



TEST REPORT

Product Name: NB-IoT module
Trademark:  
Model Number: EC-01F, EC-01, EC-01G
Prepared For: Shenzhen Ai-Thinker Technology Co., Ltd
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Manufacturer: Shenzhen Ai-Thinker Technology Co., Ltd
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Prepared By: Shenzhen CTB Testing Technology Co., Ltd.
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Sample Received Date: Sep. 1, 2021
Sample tested Date: Sep. 1, 2021 to Sep. 10, 2021
Issue Date: Sep. 23, 2021
Report No.: CTB210910043REX
Test Standards: ETSI EN 301 489-1 V2.2.3 (2019-11)
Draft ETSI EN 301 489-52 V1.1.2 (2020-12)
Test Results: PASS
Remark: This is RED EMC test report.

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(NOTE: N/A MEANS NOT APPLICABLE)

1. VERSION

ReportNo.	Issue Date	Description	Approved
CTB210910043REX	Sep. 23, 2021	Original	Valid

2. TEST SUMMARY

The Product has been tested according to the following specifications:

EMISSION		
Standard	Test Item	Test result
EN 55032	Conducted emissions from the AC mains power ports	Pass
EN 55032	Asymmetric mode conducted emissions	N/A ²
EN 55032	Conducted differential voltage emissions	N/A ²
EN 55032	Radiated emissions	Pass
EN 61000-3-2	Harmonic current emission(H)	N/A ³
EN 61000-3-3	Voltage fluctuations & flicker(F)	N/A ³

IMMUNITY		
Standard	Test Item	Test result
IEC 61000-4-2	Electrostatic discharge (ESD)	N/A ⁴
IEC 61000-4-3	Continuous RF electromagnetic field disturbances(RS)	Pass
IEC 61000-4-4	Electrical fast transients/burst (EFT)	N/A ⁴
IEC 61000-4-5	Surges	N/A ⁴
IEC 61000-4-6	Radio frequency, common mode	N/A ¹
IEC 61000-4-11	Voltage dips and interruptions (DIPS)	N/A ⁴

Remark:

1. Applicable to ports listed above and intended to connect to cables longer than 3 m.
2. The Product has no antenna port.
3. The Product is powered by the DC only, the test item is not applicable.
4. The Product belongs to Radio and ancillary equipment for vehicular use, the test item is not applicable.

3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Test item	Value (dB)
Conducted Emission (150KHz-30MHz)	3.2
Radiated Emission(30MHz ~1000MHz)	4.8
Radiated Emission(1GHz ~6GHz)	4.9

4. PRODUCT INFORMATION AND TEST SETUP

4.1 Product Information

Model(s):	EC-01F, EC-01, EC-01G
Model Description:	All the model are the same circuit and RF module, only for model name. Test sample model: EC-01F
Hardware Version:	V1.0
Software Version:	V1.0
Operation Frequency:	FDD-LTE BAND 3: TX:1710-1785MHz, RX: 1805-1880 MHz FDD-LTE BAND 8: TX:880-915 MHz, RX: 925-960MHz
Max. RF output power:	FDD-LTE BAND 3: 23.02dBm FDD-LTE BAND 8: 22.65dBm
Type of Modulation:	BPSK, QPSK
Antenna installation:	SMA antenna
Antenna Gain:	1.0dBi
Ratings:	DC 5.0V powering from PC

4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

4.3 Support Equipment

Item	Equipment	Mfr/Brand	Model/TypeNo.	SeriesNo.	Note

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

4.4 Test Mode

Test Mode	Description	Remark
Mode 1	NB-IOT BAND 3	TR, CR, TT, CT for EMS testing
Mode 2	NB-IOT BAND 5	TR, CR, TT, CT for EMS testing

NOTE: 1 The test modes were carried out for all operation modes. The final test mode of the EUT was the worst test mode for EMI, and its test data was showed.

2 "Link" is the connect horn alarm mode

5. TEST FACILITY AND TEST INSTRUMENT USED

5.1 Test Facility

All measurement facilities used to collect the measurement data are located at Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

5.2 Test Instrument Used

Continuous disturbance					
No.	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	AMN	ROHDE&SCHWARZ	ESH3-Z5	831551852	2021.09.27
2	Pulse limiter	ROHDE&SCHWARZ	ESH3Z2	357881052	2021.09.27
3	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCS30	834115/006	2021.09.27
4	Coaxial cable	ZDECL	Z302S	18091904	2021.09.27
5	AAN	Schwarzbeck	NTFM8158	183	2021.09.27
6	Communication test set	Agilent	E5515C	MY50102567	2021.09.27
7	Communication test set	R&S	CMW500	108058	2021.09.27
8	EZ-EMC	Frad	EMC-con3A1.1	/	/

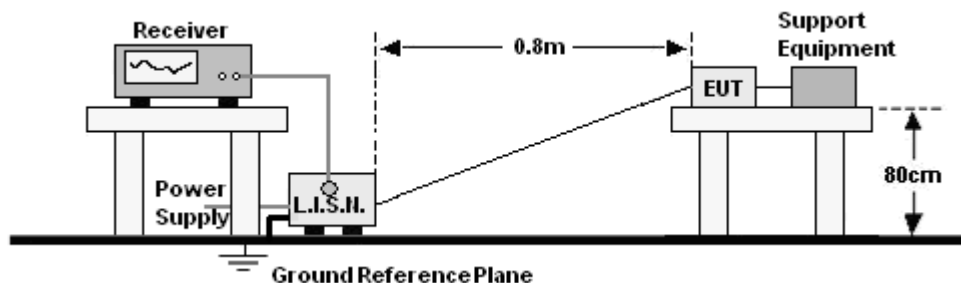
Radiated emission					
No.	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120D	1911	2021.11.01
2	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	869	2021.11.01
3	Amplifier	Agilent	8449B	3008A01838	2021.09.27
4	Amplifier	HP	8447E	2945A02747	2021.09.27
5	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESPI7	100362	2021.09.27
6	Coaxial cable	ETS	RFC-SNS-100-NMS-80 NI	/	2021.09.27
7	Coaxial cable	ETS	RFC-SNS-100-NMS-20 NI	/	2021.09.27
8	Coaxial cable	ETS	RFC-SNS-100-SMS-20 NI	/	2021.09.27
9	Coaxial cable	ETS	RFC-NNS-100-NMS-300 NI	/	2021.09.27
10	Communication test set	Agilent	E5515C	MY50102567	2021.09.27
11	Communication test set	R&S	CMW500	108058	2021.09.27
12	EZ-EMC	Frad	EMC-con3A1.1	/	/

Electrostatic discharges					
No.	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	ESD Simulator	TESTQ	NSG437	329	2021.09.27
2	Communication test set	Agilent	E5515C	MY50102567	2021.09.27
3	Communication test set	R&S	CMW500	108058	2021.09.27

Radio frequency electromagnetic field					
No.	Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Signal Generator	Agilent	N5181A	2106070101	2021.09.27
2	Stacked Double Log.-Per. Antenna	SKET	STLP 9129 Plus	2106070106	2021.09.27
3	Switch Controller	SKET	RFSU-DC18G-4C	2106070105	2021.09.27
4	RF Power Meter	Agilent	U2001	2106070102	2021.09.27
5	E-Field Probe	Narda	EP-601	2106070107	2021.09.27
6	Power Amplifier	SKET	HAP-80M01G-250W	2106070103	2021.09.27
7	Power Amplifier	SKET	HAP-01G 06G-75W	2106070104	2021.09.27
8	Audio Analysis	R&S	UPV	2106070116	2021.09.27
9	Audio Output Matching Network	SKET	RCO Network	2106070117	2021.09.27
10	Communication test set	Agilent	E5515C	MY50102567	2021.09.27
11	Communication test set	R&S	CMW500	108058	2021.09.27
12	Test Software	SKET	/	/	/

6. CONDUCTED EMISSIONS

6.1 Block Diagram Of Test Setup



6.2 Limit

Limits for Conducted emissions at the mains ports of Class B MME

Frequency range (MHz)	Limits dB(μV)	
	Quasi-peak	Average
0,15 to 0,50	66 to 56*	56 to 46*
0,50 to 5	56	46
5 to 30	60	50

