VARIANT EMC TEST REPORT

Applicant	Particle Industries,Inc
Address	325 9th St, San Francisco, CA 94103 USA,415-319-1553

Manufacturer or Supplier	Particle Industries,Inc
Address	325 9th St, San Francisco, CA 94103 USA,415-319-1553
Product	Tracker One LTE CAT1/3G/2G
Brand Name	Particle
Model Name	ONE523M, ONE524M, ONE523M-NB, ONE524M-NB
Date of tests	Oct. 10, 2020 ~ Oct. 28, 2020

The submitted sample of the above equipment has been tested according to the requirements of the following standards:

☒ **EN 301 489-1 V2.2.3 (2019-11)**
☒ **EN 301 489-3 V2.2.0 (2021-11))**
☒ **EN 301 489-17 V3.2.4 (2020-09)**
☒ **FINAL DRAFT ETSI EN 301 489-19 V2.2.1 (2022-07)**
☒ **EN 301 489-52 V1.2.1 (2021-11)**

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Prepared by Simon Wang Engineer / Mobile Department	Approved by Luke Lu Manager / Mobile Department
Simon Wang Date: Aug. 17, 2022	Luke Lu Date: Aug. 17, 2022

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RM201009W001	Original release	Oct. 28, 2020
W7L-P22080018EM01	Based on the original report RM201009W001 Update the standard and change the address, all the data is copied from the original report.	Aug. 17, 2022

1 SUMMARY OF TEST RESULTS

EN 301 489-1 V2.2.3 (2019-11) / EN 301 489-3 V2.2.0 (2021-11)) / EN 301 489-17 V3.2.4 (2020-09) / FINAL DRAFT ETSI EN 301 489-19 V2.2.1 (2022-07) / EN 301 489-52 V1.2.1 (2021-11), Emission				
Clause	Basic Standard	Phenomenon	Application	Result
8.2	EN 55032:2015 +A11:2020	Radiated emission 30-1000 MHz	Enclosure of ancillary equipment measured on a stand alone basis	Compliance
		Radiated emission 1-6 GHz		Compliance
8.3	EN 55032:2015 +A11:2020	Conducted emission 150 kHz- 30 MHz	DC power input/output ports (fixed)	Not Applicable
		Conducted emission 150 kHz- 30 MHz	DC power input ports(vehicular)	Not Applicable
8.4	EN 55032:2015 +A11:2020	Conducted emission 150 kHz- 30 MHz	AC mains input/ output ports	Compliance
8.5	EN 61000-3-2:2019	Harmonic current emissions	AC mains input port	Not Applicable
8.6	EN 61000-3-3:2013	Voltage fluctuations and flicker	AC mains input ports	Not Applicable
8.7	EN 55032:2015 +A11:2020	Conducted disturbance 150 kHz - 30 MHz	Telecommunication ports	Not Applicable

EN 301 489-1 V2.2.3 (2019-11) / EN 301 489-3 V2.2.0 (2021-11)) / EN 301 489-17 V3.2.4 (2020-09) / FINAL DRAFT ETSI EN 301 489-19 V2.2.1 (2022-07) / EN 301 489-52 V1.2.1 (2021-11), Immunity				
Clause	Basic Standard	Phenomenon	Application	Result
9.2	EN 61000-4-3:2006 +A1:2008 +A2:2010	RF Electromagnetic Field (80 MHz to 6000) (RS)	Enclosure	Compliance
9.3	EN 61000-4-2:2009	Electrostatic Discharges (ESD)	Enclosure	Compliance
9.4	EN 61000-4-4:2012	Fast Transients Common Mode (EFT)	AC power ports	Compliance
9.8	EN 61000-4-5:2006	Surge immunity test	AC power ports	Compliance
9.5	EN 61000-4-6:2014	RF Common Mode 150 kHz to 80 MHz (CS)	AC power ports	Compliance
9.6	ISO 7637-2:2004	Transients and Surges	DC power input ports (Vehicular)	Not Applicable
9.7	EN 61000-4-11:2004	Voltage Dips and Interruptions	AC mains power input ports	Compliance

1.1 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:
The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Frequency	Uncertainty
Conducted emission	150kHz ~ 30MHz	±2.70dB
Radiated emissions	30MHz ~1000MHz	±4.98dB
	1GHz ~ 6GHz	±4.70dB

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

2 GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Tracker One LTE CAT1/3G/2G	
BRAND NAME	Particle	
MODEL NAME	ONE523M, ONE524M, ONE523M-NB, ONE524M-NB	
NOMINAL VOLTAGE	LI+ pin：DC+3.6v--4.2V or Vusb PIN： DC+4.5V--5.5V or Vin PIN： DC 6V--30V	
MODULATION TYPE	**WLAN**	DSSS, OFDM
	BT_LE	GFSK
	Bluetooth	GFSK, π/4-DQPSK, 8DPSK
	GPS/ GLONASS / BDS/ GALILEO	BPSK
	NFC	ASK/FSK
	GSM/GPRS/EDGE	GMSK, 8PSK
	WCDMA	BPSK/QPSK
	LTE	QPSK/16QAM/64QAM
OPERATING FREQUENCY	**WLAN**	2412 ~ 2472MHz for 11b/g/n(HT20/HT40)
	Bluetooth/BT_LE	2402MHz ~ 2480MHz
	GPS/ GLONASS/ BDS/ GALILEO	1559MHz ~ 1610MHz
	NFC	13.56MHz
	GSM	880.2MHz ~ 914.8MHz (FOR GSM 900) 1710.2MHz ~ 1784.8MHz (FOR DCS 1800)
	WCDMA	1922.6MHz~ 1977.4MHz (FOR WCDMA Band 1) 882.4MHZ ~ 912.6MHz (FOR WCDMA Band 8)
	LTE	1922.5MHz~ 1977.5MHz (FOR LTE Band1) 1710.7MHz ~ 1784.3MHz (FOR LTE Band3) 2502.5MHz~ 2567.5MHz (FOR LTE Band7) 880.7MHz ~ 914.3MHz (FOR LTE Band8) 834.5MHz~ 859.5MHz (FOR LTE Band20) 704.5MHz ~ 746.5MHz (FOR LTE Band28)
HW VERSION	V1.0 Product HW Version：V1.0 V1.1 Product HW Version：V1.1	

SW VERSION	V1.5.4
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	USB cable: non-shielded, detachable, 2.0meter

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. The difference of V1.0 and V1.1 is V1.1 update PCBA and add some components, which not affect RF function. At the same time, we add three product models on v1.1, ONE524M, ONE523M-NB, ONE524M-NB, please see the table below for the differences of different model.

Product name	e-SIM company	Built-in LiPo battery
ONE523M	Kore	Yes
ONE524M	Twilio	Yes
ONE523M-NB	Kore	No
ONE524M-NB	Twilio	No

3. The EUT was powered by the following Battery:

BATTERY	
BRAND:	Zhaoneng
MODEL:	113450
MANUFACTURER	Zhaoneng Battery Industrial Co., Ltd
POWER RATING:	3.7V, 2000mAh

4. The EUT matched the following USB cable:

USB CABLE	
BRAND:	KAWEEI
MODEL:	CBUSB31-AM-CM-2000
SIGNAL LINE:	2.0 METER

5. V1.0 version mainly tests, V1.1 version verify v1.0 version of RE/RS/EFT
6. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report

2.2 DESCRIPTION OF TEST MODES

For Radiated Emission evaluation, the worst data was found at **230Vac/50Hz** and recorded in the applied test report.
For Conducted Emission evaluation, the worst data was found at **230Vac/50Hz** and recorded in the applied test report.

Test Mode	Test Condition
Radiated emission test	
1	GSM 900 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC
2	GSM 1800 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC
3	WCDMA B1 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link+ BT Link+ NFC
4	WCDMA B8 Link+ Adapter + USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC
5	LTE B1 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC
6	LTE B3 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link + BT Link+ NFC+
7	LTE B7 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC+
8	LTE B8 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC+
9	LTE B20 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link+ BT Link+ NFC+
10	LTE B28 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC+

Conducted emission test	
1	GSM 900 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC
2	GSM 1800 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC
3	WCDMA B1 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link+ BT Link+ NFC
4	WCDMA B8 Link+ Adapter + USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC
5	LTE B1 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC
6	LTE B3 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link + BT Link+ NFC+
7	LTE B7 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC+
8	LTE B8 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC+
9	LTE B20 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link+ BT Link+ NFC+
10	LTE B28 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC+

NOTE:
1. For conducted emission test, test mode 1 was the worst case and only this mode was presented in this report.
2. For radiated emission test, test mode 1 was the worst case and only this mode was presented in this report.

Test Mode	Test Condition
ESD test	
1	GSM 900 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC
2	GSM 1800 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC
3	WCDMA B1 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link+ BT Link+ NFC
4	WCDMA B8 Link+ Adapter + USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC
5	LTE B1 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC
6	LTE B3 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link + BT Link+ NFC+
7	LTE B7 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC+
8	LTE B8 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC+
9	LTE B20 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link+ BT Link+ NFC+
10	LTE B28 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC+

RS test	
1	GSM 900 Link+ Adapter+ USB Cable+ BLER
2	GSM 1800 Link+ Adapter+ USB Cable+ BLER
3	WCDMA B1 Link+ Adapter+ USB Cable+ BER
4	WCDMA B8 Link+ Adapter+ USB Cable+ BER
5	LTE B1 Link+ Adapter+ USB Cable+ Throughput
6	LTE B3 Link+ Adapter+ USB Cable+ Throughput
7	LTE B7 Link+ Adapter+ USB Cable+ Throughput
8	LTE B8 Link+ Adapter+ USB Cable+ Throughput
9	LTE B20 Link+ Adapter+ USB Cable+ Throughput
10	LTE B28 Link+ Adapter+ USB Cable+ Throughput
11	Adapter+ USB Cable+ WIFI 2.4
12	Adapter+ USB Cable+ BT
13	Adapter+ USB Cable+ GPS RX
14	Adapter+ USB Cable+ Glonass Rx
15	Adapter+ USB Cable+ Galileo Rx
16	Adapter+ USB Cable+ NFC

CS test	
1	GSM 900 Link+ Adapter+ USB Cable+ BLER
2	GSM 1800 Link+ Adapter+ USB Cable+ BLER
3	WCDMA B1 Link+ Adapter+ USB Cable+ BER
4	WCDMA B8 Link+ Adapter+ USB Cable+ BER
5	LTE B1 Link+ Adapter+ USB Cable+ Throughput
6	LTE B3 Link+ Adapter+ USB Cable+ Throughput
7	LTE B7 Link+ Adapter+ USB Cable+ Throughput
8	LTE B8 Link+ Adapter+ USB Cable+ Throughput
9	LTE B20 Link+ Adapter+ USB Cable+ Throughput
10	LTE B28 Link+ Adapter+ USB Cable+ Throughput
11	Adapter+ USB Cable+ WIFI 2.4
12	Adapter+ USB Cable+ BT
13	Adapter+ USB Cable+ GPS RX
14	Adapter+ USB Cable+ Glonass Rx
15	Adapter+ USB Cable+ Galileo Rx
16	Adapter+ USB Cable+ NFC

EFT, Surge, Dip tests	
1	GSM 900 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC
2	GSM 1800 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC
3	WCDMA B1 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link+ BT Link+ NFC
4	WCDMA B8 Link+ Adapter + USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC
5	LTE B1 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC
6	LTE B3 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link + BT Link+ NFC+
7	LTE B7 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC+
8	LTE B8 Link+ Adapter+ USB Cable+ Glonass RX+ WIFI 2.4G Link+ BT Link+ NFC+
9	LTE B20 Link+ Adapter+ USB Cable+ Galileo RX+ WIFI 2.4G Link+ BT Link+ NFC+
10	LTE B28 Link+ Adapter+ USB Cable+ GPS RX+ WIFI 2.4G Link+ BT Link+ NFC+

2.3 TEST PROGRAM USED AND OPERATION DESCRIPTION

<Emission Tests>

a. The EUT was charged from the adapter when the mode was tested.

b. The EUT Linked with mobilephone by Bluetooth

c. The EUT connected with Wireless AP

d. The EUT played NFC

e The computer was applied for monitoring purpose when the mode was tested

<Immunity Tests>

a. The EUT was charged from the adapter when the mode was tested.

b. The EUT Linked with mobilephone by Bluetooth

c. The EUT connected with Wireless AP

d. The EUT played NFC

e The computer was applied for monitoring purpose when the mode was tested

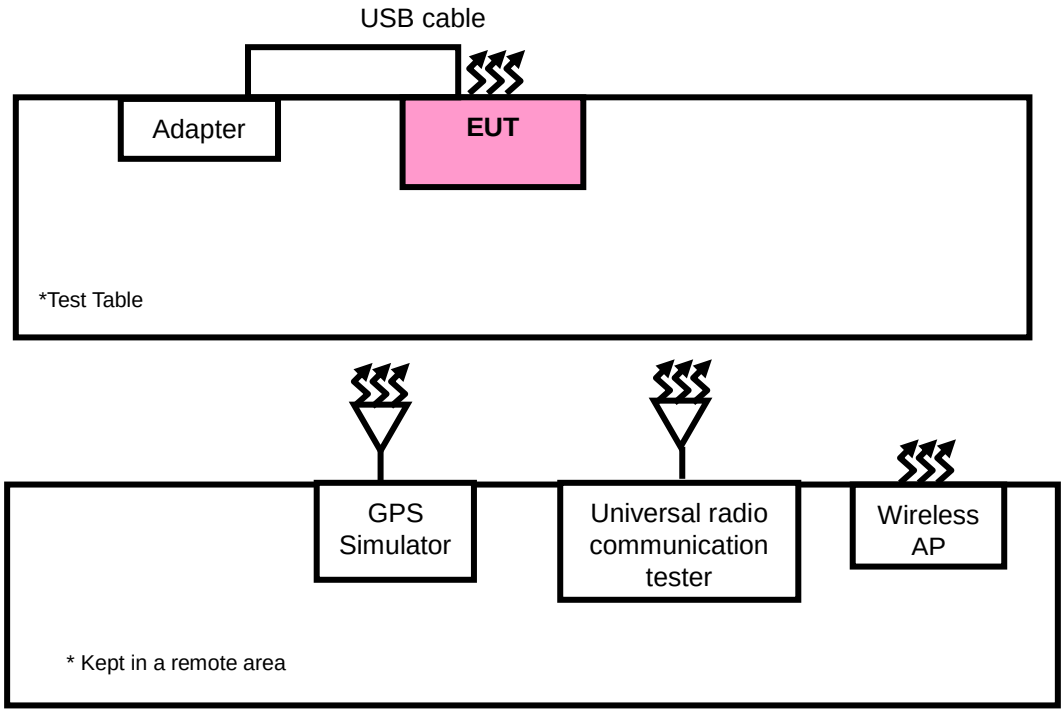
2.4 PRIMARY CLOCK FREQUENCIES OF INTERNAL SOURCE

The highest frequency generated or used within the EUT or on which the EUT operates or tunes is 5000 MHz, provided by the manufacturer, for detailed internal source, please refer to the manufacturer's specifications.

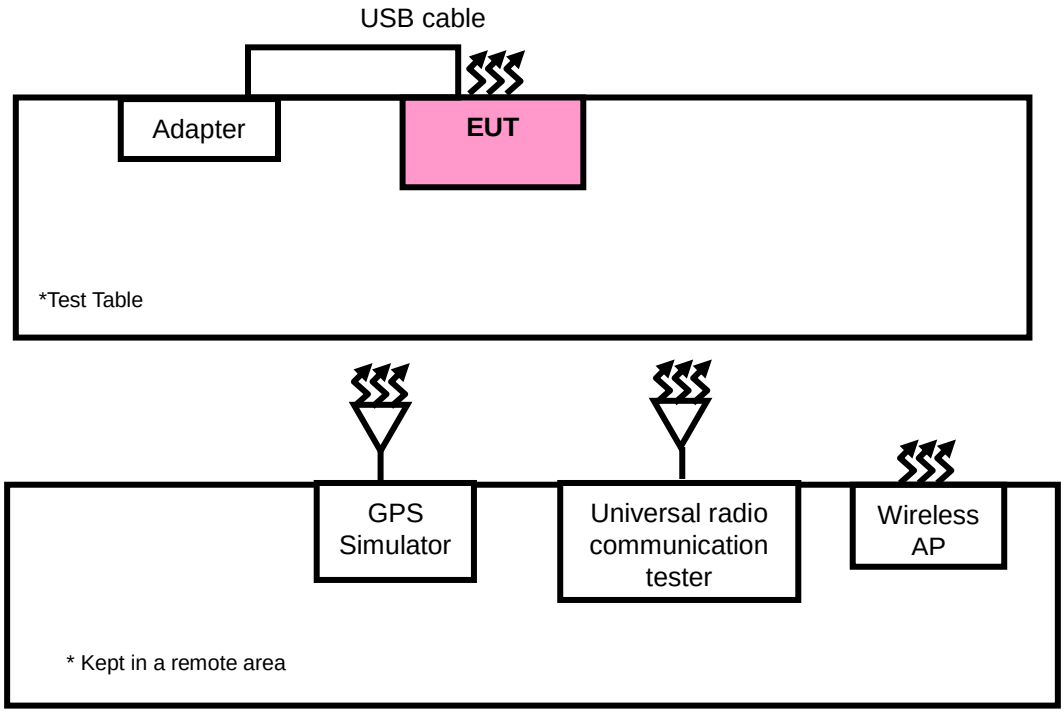
2.5 CONFIGURATION OF SYSTEM UNDER TEST

FOR EMISSION TESTS

Radiation Worst Case Mode 1



Conduction Worst Case Mode 1



2.6 DESCRIPTION OF SUPPORT UNIT

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

FOR ALL TESTS

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	Mobile phone	HUA WEI	HWI-AL00	N/A	N/A
2	Adapter	VIVO	V0510B-EU	N/A	N/A
3	Wireless AP	ABOCOM	WR224GR	060500749P	N/A
4	GPS Simulator	Spetctracom/ USA	GSG-5	200782	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	N/A
2	N/A
3	N/A
4	N/A

3 EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT AT MAINS PORTS

3.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

Frequency (MHz)	Class A (dBuV)		Class B (dBuV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15-0.5	79	66	66-56	56-46
0.5-5	73	60	56	46
5-30	73	60	60	50

NOTE: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

3.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR3	101900	Feb. 28,20	Feb. 27, 21
EMC32 test software	Rohde&Schwarz	EMC32	NA	NA	NA
LISN network	Rohde&Schwarz	ENV216	101922	Feb. 28,20	Feb. 27, 21

NOTE: The test was performed in CE Shielded Room.

