


CE EMC Test Report

Equipment : Sterling-LWB5+ 802.11a/b/g/n/ac Module with Bluetooth 5.0
Model No. : Sterling LWB5+
Brand Name : Laird Connectivity
Applicant : Laird Connectivity, Inc.
Address : W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA
Standard : EN 301 489-1 V2.2.3 (2019-11)
EN 301 489-17 V3.2.4 (2020-09)
Received Date : Jun. 11, 2020
Tested Date : Sep. 02 ~ Sep. 22, 2020

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

Reviewed by:


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Approved by:


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Release Record

Report No.	Version	Description	Issued Date
EH061103	Rev. 01	Initial issue	Nov. 10, 2020

Summary of Test Results

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	Under limit -3.52dB @ 0.383MHz.	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	Under limit -3.02dB @ 219.43MHz.	Pass
8.5	EN 61000-3-2:2014, Class A	Harmonic Current Emissions	Note ²	N/A
8.6	EN 61000-3-3:2013	Voltage Fluctuations and Flicker	Note ²	N/A
<p>N/A means Not Applicable. Note¹: The EUT w/o telecom port. Note²: The EUT consumes DC power, so the test is not required.</p>				

Declaration of Conformity:

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

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 ¹	N/A
9.8	EN 61000-4-5:2014+A1:2017	Surge		Note ²	N/A
9.5	EN 61000-4-6:2014	Conducted Disturbances (CS)		Note ¹	N/A
9.7	EN 61000-4-11:2004+A1:2017	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	Note ²	N/A
N/A means Not Applicable. Note ¹ : The EUT consumes DC power, and it is not intended to be used with cables longer than 3m. So this test is not carried out. Note ² : The EUT consumes DC power, so the test is not required.					

Comments and Explanations:

None.

1 General Description

1.1 Information

The device has 5 configurations as below:

Brand name	Model Name	Product Name	Part Number	Description
Laird Connectivity	Sterling LWB5+	Sterling-LWB5+ 802.11a/b/g/n/ac Module with Bluetooth 5.0	453-00045	Chip Antenna
Laird Connectivity	Sterling LWB5+	Sterling-LWB5+ 802.11a/b/g/n/ac Module with Bluetooth 5.0	453-00046	MHF4 Connector
Laird Connectivity	Sterling LWB5+	Sterling-LWB5+ 802.11a/b/g/n/ac Module with Bluetooth 5.0	453-00047	RF Trace Pin
Laird Connectivity	Sterling LWB5+	Sterling-LWB5+ 802.11a/b/g/n/ac Module with Bluetooth 5.0	453-00048	M.2 PCI-E Card w/SDIO and UART Interface
Laird Connectivity	Sterling LWB5+	Sterling-LWB5+ 802.11a/b/g/n/ac Module with Bluetooth 5.0	453-00049	M.2 PCI-E Card w/USB and USB Interface

1.1.1 Specification of the Equipment under Test (EUT)

S/W Version	001.001.025.0071.0000
BT	
Operating Frequency	2402 MHz ~ 2480 MHz
Modulation Type	Bluetooth BR(1Mbps): GFSK Bluetooth EDR (2Mbps): $\pi/4$ -DQPSK Bluetooth EDR (3Mbps): 8-DPSK
WLAN	
Operating Frequency	802.11b/g/n: 2412 MHz ~ 2472 MHz 802.11a/n/ac: 5180 MHz ~ 5240 MHz; 5260 MHz ~ 5320 MHz; 5500 MHz ~ 5700 MHz
Modulation Type	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n/ac: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)

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

Power Supply Type	3.3 Vdc from host
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1.1.3 Antenna Details

Ant. No.	Manufacturer	Model	Laird Part Number	Type	Connector	Antenna Gain (dBi)		
						2.4G	5.15 ~ 5.35G	5.47 ~ 5.825G
1	Laird	2.4/5.5 GHz Dipole Antenna	001-0009	Dipole	RP-SMA	2.0	2.0	2.0
2	Laird	FlexPIFA	001-0021	PIFA	IPEX MHF4L	2.5	3.0	3.0
3	Laird	Mini NanoBlade Flex	EMF2449A1-10MH4L	PCB Dipole	IPEX MHF4L	2.79	3.38	3.38
4	Laird	Nanoblade	ENB2449A1-10MH4L	PCB Dipole	IPEX MHF4L	2.0	3.9	4
5	ACX	AD1608-A2455 AAT/LF	NA	Chip Antenna	N/A	1.0	4.0	4

1.1.4 Accessories

N/A

1.2 Test Equipment and Calibration Data

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Test Date	Sep. 10, 2020				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101658	Dec. 12, 2019	Dec. 11, 2020
LISN	R&S	ENV216	101579	Mar. 12, 2020	Mar. 11, 2021
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 22, 2019	Oct. 21, 2020
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission below 1GHz				
Test Site	966 chamber 2 / (03CH02-WS)				
Test Date	Sep. 22, 2020				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	Agilent	N9038A	MY53290044	Sep. 15, 2020	Sep. 14, 2021
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 13, 2019	Nov. 12, 2020
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-523	Dec. 26, 2019	Dec. 25, 2020
Preamplifier	EMC	EMC02325	980194	Sep. 16, 2020	Sep. 15, 2021
LF cable 1M	EMC	EMCCFD400-NM-N M-1000	160501	Oct. 18, 2019	Oct. 17, 2020
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Oct. 18, 2019	Oct. 17, 2020
LF cable 10M	EMC	CFD400-E	CFD400-001	Oct. 18, 2019	Oct. 17, 2020
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission above 1GHz				
Test Site	966 chamber 2 / (03CH02-WS)				
Test Date	Sep. 16, 2020				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	Agilent	N9010A	MY53400091	Nov. 15, 2019	Nov. 14, 2020
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1095	Sep. 26, 2019	Sep. 25, 2020
Preamplifier	Agilent	83017A	MY39501309	Sep. 24, 2019	Sep. 23, 2020
RF Cable	EMC	EMC105-SM-SM-8000	180512	Oct. 18, 2019	Oct. 17, 2020
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Oct. 18, 2019	Oct. 17, 2020
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	ESD				
Test Site	ESD room 1 / (ES01-WS)				
Tested Date	Sep. 02, 2020				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
ESD Generator	EMTest	Dito	V1248114239	Aug. 13, 2020	Aug. 12, 2021
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	Sep. 03, 2020				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Signal Generator	R&S	SMB100A	103924HA	Oct. 18, 2019	Oct. 17, 2020
Power Sensor	R&S	NRP-Z91	101094-UL	Oct. 16, 2019	Oct. 15, 2020
Power Sensor	R&S	NRP-Z91	101095-KY	Oct. 16, 2019	Oct. 15, 2020
Power Amplifier	BONN	BLWA 0810-160/100D	107972A	N/A	N/A
Power Amplifier	BONN	BLMA 1060-100D	107972B	N/A	N/A
Antenna	SCHWARZBECK MESS-ELEKTRONIK	STLP 9149	9149-073	N/A	N/A
Antenna	R&S	HL046E	100076-Cd	N/A	N/A
Note: Calibration Interval of instruments listed above is one year.					

1.3 Testing Applied Standards

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

EN 301 489-1 V2.2.3 (2019-11)

EN 301 489-17 V3.2.4 (2020-09)

1.4 Deviation from Test Standard and Measurement Procedure

None

1.5 Measurement Uncertainty

The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor ($k=2$)).

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

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

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
Conducted Emissions from the AC mains power ports	CO01-WS	26°C / 57%	Alex Tsai
Radiated Emissions	03CH02-WS	22°C / 60%	Alex Tsai
ESD	ES01-WS	23°C/48%/99kPa	Zoe Yu
RS	RS01-WS	24°C/57%/98kPa	Zoe Yu

2.2 Testing Facility

Test Laboratory	International Certification Corp.
Test Site	CO01-WS, 03CH02-WS, ES01-WS, RS01-WS
Address of Test Site	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.

2.3 The Worst Case Measurement Configuration

Radiation Pretested Mode	
Pretest Mode	Operating Description
1	Carrier Board: DVK-LWB5+,Ext Ant1(Dipole), Ping Wi-Fi 2.4G, EUT: Z-axis with SDIO, with Power supply 230V/50Hz
2	Carrier Board: DVK-LWB5+,Ext Ant2(ENB2449A1-10MH4L),Ping Wi-Fi 2.4G, EUT: Z-axis with SDIO, with Power supply 230V/50Hz
3	Carrier Board: DVK-LWB5+, Ext Ant3(EMF2449A1-10MH4L), Ping Wi-Fi 5G, EUT: Z-axis with SDIO, with Power supply 230V/50Hz
4	Carrier Board: DVK-LWB5+, Ext Ant4(FlexPIFA), Ping Wi-Fi 5G,EUT: Z-axis with SDIO, with Power supply 230V/50Hz
5	Carrier Board: DVK-LWB5+,Int Ant, Ping Wi-Fi 5G, EUT: Z-axis w/SDIO, with Power supply 230V/50Hz
6	Carrier Board: LWB5+(M.2),Ext Ant1(Dipole), Ping Wi-Fi 2.4G, EUT: Z-axis with SDIO, with Power supply 230V/50Hz
7	Carrier Board: DVK-LWB5+,Ext Ant1(Dipole), Ping Wi-Fi 2.4G, EUT: Z-axis with USB, with Power supply 230V/50Hz
8	Carrier Board: DVK-LWB5+,Ext Ant1(Dipole), BT PER,EUT: Z-axis w/SDIO, with Power supply 110V/60Hz
9	Carrier Board: DVK-LWB5+, Ext Ant1(Dipole), Standby mode, with Power supply 230V/50Hz
For Pretest Mode 6 is the worst case and only its data was record in this test report.	

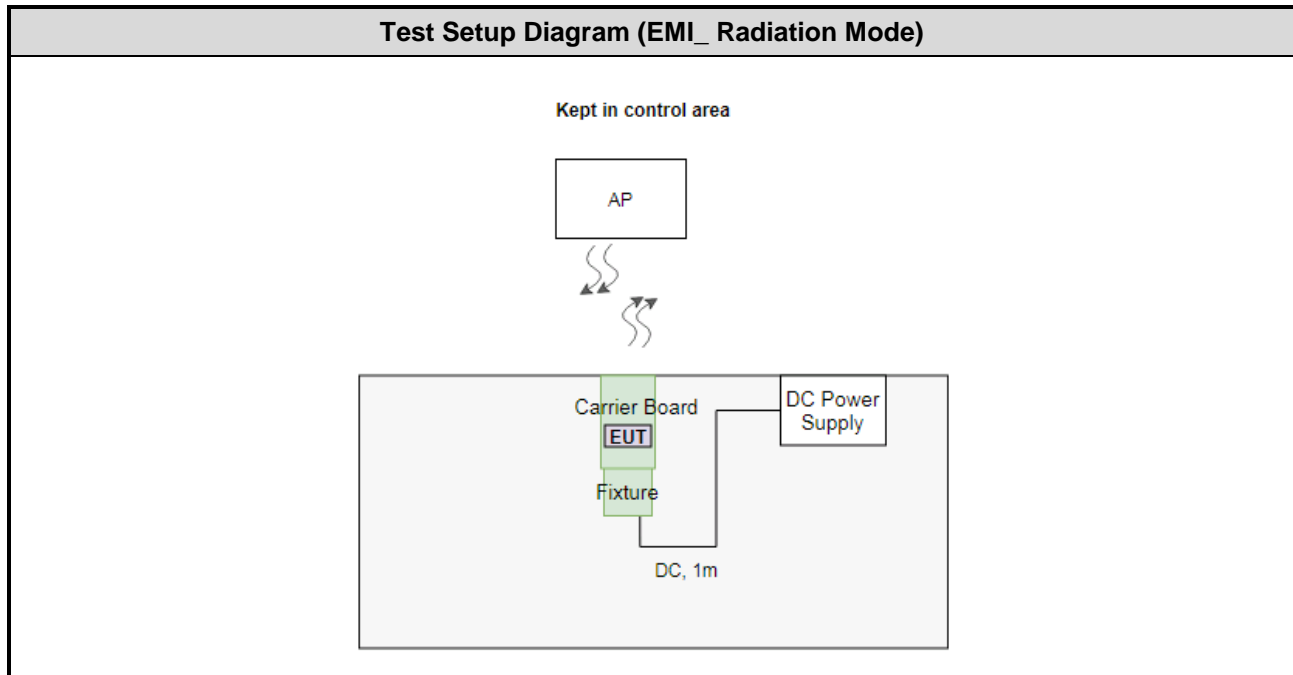
The Worst Test Configurations	
Conducted Emissions from the AC mains power ports	
Test Mode	Operating Description
1	Carrier Board: DVK-LWB5+,Ext Ant1(Dipole),Ping Wi-Fi 2.4G, EUT: X-axis with SDIO, Adapter 230V/50Hz
2	Carrier Board: DVK-LWB5+,Ext Ant2(ENB2449A1-10MH4L), Ping Wi-Fi 2.4G, EUT: X-axis with SDIO, Adapter 230V/50Hz
3	Carrier Board: DVK-LWB5+,Ext Ant3(EMF2449A1-10MH4L), Ping Wi-Fi 5G, EUT: X-axis with SDIO, Adapter 230V/50Hz
4	Carrier Board: DVK-LWB5+,Ext Ant4(FlexPIFA),Ping Wi-Fi 5G, EUT: X-axis with SDIO, Adapter 230V/50Hz
5	Carrier Board: DVK-LWB5+,Int Ant,Ping Wi-Fi 5G, EUT: X-axis with SDIO, Adapter 230V/50Hz
6	Carrier Board: LWB5+(M.2),Ext Ant1(Dipole),Ping Wi-Fi 2.4G, EUT: X-axis with SDIO, Adapter 230V/50Hz
7	Carrier Board: DVK-LWB5+,Ext Ant1(Dipole),Ping Wi-Fi 2.4G, EUT: X-axis with USB, Adapter 230V/50Hz
8	Carrier Board: DVK-LWB5+,Ext Ant1(Dipole),BT PER, EUT: X-axis with SDIO, Adapter 110V/60Hz
Radiated Emissions	
Test Mode ≤1GHz	Operating Description
1	Carrier Board: LWB5+(M.2), Ext Ant1(Dipole), Ping Wi-Fi 2.4G,EUT: Z-axis with SDIO, with Power supply 230V/50Hz
Test Mode >1GHz	Operating Description
1	Carrier Board: LWB5+(M.2), Ext Ant1(Dipole), Ping Wi-Fi 2.4G,EUT: Z-axis with SDIO, with Power supply 230V/50Hz
ESD & RS Tests	
Test Mode	Operating Description
1	Carrier Board: DVK-LWB5+, Ext Ant1(Dipole), Ping Wi-Fi 2.4G, with SDIO
2	Carrier Board: DVK-LWB5+, Ext Ant2(ENB2449A1-10MH4L), Ping Wi-Fi 2.4G, with SDIO
3	Carrier Board: DVK-LWB5+, Ext Ant3(EMF2449A1-10MH4L), Ping Wi-Fi 5G, with SDIO
4	Carrier Board: DVK-LWB5+, Ext Ant4(FlexPIFA), Ping Wi-Fi 5G, with SDIO
5	Carrier Board: DVK-LWB5+, Int Ant,Ping Wi-Fi 5G, with SDIO
6	Carrier Board: LWB5+(M.2), Ext Ant1(Dipole), Ping Wi-Fi 2.4G, with SDIO
7	Carrier Board: DVK-LWB5+,Ext Ant1(Dipole), Ping Wi-Fi 2.4G, with USB
8	Carrier Board: DVK-LWB5+, Ext Ant1(Dipole), BT PER, with SDIO

2.4 Local Support Equipment List

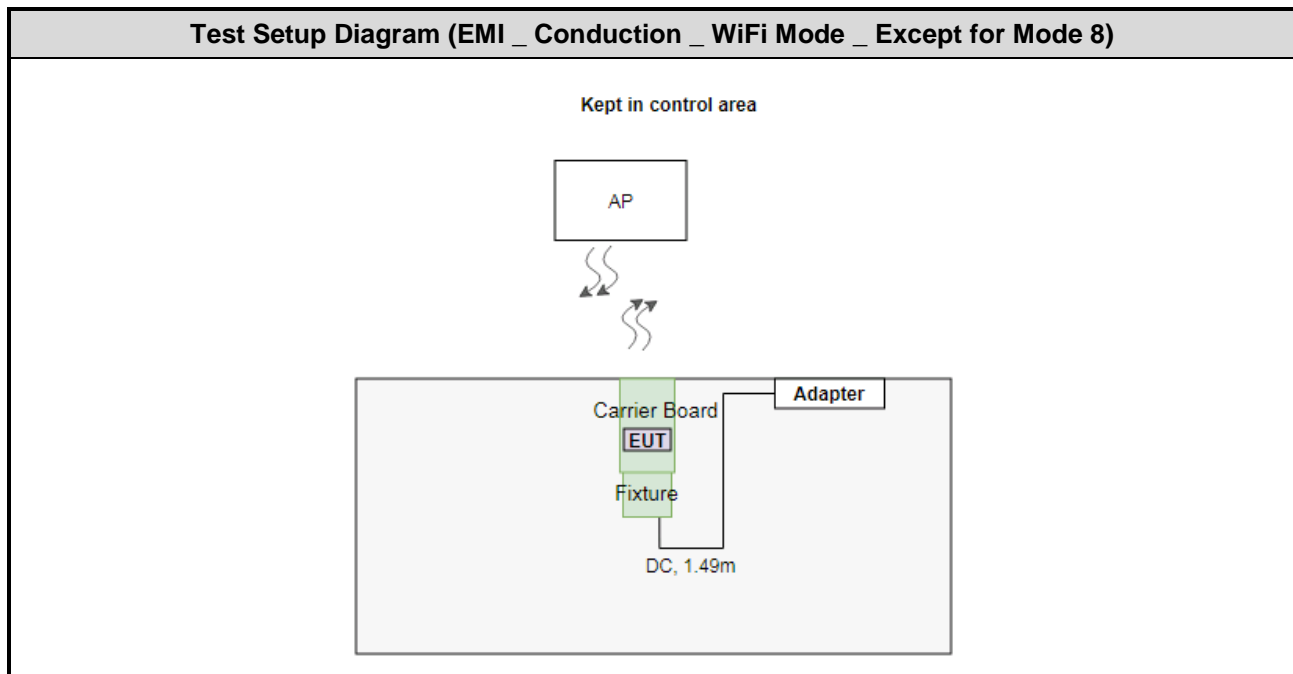
Support Equipment List (EMI)					
No.	Equipment	Brand	Model	S/N	Remarks
1	Adapter	I.T.E POWER SUPPLY	MU12AY12010 0-A1	---	Provided by applicant. (For Conduction test only.)
2	Fixture	Laird	SU60-SOMC	---	Provided by applicant.
3	Notebook	DELL	Latitude E6440	8VXMD12	For setup use
4	Wireless AP	D-LINK	DIR-850L	RZ1Q4G6000261	For WIFI mode
5	Wireless Connectivity Tester	ROHDE&SCHWA RZ	CMW270	100856	For BT mode
6	DC Power Supply	GWINSTEK	GPC-60300	EM884797	---
7	Carrier Board	Laird	LWB5+,M.2	---	Provided by applicant.
8	Carrier Board	Laird	DVK-LWB5+	---	Provided by applicant.

Support Equipment List (EMS)					
No.	Equipment	Brand	Model	S/N	Remarks
1	Adapter	OEM	ADS0128-W 120100	---	Provided by applicant.
2	Fixture	Laird	SU60-SOMC	---	Provided by applicant.
3	Notebook	DELL	Latitude E5430	6R4RWW1	For WIFI mode
4	Wireless AP	D-LINK	DIR-850L	RZ1Q4G6000262	For WIFI mode
5	Wireless Connectivity Tester	ROHDE&SCHW ARZ	CMW270	100856	For BT mode
6	Carrier Board	Laird	LWB5+,M.2	---	Provided by applicant.
7	Carrier Board	Laird	DVK-LWB5+	---	Provided by applicant.

2.5 Test Setup Chart

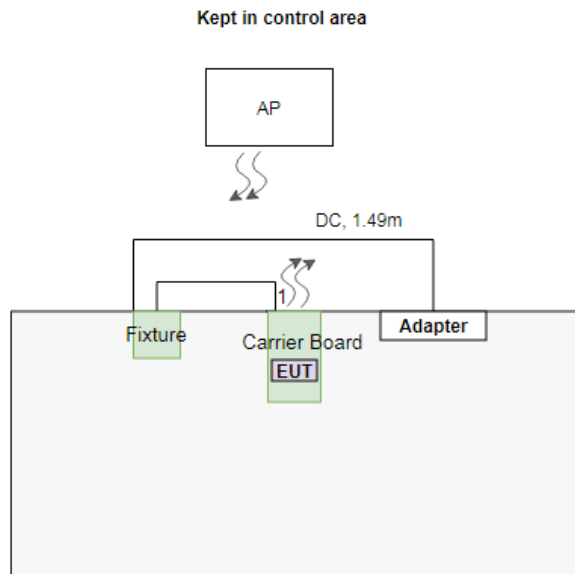


Note: The notebook is disconnected from EUT and removed from test table when EUT is set to transmit continuously.



Note: The notebook is disconnected from EUT and removed from test table when EUT is set to transmit continuously.

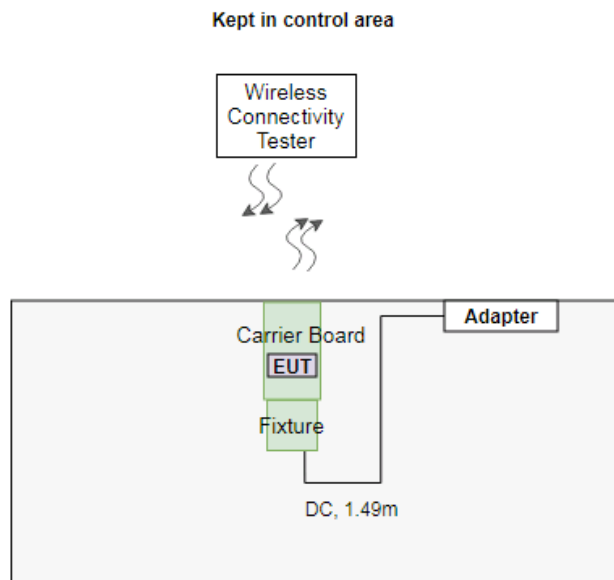
Test Setup Diagram (EMI _ Conduction _ WiFi Mode _ Only for Mode 8)



No.	Signal cable / Length (m)
1	USB, 0.96m shielded.

