EMC Test Report

Report No.: RM180620D13

Test Model: Calliope Mini

Received Date: Jun. 20, 2018

Test Date: Jul. 4 ~ 10, 2018 & Sep. 27 ~ Oct. 2, 2018

Issued Date: Oct. 4, 2018

Applicant: Calliope gGmbH

Address: Raumerstraße 11; 10437 Berlin

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

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan (R.O.C.)

Certificate #4327.01

Table of Contents

Release Control Record

Issue No.	Description	Date Issued
RM180620D13	Original release.	Oct. 4, 2018

1 Certificate of Conformity

Product:	Calliope Mini
Brand:	Calliope gGmbh
Test Model:	Calliope Mini
Sample Status:	Engineering Sample
Applicant:	Calliope gGmbH
Test Date:	Jul. 4 ~ 10, 2018 & Sep. 27 ~ Oct. 2, 2018
Standards:	**EN 301 489-1 V2.1.1 (2017-02)**
	EN 301 489-17 V3.1.1 (2017-02)
	EN 55032:2015 + AC: 2016, Class B
	EN 61000-3-2:2014 (Not Applicable)
	EN 61000-3-3:2013 (Not Applicable)
	EN 61000-4-2:2009
	EN 61000-4-3:2006 +A1:2008 +A2:2010
	EN 61000-4-4:2012 (Not Applicable)
	EN 61000-4-5:2014 (Not Applicable)
	EN 61000-4-6:2014
	EN 61000-4-11:2004 (Not Applicable)

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 RF characteristics under the conditions specified in this report.

Prepared by : Jessica Cheng , **Date:** Oct. 4, 2018

Jessica Cheng / Senior Specialist

Approved by : Jim Hsiang , **Date:** Oct. 4, 2018

Jim Hsiang / Associate Technical Manager

2 Summary of Test Results

EN 301 489-1 V2.1.1 (2017-02) / EN 301 489-17 V3.1.1 (2017-02), Emission				
Basic Standard	Phenomenon	Application	Result/Remarks	Verdict
EN 55032:2015 + AC: 2016	Radiated emission 30-1000 MHz	Enclosure of ancillary equipment measured on a stand alone basis	Minimum passing Class B margin is -4.88 dB at 52.54 MH	Pass
	Radiated emission 1-6 GHz		Minimum passing Class B margin is -18.33 dB at 5939.87 MHz	Pass
EN 55032:2015 + AC: 2016	Conducted emission 150 kHz - 30 MHz	DC power input/output ports (fixed)	Minimum passing Class B margin is -22.60 dB at 0.47062 MHz	Pass
	Conducted emission 150 kHz - 30 MHz	DC power input ports (vehicular)	Test not applicable because port does not exist.	N/A
EN 55032:2015 + AC: 2016	Conducted emission 150 kHz - 30 MHz	AC mains input/output ports	Minimum passing Class B margin is -9.79 dB at 0.47412 MH	Pass
EN 61000-3-2:2014	Harmonic current emissions	AC mains input port	Test not applicable because the port does not exists.	N/A
EN 61000-3-3:2013	Voltage fluctuations and flicker	AC mains input port	Test not applicable because the port does not exists	N/A
EN 55032:2015 + AC: 2016	Conducted disturbance 150 kHz - 30 MHz	Wired network ports	Without telecom port of the EUT	N/A

EN 301 489-1 V2.1.1 (2017-02) / EN 301 489-17 V3.1.1 (2017-02), Immunity				
Basic Standard	Phenomenon	Application	Result/Remarks	Verdict
EN 61000-4-3:2006 +A1:2008 +A2:2010	RF Electromagnetic Field (80 MHz to 6000 MHz) (RS)	Enclosure	Performance Criterion A	Pass
EN 61000-4-2:2009	Electrostatic Discharges (ESD)	Enclosure	Performance Criterion A	Pass
EN 61000-4-4:2012	Fast Transients Common Mode (EFT)	Signal, Wired networks and control ports, DC and AC power ports	EUT's cable length is not greater than 3m and EUT consumes DC power.	N/A
EN 61000-4-6:2014	RF Common Mode 150 kHz to 80 MHz (CS)	Signal, Wired networks and control ports, DC and AC power ports	EUT's cable length is not greater than 3m and EUT consumes DC power	N/A
ISO 7637-2:2011	Transients and Surges	DC power input ports (Vehicular)	Test not applicable because not intend for vehicular use.	N/A
EN 61000-4-11:2004	Voltage Dips and Interruptions	AC mains power input ports	Test not applicable because port does not exist.	N/A
EN 61000-4-5:2014	Surges	AC mains power input ports, Signal and Wired network ports	Test not applicable because port does not exist.	N/A

Note:
1. There is no deviation to the applied test methods and requirements covered by the scope of this report.
2. The above EN basic standards are applied with latest version if customer has no special requirement.
3. N/A: Not Applicable

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Expended Uncertainty (k=2) (±)	Maximum allowable uncertainty (±)
Conducted disturbance at mains port using AMN, 150kHz ~ 30MHz	2.79 dB	3.4 dB (U_{cispr})
Radiated disturbance, 30MHz ~ 1GHz	3.97 dB	6.3 dB (U_{cispr})
Radiated disturbance, 1GHz ~ 6GHz	5.08 dB	5.2 dB (U_{cispr})

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Calliope Mini
Brand	Calliope gGmbh
Test Model	Calliope Mini
Sample Status	Engineering Sample
Operating Software	N/A
Power Supply Rating	3Vdc from Battery holder, 5Vdc from from USB interface
Accessory Device	Battery holder
Data Cable Supplied	USB cable (0.15m)

Note: The EUT with Bluetooth technology.

3.2 Features of EUT

The tests reported herein were performed according to the method specified by Calliope gGmbH, 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

1. The EUT was pre-tested under operating and standby condition and the worst emission level was found under **operating condition**.

2. The EUT has been pre-tested under following test modes, and test **mode 1** was the worst case for final test.

Test Mode	Test Condition
1	Normal mode + BT Link+ power from adapter
2	Normal mode + BT Link+ power from Notebook

3. Test modes are presented in the report as below.

Mode	Test Condition	Input Power
Conducted emission test		
1	Normal mode + BT Link	3Vdc
2	Normal mode + BT Link+ power from adapter	230Vac / 50Hz (Adapter)
Radiated emission test		
1	Normal mode + BT Link	3Vdc
2	Normal mode + BT Link+ power from adapter	230Vac / 50Hz (Adapter)
RS test		
1	Normal mode + BT Link	3Vdc
2	Normal mode + BT Link+ power from adapter	230Vac / 50Hz (Adapter)
ESD test		
1	Normal mode + BT Link ***As client's request, the EUT only tested "Indirect Discharge", the more reason and detail will be put in the User's Manual.***	3Vdc
2	Normal mode + BT Link+ power from adapter ***As client's request, the EUT only tested "Indirect Discharge", the more reason and detail will be put in the User's Manual.***	230Vac / 50Hz (Adapter)

3.4 Test Program Used and Operation Descriptions

Mode 1:

a. Connect the battery box to EUT.
b. Turned on the power of all equipment.
c. Tablet link EUT via Bluetooth.
d. Tablet received messages from EUT.

Mode 2:

a. Connect the adapter to EUT.
b. Turned on the power of all equipment.
c. Tablet link EUT via Bluetooth.
d. Tablet received messages from EUT.

3.5 Primary Clock Frequencies of Internal Source

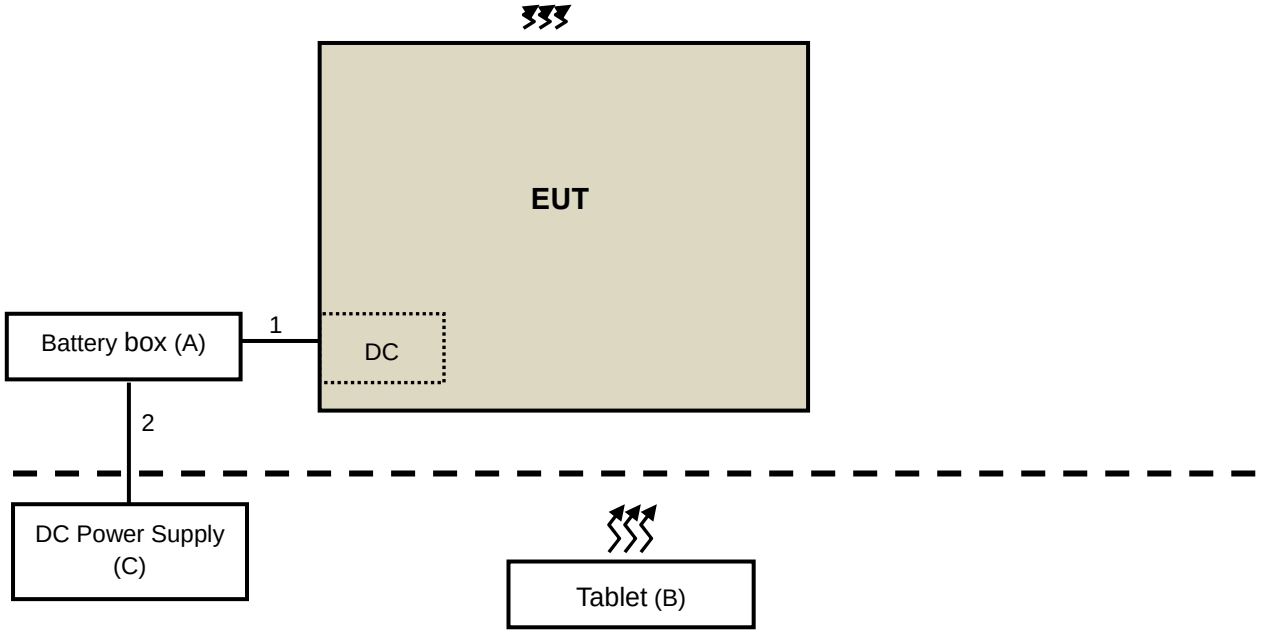
The highest frequency generated or used within the EUT or on which the EUT operates or tunes is 2.5GHz, provided by Calliope gGmbH, for detailed internal source, please refer to the manufacturer's specifications.

