

AS/NZS CISPR 32: 2015

TEST REPORT

For

Shenzhen RAKwireless Technology Co., Ltd.

Room 506, Bldg B, New Compark, Pingshan First Road, Taoyuan Street, XiLi town
Nanshan District, Shenzhen, China

Model: RAK7268

Report Type: Original Report	Product Type: WisGate
Report Number: RSZ200922006-09	
Report Date: 2021-01-12 Nancy Wang	
Reviewed By: RF Engineer	
Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn	

Note: BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

TABLE OF CONTENTS

GENERAL INFORMATION.....	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
OBJECTIVE	3
TEST METHODOLOGY	3
MEASUREMENT UNCERTAINTY	4
SYSTEM TEST CONFIGURATION.....	5
JUSTIFICATION	5
EUT EXERCISE SOFTWARE	5
EQUIPMENT MODIFICATIONS	5
SUPPORT EQUIPMENT LIST AND DETAILS	5
EXTERNAL I/O CABLE.....	5
BLOCK DIAGRAM OF TEST SETUP	6
SUMMARY OF TEST REPORT.....	8
TEST EQUIPMENT LIST	9
AS/NZS CISPR 32: 2015 §A.3-CONDUCTED EMISSION	10
APPLICABLE STANDARD	10
TEST SYSTEM SETUP	10
EMI TEST RECEIVER SETUP.....	10
TEST PROCEDURE	11
CORRECTED FACTOR & MARGIN CALCULATION	11
TEST RESULTS SUMMARY	11
TEST DATA	11
AS/NZS CISPR 32: 2015 §A.2-RADIATED EMISSION.....	22
APPLICABLE STANDARD	22
TEST SYSTEM SETUP	22
EMI TEST RECEIVER SETUP.....	23
TEST PROCEDURE	23
CORRECTED AMPLITUDE & MARGIN CALCULATION	23
TEST RESULTS SUMMARY	23
TEST DATA	23
EXHIBIT A - EUT PHOTOGRAPHS.....	32
EXHIBIT B - TEST SETUP PHOTOGRAPHS	49
CONDUCTED EMISSIONS - FRONT VIEW	49
CONDUCTED EMISSIONS - SIDE VIEW	49
CONDUCTED EMISSIONS - FRONT VIEW	50
CONDUCTED EMISSIONS - SIDE VIEW	50
CONDUCTED EMISSIONS - FRONT VIEW	51
CONDUCTED EMISSIONS - SIDE VIEW	51
RADIATED EMISSIONS – FRONT VIEW (BELOW 1 GHz)	52
RADIATED EMISSIONS – REAR VIEW (BELOW 1 GHz)	52
RADIATED EMISSIONS – FRONT VIEW (ABOVE 1 GHz).....	53
RADIATED EMISSIONS – REAR VIEW (ABOVE 1 GHz)	53
RADIATED EMISSIONS – FRONT VIEW (BELOW 1 GHz)	54
RADIATED EMISSIONS – REAR VIEW (BELOW 1 GHz)	54
RADIATED EMISSIONS – FRONT VIEW (ABOVE 1 GHz).....	55
RADIATED EMISSIONS – REAR VIEW (ABOVE 1 GHz)	55

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	WisGate
Tested Model	RAK7268
Voltage Range	DC 12.0V from adapter or DC 48V from POE
Equipment Class	Class B
Date of Test	2020-11-12
Sample serial number	RSZ200922006-RF-S1(Assigned by BACL, Shenzhen)
Received date	2020-09-22
Sample/EUT Status	Good condition
Adapter information	Model: RA040-1202000AU Input: AC 100-240V~50/60Hz, 0.6A Max Output: DC 12.0V, 2.0A 24.0W

Objective

This test report is in accordance with AS/NZS CISPR 32: 2015 rules.

The objective of the manufacturer is to determine compliance with AS/NZS CISPR 32: 2015.

Test Methodology

All measurements contained in this report were conducted with CISPR 16-1-1:2010+A1:2010+A2:2014, specification for radio disturbance and immunity measuring apparatus and methods P1-1: radio disturbance and immunity measuring apparatus measuring apparatus. CISPR16-1-4:2010+A1:2012, Specification for radio disturbance and immunity measuring apparatus and methods-Part 1-4: Radio disturbance and immunity measuring apparatus -Ancillary equipment -Radiated disturbances. CISPR 16-2-1:2014, specification for radio disturbance and immunity measuring apparatus and methods P2-1: methods of measurement of disturbance and immunity conducted disturbance measurements. CISPR 16-2-3:2010+A1:2010+A2:2014, specification for radio disturbance and immunity measuring apparatus and methods P2-3 methods of measurement of disturbances and immunity radiated disturbance measurements. CISPR 16-4-2:2011, Specification for radio disturbance and immunity measuring apparatus and methods-Part 4-2: Uncertainties, statistics and limit modeling-Uncertainty in EMC measurements.

All radiated and conducted emissions measurements were performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 Meters.

Measurement Uncertainty

Parameter		uncertainty
Conducted Emissions	AC Mains	$\pm 1.95\text{dB}$
	CAT 5	$\pm 3.86\text{dB}$
Radiated Emission	Below 1GHz	$\pm 4.75\text{dB}$
	Above 1GHz	$\pm 4.88\text{dB}$

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing in normal mode.

Testing mode 1: Wi-Fi transmitting (working and monitoring with mobile phone)

Testing mode 2: Lora transmitting (working and monitoring with SPECTRUM ANALYZER)

Testing mode 3: BLE receiving (working and monitoring with mobile phone)

EUT exercise software

No software was used.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
HUAWEI	Mobile Phone	KIW-UL00	Unknown
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120
Agilent	MXG Vector Signal Generator	N5182B	MY53051503
HIKVISION	Router	DS-3WR03-E	10021642429
GOSPELL	POE	G0720-480-050	200200015
Unknown	SD card	Unknown	SD card

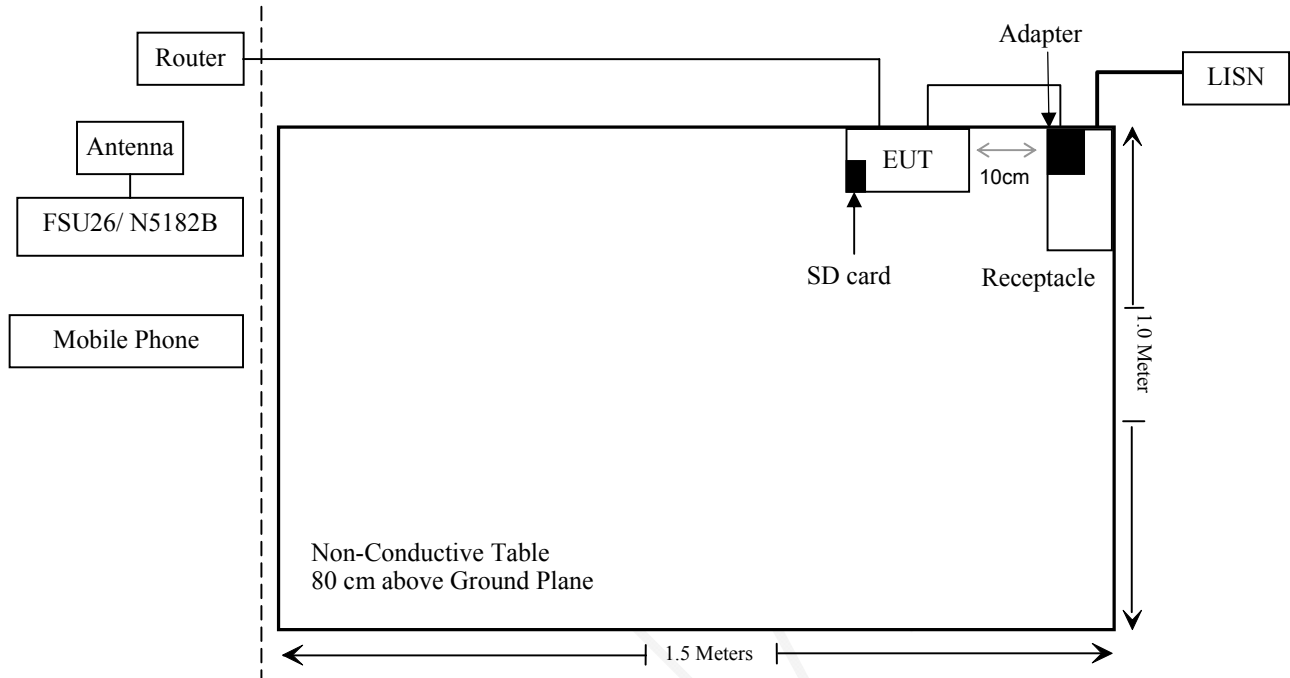
External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-shield Detachable DC cable	1.0/1.5	EUT	Adapter
Un-shield Detachable RJ45 cable	10	EUT/POE/ISN	Router
Un-shield Detachable RJ45 cable	1.0	POE/ISN	EUT

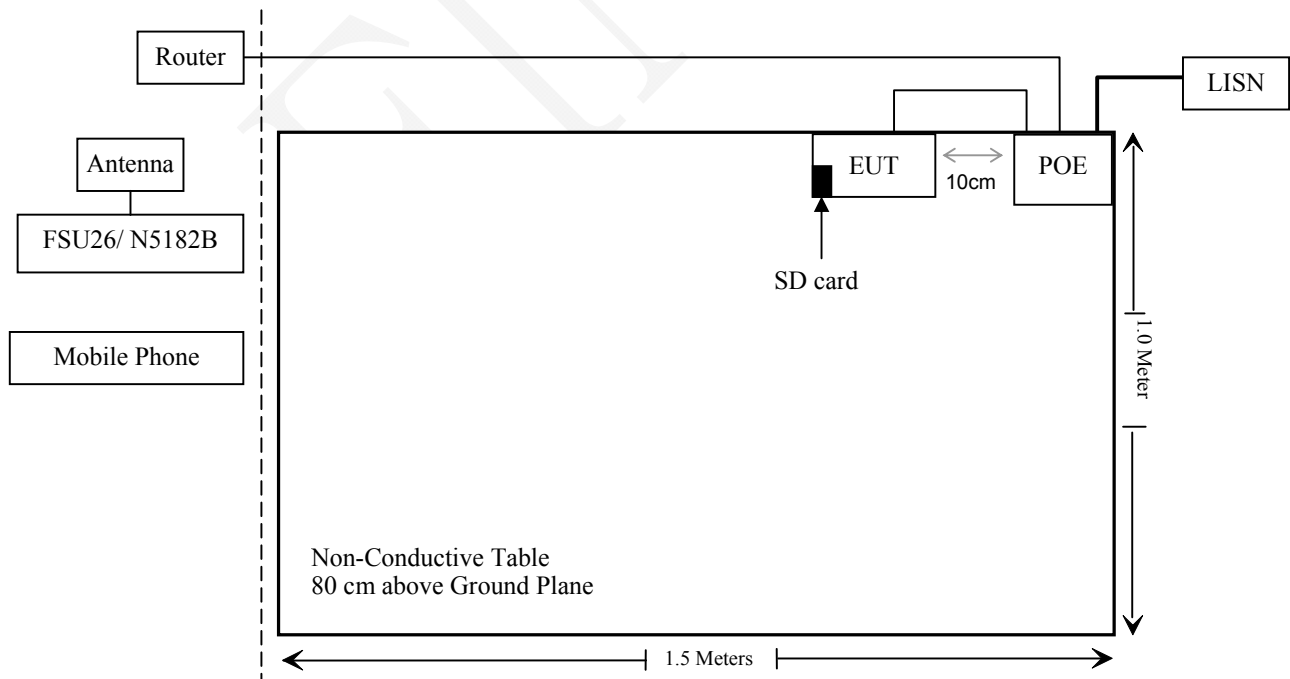
Block Diagram of Test Setup

Test Mode 1 & Test Mode 2 & Test Mode 3:

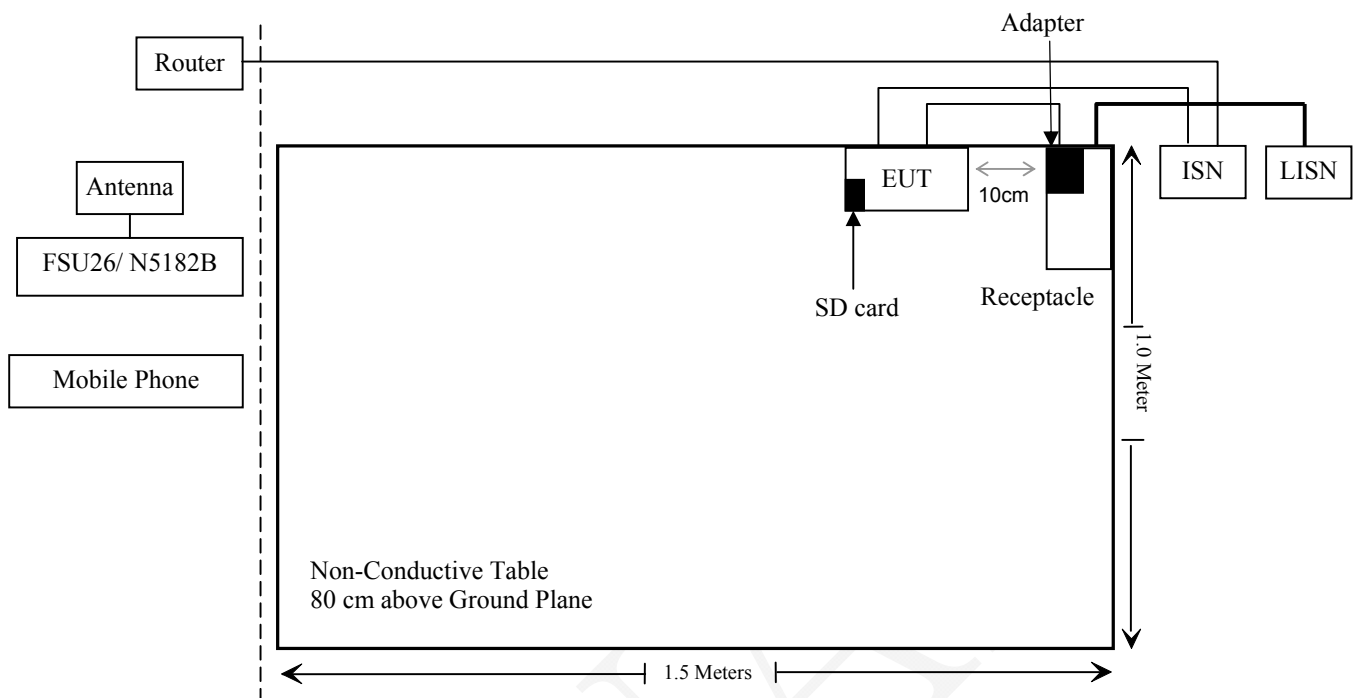
Powered by adapter:



