TEST REPORT

Applicant:	Particle Industries, Inc.
EUT Description:	Tachyon
Model:	TACH4ROW, TACH8ROW
Brand:	Particle
Standards:	ETSI EN 301 489-1 V2.2.3
	ETSI EN 301 489-3 V2.3.2
	ETSI EN 301 489-17 V3.3.1
	ETSI EN 301 489-19 V2.2.1
	ETSI EN 301 489-52 V1.3.1
	EN 55032:2015+A1:2020
	EN 55035:2017+A11:2020
Date of Receipt:	2025/06/25
Date of Test:	2025/06/25 to 2025/09/29
Date of Issue:	2025/09/29

TOWE. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

the results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of the model are manufactured with identical electrical and mechanical components. All sample tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise. without written approval of TOWE, the test report shall not be reproduced except in full.

Jim Huang
Approved By:

Mike Ou
Reviewed By:

Revision History

Rev.	Issue Date	Description	Revised by
01	2025/09/29	Original	Mike Ou

Summary of Test Results

Test Item	Test Requirement	Test Method	Result
Radiated Emission	ETSI EN 301 489-1 V2.2.3 ETSI EN 301 489-3 V2.3.2 ETSI EN 301 489-17 V3.3.1 ETSI EN 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN 55032:2015+A1:2020	EN 55032	PASS
Conducted Emission		EN 55032	PASS
Harmonic current emissions	ETSI EN 301 489-1 V2.2.3 ETSI EN 301 489-3 V2.3.2 ETSI EN 301 489-17 V3.3.1 EN IEC 61000-3-2:2019+A1:2021	EN IEC 61000-3-2	N/A
Voltage fluctuations and flicker	ETSI EN 301 489-1 V2.2.3 ETSI EN 301 489-3 V2.3.2 ETSI EN 301 489-17 V3.3.1 EN 61000-3-3:2013+A2:2021	EN 61000-3-3	N/A
RF electromagnetic field (80 MHz to 6 000 MHz)	ETSI EN 301 489-1 V2.2.3 ETSI EN 301 489-3 V2.3.2 ETSI EN 301 489-17 V3.3.1 ETSI EN 301 489-19 V2.2.1 ETSI EN 301 489-52 V1.3.1 EN 55035:2017+A11:2020	EN 61000-4-3	PASS
Electrostatic discharge		EN 61000-4-2	PASS
Fast transients common mode		EN 61000-4-4	N/A
RF common mode 0.15 MHz to 80 MHz		EN 61000-4-6	N/A
Voltage dips and interruptions		EN 61000-4-11	N/A
Surges		EN 61000-4-5	N/A
Power frequency magnetic field	EN 55035:2017+A11:2020	EN 61000-4-8	N/A
Remark: N/A: Not applicable, the EUT is powered by DC Power.			

Table of Contents

1 General Description

1.1 Lab Information

1.1.1 Testing Location

These measurements tests were conducted at the Sushi TOWE Wireless Testing(Shenzhen) Co., Ltd. facility located at F401 and F101, Building E, Hongwei Industrial Zone, Liuxian 3rd Road, Bao'an District, Shenzhen, China.
Tel.: +86-755-27212361
Contact Email: info@towewireless.com

1.1.2 Test Facility

A2LA (Certificate Number: 7088.01)
This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

FCC Designation No.: CN1353
Sushi TOWE Wireless Testing(Shenzhen) Co., Ltd. has been recognized as an accredited testing laboratory. Designation Number: CN1353.

ISED CAB identifier: CN0152
Sushi TOWE Wireless Testing(Shenzhen) Co., Ltd. has been recognized by ISED as an accredited testing laboratory.
CAB identifier: CN0152
Company Number: 31000

1.2 Client Information

1.2.1 Applicant

Applicant:	Particle Industries, Inc.
Address:	548 Market St, PMB 34833, San Francisco, CA 94104, USA

1.2.2 Manufacturer

Manufacturer:	Particle Industries, Inc.
Address:	548 Market St, PMB 34833, San Francisco, CA 94104, USA

1.3 Product Information

EUT Description:	Tachyon		
Model:	TACH4ROW, TACH8ROW		
Brand:	Particle		
Hardware Version:	V1.2		
Software Version:	1.0.160		
IMEI:	863174060029047		
Frequency Bands:	Band	TX Frequency	RX Frequency
	E-GSM900	880MHz ~ 915MHz	925MHz ~ 960MHz
	DCS1800	1710MHz ~ 1785MHz	1805MHz ~ 1880MHz
	WCDMA Band I	1920MHz ~ 1980MHz	2110MHz ~ 2170MHz
	WCDMA Band V	824MHz ~ 849MHz	869MHz ~ 894MHz
	WCDMA Band VIII	880MHz ~ 915MHz	925MHz ~ 960MHz
	LTE Band 1	1920MHz ~ 1980MHz	2110MHz ~ 2170MHz
	LTE Band 3	1710MHz ~ 1785MHz	1805MHz ~ 1880MHz
	LTE Band 5	824MHz ~ 849MHz	869MHz ~ 894MHz
	LTE Band 7	2500MHz ~ 2570MHz	2620MHz ~ 2690MHz
	LTE Band 8	880MHz ~ 915MHz	925MHz ~ 960MHz
	LTE Band 20	832MHz ~ 862MHz	791MHz ~ 821MHz
	LTE Band 28	703MHz ~ 748MHz	758MHz ~ 803MHz
	LTE Band 32	/	1452MHz ~ 1496MHz
	LTE Band 34	2010MHz ~ 2025MHz	2010MHz ~ 2025MHz
	LTE Band 38	2570MHz ~ 2620MHz	2570MHz ~ 2620MHz
	LTE Band 40	2300MHz ~ 2400MHz	2300MHz ~ 2400MHz
	LTE Band 41	2496MHz ~ 2690MHz	2496MHz ~ 2690MHz
	LTE Band 42	3400MHz ~ 3600MHz	3400MHz ~ 3600MHz
	NR Band n1	1920 ~ 1980MHz	2110 ~ 2170MHz
	NR Band n3	1710 ~ 1785MHz	1805 ~ 1880MHz
	NR Band n5	824 ~ 849 MHz	869 ~ 894 MHz
	NR Band n7	2500 ~ 2570 MHz	2620 ~ 2690 MHz
	NR Band n8	880 ~ 915 MHz	925 ~ 960 MHz
	NR Band n20	832 ~ 862MHz	791 ~ 821 MHz
	NR Band n28	703 ~ 748 MHz	758 ~ 803 MHz
	NR Band n38	2570 ~ 2620 MHz	2570 ~ 2620 MHz
	NR Band n40	2300 ~ 2400 MHz	2300 ~ 2400 MHz
	NR Band n41	2496 ~ 2690MHz	2496 ~ 2690MHz
	NR Band n77	3300 ~ 4200 MHz	3300 ~ 4200 MHz
	NR Band n78	3300 ~ 3800 MHz	3300 ~ 3800 MHz
	Bluetooth	2402 ~ 2480 MHz	2402 ~ 2480 MHz
	Wi-Fi 2.4G	2412~ 2472 MHz	2412~ 2472 MHz
	5G WIFI(U-NII-1)	5150 ~ 5250MHz	5150 ~ 5250MHz

	5G WIFI(U-NII-2A)	5250 ~ 5350MHz	5250 ~ 5350MHz
	5G WIFI(U-NII-2C)	5470 ~ 5725MHz	5470 ~ 5725MHz
	5G WIFI(U-NII-3)	5725 ~ 5850MHz	5725 ~ 5850MHz
	Wi-Fi 6E	5945 ~ 6425MHz	5945 ~ 6425MHz
	GNSS (GPS & Galileo & Glonass & Beidou & SBAS)	/	1559 ~ 1610 MHz
	GNSS (GPS & Galileo)	/	1164 ~ 1215MHz
LTE CA:	UL CA_3C; UL CA_7C; UL CA_8B; UL CA_38C; UL CA_40C; UL CA_42C; UL CA_1A-3A; UL CA_1A-7A; UL CA_1A-8A; UL CA_1A-20A; UL CA_1A-28A; UL CA_1-42A; UL CA_3A-7A; UL CA_3A-8A; UL CA_3A-20A; UL CA_3A-28A; UL CA_3A-42A; UL CA_7A-20A; UL CA_7A-28A; UL CA_8A-40A; DL CA_20A-32A;		
EN-DC:	DC_1A_n28A, DC_3A_n28A, DC_7A_n28A, DC_20A_n28A[1], DC_3A_n7A, DC_1A_n77A, DC_3A_n77A, DC_8A_n77A, DC_28A_n77A, DC_41A_n77A, DC_1A_n78A, DC_3A_n78A, DC_7A_n78A, DC_8A_n78A, DC_20A_n78A, DC_28A_n78A, DC_38A_n78A, DC_41A_n78A;		

Remark:
1. The above EUT's information was declared by applicant, please refer to the specifications or user's manual for more detailed description.
2. According to the customer's Letter of model difference, TACH4ROW and TACH8ROW are identical with each other, except for RAM and model number difference. Only the test data for Model No.(TACH4ROW) was presented in the report.
Note:
[1] DC_20A_n28A: Referring to Note 8 in Table 5.5B.4.1-1 of ETSI TS 138 521-3, The frequency range in band n28 / 28 is restricted for this band combination to 703 - 733 MHz for the UL and 758-788 MHz for the DL.

2 Test Configuration During Test

2.1 Support Unit used in test

Description	Manufacturer	Model	Serial Number
Keyboard	Logitech	YR0091	/
Mouse	Logitech	M350s	/
Monitor	Dell	U2520D	CN-0Y5GX2-QDC00-26P-03IL-A09
Wideband Radio Communication Tester	R&S	CMW500	150645
Radio Communication Test Station	Anritsu	MT8000A	6262036781

2.2 Accessory

N/A

2.3 Test Environment

Temperature:	22°C -27°C
Humidity:	30%~60%RH for Electrostatic discharge, 30%~75%RH for others
Atmospheric pressure：	900~1015mbar

2.4 Modifications made to the Sample

No modifications are made to the EUT during all test item.

2.5 EUT Test Mode

Pretest these modes to find the worst mode and finally test the worst mode:

Radiated Emission	
Mode1	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + GPS
Mode2	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + M.2 SSD+ MP4 Playing + Galileo
Mode3	EUT + LiPo + Type-C Cable + Mouse + Keyboard +Display Screen + Camera + Glonass
Mode4	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + GSM 900 Link + Beidou
Mode5	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + WCDMA Band I Link + SBAS
Mode6	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + LTE Band1 Link + GPS
Mode7	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + LTE CA_3C + Galileo
Mode8	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + SA n1 Link + Glonass
Mode9	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + NSA DC_1A_n77A Link+ Beidou
Mode10	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 2.4G Wi-Fi Link+ SBAS
Mode11	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 5G Wi-Fi Link + GPS
Mode12	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 6G Wi-Fi Link + Galileo
Mode13	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + Bluetooth Link + Glonass

Conducted Emission	
Mode1	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + GPS
Mode2	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + M.2 SSD+ MP4 Playing + Galileo
Mode3	EUT + LiPo + Type-C Cable + Mouse + Keyboard +Display Screen + Camera + Glonass
Mode4	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + GSM 900 Link + Beidou
Mode5	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + WCDMA Band I Link + SBAS
Mode6	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + LTE Band1 Link + GPS
Mode7	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + LTE CA_3C + Galileo
Mode8	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + SA n1 Link + Glonass
Mode9	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + NSA DC_1A_n77A Link+ Beidou
Mode10	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 2.4G Wi-Fi Link+ SBAS
Mode11	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 5G Wi-Fi Link + GPS
Mode12	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 6G Wi-Fi Link + Galileo
Mode13	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + Bluetooth Link + Glonass

