DTS Meas. Guidance v04 and KDB 662911 are required to be used for this kind of FCC 15.247 digital modulation device.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

2.3. General Test Procedures

2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013

2.4. Test Sample

The application provides 1sample to meet requirement;

Sample ID	Description
TZ220903661-1#	Engineer sample – continuous transmit
TZ220903661-2#	Normal sample – Intermittent transmit



3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmits condition.

3.2. EUT Exercise Software

The system was configured for Bluetooth testing in a continuous transmits condition and change test channels by software(PuTTY 0.73) provided by application.

3.3. Special Accessories

No.	Equipment	Manufacturer	Model No.	Serial No.	Length	shielded/ unshielded	Notes
1	PC	ASUS	X454L	15105- 0038A100	/	/	/

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen Tongzhou Testing Co.,Ltd has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.



4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart C			
FCC Rules	Description of Test	Test Sample(s)	Result
§15.247(b)	Maximum Conducted Output Power	TZ220903661-1#	Compliant
§15.247(e)	Power Spectral Density	TZ220903661-1#	Compliant
§15.247(a)(2)	6dB Bandwidth	TZ220903661-1#	Compliant
§15.247(a)	Occupied Bandwidth	TZ220903661-1#	Compliant
§15.209, §15.247(d)	Radiated and Conducted Spurious Emissions	TZ220903661-1#	Compliant
§15.205	Emissions at Restricted Band	TZ220903661-1#	Compliant
§15.207(a)	Conducted Emissions	TZ220903661-1# TZ220903661-2#	Compliant
§15.203	Antenna Requirements	TZ220903661-1#	Compliant
§15.247(i)§2.1093	RF Exposure	TZ220903661-1#	Compliant

Remark: The measurement uncertainty is not included in the test result.

5. TEST RESULT

5.1. On Time and Duty Cycle

5.1.1. Standard Applicable

None; for reporting purpose only.

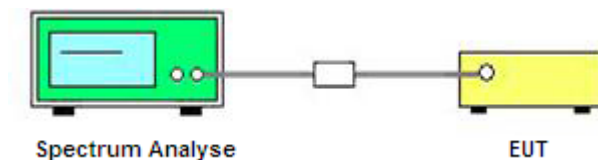
5.1.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of the spectrum analyzer.

5.1.3. Test Procedures

1. Set the center frequency of the spectrum analyzer to the transmitting frequency;
2. Set the span=0MHz, RBW=3MHz, VBW=3MHz, Sweep time=5ms;
3. Detector = peak;
4. Trace mode = Single hold.

5.1.4. Test Setup Layout



5.1.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.1.6. Test result

Pass

Remark:

1. Please refer to Appendix G of Appendix Test Data for LoRa-DTS for test data.

5.2. Maximum Peak Conducted Output Power Measurement

5.2.1. Standard Applicable

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

5.2.2. Test Procedures

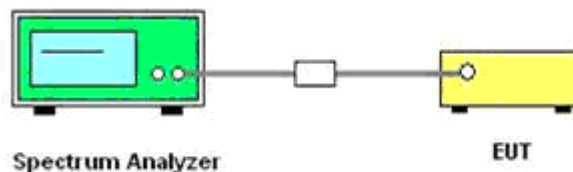
The transmitter output (antenna port) was connected to the spectrum analyzer.

According to KDB558074 D01 DTS Measurement Guidance Section 9.1 Maximum peak conducted output power 9.1.1.

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

- a) Set the RBW \geq DTS bandwidth.
- b) Set VBW $\geq 3 \times$ RBW.
- c) Set span $\geq 3 \times$ RBW
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

5.2.3. Test Setup Layout



5.2.4. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.2.5. Test Result of Maximum Conducted Output Power

Pass

Remark:

1. Test results including cable loss;
2. Please refer to Appendix C of Appendix Test Data for LoRa-DTS for test data.

5.3. Maximum peak Power Spectral Density Measurement

5.3.1. Standard Applicable

According to §15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

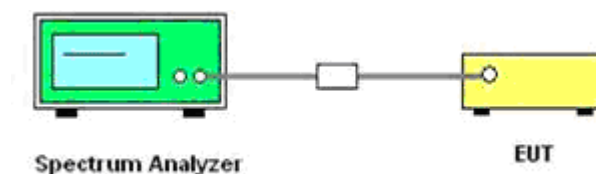
5.3.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of Spectrum Analyzer.

5.3.3. Test Procedures

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. The power was monitored at the coupler port with a Spectrum Analyzer. The power level was set to the maximum level.
3. Set the RBW = 3kHz.
4. Set the VBW $\geq 3 \times \text{RBW}$
5. Set the span to 1.5 times the DTS channel bandwidth.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum power level.
11. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
12. The resulting peak PSD level must be 8dBm.

