CE EMC Test Report

Equipment	:	**LTE Modem**
Model No.	:	**Pinnacle 100**
Brand Name	:	**Laird Connectivity**
Applicant	:	**Laird Connectivity, Inc.**
Address	:	**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**EN 301 489-1 V2.2.3 (2019-11)** **EN 301 489-3 V2.1.1 (2019-03)** **Draft EN 301 489-17 V3.2.2 (2019-12)** **Draft EN 301 489-52 V1.1.0 (2016-11)**
Received Date	:	**May 03, 2019**
Tested Date	:	**Dec. 11, 2019 ~ May 27, 2020**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:

Peter Lin / Supervisor

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Approved by:

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Testing Laboratory 2732

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Release Record

Report No.	Version	Description	Issued Date
EW950303	Rev. 01	Initial issue	Jun. 02, 2020

Summary of Test Results

Emission Tests				
Ref. Std. Clause	**Test Standard**	**Test Items**	**Measured**	**Result**
8.4	EN 55032:2015/AC:2016, Class B	Conducted Emissions from the AC mains power ports	-7.65dB QP@ 0.150MHz.	Pass
8.7	EN 55032:2015/AC:2016, Class B	Asymmetric Mode Conducted Emissions	Note[1]	N/A
8.2	EN 55032:2015/AC:2016, Class B	Radiated Emissions	-3.16dB QP@ 168.01MHz.	Pass
8.5	EN 61000-3-2:2014, Class A	Harmonic Current Emissions	Note[2]	N/A
8.6	EN 61000-3-3:2013	Voltage Fluctuations and Flicker	Note[2]	N/A

N/A means Not Applicable.
Note[1]: The EUT w/o telecom port.
Note[2]: The EUT consumes DC power, so the test is not required.

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Immunity Tests					
Ref. Std. Clause	**Test Standard**	**Description of Test**		**Pass Criterion**	**Result**
9.3	EN 61000-4-2:2009	Electrostatic Discharge (ESD)		CT/CR(A)	Pass
9.2	EN 61000-4-3:2006/A1:2008/ A2:2010	Radio Frequency Electromagnetic Field (RS)		CT/CR(A)	Pass
9.4	EN 61000-4-4:2012	Electrical Fast Transient/Burst (EFT)		Note[1]	N/A
9.8	EN 61000-4-5:2014+A1:2017	Surge		Note[2]	N/A
9.5	EN 61000-4-6:2014	Conducted Disturbances (CS)		Note[1]	N/A
9.7	EN 61000-4-11:2004	Voltage Dips	0% residual for 0.5 cycle	Note[2]	N/A
			0% residual for 1 cycle	Note[2]	N/A
			70% residual for 25 cycle	Note[2]	N/A
			30% reduction for 0.5 cycle	Note[2]	N/A
		Voltage Interruption	0% residual for 250 cycle (w/o battery back-up)	Note[2]	N/A

Note[1]: The EUT consumes DC power, and it is not intended to be used with cables longer than 3m. So this test is not carried out.
Note[2]: The EUT consumes DC power, so the test is not required.

Comments and Explanations:
None.

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

SW Version	BHL78xx.3.7.2.3
Operating Frequency	2402 MHz ~ 2480 MHz
Antenna Type	Refer to item 1.1.2 for more details
Modulation Type	Bluetooth 4.0 LE: GFSK
LTE	
OperatingFrequency	LTE Band 1: 1920 MHz ~ 1980 MHz LTE Band 3: 1710 MHz ~ 1785 MHz LTE Band 8: 880 MHz ~ 915 MHz LTE Band 20: 832 MHz ~ 862 MHz LTE Band 28: 703 MHz ~ 748 MHz
Antenna Type	Refer to item 1.1.2 for more details
Modulation Type	QPSK, 16QAM (Uplink)
NFC	
Operating Frequency	13.56 MHz
Modulaton Type	ASK

1.1.2 Antenna Details

For BT

Ant. No.	Brand	Model	Type	Gain (dBi)	Connector
1	LSR	001-0001	2.4GHz Dipole	2	RP-SMA Female with IPEX U.FL antenna cable
2	Laird	NanoBlue-IP04 (MAF94045)	PCB Dipole	2	IPEX U.FL
3	LSR	001-0014	2.4GHz Flex PIFA	2	IPEX U.FL
4	Laird	110-00665	Trace Monopole	2.6	NA

For LTE

Ant. No.	Brand / Model	Type	Connector	Gain (dBi)	Operating Band
1	Laird / DBA6927C1	Dipole	U.FL	2.2	LTE Band 1
				2.2	LTE Band 3
				0.5	LTE Band 8
				0.5	LTE Band 20
				0.5	LTE Band 28
2	Laird / EFF6925A3S	Flex	U.FL	3.7	LTE Band 1
				3.7	LTE Band 3
				1.9	LTE Band 8
				1.9	LTE Band 20
				1.9	LTE Band 28
3	Laird / 110-00665	Stamped Metal	N/A	2.6	LTE Band 1
				2.6	LTE Band 3
				1.3	LTE Band 20
				1.3	LTE Band 28

For NFC

Ant. No.	Type	Gain (dBi)	Connector
1	NFC	N/A	N/A

1.1.3 Power Supply Type of the Equipment under Test (EUT)

Power Supply Type	3.7Vdc

1.1.4 Accessories

N/A

1.2 Test Equipment and Calibration Data

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Tested Date	Dec. 11, 2019 ~ Jan. 06, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101657	Jan. 08, 2019	Jan. 07, 2020
LISN	R&S	ENV216	101579	Mar. 08, 2019	Mar. 07, 2020
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-667	Dec. 05, 2019	Dec. 04, 2020
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 22, 2019	Oct. 21, 2020
50 ohm terminal (Support Unit)	NA	50	04	May. 28, 2019	May. 27, 2020
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission below 1GHz				
Test Site	966 chamber 2 / (03CH02-WS)				
Test Date	Mar. 19, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	Agilent	N9038A	MY53290044	Sep. 17, 2019	Sep. 16, 2020
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 13, 2019	Nov. 12, 2020
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-523	Dec. 26, 2019	Dec. 25, 2020
Preamplifier	EMC	EMC02325	980194	Sep. 18, 2019	Sep. 17, 2020
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160501	Oct. 18, 2019	Oct. 17, 2020
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Oct. 18, 2019	Oct. 17, 2020
LF cable 10M	EMCC	CFD400-E	CFD400-001	Oct. 18, 2019	Oct. 17, 2020
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission above 1GHz				
Test Site	966 chamber 2 / (03CH02-WS)				
Test Date	Mar. 19, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	Agilent	N9010A	MY53400091	Nov. 15, 2019	Nov. 14, 2020
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1095	Sep. 26, 2019	Sep. 25, 2020
Preamplifier	Agilent	83017A	MY39501309	Sep. 24, 2019	Sep. 23, 2020
RF Cable	EMC	EMC105-SM-SM-8000	180512	Oct. 18, 2019	Oct. 17, 2020
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Oct. 18, 2019	Oct. 17, 2020
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	ESD				
Test Site	ESD room 1 / (ES01-WS)				
Tested Date	Dec. 23, 2019 ~ Jan. 10, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
ESD Generator	EMTest	Dito	V1248114239	Aug. 17, 2019	Aug. 16, 2020
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Immunity (80 MHz - 6 GHz)				
Test Site	RS room 1 / (RS01-WS)				
Tested Date	Dec. 18, 2019 ~ May 27, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Signal Generator	R&S	SMB100A	103924HA	Oct. 18, 2019	Oct. 17, 2020
Power Sensor	R&S	NRP-Z91	101094-UL	Oct. 16, 2019	Oct. 15, 2020
Power Sensor	R&S	NRP-Z91	101095-KY	Oct. 16, 2019	Oct. 15, 2020
Power Amplifier	BONN	BLWA 0810-160/100D	107972A	N/A	N/A
Power Amplifier	BONN	BLMA 1060-100D	107972B	N/A	N/A
Antenna	SCHWARZBECK MESS-ELEKTRONIK	STLP 9149	9149-073	N/A	N/A
Antenna	R & S	HL046E	100076-Cd	N/A	N/A
Note: Calibration Interval of instruments listed above is one year.					

1.3 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

EN 301 489-1 V2.2.3 (2019-11)
EN 301 489-3 V2.1.1 (2019-03)
Draft EN 301 489-17 V3.2.2 (2019-12)
Draft EN 301 489-52 V1.1.0 (2016-11)

1.4 Deviation from Test Standard and Measurement Procedure

None

1.5 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)).

Measurement Uncertainty		
Test Item	**Frequency**	**Uncertainty**
Conducted Emissions from the AC mains power ports	150kHz ~ 30MHz	±2.92 dB
Asymmetric Mode Conducted Emissions	150kHz ~ 30MHz	±3.26 dB
Radiated Emissions	30MHz ~ 1GHz	±4.32 dB
	Above 1GHz	±4.57 dB

Note: The results of measurements of emissions shall reference the measurement uncertainty considerations contained in CISPR 16-4-2.

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
Conducted Emissions from the AC mains power ports	CO01-WS	21°C / 61%	Alex Tsai
Radiated Emissions	03CH02-WS	20°C/60%	Rober Tsai
ESD	ES01-WS	19-20°C/49-50%/101-103kPa	Zoe Yu
RS	RS01-WS	19-23°C/57-63%/100-103kPa	Zoe Yu

2.2 The Worst Case Measurement Configuration

Pretested Mode	
Pretest Mode	**Operating Description**
1	LTE Link, EUT: Y-axis + internal antenna, DC 3.7V with Notebook, 230V/50Hz
2	LTE Link, EUT: Y-axis + external antenna (Larid/EFF692SA3S + LSR/001-0014), DC 3.7V; with Notebook, 230V/50Hz
3	LTE Link, EUT: Y-axis + external antenna (Larid/DBA6927C1 + LSR/001-0014), DC 3.7V with Notebook, 230V/50Hz
4	BT Link, EUT: Y-axis + external antenna (Larid/DBA6927C1 + LSR/001-0014), DC 3.7V with Notebook, 230V/50Hz
5	BT Link, EUT: Y-axis + external antenna (Laird/DBA6927C1 + Laird/NanoBlue-IP04 (MAF94045)), DC 3.7V with Notebook, 230V/50Hz
6	BT Link, EUT: Y-axis + external antenna (Laird/DBA6927C1 + LSR/001-0001), DC 3.7V with Notebook, 230V/50Hz
7	BT Link, EUT: Y-axis + internal antenna DC 3.7V; with Notebook, 230V/50Hz
8	NFC Link, EUT: Y-axis + external antenna (Laird/DBA6927C1 + LSR/001-0001), DC 3.7V with Notebook, 230V/50Hz
9	BT Link, EUT: Y-axis + external antenna (Laird/DBA6927C1 + LSR/001-0001), DC 3.7V with Notebook,10V/60Hz
10	LTE Link, EUT: Y-axis + internal antenna, DC 3.7V with Notebook, 230V/50Hz
For **Pretest Mode 6** is the worst case and only its data was record in this test report.	

The Determined Worst Case Configurations	
Conducted Emissions from the AC mains power ports	
Test Mode	**Operating Description**
1	BT Link, EUT: Y-axis + external antenna (Laird/DBA6927C1 + LSR/001-0001), DC 3.7V, with Notebook 230V/50Hz
2	LTE Link, EUT: Y-axis + external antenna (Laird/DBA6927C1 + LSR/001-0001), DC 3.7V; with Notebook 110V/60Hz
3	NFC Link, EUT: Y-axis + external antenna (Laird/DBA6927C1 + LSR/001-0001), DC 3.7V; with Notebook 230V/50Hz
Radiated Emissions	
Test Mode ≤1GHz	**Operating Description**
1	BT Link, EUT: Y-axis + external antenna (Laird/DBA6927C1 + LSR/001-0001), DC 3.7V with Notebook, 230V/50Hz
Test Mode >1GHz	**Operating Description**
1	BT Link, EUT: Y-axis + external antenna (Laird/DBA6927C1 + LSR/001-0001), DC 3.7V with Notebook, 230V/50Hz
Immunity Tests (ESD Tests)	
Test Mode	**Operating Description**
1	BT Tx + LTE Band1 link+ external antenna (Laird/DBA6927C1 + LSR/001-0001)
2	BT Tx + LTE Band8 link+ external antenna (Laird/DBA6927C1 + LSR/001-0014)
3	BT Tx + LTE Band28 link+ external antenna (Larid/EFF692SA3S + Laird/NanoBlue-IP04(MAF94045)
4	BT Tx + LTE Band3 idle+ external antenna (Laird/DBA6927C1 + LSR/001-0001)
5	BT Tx + LTE Band20 idle+ external antenna (Larid/EFF692SA3S + Laird/NanoBlue-IP04(MAF94045)
6	BT Tx+ internal antenna
7	NFC link + external antenna (Larid/EFF692SA3S + Laird/NanoBlue-IP04 (MAF94045)

Immunity Tests (RS Tests)	
Test Mode	**Operating Description**
1	BT Tx + LTE Band1 link+ external antenna (Laird/DBA6927C1 + LSR/001-0001)
2	BT Tx + LTE Band8 link+ external antenna (Laird/DBA6927C1 + LSR/001-0014)
3	BT Tx + LTE Band28 link+ external antenna (Larid/EFF692SA3S + Laird/NanoBlue-IP04(MAF94045)
4	BT Tx + LTE Band3 idle+ external antenna (Laird/DBA6927C1 + LSR/001-0001)
5	BT Tx + LTE Band20 idle+ external antenna (Larid/EFF692SA3S + Laird/NanoBlue-IP04(MAF94045)
6	BT Tx+ internal antenna
7	NFC link + external antenna (Larid/EFF692SA3S + Laird/NanoBlue-IP04 (MAF94045)
8	BT PER + external antenna (Laird/DBA6927C1 + LSR/001-0001)
9	BT PER + external antenna (Laird/DBA6927C1 + LSR/001-0014)
10	BT PER + external antenna (Larid/EFF692SA3S + Laird/NanoBlue-IP04 (MAF94045)
11	BT PER + internal antenna

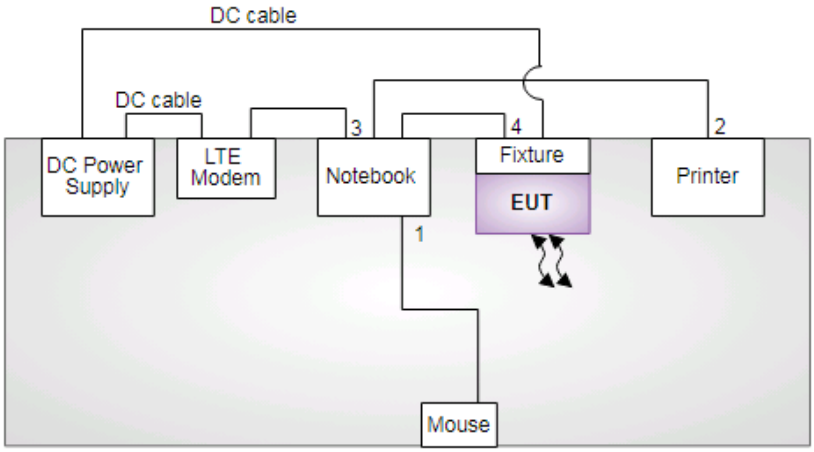
2.3 Local Support Equipment List

Support Equipment List (EMI)					
No.	**Equipment**	**Brand**	**Model**	**S/N**	**Remarks**
1	Notebook	DELL	Latitude E6440	8VXMD12	---
2	Printer	EPSON	XP-30	QSDK002410	---
3	Mouse	DELL	MS111-L	2C3-00MM	---
4	DC Power Supply	GWINSTEK	GPC-60300	EM884797	---
5	Radio Communication Analyzer	ANRITSU	MT8820C	6201240341	For LTE mode
6	LTE Modem	Laird	Pinnacle 100	---	For BT mode
7	Fixture	---	---	---	Provided by applicant.
8	Tablet	SONY	SGP511TW/B	CB5126VXTX	For NFC mode
9	USB 3.0 HDD	WD	WDBKXH5000 ABK	WX31AB210213	For NFC mode