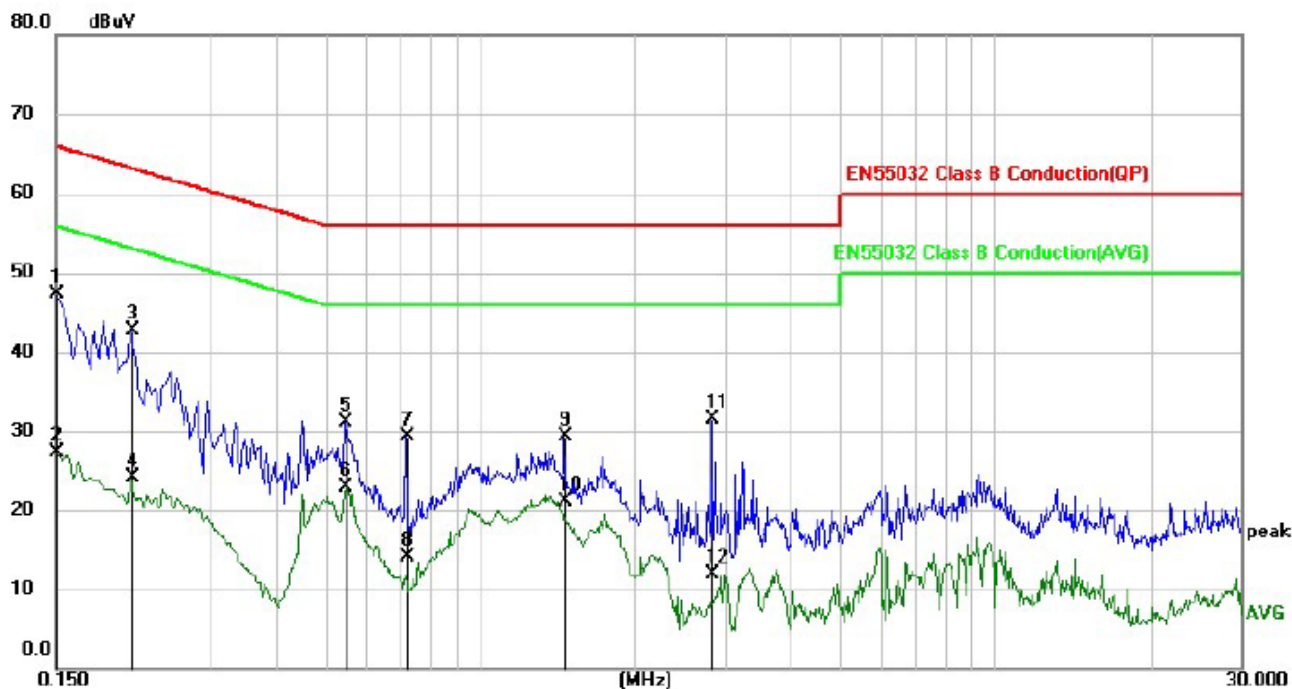
Notes: 1. *Decreasing linearly with logarithm of frequency.
2. The lower limit shall apply at the transition frequencies.

6.3 Test procedure

- The Product was placed on a nonconductive table 0.8m above the horizontal ground reference plane, and 0.4 m from the vertical ground reference plane, and connected to the main through Line Impedance Stability Network (L.I.S.N).
- The RBW of the receiver was set at 9 kHz in 150 kHz ~30MHz with Peak and AVG detector in Max Hold mode. Run the receiver's pre-scan to record the maximum disturbance generated from Product in all power lines in the full band.
- For each frequency whose maximum record was higher or close to limit, measure its QP and AVG values and record.

6.4 Test Result

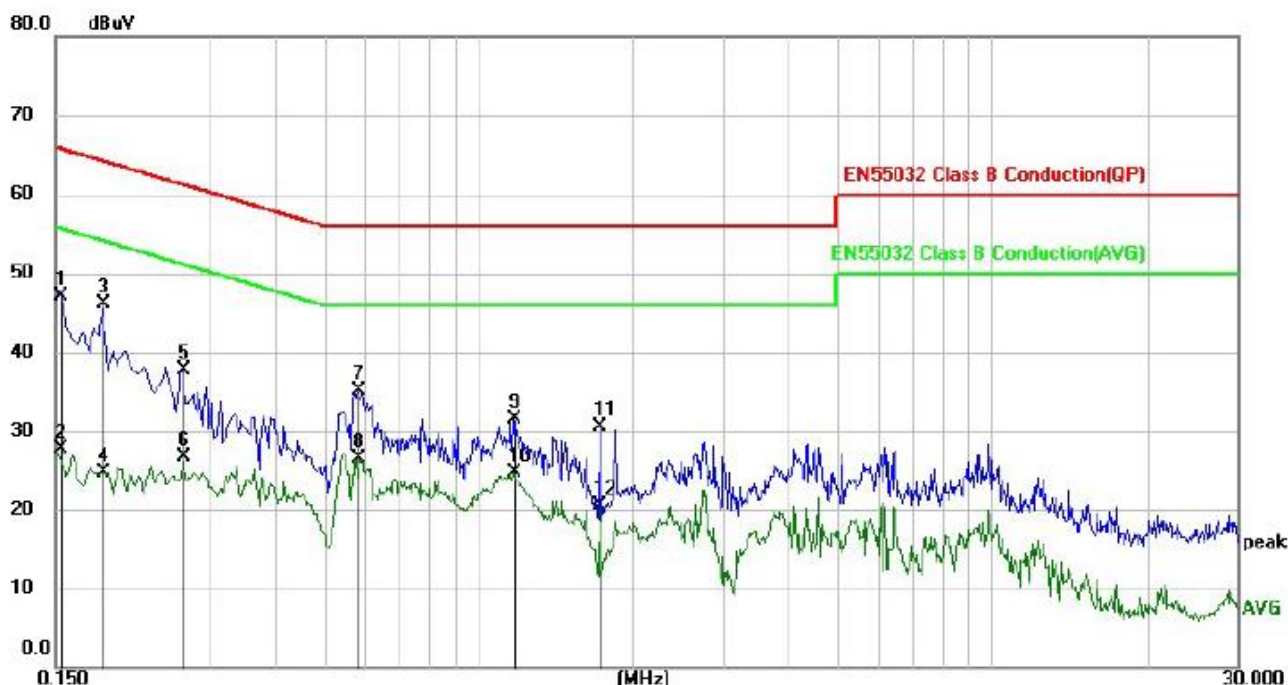
Temperature:	25.6℃	Relative Humidity:	57.8%
Pressure:	101.6kPa	Phase :	L
Test Mode	1(the worst data)	Remark:	N/A



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Margin dB	Detector
1	*	0.1500	37.31	9.96	47.27	66.00	-18.73	QP
2		0.1500	17.26	9.96	27.22	56.00	-28.78	AVG
3		0.2100	32.79	9.96	42.75	63.21	-20.46	QP
4		0.2100	14.09	9.96	24.05	53.21	-29.16	AVG
5		0.5460	21.16	9.96	31.12	56.00	-24.88	QP
6		0.5460	12.87	9.96	22.83	46.00	-23.17	AVG
7		0.7180	19.36	9.96	29.32	56.00	-26.68	QP
8		0.7180	4.14	9.96	14.10	46.00	-31.90	AVG
9		1.4620	19.27	9.98	29.25	56.00	-26.75	QP
10		1.4620	11.03	9.98	21.01	46.00	-24.99	AVG
11		2.8140	21.46	10.06	31.52	56.00	-24.48	QP
12		2.8140	1.79	10.06	11.85	46.00	-34.15	AVG

Remark: Result=Reading +Factor
Over Limit=Result -Limit

Temperature:	25.6 °C	Relative Humidity:	57.8%
Pressure:	101.6kPa	Phase :	N
Test Mode	1(the worst data)	Remark:	N/A