Powered by POE:



RJ45 Port:



SUMMARY OF TEST REPORT**AS/NZS CISPR 32: 2015**

RULE	DESCRIPTION	RESULTS
§ A.3	Conducted Emission	Compliance
§ A.2	Radiated Emission	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2020/08/04	2021/08/03
Rohde & Schwarz	LISN	ENV216	101613	2020/08/04	2021/08/03
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2019/11/29	2020/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Schwarzbeck	ISN Cat 5	NTFM 8158	cat 5-8158-0010	2020/08/04	2021/08/03
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2020/08/04	2021/08/03
Sonoma instrument	Pre-amplifier	310 N	186238	2020/08/04	2021/08/03
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2020/08/04	2021/08/03
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
R&S	Auto test Software	EMC32	V9.10	NCR	NCR

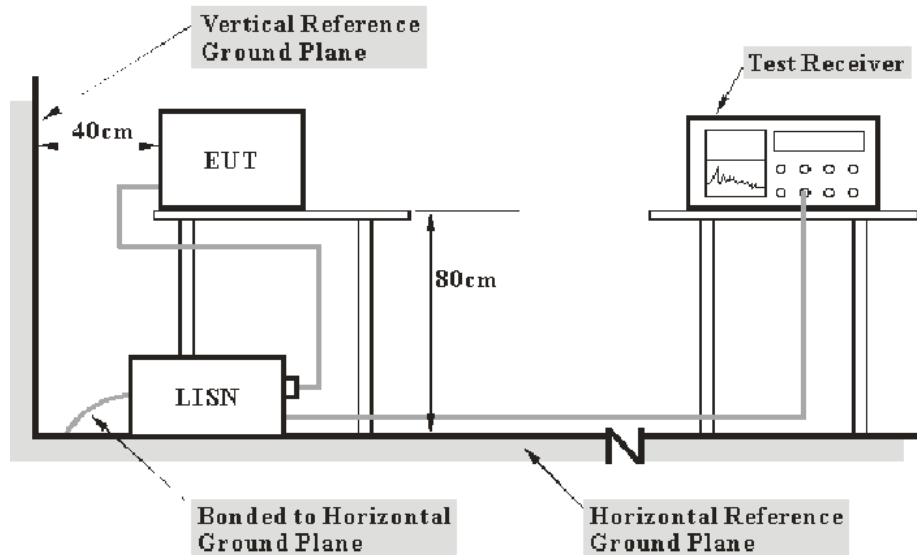
* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

AS/NZS CISPR 32: 2015 §A.3-CONDUCTED EMISSION

Applicable Standard

According to AS/NZS CISPR 32 §A.3

Test System Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure is in according with CISPR 16-2-1:2014. The related limit was specified in the AS/NZS CISPR 32: 2015.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance using all installation combination.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Pulse Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN/ISN VDF} + \text{Cable Loss} + \text{Pulse Limiter Attenuation}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Results Summary

According to the recorded data in following table, the EUT complied with the AS/NZS CISPR 32: 2015.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level is in compliance with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

in BACL, $U_{(Lm)}$ is less than U_{cispr} , if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

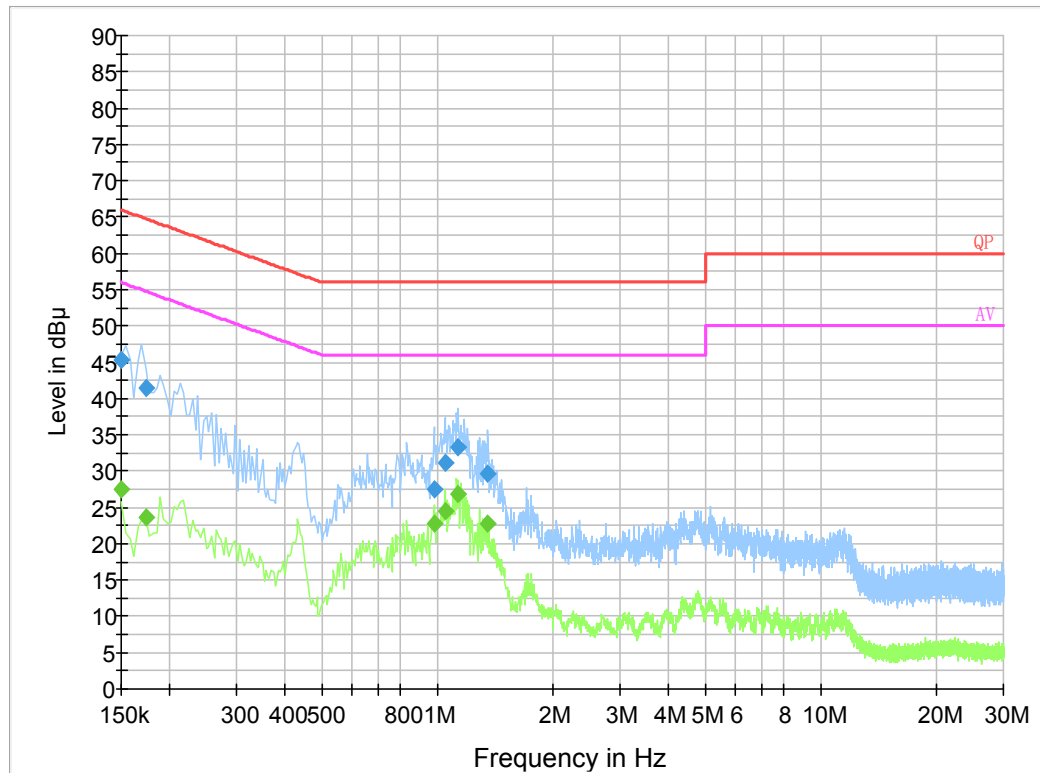
The testing was performed by Haiguo Li on 2020-11-12.

Test Mode 2 (worst case):

For Lora module of RAK 2247:

Powered by adapter:

AC 230 V/ 50 Hz, Line:

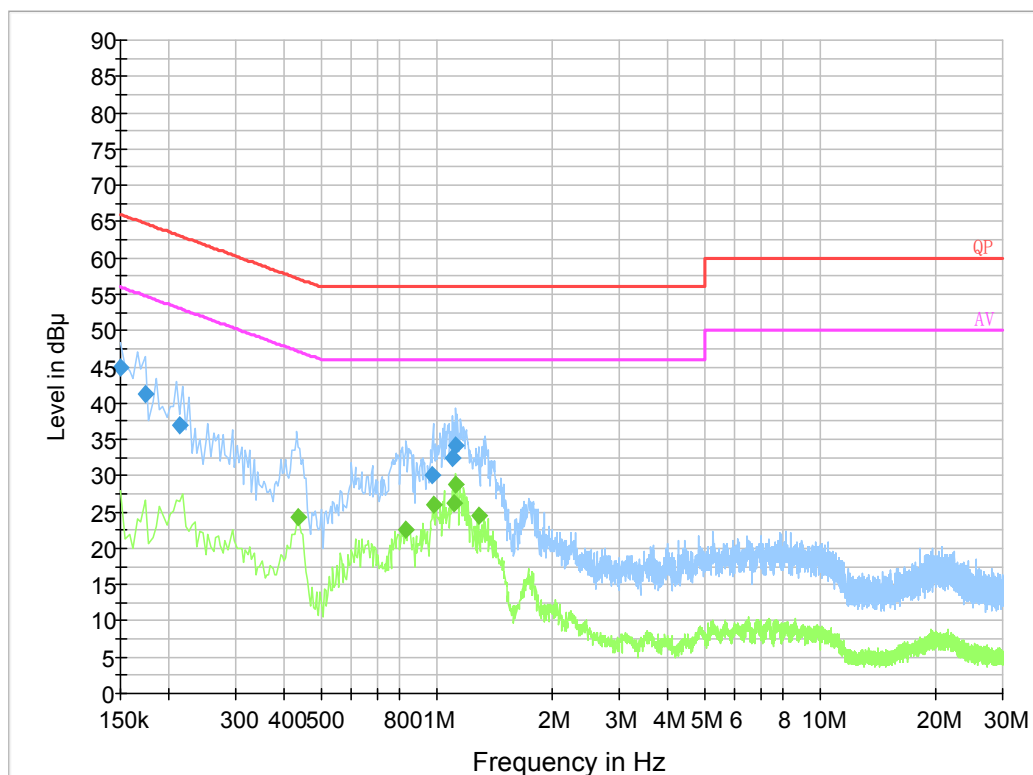


Final Result 1

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150000	45.3	0.200	L1	19.8	20.7	66.0
0.173500	41.5	9.000	L1	19.9	23.3	64.8
0.987270	27.5	9.000	L1	19.9	28.5	56.0
1.050250	31.1	9.000	L1	19.9	24.9	56.0
1.132930	33.3	9.000	L1	19.8	22.7	56.0
1.357630	29.7	9.000	L1	19.8	26.3	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150000	27.5	9.000	L1	19.8	28.5	56.0
0.173500	23.6	9.000	L1	19.9	31.2	54.8
0.987270	22.7	9.000	L1	19.9	23.3	46.0
1.050250	24.5	9.000	L1	19.9	21.5	46.0
1.132930	26.8	9.000	L1	19.8	19.2	46.0
1.357630	22.8	9.000	L1	19.8	23.2	46.0

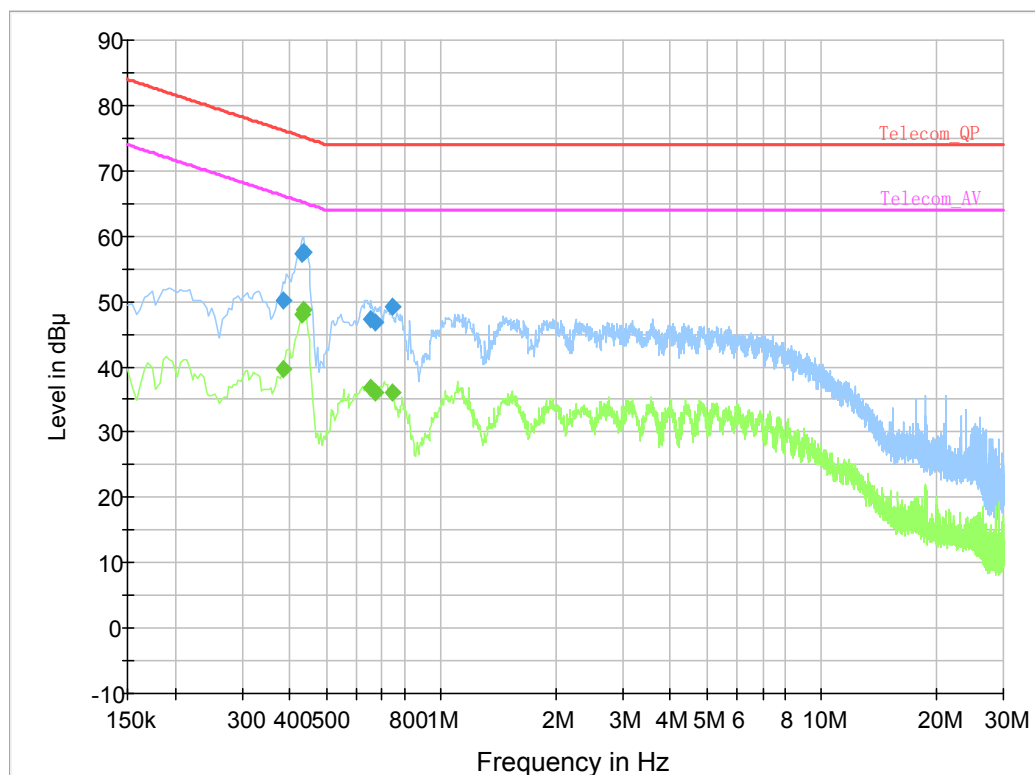
AC 230 V/ 50 Hz, Neutral:**Final Result 1**

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150000	44.9	0.200	N	19.8	21.1	66.0
0.173500	41.3	9.000	N	19.8	23.5	64.8
0.213500	36.9	9.000	N	19.8	26.2	63.1
0.979270	30.1	9.000	N	19.8	25.9	56.0
1.101470	32.5	9.000	N	19.8	23.5	56.0
1.125110	34.0	9.000	N	19.8	22.0	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.438000	24.3	9.000	N	19.8	22.8	47.1
0.834000	22.6	9.000	N	19.8	23.4	46.0
0.982000	25.9	9.000	N	19.8	20.1	46.0
1.114000	26.3	9.000	N	19.8	19.7	46.0
1.126000	28.8	9.000	N	19.8	17.2	46.0
1.290000	24.4	9.000	N	19.8	21.6	46.0

RJ45 Port: (worst case is powered by Adapter)