Support Equipment List (EMS)					
No.	**Equipment**	**Brand**	**Model**	**S/N**	**Remarks**
1	Notebook	DELL	Latitude E5430	6R4RWW1	Provided by applicant.
2	DC Power Supply	GWINSTEK	GPC-60300	EM884797	---
3	Wideband Radio Communication Tester	R&S	CMW500	106070	---
4	Spectrum Analyzer	R&S	FSV40	101499	---
5	LTE Modem	Laird	Pinnacle 100	---	For BT mode
6	Fixture	---	---	---	Provided by applicant.
7	Tablet	SONY	SGP511TW/B	CB5126VXTX	For NFC mode
8	Wireless connectivity tester	R&S	CMW270	100856	---

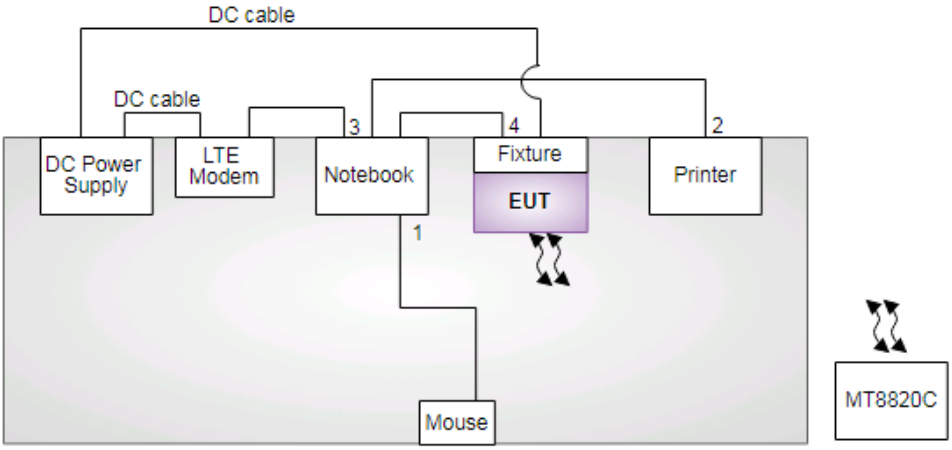
2.4 Test Setup Chart

Test Setup Diagram (EMI_BT Mode)



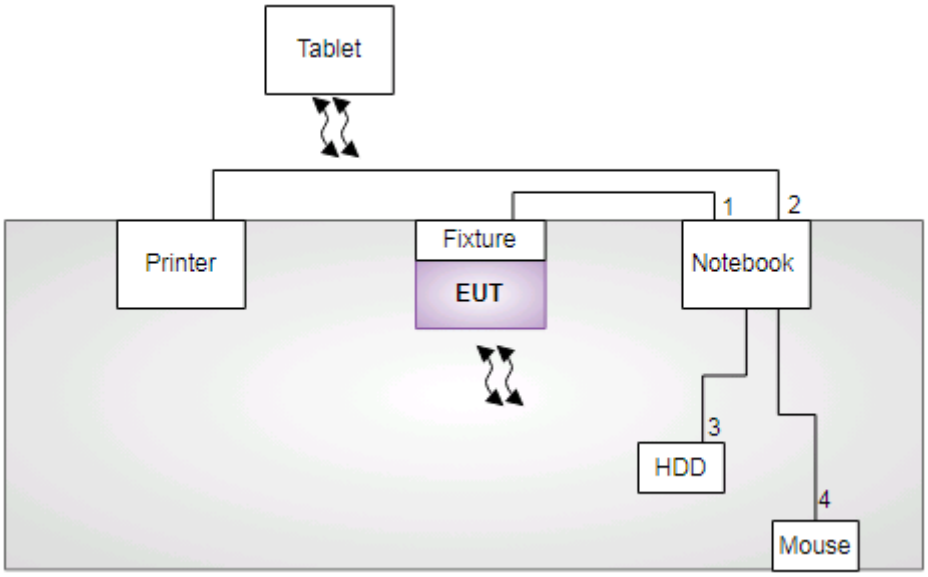
No.	Signal cable / Length (m)
1	USB, 1.8m shielded.
2	USB, 1.8m shielded.
3	USB, 1m shielded.
4	USB, 1m shielded.

Test Setup Diagram (EMI_LTE Mode)



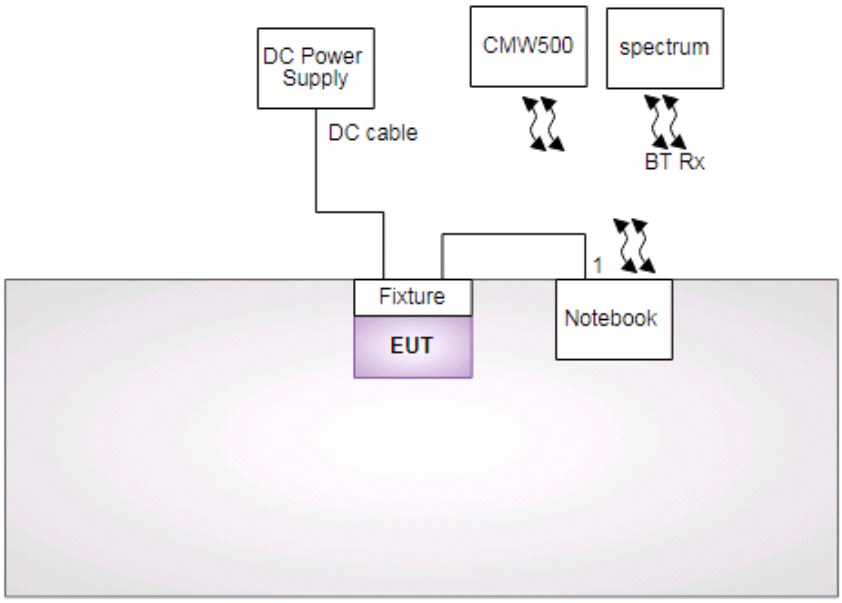
No.	Signal cable / Length (m)
1	USB, 1.8m shielded.
2	USB, 1.8m shielded.
3	USB, 1m shielded.
4	USB, 1m shielded.

Test Setup Diagram (EMI_NFC Mode)



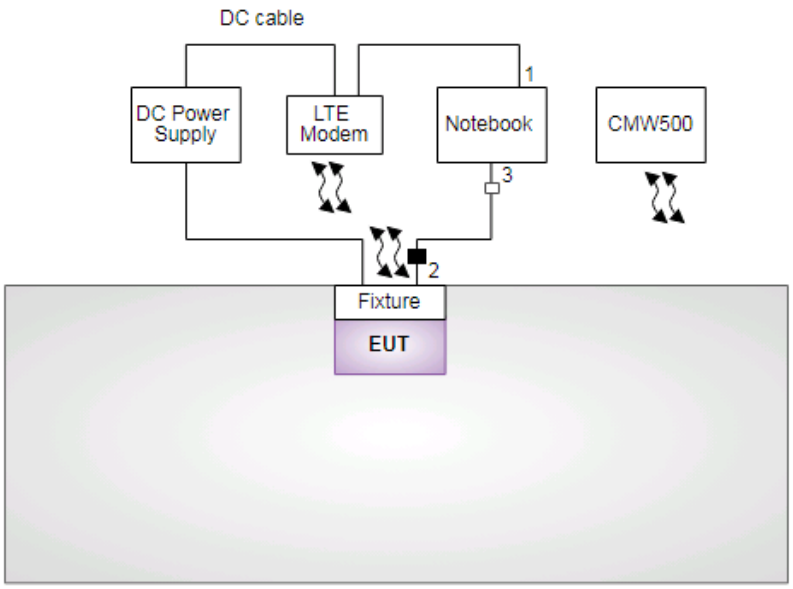
No.	Signal cable / Length (m)
1	USB, 1m shielded.
2	USB, 1.8m shielded.
3	USB, 0.5m shielded.
4	USB, 1.8m shielded.

Test Setup Diagram (EMS_ESD Mode 1~ 6)



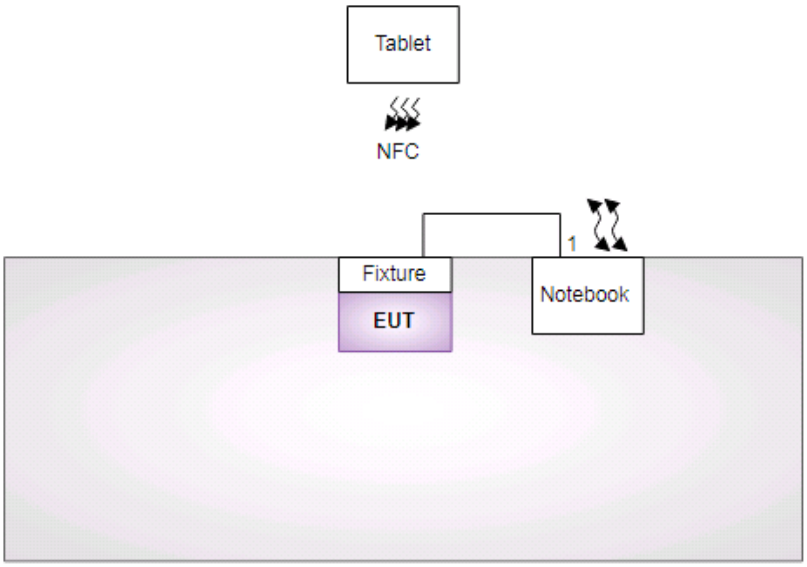
No.	Signal cable / Length (m)
1	Console USB, 1m shielded.

Test Setup Diagram (EMS_RS Mode 1 ~ 6)



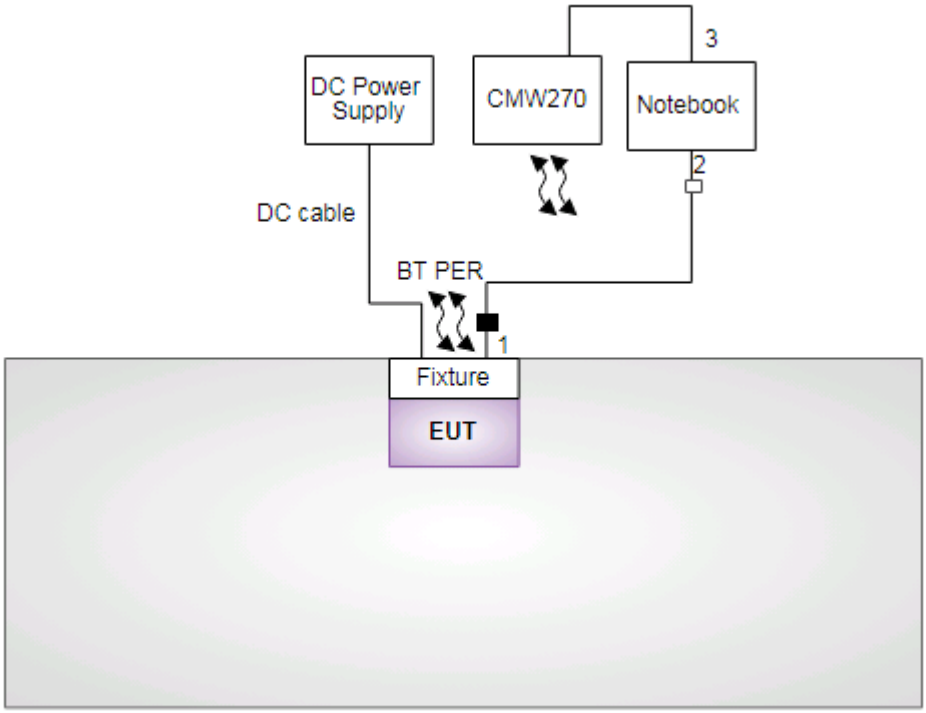
No.	Signal cable / Length (m)
1	Console USB, 1m shielded.
2	Console USB, 1m shielded with one core.
3	USB, 1.2m shielded.

Test Setup Diagram (EMS_ESD & RS Mode 7)



No.	Signal cable / Length (m)
1	USB, 1m shielded.

Test Setup Diagram (EMS_ RS Mode 8~11)



No.	Signal cable / Length (m)
1	Console USB, 1m shielded with one core.
2	Console USB, 1m shielded.
3	Console USB, 1m shielded.

2.5 Test Software and Operating Condition

EMI

a. To enable all function of test system.
b. The support notebook executed “WINEMC” to play colorbar video.
c. The support notebook executed “ UWterminal ” to BT link to LTE Modem. (For BT mode)
d. The support notebook executed “ UWterminal ” to LTE link to MT8820C. (For LTE mode)
e. The support notebook executed “ UWterminal ” to NFC link to Tablet. (For NFC mode)

EMS

For LTE Mode

a. The LTE radio function was linked between the EUT and the Wideband Radio Communication Tester (CMW500).
b. To observe the throughput less than 95% from the Wideband Radio Communication Tester (CMW500).

For BT Mode

a. The support notebook executed “ UWterminal ” to BT link to LTE Modem. (For RS test)
b. The support notebook sends the message to EUT by BT, and check any transmit delay or message error.
c. The support notebook executed “ UWterminal ” to observed BT signal from spectrum. (For ESD test).

For NFC Mode

a. The support notebook executed “ UWterminal ” to NFC link to Tablet, and check the NFC signal after the test.

For BT PER

a. The support notebook executed “Uwterminal “ to enable bluetooth function of the EUT in packet error mode via USB cable.
b. The EUT linked with the CMW270 to observe packet error rate below 10%.

3 Emission Test Results

3.1 Conducted Emissions from the AC mains power ports

3.1.1 Limits of Conducted Emissions from the AC mains power ports

Frequency range (MHz)	Limits values (dBµV)			
	Class A		Class B	
	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,5	79	66	66 to 56 *	56 to 46 *
0,5 to 5	73	60	56	46
5 to 30	73	60	60	50

Note 1: "*" Decreasing linearly with the logarithm of the frequency.
Note 2: If the limits for the average detector are met when using the quasi-peak detector, then the limits for the measurements with the average detector are considered to be met.
Note 3: The higher value measured with and without the outer conductor screen of the antenna terminal connected to earth is considered.

3.1.2 Test Procedures

a. The EUT was placed on a desk 0.8 meters height from the metal ground plane and 0.4 meter from the conducting wall of the shielding room and it was kept at least 0.8 meters from any other grounded conducting surface.

b. A thickness of ≤ 0.15m insulation should be placed between local AE and associated cabling and the RGP.

c. Connect EUT to the power mains through a line impedance stabilization network (LISN).

d. All the support units are connecting to the other LISN.

e. The LISN provides 50 ohm coupling impedance for the measuring instrument.

