CE EMC Test Report

Equipment	:	**Bluetooth 5.0 BLE Data Module**
Model No.	:	**BL654**
Brand Name	:	**Laird**
Applicant	:	**Laird Technologies**
Address	:	**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**Draft EN 301 489-1 V2.2.0 (2017-03)** **Final draft EN 301 489-3 V2.1.1 (2017-03)** **Draft EN 301 489-17 V3.2.0 (2017-03)**
Received Date	:	**Jan. 30, 2018**
Tested Date	:	**May 03 ~ Jun. 06, 2018**

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

Eason Chang / Assistant Manager

Approved by:

Kent Chen / Assistant Manager

Testing Laboratory 2732

Table of Contents

1 GENERAL DESCRIPTION 5

1.1 Information 5
1.2 Test Equipment and Calibration Data 7
1.3 Testing Applied Standards 8
1.4 Measurement Uncertainty 8

2 TEST CONFIGURATION 9

2.1 Testing Condition 9
2.2 The Worst Case Measurement Configuration 9
2.3 Local Support Equipment List 10
2.4 Test Setup Chart 11
2.5 Test Software and Operating Condition 15

3 EMISSION TEST RESULTS 16

3.1 Conducted Emissions from the AC mains power ports 16

4 IMMUNITY TESTS 32

4.1 General Description 32
4.2 Performance Criteria Description 32
4.3 Special Conditions for EMC Measurements 35
4.4 Electrostatic Discharge (ESD) 36
4.5 Radio Frequency Electromagnetic Field (RS) 40

5 PHOTOGRAPHS OF THE TEST CONFIGURATION 44

6 TEST LABORATORY INFORMATION 58

Release Record

Report No.	Version	Description	Issued Date
EW813002	Rev. 01	Initial issue	Jun. 25, 2018

Summary of Test Results

Draft EN 301 489-1 Emission Tests				
Ref. Std. Clause	**Test Standard**	**Test Items**	**Measured**	**Result**
8.3/8.4	EN 55032:2015/AC:2016, Class B	Conducted Emissions from the AC mains power ports	-14.46dB AV @ 0.152MHz.	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	Note[2]	N/A
8.5	EN 61000-3-2:2014, Class A	Harmonic Current Emissions	Note[3]	N/A
8.6	EN 61000-3-3:2013	Voltage Fluctuations and Flicker	Note[3]	N/A

N/A means Not Applicable.
Note[1]: The EUT w/o telecom port.
Note[2]: According to Clause 7.1 of EN 301 489-1, the test is not required.
Note[3]: The EUT consumes DC power, so the test is not required.

Draft EN 301 489-1 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	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
		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.
"*"Pass criterion is judged by applicant. Test method reported herein was performed according to the method specified by applicant

1 General Description

1.1 Information

1.1.1 Product Details

The following models are provided to this EUT.

Brand Name	Model Name	Product Name	Description
Laird	BL654	Bluetooth 5.0 BLE Data Module	With Printed PCB Antenna
			With Connector Type Antenna

1.1.2 Specification of the Equipment under Test (EUT)

S/W Version	29.1.1.0
Bluetooth	
Operating Frequency	2402 MHz ~ 2480 MHz
Modulation Type	Bluetooth 5.0 LE: GFSK
NFC	
Operating Frequency	13.56 MHz
Modulaton Type	ASK

1.1.3 Antenna Details

Ant. No.	Brand	Model	Type	Connector	Gain (dBi)	Remark
1	Laird	NanoBlue	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
2	Laird	FlexPIFA	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
3	Laird	FlexNotch	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
4	Mag.Layers	EDA-8709-2G4C1-B27-CY	Dipole	IPEX MHF4	2	Connector Type Antenna
5	Laird	mFlexPIFA	PIFA	IPEX MHF4	2	Connector Type Antenna
6	Laird	Laird NFC	NFC	N/A	N/A	Printed PCB Antenna & Connector Type Antenna
7	Laird	BL654-SA PCB printed antenna	Printed PCB	N/A	0	Printed PCB Antenna
8	Walsin	RFDPA870900SBAB8G1	Dipole	SMA	2	Connector Type Antenna

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

Power Supply Type	1.8Vdc & 3.3Vdc from host

1.1.5 Accessories

N/A

1.2 Test Equipment and Calibration Data

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Tested Date	May 03, 2018				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101657	Jan. 05, 2018	Jan. 04, 2019
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 13, 2017	Nov. 12, 2018
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Nov. 24, 2017	Nov. 23, 2018
RF Cable-CON	EMC	EMCCFD300-BM-BM-6000	50821	Dec. 18, 2017	Dec. 17, 2018
50 ohm terminal (Support Unit)	NA	50	04	May 12, 2017	May 11, 2018
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	ESD				
Test Site	ESD room 1 / (ES01-WS)				
Tested Date	May 08, 2018				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
ESD Generator	EMTest	Dito	V1248114239	Aug. 16, 2017	Aug. 15, 2018
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	Jun. 06, 2018				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Signal Generator	R&S	SMB100A	103924HA	Oct. 16, 2017	Oct. 15, 2018
Power Sensor	R&S	NRP-Z91	101094-UL	Oct. 16, 2017	Oct. 15, 2018
Power Sensor	R&S	NRP-Z91	101095-KY	Oct. 16, 2017	Oct. 15, 2018
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:

Draft EN 301 489-1 V2.2.0 (2017-03)
Final draft EN 301 489-3 V2.1.1 (2017-03)
Draft EN 301 489-17 V3.2.0 (2017-03)

1.4 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	150kHz ~ 30MHz	±2.90 dB

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	23°C / 56%	Alex Tsai
ESD	ES01-WS	25°C/50%/100kPa	JN Chen
RS	RS01-WS	24°C/60%/100kPa	JN Chen

2.2 The Worst Case Measurement Configuration

The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Y-plane** results were found as the worst case and were shown in this report.

The Determined Worst Case Configurations	
Conducted Emissions from the AC mains power ports	
Test Mode	**Operating Description**
1	BT Link, ANT: BL654-SA PCB printed antenna, with Notebook, 230V/50Hz
2	BT Link, ANT: NanoBlue, with Notebook, 110V/60Hz
3	BT Link, ANT: mFlexPIFA, with Notebook, 230V/50Hz
4	BT Link, ANT: EDA-8709-2G4C1-B27-CY, with Notebook, 110V/60Hz
5	BT Link, ANT: RFDPA870900SBAB8G1, with Notebook, 230V/50Hz
6	NFC Link, ANT: NanoBlue, with Notebook, 110V/60Hz
7	NFC Link, ANT: Laird NFC, with Notebook, 230V/50Hz
Immunity Tests	
Test Mode	**Operating Description**
1	BT Link, ANT: BL654-SA PCB printed antenna.
2	BT Link, ANT: NanoBlue.
3	BT Link, ANT: mFlexPIFA.
4	BT Link, ANT: EDA-8709-2G4C1-B27-CY.
5	BT Link, ANT: RFDPA870900SBAB8G1.
6	NFC Link, ANT: Laird NFC.
7	BT Link, ANT: FlexNotch.
8	BT Link, ANT: FlexPIFA

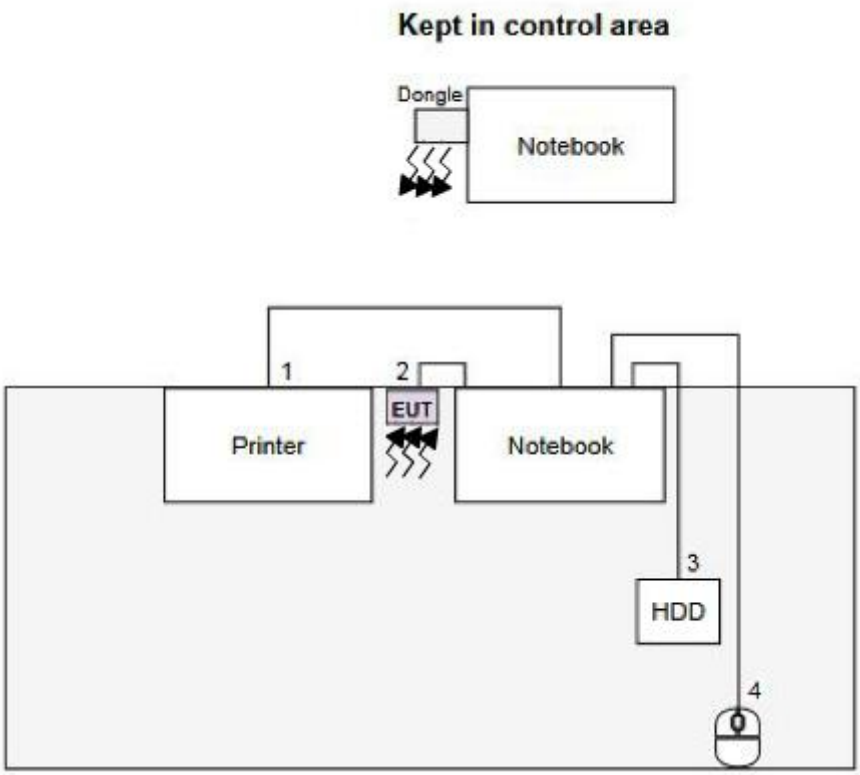
2.3 Local Support Equipment List

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	BT dongle	Laird	BL654-US	---	Provided by applicant. for BT mode
5	Notebook	DELL	Latitude E6440	2PXMD12	---
6	USB 3.0 HDD	WD	WDBKXH5000 ABK	WX31AB210213	---
7	Tablet	SONY	SGP511TW/B	CB5126VXTX	for NFC mode

Support Equipment List (EMS)					
No.	**Equipment**	**Brand**	**Model**	**S/N**	**Remarks**
1	Notebook	DELL	Latitude E5430	6R4RWW1	---
2	BT dongle	Laird	BL654-US	---	Provided by applicant. for BT mode
3	Notebook	DELL	Latitude E6440	8VXMD12	---
4	Tablet	SONY	SGP511TW/B	CB5126VXTX	for NFC mode

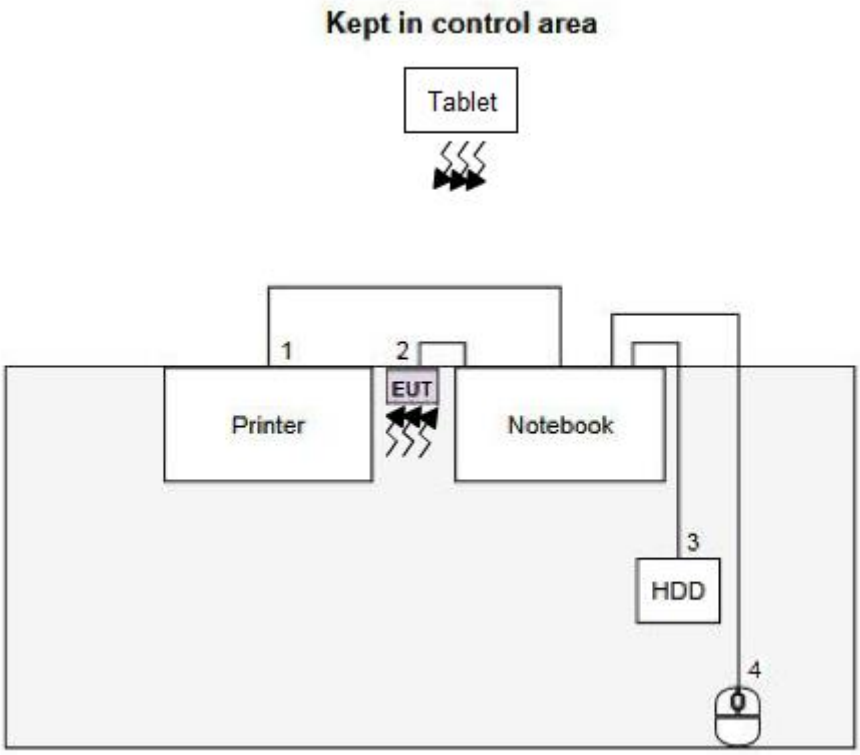
2.4 Test Setup Chart

Test Setup Diagram (EMI, BT Mode)



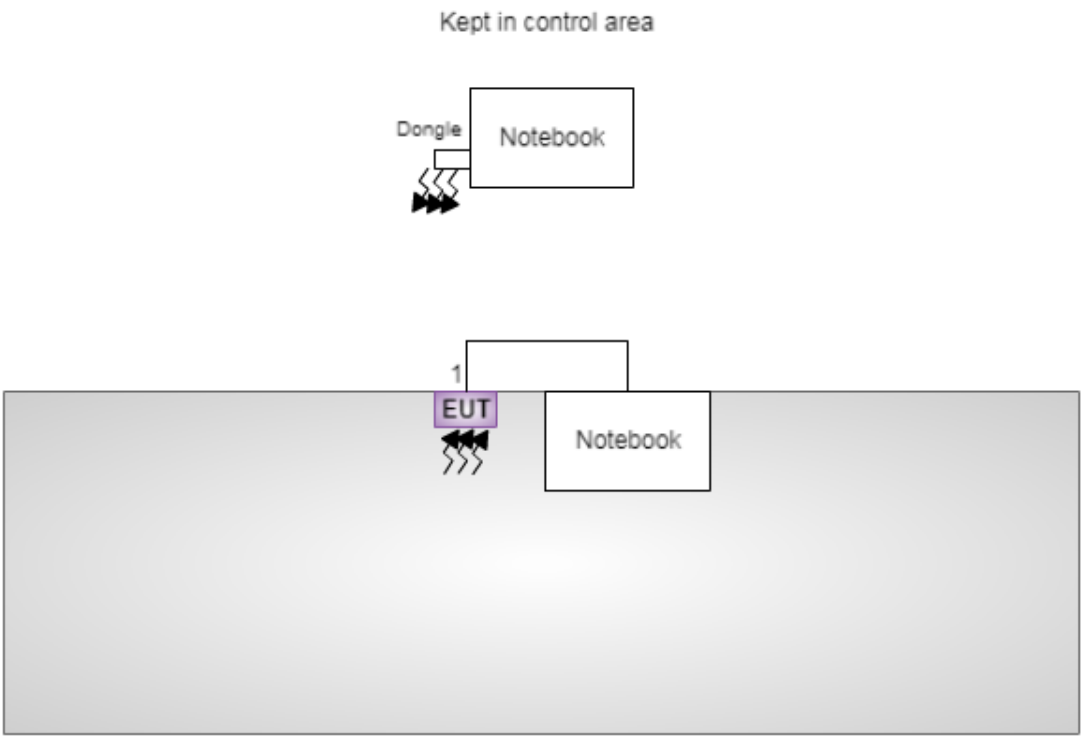
No.	Signal cable / Length (m)
1	USB, 1.8m shielded.
2	USB, 1m shielded.
3	USB, 0.5m shielded.
4	USB, 1.8m shielded.