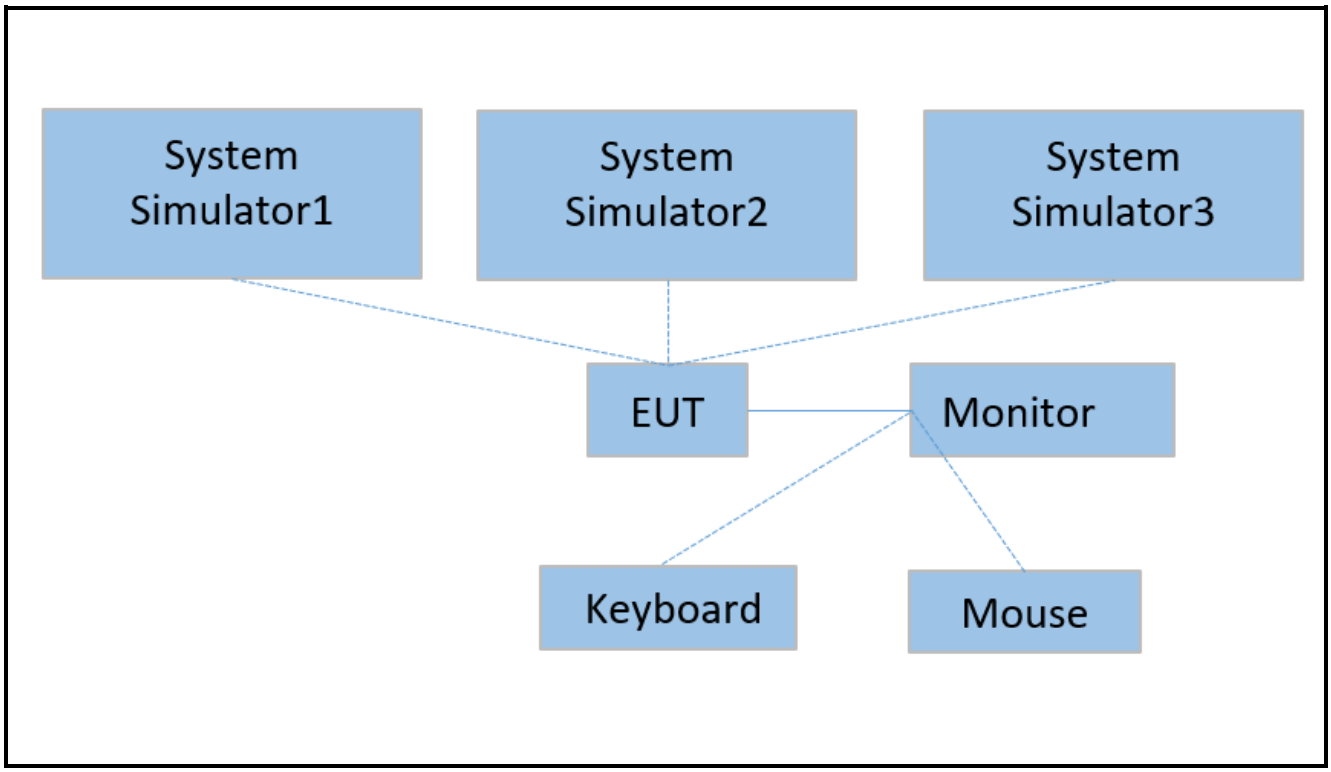
Radiated Immunity	
Mode1	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + GPS
Mode2	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + M.2 SSD+ MP4 Playing + Galileo
Mode3	EUT + LiPo + Type-C Cable + Mouse + Keyboard +Display Screen + Camera + Glonass
Mode4	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + GSM 900 Link + Beidou
Mode5	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + WCDMA Band I Link + SBAS
Mode6	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + LTE Band1 Link + GPS
Mode7	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + LTE CA_3C + Galileo
Mode8	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + SA n1 Link + Glonass
Mode9	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + NSA DC_1A_n77A Link+ Beidou
Mode10	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 2.4G Wi-Fi Link+ SBAS
Mode11	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 5G Wi-Fi Link + GPS
Mode12	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 6G Wi-Fi Link + Galileo
Mode13	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + Bluetooth Link + Glonass

ESD	
Mode1	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + GPS
Mode2	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + M.2 SSD+ MP4 Playing + Galileo
Mode3	EUT + LiPo + Type-C Cable + Mouse + Keyboard +Display Screen + Camera + Glonass
Mode4	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + GSM 900 Link + Beidou
Mode5	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + WCDMA Band I Link + SBAS
Mode6	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + LTE Band1 Link + GPS
Mode7	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + LTE CA_3C + Galileo
Mode8	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + SA n1 Link + Glonass
Mode9	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + NSA DC_1A_n77A Link+ Beidou
Mode10	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 2.4G Wi-Fi Link+ SBAS
Mode11	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 5G Wi-Fi Link + GPS
Mode12	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + 6G Wi-Fi Link + Galileo
Mode13	EUT + LiPo + Type-C Cable +Mouse + Keyboard + Display Screen + Bluetooth Link + Glonass

Test Item	Final test mode												
Radiated Emission	**2**	**/**	/	/	/	/	/	/	/	/	/	/	/
Conducted Emission	**3**	**/**	/	/	/	/	/	/	/	/	/	/	/
RF electromagnetic field (80 MHz to 6 000 MHz)	1	2	3	4	5	6	7	8	9	10	11	12	13
Electrostatic discharge	1	2	3	4	5	6	7	8	9	10	11	12	13

Remark: The highlighted mode is the worst mode for these test items, only data of worst mode (if test item has) was reported in test result.

2.6 Connection Diagram of Test System



Description	Connection Type	Test mode												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Monitor	USB Cable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Keyboard	Wireless	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mouse	Wireless	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
System Simulator1	GSM/WCDMA/LTE/NR	/	/	✓	✓	✓	✓	✓	✓	✓	/	/	/	/
System Simulator2	Bluetooth/Wi-Fi	/	/	/	/	/	/	/	/	/	✓	✓	✓	✓
System Simulator2	GNSS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

2.7 Test configuration and monitoring

General:

1. Monitor the LED display of Ancillary Equipment.

GNSS:

1. Execute program to make the EUT receive continuous signals from Vector Signal Generator
2. The GNSS receiver reception link performance is monitored, and SNR ratio is kept monitoring.

GSM:

1. The GSM radio function is linked with system simulator, and set GSM900 PCL=5, and DCS1800PCL=O for maximum output power.
2. The Uplink/Downlink radio quality is monitored via the system simulator. During the test, the RXQUAL of the downlink shall not exceed the value of three.

WCDMA:

1. The WCDMA radio function is linked with system simulator, and set all up bits for maximum output power, and the DTX is disabled.
2. The Uplink/Downlink radio quality is monitored via the system simulator. For data transmitting, the BER shall not exceed 0,001.

LTE:

1. The LTE radio function is linked with system simulator, and set all up bits for maximum output power, and the DTX is disabled.
2. The Uplink/Downlink radio quality is monitored via the system simulator. For data transmitting, the data throughput of the EUT shall not fall below 95 % of the maximum data throughput.

NR:

1. The NR radio function is linked with system simulator, and set all up bits for maximum output power, and the DTX is disabled.
2. The data throughput of the EUT is monitored via the system simulator. And it shall not fall below 95 % of the maximum data throughput.

Bluetooth:

1. The Bluetooth is linked with system simulator.
2. The Bluetooth link performance and PER are monitored via the system simulator.

Wi-Fi:

1. The Wi-Fi is linked with system simulator.
2. The Wi-Fi link performance and PER are monitored via the system simulator.

3 Equipment and Measurement Uncertainty

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, whichever is less, and where applicable is traceable to recognized national standards.

3.1 Test Equipment List

Radiated Emission					
Description	**Manufacturer**	**Model**	**S.N.**	**Last Due**	**Cal Due**
Biconic Logarithmic Periodic Antennas	Schwarzbeck	VULB9163	1643	2023/06/25	2026/06/24
Double-Ridged Horn Antennas	Schwarzbeck	BBHA 9120D	2809	2023/06/25	2026/06/24
Signal Analyzer	Keysight	N9020A	MY49100252	2025/03/11	2026/03/10
EMI Tester Receiver	Rohde & Schwarz	ESR7	102719	2025/05/29	2026/05/28
Low Noise Amplifier	Tonscend	TAP9K3G40	AP23A8060273	2025/03/11	2027/03/10
Low Noise Amplifier	Tonscend	TAP01018050	AP22G806258	2025/03/11	2027/03/10
Band Reject Filter Group	Tonscend	JS0806-F	23A806F0652	N/A	N/A
Test Software	Tonscend	TS+	Version: 5.0.0	N/A	N/A
N/A: Not applicable, confirmed internally by the laboratory					

Conducted Emission					
Description	**Manufacturer**	**Model**	**S.N.**	**Last Due**	**Cal Due**
EMI Tester Receiver	Rohde & Schwarz	ESR3	103108	2025/05/29	2026/05/28
LISN	Rohde & Schwarz	ENV 216	102836	2025/01/04	2026/01/03
Test Software	Rohde & Schwarz	ELEKTRA	Version: 4.61	N/A	N/A
N/A: Not applicable, confirmed internally by the laboratory					

ESD					
Description	**Manufacturer**	**Model**	**S.N.**	**Last Due**	**Cal Due**
ESD Generator	TESEQ	NSG 437	P2308272875	2025/06/03	2026/06/02

RF electromagnetic field					
Description	**Manufacturer**	**Model**	**S.N.**	**Last Due**	**Cal Due**
Stacked Double Log .-Per.Antenna	Schwarzbeck	STLP 9129	00246	2023/07/28	2026/07/27
Vector Signal Generator	SMCV100B	R&S	104742	2025/05/29	2026/05/28
Open Switch and Control Unit	R&S	OSP220	102819	N/A	N/A
Broadband Amplifier	R&S	BBA150 A125	105063	2025/05/29	2026/05/28
Broadband Amplifier	R&S	BBA150 BC250	105064	2025/05/29	2026/05/28
Broadband Amplifier	R&S	BBA150 D110E60	103440	2025/05/29	2026/05/28
Average Power Sensor	R&S	NRP6A	104451	2025/05/29	2026/05/28
Average Power Sensor	R&S	NRP6A	104771	2025/01/04	2026/01/03
Field Probe	LUMILOOP	LSProbe 1.2	780	2025/06/05	2026/06/04
Wideband Radio Communication Tester	R&S	CMW500	171955	2025/05/29	2026/05/28
Test Software	R&S	ELEKTRA	Version:5.02.1	N/A	N/A
N/A: Not applicable, confirmed internally by the laboratory					

3.2 Measurement Uncertainty

Parameter	U_{lab}
Conducted Emissions(150KHz~30MHz)	2.43dB
Radiated Emissions(30MHz~1000MHz)	4.66dB
Radiated Emissions(1GHz~18GHz)	5.42dB
Continuous RF electromagnetic field disturbances	2.12dB
Electrostatic discharges-First peak current	2.5%
Electrostatic discharges-Rise time	3%
Electrostatic discharges-30ns Current	2.5%
Electrostatic discharges-60ns Current	2.5%

Uncertainty figures are valid to a confidence level of 95%

4 Test results

4.1 EMI(Emission)

4.1.1 Radiated Emissions

Limit:

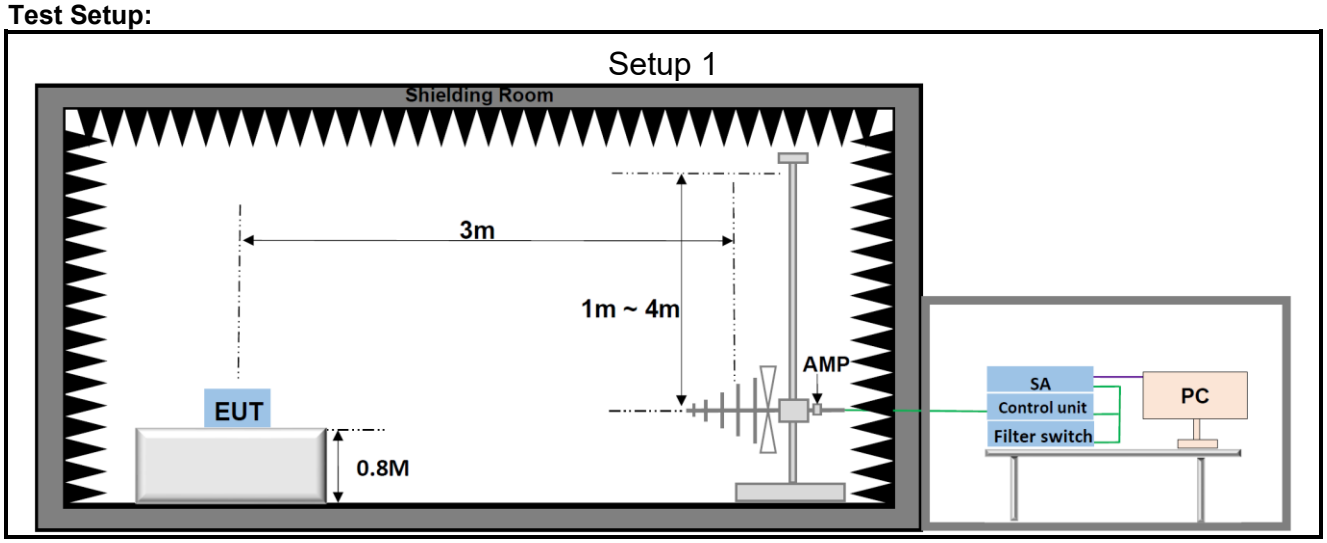
Frequency	Detector type / Bandwidth	Class B Limit (dBμV/m)	Measurement distance (m)
30MHz-230MHz	Quasi-peak / 120kHz	40.0	3
230MHz-1000MHz		47.0	
1000MHz~3000MHz	Peak / 1MHz	70	
	Average / 1MHz	50	
3000MHz~6000MHz	Peak / 1MHz	74	
	Average / 1MHz	54	

Measurement methods: EN 55032.