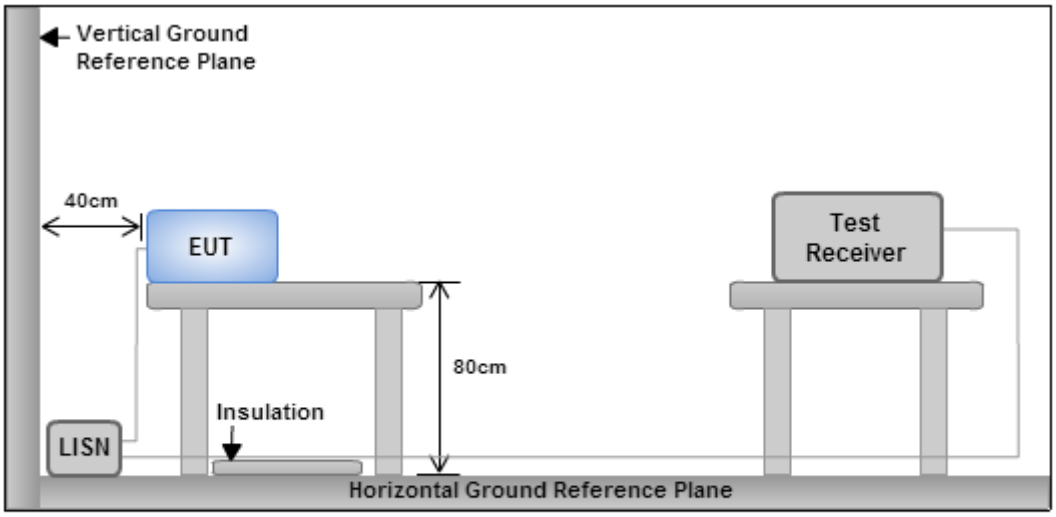
f. The CISPR states that a 50 ohm, 50 microhenry LISN should be used.

g. Both sides of AC line were checked for maximum conducted interference.

h. The frequency range from 150 kHz to 30 MHz was searched.

i. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

3.1.3 Test Setup

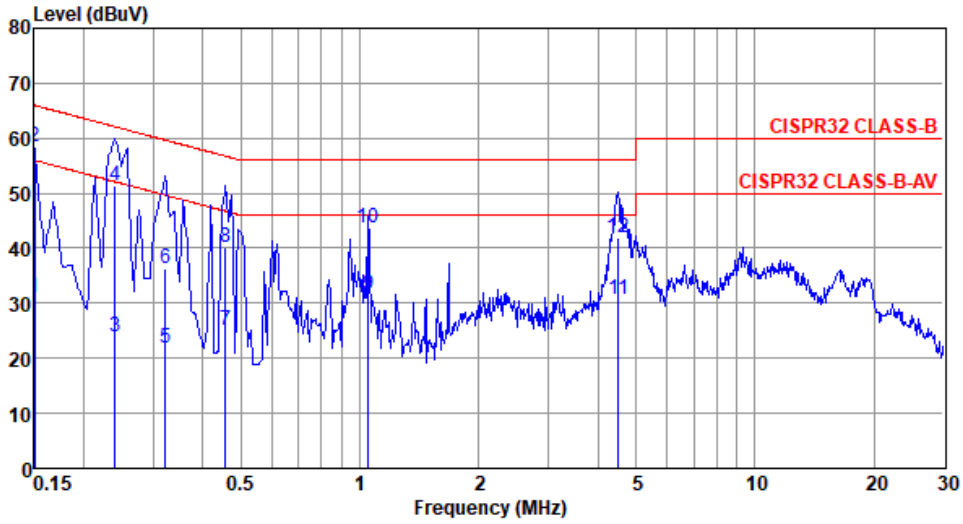


Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.1.4 Test Result of Conducted Emissions from the AC mains power ports

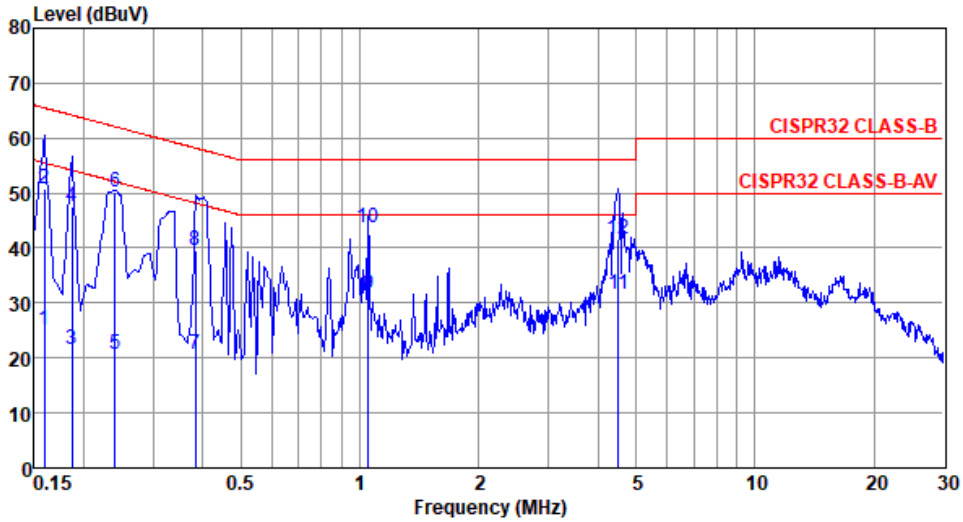
Power Phase	Line	Test Mode	1



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.150	31.03	56.00	-24.97	21.45	9.53	0.05	Average
2*	0.150	58.35	66.00	-7.65	48.77	9.53	0.05	QP
3	0.240	23.95	52.08	-28.13	14.33	9.55	0.07	Average
4	0.240	51.41	62.08	-10.67	41.79	9.55	0.07	QP
5	0.322	21.85	49.66	-27.81	12.22	9.56	0.07	Average
6	0.322	36.28	59.66	-23.38	26.65	9.56	0.07	QP
7	0.456	25.11	46.76	-21.65	15.45	9.57	0.09	Average
8	0.456	40.08	56.76	-16.68	30.42	9.57	0.09	QP
9	1.049	31.53	46.00	-14.47	21.81	9.60	0.12	Average
10	1.049	43.64	56.00	-12.36	33.92	9.60	0.12	QP
11	4.501	30.72	46.00	-15.28	20.81	9.61	0.30	Average
12	4.501	41.90	56.00	-14.10	31.99	9.61	0.30	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

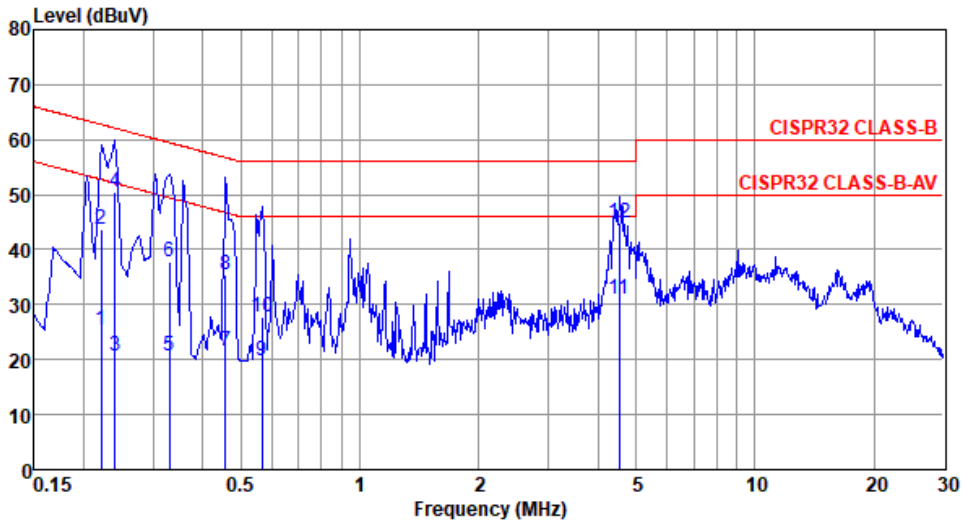
Power Phase	Neutral	Test Mode	1



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.159	24.98	55.52	-30.54	15.36	9.57	0.05	Average
2	0.159	50.69	65.52	-14.83	41.07	9.57	0.05	QP
3	0.186	21.56	54.20	-32.64	11.92	9.58	0.06	Average
4	0.186	47.66	64.20	-16.54	38.02	9.58	0.06	QP
5	0.240	20.56	52.08	-31.52	10.90	9.59	0.07	Average
6*	0.240	50.07	62.08	-12.01	40.41	9.59	0.07	QP
7	0.383	20.78	48.21	-27.43	11.09	9.61	0.08	Average
8	0.383	39.57	58.21	-18.64	29.88	9.61	0.08	QP
9	1.049	31.51	46.00	-14.49	21.75	9.64	0.12	Average
10	1.049	43.81	56.00	-12.19	34.05	9.64	0.12	QP
11	4.501	31.72	46.00	-14.28	21.75	9.67	0.30	Average
12	4.501	41.69	56.00	-14.31	31.72	9.67	0.30	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

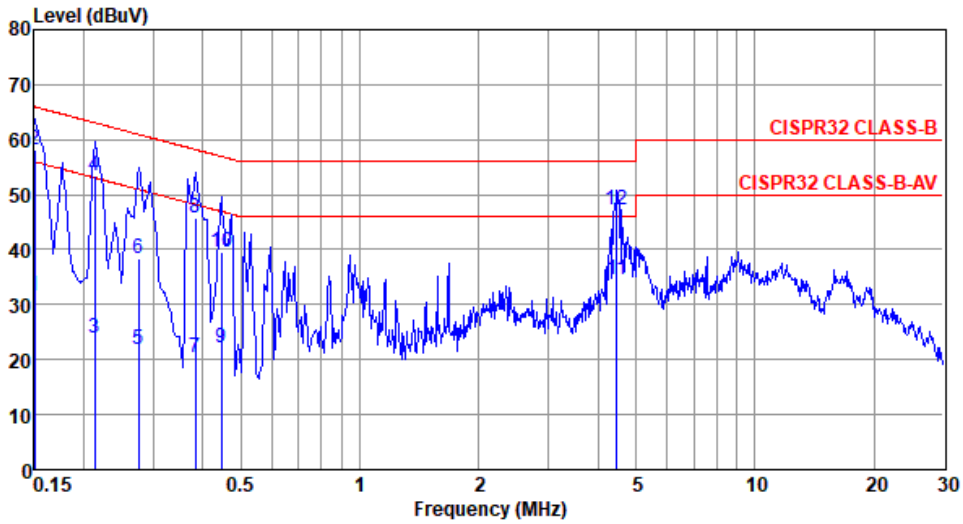
Power Phase	Line	Test Mode	2



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.222	25.47	52.74	-27.27	15.87	9.54	0.06	Average
2	0.222	43.58	62.74	-19.16	33.98	9.54	0.06	QP
3	0.240	20.61	52.08	-31.47	10.99	9.55	0.07	Average
4	0.240	50.42	62.08	-11.66	40.80	9.55	0.07	QP
5	0.330	20.55	49.44	-28.89	10.92	9.56	0.07	Average
6	0.330	37.67	59.44	-21.77	28.04	9.56	0.07	QP
7	0.456	21.47	46.76	-25.29	11.81	9.57	0.09	Average
8	0.456	35.49	56.76	-21.27	25.83	9.57	0.09	QP
9	0.564	19.90	46.00	-26.10	10.23	9.58	0.09	Average
10	0.564	27.83	56.00	-28.17	18.16	9.58	0.09	QP
11	4.525	30.86	46.00	-15.14	20.94	9.62	0.30	Average
12*	4.525	44.99	56.00	-11.01	35.07	9.62	0.30	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

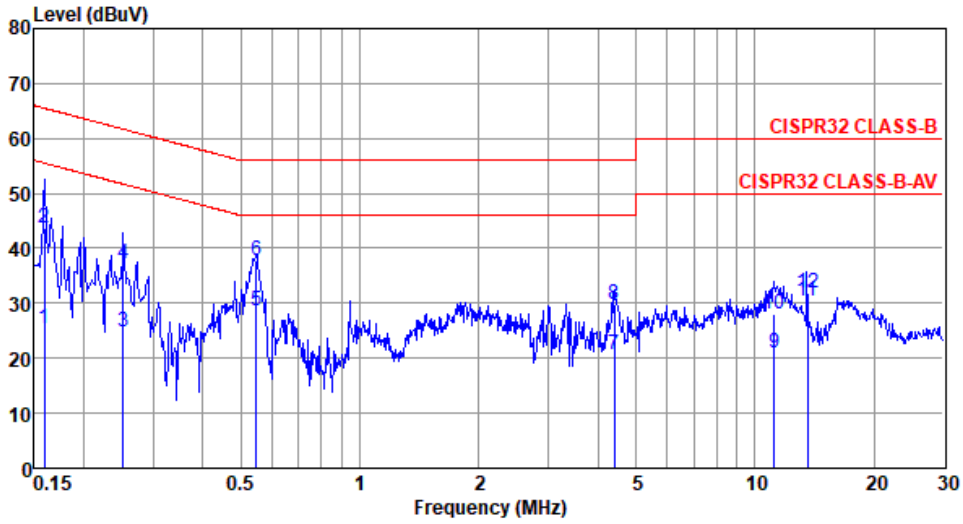
Power Phase	Neutral	Test Mode	2



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.150	31.52	56.00	-24.48	21.90	9.57	0.05	Average
2*	0.150	58.01	66.00	-7.99	48.39	9.57	0.05	QP
3	0.213	24.04	53.10	-29.06	14.40	9.58	0.06	Average
4	0.213	53.51	63.10	-9.59	43.87	9.58	0.06	QP
5	0.276	21.92	50.94	-29.02	12.26	9.59	0.07	Average
6	0.276	38.32	60.94	-22.62	28.66	9.59	0.07	QP
7	0.383	20.38	48.21	-27.83	10.69	9.61	0.08	Average
8	0.383	45.86	58.21	-12.35	36.17	9.61	0.08	QP
9	0.447	22.09	46.93	-24.84	12.40	9.61	0.08	Average
10	0.447	39.61	56.93	-17.32	29.92	9.61	0.08	QP
11	4.478	34.63	46.00	-11.37	24.66	9.67	0.30	Average
12	4.478	47.26	56.00	-8.74	37.29	9.67	0.30	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

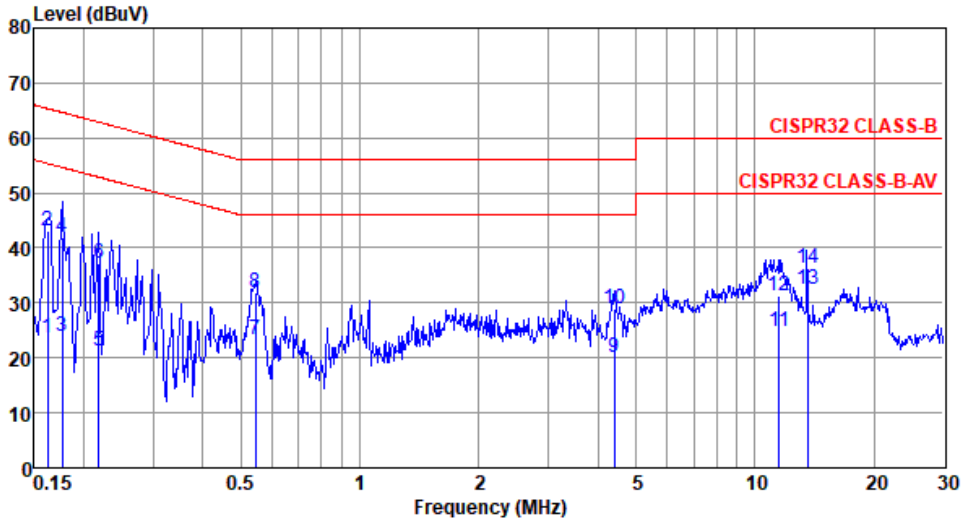
Power Phase	Line	Test Mode	3



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.159	25.50	55.52	-30.02	15.92	9.53	0.05	Average
2	0.159	43.62	65.52	-21.90	34.04	9.53	0.05	QP
3	0.252	24.83	51.69	-26.86	15.21	9.55	0.07	Average
4	0.252	37.11	61.69	-24.58	27.49	9.55	0.07	QP
5*	0.546	28.78	46.00	-17.22	19.11	9.58	0.09	Average
6	0.546	37.69	56.00	-18.31	28.02	9.58	0.09	QP
7	4.407	20.59	46.00	-25.41	10.68	9.61	0.30	Average
8	4.407	29.90	56.00	-26.10	19.99	9.61	0.30	QP
9	11.198	20.97	50.00	-29.03	10.87	9.65	0.45	Average
10	11.198	28.03	60.00	-31.97	17.93	9.65	0.45	QP
11	13.559	30.38	50.00	-19.62	20.18	9.65	0.55	Average
12	13.559	31.89	60.00	-28.11	21.69	9.65	0.55	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Power Phase	Neutral	Test Mode	3



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.162	23.57	55.34	-31.77	13.95	9.57	0.05	Average
2	0.162	43.01	65.34	-22.33	33.39	9.57	0.05	QP
3	0.177	24.04	54.64	-30.60	14.40	9.58	0.06	Average
4	0.177	41.99	64.64	-22.65	32.35	9.58	0.06	QP
5	0.219	21.35	52.88	-31.53	11.71	9.58	0.06	Average
6	0.219	37.21	62.88	-25.67	27.57	9.58	0.06	QP
7	0.544	23.27	46.00	-22.73	13.56	9.62	0.09	Average
8	0.544	31.95	56.00	-24.05	22.24	9.62	0.09	QP
9	4.407	20.06	46.00	-25.94	10.09	9.67	0.30	Average
10	4.407	28.96	56.00	-27.04	18.99	9.67	0.30	QP
11	11.498	24.80	50.00	-25.20	14.61	9.73	0.46	Average
12	11.498	31.38	60.00	-28.62	21.19	9.73	0.46	QP
13*	13.558	32.43	50.00	-17.57	22.13	9.75	0.55	Average
14	13.558	36.40	60.00	-23.60	26.10	9.75	0.55	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

3.2 Radiated Emissions

3.2.1 Limit of Radiated Emissions

Frequency Range (MHz)	Class A		Class B	
	10m	3m	10m	3m
	Quasi-peak limits (dBµV/m)			
30 to 230	40	50	30	40
230 to 1000	47	57	37	47
Note 1: The lower limit shall apply at the transition frequency. Note 2: Additional provisions may be required for cases where interference occurs.				

