

# CE EMC Test Report

**Equipment** : 802.11 ac/a/b/g/n + Bluetooth 4.2 module  
(please refer to section 1.1.1 for more details.)

**Model No.** : ST60-2230C  
(please refer to section 1.1.1 for more details.)

**Brand Name** : Laird Technologies

**Applicant** : Laird Technologies

**Address** : W66N220 Commerce Court, Cedarburg,  
Wisconsin 53012, USA

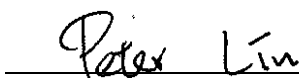
**Standard** : Draft EN 301 489-1 V2.2.0 (2017-03)  
Draft EN 301 489-17 V3.2.0 (2017-03)

**Received Date** : Apr. 07, 2017

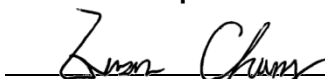
**Tested Date** : May 13 ~ May 16, 2017

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:

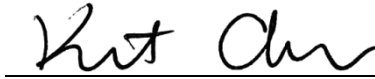


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Approved by:



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## Release Record

Report No.	Version	Description	Issued Date
EH740701	Rev. 01	Initial issue	Jun. 14, 2017
EH740701	Rev. 02	Updating software version (P.5)	Jun. 22, 2017
EH740701	Rev. 03	Revised model name	Jul. 24, 2017

## 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	-10.72VAV@ 2.334MHz.	Pass
8.7	EN 55032:2015/AC:2016, Class B	Asymmetric Mode Conducted Emissions	Note <sup>1</sup>	N/A
8.2	EN 55032:2015/AC:2016, Class B	Radiated Emissions	Note <sup>2</sup>	N/A
8.5	EN 61000-3-2:2014, Class A	Harmonic Current Emissions	Note <sup>3</sup>	N/A
8.6	EN 61000-3-3:2013	Voltage Fluctuations and Flicker	Note <sup>3</sup>	N/A
<p>N/A means Not Applicable.            Note<sup>1</sup>: The EUT w/o telecom port.            Note<sup>2</sup>: According to Clause 7.1 of EN 301 489-1, the test is not required.            Note<sup>3</sup>: The EUT consumes DC power, so the test is not required.</p>				

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)		A	Pass
9.2	EN 61000-4-3:2006/A1:2008/A2:2010	Radio Frequency Electromagnetic Field (RS)		A	Pass
9.4	EN 61000-4-4:2012	Electrical Fast Transient/Burst (EFT)		Note <sup>1</sup>	N/A
9.8	EN 61000-4-5:2014	Surge		Note <sup>2</sup>	N/A
9.5	EN 61000-4-6:2014	Conducted Disturbances (CS)		Note <sup>1</sup>	N/A
9.7	EN 61000-4-11:2004	Voltage Dips	0% residual for 0.5 cycle	Note <sup>2</sup>	N/A
			0% residual for 1 cycle	Note <sup>2</sup>	N/A
			70% residual for 25 cycle	Note <sup>2</sup>	N/A
		Voltage Interruption	0% residual for 250 cycle (w/o battery back-up)	Note <sup>2</sup>	N/A
N/A means Not Applicable. Note <sup>1</sup> : 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 <sup>2</sup> : The EUT consumes DC power, so the test is not required.					

# 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 Technologies	ST60-SIPT	802.11 ac/a/b/g/n + Bluetooth 4.2 module	SIPT only	For marketing purpose
	SU60-SIPT			
	ST60-2230C	802.11 ac/a/b/g/n M.2 2230 + Bluetooth 4.2 module	with carrier board	
	SU60-2230C			
✦ The above models, model ST60-2230C was selected as a representative one for the final test and only its data was recorded in this report.				

### 1.1.2 Specification of the Equipment under Test (EUT)

<b>S/W Version</b>	SD-UAPSTA-8997-U14-MMC-16.68.1.p95-C3X16219_V4-MGPL-src
<b>WLAN</b>	
<b>Operating Frequency</b>	802.11b/g/n: 2412 MHz ~ 2472 MHz 802.11a/n/ac: 5180 MHz ~ 5240 MHz; 5260 MHz ~ 5320 MHz; 5500 MHz ~ 5700 MHz
<b>Modulation Type</b>	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n/ac: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)
<b>BT</b>	
<b>Operating Frequency</b>	2402 MHz ~ 2480 MHz
<b>Modulation Type</b>	Bluetooth 4.2 LE: GFSK Bluetooth BR(1Mbps): GFSK Bluetooth EDR (2Mbps): $\pi/4$ -DQPSK Bluetooth EDR (3Mbps): 8-DPSK

### 1.1.3 Antenna Details

Ant. No.	Model	Type	Connector	Operating Frequencies (MHz) / Antenna Gain (dBi)			
				2400~2483.5	5150~5250	5250~5350	5470~5725
1	LSR/001-0009	Dipole	IPEX U.FL	2	2	2	2
2	Laird NanoBlade-IP04	PCB Dipole	IPEX U.FL	2	3.9	3.9	4
3	Laird MAF95310 Mini NanoBlade Flex	PCB Dipole	IPEX U.FL	2.79	3.38	3.38	3.38
4	LSR/FlexPIFA 001-0016	PIFA	IPEX U.FL	2.5	3	3	3
5	Ethertronics WLAN_1000146	Isolated Magnetic Dipole	IPEX U.FL	2.5	3.5	3.5	3.5

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

<b>Power Supply Type</b>	DC 2.97V & DC 3.3V from host
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### 1.1.5 Accessories

N/A

## 1.2 Test Equipment and Calibration Data

<b>Test Item</b>	Conducted Emission				
<b>Test Site</b>	Conduction room 1 / (CO01-WS)				
<b>Tested Date</b>	May 16, 2017				
<b>Instrument</b>	<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Calibration Date</b>	<b>Calibration Until</b>
Receiver	R&S	ESR3	101657	Dec. 21, 2016	Dec. 20, 2017
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 08, 2016	Nov. 07, 2017
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Nov. 25, 2016	Nov. 24, 2017
RF Cable-CON	EMC	EMCCFD300-BM-B M-6000	50821	Dec. 20, 2016	Dec. 19, 2017
50 ohm terminal (Support Unit)	NA	50	02	Apr. 07, 2017	Apr. 06, 2018
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

<b>Test Item</b>	ESD				
<b>Test Site</b>	ESD room 1 / (ES01-WS)				
<b>Tested Date</b>	May 12, 2017				
<b>Instrument</b>	<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Calibration Date</b>	<b>Calibration Until</b>
ESD Generator	EMTest	Dito	V1248114239	Aug. 11, 2016	Aug. 10, 2017
Note: Calibration Interval of instruments listed above is one year.					

<b>Test Item</b>	Radiated Immunity (80 MHz - 6 GHz)				
<b>Test Site</b>	RS room 1 / (RS01-WS)				
<b>Tested Date</b>	May 13, 2017				
<b>Instrument</b>	<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Calibration Date</b>	<b>Calibration Until</b>
Signal Generator	R & S	SMB100A	103924HA	Oct. 19, 2016	Oct. 18, 2017
Power Sensor	R & S	NRP-Z91	101094-UL	Oct. 14, 2016	Oct. 13, 2017
Power Sensor	R & S	NRP-Z91	101095-KY	Oct. 14, 2016	Oct. 13, 2017
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)

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 from the AC mains power ports	150kHz ~ 30MHz	$\pm 2.90$ 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	21°C/57%	Alex Tsai
ESD	ES01-WS	20°C/50%/99kPa	Jun Tseng
RS	RS01-WS	24°C/60%/100kPa	Jun Tseng

### 2.2 The Worst Case Measurement Configuration

The Determined Worst Case Configurations	
Conducted Emissions from the AC mains power ports	
Test Mode	Operating Description
1	Antenna: LSR/001-0009, BT Tx, AC230V/50Hz
2	Antenna: Laird NanoBlade-IP04, WiFi 5G Tx, AC110V/60Hz
3	Antenna: Laird MAF95310 Mini NanoBlade Flex, WiFi 2.4G Tx, AC230V/50Hz
4	Antenna: LSR/FlexPIFA 001-0016, WiFi 5G Tx, AC110V/60Hz
5	Antenna: Ethertronics WLAN_1000146, WiFi 5G Tx, AC230V/50Hz
ESD, RS Tests	
Test Mode	Operating Description
1	Antenna: LSR/001-0009, BT Tx.
2	Antenna: Laird NanoBlade-IP04, WiFi 5G Tx
3	Antenna: Laird MAF95310 Mini NanoBlade Flex, WiFi 2.4G Tx
4	Antenna: LSR/FlexPIFA 001-0016, WiFi 5G Tx
5	Antenna: Ethertronics WLAN_1000146, WiFi 5GTx

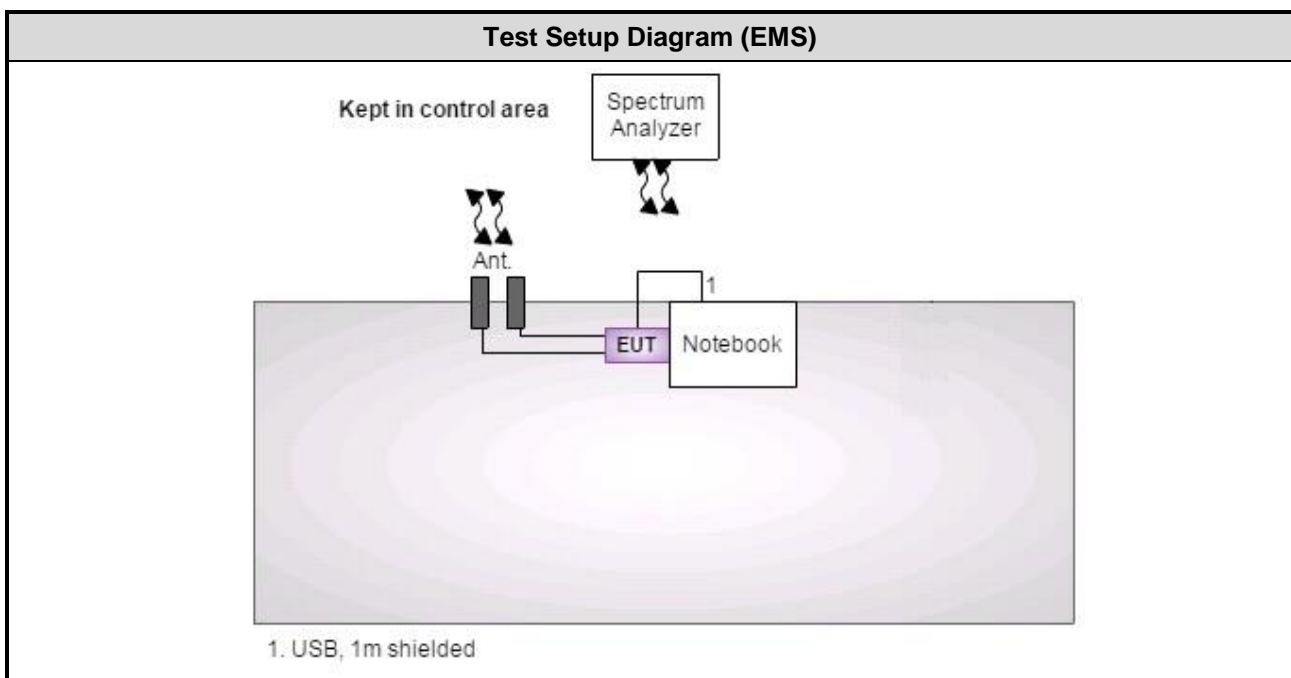
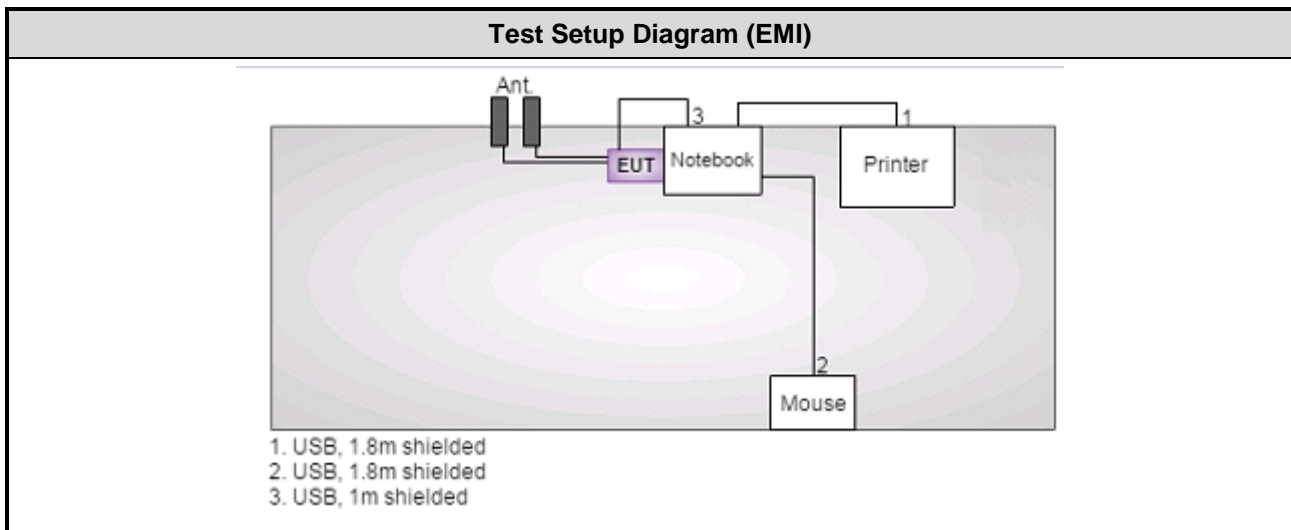
## 2.3 Local Support Equipment List

Support Equipment List (EMI)					
No.	Equipment	Brand	Model	S/N	Signal cable / Length (m)
1	Notebook	Lenovo	1706-BW8	LV-AF745 07/04	---
2	Printer	EPSON	XP-30	QSDK002410	USB, 1.8m shielded.
3	Mouse	DELL	MS111-L	2C3-00MM	USB, 1.8m shielded.

