FCC Certification Test Report

Report No.: FC200522C11

Test Model: Flex module Mini

Series Model: FlexModule Mini 1x LTEA Module, FlexModule Mini 1x LTE Module, Pismo208L, EXM-MINI-1GLTE-G, EXM-MINI-1LTEA-R, EXM-MINI-1LTEA-W, EXM-MINI-1LTE-US, Peplink FlexModule Mini 1x LTEA (CAT 18) Module, Peplink FlexModule Mini 1x LTE Module, Peplink FlexModule Mini 1x LTEA (CAT 12) Module, Peplink FlexModule Mini 1x LTEA Module (Refer to item 3.1 for more details)

FCC ID: U8G-P1208L

Received Date: May 22, 2020

Test Date: Jun. 22 ~ Jun. 23, 2020

Issued Date: Jul. 01, 2020

Applicant: PISMO LABS TECHNOLOGY LIMITED

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Lin Kou Laboratories

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Test Location: No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN

FCC Registration / Designation Number: 328930 / TW1050

Testing Laboratory 2021

ACCREDITED Certificate #4327.01

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Release Control Record

Issue No.	Description	Date Issued
FC200522C11	Original release.	Jul. 01, 2020

1 Certificate of Conformity

Product: PEPWAVE / peplink Wireless Product

Brand: PEPWAVE / peplink

FCC ID: U8G-P1208L

Test Model: Flex module Mini

Series Model: FlexModule Mini 1x LTEA Module, FlexModule Mini 1x LTE Module, Pismo208L, EXM-MINI-1GLTE-G, EXM-MINI-1LTEA-R, EXM-MINI-1LTEA-W, EXM-MINI-1LTE-US, Peplink FlexModule Mini 1x LTEA (CAT 18) Module, Peplink FlexModule Mini 1x LTE Module, Peplink FlexModule Mini 1x LTEA (CAT 12) Module, Peplink FlexModule Mini 1x LTEA Module (Refer to item 3.1 for more details)

Sample Status: Prototype

Applicant: PISMO LABS TECHNOLOGY LIMITED

Test Date: Jun. 22 ~ Jun. 23, 2020

Standards: 47 CFR FCC Part 15, Subpart B, Class A
ICES-003:2016 Issue 6, updated Apr. 2019, Class A
ANSI C63.4:2014

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Vida Chen , **Date:** Jul. 01, 2020
Vida Chen / Specialist

Approved by : Carl Chen , **Date:** Jul. 01, 2020
Carl Chen / Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart B / ICES-003:2016 Issue 6, updated Apr. 2019, Class A ANSI C63.4:2014				
FCC Clause	ICES-003 Clause	Test Item	Result/Remarks	Verdict
15.107	6.1	AC Power Line Conducted Emissions	Minimum passing Class A margin is -26.41dB at 0.15000MHz	Pass
15.109	6.2.1	Radiated Emissions up to 1 GHz	Minimum passing Class A margin is -4.93dB at 354.82MHz	Pass
	6.2.2	Radiated Emissions above 1 GHz	Minimum passing Class A margin is -5.91dB at 4864.29MHz	Pass

Note:
1. There is no deviation to the applied test methods and requirements covered by the scope of this report.
2. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.79 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	4.14 dB
Radiated Emissions above 1 GHz	Above 1GHz	5.04 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 Description of EUT

Product	PEPWAVE / peplink Wireless Product
Brand	PEPWAVE / peplink
Test Model	Flex module Mini
FCC ID	U8G-P1208L
Series Model	FlexModule Mini 1x LTEA Module, FlexModule Mini 1x LTE Module, Pismo208L, EXM-MINI-1GLTE-G, EXM-MINI-1LTEA-R, EXM-MINI-1LTEA-W, EXM-MINI-1LTE-US, Peplink FlexModule Mini 1x LTEA (CAT 18) Module, Peplink FlexModule Mini 1x LTE Module, Peplink FlexModule Mini 1x LTEA (CAT 12) Module, Peplink FlexModule Mini 1x LTEA Module
Model difference	Refer to note
Sample Status	Prototype
Operating Software	N/A
Power Supply Rating	Refer to Note
Accessory Device	N/A
Data Cable Supplied	1.5m non-shielded console cable

Note:

1. All models are listed as below. Model Flex module Mini is the representative for final test.

Brand	Model	Difference
PEPWAVE / peplink	Flex module Mini	For marketing purpose
	Pismo208L	PCBA
	FlexModule Mini 1x LTEA Module	Telit LM960A18
	EXM-MINI-1GLTE-G	
	Peplink FlexModule Mini 1x LTEA (CAT 18) Module	
	Peplink FlexModule Mini 1x LTEA Module	
	FlexModule Mini 1x LTEA Module	Sierra MC7455
	EXM-MINI-1LTEA-W	
	Peplink FlexModule Mini 1x LTEA Module	
	FlexModule Mini 1x LTEA Module	EM7511
	EXM-MINI-1LTEA-R	
	Peplink FlexModule Mini 1x LTEA (CAT 12) Module	
	Peplink FlexModule Mini 1x LTEA Module	
	FlexModule Mini 1x LTE Module	Telit LE910C4-NF
	EXM-MINI-1LTE-US	
	Peplink FlexModule Mini 1x LTE Module	

2. The EUT has three WWAN Modules for testing.

Module	Brand	Model	FCC ID
Integrated WWAN module 1	Sierra	MC7455	N7NMC7455
Integrated WWAN module 2	Telit	LE910C4-NF	RI7LE910CXNF
Integrated WWAN module 3	Telit	LM960A18	RI7LM960
Integrated WWAN module 4	Sierra	EM7511	N7NEM75S

3. The EUT consumes power from Balance 20X(FCC ID: U8G-P1AC8E, Rating: 3.3V)

3.2 Features of EUT

The tests reported herein were performed according to the method specified by PISMO LABS TECHNOLOGY LIMITED, for detailed feature description, please refer to the manufacturer's specifications or user's manual.

3.3 Operating Modes of EUT and Determination of Worst Case Operating Mode

The EUT is designed with AC power of rating 100-240Vac, 50/60Hz.

For radiated emission test, the EUT has been pre-tested under following modes and mode 1 was the worst case for final test.

Mode	Test Condition
1	Balance 20X + EUT (LM960A18) Module SIM A WCDMA Link + GPS Link + Adapter, 120Vac/60Hz
2	Balance 20X + EUT (Telit LE 910C4-NF) Module SIM A WCDMA Link + GPS Link + Adapter, 120Vac/60Hz
3	Balance 20X + EUT (EM7511) Module SIM A WCDMA Link + GPS Link + Adapter, 120Vac/60Hz
4	Balance 20X + EUT (Sierra MC7455) Module SIM A WCDMA Link + GPS Link + Adapter, 120Vac/60Hz
5	Balance 20X + EUT (LM960A18) Module SIM A LTE Link + GPS Link + Adapter, 120Vac/60Hz
6	Balance 20X + EUT (LM960A18) Module SIM B WCDMA Link + Adapter, 120Vac/60Hz
7	Balance 20X + EUT (LM960A18) Module SIM A WCDMA Link + GPS Link + Adapter, 240Vac/60Hz

For conducted emission test, the EUT has been pre-tested under following modes and mode 1 was the worst case for final test.