Frequency range (GHz)	Class A (3 m)		Class B (3 m)	
	Average limit (dBµV/m)	Peak limit (dBµV/m)	Average limit (dBµV/m)	Peak limit (dBµV/m)
1 to 3	56	76	50	70
3 to 6	60	80	54	74
Note 1: The lower limit shall apply at the transition frequency. Note 2: Additional provisions may be required for cases where interference occurs.				

For an unintentional radiator is shown in the table below.

The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes.	Upper frequency of measurement range
Below 108 MHz	1 GHz
108 MHz to 500 MHz	2 GHz
500 MHz to 1 GHz	5 GHz
Above 1 GHz	5 times the highest frequency or 6 GHz, whichever is less.

3.2.2 Test Procedures

a. The EUT was placed on a rotatable table top with a height of 0.8 meters which is placed on the ground plane.

b. A thickness of ≤ 0.15m insulation should be placed between local AE and associated cabling and the RGP.

c. The EUT received DC power source from the outlet socket under the turntable. All support equipment power received from another socket under the turntable.

d. The EUT and local AE shall be arranged in the most compact practical arrangement within the test volume. The central point of the arrangement shall be positioned at the centre of the turntable. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and calibration point of the antenna.

e. The table was rotated 360 degrees to determine the position of the highest radiation.

f. The antenna is a half wave dipole and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.

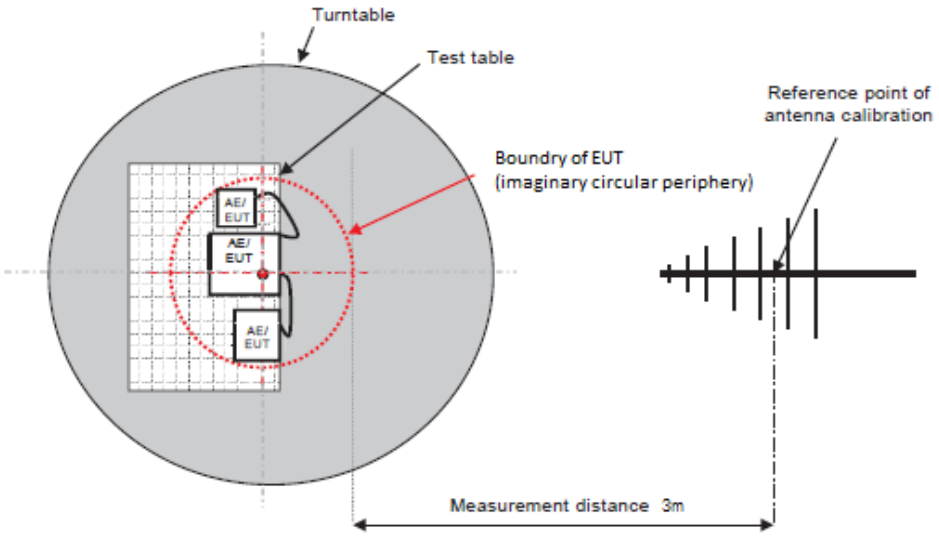
g. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 to 4 meters) and turn table (from 0 to 360 degrees) to find the maximum reading.

h. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.

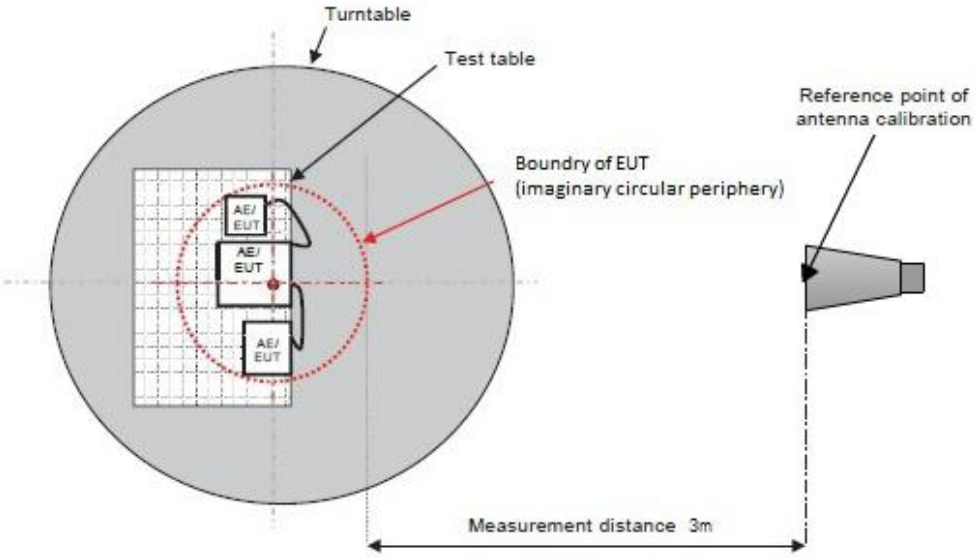
i. If the emission level of the EUT in peak mode was 2 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 2 dB margin will be repeated one by one using the quasi-peak method and reported.

3.2.3 Test Setup

Radiated Emissions below 1GHz

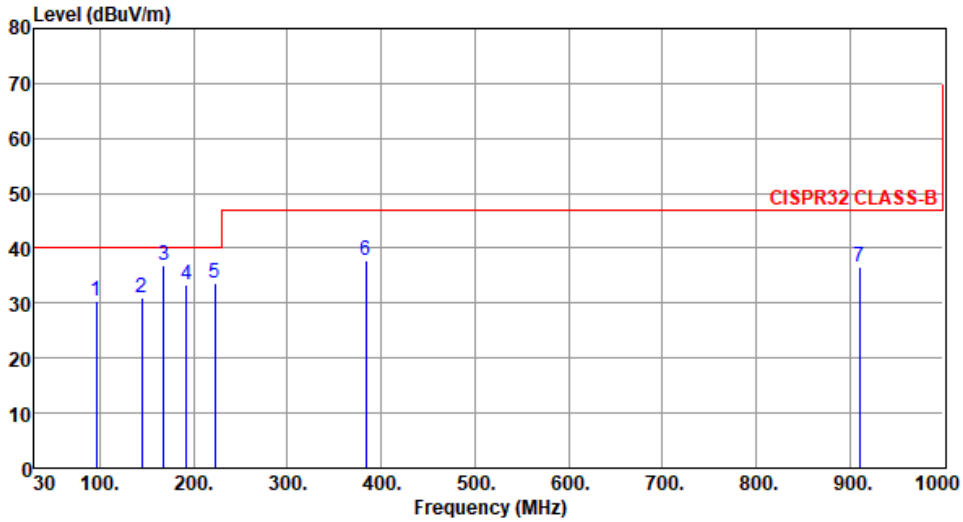


Radiated Emissions above 1GHz



3.2.4 Radiated Emissions (Below 1GHz)

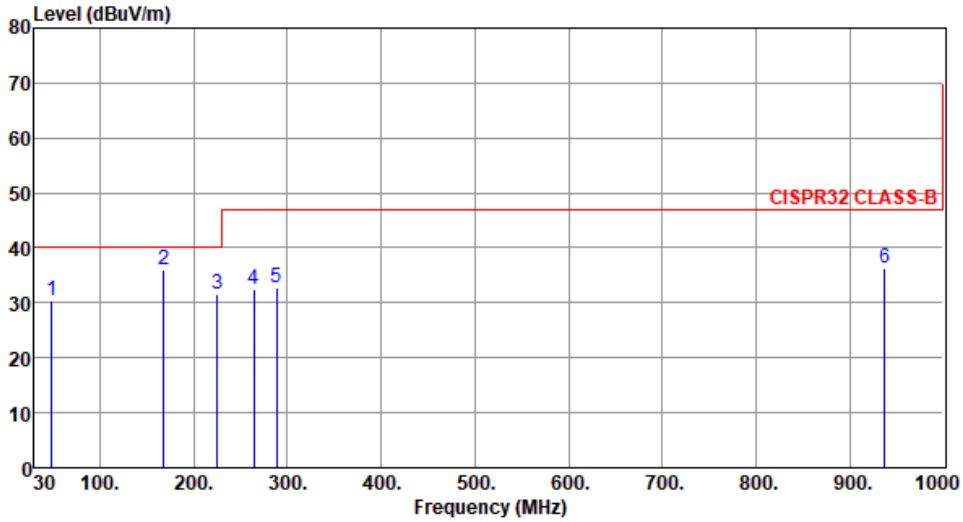
Polarization	Horizontal	Test Mode	1



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	95.96	30.47	40.00	-9.53	44.50	-14.03	Peak	---	---
2	144.46	30.90	40.00	-9.10	39.14	-8.24	Peak	---	---
3	168.01	36.84	40.00	-3.16	44.68	-7.84	QP	169	167
4	191.99	33.42	40.00	-6.58	42.28	-8.86	Peak	---	---
5	223.03	33.74	40.00	-6.26	43.61	-9.87	Peak	---	---
6	384.05	37.92	47.00	-9.08	42.91	-4.99	Peak	---	---
7	910.76	36.53	47.00	-10.47	31.45	5.08	Peak	---	---

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Polarization	Vertical	Test Mode	1

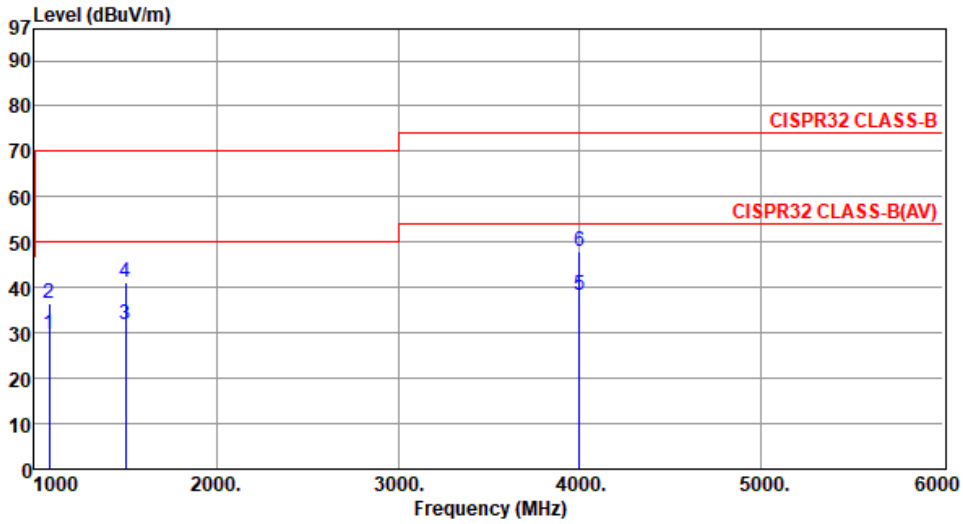


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	48.40	30.40	40.00	-9.60	38.40	-8.00	Peak	---	---
2	168.33	35.88	40.00	-4.12	43.72	-7.84	Peak	---	---
3	224.88	31.63	40.00	-8.37	41.45	-9.82	Peak	---	---
4	263.88	32.55	47.00	-14.45	40.87	-8.32	Peak	---	---
5	288.25	32.78	47.00	-14.22	40.41	-7.63	Peak	---	---
6	937.60	36.30	47.00	-10.70	30.83	5.47	Peak	---	---

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.2.5 Radiated Emissions (Above 1GHz)

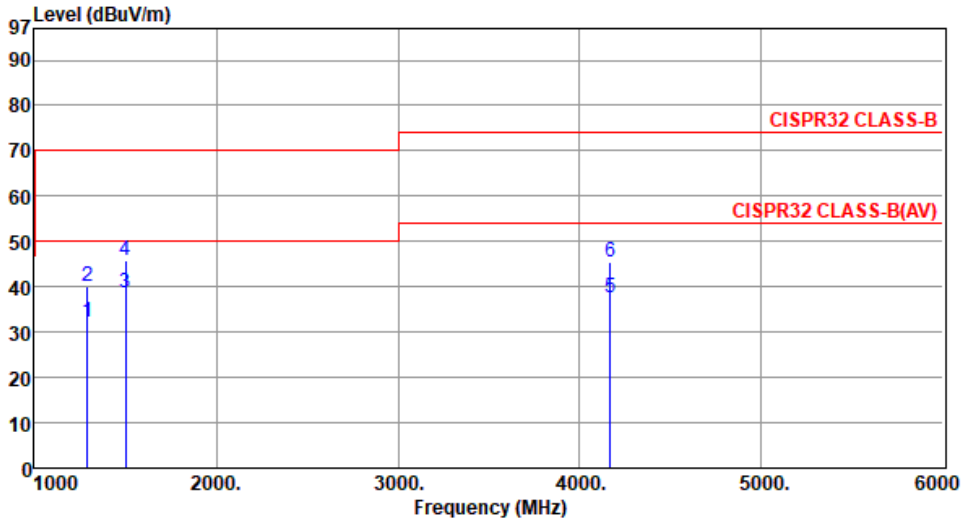
Polarization	Horizontal	Test Mode	1



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1081.88	29.65	50.00	-20.35	39.10	-9.45	Average	100	189
2	1081.88	36.56	70.00	-33.44	46.01	-9.45	Peak	100	189
3	1500.04	31.99	50.00	-18.01	38.17	-6.18	Average	100	17
4	1500.04	41.18	70.00	-28.82	47.36	-6.18	Peak	100	17
5	4000.03	38.16	54.00	-15.84	36.02	2.14	Average	100	221
6	4000.03	48.10	74.00	-25.90	45.96	2.14	Peak	100	221

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Polarization	Vertical	Test Mode	1



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1291.26	32.05	50.00	-17.95	39.20	-7.15	Average	100	309
2	1291.26	39.96	70.00	-30.04	47.11	-7.15	Peak	100	309
3	1499.66	38.83	50.00	-11.17	45.01	-6.18	Average	108	146
4	1499.66	45.99	70.00	-24.01	52.17	-6.18	Peak	108	146
5	4166.02	37.62	54.00	-16.38	34.96	2.66	Average	100	305
6	4166.02	45.62	74.00	-28.38	42.96	2.66	Peak	100	305

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

4 Immunity Tests

4.1 General Description

Product Standard: EN 301 489-1, EN 301 489-3, Draft EN 301 489-17, Draft EN 301 489-52		
Basic Standard	**Spec. Requirement**	**Performance Criteria**
EN 61000-4-2 (ESD)	Contact Discharge: ± 4 kV Air Discharge: ± 8 kV	TT/TR (B)
EN 61000-4-3 (RS)	80 MHz to 6000 MHz 3 V/m, 1 kHz Sine Wave 80%, AM Modulation	CT/CR (A)

4.2 Performance Criteria Description

EN 301 489-3		
Criteria	**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

Draft EN 301 489-17		
Criteria	***During test***	***After test (i.e. as a result of the application of the test)***
A	*Shall operate as intended.* *(see note).* *Shall be no loss of function.* *Shall be no unintentional transmissions.*	*Shall operate as intended.* *Shall be no degradation of performance* *Shall be no loss of function.* *Shall be no loss of critical stored data.*
B	*May be loss of function.*	*Functions shall be self-recoverable.* *Shall operate as intended after recovering.* *Shall be no loss of critical stored data.*
C	*May be loss of function.*	*Functions shall be recoverable by the operator.* *Shall operate as intended after recovering.* *Shall be no loss of critical stored data.*
Note: Operate as intended during the test allows a level of degradation in accordance with clause 6.2.2. ***Clause 6.2.2 Minimum performance level*** *For equipment that supports a PER or FER, the minimum performance level shall be a PER or FER less than or equal to 10%.* *For equipment that does not support a PER or FER, the minimum performance level shall be no loss of wireless transmission function needed for the intended use of the equipment.*		

Draft EN 301 489-17 Performance Criteria	
CT	The performance criteria A shall apply. Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.
TT	The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration, for which performance criteria C shall apply. Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.
CR	The performance criteria A shall apply. Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.
TR	The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration for which performance criteria C shall apply. Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Draft EN 301 489-52 GSM and DCS Performance Criteria	
CT	A communication link shall be established at the start of the test, and maintained during the test 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 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 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. 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. 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.
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.