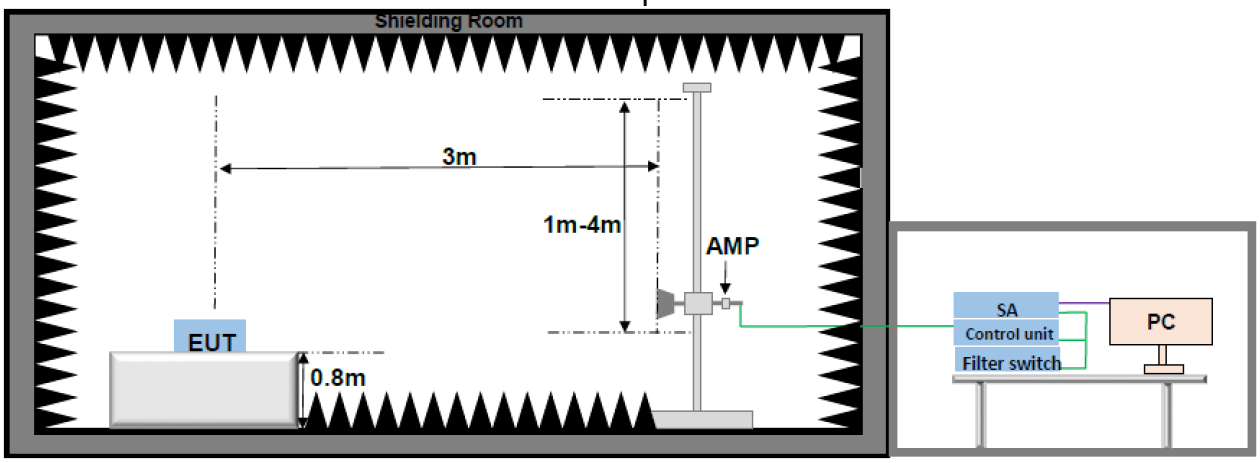
Test Procedure:

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 SAC chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. For each suspected emission, the EUT was ranged to its worst case and then tune the antenna tower(from 1~4m) and turntable(from 0~360°) to find the maximum reading. Preamplifier and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
3. The radiation measurements are performed in X, Y, Z axis positioning for portable equipment, And find the worst-case axis positioning record in the report.
4. For measurements below 1GHz the resolution bandwidth is set to 100kHz and the video resolution is set to 300kHz for peak detection measurements or resolution bandwidth is set to 120kHz and the video resolution is set to 300kHz for Quasi-peak detection measurements in the 30~1000MHz range.
5. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, peak values of EUT will be reported. Otherwise, the emission will be repeated by using the quasi-peak method and reported for frequency range below 1GHz.
6. For measurements above 1GHz the resolution bandwidth is set to 1MHz and the video resolution is set to 3MHz, the peak emission measurement will be measured by the peak detector, the average emission measurement will be measured by the average detector.
7. Repeat above procedures until all frequencies measured was complete.
8. Measure and record the results in the test report.

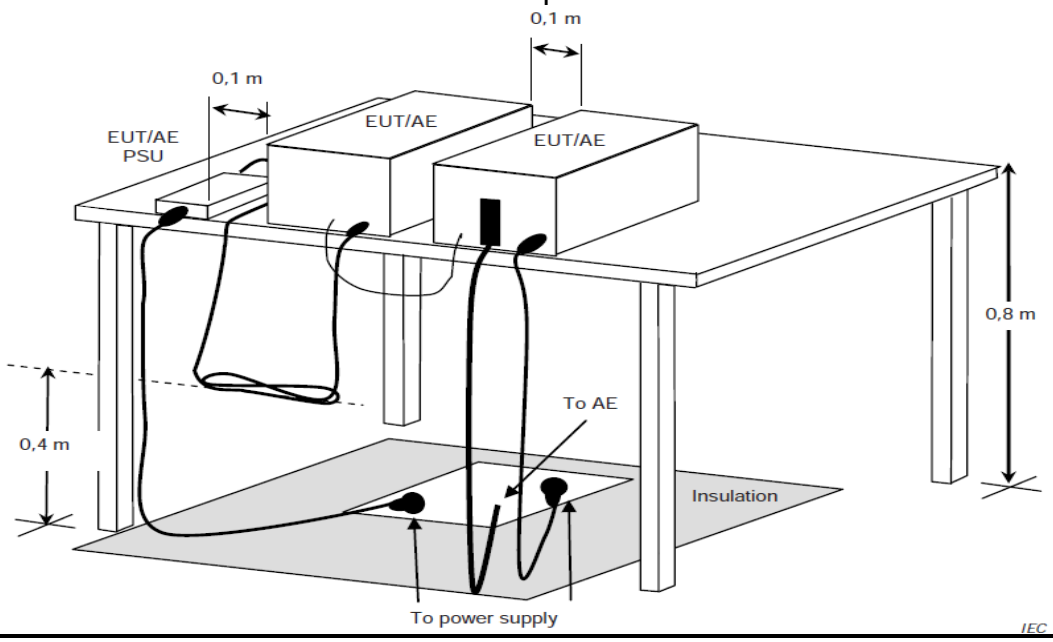
Test Setup:



Setup 2



Setup 3

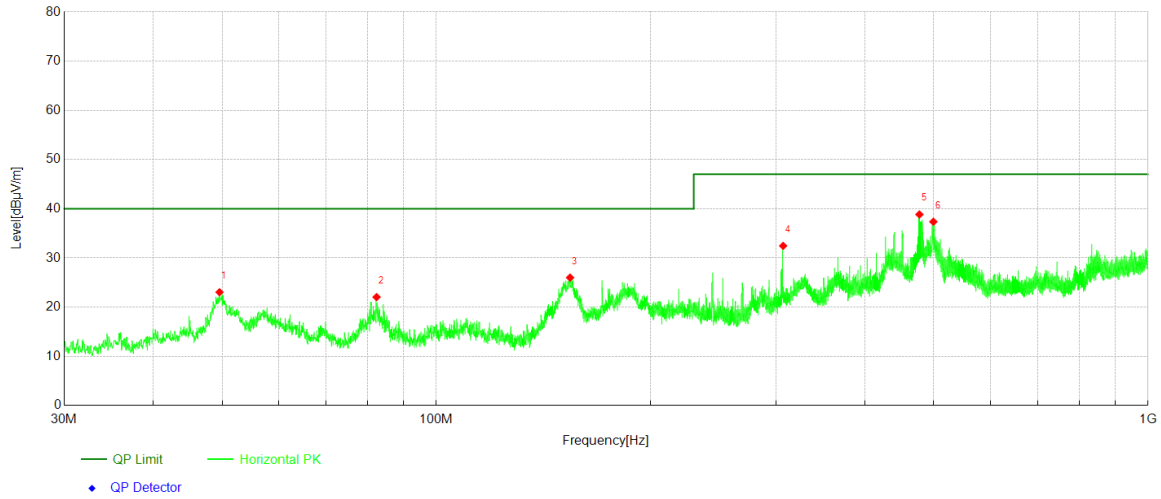


Measuring Instruments:

The measuring equipment is listed in the section 3.1 of this test report.

Test Result for TACH4ROW capacitor 1(TLJT107M010R0900):

Test Frequency	Below 1000MHz	Final Test mode:	Mode 2
Test Voltage:	AC 230V/50Hz	Polarization:	Horizontal

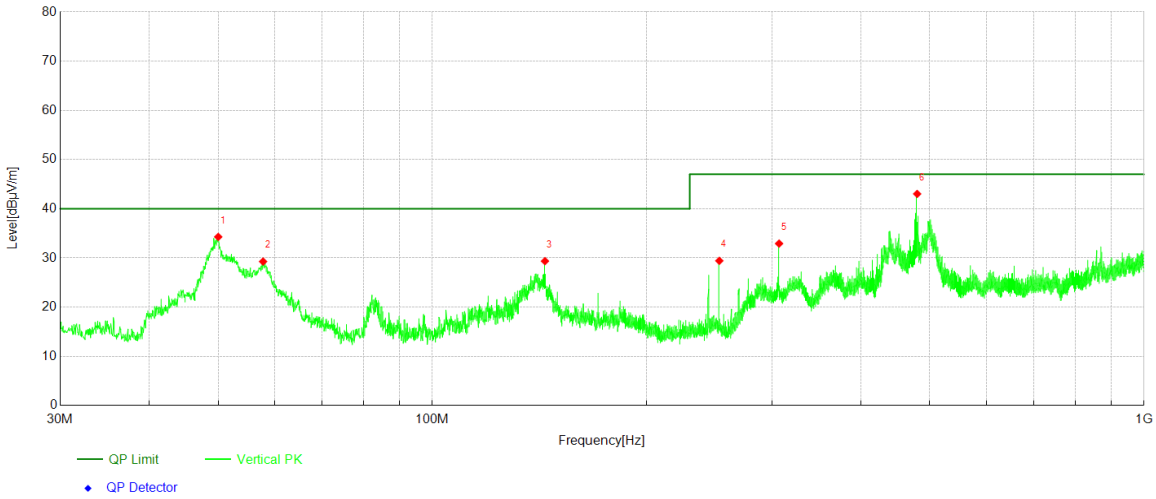


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	49.59	45.22	-22.18	23.04	40.00	16.96	Horizontal	PASS
2	82.43	48.29	-26.25	22.04	40.00	17.96	Horizontal	PASS
3	154.16	51.72	-25.72	26.00	40.00	14.00	Horizontal	PASS
4	307.13	51.71	-19.26	32.45	47.00	14.55	Horizontal	PASS
5	477.32	47.50	-8.66	38.84	47.00	8.16	Horizontal	PASS
6	499.33	45.84	-8.49	37.35	47.00	9.65	Horizontal	PASS

Note:
1. Level = Reading(dBµV) + Factor(dB):
2. Factor = Cable Factor(dB) + Antenna Factor(dB/m) - Preamplifier gain(dB)
3. Margin = Limit(dBµV/m) - Value(dBµV/m)

Test Frequency	Below 1000MHz	Final Test mode:	Mode 2
Test Voltage:	AC 230V/50Hz	Polarization:	Vertical

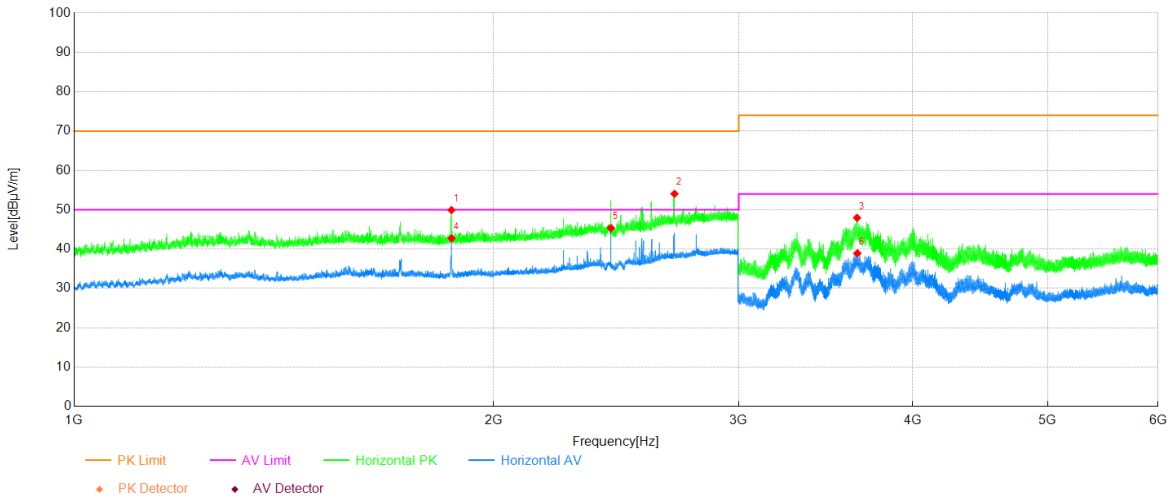


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	50.03	56.21	-21.93	34.28	40.00	5.72	Vertical	PASS
2	57.84	51.74	-22.47	29.27	40.00	10.73	Vertical	PASS
3	143.98	54.55	-25.20	29.35	40.00	10.65	Vertical	PASS
4	253.10	50.22	-20.80	29.42	47.00	17.58	Vertical	PASS
5	307.08	52.48	-19.56	32.92	47.00	14.08	Vertical	PASS
6	479.98	51.32	-8.30	43.02	47.00	3.98	Vertical	PASS