4 Configuration and Connections with EUT

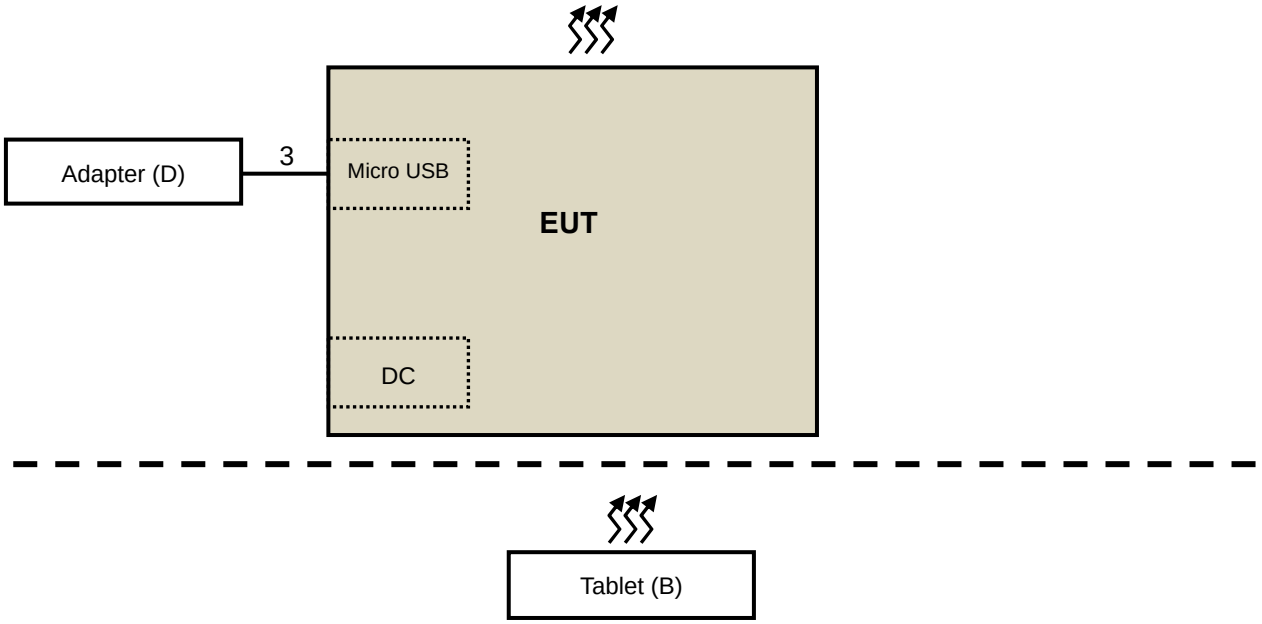
4.1 Connection Diagram of EUT and Peripheral Devices

Emission tests:

Mode 1:

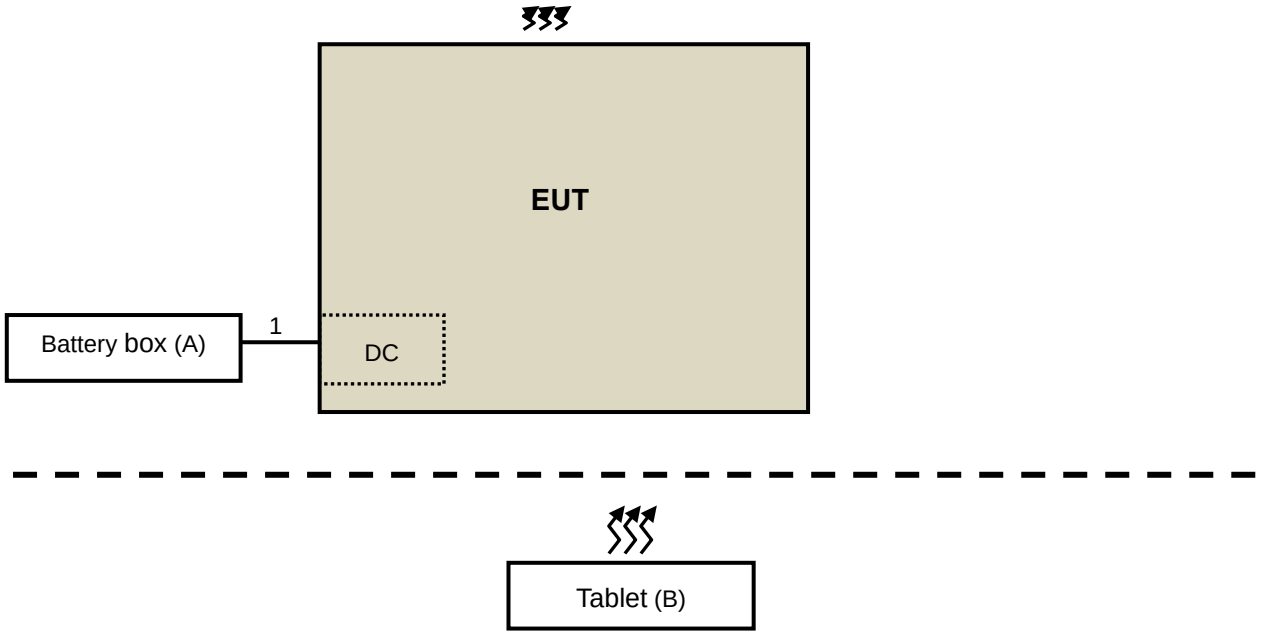


Mode 2:

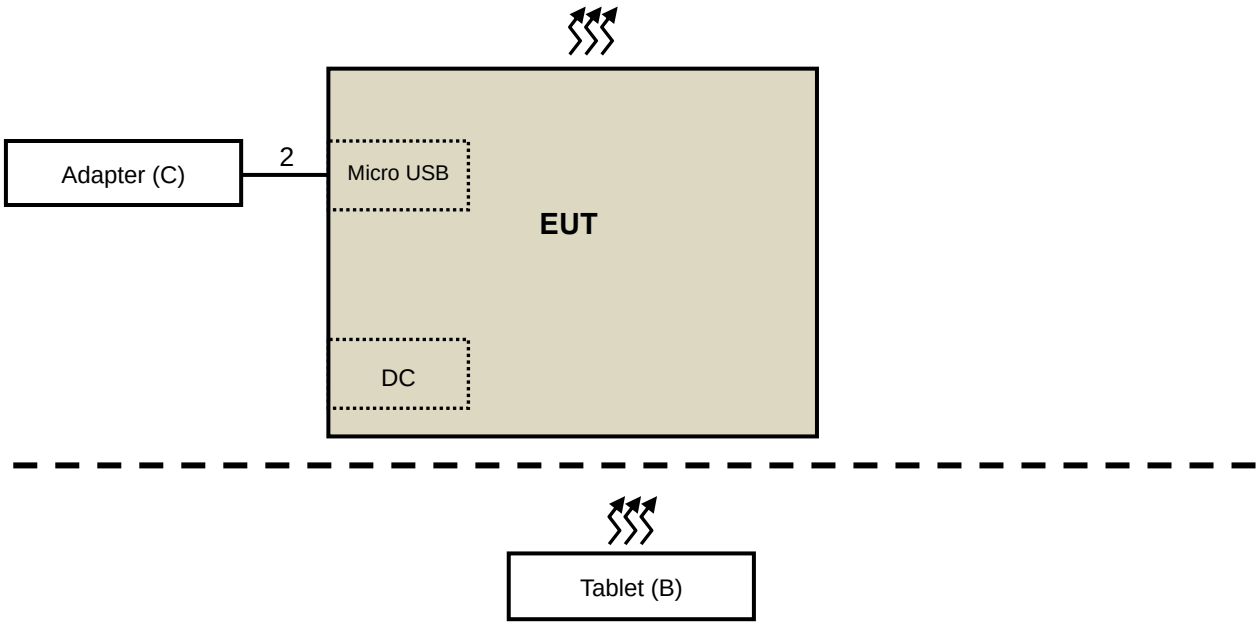


Immunity tests:

Mode 1:



Mode 2:



4.2 Configuration of Peripheral Devices and Cable Connections

Emission tests:

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Battery Box	N/A	N/A	N/A	N/A	Supplied by client
B.	Tablet	ASUS	K00R(ME572CL)	N/A	N/A	Provided by Lab
C.	DC Power Supply	hila	DP6010	1616AP051502087	N/A	Provided by Lab
D.	Adapter	HTC	TC U250	N/A	N/A	Provided by Lab

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item B acted as communication partners to transfer data.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	DC cable	1	0.1	N	0	Supplied by client
2.	DC cable	2	1.5	N	0	Provided by Lab
3.	USB cable	1	0.15	Y	0	Supplied by client

Note: The core(s) is(are) originally attached to the cable(s).

Immunity tests:

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Battery Box	N/A	N/A	N/A	N/A	Supplied by client
B.	Tablet	ASUS	MEMO PAD 7	N/A	N/A	Provided by Lab
C.	Adapter	Lenovo	ADL40WLG	N/A	N/A	Provided by Lab

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item B acted as communication partners to transfer data.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	DC cable	1	0.2	N	0	Supplied by client
2.	USB cable	1	0.15	Y	0	Supplied by client

Note: The core(s) is(are) originally attached to the cable(s).

5 Conducted Emission from the AC Mains Power Port

5.1 Limits

Frequency range (MHz)	Coupling device	Detector type / bandwidth	Class A limits (dBuV)
0.15 - 0.5	AMN	Quasi-peak / 9kHz	79
0.5 - 30.0			73
0.15 - 0.5		Average / 9kHz	66
0.5 - 30.0			60

Frequency range (MHz)	Coupling device	Detector type / bandwidth	Class B limits (dBuV)
0.15 - 0.5	AMN	Quasi-peak / 9kHz	66 - 56
0.5 - 5			56
5 - 30.0			60
0.15 - 0.5		Average / 9kHz	56 - 46
0.5 - 5			46
5 - 30.0			50

5.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
ROHDE & SCHWARZ TEST RECEIVER	ESR3	102413	Feb. 8, 2018	Feb. 7, 2019
ROHDE & SCHWARZ Artificial Mains Network (for EUT)	ESH2-Z5	100104	Dec. 6, 2017	Dec. 5, 2018
LISN With Adapter (for EUT)	AD10	C09Ada-001	Dec. 6, 2017	Dec. 5, 2018
ROHDE & SCHWARZ Artificial Mains Network (for peripherals)	ESH3-Z5	847265/023	Nov. 3, 2017	Nov. 2, 2018
SCHWARZBECK Artificial Mains Network (For EUT)	NNLK8129	8129229	May 3, 2018	May 2, 2019
Software	Cond_V7.3.7.4	NA	NA	NA
RF cable (JYEBAO) With 10dB PAD	5D-FB	Cable-C09.01	Feb. 21, 2018	Feb. 20, 2019
SUHNER Terminator (For ROHDE & SCHWARZ LISN)	65BNC-5001	E1-010789	May 8, 2018	May 7, 2019

Notes: 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 Shielded Room No. 9.
3. The VCCI Site Registration No. C-1312.
4. Tested Date: Jul. 4 ~ Sep. 27, 2018

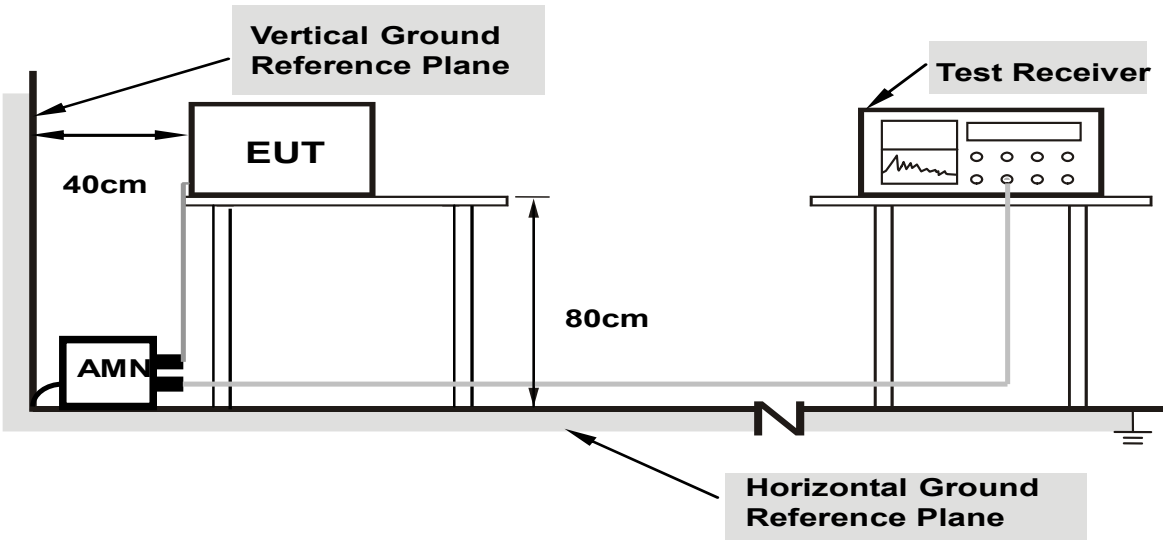
5.3 Test Arrangement

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 an Artificial Mains Network (AMN). Other support units were connected to the power mains through another AMN. The two AMNs 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 AMN.
2. The distance specified between EUT/AE and other metallic objects is ≥ 0.8 m in the measurement arrangement for table-top EUT.
3. Cable on the RGP must to be insulated.