Draft EN 301 489-52 CDMA Direct Spread (UTRA and E-UTRA) Performance Criteria	
Criteria	**During test / 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 ETSI TS 134 109) is used, it shall not exceed 0,001 during the test sequence; ● if the BLER (as referred in ETSI 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 ETSI TS 136 101 with parameters specified in tables 7.3.1-1 and 7.3.1-2 in ETSI 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 in idle mode, and the transmitter shall not unintentionally operate.

4.3 Special Conditions for EMC Measurements

4.3.1 Special Conditions for Emission Measurements

EN 301 489-3

The provisions of EN 301 489-1 , clause 7.1 shall apply.

Draft EN 301 489-52 GSM and DCS

Reference to clauses in EN 301 489-1	Special product-related conditions, additional to or modifying the test conditions in EN 301 489-1 , clause 8
8.2 Enclosure of ancillary equipment measured on a stand alone basis	At the manufacturer's discretion, ancillary equipment can also be measured in combination with the radio equipment under test. When the ancillary equipment is measured in combination with the radio equipment, radiated emissions from the transmitter/transceiver shall be ignored, but recorded in the test report.

Draft EN 301 489-17 / Draft EN 301 489-52 CDMA Direct Spread (UTRA and E-UTRA)

No special conditions.

4.3.2 Special Conditions for Immunity Measurements

EN 301 489-3

Reference to clauses in EN 301 489-1	Special product-related conditions, additional to or modifying the test conditions in EN 301 489-1 , clause 9
9.2.2: Test method; Radio frequency electromagnetic field	The test shall be performed over the range 80 MHz to 2 700 MHz with the exception of the exclusion bands defined in clause 4.6. Where the EUT is subject to EMC Immunity testing under a Harmonised Standard of a Directive other than the Directive 2014/53/EU [i.3] then the modulating signal frequency specified in that Harmonised Standard may be used. If this alternative modulating frequency is used, then the applicable Directive, Harmonised Standard & modulating frequency shall be noted in the test report.
9.5.2: Test method; Radio frequency, common mode	Where the EUT is subject to EMC Immunity testing under a Harmonised Standard of a Directive other than the Directive 2014/53/EU then the modulating signal frequency specified in that Harmonised Standard may be used. If this alternative modulating frequency is used, then the applicable Directive, Harmonised Standard & modulating frequency shall be noted in the test report.

Draft EN 301 489-52 GSM and DCS

Reference to clauses in EN 301 489-1	Special product-related conditions, additional to or modifying the test conditions in EN 301 489-1 , clause 9
9.2 Radio frequency electromagnetic field 9.2.2 Test method	When using the max hold detector method (see annex B) at each test frequency step initially an unmodulated test signal shall be applied. Then the test modulation shall be applied. The test shall be repeated with the equipment in the idle mode of operation and the exclusion band shall not be used during this test.
9.5 Radio frequency, common mode	When using the max hold detector method (see annex B) at each test frequency step initially an unmodulated test signal shall be applied. Then the test modulation shall be applied.
9.5.2 Test method	The stepped frequency increments may be 50 kHz increment of the momentary frequency in the frequency range 150 kHz to 5 MHz. When using the max hold detector method, initially at each test frequency step an unmodulated immunity test signal shall be applied. Then the modulation of the immunity RF test signal (1 kHz tone) shall be applied as specified in the EN 301 489-1.
9.6.3 Performance criteria	During tests with pulses 3a and 3b, the performance criteria TT shall apply, see clause 6.2.
9.7.3 Performance criteria; Voltage dips and interruptions	For a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms the performance criteria TT or CR specified in clauses 6.2 or 6.3 shall apply as appropriate.

Draft EN 301 489-52 CDMA Direct Spread (UTRA and E-UTRA)

Reference to clauses in EN 301 489-1	Special product-related conditions, additional to or modifying the test conditions in EN 301 489-1, clause 9
9.2 Radio frequency electromagnetic field 9.2.2 Test method	When using the max hold detector method (see annex B) at each test frequency step initially an unmodulated test signal shall be applied. Then the test modulation shall be applied.
9.5 Radio frequency, common mode 9.5.2 Test method	There is no exclusion band for the equipment in the scope of the present document. When using the max hold detector method (see annex B) at each test frequency step initially an unmodulated test signal shall be applied. Then the test modulation shall be applied. The procedure used for identifying narrowband responses does not apply to conducted immunity tests in the frequency range 150 kHz to 80 MHz (see clause 4.4).
9.6.3 Performance criteria	During tests with pulses 3a and 3b, the performance criteria TT shall apply, see clause 6.2.

Draft EN 301 489-17

No special conditions.

4.4 Electrostatic Discharge (ESD)

4.4.1 Test Specification of Electrostatic Discharge (ESD)

Basic Standard	EN 61000-4-2
Discharge Voltage	Contact Discharge: ± 2 kV / ± 4 kV Air Discharge: ± 2 kV / ± 4 kV / ± 8 kV
Discharge Impedance	330 ohm / 150 pF
Number of Discharge	Air Discharge: minimum 20 times at each test point Contact Discharge: minimum 20 times at each test point
Discharge Mode	Single Discharge
Discharge Period	1 second minimum

4.4.2 Test Procedures

a. In the case of air discharge testing the climatic conditions shall be within the following ranges:
- ambient temperature: 15°C to 35°C;
- relative humidity : 30% to 60%;
- atmospheric pressure : 86 kPa (860 mbar) to 106 kPa (1060 mbar).

b. Test programs and software shall be chosen so as to exercise all normal modes of operation of the EUT. The use of special exercising software is encouraged, but permitted only where it can be shown that the EUT is being comprehensively exercised.

c. The test voltage shall be increased from the minimum to the selected test severity level, in order to determine any threshold of failure. The final severity level should not exceed the product specification value in order to avoid damage to the equipment.

d. The test shall be performed with both air discharge and contact discharge. On preselected points at least 10 single discharges (in the most sensitive polarity) shall be applied on air discharge. On preselected points at least 10 single discharges (in the most sensitive polarity) shall be applied on contact discharge.

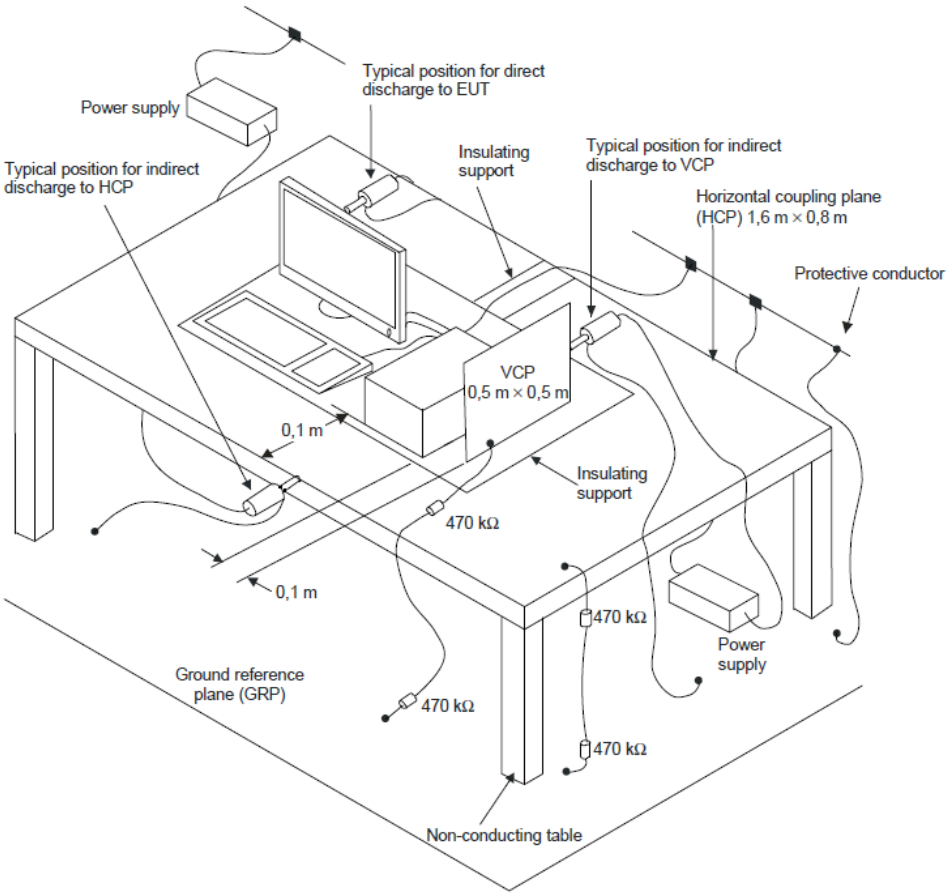
e. For the time interval between successive single discharges an initial value of one second is recommended. Longer intervals may be determined whether a system failure has occurred.

f. In the case of contact discharges, the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.

g. In the case of painted surface covering a conducting substrate, the following procedure shall be adopted:
- If the coating is not declared to be an insulating coating by the equipment manufacturer, then the pointed tip of the generator shall penetrate the coating so as to make contact with the conducting substrate.
- Coating declared as insulating by the manufacturer shall only be submitted to the air discharge.
- The contact discharge test shall not be applied to such surfaces.

h. In the case of air discharges, the round discharge tip of the discharge electrode shall be approached as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator (discharge electrode) shall be removed from the EUT. The generator is then retriggered for a new single discharge. This procedure shall be repeated until the discharges are completed. In the case of an air discharge test, the discharge switch, which is used for contact discharge, shall be closed.

4.4.3 Test Setup



The test setup shall consist of a non-conductive table, (0.8 ± 0.08) m high, standing on the ground reference plane.

A horizontal coupling plane (HCP), (1.6 ± 0.02) m × (0.8 ± 0.02) m, shall be placed on the table. The EUT and its cables shall be isolated from the coupling plane by an insulating support (0.5 ± 0.05) mm in thickness.

4.4.4 Test Result of Electrostatic Discharge (ESD)

Test Mode	1, 4				
Direct Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Contact Discharge**	**Air Discharge**	**Performance Criteria**
2, 4, 8	+/-	1, 2	N/A	Note	CT/CR (A)
2, 4	+/-	3, 4	Note	N/A	CT/CR (A)
Indirect Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Horizontal Coupling Plane (HCP)**	**Vertical Coupling Plane (VCP)**	**Performance Criteria**
2, 4	+/-	At front, rear, left and right side	Note	Note	CT/CR (A)

Note: There was no abnormal situation during the test compared with initial operation.

Test Mode	2				
Direct Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Contact Discharge**	**Air Discharge**	**Performance Criteria**
2, 4, 8	+/-	1	N/A	Note	CT/CR (A)
2, 4	+/-	2	Note	N/A	CT/CR (A)
Indirect Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Horizontal Coupling Plane (HCP)**	**Vertical Coupling Plane (VCP)**	**Performance Criteria**
2, 4	+/-	At front, rear, left and right side	Note	Note	CT/CR (A)

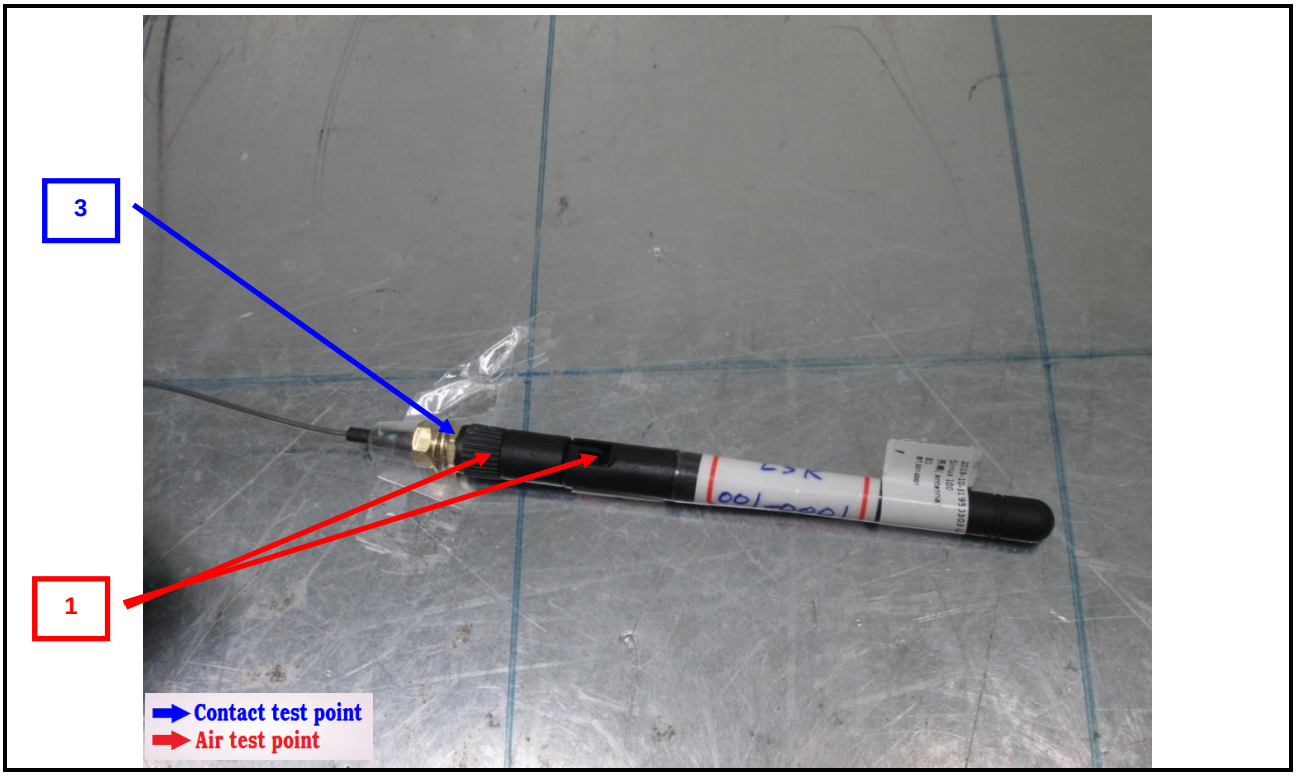
Note: There was no abnormal situation during the test compared with initial operation.

Test Mode	3, 5, 6, 7				
Indirect Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Horizontal Coupling Plane (HCP)**	**Vertical Coupling Plane (VCP)**	**Performance Criteria**
2, 4	+/-	At front, rear, left and right side	Note	Note	CT/CR (A)

Note: There was no abnormal situation during the test compared with initial operation.

4.4.5 Test Point Photo

Mode 1 & 4



Mode 2

4.5 Radio Frequency Electromagnetic Field (RS)

4.5.1 Test Specification of Radio Frequency Electromagnetic Field (RS)

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
Antenna Distance	80 MHz ~ 1000 MHz: 3 m 1000 MHz ~ 6000 MHz: 1 m
Dwell Time	3 seconds

4.5.2 Test Procedures

a. The test level shall be 3 V/m (measured unmodulated). The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1000 Hz. If the wanted signal is modulated at 1000 Hz, then an audio signal of 400 Hz shall be used.

b. The test shall be performed over the frequency range 80 MHz to 6000 MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers, as appropriate.

c. For receivers and transmitters the stepped frequency increments shall be 1 % frequency increment of the momentary used frequency, unless specified otherwise in the part of EN 301 489 series [i.13] dealing with the relevant type of radio equipment.

d. Further product related spot frequency tests may be specified in the relevant part of EN 301 489 series [i.13] dealing with the particular type of radio equipment.

e. Responses on receivers occurring at discrete frequencies, which are narrow band responses, shall be disregarded from the test.

f. The frequencies selected and used during the test shall be recorded in the test report.

g. When testing at frequencies above 1 GHz, the test distance shall be 1 m when using the independent windows method. Compliance with the field uniformity requirement shall be verified for the selected test distance.

h. The alternative method for frequencies above 1 GHz divides the calibration area into a suitable array of 0,5 m × 0,5 m windows such that the whole area to be occupied by the face of the EUT is covered. The field uniformity shall be independently calibrated over each window.

i. During the test, at each frequency the forward power shall be applied to the field-generating antenna. The test shall be repeated with the field-generating antenna repositioned to illuminate each of the required windows in turn.