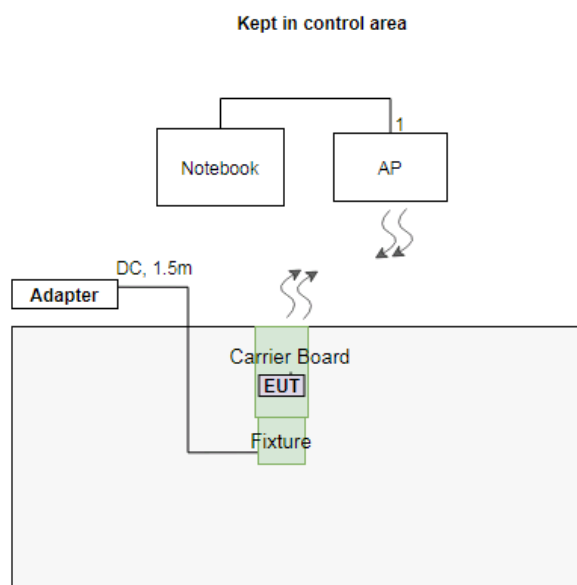
Note: The notebook is disconnected from EUT and removed from test table when EUT is set to transmit continuously.

Test Setup Diagram (EMI _ Conduction _ BT Mode)



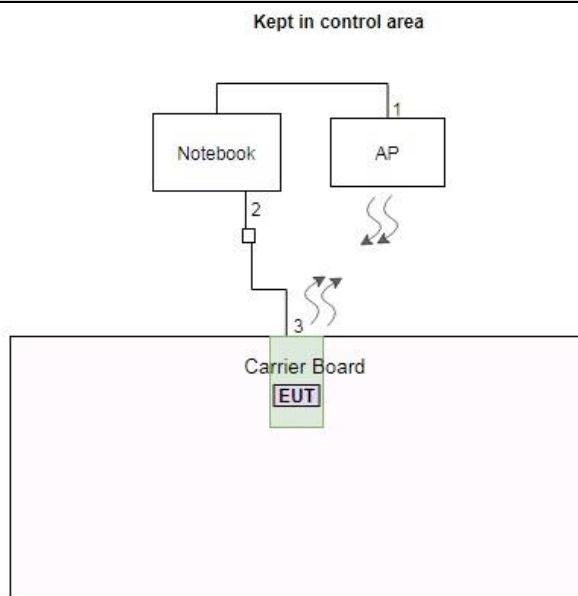
Note: The notebook is disconnected from EUT and removed from test table when EUT is set to transmit continuously.

Test Setup Diagram (EMS _ Mode 1 ~ 6)



No.	Signal cable / Length (m)
1	RJ45, 3m non-shielded.

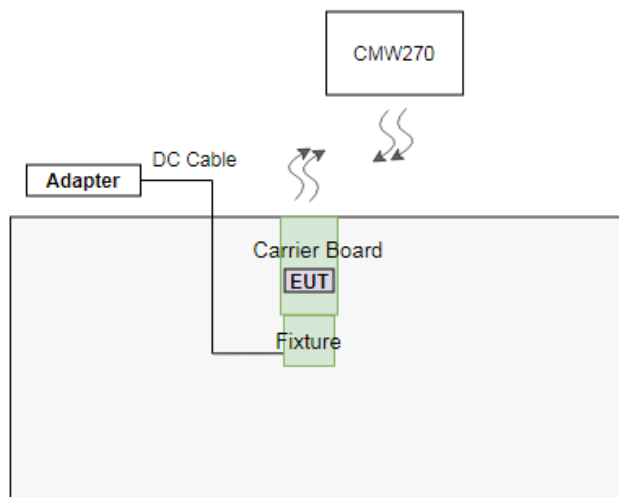
Test Setup Diagram (EMS _ Mode 7)



No.	Signal cable / Length (m)
1	RJ45, 3m non-shielded.
2	USB, 1.3m shielded.
3	USB extend, 3m shielded.

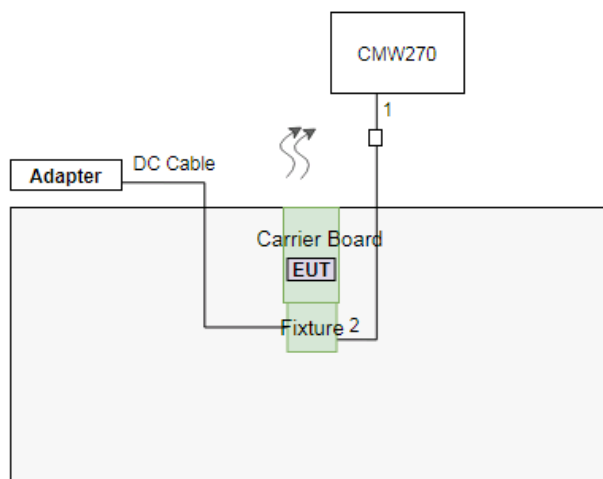
Test Setup Diagram (EMS _ ESD_ Mode 8)

Kept in control area



Test Setup Diagram (EMS _ RS_ Mode 8)

Kept in control area



No.	Signal cable / Length (m)
1	USB, 1.3m shielded.
2	USB extend, 3m shielded.

2.6 Test Software and Operating Condition

- a. To enable all function of test system.
- b. The support notebook executed “Teraterm” & “Blue tool ” program to enable WLAN and bluetooth function of EUT.
- c. The EUT linked to support AP by WiFi.
- d. The support notebook executed “ Teraterm“ and observe packet error rate below 10%.
- e. The EUT linked to support Wireless Connectivity Tester by BT.

BT PER

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

3 Emission Test Results

3.1 Conducted Emissions from the AC mains power ports

3.1.1 Limits of Conducted Emissions from the AC mains power ports

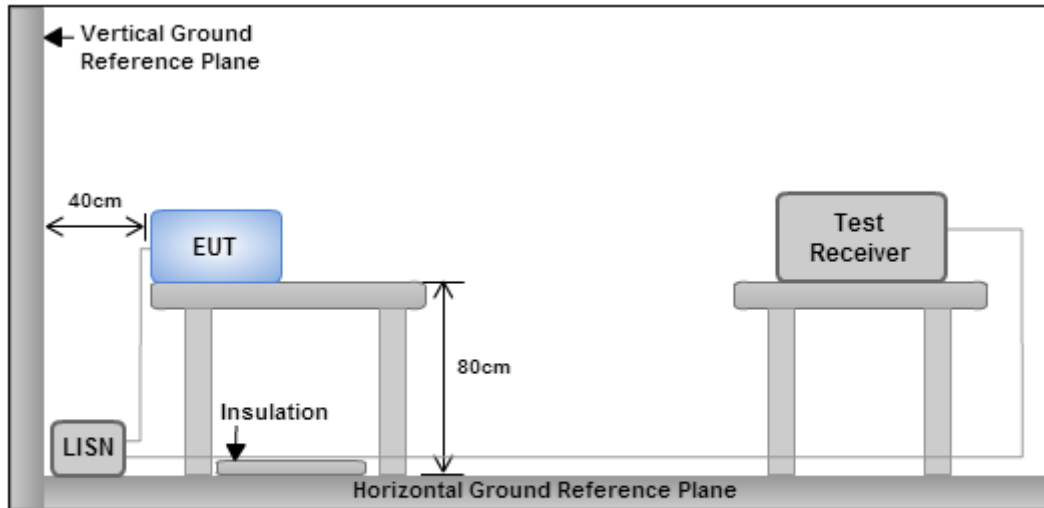
Frequency Range	Limits values (dB μ V)			
	Class A		Class B	
	Quasi-Peak	Average	Quasi-Peak	Average
0,15 MHz to 0,5 MHz	79	66	66 to 56 *	56 to 46 *
> 0,5 MHz to 5 MHz	73	60	56	46
> 5 MHz to 30 MHz	73	60	60	50

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

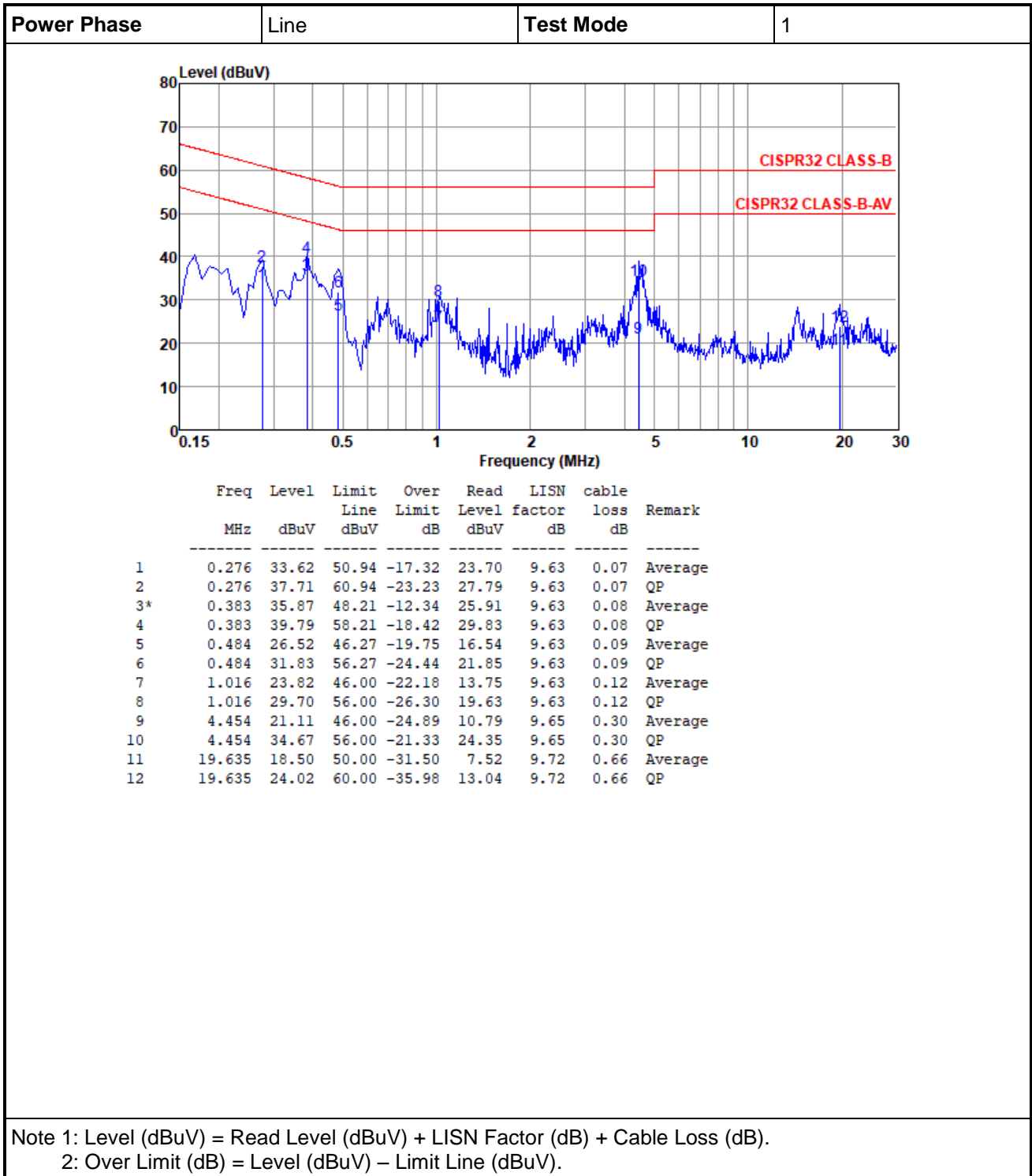
- The EUT was placed on a desk 0.8 meters height from the metal ground plane and 0.4 meter from the conducting wall of the shielding room and it was kept at least 0.8 meters from any other grounded conducting surface.
- A thickness of ≤ 0.15 m insulation should be placed between local AE and associated 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

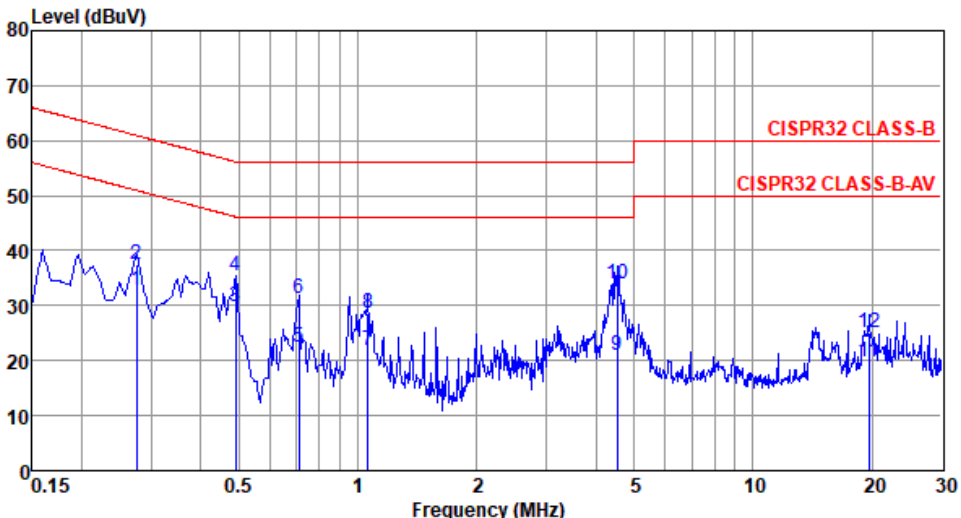


- Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

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



Power Phase	Neutral	Test Mode	1
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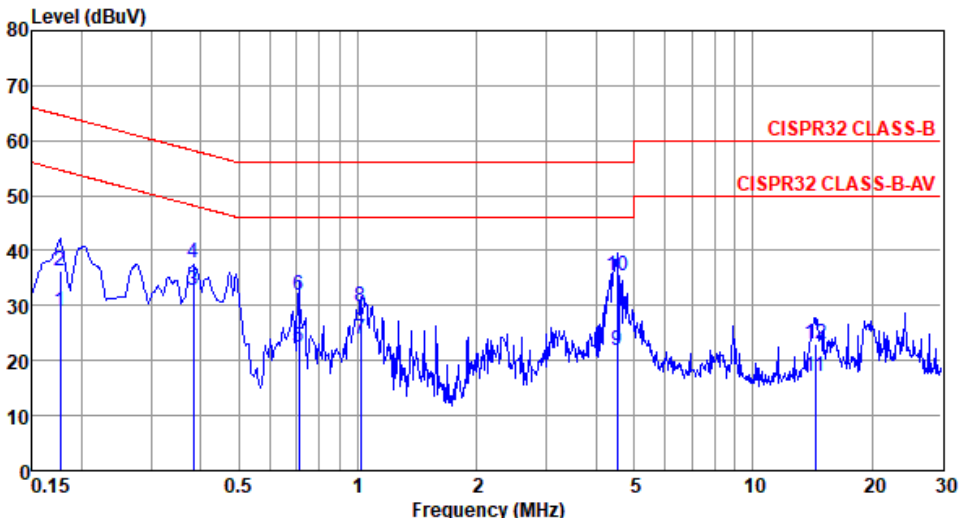


The graph displays the measured level in dBuV against frequency in MHz. The y-axis ranges from 0 to 80 dBuV, and the x-axis ranges from 0.15 to 30 MHz. Two red lines represent the CISPR32 CLASS-B and CISPR32 CLASS-B-AV limits. The blue line shows the measured level with peaks labeled 1 through 12. The measured level is generally below the limits, with some peaks exceeding the limit by a small amount.

	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.276	32.87	50.94	-18.07	22.99	9.65	0.07	Average
2	0.276	37.38	60.94	-23.56	27.50	9.65	0.07	QP
3*	0.491	29.95	46.14	-16.19	20.03	9.65	0.09	Average
4	0.491	35.47	56.14	-20.67	25.55	9.65	0.09	QP
5	0.708	22.46	46.00	-23.54	12.52	9.65	0.10	Average
6	0.708	31.18	56.00	-24.82	21.24	9.65	0.10	QP
7	1.060	21.78	46.00	-24.22	11.81	9.65	0.12	Average
8	1.060	28.64	56.00	-27.36	18.67	9.65	0.12	QP
9	4.525	20.92	46.00	-25.08	10.67	9.68	0.30	Average
10	4.525	34.02	56.00	-21.98	23.77	9.68	0.30	QP
11	19.635	19.65	50.00	-30.35	8.64	9.84	0.66	Average
12	19.635	25.12	60.00	-34.88	14.11	9.84	0.66	QP

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

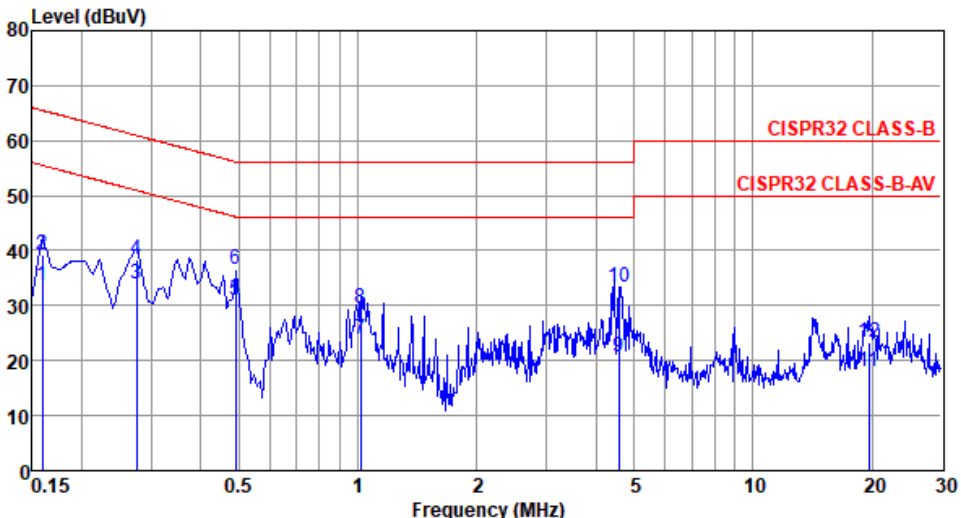
Power Phase	Line	Test Mode	2
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	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.177	28.98	54.64	-25.66	19.11	9.63	0.06	Average
2	0.177	36.45	64.64	-28.19	26.58	9.63	0.06	QP
3*	0.383	32.68	48.21	-15.53	22.72	9.63	0.08	Average
4	0.383	37.77	58.21	-20.44	27.81	9.63	0.08	QP
5	0.708	22.49	46.00	-23.51	12.47	9.63	0.10	Average
6	0.708	31.91	56.00	-24.09	21.89	9.63	0.10	QP
7	1.016	23.97	46.00	-22.03	13.90	9.63	0.12	Average
8	1.016	29.73	56.00	-26.27	19.66	9.63	0.12	QP
9	4.525	21.84	46.00	-24.16	11.51	9.66	0.30	Average
10	4.525	35.30	56.00	-20.70	24.97	9.66	0.30	QP
11	14.364	17.25	50.00	-32.75	6.50	9.71	0.57	Average
12	14.364	23.01	60.00	-36.99	12.26	9.71	0.57	QP

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

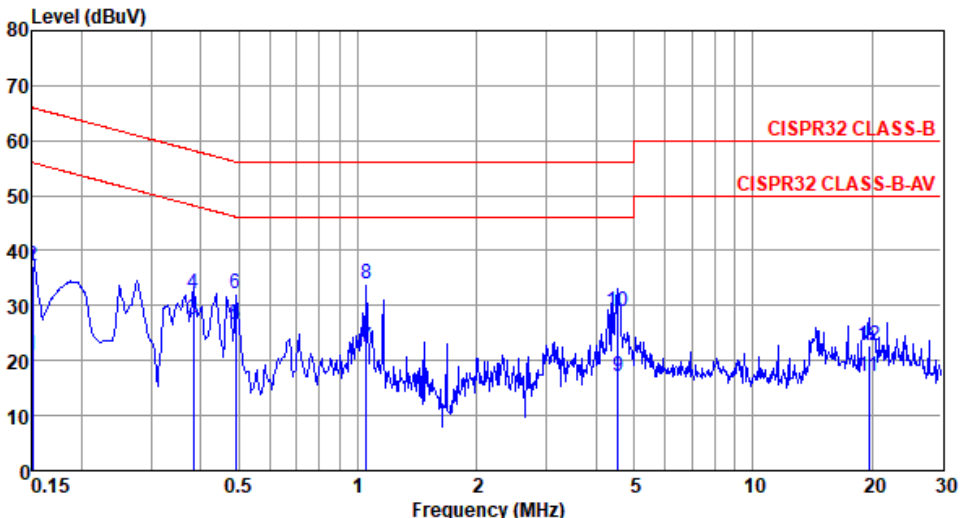
Power Phase	Neutral	Test Mode	2
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	Freq	Level	Limit	Over	Read	LISN	cable	
	MHz	dBuV	Line	Limit	Level	factor	loss	Remark
			dBuV	dB	dBuV	dB	dB	
1	0.159	33.64	55.52	-21.88	23.80	9.66	0.05	Average
2	0.159	39.31	65.52	-26.21	29.47	9.66	0.05	QP
3	0.276	33.86	50.94	-17.08	23.98	9.65	0.07	Average
4	0.276	38.45	60.94	-22.49	28.57	9.65	0.07	QP
5*	0.491	30.88	46.14	-15.26	20.96	9.65	0.09	Average
6	0.491	36.58	56.14	-19.56	26.66	9.65	0.09	QP
7	1.016	23.93	46.00	-22.07	13.96	9.65	0.12	Average
8	1.016	29.65	56.00	-26.35	19.68	9.65	0.12	QP
9	4.574	20.71	46.00	-25.29	10.46	9.68	0.30	Average
10	4.574	33.33	56.00	-22.67	23.08	9.68	0.30	QP
11	19.635	17.89	50.00	-32.11	6.88	9.84	0.66	Average
12	19.635	23.46	60.00	-36.54	12.45	9.84	0.66	QP