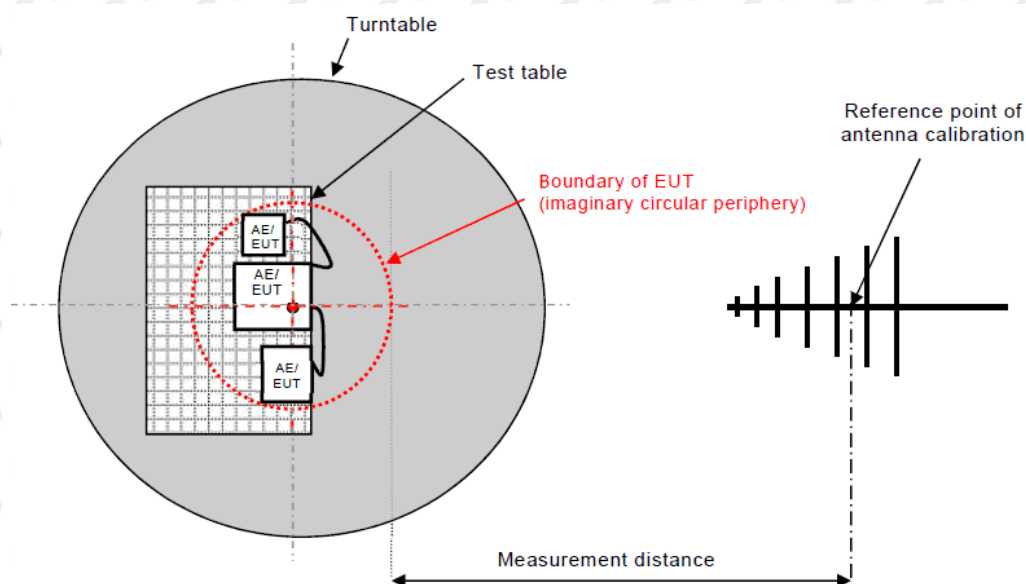
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Margin dB	Detector
1		0.1532	37.21	9.96	47.17	65.82	-18.65	QP
2		0.1532	17.82	9.96	27.78	55.82	-28.04	AVG
3	*	0.1860	36.07	9.96	46.03	64.21	-18.18	QP
4		0.1860	14.81	9.96	24.77	54.21	-29.44	AVG
5		0.2660	27.77	9.96	37.73	61.24	-23.51	QP
6		0.2660	16.71	9.96	26.67	51.24	-24.57	AVG
7		0.5820	25.19	9.96	35.15	56.00	-20.85	QP
8		0.5820	16.59	9.96	26.55	46.00	-19.45	AVG
9		1.1700	21.61	9.97	31.58	56.00	-24.42	QP
10		1.1700	14.80	9.97	24.77	46.00	-21.23	AVG
11		1.7180	20.50	10.00	30.50	56.00	-25.50	QP
12		1.7180	10.58	10.00	20.58	46.00	-25.42	AVG

Remark: Result=Reading +Factor
Over Limit=Result -Limit

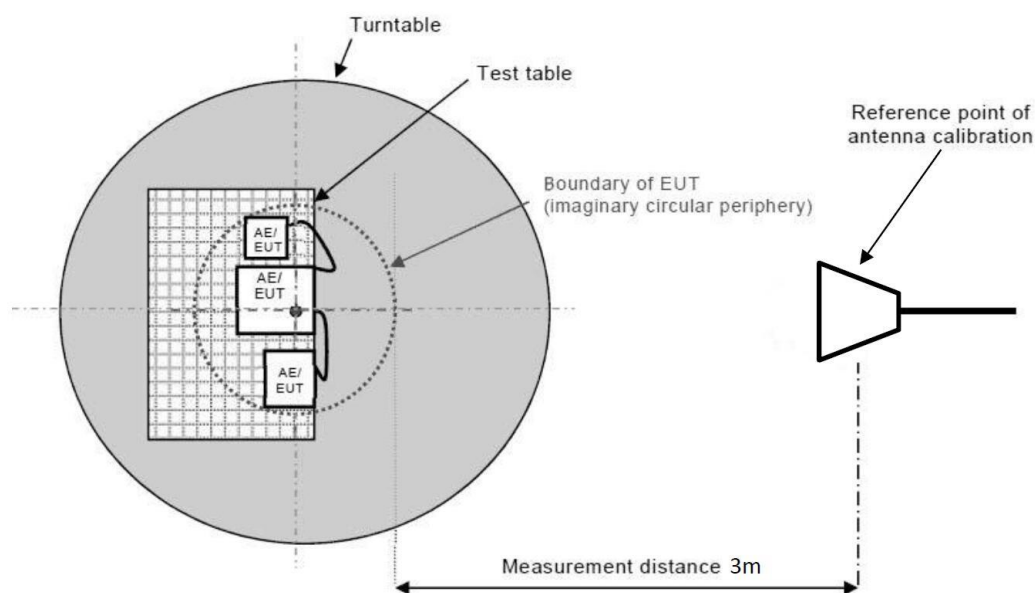
7. RADIATEDEMISSIONS TEST

7.1 Block Diagram Of Test Setup

30MHz ~ 1GHz:



Above 1GHz:



7.2 Limits

Limits for radiated disturbance of Class B MME

Frequency (MHz)	Quasi-peak limits at 3m dB(μ V/m)
30-230	40
230-1000	47

Frequency (GHz)	limit above 1G at 3m dB(μ V/m)	
	Average	peak
1-3	50	70
3-6	54	74

Note: The lower limit shall apply at the transition frequencies.

7.3 Test Procedure

30MHz ~ 1GHz:

- The Product was placed on the nonconductive turntable 0.8m above the ground in a semi anechoic chamber.
- Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 120 kHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied between 1~4 m in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.
- For each frequency whose maximum record was higher or close to limit, measure its QP value: vary the antenna's height and rotate the turntable from 0 to 360 degrees to find the height and degree where Product radiated the maximum emission, then set the test frequency analyzer/receiver to QP Detector and specified bandwidth with Maximum Hold Mode, and record the maximum value.

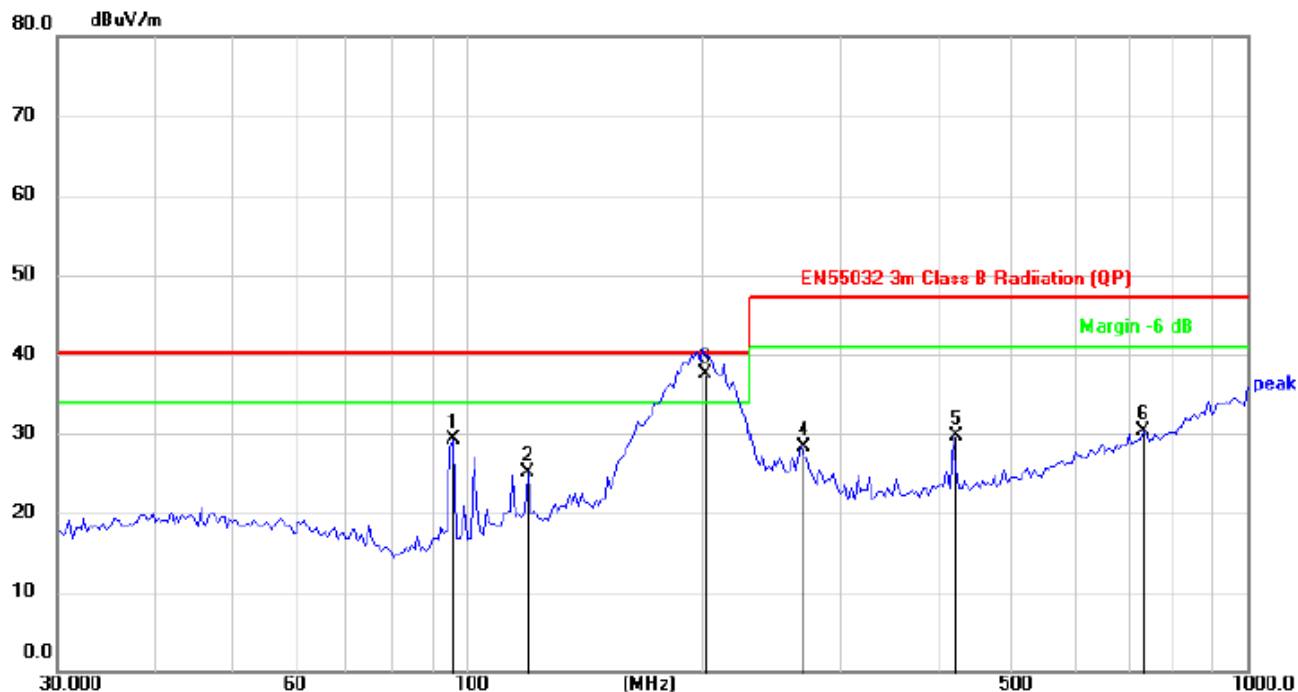
Above 1GHz:

- The Product was placed on the non-conductive turntable 0.8m above the ground in a full anechoic chamber..
- Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 1MHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.
- For each frequency whose maximum record was higher or close to limit, measure its AV value: rotate the turntable from 0 to 360 degrees to find the degree where Product radiated the maximum emission, then set the test frequency analyzer/receiver to AV value and specified bandwidth with Maximum Hold Mode, and record the maximum value.