Mode	Test Condition
1	Balance 20X + EUT (LM960A18) Module SIM A WCDMA Link + GPS Link + Adapter, 120Vac/60Hz
2	Balance 20X + EUT (LM960A18) Module SIM A WCDMA Link + GPS Link + Adapter, 240Vac/60Hz

Test modes are presented in the report as below.

Mode	Test Condition
Conducted emission test	
-	Balance 20X + EUT (LM960A18) Module SIM A WCDMA Link + GPS Link + Adapter
Radiated emission up to 1GHz test	
-	Balance 20X + EUT (LM960A18) Module SIM A WCDMA Link + GPS Link + Adapter
Radiated emission above 1GHz test	
-	Balance 20X + EUT (LM960A18) Module SIM A WCDMA Link + GPS Link + Adapter

3.4 Test Program Used and Operation Descriptions

a. Placed the EUT on the test table.

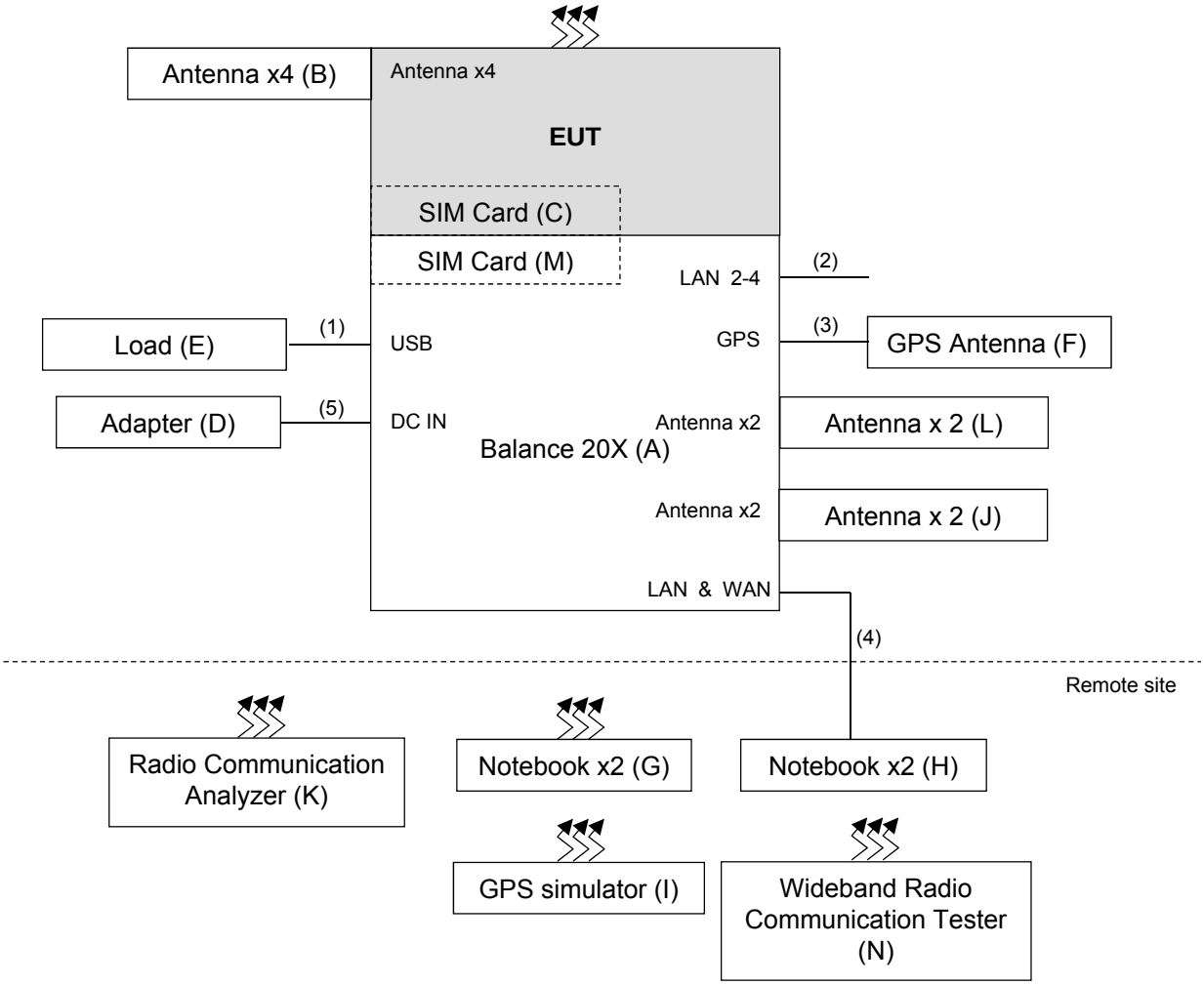
b. EUT linked with Balance 20X through WWAN and linked with GPS simulator through GPS.

3.5 Primary Clock Frequencies of Internal Source

The highest frequency generated or used within the EUT or on which the EUT operates or tunes is 59250MHz, provided by PISMO LABS TECHNOLOGY LIMITED, for detailed internal source, please refer to the manufacturer's specifications.

4 Configuration and Connections with EUT

4.1 Connection Diagram of EUT and Peripheral Devices



4.2 Configuration of Peripheral Devices and Cable Connections

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Balance 20x	PEPWAVE / peplink	Balance 20x	NA	NA	Provided by client
B.	Antenna x4	Master Wave	98619ZSAX053	NA	NA	Provided by client
C.	SIM card	R&S	CMW-Z05	NA	NA	Provided by Lab
D.	Adapter	DVE	DSA-36PFH-12 FUS 120300AN	NA	NA	Provided by client
E.	Load	BV-ADT	NA	NA	NA	-
F.	GPS Antenna	Master Wave	98335KSAF000	NA	NA	Provided by client
G.	Notebook	DELL	E6440	6QLNM32	FCC DoC Approved	-
	Notebook	DELL	E6440	FNLNM32	FCC DoC Approved	-
H.	Notebook	DELL	E6440	FMLNM32	FCC DoC Approved	-
	Notebook	DELL	Vostro 14-5459	9N9D2D2	FCC DoC Approved	-
I.	GPS simulator	T&E	GS-50	610493	NA	-
J.	Antenna x2	Master Wave	98614PRSX000	NA	NA	Provided by client
K.	Radio Communication Analyzer	Anritsu	MT8820C	6201010284	NA	-
L.	Antenna x2	Master Wave	98619ZSAX025	NA	NA	Provided by client
M.	Sim card	R&S	CMW-Z05	NA	NA	Provided by Lab
N.	Wideband Radio Communication Tester	R&S	CMW500	151084	NA	-

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item F, G-H, J & M acted as communication partners to transfer data.

