

## CE EMC Test Report

**Report No.:** CE180620D13B

**Test Model:** Calliope Mini

**Received Date:** Aug. 5, 2019

**Test Date:** Aug. 16 to 21, 2019

**Issued Date:** Aug. 22, 2019

**Applicant:** Calliope gGmbH

**Address:** Raumerstraße 11; 10437 Berlin

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

**Lab Address:** No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan



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### Release Control Record

Issue No.	Description	Date Issued
CE180620D13B	Original release.	Aug. 22, 2019

## 1 Certificate of Conformity

**Product:** Calliope Mini

**Brand:** Calliope gGmbH

**Test Model:** Calliope Mini

**Sample Status:** Engineering Sample

**Applicant:** Calliope gGmbH

**Test Date:** Aug. 16 to 21, 2019

**Standards:** **EN 55032:2012 +AC:2013, Class B**

**EN 61000-3-2:2014** (Not Applicable)

**EN 61000-3-3:2013** (Not Applicable)

**EN 55024:2010 /EN 55024:2010 +A1:2015**

EN 61000-4-2:2009 / IEC 61000-4-2:2008 ED. 2.0

EN 61000-4-3:2006 +A1:2008 +A2:2010 / IEC 61000-4-3:2010 ED. 3.2

EN 61000-4-4:2012 / IEC 61000-4-4:2012 ED. 3.0 (Not Applicable)

EN 61000-4-5:2014 +A1:2017 / IEC 61000-4-5:2014 +A1:2017 ED. 3.0 (Not Applicable)

EN 61000-4-6:2014 +AC:2015 / IEC 61000-4-6:2013 ED. 4.0 (Not Applicable)

EN 61000-4-8:2010 / IEC 61000-4-8:2009 ED. 2.0

EN 61000-4-11:2004 +A1:2017 / IEC 61000-4-11:2004 +A1:2017 ED. 2.0 (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 EMC characteristics under the conditions specified in this report.

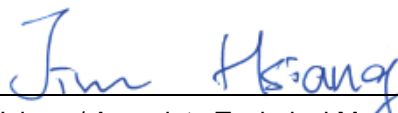
**Prepared by :**



Celia Chen / Supervisor

**Date:** Aug. 22, 2019

**Approved by :**



Jim Hsiang / Associate Technical Manager

**Date:** Aug. 22, 2019

## 2 Summary of Test Results

Emission			
Standard	Test Item	Result/Remarks	Verdict
EN 55032:2012 +AC:2013	Conducted emission from the AC mains power port	Minimum passing Class B margin is -17.56 dB at 0.82188 MHz	Pass
	Asymmetric mode conducted emission at telecommunication ports	Without telecom port of the EUT.	N/A
	Radiated emission 30-1000 MHz	Minimum passing Class B margin is -5.78 dB at 61.45 MHz	Pass
	Radiated emission above 1GHz	Minimum passing Class B margin is -17.28 dB at 2839.12 MHz	Pass
EN 61000-3-2:2014	Harmonic current emissions	Test not applicable because the port does not exist.	N/A
EN 61000-3-3:2013	Voltage fluctuations and flicker	Test not applicable because the port does not exist.	N/A

Immunity				
EN 55024 Clause	Basic standard	Test Item	Result/Remarks	Verdict
4.2.1	EN 61000-4-2:2009 / IEC 61000-4-2:2008 ED. 2.0	Electrostatic discharges (ESD)	Performance Criterion A	Pass
4.2.3.2	EN 61000-4-3:2006 +A1:2008 +A2:2010 / IEC 61000-4-3:2010 ED. 3.2	Continuous radiated disturbances (RS)	Performance Criterion A	Pass
4.2.2	EN 61000-4-4:2012 / IEC 61000-4-4:2012 ED. 3.0	Electrical fast transients (EFT)	EUT's cable length is not greater than 3m and EUT consumes DC power.	N/A
4.2.5	EN 61000-4-5:2014 +A1:2017 / IEC 61000-4-5:2014 +A1:2017 ED. 3.0	Surges	EUT doesn't connect directly to outdoor cables and EUT consumes DC power.	N/A
4.2.3.3	EN 61000-4-6:2014 +AC:2015 / IEC 61000-4-6:2013 ED. 4.0	Continuous conducted disturbances (CS)	EUT's cable length is not greater than 3m and EUT consumes DC power.	N/A
4.2.4	EN 61000-4-8:2010 / IEC 61000-4-8:2009 ED. 2.0	Power-frequency magnetic fields (PFMF)	Performance Criterion A	Pass
4.2.6	EN 61000-4-11:2004 +A1:2017 / IEC 61000-4-11:2004 +A1:2017 ED. 2.0	Voltage dips and interruptions	Test not applicable because AC power 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. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
3. The above EN/IEC basic standards are applied with latest version if customer has no special requirement.
4. 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:

Measurement	Expanded Uncertainty (k=2) ( $\pm$ )	Maximum allowable uncertainty ( $\pm$ )
Conducted emission from AC mains power port using AMN, 150kHz ~ 30MHz	2.79 dB	3.4 dB ( $U_{\text{cispr}}$ )
Radiated emission, 30MHz ~ 1GHz	3.67 dB	6.3 dB ( $U_{\text{cispr}}$ )
Radiated emission, 1GHz ~ 6GHz	4.85 dB	5.2 dB ( $U_{\text{cispr}}$ )

## 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 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 USB interface
Accessory Device	Battery holder
Data Cable Supplied	USB cable (0.15m)

Note:

1. This report is issued as a supplementary report to BV CPS report no.: CE180620D13. The difference compared with original report is change the hardware a bit and add a memory chip on the PCB, therefore the EUT is re-tested in this report.
2. 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 tested with previous worst case (test condition: normal mode + BT Link+ power from adapter) for final test.
2. Test modes are presented in the report as below.