Support Equipment List (EMS)					
No.	Equipment	Brand	Model	S/N	Signal cable / Length (m)
1	Notebook	Lenovo	1706-BW8	LV-AF745 07/04	---
2	Spectrum Analyzer	R&S	FSV40	101499	---

Note: No. 1 was supplied by applicant.

## 2.4 Test Setup Chart



## 2.5 Test Software and Operating Condition

### <EMI>

- a. To enable all functions of test system.
- b. The support notebook was set in Linux OS.
- c. The support notebook communicated with EUT by executing "Terminal.exe" to transmitting continuously by BT or WiFi.

### <EMS>

- a. To enable all functions of test system.
- b. The support notebook was set in Linux OS.
- c. The support notebook communicated with EUT by executing "Terminal.exe" to transmitting continuously by BT or WiFi and monitored radio signal by spectrum.

### 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

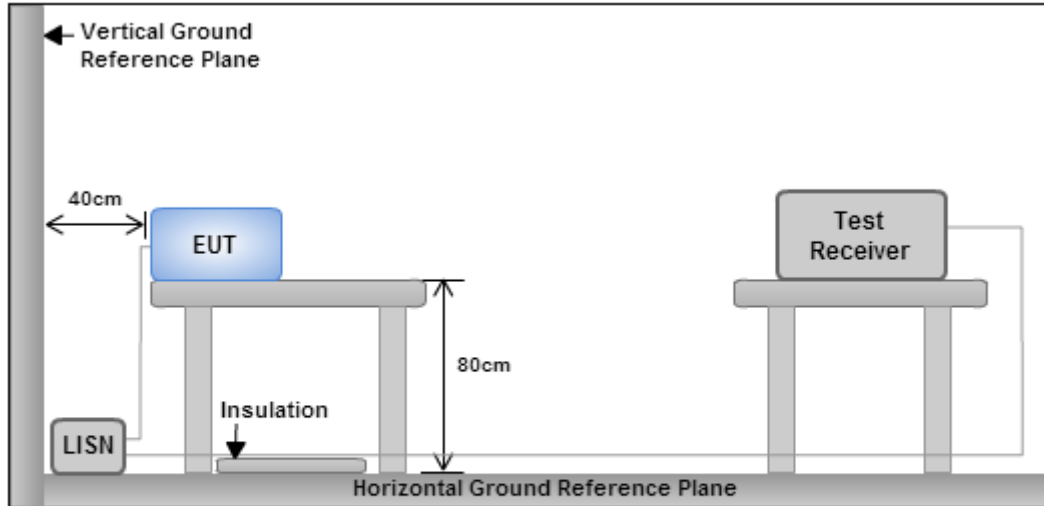
Frequency range (MHz)	Limits values (dBμV)			
	Class A		Class B	
	Quasi-peak	Average	Quasi-peak	Average
0.15 to 0,50	79	66	66 to 56 *	56 to 46 *
0,50 to 5	73	60	56	46
5 to 30	73	60	60	50

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

- 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.
- A thickness of  $\leq 0.15\text{m}$  insulation should be placed between local AE and associated cabling and the RGP.
- Connect EUT to the power mains through a line impedance stabilization network (LISN).
- All the support units are connecting to the other LISN.
- The LISN provides 50 ohm coupling impedance for the measuring instrument.
- The CISPR states that a 50 ohm, 50 microhenry LISN should be used.
- Both sides of AC line were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

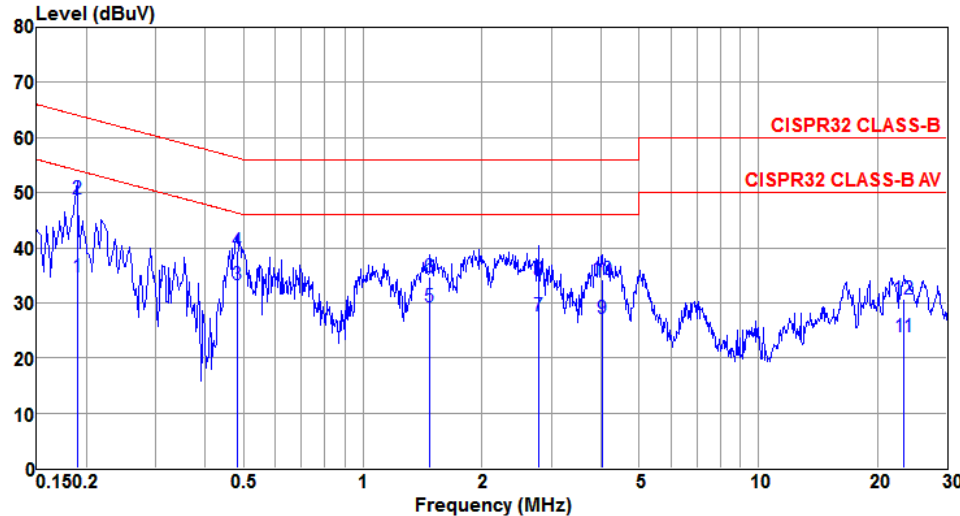
### 3.1.3 Test Setup



- 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

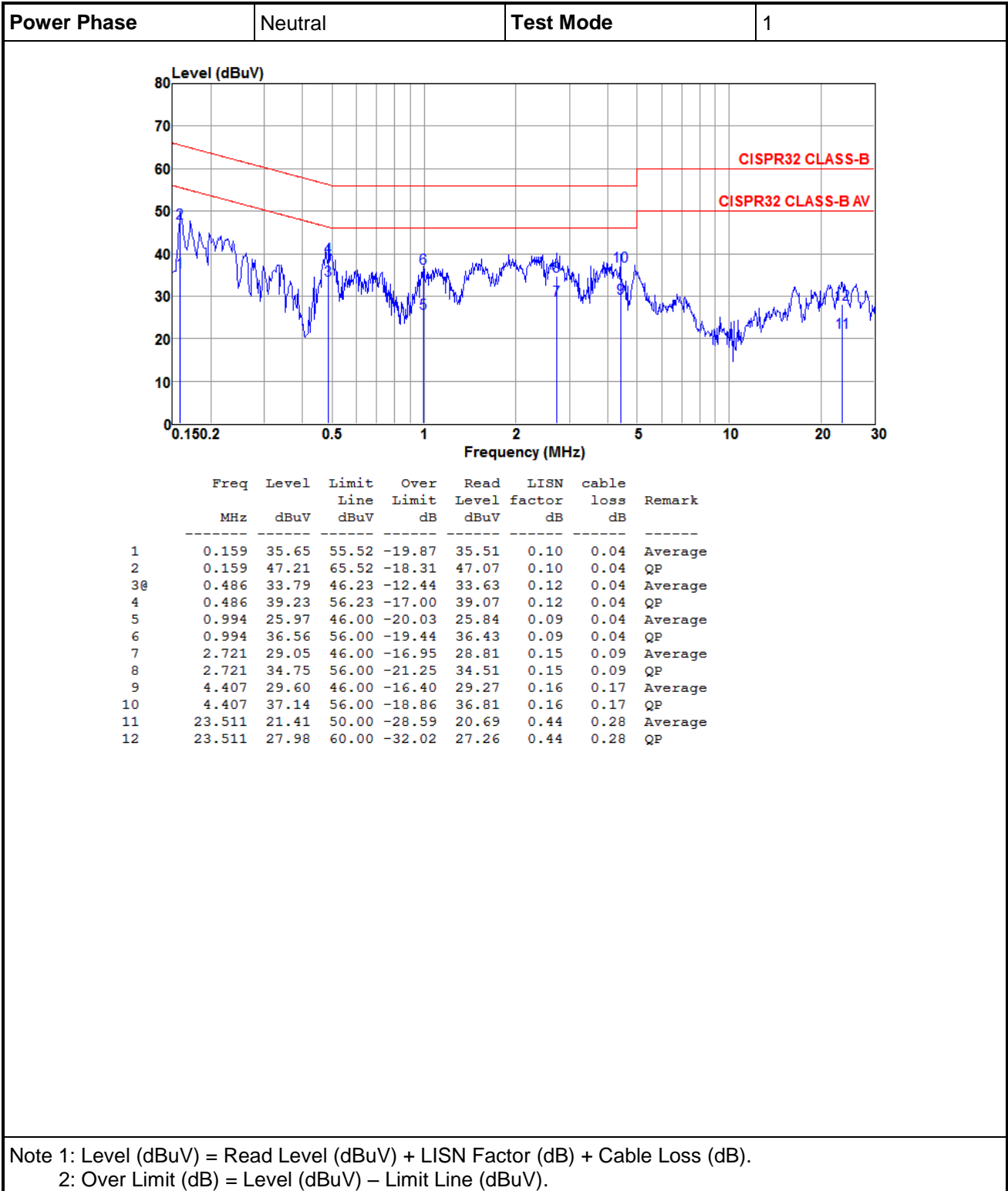
Power Phase	Line	Test Mode	1
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Freq	Level	Limit	Over	Read	LISN	cable	Remark	
MHz	dBuV	dBuV	Limit	Level	factor	loss		
			dB	dBuV	dB	dB		
1	0.189	34.72	54.06	-19.34	34.59	0.09	0.04	Average
2	0.189	48.87	64.06	-15.19	48.74	0.09	0.04	QP
3@	0.481	33.19	46.32	-13.13	33.09	0.06	0.04	Average
4	0.481	39.51	56.32	-16.81	39.41	0.06	0.04	QP
5	1.480	29.38	46.00	-16.62	29.24	0.10	0.04	Average
6	1.480	34.77	56.00	-21.23	34.63	0.10	0.04	QP
7	2.779	27.57	46.00	-18.43	27.32	0.15	0.10	Average
8	2.779	34.04	56.00	-21.96	33.79	0.15	0.10	QP
9	4.027	27.05	46.00	-18.95	26.72	0.17	0.16	Average
10	4.027	34.15	56.00	-21.85	33.82	0.17	0.16	QP
11	23.387	23.84	50.00	-26.16	23.14	0.42	0.28	Average
12	23.387	30.58	60.00	-29.42	29.88	0.42	0.28	QP

Note 1: Level (dBUV) = Read Level (dBUV) + LISN Factor (dB) + Cable Loss (dB).

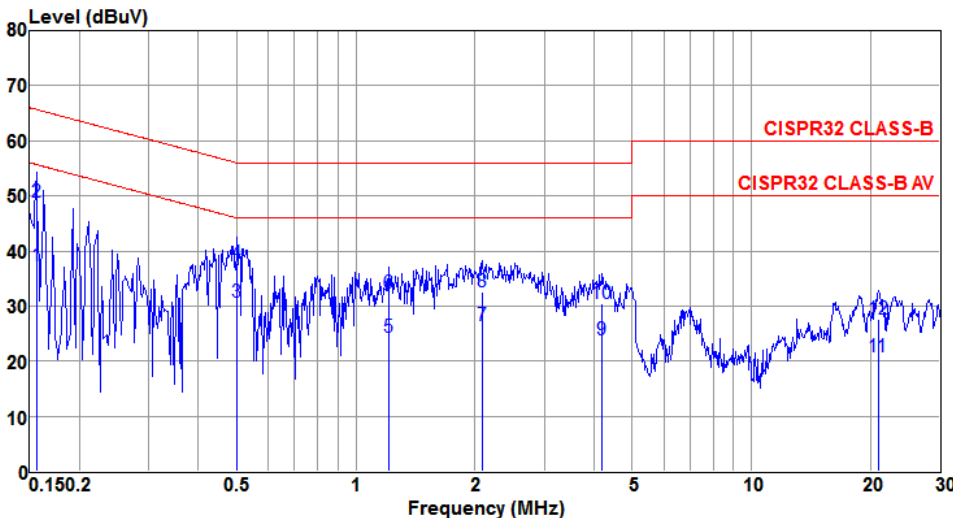
2: Over Limit (dB) = Level (dBUV) – Limit Line (dBUV).





