
EMC Test Report

Report No.: AGC00688210624EE01

PRODUCT DESIGNATION : Ruuvi Gateway
BRAND NAME : Ruuvi
MODEL NAME : Ruuvi Gateway
APPLICANT : Ruuvi Innovations Ltd (Oy)
DATE OF ISSUE : Aug. 12, 2021
STANDARD(S) : ETSI EN 301 489-1 V2.2.3 (2019-11)
ETSI EN 301 489-17 V3.2.4 (2020-09)
REPORT VERSION : V1.0

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Tel: +86-755 2523 4088 E-mail: agc@agc-cert.com Web: http://cn.agc-cert.com/



Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Aug. 12, 2021	Valid	Initial Release

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1. TEST REPORT CERTIFICATION

Applicant	Ruuvi Innovations Ltd (Oy)
Address	Hämeenkatu 10 B 132, 11100 RIIHIMÄKI, FINLAND
Manufacturer	Ruuvi Innovations Ltd (Oy)
Address	Hämeenkatu 10 B 132, 11100 RIIHIMÄKI, FINLAND
Factory	Promistel Industries
Address	11 Rue de l'essor - 77760 La Chapelle la Reine, FRANCE
Product Designation	Ruuvi Gateway
Brand Name	Ruuvi
Test Model	Ruuvi Gateway
Date of test	Jul. 12, 2021 to Aug. 12, 2021
Deviation	None
Condition of Test Sample	Normal
Test Result	Pass
Report Template	AGCRT-EC-EMC

We, Attestation of Global Compliance (Shenzhen) Co., Ltd., hereby certify that the submitted samples of the above item, as detailed in chapter 2.1 of this report, has been tested in our facility. The test record, data evaluation and test configuration represented herein are true and accurate accounts of measurements of the sample's EMC characteristics under the conditions herein specified.

Prepared By

Cool Cheng

Cool Cheng
Project Engineer

Aug. 12, 2021

Reviewed By

Max Zhang

Max Zhang
Reviewer

Aug. 12, 2021

Approved By

Forrest Lei

Forrest Lei
Authorized Officer

Aug. 12, 2021

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2. GENERAL INFORMATION

2.1. DESCRIPTION OF EUT

Details of technical specification refer to the description in follows:

Transmitter/Receiver (TX/RX)

Operating Frequency	2402-2480MHz, 2412-2472MHz
Modulation type	BT(BLE):GFSK 2.4GWIFI; 802.11b:DQPSK, DBPSK, CCK 802.11g/n: 64-QAM, 16-QAM, QPSK, BPSK
Bluetooth Version	V5.0
Hardware Version	A2
Software Version	1
Antenna designation	BT(BLE) : SMA cloverleaf/dipole Antenna 2.4G WIFI: PCB Antenna
Number of channels	BT(BLE) :40 2.4G WIFI:13
Antenna Gain	BT(BLE) :0dBi 2.4G WIFI: 0dBi
Power Supply	DC 5V by adapter

2.2. OBJECTIVE

Perform Electro Magnetic Interference (EMI) and Electro Magnetic Susceptibility (EMS) tests for CE Marking.

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2.3. TEST STANDARDS AND RESULTS

The EUT has been tested according to ETSI EN 301 489-1 V2.2.3 (2019-11), ETSI EN 301 489-3 V2.1.1 (2019-03) and ETSI EN 301 489-17 V3.2.4 (2020-09).

ETSI EN 301 489-1	Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for Electro Magnetic Compatibility.
ETSI EN 301 489-17	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems; Harmonised Standard for ElectroMagnetic Compatibility

2.4. TEST ITEMS AND THE RESULTS

No.	Basic Standard	Test Type	Result
EMISSION (EN 301 489-1 §7.1)			
1	EN 55032	Radiated emission	PASS
3	EN 55032	Conducted emission, AC ports	PASS
4	EN 55032	Conducted emission, Telecom ports	PASS
5	EN 61000-3-2	Harmonic current emissions	N/A
6	EN 61000-3-3	Voltage fluctuations & flicker	PASS
IMMUNITY (EN 301 489-1 §7.2)			
7	EN 61000-4-2	Electrostatic discharge immunity	PASS
8	EN 61000-4-3	Radiated RF electromagnetic field immunity	PASS
9	EN 61000-4-4	Electrical fast transient/burst immunity	PASS
10	ISO 7637-1, -2	Transients and surges, DC ports	N/A
11	EN 61000-4-5	Surge immunity, AC ports, Telecom ports	PASS
12	EN 61000-4-6	Immunity to conducted disturbances induced by RF fields	PASS
13	EN 61000-4-11	Voltage dips and short interruptions immunity	PASS

Note: 1. N/A- Not Applicable.

2. The latest versions of basic standards are applied.

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2.5. ENVIRONMENTAL CONDITIONS

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

- Temperature: 15-35°C
- Relative Humidity: 30-60 %
- Atmospheric pressure: 86-106 kPa

3. TEST MODE DESCRIPTION

TEST MODE DESCRIPTION		
NO.	TEST MODE DESCRIPTION	WORST
1	2.4G WIFI mode	V
2	2.4G WIFI mode with LAN Port	--
3	BT mode	--

Note: 1. V means EMI worst mode
2. Only worst mode data recorded in the test report.

I/O Port Information (Applicable Not Applicable)

I/O Port of EUT			
I/O Port Type	Number	Cable Description	Tested With
DC IN	1	--	1
LAN	1	--	1
Flexible flat cable	3	--	3

4. MEASUREMENT UNCERTAINTY

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in measurement" (GUM) published by CISPR and ANSI.

- Uncertainty of Conducted Emission, $U_c = \pm 3.2 \text{ dB}$
- Uncertainty of Radiated Emission below 1GHz, $U_c = \pm 3.9 \text{ dB}$
- Uncertainty of Radiated Emission above 1GHz, $U_c = \pm 4.8 \text{ dB}$

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5. SUPPORT EQUIPMENT

Device Type	Manufacturer	Model Name	Data Cable
Mobile phone	TCL	J326T	--
Adapter	Zhongli	ZL-PCB0100020502000	--

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6. IDENTIFICATION OF THE RESPONSIBLE TESTING LOCATION

Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location	1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

TEST EQUIPMENT OF CONDUCTED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESPI	101206	May 15, 2021	May 14, 2022
LISN	R&S	ESH2-Z5	100086	Jun. 09, 2021	Jun. 08, 2022

TEST EQUIPMENT OF RADIATED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESCI	10096	May 15, 2021	May 14, 2022
ANTENNA	SCHWARZBECK	VULB9168	494	Sep. 20, 2019	Sep. 19, 2021
Double-Ridged Waveguide Horn	ETS	3117	00034609	Apr. 23, 2021	Apr. 22, 2023
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MY53470504	Dec. 07, 2020	Dec. 06, 2021

TEST EQUIPMENT OF POWER HARMONICS / VOLTAGE FLUCTUATION / FLICKER TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
Signal Conditioning Unit	Schaffner	CCN1000-1	72431	Jul. 15,2020	Jul. 14,2022
AC Source	Schaffner	NSG1007	56825	Jul. 15,2020	Jul. 14,2022

TEST EQUIPMENT OF SURGE/EFT/DIPSTEST

Description	Manufacturer	Model	S/N	Cal. Date	Cal. Due
EFT、Surge Generator	Schaffner	Modula 6150	34437	Jul. 03,2020	Jul. 02,2022

TEST EQUIPMENT OF ESD TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
ESD Simulator	EM Test	NSG 438	782	Jan. 10, 2020	Jan. 09, 2022

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TEST EQUIPMENT OF RS IMMUNITY TEST

Description	Manufacturer	Model	S/N	Cal. Date	Cal. Due
Signal Generator	R&S	E4421B	MY43351603	Jun. 08, 2020	Jun. 07, 2022
POWER SENSOR	R&S	URV5-Z4	100124	May 22, 2020	May 21, 2022
POWER METER	R&S	NRVD	8323781027	May 22, 2020	May 21, 2022
POWER AMPLIFIER	KALMUS	7100LC	04-02/17-06-001	N/A	N/A
RF AMPLIFIER	Milmega	AS0104-55 _55	1004793	N/A	N/A
Double-Ridged Waveguide Horn	ETS LINDGREN	3117	00034609	Apr. 23, 2021	Apr. 22, 2023
ANTENNA	SCHWARZBEC K	VULB9168	494	Jan. 08, 2021	Jan. 07, 2023

TEST EQUIPMENT OF CS IMMUNITY TEST

Description	Manufacturer	Model	S/N	Cal. Date	Cal. Due
Power Amplifier	AR	75A250	18464	N/A	N/A
CDN	ZHINAN	ZN3751	15004	Sep. 09, 2019	Sep. 02, 2022
6dB attenuator	ZHINAN	E-002	N/A	Sep. 09, 2019	Sep. 02, 2022
Electromagnetic Injection Clamp	Luthi	EM101	35773	Sep. 27, 2019	Aug. 24, 2022
Power Sensor	R&S	URV5-Z4	100124	May 22, 2020	May 21, 2022
Power Meter	R&S	NRVD	8323781027	May 22, 2020	May 21, 2022
SIGNAL GENERATOR	R&S	E4421B	MY43351603	Jun. 08, 2020	Jun. 07, 2022

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7. EMISSION TEST

7.1. MAINS TERMINAL DISTURBANCE VOLTAGE MEASUREMENT

7.1.1 LIMITS OF MAINS TERMINAL DISTURBANCE VOLTAGE

AT MAIN PORT

Frequency	Maximum RF Line Voltage	
	Q.P.(dBuV)	Average(dBuV)
150kHz-500kHz	66-56	56-46
500kHz-5MHz	56	46
5MHz-30MHz	60	50

Note: 1. The lower limit shall apply at the transition frequency.

2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50MHz.

AT TELECOMMUNICATION PORT

Frequency	Maximum RF Line Voltage	
	Q.P.(dBuV)	Average(dBuV)
150kHz-500kHz	84-74	74-64
500kHz-30MHz	74	64

NOTE 1 The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.

NOTE 2 The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode (asymmetric mode) impedance of 150 Ω to the telecommunication port under test (conversion factor is $20 \log_{10} 150 / I = 44 \text{ dB}$).

7.1.2 TEST PROCEDURE

1. The EUT was placed 0.4 meters from the conducting wall of shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provide 50Ω/50µH of coupling impedance for the measuring instrument.
2. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
3. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 20dB under the prescribed limits are not reported.

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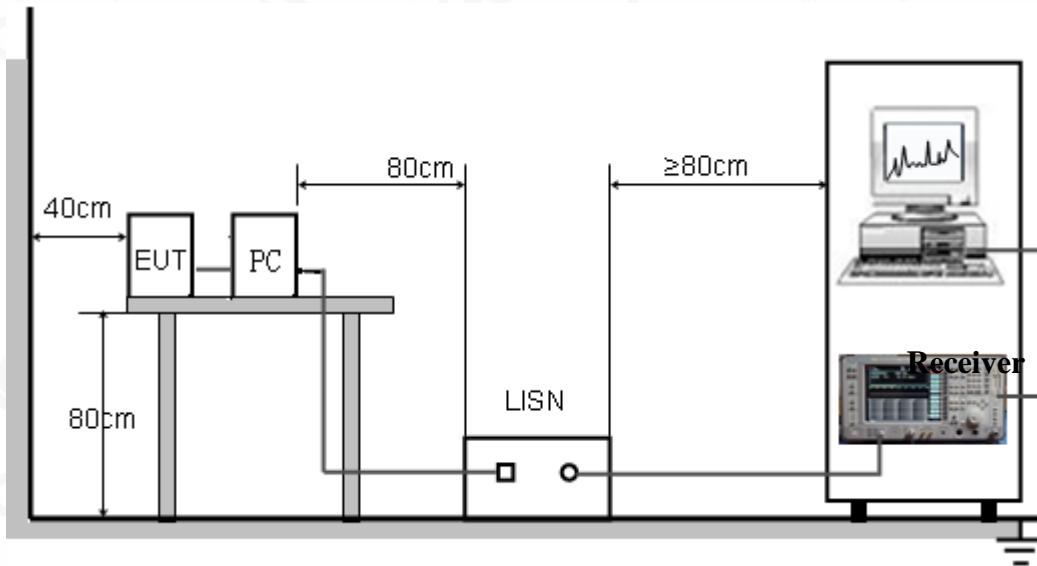
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7.1.3 TEST SETUP



For the actual test configuration, please refer to the related item - Photographs of the Test Configuration.