5.3.4. Test Setup Layout



5.3.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.



5.3.6. Test Result of Power Spectral Density

Pass

Remark:

1. *Test results including cable loss;*
2. *Please refer to Appendix D of Appendix Test Data for LoRa-DTS for test data.*

5.4. 6 dB Spectrum Bandwidth Measurement

5.4.1. Standard Applicable

According to §15.247(a) (2): For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

5.4.2. Measuring Instruments and Setting

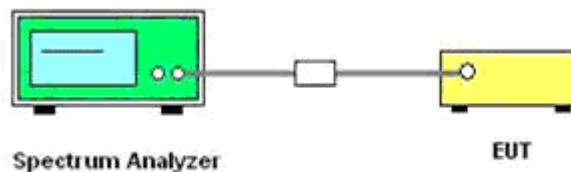
Please refer to section 6 of equipment list in this report. The following table is the setting of the Spectrum Analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> RBW
Detector	Peak
Trace	Max Hold
Sweep Time	100ms

5.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth and the video bandwidth were set according to KDB558074.
3. Measured the spectrum width with power higher than 6dB below carrier.

5.4.4. Test Setup Layout



5.4.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.4.6. Test Result of 6dB Spectrum Bandwidth

Pass

Remark:

1. Test results including cable loss;
2. please refer to following plots;
3. Please refer to Appendix A of Appendix Test Data for LoRa-DTS for test data.



5.5. Radiated Emissions and Restricted Band Emission Measurement

5.5.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

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			

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510MHz.

\2\ Above 38.6

According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
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

5.5.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10 th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

5.5.3. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.
- If the EUT is a floor standing device, it is placed on the ground.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.3 meter.
- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).
- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 to 3 meter.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter.
- The final measurement will be done with QP detector with an EMI receiver.
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.



3) Sequence of testing 1 GHz to 18 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 2.5 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 1 meter.
- The EUT was set into operation.

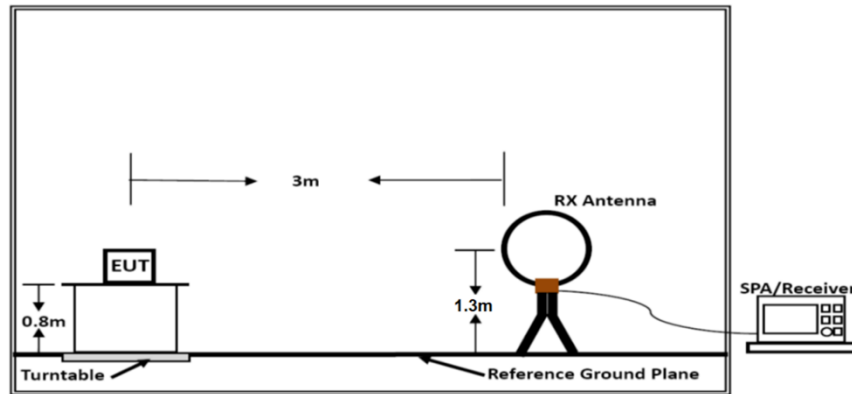
Premeasurement:

- The antenna is moved spherical over the EUT in different polarizations of the antenna.

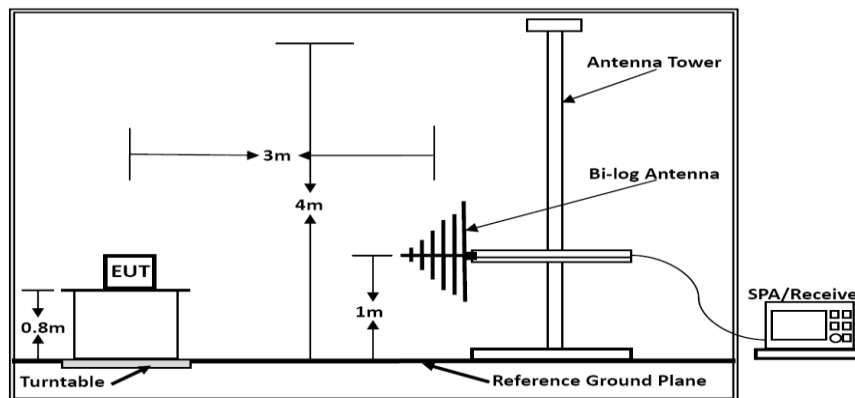
Final measurement:

- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

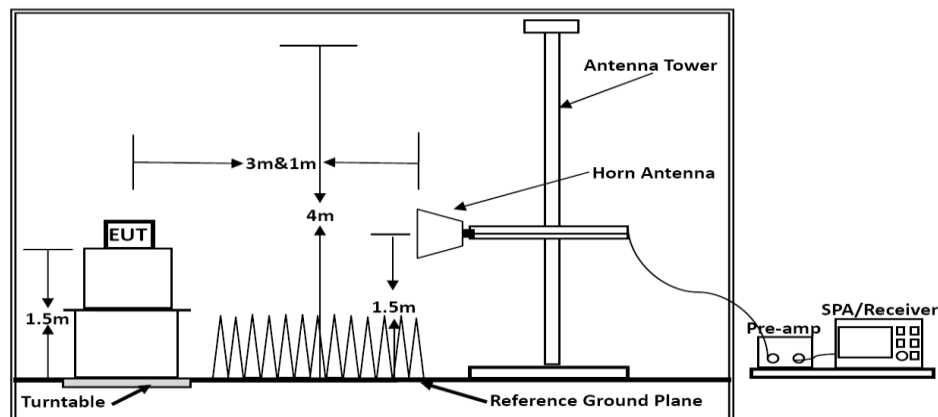
5.5.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1.5m.

Distance extrapolation factor = $20 \log (\text{specific distance [3m]} / \text{test distance [1.5m]})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].



5.5.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.5.6. Results of Radiated Emissions (9 kHz~30MHz)

Temperature	24.3℃	Humidity	55%
Test Engineer	Anna Hu	Configurations	LoRa-DTS

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

5.5.7. Results of Radiated Emissions (30MHz~1GHz)

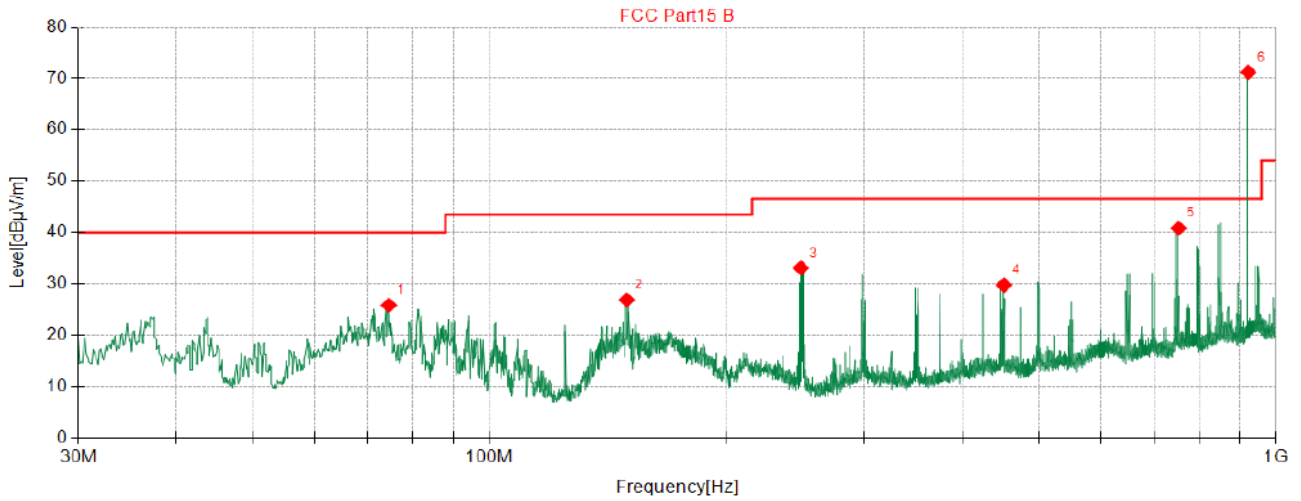
Temperature	24.3℃	Humidity	55%
Test Engineer	Anna Hu	Configurations	LoRa-DTS



Results of Radiated Emissions (30MHz)~1GHz)

Low Channel

Vertical

**Suspected Data List**

NO.	Freq. [MHz]	Reading [dBμV]	Factor [dB/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	74.49	44.10	-18.24	25.86	40.00	14.14	100	269	Vertical
2	149.5	44.57	-17.67	26.90	43.50	16.60	100	187	Vertical
3	249.2	46.88	-13.80	33.08	46.50	13.42	100	162	Vertical
4	451.5	39.23	-9.45	29.78	46.50	16.72	100	285	Vertical
5	752.8	44.95	-4.12	40.83	46.50	5.67	100	336	Vertical
6	923.2	72.02	-0.82	71.20	46.50	-24.70	100	309	Vertical