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

### 3.4 Test Program Used and Operation Descriptions

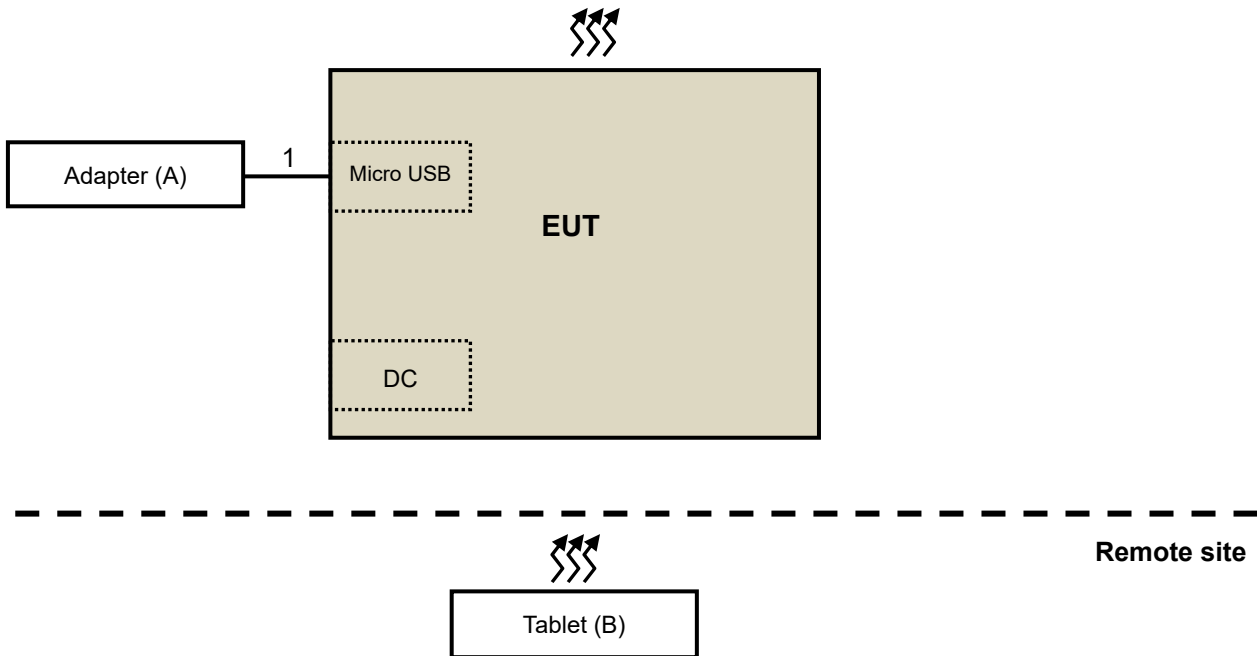
- a. Connect the adapter to EUT.
- b. Turned on the power of all equipment.
- c. Tablet (kept in a remote area) link EUT via Bluetooth transmission.
- d. Tablet (kept in a remote area) received messages from EUT.

### 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



### 4.2 Configuration of Peripheral Devices and Cable Connections

#### Emission tests:

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Adapter	Apple	A1385	N/A	N/A	Provided by Lab
B.	Tablet	ASUS	K00R(ME572CL)	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.	USB cable	1	0.15	Y	0	Supplied by client

#### Immunity tests:

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Adapter	Lenovo	ADL40WLG	N/A	N/A	Provided by Lab
B.	Tablet	ASUS	K00R(ME572CL)	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.	USB cable	1	0.15	Y	0	Supplied by client

## 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

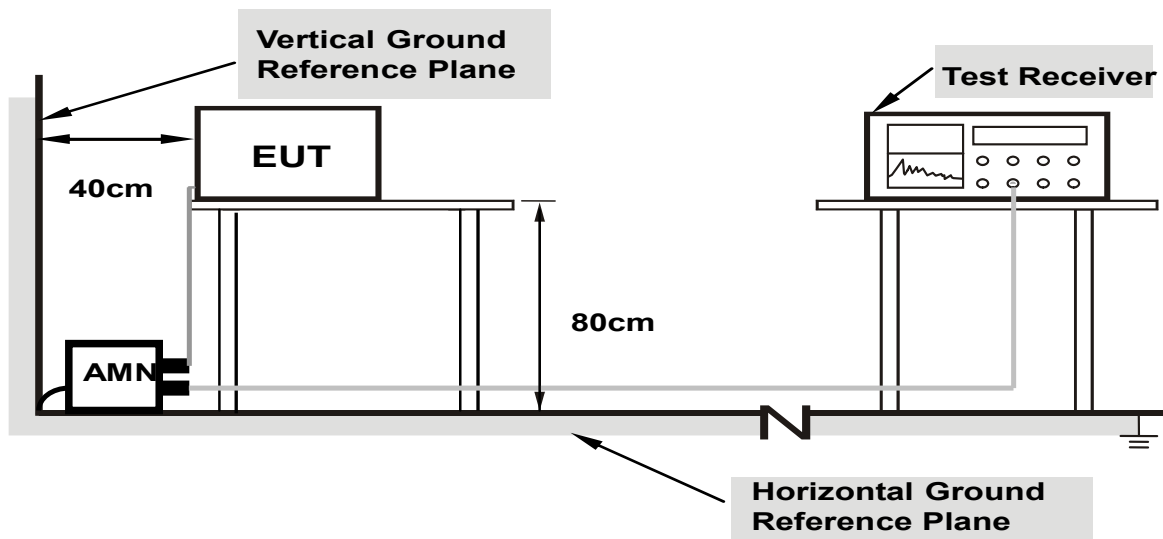
Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
ROHDE & SCHWARZ TEST RECEIVER	ESCS 30	100290	Dec. 18, 2018	Dec. 17, 2019
ROHDE & SCHWARZ Artificial Mains Network (for EUT)	ENV216	101197	Jun. 5, 2019	Jun. 4, 2020
LISN With Adapter (for EUT)	101197	NA	Jun. 5, 2019	Jun. 4, 2020
ROHDE & SCHWARZ Artificial Mains Network (for peripherals)	ESH3-Z5	100218	Nov. 30, 2018	Nov. 29, 2019
SCHWARZBECK Artificial Mains Network (For EUT)	NNLK8129	8129229	May 14, 2019	May 13, 2020
SCHWARZBECK Artificial Mains Network (For EUT)	NNLK 8121	8121-808	Mar. 15, 2019	Mar. 14, 2020
Software	Cond_V7.3.7.4	NA	NA	NA
RF cable (JYEBAO) With 10dB PAD	5D-FB	Cable-C10.01	Feb. 13, 2019	Feb. 12, 2020
LYNICS Terminator (For ROHDE & SCHWARZ LISN)	0900510	E1-011484	May 13, 2019	May 12, 2020
ROHDE & SCHWARZ Artificial Mains Network (For TV EUT)	ENV216	101196	Apr. 16, 2019	Apr. 15, 2020
LISN With Adapter (for TV EUT)	101196	NA	Apr. 16, 2019	Apr. 15, 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 Shielded Room No. 10.  
 3. The VCCI Site Registration No. C-11852.  
 4. Tested Date: Aug. 16, 2019

### 5.3 Test Arrangement

- 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.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- 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:**
- Support units were connected to second AMN.
  - The distance specified between EUT/AE and other metallic objects is  $\geq 0.8$  m in the measurement arrangement for table-top EUT.
  - Cable on the RGP must to be insulated.