Final Result 1

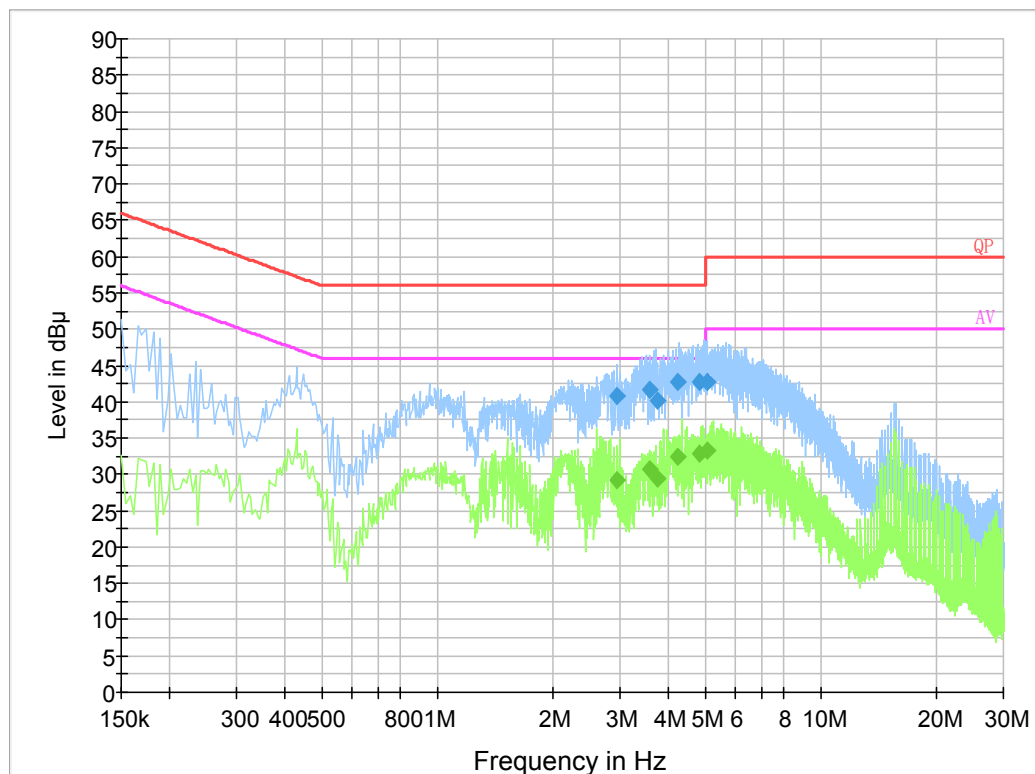
Frequency (MHz)	QuasiPeak (dB μV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μV)
0.386000	50.1	9.000	N	19.8	26.0	76.1
0.430000	57.2	9.000	N	19.8	18.1	75.3
0.434000	57.6	9.000	N	19.8	17.6	75.2
0.654000	47.2	9.000	N	19.8	26.8	74.0
0.674000	46.7	9.000	N	19.8	27.3	74.0
0.742000	49.2	9.000	N	19.8	24.8	74.0

Final Result 2

Frequency (MHz)	Average (dB μV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μV)
0.386000	39.6	9.000	N	19.8	26.5	66.1
0.430000	48.0	9.000	N	19.8	17.3	65.3
0.434000	48.8	9.000	N	19.8	16.4	65.2
0.654000	36.7	9.000	N	19.8	27.3	64.0
0.674000	36.0	9.000	N	19.8	28.0	64.0
0.742000	36.2	9.000	N	19.8	27.8	64.0

Powered by POE:

AC 230 V/ 50 Hz, Line:

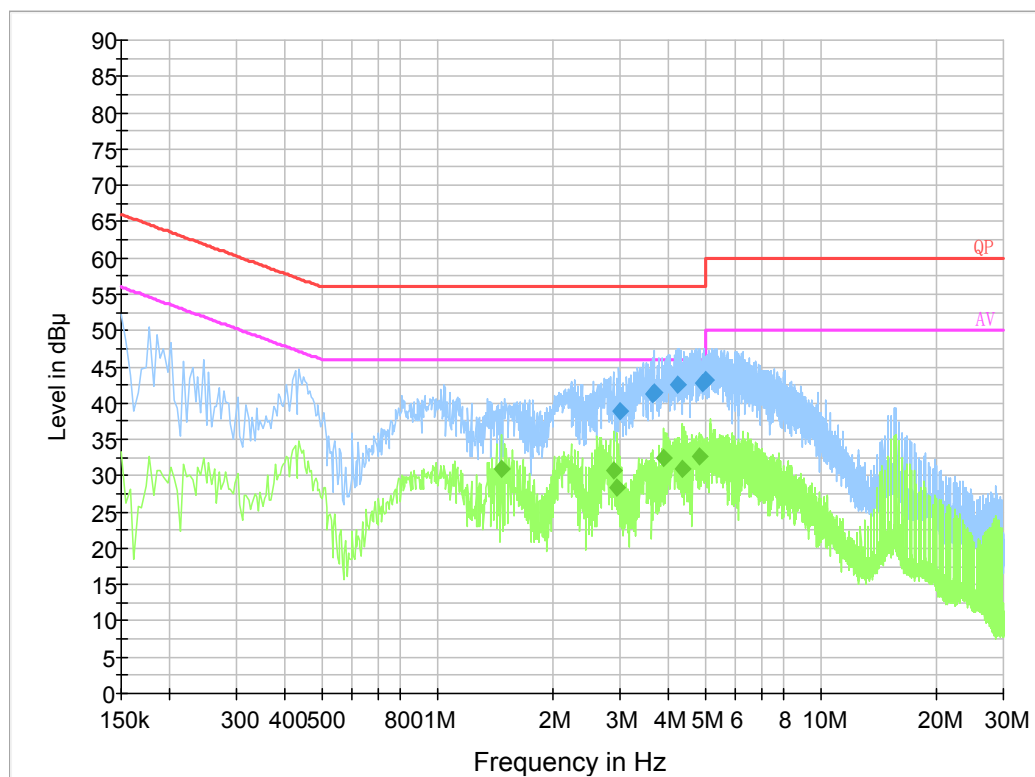


Final Result 1

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
2.953750	40.7	9.000	L1	19.9	15.3	56.0
3.577110	41.6	9.000	L1	19.9	14.4	56.0
3.738290	40.3	9.000	L1	19.9	15.7	56.0
4.237830	42.7	9.000	L1	19.9	13.3	56.0
4.830330	42.7	9.000	L1	19.9	13.3	56.0
5.043210	42.8	9.000	L1	19.9	17.2	60.0

Final Result 2

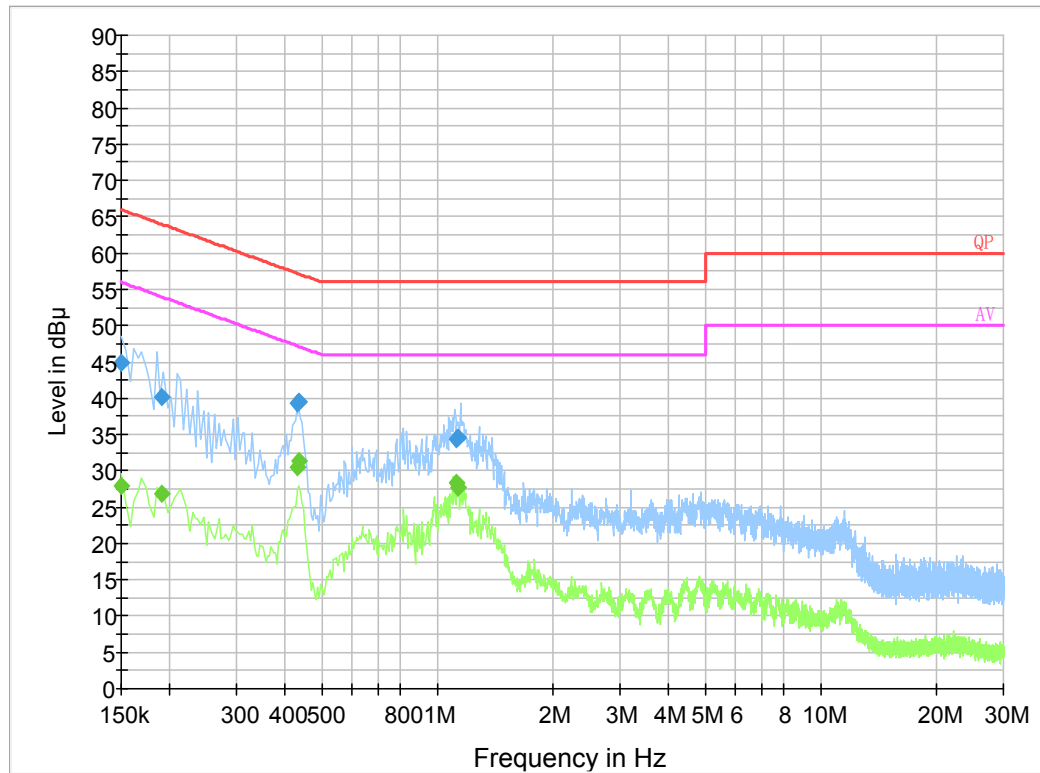
Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
2.953750	29.3	9.000	L1	19.9	16.7	46.0
3.577110	30.8	9.000	L1	19.9	15.2	46.0
3.738290	29.4	9.000	L1	19.9	16.6	46.0
4.237830	32.5	9.000	L1	19.9	13.5	46.0
4.830330	32.9	9.000	L1	19.9	13.1	46.0
5.043210	33.3	9.000	L1	19.9	16.7	50.0

AC 230 V/ 50 Hz, Neutral:**Final Result 1**

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
3.005270	38.9	9.000	N	19.9	17.1	56.0
3.643970	41.2	9.000	N	19.9	14.8	56.0
3.682890	41.4	9.000	N	19.9	14.6	56.0
4.253590	42.5	9.000	N	19.9	13.5	56.0
4.917190	42.8	9.000	N	19.9	13.2	56.0
5.039150	43.1	9.000	N	19.9	16.9	60.0

Final Result 2

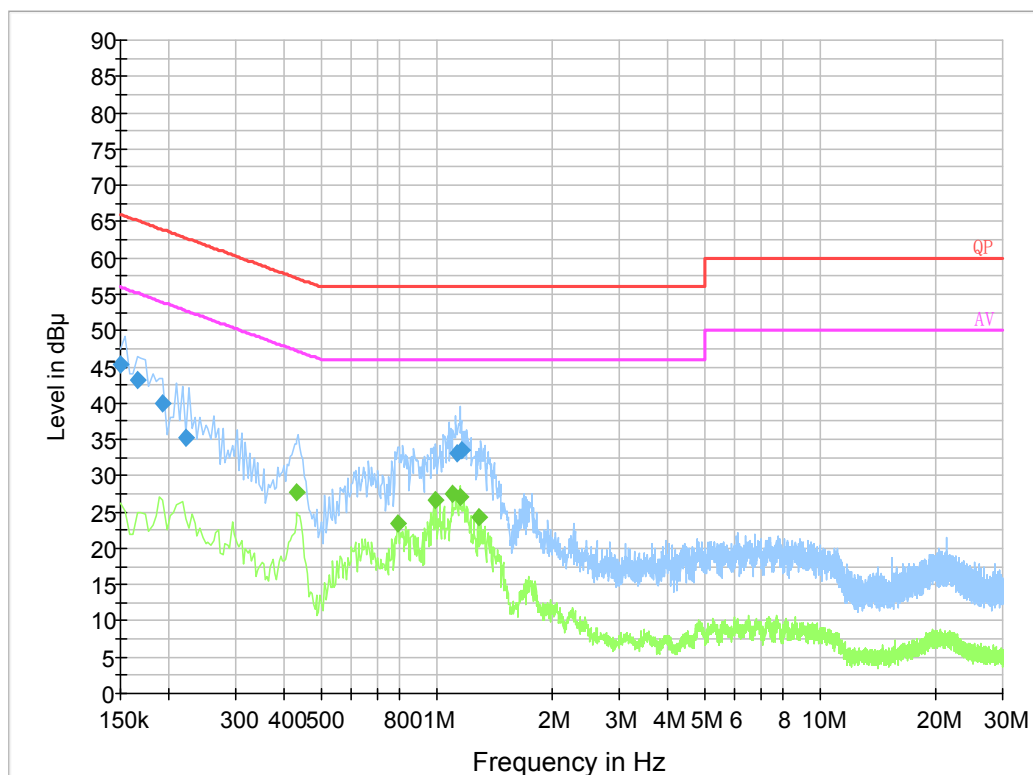
Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
1.466000	30.8	9.000	N	19.8	15.2	46.0
2.882000	30.8	9.000	N	19.9	15.2	46.0
2.946000	28.4	9.000	N	19.9	17.6	46.0
3.886000	32.5	9.000	N	19.9	13.5	46.0
4.346000	31.0	9.000	N	19.9	15.0	46.0
4.822000	32.7	9.000	N	19.9	13.3	46.0

For Lora module of RAK2287**Powered by adapter:****AC 230 V/ 50 Hz, Line****Final Result 1**

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150000	44.9	0.200	L1	19.8	21.1	66.0
0.190501	40.3	9.000	L1	19.8	23.7	64.0
0.431430	39.3	9.000	L1	19.8	17.9	57.2
0.435550	39.6	9.000	L1	19.8	17.5	57.1
1.125350	34.5	9.000	L1	19.8	21.5	56.0
1.136750	34.6	9.000	L1	19.8	21.4	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150000	28.0	9.000	L1	19.8	28.0	56.0
0.190501	26.8	9.000	L1	19.8	27.2	54.0
0.431430	30.6	9.000	L1	19.8	16.6	47.2
0.435550	31.4	9.000	L1	19.8	15.7	47.1
1.125350	28.4	9.000	L1	19.8	17.6	46.0
1.136750	27.8	9.000	L1	19.8	18.2	46.0

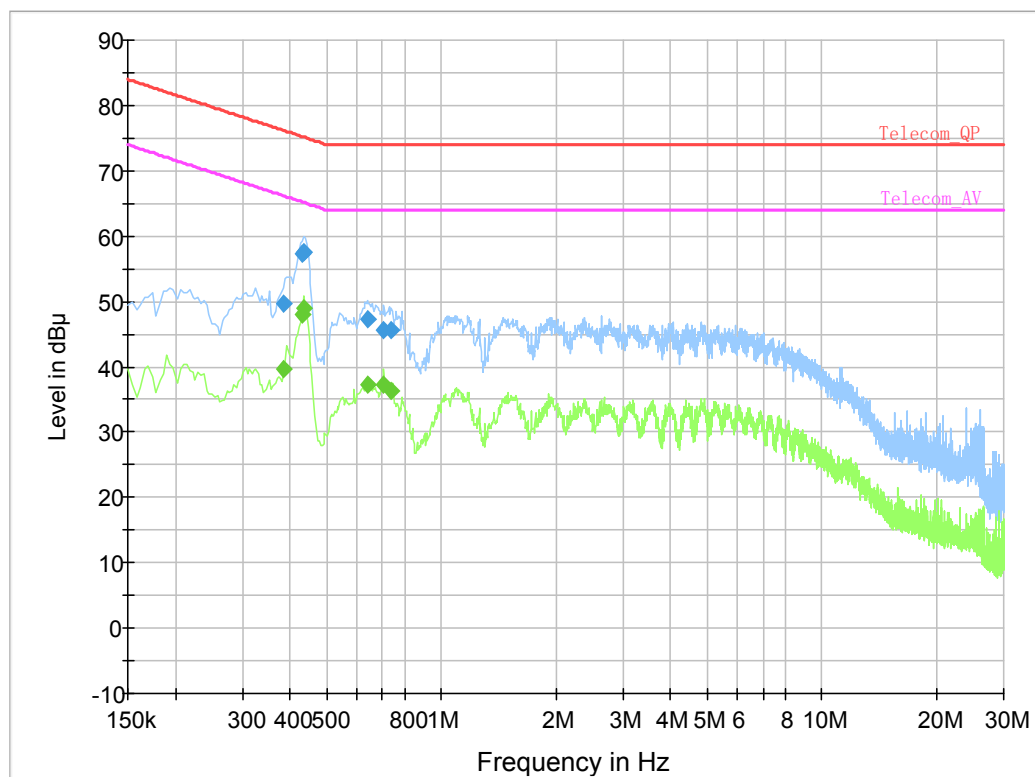
AC 230 V/ 50 Hz, Neutral:**Final Result 1**