7.4 Test Results

Below 1GHz

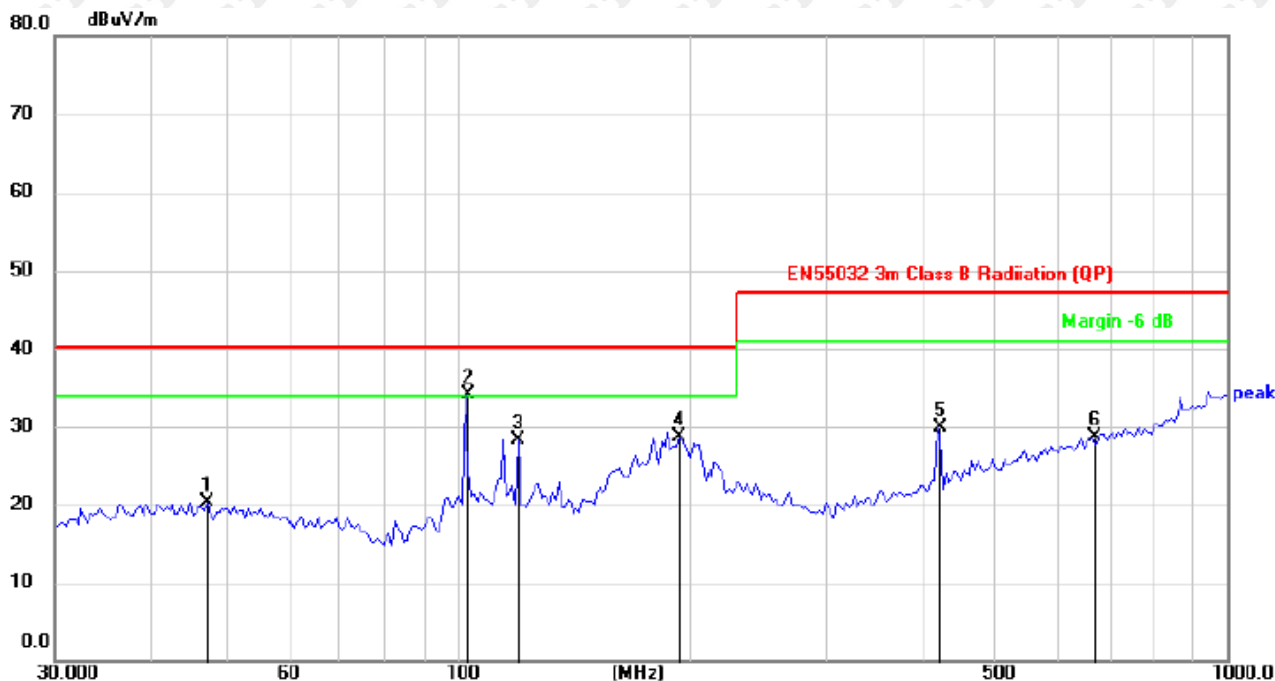
Temperature:	25.6 °C	Relative Humidity:	57.8%
Pressure:	101.6kPa	Polarization :	Horizontal
Test Mode	1(the worst data)	Remark:	N/A



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		96.2672	40.04	-10.69	29.35	40.00	-10.65	QP
2		119.8556	33.62	-8.60	25.02	40.00	-14.98	QP
3	*	201.8852	47.65	-10.20	37.45	40.00	-2.55	QP
4		268.4853	35.82	-7.59	28.23	47.00	-18.77	QP
5		419.8436	33.95	-4.19	29.76	47.00	-17.24	QP
6		735.7802	27.09	3.23	30.32	47.00	-16.68	QP

Remark: Result=Reading +Factor
Over Limit=Result -Limit

Temperature:	25.6 °C	Relative Humidity:	57.8%
Pressure:	101.6kPa	Polarization :	Vertical
Test Mode	1(the worst data)	Remark:	N/A



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		47.3255	27.20	-6.99	20.21	40.00	-19.79	QP
2	*	102.3597	44.35	-10.15	34.20	40.00	-5.80	QP
3		119.8556	36.99	-8.60	28.39	40.00	-11.61	QP
4		194.1128	38.66	-9.93	28.73	40.00	-11.27	QP
5		419.8436	34.10	-4.19	29.91	47.00	-17.09	QP
6		668.1423	26.49	2.16	28.65	47.00	-18.35	QP

Remark: Result=Reading +Factor
Over Limit=Result -Limit

Above 1GHz

Temperature:	25.6 °C	Relative Humidity:	57.8%
Pressure:	101.6kPa	Polarization :	Horizontal
Test Mode	1(the worst data)	Remark:	N/A

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	1968.09	45.92	1.51	47.42	70.00	-22.58	peak
2	1969.74	27.62	1.51	29.12	50.00	-20.88	AVG
3	3772.85	43.14	5.75	48.89	74.00	-25.11	peak
4	3777.31	25.15	5.75	30.90	54.00	-23.10	AVG
5	4839.57	42.28	9.56	51.84	74.00	-22.16	peak
6	4839.72	25.42	9.56	34.98	54.00	-19.02	AVG

Remark: Result=Reading +Factor
Over Limit=Result -Limit

Temperature:	25.6 °C	Relative Humidity:	57.8%
Pressure:	101.6kPa	Polarization :	Vertical
Test Mode	1(the worst data)	Remark:	N/A

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	1993.51	46.82	1.51	48.33	70.00	-21.67	peak
2	1995.56	28.30	1.51	29.81	50.00	-20.19	AVG
3	3810.02	46.58	5.86	52.43	74.00	-21.57	peak
4	3808.06	27.95	5.86	33.81	54.00	-20.19	AVG
5	4773.48	44.05	9.30	53.35	74.00	-20.65	peak
6	4774.54	27.79	9.30	37.09	54.00	-16.91	AVG

Remark: Result=Reading +Factor
Over Limit=Result -Limit

8. IMMUNITY TEST OF GENERAL THE PERFORMANCE CRITERIA

Product Standard	ETSI EN 301 489-1
<p>The performance criteria are used to take a decision on whether a radio equipment passes or fails immunity tests.</p> <p>For the purpose of the present document two categories of performance criteria apply:</p> <ul style="list-style-type: none">•Performance criteria for continuous phenomena.•Performance criteria for transient phenomena. <p>NOTE: Normally, the performance criteria depends upon the type of radio equipment and/or its intended application. Thus, the present document only contains general performance criteria commonly used for the assessment of radio equipment.</p>	
Performance criteria for continuous phenomena	<p>During the test, the equipment shall:</p> <ul style="list-style-type: none">•continue to operate as intended;•not unintentionally transmit;•not unintentionally change its operating state;•not unintentionally change critical stored data.
Performance criteria for transient phenomena	<p>For all ports and transient phenomena with the exception described below, the following applies:</p> <ul style="list-style-type: none">•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. <p>For surges applied to symmetrically operated wired network ports intended to be connected directly to outdoor lines the following criteria applies:</p> <ul style="list-style-type: none">•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.

According To EN 301489 -52standard, The General Performance Criteria As Following:

GSM and DCS Performance Criteria

General

The equipment shall meet the performance criteria specified in this clause and clauses 6.1.1 to 6.1.4, as appropriate.

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

Portable or mobile equipment powered by the AC mains shall additionally fulfil the applicable requirements of ETSI EN 301 489-1 [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.

Performance criteria for Continuous phenomena applied to Transmitters (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 (audio breakthrough check).

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.

Performance criteria for Transient phenomena applied to Transmitters (TT)

A communications link shall be established at the start of the test, see appropriate 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.

Performance criteria for Continuous phenomena applied to Receivers (CR)

A communications link shall be established at the start of the test, see appropriate 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 (audio breakthrough check).

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.

Performance criteria for Transient phenomena applied to Receivers (TR)

A communications link shall be established at the start of the test, see appropriate 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.

Performance criteria for ancillary equipment tested on a stand alone basis

The provision of ETSI EN 301 489-1 [1], clause 6.4 shall apply.

CDMA Direct Spread (UTRA and E-UTRA) Performance Criteria

General

The equipment shall meet the performance criteria specified in this clause and clauses 6.2.2 and 6.2.3 as appropriate.

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.

Performance criteria for continuous phenomena

General

A communication link shall be established at the start of the test, and maintained during the test, clauses 4.1 and 4.2.