7.1.4 TEST RESULT

The test modes were carried out for all operation modes

The worst test mode of the EUT was Mode 1, and its test data was showed as the follow:

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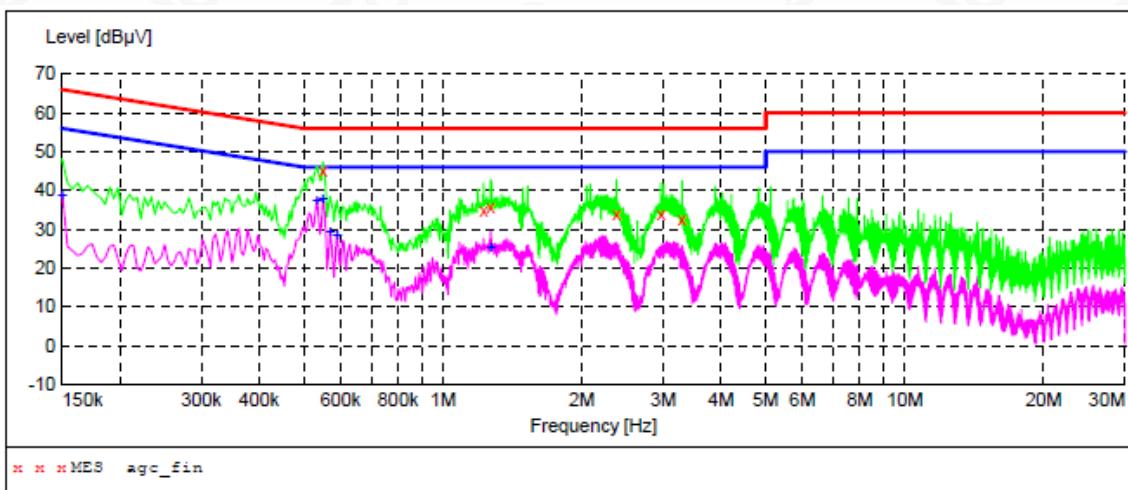
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LINE CONDUCTED EMISSION TEST-L


MEASUREMENT RESULT: "agc_fin"

2021/7/13 19:12

Frequency MHz	Level dB μ V	Transd dB	Limit dB μ V	Margin dB	Detector	Line
0.550000	45.10	5.4	56	10.9	QP	L1
1.226000	34.90	6.0	56	21.1	QP	L1
1.270000	35.70	6.1	56	20.3	QP	L1
2.378000	33.90	7.5	56	22.1	QP	L1
2.966000	34.00	7.5	56	22.0	QP	L1
3.298000	32.70	7.5	56	23.3	QP	L1

MEASUREMENT RESULT: "agc_fin2"

2021/7/13 19:12

Frequency MHz	Level dB μ V	Transd dB	Limit dB μ V	Margin dB	Detector	Line
0.150000	38.80	6.9	56	17.2	AV	L1
0.534000	37.60	5.4	46	8.4	AV	L1
0.550000	37.90	5.4	46	8.1	AV	L1
0.570000	29.40	5.4	46	16.6	AV	L1
0.590000	28.70	5.4	46	17.3	AV	L1
1.270000	25.20	6.1	46	20.8	AV	L1

RESULT: PASS

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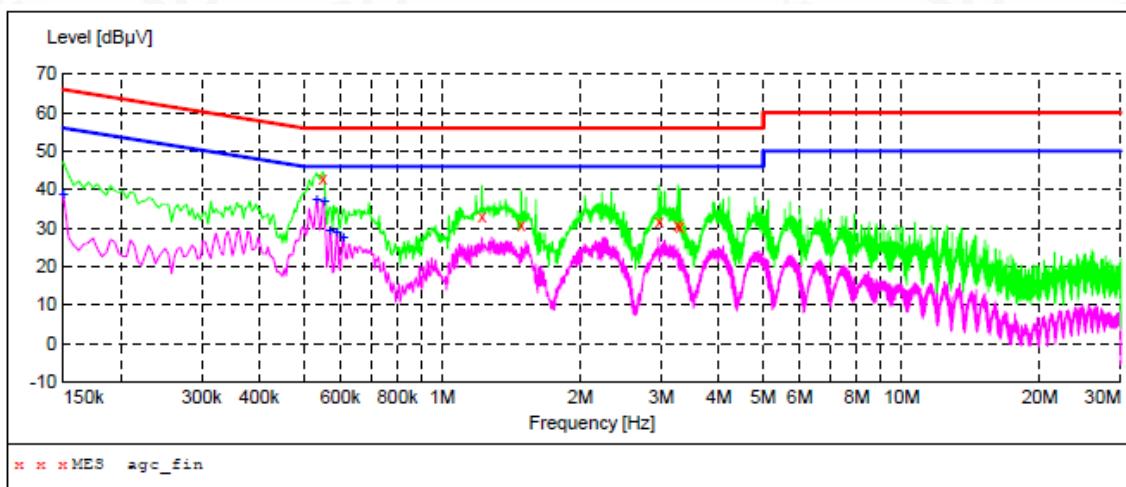
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LINE CONDUCTED EMISSION TEST-N

**MEASUREMENT RESULT: "agc_fin"**

2021/7/13 18:57

Frequency MHz	Level dB μ V	Transd dB	Limit dB μ V	Margin dB	Detector	Line
0.550000	42.80	5.4	56	13.2	QP	N
1.222000	33.00	6.0	56	23.0	QP	N
1.486000	30.80	6.6	56	25.2	QP	N
2.966000	31.70	7.5	56	24.3	QP	N
3.258000	30.90	7.5	56	25.1	QP	N
3.294000	30.10	7.5	56	25.9	QP	N

MEASUREMENT RESULT: "agc_fin2"

2021/7/13 18:57

Frequency MHz	Level dB μ V	Transd dB	Limit dB μ V	Margin dB	Detector	Line
0.150000	38.70	6.9	56	17.3	AV	N
0.534000	37.60	5.4	46	8.4	AV	N
0.554000	37.20	5.4	46	8.8	AV	N
0.570000	29.40	5.4	46	16.6	AV	N
0.590000	29.00	5.4	46	17.0	AV	N
0.610000	27.60	5.4	46	18.4	AV	N

RESULT: PASS

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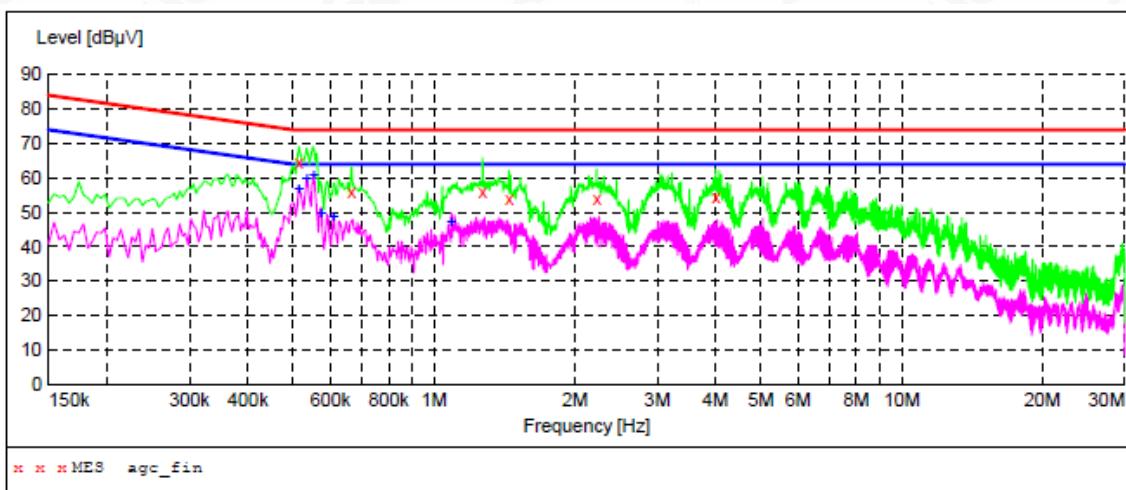
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SIGNAL PORT EMISSION TEST



MEASUREMENT RESULT: "agc_fin"

2021/7/14 19:26

Frequency MHz	Level dB μ V	Transd dB	Limit dB μ V	Margin dB	Detector	Line
0.514000	64.50	16.5	74	9.5	QP	N
0.666000	55.90	16.5	74	18.1	QP	N
1.270000	56.00	16.5	74	18.0	QP	N
1.446000	54.00	16.5	74	20.0	QP	N
2.226000	53.70	16.6	74	20.3	QP	N
4.002000	54.20	16.6	74	19.8	QP	N

MEASUREMENT RESULT: "agc_fin2"

2021/7/14 19:26

Frequency MHz	Level dB μ V	Transd dB	Limit dB μ V	Margin dB	Detector	Line
0.514000	56.80	16.5	64	7.2	AV	N
0.534000	60.10	16.5	64	3.9	AV	N
0.554000	60.70	16.5	64	3.3	AV	N
0.574000	50.00	16.5	64	14.0	AV	N
0.610000	48.70	16.5	64	15.3	AV	N
1.090000	47.20	16.6	64	16.8	AV	N

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7.2. RADIATED DISTURBANCE MEASUREMENT

7.2.1. LIMITS OF RADIATED DISTURBANCES

Limits for radiated disturbance 30M to 1 GHz at a measurement distance of 3 m

Frequency range (MHz)	Quasi peak limits(dBuV/m), for Class B ITE, at 3m measurement distance
30 - 230	40
230 - 1000	47

Limits for radiated disturbance above 1 GHz at a measurement distance of 3 m

Frequency range (MHz)	Limits (dBuV/m), Class B ITE	
	Peak	Average
1000-3000MHz	70	50
3000-6000MHz	74	54

Note:1. The lower limit shall apply at the transition frequency.

2. Additional provisions may be required for cases where interference occurs.

7.2.2. TEST PROCEDURE

- (1). The EUT was placed on the top of an insulating table 0.8 meters above the ground at a semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- (2). The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- (3).The antenna is a broadband antenna, and its height is varied from 1 to 4 meter above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- (4). For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to the heights from 1 to 4 meters and the ratable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- (5).The test-receiver system was set to Peak Detector Function and Specified Bandwidth with Maximum Hold Mode. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emission that did not have 10dB margin would be retested one by one using the quasi-peak method.