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150000	45.3	0.200	N	19.8	20.7	66.0
0.165500	43.2	9.000	N	19.8	22.0	65.2
0.193500	40.0	9.000	N	19.8	23.9	63.9
0.221500	35.2	9.000	N	19.8	27.6	62.8
1.129170	33.1	9.000	N	19.8	22.9	56.0
1.160690	33.5	9.000	N	19.8	22.5	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.434000	27.8	9.000	N	19.8	19.4	47.2
0.794000	23.4	9.000	N	19.8	22.6	46.0
0.998000	26.6	9.000	N	19.8	19.4	46.0
1.102000	27.5	9.000	N	19.8	18.5	46.0
1.154000	27.1	9.000	N	19.8	18.9	46.0
1.286000	24.4	9.000	N	19.8	21.6	46.0

RJ45 Port: (worst case is powered by Adapter)



Final Result 1

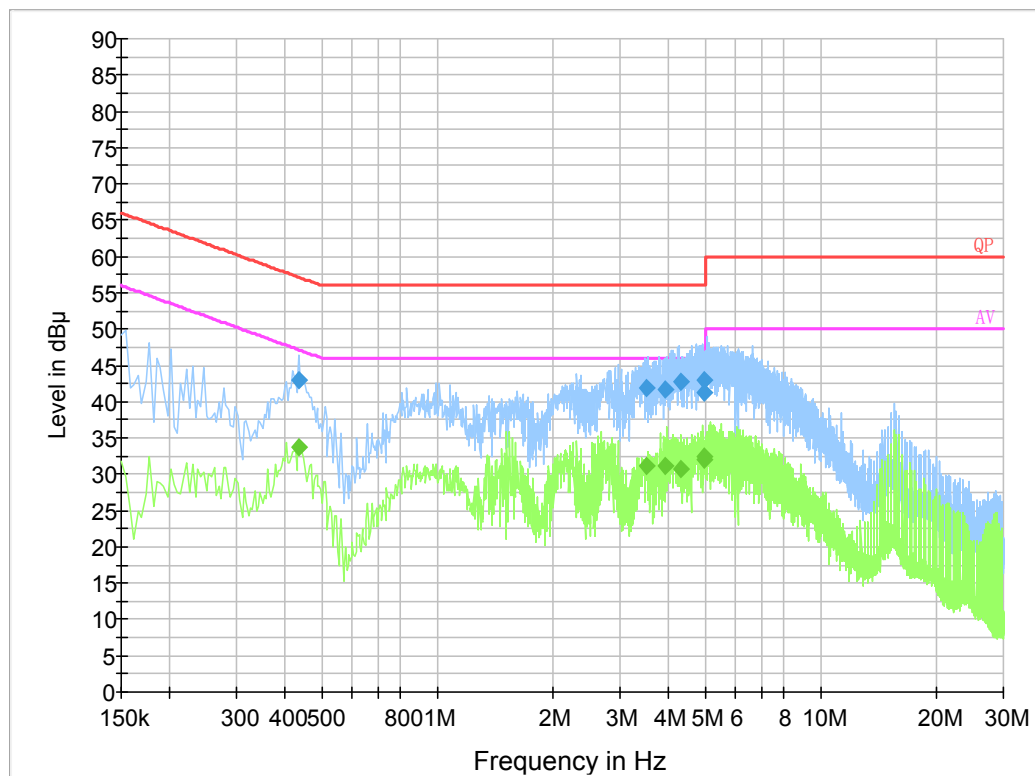
Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.386000	49.7	9.000	N	19.8	26.4	76.1
0.430000	57.2	9.000	N	19.8	18.1	75.3
0.434000	57.6	9.000	N	19.8	17.6	75.2
0.638000	47.2	9.000	N	19.8	26.8	74.0
0.706000	45.6	9.000	N	19.8	28.4	74.0
0.738000	45.6	9.000	N	19.8	28.4	74.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.386000	39.6	9.000	N	19.8	26.5	66.1
0.430000	48.0	9.000	N	19.8	17.3	65.3
0.434000	49.0	9.000	N	19.8	16.2	65.2
0.638000	37.2	9.000	N	19.8	26.8	64.0
0.706000	37.2	9.000	N	19.8	26.8	64.0
0.738000	36.3	9.000	N	19.8	27.7	64.0

Powered by POE:

AC 230 V/ 50 Hz, Line

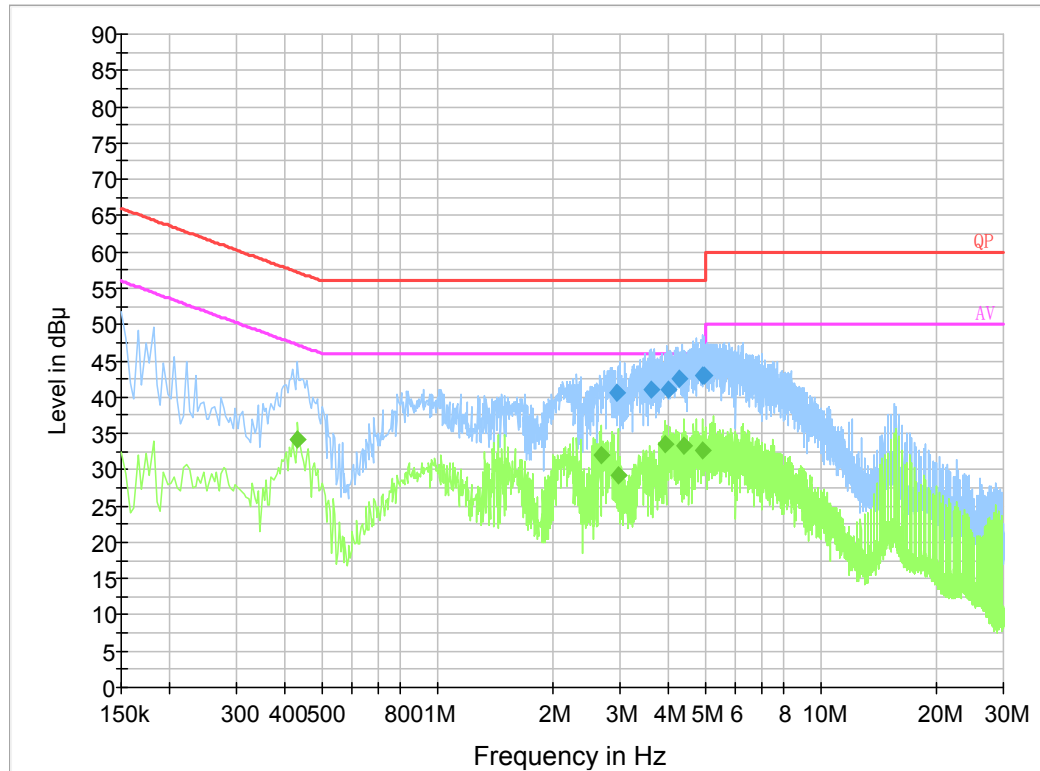


Final Result 1

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.435430	43.0	9.000	L1	19.8	14.1	57.1
3.524690	41.8	9.000	L1	19.9	14.2	56.0
3.946390	41.7	9.000	L1	19.9	14.3	56.0
4.329770	42.7	9.000	L1	19.9	13.3	56.0
4.980170	41.2	9.000	L1	19.9	14.8	56.0
4.987030	43.0	9.000	L1	19.9	13.0	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.435430	33.7	9.000	L1	19.8	13.4	47.1
3.524690	31.1	9.000	L1	19.9	14.9	46.0
3.946390	31.1	9.000	L1	19.9	14.9	46.0
4.329770	30.8	9.000	L1	19.9	15.2	46.0
4.980170	32.0	9.000	L1	19.9	14.0	46.0
4.987030	32.4	9.000	L1	19.9	13.6	46.0

AC 230 V/ 50 Hz, Neutral:**Final Result 1**

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
2.957090	40.5	9.000	N	19.9	15.5	56.0
3.627970	41.1	9.000	N	19.9	14.9	56.0
4.022450	41.0	9.000	N	19.9	15.0	56.0
4.292630	42.5	9.000	N	19.9	13.5	56.0
4.940230	42.9	9.000	N	19.9	13.1	56.0
4.963210	42.9	9.000	N	19.9	13.1	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.434000	34.1	9.000	N	19.8	13.1	47.2
2.678000	32.0	9.000	N	19.8	14.0	46.0
2.958000	29.2	9.000	N	19.9	16.8	46.0
3.942000	33.5	9.000	N	19.9	12.5	46.0
4.410000	33.2	9.000	N	19.9	12.8	46.0
4.918000	32.6	9.000	N	19.9	13.4	46.0

Note:

- 1) Correction Factor = LISN/ISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
- 2) Corrected Amplitude = Reading + Correction Factor
- 3) Margin = Limit – Corrected Amplitude

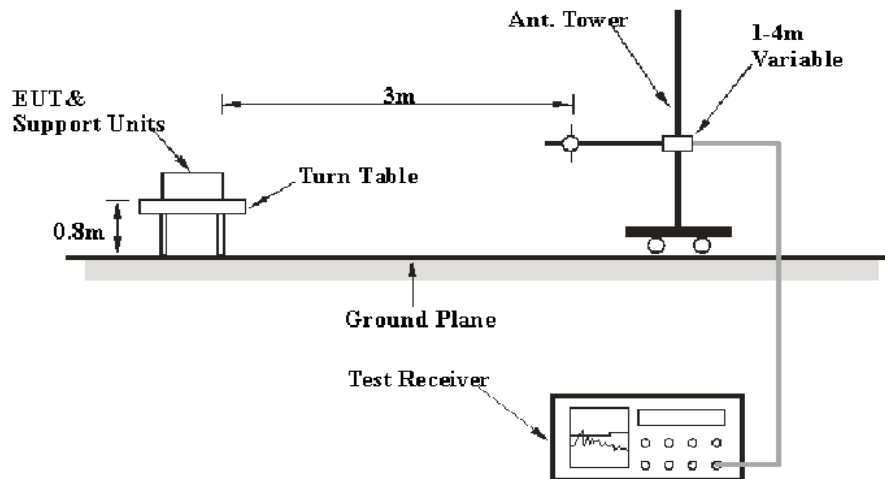
AS/NZS CISPR 32: 2015 §A.2-RADIATED EMISSION

Applicable Standard

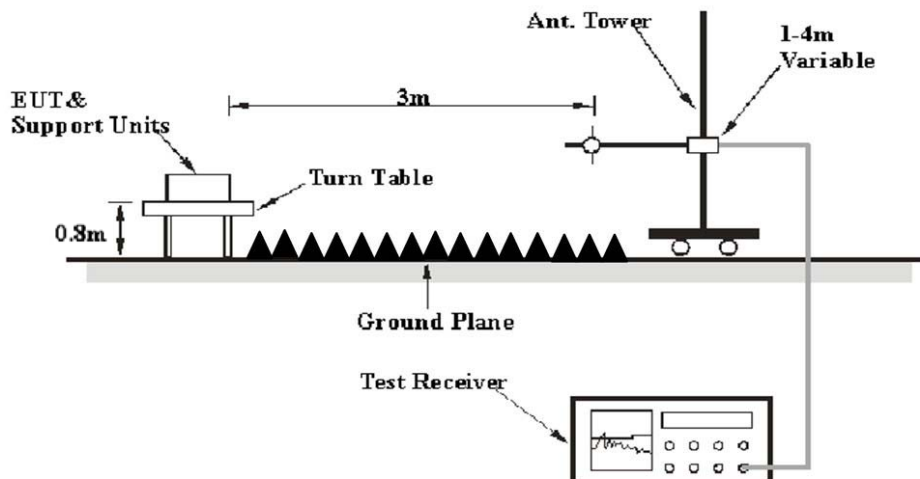
According to AS/NZS CISPR 32 §A.2

Test System Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, the setup of EUT is according with CISPR 16-1-4: 2010+A1: 2012, CISPR 16-2-3:2010+A1:2010+A2:2014 measurement procedure, the related limit was specified in the AS/NZS CISPR 32: 2015.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

During the radiated emission test, the EMI test receiver was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
1 GHz~6 GHz	1 MHz	3 MHz	/	Peak
1 GHz~6 GHz	1 MHz	10 Hz	/	Average

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Results Summary

According to the data in the following table, the EUT complied with the limit of AS/NZS CISPR 32: 2015

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(L_m)} \leq L_{\text{lim}} + U_{\text{cispr}}$$

In BACL., $U_{(L_m)}$ is less than $+ U_{\text{cispr}}$, if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

Test Data

Environmental Conditions

Temperature:	24~29.3 °C
Relative Humidity:	44~60 %
ATM Pressure:	100.9~101.0 kPa

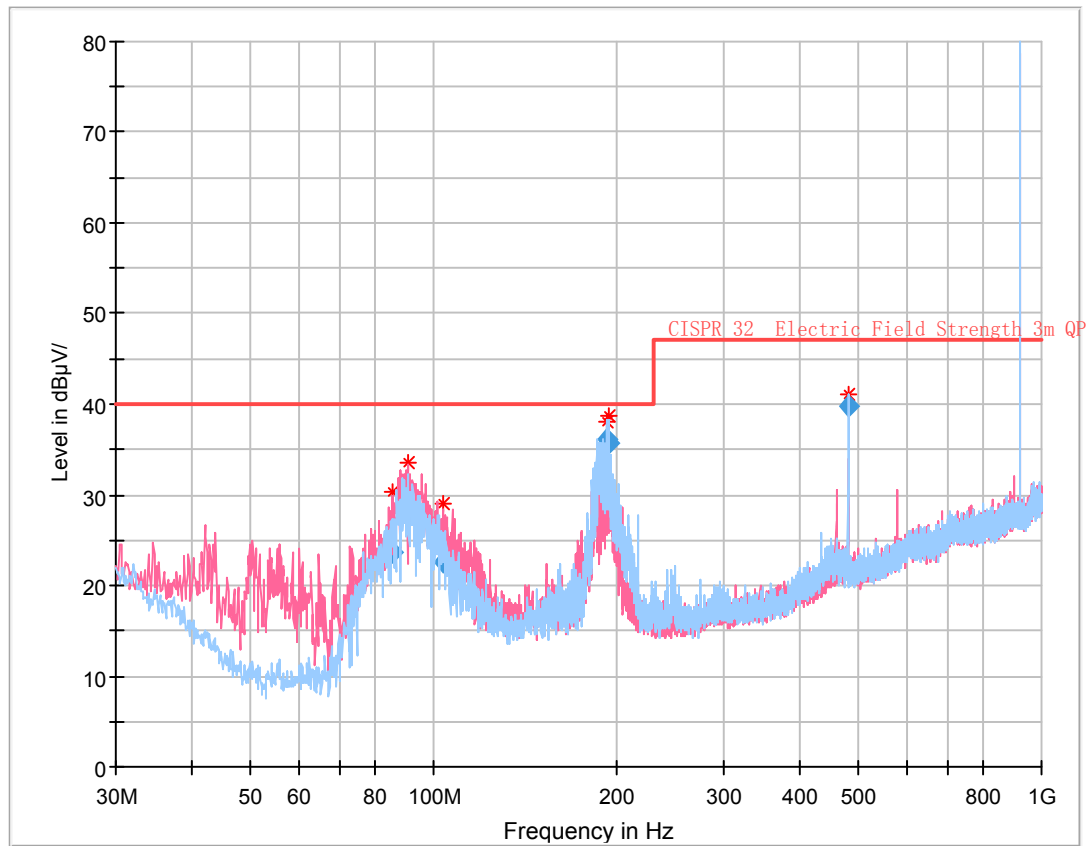
The testing was performed by Harris He for below 1GHz and Leven Gan for above 1GHz on 2020-11-12.