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

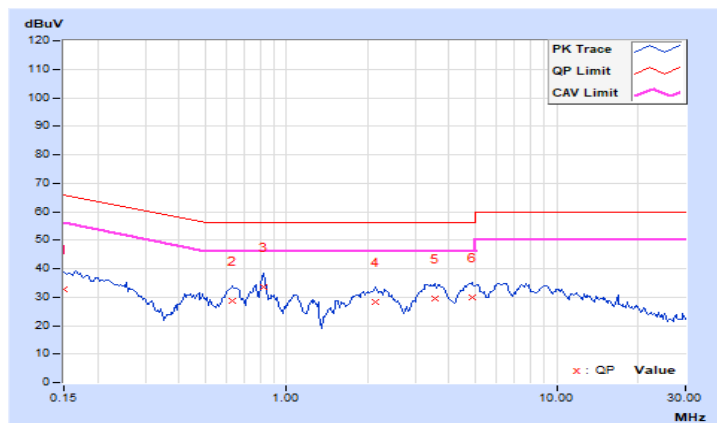
### 5.4 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	230Vac, 50Hz	Environmental Conditions	25°C, 75%RH, 993mbar
Tested by	Vincent Lin		
Test Mode	Mode 1		

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	9.66	22.99	2.69	32.65	12.35	66.00	56.00	-33.35	-43.65
2	0.63438	9.82	18.87	13.39	28.69	23.21	56.00	46.00	-27.31	-22.79
<b>3</b>	<b>0.82188</b>	<b>9.87</b>	<b>23.72</b>	<b>18.57</b>	<b>33.59</b>	<b>28.44</b>	<b>56.00</b>	<b>46.00</b>	<b>-22.41</b>	<b>-17.56</b>
4	2.13281	10.00	18.22	13.14	28.22	23.14	56.00	46.00	-27.78	-22.86
5	3.55078	10.06	19.29	14.19	29.35	24.25	56.00	46.00	-26.65	-21.75
6	4.86719	10.11	19.86	14.84	29.97	24.95	56.00	46.00	-26.03	-21.05

**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

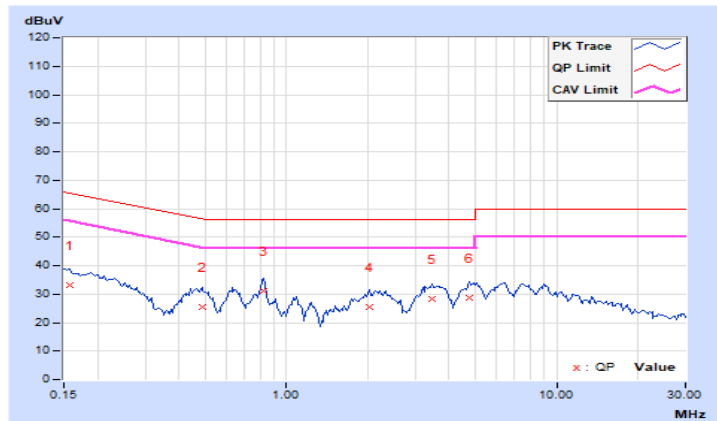


<b>Frequency Range</b>	150kHz ~ 30MHz	<b>Detector Function &amp; Bandwidth</b>	Quasi-Peak (QP) / Average (AV), 9kHz
<b>Input Power</b>	230Vac, 50Hz	<b>Environmental Conditions</b>	25°C, 75%RH, 993mbar
<b>Tested by</b>	Vincent Lin		
<b>Test Mode</b>	Mode 1		

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	0.15781	9.71	23.44	1.60	33.15	11.31	65.58	55.58	-32.43	-44.27
2	0.48594	9.84	15.70	3.50	25.54	13.34	56.24	46.24	-30.70	-32.90
3	0.82188	9.91	21.08	15.12	30.99	25.03	56.00	46.00	-25.01	-20.97
4	2.02344	10.04	15.56	10.60	25.60	20.64	56.00	46.00	-30.40	-25.36
5	3.45703	10.11	18.09	13.47	28.20	23.58	56.00	46.00	-27.80	-22.42
6	4.77344	10.15	18.51	13.85	28.66	24.00	56.00	46.00	-27.34	-22.00

**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
EMCI Preampifier	EMC9135	980326	Feb. 20, 2019	Feb. 19, 2020
EMCI Preampifier	EMC9135	980327	Feb. 20, 2019	Feb. 19, 2020
Agilent Test Receiver	N9038A	MY55420137	Apr. 15, 2019	Apr. 14, 2020
Agilent Test Receiver	N9038A	MY50010135	May 29, 2019	May 28, 2020
Schwarzbeck Antenna	VULB9168	9168-316	Nov. 27, 2018	Nov. 26, 2019
Schwarzbeck Antenna	VULB9168	9168-317	Nov. 27, 2018	Nov. 26, 2019
Max Full. Turn Table & Tower	MF7802	MF7802121	NA	NA
Max Full. Tower	MF7802	MF780208105	NA	NA
Software	Radiated_V8.7.08	NA	NA	NA
JYEBAO RF cable With 5dB PAD	LMR-600	CABLE-CH8-01.V	Sep. 28, 2018	Sep. 27, 2019
JYEBAO RF cable With 5dB PAD	LMR-600	CABLE-CH8-02.H	Sep. 28, 2018	Sep. 27, 2019
WOKEN RF cable With 5dB PAD	8D	CABLE-CH8-03.3M	Sep. 28, 2018	Sep. 27, 2019

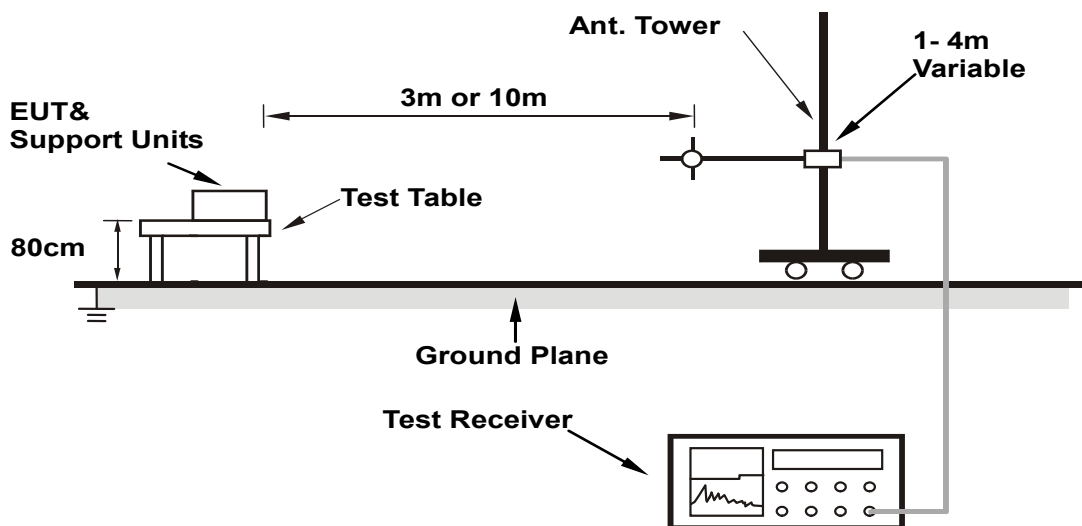
- Note:
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
  2. The test was performed in Chamber No. 8.
  3. The VCCI Site Registration No. R-12946.
  4. Tested Date: Aug. 16, 2019

### 6.3 Test Arrangement

- 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.
- The EUT was set 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 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.
- 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.
- 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.
- 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 be insulated.**