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

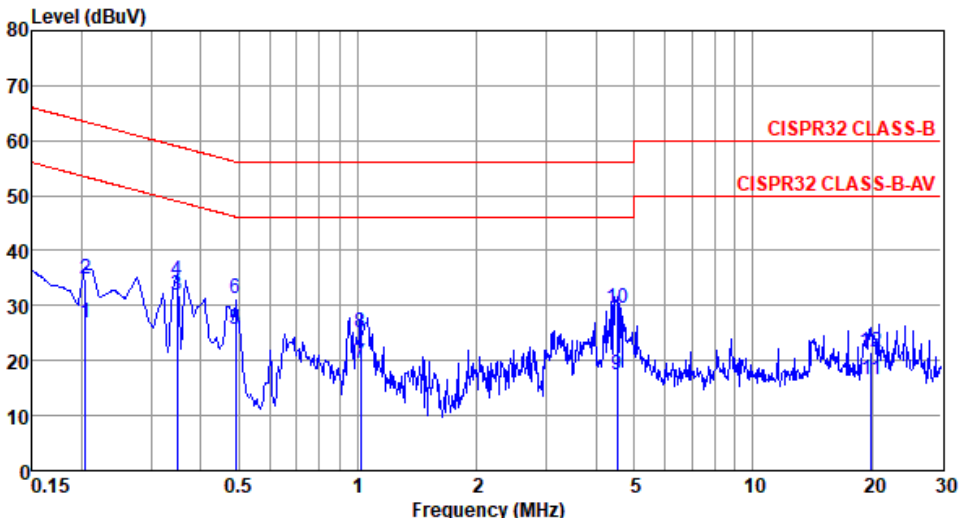
Power Phase	Line	Test Mode	3
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	Freq MHz	Level dBUV	Limit Line dBUV	Over Limit dB	Read Level dBUV	LISN factor dB	cable loss dB	Remark
1	0.150	21.02	56.00	-34.98	11.17	9.64	0.05	Average
2	0.150	37.08	66.00	-28.92	27.23	9.64	0.05	QP
3	0.383	27.33	48.21	-20.88	17.37	9.63	0.08	Average
4	0.383	32.32	58.21	-25.89	22.36	9.63	0.08	QP
5*	0.491	26.47	46.14	-19.67	16.48	9.63	0.09	Average
6	0.491	32.07	56.14	-24.07	22.08	9.63	0.09	QP
7	1.049	22.45	46.00	-23.55	12.38	9.63	0.12	Average
8	1.049	34.03	56.00	-21.97	23.96	9.63	0.12	QP
9	4.549	17.19	46.00	-28.81	6.86	9.66	0.30	Average
10	4.549	29.03	56.00	-26.97	18.70	9.66	0.30	QP
11	19.635	17.06	50.00	-32.94	6.08	9.72	0.66	Average
12	19.635	22.67	60.00	-37.33	11.69	9.72	0.66	QP

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

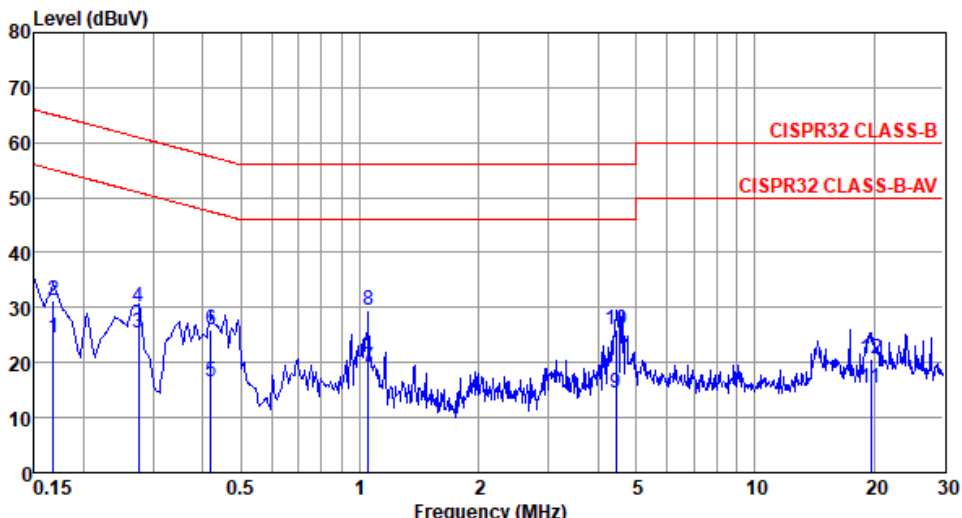
Power Phase	Neutral	Test Mode	3
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	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.204	26.97	53.45	-26.48	17.11	9.65	0.06	Average
2	0.204	34.79	63.45	-28.66	24.93	9.65	0.06	QP
3*	0.348	31.93	49.00	-17.07	22.03	9.65	0.08	Average
4	0.348	34.51	59.00	-24.49	24.61	9.65	0.08	QP
5	0.491	25.77	46.14	-20.37	15.85	9.65	0.09	Average
6	0.491	31.33	56.14	-24.81	21.41	9.65	0.09	QP
7	1.016	19.60	46.00	-26.40	9.63	9.65	0.12	Average
8	1.016	25.18	56.00	-30.82	15.21	9.65	0.12	QP
9	4.525	17.39	46.00	-28.61	7.14	9.68	0.30	Average
10	4.525	29.42	56.00	-26.58	19.17	9.68	0.30	QP
11	19.950	16.39	50.00	-33.61	5.37	9.84	0.66	Average
12	19.950	21.52	60.00	-38.48	10.50	9.84	0.66	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
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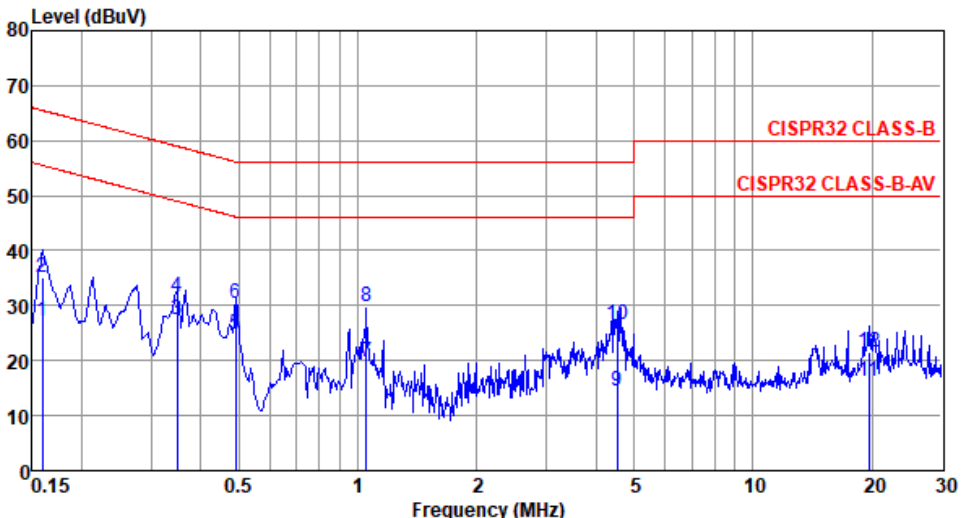


Freq	Level	Limit	Over	Read	LISN	cable	Remark	
MHz	dBuV	Line	Limit	Level	factor	loss		
		dBuV	dB	dBuV	dB	dB		
1	0.168	24.51	55.08	-30.57	14.65	9.64	0.05	Average
2	0.168	31.31	65.08	-33.77	21.45	9.64	0.05	QP
3*	0.276	25.47	50.94	-25.47	15.55	9.63	0.07	Average
4	0.276	30.13	60.94	-30.81	20.21	9.63	0.07	QP
5	0.419	16.53	47.46	-30.93	6.57	9.63	0.08	Average
6	0.419	25.95	57.46	-31.51	15.99	9.63	0.08	QP
7	1.049	19.27	46.00	-26.73	9.20	9.63	0.12	Average
8	1.049	29.61	56.00	-26.39	19.54	9.63	0.12	QP
9	4.454	14.41	46.00	-31.59	4.09	9.65	0.30	Average
10	4.454	26.09	56.00	-29.91	15.77	9.65	0.30	QP
11	19.635	15.37	50.00	-34.63	4.39	9.72	0.66	Average
12	19.635	20.73	60.00	-39.27	9.75	9.72	0.66	QP

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

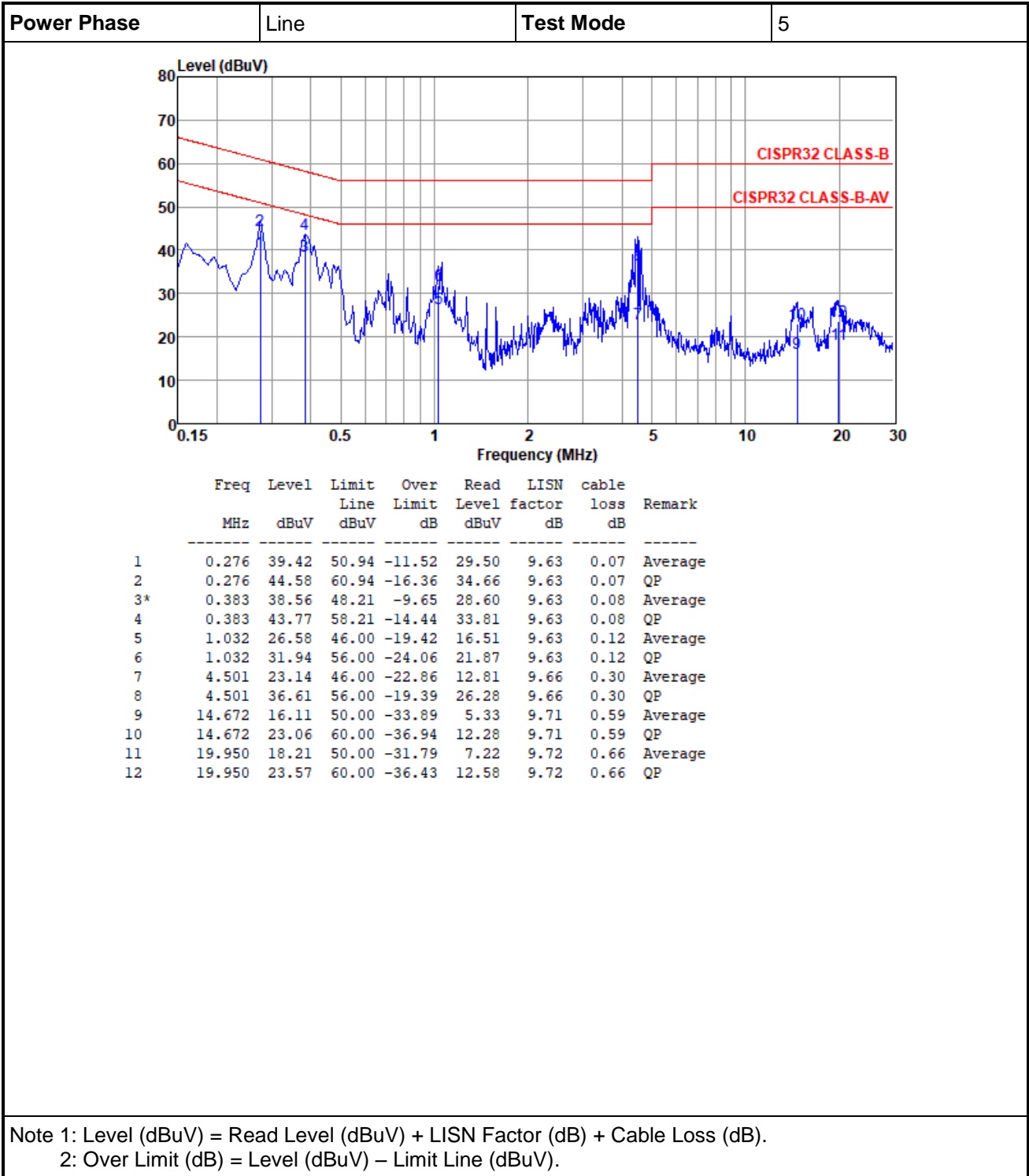
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

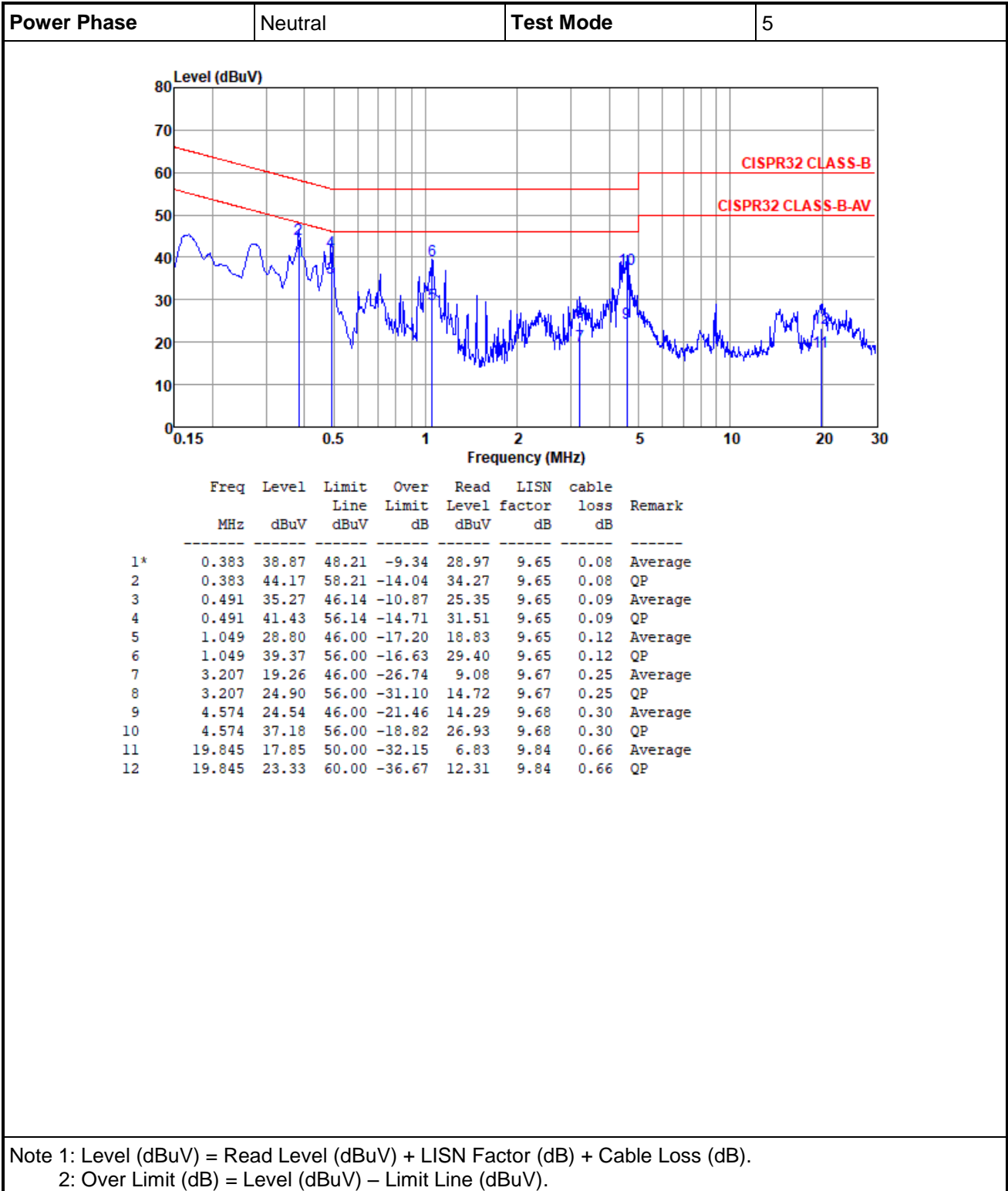
Power Phase	Neutral	Test Mode	4
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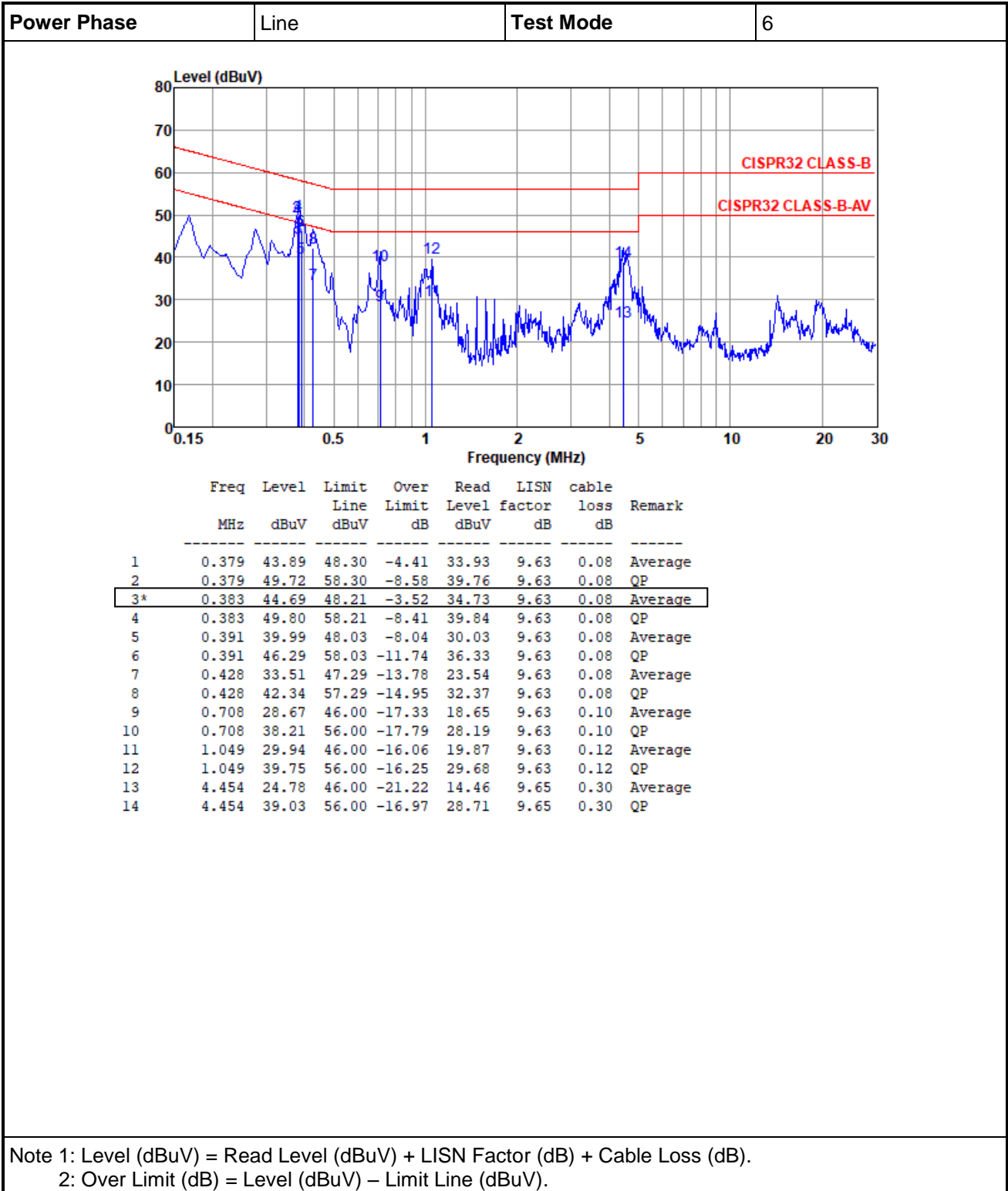


	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.159	27.25	55.52	-28.27	17.41	9.66	0.05	Average
2	0.159	35.05	65.52	-30.47	25.21	9.66	0.05	QP
3	0.348	27.58	49.00	-21.42	17.68	9.65	0.08	Average
4	0.348	31.57	59.00	-27.43	21.67	9.65	0.08	QP
5*	0.491	24.89	46.14	-21.25	14.97	9.65	0.09	Average
6	0.491	30.48	56.14	-25.66	20.56	9.65	0.09	QP
7	1.049	19.64	46.00	-26.36	9.67	9.65	0.12	Average
8	1.049	29.91	56.00	-26.09	19.94	9.65	0.12	QP
9	4.525	14.58	46.00	-31.42	4.33	9.68	0.30	Average
10	4.525	26.62	56.00	-29.38	16.37	9.68	0.30	QP
11	19.635	16.32	50.00	-33.68	5.31	9.84	0.66	Average
12	19.635	21.44	60.00	-38.56	10.43	9.84	0.66	QP

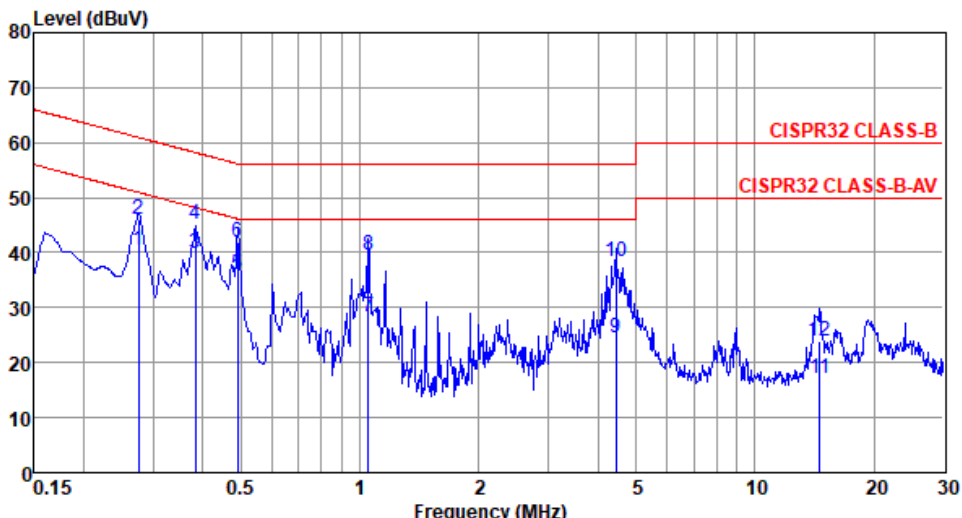
Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).