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

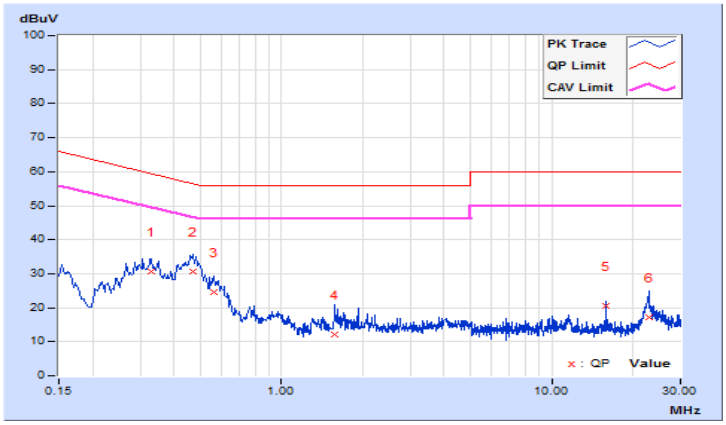
5.4 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	3Vdc	Environmental Conditions	28℃, 68%RH, 992mbar
Tested by	Steven Lin		
Test Mode	Mode 1		

Phase Of Power : Positive (+)										
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	0.32986	10.04	20.62	15.19	30.66	25.23	59.45	49.45	-28.79	-24.22
2	**0.47062**	**10.05**	**20.46**	**13.85**	**30.51**	**23.90**	**56.50**	**46.50**	**-25.99**	**-22.60**
3	0.56256	10.06	14.61	8.71	24.67	18.77	56.00	46.00	-31.33	-27.23
4	1.57916	10.14	1.94	1.31	12.08	11.45	56.00	46.00	-43.92	-34.55
5	15.98159	10.46	10.19	9.33	20.65	19.79	60.00	50.00	-39.35	-30.21
6	22.89216	10.58	6.44	2.09	17.02	12.67	60.00	50.00	-42.98	-37.33

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

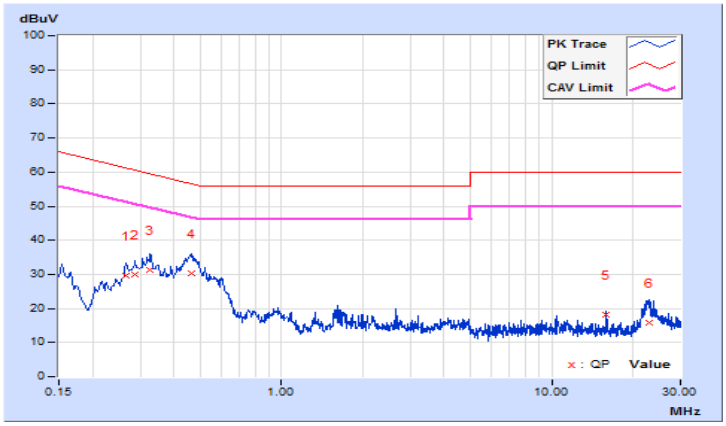


Frequency Range	150kHz ~ 30MHz	**Detector Function & Bandwidth**	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	3Vdc	**Environmental Conditions**	28℃, 68%RH, 992mbar
Tested by	Steven Lin		
Test Mode	Mode 1		

Phase Of Power : Negative (-)										
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	0.26695	10.05	19.56	12.29	29.61	22.34	61.21	51.21	-31.60	-28.87
2	0.28663	10.05	20.07	14.14	30.12	24.19	60.62	50.62	-30.50	-26.43
3	0.32595	10.05	21.41	15.73	31.46	25.78	59.55	49.55	-28.09	-23.77
4	0.46280	10.07	20.25	13.24	30.32	23.31	56.64	46.64	-26.32	-23.33
5	15.98710	10.53	7.60	6.64	18.13	17.17	60.00	50.00	-41.87	-32.83
6	23.08766	10.67	5.20	1.22	15.87	11.89	60.00	50.00	-44.13	-38.11

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

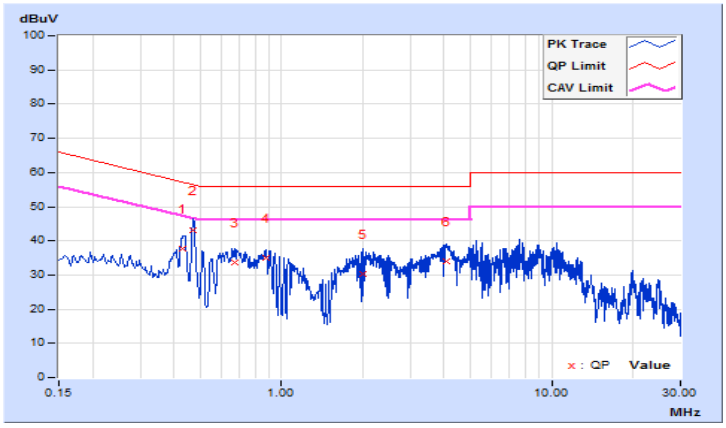


Frequency Range	150kHz ~ 30MHz	**Detector Function & Bandwidth**	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	230Vac, 50Hz	**Environmental Conditions**	24℃, 72%RH, 1001mbar
Tested by	Harvey Wu		
Test Mode	Mode 2		

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	0.43235	10.23	27.54	18.72	37.77	28.95	57.21	47.21	-19.44	-18.26
2	0.47038	10.24	32.95	25.59	43.19	35.83	56.51	46.51	-13.32	-10.68
3	0.66780	10.28	23.48	12.12	33.76	22.40	56.00	46.00	-22.24	-23.60
4	0.87536	10.32	24.78	15.57	35.10	25.89	56.00	46.00	-20.90	-20.11
5	2.01317	10.45	19.76	6.22	30.21	16.67	56.00	46.00	-25.79	-29.33
6	4.08547	10.63	23.48	12.76	34.11	23.39	56.00	46.00	-21.89	-22.61

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

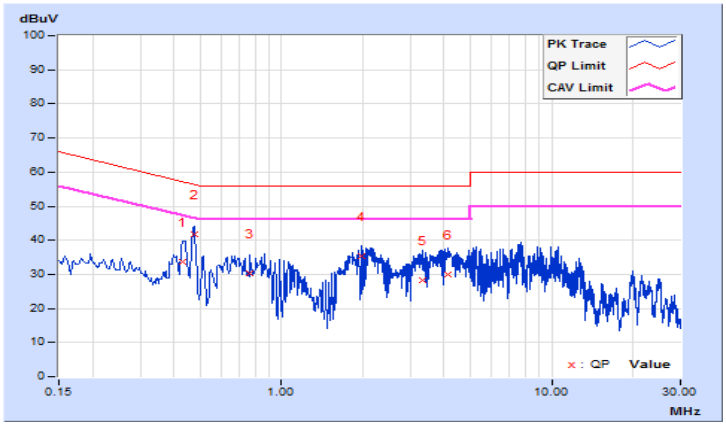


Frequency Range	150kHz ~ 30MHz	**Detector Function & Bandwidth**	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	230Vac, 50Hz	**Environmental Conditions**	24℃, 72%RH, 1001mbar
Tested by	Harvey Wu		
Test Mode	Mode 2		

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	0.43121	10.22	23.61	14.91	33.83	25.13	57.23	47.23	-23.40	-22.10
2	**0.47412**	**10.23**	**31.66**	**26.42**	**41.89**	**36.65**	**56.44**	**46.44**	**-14.55**	**-9.79**
3	0.76586	10.31	20.13	11.86	30.44	22.17	56.00	46.00	-25.56	-23.83
4	1.97016	10.48	24.92	15.45	35.40	25.93	56.00	46.00	-20.60	-20.07
5	3.31129	10.61	17.81	5.49	28.42	16.10	56.00	46.00	-27.58	-29.90
6	4.11284	10.68	19.16	4.77	29.84	15.45	56.00	46.00	-26.16	-30.55

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 Emission at Frequencies up to 1GHz

6.1 Limits

For Class A Equipment

Frequency range (MHz)	Distance (m)	Limits (dBuV/m)
30 - 230	10	40
230 - 1000		47
30 - 230	3	50
230 - 1000		57

For Class B Equipment

Frequency range (MHz)	Distance (m)	Limits (dBuV/m)
30 - 230	10	30
230 - 1000		37
30 - 230	3	40
230 - 1000		47

6.2 Test Instruments

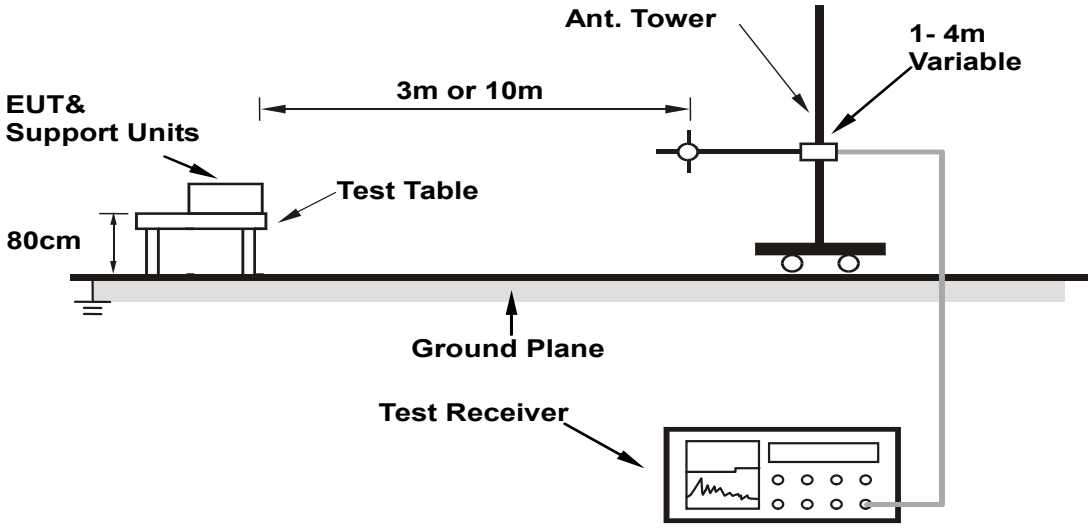
Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
ROHDE & SCHWARZ TEST RECEIVER	ESCS 30	100027	Dec. 4, 2017	Dec. 3, 2018
Schwarzbeck Bilog Antenna	VULB9168	9168-303	Nov. 29, 2017	Nov. 28, 2018
Agilent Preamplifier	8447D	2944A08119	Feb. 21, 2018	Feb. 20, 2019
ADT. Turn Table	TT100	0205	NA	NA
ADT. Tower	AT100	0205	NA	NA
Software	Radiated_V7.6.15.9.5	NA	NA	NA
ADT RF Switches BOX	EMH-011	1001	Oct. 26, 2017	Oct. 25, 2018
Pacific RF cable With 5dB PAD	8D	CABLE-ST2-01	Oct. 26, 2017	Oct. 25, 2018

Notes: 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 Open Site No. 2.
3. The VCCI Site Registration No. R-237.
4. Tested Date: Jul. 5 ~ Oct. 1, 2018

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:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for quasi-peak detection (QP) at frequency up to 1GHz.
2. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and the calibration point of the antenna.