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 ETSI TS 134 109 [4]) is used, it shall not exceed 0,001 during the test sequence;
- if the BLER (as referred in ETSI TS 134 109 [4]) is used, it shall not exceed 0,01 during the test sequence.

The BLER calculation shall be based on evaluating the CRC on each transport block.

E-UTRA

In the data transfer mode, the performance criteria shall be that the throughput shall be $\geq 95\%$ of the

maximum throughput of the reference measurement channel as specified in annex C in ETSI TS 136 101 [9] with parameters specified in tables 7.3.1-1 and 7.3.1-2 in ETSI TS 136 101 [9] during the test sequence.

Performance criteria for Transient phenomena

A communications link shall be established at the start of the test, clauses 4.1 and 4.2.

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.

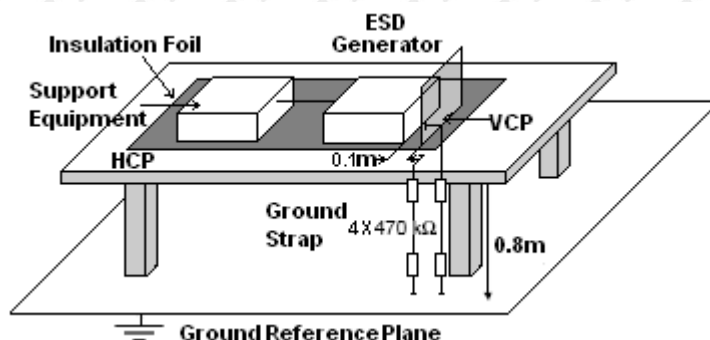
In addition to confirming the above performance in traffic mode, the test shall also be performed in idle mode, and the transmitter shall not unintentionally operate.

9. ELECTROSTATIC DISCHARGE (ESD)

9.1 Test Specification

Test Port	: Enclosure port
Discharge Impedance	: 330 ohm / 150 pF
Discharge Mode	: Single Discharge
Discharge Period	: one second between each discharge

9.2 Block Diagram of Test Setup



9.3 Test Procedure

- Electrostatic discharges were applied only to those points and surfaces of the Product that are accessible to users during normal operation.
- The test was performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.
- The time interval between two successive single discharges was at least 1 second.
- 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 Product.
- Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.
- Air discharges were applied with the round discharge tip of the discharge electrode approaching the Product as fast as possible (without causing mechanical damage) to touch the Product. After each discharge, the ESD generator was removed from the Product and re-triggered for a new single discharge. The test was repeated until all discharges were complete.
- At least ten single discharges (in the most sensitive polarity) were applied to the Horizontal Coupling Plane at points on each side of the Product. The ESD generator was positioned vertically at a distance of 0.1 meters from the Product 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 Product were completely illuminated. The VCP (dimensions 0.5m x 0.5m) was placed vertically to and 0.1 meters from the Product.

9.4 Test Results

Temperature :	25 °C	Relative Humidity :	45%
Pressure :	101.6kPa	Test Mode :	Mode1, Mode 2

Discharge Method	Discharge Position	Voltage (±kV)	Min. No. of Discharge per polarity (Each Point)	Performance Criterion
Contact Discharge	Conductive Surfaces	4	10	A
	Indirect Discharge HCP	4	10	A
	Indirect Discharge VCP	4	10	A
Air Discharge	Slots, Apertures, and Insulating Surfaces	8	10	A

Note: A: No performance degradation during test.

B: During the test, the EUT shut down, after the test, it reset by itself.

C: During the test, the EUT shut down, after the test, it reset by user.

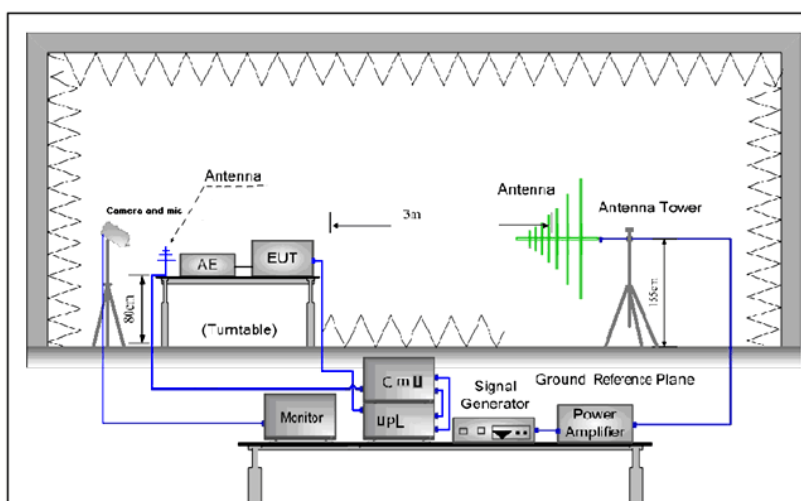
10. CONTINUOUS RF ELECTROMAGNETIC FIELD DISTURBANCES(RS)

10.1 Test Specification

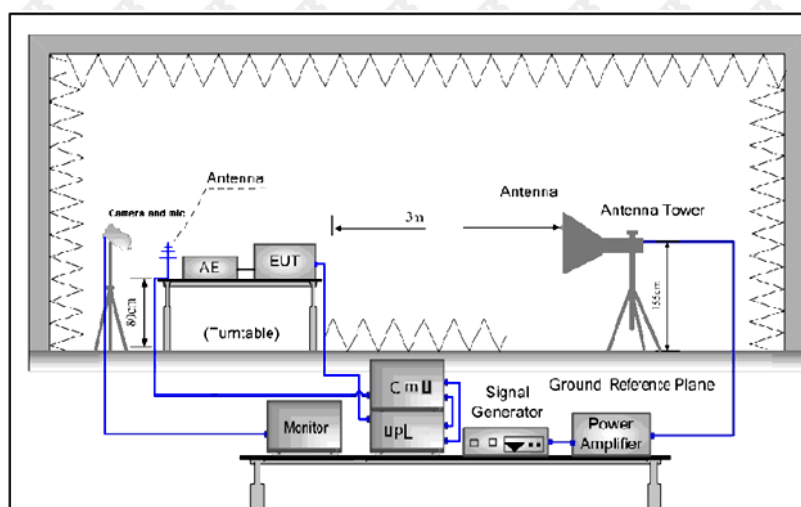
Test Port	: Enclosure port
Step Size	: 1%
Modulation	: 1kHz, 80% AM
Dwell Time	: 1 second
Polarization	: Horizontal & Vertical

10.2 Block Diagram of Test Setup

Below 1GHz:



Above 1GHz:



10.3 TestProcedure

- The testing was performed in a fully-anechoic chamber. The transmit antenna was located at a distance of 3 meters from the Product.
- The frequency range is swept from 80MHz to 6000MHz, with the signal 80% amplitude modulated with a 1 kHz sine wave, and the step size was 1%.
- The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised and to be able to respond, but should not exceed 5 s at each of the frequencies during the scan.
- The test was performed with the Product exposed to both vertically and horizontally polarized fields on each of the four sides.
- For Broadcast reception function: Group 2 not apply in this test.

10.4 Test Results

Temperature :	25℃	Relative Humidity :	55%
Pressure :	101.6kPa	Test Mode :	Mode1, Mode 2

Frequency	Position	Field Strength (V/m)	Performance Criterion
80 - 6000MHz	Front, Right, Back, Left	3	A
Note: A: No performance degradation during test.			

Type	Antenna Polar.	Observation item	Test Result	Limit	Result
LTE Band 3	VERT/HOTRI	Throughput	100	>95	Pass
LTE Band 8	VERT/HOTRI	Throughput	100	>95	Pass

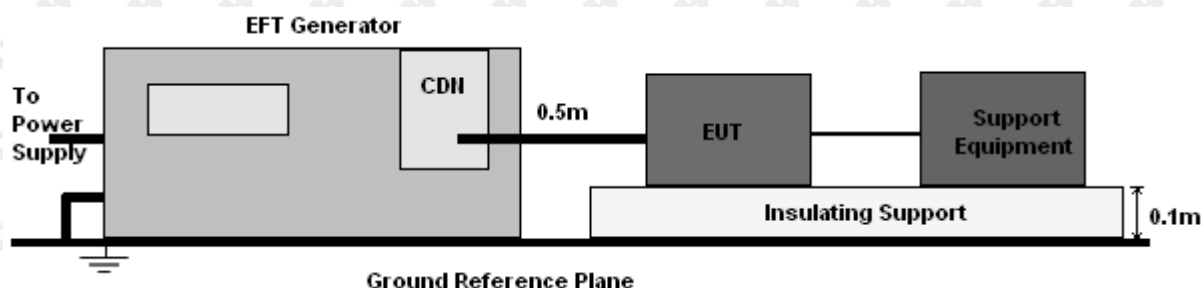
11. ELECTRICAL FAST TRANSIENTS/BURST (EFT)

11.1 Test Specification

Test Port	: input a.c. power port
Impulse Frequency	: 5 kHz
Impulse Wave-shape	: 5/50 ns
Burst Duration	: 15 ms
Burst Period	: 300 ms
Test Duration	: 2 minutes per polarity

11.2 Block Diagram of EUT Test Setup

For input a.c.power port:



11.3 Test Procedure

- The Product and support units were located on a non-conductive table above ground reference plane.
- A 0.5m-long power cord was attached to Product during the test.