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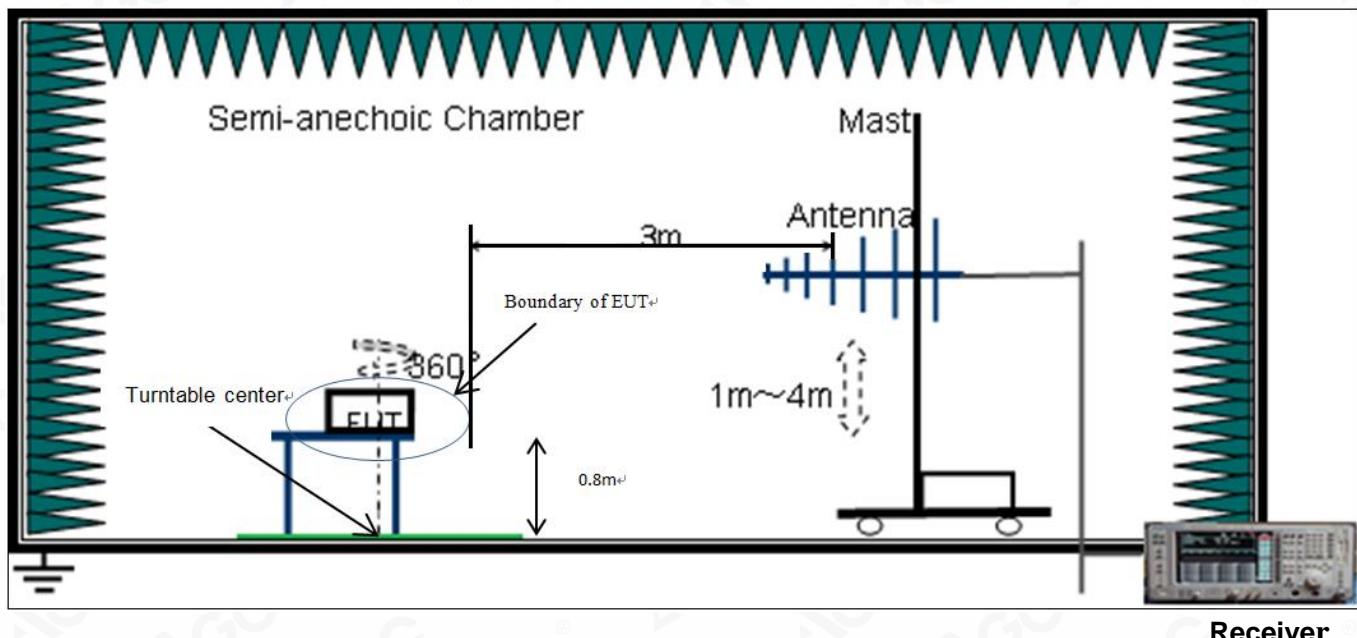
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7.2.3. BLOCK DIAGRAM OF TEST SETUP

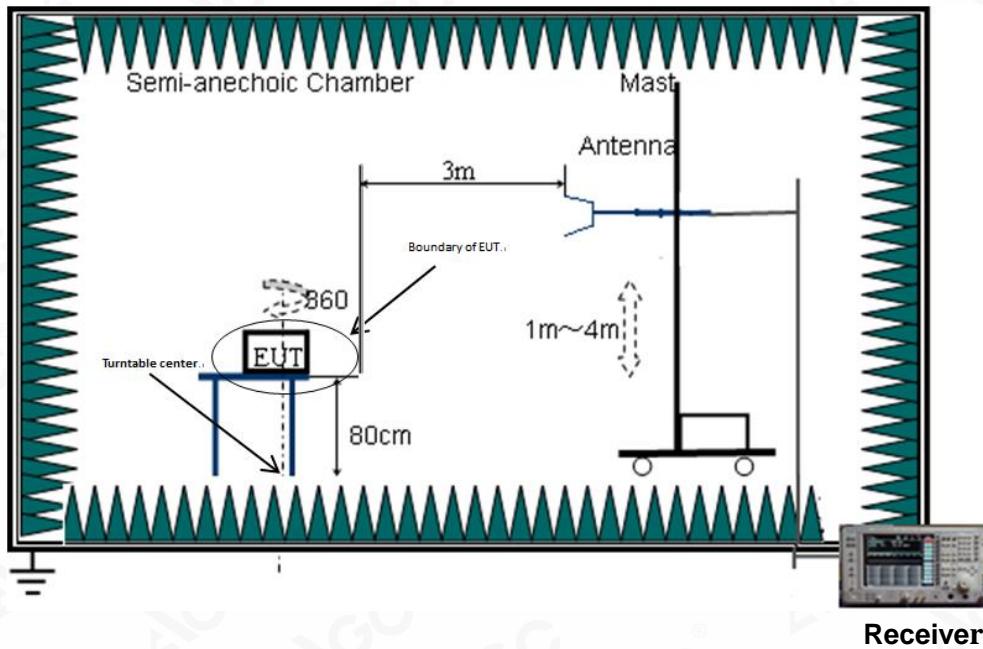
System Diagram of Connections between EUT and Simulators

Radiated Disturbance 30M to 1 GHz



Note: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for quasi-peak detection (QP) at frequency up to 1GHz.

Radiated Disturbance above 1 GHz



Note: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection (PK) at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz for Average detection (AV) at frequency above 1GHz.

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

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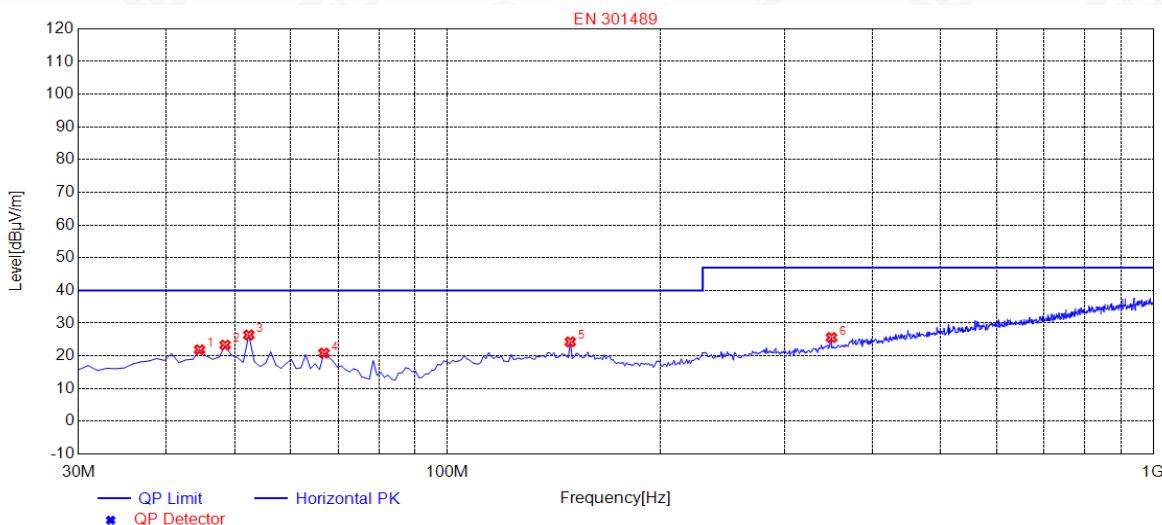


7.2.4 TEST RESULT

The test modes were carried out for all operation modes

The worst test mode of the EUT was Mode 1, and its test data was showed as the follow:

RADIATED EMISSION BELOW 1GHZ– HORIZONTAL



NO.	Freq. [MHz]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	44.5500	21.87	11.82	40.00	18.13	100	137	Horizontal
2	48.4300	23.32	11.71	40.00	16.68	100	5	Horizontal
3	52.3100	26.42	11.49	40.00	13.58	100	255	Horizontal
4	66.8600	20.85	9.76	40.00	19.15	100	276	Horizontal
5	149.3100	24.31	14.88	40.00	15.69	100	298	Horizontal
6	350.1000	25.63	17.85	47.00	21.37	100	290	Horizontal

RESULT: PASS

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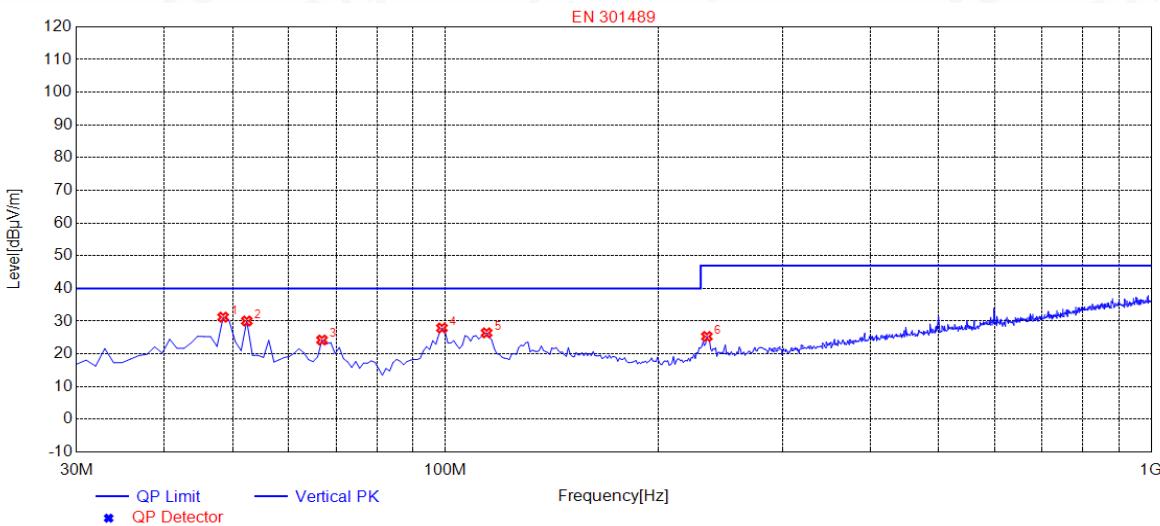
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RADIATED EMISSION BELOW 1GHZ- VERTICAL



NO.	Freq. [MHz]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	48.4300	31.24	11.71	40.00	8.76	100	96	Vertical
2	52.3100	30.06	11.49	40.00	9.94	100	359	Vertical
3	66.8600	24.24	9.76	40.00	15.76	100	1	Vertical
4	98.8700	27.92	10.91	40.00	12.08	100	359	Vertical
5	114.3900	26.43	12.89	40.00	13.57	100	75	Vertical
6	234.6700	25.33	14.40	47.00	21.67	100	302	Vertical

RESULT: PASS

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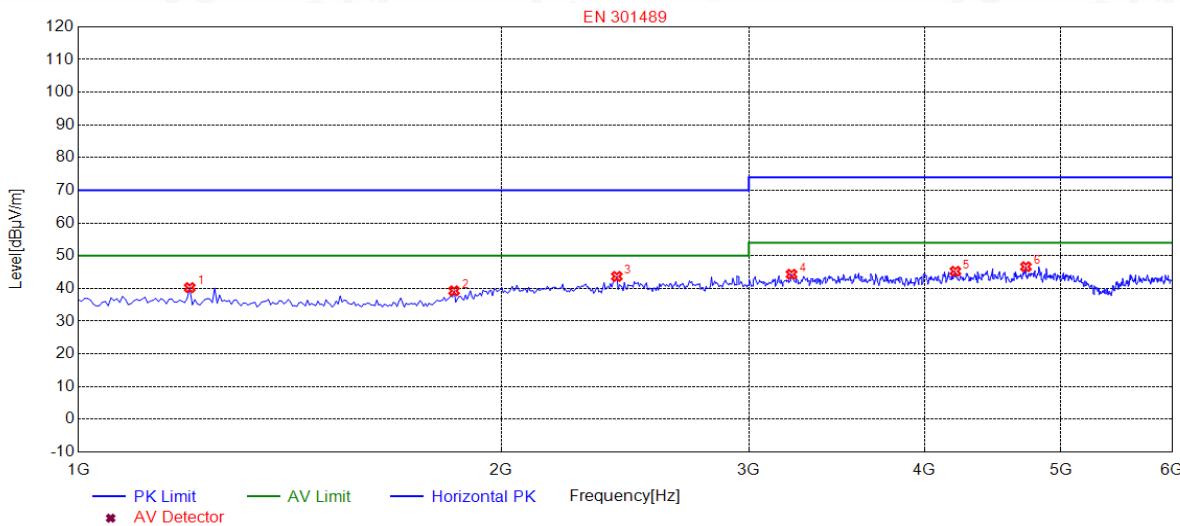
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RADIATED EMISSION ABOVE 1GHZ– HORIZONTAL



NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1200.2002	40.26	-16.84	70.00	29.74	100	40	Horizontal
2	1850.8509	39.28	-13.40	70.00	30.72	100	60	Horizontal
3	2416.4164	43.69	-10.07	70.00	26.31	100	80	Horizontal
4	3217.2172	44.35	-8.58	74.00	29.65	100	170	Horizontal
5	4208.2082	45.27	-5.96	74.00	28.73	100	230	Horizontal
6	4723.7237	46.65	-4.99	74.00	27.35	100	100	Horizontal

RESULT: PASS

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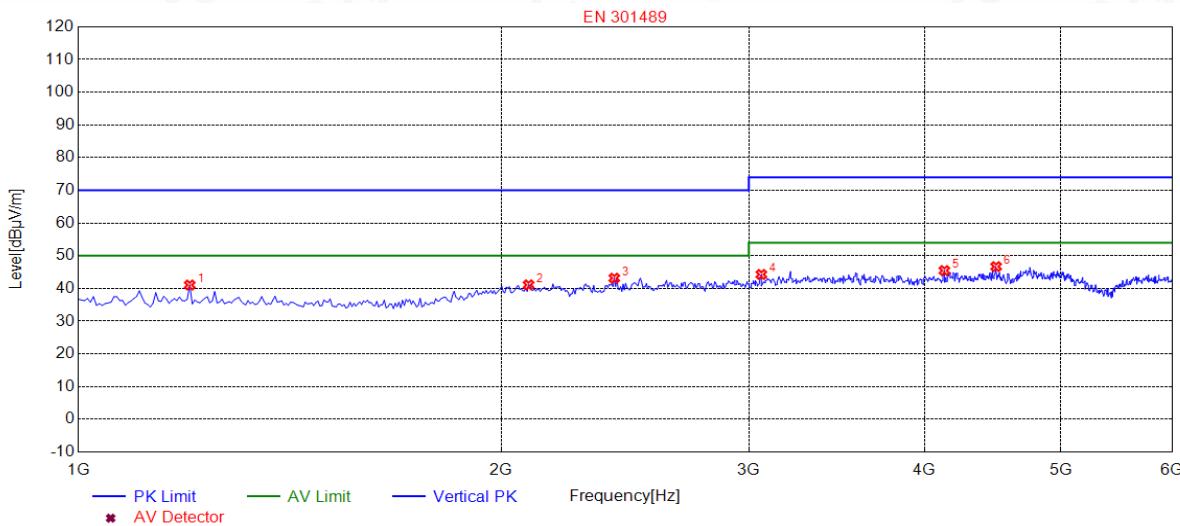
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RADIATED EMISSION ABOVE 1GHZ– VERTICAL



NO.	Freq. [MHz]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1200.2002	41.06	-16.84	70.00	28.94	100	50	Vertical
2	2091.0911	41.11	-11.44	70.00	28.89	100	120	Vertical
3	2406.4064	43.16	-10.11	70.00	26.84	100	280	Vertical
4	3062.0621	44.29	-9.12	74.00	29.71	100	330	Vertical
5	4133.1331	45.48	-6.15	74.00	28.52	100	140	Vertical
6	4498.4985	46.70	-5.20	74.00	27.30	100	280	Vertical

RESULT: PASS

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7.3. HARMONIC CURRENT MEASUREMENT

7.3.1 LIMITS OF HARMONIC CURRENT

Limits for Class A Equipment	
Harmonics Order n	Max. permissible harmonic current (A)
Odd harmonics	
3	2.30
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
15≤n≤39	0.15×15/n
2	1.08
4	0.43
6	0.30
8≤n≤40	0.23×8/n

Note: 1.According to section 5 of EN61000-3-2: 2014, the EUT is Class A equipment.

2.The above limits are for all applications having an active input power>75W. No limits apply for equipment with an active input power up to and including 75W.

7.3.2 TEST PROCEDURE

1. The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the maximum harmonic components under normal operating conditions for each successive harmonic component in turn.
2. The correspondent test program of test instrument to measure the current harmonics emanated from EUT is chosen. The measure time shall be not less than the necessary for the EUT to be exercised.

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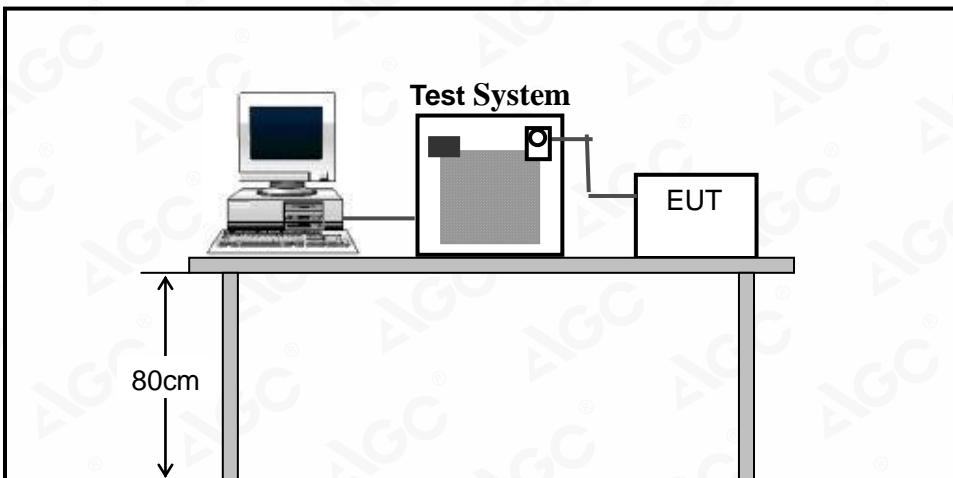
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7.3.3 TEST SETUP



For the actual test configuration, please refer to Appendix II : Photographs of the Test Configuration.

7.3.4 TEST RESULT

- Note:** 1.The active input power of the EUT is **less than 75W**.
2.No limits apply for equipment with an active input power up to and including 75W.

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7.4. VOLTAGE FLUCTUATIONS AND FLICK MEASUREMENT

7.4.1 LIMITS OF VOLTAGE FLUCTUATIONS AND FLICK

Test Item	Limit	Note
P _{st}	1.0	P _{st} means Short-term flicker indicator
P _{lt}	0.65	P _{lt} means long-term flicker indicator
T _{dt}	0.5	T _{dt} means maximum time that d _t exceeds 3%
d _{max} (%)	4%	d _{max} means maximum relative voltage change.
d _c (%)	3.3%	d _c means relative steady-state voltage change.

7.4.2 TEST PROCEDURE

- The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the most unfavorable sequence of voltage changes under normal conditions
- During the flick measurement, the measure time shall include that part of whole operation changes. The observation period for short-term flicker indicator is 10 minutes and the observation period for long-term flicker indicator is 2 hours.

7.4.3 TEST SETUP

Same as 3.4.3

7.4.4 TEST RESULT

Test Specification

Test Frequency	50Hz	Test Voltage	AC 230V
Waveform	Sine	Test Time	10 minutes(P _{st}); 2 hours (P _{lt})

Test Result

Test Parameter	Measurement Value	Limit	Remarks
P _{st}	0.160	1.0	Pass
P _{lt}	0.070	0.65	Pass
T _{dt(s)}	0.00	0.5	Pass
d _{max} (%)	0.08	4%	Pass
d _c (%)	0.00	3.3%	Pass

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8. IMMUNITY TEST

8.1. DESCRIPTION OF PERFORMANCE CRITERIA

The performance criteria are used to take a decision on whether a radio equipment passes or fails immunity tests.

For the purpose of the present document two categories of performance criteria apply:

- Performance criteria for continuous phenomena.
- Performance criteria for transient phenomena.

8.2. GENERAL PERFORMANCE CRITERIA

1. Performance criteria for continuous phenomena

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.

2. Performance criteria for transient phenomena

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.

For a 0 % residual voltage dip tests the following performance criteria apply:

- The performance criteria for transient phenomena shall apply.

For a 70 % residual voltage dip and voltage interruption tests, the following performance criteria apply:

- in the case where the equipment is fitted with or connected to a battery back-up, the performance criteria for transient phenomena shall apply;
- in the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained and lost functions should be recoverable by user or operator;
- no unintentional responses shall occur at the end of the test, when the voltage is restored to nominal;
- in the event of loss of function(s) or in the event of loss of user stored data, this fact shall be recorded.

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5. Performance Table

EN 301 489-17 Performance criteria		
Criteria	During Test	After Test (i.e. as a result of the application of the test)
A	Shall operate as intended. (see note). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance. Shall be no loss of function. Shall be no loss of critical stored data.
B	May be loss of function.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no loss of critical stored data.
C	May be loss of function.	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no loss of critical stored data.
<p>The performance criteria A shall apply for continuous phenomena. The performance criteria B shall apply for transient phenomena, except for voltage dips greater than or equal to 100 ms and voltage interruptions of 5 000 ms duration, for which performance criteria C shall apply. Where the EUT is a transmitter in standby mode or receive mode, unintentional transmission shall not occur during the test.</p>		
<p>Note: Operate as intended during the test allows a level of degradation in accordance with the Minimum performance level.</p>		
Minimum performance level		
<p>For equipment that supports a PER or FER, the minimum performance level shall be a PER or FER less than or equal to 10 %.</p>		
<p>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.</p>		

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8.3. ELECTROSTATIC DISCHARGE IMMUNITY TEST

8.3.1 TEST SPECIFICATION

Basic Standard	EN 61000-4-2
Discharge Impedance	330Ω / 150 pF
Discharge Voltage	Air Discharge: ± 8 kV , Contact Discharge: ± 4 kV
Polarity	Positive / Negative
Number of Discharge	Minimum 25 times at each test point
Discharge Mode	Single discharge
Discharge Period	1-second minimum

8.3.2 TEST PROCEDURE

The test procedure was in accordance with EN 61000-4-2:

- a. Electrostatic discharges were applied only to those points and surfaces of the EUT that are accessible to users during normal operation.
- b. The test was performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.
- c. The time interval between two successive single discharges was at least 1 second.
- d. The ESD generator was held perpendicularly to the surface to which the discharge was applied and the return cable was at least 0.2 meters from the EUT.
- e. Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.
- f. Air discharges were applied with the round discharge tip of the discharge electrode approaching the EUT as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator was removed from the EUT and re-triggered for a new single discharge. The test was repeated until all discharges were completed.
- g. At least ten single discharges (in the most sensitive polarity) were applied to the Horizontal Coupling Plane at points on each side of the EUT. The ESD generator was positioned vertically at a distance of 0.1 meters from the EUT with the discharge electrode touching the HCP.
- h. At least ten single discharges (in the most sensitive polarity) were applied to the center of one vertical edge of the Vertical Coupling Plane in sufficiently different positions that the four faces of the EUT were completely illuminated. The VCP (dimensions 0.5mx0.5m) was placed vertically to and 0.1 meters from the EUT.