Note: Cable on the RGP must to be insulated.

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

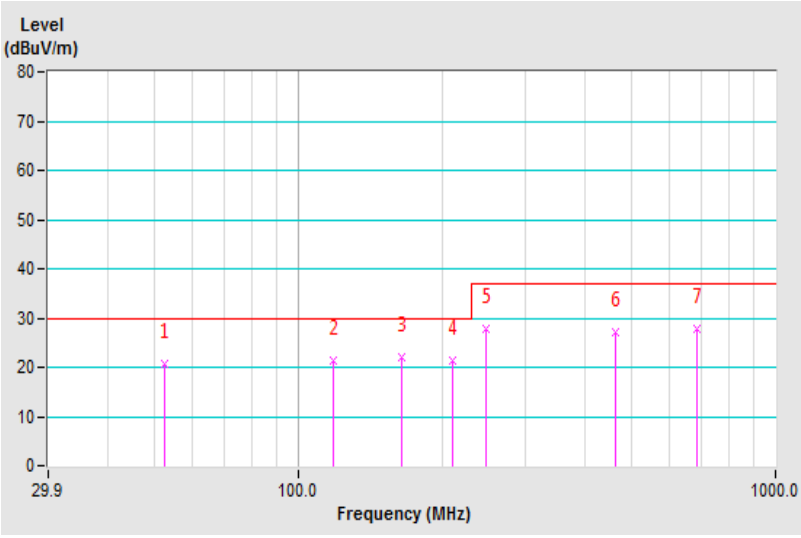
6.4 Test Results

Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	3Vdc	Environmental Conditions	29℃, 62%RH, 993mbar
Tested by	Paul Chen		
Test Mode	Mode 1		

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	52.38	20.68 QP	30.00	-9.32	4.00 H	332	29.51	-8.83
2	118.42	21.33 QP	30.00	-8.67	4.00 H	195	32.68	-11.35
3	164.21	21.93 QP	30.00	-8.07	4.00 H	120	30.89	-8.96
4	210.98	21.19 QP	30.00	-8.81	4.00 H	337	33.44	-12.25
5	247.19	27.96 QP	37.00	-9.04	3.73 H	255	38.33	-10.37
6	460.39	27.18 QP	37.00	-9.82	2.03 H	257	31.85	-4.67
7	685.46	27.74 QP	37.00	-9.26	1.28 H	96	28.29	-0.55

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

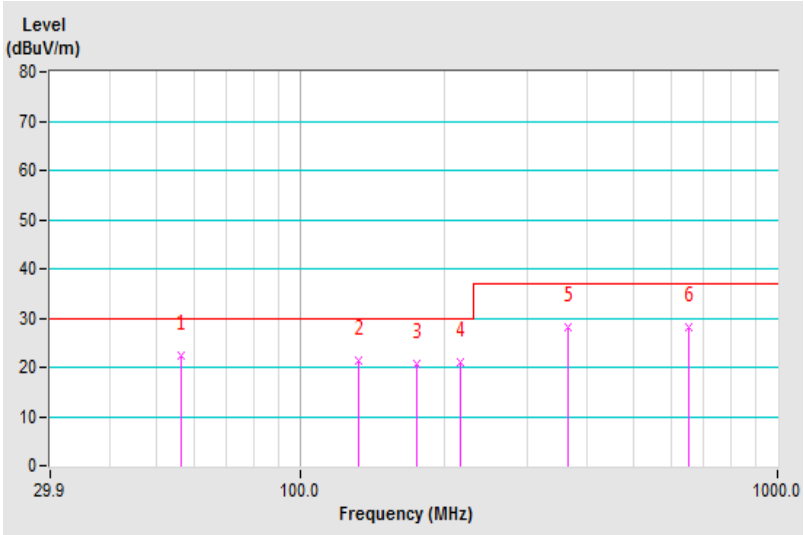


Frequency Range	30MHz ~ 1GHz	**Detector Function & Bandwidth**	Quasi-Peak (QP), 120kHz
Input Power	3Vdc	**Environmental Conditions**	29℃, 62%RH, 993mbar
Tested by	Paul Chen		
Test Mode	Mode 1		

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	56.42	22.28 QP	30.00	-7.72	1.25 V	313	31.42	-9.14
2	132.64	21.19 QP	30.00	-8.81	1.00 V	269	31.10	-9.91
3	174.83	20.75 QP	30.00	-9.25	1.00 V	321	30.46	-9.71
4	216.64	20.85 QP	30.00	-9.15	1.00 V	196	32.93	-12.08
5	364.27	28.19 QP	37.00	-8.81	1.00 V	178	35.04	-6.85
6	649.86	28.10 QP	37.00	-8.90	2.97 V	282	28.95	-0.85

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

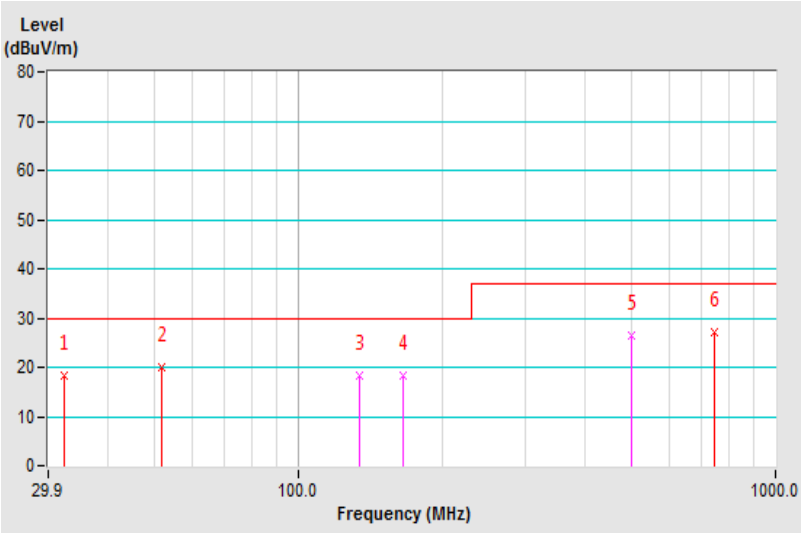


Frequency Range	30MHz ~ 1GHz	**Detector Function & Bandwidth**	Quasi-Peak (QP), 120kHz
Input Power	230Vac, 50Hz	**Environmental Conditions**	24℃, 71%RH, 1005mbar
Tested by	Vhenson Huang		
Test Mode	Mode 2		

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	32.35	18.23 QP	30.00	-11.77	4.00 H	124	28.41	-10.18
2	51.53	19.89 QP	30.00	-10.11	3.85 H	162	28.72	-8.83
3	134.56	18.14 QP	30.00	-11.86	4.00 H	174	27.84	-9.70
4	165.56	18.47 QP	30.00	-11.53	4.00 H	360	27.48	-9.01
5	499.23	26.45 QP	37.00	-10.55	2.25 H	177	30.12	-3.67
6	743.40	27.23 QP	37.00	-9.77	1.08 H	115	26.78	0.45

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

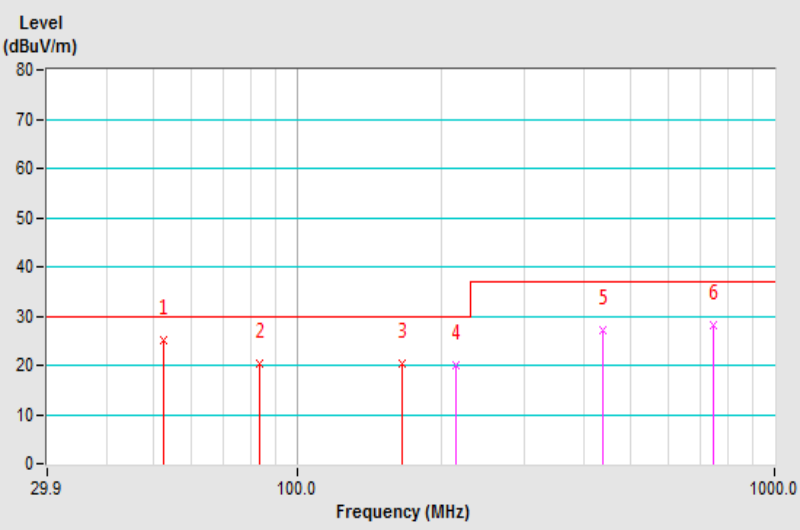


Frequency Range	30MHz ~ 1GHz	**Detector Function & Bandwidth**	Quasi-Peak (QP), 120kHz
Input Power	230Vac, 50Hz	**Environmental Conditions**	24℃, 71%RH, 1005mbar
Tested by	Vhenson Huang		
Test Mode	Mode 2		

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	**52.54**	**25.12 QP**	**30.00**	**-4.88**	**1.60 V**	**152**	**33.95**	**-8.83**
2	83.57	20.45 QP	30.00	-9.55	1.70 V	241	34.85	-14.40
3	165.24	20.45 QP	30.00	-9.55	1.00 V	341	29.44	-8.99
4	215.00	20.15 QP	30.00	-9.85	1.00 V	152	32.25	-12.10
5	435.35	27.15 QP	37.00	-9.85	3.59 V	263	32.21	-5.06
6	745.52	28.15 QP	37.00	-8.85	2.63 V	58	27.65	0.50

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 Emission at Frequencies above 1GHz

7.1 Limits

For Class A Equipment

Frequency range (MHz)	Distance (m)	Detector type	Limits (dBuV/m)
1000 - 3000	3	Average	56
3000 - 6000			60
1000 - 3000		Peak	76
3000 - 6000			80

For Class B Equipment

Frequency range (MHz)	Distance (m)	Detector type	Limits (dBuV/m)
1000 - 3000	3	Average	50
3000 - 6000			54
1000 - 3000		Peak	70
3000 - 6000			74

Required highest frequency for radiated measurement

Highest internal frequency (F_x)	Highest measured frequency
$F_x \leqq$ 108 MHz	1 GHz
108 MHz $<$ $F_x \leqq$ 500 MHz	2 GHz
500 MHz $<$ $F_x \leqq$ 1 GHz	5 GHz
$F_x >$ 1 GHz	5 x F_x up to a maximum of 6 GHz

NOTE 1 For FM and TV broadcast receivers, F_x is determined from the highest frequency generated or used excluding the local oscillator and tuned frequencies.