Test Setup Diagram (EMI, NFC Mode)



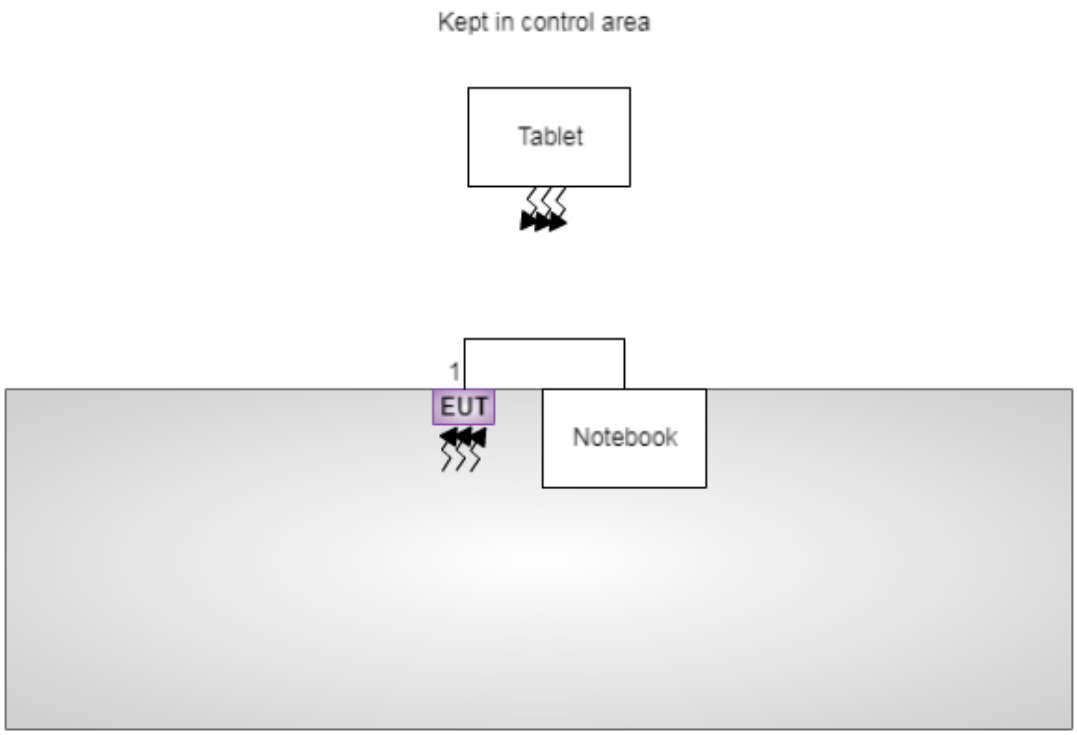
No.	Signal cable / Length (m)
1	USB, 1.8m shielded.
2	USB, 1m shielded.
3	USB, 0.5m shielded.
4	USB, 1.8m shielded.

Test Setup Diagram (EMS, BT Mode)



No.	Signal cable / Length (m)
1	USB, 1.2m shielded.

Test Setup Diagram (EMS, NFC Mode)



No.	Signal cable / Length (m)
1	USB, 1.2m shielded.

2.5 Test Software and Operating Condition

EMI

a. Enabled all function of test system.
b. The support notebook executed “WinEMC.exe” to send “H” patterns to the printer.
c. The support notebook executed “WinEMC.exe” to read and wrote data from USB 3.0 HDD.
d. The notebook executed “KM player.exe” to play colorbar video.
e. The support notebooks executed “UwTerminal.exe” for data transmission by BT. (for BT Mode)
f. The support notebook executed “UwTerminal.exe” to link to tablet by NFC. (for NFC Mode)

EMS

BT Mode

a. The support notebooks executed “UwTerminal.exe” for data transmission by BT.

NFC Mode

a. The support notebook executed “UwTerminal.exe” to link to tablet by NFC.

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 0,50	79	66	66 to 56 *	56 to 46 *
0,50 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.

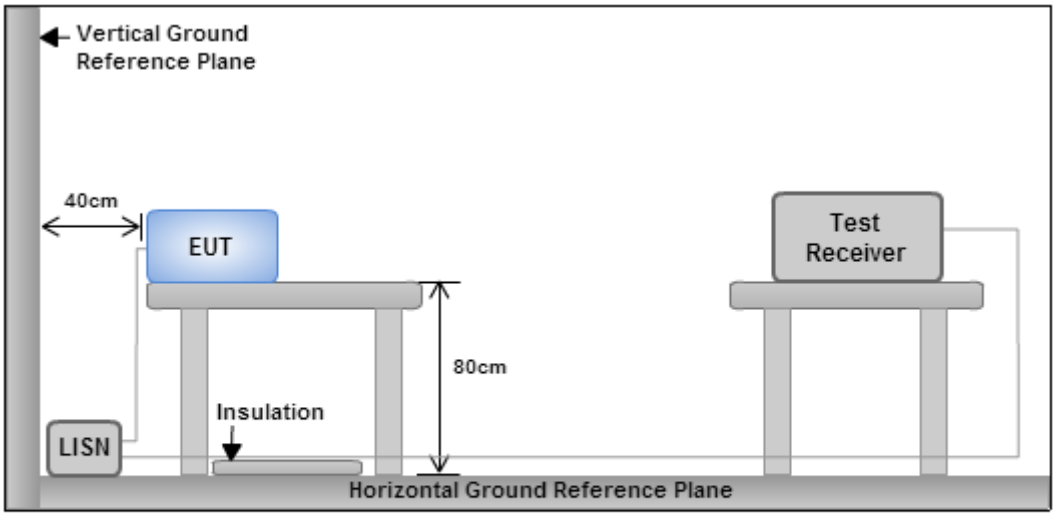
f. The CISPR states that a 50 ohm, 50 microhenry LISN should be used.

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

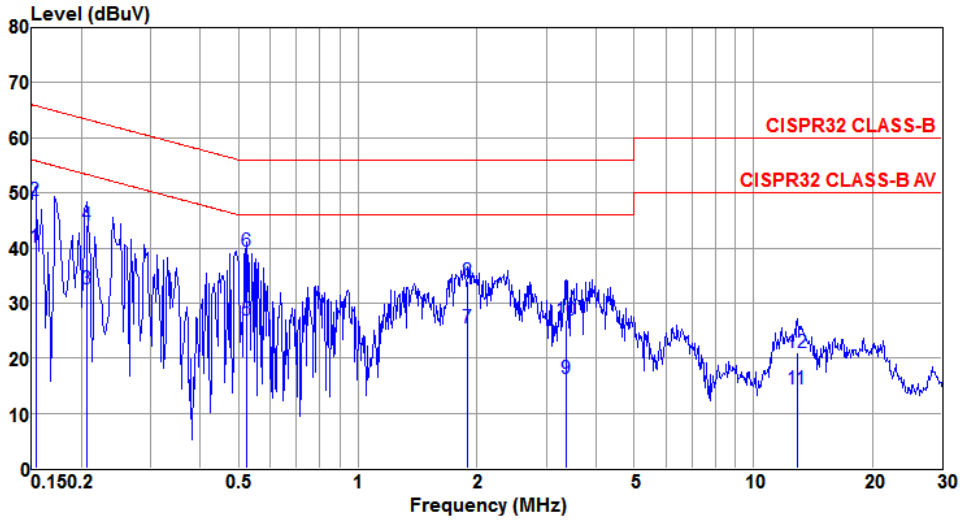


Note: 1. Support units were connected to second LISN.

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

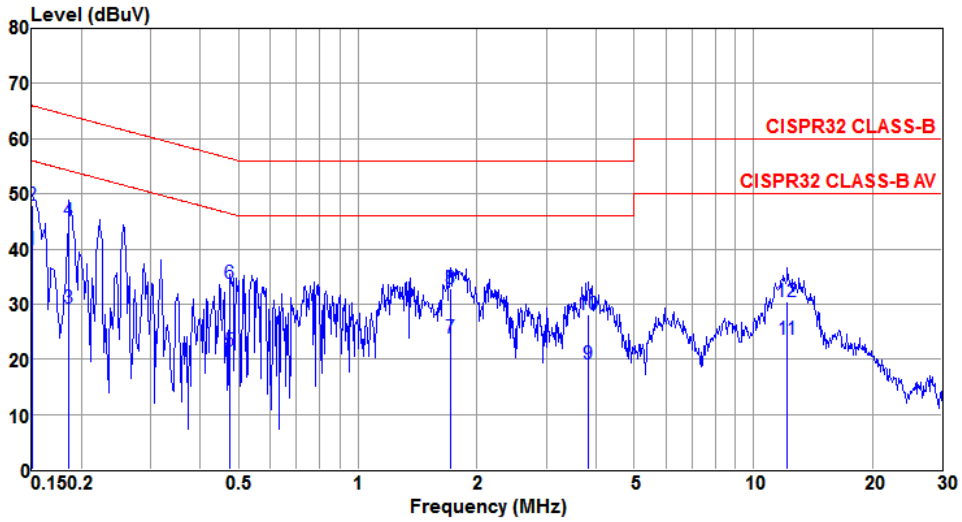
Power Phase	Line	Test Mode	1



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1@	0.153	40.15	55.82	-15.67	40.07	0.07	0.01	Average
2	0.153	48.62	65.82	-17.20	48.54	0.07	0.01	QP
3	0.207	32.56	53.32	-20.76	32.45	0.08	0.03	Average
4	0.207	44.15	63.32	-19.17	44.04	0.08	0.03	QP
5	0.524	26.80	46.00	-19.20	26.70	0.08	0.02	Average
6	0.524	39.39	56.00	-16.61	39.29	0.08	0.02	QP
7	1.898	25.58	46.00	-20.42	25.37	0.11	0.10	Average
8	1.898	34.03	56.00	-21.97	33.82	0.11	0.10	QP
9	3.364	16.39	46.00	-29.61	16.08	0.12	0.19	Average
10	3.364	26.86	56.00	-29.14	26.55	0.12	0.19	QP
11	12.920	14.31	50.00	-35.69	13.76	0.23	0.32	Average
12	12.920	21.08	60.00	-38.92	20.53	0.23	0.32	QP

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

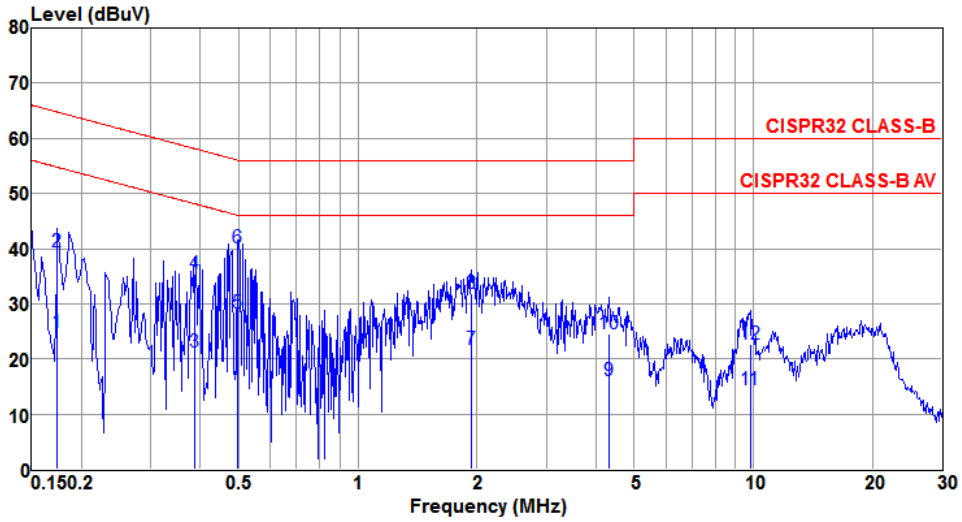
Power Phase	Neutral	Test Mode	1



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1@	0.150	39.95	56.00	-16.05	39.90	0.04	0.01	Average
2	0.150	47.90	66.00	-18.10	47.85	0.04	0.01	QP
3	0.186	29.27	54.20	-24.93	29.20	0.04	0.03	Average
4	0.186	44.99	64.20	-19.21	44.92	0.04	0.03	QP
5	0.476	21.41	46.41	-25.00	21.35	0.04	0.02	Average
6	0.476	33.65	56.41	-22.76	33.59	0.04	0.02	QP
7	1.716	23.93	46.00	-22.07	23.78	0.07	0.08	Average
8	1.716	32.71	56.00	-23.29	32.56	0.07	0.08	QP
9	3.820	19.09	46.00	-26.91	18.79	0.09	0.21	Average
10	3.820	28.16	56.00	-27.84	27.86	0.09	0.21	QP
11	12.188	23.50	50.00	-26.50	22.98	0.20	0.32	Average
12	12.188	30.55	60.00	-29.45	30.03	0.20	0.32	QP

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

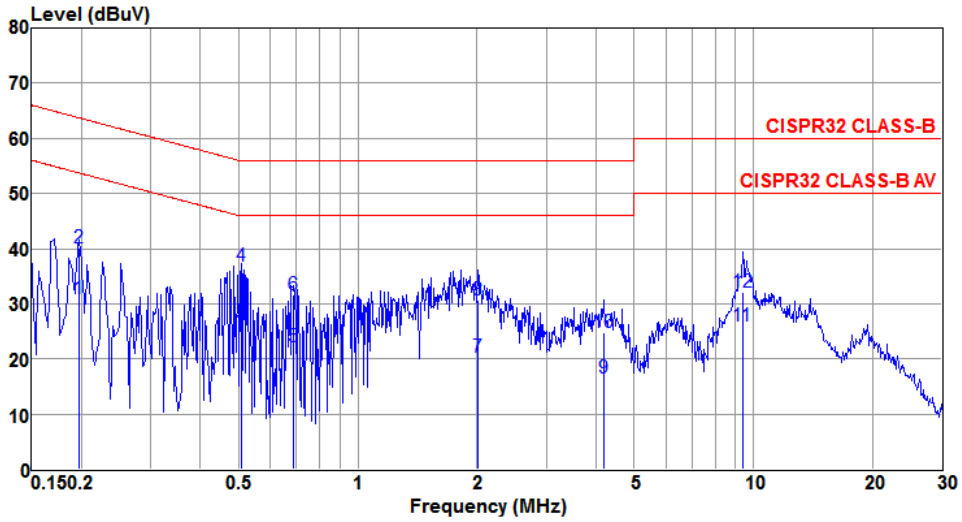
Power Phase	Line	Test Mode	2



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.174	24.82	54.77	-29.95	24.72	0.08	0.02	Average
2	0.174	39.45	64.77	-25.32	39.35	0.08	0.02	QP
3	0.387	21.32	48.12	-26.80	21.22	0.08	0.02	Average
4	0.387	35.36	58.12	-22.76	35.26	0.08	0.02	QP
5	0.497	28.27	46.05	-17.78	28.17	0.08	0.02	Average
6@	0.497	40.21	56.05	-15.84	40.11	0.08	0.02	QP
7	1.939	21.75	46.00	-24.25	21.54	0.11	0.10	Average
8	1.939	31.88	56.00	-24.12	31.67	0.11	0.10	QP
9	4.315	16.10	46.00	-29.90	15.73	0.14	0.23	Average
10	4.315	24.50	56.00	-31.50	24.13	0.14	0.23	QP
11	9.809	14.46	50.00	-35.54	13.94	0.20	0.32	Average
12	9.809	22.70	60.00	-37.30	22.18	0.20	0.32	QP

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

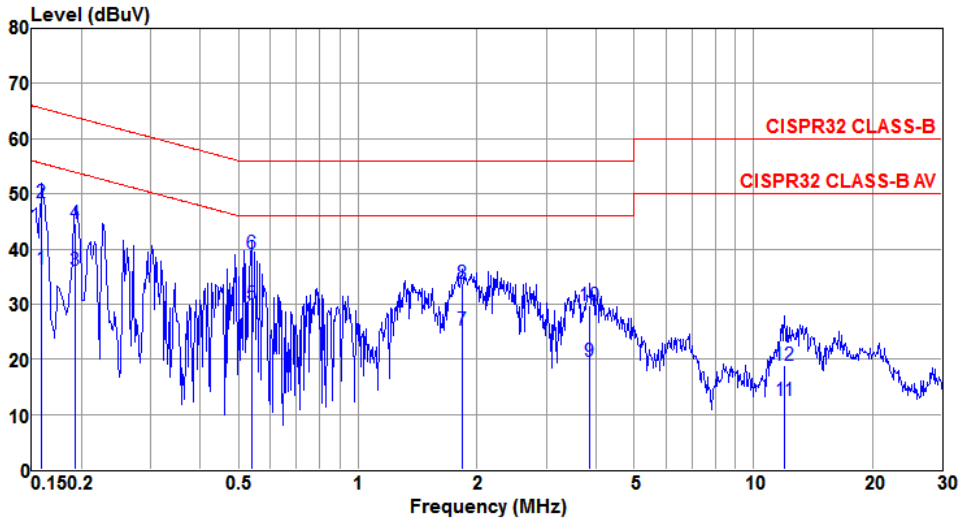
Power Phase	Neutral	Test Mode	2



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.198	30.83	53.71	-22.88	30.76	0.04	0.03	Average
2	0.198	40.13	63.71	-23.58	40.06	0.04	0.03	QP
3	0.507	26.41	46.00	-19.59	26.35	0.04	0.02	Average
4@	0.507	36.74	56.00	-19.26	36.68	0.04	0.02	QP
5	0.686	22.14	46.00	-23.86	22.06	0.05	0.03	Average
6	0.686	31.65	56.00	-24.35	31.57	0.05	0.03	QP
7	2.012	20.27	46.00	-25.73	20.10	0.07	0.10	Average
8	2.012	30.64	56.00	-25.36	30.47	0.07	0.10	QP
9	4.180	16.51	46.00	-29.49	16.20	0.09	0.22	Average
10	4.180	24.71	56.00	-31.29	24.40	0.09	0.22	QP
11	9.401	25.86	50.00	-24.14	25.39	0.16	0.31	Average
12	9.401	32.15	60.00	-27.85	31.68	0.16	0.31	QP