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Micro USB cable	1	1	Y	0	-
2.	LAN cable	3	1	N	0	Provided by Lab RJ45, Cat.5e
3.	GPS cable	1	5.05	Y	0	Provided by client
4.	LAN cable	2	10	N	0	Provided by Lab RJ45, Cat.5e
5.	DC cable	1	1.45	N	0	Provided by client

5 Conducted Emissions at Mains Ports

5.1 Limits

Frequency (MHz)	Class A (dBuV)		Class B (dBuV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 - 0.5	79	66	66 - 56	56 - 46
0.50 - 5.0	73	60	56	46
5.0 - 30.0	73	60	60	50

Notes: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases linearly with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

5.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Dec. 11, 2019	Dec. 10, 2020
RF signal cable Woken	5D-FB	Cable-cond1-01	Sep. 05, 2019	Sep. 04, 2020
LISN ROHDE & SCHWARZ (EUT)	ENV216	101826	Feb. 20, 2020	Feb. 19, 2021
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Aug. 22, 2019	Aug. 21, 2020
Software ADT	BV ADT_Cond_ V7.3.7.4	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Shielded Room 1 (Conduction 1).
3. The VCCI Site Registration No. is C-12040.

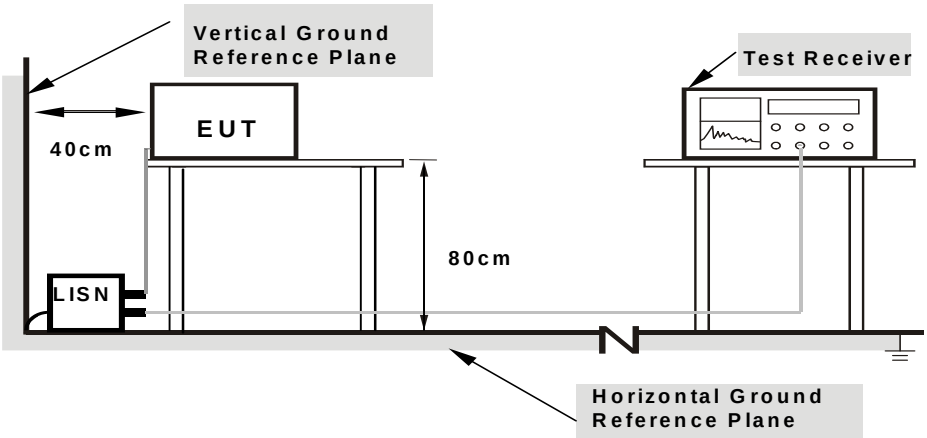
5.3 Test Arrangement

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

c. The test results of conducted emissions at mains ports are recorded of six worst margins for quasi-peak (mandatory) [and average (if necessary)] values against the limits at frequencies of interest unless the margin is 20 dB or greater.

Note: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.



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

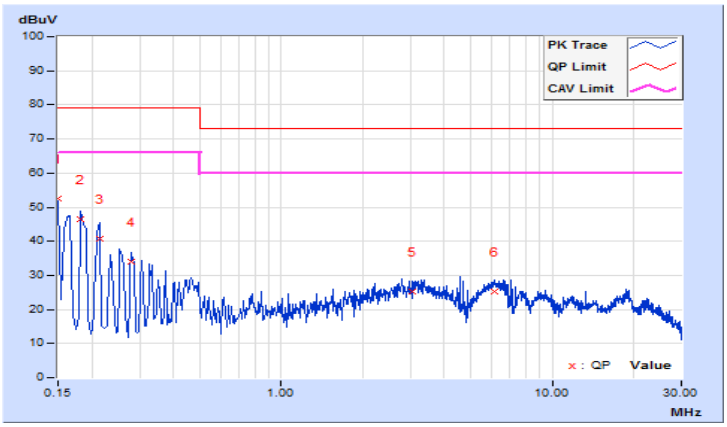
5.4 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25℃, 75%RH
Tested by	Rolan Zheng	Test Date	2020/6/22

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	9.80	42.59	22.06	52.39	31.86	79.00	66.00	-26.61	-34.14
2	0.18200	9.81	36.79	17.95	46.60	27.76	79.00	66.00	-32.40	-38.24
3	0.21400	9.81	30.81	12.52	40.62	22.33	79.00	66.00	-38.38	-43.67
4	0.27800	9.83	24.21	6.68	34.04	16.51	79.00	66.00	-44.96	-49.49
5	3.05000	10.01	15.12	7.31	25.13	17.32	73.00	60.00	-47.87	-42.68
6	6.16200	10.08	15.15	9.05	25.23	19.13	73.00	60.00	-47.77	-40.87

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

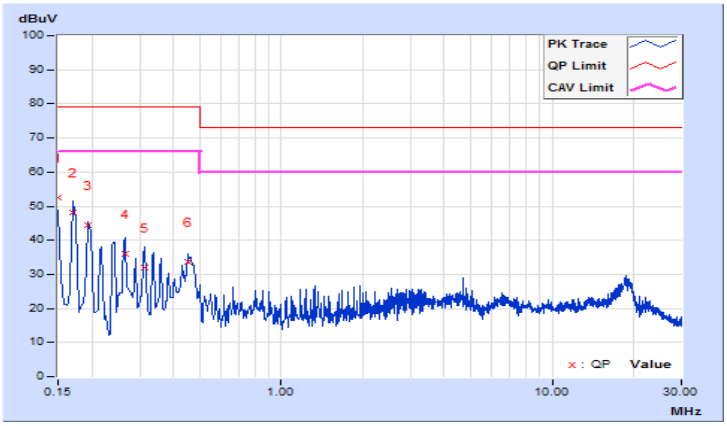


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25℃, 75%RH
Tested by	Rolan Zheng	Test Date	2020/6/22

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	**0.15000**	**9.82**	**42.77**	**22.96**	**52.59**	**32.78**	**79.00**	**66.00**	**-26.41**	**-33.22**
2	0.17000	9.82	38.20	18.29	48.02	28.11	79.00	66.00	-30.98	-37.89
3	0.19400	9.81	34.54	15.49	44.35	25.30	79.00	66.00	-34.65	-40.70
4	0.26569	9.84	26.14	11.64	35.98	21.48	79.00	66.00	-43.02	-44.52
5	0.31365	9.86	22.19	6.83	32.05	16.69	79.00	66.00	-46.95	-49.31
6	0.45400	9.90	23.67	15.82	33.57	25.72	79.00	66.00	-45.43	-40.28

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value



6 Radiated Emissions up to 1 GHz

6.1 Limits

Emissions radiated outside of the specified bands, shall be according to the general radiated limits as following:

Radiated Emissions Limits at 10 meters (dBμV/m)				
Frequencies (MHz)	FCC 15B / ICES-003, Class A	FCC 15B / ICES-003, Class B	CISPR 22, Class A	CISPR 22, Class B
30-88	39	29.5	40	30
88-216	43.5	33.1		
216-230	46.4	35.6		
230-960			47	37
960-1000	49.5	43.5		

Radiated Emissions Limits at 3 meters (dBμV/m)				
Frequencies (MHz)	FCC 15B / ICES-003, Class A	FCC 15B / ICES-003, Class B	CISPR 22, Class A	CISPR 22, Class B
30-88	49.5	40	50.5	40.5
88-216	54	43.5		
216-230	56.9	46		
230-960			57.5	47.5
960-1000	60	54		

Notes:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. QP detector shall be applied if not specified.