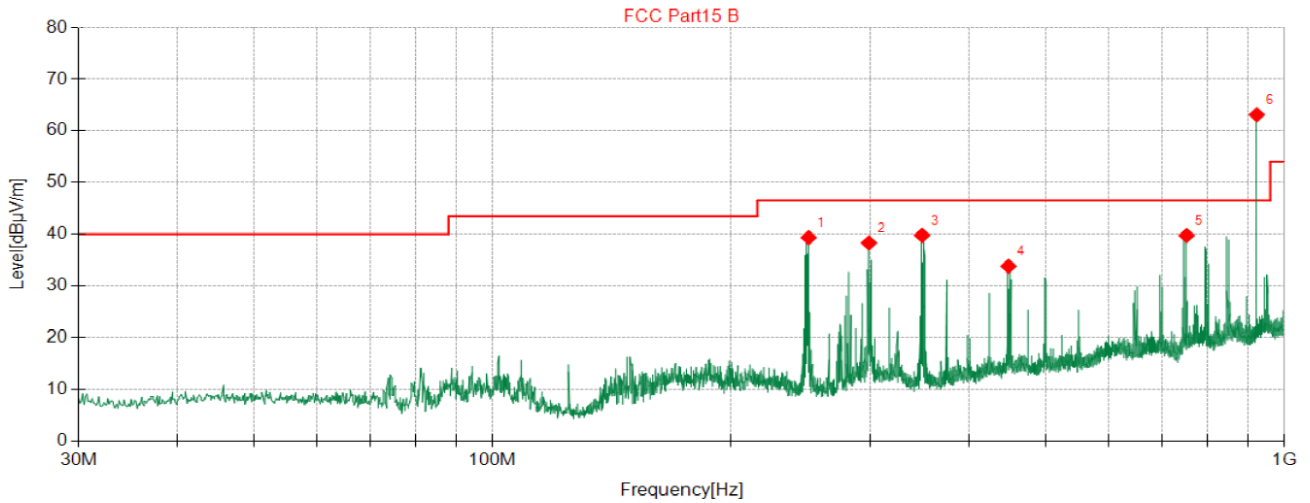
***Note:

1. Level [dBμV/m] = Reading [dBμV] + Factor [dB/m]

2. Margin [dB] = Limit [dBμV/m] - Level [dBμV/m]



Horizontal



◆ QP Detector

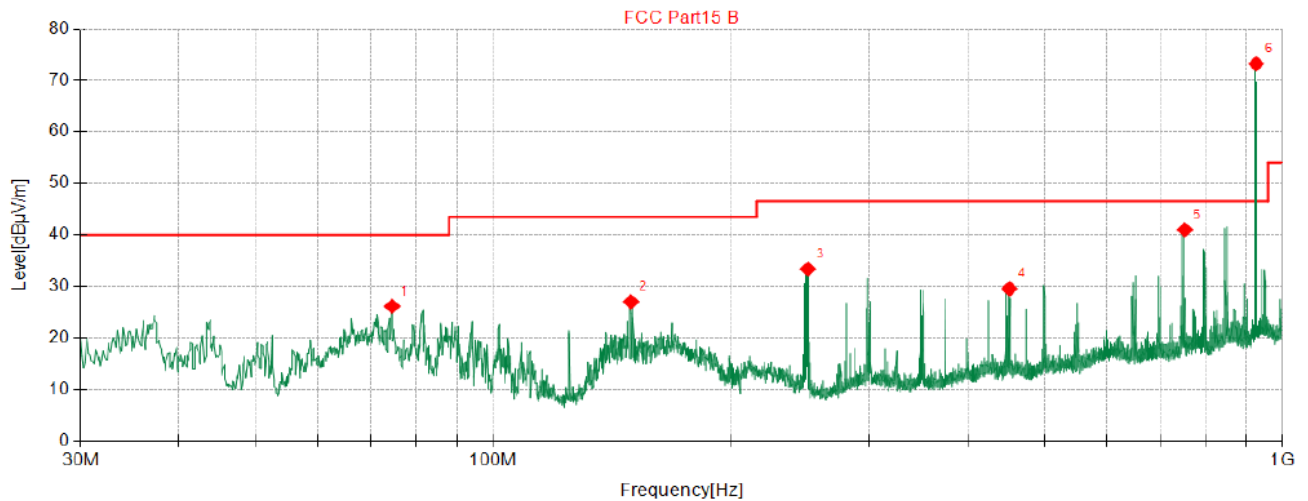
Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV]	Factor [dB/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	250.7	53.18	-13.85	39.33	46.50	7.17	100	61	Horizontal
2	298.81	51.13	-12.83	38.30	46.50	8.20	100	252	Horizontal
3	348.7	51.22	-11.45	39.77	46.50	6.73	100	249	Horizontal
4	448.4	42.88	-9.08	33.80	46.50	12.70	100	246	Horizontal
5	752.8	43.32	-3.58	39.74	46.50	6.76	100	113	Horizontal
6	923.2	63.88	-0.76	63.12	46.50	-16.62	100	268	Horizontal