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

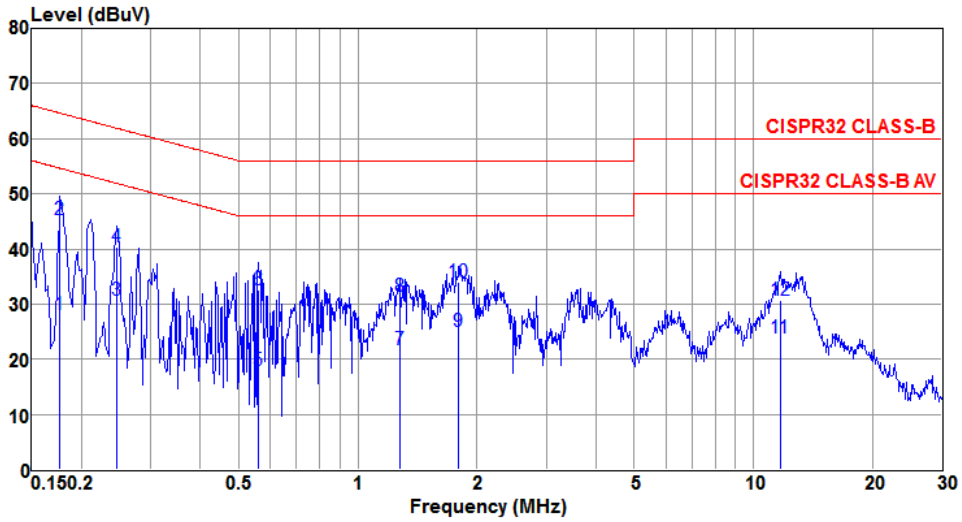
Power Phase	Line	Test Mode	3



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.159	36.30	55.52	-19.22	36.22	0.07	0.01	Average
2	0.159	48.32	65.52	-17.20	48.24	0.07	0.01	QP
3	0.192	36.10	53.93	-17.83	35.99	0.08	0.03	Average
4	0.192	44.58	63.93	-19.35	44.47	0.08	0.03	QP
5@	0.538	30.09	46.00	-15.91	29.99	0.08	0.02	Average
6	0.538	39.29	56.00	-16.71	39.19	0.08	0.02	QP
7	1.839	25.15	46.00	-20.85	24.95	0.11	0.09	Average
8	1.839	33.76	56.00	-22.24	33.56	0.11	0.09	QP
9	3.860	19.52	46.00	-26.48	19.18	0.13	0.21	Average
10	3.860	29.63	56.00	-26.37	29.29	0.13	0.21	QP
11	11.996	12.43	50.00	-37.57	11.89	0.22	0.32	Average
12	11.996	18.79	60.00	-41.21	18.25	0.22	0.32	QP

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

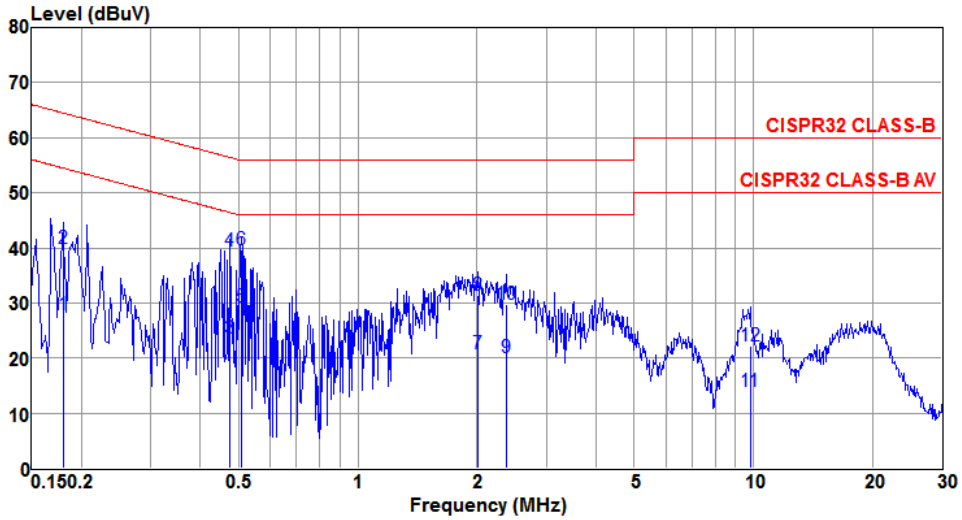
Power Phase	Neutral	Test Mode	3



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.177	28.17	54.64	-26.47	28.11	0.04	0.02	Average
2@	0.177	45.41	64.64	-19.23	45.35	0.04	0.02	QP
3	0.246	30.77	51.91	-21.14	30.70	0.04	0.03	Average
4	0.246	40.45	61.91	-21.46	40.38	0.04	0.03	QP
5	0.561	18.04	46.00	-27.96	17.98	0.04	0.02	Average
6	0.561	32.52	56.00	-23.48	32.46	0.04	0.02	QP
7	1.276	21.71	46.00	-24.29	21.60	0.06	0.05	Average
8	1.276	31.51	56.00	-24.49	31.40	0.06	0.05	QP
9	1.800	25.14	46.00	-20.86	24.98	0.07	0.09	Average
10	1.800	33.92	56.00	-22.08	33.76	0.07	0.09	QP
11	11.683	23.84	50.00	-26.16	23.33	0.19	0.32	Average
12	11.683	30.79	60.00	-29.21	30.28	0.19	0.32	QP

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

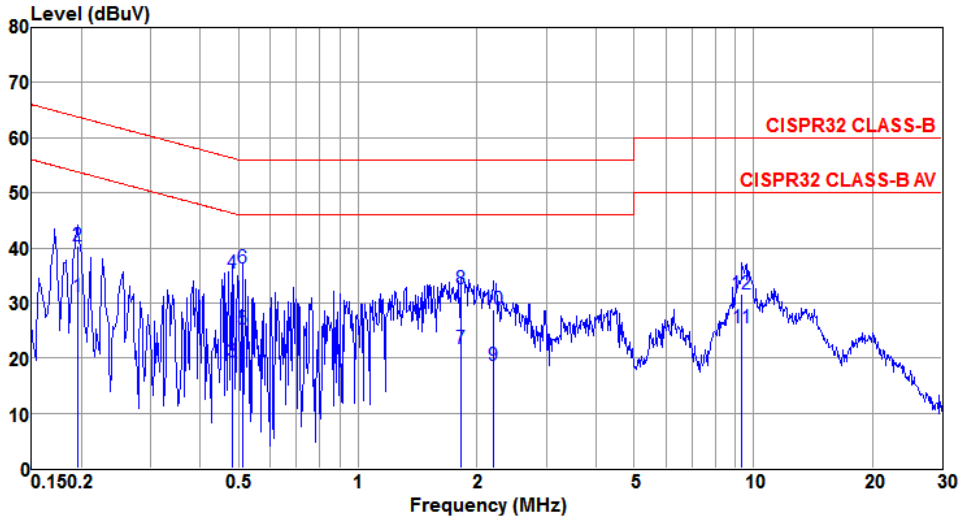
Power Phase	Line	Test Mode	4



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.180	27.74	54.50	-26.76	27.64	0.08	0.02	Average
2	0.180	39.78	64.50	-24.72	39.68	0.08	0.02	QP
3	0.476	23.52	46.41	-22.89	23.42	0.08	0.02	Average
4	0.476	39.31	56.41	-17.10	39.21	0.08	0.02	QP
5	0.507	29.19	46.00	-16.81	29.09	0.08	0.02	Average
6@	0.507	39.64	56.00	-16.36	39.54	0.08	0.02	QP
7	2.012	20.81	46.00	-25.19	20.60	0.11	0.10	Average
8	2.012	31.36	56.00	-24.64	31.15	0.11	0.10	QP
9	2.371	20.08	46.00	-25.92	19.84	0.11	0.13	Average
10	2.371	29.80	56.00	-26.20	29.56	0.11	0.13	QP
11	9.809	13.97	50.00	-36.03	13.45	0.20	0.32	Average
12	9.809	22.09	60.00	-37.91	21.57	0.20	0.32	QP

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

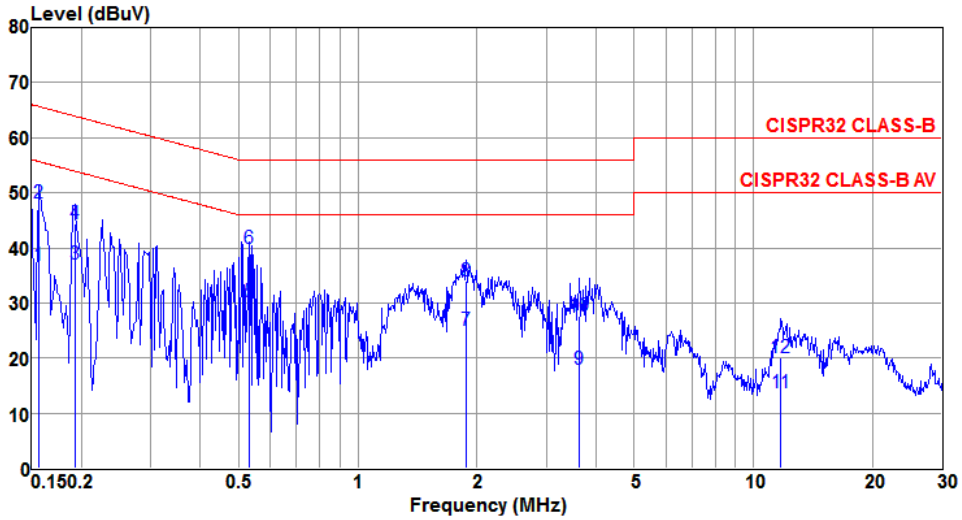
Power Phase	Neutral	Test Mode	4



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.195	31.08	53.80	-22.72	31.01	0.04	0.03	Average
2	0.195	40.36	63.80	-23.44	40.29	0.04	0.03	QP
3	0.481	19.28	46.32	-27.04	19.22	0.04	0.02	Average
4	0.481	35.36	56.32	-20.96	35.30	0.04	0.02	QP
5	0.510	25.24	46.00	-20.76	25.18	0.04	0.02	Average
6@	0.510	36.28	56.00	-19.72	36.22	0.04	0.02	QP
7	1.819	21.61	46.00	-24.39	21.45	0.07	0.09	Average
8	1.819	32.48	56.00	-23.52	32.32	0.07	0.09	QP
9	2.201	18.63	46.00	-27.37	18.44	0.07	0.12	Average
10	2.201	28.86	56.00	-27.14	28.67	0.07	0.12	QP
11	9.352	25.38	50.00	-24.62	24.91	0.16	0.31	Average
12	9.352	31.53	60.00	-28.47	31.06	0.16	0.31	QP

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

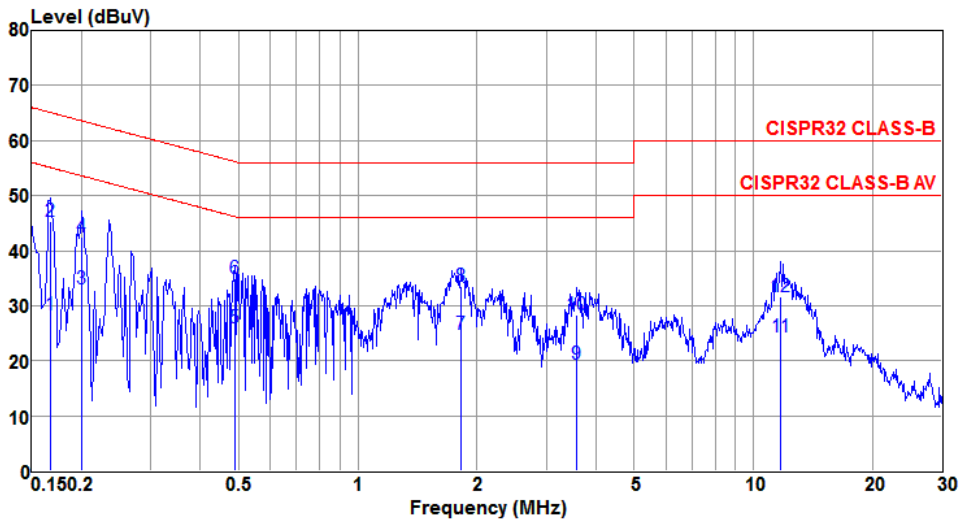
Power Phase	Line	Test Mode	5



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.156	36.74	55.69	-18.95	36.66	0.07	0.01	Average
2	0.156	48.14	65.69	-17.55	48.06	0.07	0.01	QP
3	0.192	37.10	53.93	-16.83	36.99	0.08	0.03	Average
4	0.192	44.47	63.93	-19.46	44.36	0.08	0.03	QP
5@	0.532	30.15	46.00	-15.85	30.05	0.08	0.02	Average
6	0.532	39.80	56.00	-16.20	39.70	0.08	0.02	QP
7	1.878	25.09	46.00	-20.91	24.89	0.11	0.09	Average
8	1.878	33.99	56.00	-22.01	33.79	0.11	0.09	QP
9	3.623	17.92	46.00	-28.08	17.59	0.13	0.20	Average
10	3.623	27.68	56.00	-28.32	27.35	0.13	0.20	QP
11	11.745	13.66	50.00	-36.34	13.12	0.22	0.32	Average
12	11.745	20.07	60.00	-39.93	19.53	0.22	0.32	QP

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

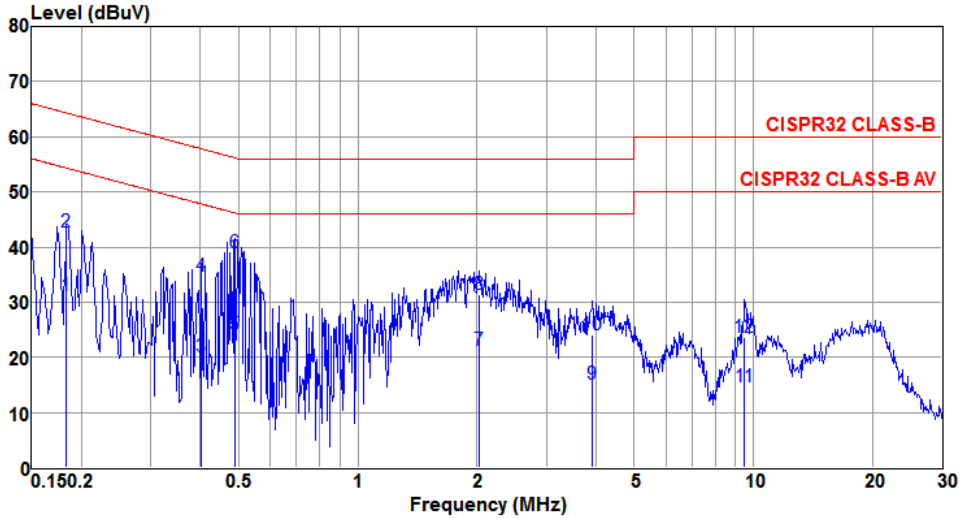
Power Phase	Neutral	Test Mode	5



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.168	28.22	55.08	-26.86	28.16	0.04	0.02	Average
2@	0.168	45.39	65.08	-19.69	45.33	0.04	0.02	QP
3	0.201	33.09	53.58	-20.49	33.02	0.04	0.03	Average
4	0.201	42.55	63.58	-21.03	42.48	0.04	0.03	QP
5	0.489	25.88	46.19	-20.31	25.82	0.04	0.02	Average
6	0.489	35.04	56.19	-21.15	34.98	0.04	0.02	QP
7	1.829	24.84	46.00	-21.16	24.68	0.07	0.09	Average
8	1.829	33.62	56.00	-22.38	33.46	0.07	0.09	QP
9	3.584	19.39	46.00	-26.61	19.10	0.09	0.20	Average
10	3.584	28.23	56.00	-27.77	27.94	0.09	0.20	QP
11	11.745	24.39	50.00	-25.61	23.88	0.19	0.32	Average
12	11.745	31.57	60.00	-28.43	31.06	0.19	0.32	QP