Power Phase	Line	Test Mode	2
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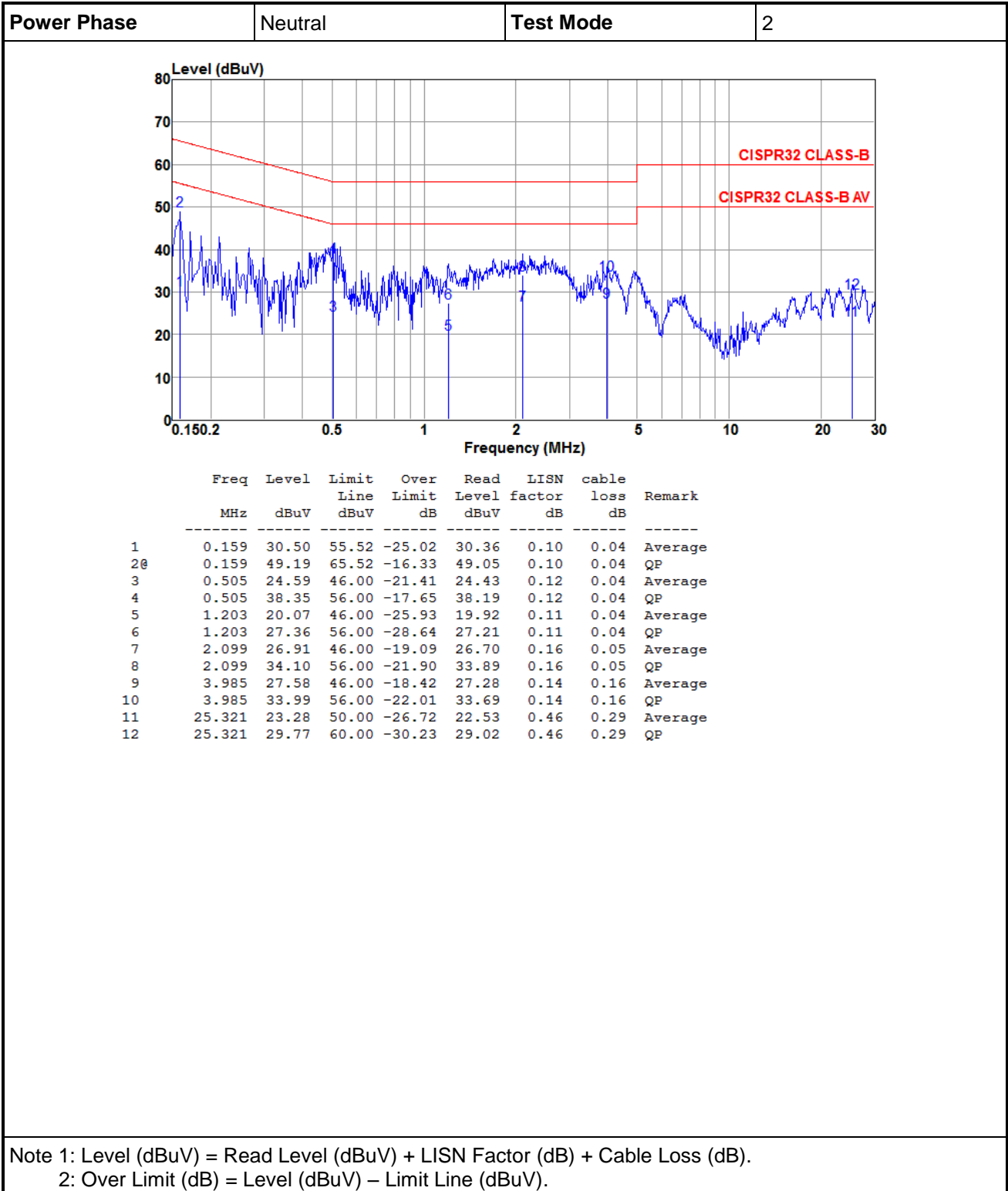


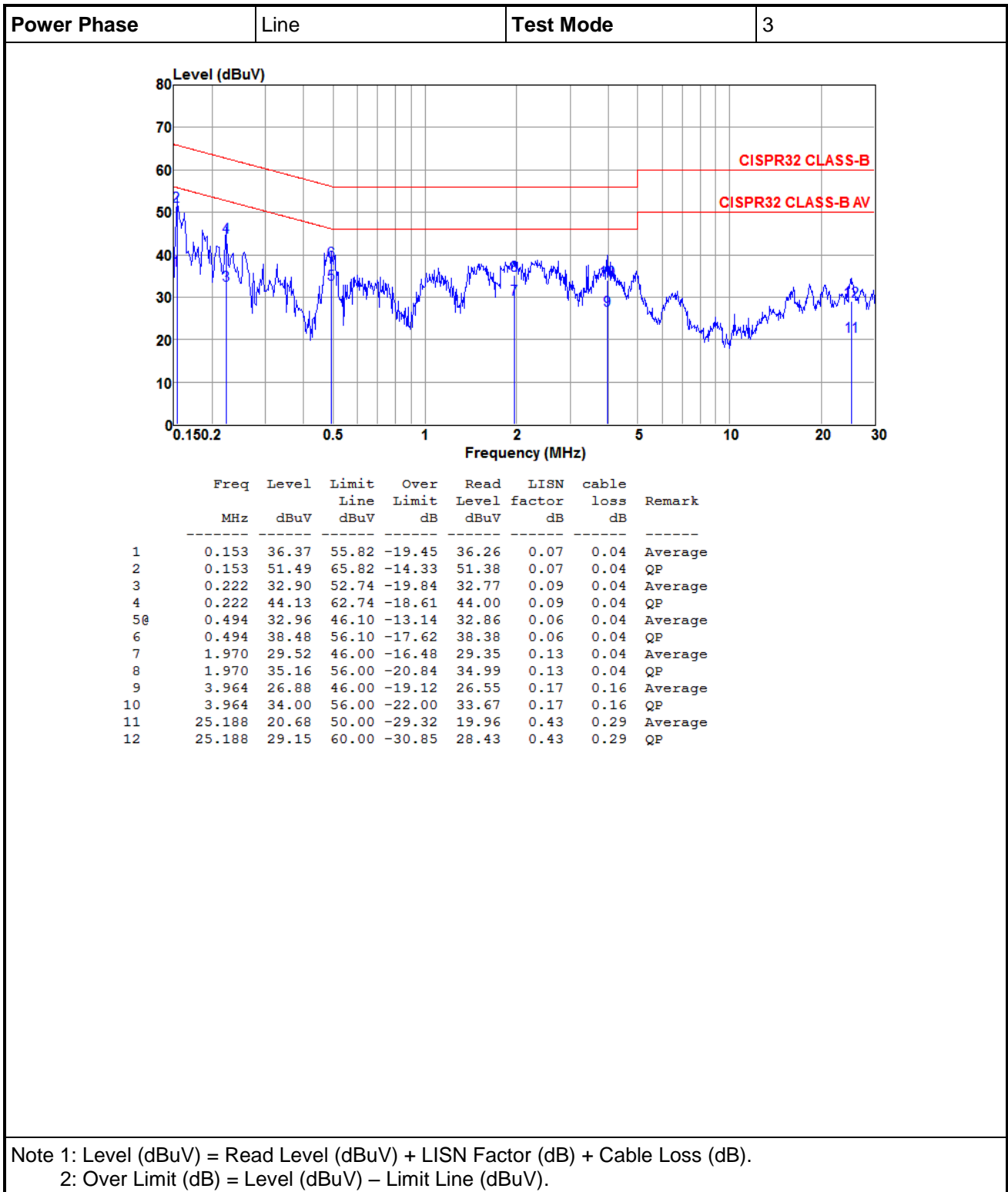
  

	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.156	37.21	55.69	-18.48	37.10	0.07	0.04	Average
2	0.156	48.93	65.69	-16.76	48.82	0.07	0.04	QP
3	0.502	30.72	46.00	-15.28	30.62	0.06	0.04	Average
4	0.502	37.67	56.00	-18.33	37.57	0.06	0.04	QP
5	1.210	24.30	46.00	-21.70	24.17	0.09	0.04	Average
6	1.210	32.23	56.00	-23.77	32.10	0.09	0.04	QP
7	2.088	26.51	46.00	-19.49	26.33	0.13	0.05	Average
8	2.088	32.55	56.00	-23.45	32.37	0.13	0.05	QP
9	4.202	23.80	46.00	-22.20	23.47	0.17	0.16	Average
10	4.202	30.40	56.00	-25.60	30.07	0.17	0.16	QP
11	20.924	20.77	50.00	-29.23	20.09	0.41	0.27	Average
12	20.924	27.52	60.00	-32.48	26.84	0.41	0.27	QP

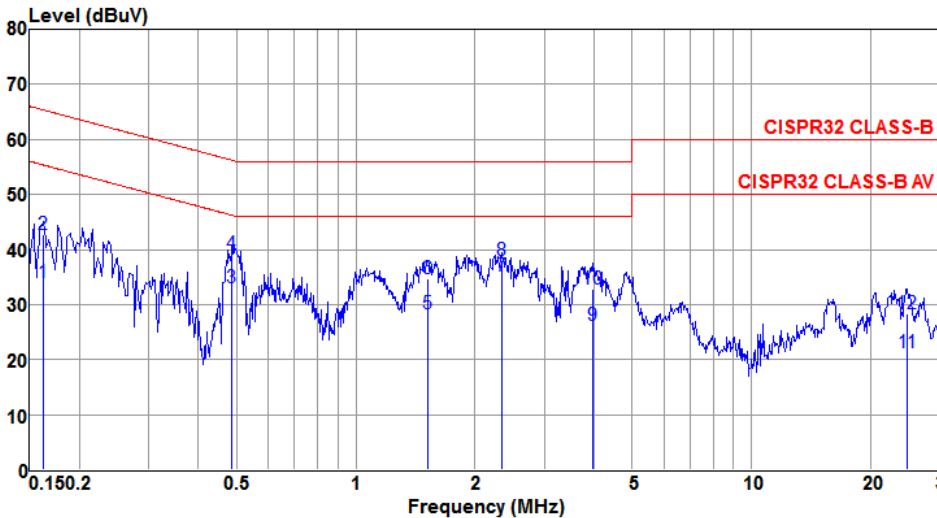
Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).  
 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).





Power Phase	Neutral	Test Mode	3
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Level (dBuV)

Frequency (MHz)