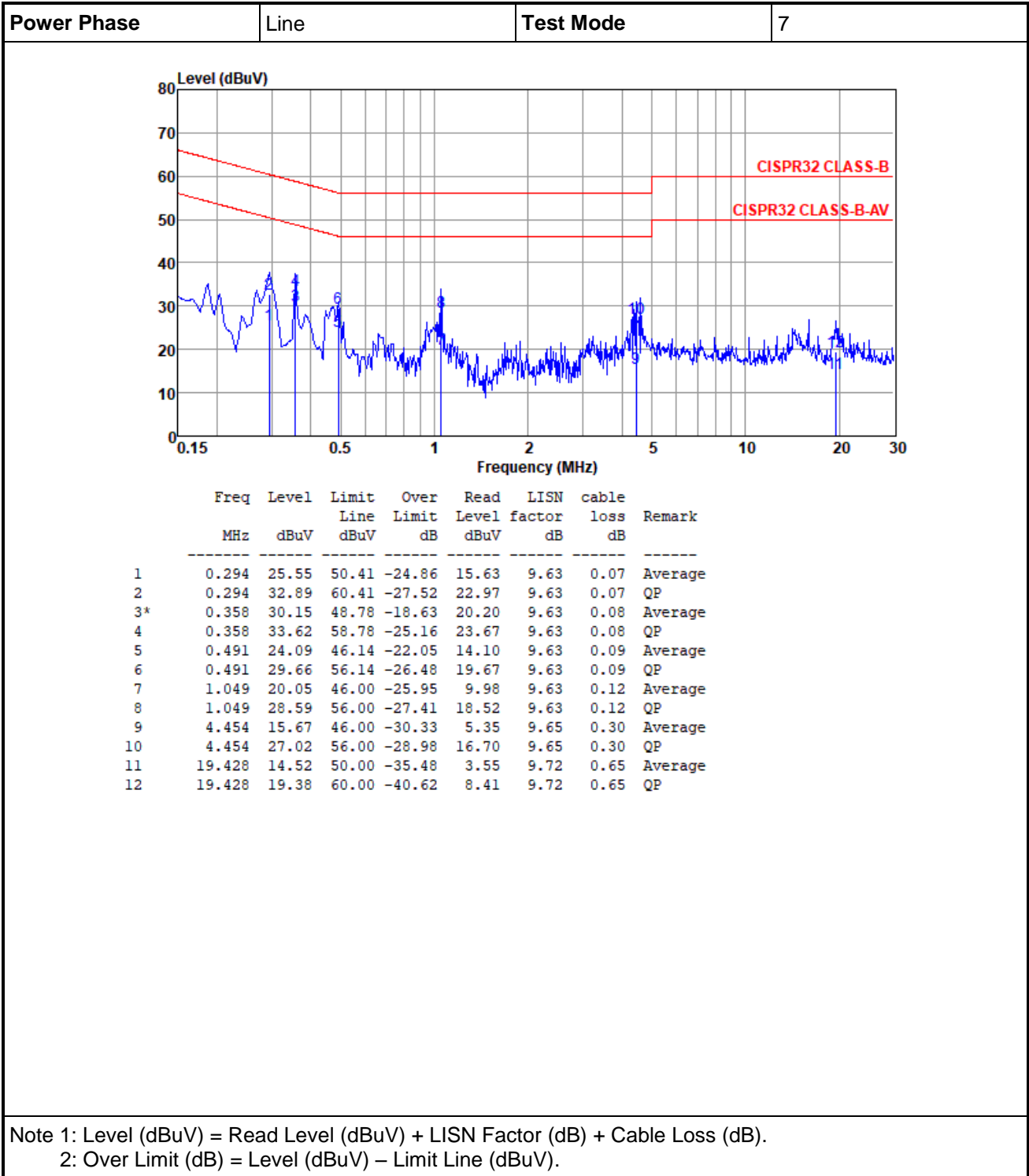
Power Phase	Neutral	Test Mode	6
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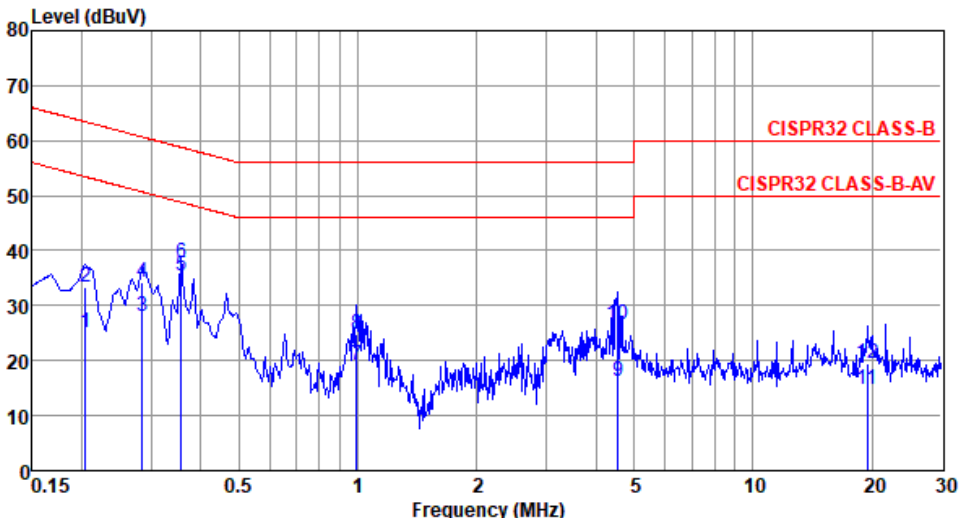
	Freq	Level	Limit	Over	Read	LISN	cable	
	MHz	dBuV	Line	Limit	Level	factor	loss	Remark
			dBuV	dB	dBuV	dB	dB	
1	0.276	40.49	50.94	-10.45	30.61	9.65	0.07	Average
2	0.276	46.05	60.94	-14.89	36.17	9.65	0.07	QP
3*	0.383	39.95	48.21	-8.26	30.05	9.65	0.08	Average
4	0.383	45.29	58.21	-12.92	35.39	9.65	0.08	QP
5	0.491	35.94	46.14	-10.20	26.02	9.65	0.09	Average
6	0.491	42.06	56.14	-14.08	32.14	9.65	0.09	QP
7	1.049	28.25	46.00	-17.75	18.28	9.65	0.12	Average
8	1.049	39.50	56.00	-16.50	29.53	9.65	0.12	QP
9	4.454	24.44	46.00	-21.56	14.19	9.68	0.30	Average
10	4.454	38.41	56.00	-17.59	28.16	9.68	0.30	QP
11	14.594	17.08	50.00	-32.92	6.34	9.79	0.58	Average
12	14.594	23.99	60.00	-36.01	13.25	9.79	0.58	QP

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

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



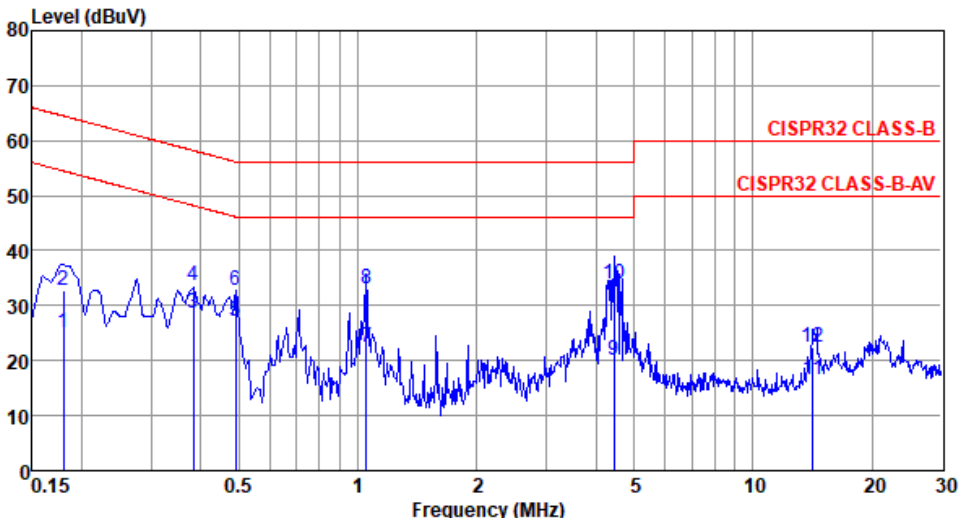
Power Phase	Neutral	Test Mode	7
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	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.204	25.12	53.45	-28.33	15.26	9.65	0.06	Average
2	0.204	33.46	63.45	-29.99	23.60	9.65	0.06	QP
3	0.285	27.99	50.68	-22.69	18.11	9.65	0.07	Average
4	0.285	34.12	60.68	-26.56	24.24	9.65	0.07	QP
5*	0.358	35.50	48.78	-13.28	25.60	9.65	0.08	Average
6	0.358	37.66	58.78	-21.12	27.76	9.65	0.08	QP
7	0.994	19.04	46.00	-26.96	9.07	9.65	0.12	Average
8	0.994	24.67	56.00	-31.33	14.70	9.65	0.12	QP
9	4.549	16.21	46.00	-29.79	5.96	9.68	0.30	Average
10	4.549	26.45	56.00	-29.55	16.20	9.68	0.30	QP
11	19.428	14.67	50.00	-35.33	3.67	9.84	0.65	Average
12	19.428	19.37	60.00	-40.63	8.37	9.84	0.65	QP

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

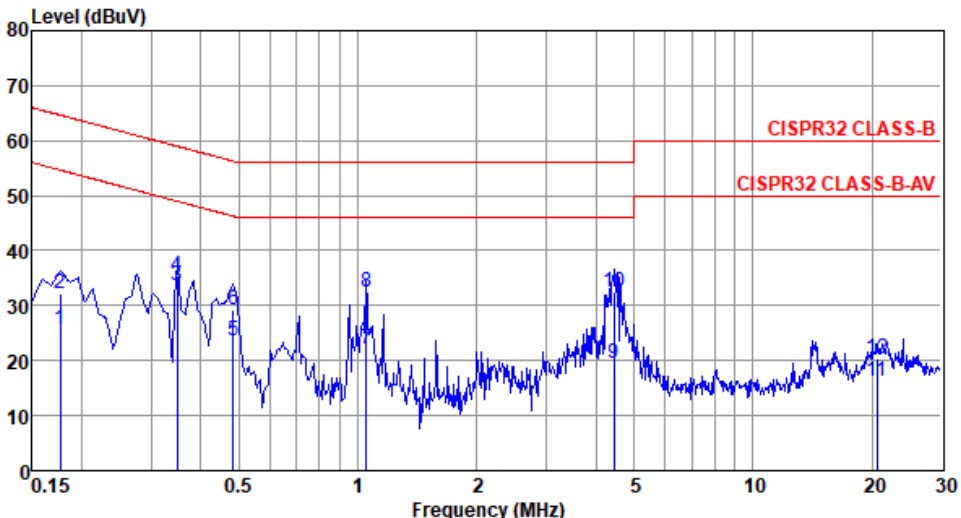
Power Phase	Line	Test Mode	8
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	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.180	25.19	54.50	-29.31	15.32	9.63	0.06	Average
2	0.180	32.66	64.50	-31.84	22.79	9.63	0.06	QP
3	0.383	28.59	48.21	-19.62	18.63	9.63	0.08	Average
4	0.383	33.54	58.21	-24.67	23.58	9.63	0.08	QP
5*	0.491	27.09	46.14	-19.05	17.10	9.63	0.09	Average
6	0.491	32.69	56.14	-23.45	22.70	9.63	0.09	QP
7	1.049	22.55	46.00	-23.45	12.48	9.63	0.12	Average
8	1.049	33.07	56.00	-22.93	23.00	9.63	0.12	QP
9	4.454	20.19	46.00	-25.81	9.87	9.65	0.30	Average
10	4.454	33.82	56.00	-22.18	23.50	9.65	0.30	QP
11	14.213	16.53	50.00	-33.47	5.78	9.71	0.57	Average
12	14.213	22.41	60.00	-37.59	11.66	9.71	0.57	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	8
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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	0.177	25.69	54.64	-28.95	15.84	9.65	0.06	Average
2	0.177	32.21	64.64	-32.43	22.36	9.65	0.06	QP
3*	0.348	33.68	49.00	-15.32	23.78	9.65	0.08	Average
4	0.348	35.33	59.00	-23.67	25.43	9.65	0.08	QP
5	0.484	23.47	46.27	-22.80	13.55	9.65	0.09	Average
6	0.484	29.21	56.27	-27.06	19.29	9.65	0.09	QP
7	1.049	22.23	46.00	-23.77	12.26	9.65	0.12	Average
8	1.049	32.58	56.00	-23.42	22.61	9.65	0.12	QP
9	4.454	19.34	46.00	-26.66	9.09	9.68	0.30	Average
10	4.454	32.38	56.00	-23.62	22.13	9.68	0.30	QP
11	20.594	16.26	50.00	-33.74	5.22	9.83	0.67	Average
12	20.594	20.47	60.00	-39.53	9.43	9.83	0.67	QP

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

3.2 Radiated Emissions

3.2.1 Limit of Radiated Emissions

Frequency Range (MHz)	Class A		Class B	
	10m	3m	10m	3m
	Quasi-peak limits (dB μ V/m)			
30 to 230	40	50	30	40
230 to 1000	47	57	37	47

Note 1: The lower limit shall apply at the transition frequency.
Note 2: Additional provisions may be required for cases where interference occurs.

Frequency range (GHz)	Class A (3 m)		Class B (3 m)	
	Average limit (dB μ V/m)	Peak limit (dB μ V/m)	Average limit (dB μ V/m)	Peak limit (dB μ V/m)
1 to 3	56	76	50	70
3 to 6	60	80	54	74

Note 1: The lower limit shall apply at the transition frequency.
Note 2: Additional provisions may be required for cases where interference occurs.

For an unintentional radiator is shown in the table below.

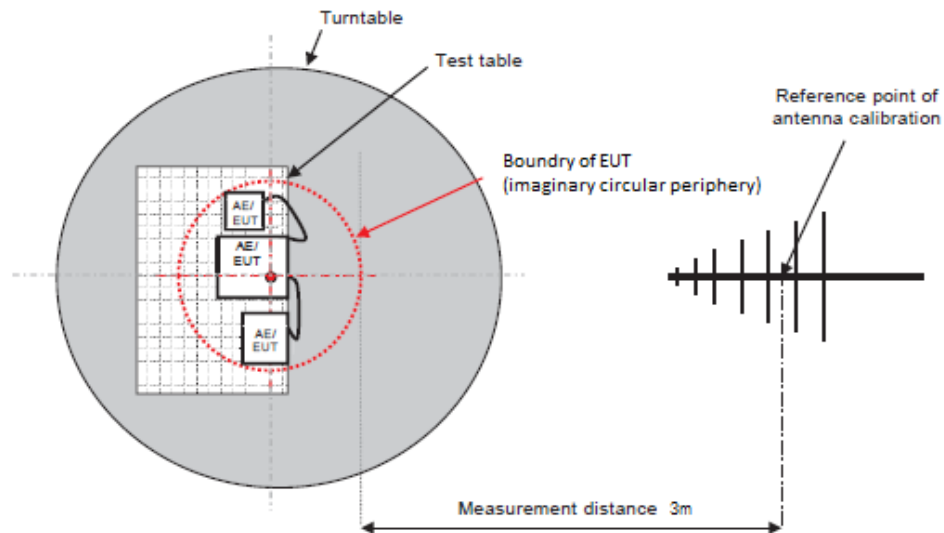
The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes.	Upper frequency of measurement range
Below 108 MHz	1 GHz
108 MHz to 500 MHz	2 GHz
500 MHz to 1 GHz	5 GHz
Above 1 GHz	5 times the highest frequency or 6 GHz,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

3.2.2 Test Procedures

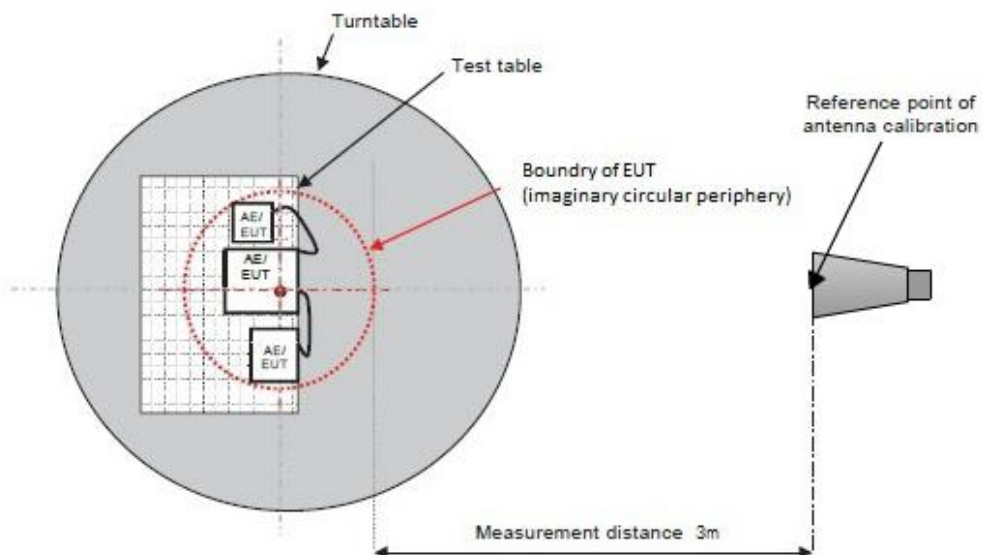
- a. The EUT was placed on a rotatable table top with a height of 0.8 meters which is placed on the ground plane.
- b. A thickness of $\leq 0.15\text{m}$ insulation should be placed between local AE and associated cabling and the RGP.
- c. The EUT received DC power source from the outlet socket under the turntable. All support equipment power received from another socket under the turntable.
- d. The EUT and local AE shall be arranged in the most compact practical arrangement within the test volume. The central point of the arrangement shall be positioned at the centre of the turntable. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and calibration point of the antenna.
- e. The table was rotated 360 degrees to determine the position of the highest radiation.
- f. The antenna is a half wave dipole and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
- g. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 to 4 meters) and turn table (from 0 to 360 degrees) to find the maximum reading.
- h. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
- i. If the emission level of the EUT in peak mode was 2 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 2 dB margin will be repeated one by one using the quasi-peak method and reported.

3.2.3 Test Setup

Radiated Emissions below 1GHz

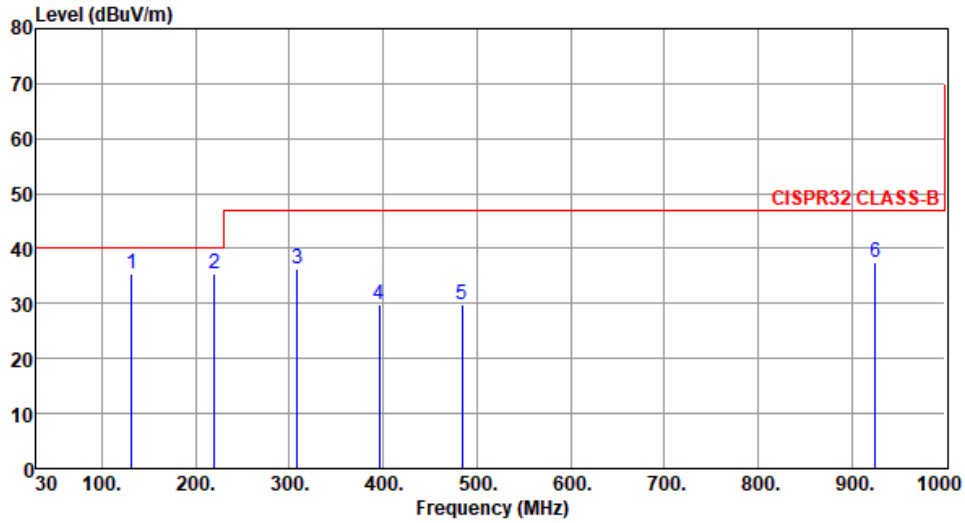


Radiated Emissions above 1GHz



3.2.4 Radiated Emissions (Below 1GHz)

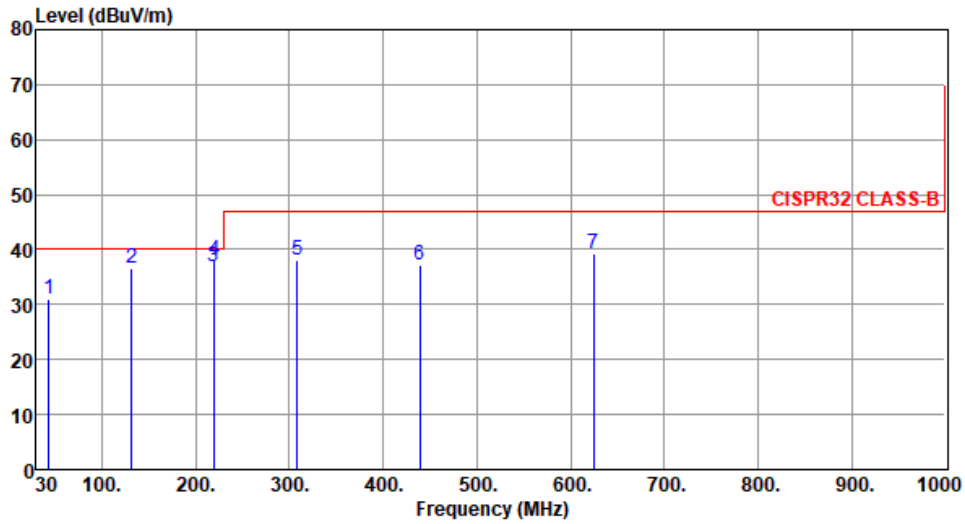
Polarization	Horizontal			Test Mode		1			
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	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	131.85	35.49	40.00	-4.51	44.85	-9.36	Peak	---	---
2	220.12	35.33	40.00	-4.67	45.25	-9.92	Peak	---	---
3	308.39	36.39	47.00	-10.61	43.56	-7.17	Peak	---	---
4	395.69	29.80	47.00	-17.20	34.47	-4.67	Peak	---	---
5	483.96	29.75	47.00	-17.25	32.43	-2.68	Peak	---	---
6	925.31	37.55	47.00	-9.45	31.88	5.67	Peak	---	---

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

Polarization	Vertical				Test Mode	1			
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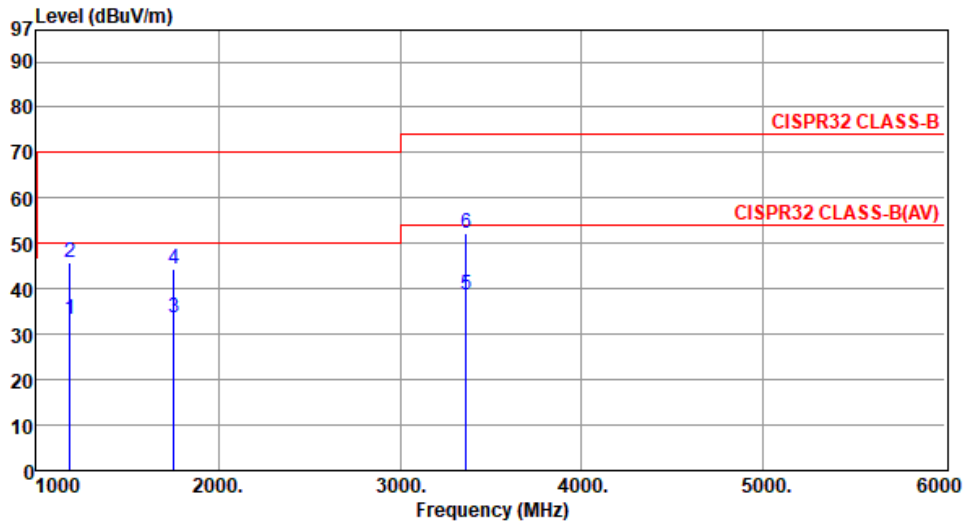
The graph displays the emission level in dBuV/m on the y-axis (0 to 80) against frequency in MHz on the x-axis (30 to 1000). A red line represents the CISPR32 CLASS-B limit, which is 40 dBuV/m from 30 MHz to 200 MHz, then rises to 47 dBuV/m from 200 MHz to 1000 MHz. Seven test results are plotted as blue vertical lines, labeled 1 through 7, corresponding to the data in the table below.