3.1.3 TEST PROCEDURE

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

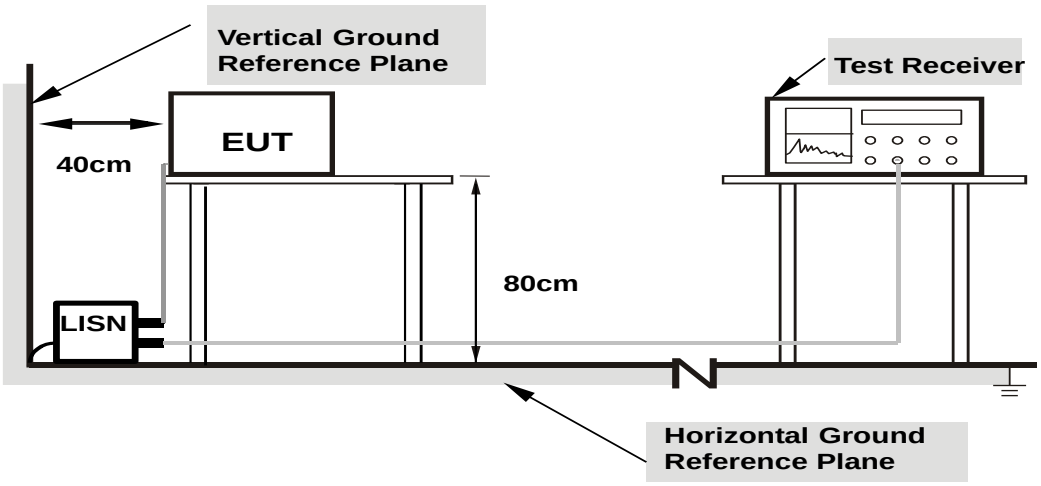
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels under Limit - 20dB was not recorded.

3.1.4 DEVIATION FROM TEST STANDARD

No deviation.

3.1.5 TEST SETUP



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

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

3.1.6 EUT OPERATING CONDITIONS

Same as clause 3.3

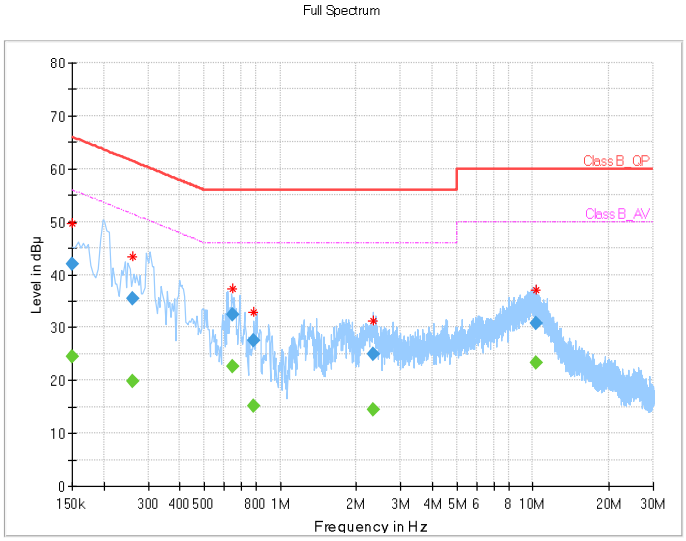
3.1.7 TEST RESULTS

CONDUCTED WORST-CASE DATA:

TEST VOLTAGE	Input 230 Vac, 50 Hz	**DETECTOR FUNCTION & RESOLUTION BANDWIDTH**	Quasi-Peak(QP)/ Average(AV), 9 KHz
ENVIRONMENTAL CONDITIONS	23deg. C, 55% RH	**TESTED BY**	Chase Zhou

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.150000	---	24.53	56.00	-31.47	L1	ON	9.7
0.150000	42.10	---	66.00	-23.90	L1	ON	9.7
0.260000	---	19.85	51.43	-31.58	L1	ON	9.7
0.260000	35.48	---	61.43	-25.95	L1	ON	9.7
0.648000	---	22.69	46.00	-23.31	L1	ON	9.7
0.648000	32.45	---	56.00	-23.55	L1	ON	9.7
0.788000	---	15.15	46.00	-30.85	L1	ON	9.7
0.788000	27.44	---	56.00	-28.56	L1	ON	9.7
2.328000	---	14.46	46.00	-31.54	L1	ON	9.8
2.328000	25.06	---	56.00	-30.94	L1	ON	9.8
10.300000	---	23.40	50.00	-26.60	L1	ON	10.0
10.300000	30.78	---	60.00	-29.22	L1	ON	10.0

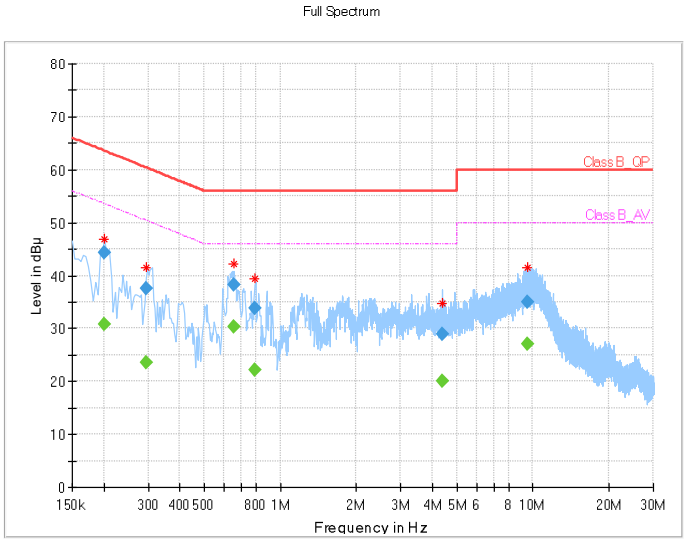
REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Emission level - Limit value
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Reading Value.



TEST VOLTAGE	Input 230 Vac, 50 Hz	DETECTOR FUNCTION & RESOLUTION BANDWIDTH	Quasi-Peak(QP)/ Average(AV), 9 KHz
ENVIRONMENTAL CONDITIONS	23deg. C, 55% RH	TESTED BY	Chase Zhou

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.200000	---	30.84	53.61	-22.77	N	ON	9.8
0.200000	44.25	---	63.61	-19.36	N	ON	9.8
0.296000	---	23.58	50.35	-26.78	N	ON	9.8
0.296000	37.59	---	60.35	-22.77	N	ON	9.8
0.652000	**---**	**30.34**	**46.00**	**-15.66**	**N**	**ON**	**9.8**
0.652000	38.24	---	56.00	-17.76	N	ON	9.8
0.792000	---	22.23	46.00	-23.77	N	ON	9.8
0.792000	33.76	---	56.00	-22.24	N	ON	9.8
4.404000	---	20.13	46.00	-25.87	N	ON	9.9
4.404000	28.93	---	56.00	-27.07	N	ON	9.9
9.556000	---	26.96	50.00	-23.04	N	ON	10.0
9.556000	35.05	---	60.00	-24.95	N	ON	10.0

REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Emission level - Limit value
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Reading Value.



3.2 RADIATED DISTURBANCE MEASUREMENT

3.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT

FOR FREQUENCY BELOW 1000 MHz

Frequency (MHz)	Class A (at 10m)	Class B (at 10m)
	Quasi-peak (dBuV/m)	Quasi-peak (dBuV/m)
30-230	40	30
230-1000	47	37
Frequency (MHz)	**Class A (at 3m)**	**Class B (at 3m)**
	Quasi-peak (dBuV/m)	**Quasi-peak (dBuV/m)**
30-230	50	40
230-1000	57	47

FOR FREQUENCY ABOVE 1000 MHz

Frequency (MHz)	Class A (at 3m)		Class B (at 3m)	
	Peak (dBuV/m)	Average (dBuV/m)	Peak (dBuV/m)	Average (dBuV/m)
1000-3000	76	56	70	50
3000-6000	80	60	74	54

NOTE: 1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

FREQUENCY RANGE OF RADIATED MEASUREMENT

Highest frequency generated or used within the EUT or on which the EUT operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 108	1000
108-500	2000
500-1000	5000
Above 1000	Up to 5 times of the highest frequency or 6 GHz, whichever is less

3.2.2 TEST INSTRUMENTS

Frequency range below 1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	Euroshieldpn-CT0001143-1216	May. 19,20	May. 18,23
Bilog Antenna	ETS-LINDGREN	3143B	00161965	Feb. 28,20	Feb. 27,21
MXE EMI Receiver	KEYSIGHT	N9038A-544	MY54450026	Feb. 28,20	Feb. 27,21
Signal Pre-Amplifier	EMSI	EMC 9135	980249	Jun. 02,20	Jun. 01,21

Frequency range above 1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	Euroshieldpn-CT0001143-1216	May. 19,20	May. 18,23
Horn Antenna	ETS-LINDGREN	3117	00168728	Feb. 28,20	Feb. 27,21
MXE EMI Receiver	KEYSIGHT	N9038A-544	MY54450026	Feb. 28,20	Feb. 27,21
Signal Pre-Amplifier	EMSI	EMC 012645B	980257	Jun. 02,20	Jun. 01,21

NOTE: The test was performed in 3m Chamber.

3.2.3 TEST PROCEDURE

Frequency range 30MHz~1GHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from 1 meter to 4 meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1GHz.

NOTE:

1. The resolution bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB/m)
3. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) (if the raw value not contains the amplifier);
4. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Amplifier Gain (dB) (if the raw value contains the amplifier).
5. Margin value = Emission level – Limit value.

Frequency range above 1GHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter Fully-anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna can be varied from 1 meter to 4 meters, the height of adjustment depends on the EUT height and the antenna 3dB beamwidth both, to detect the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. The bore sight should be used during the test above 1GHz.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test receiver/spectrum was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1GHz.

NOTE:

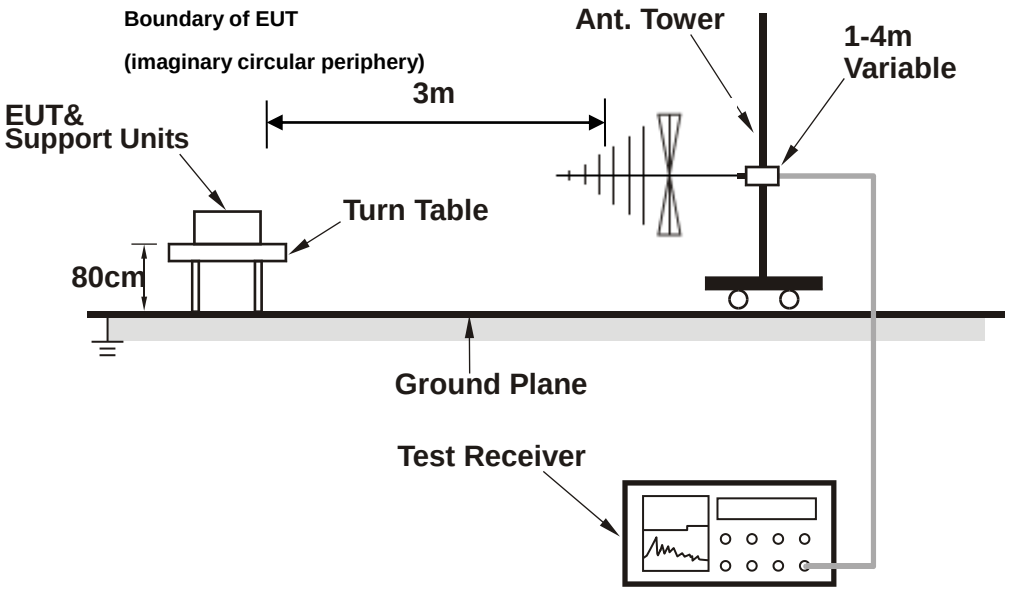
1. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Peak detection at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz for Average detection (AV) at frequency above 1GHz.
2. For measurement of frequency above 1000 MHz, the EUT was set 3 meters away from the receiver antenna.
3. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB/m)
4. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) (if the raw value not contains the amplifier);
5. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Amplifier Gain(dB) (if the raw value contains the amplifier).
6. Margin value = Emission level – Limit value.

3.2.4 DEVIATION FROM TEST STANDARD

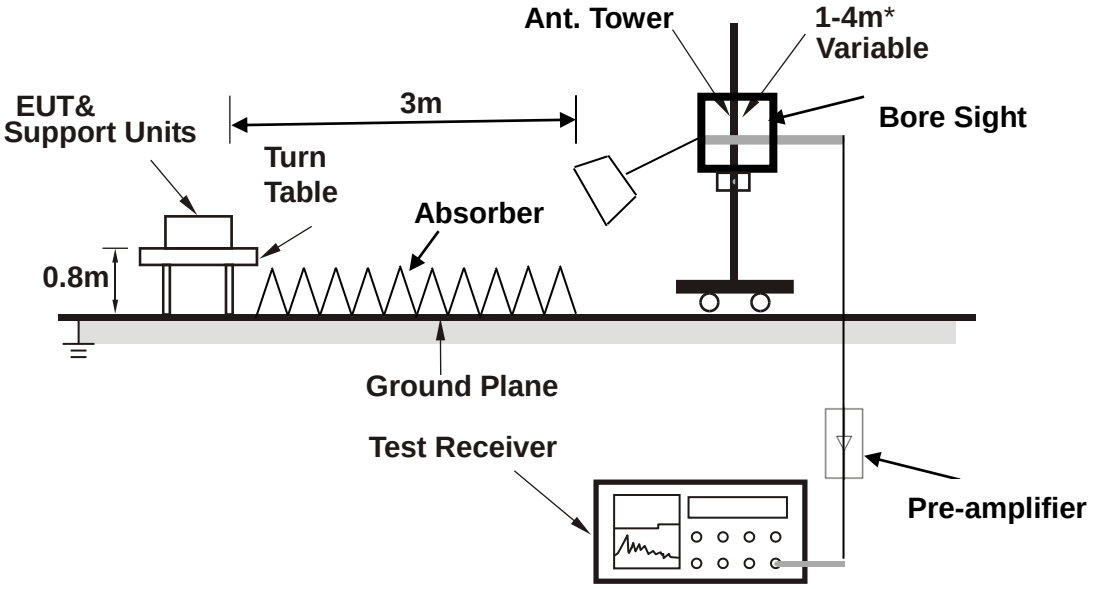
No deviation.

3.2.5 TEST SETUP

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



Note: Above 1G is a directional antenna

***** depends on the EUT height and the antenna 3dB beam width both, refer to section 7.3 of CISPR 16-2-3.

3.2.6 EUT OPERATING CONDITIONS

Same as clause 3.3

3.2.7 TEST RESULTS

V1.0

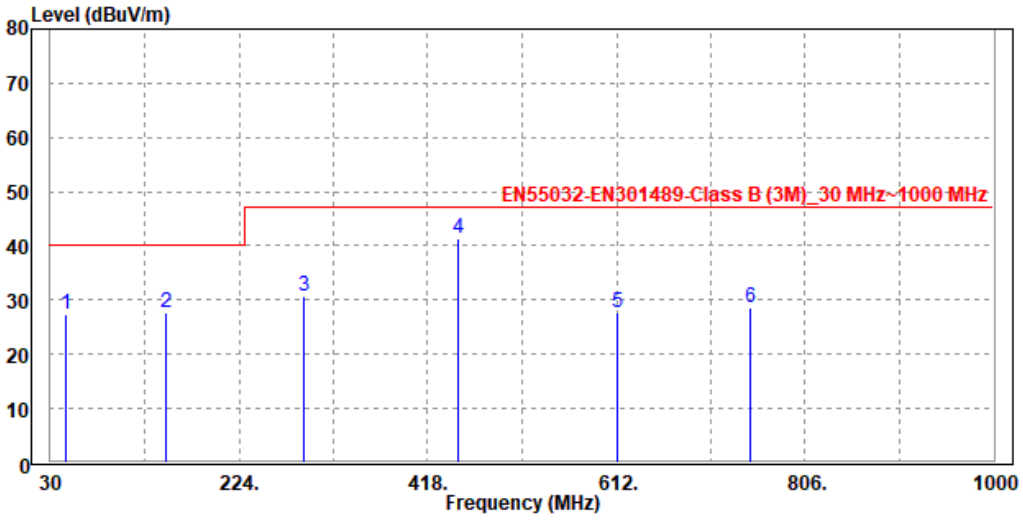
Below 1GHz worst case data

TEST VOLTAGE	Input 230 Vac, 50 Hz	**FREQUENCY RANGE**	30-1000 MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70% RH	**DETECTOR FUNCTION & RESOLUTION BANDWIDTH**	Quasi-Peak , 120 kHz
TESTED BY	Jacky		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	**EMISSION LEVEL (dBuV/m)**	**READ LEVEL (dBuV)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA FACTOR (dB /m)**	**CABLE LOSS (dB)**	**PREAMP FACTOR (dB)**	**ANTENNA HEIGHT (cm)**	**TABLE ANGLE (Degree)**	**REMARK**
45.52	27.28	52.93	40	-12.72	10.71	1.04	37.4	200	360	QP
148.34	27.81	53.65	40	-12.19	9.43	1.56	36.83	200	360	QP
289.96	30.63	51.6	47	-16.37	13.58	2.18	36.73	200	360	QP
449.04	**41.41**	**57.54**	**47**	**-5.59**	**17.98**	**2.8**	**36.91**	**200**	**360**	**QP**
612.97	27.82	41.72	47	-19.18	20.28	3.21	37.39	200	360	QP
749.74	28.7	39.46	47	-18.3	23.15	3.71	37.62	200	360	QP

REMARKS: 1. Emission level(dBuV/m)=Read Value(dBuV) + Correction Factor(dB/m)

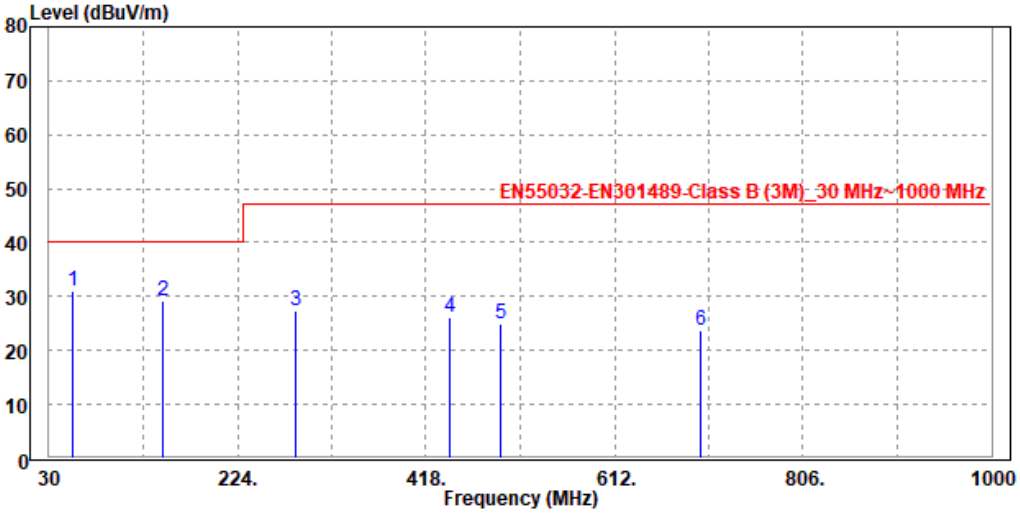
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)– Amplifier Gain
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.