11.4 Test Results

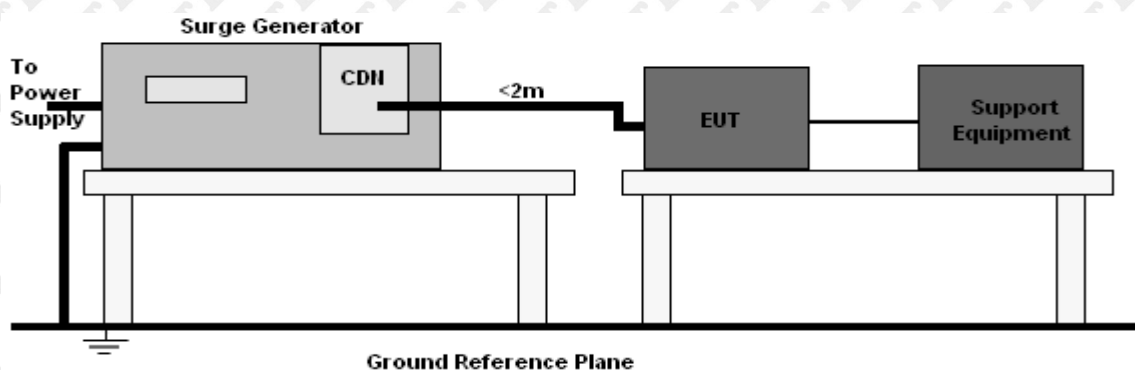
N/A

12. SURGES IMMUNITY TEST

12.1 Test Specification

Test Port	: input a.c. power port
Wave-Shape	: Open Circuit Voltage - 1.2 / 50 us Short Circuit Current - 8 / 20 us
Pulse Repetition Rate	: 1 pulse / min.
Phase Angle	: 0° / 90° / 180° / 270°
Test Events	: 5 pulses (positive & negative) for each polarity

12.2 Block Diagram of EUT Test Setup



12.3 Test Procedure

- The surge is to be applied to the Product 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 Product and the coupling/decoupling networks shall be 2 meters in length (or shorter). Interconnection line between the Product and the coupling/decoupling networks shall be 2 meters in length (or shorter).

12.4 Test Result

N/A

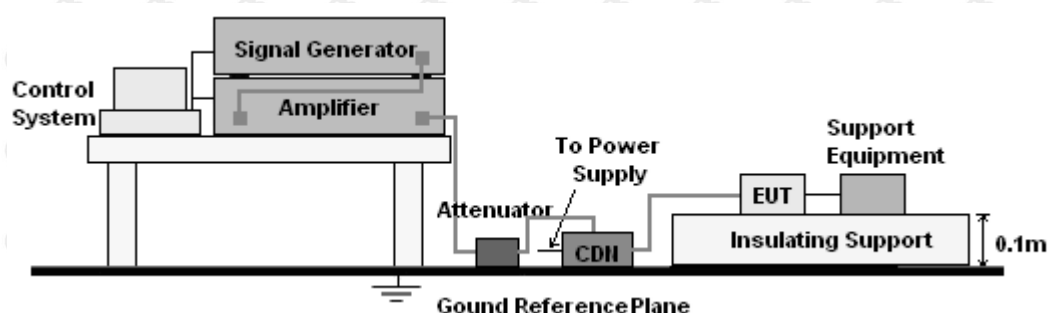
13. CONTINUOUS INDUCED RF DISTURBANCES (CS)

13.1 Test Specification

Test Port	: input a.c.power port
Step Size	: 1%
Modulation	: 1kHz, 80% AM
Dwell Time	: 1 second

13.2 Block Diagram of EUT Test Setup

For input a.c. power port:



13.3 Test Procedure

For input a.c.power port:

- The Product and support units were located at a ground reference plane with the interposition of a 0.1 m thickness insulating support and the CDN was located on GRP directly.
- The frequency range is swept from 150 kHz to 10MHz, 10MHz to 30MHz, 30MHz to 80MHz with the signal 80% amplitude modulated with a 1 kHz sine wave, and the step size was 1% of fundamental.
- The dwell time at each frequency shall be not less than the time necessary for the Product to be able to respond.

13.4 Test Result

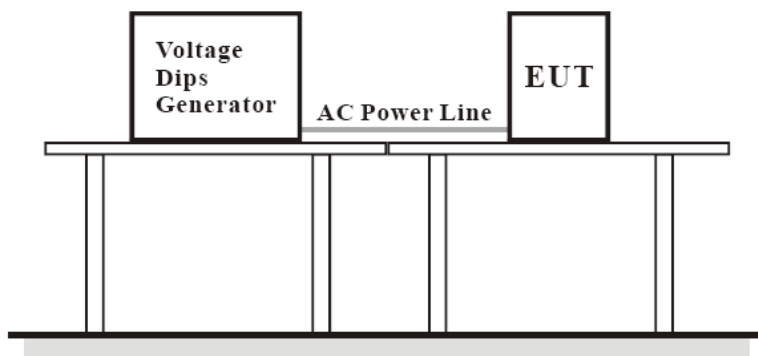
N/A

14. VOLTAGE DIPS AND INTERRUPTIONS (DIPS)

14.1 Test Specification

Test Port	: input a.c. power port
Phase Angle	: 0°, 180°
Test cycle	: 3 times

14.2 Block Diagram of EUT Test Setup



14.3 Test Procedure

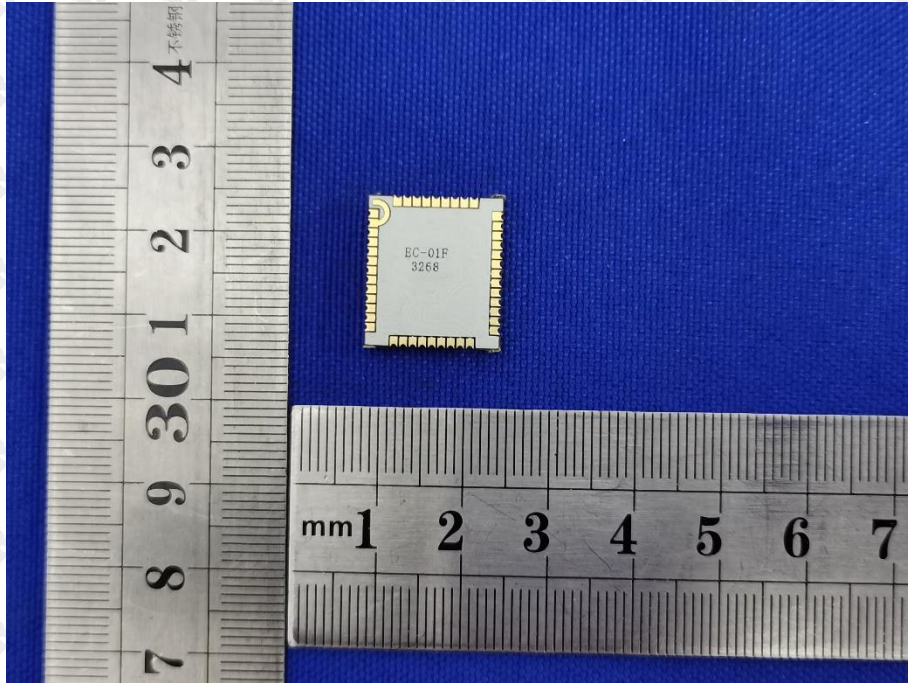
- The Product and support units were located on a non-conductive table above ground floor.
- Set the parameter of tests and then perform the test software of test simulator.
- Conditions changes to occur at 0 degree crossover point of the voltage waveform.