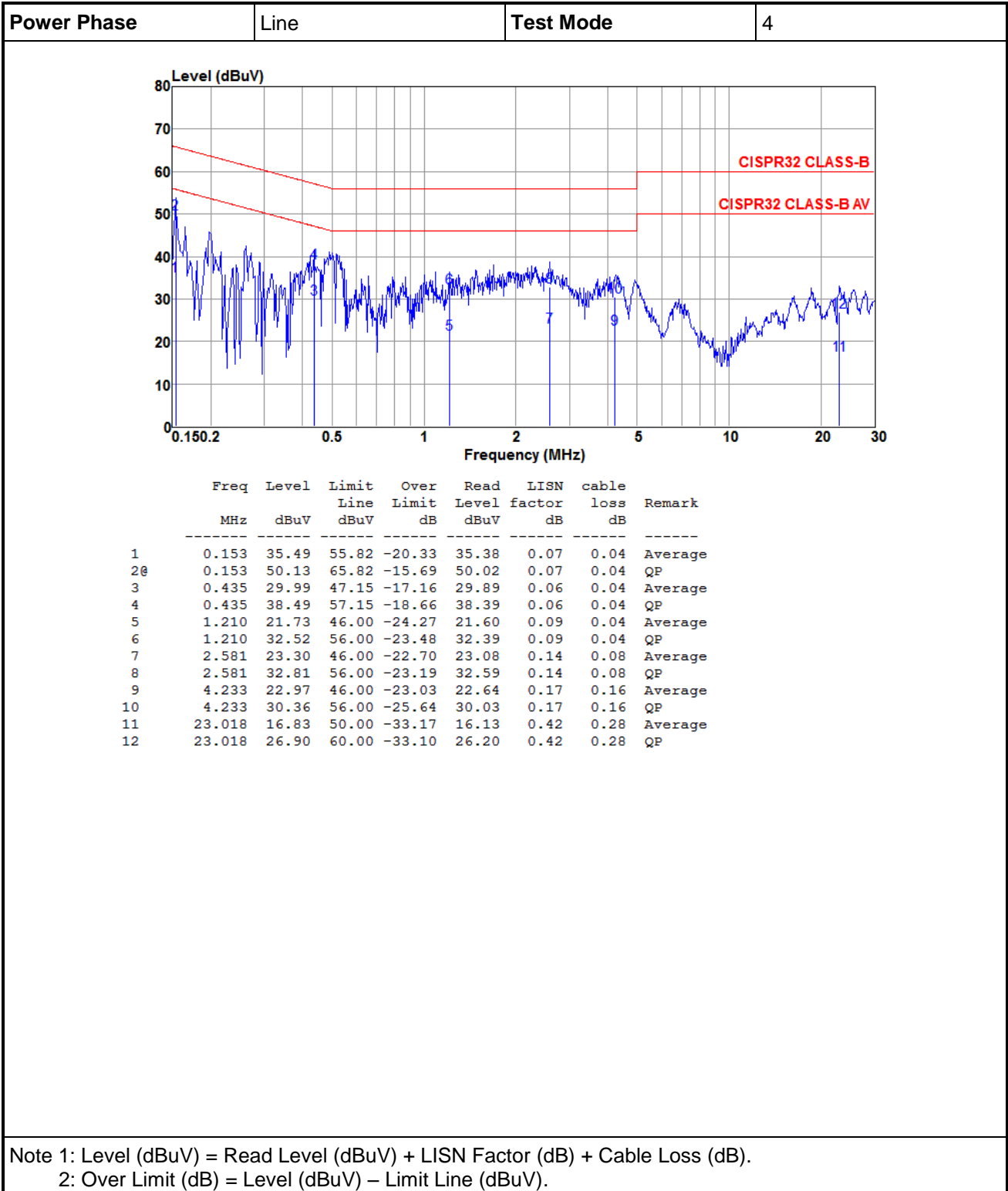
CISPR32 CLASS-B

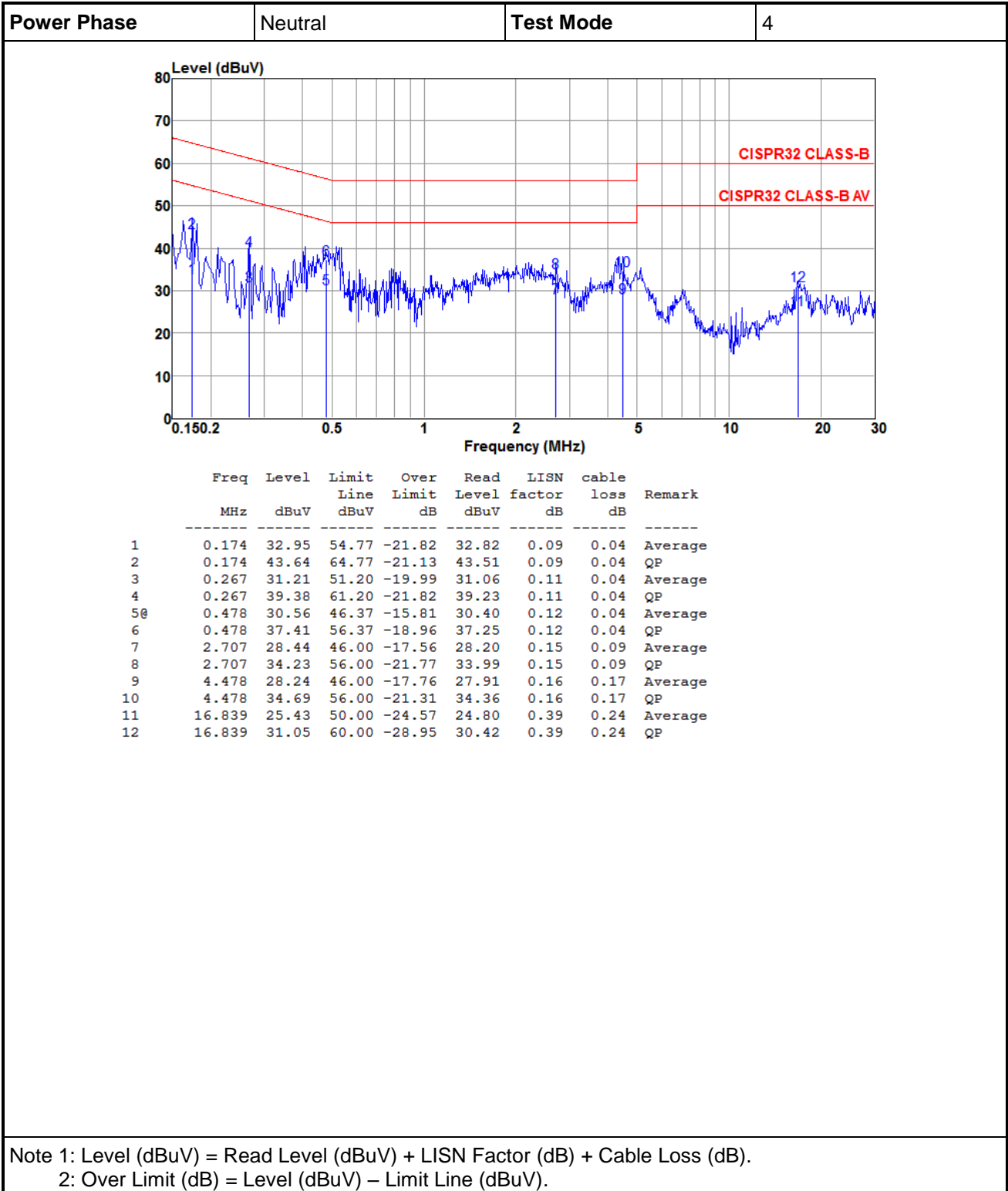
CISPR32 CLASS-B AV

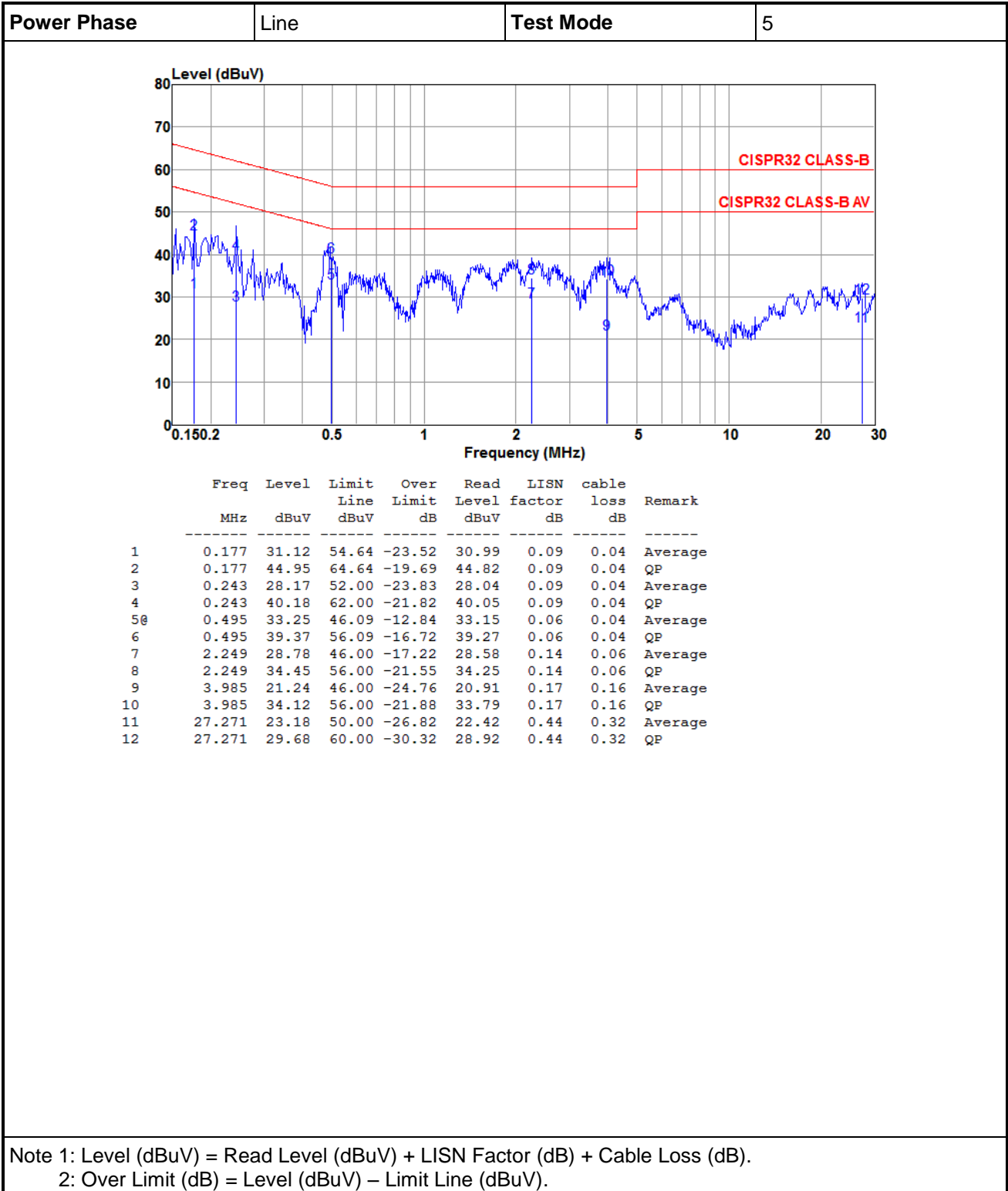
  

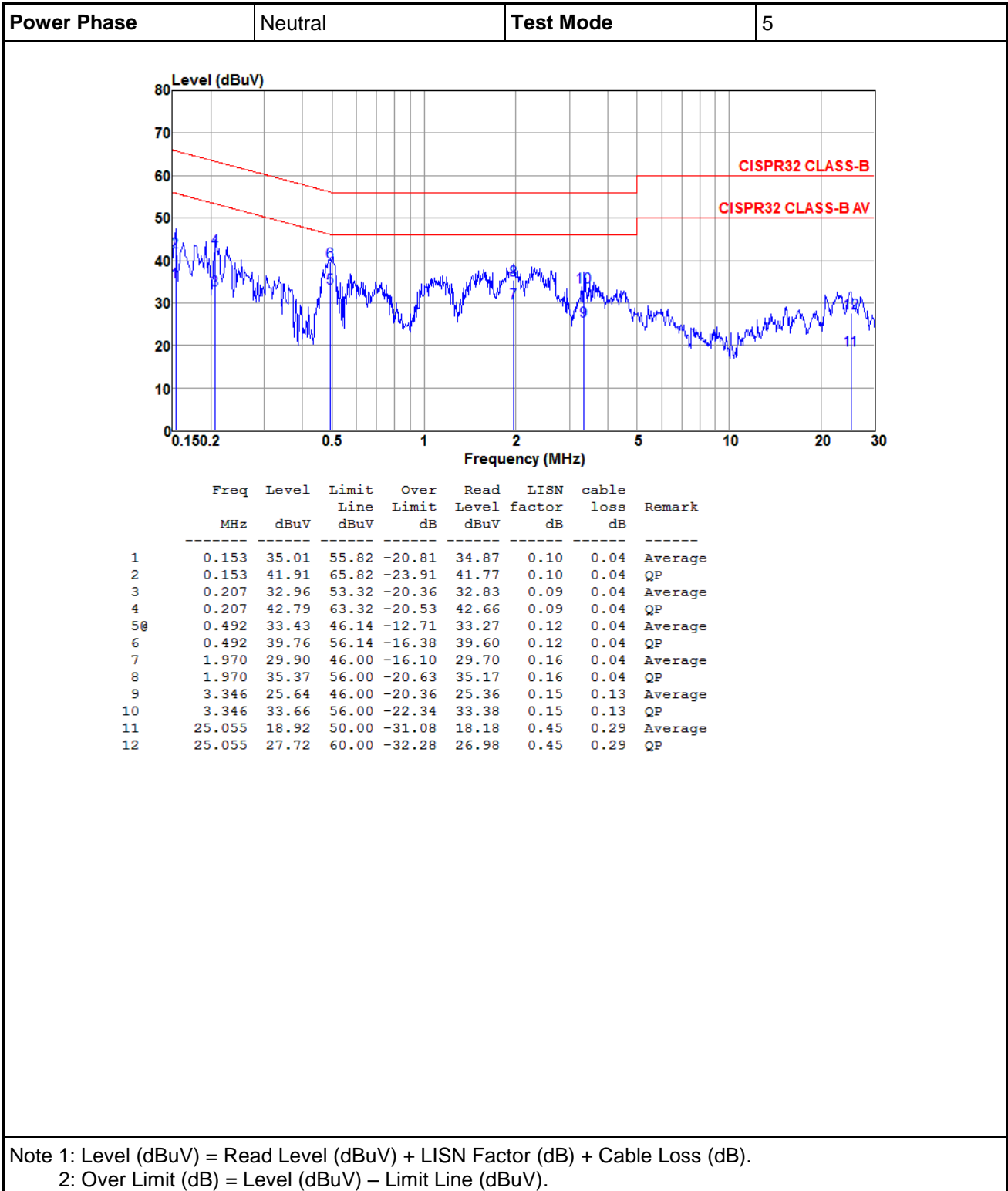
	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.162	33.94	55.34	-21.40	33.80	0.10	0.04	Average
2	0.162	42.64	65.34	-22.70	42.50	0.10	0.04	QP
3	0.486	32.96	46.23	-13.27	32.80	0.12	0.04	Average
4	0.486	39.14	56.23	-17.09	38.98	0.12	0.04	QP
5	1.519	28.28	46.00	-17.72	28.11	0.13	0.04	Average
6	1.519	34.74	56.00	-21.26	34.57	0.13	0.04	QP
7@	2.334	35.28	46.00	-10.72	35.05	0.16	0.07	Average
8	2.334	37.89	56.00	-18.11	37.66	0.16	0.07	QP
9	3.964	26.16	46.00	-19.84	25.86	0.14	0.16	Average
10	3.964	32.80	56.00	-23.20	32.50	0.14	0.16	QP
11	24.790	21.34	50.00	-28.66	20.60	0.45	0.29	Average
12	24.790	28.40	60.00	-31.60	27.66	0.45	0.29	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, Draft EN 301 489-17		
Basic Standard	Spec. Requirement	Performance Criteria
EN 61000-4-2 (ESD)	Contact Discharge: $\pm 4$ kV Air Discharge: $\pm 8$ kV	B
EN 61000-4-3 (RS)	80 MHz to 6000 MHz 3 V/m, 1 kHz Sine Wave 80%, AM Modulation	A

## 4.2 Performance Criteria Description

Draft EN 301 489-17		
Criteria	During test	After test
A	<p>Shall operate as intended.</p> <p>May show degradation of performance (see note 1).</p> <p>Shall be no loss of function.</p> <p>Shall be no unintentional transmissions.</p>	<p>Shall operate as intended.</p> <p>Shall be no degradation of performance (see note 3).</p> <p>Shall be no loss of function.</p> <p>Shall be no loss of stored data or user programmable functions.</p>
B	<p>May show loss of function (one or more).</p> <p>May show degradation of performance (see note 2).</p> <p>No unintentional transmissions.</p>	<p>Functions shall be self-recoverable.</p> <p>Shall operate as intended after recovering.</p> <p>Shall be no degradation of performance (see note 3).</p> <p>Shall be no loss of stored data or user programmable functions.</p>
C	<p>May be loss of function (one or more).</p>	<p>Functions shall be recoverable by the operator.</p> <p>Shall operate as intended after recovering.</p> <p>Shall be no degradation of performance (see note 3).</p>
<p>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.</p>		
<p>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.</p>		
<p>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 from the apparatus if used as intended.</p>		

#### 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 WLAN signal loss or any degradation of performance.
B	The BT or WLAN signal loss or degradation of performance. Functions shall be self-recoverable after the test.