Test Mode 2 (worst case):

Powered by Adapter:

For Lora module of RAK2247:

30 MHz ~ 1GHz:



Final_Result

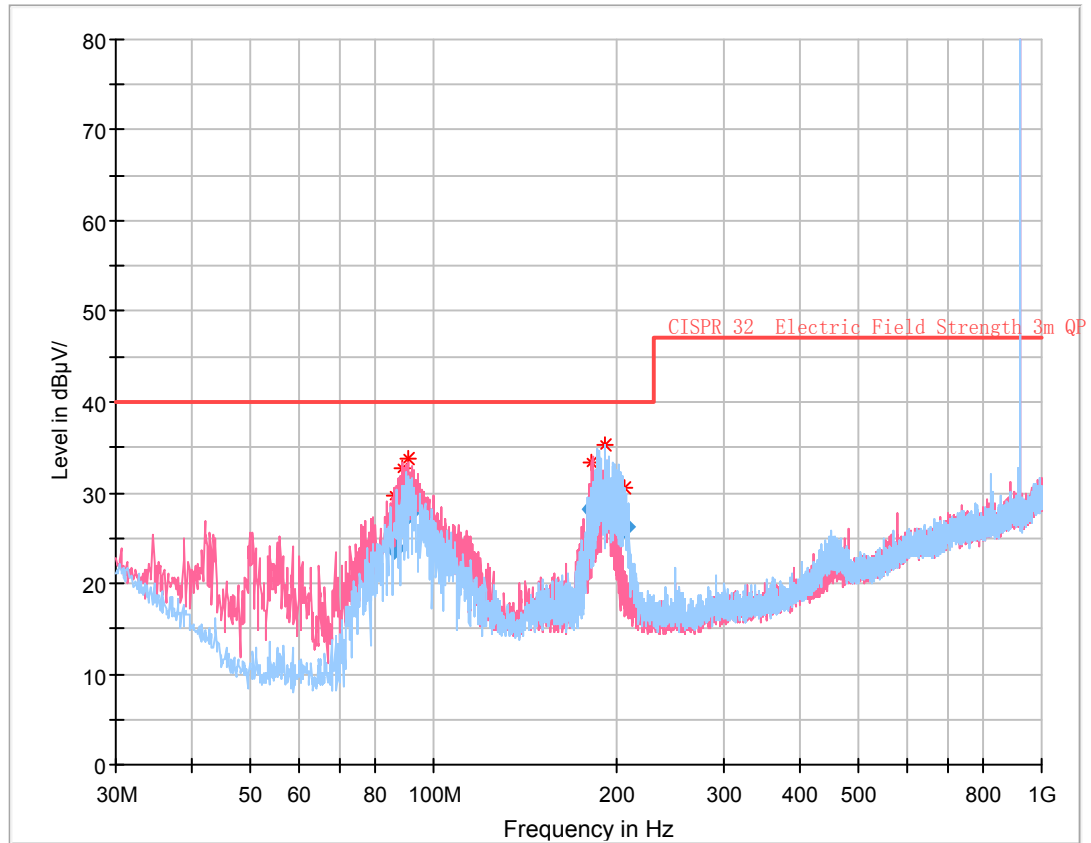
Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
85.594500	23.70	40.00	16.30	173.0	V	261.0	-16.3
90.904375	27.76	40.00	12.24	135.0	V	247.0	-15.7
103.392875	22.60	40.00	17.40	102.0	V	280.0	-13.3
192.518500	36.09	40.00	3.91	118.0	H	147.0	-11.7
194.446375	35.62	40.00	4.38	192.0	H	143.0	-11.4
480.171000	39.81	47.00	7.19	109.0	H	335.0	-5.3

1-6 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	AS/NZS CISPR 32	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
1199.23	48.90	PK	228	2.2	H	-4.88	44.02	70	25.98
1199.23	32.45	Ave.	228	2.2	H	-4.88	27.57	50	22.43
1199.23	48.42	PK	197	2.1	V	-4.88	43.54	70	26.46
1199.23	32.51	Ave.	197	2.1	V	-4.88	27.63	50	22.37
2465.31	50.02	PK	151	2.1	H	-0.25	49.77	70	20.23
2465.31	30.79	Ave.	151	2.1	H	-0.25	30.54	50	19.46
2465.31	48.75	PK	60	1.5	V	-0.25	48.50	70	21.50
2465.31	30.57	Ave.	60	1.5	V	-0.25	30.32	50	19.68

For Lora module of RAK2287:

30 MHz ~ 1GHz:



Final Result

Frequency (MHz)	QuasiPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
86.082625	23.88	40.00	16.12	171.0	V	253.0	-16.2
88.928250	27.16	40.00	12.84	139.0	V	234.0	-16.0
90.586375	27.66	40.00	12.34	141.0	V	223.0	-15.7
182.308750	28.15	40.00	11.85	114.0	V	220.0	-12.0
191.557625	30.28	40.00	9.72	281.0	H	12.0	-11.8
206.363875	26.15	40.00	13.85	206.0	H	142.0	-10.7

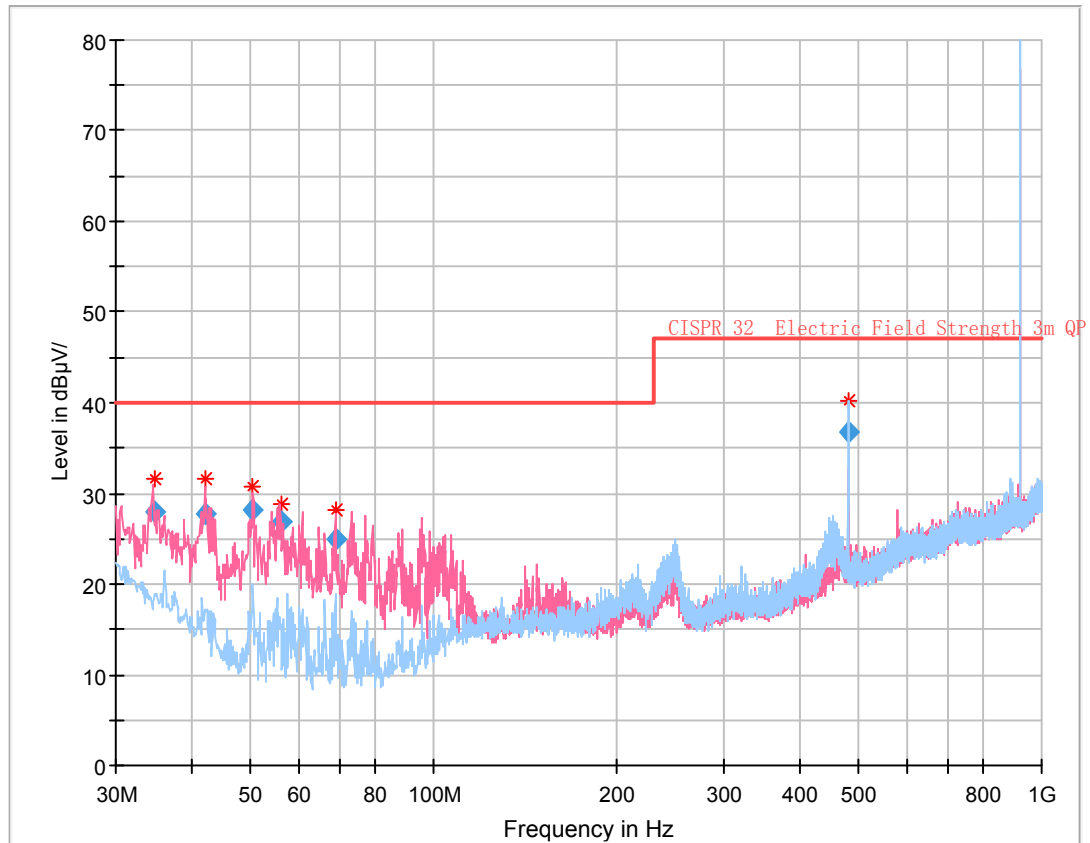
1-6 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	AS/NZS CISPR 32	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
1199.23	48.90	PK	228	2.2	H	-4.88	44.02	70	25.98
1199.23	32.45	Ave.	228	2.2	H	-4.88	27.57	50	22.43
1199.23	48.42	PK	197	2.1	V	-4.88	43.54	70	26.46
1199.23	32.51	Ave.	197	2.1	V	-4.88	27.63	50	22.37
2530.46	51.27	PK	165	1.7	H	-0.05	51.22	70	18.78
2530.46	30.24	Ave.	165	1.7	H	-0.05	30.19	50	19.81
2530.46	49.96	PK	28	2.1	V	-0.05	49.91	70	20.09
2530.46	30.36	Ave.	28	2.1	V	-0.05	30.31	50	19.69

Powered by POE:

For Lora module of RAK2247

30 MHz ~ 1GHz:

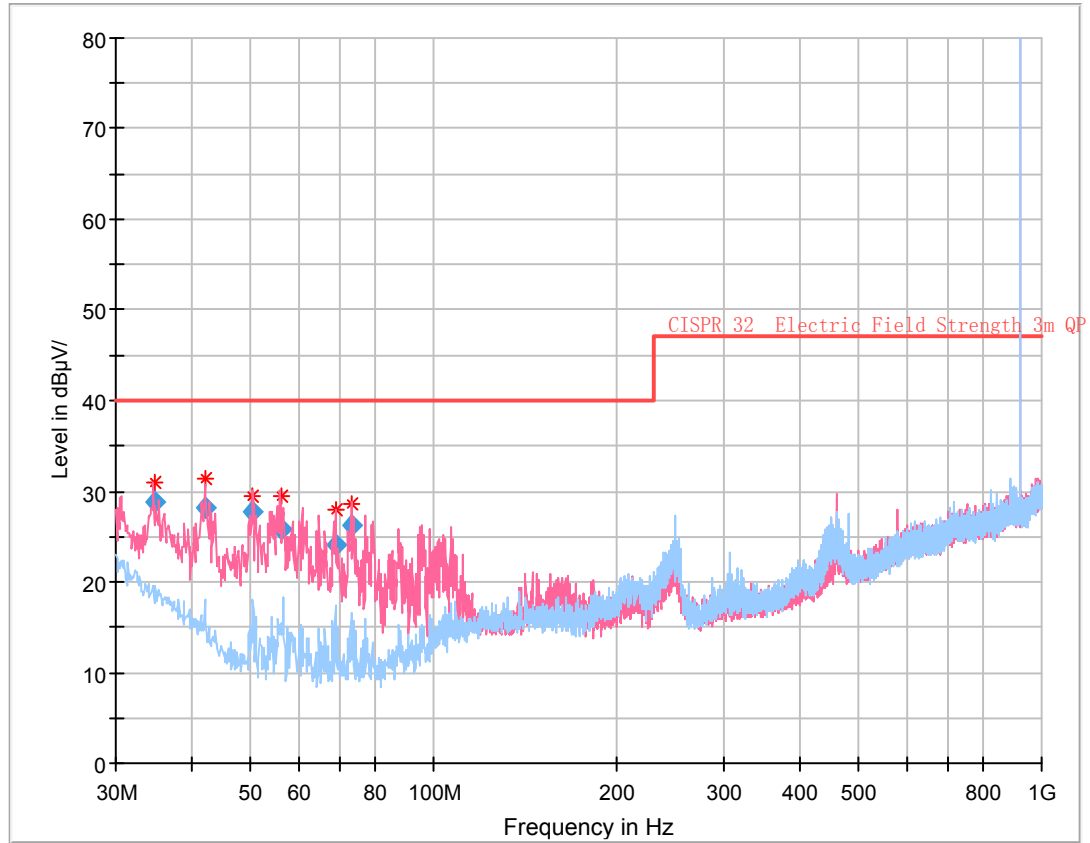


Final Result

Frequency (MHz)	QuasiPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
34.663750	27.95	40.00	12.05	102.0	V	32.0	-7.2
42.082625	27.80	40.00	12.20	114.0	V	251.0	-12.1
50.460875	28.18	40.00	11.82	104.0	V	118.0	-16.5
56.045500	26.79	40.00	13.21	121.0	V	234.0	-16.9
68.990250	24.91	40.00	15.09	166.0	V	0.0	-17.5
479.944125	36.88	47.00	10.12	109.0	H	336.0	-5.3

1-6 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	AS/NZS CISPR 32	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
1199.85	49.63	PK	44	2.4	H	-4.88	44.75	70	25.25
1199.85	31.45	Ave.	44	2.4	H	-4.88	26.57	50	23.43
1199.85	48.78	PK	164	2.4	V	-4.88	43.90	70	26.10
1199.85	31.10	Ave.	164	2.4	V	-4.88	26.22	50	23.78
2350.38	59.29	PK	81	2.5	H	-0.46	58.83	70	11.17
2350.38	30.89	Ave.	81	2.5	H	-0.46	30.43	50	19.57
2350.38	52.43	PK	166	2.4	V	-0.46	51.97	70	18.03
2350.38	30.29	Ave.	166	2.4	V	-0.46	29.83	50	20.17

