

CE EMC Test Report (EN 50155 & EN 50121-3-2)

Report No.: CE191231C22-1

Test Model: SPC-5200

Series Model: SPC-5000 Series, SPC-5XXXXXXXXXXXXXXXXXXXXX ("X" can be 0-9, A-Z or blank for marketing purpose)

Received Date: Dec. 31, 2019

Test Date: Jan. 15 ~ Jun. 01, 2020

Issued Date: Jun. 12, 2020

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Release Control Record

Issue No.	Description	Date Issued
CE191231C22-1	Original Release	Jun. 12, 2020

1 Certificate of Conformity

Product: SPC-5000 Series
Brand: Vecow
Test Model: SPC-5200
Series Model: SPC-5000 Series, SPC-5XXXXXXXXXXXXXXXXXXXXX ("X" can be 0-9, A-Z or blank for marketing purpose)
Sample Status: Engineering Sample
Applicant: Vecow Co., Ltd.
Test Date: Jan. 15 ~ Jun. 01, 2020
Standards: **EN 50155:2017, Clause 13.4.8**
EN 50121-1:2017
EN 50121-3-2:2016
EN 61000-4-2:2009
EN 61000-4-3:2006 +A1:2008 +A2:2010
EN 61000-4-4:2012
EN 61000-4-5:2014 +A1:2017
EN 61000-4-6:2014 +AC:2015

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 :  , Date: Jun. 12, 2020
Lena Wang / Specialist

Approved by :  , Date: Jun. 12, 2020
Mitch Jen / Assistant Manager

2 Summary of Test Results

EN 50121-3-2:2016, Emission EN 50155:2017, Clause 13.4.8			
Port	Test Item / specifications	Result/Remarks	Verdict
Auxiliary a.c. or d.c. power ports - Auxiliary supply sinusoidal a.c. or d.c.	Conducted disturbance 150 kHz- 500 kHz: 99 dB μ V quasi-peak 500 kHz- 30 MHz: 93 dB μ V quasi-peak	Minimum passing margin is -48.78 dB at 1.03125 MHz	Pass
Auxiliary a.c. or d.c. power ports – AC power outlet port for	Conducted disturbance 50 kHz- 2 kHz: THD<8% (THD: total harmonic distortion)	Test not applicable because the port does not exist.	N/A
Battery referenced ports Battery power supply	Conducted disturbance 150 kHz- 500 kHz: 99 dB μ V quasi-peak 500 kHz- 30 MHz: 93 dB μ V quasi-peak	Test not applicable because the port does not exist.	N/A
Enclosure	Radiated disturbance 30 MHz- 230 MHz: 40 dB μ V/m quasi-peak 230 MHz -1 GHz: 47 dB μ V/m quasi-peak	Minimum passing margin is -3.04 dB at 445.47 MHz	Pass
Enclosure	Radiated disturbance 1 GHz- 3 GHz: 76 dB μ V/m peak 56 dB μ V/m average 3 GHz - 6 GHz: 80 dB μ V/m peak 60 dB μ V/m average	Minimum passing margin is -12.17 dB at 1500.05 MHz	Pass

EN 50121-3-2:2016, Immunity requirements, EN 50155:2017, Clause 13.4.8					
Table Clause	Basic standard	Port	Test Item / specifications	Result/Remarks	Verdict
3.1	EN 61000-4-6:2014 + AC:2015	Battery referenced ports (except at the output of energy sources), Auxiliary a.c. power input ports (rated voltage \leq 400 Vrms)	Radio-frequency common mode (CS) 80% AM (1kHz) 0.15-80 MHz, 10V Performance Criterion A	Performance Criterion A	Pass
3.2	EN 61000-4-4:2012	Battery referenced ports (except at the output of energy sources), Auxiliary a.c. power input ports (rated voltage \leq 400 Vrms)	Fast Transients (EFT) 5/50 (T _r /T _h) ns, 5kHz \pm 2kV Performance Criterion A	Meets the manufacturer's requirements of performance.	Pass
3.3	EN 61000-4-5:2014 + A1:2017	Battery referenced ports (except at the output of energy sources), Auxiliary a.c. power input ports (rated voltage \leq 400 Vrms)	Surges 1.2/50 (8/20) (T _r /T _h) μ s Line to ground: \pm 2kV 42 Ω , 0.5 μ F Line to line: \pm 1kV 42 Ω , 0.5 μ F Performance Criterion B	Performance Criterion A	Pass