NOTE 2 F_x is highest fundamental frequency generated or used within the EUT or highest frequency at which it operates.

Where F_x is unknown, the radiated emission measurements shall be performed up to 6 GHz.

7.2 Test Instruments

Mode 1:

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Agilent Spectrum	E4446A	MY51100009	Jun. 4, 2018	Jun. 3, 2019
Agilent Test Receiver	N9038A	MY51210137	Jun. 19, 2018	Jun. 18, 2019
Agilent Preamplifier	8449B	3008A01292	Feb. 22, 2018	Feb. 21, 2019
MITEQ Preamplifier	AMF-6F-260400-33-8P	892164	Feb. 21, 2018	Feb. 20, 2019
EMCI Preamplifier	EMC184045B	980235	Feb. 22, 2018	Feb. 21, 2019
Schwarzbeck Horn Antenna	BBHA-9170	212	Dec. 1, 2017	Nov. 30, 2018
EMCO Horn Antenna	3115	6714	Dec. 12, 2017	Dec. 11, 2018
Max Full. Turn Table	MF7802	MF780208216	NA	NA
Software	Radiated_V8.7.08	NA	NA	NA
SUHNER RF cable With 3/4dB PAD	SF102	Cable-CH10-3.6m	Aug. 14, 2017	Aug. 13, 2018
MICRO-TRONICS Notch filter	BRC50703-01	010	May 31, 2018	May 30, 2019
MICRO-TRONICS Band Pass Filter	BRM17690	005	May 31, 2018	May 30, 2019

Notes: 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 3dB beamwidth of the horn antenna is minimum 41degree (or w = 2.24m at 3m distance) for 1~6 GHz.
3. The test was performed in Chamber No. 10.
4. The Industry Canada Reference No. IC 7450E-11.
5. The VCCI Site Registration No. G-10427
6. Tested Date: Jul. 5, 2018

Mode 2:

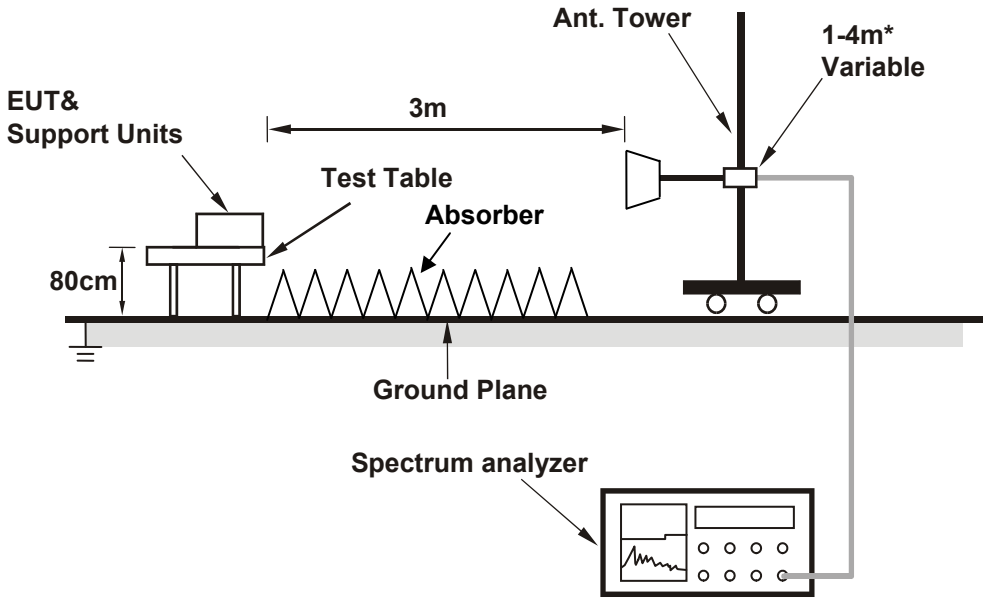
Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Agilent Spectrum	E4446A	MY51100009	Jun. 4, 2018	Jun. 3, 2019
Agilent Test Receiver	N9038A	MY51210137	Jun. 19, 2018	Jun. 18, 2019
Agilent Preamplifier	8449B	3008A01292	Feb. 22, 2018	Feb. 21, 2019
MITEQ Preamplifier	AMF-6F-260400-33-8P	892164	Feb. 21, 2018	Feb. 20, 2019
EMCI Preamplifier	EMC184045B	980235	Feb. 22, 2018	Feb. 21, 2019
Schwarzbeck Horn Antenna	BBHA-9170	212	Dec. 1, 2017	Nov. 30, 2018
EMCO Horn Antenna	3115	6714	Dec. 12, 2017	Dec. 11, 2018
Max Full. Turn Table	MF7802	MF780208216	NA	NA
Software	Radiated_V8.7.08	NA	NA	NA
SUHNER RF cable With 3/4dB PAD	SF102	Cable-CH10-3.6m	Aug. 13, 2018	Aug. 12, 2019
MICRO-TRONICS Notch filter	BRC50703-01	010	May 31, 2018	May 30, 2019
MICRO-TRONICS Band Pass Filter	BRM17690	005	May 31, 2018	May 30, 2019

Notes: 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 Chamber No. 10.
3. The Industry Canada Reference No. IC 7450E-11.
4. The VCCI Site Registration No. G-10427
5. Tested Date: Sep. 28, 2018

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. 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. 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.
d. 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.
e. 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:
1. 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.
2. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and the calibration point of the antenna.



Note: Cable on the RGP must to be insulated.

* :depends on the EUT height and the antenna 3dB beamwidth both.

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

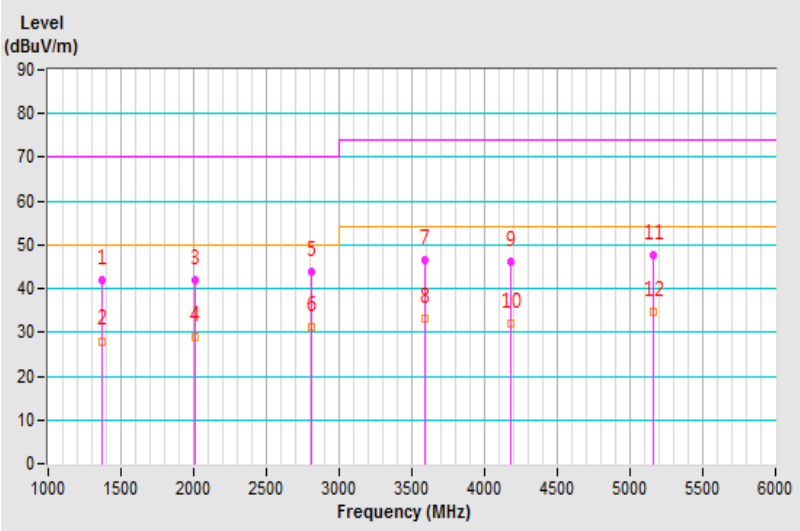
7.4 Test Results

Frequency Range	1GHz ~ 6GHz	Detector Function & Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	3Vdc	Environmental Conditions	25℃, 75%RH, 993mbar
Tested by	Vhenson Huang		
Test Mode	Mode 1		

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	1368.00	41.86 PK	70.00	-28.14	1.11 H	238	46.27	-4.41
2	1368.00	28.01 AV	50.00	-21.99	1.11 H	238	32.42	-4.41
3	2009.87	42.07 PK	70.00	-27.93	1.00 H	360	44.49	-2.42
4	2009.87	28.96 AV	50.00	-21.04	1.00 H	360	31.38	-2.42
5	2813.12	44.00 PK	70.00	-26.00	2.05 H	235	44.35	-0.35
6	2813.12	31.34 AV	50.00	-18.66	2.05 H	235	31.69	-0.35
7	3590.37	46.55 PK	74.00	-27.45	1.00 H	3	43.86	2.69
8	3590.37	33.29 AV	54.00	-20.71	1.00 H	3	30.60	2.69
9	4183.37	46.14 PK	74.00	-27.86	2.55 H	342	42.52	3.62
10	4183.37	32.15 AV	54.00	-21.85	2.55 H	342	28.53	3.62
11	5161.87	47.75 PK	74.00	-26.25	1.00 H	87	42.25	5.50
12	5161.87	34.61 AV	54.00	-19.39	1.00 H	87	29.11	5.50

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

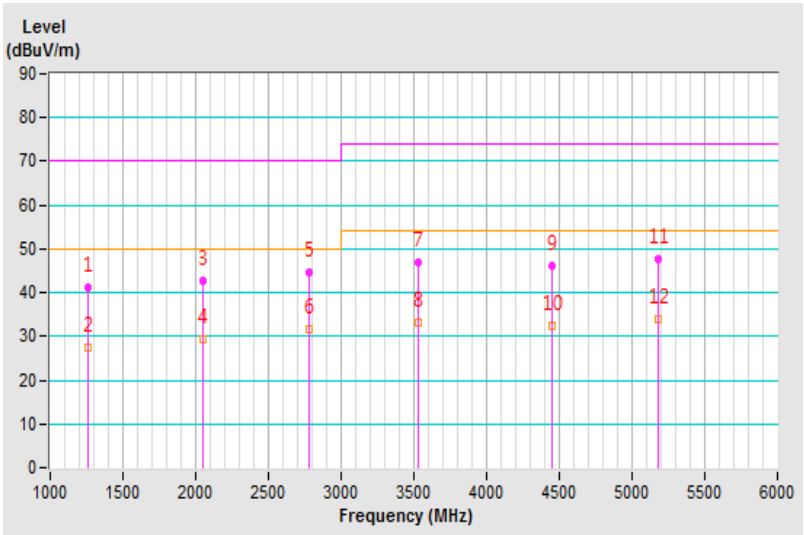


Frequency Range	1GHz ~ 6GHz	**Detector Function & Bandwidth**	Peak (PK) / Average (AV), 1MHz
Input Power	3Vdc	**Environmental Conditions**	25℃, 75%RH, 993mbar
Tested by	Vhenson Huang		
Test Mode	Mode 1		

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	1259.50	41.13 PK	70.00	-28.87	1.71 V	112	46.05	-4.92
2	1259.50	27.38 AV	50.00	-22.62	1.71 V	112	32.30	-4.92
3	2053.37	42.63 PK	70.00	-27.37	1.28 V	264	44.84	-2.21
4	2053.37	29.28 AV	50.00	-20.72	1.28 V	264	31.49	-2.21
5	2784.12	44.65 PK	70.00	-25.35	1.88 V	218	45.09	-0.44
6	2784.12	31.64 AV	50.00	-18.36	1.88 V	218	32.08	-0.44
7	3533.12	46.99 PK	74.00	-27.01	1.00 V	36	44.73	2.26
8	3533.12	32.99 AV	54.00	-21.01	1.00 V	36	30.73	2.26
9	4451.37	46.10 PK	74.00	-27.90	1.43 V	61	42.27	3.83
10	4451.37	32.28 AV	54.00	-21.72	1.43 V	61	28.45	3.83
11	5184.75	47.67 PK	74.00	-26.33	2.47 V	261	42.12	5.55
12	5184.75	33.85 AV	54.00	-20.15	2.47 V	261	28.30	5.55