6.2 Test Instruments

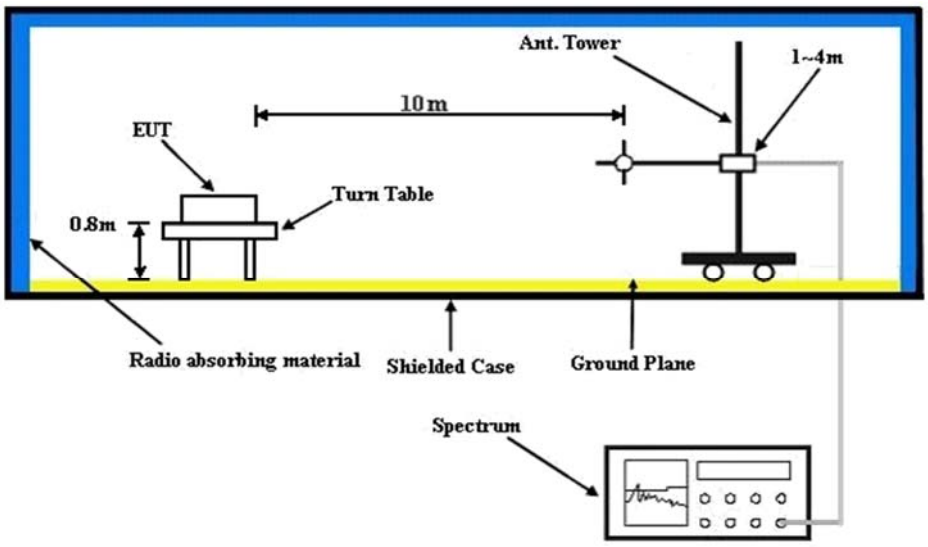
Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ (V)	ESR	101240	Oct. 31, 2019	Oct. 30, 2020
Test Receiver ROHDE & SCHWARZ (H)	ESR	101264	Apr. 16, 2020	Apr. 15, 2021
BILOG Antenna SCHWARZBECK (V)	VULB9168	9168-148	Nov. 08, 2019	Nov. 07, 2020
BILOG Antenna SCHWARZBECK (H)	VULB9168	9168-156	Nov. 08, 2019	Nov. 07, 2020
Preamplifier Sonoma (V)	310N	352924	Jun. 08, 2020	Jun. 07, 2021
Preamplifier Sonoma (H)	310N	352923	Jun. 08, 2020	Jun. 07, 2021
RF signal cable (with 5dB PAD) Times (V)	LMR-600 (18M) +LMR-400 (7M)	CABLE-CH1 (VER) -01	Sep. 05, 2019	Sep. 04, 2020
RF signal cable (with 5dB PAD) Times (H)	LMR-600 (11.8M) +LMR-400 (7M)	CABLE-CH1 (HOR) -01	Sep. 05, 2019	Sep. 04, 2020
Software BV ADT	BV ADT_Radiated_ V8.7.08	NA	NA	NA
Antenna Tower (V)	MFA-440	9707	NA	NA
Antenna Tower (H)	MFA-440	970705	NA	NA
Turn Table	DS430	50303	NA	NA
Controller (V)	MF7802	074	NA	NA
Controller (H)	MF7802	08093	NA	NA

Note:
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 1.
3. The VCCI Site Registration No. is R-11893

6.3 Test Arrangement

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at an accredited test facility. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is up to 1 GHz.

Note: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for quasi-peak detection (QP) at frequency up to 1GHz.



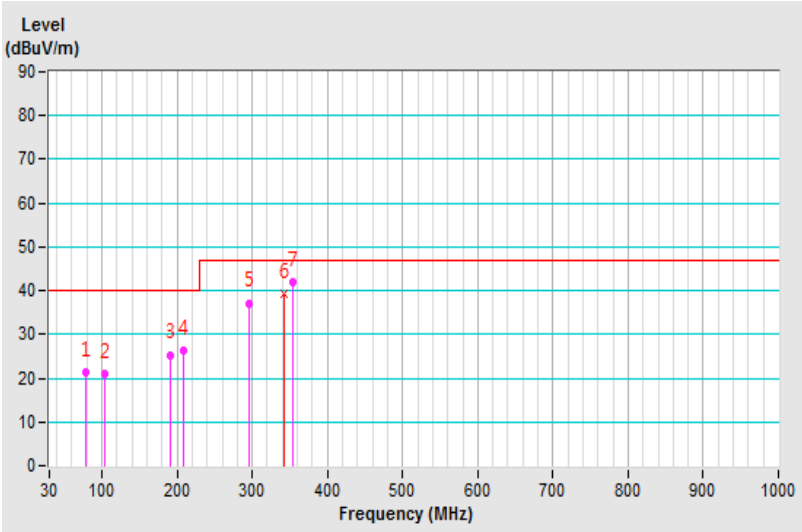
6.4 Test Results

Frequency Range	30MHz ~ 1GHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	120Vac, 60Hz	Environmental Conditions	20℃, 62%RH
Tested by	Daniel Lin	Test Date	2020/6/23

Antenna Polarity & Test Distance : Horizontal at 10 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	77.77	21.41 QP	40.00	-18.59	2.00 H	34	38.53	-17.12
2	103.00	20.97 QP	40.00	-19.03	4.00 H	103	38.26	-17.29
3	191.17	25.32 QP	40.00	-14.68	4.00 H	34	41.20	-15.88
4	207.81	26.37 QP	40.00	-13.63	4.00 H	34	42.63	-16.26
5	294.97	37.14 QP	47.00	-9.86	3.50 H	105	49.82	-12.68
6	341.77	39.34 QP	47.00	-7.66	3.00 H	302	51.04	-11.70
7	**354.82**	**42.07 QP**	**47.00**	**-4.93**	**3.00 H**	**53**	**53.47**	**-11.40**