For Lora module of RAK2287**30 MHz ~ 1GHz:****Final Result**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
34.646625	28.71	40.00	11.29	108.0	V	142.0	-7.2
42.070500	28.15	40.00	11.85	119.0	V	204.0	-12.0
50.415500	27.81	40.00	12.19	109.0	V	117.0	-16.5
56.030000	25.76	40.00	14.24	149.0	V	104.0	-16.9
69.073875	24.14	40.00	15.86	129.0	V	0.0	-17.5
73.176500	26.30	40.00	13.70	111.0	V	170.0	-17.3

1-6 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	AS/NZS CISPR 32	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
1572.96	42.85	PK	44	1.5	H	-2.71	40.14	70	29.86
1572.96	28.63	Ave.	44	1.5	H	-2.71	25.92	50	24.08
1572.96	43.88	PK	299	1.3	V	-2.71	41.17	70	28.83
1572.96	28.75	Ave.	299	1.3	V	-2.71	26.04	50	23.96
2537.63	52.34	PK	1	2.3	H	-0.05	52.29	70	17.71
2537.63	30.46	Ave.	1	2.3	H	-0.05	30.41	50	19.59
2537.63	51.45	PK	208	1.3	V	-0.05	51.40	70	18.60
2537.63	30.41	Ave.	208	1.3	V	-0.05	30.36	50	19.64

Note:

- 1) Corrected Amplitude = Meter Reading + Correction Factor
- 2) Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain
- 3) Margin = Limit – Corrected Amplitude