***Note:

1. Level [dBμV/m] = Reading [dBμV] + Factor [dB/m]

2. Margin [dB] = Limit [dBμV/m] - Level [dBμV/m]

**High Channel**
Vertical

◆ QP Detector

Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV]	Factor [dB/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	74.49	44.42	-18.24	26.18	40.00	13.82	100	344	Vertical
2	149.5	44.72	-17.67	27.05	43.50	16.45	100	183	Vertical
3	250.7	47.14	-13.76	33.38	46.50	13.12	100	158	Vertical
4	451.5	39.02	-9.45	29.57	46.50	16.93	100	267	Vertical
5	752.8	45.11	-4.12	40.99	46.50	5.51	100	332	Vertical
6	927.4	74.03	-0.81	73.22	46.50	-26.72	100	332	Vertical

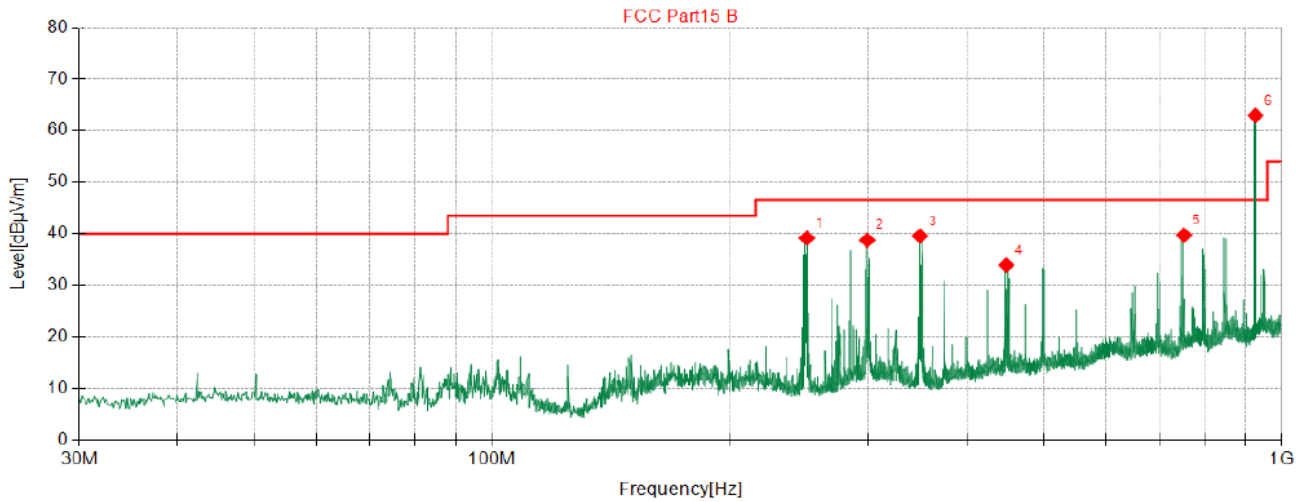
***Note:

1. Level [dBμV/m] = Reading [dBμV] + Factor [dB/m]

2. Margin [dB] = Limit [dBμV/m] - Level [dBμV/m]



Horizontal



◆ QP Detector

Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV]	Factor [dB/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	250.7	52.99	-13.85	39.14	46.50	7.36	100	56	Horizontal
2	298.81	51.57	-12.83	38.74	46.50	7.76	100	52	Horizontal
3	348.7	51.01	-11.45	39.56	46.50	6.94	100	257	Horizontal
4	448.4	42.99	-9.08	33.91	46.50	12.59	100	250	Horizontal
5	752.8	43.28	-3.58	39.70	46.50	6.80	100	105	Horizontal
6	927.6	63.65	-0.72	62.93	46.50	-16.43	100	297	Horizontal

***Note:

1. Level [dBμV/m] = Reading [dBμV] + Factor [dB/m]
2. Margin [dB] = Limit [dBμV/m] - Level [dBμV/m]



5.5.8. Results for Radiated Emissions (Above 1GHz)

Low Channel: 923.3MHz

Freq. MHz	Reading dBuv	Ant. Fac dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuv/m	Limit dBuv/m	Margin dB	Remark	Pol.
1846.71	46.59	33.06	35.04	3.94	48.55	74.00	25.45	Peak	Horizontal
1847.06	48.32	33.06	35.04	3.94	50.28	74.00	23.72	Peak	Vertical
2770.22	49.82	33.06	35.04	3.94	51.78	74.00	22.22	Peak	Horizontal
2770.76	47.16	33.06	35.04	3.94	49.12	74.00	24.88	Peak	Vertical