TEST VOLTAGE	Input 230 Vac, 50 Hz	**FREQUENCY RANGE**	30-1000 MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70% RH	**DETECTOR FUNCTION & RESOLUTION BANDWIDTH**	Quasi-Peak , 120 kHz
TESTED BY	Jacky		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
55.22	31.08	59.59	40	-8.92	7.78	1.04	37.33	100	360	QP
147.37	29.23	55.23	40	-10.77	9.28	1.56	36.84	100	360	QP
283.17	27.52	48.52	47	-19.48	13.57	2.15	36.72	100	360	QP
443.22	26.26	42.54	47	-20.74	17.84	2.78	36.9	100	360	QP
494.63	24.97	39.92	47	-22.03	19.07	2.97	36.99	100	360	QP
701.24	23.62	34.81	47	-23.38	22.81	3.53	37.53	100	360	QP

REMARKS: 1. Emission level(dBuV/m)=Read Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) −Amplifier Gain
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.



V1.1

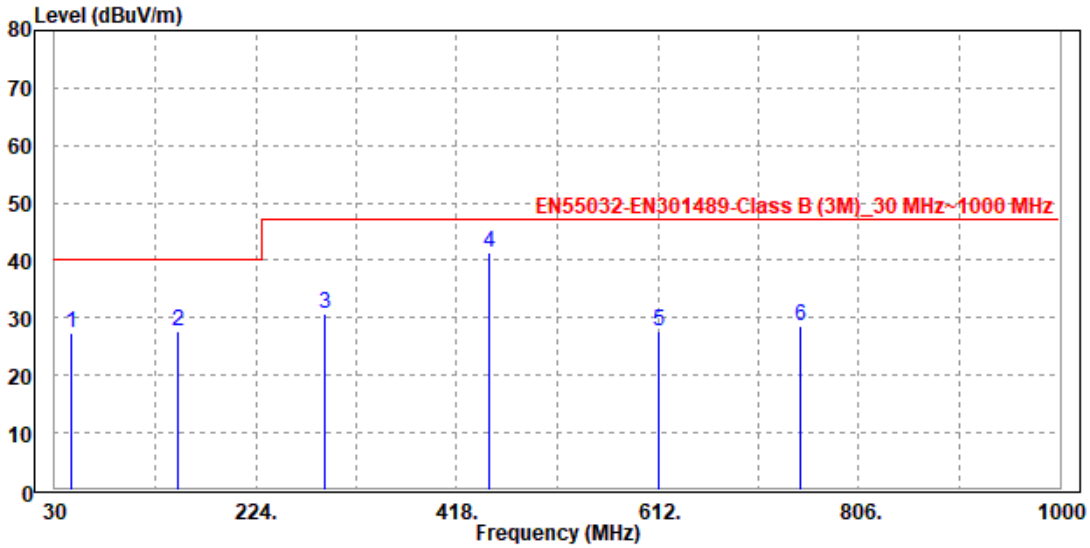
Below 1GHz worst case data

TEST VOLTAGE	Input 230 Vac, 50 Hz	**FREQUENCY RANGE**	30-1000 MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70% RH	**DETECTOR FUNCTION & RESOLUTION BANDWIDTH**	Quasi-Peak , 120 kHz
TESTED BY	Jacky		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	**EMISSION LEVEL (dBuV/m)**	**READ LEVEL (dBuV)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA FACTOR (dB /m)**	**CABLE LOSS (dB)**	**PREAMP FACTOR (dB)**	**ANTENNA HEIGHT (cm)**	**TABLE ANGLE (Degree)**	**REMARK**
45.52	27.28	52.93	40	-12.72	10.71	1.04	37.4	200	360	QP
148.34	27.81	53.65	40	-12.19	9.43	1.56	36.83	200	360	QP
289.96	30.63	51.6	47	-16.37	13.58	2.18	36.73	200	360	QP
449.04	41.41	57.54	47	-5.59	17.98	2.8	36.91	200	360	QP
612.97	27.82	41.72	47	-19.18	20.28	3.21	37.39	200	360	QP
749.74	28.7	39.46	47	-18.3	23.15	3.71	37.62	200	360	QP

REMARKS: 1. Emission level(dBuV/m)=Read Value(dBuV) + Correction Factor(dB/m)

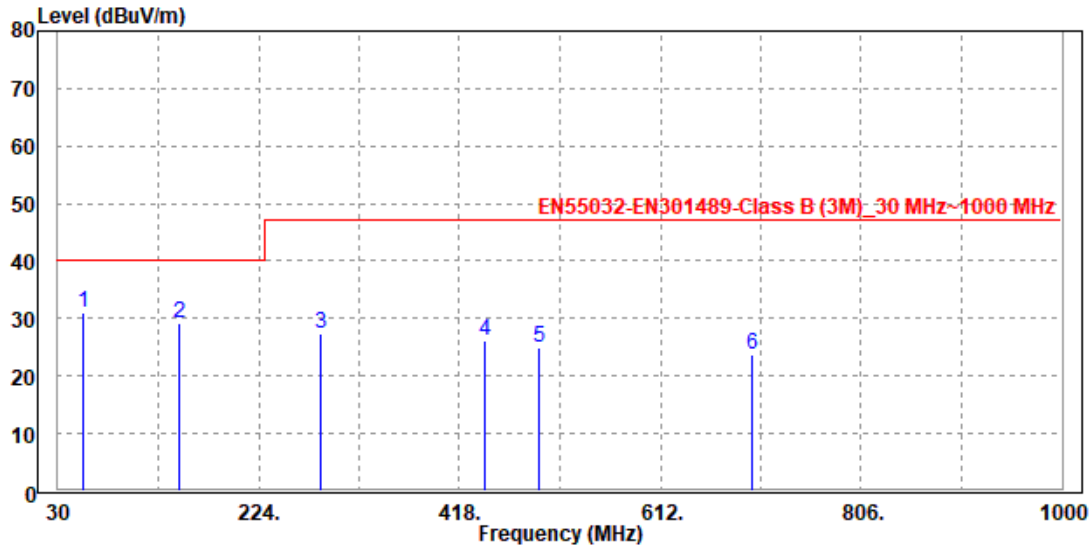
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)– Amplifier Gain
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.



TEST VOLTAGE	Input 230 Vac, 50 Hz	**FREQUENCY RANGE**	30-1000 MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70% RH	**DETECTOR FUNCTION & RESOLUTION BANDWIDTH**	Quasi-Peak , 120 kHz
TESTED BY	Jacky		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
55.22	**31.08**	**59.59**	**40**	**-8.92**	**7.78**	**1.04**	**37.33**	**100**	**360**	**QP**
147.37	29.23	55.23	40	-10.77	9.28	1.56	36.84	100	360	QP
283.17	27.52	48.52	47	-19.48	13.57	2.15	36.72	100	360	QP
443.22	26.26	42.54	47	-20.74	17.84	2.78	36.9	100	360	QP
494.63	24.97	39.92	47	-22.03	19.07	2.97	36.99	100	360	QP
701.24	23.62	34.81	47	-23.38	22.81	3.53	37.53	100	360	QP

REMARKS: 1. Emission level(dBuV/m)=Read Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) −Amplifier Gain
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.



Above 1GHz worst case data

TEST VOLTAGE	Input 230 Vac, 50 Hz	**FREQUENCY RANGE**	1-6 GHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70% RH	**DETECTOR FUNCTION & RESOLUTION BANDWIDTH**	Peak/Average, 1 MHz
TESTED BY	Jacky		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	**EMISSION LEVEL (dBuV/m)**	**READ LEVEL (dBuV)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA FACTOR (dB /m)**	**CABLE LOSS (dB)**	**PREAMP FACTOR (dB)**	**ANTENNA HEIGHT (cm)**	**TABLE ANGLE (Degree)**	**REMARK**
1835	50.88	65.54	70	-19.12	31.81	-0.03	46.44	200	360	Peak
1835	23.82	38.48	50	-26.18	31.81	-0.03	46.44	200	360	Average
2325	**51.61**	**60.64**	**70**	**-18.39**	**32.53**	**4.81**	**46.37**	**200**	**360**	**Peak**
2325	28.98	38.01	50	-21.02	32.53	4.81	46.37	200	360	Average
2795	43.41	51.24	70	-26.59	32.72	5.31	45.86	200	360	Peak
2795	29.9	37.73	50	-20.1	32.72	5.31	45.86	200	360	Average
3595	50.54	57.78	74	-23.46	33.18	5.96	46.38	200	360	Peak
3595	30.44	37.68	54	-23.56	33.18	5.96	46.38	200	360	Average
3675	50.95	60.33	74	-23.05	33.24	3.76	46.38	200	360	Peak
3675	28.22	37.6	54	-25.78	33.24	3.76	46.38	200	360	Average
4400	43.33	50.3	74	-30.67	33.82	5.6	46.39	200	360	Peak
4400	31.06	38.03	54	-22.94	33.82	5.6	46.39	200	360	Average
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	**EMISSION LEVEL (dBuV/m)**	**READ LEVEL (dBuV)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA FACTOR (dB /m)**	**CABLE LOSS (dB)**	**PREAMP FACTOR (dB)**	**ANTENNA HEIGHT (cm)**	**TABLE ANGLE (Degree)**	**REMARK**
1835	45.97	61.83	70	-24.03	30.61	-0.03	46.44	200	360	Peak
1835	23.14	39	50	-26.86	30.61	-0.03	46.44	200	360	Average
2100	40.07	50.4	70	-29.93	31.46	4.57	46.36	200	360	Peak
2100	28.2	38.53	50	-21.8	31.46	4.57	46.36	200	360	Average
2965	43	50.3	70	-27	32.78	5.48	45.56	200	360	Peak
2965	31.29	38.59	50	-18.71	32.78	5.48	45.56	200	360	Average
3595	52.93	59.4	74	-21.07	33.95	5.96	46.38	200	360	Peak
3595	31.72	38.19	54	-22.28	33.95	5.96	46.38	200	360	Average
3985	44.11	48.77	74	-29.89	36.21	5.51	46.38	200	360	Peak
3985	33.14	37.8	54	-20.86	36.21	5.51	46.38	200	360	Average
4850	48.77	52.2	74	-25.23	36.11	6.86	46.4	200	360	Peak
4850	33.83	37.26	54	-20.17	36.11	6.86	46.4	200	360	Average

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

4 IMMUNITY TEST

4.1 GENERAL DESCRIPTION

EN 301 489-1 V2.2.3 (2019-11) / EN 301 489-3 V2.2.0 (2021-11)) / EN 301 489-17 V3.2.4 (2020-09) / FINAL DRAFT ETSI EN 301 489-19 V2.2.1 (2022-07) / EN 301 489-52 V1.2.1 (2021-11), Immunity requirements			
Clause	**Reference standard**	**Test specification**	**Performance Criterion**
9.3	EN 61000-4-2 ESD	Enclosure port: ±8 kV Air discharge, ±4 kV Contact discharge	TT/TR
9.2	EN 61000-4-3 RS	Enclosure port: 80-6000 MHz, 3 V/m, 80 % AM (1 kHz)	CT/CR
9.4	EN 61000-4-4 EFT	Signal ports, telecommunication ports and control ports: ±0.5 kV, 5/50 T_r/T_h ns, 5 kHz Input DC power ports: ±0.5 kV, 5/50 T_r/T_h ns, 5 kHz Input AC Power ports: ±1 kV, 5/50 T_r/T_h ns, 5 kHz	TT/TR
9.8	EN 61000-4-5 Surge	Wired network ports(directly connected to outdoor cables): Symmetrically operated : ±1 kV, 10/700 Tr/Th μs Non-symmetrically operated : line to line: ±0.5 kV, 1.2/50 Tr/Th μs line to ground: ±1 kV, 1.2/50 Tr/Th μs Wired network ports(indoor cables, longer than 30 m): ±0.5 kV, 1.2/50 Tr/Th μs	TT/TR
		Input AC Power ports: Telecom centres: line to line: ±0.5 kV, 1.2/50 Tr/Th μs line to ground: ±1 kV, 1.2/50 Tr/Th μs Others: line to line: ±1 kV, 1.2/50 Tr/Th μs line to ground: ±2 kV, 1.2/50 Tr/Th μs	TT/TR
9.5	EN 61000-4-6 CS	Signal ports, telecommunication ports, control ports and DC power ports (if cables length > 3 m): 0.15-80 MHz, 3 V, 80 % AM (1 kHz) AC Power ports: 0.15-80 MHz, 3 V, 80 % AM (1 kHz)	CT/CR
9.7	EN 61000-4-11 Dips & Interruptions	AC Power ports: Voltage Dips: 0 % residual, 0.5 cycle 0 % residual, 1 cycle 70 % residual, 25 cycles (at 50 Hz) Voltage Interruptions: 0 % residual, 250 cycles (at 50 Hz) EUT with battery back-up EUT without battery back-up	TT/TR TT/TR TT/TR Recoverable by user or better

EN 301 489-52 V1.2.1 (2021-11), Immunity, requirements for GSM and DCS			
Clause	**Reference standard**	**Test specification**	**Performance Criterion**
9.7	EN 61000-4-11 Dips & Interruptions	AC Power ports: Voltage Dips: 30 % reduction, 10 ms	TT or CR

4.2 PERFORMANCE CRITERIA

General Performance Criteria

- Performance criteria for continuous phenomena applied to transmitters and receivers (CT/CR)

During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.

During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data.

If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

- Performance criteria for transient phenomena applied to transmitters and receivers (TT/TR)

After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.

During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed.

If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

- Performance criteria for equipment which does not provide a continuous communication Link

For radio equipment which does not provide a continuous communication Link, the performance criteria described in CT/CR and TT/TR are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in CT/CR and TT/TR.

- Performance criteria for ancillary equipment tested on a stand alone basis

If ancillary equipment is intended to be tested on a stand alone basis, the performance criteria described in CT/CR and TT/TR are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in CT/CR and TT/TR.

Product Specific Performance Criteria

The particular performance criteria which are specified in the relevant part of EN 301 489 series dealing with the particular type of radio equipment, take precedence over the corresponding parts of the general performance criteria.

Where particular performance criteria for specific functions are not given, then the general performance criteria shall apply.

EN 301 489-3, SRD

TYPE of Device

Device Type	Risk assessment of communication link performance
1	Highly reliable SRD communication media; e.g. serving human life inherent systems (may result in a physical risk to a person)
2	Medium reliable SRD communication media; e.g. causing inconvenience to persons, which cannot simply be overcome by other means
3	Standard reliable SRD communication media; e.g. inconvenience to persons, which can simply be overcome by other means (e.g. manual)

The performance criteria are:

- Performance criterion A applies for immunity tests with phenomena of a continuous nature;
- Performance criterion B applies for immunity tests with phenomena of a transient nature.

Table 2: Performance Requirements

Criterion	During test	After test
A	Operate as intended No loss of function No unintentional responses	Operate as intended No loss of function No degradation of performance No loss of stored data or user programmable functions
B	May show loss of function No unintentional responses	Operate as intended Lost function(s) shall be self-recoverable No degradation of performance No loss of stored data or user programmable functions

EN 301 489-17, Broadband Data Transmission Systems

Special conditions for Draft EN 301489-17		
Criteria	During test	After test
A	Shall operate as intended. May show degradation of performance (see note 1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 2). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.
B	May show loss of function (one or more). May show degradation of performance (see note 1). No unintentional transmissions.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see note 2). Shall be no loss of stored data or user programmable functions.
C	May be loss of function (one or more).	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no degradation of performance (see note 2).
Note 1: Degradation of performance during the test is understood as degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended. Note 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.		

Note:

1. The WLAN Linking mode is activated and monitoring communication status via notebook by ping command during and after tests.
2. The BT Linking mode is activated and the communication status is monitored via the earphone during and after tests.

EN 301 489-19, GPS and GLONASS

If the EUT is of a non-specialized nature or the EUT is combined with an ancillary equipment, the test modulation, test arrangements, etc. as required in clause 4 shall apply.

The EUT, for all immunity tests according to the present document, except the spot frequency test of the immunity test with radiated RF electromagnetic fields (see ETSI EN 301 489-1 [1], clause 9.2), shall be assessed for:

- the storage of messages in the memory of the EUT at the start of the test;
- unintentional responses of the EUT during the test;
- the maintenance of the EUT memory assessed at the conclusion of the test;
- the ability to receive and store messages at the conclusion of the test.

For the spot frequency test of the immunity test with radiated RF electromagnetic fields (see ETSI EN 301 489-1 [1],clause 9.2) the EUT shall be assessed by monitoring the accuracy of the call received alert signal.

EN 301 489-52, GSM and DCS

The equipment shall meet the performance criteria specified in this clause.

Portable equipment intended for use whilst powered by the main battery of a vehicle shall additionally fulfill the applicable requirements set out in EN 301 489-1, clauses 7.1 and 7.2 for mobile equipment.

Portable or mobile equipment powered by the AC mains shall additionally fulfill the applicable requirements of
EN 301 489-1, clauses 7.1 and 7.2 for radio and ancillary equipment for fixed use.

The establishment and maintenance of a communications Link, the assessment of RXQUAL, and the assessment of the audio breakthrough by monitoring the speech output signal level, are used as performance criteria to ensure that all primary functions of the transmitter and receiver are evaluated during the immunity tests. In addition, the test shall also be performed in idle mode to ensure the transmitter does not unintentionally operate.

The maintenance of a communications Link shall be assessed using an indicator which may be part of the test system or the EUT.

If an equipment is of a specialized nature, such that the performance criteria described in the following clauses are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests. The performance specification shall be included in the product description and documentation.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in the following clauses.

The phenomena allowed during and after test are stated in the following table.