	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	43.58	31.07	40.00	-8.93	38.89	-7.82	Peak	---	---
2	131.85	36.50	40.00	-3.50	45.86	-9.36	Peak	---	---
3	219.43	36.98	40.00	-3.02	46.91	-9.93	QP	112	59
4	220.12	38.12	40.00	-1.88	48.04	-9.92	Peak	---	---
5	308.39	38.12	47.00	-8.88	45.29	-7.17	Peak	---	---
6	439.34	37.07	47.00	-9.93	40.71	-3.64	Peak	---	---
7	624.61	39.21	47.00	-7.79	38.95	0.26	Peak	---	---

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

3.2.5 Radiated Emissions (Above 1GHz)

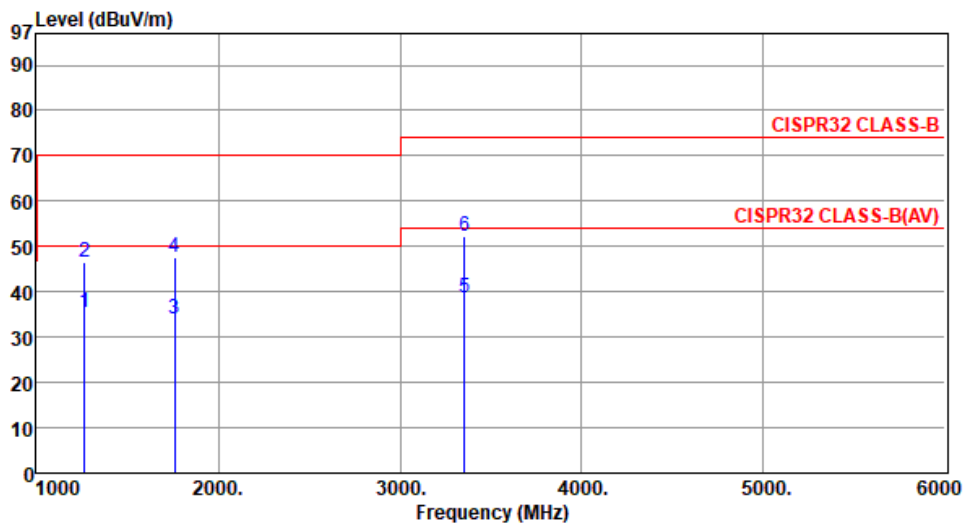
Polarization	Horizontal			Test Mode		1			
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	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1184.25	33.21	50.00	-16.79	41.21	-8.00	Average	139	180
2	1184.25	45.96	70.00	-24.04	53.96	-8.00	Peak	139	180
3	1758.52	33.56	50.00	-16.44	41.23	-7.67	Average	126	315
4	1758.52	44.30	70.00	-25.70	51.97	-7.67	Peak	126	315
5	3362.91	38.73	54.00	-15.27	41.68	-2.95	Average	146	146
6	3362.91	52.26	74.00	-21.74	55.21	-2.95	Peak	146	146

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

Polarization	Vertical	Test Mode	1
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	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1266.05	35.42	50.00	-14.58	43.05	-7.63	Average	129	226
2	1266.05	46.58	70.00	-23.42	54.21	-7.63	Peak	129	226
3	1759.43	34.05	50.00	-15.95	41.72	-7.67	Average	117	298
4	1759.43	47.45	70.00	-22.55	55.12	-7.67	Peak	117	298
5	3356.43	38.70	54.00	-15.30	41.71	-3.01	Average	100	82
6	3356.43	52.22	74.00	-21.78	55.23	-3.01	Peak	100	82

Note 1: Emission level (dBUV/m) = SA reading (dBUV) + Factor (dB).

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

4 Immunity Tests

4.1 General Description

Product Standard: EN 301 489-1, EN 301 489-17		
Basic Standard	Spec. Requirement	Performance Criteria
EN 61000-4-2 (ESD)	Contact Discharge: ± 4 kV Air Discharge: ± 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

EN 301 489-17		
Criteria	During test	After test (i.e. as a result of the application of the test)
A	Shall operate as intended. (see note). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance Shall be no loss of function. Shall be no loss of critical stored data.
B	May be loss of function.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no loss of critical stored data.
C	May be loss of function.	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no loss of critical stored data.

Note: Operate as intended during the test allows a level of degradation in accordance with clause 6.2.2.

Clause 6.2.2 Minimum performance level
For equipment that supports a PER or FER, the minimum performance level shall be a PER or FER less than or equal to 10%.
For equipment that does not support a PER or FER, the minimum performance level shall be no loss of wireless transmission function needed for the intended use of the equipment.

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.

4.3 Electrostatic Discharge (ESD)

4.3.1 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

4.3.2 Test Procedures

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

4.3.4 Test Result of Electrostatic Discharge (ESD)

Test Mode	1, 6, 7, 8				
Direct Application					
Test Voltage (kV)	Polarity	Test Point	Contact Discharge	Air Discharge	Performance Criteria
2, 4	+/-	1	Note	N/A	A
2, 4, 8	+/-	2	N/A	Note	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

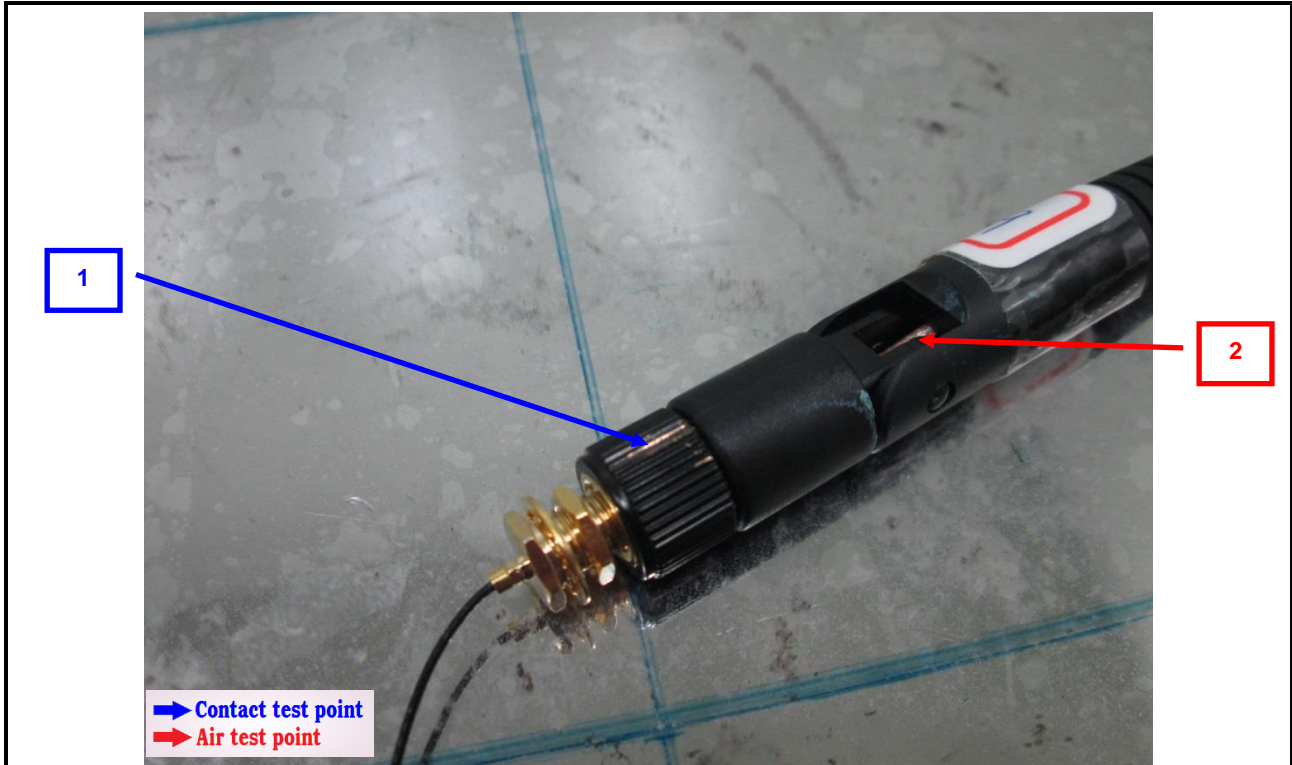
Note: There was no abnormal situation during the test compared with initial operation.

Test Mode	2, 3, 4, 5				
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

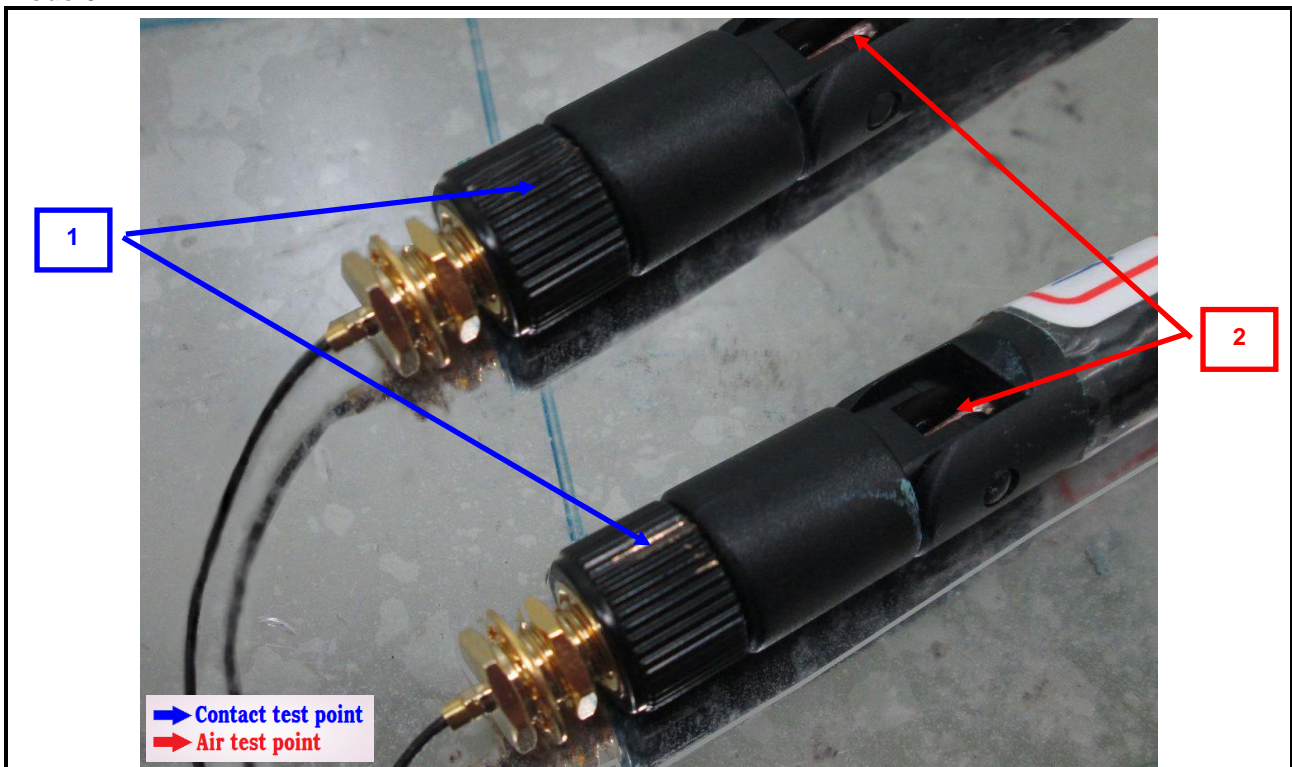
Note: There was no abnormal situation during the test compared with initial operation.

4.3.5 Test Point Photo

Mode 1, 7, 8



Mode 6



4.4 Radio Frequency Electromagnetic Field (RS)

4.4.1 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

4.4.2 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:

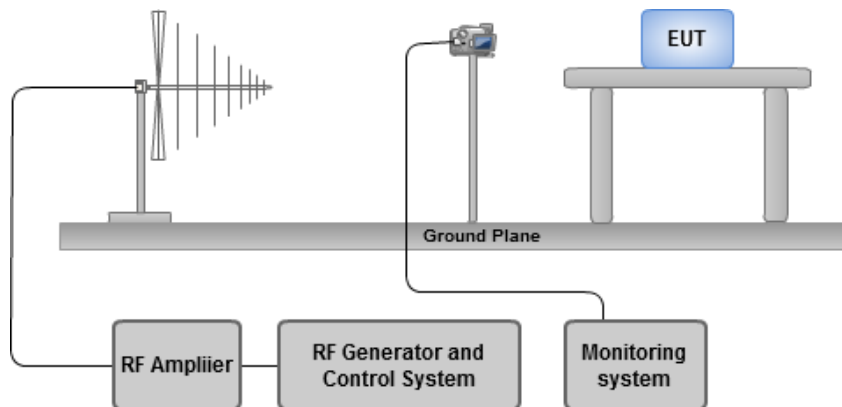
- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 4 880 MHz;
- upper limit of exclusion band = highest allocated band edge frequency +270 MHz, i.e. 5 995 MHz.

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, 6, 7				
Frequency Range (MHz)	Azimuth	Polarity	Test Field Strength (V/m)	Observation	Performance Criteria
80 - 6000	0	V&H	3	Note 1, 2	A
80 - 6000	90	V&H	3	Note 1, 2	A
80 - 6000	180	V&H	3	Note 1, 2	A
80 - 6000	270	V&H	3	Note 1, 2	A

Note:

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

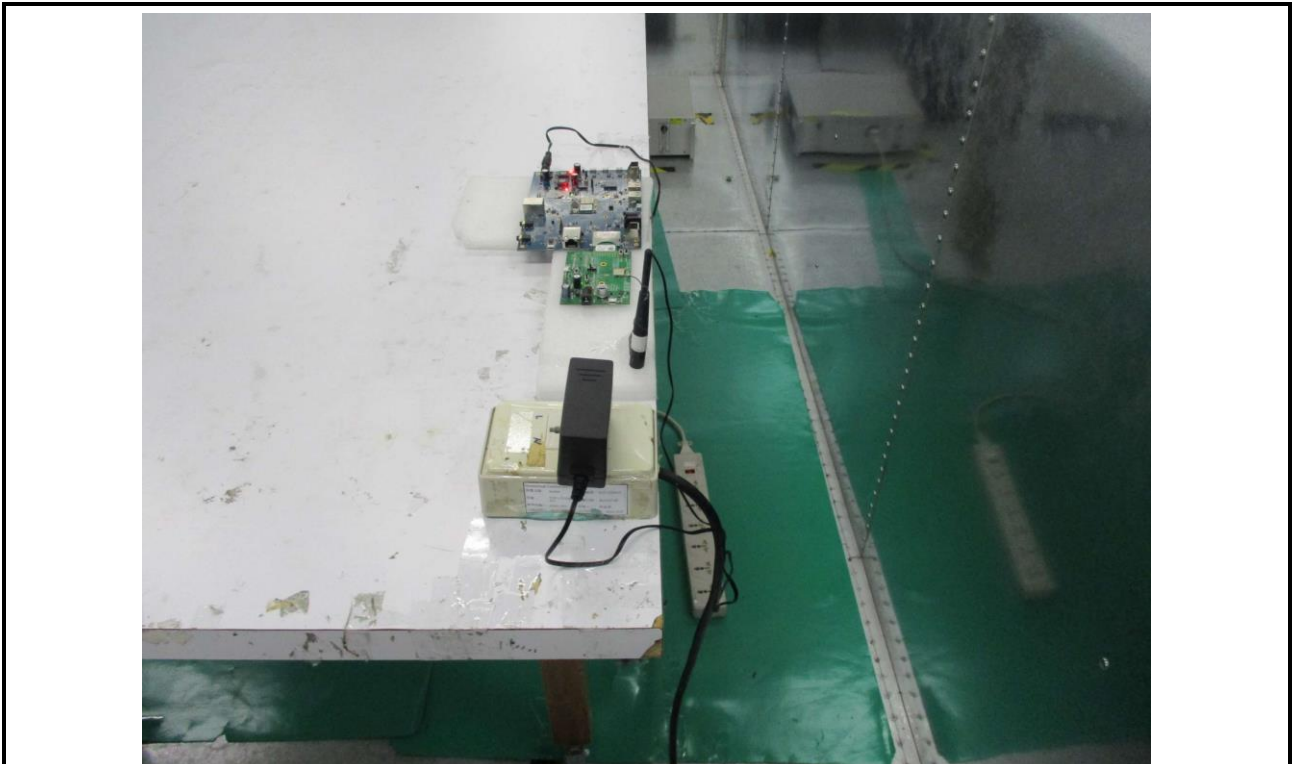
Test Mode	8				
Frequency Range (MHz)	Azimuth	Polarity	Test Field Strength (V/m)	Observation	Performance Criteria
80 - 6000	0	V&H	3	Note 1, 2	A
80 - 6000	90	V&H	3	Note 1, 2	A
80 - 6000	180	V&H	3	Note 1, 2	A
80 - 6000	270	V&H	3	Note 1, 2	A

Note:

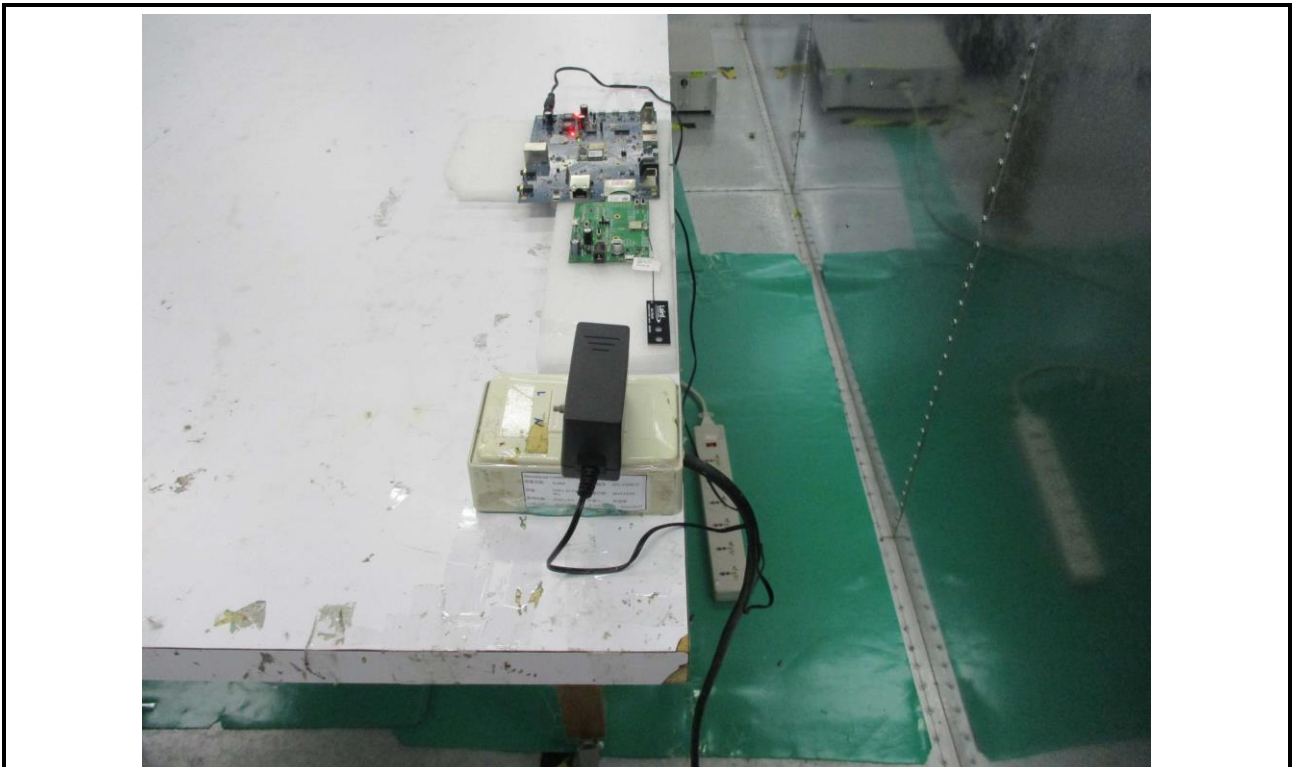
- 1) There was no abnormal situation during the test compared with initial operation.
- 2) The PER less than or equal to 10%.