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

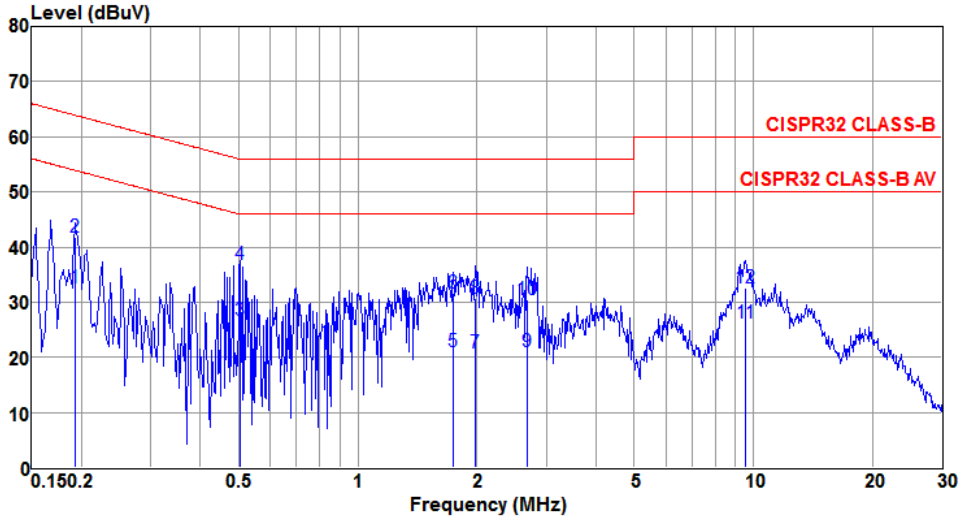
Power Phase	Line	Test Mode	6



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.183	31.17	54.33	-23.16	31.07	0.08	0.02	Average
2	0.183	42.78	64.33	-21.55	42.68	0.08	0.02	QP
3	0.402	20.12	47.81	-27.69	20.02	0.08	0.02	Average
4	0.402	34.68	57.81	-23.13	34.58	0.08	0.02	QP
5	0.489	24.09	46.19	-22.10	23.99	0.08	0.02	Average
6@	0.489	38.91	56.19	-17.28	38.81	0.08	0.02	QP
7	2.023	21.30	46.00	-24.70	21.09	0.11	0.10	Average
8	2.023	31.48	56.00	-24.52	31.27	0.11	0.10	QP
9	3.922	15.04	46.00	-30.96	14.69	0.13	0.22	Average
10	3.922	24.18	56.00	-31.82	23.83	0.13	0.22	QP
11	9.502	14.66	50.00	-35.34	14.15	0.20	0.31	Average
12	9.502	23.60	60.00	-36.40	23.09	0.20	0.31	QP

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

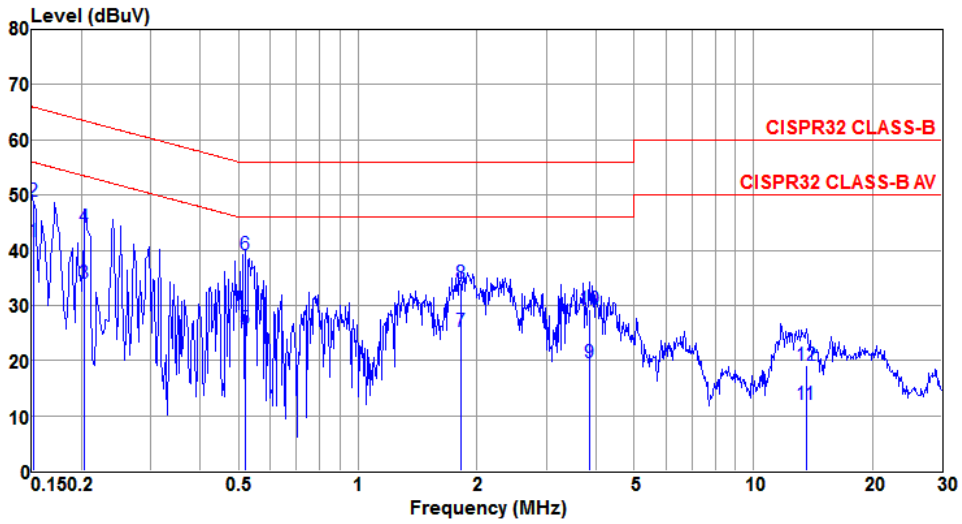
Power Phase	Neutral	Test Mode	6



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.192	32.66	53.93	-21.27	32.59	0.04	0.03	Average
2	0.192	41.85	63.93	-22.08	41.78	0.04	0.03	QP
3	0.505	26.76	46.00	-19.24	26.70	0.04	0.02	Average
4@	0.505	36.94	56.00	-19.06	36.88	0.04	0.02	QP
5	1.744	20.95	46.00	-25.05	20.79	0.07	0.09	Average
6	1.744	31.58	56.00	-24.42	31.42	0.07	0.09	QP
7	1.980	20.73	46.00	-25.27	20.56	0.07	0.10	Average
8	1.980	30.69	56.00	-25.31	30.52	0.07	0.10	QP
9	2.678	21.03	46.00	-24.97	20.80	0.08	0.15	Average
10	2.678	30.47	56.00	-25.53	30.24	0.08	0.15	QP
11	9.552	26.17	50.00	-23.83	25.69	0.17	0.31	Average
12	9.552	32.60	60.00	-27.40	32.12	0.17	0.31	QP

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

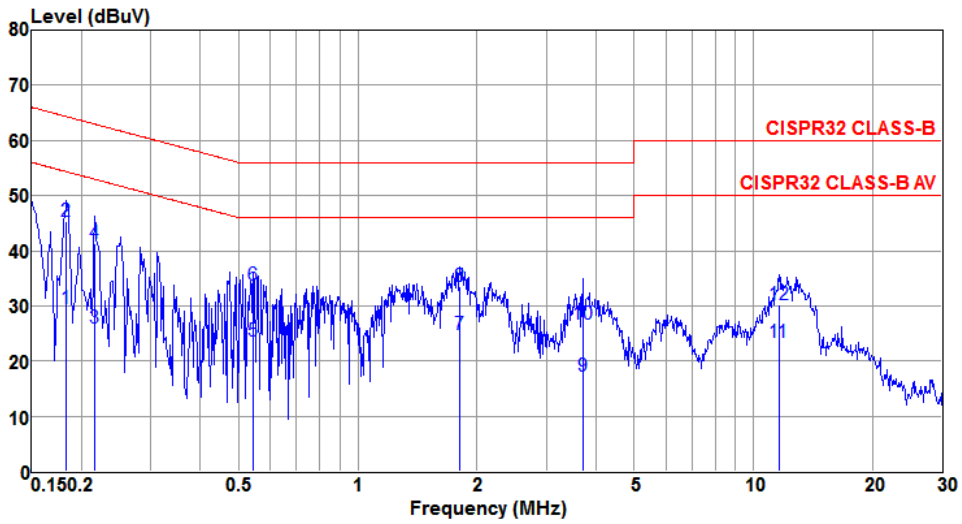
Power Phase	Line	Test Mode	7



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1@	0.152	41.45	55.91	-14.46	41.37	0.07	0.01	Average
2	0.152	48.88	65.91	-17.03	48.80	0.07	0.01	QP
3	0.204	33.91	53.45	-19.54	33.80	0.08	0.03	Average
4	0.204	44.18	63.45	-19.27	44.07	0.08	0.03	QP
5	0.518	25.85	46.00	-20.15	25.75	0.08	0.02	Average
6	0.518	39.16	56.00	-16.84	39.06	0.08	0.02	QP
7	1.829	25.23	46.00	-20.77	25.03	0.11	0.09	Average
8	1.829	33.89	56.00	-22.11	33.69	0.11	0.09	QP
9	3.860	19.58	46.00	-26.42	19.24	0.13	0.21	Average
10	3.860	29.20	56.00	-26.80	28.86	0.13	0.21	QP
11	13.623	12.06	50.00	-37.94	11.51	0.23	0.32	Average
12	13.623	19.17	60.00	-40.83	18.62	0.23	0.32	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	7



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.183	29.43	54.33	-24.90	29.37	0.04	0.02	Average
2@	0.183	45.23	64.33	-19.10	45.17	0.04	0.02	QP
3	0.216	25.85	52.96	-27.11	25.78	0.04	0.03	Average
4	0.216	41.30	62.96	-21.66	41.23	0.04	0.03	QP
5	0.544	23.52	46.00	-22.48	23.46	0.04	0.02	Average
6	0.544	33.64	56.00	-22.36	33.58	0.04	0.02	QP
7	1.810	24.80	46.00	-21.20	24.64	0.07	0.09	Average
8	1.810	33.63	56.00	-22.37	33.47	0.07	0.09	QP
9	3.700	17.22	46.00	-28.78	16.92	0.09	0.21	Average
10	3.700	26.62	56.00	-29.38	26.32	0.09	0.21	QP
11	11.621	23.42	50.00	-26.58	22.91	0.19	0.32	Average
12	11.621	30.25	60.00	-29.75	29.74	0.19	0.32	QP

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

4 Immunity Tests

4.1 General Description

Product Standard: Draft EN 301 489-1, Final draft EN 301 489-3, Draft EN 301 489-17		
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

Final draft 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**
A	Shall operate as intended. May show degradation of performance (see note1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 3). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.
B	May show loss of function (one or more). May show degradation of performance (see note 2). No unintentional transmissions.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see note 3). Shall be no loss of stored data or user programmable functions.
C	May be loss of function (one or more).	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no degradation of performance (see note 3).
Note 1:	Operate as intended during the test allows a level of degradation not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.	
Note 2:	Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.	
Note 3:	No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect form the apparatus if used as intended.	

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.

Performance Criteria by Manufacturer	
A	Without any BT or NFC signal loss or any degradation of performance.
B	The BT signal loss or degradation of performance. Functions shall be self-recoverable after the test.

For RS

Performance Criteria by Manufacturer	
A	The BL654 must sustain a communication link when the received signal level is greater than or equal to the sensitivity level of the receiver. When a high level interference signal is temporarily present above the de-sensitization threshold level, the receiver is de-sensitized, raising the sensitivity level temporarily. If the temporary interference level is greater than the threshold level, the receiver sensitivity degradation is expected to be large enough that a temporary complete loss of the communication link is expected and functionally acceptable. When the temporary interference signal is removed from the receiver, the communication link is expected to be re-established .

4.3 Special Conditions for EMC Measurements

4.3.1 Special Conditions for Emission Measurements

Final draft EN 301 489-3

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

Draft EN 301 489-17

No special conditions.

4.3.2 Special Conditions for Immunity Measurements

Final draft EN 301 489-3

Reference to clauses in EN 301 489-1 [1]	Special product-related conditions, additional to or modifying the test conditions in EN 301 489-1 [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 [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.

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.

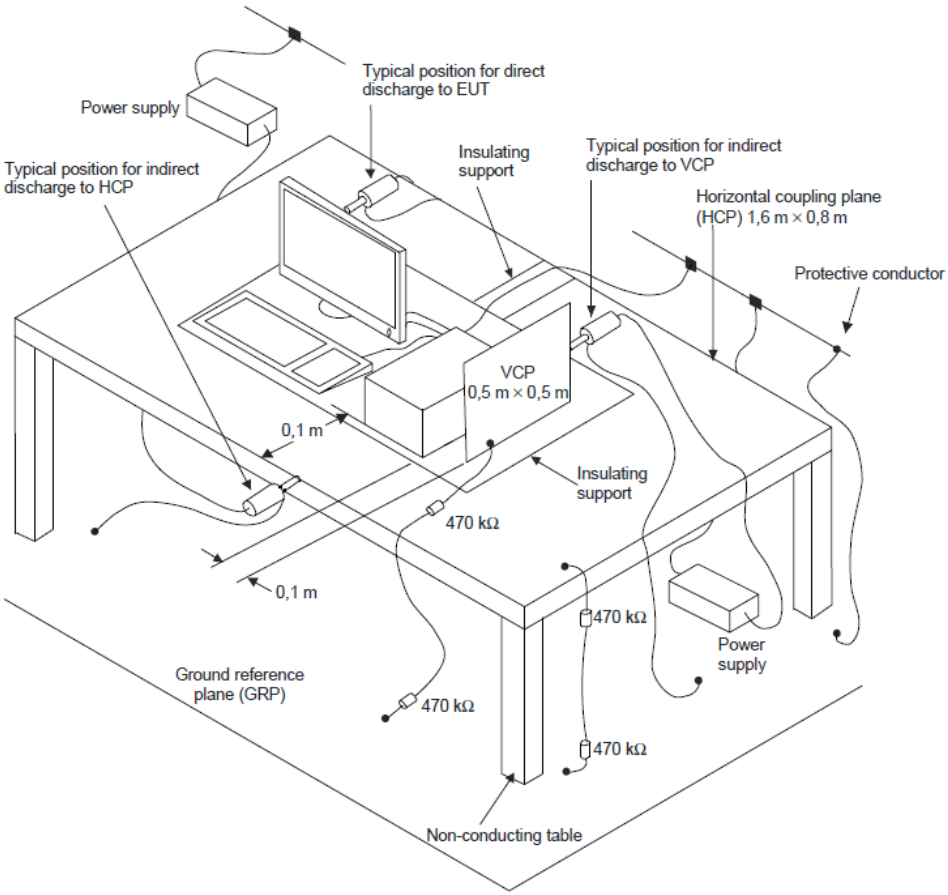
e. For the time interval between successive single discharges an initial value of one second is recommended. Longer intervals may be determined whether a system failure has occurred.

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, 2, 3, 6, 7, 8				
Direct Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Contact Discharge**	**Air Discharge**	**Performance Criteria**
---	---	---	---	---	---
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)

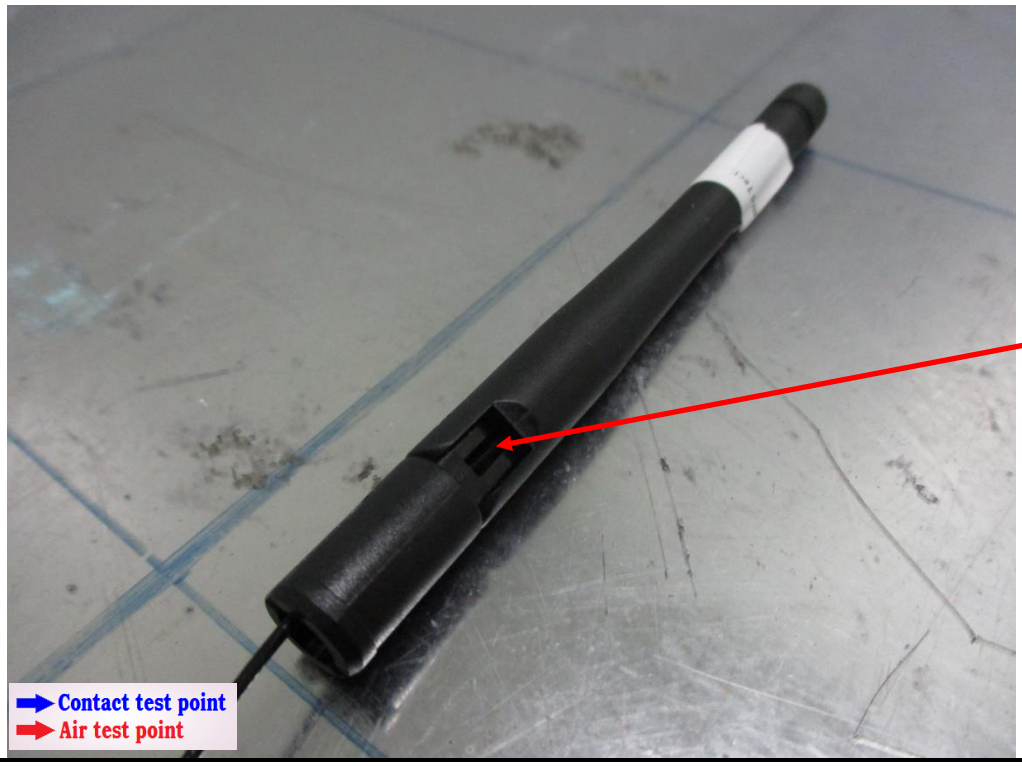
Note: There was no abnormal situation during the test compared with initial operation.