## 4.3 Electrostatic Discharge (ESD)

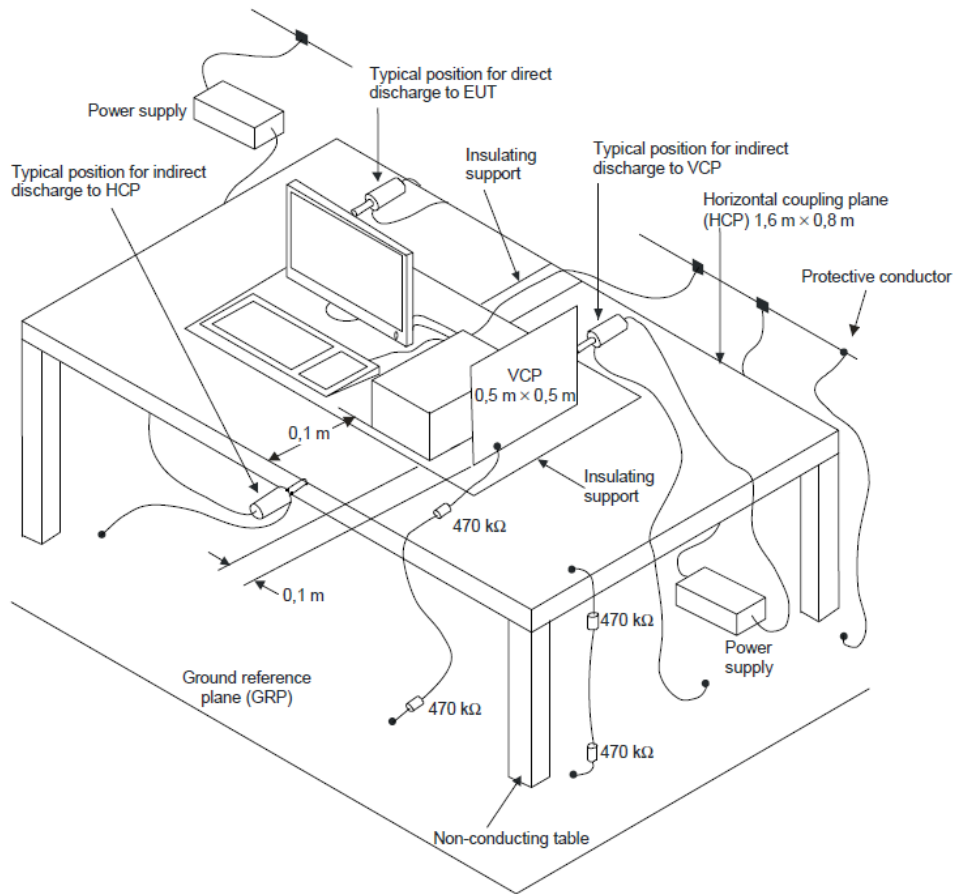
### 4.3.1 Test Specification of Electrostatic Discharge (ESD)

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

### 4.3.2 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.

### 4.3.3 Test Setup



The test setup shall consist of a non-conductive table,  $(0.8 \pm 0.08) \text{ m}$  high, standing on the ground reference plane.

A horizontal coupling plane (HCP),  $(1.6 \pm 0.02) \text{ m} \times (0.8 \pm 0.02) \text{ m}$ , shall be placed on the table. The EUT and its cables shall be isolated from the coupling plane by an insulating support  $(0.5 \pm 0.05) \text{ mm}$  in thickness.

#### 4.3.4 Test Result of Electrostatic Discharge (ESD)

Test Mode	1				
Direct Application					
Test Voltage (kV)	Polarity	Test Point	Contact Discharge	Air Discharge	Performance Criteria
2	+/-	1	Note	N/A	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	A

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

Test Mode	2, 3, 4, 5				
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	A

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

#### 4.3.5 Test Point Photo

##### Mode 1



## 4.4 Radio Frequency Electromagnetic Field (RS)

### 4.4.1 Test Specification of Radio Frequency Electromagnetic Field (RS)

<b>Basic Standard</b>	EN 61000-4-3
<b>Frequency Range</b>	80 MHz ~ 6000 MHz
<b>Field Strength</b>	3 V/m
<b>Modulation</b>	1 kHz Sine Wave, 80%, AM Modulation
<b>Frequency Step</b>	1 % of preceding frequency value
<b>Polarity of Antenna</b>	Horizontal and Vertical
<b>Antenna Height</b>	1.5 m
<b>Antenna Distance</b>	80 MHz ~ 1000 MHz: 3 m 1000 MHz ~ 6000 MHz: 1 m
<b>Dwell Time</b>	3 seconds

### 4.4.2 Test Procedures

- 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.
- 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.
- 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.
- 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.
- Responses on receivers occurring at discrete frequencies, which are narrow band responses, shall be disregarded from the test.
- The frequencies selected and used during the test shall be recorded in the test report.
- 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.
- 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.
- 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.



### 4.4.3 Exclusion bands

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:

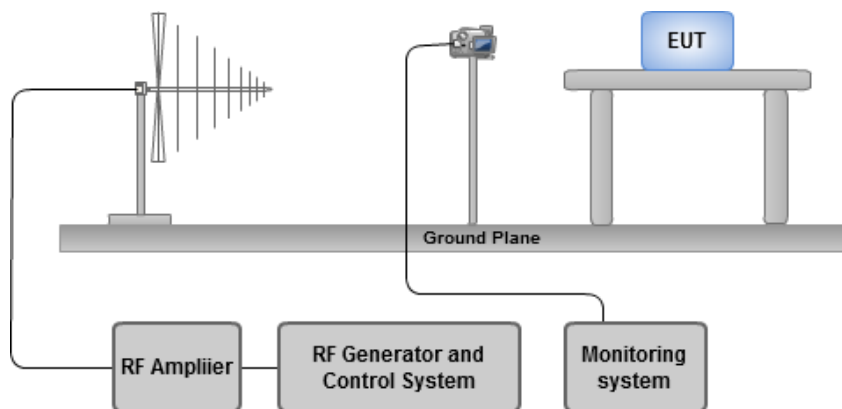
- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 4 880 MHz;
- upper limit of exclusion band = highest allocated band edge frequency +270 MHz, i.e. 5 995 MHz.

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.

### 4.4.4 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.

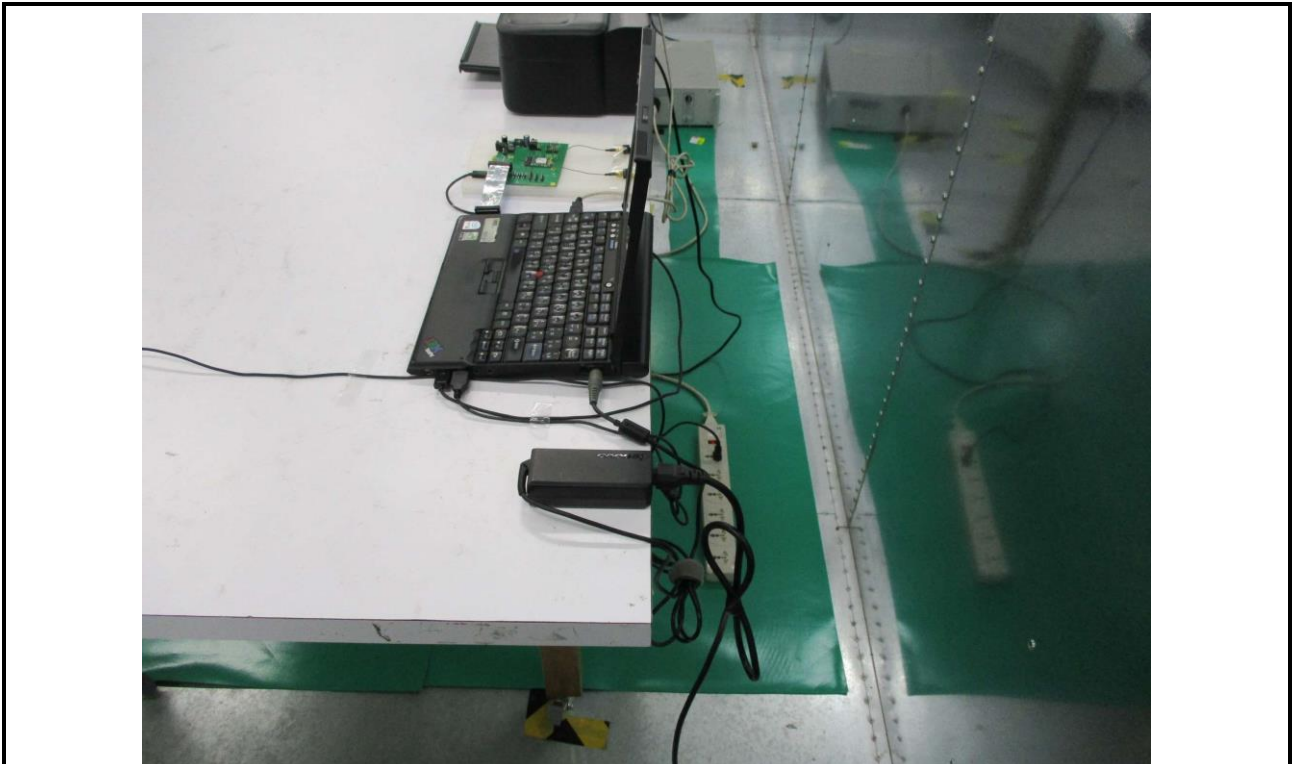
#### 4.4.5 Test Result of Radio Frequency Electromagnetic Field (RS)

Test Mode	1, 2, 3, 4, 5				
Frequency Range (MHz)	Azimuth	Polarity	Test Field Strength (V/m)	Observation	Performance Criteria
80 – 6000	0	V&H	3	Note	A
80 – 6000	90	V&H	3	Note	A
80 – 6000	180	V&H	3	Note	A
80 – 6000	270	V&H	3	Note	A

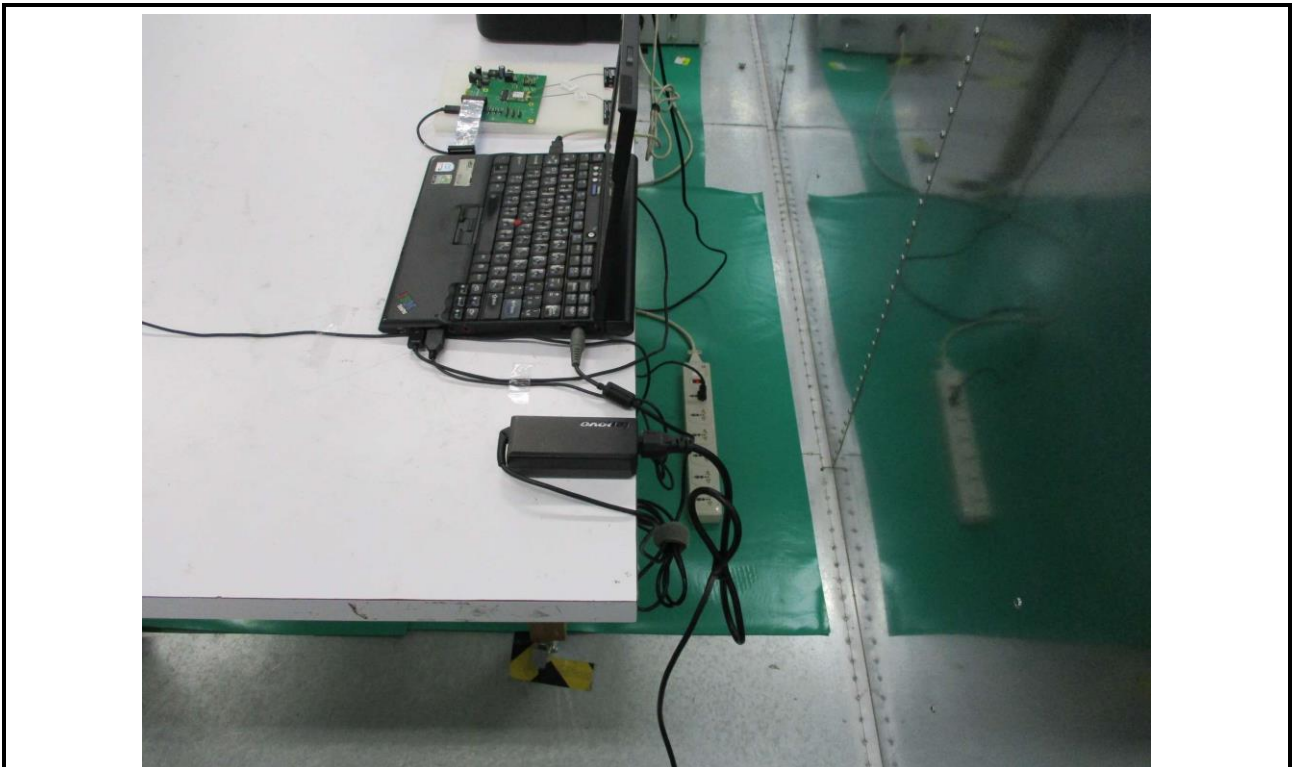
Note: There was no abnormal situation during the test compared with initial operation.