5 Photographs of the Test Configuration

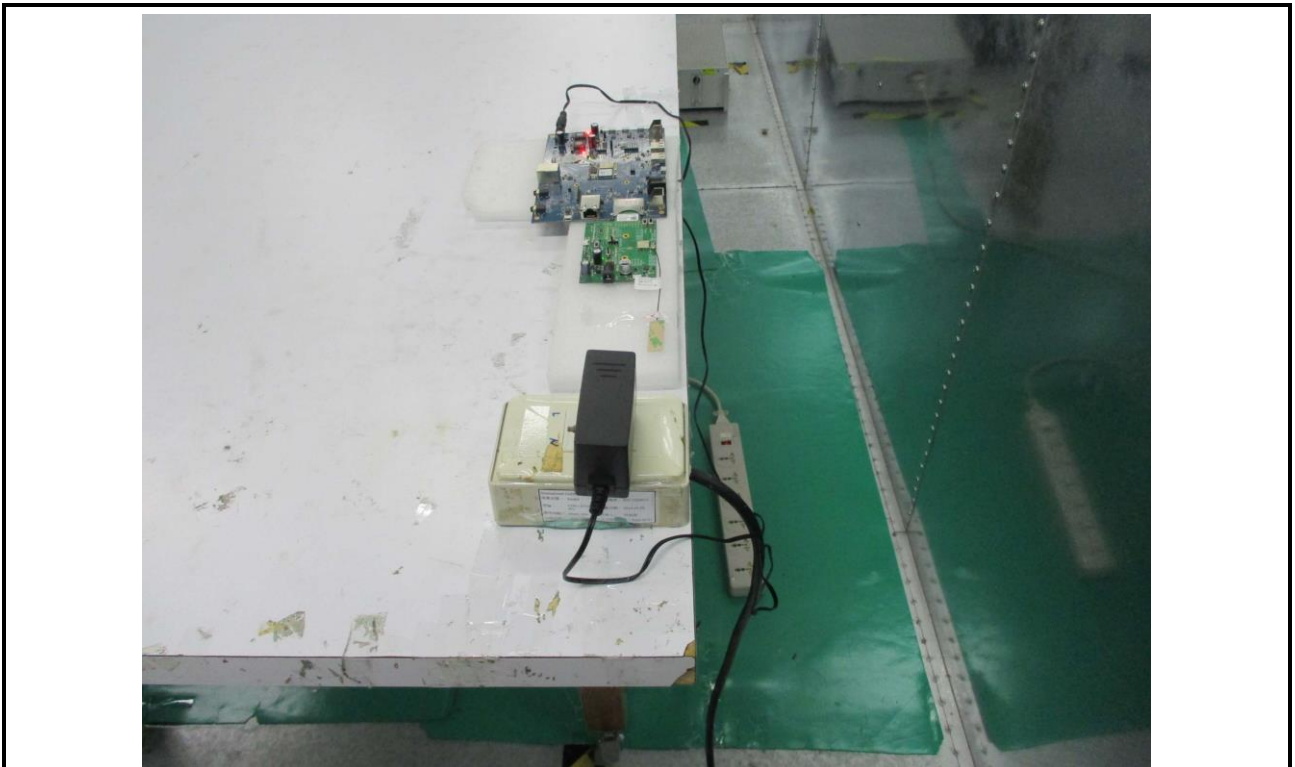
Conducted Emissions from the AC mains power ports (Mode 1 & 8)



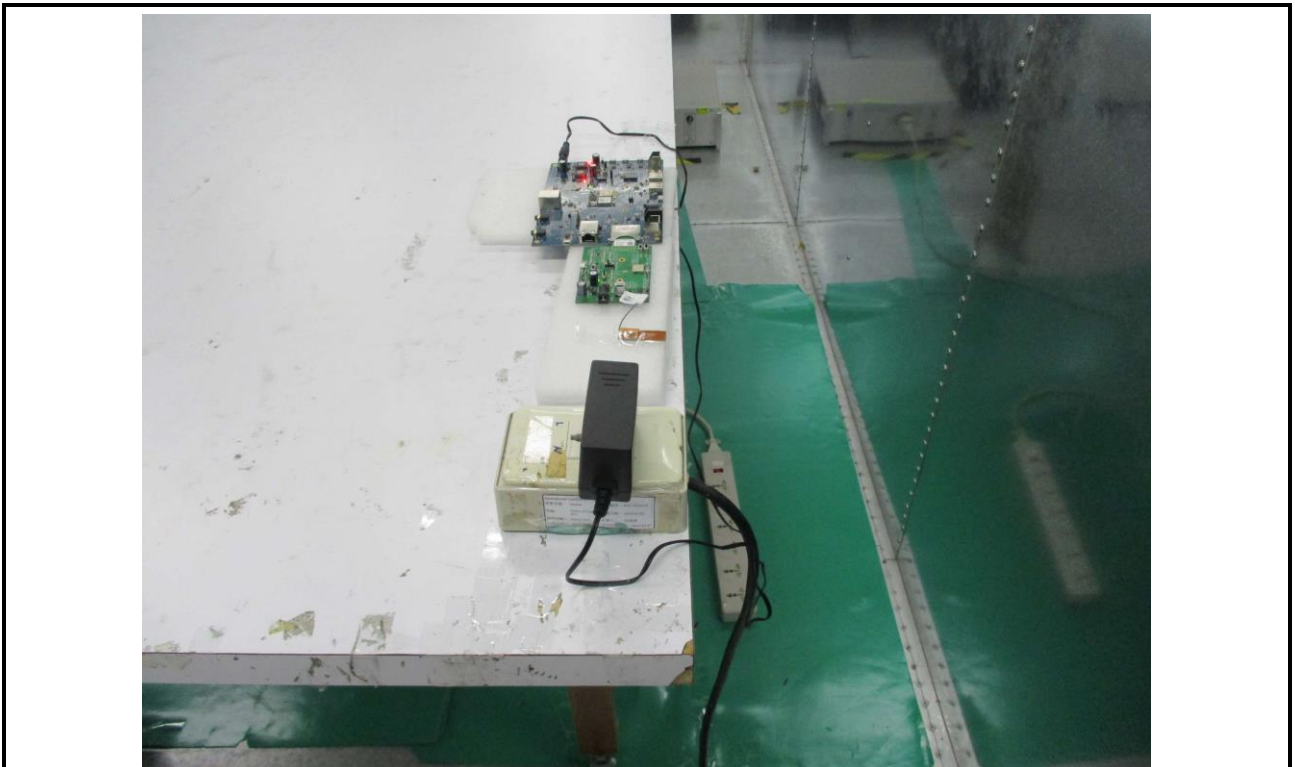
Conducted Emissions from the AC mains power ports (Mode 2)



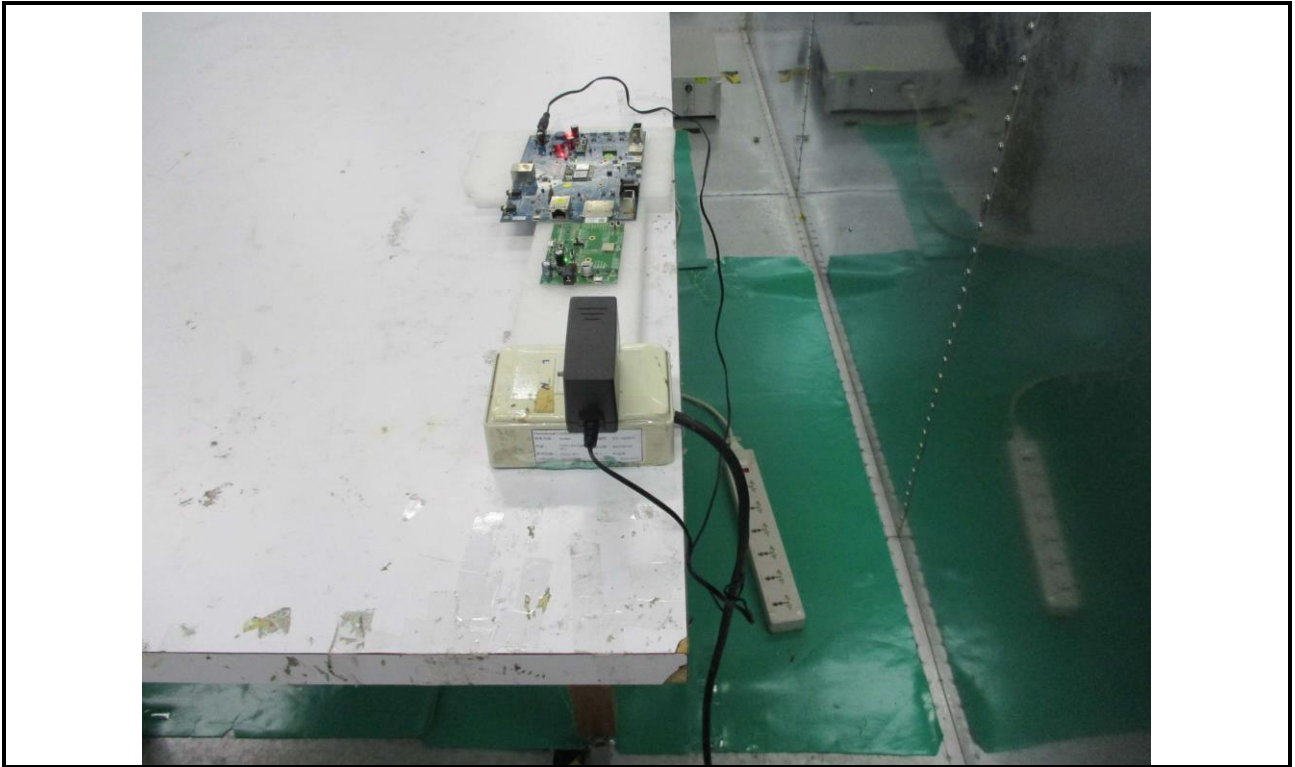
Conducted Emissions from the AC mains power ports (Mode 3)



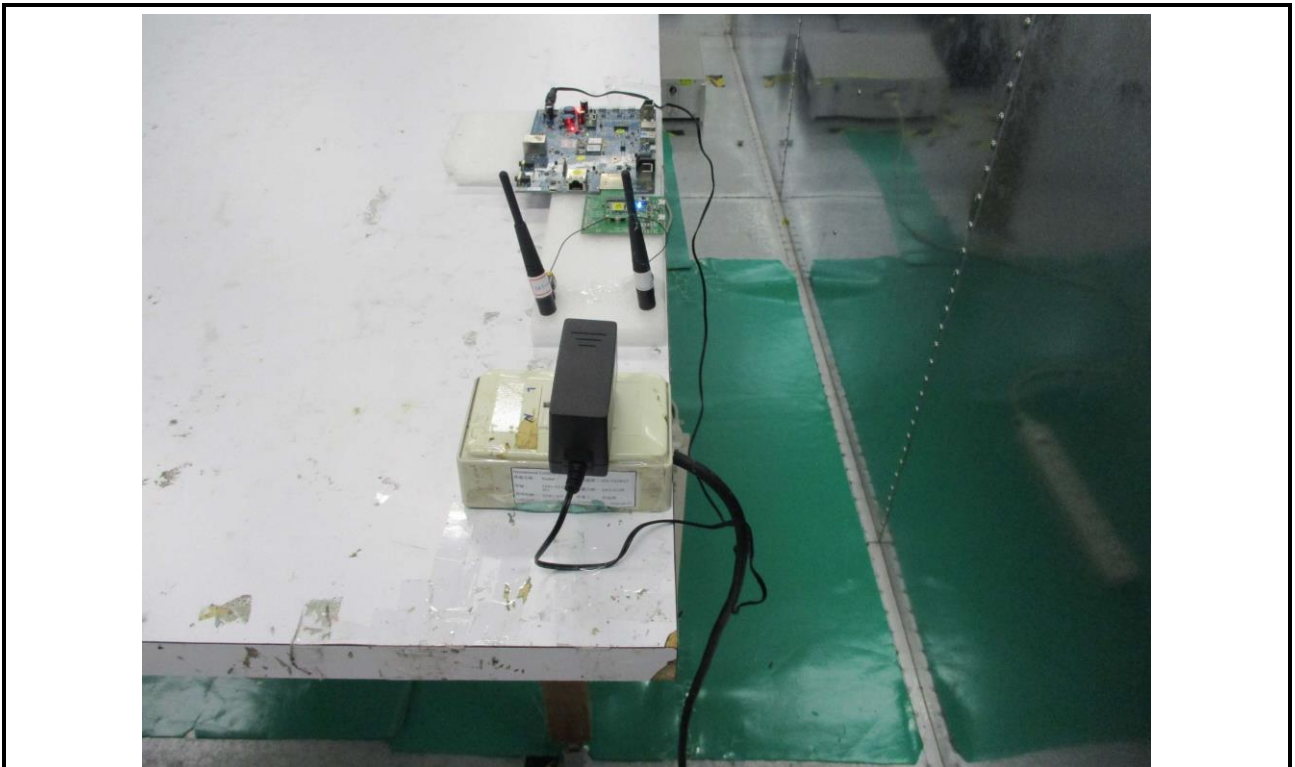
Conducted Emissions from the AC mains power ports (Mode 4)



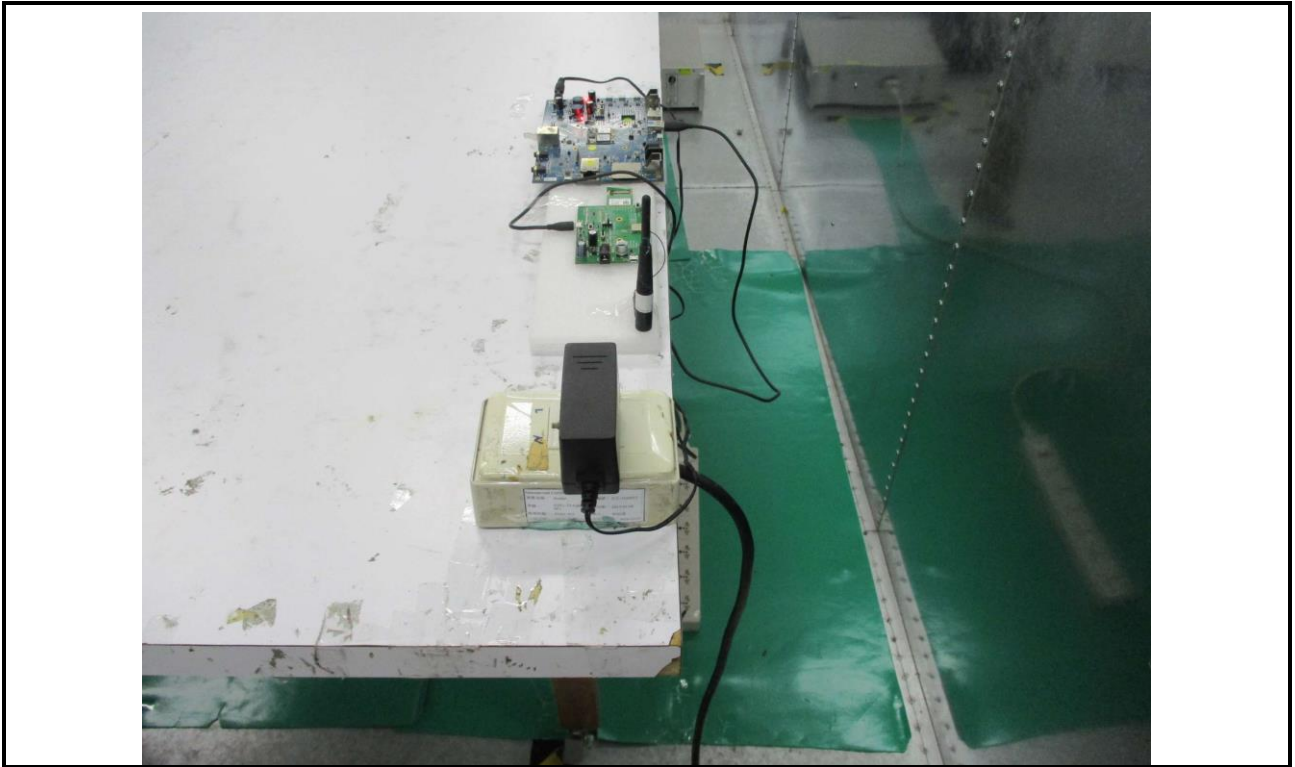
Conducted Emissions from the AC mains power ports (Mode 5)



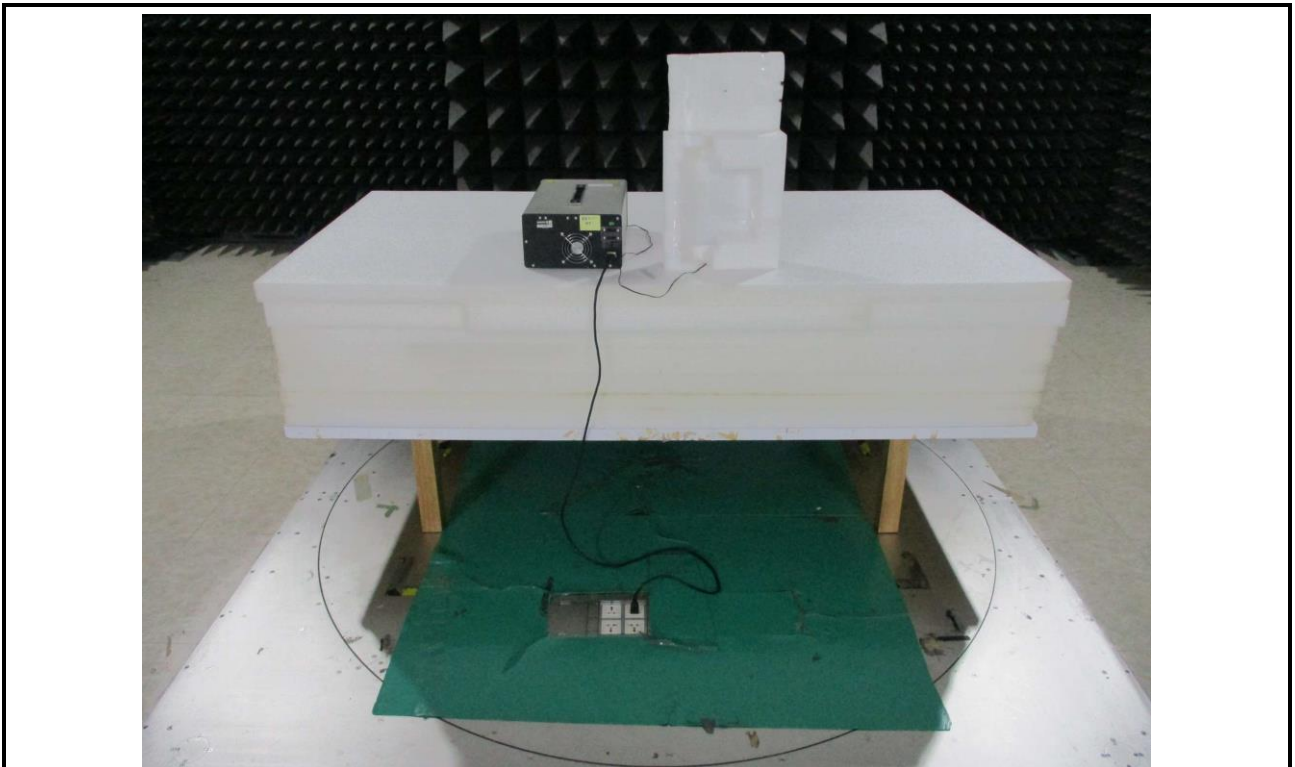
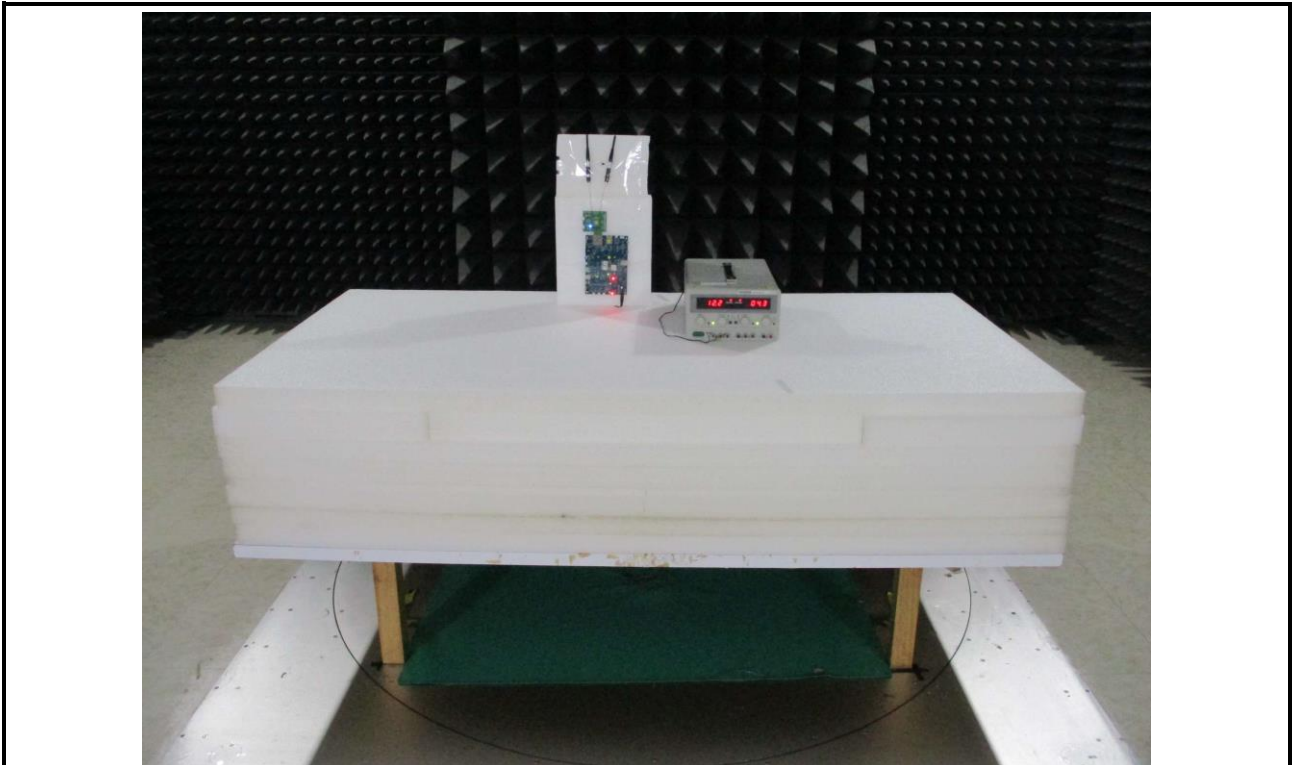
Conducted Emissions from the AC mains power ports (Mode 6)