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

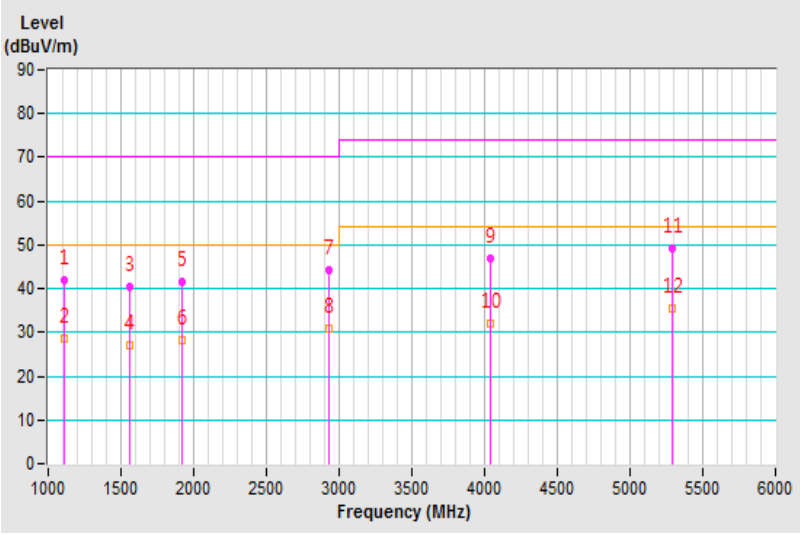


Frequency Range	1GHz ~ 6GHz	**Detector Function & Bandwidth**	Peak (PK) / Average (AV), 1MHz
Input Power	230Vac, 50Hz	**Environmental Conditions**	25℃, 69%RH, 1001mbar
Tested by	Jary Huang		
Test Mode	Mode 2		

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	1108.75	41.78 PK	70.00	-28.22	1.91 H	306	46.48	-4.70
2	1108.75	28.55 AV	50.00	-21.45	1.91 H	306	33.25	-4.70
3	1563.37	40.55 PK	70.00	-29.45	1.42 H	135	45.33	-4.78
4	1563.37	26.94 AV	50.00	-23.06	1.42 H	135	31.72	-4.78
5	1921.37	41.63 PK	70.00	-28.37	2.20 H	360	44.86	-3.23
6	1921.37	28.33 AV	50.00	-21.67	2.20 H	360	31.56	-3.23
7	2930.50	44.16 PK	70.00	-25.84	1.05 H	209	44.36	-0.20
8	2930.50	30.80 AV	50.00	-19.20	1.05 H	209	31.00	-0.20
9	4042.00	46.82 PK	74.00	-27.18	1.67 H	100	42.59	4.23
10	4042.00	32.06 AV	54.00	-21.94	1.67 H	100	27.83	4.23
11	5289.25	49.32 PK	74.00	-24.68	2.00 H	55	42.15	7.17
12	5289.25	35.37 AV	54.00	-18.63	2.00 H	55	28.20	7.17

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

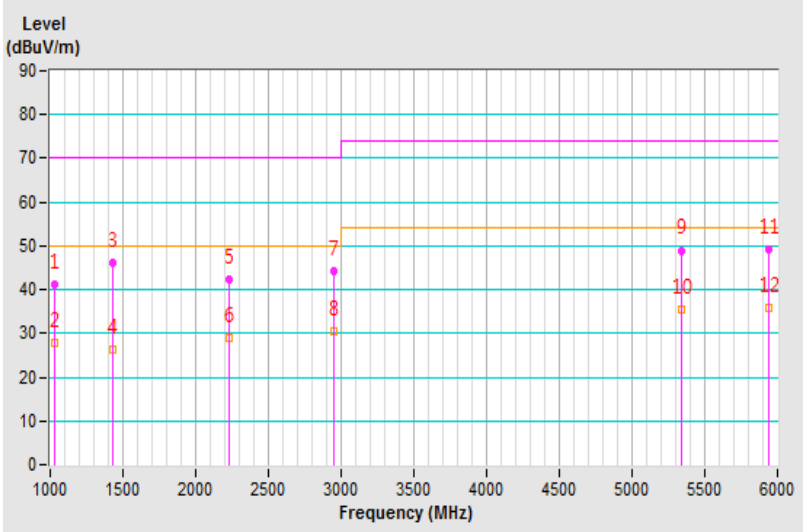


Frequency Range	1GHz ~ 6GHz	**Detector Function & Bandwidth**	Peak (PK) / Average (AV), 1MHz
Input Power	230Vac, 50Hz	**Environmental Conditions**	25℃, 69%RH, 1001mbar
Tested by	Jary Huang		
Test Mode	Mode 2		

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	1033.62	41.26 PK	70.00	-28.74	1.04 V	348	46.86	-5.60
2	1033.62	27.69 AV	50.00	-22.31	1.04 V	348	33.29	-5.60
3	1432.62	46.11 PK	70.00	-23.89	1.33 V	215	51.32	-5.21
4	1432.62	26.46 AV	50.00	-23.54	1.33 V	215	31.67	-5.21
5	2232.12	42.40 PK	70.00	-27.60	1.84 V	86	44.86	-2.46
6	2232.12	28.95 AV	50.00	-21.05	1.84 V	86	31.41	-2.46
7	2953.62	44.06 PK	70.00	-25.94	2.53 V	248	44.12	-0.06
8	2953.62	30.58 AV	50.00	-19.42	2.53 V	248	30.64	-0.06
9	5338.37	48.97 PK	74.00	-25.03	2.11 V	143	41.71	7.26
10	5338.37	35.34 AV	54.00	-18.66	2.11 V	143	28.08	7.26
11	5939.87	49.24 PK	74.00	-24.76	2.00 V	115	41.53	7.71
12	**5939.87**	**35.67 AV**	**54.00**	**-18.33**	**2.00 V**	**115**	**27.96**	**7.71**

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 General Immunity Requirements

EN 301 489-1 V2.1.1 (2017-02) / EN 301 489-17 V3.1.1 (2017-02), Immunity requirements		
Reference standard	Test specification	Performance Criterion
EN 61000-4-2 ESD	Enclosure port: ±8kV Air discharge, ±4kV Contact discharge	B
EN 61000-4-3 RS	Enclosure port: 80% AM (1kHz) 80-6000 MHz, 3V/m	A

8.1 Performance Criteria

General Performance Criteria

- Performance criteria for continuous phenomena applied to transmitters and receivers (CT/CR)

During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.

During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data.

If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

- Performance criteria for transient phenomena applied to transmitters and receivers (TT/TR)

After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.

During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed.

If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

- Performance criteria for equipment which does not provide a continuous communication link

For radio equipment which does not provide a continuous communication link, the performance criteria described in CT/CR and TT/TR are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in CT/CR and TT/TR.

- Performance criteria for ancillary equipment tested on a stand alone basis

If ancillary equipment is intended to be tested on a stand alone basis, the performance criteria described in CT/CR and TT/TR are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in CT/CR and TT/TR.

Product Specific Performance Criteria

The particular performance criteria which are specified in the relevant part of EN 301 489 series dealing with the particular type of radio equipment, take precedence over the corresponding parts of the general performance criteria.

Where particular performance criteria for specific functions are not given, then the general performance criteria shall apply.

EN 301 489-17, Broadband Data Transmission Systems

The performance criteria are:

- performance criteria A for immunity tests with phenomena of a continuous nature (CT/CR);
- performance criteria B for immunity tests with phenomena of a transient nature (TT/TR);
- performance criteria C for immunity tests with power interruptions exceeding a certain time.

Special conditions for EN 301489-17		
Criteria	During test	After test
A	Shall operate as intended. May show degradation of performance (see note1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 2). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.
B	May show loss of function (one or more). May show degradation of performance (see note 1). No unintentional transmissions.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see note 2). Shall be no loss of stored data or user programmable functions.
C	May be loss of function (one or more).	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no degradation of performance (see note 2).

Note 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

Note 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

Note: The BT linking mode is activated and monitoring communication status via Tablet by ping command during and after tests.

9 Electrostatic Discharge Immunity Test (ESD)

9.1 Test Specification

Basic Standard:	EN 61000-4-2
Discharge Impedance:	330 ohm / 150 pF
Discharge Voltage:	Air Discharge: N/A **** As client's request, EUT only tested "Indirect Discharge"***
	Contact Discharge: ±2kV, ±4kV (Indirect)
Number of Discharge:	Minimum 20 times at each test point
Discharge Mode:	Single Discharge
Discharge Period:	1-second minimum

9.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
KeyTek, ESD Simulator	MZ-15/EC	0504259	Oct. 25, 2017	Oct. 24, 2018

Notes: 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 ESD Room No. 1.
3. Tested Date: Jul. 10 ~ Oct. 2, 2018

9.3 Test Arrangement

a. Electrostatic discharges were applied only to those points and surfaces of the EUT that are accessible to users during normal operation.

b. The test was performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.

c. The time interval between two successive single discharges was at least 1 second.

d. The ESD generator was held perpendicularly to the surface to which the discharge was applied and the return cable was at least 0.2 meters from the EUT.

e. Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.

f. Air discharges were applied with the round discharge tip of the discharge electrode approaching the EUT as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator was removed from the EUT and re-triggered for a new single discharge. The test was repeated until all discharges were complete.

g. At least ten single discharges (in the most sensitive polarity) were applied to the **H**orizontal **C**oupling **P**lane at points on each side of the EUT. The ESD generator was positioned at a distance of 0.1 meters from the EUT with the discharge electrode touching the **HCP.**

h. At least ten single discharges (in the most sensitive polarity) were applied to the center of one vertical edge of the **V**ertical **C**oupling **P**lane in sufficiently different positions that the four faces of the EUT were completely illuminated. The **VCP** (dimensions 0.5m x 0.5m) was placed vertically to and 0.1 meters from the EUT.