Test Mode	4, 5				
Direct Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Contact Discharge**	**Air Discharge**	**Performance Criteria**
2, 4, 8	+/-	1 ~ 5	N/A	Note	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)

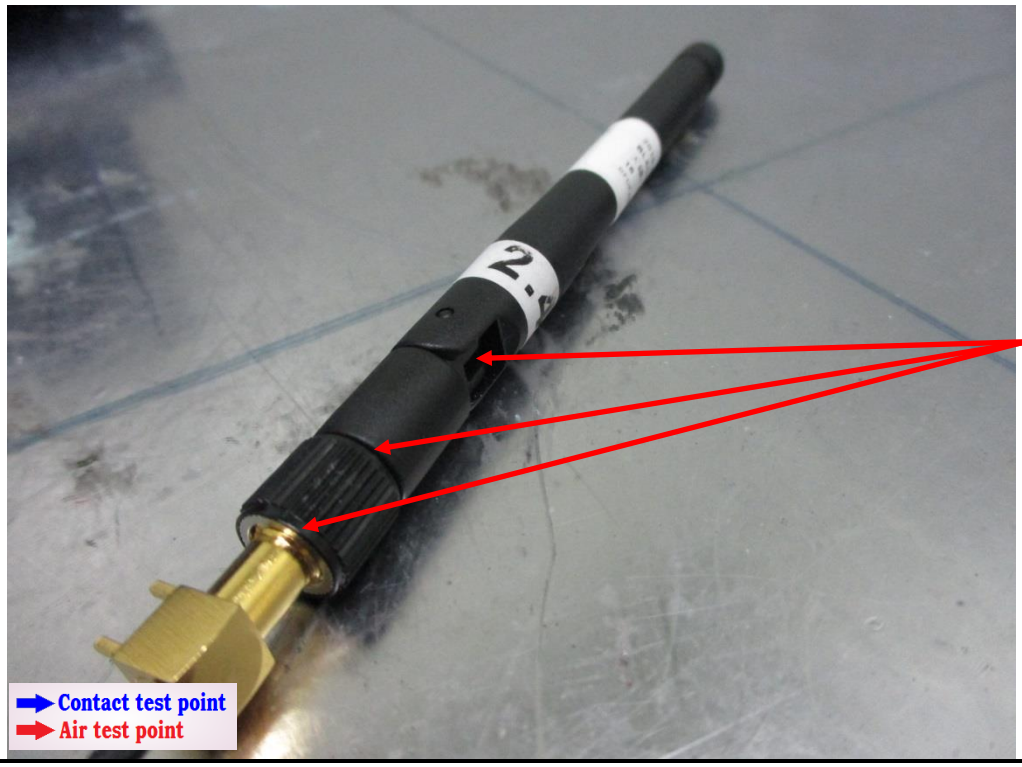
Note: There was no abnormal situation during the test compared with initial operation.

4.4.5 Test Point Photo

Test Mode 4



Test Mode 5



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

Final draft EN 301 489-3

- Transmitters

The exclusion band shall be those frequencies specified in the relevant radio standard as the operating frequency band and the Out of Band domain.

Where this is not so specified the exclusions bands shall be as below:

For transmitters operating, or intended to operate, in a channelized frequency band, the exclusion band is five times (i.e. ±250 %) the maximum operating channel width (OCW) allowed for that service, centred around the operating frequency.

For wide band transmitters, i.e. transmitters in a non-channelized frequency band, the exclusion band is twice the intended operating frequency band centred around the centre frequency of the intended operating frequency band.

The exclusion band shall only apply when the EUT is in transmit mode of operation.

- Receivers

The exclusion band is based on an extension value.

The lower limit of the exclusion band is the lower edge of the Operating Channel (OC) minus the extension value, or zero, whichever is the greater.

The upper limit is the upper edge of the OC plus the extension value.

The extension value is given in below table. The OC is defined in the relevant radio standard.

Receiver operating frequency fo	Extension value
< 300 kHz	300 kHz
300 kHz to < 30 MHz	3 MHz
30 MHz to < 1 GHz	15 MHz, or 5 % × fo, whichever is greater
1 GHz to < 6 GHz	100 MHz
≥ 6 GHz	5 % × fo

NOTE: The receiver exclusion band frequency range aligns as far as possible with the blocking test frequency range defined in ETSI EN 300 220-1.

- Duplex and multi-mode equipment

In the case of EUT tested with a simultaneous transmit and receive mode, the exclusion band used shall be the combination of the exclusion band for the transmitter and the exclusion band for the receiver. I.e. both exclusion bands shall be applied.

In the case of transmitters capable of operating on more than one frequency band, testing shall be carried out on each band separately.

In the case of receivers operating on more than one frequency, the exclusion band used shall be the combination of the exclusion bands for each frequency, i.e. an exclusion band for each frequency shall be applied.

NOTE: Where the frequencies are in the same operational frequency band, the result will usually be an enlarged single exclusion band. Where the frequencies are widely spaced, e.g. in different bands, the result will be to create multiple separate 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:

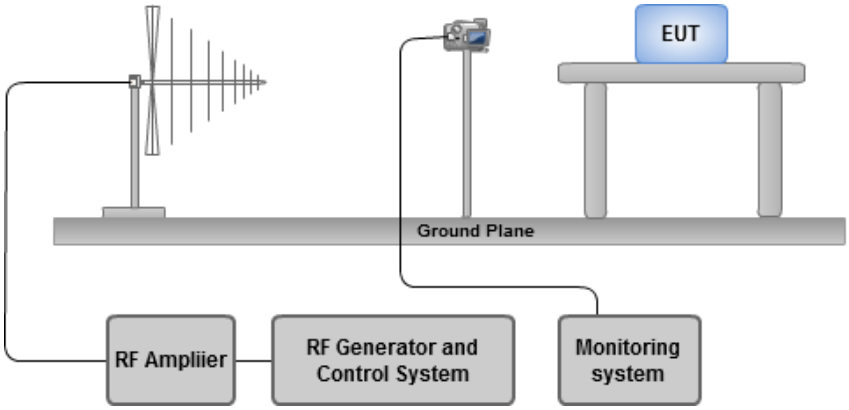
- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 4 880 MHz;
- upper limit of exclusion band = highest allocated band edge frequency +270 MHz, i.e. 5 995 MHz.

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.

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)

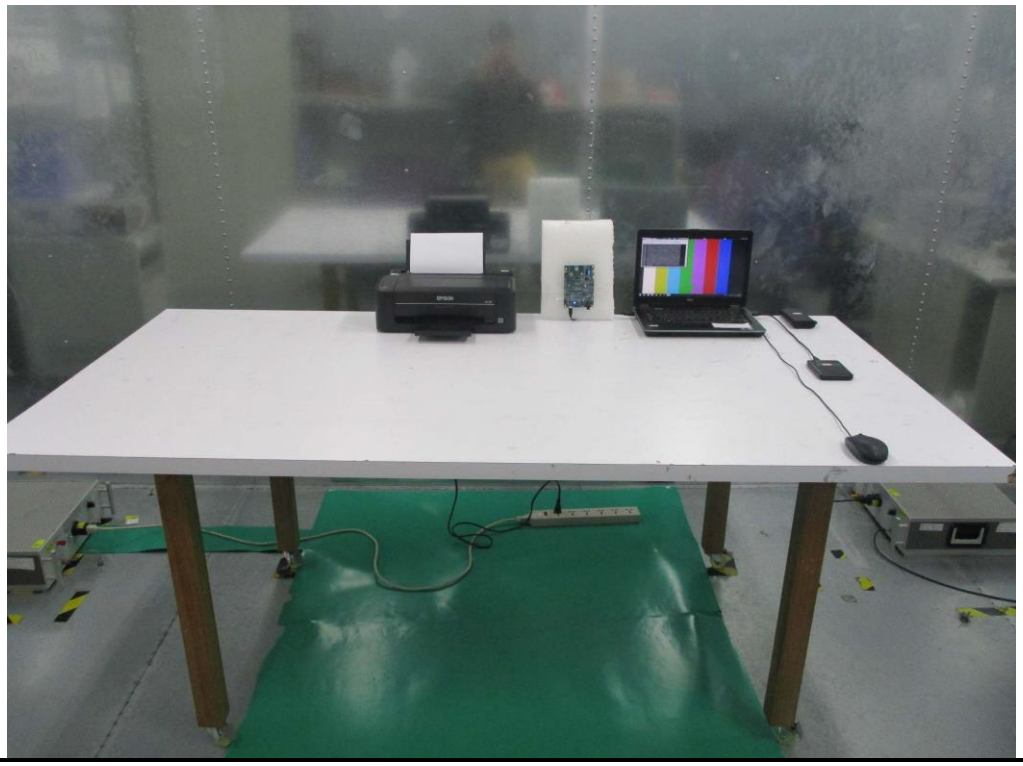
Test Mode	1 ~ 8				
Frequency Range (MHz)	**Azimuth**	**Polarity**	**Test Field Strength (V/m)**	**Observation**	**Performance Criteria**
80 - 6000	0	V&H	3	Note	CT/CR (A)
80 - 6000	90	V&H	3	Note	CT/CR (A)
80 - 6000	180	V&H	3	Note	CT/CR (A)
80 - 6000	270	V&H	3	Note	CT/CR (A)

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

- Pass criterion is judged by applicant. Test method reported herein was performed according to the method specified by applicant.

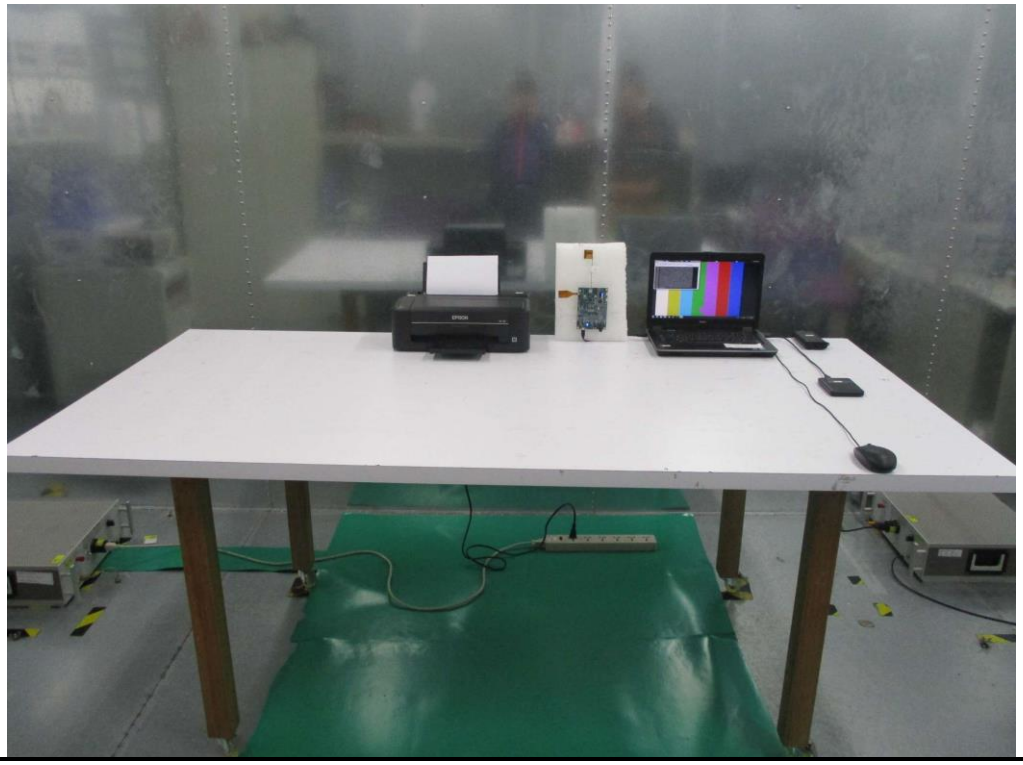
5 Photographs of the Test Configuration

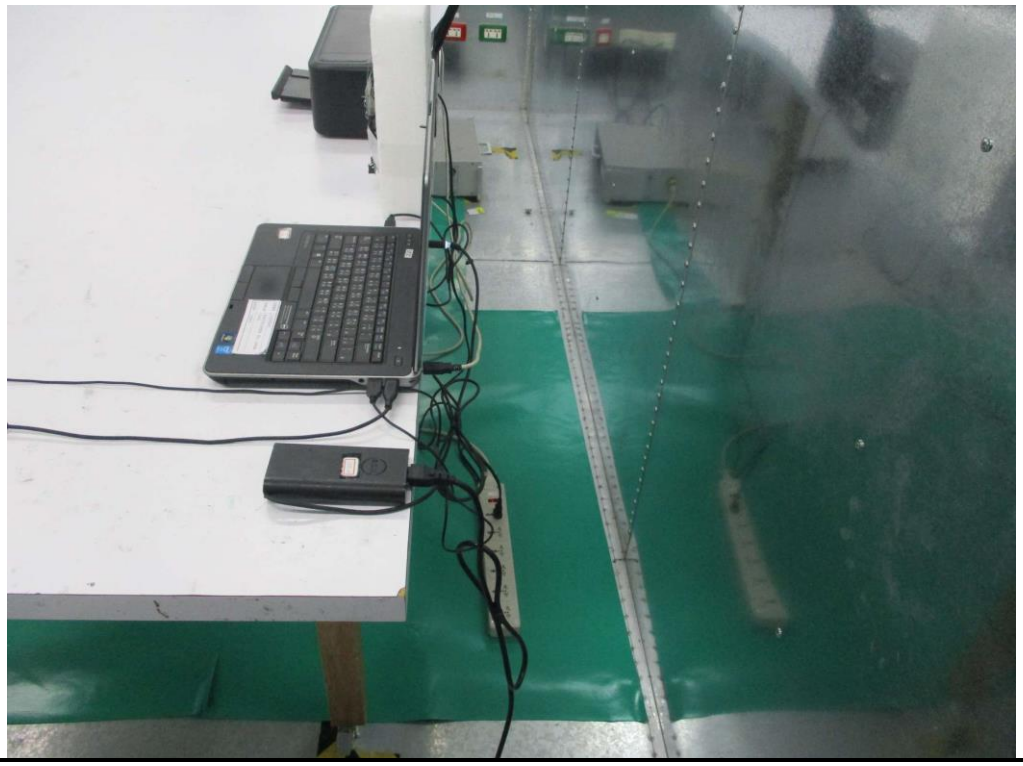
Conducted Emissions from the AC mains power ports (Test Mode 1)



Conducted Emissions from the AC mains power ports (Test Mode 2, 6)