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



### 6.4 Test Results

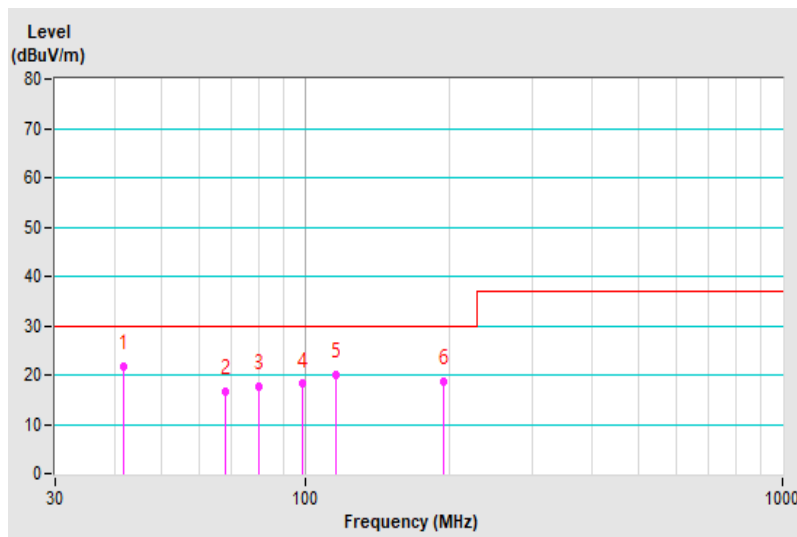
<b>Frequency Range</b>	30MHz ~ 1GHz	<b>Detector Function &amp; Bandwidth</b>	Quasi-Peak (QP), 120kHz
<b>Input Power</b>	230Vac, 50Hz	<b>Environmental Conditions</b>	31°C, 64%RH, 993mbar
<b>Tested by</b>	Vincent Lin		
<b>Test Mode</b>	Mode 1		

#### 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	41.57	21.64 QP	30.00	-8.36	1.00 H	25	39.97	-18.33
2	67.95	16.77 QP	30.00	-13.23	4.00 H	346	36.28	-19.51
3	79.91	17.62 QP	30.00	-12.38	4.00 H	322	39.78	-22.16
4	98.51	18.16 QP	30.00	-11.84	4.00 H	240	40.10	-21.94
5	115.89	19.95 QP	30.00	-10.05	3.52 H	54	39.72	-19.77
6	195.38	18.75 QP	30.00	-11.25	4.00 H	74	38.20	-19.45

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

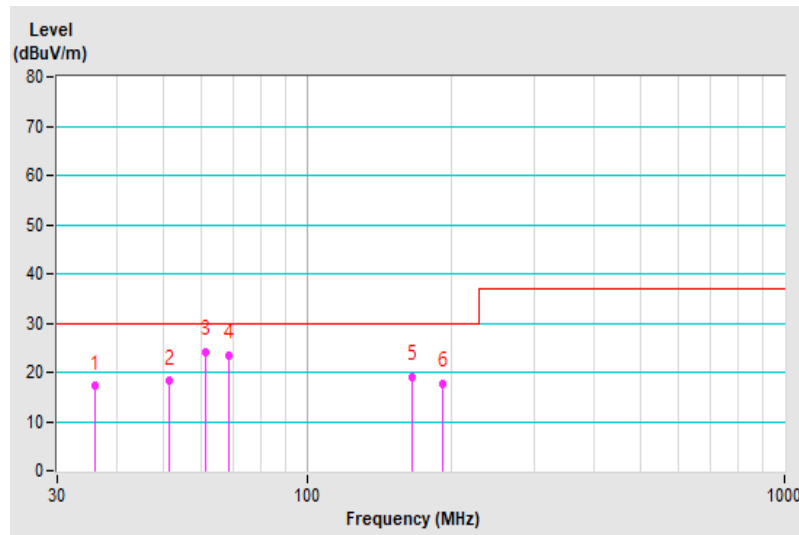


<b>Frequency Range</b>	30MHz ~ 1GHz	<b>Detector Function &amp; Bandwidth</b>	Quasi-Peak (QP), 120kHz
<b>Input Power</b>	230Vac, 50Hz	<b>Environmental Conditions</b>	31°C, 64%RH, 993mbar
<b>Tested by</b>	Vincent Lin		
<b>Test Mode</b>	Mode 1		

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	36.11	17.17 QP	30.00	-12.83	1.00 V	321	36.58	-19.41
2	51.53	18.17 QP	30.00	-11.83	2.00 V	326	36.22	-18.05
<b>3</b>	<b>61.45</b>	<b>24.22 QP</b>	<b>30.00</b>	<b>-5.78</b>	<b>1.96 V</b>	<b>332</b>	<b>43.12</b>	<b>-18.90</b>
4	68.58	23.54 QP	30.00	-6.46	2.25 V	332	43.39	-19.85
5	165.87	18.94 QP	30.00	-11.06	1.00 V	160	35.72	-16.78
6	192.94	17.64 QP	30.00	-12.36	1.00 V	158	36.75	-19.11

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
$F_x \leq 108$ MHz	1 GHz
$108 \text{ MHz} < F_x \leq 500$ MHz	2 GHz
$500 \text{ MHz} < F_x \leq 1$ GHz	5 GHz
$F_x > 1$ GHz	$5 \times F_x$ 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

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Agilent Spectrum	E4446A	MY51100009	Jun. 6, 2019	Jun. 5, 2020
Agilent Test Receiver	N9038A	MY51210137	Jun. 6, 2019	Jun. 5, 2020
Agilent Preamplifier	8449B	3008A01292	Feb. 21, 2019	Feb. 20, 2020
MITEQ Preamplifier	AMF-6F-260400-33-8P	892164	Feb. 21, 2019	Feb. 20, 2020
EMCI Preamplifier	EMC184045B	980235	Feb. 21, 2019	Feb. 20, 2020
ETS Preamplifier	3117-PA	00215857	Nov. 25, 2018	Nov. 24, 2019
Schwarzbeck Horn Antenna	BBHA-9170	212	Nov. 25, 2018	Nov. 24, 2019
EMCO Horn Antenna	3115	6714	Nov. 25, 2018	Nov. 24, 2019
Max Full. Turn Table	MF7802	MF780208216	NA	NA
Software	Radiated_V8.7.08	NA	NA	NA
KIK + WOKEN RF cable With 3/4dB PAD	K1K50-UP0279-K1K50 -3000+WC01	Cable-CH10(3m) -04 +Cable-CH10-03	Jul. 10, 2019	Jul. 9, 2020
MICRO-TRONICS Notch filter	BRC50703-01	010	May 30, 2019	May 29, 2020
MICRO-TRONICS Band Pass Filter	BRM17690	005	May 30, 2019	May 29, 2020