Special conditions for EN301489-52	
Criteria	During / After Test
CT	A communication Link shall be established at the start of the test, and maintained during the test, see clauses 4.2.3 and 4.2.4. 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. Note: When there is a high level background noise present the filter bandwidth can 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 stored data, and the communication Link shall have been maintained. In addition to confirming the above performance during a call, the test shall also be performed in idle mode, and the transmitter shall not unintentionally operate.
TT	A communications Link shall be established at the start of the test, see clauses 4.2 to 4.2.4. At the conclusion of each exposure the EUT shall operate with no user noticeable loss of the communication Link. At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication Link shall have been maintained. In addition to confirming the above performance during a call, the test shall also be performed in idle mode, and the transmitter shall not unintentionally operate.
CR	A communications Link shall be established at the start of the test, clauses 4.2 to 4.2.6. During the test, the RXQUAL of the downLink shall not exceed the value of three, measured during each individual exposure in the test sequence. 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. Note: When there is a high level background noise present the filter bandwidth can 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 stored data, and the communication Link shall have been maintained.
TR	A communications Link shall be established at the start of the test, clauses 4.2 to 4.2.6. At the conclusion of each exposure the EUT shall operate with no user noticeable loss of the communication Link. At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication Link shall have been maintained.
Ancillary equipment tested on a stand alone bases	The provision of EN 301 489-1, clause 6.4 shall apply.

EN 301 489-52, UTRA and E-UTRA, Mobile and Portable UE

The equipment shall meet the performance criteria specified in this clause.

The maintenance of a communications Link shall be assessed by using an indicator, which may be part of the test system or the equipment under test.

If an equipment is of a specialized nature, that the performance criteria described in the following clauses are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after testing, as required by the present document.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in the following clauses.

In addition, the test shall also be performed in idle mode to ensure the transmitter does not unintentionally operate.

The requirements apply to all types of UTRA and E-UTRA (FDD or TDD) for the UE.

Special conditions for EN301489-52	
Criteria	During / After Test
CT/CR	A communication Link shall be established at the start of the test, and maintained during the test. In the speech mode, the performance criteria shall be that the Up Link and Down Link speech output levels shall be at least 35 dB less than the recorded reference levels, when measured through an audio band pass filter of width 200 Hz, centred on 1 kHz (annex B). Note: When there is a high level of background audio noise present, the filter bandwidth can 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 stored data, and the communication Link shall have been maintained. In addition to confirming the above performance in traffic mode, the test shall be performed in idle mode, and the transmitter shall not unintentionally operate. ● UTRA In the data transfer mode, the performance criteria can be one of the following: - if the BER (as referred in TS 134 109) is used, it shall not exceed 0,001 during the test sequence; - if the BLER (as referred in TS 134 109) 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. ● E-UTRA In the data transfer mode, the performance criteria shall be that the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channel as specified in annex C in TS 136 101 with parameters specified in tables 7.3.1-1 and 7.3.1-2 in TS 136 101 during the test sequence.
TT/TR	A communications Link shall be established at the start of the test. At the conclusion of each exposure the EUT shall operate with no user noticeable loss of the communication Link. At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication Link shall have been maintained. In addition to confirming the above performance in traffic mode, the test shall also be performed

4.3 ELECTROSTATIC DISCHARGE IMMUNITY TEST (ESD)

4.3.1 TEST SPECIFICATION

Basic Standard:	EN 61000-4-2
Discharge Impedance:	330 ohm / 150 pF
Discharge Voltage:	Air Discharge: 2, 4, 8 kV (Direct) Contact Discharge: 2, 4 kV Indirect Discharge: 2, 4kV
Polarity:	Positive & Negative
Number of Discharge:	Minimum 20 times at each test point
Discharge Mode:	Single Discharge
Discharge Period:	1 second minimum

4.3.2 TEST INSTRUMENT

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
ESD GUN	TESEQ	NSG 438	1399	Feb. 28,20	Feb. 27,21
ESD GUN-POWER	TESEQ	NSG 438-ACC	NA	Feb. 28,20	Feb. 27,21

NOTE: The test was performed in EMS Room.

4.3.3 TEST PROCEDURE

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 complete.

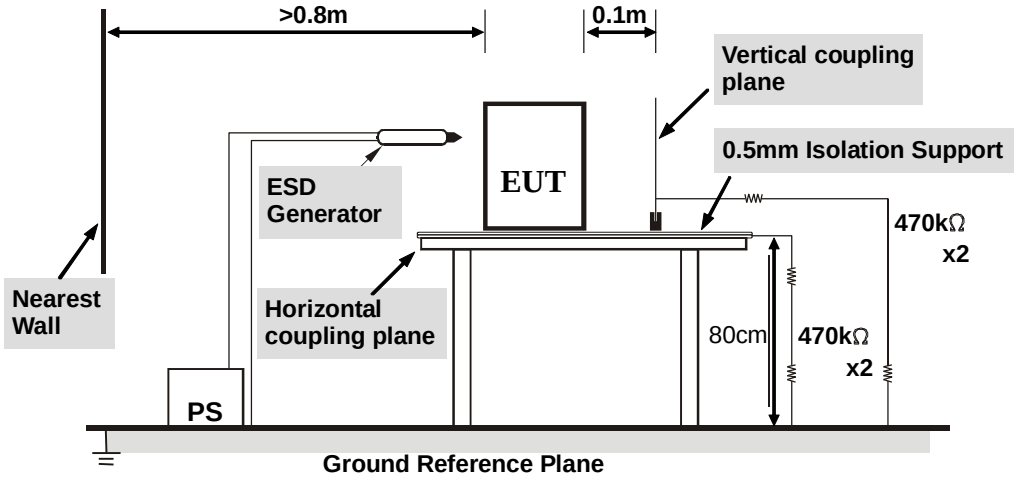
g. At least ten single discharges (in the most sensitive polarity) were applied to the **H**orizontal **C**oupling **P**lane at points on each side of the EUT. The ESD generator was positioned horizontally at a distance of 0.1 meters from the EUT with the discharge electrode touching the **HCP.**

h. At least ten single discharges (in the most sensitive polarity) were applied to the center of one vertical edge of the **V**ertical **C**oupling **P**lane in sufficiently different positions that the four faces of the EUT were completely illuminated. The **VCP** (dimensions 0.5m x 0.5m) was placed vertically to and 0.1 meters from the EUT.

4.3.4 DEVIATION FROM TEST STANDARD

No deviation.

4.3.5 TEST SETUP



NOTE:

TABLE-TOP EQUIPMENT

The configuration consisted of a wooden table 0.8 meters high standing on the **G**round **R**eference **P**lane. The **GRP** consisted of a sheet of aluminum or copper at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system. A **H**orizontal **C**oupling **P**lane (1.6m x 0.8m) was placed on the table and attached to the **GRP** by means of a cable with 940kΩ total impedance. The equipment under test, was installed in a representative system as described in section 7 of IEC 61000-4-2, and its cables were placed on the **HCP** and isolated by an insulating support of 0.5mm thickness. A distance of 0.8 meter minimum was provided between the EUT and the walls of the laboratory and any other metallic structure.

FLOOR-STANDING EQUIPMENT

The equipment under test was installed in a representative system as described in section 7 of IEC 61000-4-2, and its cables were isolated from the Ground Reference Plane by an insulating support of 0.1-meter thickness. The GRP consisted of a sheet of aluminum or copper that is at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system and extended at least 0.5 meters from the EUT on all sides.

4.3.6 TEST RESULTS

TEST VOLTAGE	Input 230 Vac, 50 Hz	**ENVIRONMENTAL CONDITIONS**	23deg. C, 54% RH, 101kpa
TEST MODE	See section 2.2	**TESTED BY**	Chase Zhou

Discharge Level	Polarity	Test Points	Contact Discharge	Air Discharge	Performance Criterion	Test Result
2,4,8	+/-	1-5,7	N/A	Apply	TT/TR	Complied
2,4	+/-	6	Apply	N/A	TT/TR	Complied
2,4	+/-	HCP	Apply	N/A	TT/TR	Complied
2,4	+/-	VCP	Apply	N/A	TT/TR	Complied

NOTE: 1. The EUT function was correct during the test.

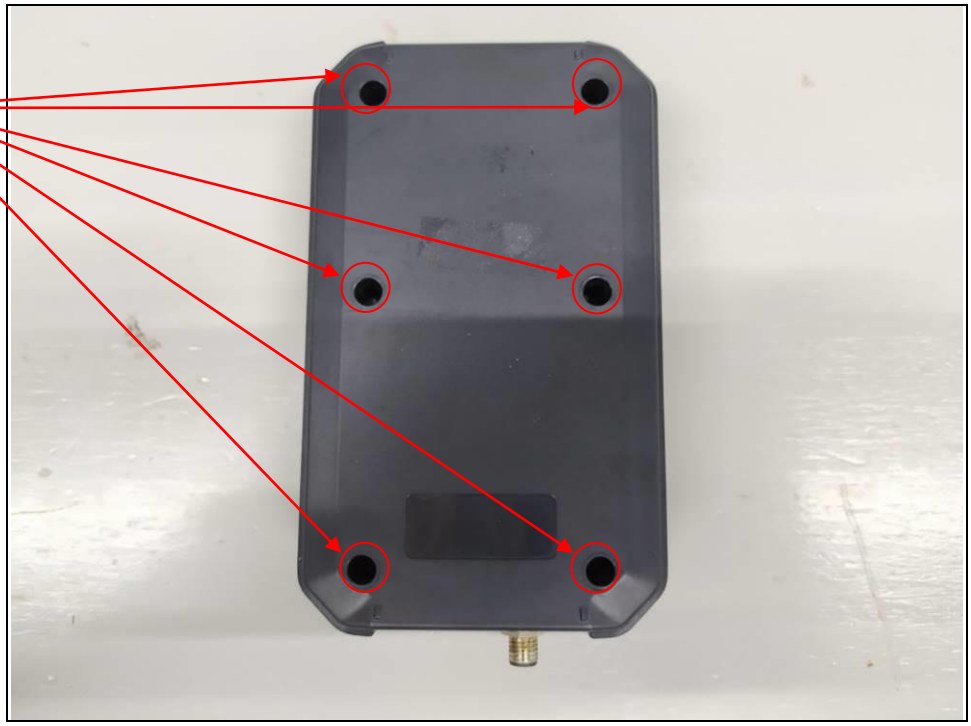
2. “ ○ ” means Air Discharge

3. “ ✦ ” means Contact Discharge

ESD TEST POINTS

1

2



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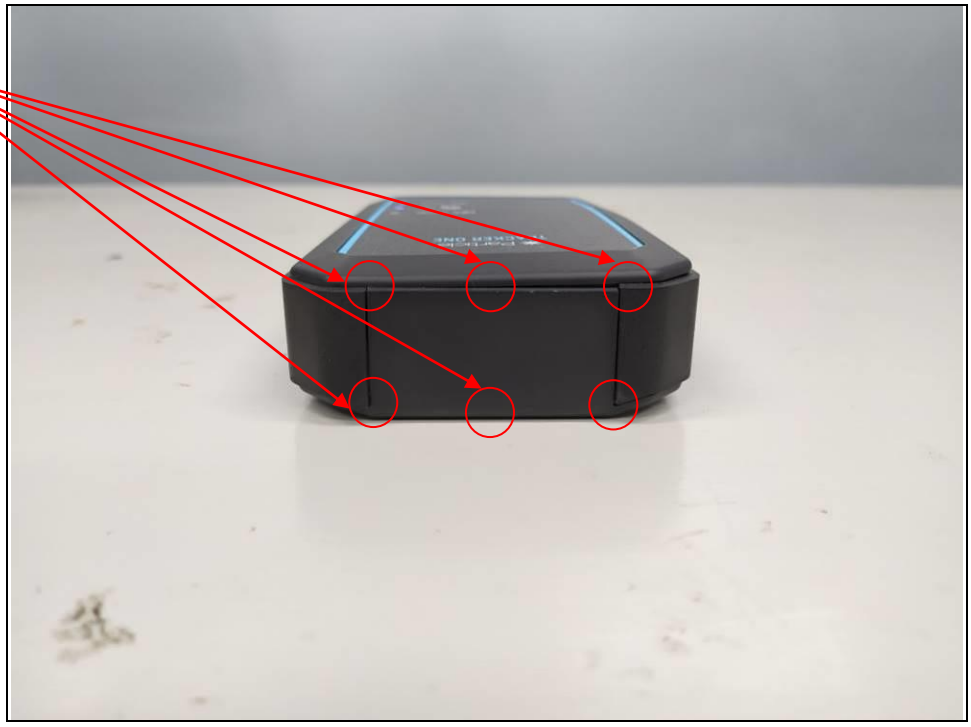

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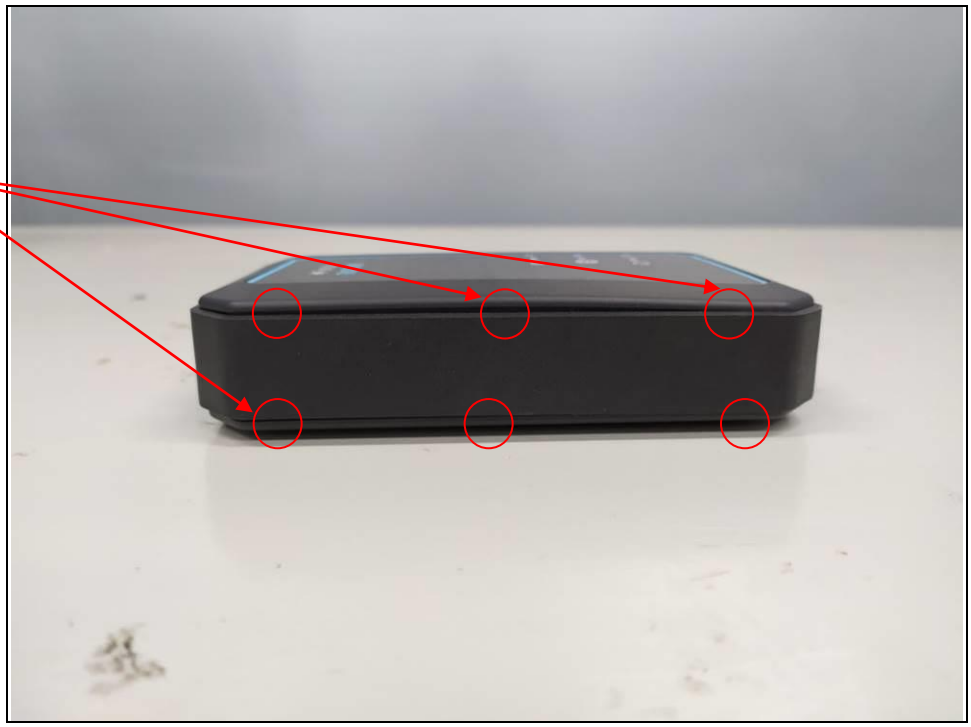

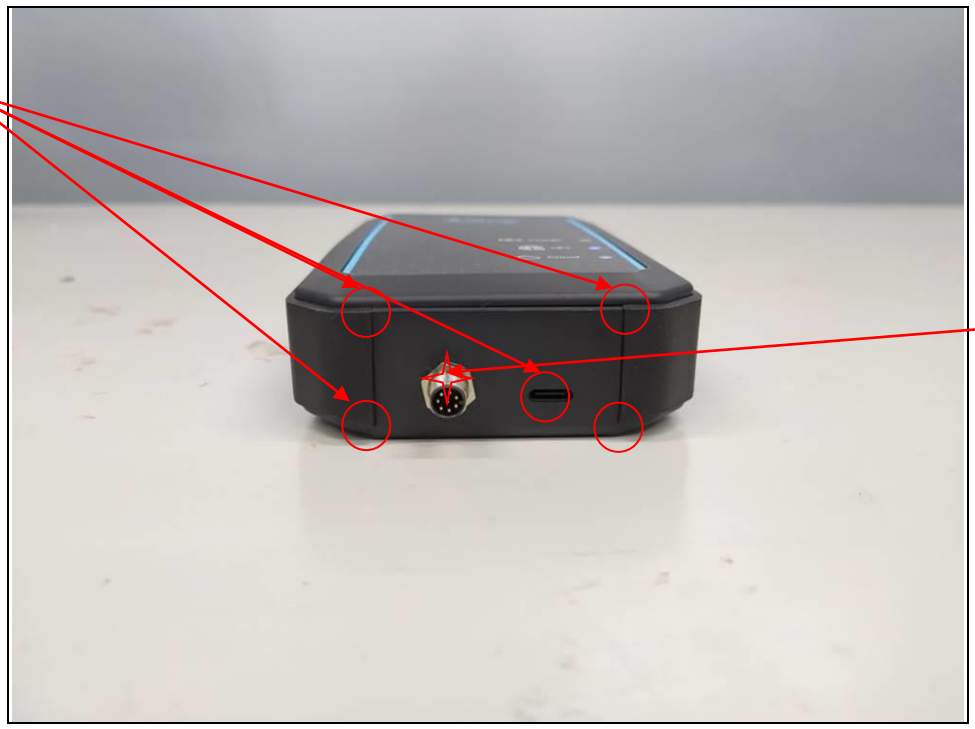
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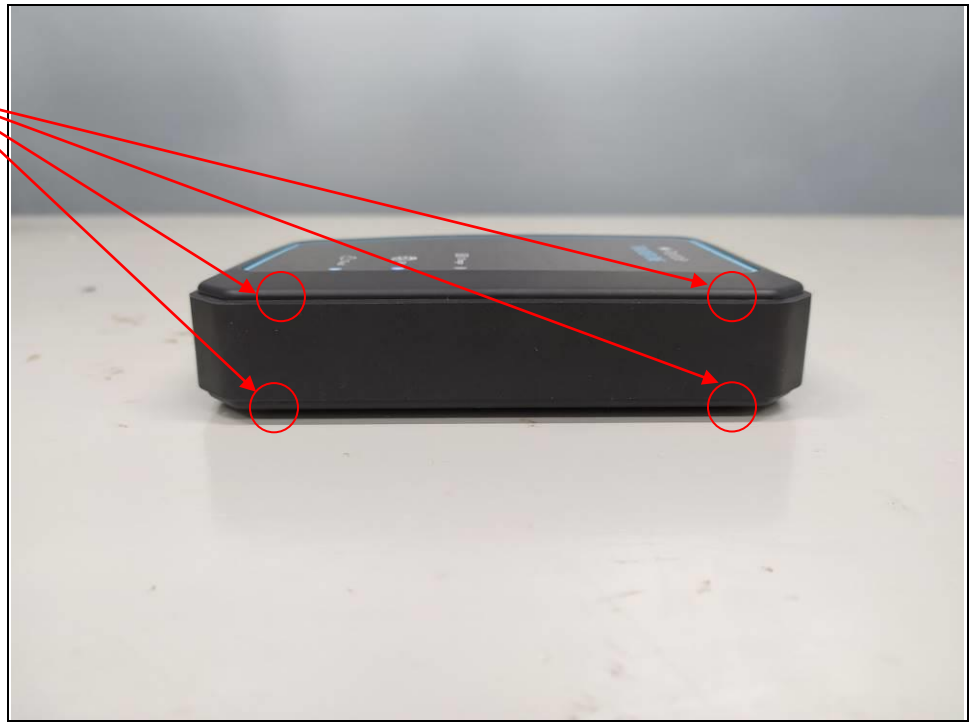
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4.4 RADIATED, RADIO-FREQUENCY, ELECTROMAGNETIC FIELD IMMUNITY TEST (RS)