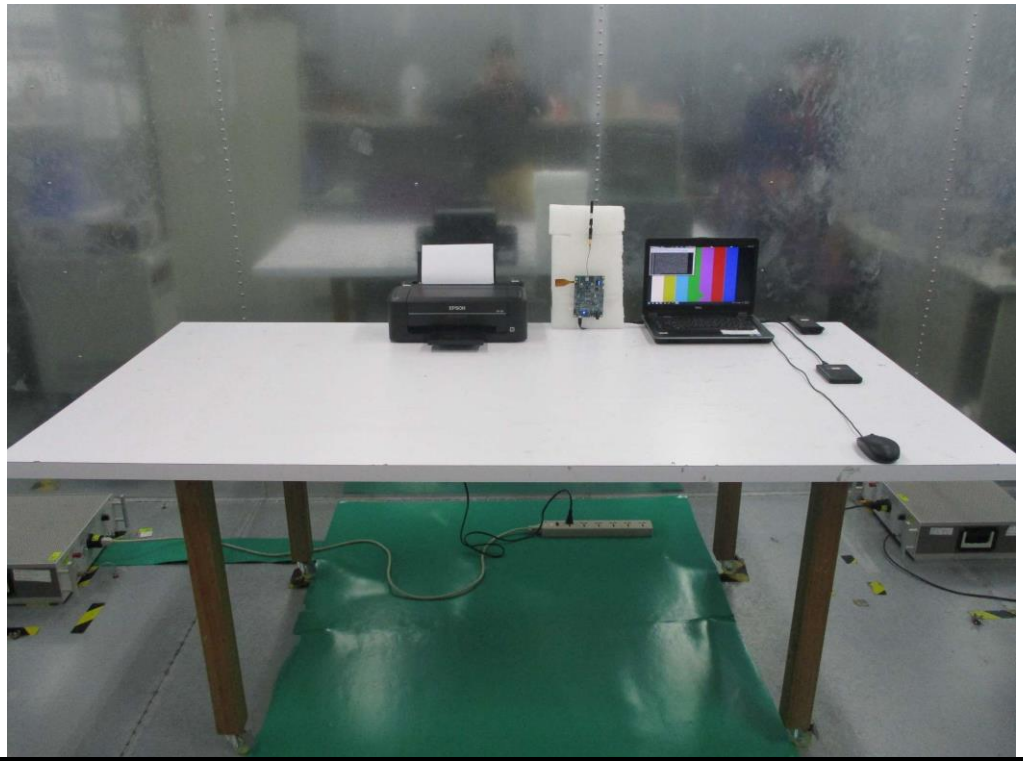
Conducted Emissions from the AC mains power ports (Test Mode 3)

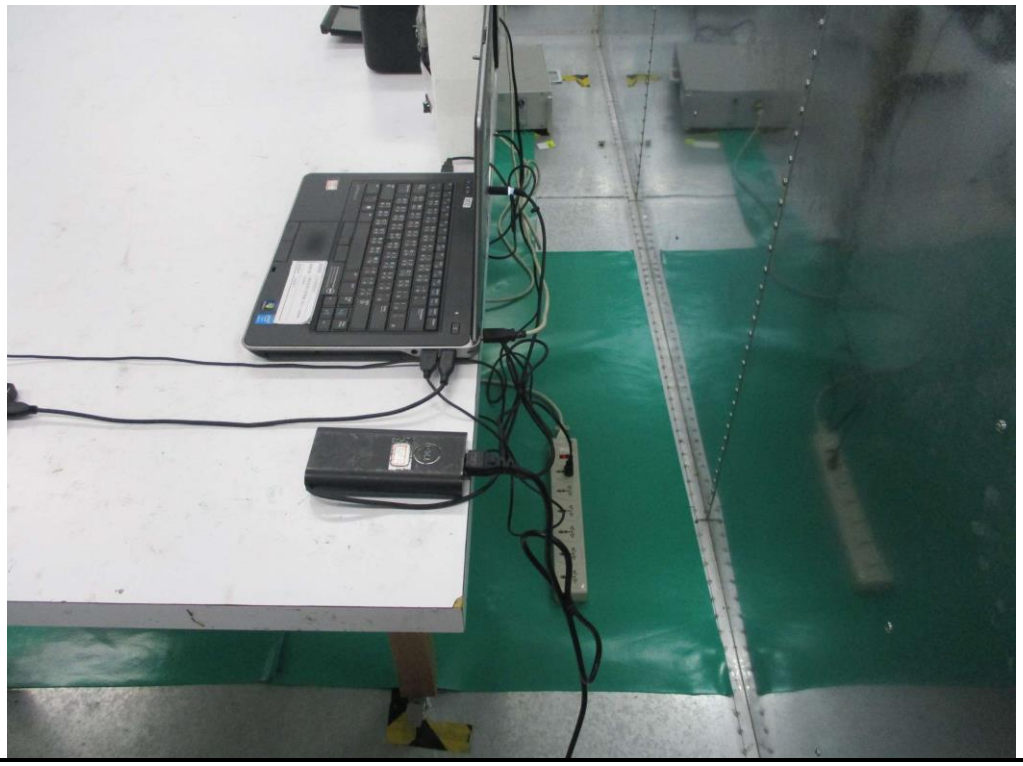




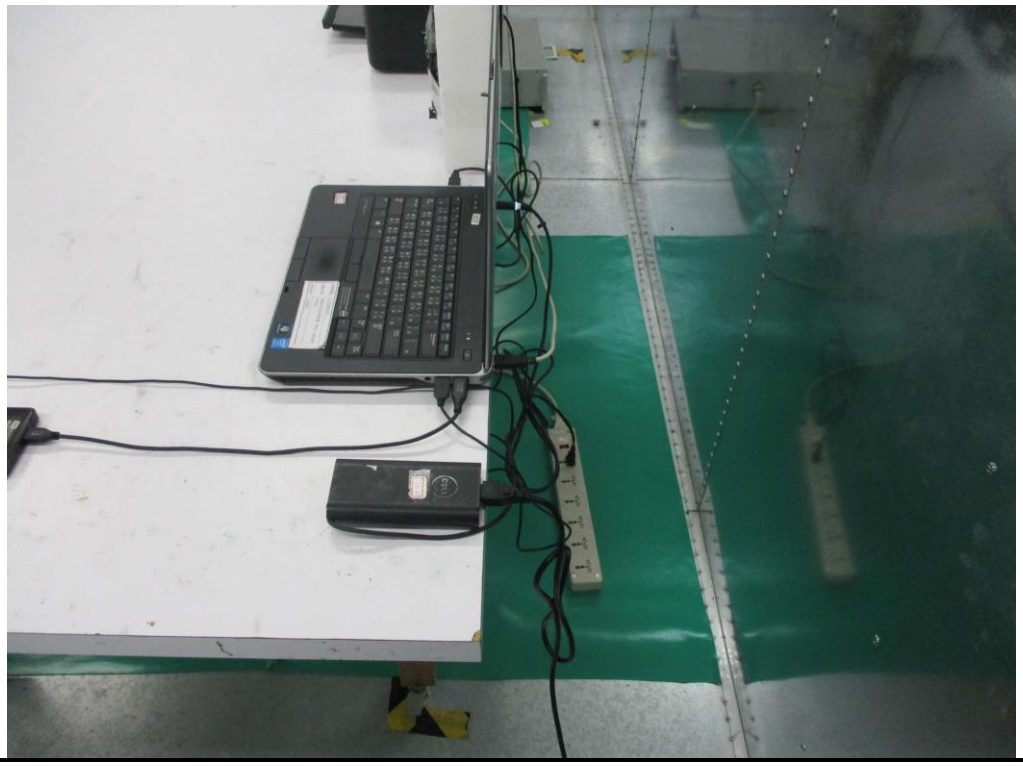
Conducted Emissions from the AC mains power ports (Test Mode 4)

Conducted Emissions from the AC mains power ports (Test Mode 5)

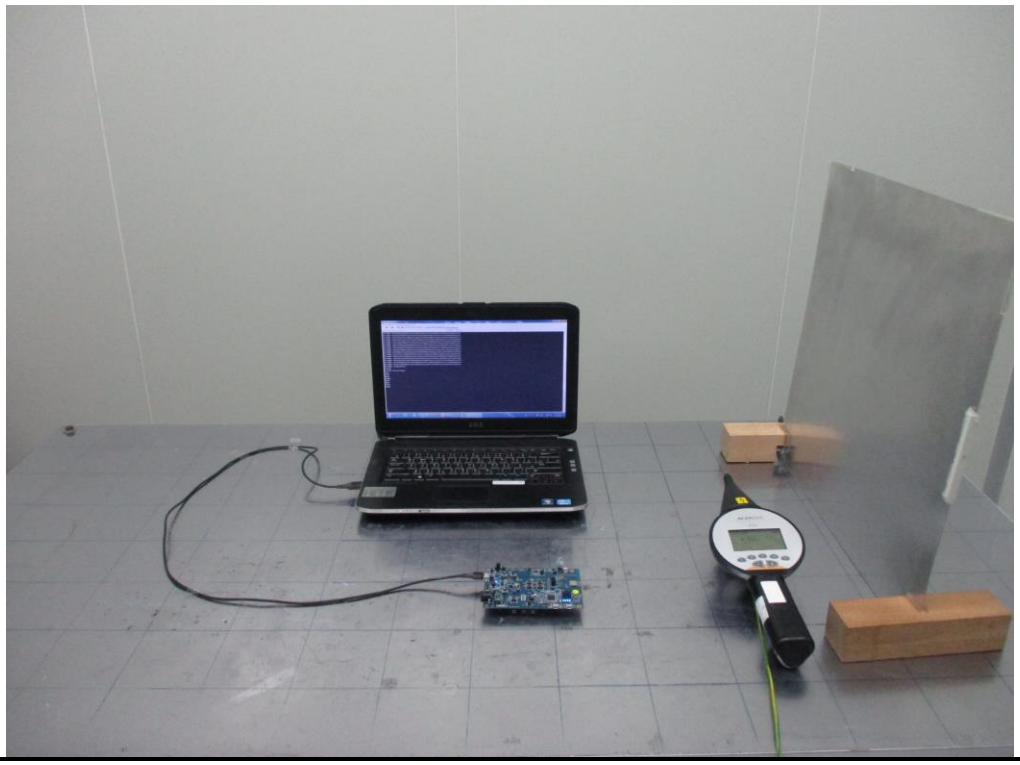




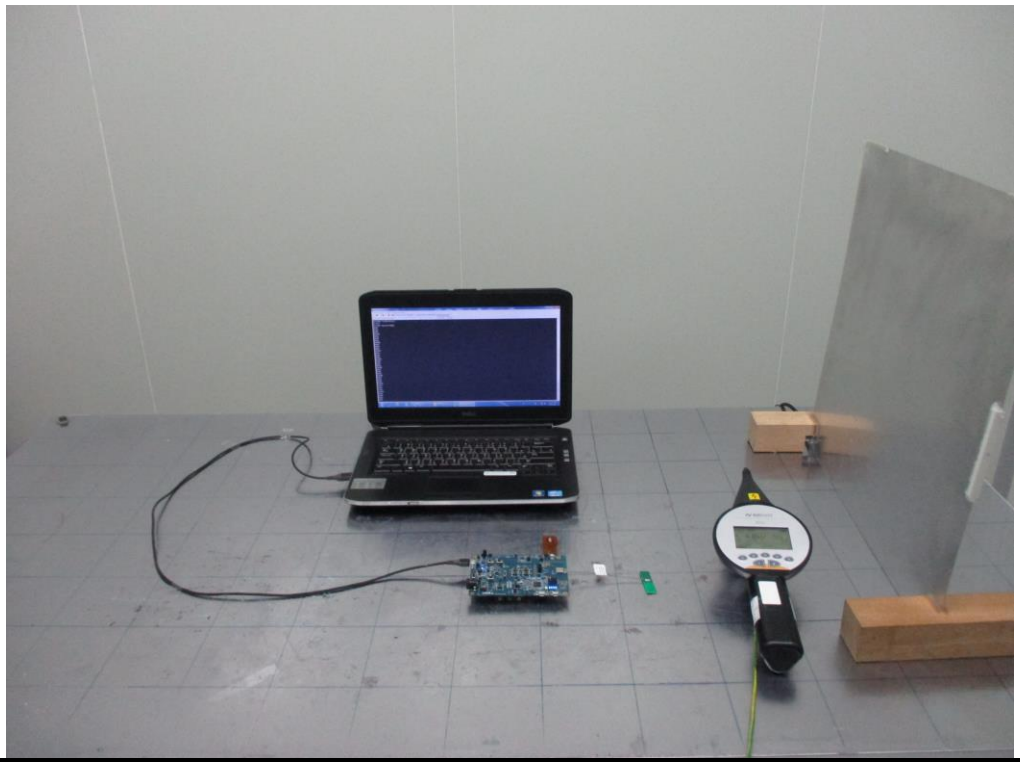
Conducted Emissions from the AC mains power ports (Test Mode 7)



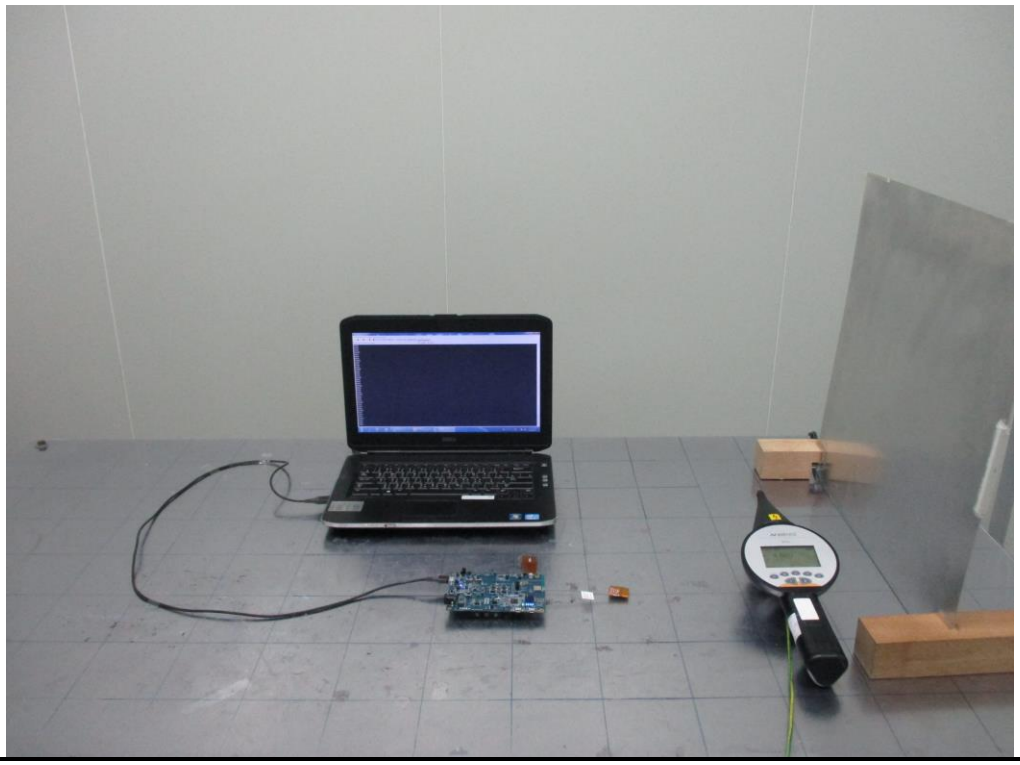
ESD Test (Test Mode 1)



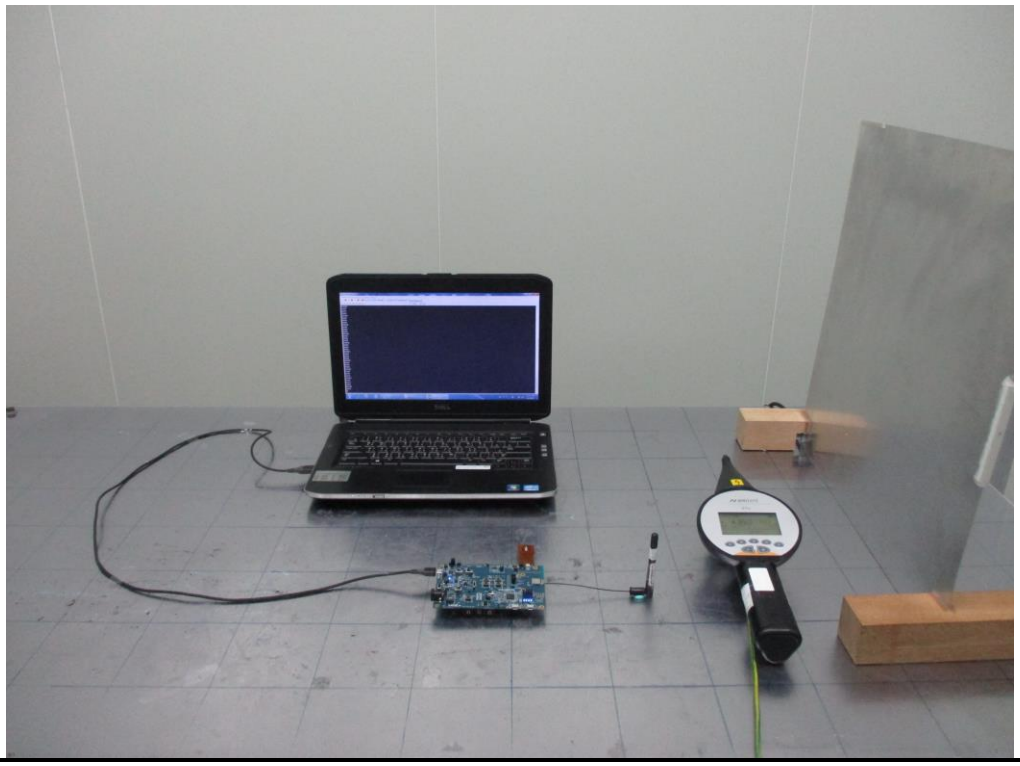
ESD Test (Test Mode 2)