14.4 Test Result

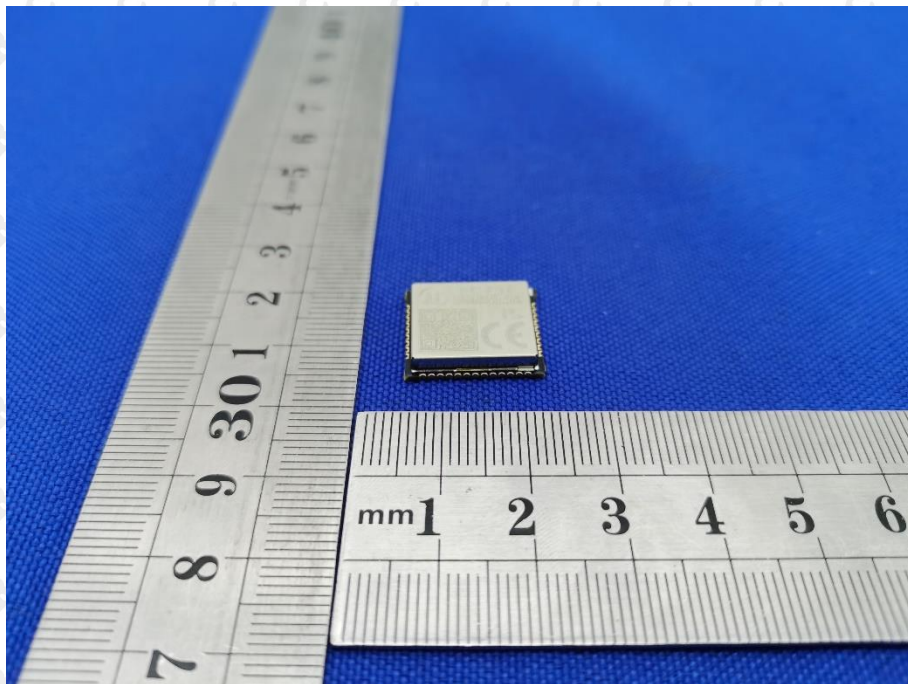
N/A

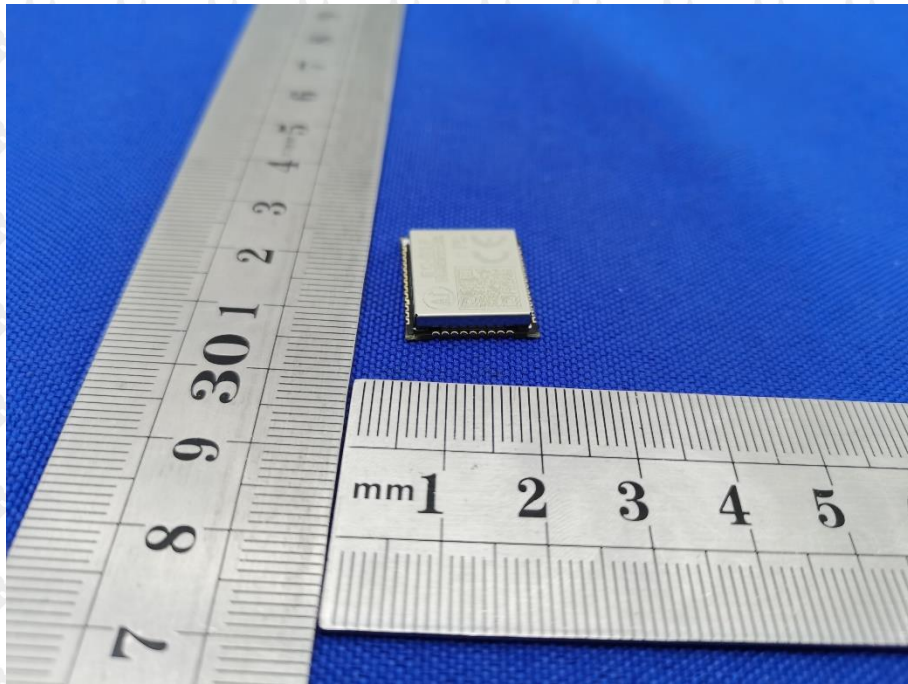
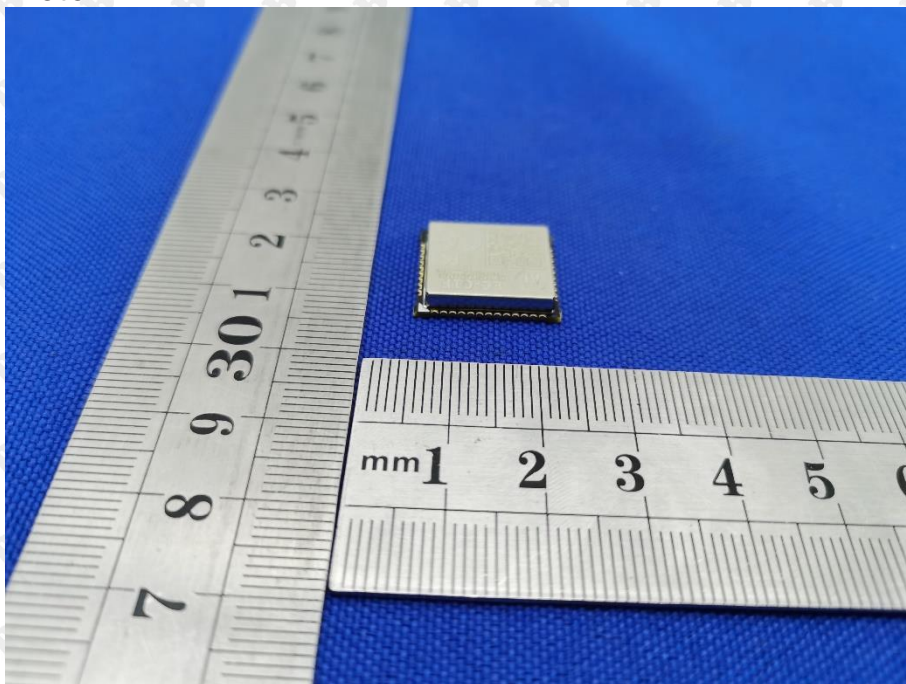
15. EUT PHOTOGRAPHS