4.4.1 TEST SPECIFICATION

Basic Standard:	EN 61000-4-3
Frequency Range:	80 MHz ~ 6000 MHz
Field Strength:	3 V/m
Modulation:	1 kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of preceding frequency value
Polarity of Antenna:	Horizontal and Vertical
Antenna Height:	1.5 m
Dwell Time:	3 seconds

4.4.2 TEST INSTRUMENT

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Base station R&S CMW500	Rohde&Schwarz	CMW500	153084	Feb. 28,20	Feb. 27, 21
Audio Analyzer	Rohde&Schwarz	UPV	104035	Feb. 28,20	Feb. 27, 21
RS Test System TS9982	Rohde&Schwarz	SMB100A + SMB-B106	109279	Feb. 28,20	Feb. 27, 21
EMC32 test software	Rohde&Schwarz	EMC32	NA	NA	NA
POWER AMPLIFIER_RS	Rohde&Schwarz	BBA100-B250	101805	Feb. 28,20	Feb. 27, 21
POWER AMPLIFIER_RS	Rohde&Schwarz	BBA150-D110	101823	Feb. 28,20	Feb. 27, 21
RS Antenna_LF	Rohde&Schwarz	R&S® HL046E	HL064E	NA	NA
RS Antenna_HF	Rohde&Schwarz	STLP 9149	9149-329	NA	NA
3m Fully-anechoic Chamber	ETS-LINDGREN	10m*10m*5m	Euroshieldpn-CT0001143-1217	Feb. 28,20	Feb. 27, 21
Ear Simulator	Rohde&Schwarz	4182	2981654	Feb. 28,20	Feb. 27, 21
Mouth Simulator	Rohde&Schwarz	4227	2837781	NA	NA
conditionaling Amplifier	Rohde&Schwarz	Type 5935	2997236	Feb. 28,20	Feb. 27, 21
power sensor	Rohde&Schwarz	NRP-Z91	102958	Aug. 26,20	Aug. 25,21
power sensor	Rohde&Schwarz	NRP-Z91	102959	Aug. 26,20	Aug. 25,21

NOTE: 1. The test was performed in RS Room.

4.4.3 TEST PROCEDURE

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

a. The testing was performed in a fully-anechoic chamber.

b. The frequency range is swept from 80 MHz to 6000 MHz with the signal 80% amplitude modulated with a 1 kHz sine wave.

c. The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised and to respond, but shall in no case be less than 0.5s.

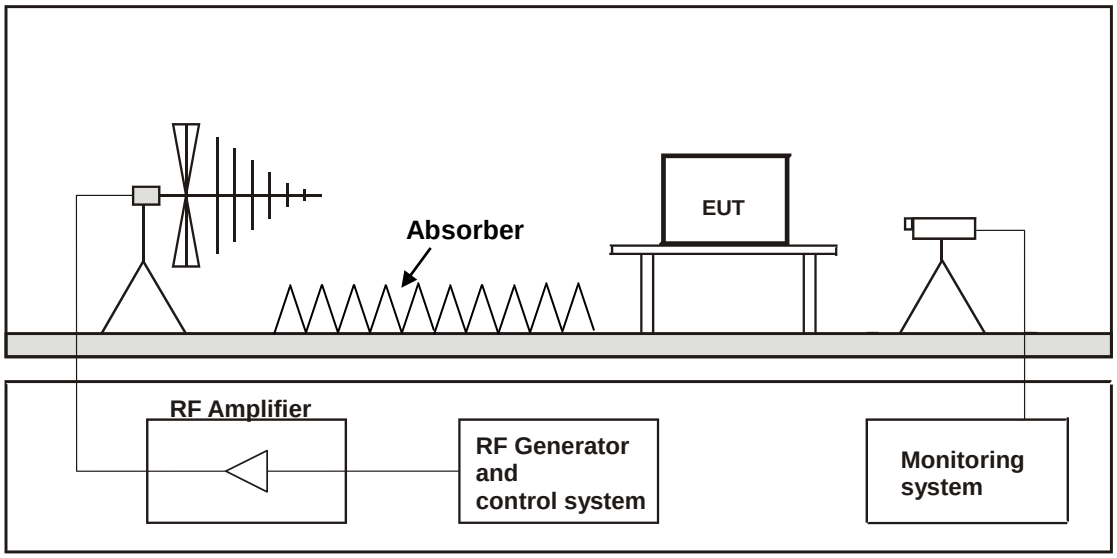
d. The field strength level was 3 V/m.

e. The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.

4.4.4 DEVIATION FROM TEST STANDARD

No deviation.

4.4.5 TEST SETUP



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

NOTE:

TABLETOP EQUIPMENT

The EUT installed in a representative system as described in section 7 of EN 61000-4-3 was placed on a non-conductive table 0.8 meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.

4.4.6 TEST RESULTS

TEST VOLTAGE	Input 230 Vac, 50 Hz	ENVIRONMENTAL CONDITIONS	21.5deg. C, 50.6% RH
TEST MODE	1 ~ 2	TESTED BY	Star Le

Field Strength (V/m)	Test Frequency Note#1 (MHz)	Polarization of antenna (Horizontal / Vertical)	Azimuth (0)	Test Distance (m)	Performance Criterion	Test Result
3	80 - 6000	H&V	0/90/180/270	3	CT/CR	Complied

* The exclusion band for transmitters is 250 % of the channel width either side of the nominal operating frequency of the transmitter.
* The exclusion band for receivers shall be calculated by using the following formulae:

For the lower edge for the exclusion band: $EXband(lower) = Band_{RX}(lower) - ChW_{RX}$

For the upper edge of the exclusion band: $EXband(lower) = Band_{RX}(upper) + ChW_{RX}$

* GSM and DCS Channel Width 200kHz
* UTRA Channel Width 5MHz

NOTE:

1. For normal operating function: There was no change compared with the initial operation during and after the test.
2. For the BLER Measurement: During the test, the measured BLER shall not exceed 0.01 during the test sequence.
3. Test mode 1 was the worst case and only this mode was presented in the report.

TEST VOLTAGE	Input 230 Vac, 50 Hz	ENVIRONMENTAL CONDITIONS	21.5deg. C, 50.6% RH
TEST MODE	3~4	TESTED BY	Star Le

Field Strength (V/m)	Test Frequency Note#1 (MHz)	Polarization of antenna (Horizontal / Vertical)	Azimuth (0)	Test Distance (m)	Performance Criterion	Test Result
3	80 - 6000	H&V	0/90/180/270	3	CT/CR	Complied

* The exclusion band for transmitters is 250 % of the channel width either side of the nominal operating frequency of the transmitter.
* The exclusion band for receivers shall be calculated by using the following formulae:

For the lower edge for the exclusion band: $EXband(lower) = Band_{RX}(lower) - ChW_{RX}$

For the upper edge of the exclusion band: $EXband(lower) = Band_{RX}(upper) + ChW_{RX}$

* UTRA Channel Width 5MHz

NOTE:

1. For normal operating function: There was no change compared with the initial operation during and after the test.
2. For the BER Measurement: During the test, the measured BER shall not exceed 0.001 during the test sequence.
3. Test mode 3 was the worst case and only this mode was presented in the report.

TEST VOLTAGE	Input 230 Vac, 50 Hz	ENVIRONMENTAL CONDITIONS	21.5deg. C, 50.6% RH
TEST MODE	5~10	TESTED BY	Star Le

Field Strength (V/m)	Test Frequency Note#1 (MHz)	Polarization of antenna (Horizontal / Vertical)	Azimuth (0)	Test Distance (m)	Performance Criterion	Test Result
3	80 - 6000	H&V	0/90/180/270	3	CT/CR	Complied

* The exclusion band for transmitters is 250 % of the channel width either side of the nominal operating frequency of the transmitter.
* The exclusion band for receivers shall be calculated by using the following formulae:

For the lower edge for the exclusion band: $EXband(lower) = Band_{RX}(lower) - ChW_{RX}$

For the upper edge of the exclusion band: $EXband(lower) = Band_{RX}(upper) + ChW_{RX}$

* E-UTRA Channel Width 20MHz

NOTE:

1. For normal operating function: There was no change compared with the initial operation during and after the test.
2. For throughput Measurement: During the test, the measured Throughput shall not found less than 95% of the maximum throughput of the reference measurement channel.
3. Test mode 5 was the worst case and only this mode was presented in the report.

TEST VOLTAGE	Input 230 Vac, 50 Hz	ENVIRONMENTAL CONDITIONS	21.5deg. C, 50.6% RH
TEST MODE	13~15	TESTED BY	Star Le

Field Strength (V/m)	Test Frequency Note#1 (MHz)	Polarization of antenna (Horizontal / Vertical)	Azimuth（0）	Test Distance (m)	Performance Criterion	Test Result
3	80 - 6000	H&V	0/90/180/270	3	CT/CR	Complied
3	Spot frequency	H&V	0/90/180/270	3	CT/CR	Complied

NOTE:

* Spot frequency test: A spot frequency test shall additionally be performed at: 80 MHz; 104 MHz;136 MHz;165 MHz;200 MHz; 260 MHz; 330 MHz;430 MHz;560 MHz;715 MHz ± 1 MHz; a spot frequency test shall be performed at 920 MHz ± 1 MHz using a test level of 3 V/m (measured unmodulated) 100 % modulated by 200 Hz pulses of equal mark to space ratio.

* Exclusion band

The lower frequency of the receiver exclusion band is the lower frequency of the complete receive band of the EUT minus 5 % of that lower frequency.

The upper frequency of the receiver exclusion band is the upper frequency of the complete receive band of the EUT plus 5 % of that upper frequency.

NOTE:

1. There was no change compared with initial operation during and after the test.

TEST VOLTAGE	Input 230 Vac, 50 Hz	ENVIRONMENTAL CONDITIONS	21.5deg. C, 50.6% RH
TEST MODE	11~12	TESTED BY	Star Le

Field Strength (V/m)	Test Frequency Note#1 (MHz)	Polarization of antenna (Horizontal / Vertical)	Azimuth（0）	Test Distance (m)	Performance Criterion	Test Result
3	80 - 6000	H&V	0/90/180/270	3	CT/CR	Complied

* The exclusion band for the transmitter and / or receiver part of the 2.4 GHz band equipment under test shall extend from 2280 MHz to 2603.5 MHz., The WLAN connection of EUT goes offline during the test.

NOTE:

1. There was no change compared with initial operation during and after the test.

TEST VOLTAGE	Input 230 Vac, 50 Hz	**ENVIRONMENTAL CONDITIONS**	21.5deg. C, 50.6% RH
TEST MODE	16	**TESTED BY**	Star Le

Field Strength (V/m)	Test Frequency Note#1 (MHz)	Polarization of antenna (Horizontal / Vertical)	Azimuth（0）	Test Distance (m)	Performance Criterion	Test Result
3	80 - 6000	H&V	0/90/180/270	3	CT/CR	Complied

NOTE:

1. There was no change compared with initial operation during and after the test.

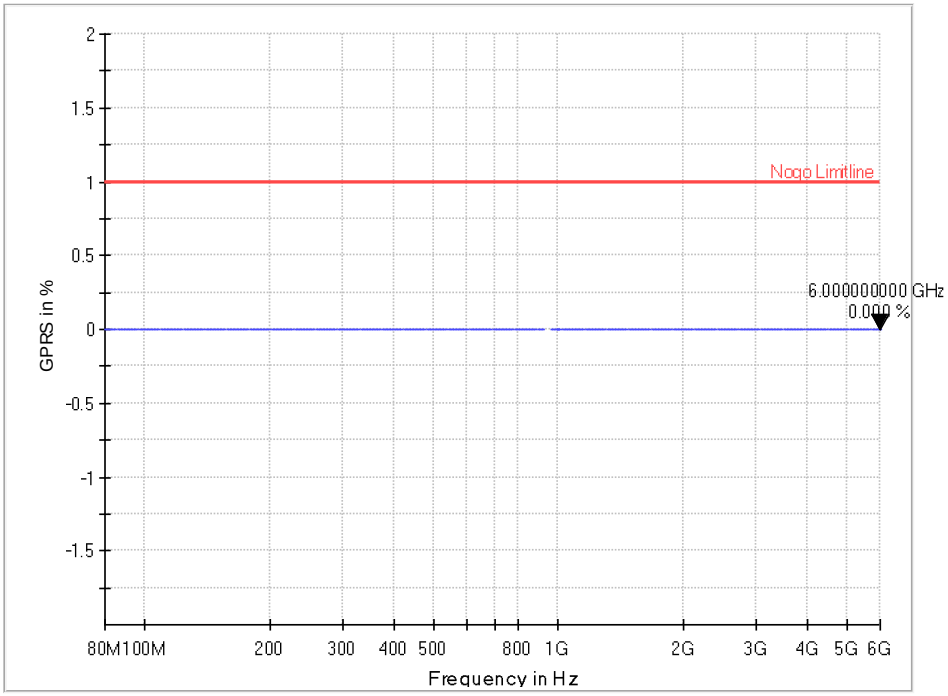
4.4.7 AUDIO BREAKTHROUGH MEASUREMENT RESULTS

V1.0

Worst mode 1

Mobile Phone Parameters:

Network Standard:	GPRS 900
Field Polar	Horizontal
Degree	0

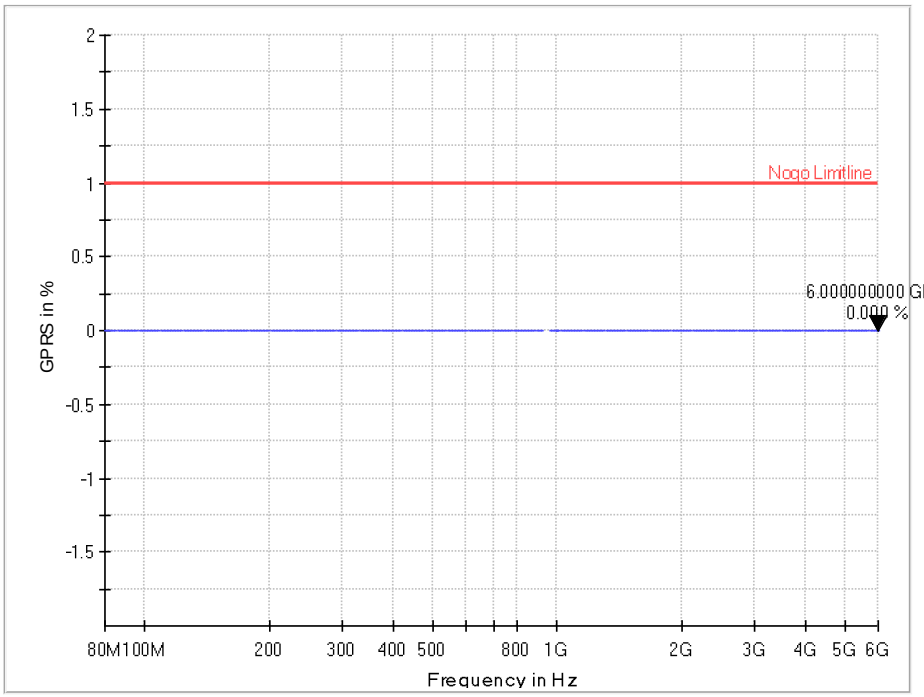


V1.1

Worst mode 1

Mobile Phone Parameters:

Network Standard:	GPRS 900
Field Polar	Horizontal
Degree	0



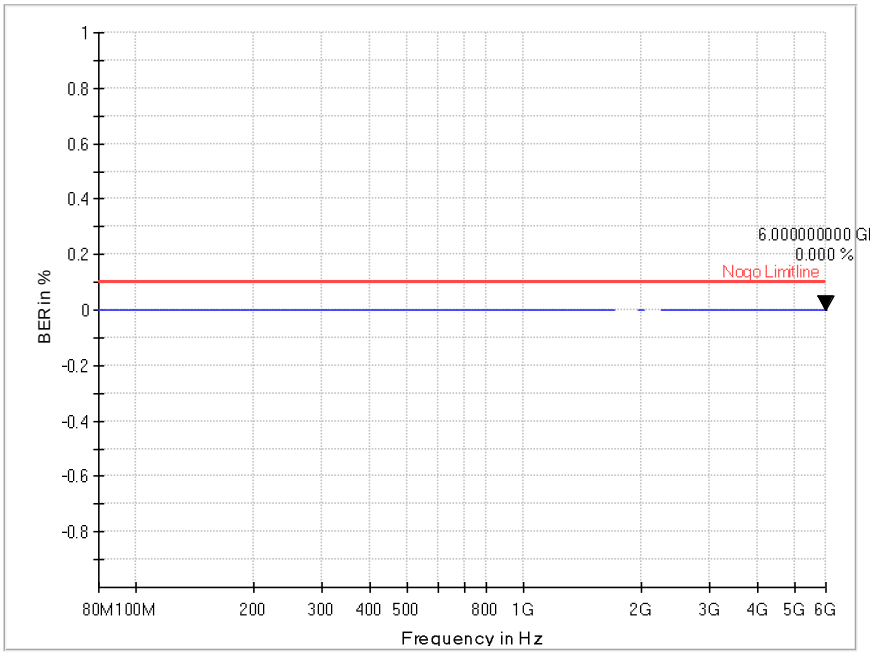
4.4.8 DATA TRANSFER MEASUREMENT RESULTS

Worst case of the test modes:

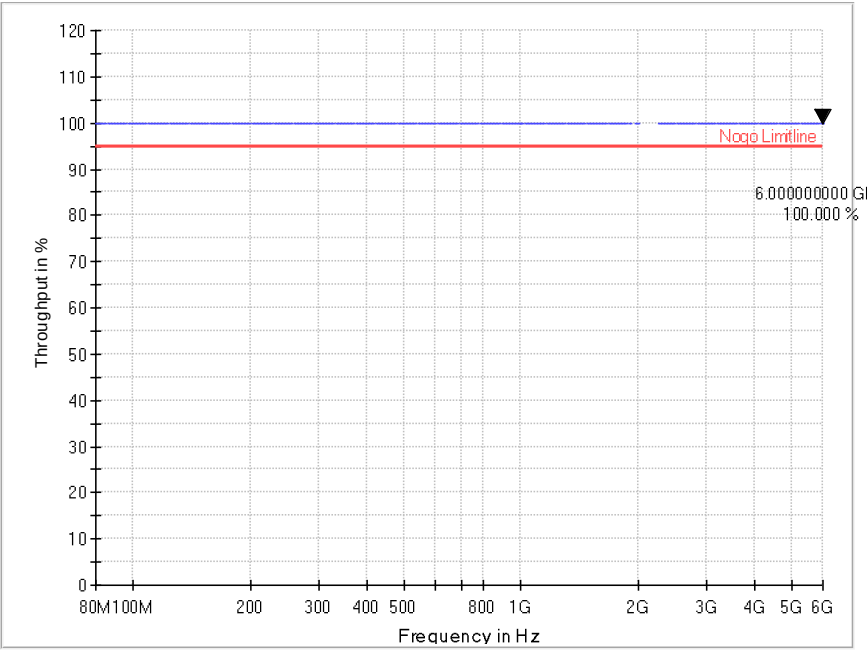
For BER

Mode 3

Horizontal (0 degree)



For Throughput
Mode 5
Horizonta (0 degree)



4.5 ELECTRICAL FAST TRANSIENT (EFT)

4.5.1 TEST SPECIFICATION

Basic Standard:	EN 61000-4-4
Test Voltage:	Input AC Power ports: ±1 kV
EFT Input/Output:	L,N
Polarity:	Positive & Negative
Impulse Repetition Frequency:	others: 5 kHz
Impulse Waveshape:	T_r/T_h 5/50 ns
Burst Duration:	15 ms for 5 kHz Repetition Frequency 0.75 ms for 100 kHz Repetition Frequency
Burst Period:	300 ms
Test Duration:	1 min

4.5.2 TEST INSTRUMENT

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Surge Pulse for power port	TESEQ	CWM 3650	3053	Aug. 26, 20	Aug. 25, 21
Surge Pulse for RJ45/RJ11 port	TESEQ	TSM 3751	1086	Aug. 26, 20	Aug. 25, 21
EFT/Burst Module for power port	TESEQ	FTM 3425-60	3298	Aug. 26, 20	Aug. 25, 21
EFT CDN Clamp for DATA LINE	TESEQ	CDN 3425	1985	Aug. 26, 20	Aug. 25, 21
DIP KIT	TESEQ	VAR-3005-S16	890	Aug. 26, 20	Aug. 25, 21
EFT check voltage	TESEQ	CAS 3025	40446	Jul. 02,20	Jul. 01,21
surge check voltage	TESEQ	MD 200A	152841	Jul. 02,20	Jul. 01,21

NOTE: The test was performed in EMS Room.

4.5.3 TEST PROCEDURE

a. Both positive and negative polarity discharges were applied.

b. The distance between any coupling devices and the EUT should be (0.5 − 0/+0.1) m for table-top equipment testing, and (1.0 ± 0.1) m for floor standing equipment.

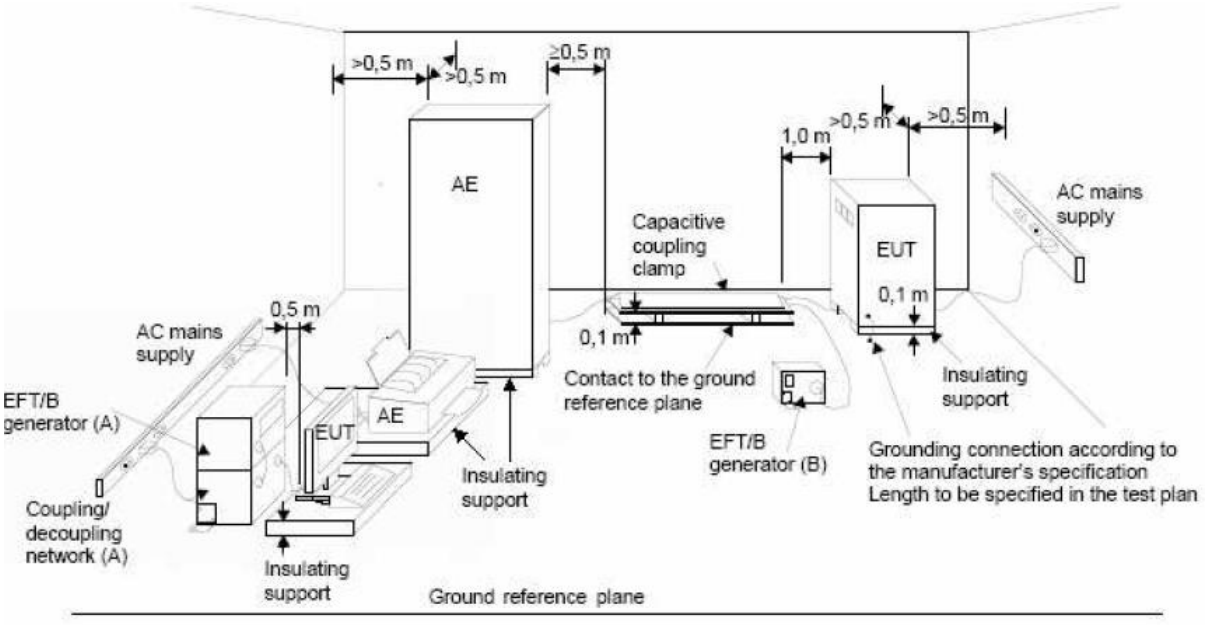
c. The duration time of each test sequential was 1 minute.

d. The transient/burst waveform was in accordance with IEC 61000-4-4, 5/50ns.

4.5.4 DEVIATION FROM TEST STANDARD

No deviation.

4.5.5 TEST SETUP



(A) location for supply line coupling
(B) location for signal lines coupling

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

4.5.6 TEST RESULTS

TEST VOLTAGE	Input 230 Vac, 50 Hz	ENVIRONMENTAL CONDITIONS	23deg. C, 54% RH
TEST MODE	See section 2.2	TESTED BY	Chase Zhou

V1.0

Test Point	Polarity	Test Level (kV)	Observation	Performance Criterion	Test Result
L	+/-	1	NOTE	TT/TR	Complied
N	+/-	1	NOTE	TT/TR	Complied

V1.1

Test Point	Polarity	Test Level (kV)	Observation	Performance Criterion	Test Result
L	+/-	1	NOTE	TT/TR	Complied
N	+/-	1	NOTE	TT/TR	Complied

NOTE: There was no change compared with initial operation during and after the test.

4.6 SURGE IMMUNITY

4.6.1 TEST SPECIFICATION

Basic Standard:	EN 61000-4-5
Wave-Shape:	Input AC power port: 1.2/50 μs Open Circuit Voltage 8/20 μs Short Circuit Current
Test Voltage:	Input AC power ports: Line to line: ±1 kV
Surge Input/Output:	L-N
Generator Source Impedance:	2 ohm between networks
Polarity:	Positive/Negative
Phase Angle:	0°/90°/180°/270°
Pulse Repetition Rate:	1 time / 60 sec.
Number of Tests:	5 positive and 5 negative at selected points

4.6.2 TEST INSTRUMENT

Refer to section 5.5.2 to get information of above instrument.

4.6.3 TEST PROCEDURE

a. For EUT power supply:

The surge is applied to the EUT power supply terminals via the capacitive coupling network. Decoupling networks are required in order to avoid possible adverse effects on equipment not under test that may be powered by the same lines, and to provide sufficient decoupling impedance to the surge wave. The power cord between the EUT and the coupling/decoupling networks was shorter than 2 meters in length.

For double-insulated products without PE or external earth connections, the test shall be done in a similar way as for grounded products but without adding any additional external grounded connections. If there are no other possible connections to earth, line-to-ground tests may be omitted.

b. Signal and telecommunication ports,

- Unshielded unsymmetrical interconnection lines:

The surge is applied to the lines via the capacitive coupling. The coupling / decoupling networks shall not influence the specified functional conditions of the EUT. The interconnection line between the EUT and the coupling/decoupling networks shall be 2 meters in length.

- Unshielded symmetrical interconnections communication lines:

The surge is applied to the lines via gas arrestors coupling. Test levels below the ignition point of the coupling arrestor cannot be specified. The interconnection line between the EUT and the coupling/decoupling networks shall be 2 meters in length.

- High speed communications lines

Prior to the test, the correct operation of the port shall be verified; the external connection shall then be removed and the surge applied directly to the port's terminals with no coupling /decoupling network. After the surge, the correct operation of the port shall again be verified.

- Shielded lines:

  - Direct application,

The EUT is isolated from ground and the surge is applied to its metallic enclosure; the termination (or auxiliary equipment) at the port(s) under test is grounded. This test applies to equipment with single or multiple shielded cables.

Rules for application of the surge to shielded lines:

a) Shields grounded at both ends

> The surge injection on the shield.

b) Shields grounded at one end

> If in the installation the shield is connected only at the auxiliary equipment, test shall be done in that configuration but with the generator still connected to the EUT side. If cable lengths allow, the cables shall be on insulated supports 0,1 m above the ground plane or cable tray.

For products which do not have metallic enclosures, the surge is applied directly to the shielded cable.

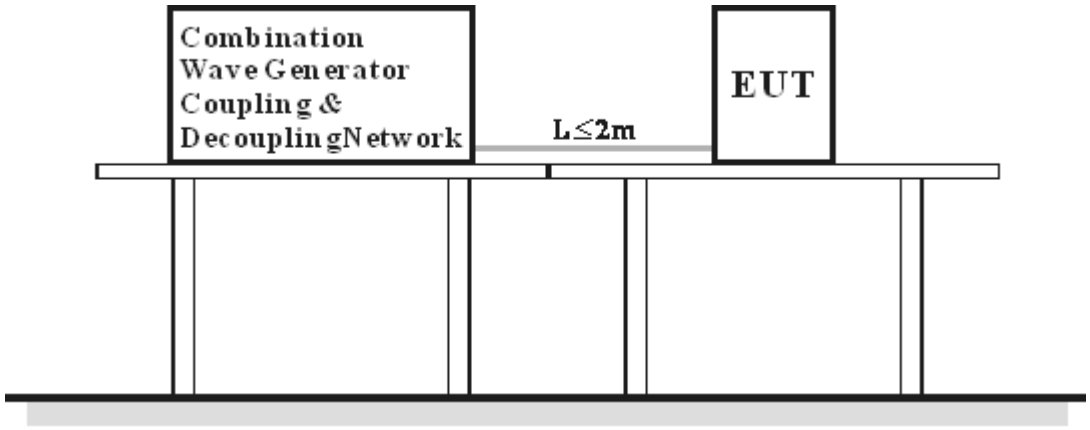
- Alternative coupling method for testing single cables in a multi-shield configuration,

Surges are applied in close proximity to the interconnection cable under test by a wire. The length of the cable between the port(s) under test and the device attached to the other end of the cable shall be the lesser of: the maximum length permitted by the EUT's specification, or 20 m. Where the length exceeds 1 m, excess lengths of cables shall be bundled at the approximate centre of the cables with the bundles 30 cm to 40 cm in length.

4.6.4 DEVIATION FROM TEST STANDARD

No deviation.

4.6.5 TEST SETUP



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

4.6.6 TEST RESULTS

TEST VOLTAGE	Input 230 Vac, 50 Hz	**ENVIRONMENTAL CONDITIONS**	23deg. C, 54% RH
TEST MODE	See section 2.2	**TESTED BY**	Chase Zhou

AC Power port：

\Phase angle \ Test result \Voltage (kV) \ Test point\ Polarity			0°	90°	180°	270°	Performance Criterion	Test Result
1	L-N	+	PASS	PASS	PASS	PASS	TT/TR	Complied
		-	PASS	PASS	PASS	PASS	TT/TR	Complied

NOTE: There was no change compared with initial operation during and after the test.

4.7 CONDUCTED RADIO FREQUENCY DISTURBANCES (CS)

4.7.1 TEST SPECIFICATION

Basic Standard:	EN 61000-4-6
Frequency Range:	0.15 MHz ~ 80 MHz
Field Strength:	3 Vrms
Modulation:	1 kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of preceding frequency value
Coupled cable:	Power Mains, Unshielded
Coupling device:	CDN-M2

4.7.2 TEST INSTRUMENT

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Current Injection	Rohde&Schwarz	F-120-9A	160178	Feb. 28,20	Feb. 27, 21
Current Probe	Rohde&Schwarz	F-52	160179	Feb. 28,20	Feb. 27, 21
Base station R&S CMU200	Rohde&Schwarz	CMU200	119991	Aug. 26, 20	Aug. 25, 21
Audio Analyzer	Rohde&Schwarz	UPV	104033	Feb. 28,20	Feb. 27, 21
CS Test System TS9982	Rohde&Schwarz	SMC100A + SMC-B101	109278	Feb. 28,20	Feb. 27, 21
POWER AMPLIFIER_CS	Rohde&Schwarz	BBA100-A125C125	101804	Feb. 28,20	Feb. 27, 21
CDN	Rohde&Schwarz	FCC-801-M2/M3-16A	160181	Feb. 28,20	Feb. 27, 21
BCI Impedance	Rohde&Schwarz	FCC-801-150-50-BCI	160185	Feb. 28,20	Feb. 27, 21
CDN	Rohde&Schwarz	FCC-801-150-50-CDN-ED4	160182	Feb. 28,20	Feb. 27, 21
calibration Fixture	Rohde&Schwarz	FCC-BCICF-6-150	160184	Feb. 28,20	Feb. 27, 21
Proble Kit	Rohde&Schwarz	FCC-MPCF-3-F-52	160180	Feb. 28,20	Feb. 27, 21
Coupling-decoupling network-T4AS	TESEQ	CDN T4AS	N/A	Feb. 28,20	Feb. 27, 21
Ear Simulator	Rohde&Schwarz	4182	2959480	Feb. 28,20	Feb. 27, 21
Mouth Simulator	Rohde&Schwarz	4227	2837779	NA	NA
conditionaling Amplifier	Rohde&Schwarz	Type 5935	2997235	Feb. 28,20	Feb. 27, 21
power sensor	Rohde&Schwarz	NRP-Z91	102957	Aug. 26, 20	Aug. 25, 21
power sensor	Rohde&Schwarz	NRP-Z91	102960	Aug. 26, 20	Aug. 25, 21

NOTE: The test was performed in CS Room.

4.7.3 TEST PROCEDURE

a. The EUT shall be tested within its intended operating and climatic conditions.

b. An artificial hand was placed on the hand-held accessory and connected to the ground reference plane.

c. One of the CDNs not used for injection was terminated with 50Ω , providing only one return path. All other CDNs were coupled as decoupling networks.

d. 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 signal is modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or the switch coupling devices as necessary. Where the frequency is swept incrementally, the step size shall not exceed 1% of the preceding frequency value.

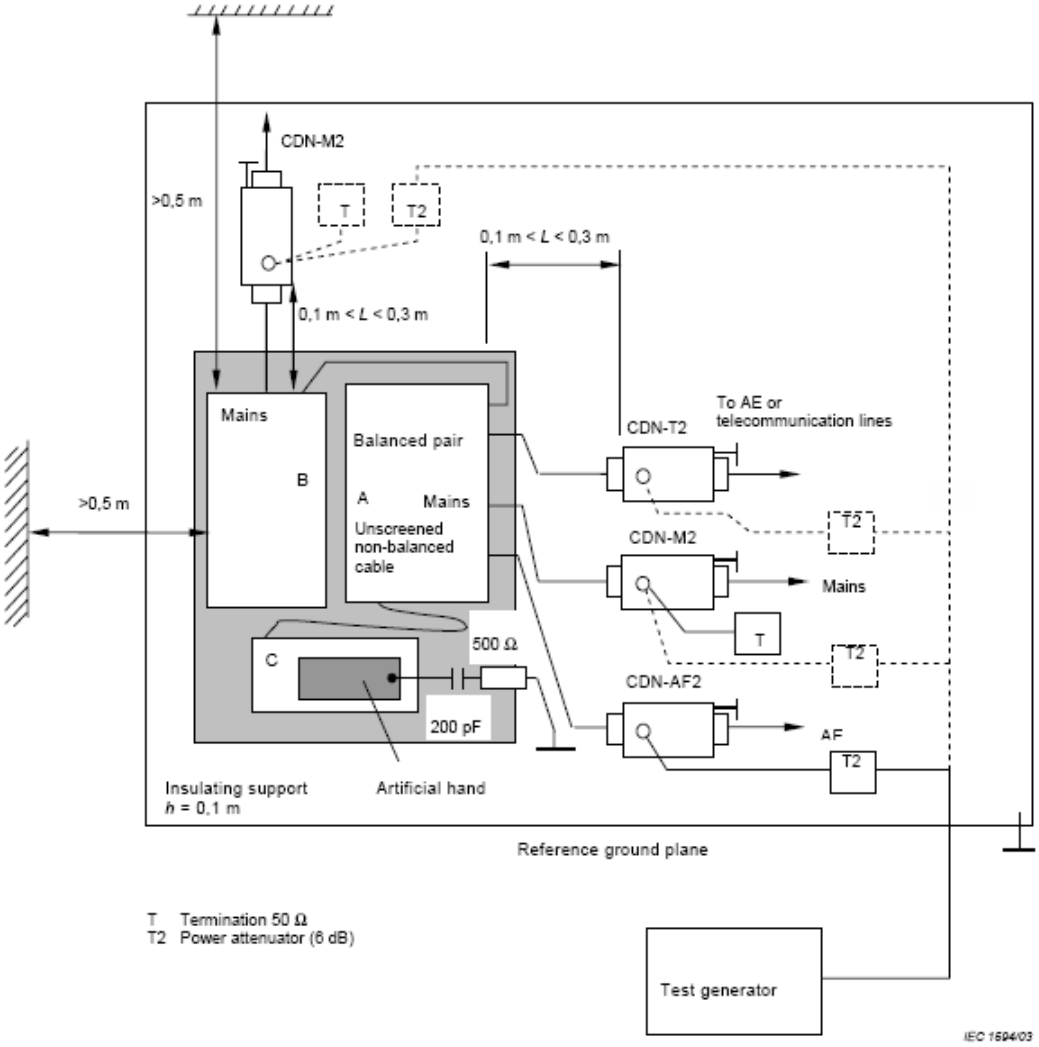
e. The dwell time of the amplitude modulated carrier at each frequency shall not be less than the time necessary for the EUT to be exercised and to respond, but shall in no case be less than 0.5 s. The sensitive frequencies (e.g. clock frequencies) shall be analyzed separately.

f. Attempts should be made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.