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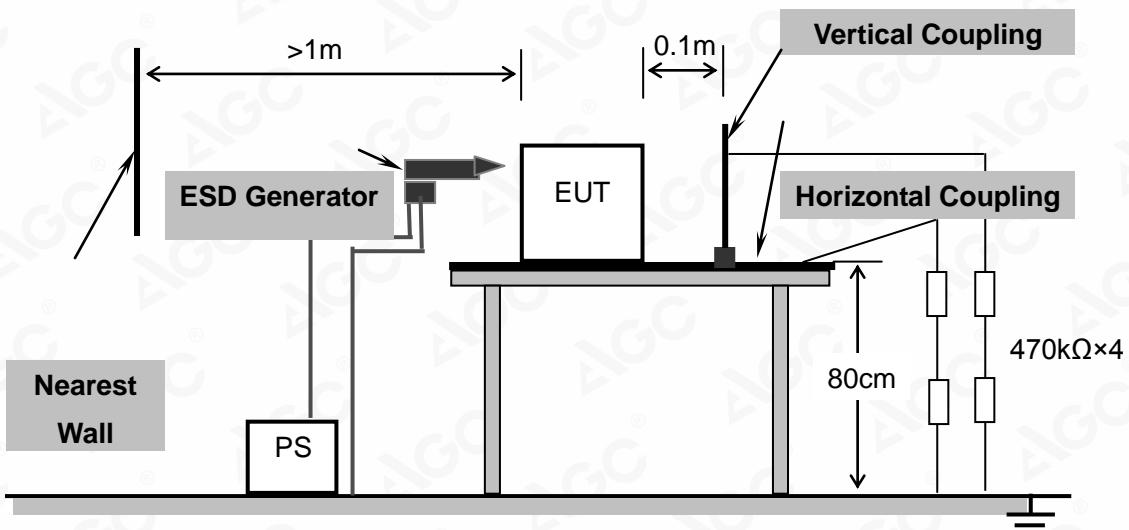
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8.3.3 TEST SETUP



For the actual test configuration, please refer to Appendix II : Photographs of the Test Configuration.

8.3.4 TEST RESULT

DESCRIPTION OF THE ELECTROSTATIC DISCHARGES (ESD)

Times of Discharge	Voltage	Coupling	Test Mode	Performance criteria
Mini 25 / Point	±2kV; ±4kV	Contact discharge	Mode 1/2/3	A
Mini 25 / Point	±2kV; ±4kV; ±8kV	Air Discharge	Mode 1/2/3	A
Mini 25 / Point	±4kV	Indirect Discharge HCP	Mode 1/2/3	A
Mini 25 / Point	±4kV	Indirect Discharge VCP	Mode 1/2/3	A

A: No degradation in the performance of the EUT was observed.

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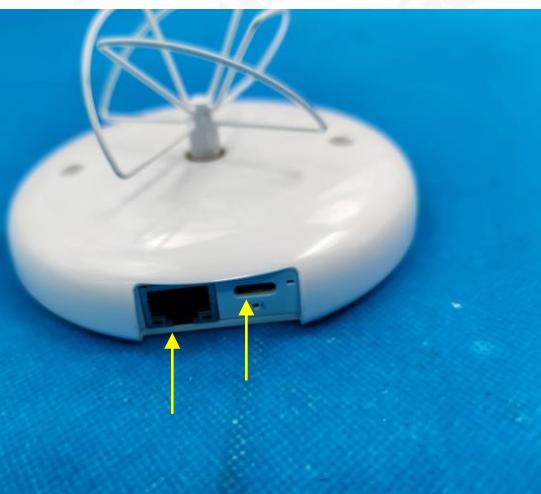
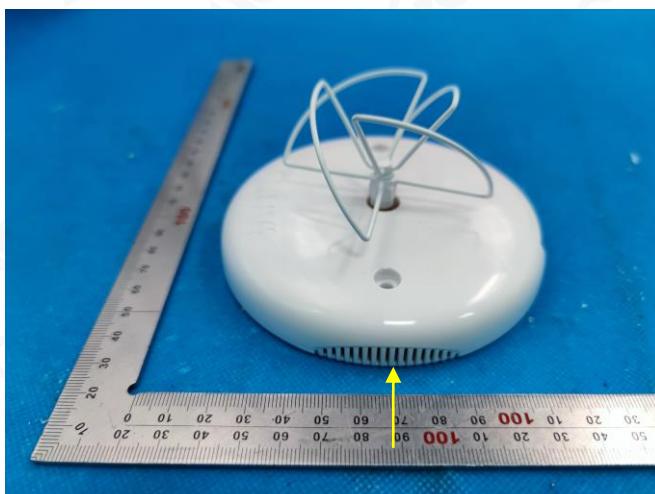
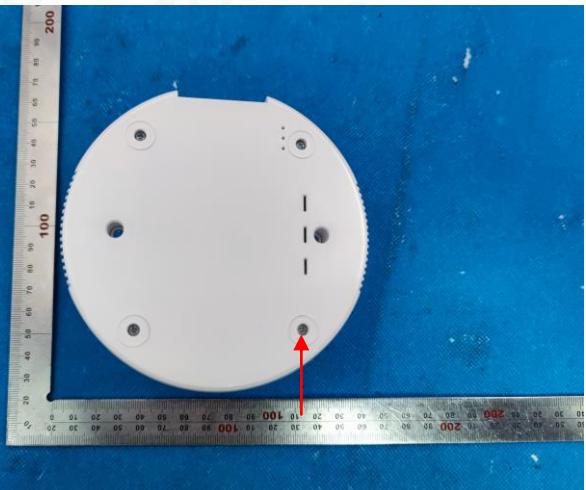
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ESD location:

Yellow line: Air discharge

Red line: Contact discharge



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8.3.5 PERFORMANCE

<input checked="" type="checkbox"/> Criteria A:	The apparatus continues to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance.
<input type="checkbox"/> Criteria B:	The apparatus continues to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed.
<input type="checkbox"/> Criteria C:	Temporary loss of function is allowed, provided the functions self recoverable or can be restored by the operation of controls.

 PASS **FAIL**

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8.4. RADIATED, RADIO FREQUENCY ELECTROMAGNETIC FIELD IMMUNITY TEST

8.4.1 TEST SPECIFICATION

Basic Standard	EN 61000-4-3
Frequency Range	80 MHz – 6000MHz
Field Strength	3V/m
Modulation	1 kHz sine wave, 80%, AM modulation
Frequency Step	1% of fundamental
Polarity of Antenna	Horizontal and Vertical
Test Distance	3m
Antenna Height	1.55m
Dwell Time	3 seconds

8.4.2 TEST PROCEDURE

The test procedure was in accordance with EN 61000-4-3.

- The testing was performed in a fully anechoic chamber. The transmit antenna was located at a distance of 3 meters from the EUT.
- The test signal was 80% amplitude modulated with a 1 kHz sine wave.
- The frequency range was swept from 80 MHz to 6000MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers. The rate of sweep did not exceed 1.5×10^{-3} decade/s. Where the frequency range is swept incrementally, the step size was 1% of fundamental.
- The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.
- The field strength level was 3V/m.
- The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.

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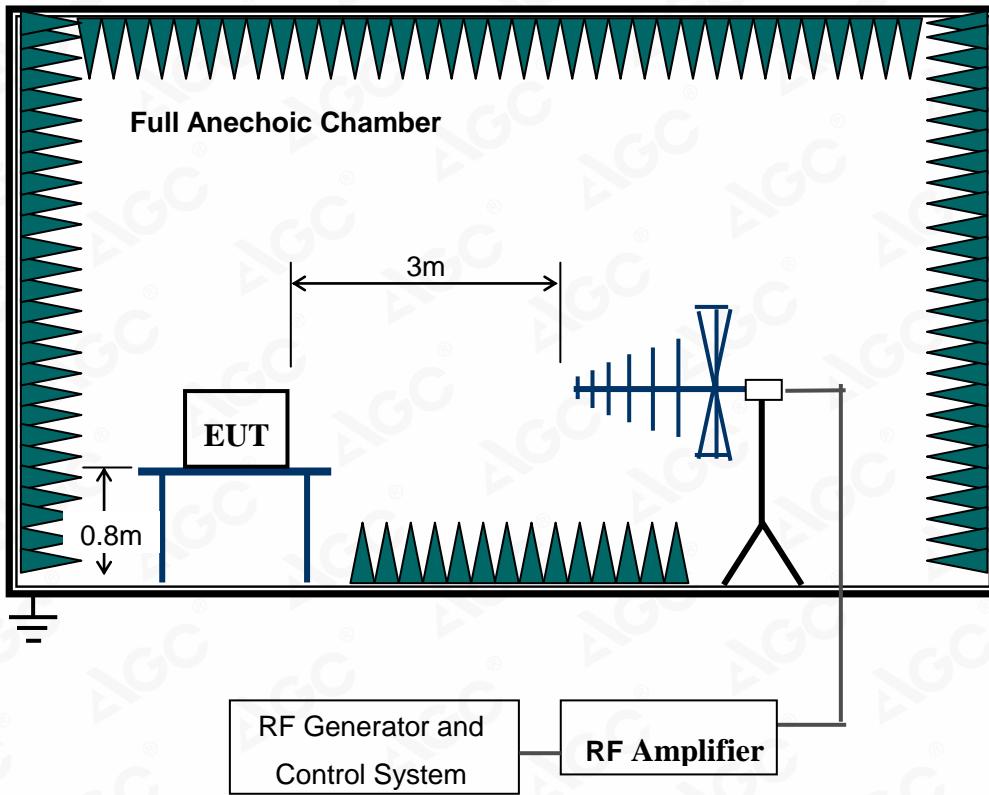
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8.4.3 TEST SETUP



For the actual test configuration, please refer to Appendix II : Photographs of the Test Configuration.

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8.4.4 TEST RESULT**TEST PROCEDURE**

Please refer to ETSI EN 301 489-1 Clause 9.2.2, ETSI EN 301 489-17 and EN 61000-4-3 for the measurement methods.

Freq. Range (MHz)	Field	Modulation	Polarity	Position	Test Mode	Performance criteria
80-6000	3V/m	Yes	H	Front	Mode 1/2/3	A
80-6000	3V/m	Yes	H	Back	Mode 1/2/3	A
80-6000	3V/m	Yes	H	Left	Mode 1/2/3	A
80-6000	3V/m	Yes	H	Right	Mode 1/2/3	A
80-6000	3V/m	Yes	V	Front	Mode 1/2/3	A
80-6000	3V/m	Yes	V	Back	Mode 1/2/3	A
80-6000	3V/m	Yes	V	Left	Mode 1/2/3	A
80-6000	3V/m	Yes	V	Right	Mode 1/2/3	A

A: No degradation or PER < 10% in the performance of the EUT was observed.

8.4.5. PERFORMANCE

<input checked="" type="checkbox"/> Criteria A:	The apparatus continues to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance.
<input type="checkbox"/> Criteria B:	The apparatus continues to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed.
<input type="checkbox"/> Criteria C:	Temporary loss of function is allowed, provided the functions self recoverable or can be restored by the operation of controls.

 PASS **FAIL**

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8.5. ELECTRICAL FAST TRANSIENT/BURST IMMUNITY TEST

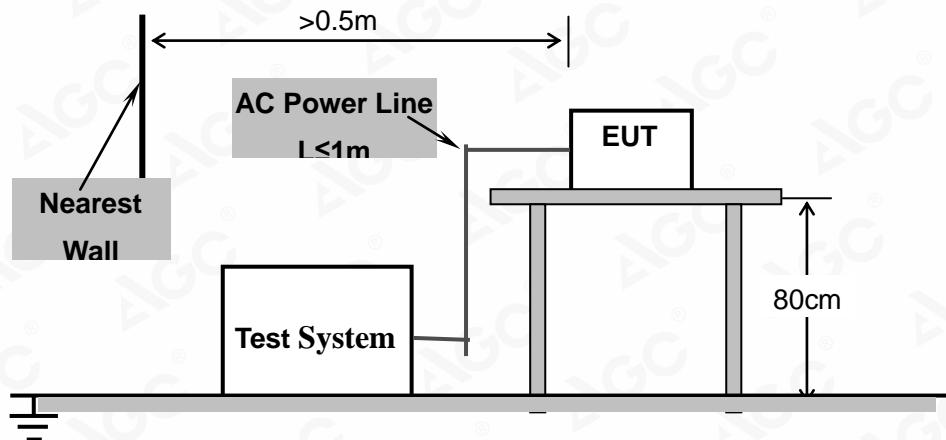
8.5.1 TEST SPECIFICATION

Basic Standard	EN 61000-4-4
Test Voltage	a.c. power port :1 kV; LAN port: 0.5KV
Polarity	Positive/Negative
Impulse Frequency	5kHz
Impulse wave shape	5/50ns
Burst Duration	15ms
Burst Period	300ms
Test Duration	Not less than 1 min.