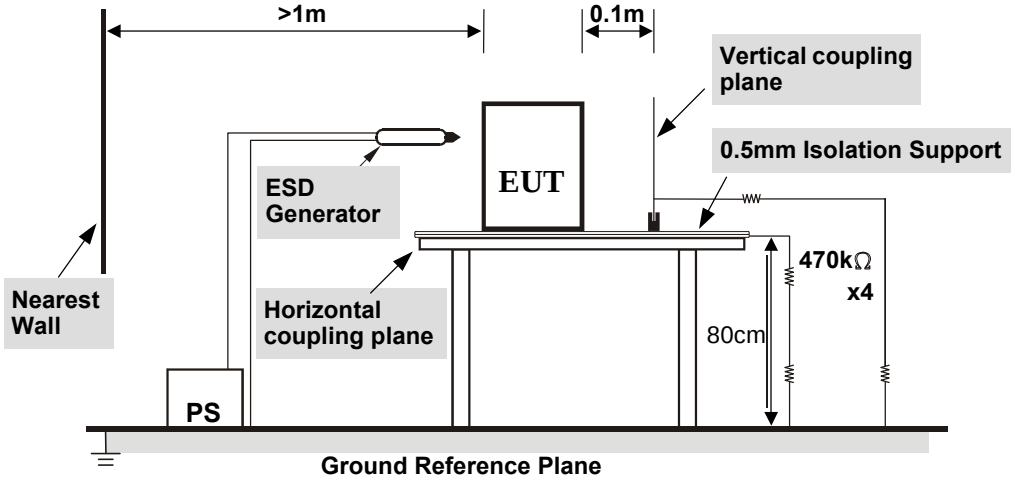


TABLE-TOP EQUIPMENT

The configuration consisted of a wooden table 0.8 meters high standing on the **G**round **R**eference **P**lane. The **GRP** consisted of a sheet of aluminum at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system. A **H**orizontal **C**oupling **P**lane (1.6m x 0.8m) was placed on the table and attached to the **GRP** by means of a cable with 940kΩ total impedance. The equipment under test, was installed in a representative system as described in section 7 of
EN 61000-4-2, and its cables were placed on the **HCP** and isolated by an insulating support of 0.5mm thickness. A distance of 1-meter minimum was provided between the EUT and the walls of the laboratory and any other metallic structure.

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

9.4 Test Results

Test mode	Mode 1	Input Power	3Vdc
Environmental Conditions	27 °C, 46% RH 1008 mbar	Tested by	Thomas Cheng

Test Results of Indirect Application					
Discharge Level (kV)	Polarity (+/-)	Test Point	Horizontal Coupling Plane	Vertical Coupling Plane	Performance Criterion
2, 4	+/-	Four Sides	Note	Note	A

Description of test points of indirect application:

1. Front side 2. Rear side 3. Right side 4. Left side

Note: The EUT function was correct during the test.

As client's request, the EUT only tested "Indirect Discharge", the more reason and detail will be put in the User's Manual.

Test mode	Mode 2	Input Power	230Vac, 50Hz
Environmental Conditions	23 °C, 40% RH 1003 mbar	Tested by	Thomas Cheng

Test Results of Indirect Application					
Discharge Level (kV)	Polarity (+/-)	Test Point	Horizontal Coupling Plane	Vertical Coupling Plane	Performance Criterion
2, 4	+/-	Four Sides	Note	Note	A

Description of test points of indirect application:

1. Front side 2. Rear side 3. Right side 4. Left side

Note: The EUT function was correct during the test.

As client's request, the EUT only tested "Indirect Discharge", the more reason and detail will be put in the User's Manual.

10 Radiated, Radio-frequency, Electromagnetic Field Immunity Test (RS)

10.1 Test Specification

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

10.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Agilent Signal Generator	E8257D	MY48050465	Jun. 6, 2018	Jun. 5, 2019
PRANA RF Amplifier	AP32DP280	0811-894	NA	NA
TESEQ RF Amplifier	CBA1G-150	T44220	NA	NA
AR RF Amplifier	35S4G8AM4	0326094	NA	NA
AR RF Amplifier	100S1G4M3	0329249	NA	NA
AR Controller	SC1000M3	305910	NA	NA
ETS Electric Field Sensor	HI-6105	00217912	Nov. 27, 2017	Nov. 26, 2018
BOONTON RF Voltage Meter	4232A	10180	May 23, 2018	May 22, 2019
BOONTON Power Sensor	51013-4E	34870	Jun. 4, 2018	Jun. 3, 2019
BOONTON Power Sensor	51013-4E	34873	Jun. 4, 2018	Jun. 3, 2019
AR Log-Periodic Antenna	AT6080	0329465	NA	NA
EMCO BiconiLog Antenna	3141	1001	NA	NA
AR High Gain Antenna	AT4010	0329800	NA	NA
Schwarzbeck LOG ANTENNA	Stlp 9149	9149-260	NA	NA
CHANCE MOST Full Anechoic Chamber (9x5x3m)	Chance Most	RS-002	Feb. 6, 2018	Feb. 5, 2019
Software	RS_V7.6	NA	NA	NA

Notes: 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 RS Room No.2.
3. Tested Date: Jul. 9 ~ Oct. 2, 2018

10.3 Test Arrangement

The test procedure was in accordance with EN 61000-4-3.

a. The testing was performed in a fully anechoic chamber.

b. The frequency range is swept from 80 MHz to 6000 MHz, with the signal 80% amplitude modulated with a 1kHz sine wave.

c. The field strength level was 3 V/m.

d. The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.

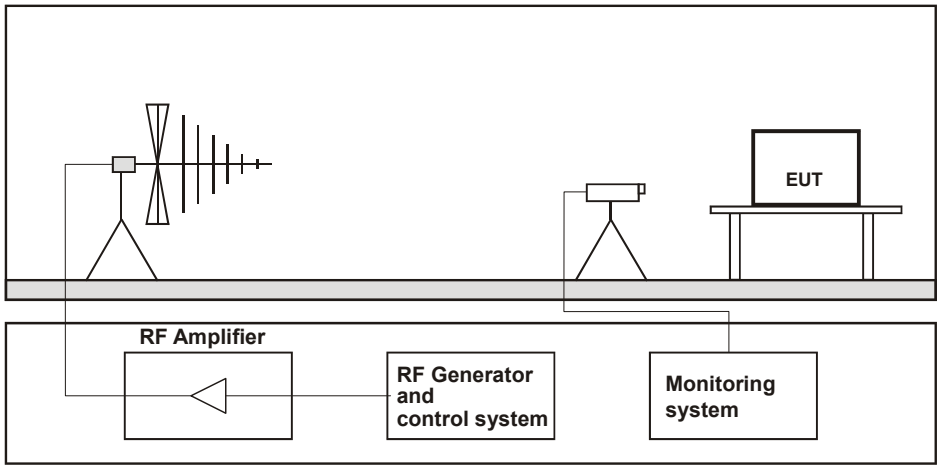


Table-top Equipment

The EUT installed in a representative system as described in section 7 of EN 61000-4-3 was placed on a non-conductive table 0.8 meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

10.4 Test Results

Test mode	Mode 1	Input Power	3Vdc
Environmental Conditions	29 °C, 68% RH	Tested by	Thomas Cheng

Frequency (MHz)	Polarity	Azimuth(°)	Applied Field Strength		Observation	Remarks	Performance Criterion
			(V/m)	Modulation			
80 - 1000	V&H	0, 90, 180, 270	3	80% AM (1kHz)	Note	-	A
1000 - 6000	V&H	0, 90, 180, 270	3	80% AM (1kHz)	Note	-	A

Note: The EUT function was correct during the test.

Test mode	Mode 1	Input Power	230Vac, 50Hz
Environmental Conditions	26 °C, 61% RH	Tested by	Thomas Cheng

Frequency (MHz)	Polarity	Azimuth(°)	Applied Field Strength		Observation	Remarks	Performance Criterion
			(V/m)	Modulation			
80 - 1000	V&H	0, 90, 180, 270	3	80% AM (1kHz)	Note	-	A
1000 - 6000	V&H	0, 90, 180, 270	3	80% AM (1kHz)	Note	-	A

Note: The EUT function was correct during the test.

11 Pictures of Test Arrangements

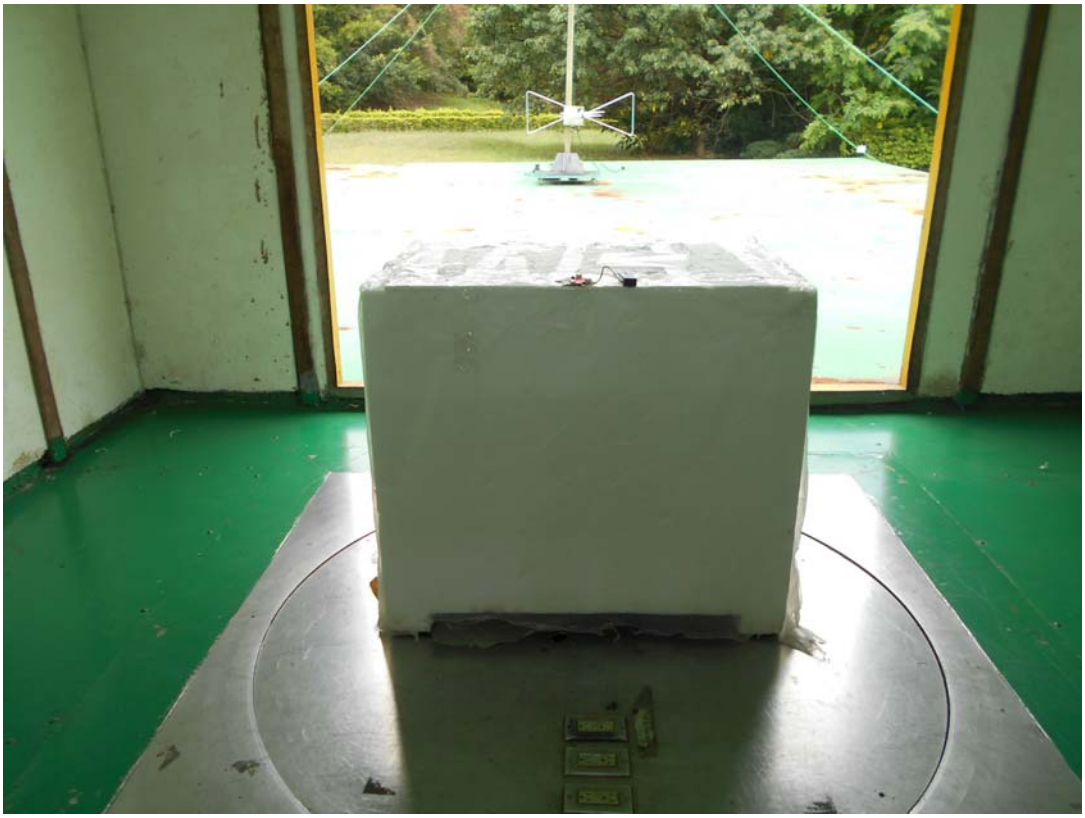
11.1 Conducted Emission from the AC Mains Power Port