EN 50121-3-2:2016, Immunity requirements,
 EN 50155:2017, Clause 13.4.8

Table Clause	Basic standard	Port	Test Item / specifications	Result/Remarks	Verdict
4.1	EN 61000-4-6:2014 + AC:2015	Signal & communication, process measurement & control ports	Radio-frequency common mode (CS) 80% AM (1kHz) 0.15-80 MHz, 10V Performance Criterion A	Performance Criterion A	Pass
4.2	EN 61000-4-4:2012	Signal & communication, process measurement & control ports	Fast Transients (EFT) 5/50 (T _r /T _h) ns, 5kHz ±2kV, Capacitive clamp Performance Criterion A	Meets the manufacturer's requirements of performance.	Pass
5.1	EN 61000-4-3:2006 + A1:2008 + A2:2010	Enclosure ports	Radio-frequency electromagnetic field amplitude modulated (RS) ¹ , 80% AM (1kHz) 80-800 MHz, 20V/m Performance Criterion A	Performance Criterion A	Pass
5.2	EN 61000-4-3:2006 + A1:2008 + A2:2010	Enclosure ports	Radio-frequency electromagnetic field from digital mobile telephones (RS) ² , 80% AM (1kHz) 800-1000 MHz, 20V/m 1400-2000 MHz, 10V/m 2000-2700 MHz, 5V/m 5100-6000 MHz, 3V/m Performance Criterion A	Performance Criterion A	Pass
5.3	EN 61000-4-2:2009	Enclosure ports	Electrostatic Discharges (ESD) ±6kV Contact discharge ±8kV Air discharge Performance Criterion B	Performance Criterion B	Pass

Note 1: This limit applies to equipment mounted in the passenger compartments, drivers cab or external to the rolling stock (roof, underframe). For equipment mounted in all other areas a severity level of 10 V/m may be used.

Note 2: For large apparatus (e.g. traction drives, auxiliary converters) it is often not practical to perform the immunity test to radiated electromagnetic fields on the complete unit. In such cases the manufacturer should test susceptible sub-systems (e.g. control electronics). The test report should justify the selection or not of sub-systems and any assumptions made (e.g. reduction of field due to case shielding).

N/A: Not Applicable

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. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Performance Criteria

General Performance Criteria

The general performance criteria apply for those ports for which no specific performance criteria are defined (e.g. auxiliary ports) in the report.

Performance criterion A: The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus 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, either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended..

Performance criterion B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended.

Performance criterion C: Temporary loss of function is allowed, provided the function is selfrecoverable or can be restored by the operation of the controls.

2.2 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 disturbance at mains port using AMN, 150 kHz ~ 30 MHz	3.00 dB	3.4 dB (U_{CISPR})
Asymmetric mode conducted emission using AAN, 150 kHz ~ 30 MHz	3.94 dB	5.0 dB (U_{CISPR})
Radiated disturbance, 30 MHz ~ 1 GHz	4.14 dB	6.3 dB (U_{CISPR})
Radiated disturbance, 1 GHz ~ 6 GHz	2.29 dB	5.2 dB (U_{CISPR})