8.5.2 TEST PROCEDURE

- The EUT was tested with 1000 volt discharges to the AC power input leads.
- Both positive and negative polarity discharges were applied.
- The length of the “hot wire” from the coaxial output of the EFT generator to the terminals on the EUT should not exceed 1 meter.
- The duration time of each test sequential was 1 minute.
- The transient/burst waveform was in accordance with EN 61000-4-4, 5/50ns.

8.5.3 TEST SETUP



For the actual test configuration, please refer to Appendix II : Photographs of the Test Configuration.

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8.5.4 TEST RESULT

Test Point	Polarity	Test Level (kV)	Test Mode	Performance criteria
a.c. port, L	+/-	1	Mode 1/2/3	A
a.c. port, N	+/-	1	Mode 1/2/3	A
a.c. port, L-N	+/-	1	Mode 1/2/3	A
LAN port	+/-	0.5	Mode 1/2/3	A
A: No degradation in the performance of the EUT was observed.				

8.5.5. PERFORMANCE

<input checked="" type="checkbox"/> Criteria A:	The apparatus continues to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance.
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<input type="checkbox"/> Criteria C:	Temporary loss of function is allowed, provided the functions self recoverable or can be restored by the operation of controls.

 PASS **FAIL**

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8.6. SURGE IMMUNITY TEST

8.6.1 TEST SPECIFICATION

Basic Standard	EN 61000-4-5
Waveform	Voltage 1.2/50 μ s; Current 8/20 μ s
Test Voltage	a.c. power port, line to line 1.0 kV; LAN port 0.5 kV
Polarity	Positive/Negative
Phase Angle	0°, 90°, 180°, 270°
Repetition Rate	60sec
Times	5 time/each condition.

8.6.2 TEST PROCEDURE

- The EUT and the auxiliary equipment were placed on a table of 0.8m heights above a metal ground reference plane. The size of ground plane is greater than 1mx1m and project beyond the EUT by at least 0.1m on all sides. The ground plane is connected to the protective earth. The length of power cord between the coupling device and the EUT was less than 2 meters (provided by the manufacturer).
- The EUT was connected to the power mains through a coupling device that directly couples the surge interference signal. The surge noise was applied synchronized to the voltage phase at the zero crossing and the peak value of the AC voltage wave (positive and negative).
- The surges were applied line to line and line(s) to earth. When testing line to earth the test voltage was applied successively between each of the lines and earth. Steps up to the test level specified increased the test voltage. All lower levels including the selected test level were tested. The polarity of each surge level included positive and negative test pulses.

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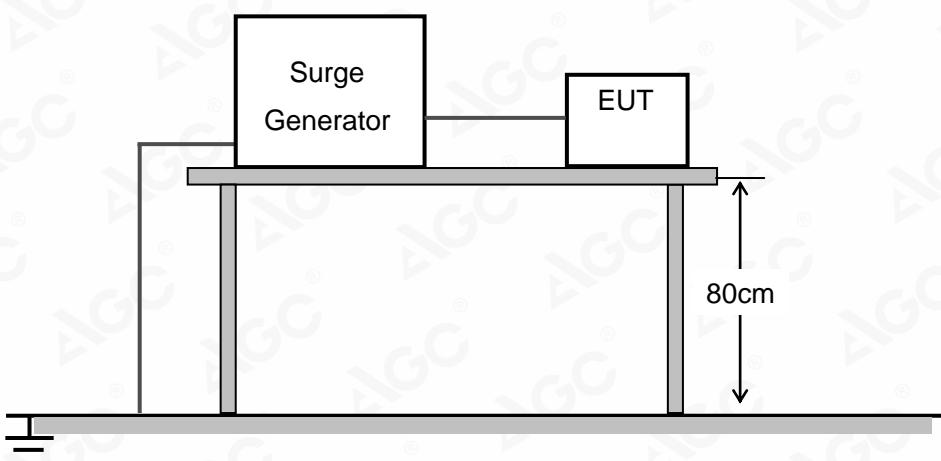
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8.6.3 TEST SETUP



For the actual test configuration, please refer to Appendix II : Photographs of the Test Configuration.

8.6.4 TEST RESULT

Coupling Line	Polarity	Voltage (kV)	Test Mode	Performance criteria
a.c. power, L-N	+/-	1.0	Mode 1/2/3	A
LAN Port	+/-	0.5	Mode 1/2/3	A

A: No degradation in the performance of the EUT was observed.

8.6.5. PERFORMANCE

<input checked="" type="checkbox"/> Criteria A:	The apparatus continues to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance.
<input type="checkbox"/> Criteria B:	The apparatus continues to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed.
<input type="checkbox"/> Criteria C:	Temporary loss of function is allowed, provided the functions self recoverable or can be restored by the operation of controls.

PASS

FAIL

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8.7. IMMUNITY TO CONDUCTED DISTURBANCES INDUCED BY RF FIELDS

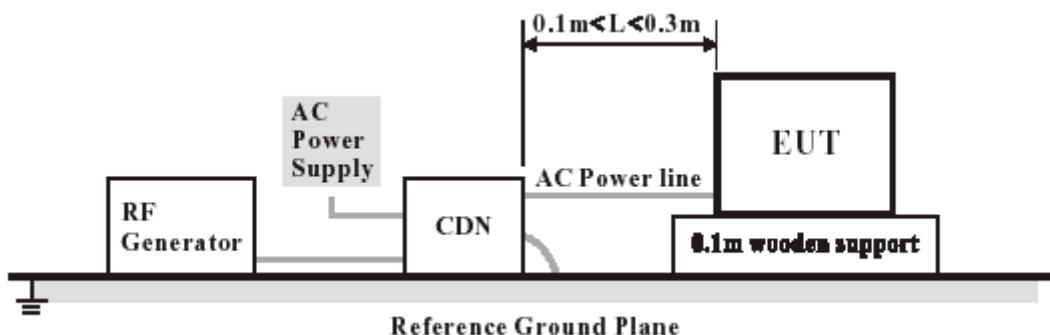
8.7.1 TEST SPECIFICATION

Basic Standard	EN 61000-4-6
Frequency Range	0.15 MHz – 80 MHz
Field Strength	3Vrms
Modulation	1 kHz Sine Wave, 80% AM
Frequency Step	1% of fundamental
Coupled Cable	a.c. power line and LAN line
Coupling Device	CDN-M2

8.7.2 TEST PROCEDURE

- The EUT shall be tested within its intended operating and climatic conditions.
- The test shall be performed with the test generator connected to each of the coupling and decoupling devices in turn, while the other non-excited RF input ports of the coupling devices are terminated by a 50-ohm load resistor.
- The test signal was 80% amplitude modulated with a 1 kHz sine wave
- The frequency range is swept from 150 kHz to 80 MHz, using the signal level established during the setting process and with a disturbance signal of 80% amplitude. The sweep rate shall not exceed 1.5×10^{-3} decades/s. The step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency value where the frequency is swept incrementally.
- The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies such as clock frequencies and harmonics or frequencies of dominant interest, shall be analyzed separately.
- Attempts should be made to fully exercise the EUT during test, and to fully interrogate all exercise modes selected for susceptibility.

8.7.3 TEST SETUP



For the actual test configuration, please refer to Appendix II : Photographs of the Test Configuration.

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8.7.4 TEST RESULT

Test Point	Frequency (MHz)	Level (V rms)	Test Mode	Performance criteria
a.c. port	0.15 – 80	3	Mode 1/2/3	A
LAN Port	0.15 – 80	3	Mode 1/2/3	A

A: No degradation in the performance of the EUT was observed.

8.7.5. PERFORMANCE

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 PASS **FAIL**

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8.8. VOLTAGE DIPS AND SHORT INTERRUPTIONS IMMUNITY TEST

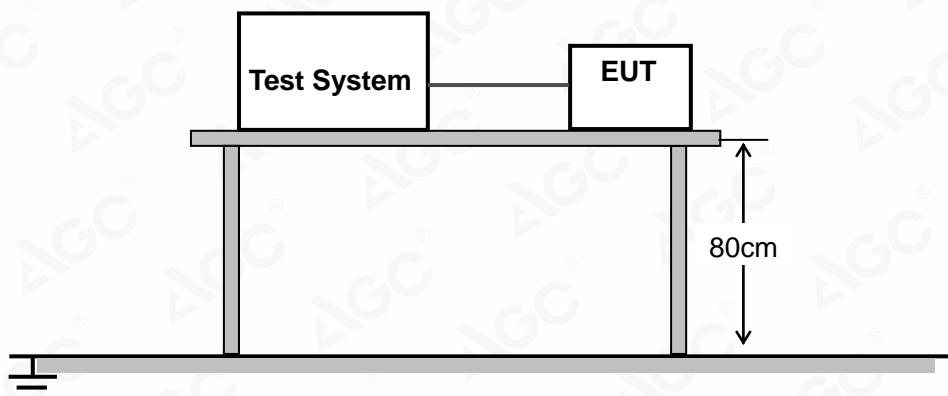
8.8.1 TEST SPECIFICATION

Basic Standard	EN 61000-4-11
Voltage Dips	100% reduction, 0.5 Cycle 100% reduction, 1.0 Cycle 30% reduction, 25 Cycles
Voltage Interruptions	100% reduction, 250 Cycles
Voltage Phase Angle	0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°

8.8.2 TEST PROCEDURE

- The power cord was used as supplied by the manufacturer. The EUT was connected to the line output of the Voltage Dips and Interruption Generator.
- The EUT was tested for (1) 100% voltage dip of supplied voltage with duration of 0.5 cycles, (2) 100% voltage dip of supplied voltage and duration 1.0 cycle. (3) 30% voltage dip of supplied voltage and duration 25 cycles. (4) 100% voltage interruption of supplied voltage with duration of 250 Cycles was followed,
- Voltage reductions occur at 0 degree crossover point of the voltage waveform. The performance of the EUT was checked after the voltage dip or interruption.

8.8.3 TEST SETUP



For the actual test configuration, please refer to Appendix II : Photographs of the Test Configuration.

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8.8.4 TEST RESULT

Test Mode	Voltage Reduction	Duration (cycle)	Times	Interval (Sec)	Test Mode	Performance criteria
Voltage dips	100%	0.5	3	10	Mode 1	B
	100%	1	3	10	Mode 1	B
	30%	25	3	10	Mode 1	B
Voltage interruptions	100%	250	3	10	Mode 1	C

A: No degradation in the performance of the EUT was observed.

B: Stop charging during the test and self-recoverable after test.

C: Lost functions can be recoverable by user or operator.