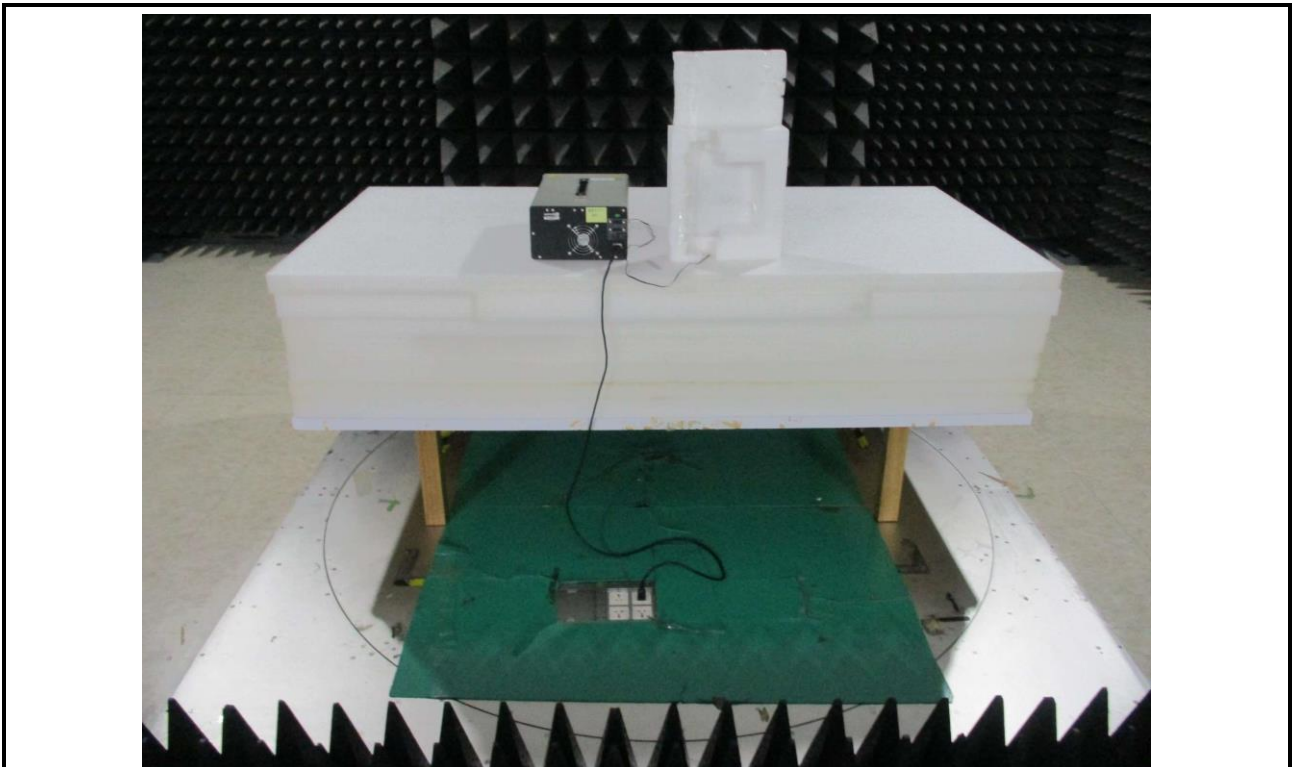
Conducted Emissions from the AC mains power ports (Mode 7)



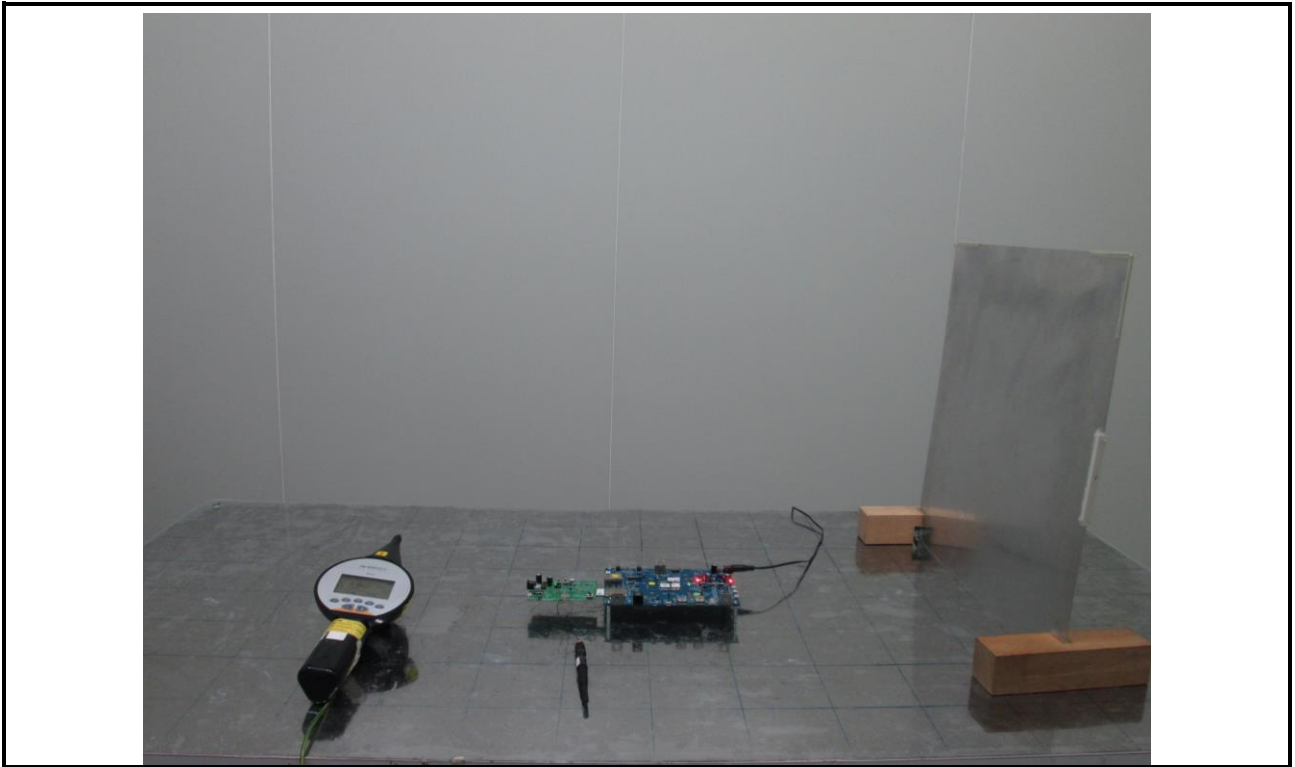
Radiated Emissions below 1GHz test



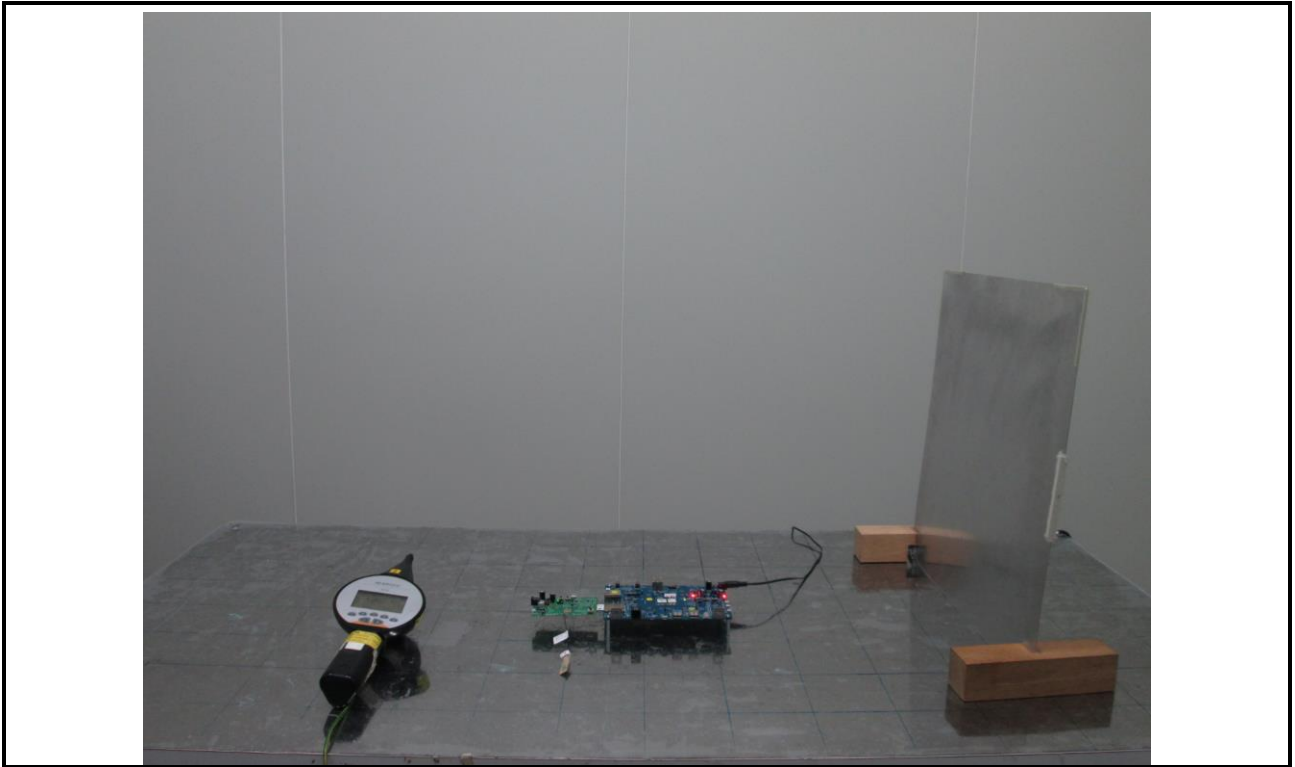
Radiated Emissions above 1GHz test



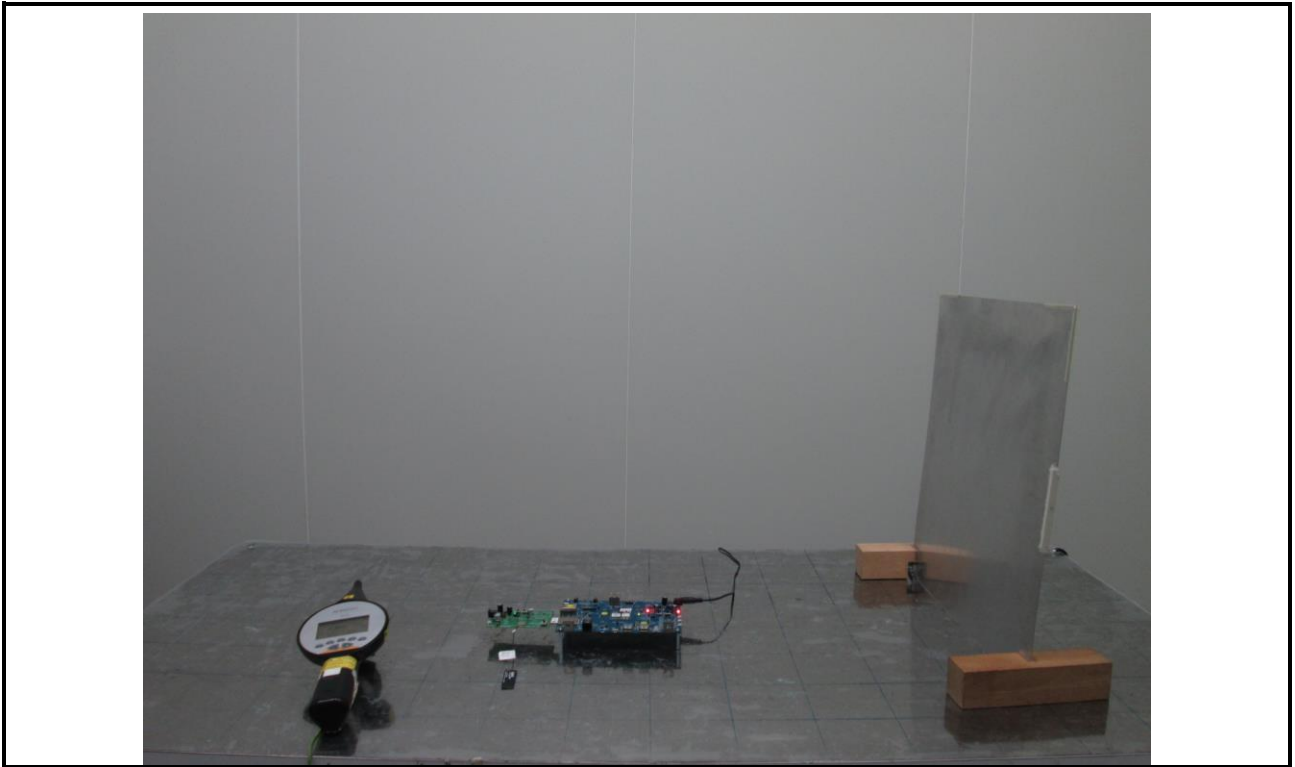
ESD Test (Mode 1 & 8)



ESD Test (Mode 2)



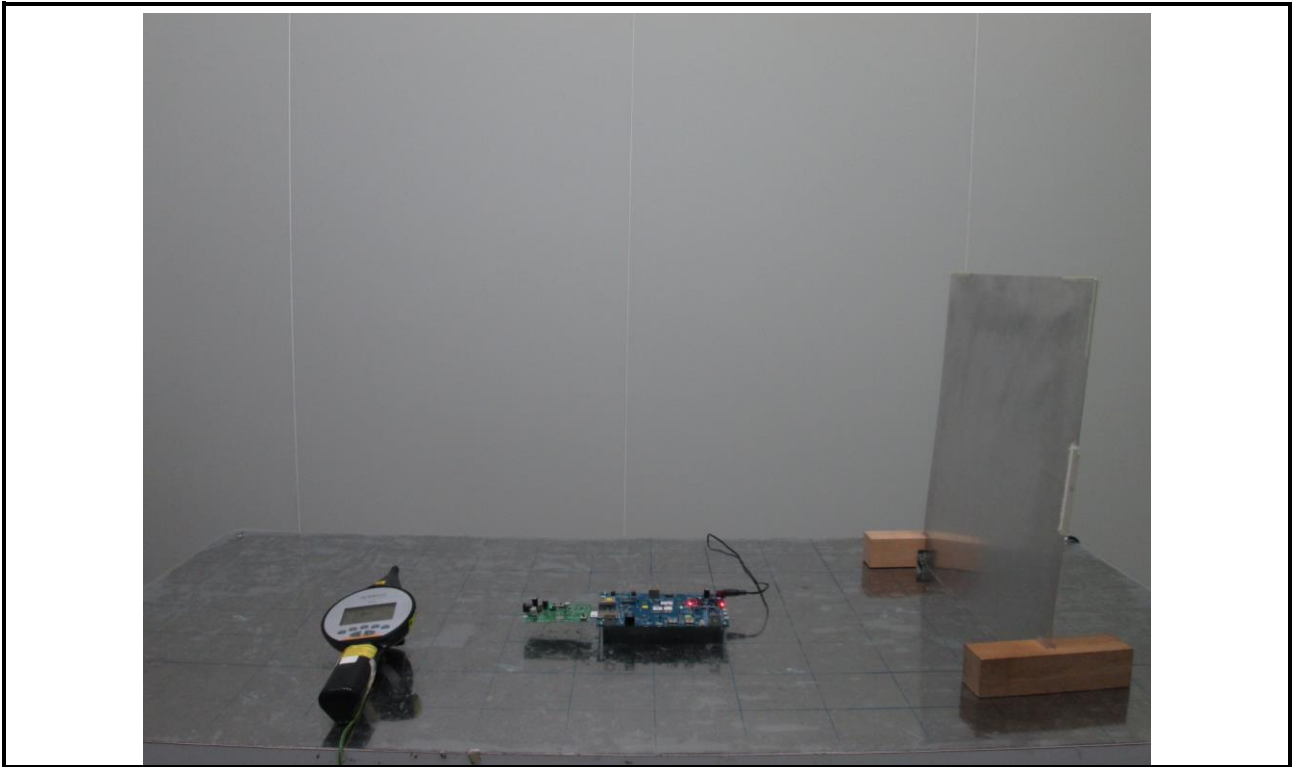
ESD Test (Mode 3)



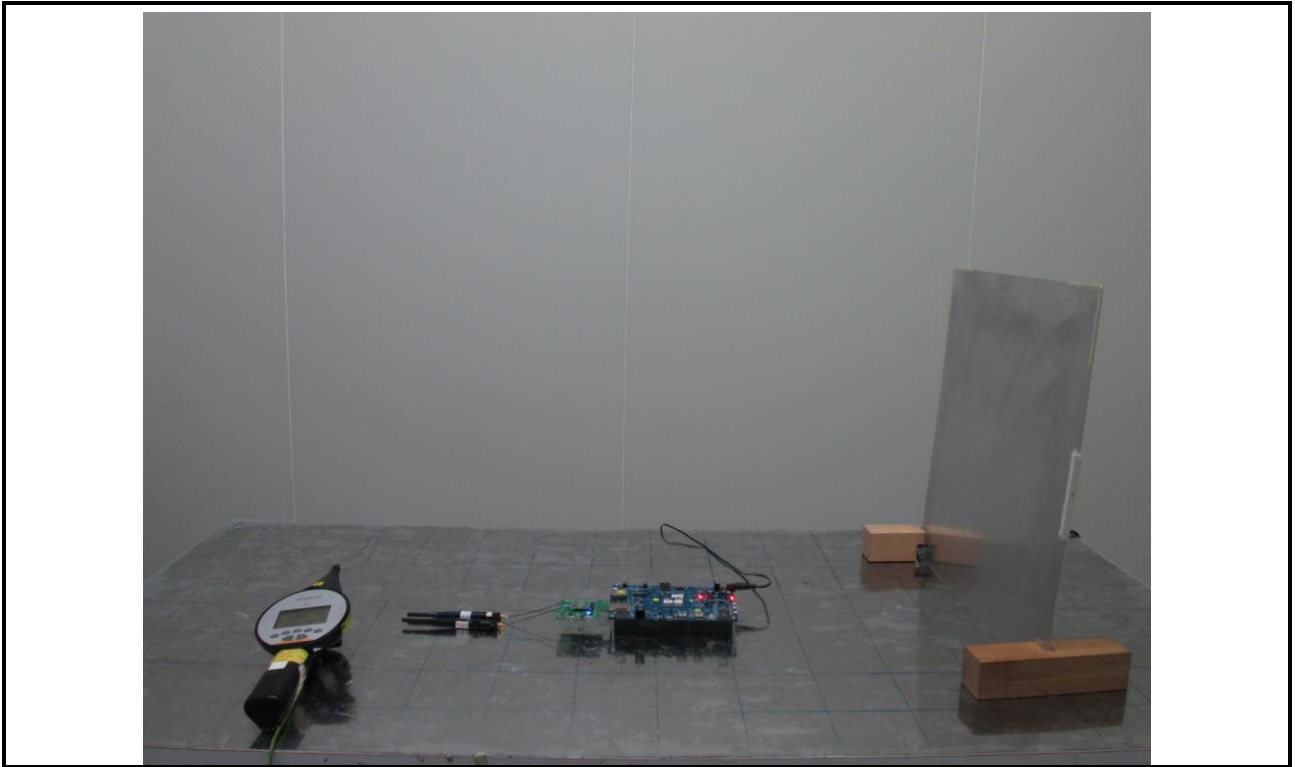
ESD Test (Mode 4)



ESD Test (Mode 5)