2.3 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	SPC-5000 Series
Brand	Vecow
Test Model	SPC-5200
Series Model	SPC-5000 Series, SPC-5XXXXXXXXXXXXXXXXXXXXX ("X" can be 0-9, A-Z or blank for marketing purpose)
Model Difference	Refer to Note as below
Status of EUT	Engineering Sample
Operating Software	WIN10
Power Supply Rating	24 Vdc (Adapter)
Accessory Device	Refer to Note as below
Data Cable Supplied	1.2m non-shielded DC cable with 1 core

Note:

1. All models are listed as below.

SKU	Brand	Model	Difference
A	Vecow	SPC-5100	Without PoE LAN module
B		SPC-5200	With PoE LAN module

2. The EUT contains following accessory devices.

Product	Brand	Model	Description
Adapter	FSP	FSP120-AABN2	I/P: 100-240 Vac, 50-60 Hz, 1.8 A O/P: 24 Vdc, 5 A 1.2 m non-shielded DC cable with 1 core
CPU	Intel	i7-8665UE	Intel® Core™ i7-8665UE Processor 1.7 GHz
Memory	--	--	SLINK DDR4-2666 4GB SODIMM
SATA SDD	Innodisk	3MG2-P	Innodisk 2.5 SATA SSD 3MG2-P 64G
Motherboard	Vecow	EMBC-3XXXXXXXXXXXXX Series	--
Mini PCIe Digital IO Card	Vecow	DMX-100	--
Mini PCIe 2-port GigE LAN Card	Vecow	LMX-200	--
Mini PCIe 2-port GigE PoE + LAN Card	Vecow	PMX-100	--

3.2 Features of EUT

The tests reported herein were performed according to the method specified by Vecow Co., Ltd., for detailed feature description, please refer to the manufacturer's specifications or user's manual.

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

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

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

Mode	SKU	Test Condition
1	A	RS232 with Load + DVI & DP out (1920*1080 & 3840*2160) + LAN 1Gbps Ping + HDD R/W + Mic in + Speaker out, 110V/60Hz
2	B	RS232 with Load + DVI & DP out (1920*1080 & 3840*2160) + LAN 1Gbps Ping + HDD R/W + Mic in + Speaker out + POE out with Camera Ping + DIO with Cable, 110V/60Hz
3	B	RS232 with Load + DVI & DP out (1920*1080 & 3840*2160) + LAN 1Gbps Ping + HDD R/W + Mic in + Speaker out + POE out with Camera Ping + DIO with Cable, 230V/50Hz

Test modes are presented in the report as below.

Mode	SKU	Test Condition
Conducted emission test		
-	B	RS232 with Load + DVI & DP out (1920*1080 & 3840*2160) + LAN 1Gbps Ping + HDD R/W + Mic in + Speaker out + POE out with Camera Ping + DIO with Cable
Radiated emission test		
-	B	RS232 with Load + DVI & DP out (1920*1080 & 3840*2160) + LAN 1Gbps Ping + HDD R/W + Mic in + Speaker out + POE out with Camera Ping + DIO with Cable
Harmonics, Flicker, Immunity tests		
-	B	RS232 with Load + DVI & DP out (1920*1080 & 3840*2160) + LAN 1Gbps Ping + HDD R/W + Mic in + Speaker out + POE out with Camera Ping + DIO with Cable

3.4 Test Program Used and Operation Descriptions

<Emission Tests>

- a. The EUT powered by adapter and placed on the test table.
- b. The EUT linked with Notebook via LAN cable.
- c. The camera powered by EUT through LAN.
- d. The EUT sent audio signal to the earphone / Microphone.
- e. The EUT read and wrote data with HDD via USB Cable.
- f. The EUT sent "H" patterns to monitors, and monitors displayed them via DVI cable / DP Cable.
- g. The EUT linked with Mouse Keyboard and Printer via USB cable.
- h. The EUT linked with RS-232 TERMINAL.
- i. The EUT communicated data with the Notebooks, which acted as communication partners.