Low Channel: 925.7MHz

Freq. MHz	Reading dBuv	Ant. Fac dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuv/m	Limit dBuv/m	Margin dB	Remark	Pol.
1852.18	46.89	33.16	35.15	3.96	48.86	74.00	25.14	Peak	Horizontal
1852.39	44.28	33.16	35.15	3.96	46.25	74.00	27.75	Peak	Vertical
2777.31	47.17	33.16	35.15	3.96	49.14	74.00	24.86	Peak	Horizontal
2777.87	49.90	33.16	35.15	3.96	51.87	74.00	22.13	Peak	Vertical

Low Channel: 927.5MHz

Freq. MHz	Reading dBuv	Ant. Fac dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuv/m	Limit dBuv/m	Margin dB	Remark	Pol.
1855.27	46.58	33.26	35.14	3.98	48.68	74.00	25.32	Peak	Horizontal
1855.74	46.70	33.26	35.14	3.98	48.80	74.00	25.20	Peak	Vertical
2782.69	47.04	33.26	35.14	3.98	49.14	74.00	24.86	Peak	Horizontal
2782.62	49.58	33.26	35.14	3.98	51.68	74.00	22.32	Peak	Vertical

Notes:

- 1). Measuring frequencies from 9k~10th harmonic (ex. 10GHz), No emission found between lowest internal used/generated frequency to 30 MHz.
- 2). Radiated emissions measured in frequency range from 9k~10th harmonic (ex. 10GHz) were made with an instrument using Peak detector mode.
- 3). Measured = Reading + Ant. Fac - Pre. Fac. + Cab. Loss; Margin = Limit - Measured



5.6. Conducted Spurious Emissions and Band Edges Test

5.6.1. Standard Applicable

According to §15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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 of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

5.6.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Detector	Peak
Attenuation	Auto
RB / VB (Emission in restricted band)	100KHz/300KHz
RB / VB (Emission in non-restricted band)	100KHz/300KHz

5.6.3. Test Procedures

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz

The spectrum from 9 kHz to 26.5GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

5.6.4. Test Setup Layout

This test setup layout is the same as that shown in section 5.4.4.

5.6.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.6.6. Test Results of Conducted Spurious Emissions

Pass

Remark:

1. *Test results including cable loss;*
2. *“---”means that the fundamental frequency not for 15.209 limits requirement.*
3. *Not recorded values as emission level lower than limit at least 20 dBc;*
4. *Please refer to Appendix F of Appendix Test Data for LoRa-DTS for Conducted Spurious Emissions test data.*
5. *Please refer to Appendix E of Appendix Test Data for LoRa-DTS for Conducted Band Edges test data.*



5.7. AC Power line conducted emissions

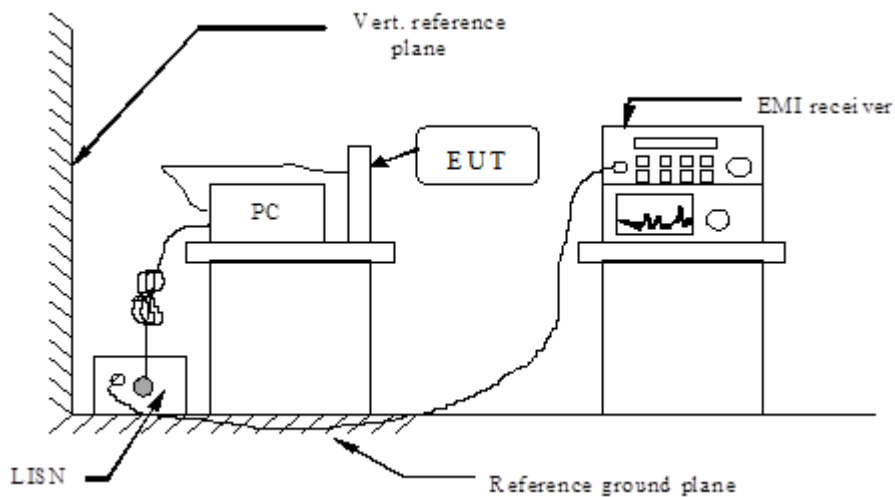
5.7.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which 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 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