Mode 1

Mode 2

11.2 Radiated Emission at Frequencies up to 1GHz

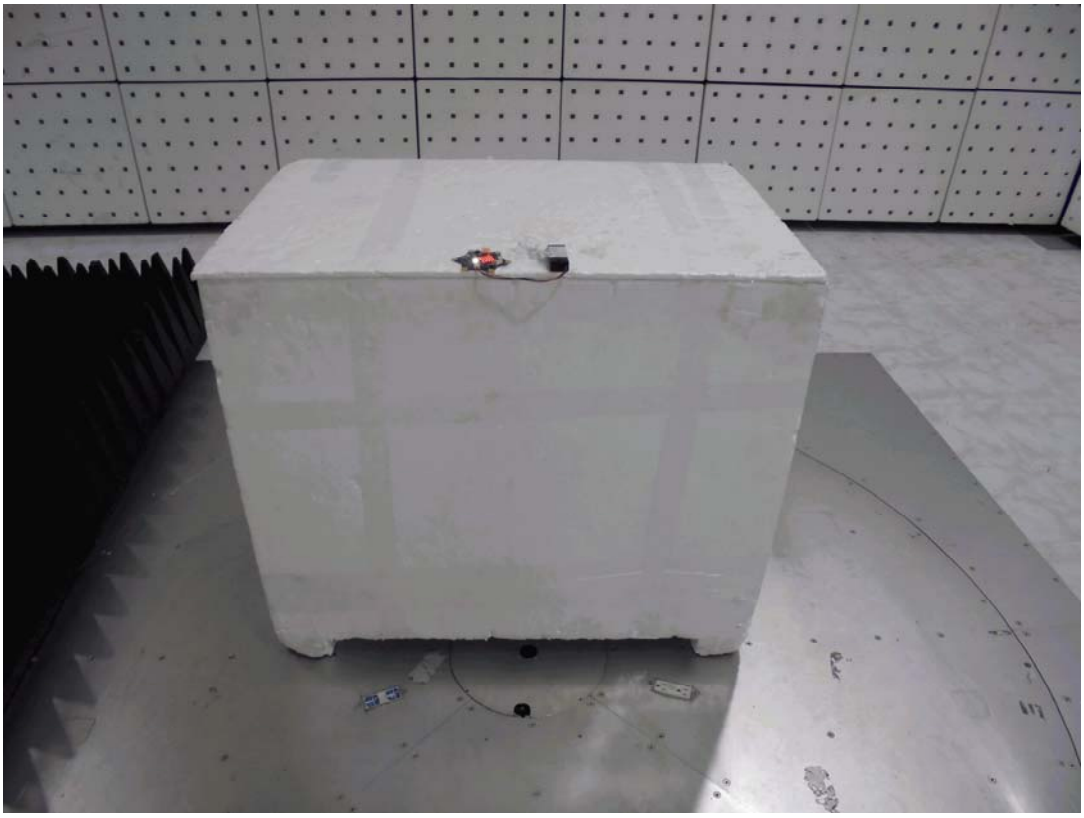
Mode 1



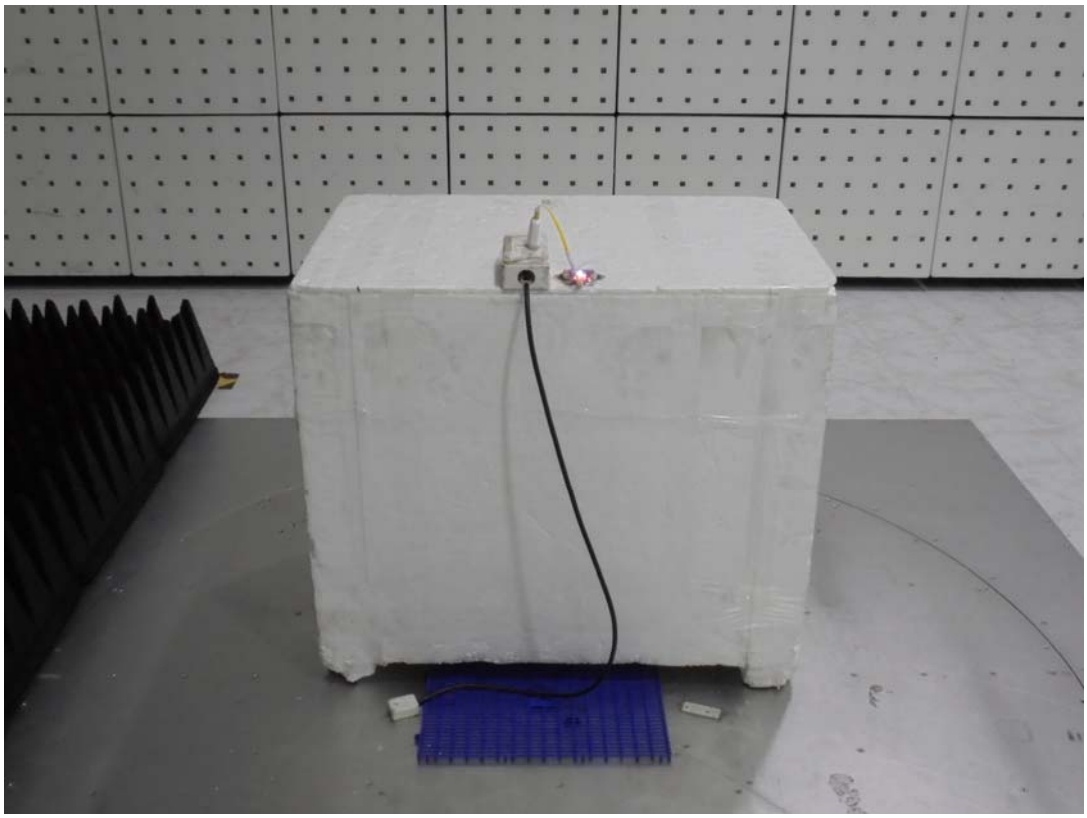
Mode 2

11.3 Radiated Emission at Frequencies above 1GHz

Mode 1



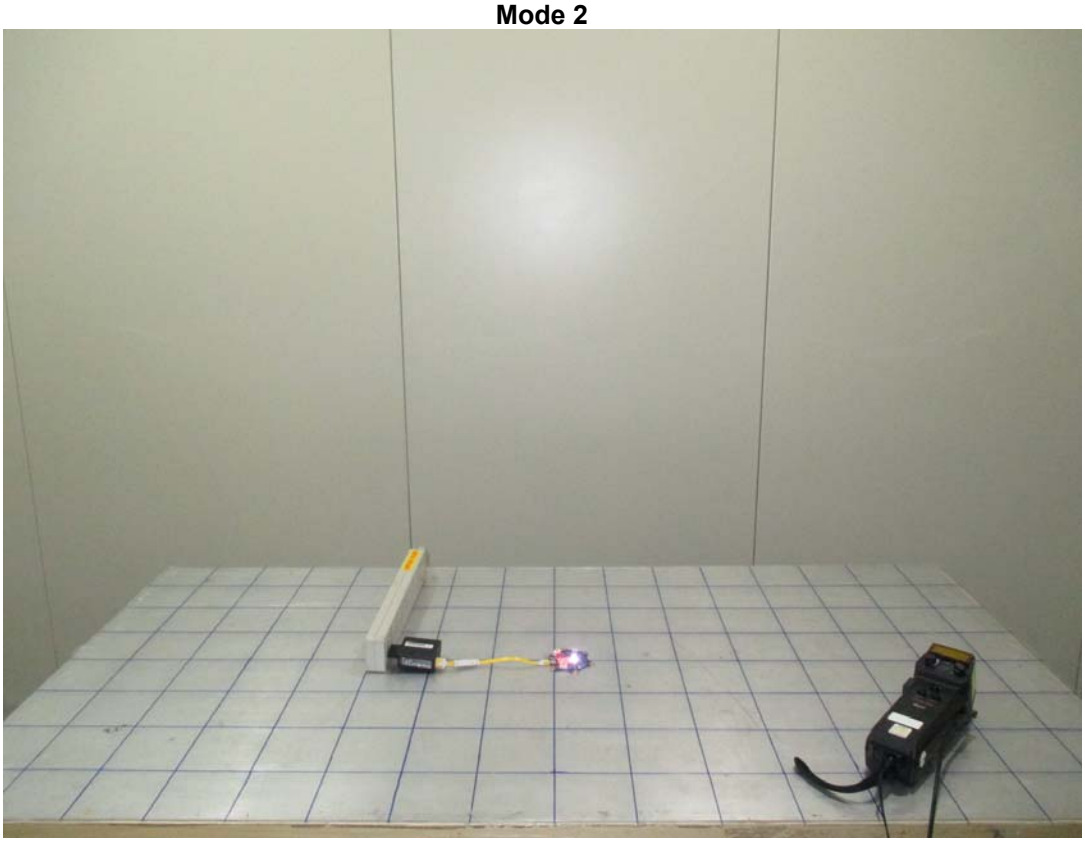
Mode 2



11.4 Electrostatic Discharge Immunity Test (ESD)

Mode 1

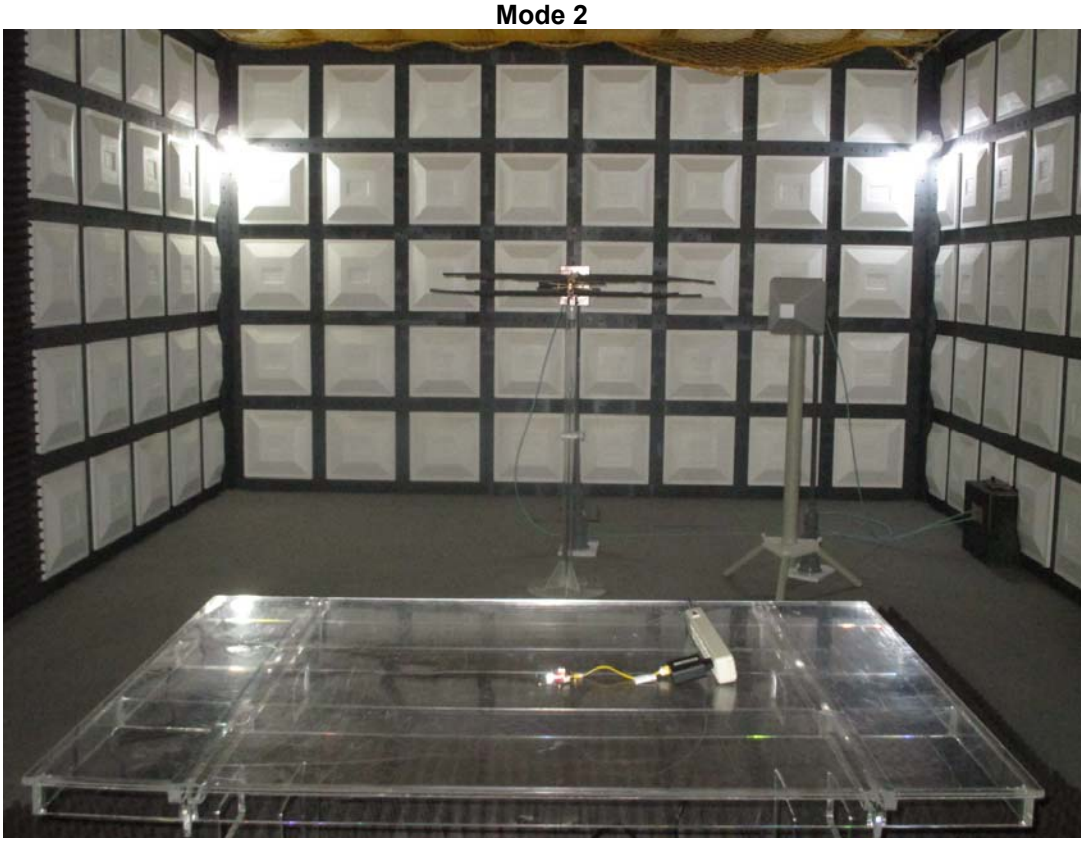
Mode 2



11.5 Radio-frequency, Electromagnetic Field Immunity Test (RS)

Mode 1

Mode 2



Appendix – Information on 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 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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