Note:
1. Level = Reading(dBµV) + Factor(dB):
2. Factor = Cable Factor(dB) + Antenna Factor(dB/m) - Preamplifier gain(dB)
3. Margin = Limit(dBµV/m) - Value(dBµV/m)

Test Frequency	Above 1000MHz	Final Test mode:	Mode 2
Test Voltage:	AC 230V/50Hz	Polarization:	Horizontal

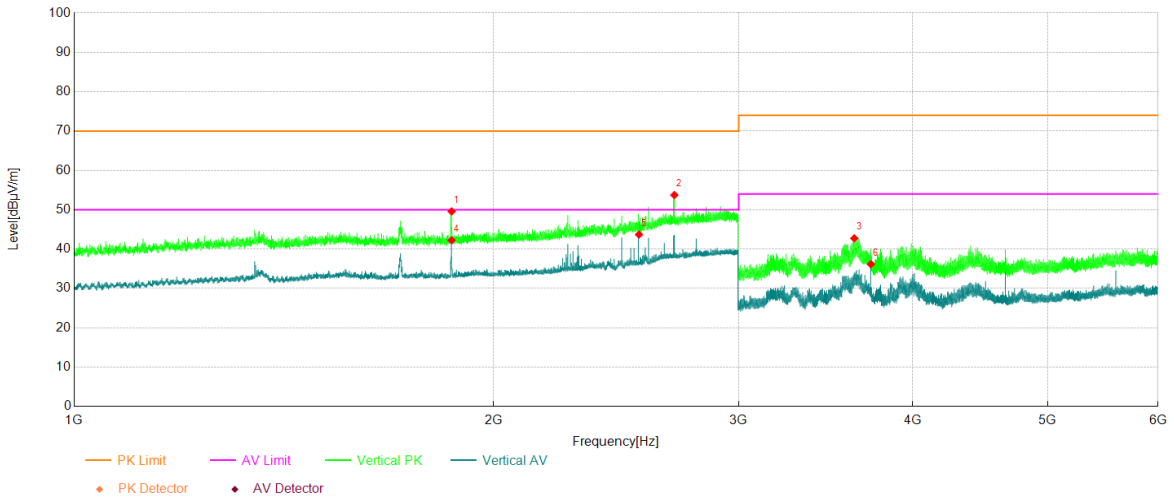


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	1865.89	49.32	0.59	49.91	70.00	20.09	Horizontal	PASS
2	2697.77	50.12	3.94	54.06	70.00	15.94	Horizontal	PASS
3	3647.85	59.62	-11.67	47.95	74.00	26.05	Horizontal	PASS
4	1866.09	42.15	0.59	42.74	50.00	7.26	Horizontal	PASS
5	2428.74	43.09	2.26	45.35	50.00	4.65	Horizontal	PASS
6	3649.95	50.60	-11.67	38.93	54.00	15.07	Horizontal	PASS

Note:
1. Level = Reading(dBµV) + Factor(dB):
2. Factor = Cable Factor(dB) + Antenna Factor(dB/m) - Preamplifier gain(dB)
3. Margin = Limit(dBµV/m) - Value(dBµV/m)
4. These frequencies which near “-” should be ignored because they are harmonics of the Fundamental frequency.

Test Frequency	Above 1000MHz	Final Test mode:	Mode 2
Test Voltage:	AC 230V/50Hz	Polarization:	Vertical



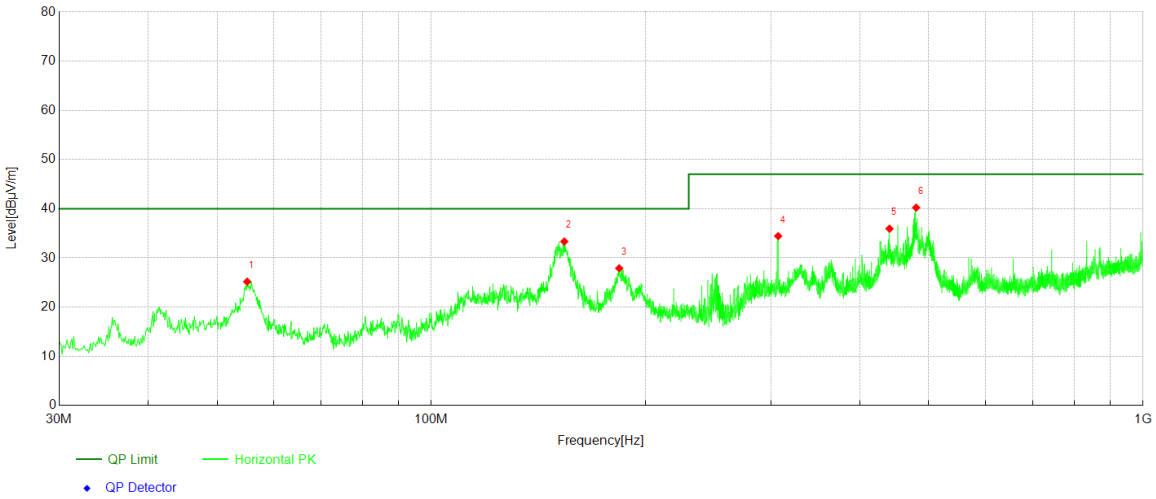
Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	1866.29	48.99	0.59	49.58	70.00	20.42	Vertical	PASS
2	2696.97	49.80	3.94	53.74	70.00	16.26	Vertical	PASS
3	3631.50	54.42	-11.69	42.73	74.00	31.27	Vertical	PASS
4	1866.09	41.65	0.59	42.24	50.00	7.76	Vertical	PASS
5	2543.95	41.30	2.40	43.70	50.00	6.30	Vertical	PASS
6	3732.15	48.37	-12.19	36.18	54.00	17.82	Vertical	PASS

Note:
1. Level = Reading(dBµV) + Factor(dB):
2. Factor = Cable Factor(dB) + Antenna Factor(dB/m) - Preamplifier gain(dB)
3. Margin = Limit(dBµV/m) - Value(dBµV/m)
4. These frequencies which near “-” should be ignored because they are harmonics of the Fundamental frequency.

Test Result for TACH4ROW capacitor 2(GRM31CR61A107MEA8L):

Test Frequency	Below 1000MHz	Final Test mode:	Mode 2
Test Voltage:	AC 230V/50Hz	Polarization:	Horizontal

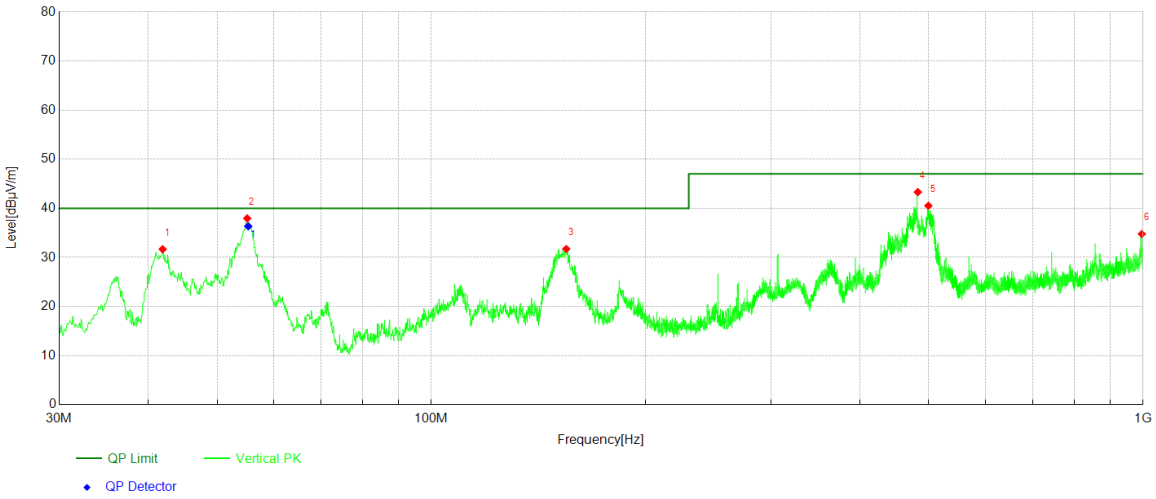


Data List

NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	55.12	47.76	-22.58	25.18	40.00	14.82	Horizontal	PASS
2	153.77	59.29	-25.94	33.35	40.00	6.65	Horizontal	PASS
3	183.65	51.97	-24.07	27.90	40.00	12.10	Horizontal	PASS
4	307.13	53.70	-19.26	34.44	47.00	12.56	Horizontal	PASS
5	440.31	44.65	-8.71	35.94	47.00	11.06	Horizontal	PASS
6	479.98	48.53	-8.30	40.23	47.00	6.77	Horizontal	PASS

Note:
1. Level = Reading(dBµV) + Factor(dB):
2. Factor = Cable Factor(dB) + Antenna Factor(dB/m) - Preamplifier gain(dB)
3. Margin = Limit(dBµV/m) - Value(dBµV/m)

Test Frequency	Below 1000MHz	Final Test mode:	Mode 2
Test Voltage:	AC 230V/50Hz	Polarization:	Vertical



Data List

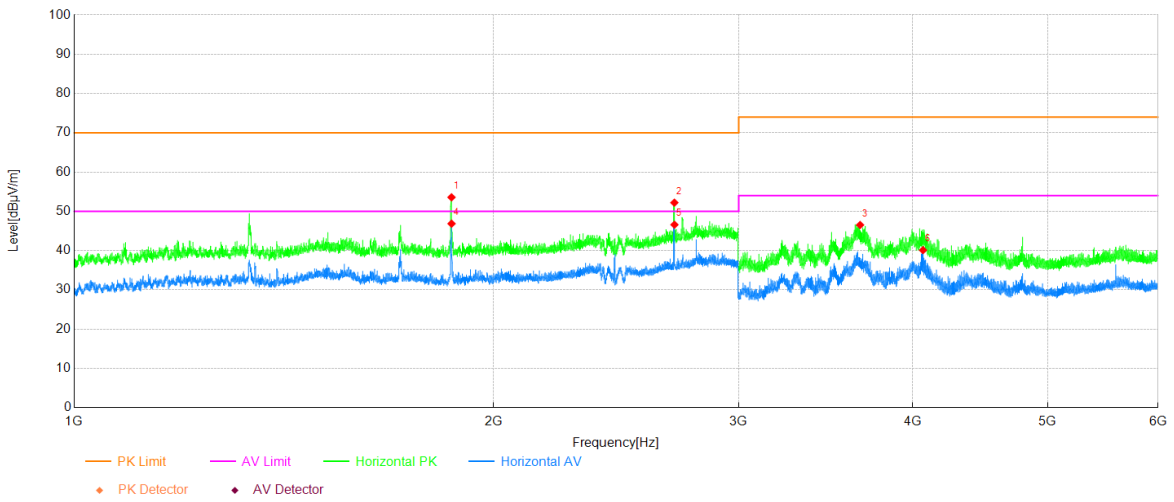
NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	41.93	55.09	-23.42	31.67	40.00	8.33	Vertical	PASS
2	55.12	60.48	-22.53	37.95	40.00	2.05	Vertical	PASS
3	154.74	57.52	-25.80	31.72	40.00	8.28	Vertical	PASS
4	482.60	51.69	-8.38	43.31	47.00	3.69	Vertical	PASS
5	499.38	48.92	-8.40	40.52	47.00	6.48	Vertical	PASS
6	996.12	40.76	-5.97	34.79	47.00	12.21	Vertical	PASS

Data List

NO.	Freq. [MHz]	Factor [dB/m]	QP Reading [dBµV]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1	55.3071	-22.53	58.87	36.34	40.00	3.66	100	127.9	Vertical	PASS

Note:
1. Level = Reading(dBµV) + Factor(dB):
2. Factor = Cable Factor(dB) + Antenna Factor(dB/m) - Preamplifier gain(dB)
3. Margin = Limit(dBµV/m) - Value(dBµV/m)

Test Frequency	Above 1000MHz	Final Test mode:	Mode 2
Test Voltage:	AC 230V/50Hz	Polarization:	Horizontal