<Immunity Tests>

- a. The EUT powered by adapter and placed on the test table.
- b. The EUT linked with Notebook via LAN cable.
- c. The camera powered by EUT through LAN.
- d. The EUT sent audio signal to the earphone / Microphone.
- e. The EUT read and wrote data with HDD via USB Cable.
- f. The EUT sent "H" patterns to monitors, and monitors displayed them via DVI cable / DP Cable.
- g. The EUT linked with Mouse and Keyboard via USB cable.
- h. The EUT linked with RS-232 TERMINAL.
- i. The EUT communicated data with the Notebooks, which acted as communication partners.

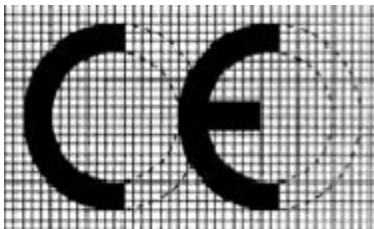
3.5 Primary Clock Frequencies of Internal Source

The highest frequency generated or used within the EUT or on which the EUT operates or tunes is 1.7 GHz, provided by Vecow Co., Ltd., for detailed internal source, please refer to the manufacturer's specifications.

3.6 Miscellaneous

➤ Affix CE marking

The marking must be placed visibly and legibly on the product or, if not possible due to the nature of the product, be affixed to the packaging and the accompanying document. The CE marking shall consist of the initials 'CE' taking the following form:



The various components of the CE marking must have the same vertical dimension, and may not be smaller than 5 mm. If the CE marking is reduced or enlarged, the proportions given in the graduated drawing above must be respected.

When the product is subject to other Directives covering other aspects and which also provide for the 'CE' marking, the accompanying documents must indicate that the product also conforms to those other Directives.

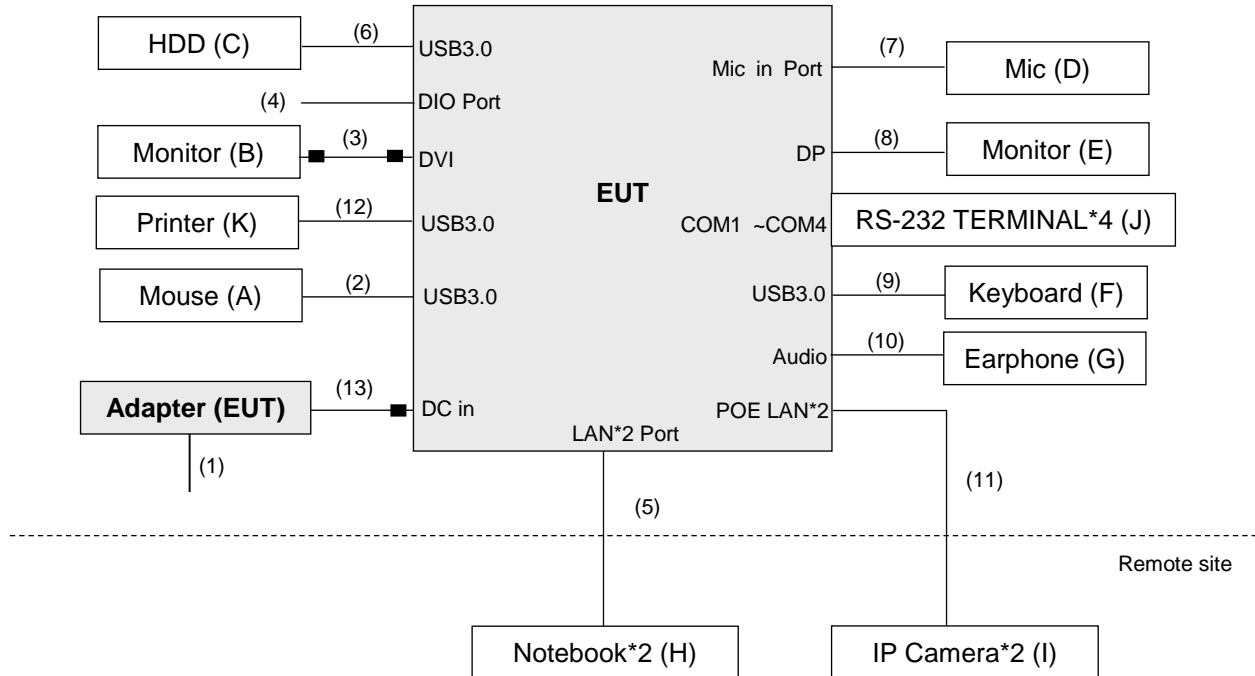
However, when one or more of those Directives allow the manufacturer, during a transitional period, to choose which arrangements to apply, the 'CE' marking has to indicate conformity only with the Directives applied by the manufacturer. In this case, the particularities of the Directives applied, as published in the Official Journal of the European Union, must be given in the documents, notices or instructions required by the Directives and accompanying such products.