4.5.3 Exclusion bands

Draft EN 301 489-17

The frequencies on which the transmitter part of the EUT is intended to operate shall be excluded from radiated emission measurements when performed in transmit mode of operation.

There shall be no frequency exclusion band applied to emission measurements of the receiver part of transceivers or the stand alone receiver under test, and/or associated ancillary equipment.

The exclusion band for immunity testing of equipment operating in the 2,4 GHz band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -120 MHz, i.e. 2 280 MHz;
- upper limit of exclusion band = highest allocated band edge frequency +120 MHz, i.e. 2 603,5MHz.

The exclusion band for immunity testing of equipment operating in the 5 GHz Wi-Fi band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 4 880 MHz;
- upper limit of exclusion band = highest allocated band edge frequency +270 MHz, i.e. 5 995 MHz.

The exclusion band for immunity testing of equipment operating in the 5,8 GHz band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 5 455 MHz;
- as the immunity requirements have an upper frequency range of 6 GHz and any upper edge exclusion band would be greater than this for the 5,8 GHz band. The above frequency shall also be regarded as the upper end of the test range.

NOTE: These receiver exclusion band ranges align with the relevant blocking test ranges.

Draft EN 301 489-52

GSM and DCS Receiver and receivers of duplex transceivers exclusion band

- The exclusion band for receivers and receiver sections of transceivers is the band of frequencies over which no immunity tests with radiated RF are made.
- As defined in clause 4.3.3 of ETSI EN 301 489-1 where n=1 and Channel Width is 200 kHz.

GSM and DCS Transmitter exclusion band

- The exclusion band for transmitters and transmitter sections of transceivers is the band of frequencies over which no immunity tests with radiated RF are made.
- The exclusion band for transmitters is as defined in clause 4.3.2.2 of ETSI EN 301 489-1 250 % of the channel width either side of the nominal operating frequency of the transmitter.

CDMA Direct Spread (UTRA and E-UTRA) Transmitter exclusion band

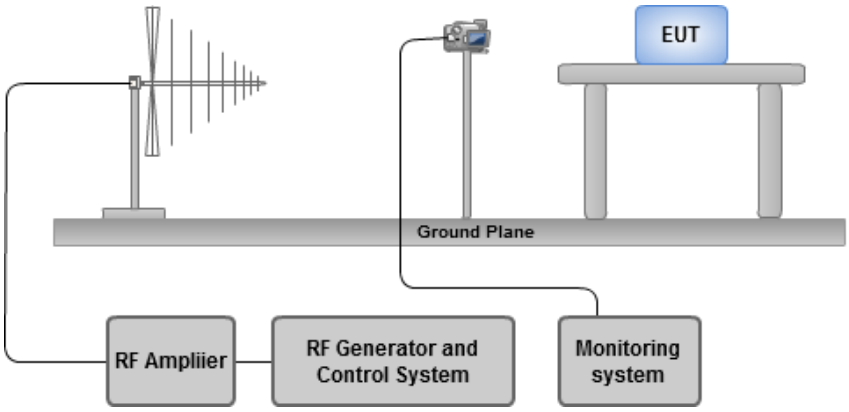
- UTRA
  - In the frequency bands including in band emissions and out of band emissions are covered by the RF spectral mask specification and need no further consideration.
  - For the purpose of EMC specifications the transmitter exclusion band this shall be as defined in clause 4.3.2.2 of ETSI EN 301 489-1.
- E-UTRA
  - For the purpose of EMC specifications there shall be a transmitter exclusion band as defined in clause 4.3.2.2 of ETSI EN 301 489-1 where BWChannel is the channel bandwidth as defined in ETSI TS 136 101.

CDMA Direct Spread (UTRA and E-UTRA) Receiver exclusion band

As defined in clause 4.3.3 of ETSI EN 301 489-1 where n=1 and Channel Width is as follows:

- UTRA Channel Width 5 MHz.
- E-UTRA Channel Width 20 MHz.

4.5.4 Test Setup



Note: The procedure defined in this part requires the generation of electromagnetic fields within which the test sample is placed and its operation observed. To generate fields that are useful for simulation of actual (field) conditions may require significant antenna drive power and the resultant high field strength levels. To comply with local regulations and to prevent biological hazards to the testing personnel, it is recommended that these tests be carried out in a shielded enclosure or semi-anechoic chamber.

4.5.5 Test Result of Radio Frequency Electromagnetic Field (RS)

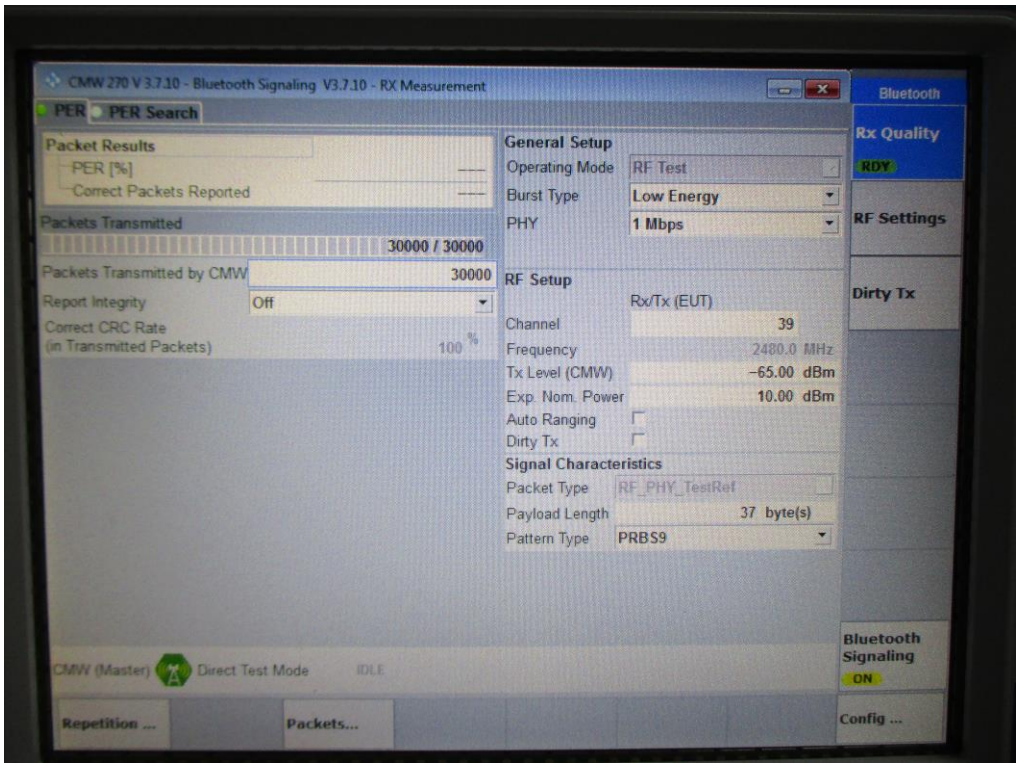
Test Mode	1~7					
Frequency Range (MHz)	**Azimuth**	**Polarity**	**Test Field Strength (V/m)**	**Obser--vation**	**Performance Criteria**	**Remarks**
80 - 6000	0, 90, 180, 270	V&H	3	Note 1	CT/CR (A)	---
80 - 6000	0, 90, 180, 270	V&H	3	Note 2	CT/CR (A)	Throughput shall be ≥ 95%

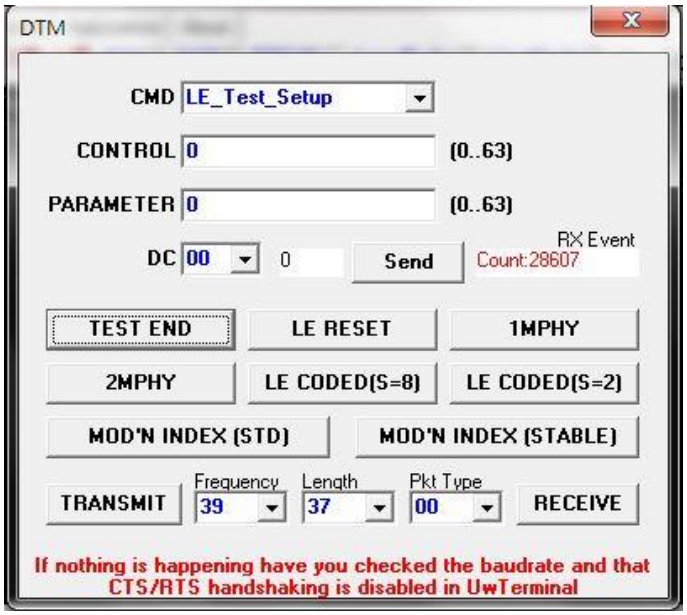
Note:
1) There was no abnormal situation during the test compared with initial operation.
2) The throughput of LTE data transfer measurement: During the test, the measured throughput was found no less than 95% of the maximum throughput of the reference measurement channel.

Test Mode	8 ~11				
Frequency Range (MHz)	**Azimuth**	**Polarity**	**Test Field Strength (V/m)**	**Observation**	**Performance Criteria**
80 - 6000	0	V&H	3	Note 1, 2	CT/CR (A)
80 - 6000	90	V&H	3	Note 1, 2	CT/CR (A)
80 - 6000	180	V&H	3	Note 1, 2	CT/CR (A)
80 - 6000	270	V&H	3	Note 1, 2	CT/CR (A)

Note:
1) There was no abnormal situation during the test compared with initial operation.
2) The PER shall be less than or equal to 10%.

PER mode

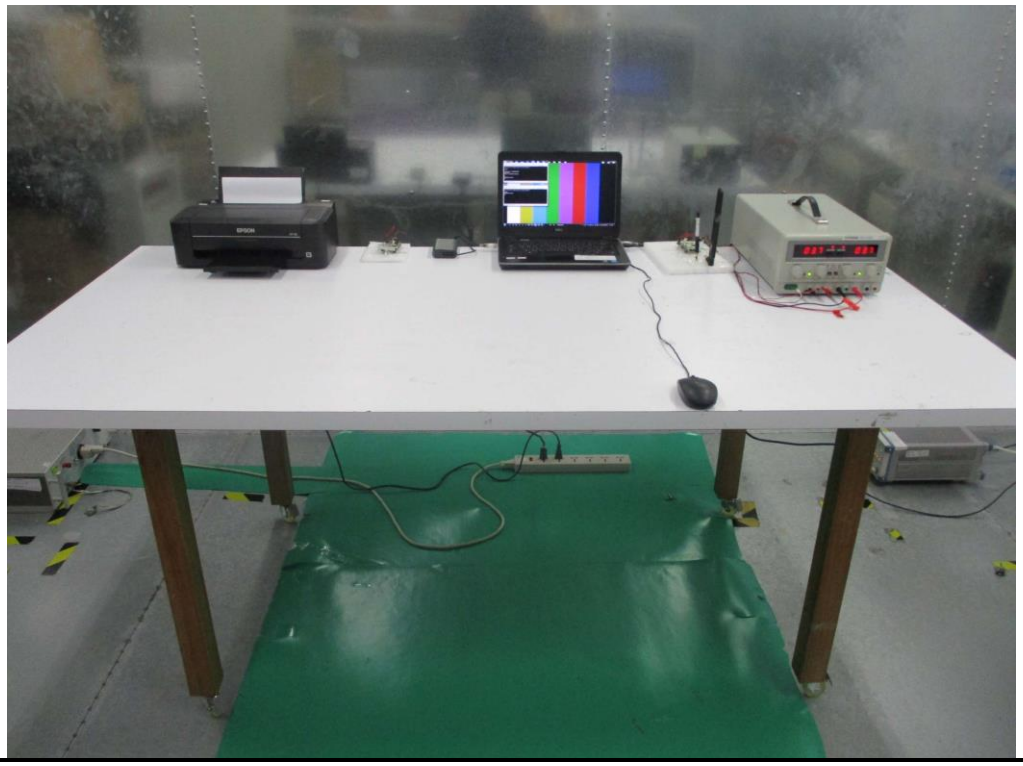


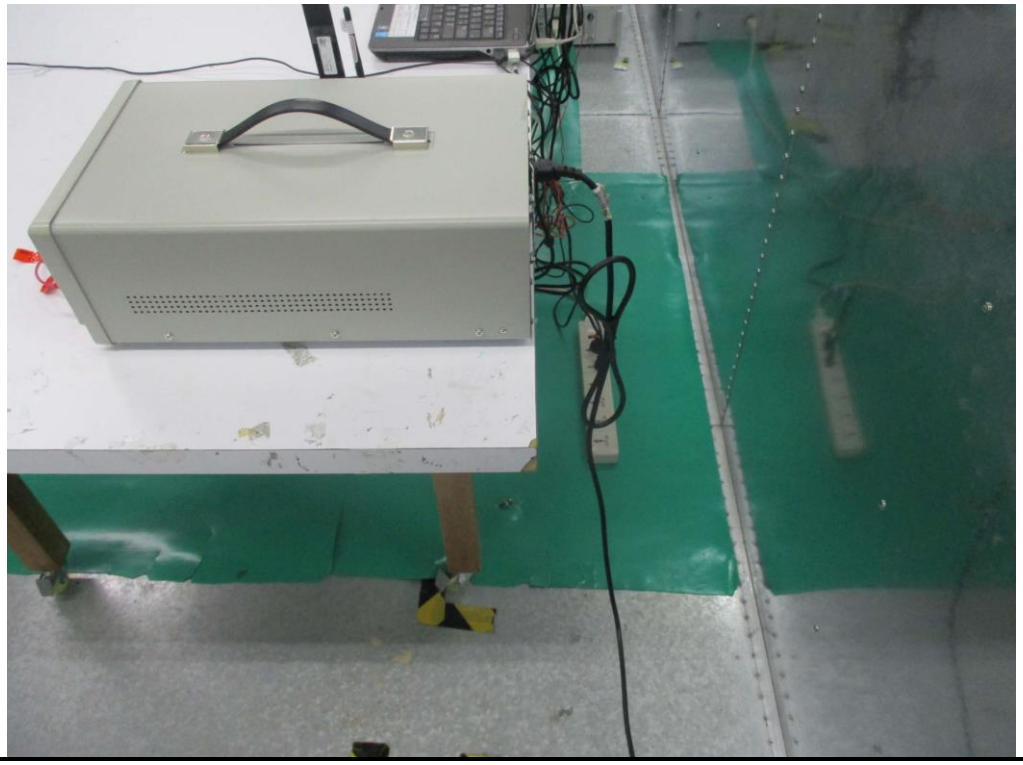


PER (%)=	100*(1-Packets Received number / Packets Sent number)
Packet Sent Numbrs	30000
Packet Received Numbrs	28607
PER (%)=	4.643333333