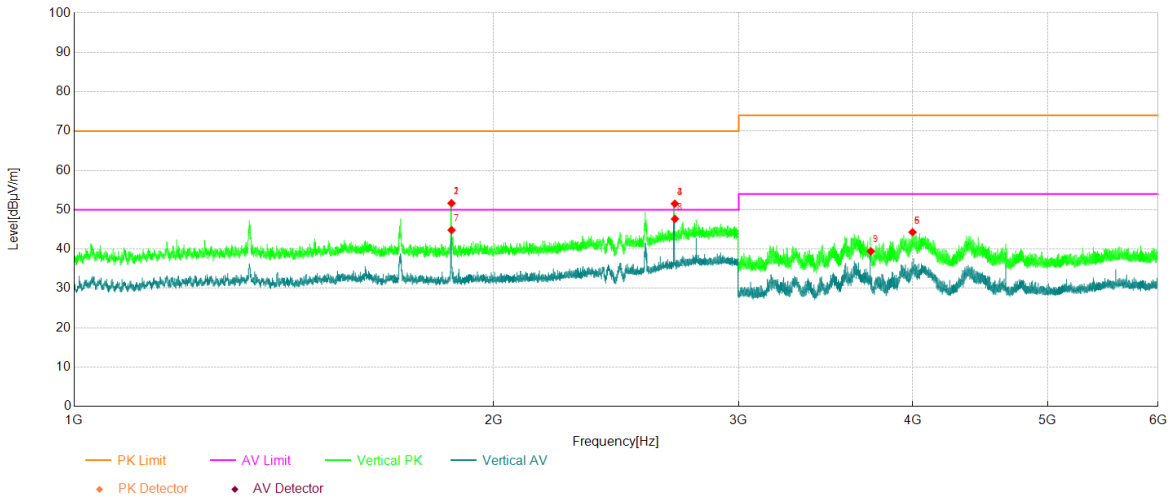


Data List

NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	1866.00	52.98	0.59	53.57	70.00	16.43	Horizontal	PASS
2	2697.20	48.26	3.94	52.20	70.00	17.80	Horizontal	PASS
3	3666.30	58.38	-11.86	46.52	74.00	27.48	Horizontal	PASS
4	1866.20	46.27	0.59	46.86	50.00	3.14	Horizontal	PASS
5	2697.60	42.65	3.94	46.59	50.00	3.41	Horizontal	PASS
6	4068.30	50.93	-10.81	40.12	54.00	13.88	Horizontal	PASS

Note:
1. Level = Reading(dBµV) + Factor(dB):
2. Factor = Cable Factor(dB) + Antenna Factor(dB/m) - Preamplifier gain(dB)
3. Margin = Limit(dBµV/m) - Value(dBµV/m)
4. These frequencies which near “-” should be ignored because they are harmonics of the Fundamental frequency.

Test Frequency	Above 1000MHz	Final Test mode:	Mode 2
Test Voltage:	AC 230V/50Hz	Polarization:	Vertical



Data List

NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	1866.00	51.08	0.59	51.67	70.00	18.33	Vertical	PASS
2	1866.00	51.08	0.59	51.67	70.00	18.33	Vertical	PASS
3	2699.20	47.58	3.96	51.54	70.00	18.46	Vertical	PASS
4	2699.20	47.58	3.96	51.54	70.00	18.46	Vertical	PASS
5	3998.70	55.56	-11.26	44.30	74.00	29.70	Vertical	PASS
6	3998.70	55.56	-11.26	44.30	74.00	29.70	Vertical	PASS
7	1866.20	44.25	0.59	44.84	50.00	5.16	Vertical	PASS
8	2699.80	43.72	3.96	47.68	50.00	2.32	Vertical	PASS
9	3732.30	51.64	-12.19	39.45	54.00	14.55	Vertical	PASS

Note:
1. Level = Reading(dBµV) + Factor(dB):
2. Factor = Cable Factor(dB) + Antenna Factor(dB/m) - Preamplifier gain(dB)
3. Margin = Limit(dBµV/m) - Value(dBµV/m)
4. These frequencies which near "-" should be ignored because they are harmonics of the Fundamental frequency.

4.1.2 Conducted Emissions

Limit:

Frequency	Detector type / Bandwidth	Class B Limit (dBμV/m)	Coupling device
150kHz~500kHz	Quasi-peak / 9kHz	66 to 56	AMN
	Average / 9kHz	56 to 46	
500kHz~5MHz	Quasi-peak / 9kHz	56	
	Average / 9kHz	46	
5MHz~30MHz	Quasi-peak / 9kHz	60	
	Average / 9kHz	50	

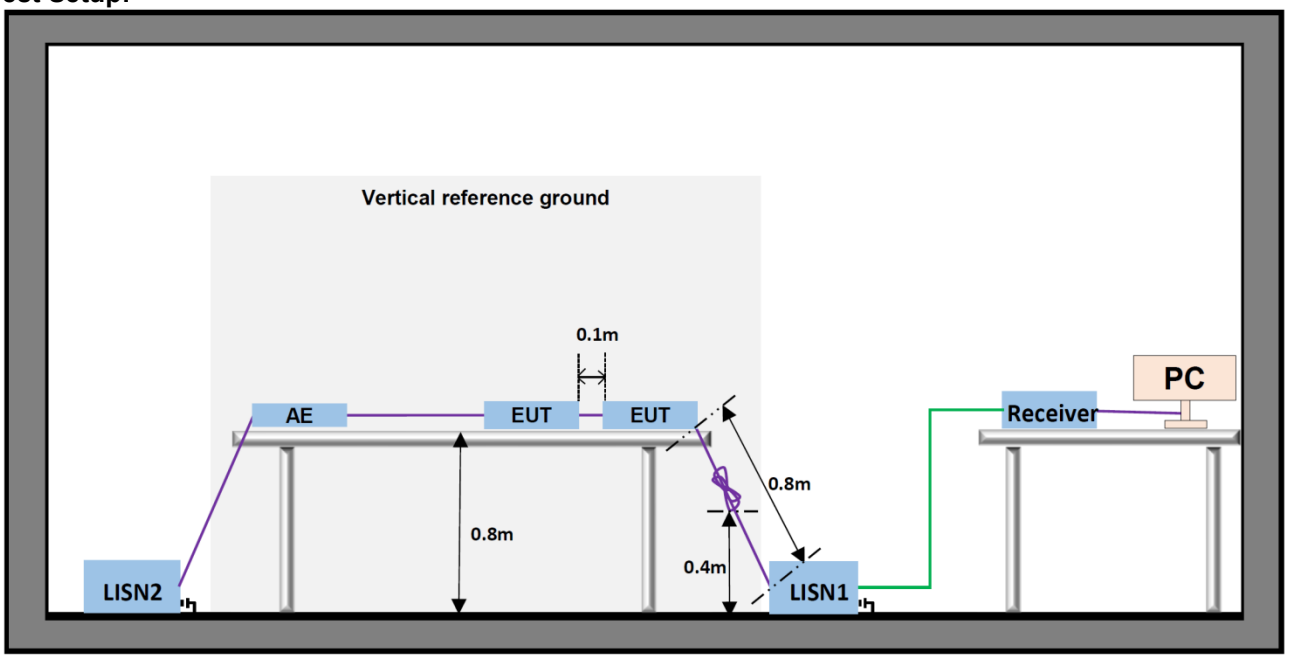
Measurement methods: EN 55032.

Test Procedure:

1. The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network). The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
2. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane.
3. The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.

   The receiver is set to a resolution bandwidth of 9kHz. Measurements shall be made with quasi-peak detector and average detector. In order to speed-up the measurement procedure, peak detector may be used instead of a quasi-peak detector.
4. Both sides of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to EN 55032 on conducted measurement.

Test Setup:



Measuring Instruments:

The measuring equipment is listed in the section 3.1 of this test report.

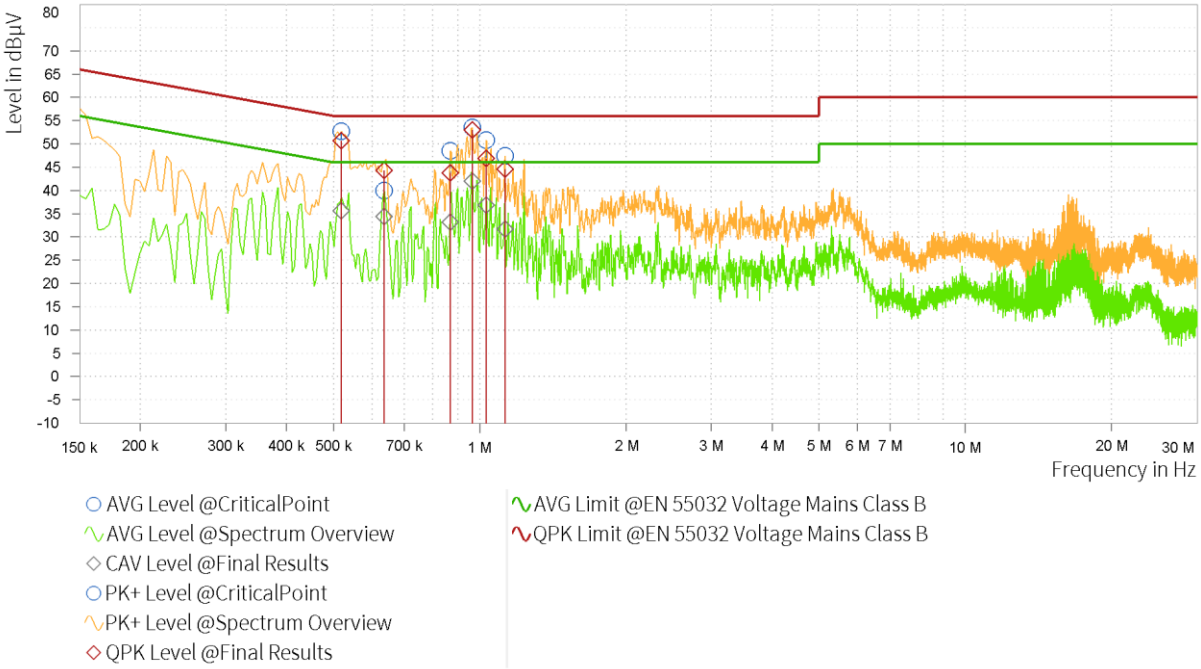
Test Result:

Final Test mode:	Mode3		
Test Voltage:	AC 230V/50Hz	Phase:	Line

Rg	Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	CAV Level [dBµV]	CAV: AVG Limit [dBµV]	CAV Margin [dB]	Correction [dB]	Line
1	0.533	49.47	56.00	6.53	38.44	46.00	7.56	9.81	L1
1	0.875	46.51	56.00	9.49	37.06	46.00	8.94	9.90	L1
1	0.902	48.64	56.00	7.36	34.85	46.00	11.15	9.88	L1
1	0.965	52.60	56.00	3.40	42.20	46.00	3.80	9.84	L1
1	1.032	47.12	56.00	8.88	37.17	46.00	8.83	9.83	L1
1	1.127	46.05	56.00	9.95	33.95	46.00	12.05	9.85	L1

Note:
1. Margin = Limit(dBµV) - Level(dBµV).

Final Test mode:	Mode 3		
Test Voltage:	AC 230V/50Hz	Phase:	Neutral



Rg	Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	CAV Level [dBµV]	CAV: AVG Limit [dBµV]	CAV Margin [dB]	Correction [dB]	Line
1	0.519	50.72	56.00	5.28	35.63	46.00	10.37	9.80	N
1	0.636	44.34	56.00	11.66	34.34	46.00	11.66	9.87	N
1	0.870	43.73	56.00	12.27	33.12	46.00	12.88	9.75	N
1	0.965	52.94	56.00	3.06	42.00	46.00	4.00	9.67	N
1	1.032	46.84	56.00	9.16	36.88	46.00	9.12	9.66	N
1	1.127	44.59	56.00	11.41	31.63	46.00	14.37	9.70	N

Note:
1. Margin = Limit(dBµV) - Level(dBµV).