External Photos EUT Photo 1

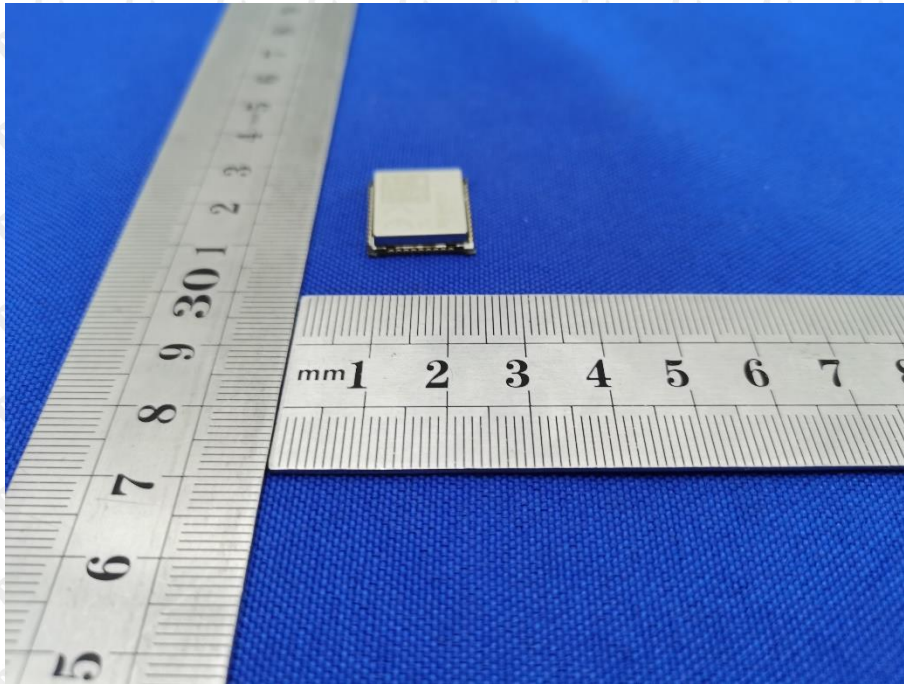


EUT Photo 2

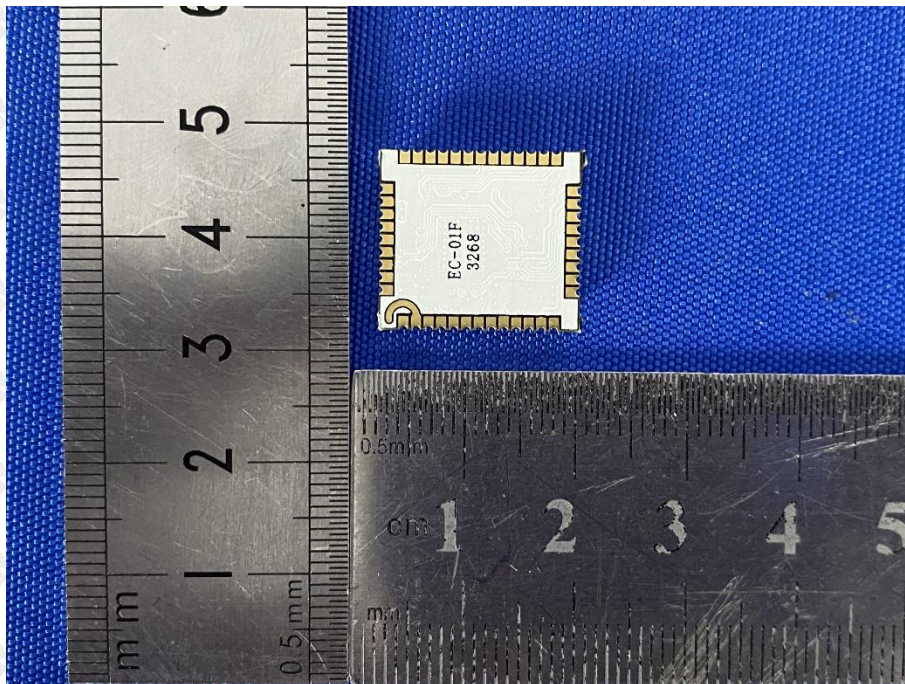


EUT Photo 3**EUT Photo 4**

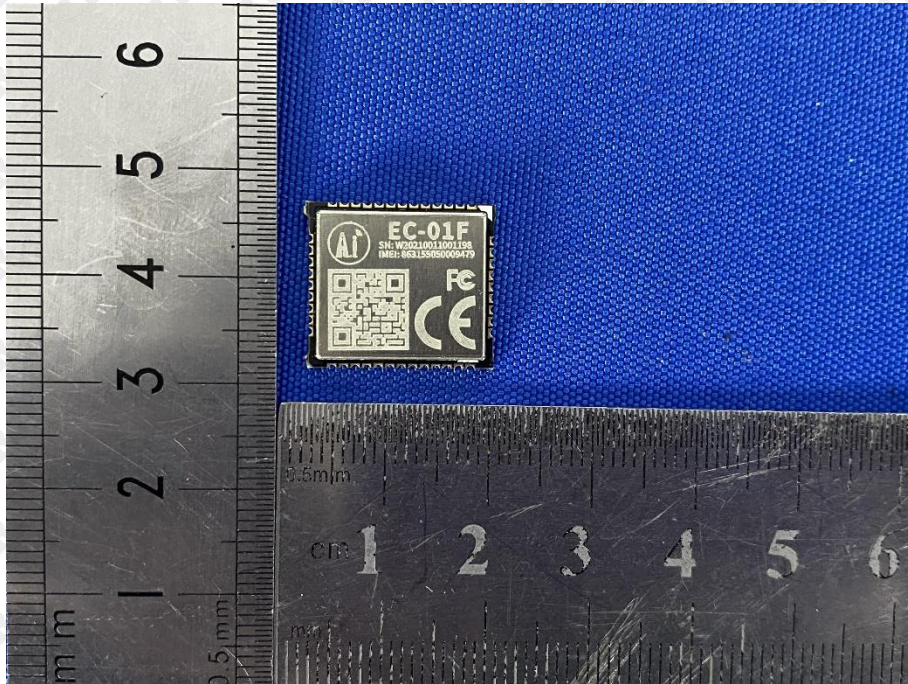
EUT Photo 5



**Internal Photos
EUT Photo 1**



EUT Photo 2

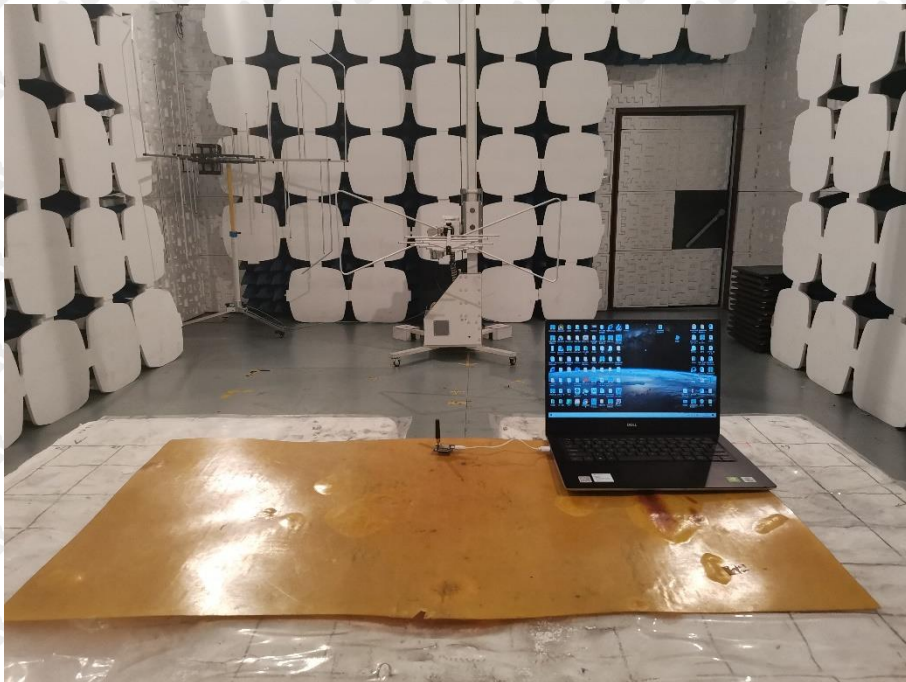


16. EUT TEST SETUP PHOTOGRAPHS

Conducted emission



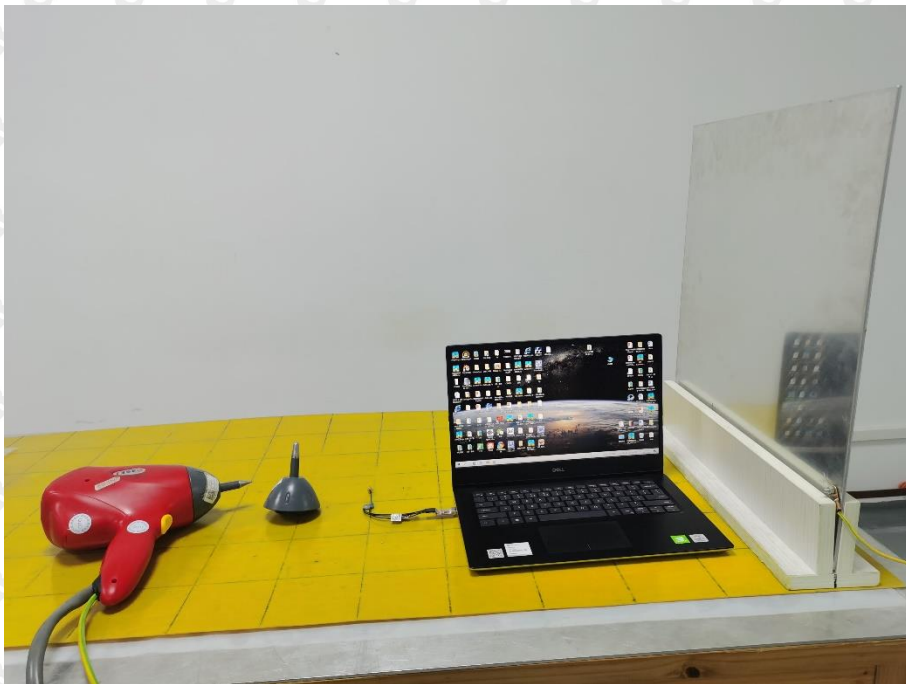
Radiated emissions below 1G



RS



ESD



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