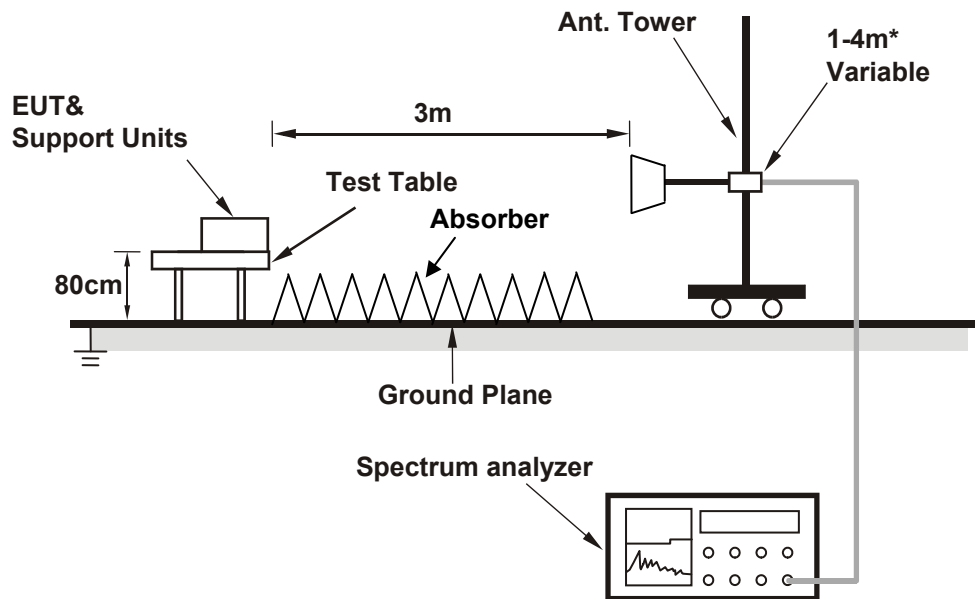
- Note:
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
  2. The 3dB beamwidth of the horn antenna is minimum 41degree (or w = 2.24m at 3m distance) for 1~6 GHz.
  3. The test was performed in Chamber No. 10.
  4. The VCCI Site Registration No. G-10427
  5. Tested Date: Aug. 16, 2019

### 7.3 Test Arrangement

- 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.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 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.
- 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.
- 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.
- 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 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

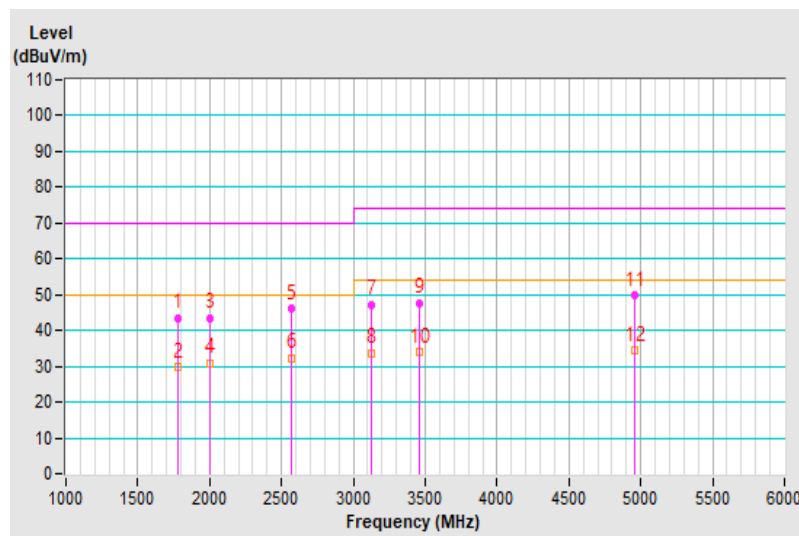
<b>Frequency Range</b>	1GHz ~ 6GHz	<b>Detector Function &amp; Bandwidth</b>	Peak (PK) / Average (AV), 1MHz
<b>Input Power</b>	230Vac, 50Hz	<b>Environmental Conditions</b>	27°C, 77%RH, 993mbar
<b>Tested by</b>	Chenghan Wu		
<b>Test Mode</b>	Mode 1		

#### 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	1781.87	43.30 PK	70.00	-26.70	1.06 H	174	45.01	-1.71
2	1781.87	29.61 AV	50.00	-20.39	1.06 H	174	31.32	-1.71
3	1999.00	43.54 PK	70.00	-26.46	2.05 H	103	44.52	-0.98
4	1999.00	30.77 AV	50.00	-19.23	2.05 H	103	31.75	-0.98
5	2571.00	45.95 PK	70.00	-24.05	1.45 H	181	45.26	0.69
6	2571.00	32.26 AV	50.00	-17.74	1.45 H	181	31.57	0.69
7	3124.00	47.30 PK	74.00	-26.70	2.41 H	360	44.51	2.79
8	3124.00	33.78 AV	54.00	-20.22	2.41 H	360	30.99	2.79
9	3455.87	47.65 PK	74.00	-26.35	2.18 H	206	44.30	3.35
10	3455.87	33.86 AV	54.00	-20.14	2.18 H	206	30.51	3.35
11	4960.00	49.65 PK	74.00	-24.35	1.54 H	208	43.18	6.47
12	4960.00	34.37 AV	54.00	-19.63	1.54 H	208	27.90	6.47

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

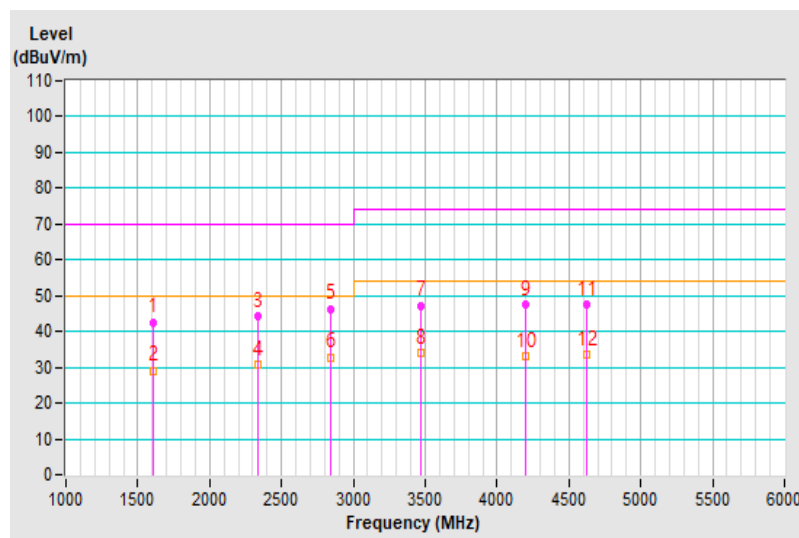


<b>Frequency Range</b>	1GHz ~ 6GHz	<b>Detector Function &amp; Bandwidth</b>	Peak (PK) / Average (AV), 1MHz
<b>Input Power</b>	230Vac, 50Hz	<b>Environmental Conditions</b>	27°C, 77%RH, 993mbar
<b>Tested by</b>	Chenghan Wu		
<b>Test Mode</b>	Mode 1		