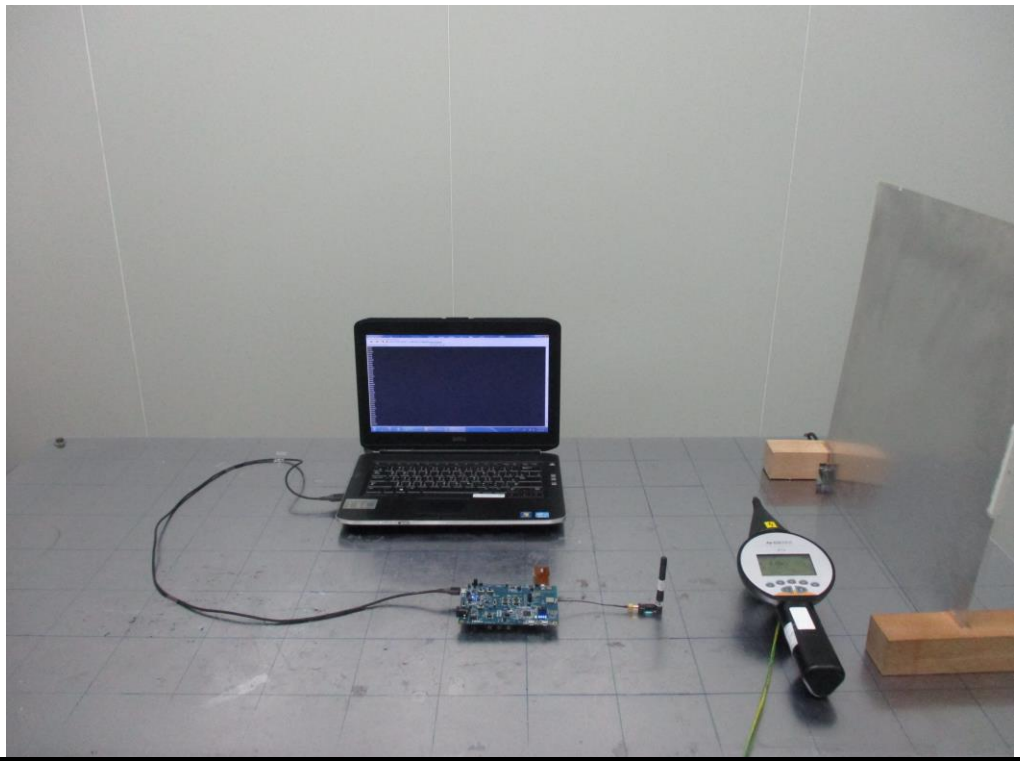
ESD Test (Test Mode 3)



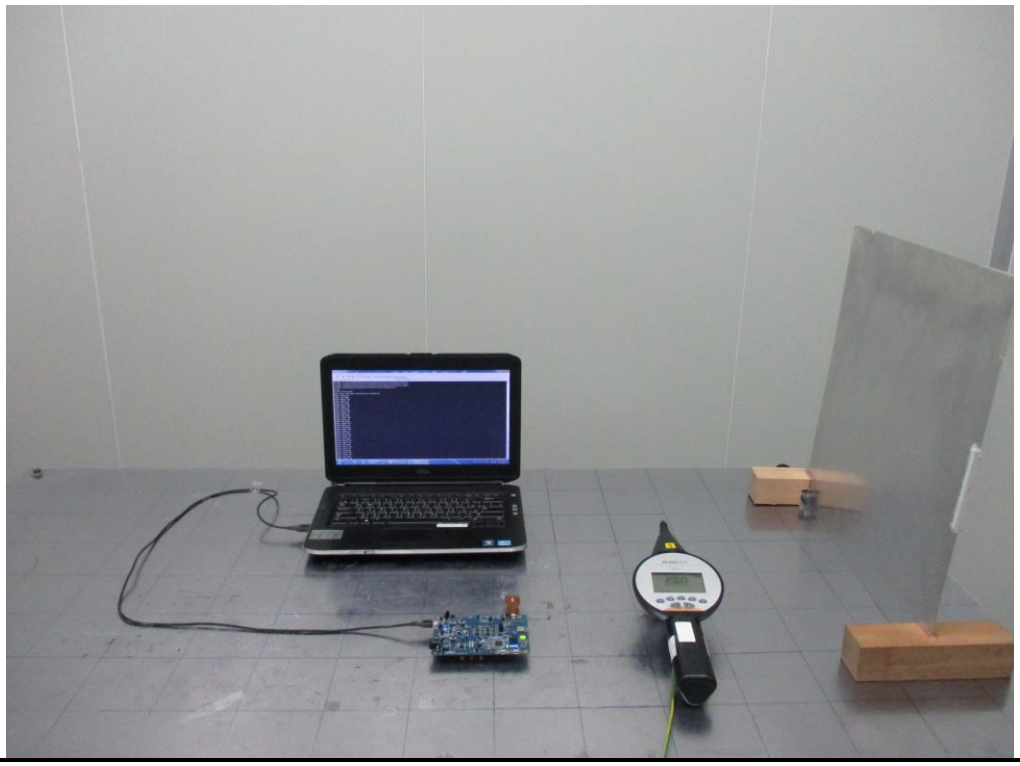
ESD Test (Test Mode 4)



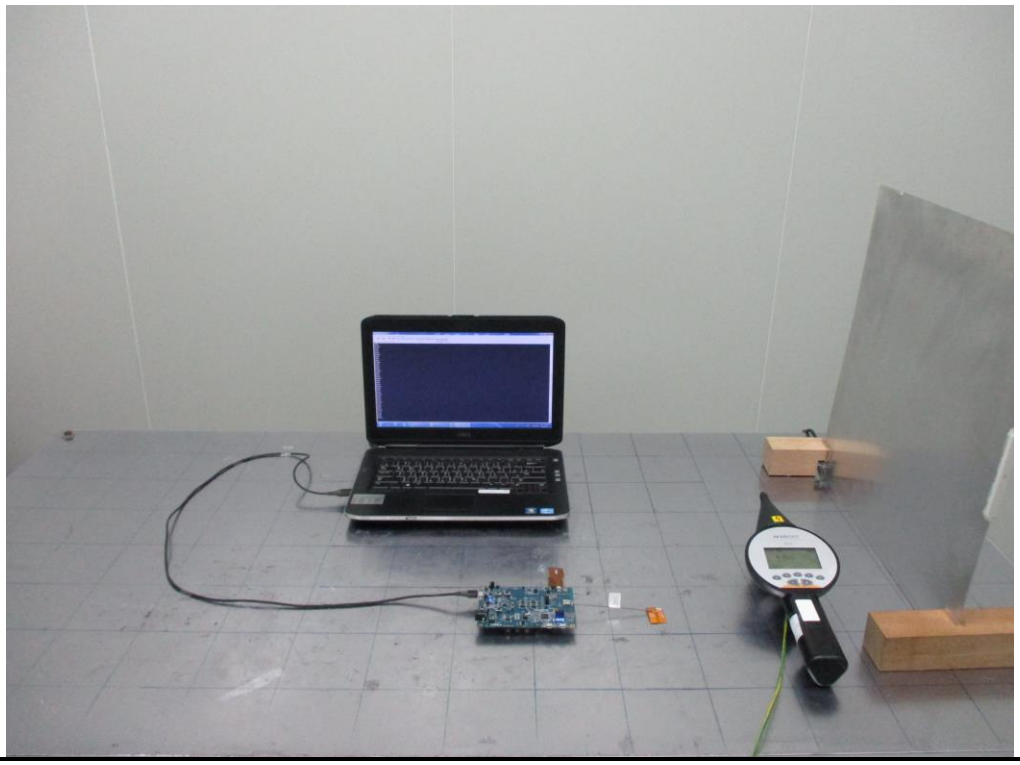
ESD Test (Test Mode 5)



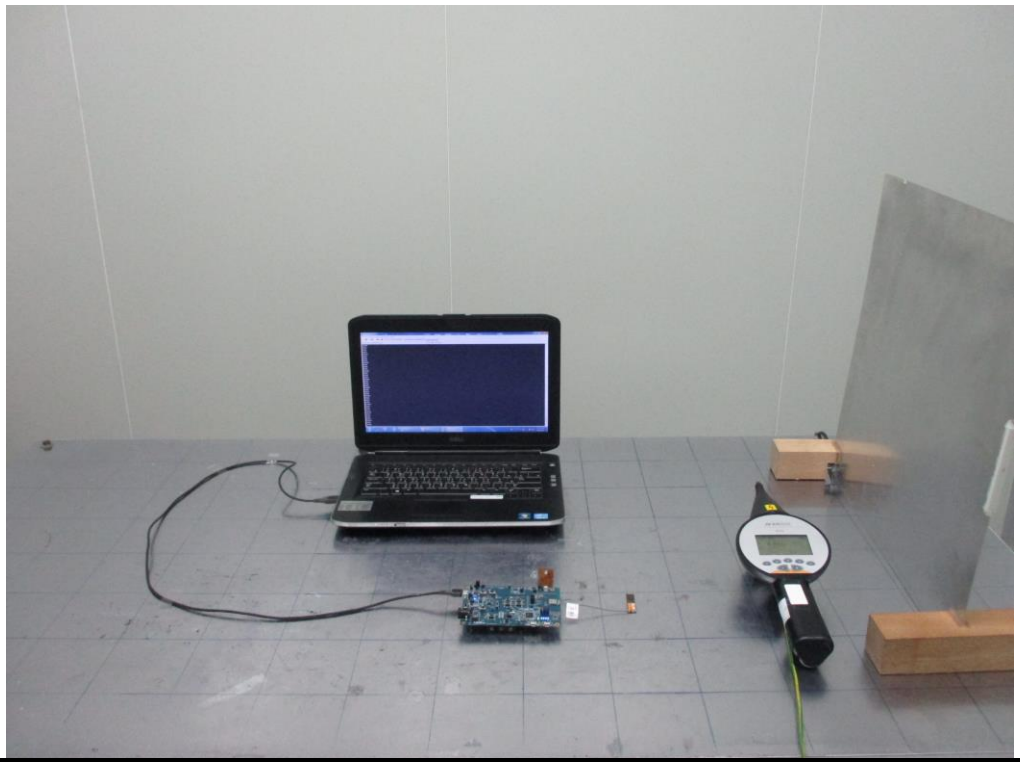
ESD Test (Test Mode 6)



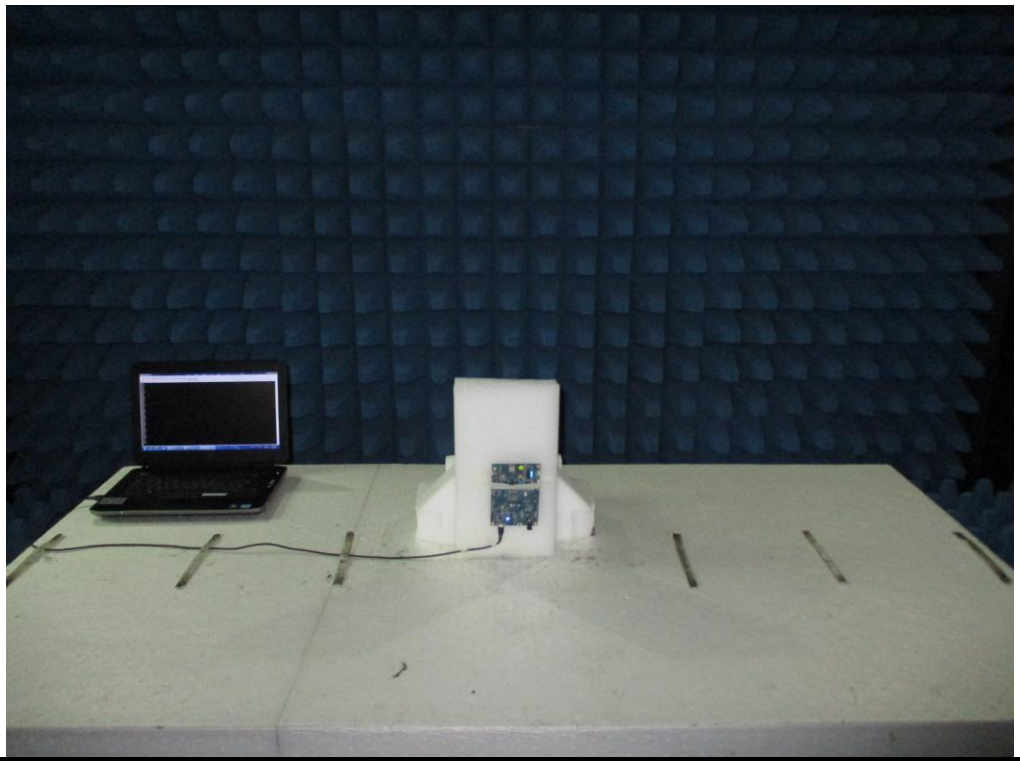
ESD Test (Test Mode 7)



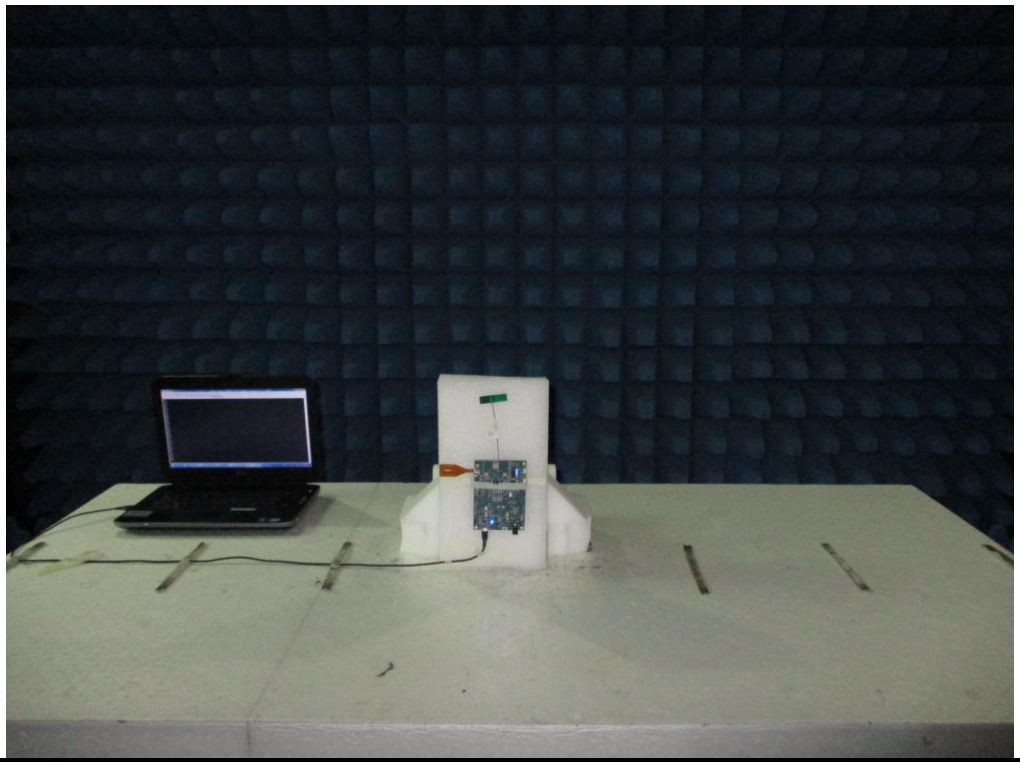
ESD Test (Test Mode 8)