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

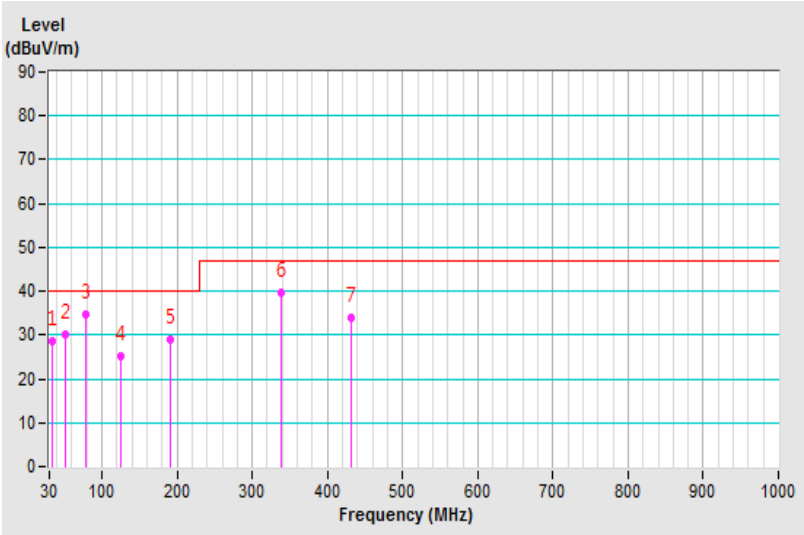


Frequency Range	30MHz ~ 1GHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	120Vac, 60Hz	Environmental Conditions	20℃, 62%RH
Tested by	Daniel Lin	Test Date	2020/6/23

Antenna Polarity & Test Distance : Vertical at 10 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	34.46	28.54 QP	40.00	-11.46	1.00 V	212	43.46	-14.92
2	51.44	29.97 QP	40.00	-10.03	1.50 V	317	43.49	-13.52
3	78.55	34.79 QP	40.00	-5.21	2.50 V	29	52.44	-17.65
4	124.97	25.12 QP	40.00	-14.88	3.00 V	261	40.59	-15.47
5	191.13	29.12 QP	40.00	-10.88	1.00 V	76	45.42	-16.30
6	339.40	39.56 QP	47.00	-7.44	1.00 V	331	51.66	-12.10
7	432.33	33.98 QP	47.00	-13.02	1.00 V	166	43.62	-9.64

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value



7 Radiated Emissions above 1 GHz

7.1 Limits

Emissions radiated outside of the specified bands, shall be according to the general radiated limits as following:

Radiated Emissions Limits at 10 meters (dBμV/m)				
Frequencies (MHz)	FCC 15B / ICES-003, Class A	FCC 15B / ICES-003, Class B	CISPR 22, Class A	CISPR 22, Class B
1000-3000	Avg: 49.5 Peak: 69.5	Avg: 43.5 Peak: 63.5	Not defined	Not defined
Above 3000			Not defined	Not defined

Radiated Emissions Limits at 3 meters (dBμV/m)				
Frequencies (MHz)	FCC 15B / ICES-003, Class A	FCC 15B / ICES-003, Class B	CISPR 22, Class A	CISPR 22, Class B
1000-3000	Avg: 60 Peak: 80	Avg: 54 Peak: 74	Avg: 56 Peak: 76	Avg: 50 Peak: 70
Above 3000			Avg: 60 Peak: 80	Avg: 54 Peak: 74

Notes:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

Radiated Emissions Limits at 1.5 meter (dBμV/m)		
Frequencies (MHz)	FCC 15B / ICES-003, Class A	FCC 15B / ICES-003, Class B
18000-40000	Avg: 66 Peak: 86	Avg: 60 Peak: 80

Note: Limit@1.5m = Limit@3m + 20log(3/1.5)

Frequency Range (For unintentional radiators)

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
Above 1000	5th harmonic of the highest frequency or 40GHz, whichever is lower

7.2 Test Instruments

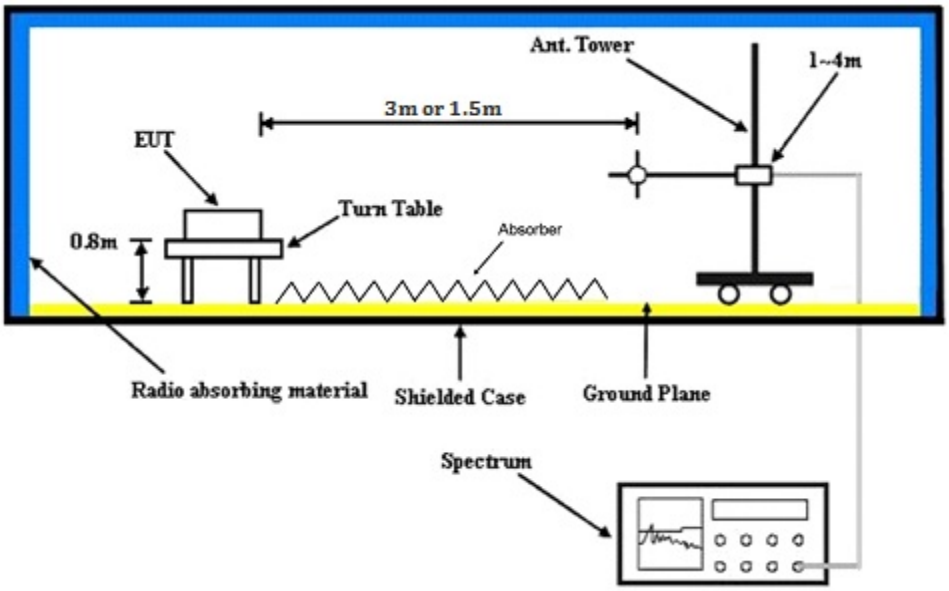
Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ (Above 1GHz)	ESR7	101471	Mar. 11, 2020	Mar. 10, 2021
Spectrum Analyzer Agilent	E4446A	MY51100039	Sep. 05, 2019	Sep. 04, 2020
BILOG Antenna SCHWARZBECK	VULB9168	9168-149	Nov. 07, 2019	Nov. 06, 2020
RF signal cable (with 5dB PAD) Times	LMR-400 (18M)	CABLE-CH2-01	Mar. 23, 2020	Mar. 22, 2021
HORN Antenna (with 4dB PAD) SCHWARZBECK	BBHA 9120 D	9120D-405	Nov. 24, 2019	Nov. 23, 2020
Pre-Amplifier Agilent (Above 1GHz)	8449B	3008A01961	Sep. 05, 2019	Sep. 04, 2020
Software BV ADT	BV ADT_Radiated_ V8.7.08	NA	NA	NA
Antenna Tower BV ADT	AT100	AT93021702	NA	NA
Turn Table BV ADT	TT100	TT93021702	NA	NA
Controller BV ADT	SC100	SC93021702	NA	NA
RF Coaxial Cable EMCI	EMC102-KM-KM-1000	170819	Oct. 08, 2019	Oct. 07, 2020
RF Coaxial Cable Rosnol	K1K50-UP0279- K1K50-3000	181129-1	Oct. 08, 2019	Oct. 07, 2020
RF Coaxial Cable JUNFLON+EMC	JUNFLON+EMC104- SM-SM-6000	Cable-CH2- 02(MWX3221308 G003+130710)	Jan. 18, 2020	Jan. 17, 2021
Fix tool for Boresight antenna	BAF-01	2	NA	NA
Pre-amplifier (18GHz-40GHz) EMC	EMC184045B	980175	Sep. 05, 2019	Sep. 04, 2020
HORN Antenna (with 3dB PAD) SCHWARZBECK	BBHA 9170	148	Nov. 24, 2019	Nov. 23, 2020

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 2. (966 Chamber 1)
3. The VCCI Site Registration No. is G-10018.