EXHIBIT A - EUT PHOTOGRAPHS



Lora Antenna



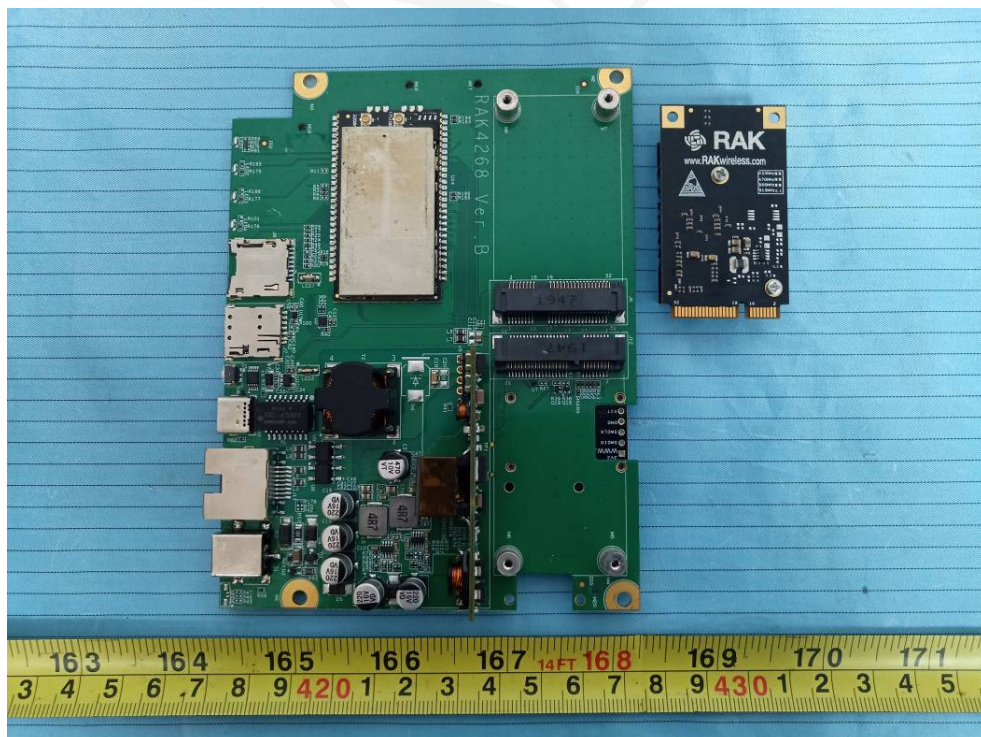




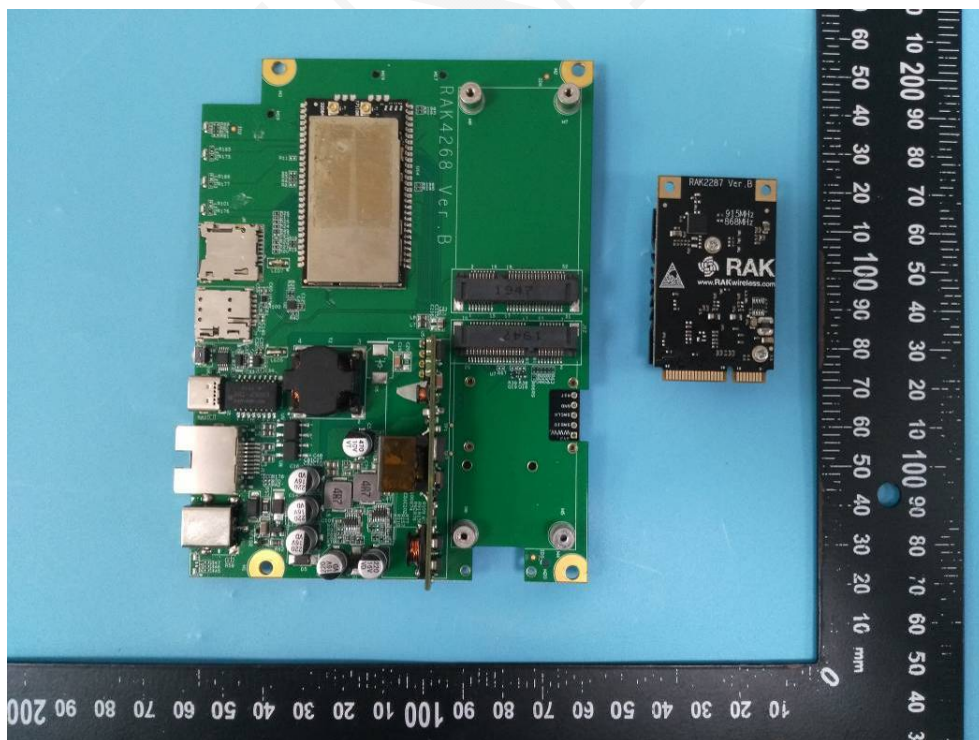


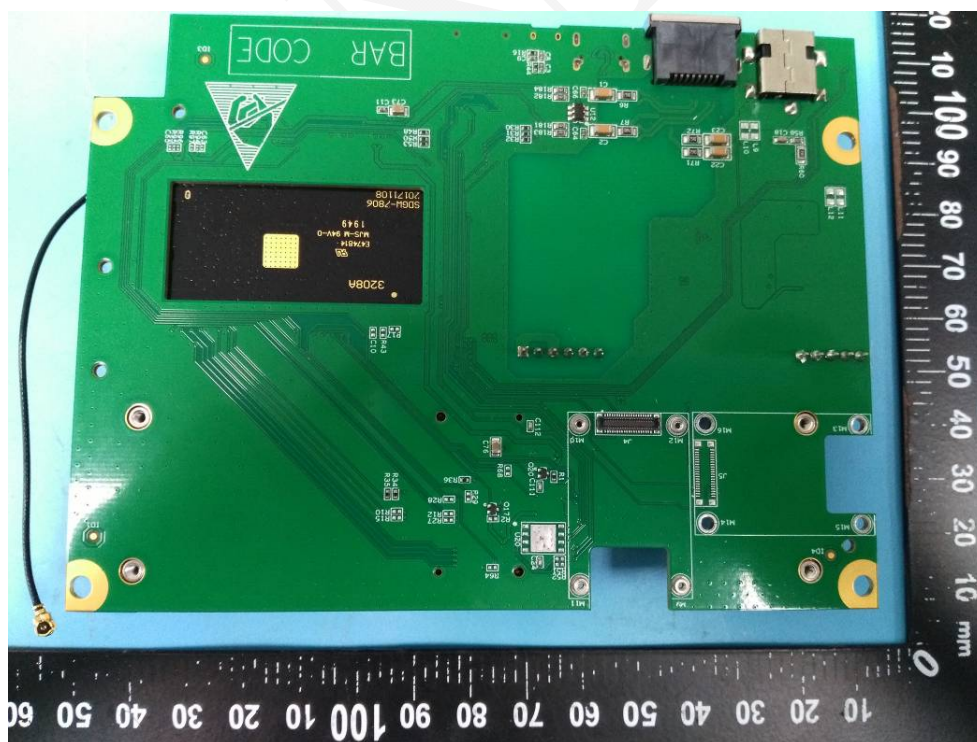
With the Lora module RAK2247

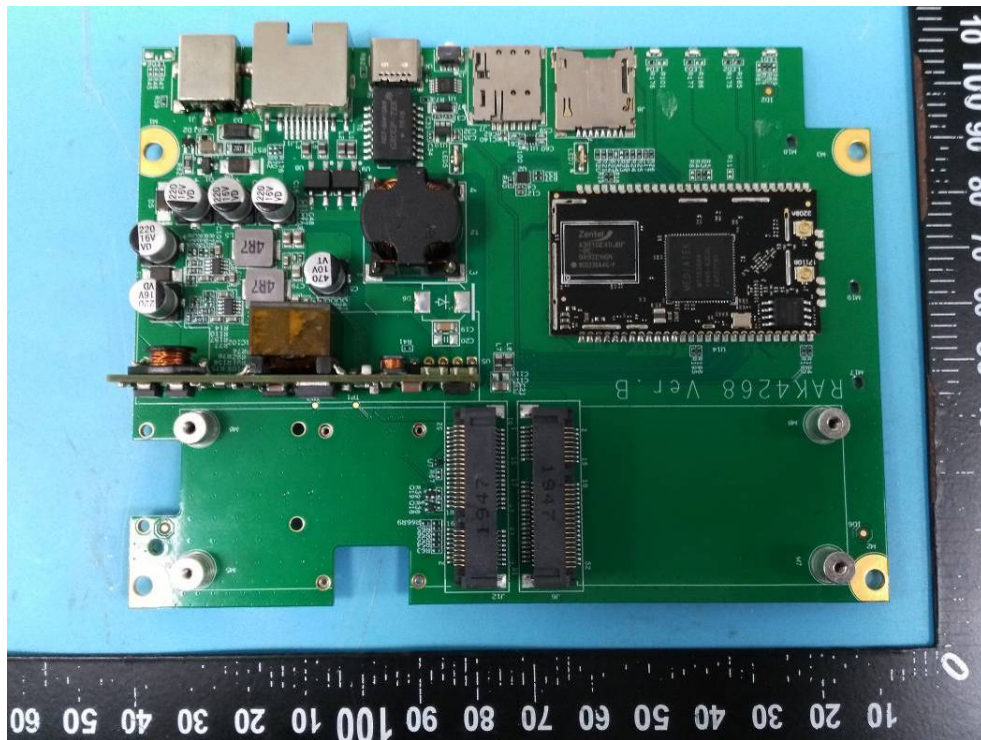


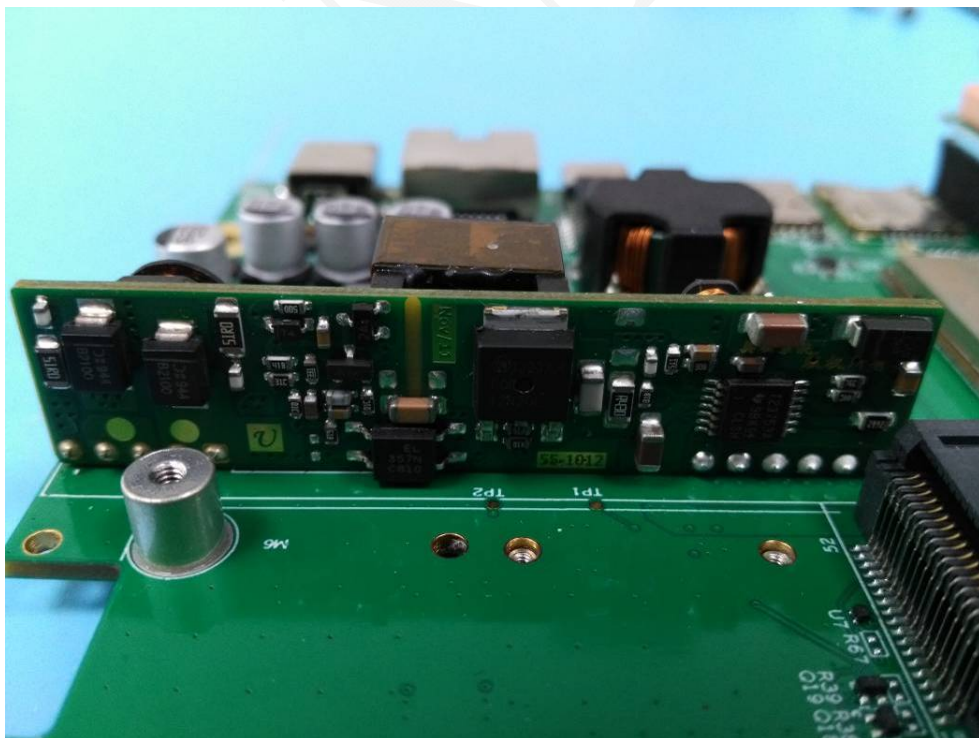


With the Lora module RAK2287

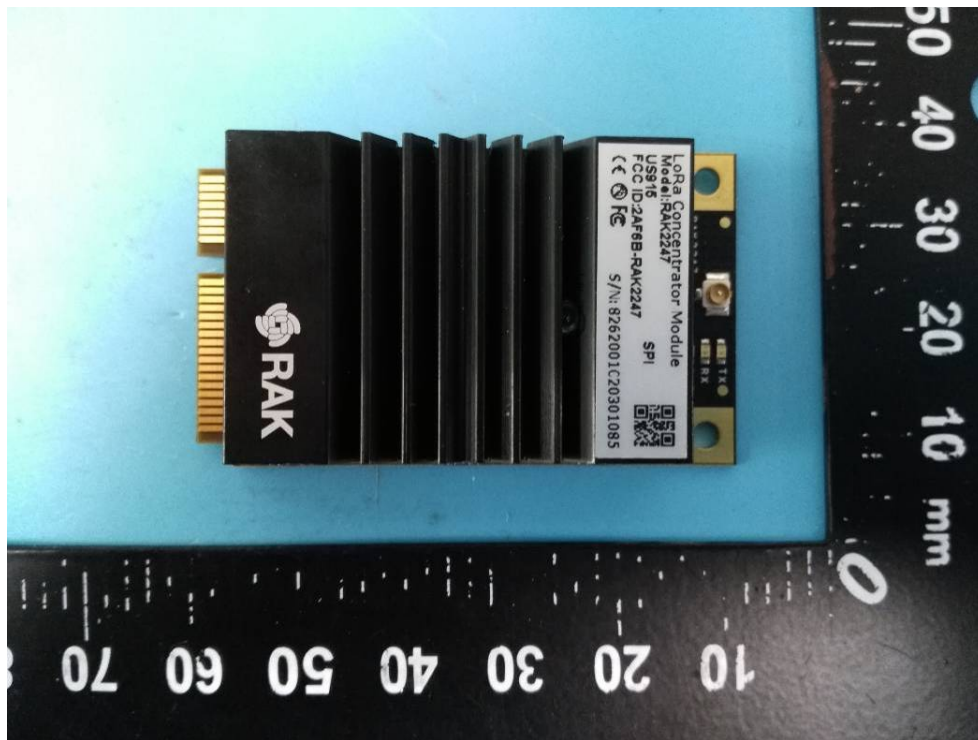




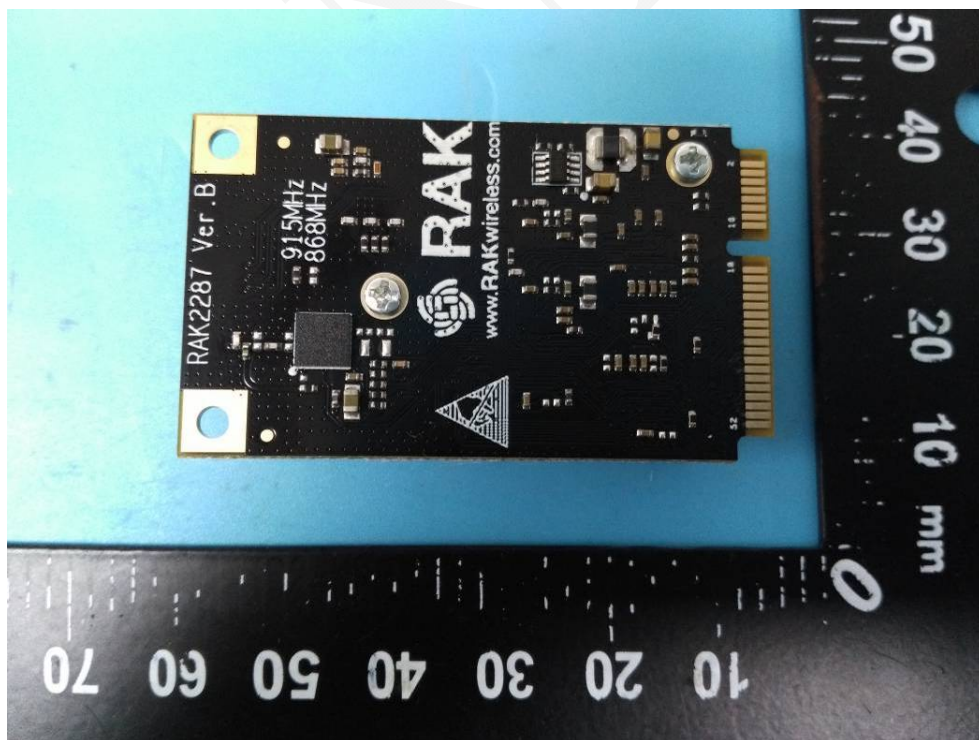




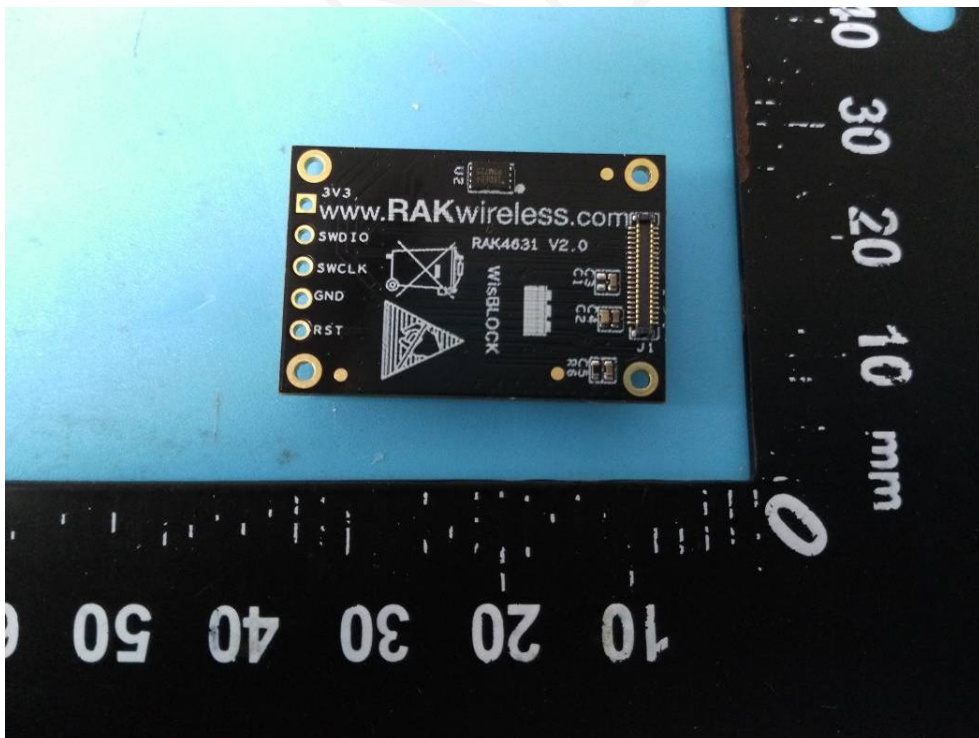
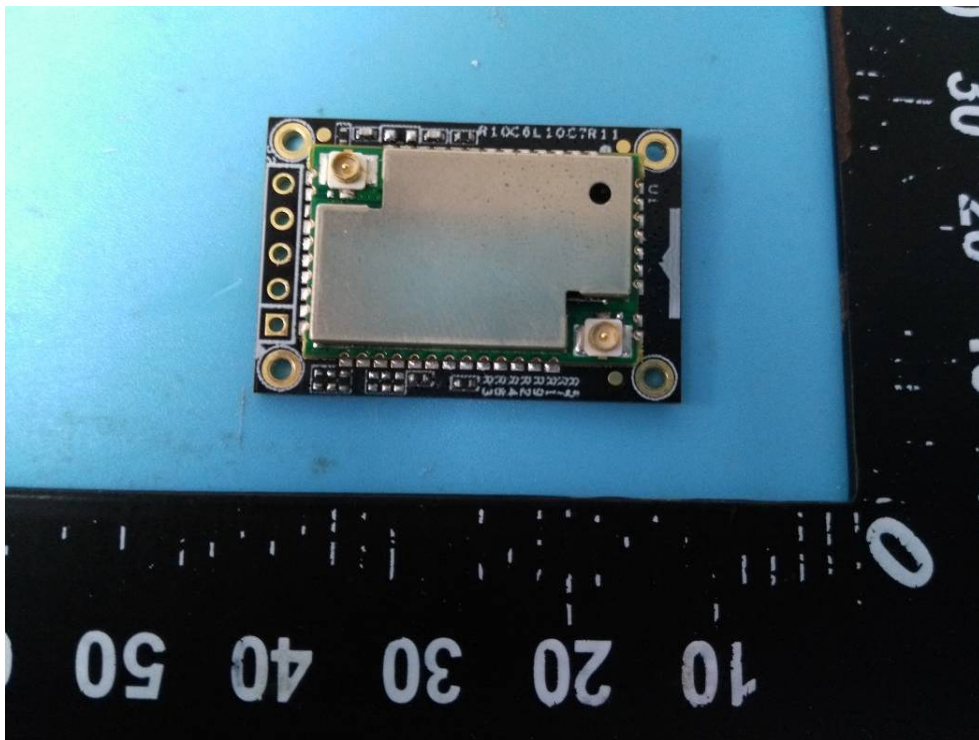
Lora module RAK2247