## 5 Photographs of the Test Configuration

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

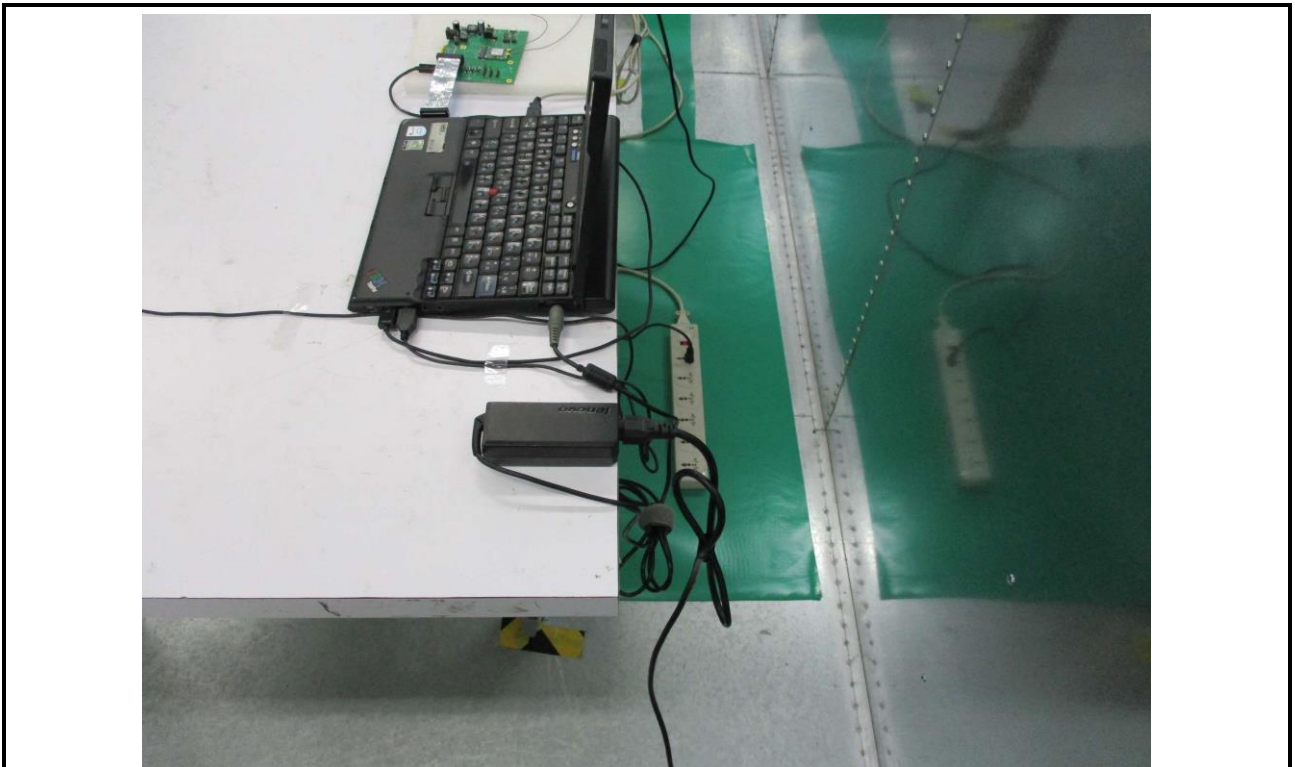


**Conducted Emissions from the AC mains power ports (Mode 2)**

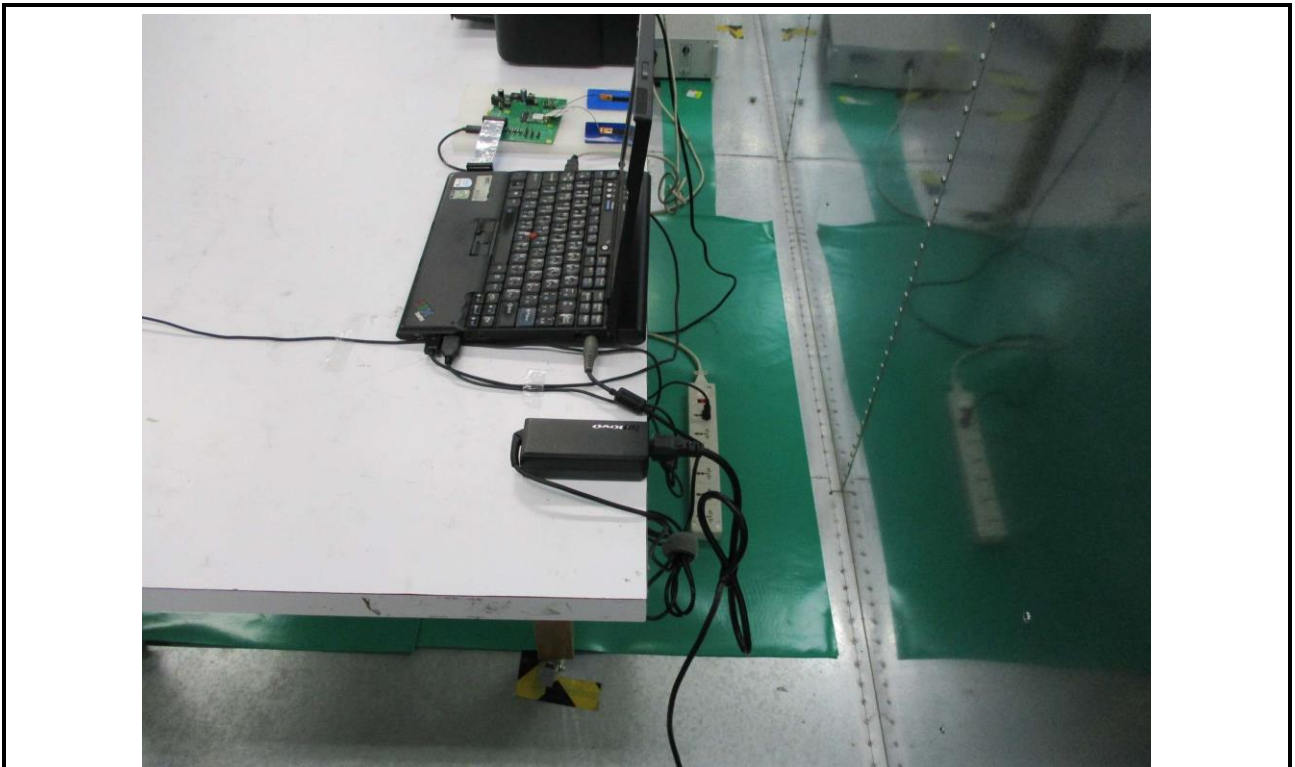




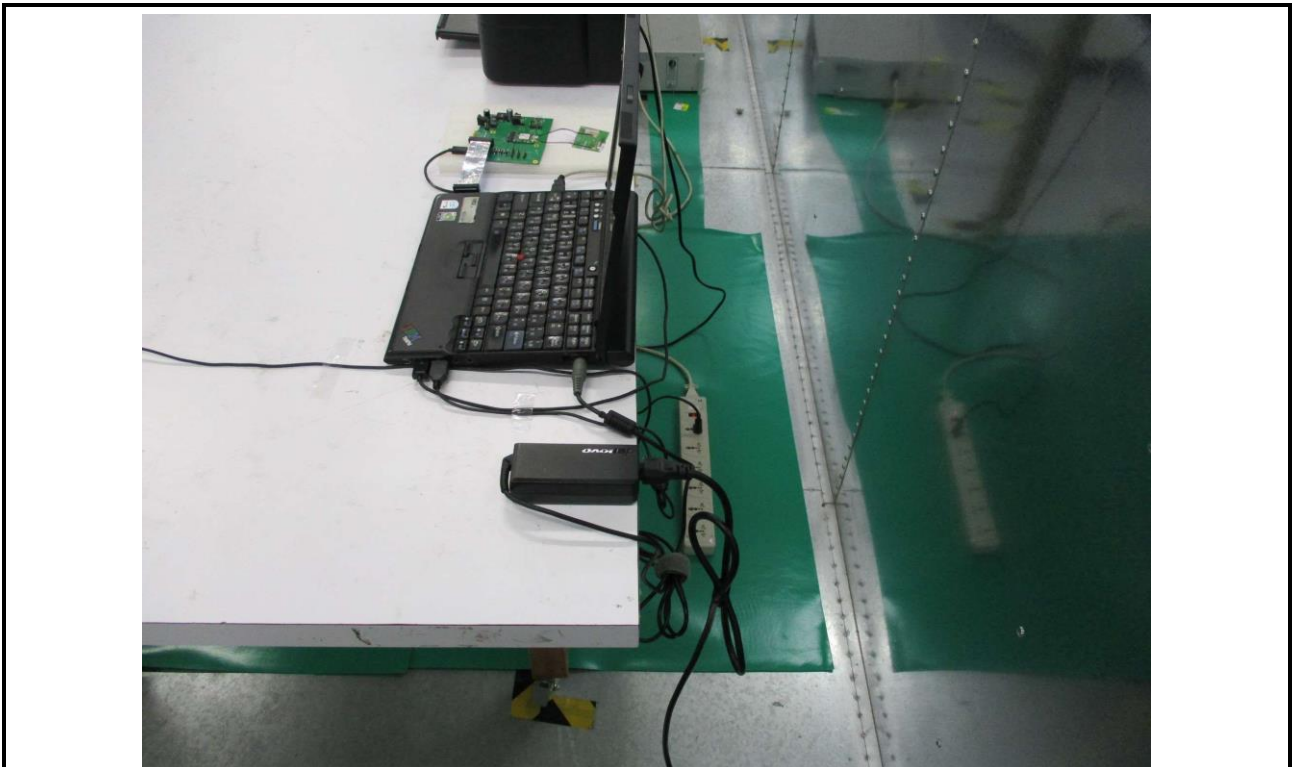
**Conducted Emissions from the AC mains power ports (Mode 3)**