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	1605.62	42.53 PK	70.00	-27.47	1.05 V	1	45.16	-2.63
2	1605.62	28.96 AV	50.00	-21.04	1.05 V	1	31.59	-2.63
3	2331.00	44.11 PK	70.00	-25.89	2.44 V	98	43.97	0.14
4	2331.00	30.63 AV	50.00	-19.37	2.44 V	98	30.49	0.14
5	2839.12	46.26 PK	70.00	-23.74	2.10 V	96	45.11	1.15
<b>6</b>	<b>2839.12</b>	<b>32.72 AV</b>	<b>50.00</b>	<b>-17.28</b>	<b>2.10 V</b>	<b>96</b>	<b>31.57</b>	<b>1.15</b>
7	3470.50	47.18 PK	74.00	-26.82	1.07 V	300	43.79	3.39
8	3470.50	33.80 AV	54.00	-20.20	1.07 V	300	30.41	3.39
9	4201.12	47.39 PK	74.00	-26.61	1.41 V	360	42.52	4.87
10	4201.12	32.90 AV	54.00	-21.10	1.41 V	360	28.03	4.87
11	4620.50	47.31 PK	74.00	-26.69	2.38 V	74	42.06	5.25
12	4620.50	33.35 AV	54.00	-20.65	2.38 V	74	28.10	5.25

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 55024:2010 / EN 55024:2010 +A1:2015, Immunity requirements

Clause	Reference standard	Table	Test specification	Performance Criterion
4.2.1	EN/IEC 61000-4-2 ESD	1.3	Enclosure port: ±8kV Air discharge, ±4kV Contact discharge	B
4.2.3.2	EN/IEC 61000-4-3 RS	1.2	Enclosure port: 80-1000 MHz, 3V/m, 80% AM (1kHz)	A
4.2.4	EN/IEC 61000-4-8 PFMF	1.1	Enclosure port: 50 or 60 Hz, 1A/m	A

### 8.1 Performance Criteria

#### General Performance Criteria

##### Performance criterion A

The equipment shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

##### Performance criterion B

After the test, the equipment shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed, after the application of the phenomena below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is allowed. However, no change of operating state or stored data is allowed to persist after the test. If the minimum performance level (or the permissible performance loss) is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

##### Performance criterion C

Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. Functions, and/or information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

#### Particular performance criteria

The particular performance criteria which are specified in the normative annexes of EN 55024 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.



## 9 Electrostatic Discharge Immunity Test (ESD)

### 9.1 Test Specification

<b>Basic Standard:</b>	EN/IEC 61000-4-2
<b>Discharge Impedance:</b>	330 ohm / 150 pF
<b>Discharge Voltage:</b>	Air Discharge: N/A * <i>As client's request, EUT only tested "Indirect Discharge"</i> Contact Discharge: $\pm 2\text{kV}$ , $\pm 4\text{kV}$ (Indirect)
<b>Number of Discharge:</b>	Air – Direct: 10 discharges per location (each polarity) Contact – Direct & Indirect: 25 discharges per location (each polarity) and min. 200 times in total
<b>Discharge Mode:</b>	Single Discharge
<b>Discharge Period:</b>	1-second minimum

### 9.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
EM Test ESD Simulator	Dito	V0707102251	Apr. 08, 2019	Apr. 07, 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 ESD Room No. 2.
  3. Tested Date: Aug. 21, 2019

### 9.3 Test Arrangement

The discharges shall be applied in two ways:

- a. Contact discharges to the conductive surfaces and coupling planes:

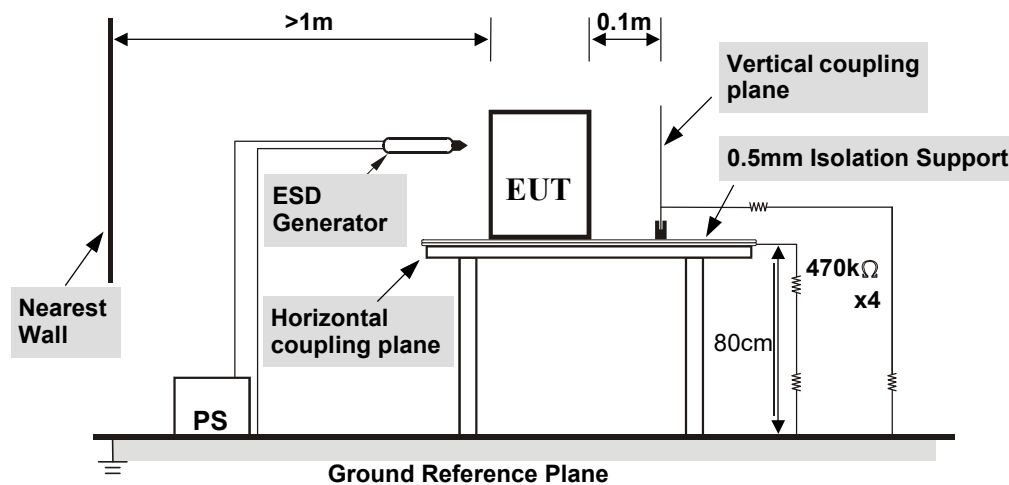
The EUT shall be exposed to at least 200 discharges, 100 each at negative and positive polarity, at a minimum of four test points. One of the test points shall be subjected to at least 50 indirect discharges to the center of the front edge of the horizontal coupling plane. The remaining three test points shall each receive at least 50 direct contact discharges. If no direct contact test points are available, then at least 200 indirect discharges shall be applied in the indirect mode. Test shall be performed at a maximum repetition rate of one discharge per second.

- b. Air discharges at slots and apertures and insulating surfaces:

On those parts of the EUT where it is not possible to perform contact discharge testing, the equipment should be investigated to identify user accessible points where breakdown may occur. Such points are tested using the air discharge method. This investigation should be restricted to those area normally handled by the user. A minimum of 10 single air discharges shall be applied to the selected test point for each such area.

The basic test procedure was in accordance with EN/IEC 61000-4-2:

- 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 **Horizontal Coupling Plane** 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 **Vertical Coupling Plane** 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 **Ground Reference Plane**. 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 **Horizontal Coupling Plane** (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/IEC 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	230Vac, 50Hz
Environmental Conditions	25 °C, 39% RH 997 mbar	Tested by	Sean Chou

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/IEC 61000-4-3
Frequency Range:	80 MHz - 1000 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