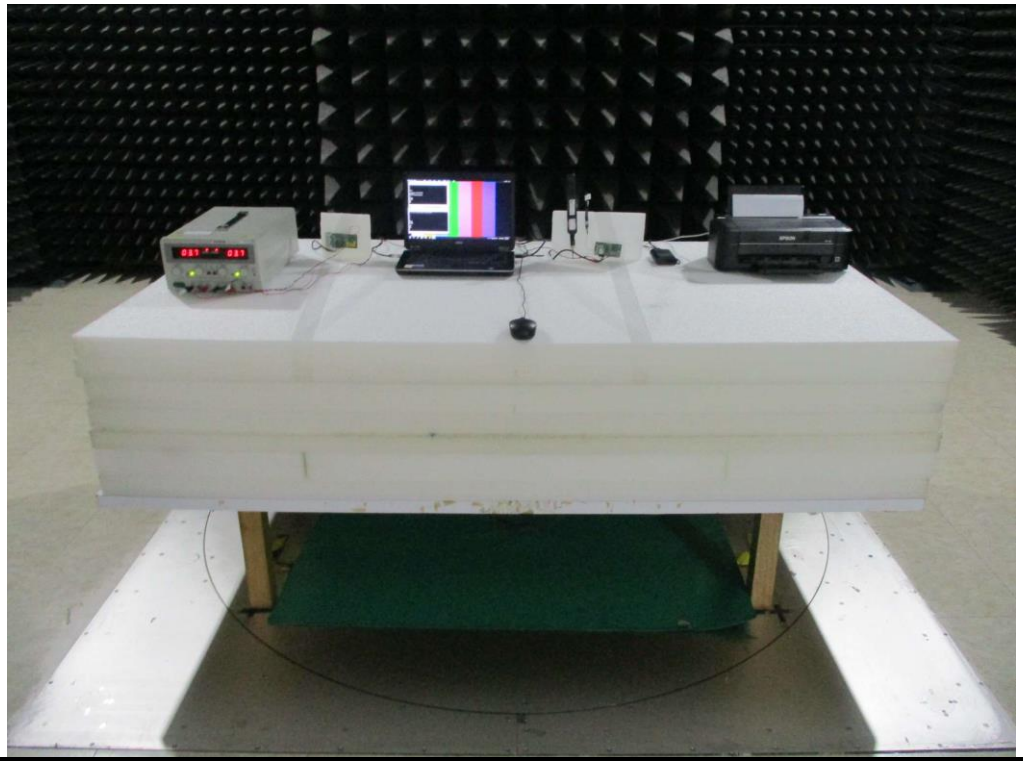
5 Photographs of the Test Configuration

Conducted Emissions from the AC mains power ports

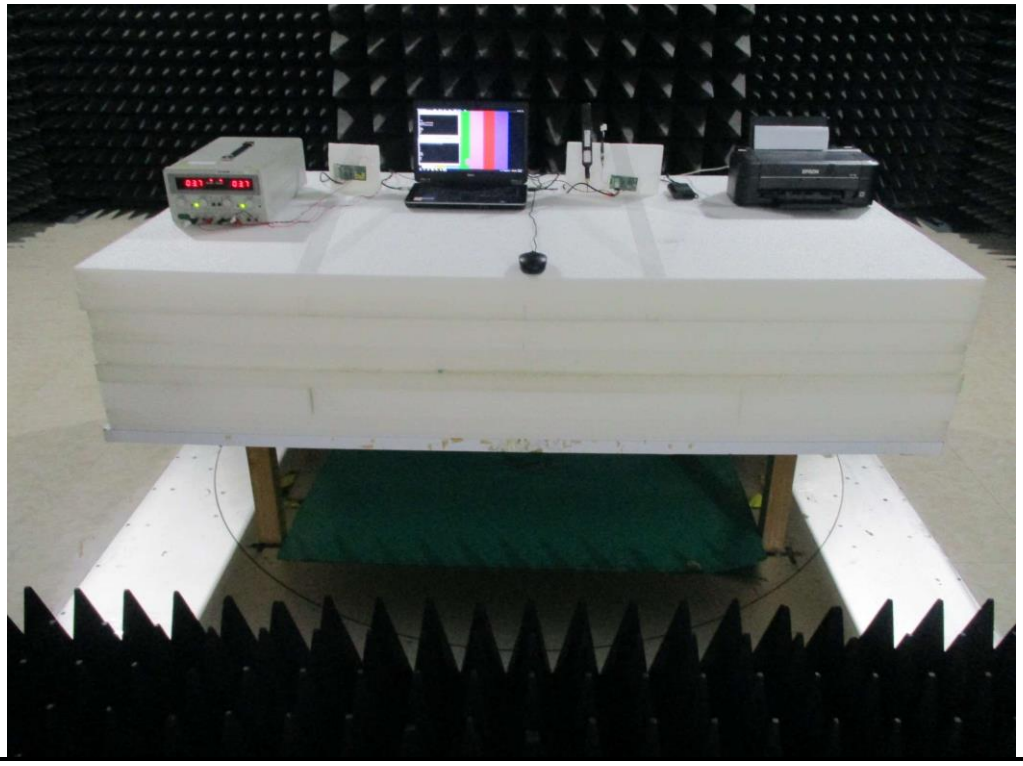


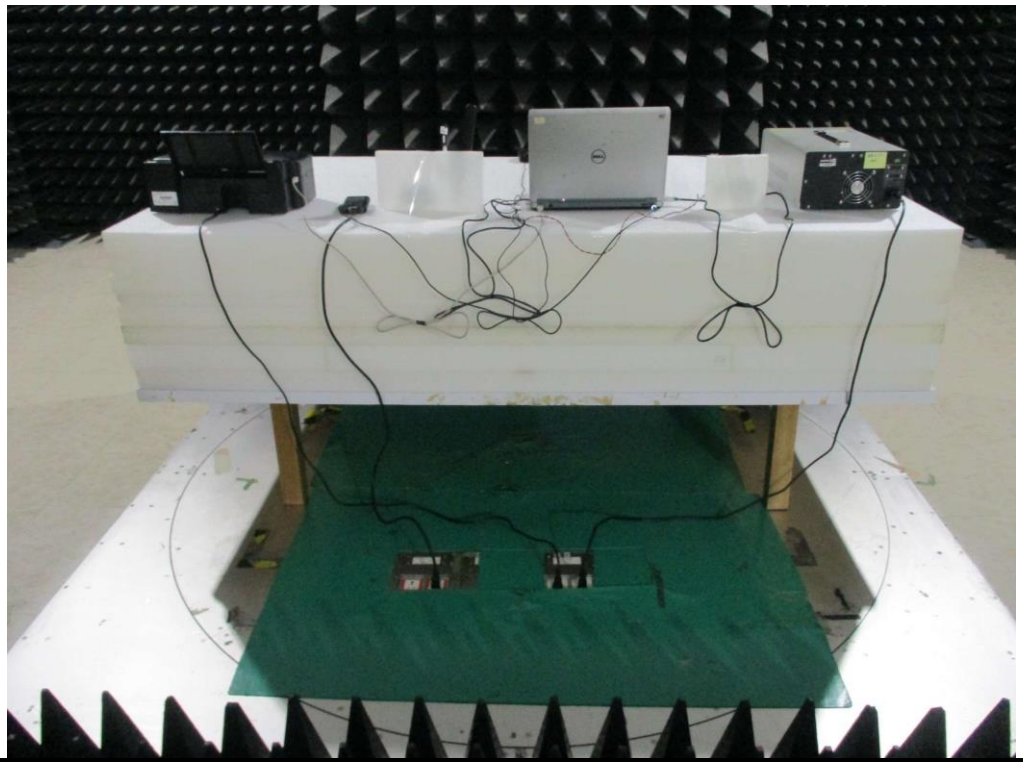


Radiated Emissions below 1GHz test

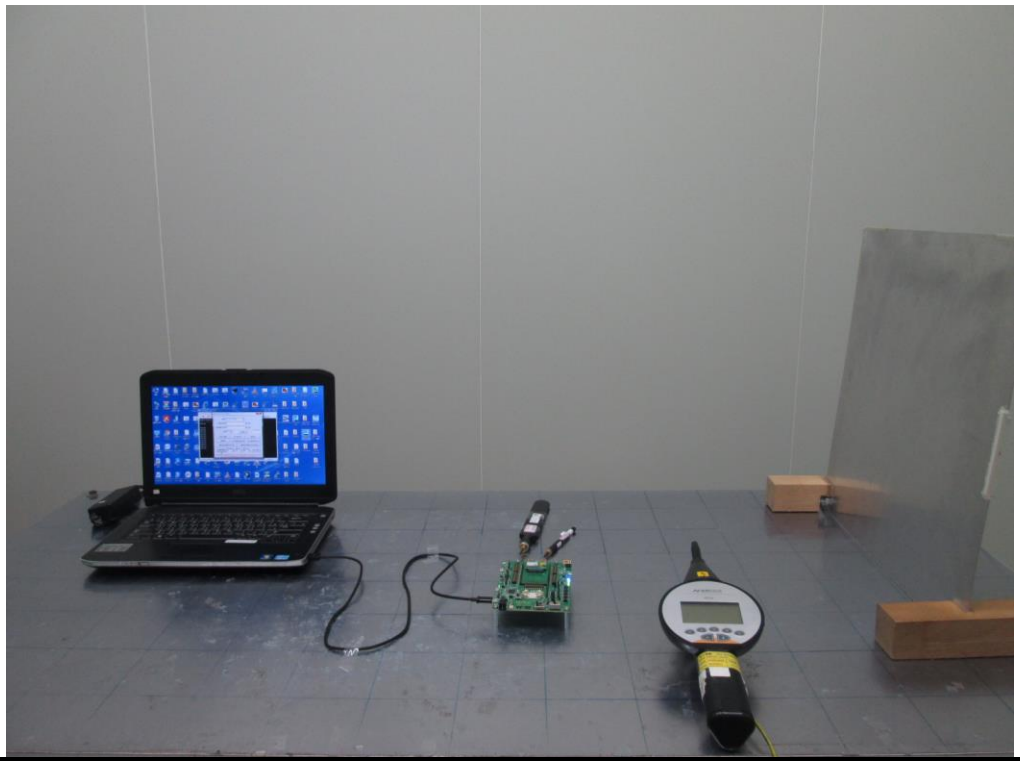


Radiated Emissions above 1GHz test

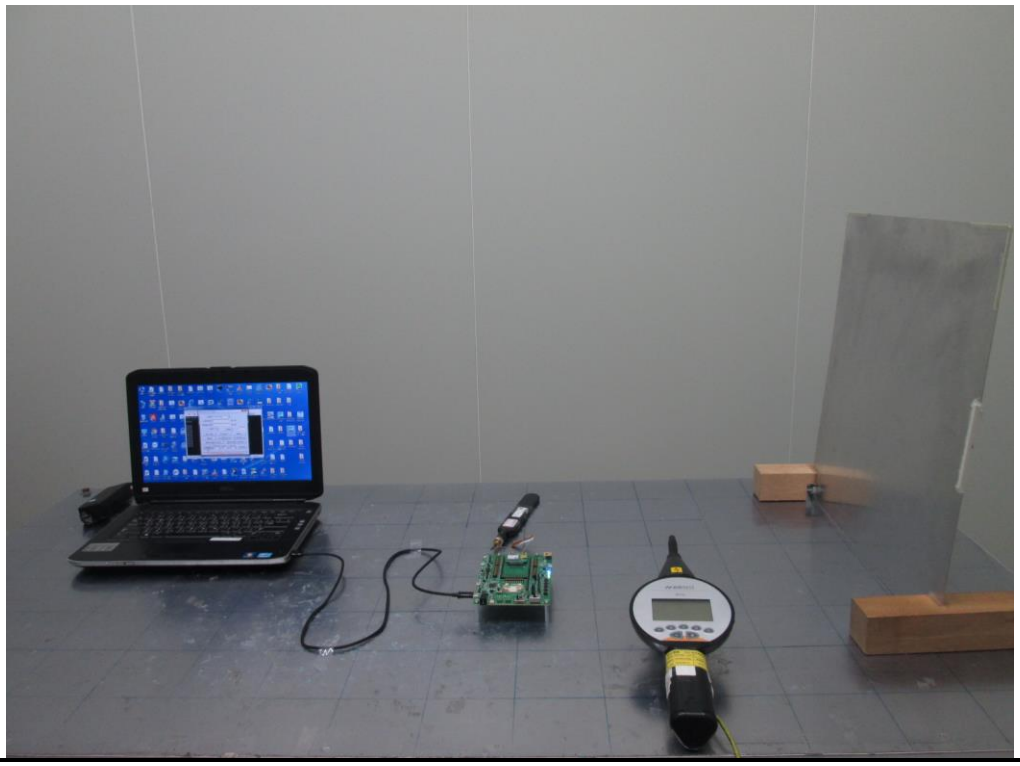




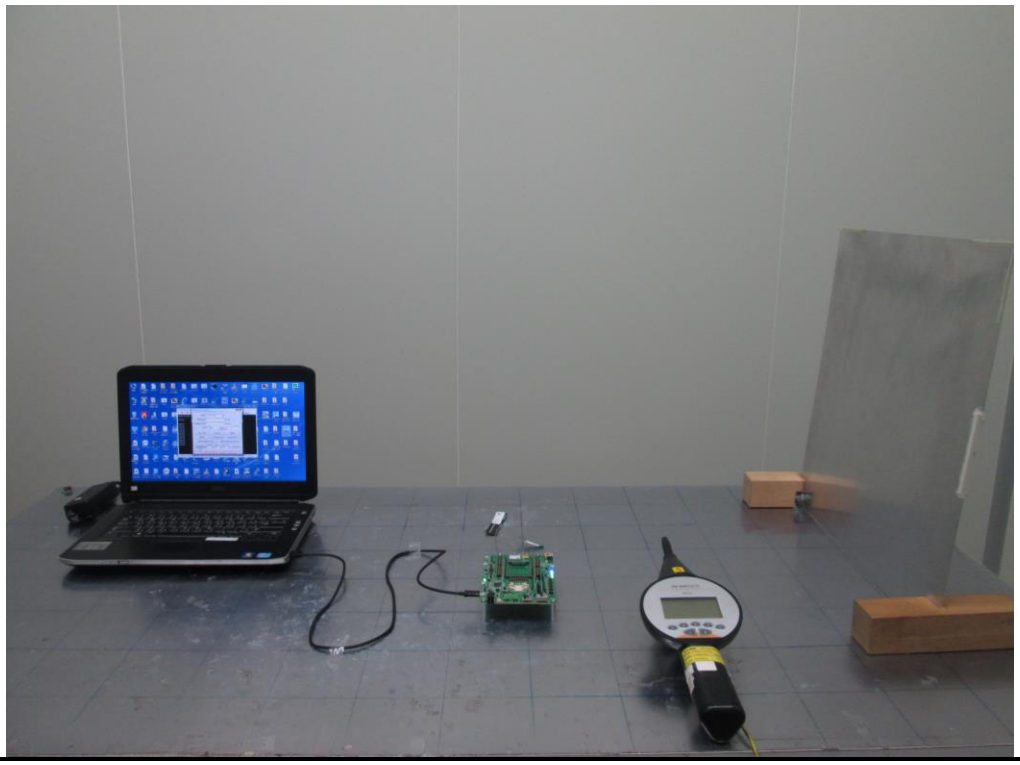
ESD Test (Test mode 1 & 4)



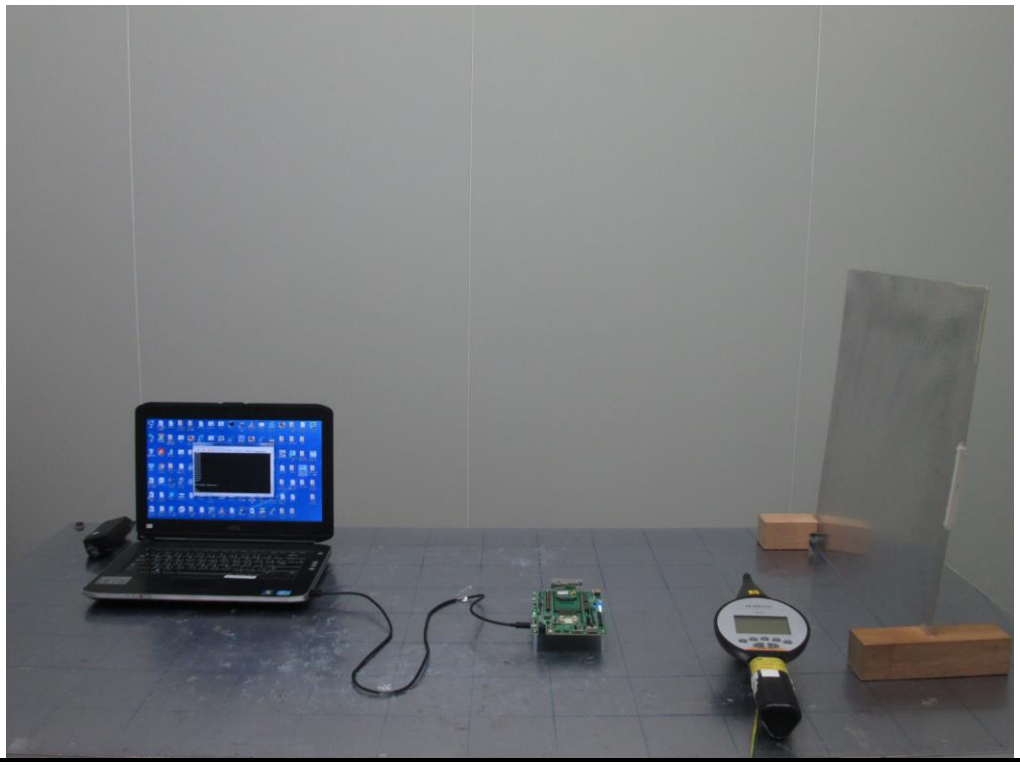
ESD Test (Test mode 2)