7.3 Test Arrangement

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at an accredited chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b. For frequency range 1GHz ~ 18GHz, the EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. For frequency range 18GHz ~ 40GHz, the EUT was set 1.5 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
d. The height of antenna can be varied from one meter to four meters, the height of adjustment depends on the EUT height and the antenna 3dB beamwidth both, to detect the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
f. The spectrum analyzer system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.

Note: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection (PK) at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz for Average detection (AV) at frequency above 1GHz.



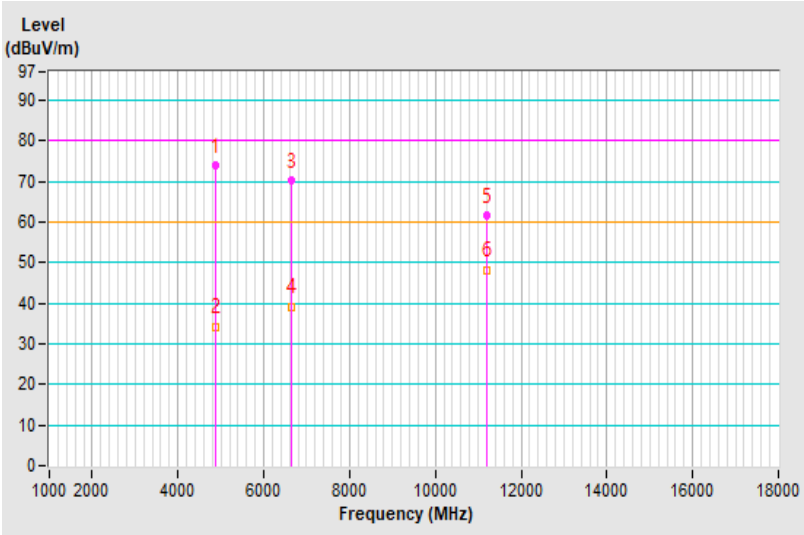
7.4 Test Results

Frequency Range	1GHz ~ 18GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	120Vac, 60Hz	Environmental Conditions	27℃, 61%RH
Tested by	Kai Chu	Test Date	2020/6/22

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	**4864.29**	**74.09 PK**	**80.00**	**-5.91**	**1.96 H**	**351**	**66.76**	**7.33**
2	4864.29	34.32 AV	60.00	-25.68	1.96 H	351	26.99	7.33
3	6629.36	70.08 PK	80.00	-9.92	1.00 H	161	56.64	13.44
4	6629.36	39.21 AV	60.00	-20.79	1.00 H	161	25.77	13.44
5	11198.50	61.57 PK	80.00	-18.43	1.36 H	354	38.84	22.73
6	11198.50	48.28 AV	60.00	-11.72	1.36 H	354	25.55	22.73

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

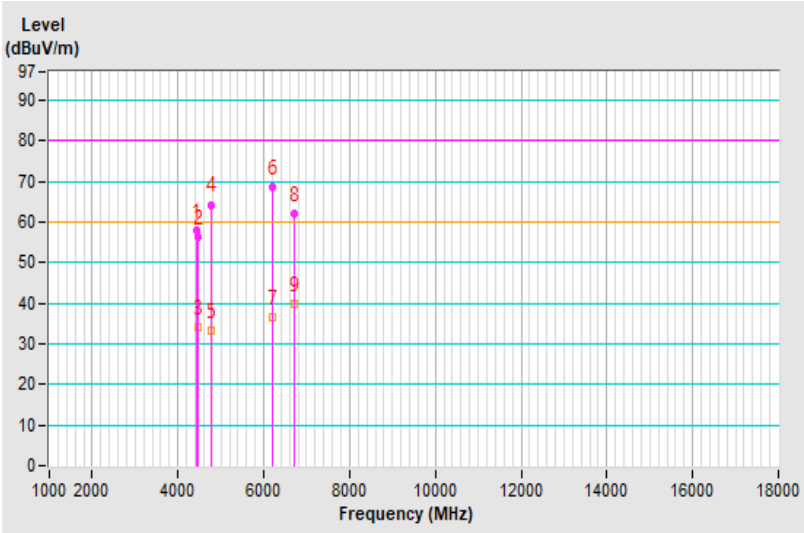


Frequency Range	1GHz ~ 18GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	120Vac, 60Hz	Environmental Conditions	27℃, 61%RH
Tested by	Kai Chu	Test Date	2020/6/22

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4449.40	57.87 PK	80.00	-22.13	1.00 V	58	51.24	6.63
2	4452.86	56.43 PK	80.00	-23.57	1.00 V	59	49.80	6.63
3	4452.86	34.13 AV	60.00	-25.87	1.00 V	59	27.50	6.63
4	4761.07	64.27 PK	80.00	-15.73	1.91 V	214	57.21	7.06
5	4761.07	33.34 AV	60.00	-26.66	1.91 V	214	26.28	7.06
6	6198.92	68.67 PK	80.00	-11.33	1.88 V	108	58.24	10.43
7	6198.92	36.69 AV	60.00	-23.31	1.88 V	108	26.26	10.43
8	6723.56	62.11 PK	80.00	-17.89	1.58 V	37	49.18	12.93
9	6723.56	39.77 AV	60.00	-20.23	1.58 V	37	26.84	12.93

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

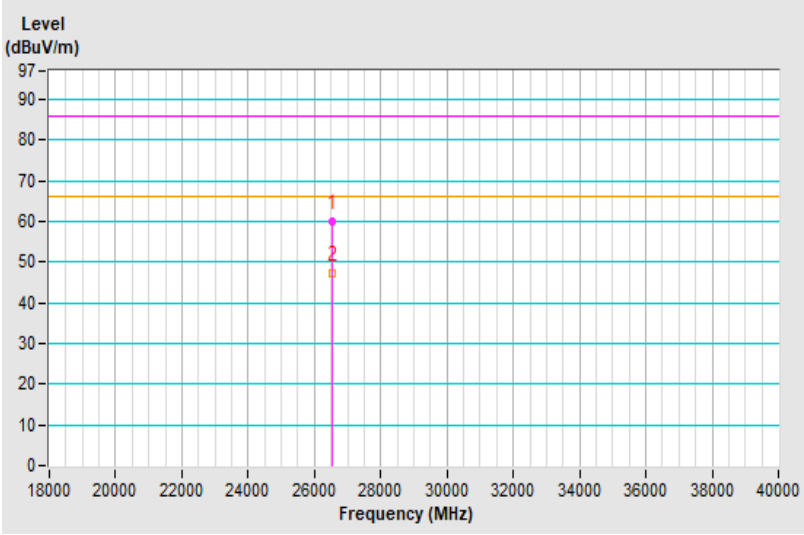


Frequency Range	18GHz ~ 40GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	120Vac, 60Hz	Environmental Conditions	27℃, 61%RH
Tested by	Kai Chu	Test Date	2020/6/22