4.2 EMS (Immunity)

Criteria	General performance criteria for EN 55035:2017+A11:2020
A	The equipment shall continue to operate as intended without operator intervention. No degradation of performance, loss of function or change of operating state is allowed below a performance level specified by the manufacturer when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.
B	During the application of the disturbance, degradation of performance is allowed. However, no unintended change of actual operating state or stored data is allowed to persist after the test. After the test, the equipment shall continue to operate as intended without operator intervention; no degradation of performance or loss of function is allowed, below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level (or the permissible performance loss), or recovery time, is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.
C	Loss of function is allowed, provided the function is self-recoverable or can be restored hv the operation of the controls by the user in accordance with the manufacturer's instructions A reboot or re-start operation is allowed. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

Criteria	Performance criteria for EN 301489-1 Clause 6
CT&CR	During the test, the equipment shall: ● continue to operate as intended; ● not unintentionally transmit; ● not unintentionally change its operating state; ● not unintentionally change critical stored data.
TT&TR	For all ports and transient phenomena with the exception described below, the following applies: ● The application of the transient phenomena shall not result in a change of the mode of operation (e.g. unintended transmission) or the loss of critical stored data. ● After application of the transient phenomena, the equipment shall operate as intended. For surges applied to symmetrically operated wired network ports intended to be connected directly to outdoor lines the following criteria applies: ● For products with only one symmetrical port intended for connection to outdoor lines, loss of function is allowed, provided the function is self-recoverable, or can be otherwise restored. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost. ● For products with more than one symmetrical port intended for connection to outdoor lines, loss of function on the port under test is allowed, provided the function is self-recoverable. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

Performance criteria for EN 301489-3 Clause 6
Continuous and non-continuous operation: Latency is the time delay between the initiation and the completion of operation of the EUT. Correct functioning requires completing the relevant operation within the maximum latency time. Where the maximum latency is specified in the applicable harmonized radio standard (in the wanted performance criterion, or an acknowledge requirement), that value shall be used. Where this is not the case, then the maximum latency is that required by the intended use of the EUT.
Operating modes: Where the EUT has more than one mode of operation (see clause 4.4.1 of EN 301 489-3), an unplanned transition from one mode to another is considered as an unintentional response. The EUT shall be tested in all modes to confirm there are no such unintentional responses.

<table>
<tr><th>Criteria</th><th>Performance criteria for EN 301489-17 Clause 6</th></tr>
<tr><td colspan="2">Performance criteria overview
The performance criteria are:
• performance criteria A for immunity tests with phenomena of a continuous nature;
• performance criteria B for immunity tests with phenomena of a transient nature;
• performance criteria C for immunity tests with power interruptions exceeding a certain time.</td></tr>
<tr><td>Criteria</td><td>During test</td><td>After test
(i.e. as a result of the application of the test)</td></tr>
<tr><td>A</td><td>Shall operate as intended.
(See note).
Shall be no loss of function.
Shall be no unintentional transmissions.</td><td>Shall operate as intended.
Shall be no degradation of performance.
Shall be no loss of function.
Shall be no loss of critical stored data.</td></tr>
<tr><td>B</td><td>May be loss of function.</td><td>Functions shall be self-recoverable.
Shall operate as intended after recovering.
Shall be no loss of critical stored data.</td></tr>
<tr><td>C</td><td>May be loss of function.</td><td>Functions shall be recoverable by the operator.
Shall operate as intended after recovering.
Shall be no loss of critical stored data.</td></tr>
<tr><td colspan="3">NOTE: Operate as intended during the test allows a level of degradation in accordance with clause 6.2.2. of EN 301 489-17 (Minimum performance level)</td></tr>
<tr><td colspan="3">Minimum performance level
For equipment that supports a PER or FER, the minimum performance level shall be a PER or FER less than or equal to 10 %.
For equipment that does not support a PER or a FER, the minimum performance level shall be no loss of the wireless transmission function needed for the intended use of the equipment.</td></tr>
<tr><td>CT&CR</td><td colspan="2">The performance criteria A shall apply.
Where the EUT is a transmitter in standby mode, unintentional transmission shall not occur during the test.
Where the EUT is a transceiver in receive mode, unintentional transmission shall not occur during the test.</td></tr>
<tr><td>TT&TR</td><td colspan="2">The performance criteria B shall apply, except for voltage dips greater than or equal to 100ms and voltage interruptions of 5000ms duration, for which performance criteria C shall apply.
Where the EUT is a transmitter in standby mode, unintentional transmission shall not occur as a result of the application of the test.
Where the EUT is a transceiver in receive mode, unintentional transmission shall not occur as a result of the application of the test.</td></tr>
</table>

Criteria	Performance criteria for EN 301489-19 Clause 6
CR	During the test, the equipment shall operate as intended, e.g. not unintentionally change its operating state and not unintentionally change critical stored data. After the test, the equipment shall operate as intended, e.g. have no loss of function and have no loss of critical stored data.
TR	After the test, functions shall be self-recoverable and the equipment shall operate as intended and the equipment shall have no loss of critical stored data.

Criteria	Performance criteria for EN 301489-52 Clause 6
GSM and voice call:	
CT	With a link established, during the test, the uplink speech output level shall be at least 35 dB less than the previously recorded reference levels, when measured through an audio band pass filter of width 200 Hz, centred on 1 kHz (audio breakthrough check). NOTE: When there is a high-level background noise present, the filter bandwidth may be reduced down to a minimum of 40 Hz. In idle mode, the transmitter shall not operate unintentionally. At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or critical stored data, and the communication link shall have been maintained.
CR	During the test, the RXQUAL of the downlink shall not exceed the value of three, measured during each individual exposure in the test sequence. In the case of narrow band responses, the procedure in clause 4.4.1 of EN 301 489-52 shall be followed. During the test, the downlink speech output level shall be at least 35 dB less than the previously recorded reference levels, when measured through an audio band pass filter of width 200 Hz, centred on 1 kHz (audio breakthrough check). NOTE: When there is a high-level background noise present, the filter bandwidth may be reduced down to a minimum of 40 Hz. At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or critical stored data, and the communication link shall have been maintained.
UTRA:	
CT&CR	In the data transfer mode, the performance criteria can be one of the following: if the BER (as referred in clause 5.3.1 of ETSI TS 134 109 [4]) is used, it shall not exceed 0,001 during the test sequence; if the BLER (as referred in ETSI TS 134 109 [4]) is used, it shall not exceed 0,01 during the test sequence. The BLER calculation shall be based on evaluating the CRC on each transport block. Details are specified in annex C of EN 301 489-52. In the case of narrow band responses, the procedure in clause 4.4.2.1 of EN 301 489-52 shall be followed. When testing a voice call, the performance criteria in clause 6.1.1 of EN 301 489-52 shall apply.
E-UTRA, E-UTRA with LAA, inband or guard band NB-IoT, Standalone NB-IoT:	
CT&CR	In data transfer mode, the data throughput of the EUT shall not fall below 95 % of the maximum data throughput. Details are specified in annex C of EN 301 489-52. In the case of narrow band responses, the procedure in clause 4.4.2.2 of EN 301 489-52 shall be followed. When testing a voice call, the performance criteria in clause 6.1.1 of EN 301 489-52 shall apply.
NR:	
CT&CR	In data transfer mode, the data throughput of the EUT shall not fall below 95 % of the maximum data throughput. Details are specified in annex C of EN 301 489-52. In the case of narrow band responses, the procedure in clause 4.4.3 of EN 301 489-52 shall be followed. When testing a voice call, the performance criteria in clause 6.1.1 of EN 301 489-52 shall apply.
TT&TR	At the conclusion of each exposure of the transient phenomena, the EUT shall operate without loss of the communication link. At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended without loss of user control functions or critical stored data. In addition where the EUT supports idle mode it should be verified that the transmitter shall not unintentionally operate when transient phenomena are applied.

4.2.1 RF electromagnetic field(RS)

Measurement methods:

The test method shall be in accordance with CENELEC EN 61000-4-3 [3], clauses 6, 7 and 8.
The following requirements and evaluation of test results shall apply:

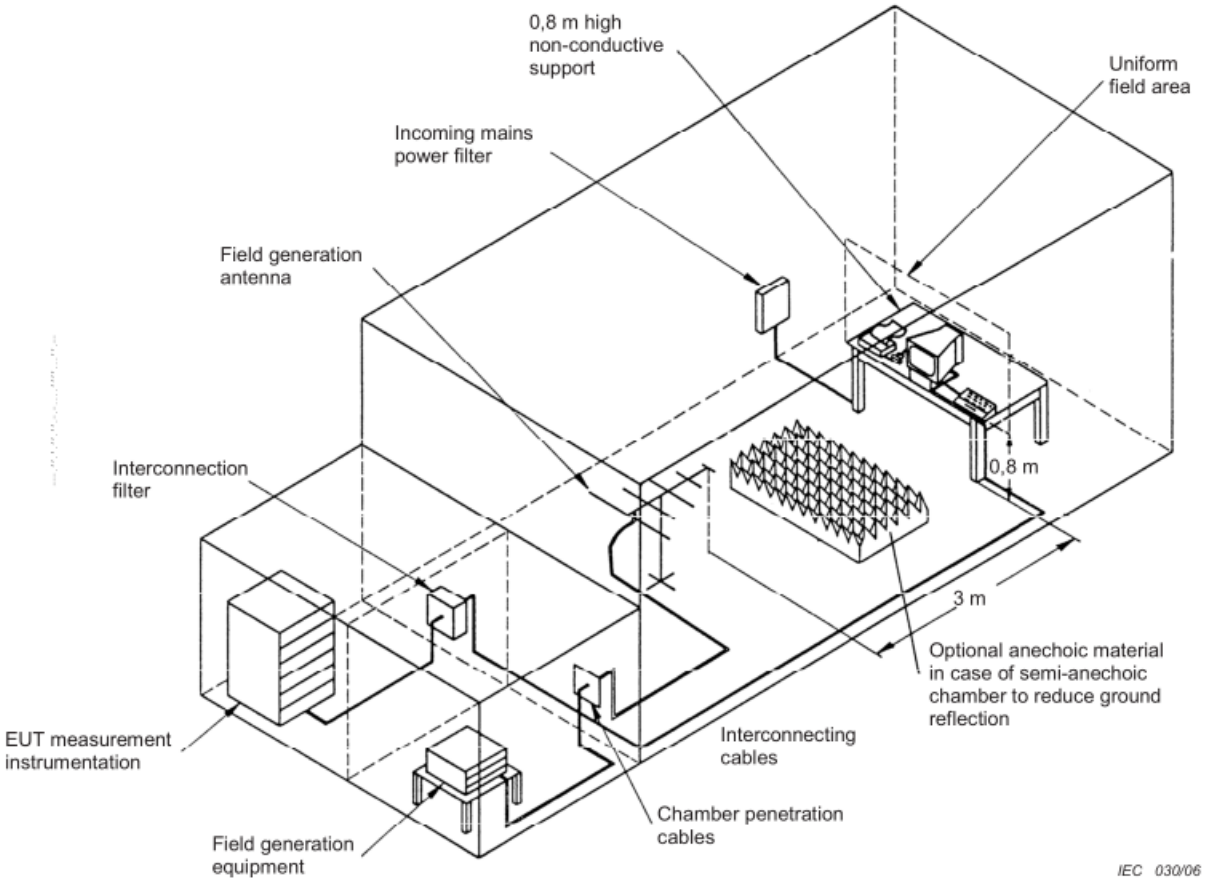
- the test level shall be 3V/m (measured unmodulated). The test signal shall be amplitude modulated to a depth of 80% by a sinusoidal audio signal of 1000Hz. If the wanted signal is modulated at 1000Hz, then an audio signal of 400Hz shall be used;
- the test shall be performed over the frequency range 80MHz to 6000 MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers (see clause 4.3 of EN 301 489-1), as appropriate;
- for receivers and transmitters the stepped frequency increments shall be 1% frequency increment of the momentary used frequency;
- the dwell time of the test phenomena at each frequency shall not be less than the time necessary for the EUT to be exercised and to be able to respond;
  NOTE: Dwell time is product dependent.
- the frequencies selected and used during the test shall be recorded.

Test Procedure:

1. The equipment to be tested is placed in the test facility on a non-conductive table 0,8 m high.
2. The EUT was initially placed with one face coincident with the calibration plane. The EUT face being illuminated was contained within the UFA (Uniform Field Areal).
3. If the manufacturer's specification requires a wiring length of less than or equal to 3 m, then the specified length shall be used. If the length specified is greater than 3 m or is not specified, then the length of cable used shall be chosen according to typical installation practices. If possible, a minimum of 1 m of cable is exposed to the electromagnetic field. Excess length of cables interconnecting units of the EUT shall be bundled low-inductively in the approximate center of the cable to form a bundle 30 cm to 40 cm in length.
4. The frequency ranges to be considered were swept with the signal modulated and pausing to adjust the RF signal level or to switch oscillators and antennas as necessary. Where the frequency range was swept incrementally, the step size was not exceeded 1 % of the preceding frequency value.
5. The dwell time of the amplitude modulated carrier at each frequency was not less than the time necessary for the EUT to be exercised and to respond and was not less than 0.5s.
6. The test shall normally be performed with the generating antenna facing each side of the EUT. When equipment can be used in different orientations (i.e. vertical or horizontal) all sides shall be exposed to the field during the test. When technically justified, some EUTs can be tested by exposing fewer faces to the generating antenna. In other cases, as determined for example by the type and size of EUT or the frequencies of test, more than four azimuths may need to be exposed.
7. The EUT was performed in a configuration to actual installation conditions, a video camera and/or a audio monitor were used to monitor the performance of the EUT.