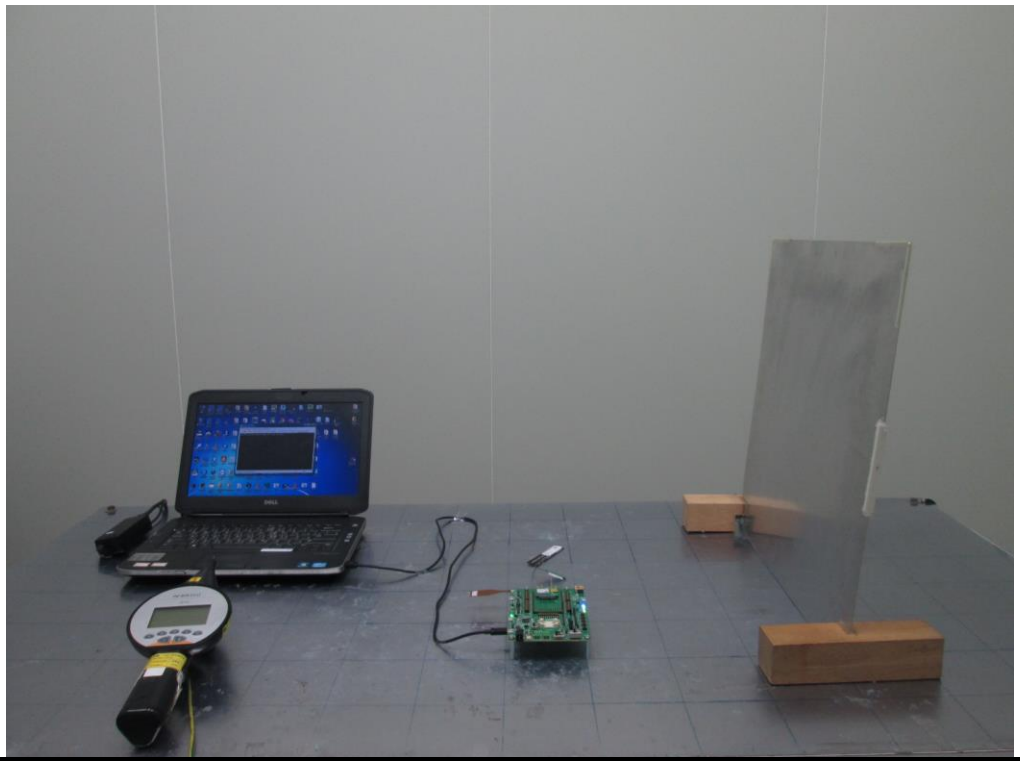
ESD Test (Test mode 3 & 5)



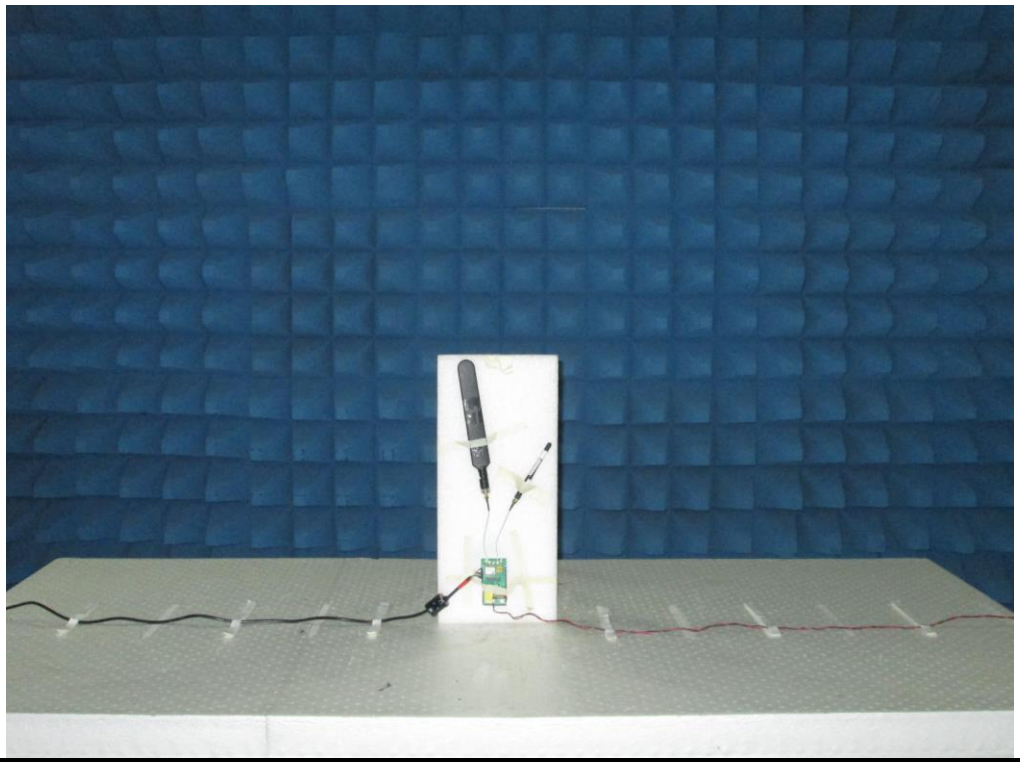
ESD Test (Test mode 6)



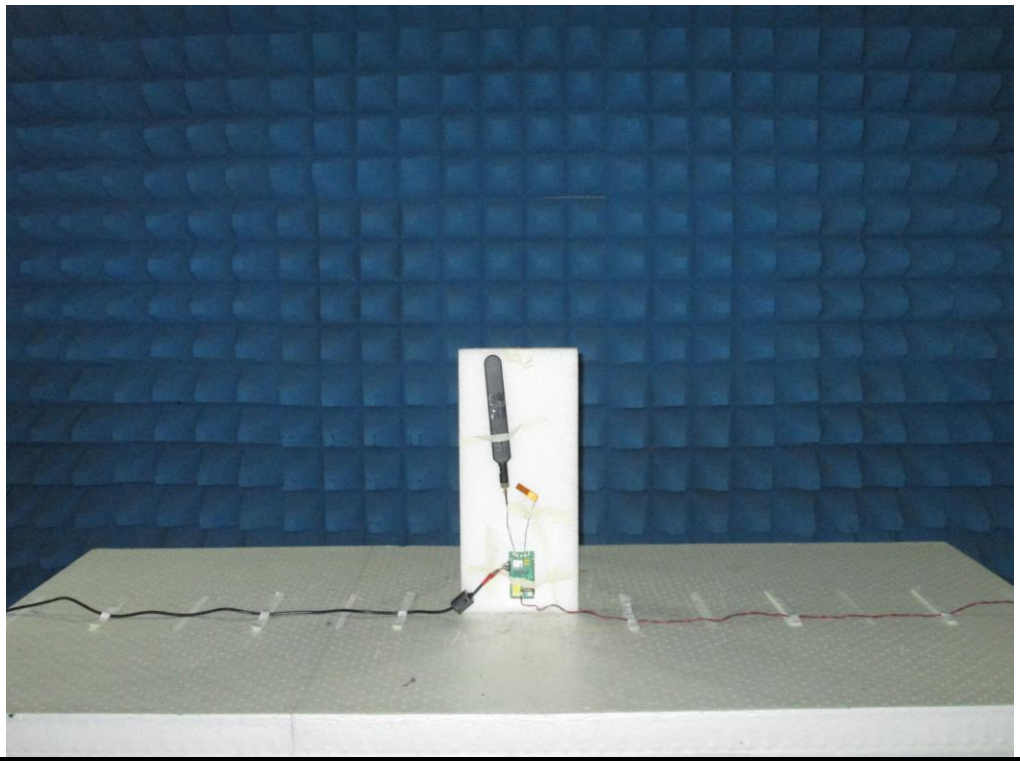
ESD Test (Test mode 7)



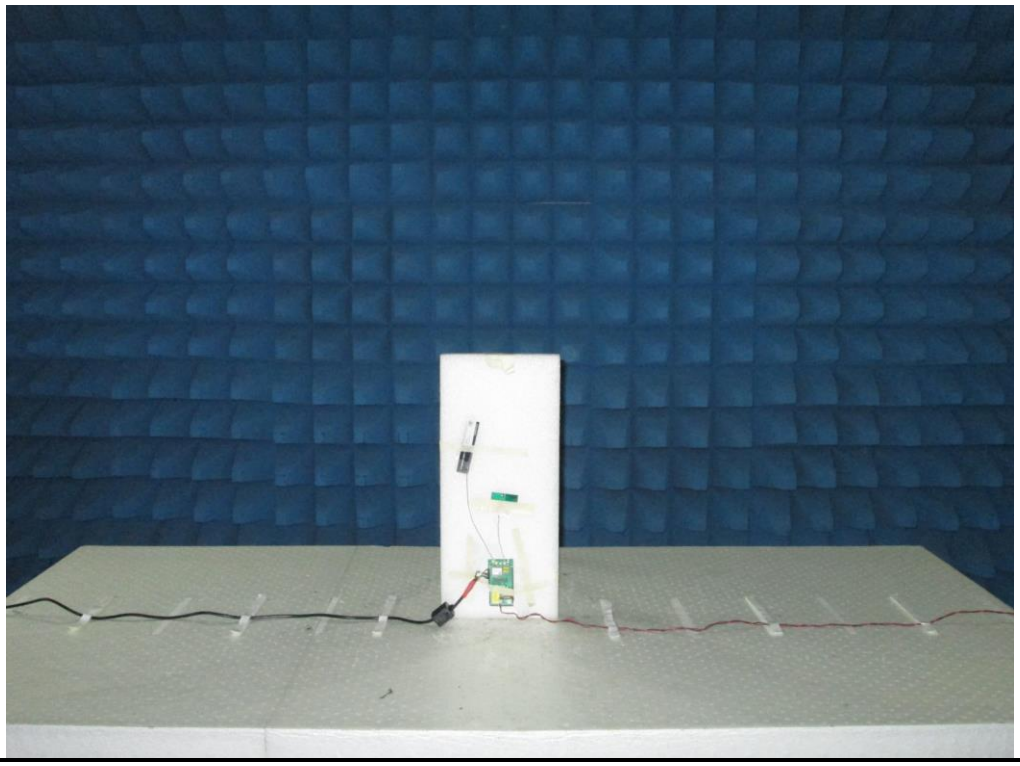
RS Test (Test mode 1, 4 & 8)



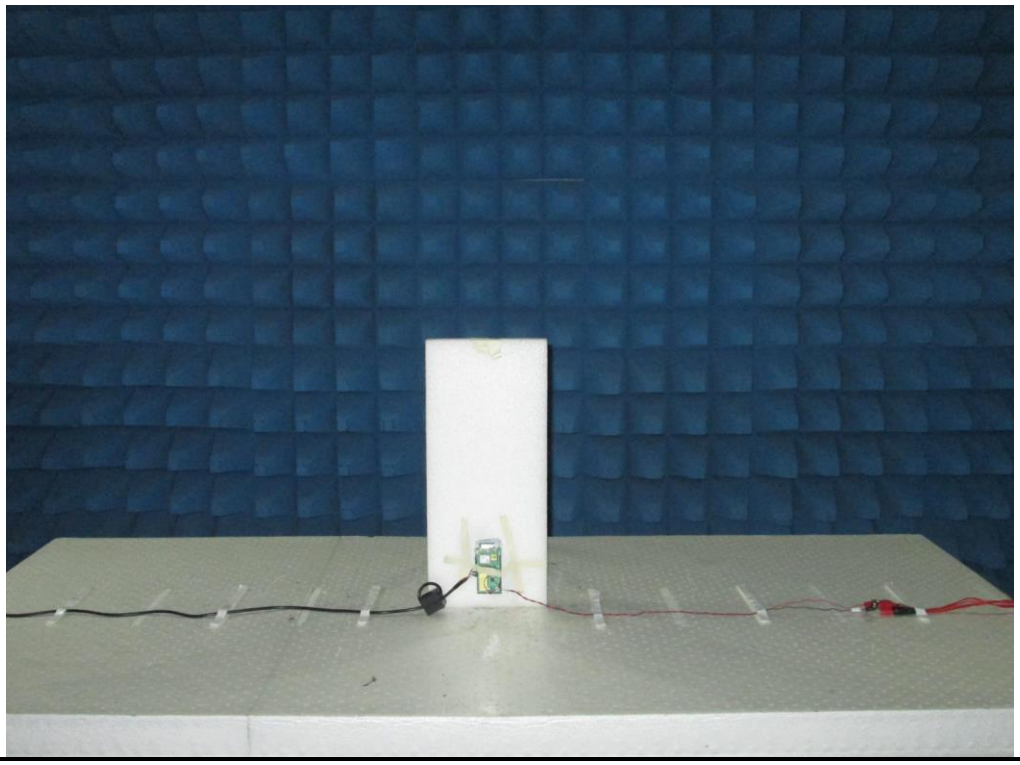
RS Test (Test mode 2 & 9)



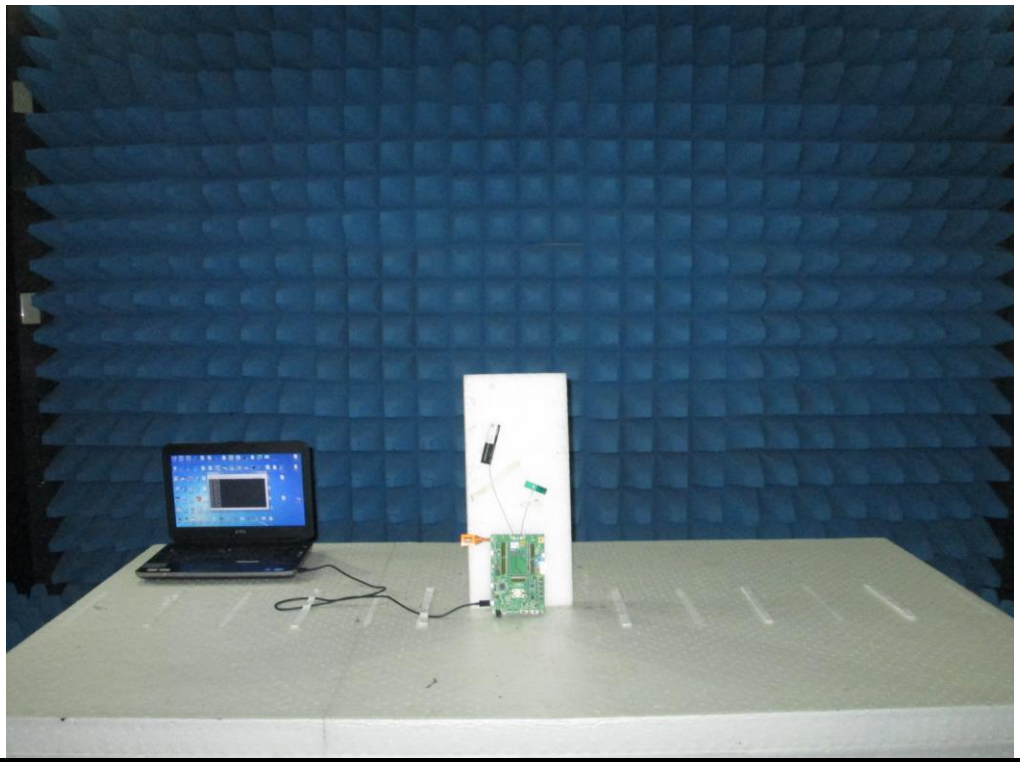
RS Test (Test mode 3, 5 & 10)



RS Test (Test mode 6 & 11)



RS Test (Test mode 7)



6 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666
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Email: ICC_Service@icertifi.com.tw

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