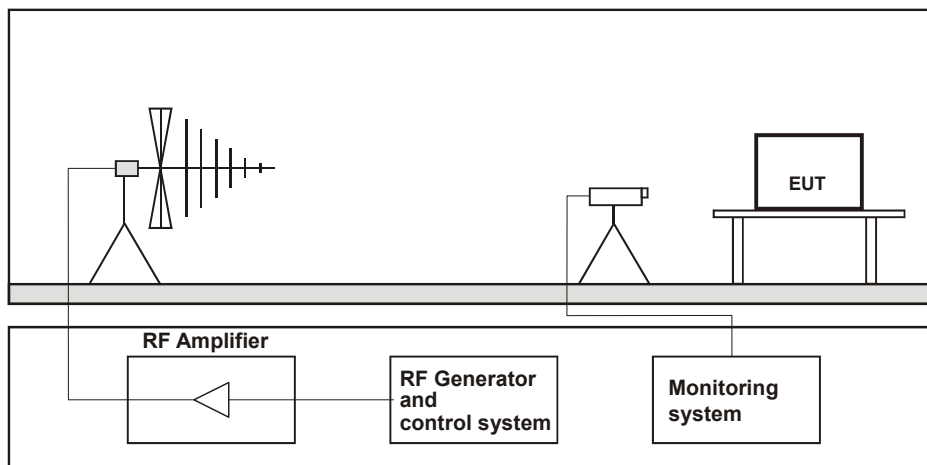
Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
AgilentSignal Generator	E8257D	MY48050465	Jun. 7, 2019	Jun. 6, 2020
PRANA RF Amplifier	AP32DP280	0811-894	NA	NA
TESTQAmplifier	CBA 1G-275	T44344	NA	NA
AR RF Amplifier	35S4G8AM4	0326094	NA	NA
AR RF Amplifier	100S1G4M3	0329249	NA	NA
AR Controller	SC1000M3	305910	NA	NA
ETS Electric Field Sensor	HI-6105	00086973	Dec. 4, 2018	Dec. 3, 2019
BOONTON RF Voltage Meter	4232A	10180	May 29, 2019	May 28, 2020
BOONTON Power Sensor	51011-EMC	34152	May 29, 2019	May 28, 2020
BOONTON Power Sensor	51011-EMC	34153	May 29, 2019	May 28, 2020
ARLog-Periodic Antenna	AT6080	0329465	NA	NA
EMCO BiconiLog Antenna	3141	1001	NA	NA
ARHigh Gain Antenna	AT4010	0329800	NA	NA
SchwarzbeckLOG ANTENNA	Stlp 9149	9149-260	NA	NA
CHANCE MOST Full Anechoic Chamber (9x5x3m)	Chance Most	RS-002	Feb. 6, 2019	Feb. 5, 2020
Software	RS_V7.6	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 RS Room No.2.
  3. The transmit antenna was located at a distance of 3 meters from the EUT.
  4. Tested Date: Aug. 20, 2019

### 10.3 Test Arrangement

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

- a. The testing was performed in a fully anechoic chamber.
- b. The frequency range is swept from 80 MHz to 1000 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/IEC 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	230Vac, 50Hz
Environmental Conditions	24 °C, 69% RH	Tested by	Bernie Lu

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

Note: The EUT function was correct during the test.

## 11 Power Frequency Magnetic Field Immunity Test

### 11.1 Test Specification

Basic Standard:	EN/IEC 61000-4-8
Frequency Range:	50Hz
Field Strength:	1 A/m
Observation Time:	1 minute
Inductance Coil:	Rectangular type, 1 m x 1 m

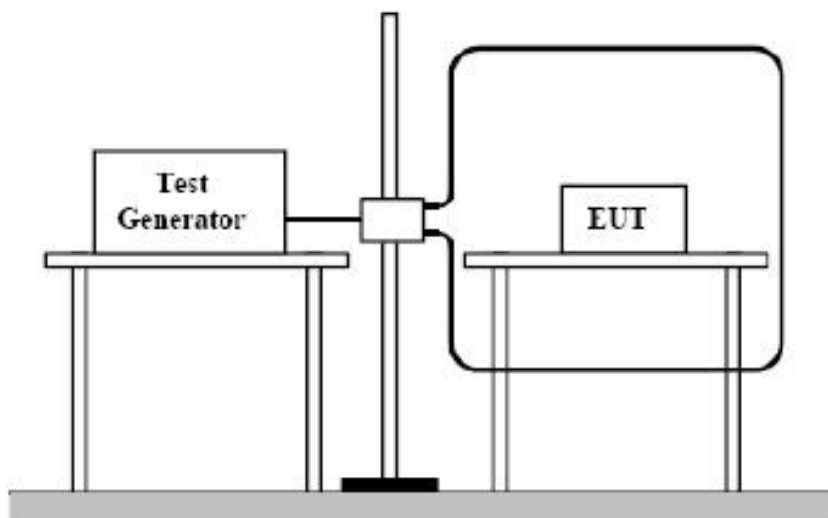
### 11.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
HAEFELY Magnetic Field Tester	MAG 100	083794-06	NA	NA
COMBINOVA Magnetic Field Meter	MFM10	224	Apr. 23, 2019	Apr. 22, 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 EMS Room No. 1
  3. Tested Date: Aug. 21, 2019

### 11.3 Test Arrangement

- a. The equipment is configured and connected to satisfy its functional requirements.
- b. The power supply, input and output circuits shall be connected to the sources of power supply, control and signal.
- c. The cables supplied or recommended by the equipment manufacturer shall be used. 1 meter of all cables used shall be exposed to the magnetic field.



#### TABLETOP EQUIPMENT

The equipment shall be subjected to the test magnetic field by using the induction coil of standard dimension (1 m x 1 m). The induction coil shall then be rotated by 90 degrees in order to expose the EUT to the test field with different orientations.

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

#### 11.4 Test Results

Test mode	Mode 1	Input Power	230Vac, 50Hz
Environmental Conditions	25 °C, 65% RH	Tested by	Sean Chou

Application	Frequency (Hz)	Field Strength (A/m)	Observation	Performance Criterion
X - Axis	50	1	Note	A
Y - Axis	50	1	Note	A
Z - Axis	50	1	Note	A

Note: The EUT function was correct during the test.