Note:
For radiated immunity tests, the level of the wanted signal at the enclosure port of the EUT is 30 dB (±3 dB) above the Pmin of the EUT(For BT Wi-Fi).And, the level of the wanted signal at the enclosure port of the EUT is 18 dB above the reference sensitivity level for the EUT (For GSM,WCDMA,LTE,NR)

Test Setup:



Measuring Instruments:

The measuring equipment is listed in the section 3.1 of this test report.

Test Result:

Continuous RF electromagnetic radiated field disturbances swept/spot test						
Test Frequency	Level	Modulation	EUT Face	ANT Polarization	Performance criteria	Result
80MHz-1GHz 1GHz-6GHz	3V/m	80 % amplitude modulated with a 1 kHz sine wave, 1% increment, Dwell time=1s	Top	H	A	PASS
				V	A	PASS
			Bottom	H	A	PASS
				V	A	PASS
			Front	H	A	PASS
				V	A	PASS
			Rear	H	A	PASS
				V	A	PASS
			Left	H	A	PASS
				V	A	PASS
			Right	H	A	PASS
				V	A	PASS
Observations:						
Bluetooth: The PER less than 10 %.						
Wi-Fi: The PER less than 10 %.						
GSM: The RXQUAL of the downlink shall not exceed the value of three.						
WCDMA: The BER not exceed 0,001, during the test sequence.						
LTE: The data throughput of the EUT more than 95 % of the maximum data throughput.						
NR: The data throughput of the EUT more than 95 % of the maximum data throughput.						
GNSS: During the test, the equipment shall operate as intended, e.g. not unintentionally change its operating state and not unintentionally change critical stored data. After the test, the equipment shall operate as intended, e.g. have no loss of function and have no loss of critical stored data.						

4.2.2 Electrostatic discharges(ESD)

Measurement methods:
The test method shall be in accordance with CENELEC EN 61000-4-2 [2], clauses 6, 7 and 8.
For radio equipment and ancillary equipment the following requirements and evaluation of test results shall apply.
The test severity level for contact discharge shall be ±4 kV and for air discharge ±8 kV. All other details, including intermediate test levels, are contained within CENELEC EN 61000-4-2 [2], clause 5.
Electrostatic discharges shall be applied to all exposed surfaces of the EUT except where the user documentation specifically indicates a requirement for appropriate protective measures (as specified in CENELEC EN 61000-4-2 [2], clauses 8.3.2 and 8.3.3).

Test Procedure:

The test shall be performed with single discharges. On each pre-selected point at least 10 single discharges (in the most sensitive polarity) shall be applied.
Note1: the minimum number of discharges applied is depending on the EUT; for products with synchronized circuits the number of discharges should be larger.

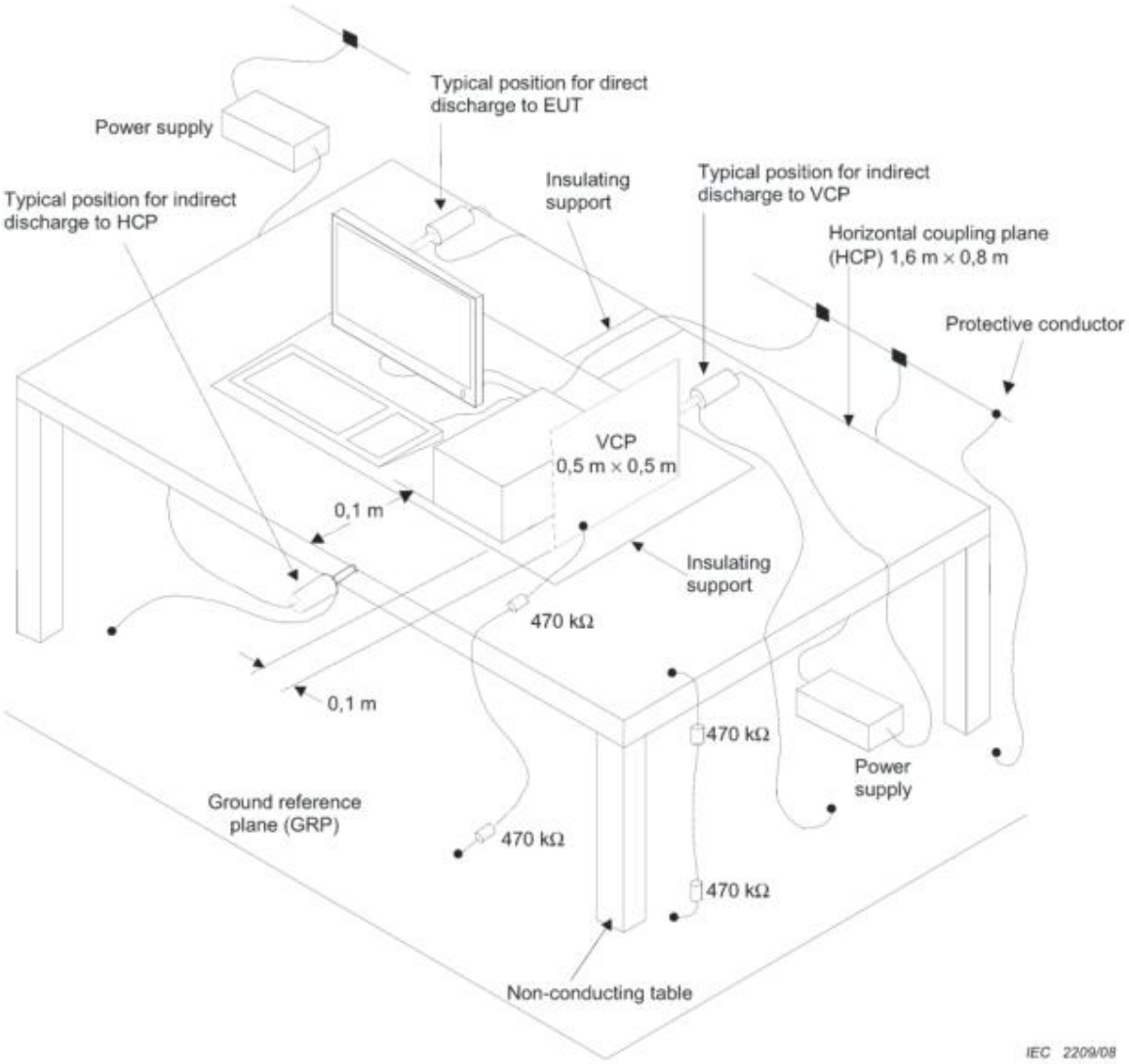
For the time interval between successive single discharges an initial value of is 1s recommended. Longer intervals may be necessary to determine whether a system failure has occurred.
Note2: the points to which the discharges should be applied may be selected by means of an exploration carried out at a repetition rate of 20 discharges per second, or more.

The ESD generator shall be held perpendicular, whenever possible, to the surface to which the discharge is applied This improves repeatability of the test results.

The discharge return cable of the generator shall be kept at a distance of at least 0.2m from the EUT whilst the discharge is being applied and should not be held by the operator.

1. **Air discharges:** the ESD generator shall approach the EUT as fast as possible until contact between the electrode and the EUT is made (without causing mechanical damage). After each discharge, the ESD generator (discharge electrode) shall be removed from the EUT. The generator is then retriggered for a new single discharge. This procedure shall be repeated until the discharges are completed. In the case of an air discharge test, the discharge switch, which is used for contact discharge, shall be closed.
2. **Contact discharge:** the tip of the discharge electrode shall touch the EUT, before the discharge switch is operated.
3. **Horizontal coupling plane (HCP) under the EUT:** Discharge to the HCP shall be made horizontally to the edge of the HCP.
   At least 10 single discharges (in the most sensitive polarity) shall be applied at the front edge of each HCP opposite the centre point of each unit (if applicable) of the EUT and 0.1m from the front of the EUT. The long axis of the discharge electrode shall be in the plane of the HCP and perpendicular to its front edge during the discharge.
4. **Vertical coupling plane (VCP):** At least 10 singe discharge (in the most sensitive polarity) shall be applied to the centre of on vertical edge of the coupling plane. The coupling plane, of dimensions 0.5m x 0.5m, is placed parallel to, and positioned at a distance of 0.1m from, the EUT.

Test Setup:



Measuring Instruments:

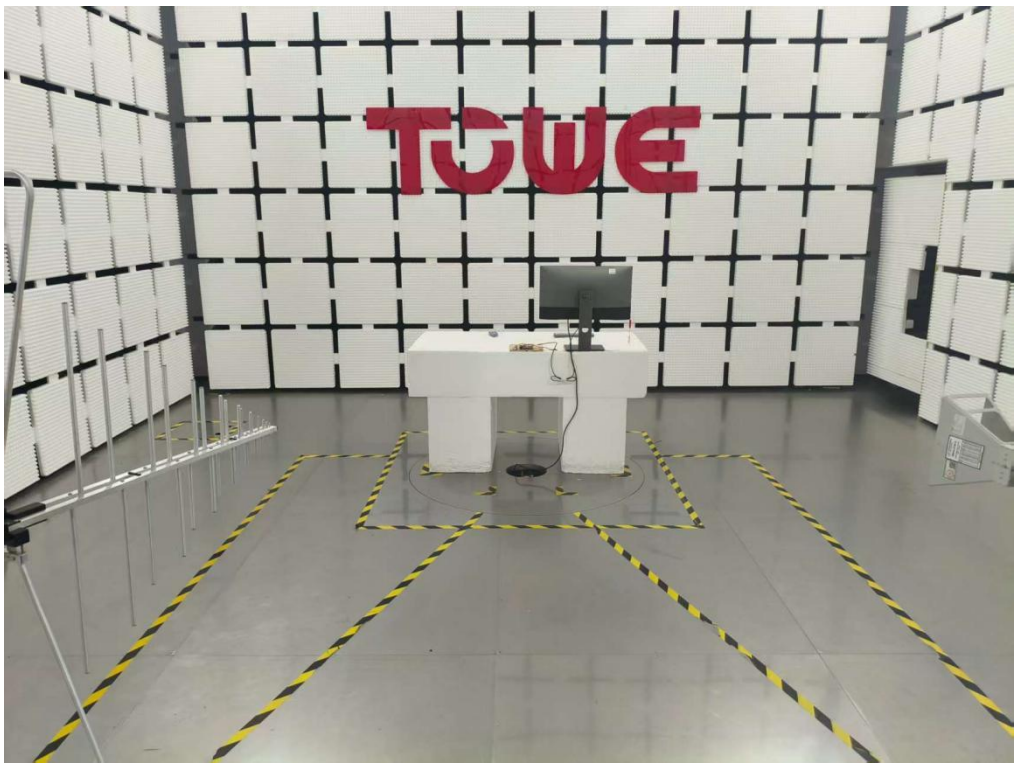
The measuring equipment is listed in the section 3.1 of this test report.