8.8.5. PERFORMANCE

<input type="checkbox"/> Criteria A:	The apparatus continues to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance.
<input checked="" type="checkbox"/> Criteria B:	The apparatus continues to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed.
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 PASS **FAIL**

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APPENDIX A: PHOTOGRAPHS OF TEST SETUP**LINE CONDUCTED EMISSION TEST SETUP****AT TELECOMMUNICATION PORT LINE CONDUCTED EMISSION TEST SETUP**

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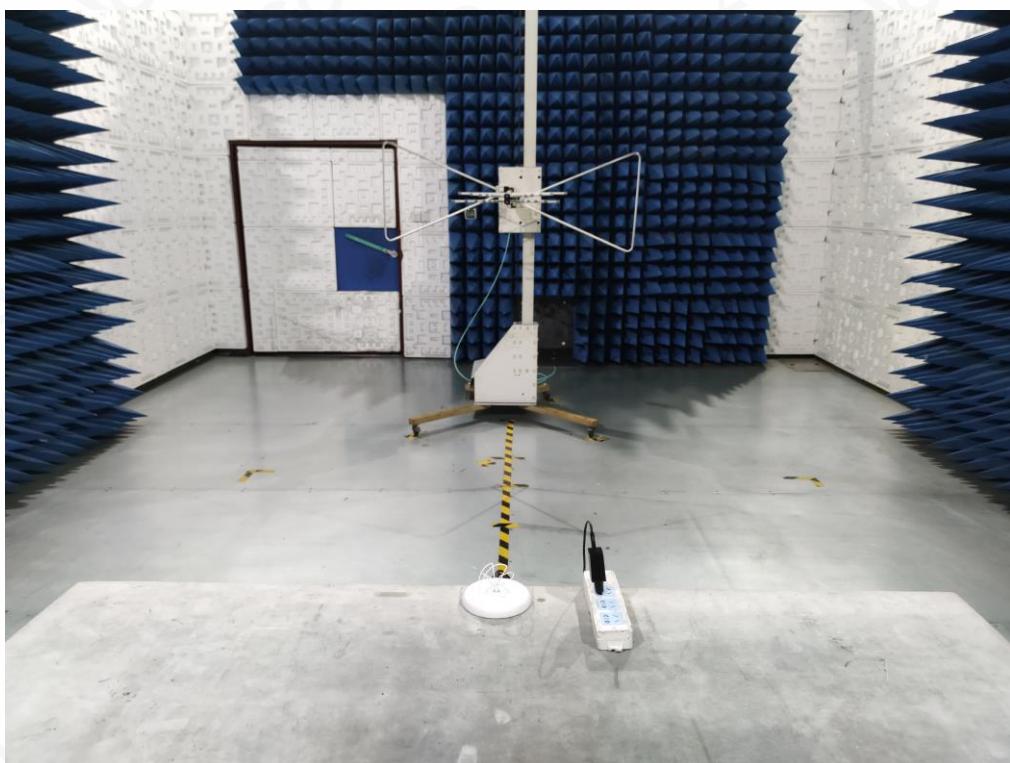
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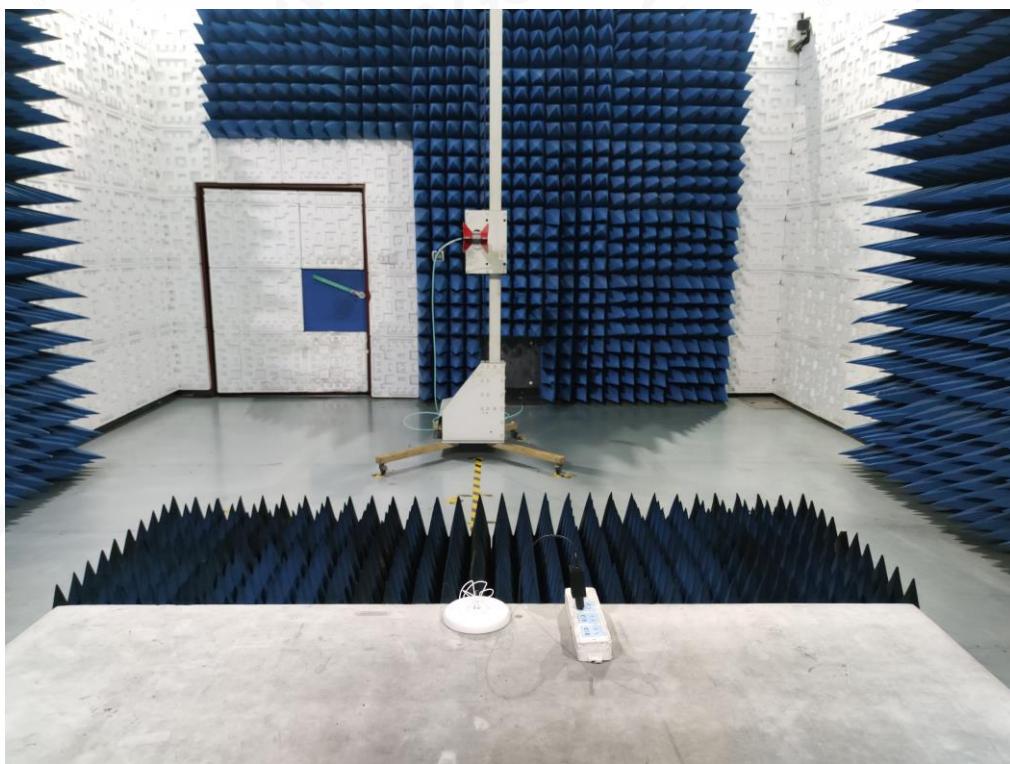
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RADIATED EMISSION TEST SETUP (BELOW 1GHz)



RADIATED EMISSION TEST SETUP (ABOVE 1GHz)



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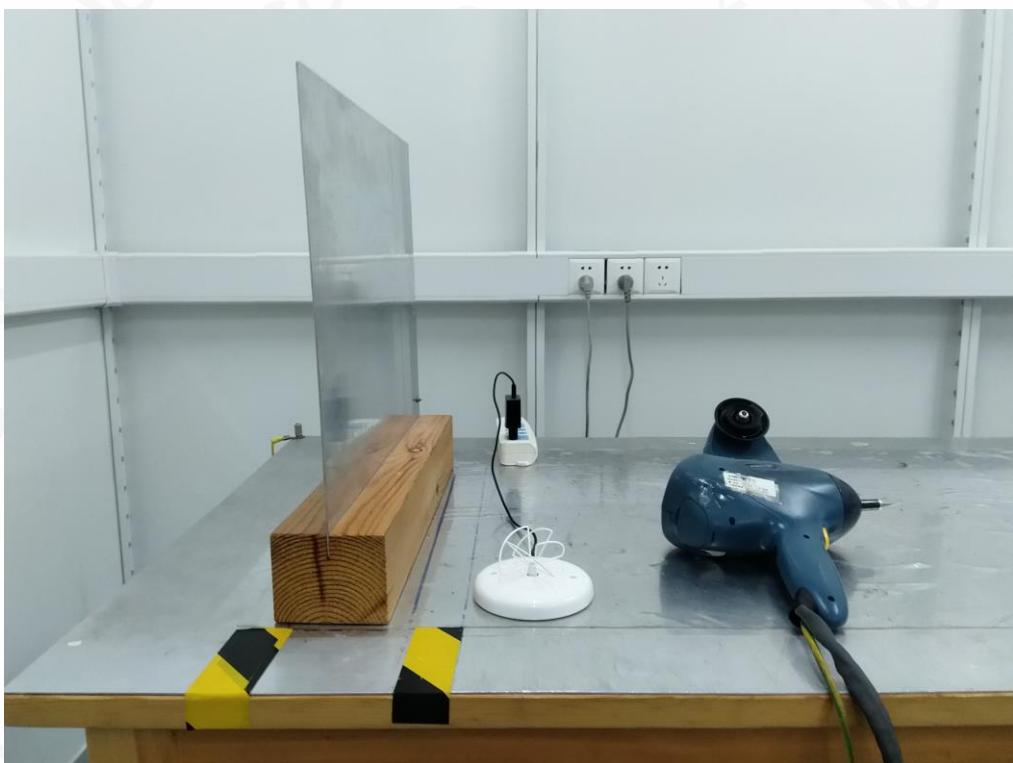
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EN 61000-4-2 ESD TEST SETUP



EN61000-3-3 VOLTAGE FLUCTUATION / FLICKER TEST SETUP



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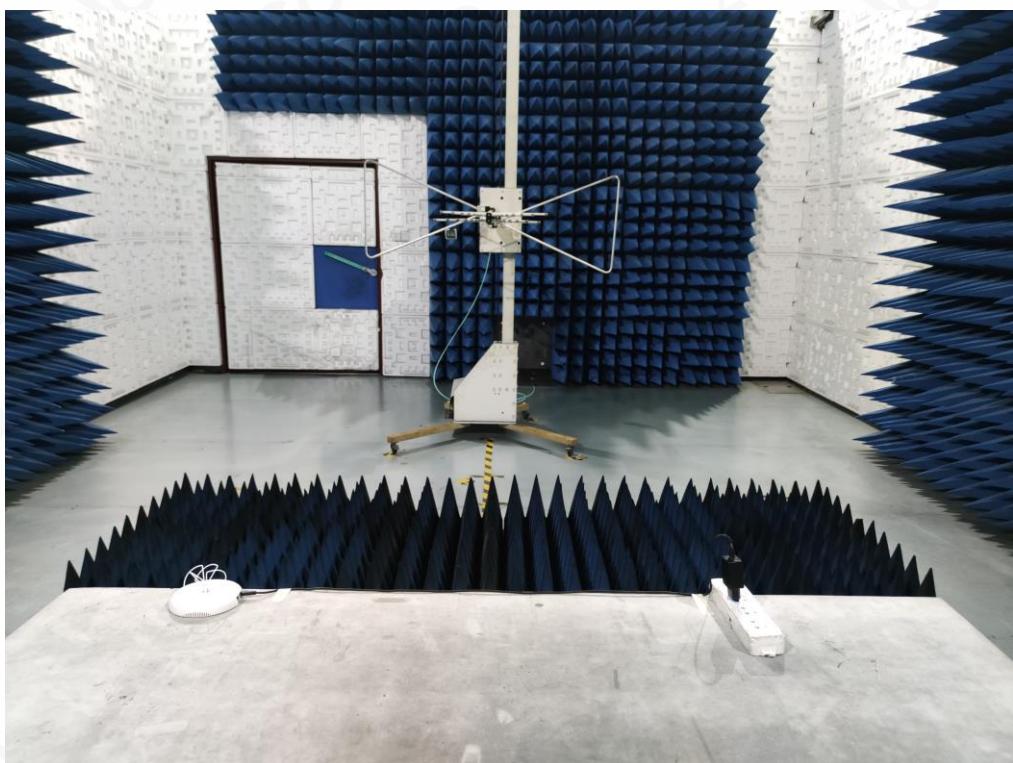
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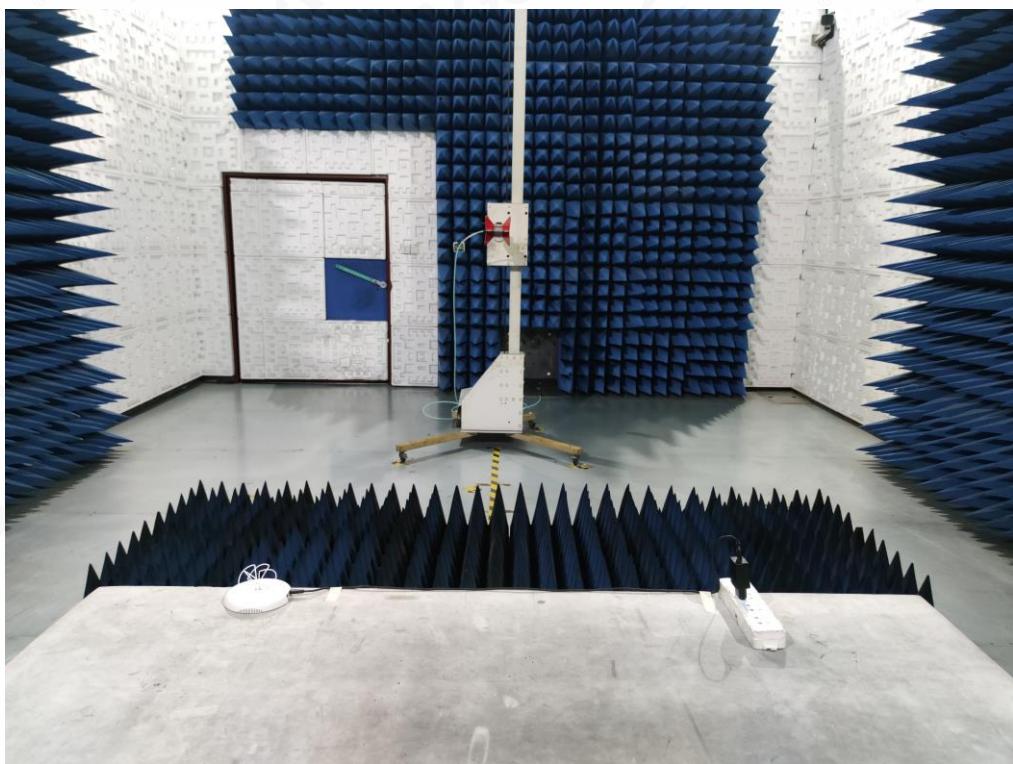
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EN 61000-4-3 RS TEST SETUP (BELOW 1GHz)