4.7.4 DEVIATION FROM TEST STANDARD

No deviation.

4.7.5 TEST SETUP



Note: 1.The EUT clearance from any metallic obstacles shall be at least 0.5 m.

2. Interconnecting cables (≦ 1 m) belonging to the EUT shall remain on the insulating support.

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

NOTE:
The equipment to be tested is placed on an insulating support of 0.1 meters height above a ground reference plane. All relevant cables shall be provided with the appropriate coupling and decoupling devices at a distance between 0.1 meters and 0.3 meters from the projected geometry of the EUT on the ground reference plane.

4.7.6 TEST RESULTS

TEST VOLTAGE	Input 230 Vac, 50 Hz	ENVIRONMENTAL CONDITIONS	22.4deg. C, 50.2% RH
TEST MODE	1 ~ 2	TESTED BY	Jacky Liu

Voltage (V)	Test Frequency Note#1 (MHz)	Tested Line	Injection Method.	Performance Criterion	Test Result
3	0.15 – 80	AC line	CDN-M2	CT/CR	Complied

NOTE:
1. For normal operating function: There was no change compared with the initial operation during and after the test.
2. For the BLER Measurement: During the test, the measured BLER shall not exceed 0.01 during the test sequence.
3. Test mode 1 was the worst case and only this mode was presented in the report.

TEST VOLTAGE	Input 230 Vac, 50 Hz	ENVIRONMENTAL CONDITIONS	22.4deg. C, 50.2% RH
TEST MODE	3 ~ 4	TESTED BY	Jacky Liu

Voltage (V)	Test Frequency Note#1 (MHz)	Tested Line	Injection Method.	Performance Criterion	Test Result
3	0.15 – 80	AC line	CDN-M2	CT/CR	Complied

NOTE:
1. For normal operating function: There was no change compared with the initial operation during and after the test.
2. For the BER Measurement: During the test, the measured BER shall not exceed 0.001 during the test sequence.
3. Test mode 3 was the worst case and only this mode was presented in the report.

TEST VOLTAGE	Input 230 Vac, 50 Hz	ENVIRONMENTAL CONDITIONS	22.4deg. C, 50.2% RH
TEST MODE	5 ~ 10	TESTED BY	Jacky Liu

Voltage (V)	Test Frequency Note#1 (MHz)	Tested Line	Injection Method.	Performance Criterion	Test Result
3	0.15 – 80	AC line	CDN-M2	CT/CR	Complied

NOTE:

1. For normal operating function: There was no change compared with the initial operation during and after the test.
2. For the Throughput Measurement: During the test, the measured Throughput shall not found less than 95% of the maximum throughput of the reference measurement channel.
3. Test mode 5 was the worst case and only this mode was presented in the report.

TEST VOLTAGE	Input 230 Vac, 50 Hz	ENVIRONMENTAL CONDITIONS	22.4deg. C, 50.2% RH
TEST MODE	11~16	TESTED BY	Jacky Liu

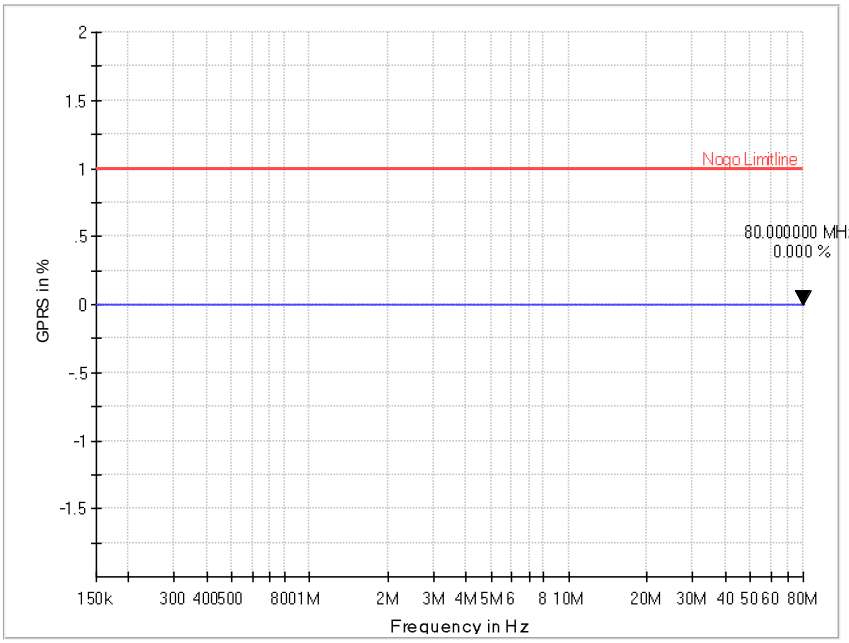
Voltage (V)	Test Frequency Note#1 (MHz)	Tested Line	Injection Method.	Performance Criterion	Test Result
3	0.15 – 80	AC line	CDN-M2	CT/CR	Complied

NOTE: 1. There was no change compared with the initial operation during and after the test.

4.7.7 AUDIO BREAKTHROUGH MEASUREMENT RESULTS

Worst case mode 1

Mobile Phone Parameters:
Network Standard: GPRS 900

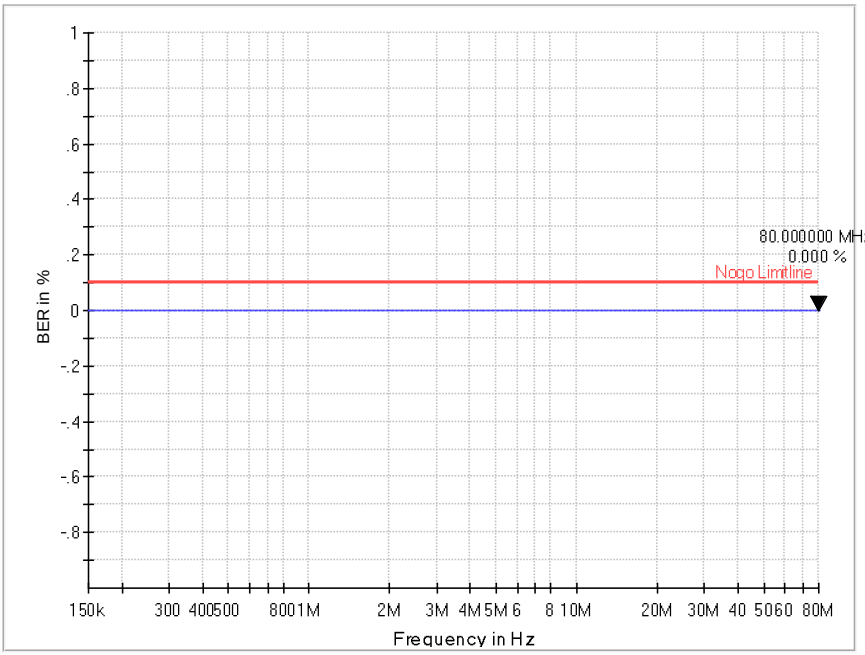


4.7.8 DATA TRANSFER MEASUREMENT RESULTS

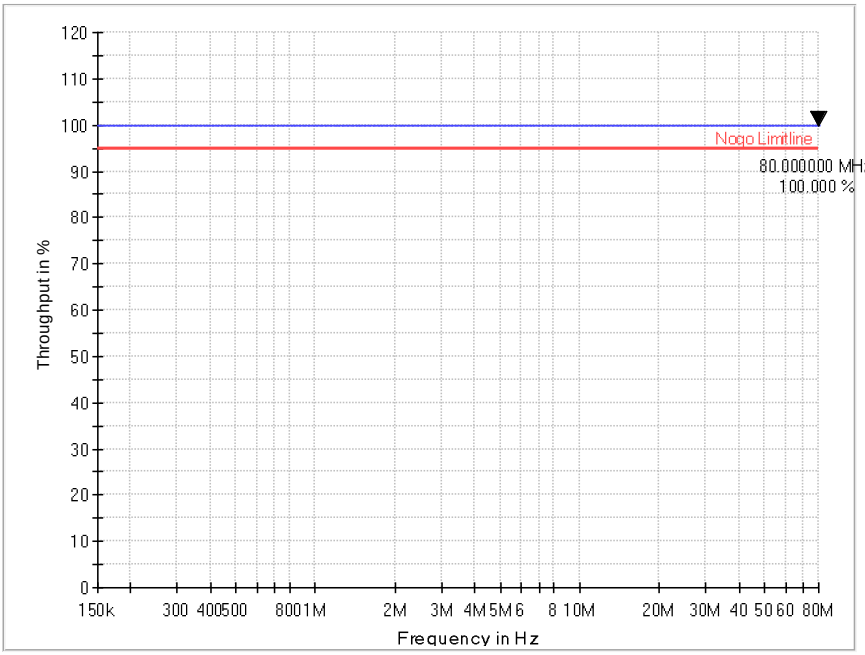
Worst case of the test modes:

For BER

Mode 3



For Throughput
Mode 5



4.8 VOLTAGE DIP/SHORT INTERRUPTIONS/VOLTAGE VARIATIONS (DIP) IMMUNITY TEST

4.8.1 TEST SPECIFICATION

Basic Standard:	EN 61000-4-11
Test Levels:	Voltage Dips: 0% residual voltage for 0.5 cycle 0% residual voltage for 1 cycle 70% residual voltage for 25 cycles Voltage Interruptions: 0% residual voltage for 250 cycles
Special conditions for EN301489-52:	Voltage Dips: 30 % reduction for 10 ms
Interval between Event:	10 seconds
Phase Angle:	0°/180°
Test cycle:	3 times

4.8.2 TEST INSTRUMENT

Refer to section 5.5.2 to get information of above instrument.

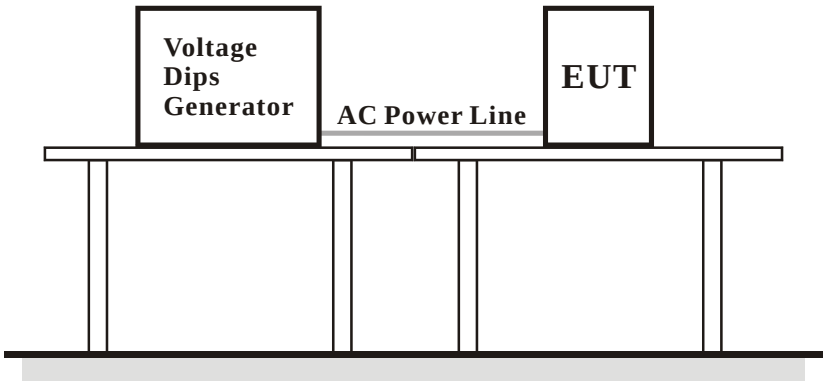
4.8.3 TEST PROCEDURE

The EUT was tested for each selected combination of test levels and duration with a sequence of three dips/interruptions with intervals of 10s minimum (between each test event). Each representative mode of operation shall be tested. Abrupt changes in supply voltage shall occur at zero crossings of the voltage waveform.

4.8.4 DEVIATION FROM TEST STANDARD

No deviation.

4.8.5 TEST SETUP



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

4.8.6 TEST RESULTS

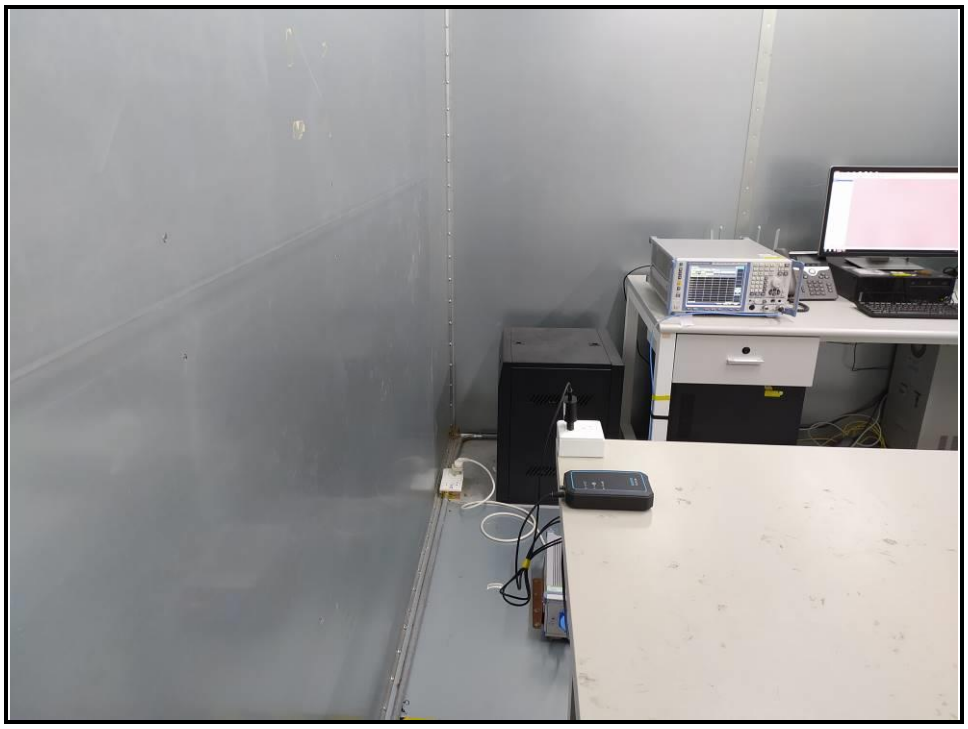
TEST VOLTAGE	Input 230 Vac, 50 Hz	**ENVIRONMENTAL CONDITIONS**	23deg. C, 54% RH
TEST MODE	See section 2.2	**TESTED BY**	Chase Zhou

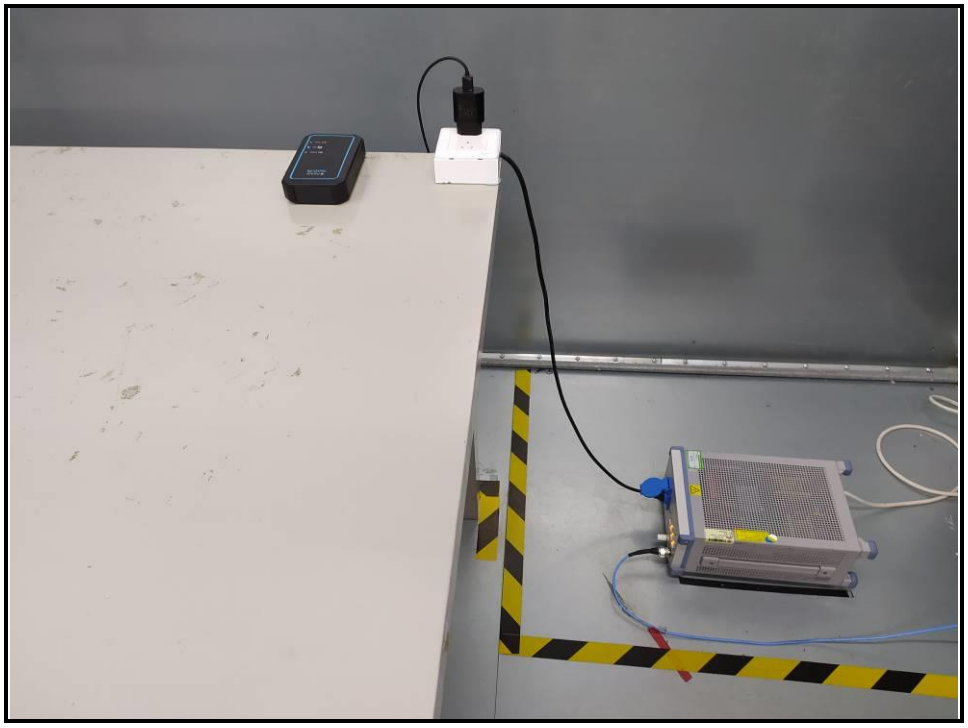
Ut : 230 Vac 50 Hz	Durations		Event interval (sec)	Total events (time)	Performance Criterion	Test result
voltage residual (%)	(period)	(ms)				
0	0.5	10	10	3	TT/TR	Complied
0	1	20	10	3	TT/TR	Complied
70	25	500	10	3	TT/TR	Complied
0	250	5000	10	3	TT/TR	Complied

NOTE: There was no change compared with the initial operation during and after the test.