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

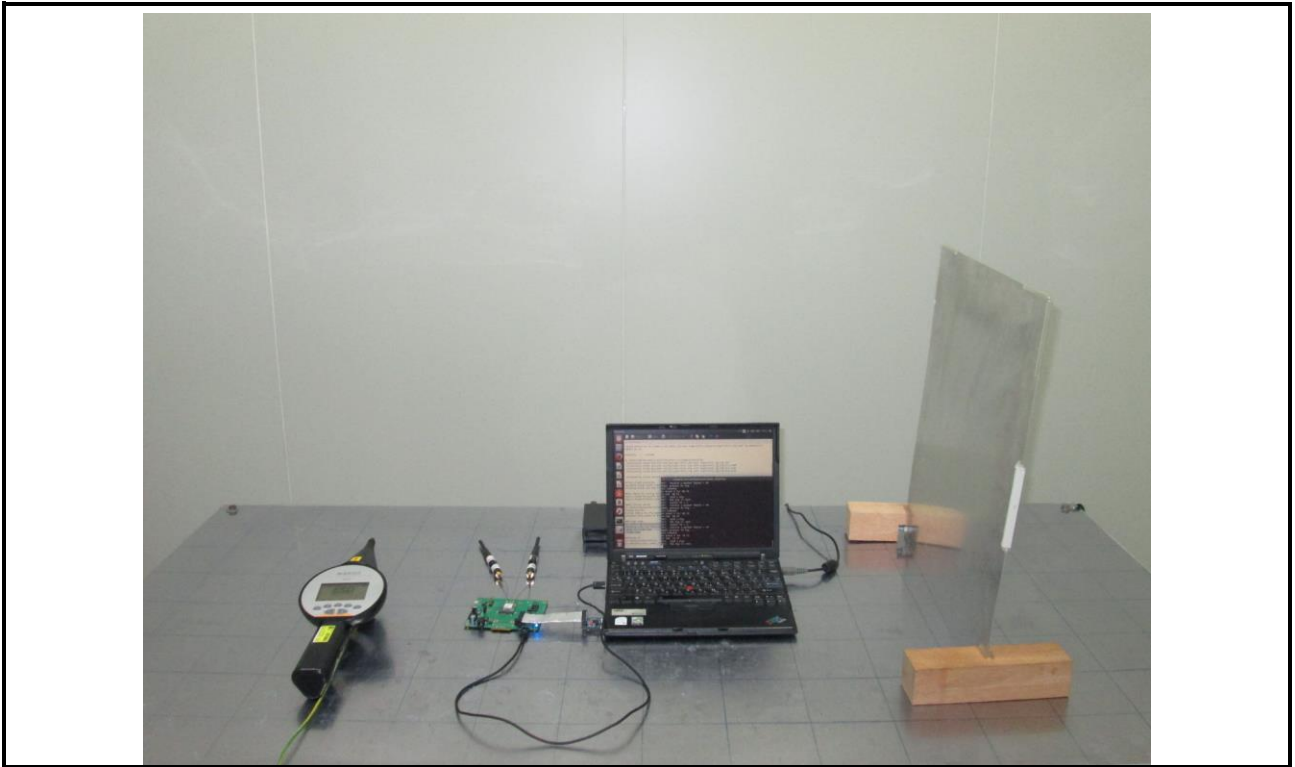


**Conducted Emissions from the AC mains power ports (Mode 5)**

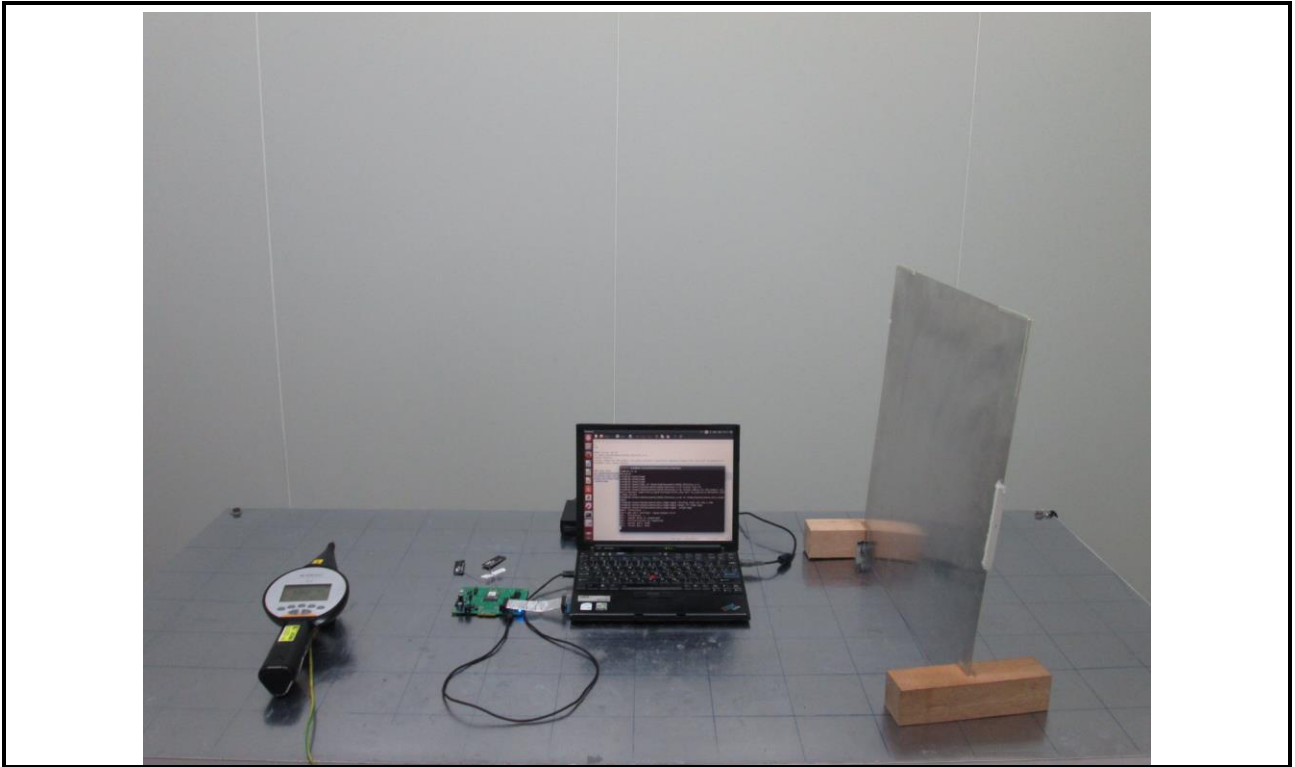




**ESD Test (Mode 1)**

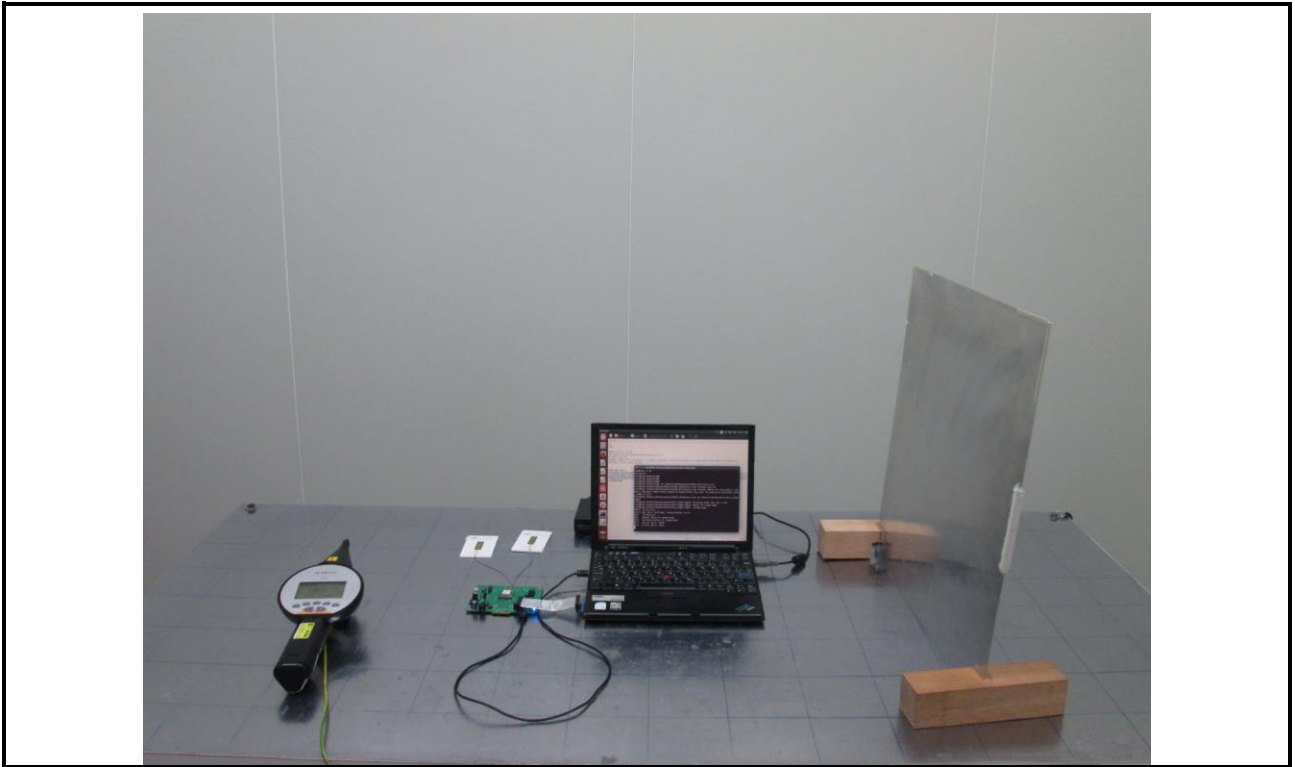


**ESD Test (Mode 2)**

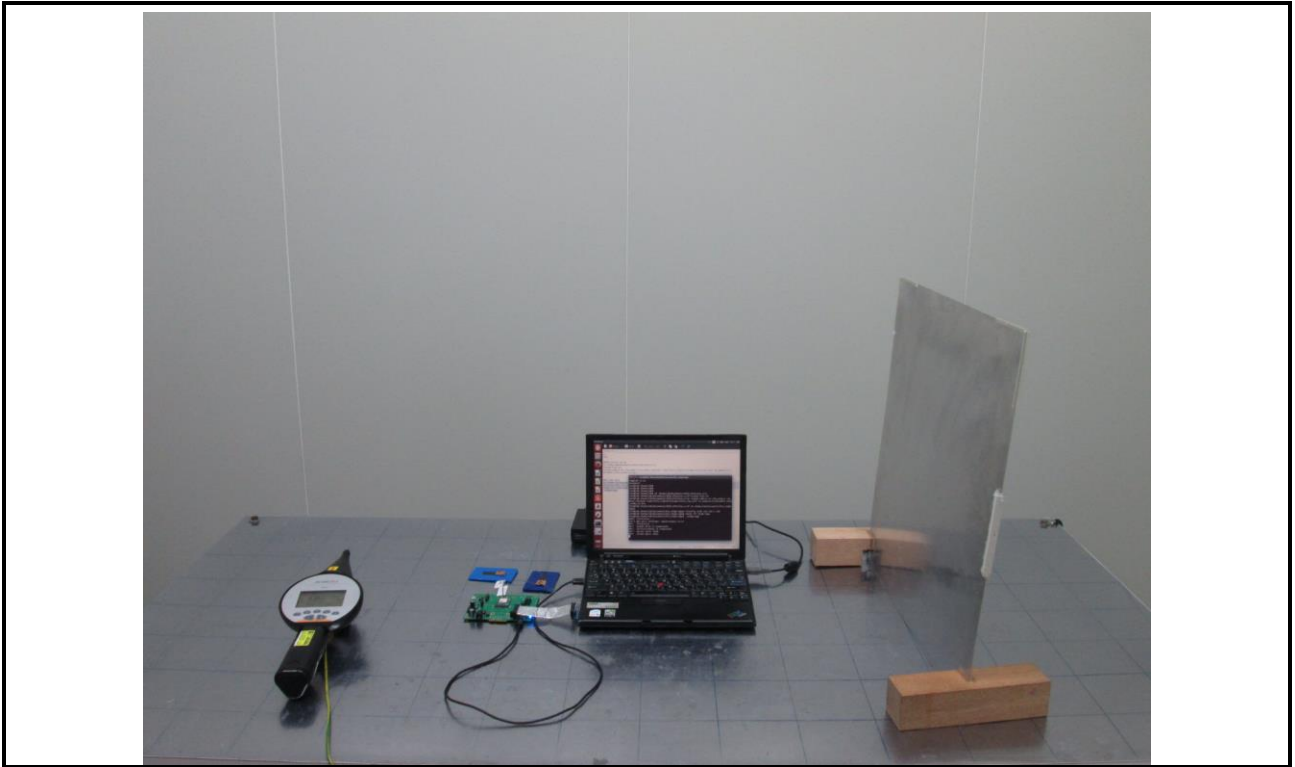




**ESD Test (Mode 3)**



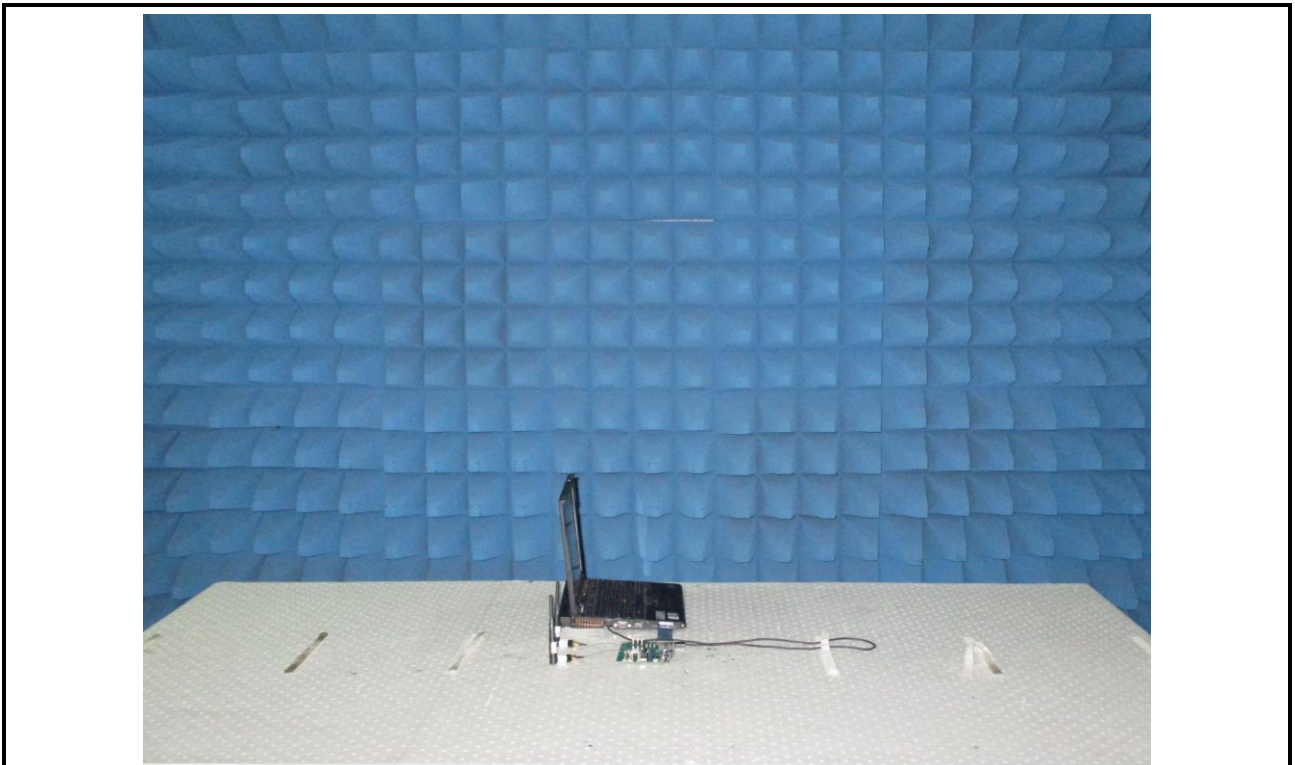
**ESD Test (Mode 4)**



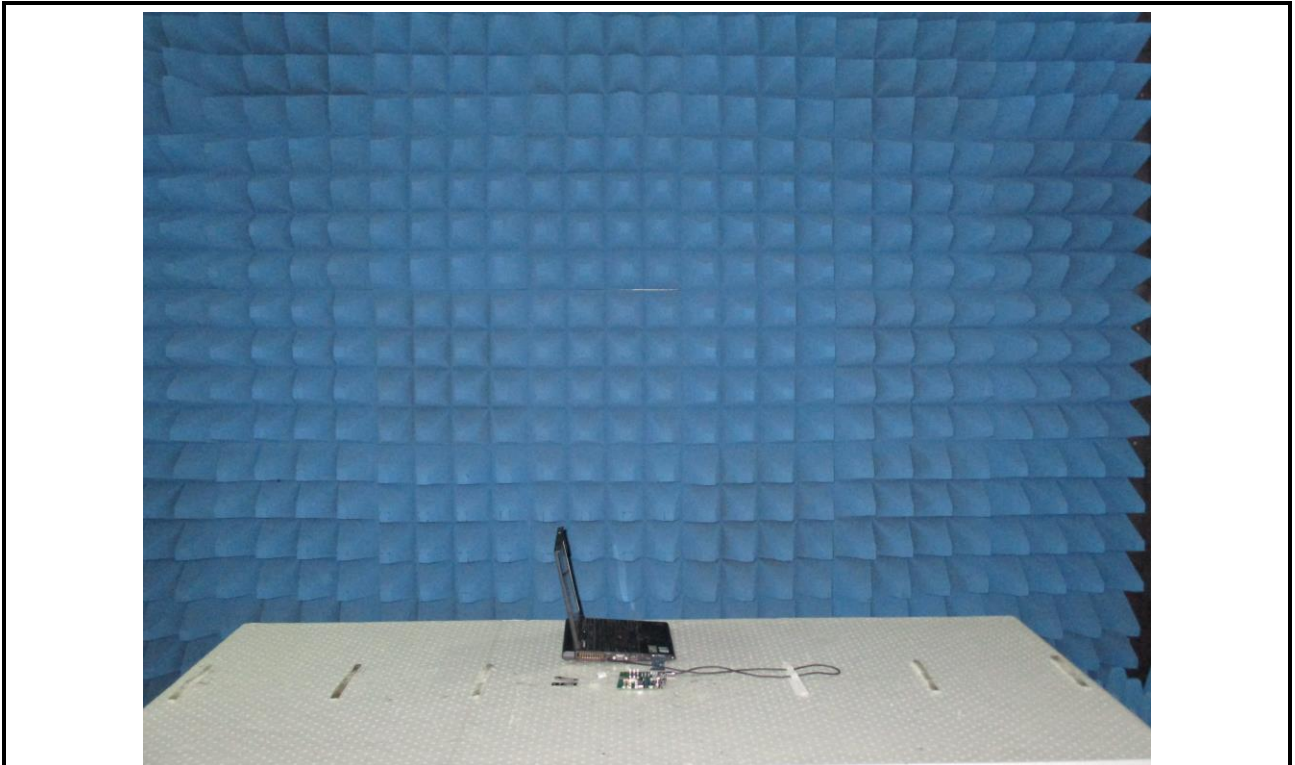
**ESD Test (Mode 5)**



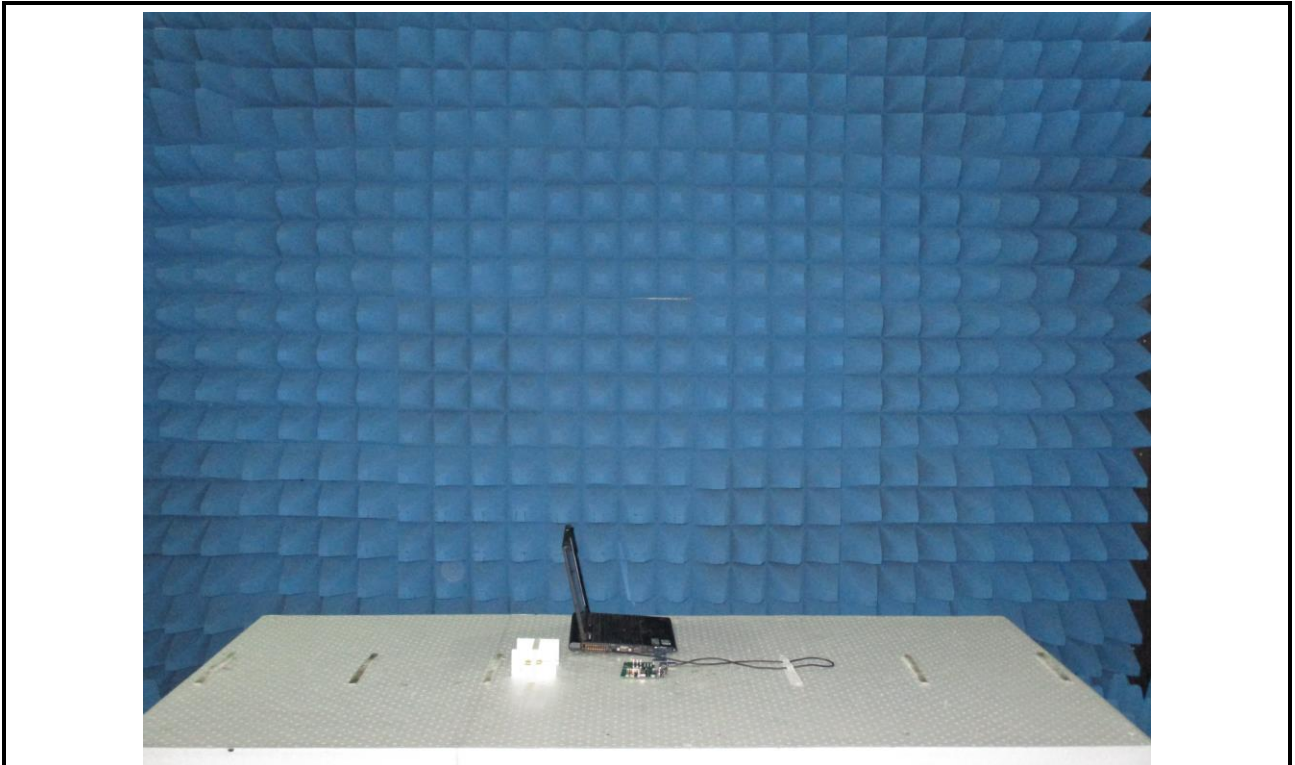