5.7.2 Block Diagram of Test Setup

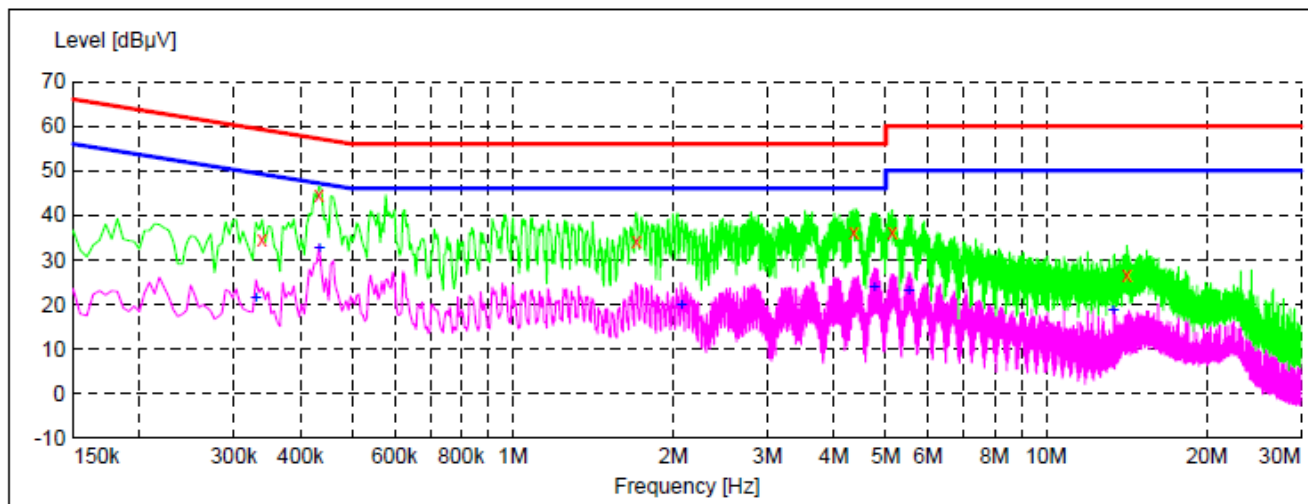


5.7.3 Test Results

6. Temperature	22.8°C	Humidity	56%
Test Engineer	Nancy Li	Configurations	LoRa-DTS

PASS.

The test data please refer to following page.

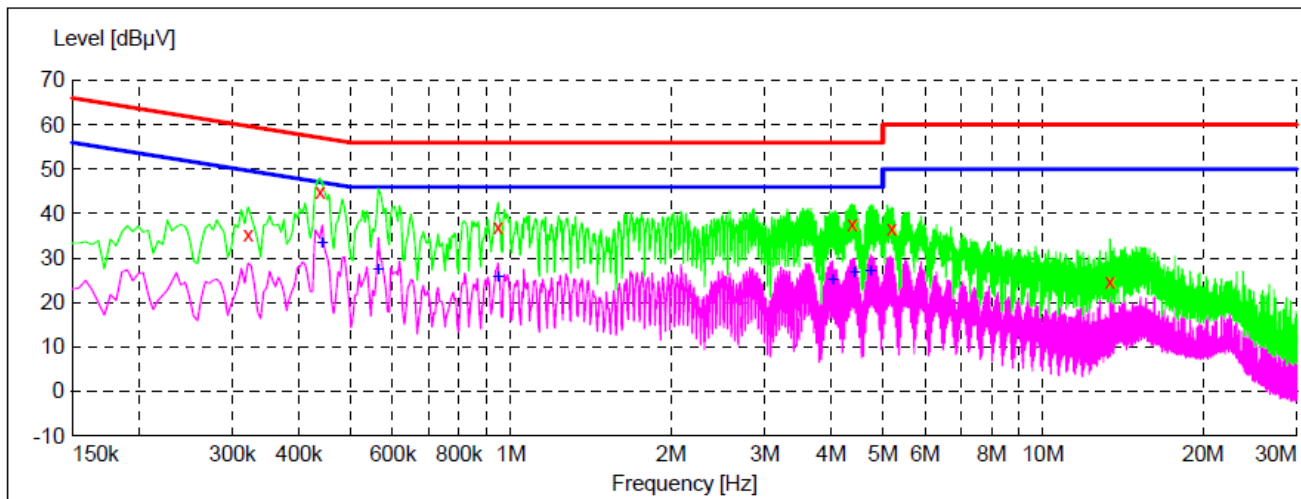
**Neutral Line**

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.339000	34.50	10.1	59	24.7	QP	N	GND
0.433500	44.50	10.0	57	12.7	QP	N	GND
1.702500	34.10	9.7	56	21.9	QP	N	GND
4.357500	36.10	9.7	56	19.9	QP	N	GND
5.136000	36.00	9.8	60	24.0	QP	N	GND
14.154000	26.80	9.8	60	33.2	QP	N	GND