Antenna Polarity & Test Distance : Horizontal at 1.5 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	26557.38	60.03 PK	86.00	-25.97	1.88 H	7	52.27	7.76
2	26557.38	47.10 AV	66.00	-18.90	1.88 H	7	39.34	7.76

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

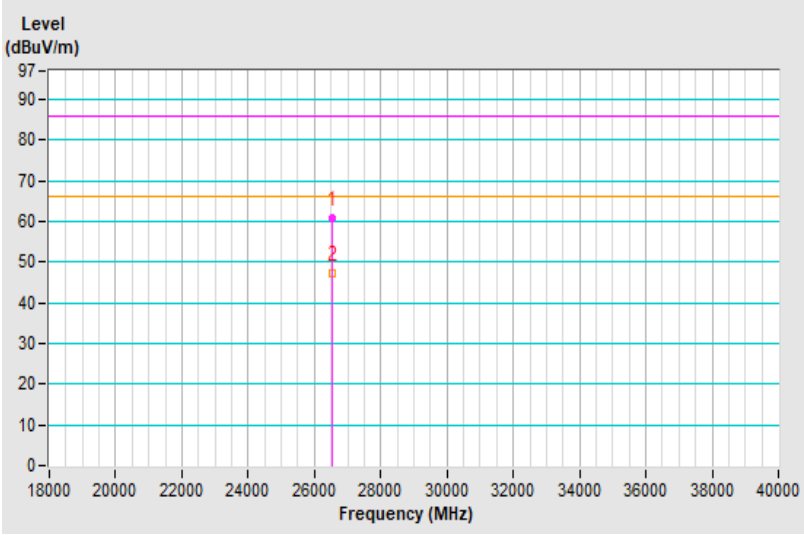


Frequency Range	18GHz ~ 40GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	120Vac, 60Hz	Environmental Conditions	27℃, 61%RH
Tested by	Kai Chu	Test Date	2020/6/22

Antenna Polarity & Test Distance : Vertical at 1.5 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	26523.15	60.67 PK	86.00	-25.33	1.40 V	350	52.90	7.77
2	26523.15	47.32 AV	66.00	-18.68	1.40 V	350	39.55	7.77

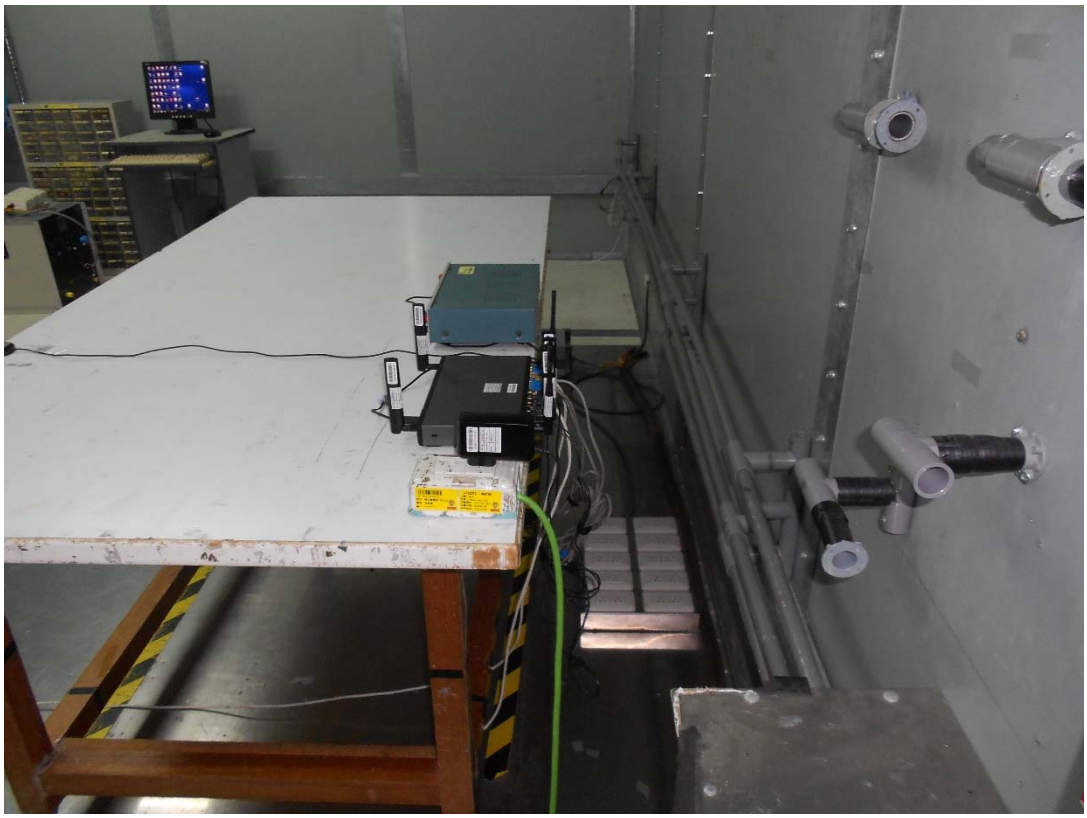
Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