**RS Test (Mode 1)**



**RS Test (Mode 2)**

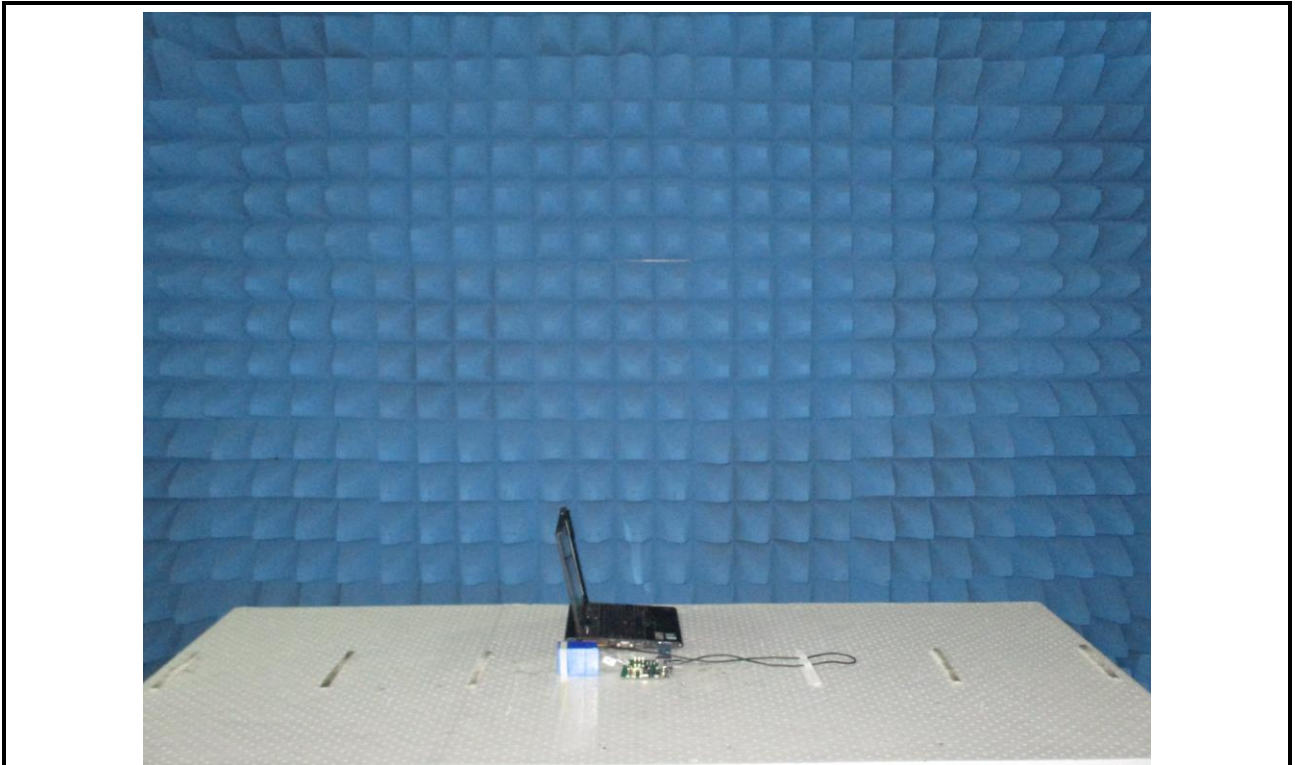


**RS Test (Mode 3)**

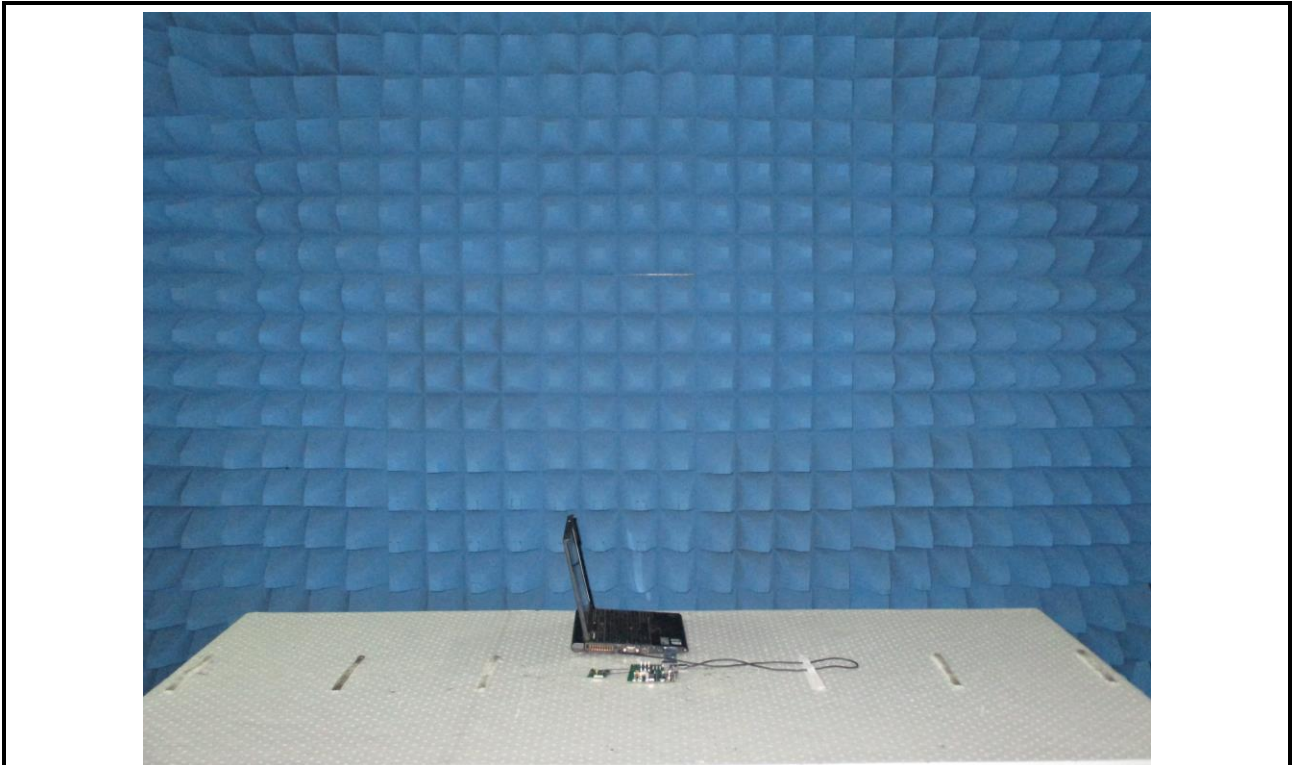




**RS Test (Mode 4)**



**RS Test (Mode 5)**



## 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>.

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St., Kwei Shan District, Tao Yuan  
City 333, Taiwan, R.O.C.

### **Kwei Shan Site II**

Tel: 886-3-271-8640

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

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Email: ICC\_Service@icertifi.com.tw

==END==