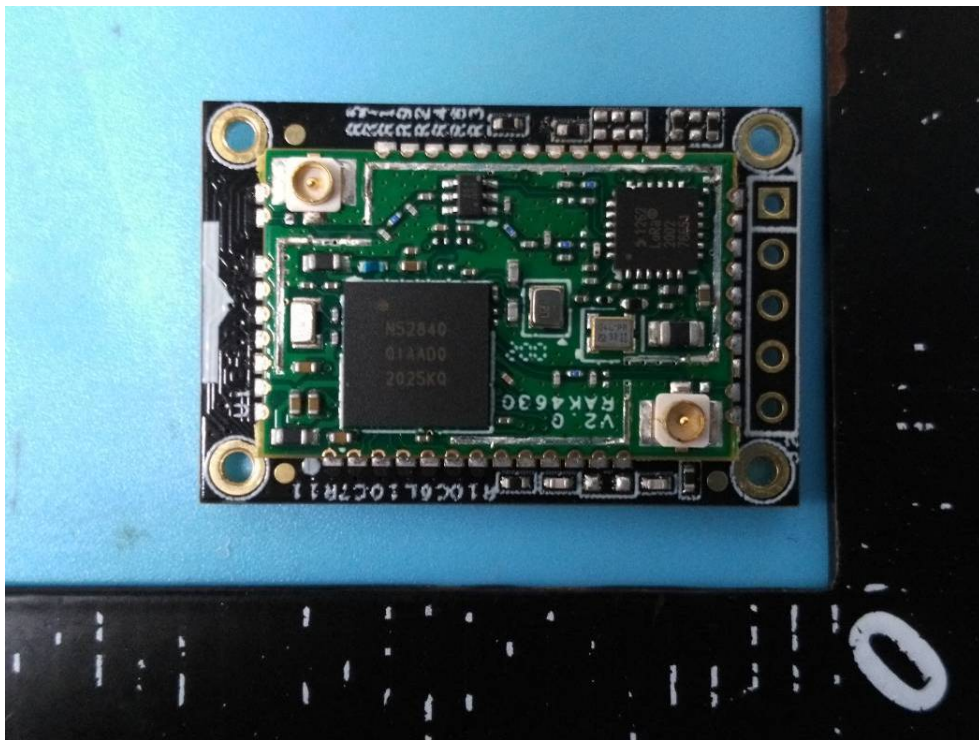






BT Module





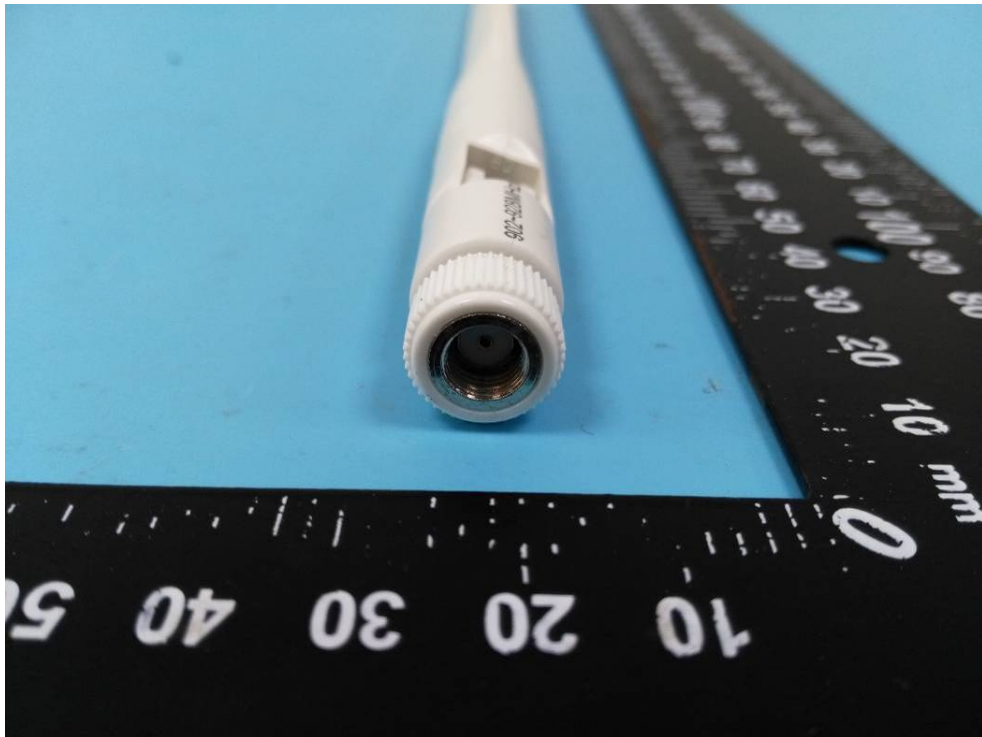
BT Antenna



Wi-Fi Antenna



Lora Antenna Port



Adapter





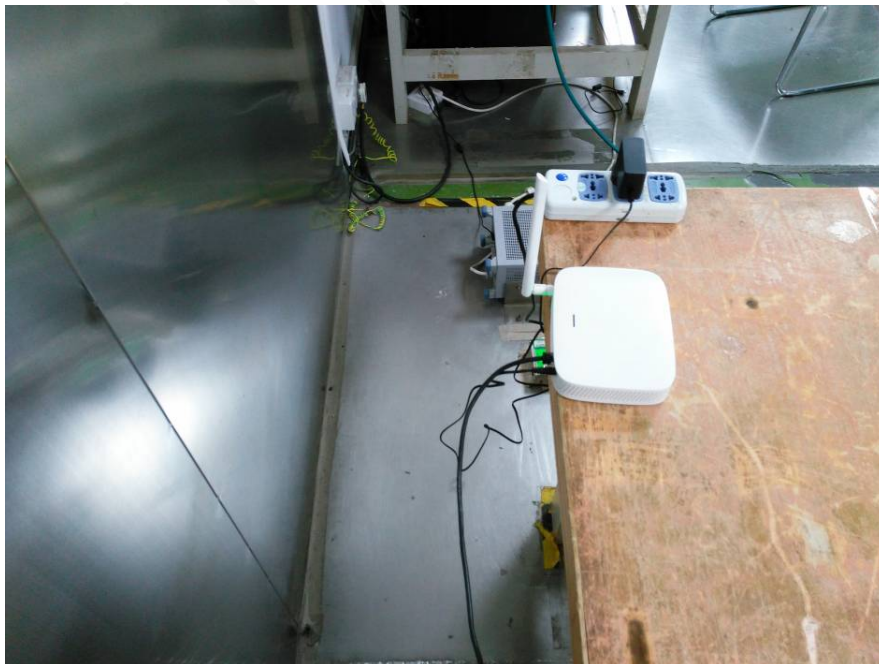
EXHIBIT B - TEST SETUP PHOTOGRAPHS

Power by Adapter

Conducted Emissions - Front View



Conducted Emissions - Side View



Power by POE

Conducted Emissions - Front View



Conducted Emissions - Side View

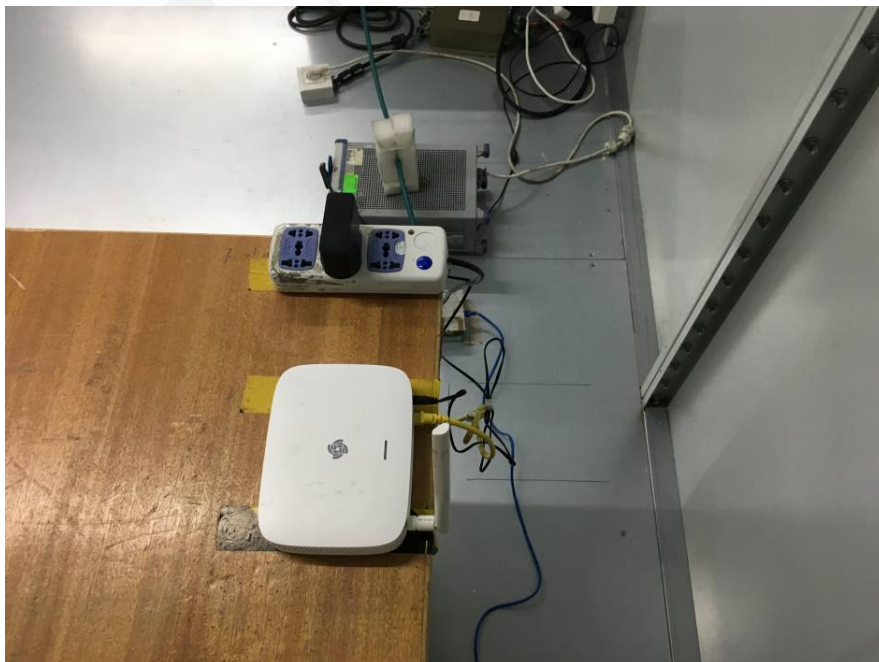


RJ45 Port

Conducted Emissions - Front View

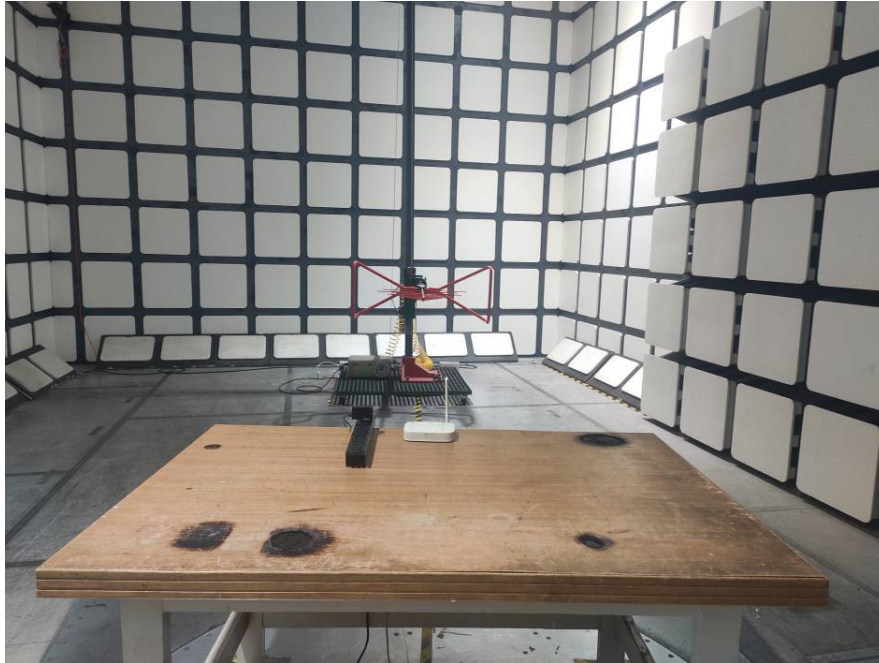


Conducted Emissions - Side View

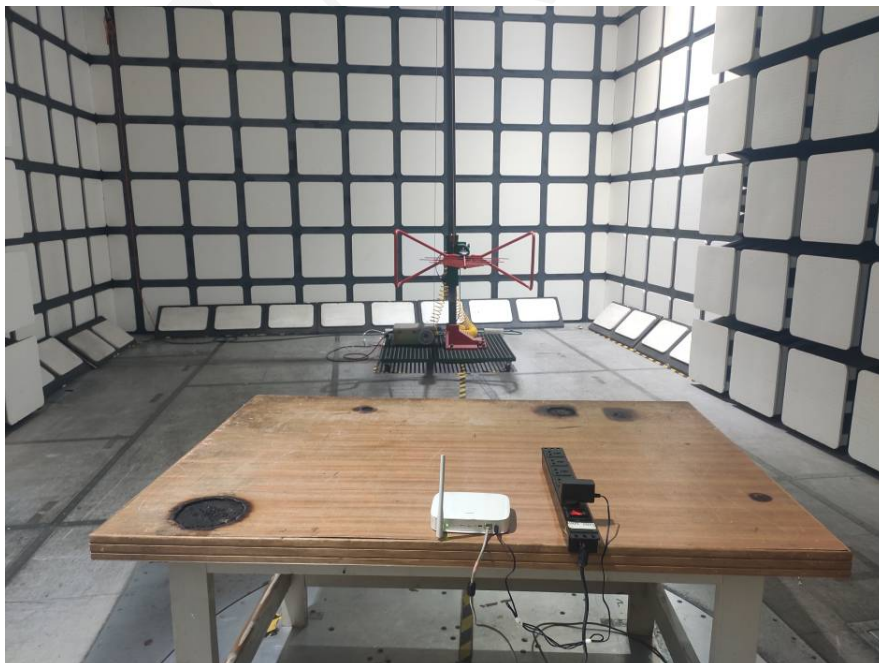


Power by Adapter

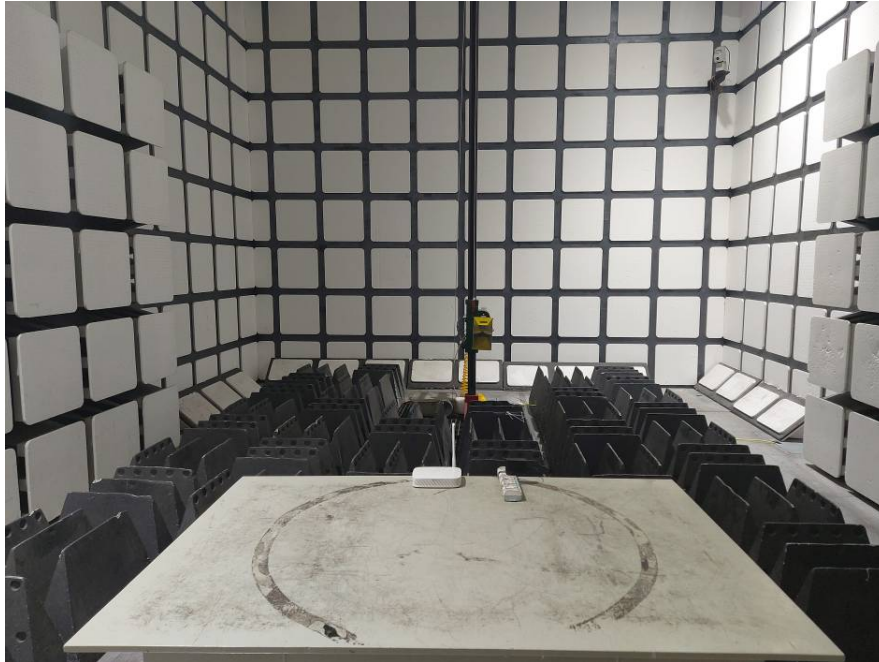
Radiated Emissions – Front View (Below 1 GHz)



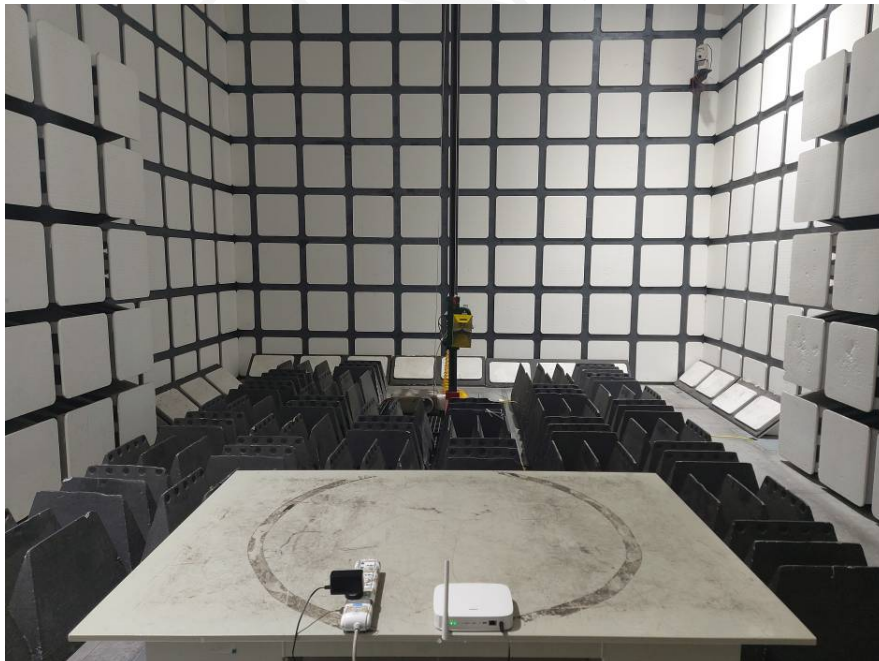
Radiated Emissions – Rear View (Below 1 GHz)



Radiated Emissions – Front View (Above 1 GHz)



Radiated Emissions – Rear View (Above 1 GHz)

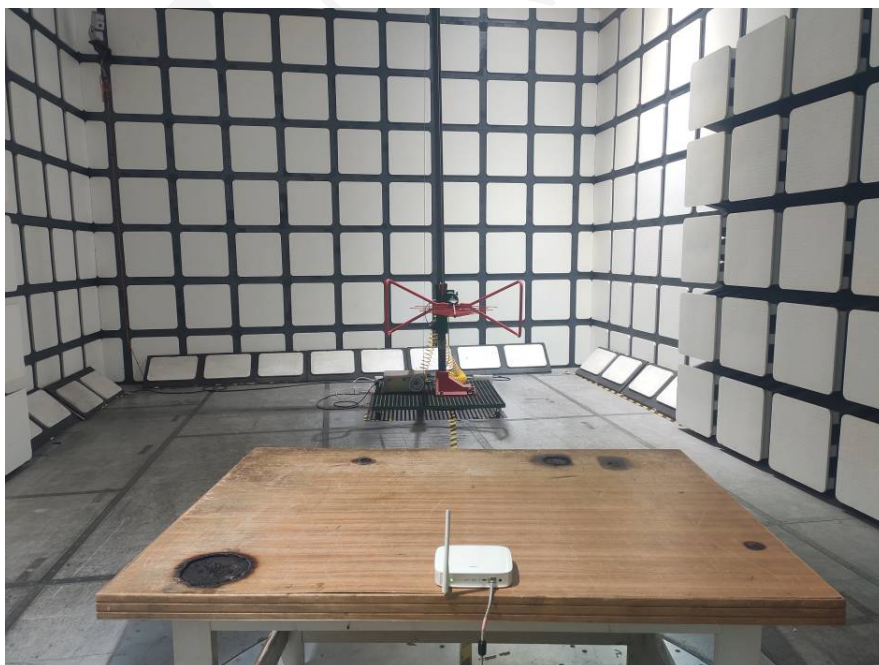


Powered by POE

Radiated Emissions – Front View (Below 1 GHz)



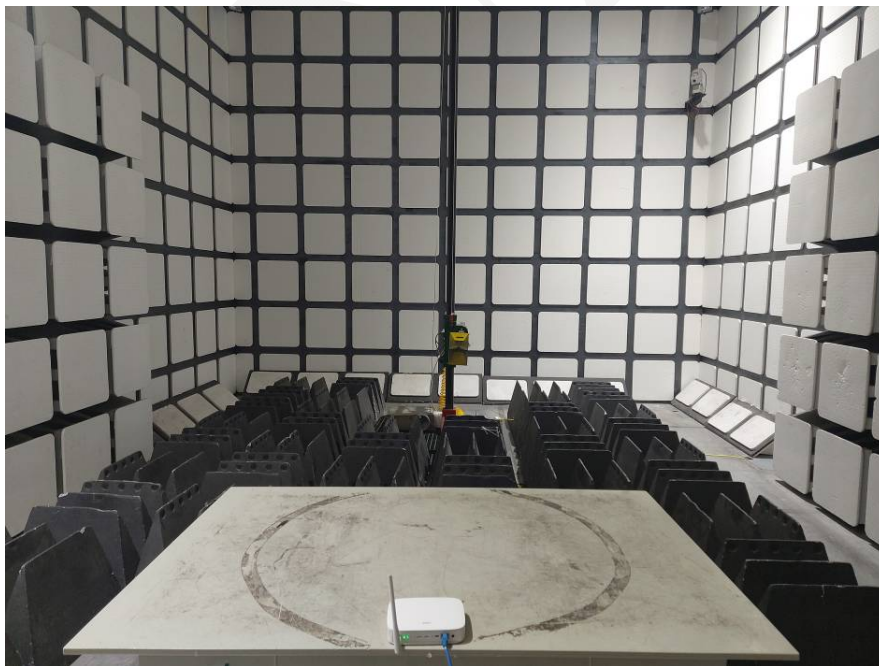
Radiated Emissions – Rear View (Below 1 GHz)



Radiated Emissions – Front View (Above 1 GHz)



Radiated Emissions – Rear View (Above 1 GHz)



******* END OF REPORT *******