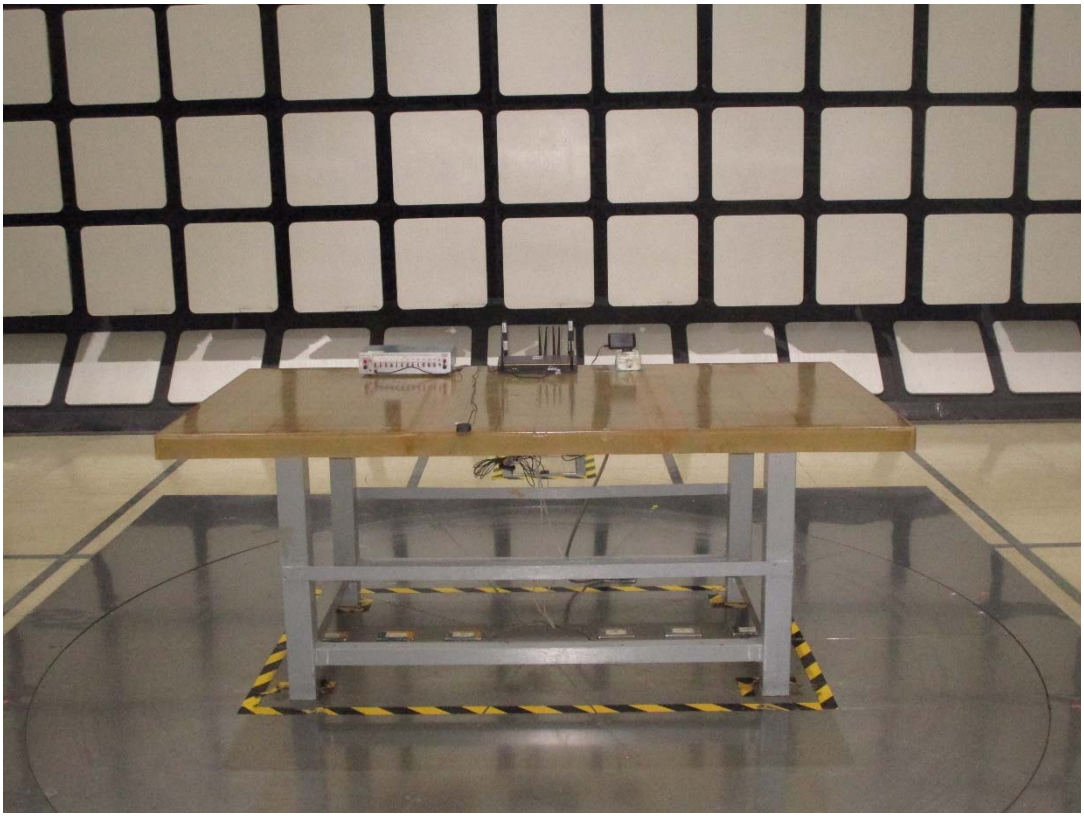


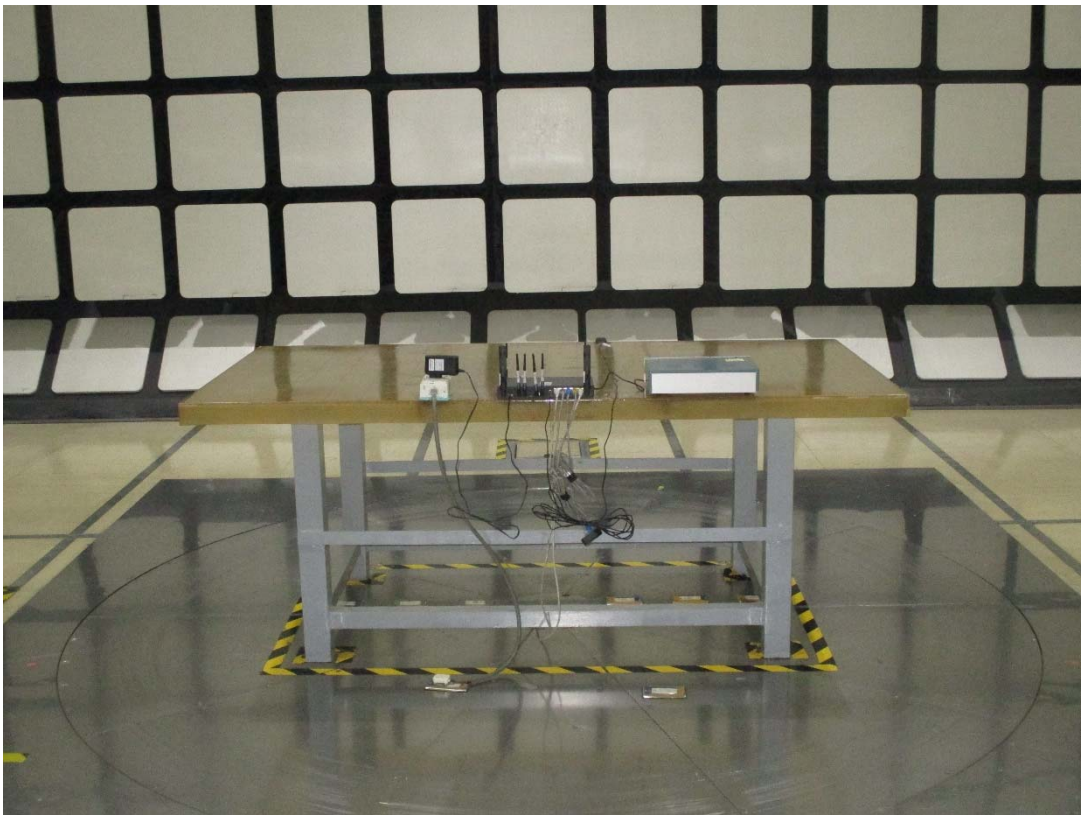
8 Pictures of Test Arrangements

8.1 Conducted Emissions at Mains Ports

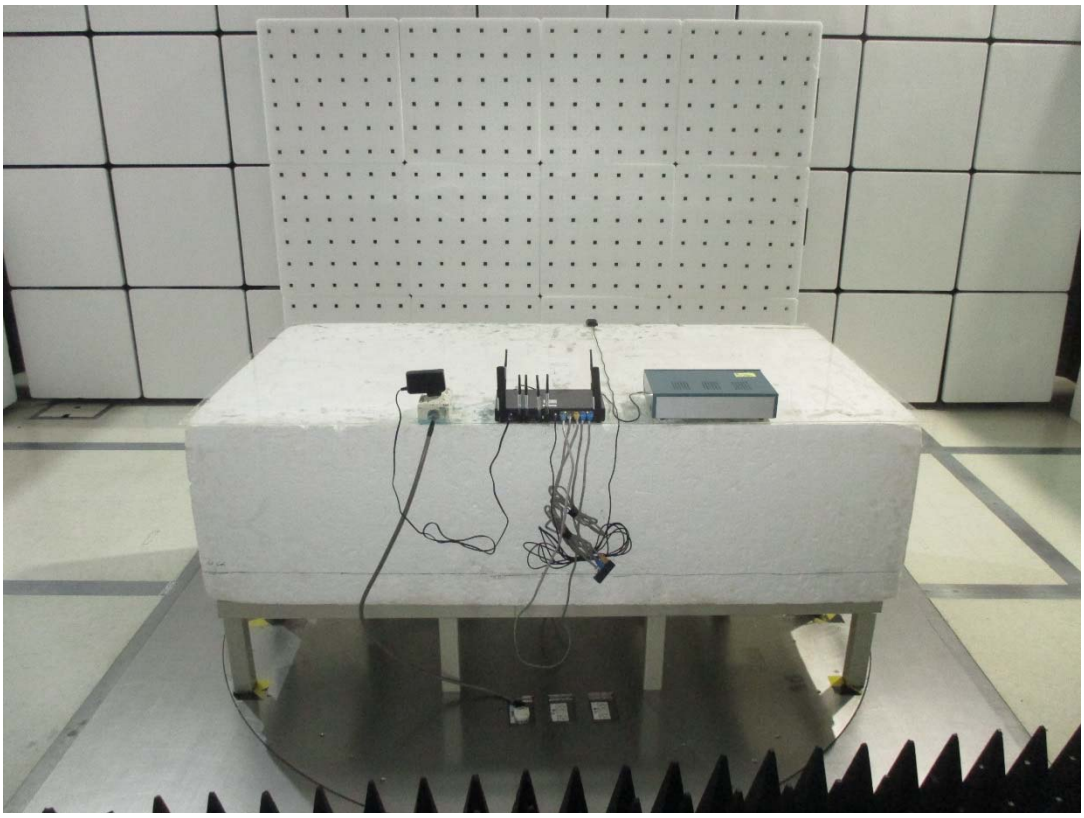


8.2 Radiated Emissions up to 1 GHz





8.3 Radiated Emissions above 1 GHz



Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

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