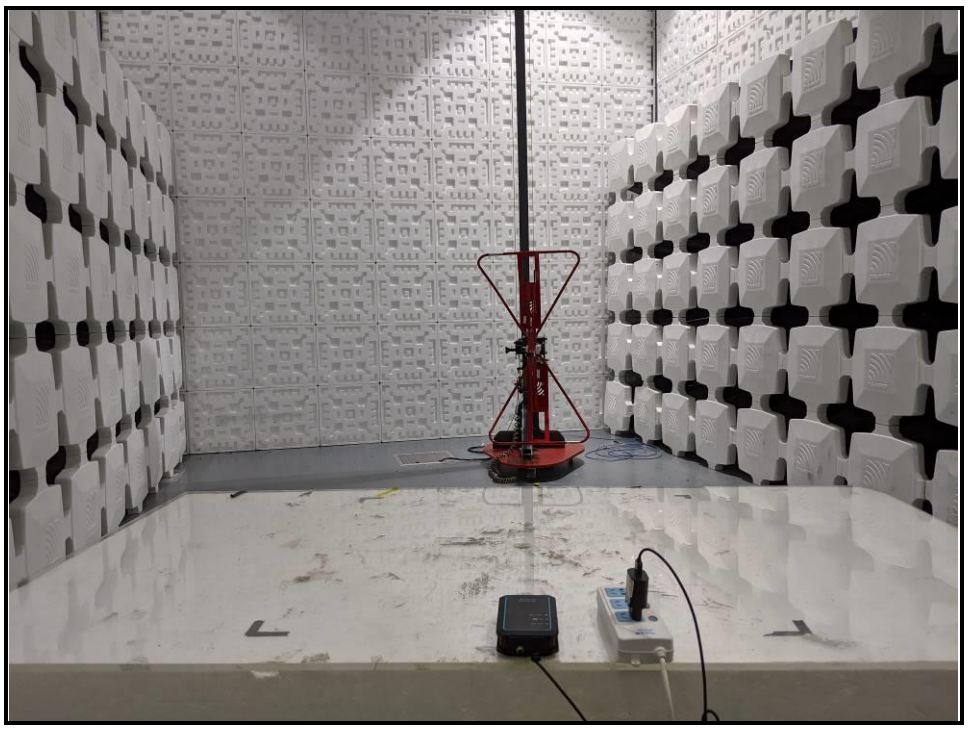
5 PHOTOGRAPHS OF THE TEST CONFIGURATION

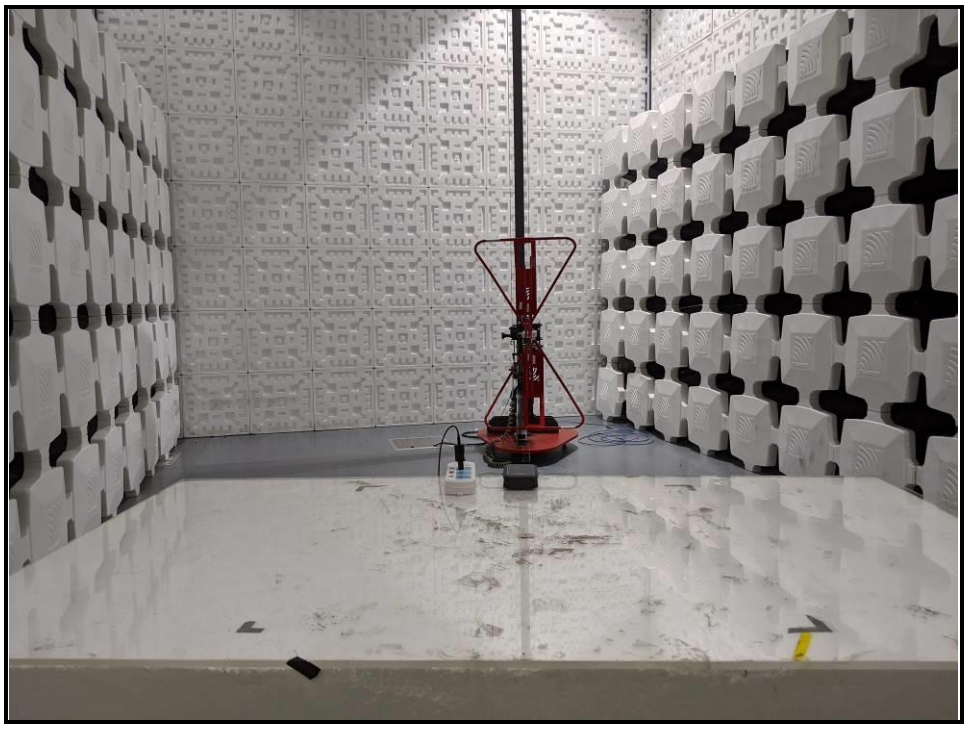
Conducted Emission Test at Mains Port



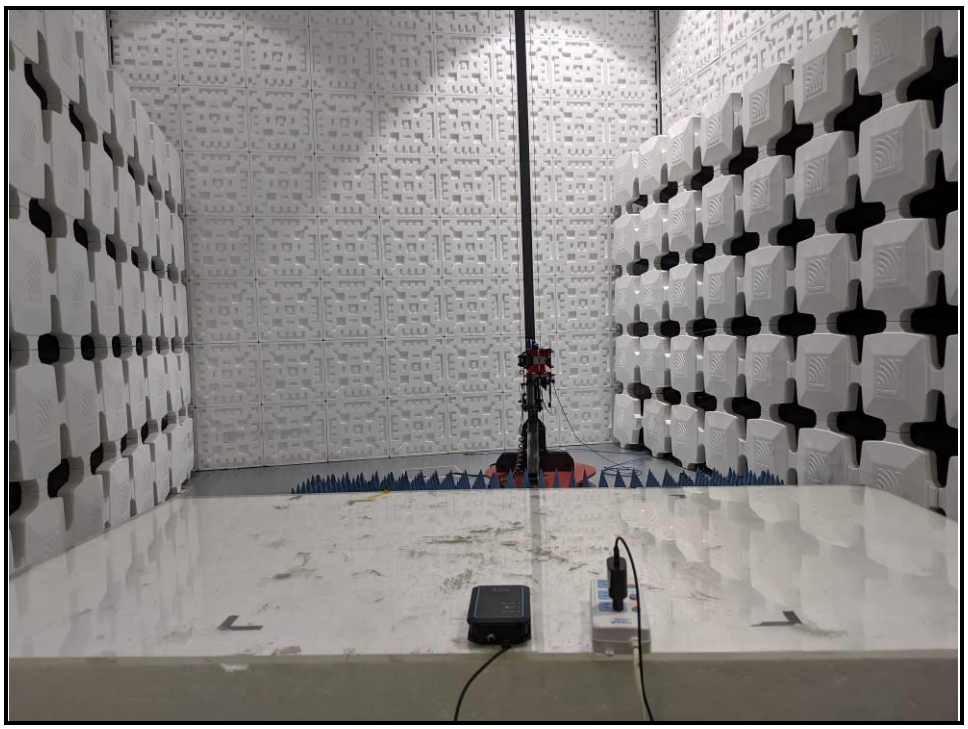


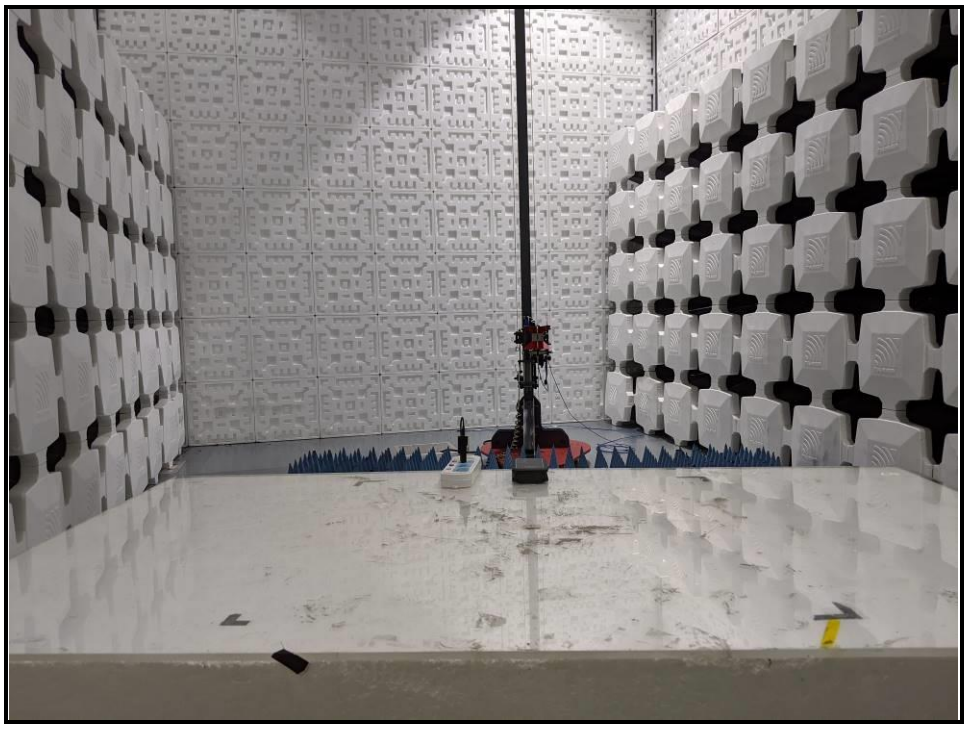
Radiated Emission Test (Frequency range 30MHz ~1GHz)



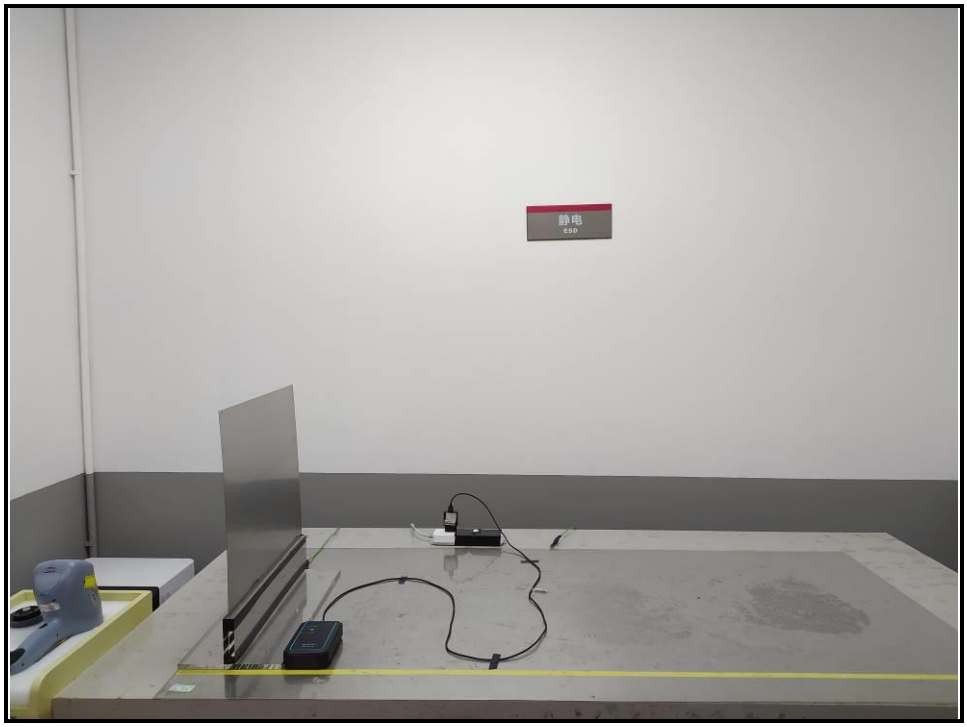


Radiated Emission Test (Frequency range above 1GHz)

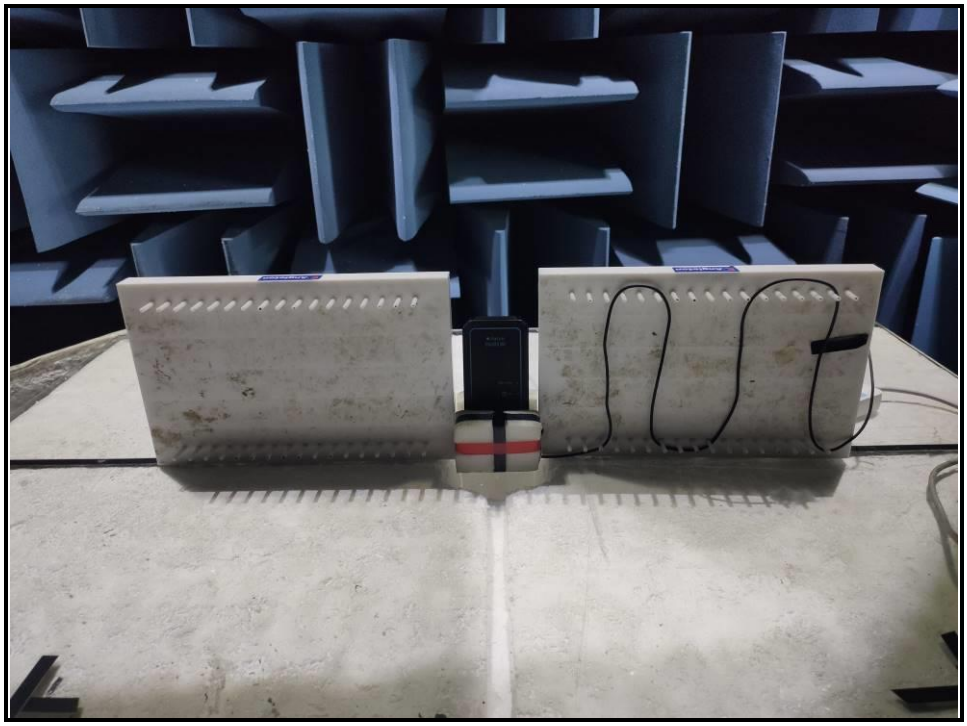




ESD Test

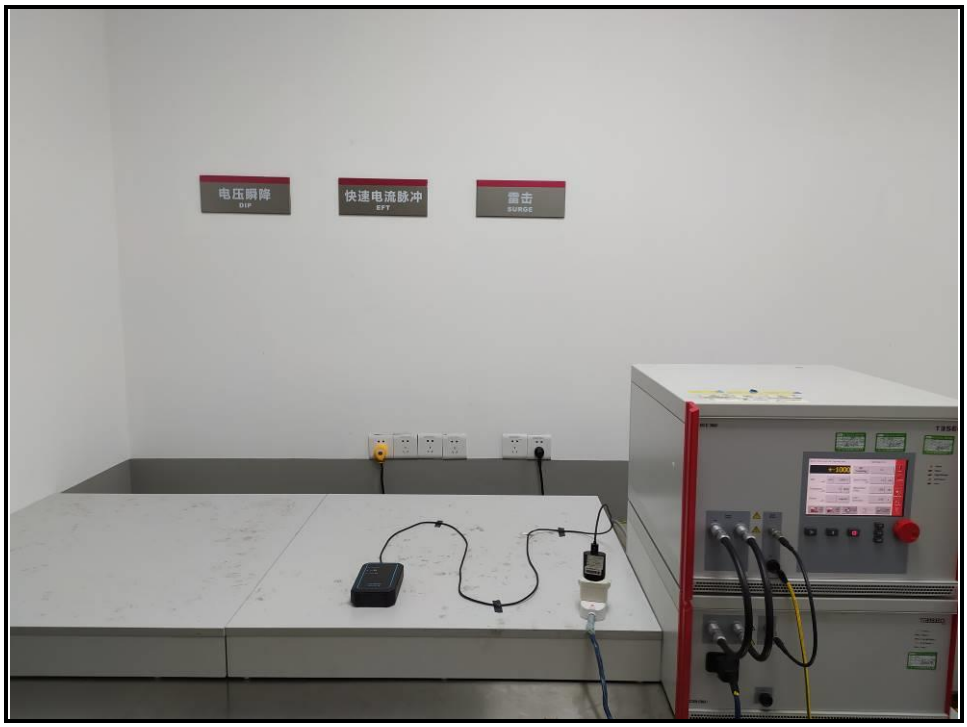


RS Test

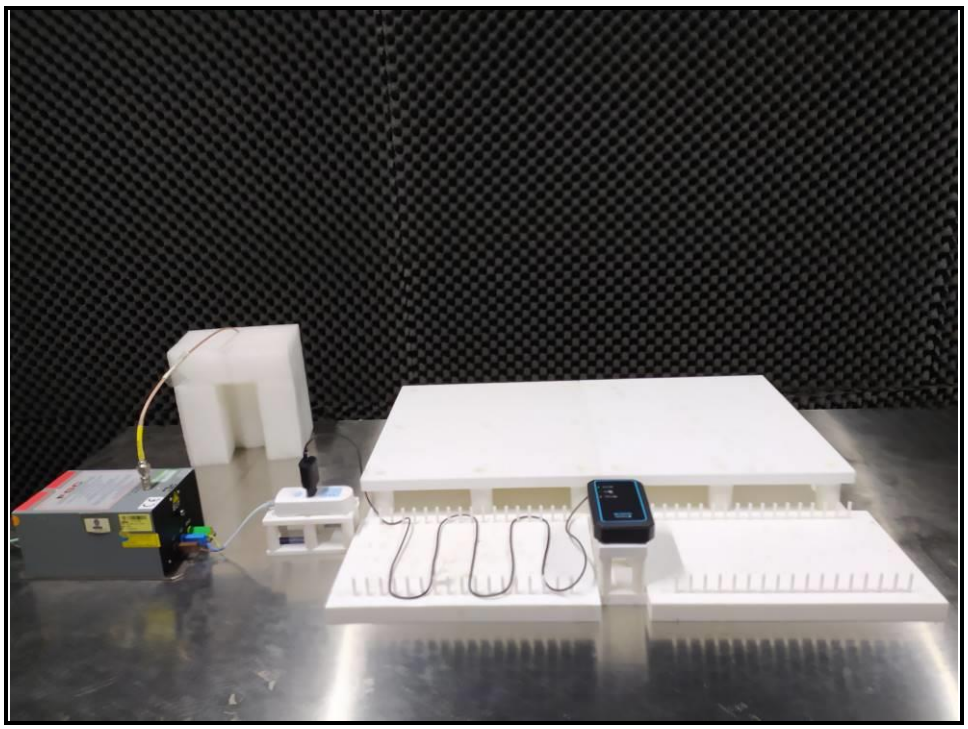


EFT Test

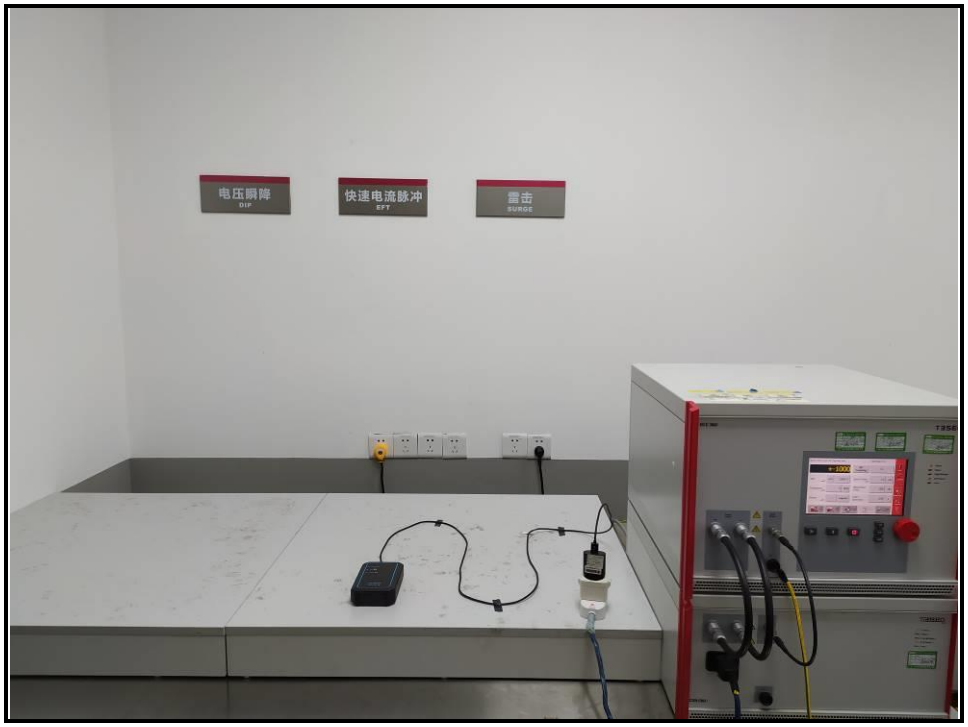
Surge Test



CS Test



Voltage Dip and Interruption Test



6 APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications were made to the EUT by the lab during the test.

---END---