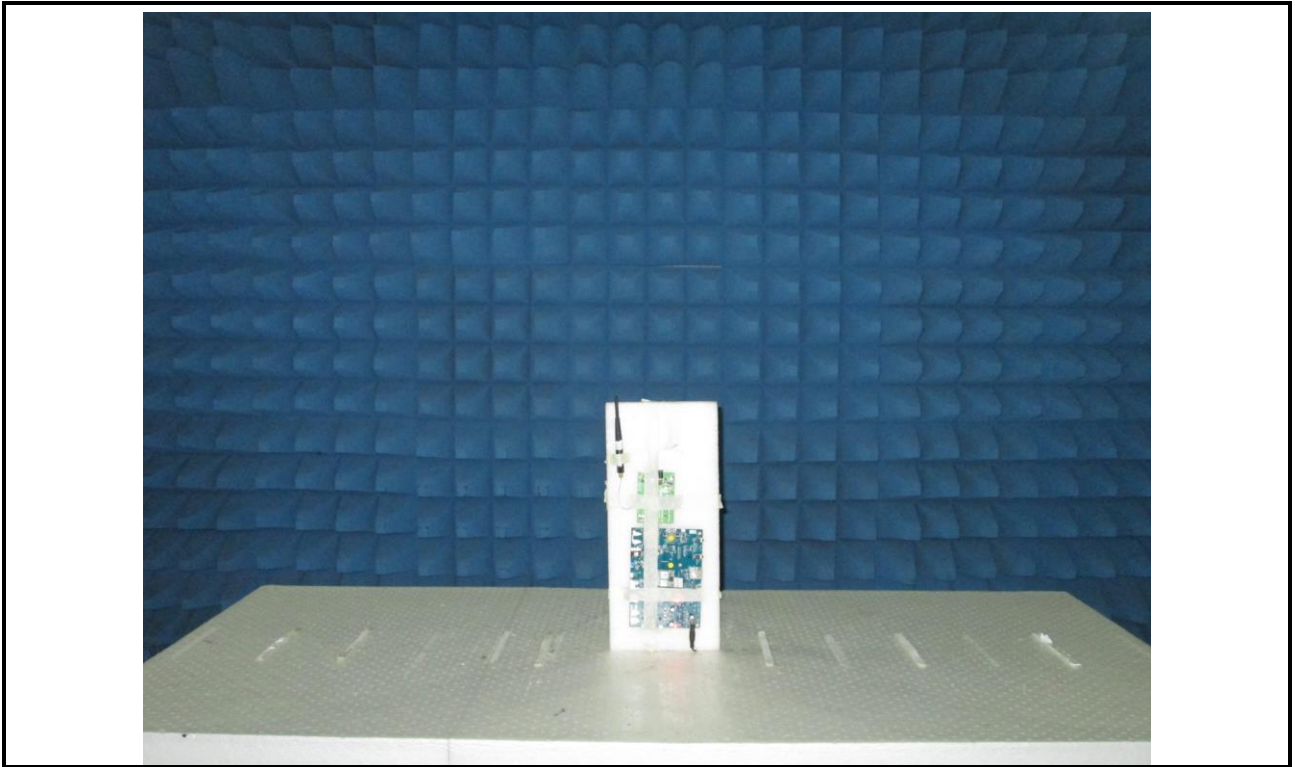
ESD Test (Mode 6)



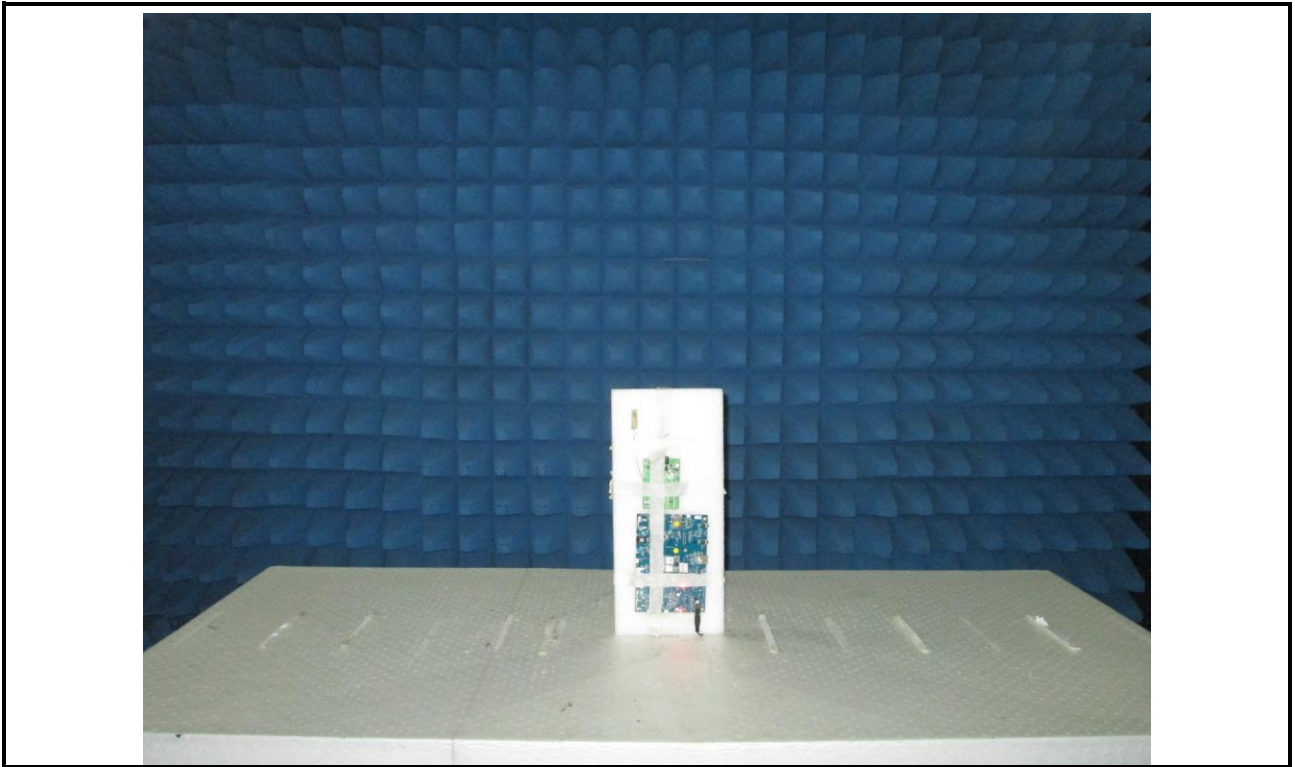
ESD Test (Mode 7)



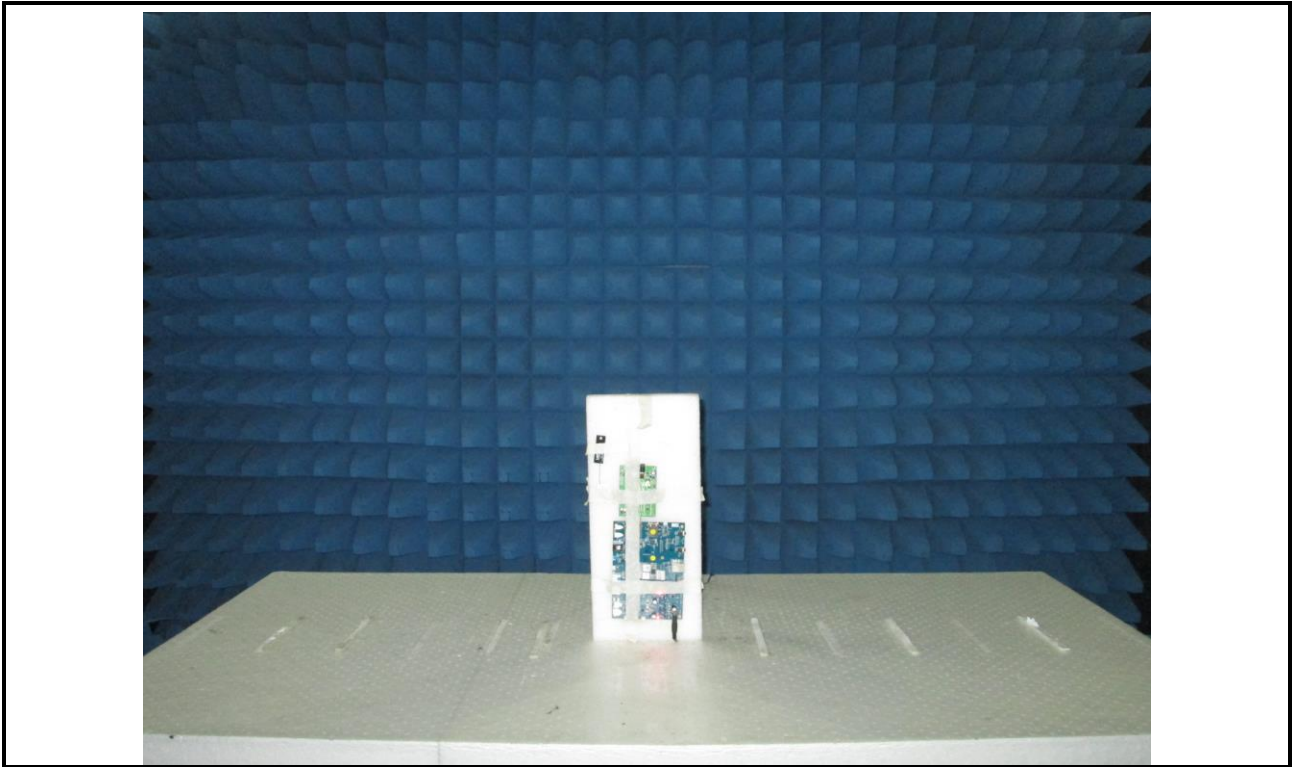
RS Test (Mode 1 & 8)



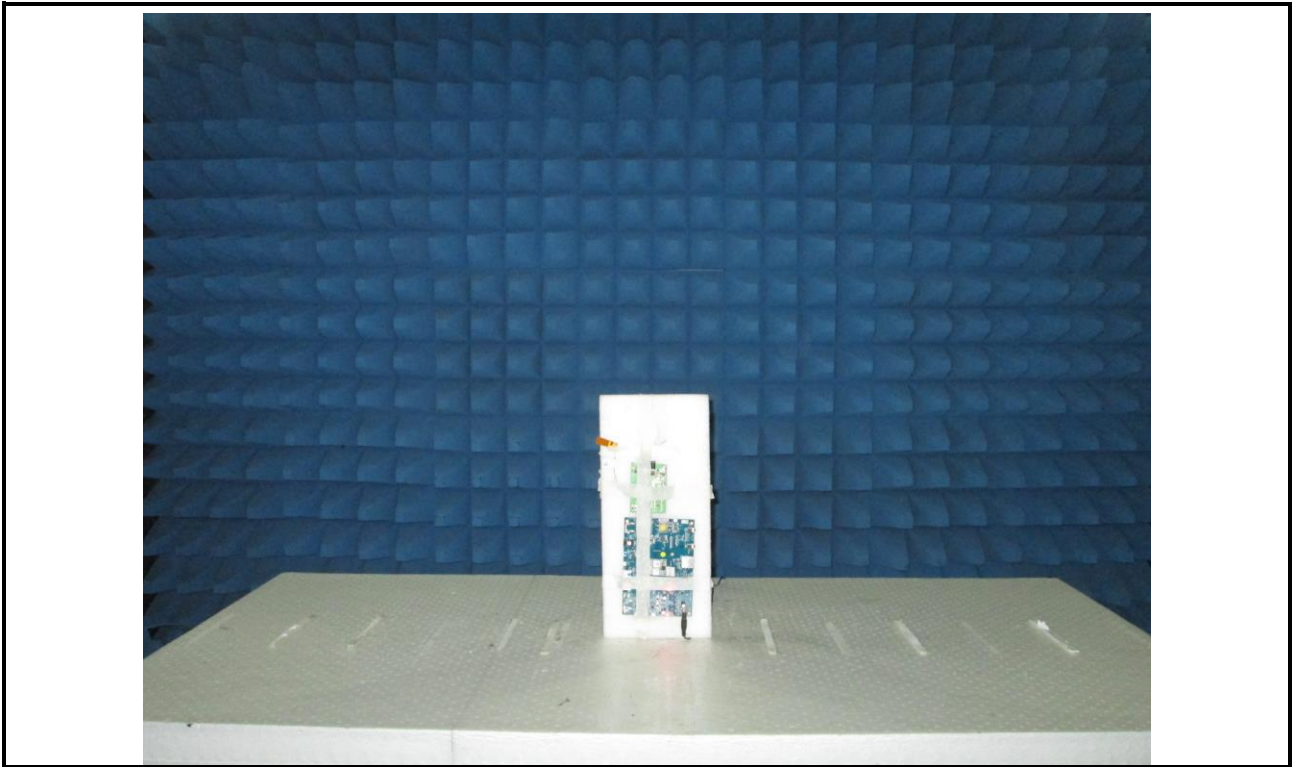
RS Test (Mode 2)



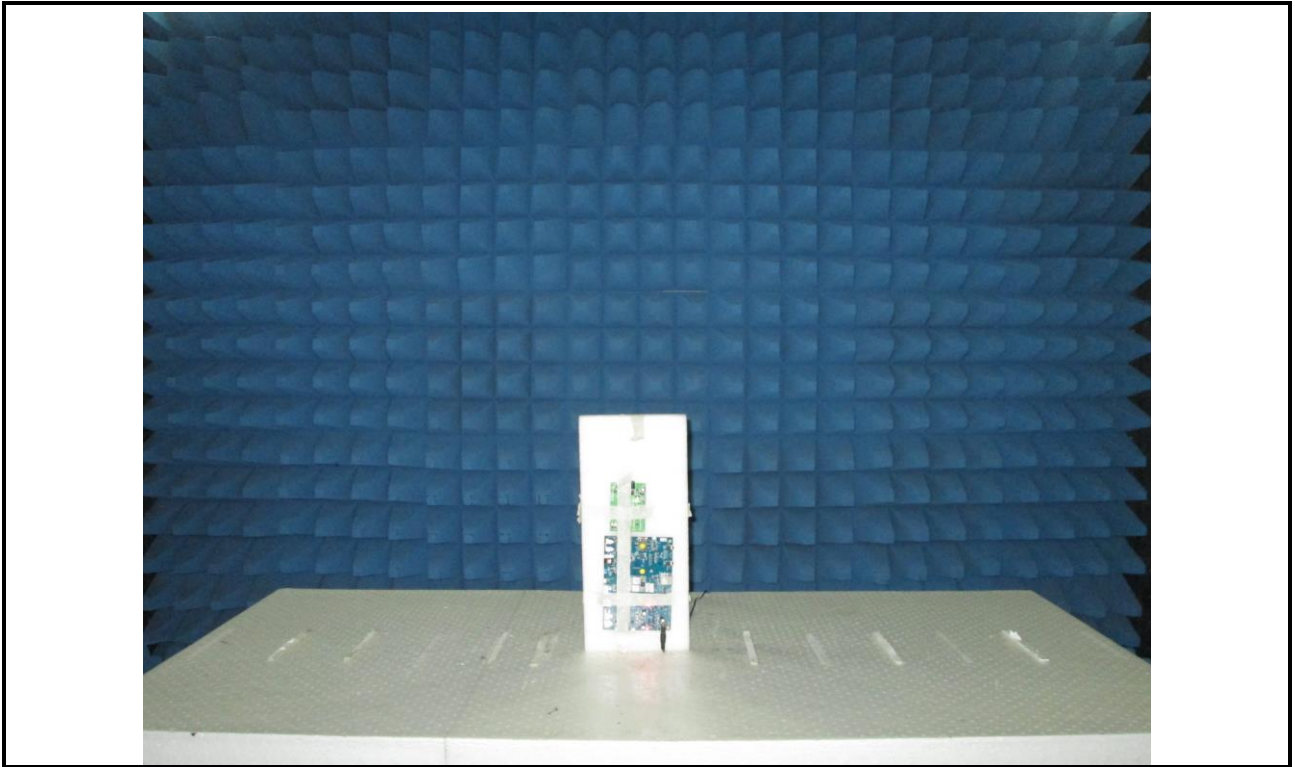
RS Test (Mode 3)



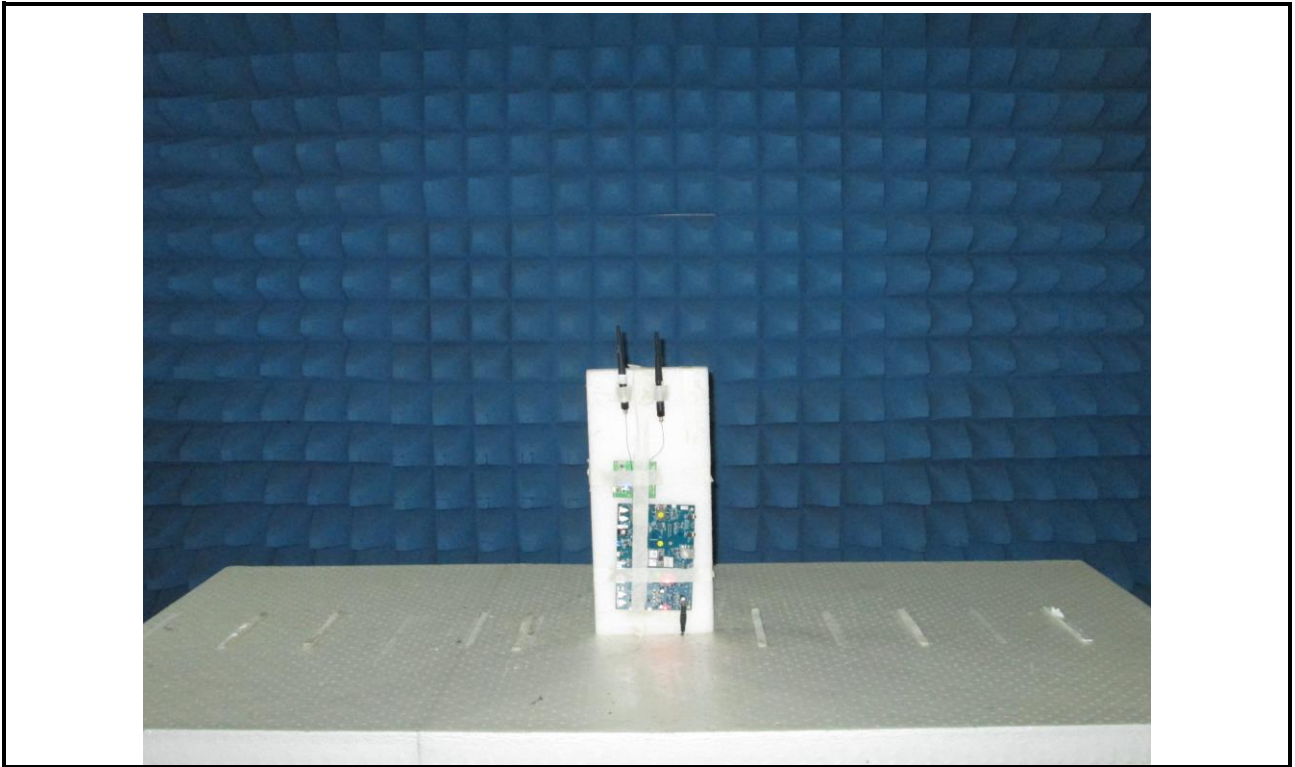
RS Test (Mode 4)



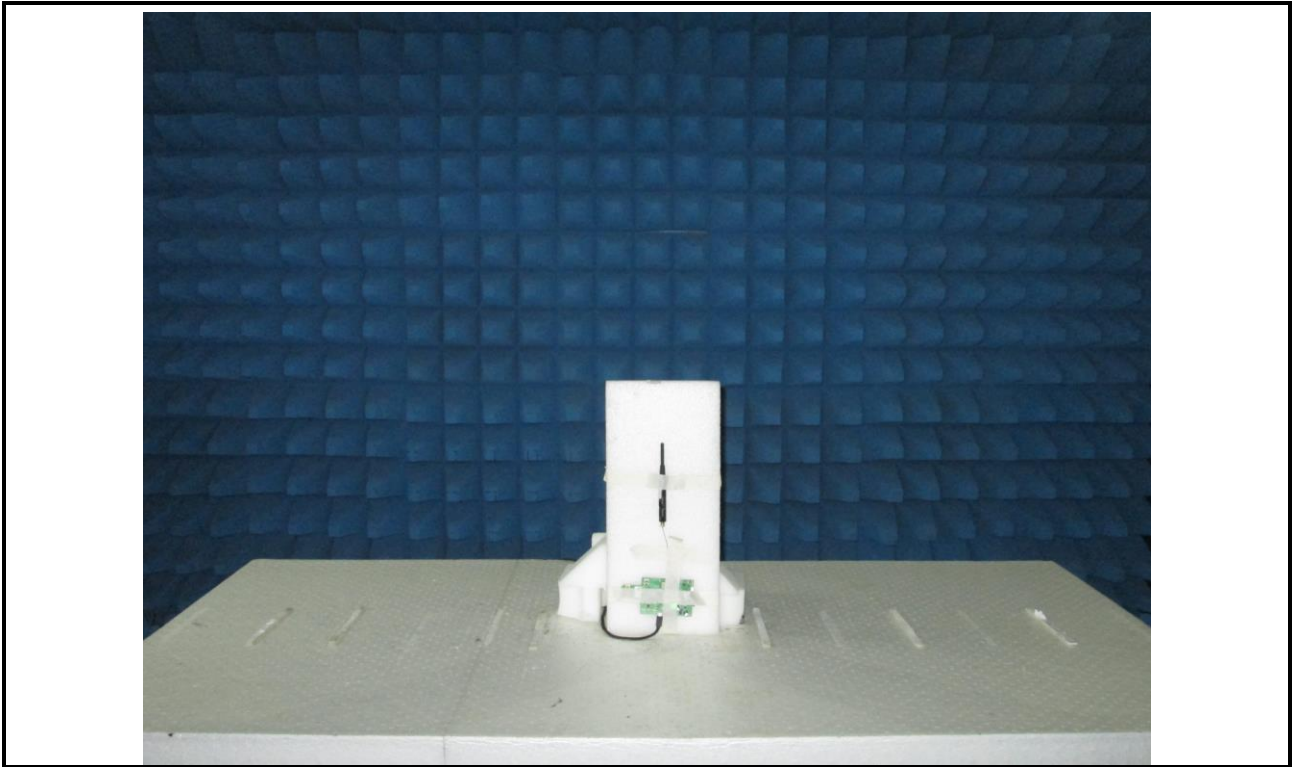
RS Test (Mode 5)



RS Test (Mode 6)



RS Test (Mode 7)



6 Test laboratory information

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

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

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

Linkou

Tel: 886-2-2601-1640

No. 30-2, Ding Fwu Tsuen, Lin Kou
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R.O.C.

Kwei Shan

Tel: 886-3-271-8666

No. 3-1, Lane 6, Wen San 3rd
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

Tel: 886-3-271-8666

Fax: 886-3-318-0155

Email: ICC_Service@icertifi.com.tw

==END==