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.330000	21.50	10.1	50	28.0	AV	N	GND
0.433500	32.50	10.0	47	14.7	AV	N	GND
2.067000	19.70	9.7	46	26.3	AV	N	GND
4.758000	24.00	9.8	46	22.0	AV	N	GND
5.523000	23.20	9.8	50	26.8	AV	N	GND
13.357500	18.50	9.8	50	31.5	AV	N	GND

Note:

1. $\text{Margin(dB)} = \text{Limit(dB}\mu\text{V)} - \text{Level(dB}\mu\text{V)}$
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: 9 kHz (150 kHz—30 MHz), Step size: 4 kHz, Scan time: auto.
4. Pre-scan all modes and recorded the worst case result in this report

**Live Line**

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.321000	35.20	10.2	60	24.5	QP	L1	GND
0.438000	44.90	10.0	57	12.2	QP	L1	GND
0.946500	37.00	9.8	56	19.0	QP	L1	GND
4.380000	37.50	9.7	56	18.5	QP	L1	GND
5.190000	36.80	9.8	60	23.2	QP	L1	GND
13.353000	24.70	9.8	60	35.3	QP	L1	GND

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.442500	33.20	10.0	47	13.8	AV	L1	GND
0.564000	27.30	9.9	46	18.7	AV	L1	GND
0.946500	25.70	9.8	46	20.3	AV	L1	GND
4.020000	25.10	9.7	46	20.9	AV	L1	GND
4.416000	26.60	9.7	46	19.4	AV	L1	GND
4.744500	26.90	9.8	46	19.1	AV	L1	GND

Note:

1. $\text{Margin(dB)} = \text{Limit(dB}\mu\text{V)} - \text{Level(dB}\mu\text{V)}$
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: 9 kHz (150 kHz—30 MHz), Step size: 4 kHz, Scan time: auto.
4. Pre-scan all modes and recorded the worst case result in this report



5.8. Antenna Requirements

5.8.1 Standard Applicable

According to antenna requirement of §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 re-placed 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 Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 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 §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

5.8.2 Antenna Connected Construction

5.8.2.1. Standard Applicable

According to § 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.

5.8.2.2. Antenna Connector Construction

The directional gains of antenna refer to section 1.1 of this report, and the antenna is an External antenna connect to EUT with Anti-SMA connector and no consideration of replacement. Please see EUT photo for details.

5.8.2.3. Results: Compliance.



6. LIST OF MEASURING EQUIPMENTS

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
1	MXA Signal Analyzer	Keysight	N9020A	MY52091623	2022/1/13	2023/1/12
2	Power Sensor	Agilent	U2021XA	MY5365004	2022/1/13	2023/1/12
3	Power Meter	Agilent	U2531A	TW53323507	2022/1/13	2023/1/12
4	Loop Antenna	schwarzbeck	FMZB1519B	00023	2019/11/16	2022/11/15
5	Wideband Antenna	schwarzbeck	VULB 9163	958	2019/11/16	2022/11/15
6	Horn Antenna	schwarzbeck	9120D-1141	1574	2019/11/16	2022/11/15
7	EMI Test Receiver	R&S	ESCI	100849/003	2022/1/12	2023/1/11
8	Controller	MF	MF7802	N/A	N/A	N/A
9	Amplifier	schwarzbeck	BBV 9743	209	2022/1/12	2023/1/11
10	Amplifier	Tonscend	TSAMP-0518SE	--	2022/1/12	2023/1/11
11	RF Cable(below 1GHz)	HUBER+SUHNER	RG214	N/A	2022/1/12	2023/1/11
12	RF Cable(above 1GHz)	HUBER+SUHNER	RG214	N/A	2022/1/14	2023/1/13
12	Artificial Mains	ROHDE & SCHWARZ	ENV 216	101333-IP	2022/1/13	2023/1/12
14	EMI Test Software	ROHDE & SCHWARZ	ESK1	V1.71	N/A	N/A
15	RE test software	Tonscend	JS32-RE	V2.0.2.0	N/A	N/A
16	Test Software	Tonscend	JS1120-3	V2.5.77.0418	N/A	N/A
17	Horn Antenna	A-INFO	LB-180400-KF	J211020657	2022/10/12	2024/10/11
18	Amplifier	CDSA	PAP-1840	17021	2022/10/10	2023/10/09
19	Spectrum Analyzer	R&S	FSP40	100550	2022/1/10	2023/1/9



7. TEST SETUP PHOTOGRAPHS

Please refer to separated files for Test Setup Photos of the EUT.

8.EXTERNAL PHOTOS OF THE EUT

Please refer to separated files for External Photos of the EUT.

9.INTERIOR PHOTOS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

-----THE END OF REPORT-----