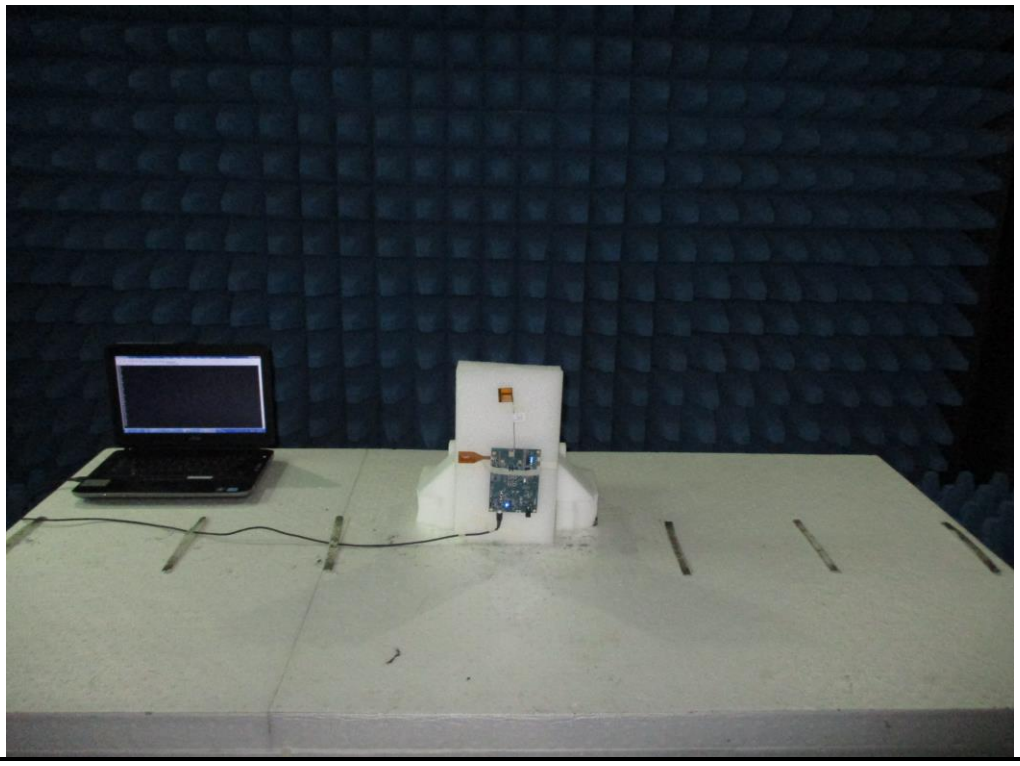
RS Test (Test Mode1)



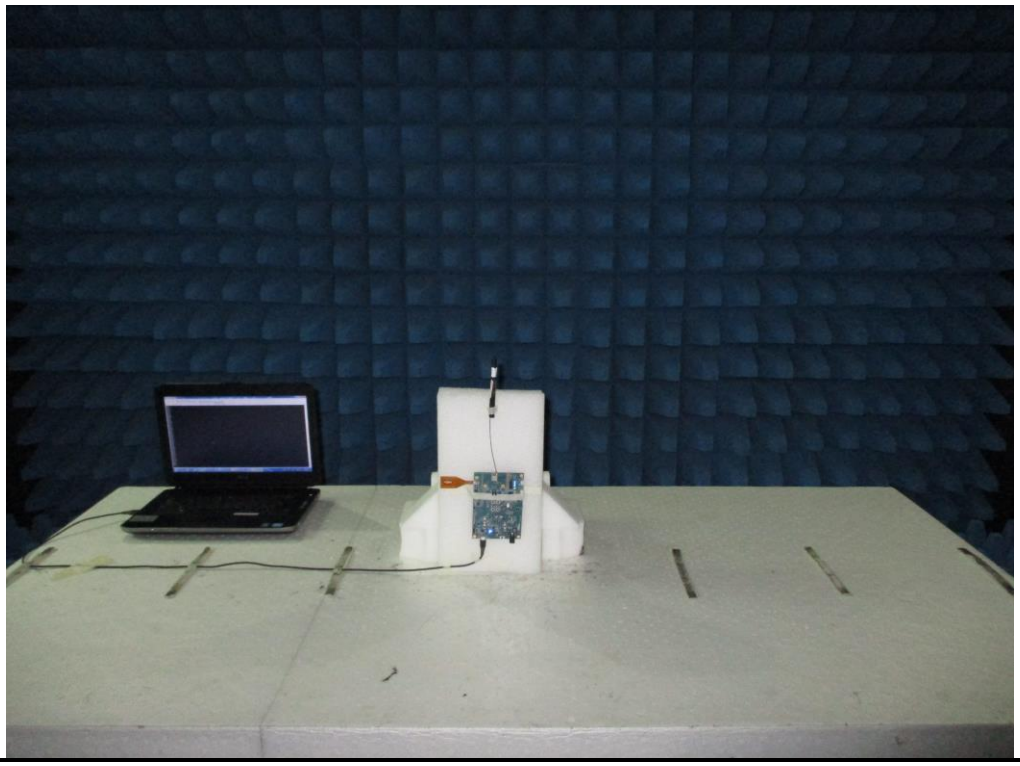
RS Test (Test Mode2)



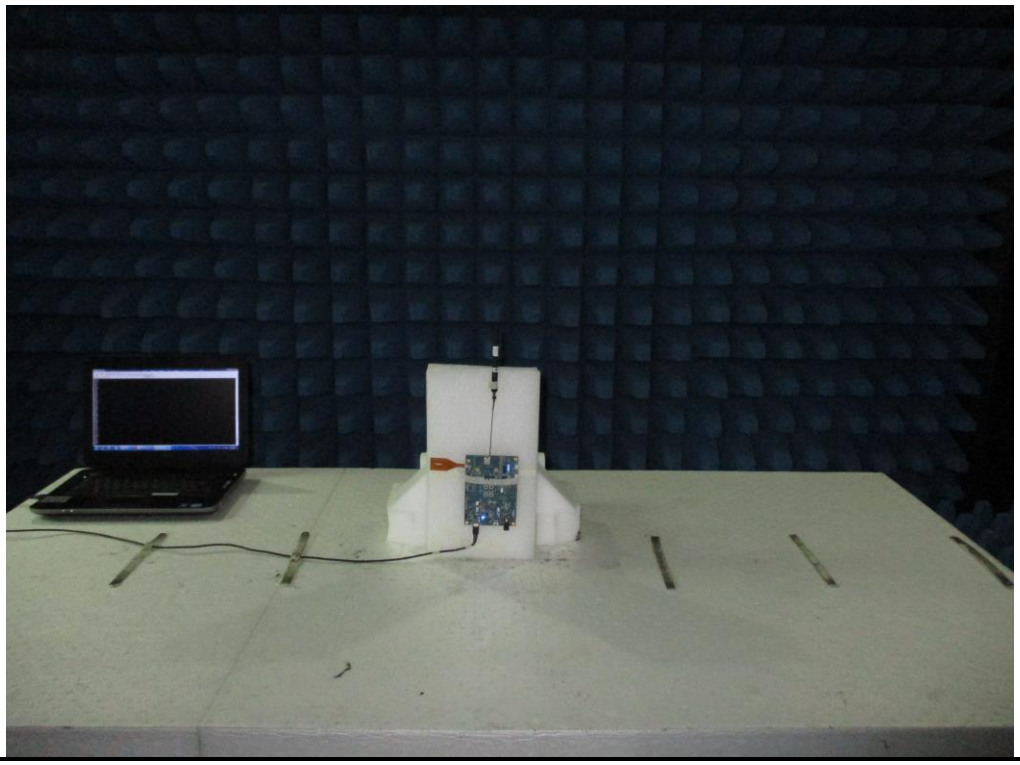
RS Test (Test Mode3)



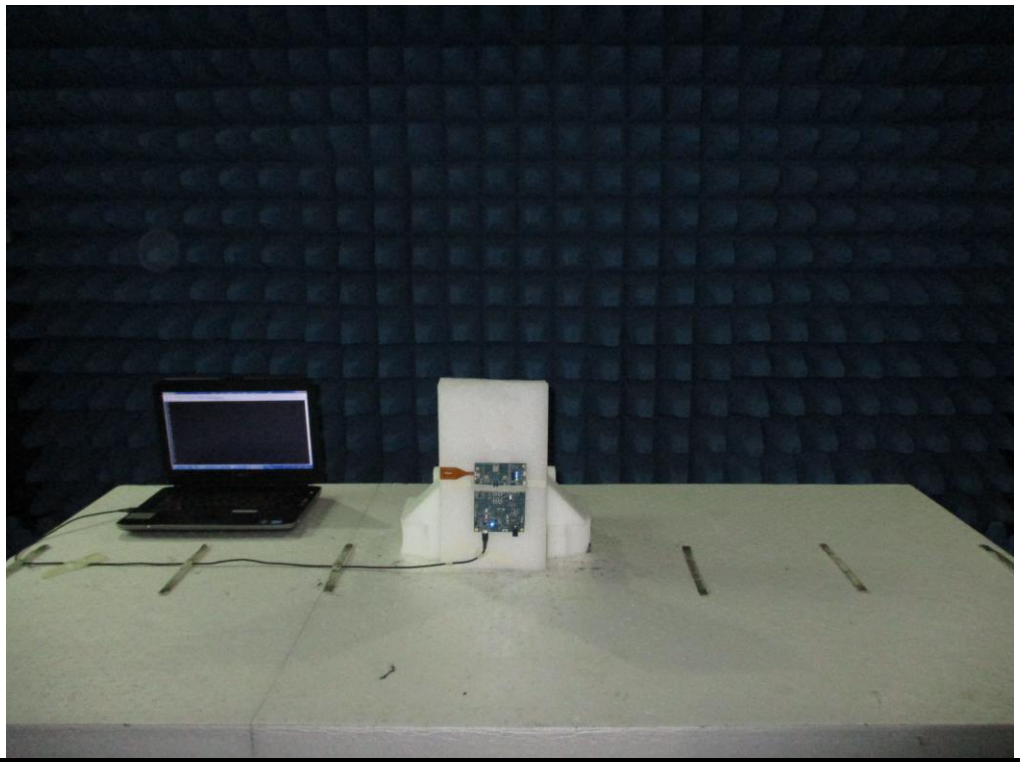
RS Test (Test Mode4)



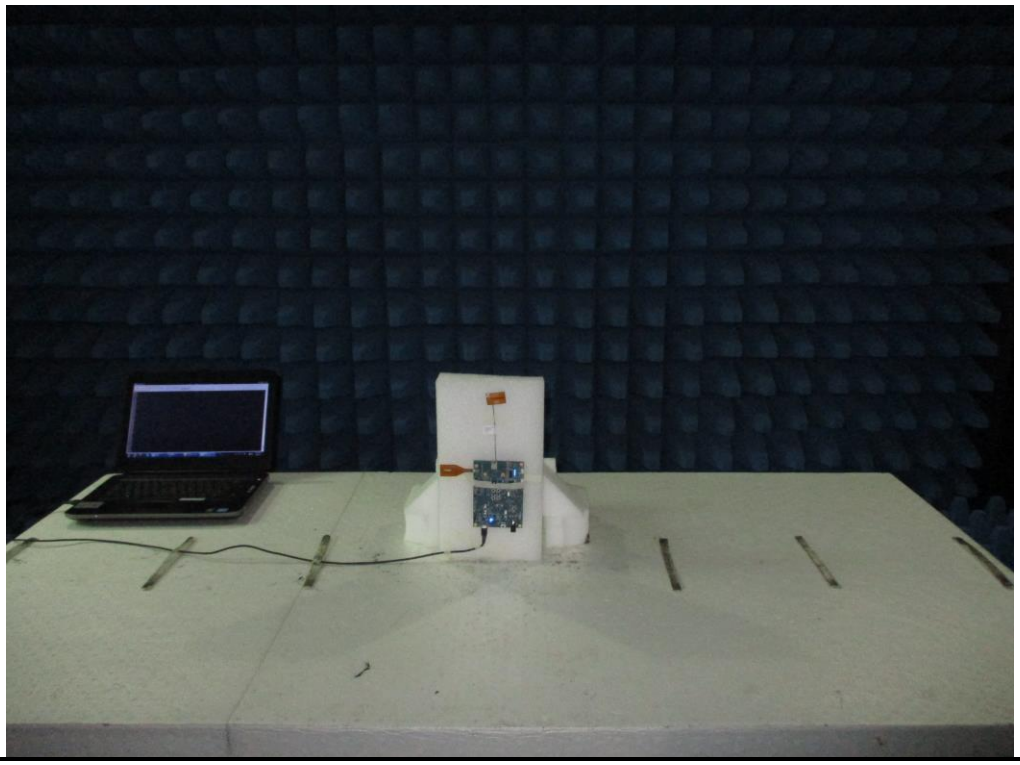
RS Test (Test Mode5)



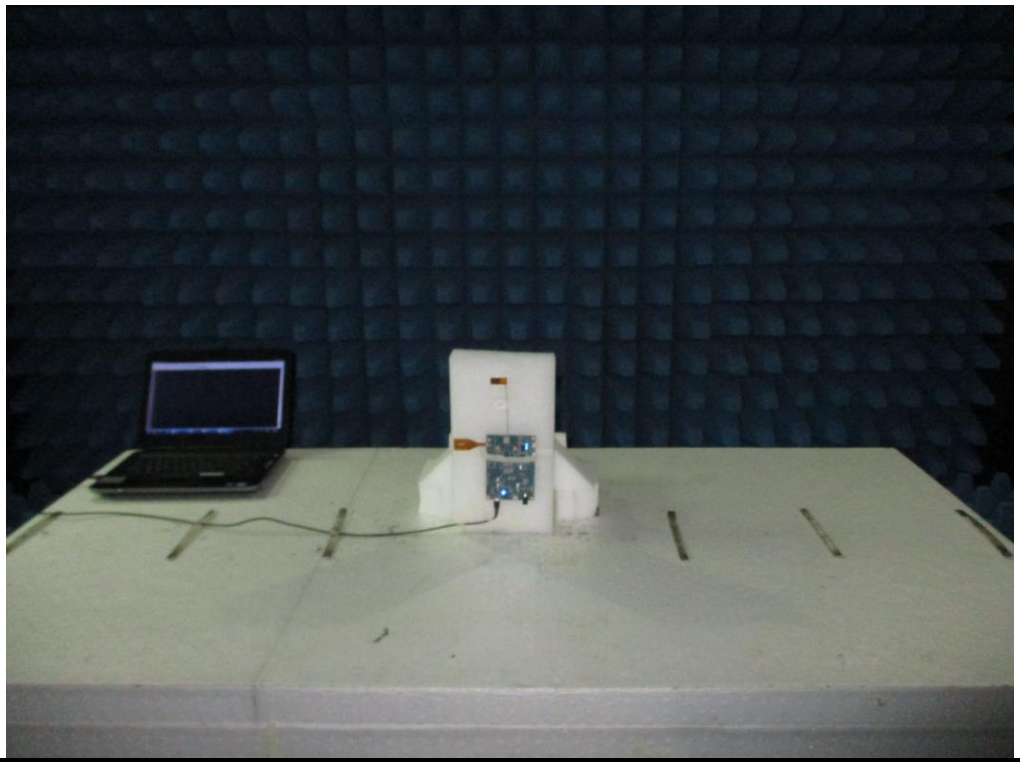
RS Test (Test Mode6)



RS Test (Test Mode7)



RS Test (Test Mode8)



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
Fax: 886-3-318-0155
Email: ICC_Service@icertifi.com.tw

═END═