EN 61000-4-3 RS TEST SETUP (ABOVE 1GHz)



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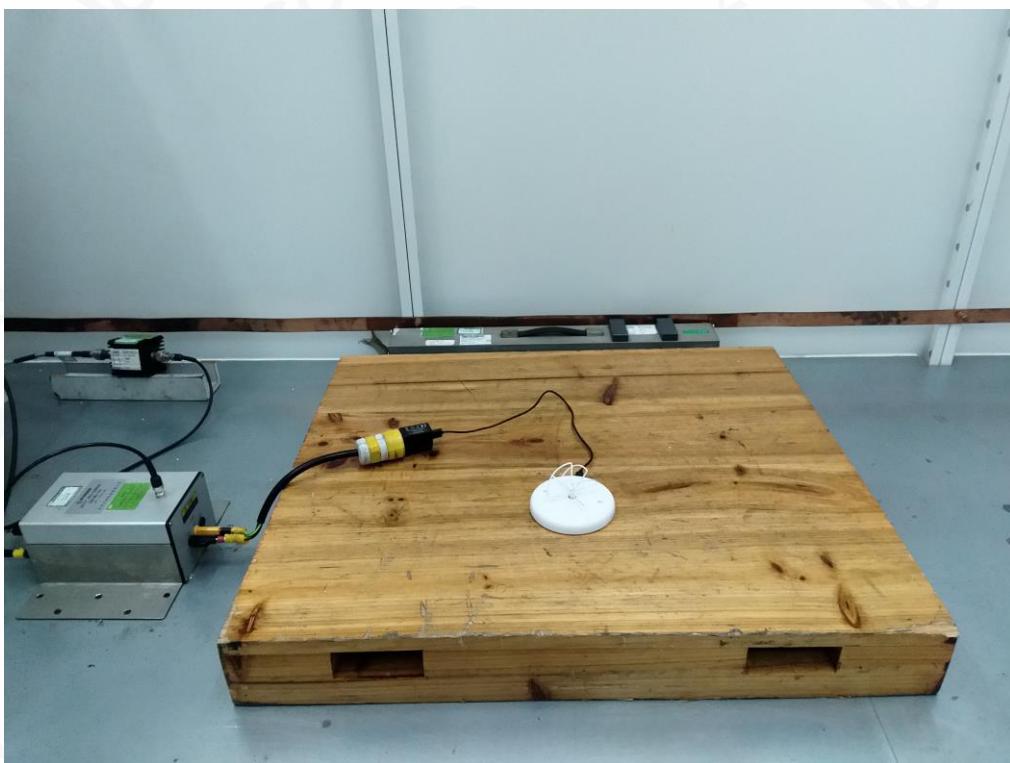
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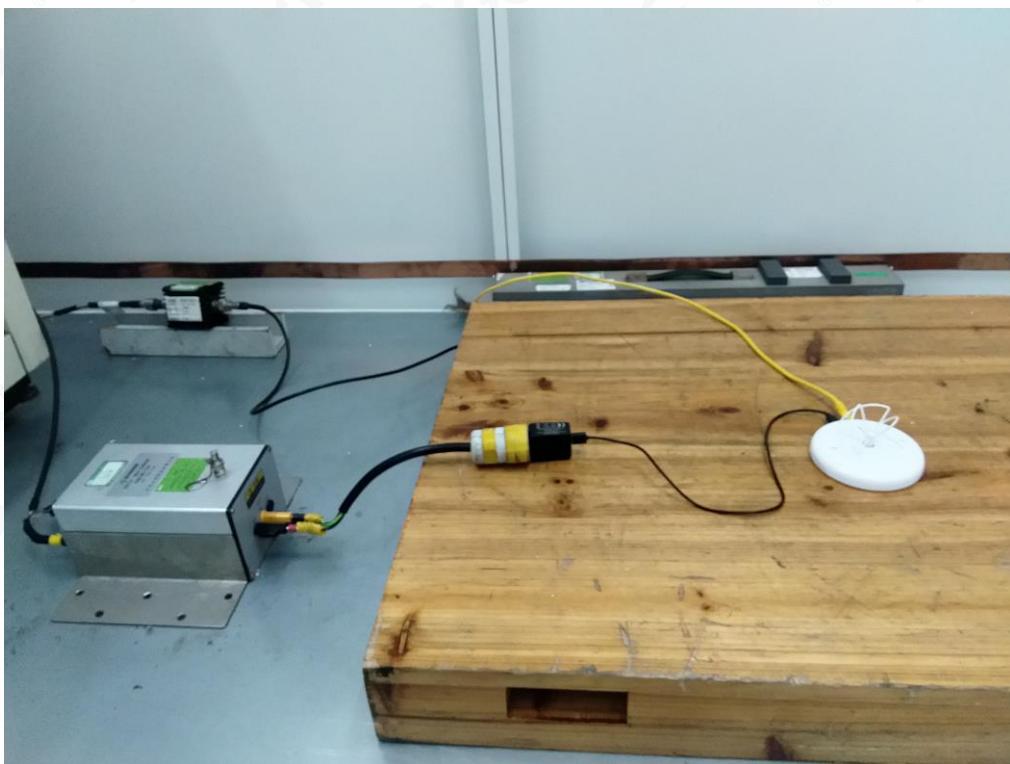
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EN 61000-4-6 CS IMMUNITY TEST SETUP



AT LAN PORT CS TEST SETUP



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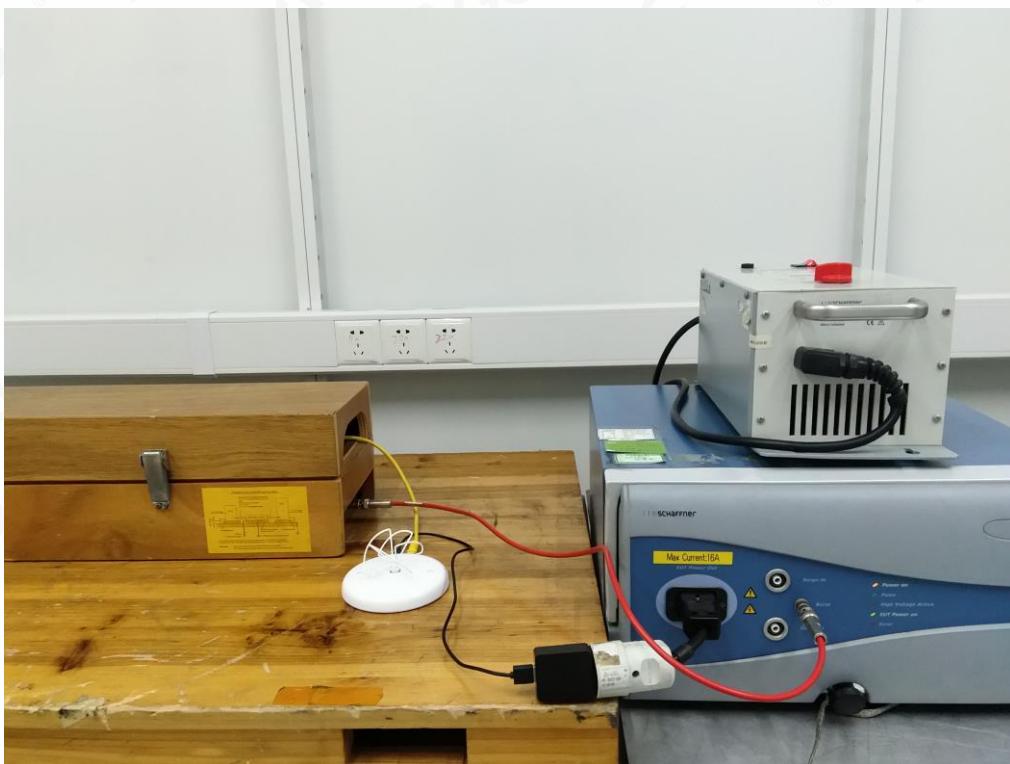
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EN 61000-4-4/-5/-11 EFT/SURGE/DIPS TEST SET UP



AT LAN PORT EFT/SURGE/DIPS TEST SET UP



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APPENDIX B: PHOTOGRAPHS OF THE EUT

Refer to the Report No.: AGC00688210624AP01

----END OF REPORT----

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Conditions of Issuance of Test Reports

1. All samples and goods are accepted by the Attestation of Global Compliance (Shenzhen) Co., Ltd (the "Company") solely for testing and reporting in accordance with the following terms and conditions. The company provides its services on the basis that such terms and conditions constitute express agreement between the company and any person, firm or company requesting its services (the "Clients").
2. Any report issued by Company as a result of this application for testing services (the "Report") shall be issued in confidence to the Clients and the Report will be strictly treated as such by the Company. It may not be reproduced either in its entirety or in part and it may not be used for advertising or other unauthorized purposes without the written consent of the Company. The Clients to whom the Report is issued may, however, show or send it, or a certified copy thereof prepared by the Company to its customer, supplier or other persons directly concerned. The Company will not, without the consent of the Clients, enter into any discussion or correspondence with any third party concerning the contents of the Report, unless required by the relevant governmental authorities, laws or court orders.
3. The Company shall not be called or be liable to be called to give evidence or testimony on the Report in a court of law without its prior written consent, unless required by the relevant governmental authorities, laws or court orders.
4. The non-CMA report issued by AGC is only permitted to be used by the client as internal reference use and shall not be used for public demonstration purpose.
5. In the event of the improper use of the report as determined by the Company, the Company reserves the right to withdraw it, and to adopt any other additional remedies which may be appropriate.
6. Samples submitted for testing are accepted on the understanding that the Report issued cannot form the basis of, or be the instrument for, any legal action against the Company.
7. The Company will not be liable for or accept responsibility for any loss or damage however arising from the use of information contained in any of its Reports or in any communication whatsoever about its said tests or investigations.
8. Clients wishing to use the Report in court proceedings or arbitration shall inform the Company to that effect prior to submitting the sample for testing.
9. The Company is not responsible for recalling the electronic version of the original report when any revision is made to them. The Client assumes the responsibility to providing the revised version to any interested party who uses them.
10. Subject to the variable length of retention time for test data and report stored hereinto as otherwise specifically required by individual accreditation authorities, the Company will only keep the supporting test data and information of the test report for a period of six years. The data and information will be disposed of after the aforementioned retention period has elapsed. Under no circumstances shall we provide any data and information which has been disposed of after retention period. Under no circumstances shall we be liable for damage of any kind, including (but not limited to) compensatory damages, lost profits, lost data, or any form of special, incidental, indirect, consequential or punitive damages of any kind, whether based on breach of contract or warranty, tort (including negligence), product liability or otherwise, even if we are informed in advance of the possibility of such damages.

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