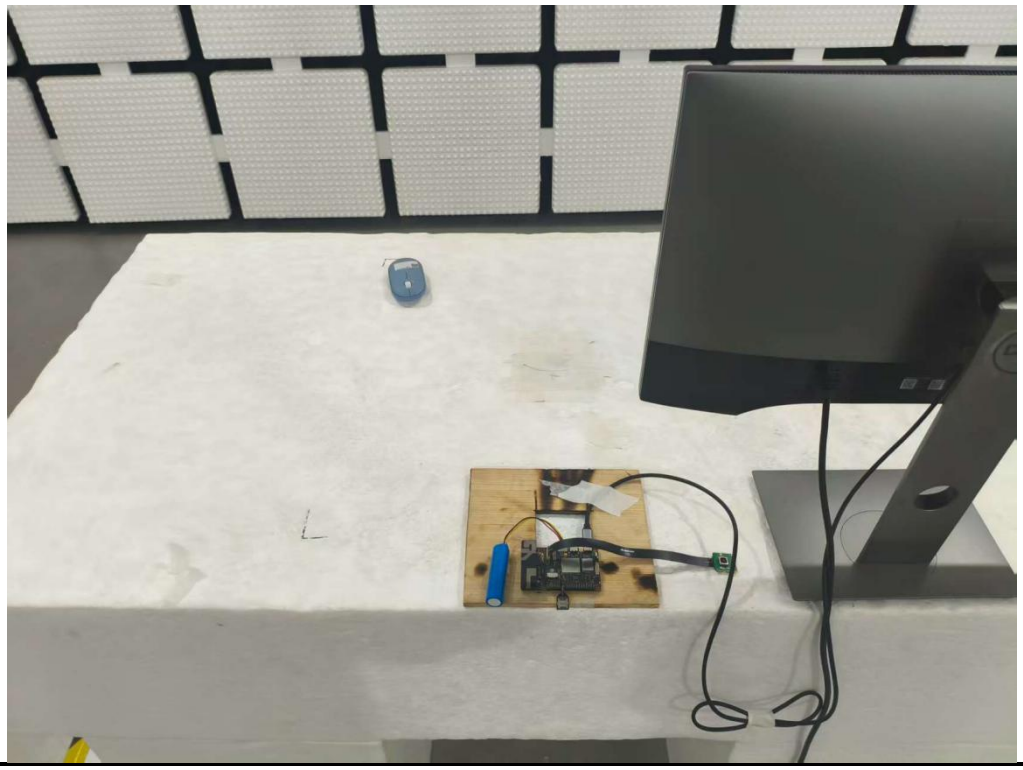
Test Result:

Direct application of discharges to the EUT:				
Test voltage	Discharge position	Test points	Performance criteria	Result
±2 kV, ±4 kV, ±8 kV	Air discharge	N/A	N/A	N/A
±2 kV, ±4 kV	Contact discharge	N/A	N/A	N/A
Indirect application of the discharge:				
Test voltage	Discharge position	Test points	Performance criteria	Result
±2 kV, ±4 kV	HCP - EUT (Top / Bottom / Front / Back / Left / Right)	Edge of the HCP	B	PASS
	VCP - EUT (Front / Back / Left / Right)	Center of the VCP	B	PASS
Observations:				
N/A: Not Applicable. In normal use, the module is internal to the host				
Bluetooth: keeps the communication connection, and no performance degradation was found				
Wi-Fi: keeps the communication connection, and no performance degradation was found				
GSM: keeps the communication connection, and no performance degradation was found				
WCDMA: keeps the communication connection, and no performance degradation was found				
LTE: keeps the communication connection, and no performance degradation was found				
NR: keeps the communication connection, and no performance degradation was found				

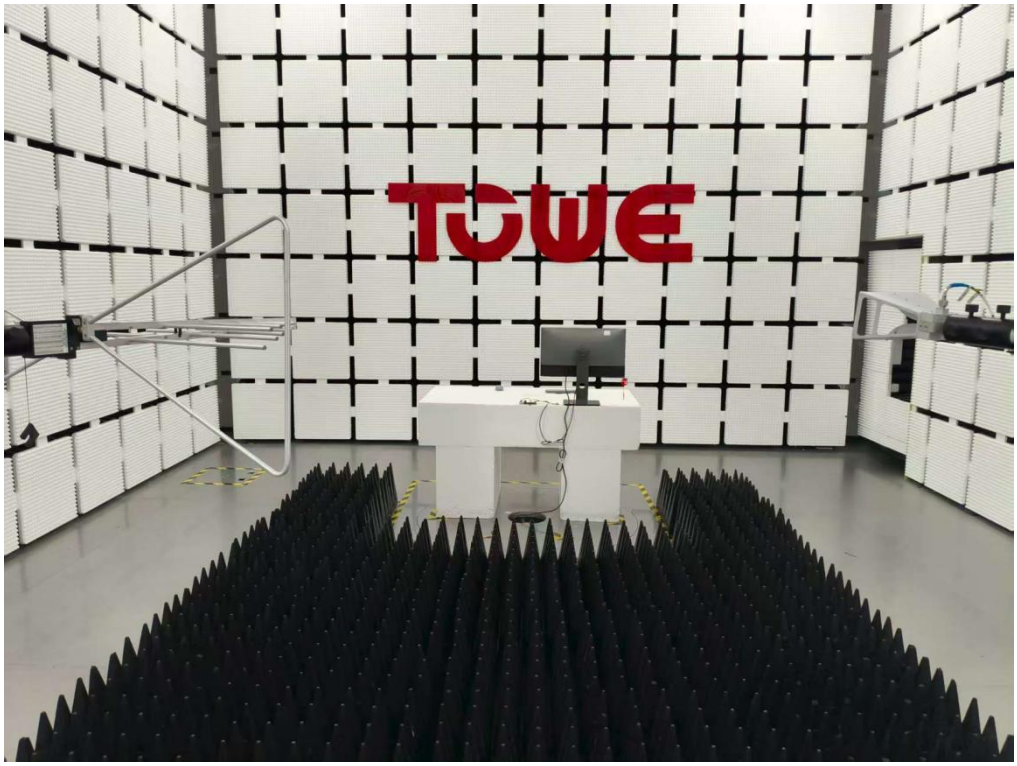
5 Setup Photo

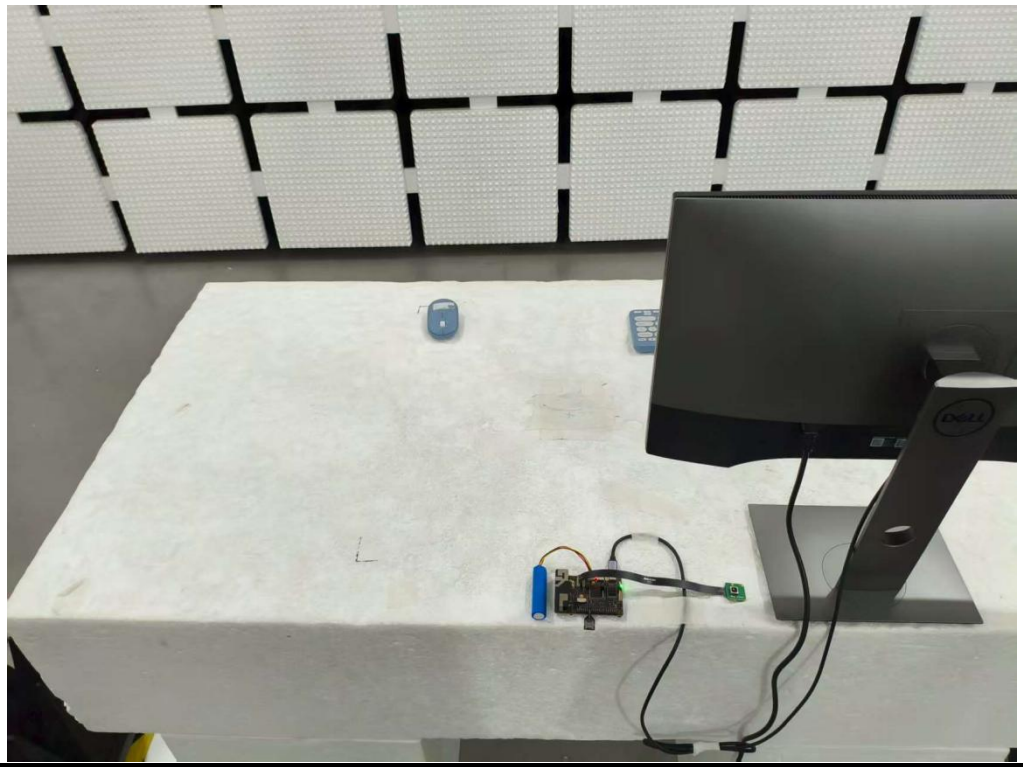
Radiated Emission Below 1GHz



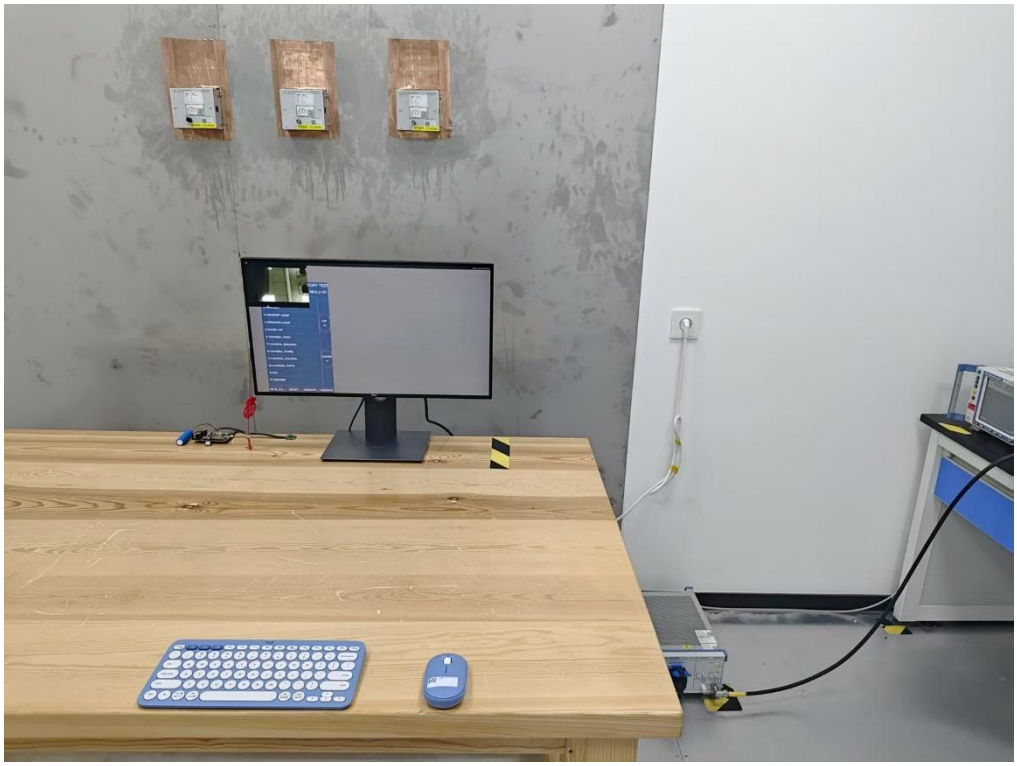


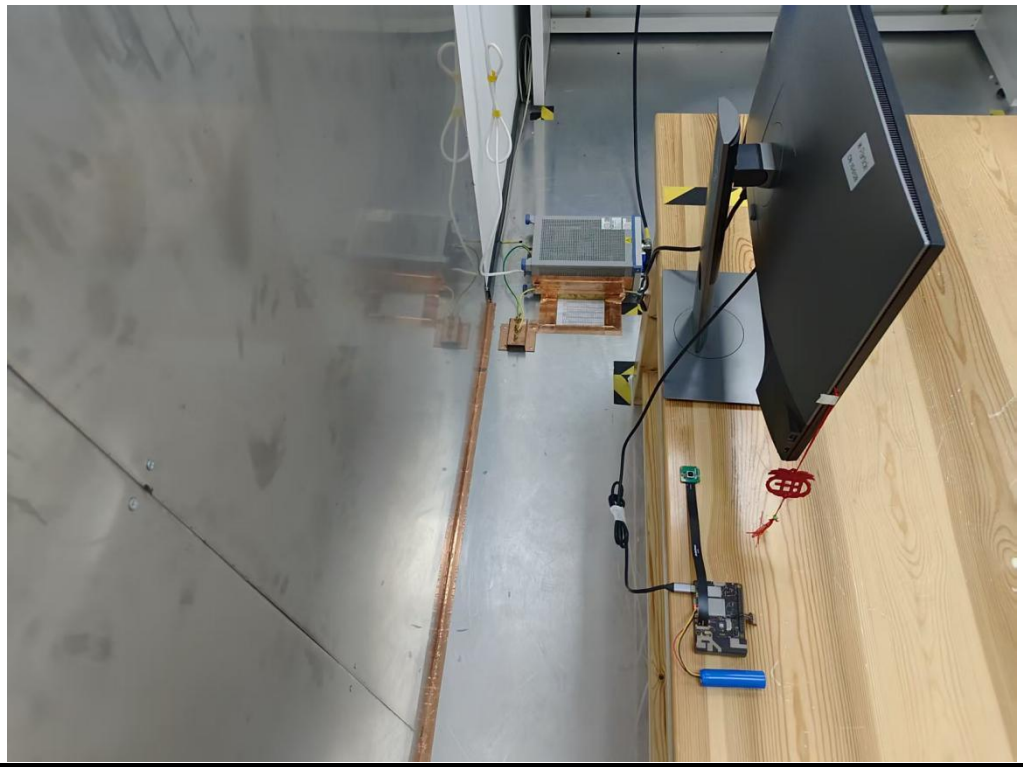
Radiated Emission Above 1GHz





Conducted Emission





ESD

RS

~The End~