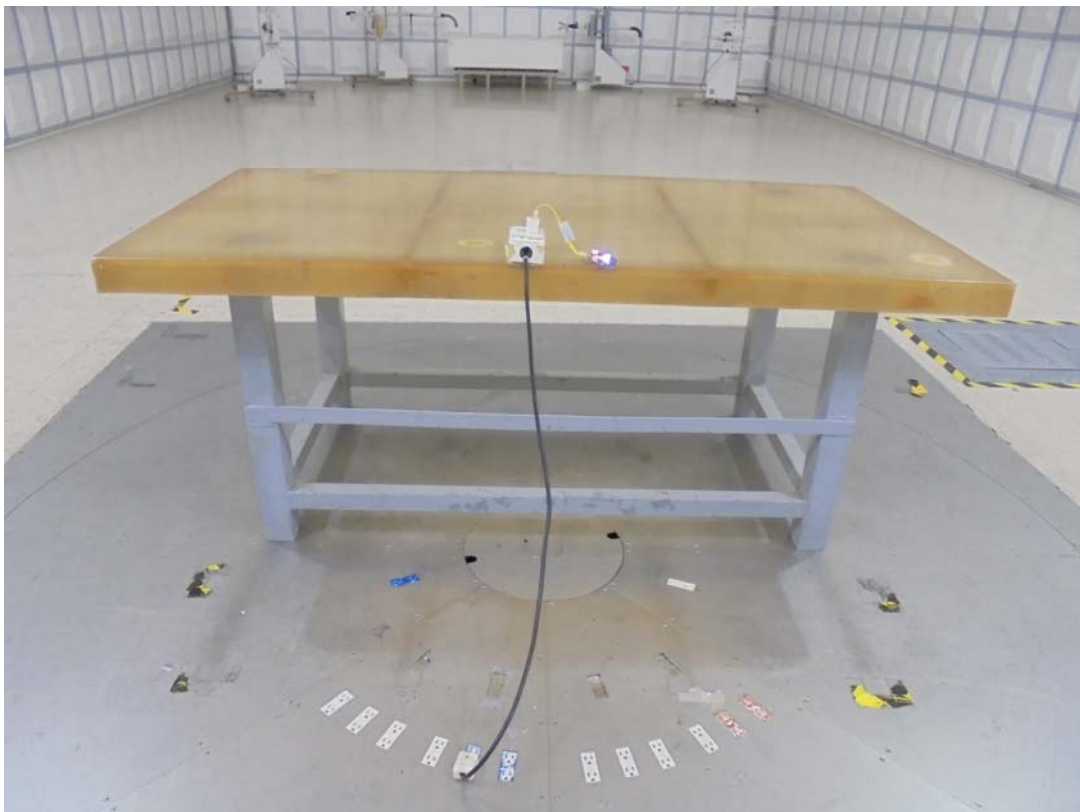


## 12 Pictures of Test Arrangements

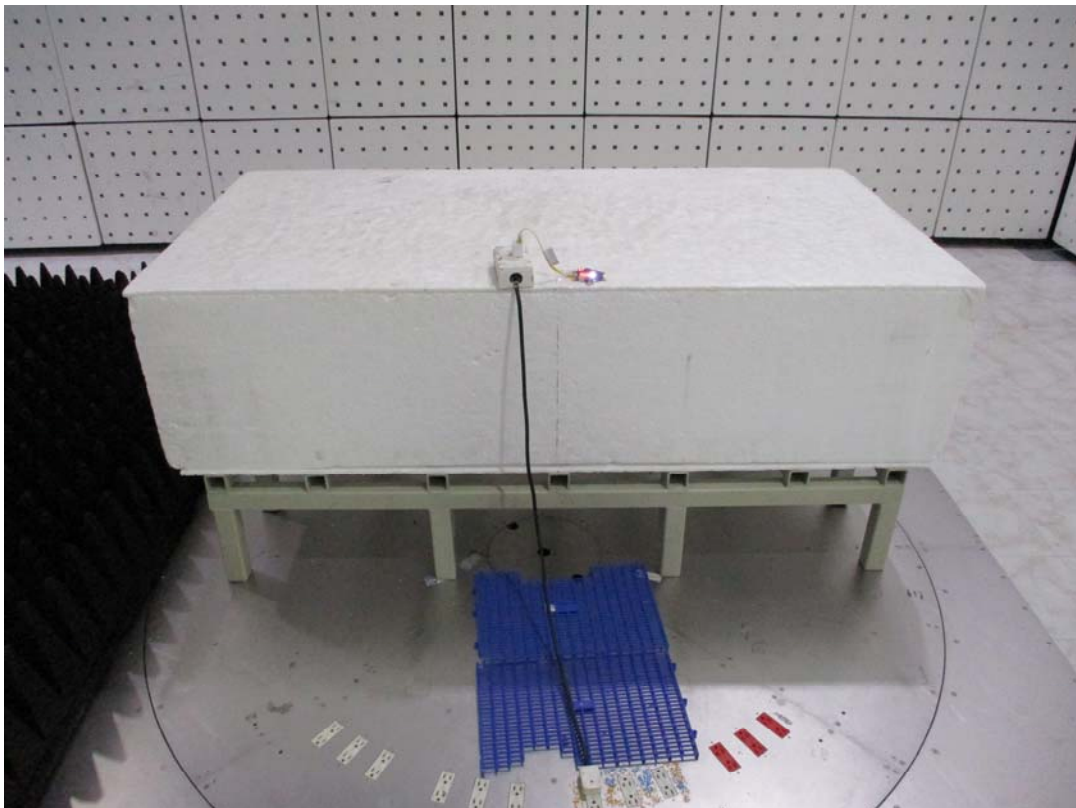
### 12.1 Conducted Emission from the AC Mains Power Port



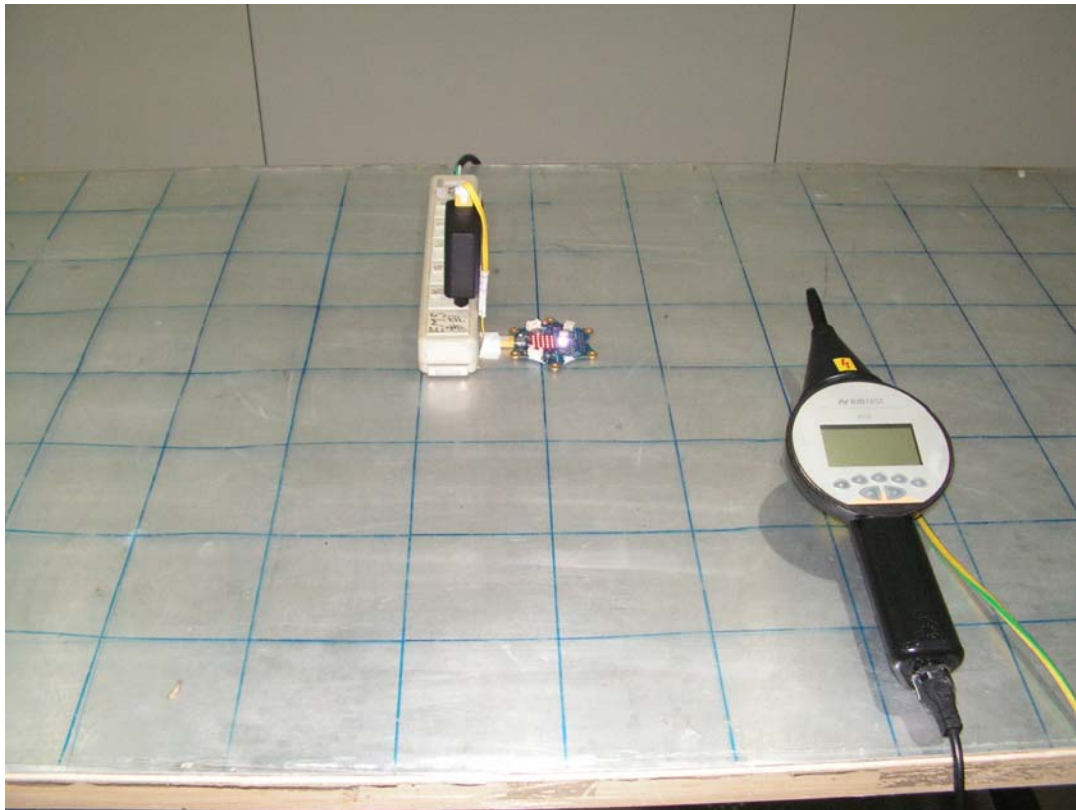
## 12.2 Radiated Emission at Frequencies up to 1GHz



### 12.3 Radiated Emission at Frequencies above 1GHz



## 12.4 Electrostatic Discharge Immunity Test (ESD)



## 12.5 Radio-frequency, Electromagnetic Field Immunity Test (RS)



## 12.6 Power Frequency Magnetic Field Immunity Test (PFMF)



## 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 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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