4 Configuration and Connections with EUT

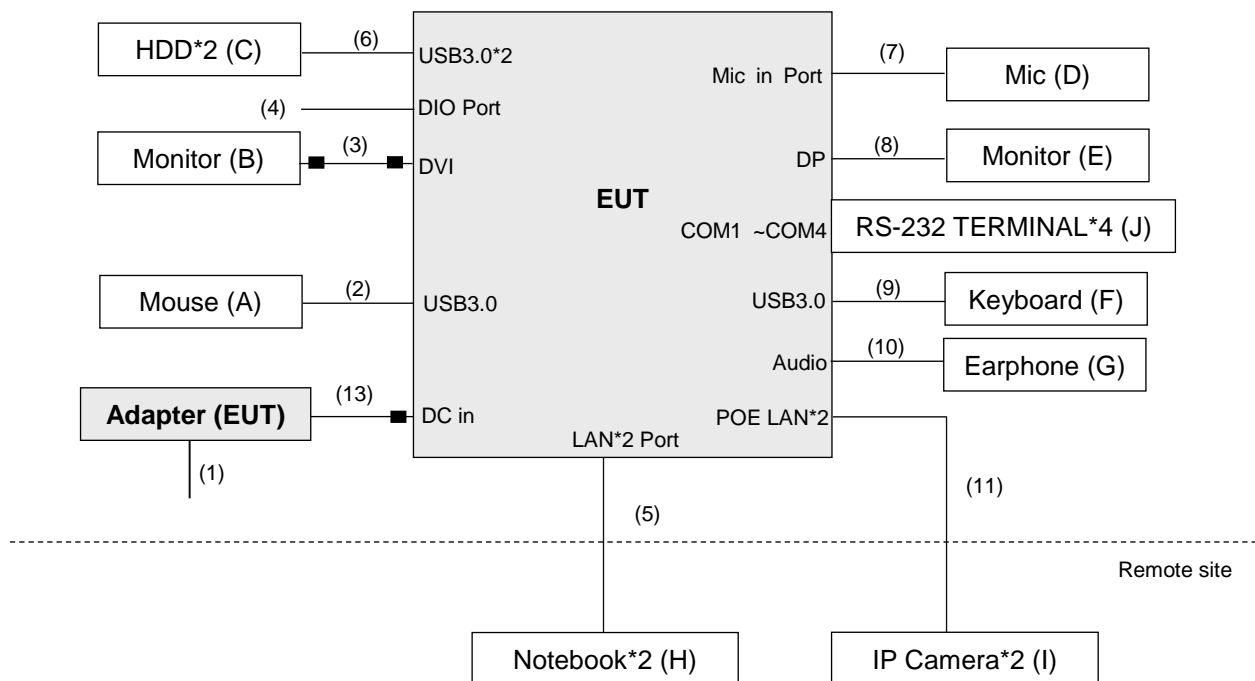
4.1 Connection Diagram of EUT and Peripheral Devices

Emission tests (Harmonics & Flicker excluded):

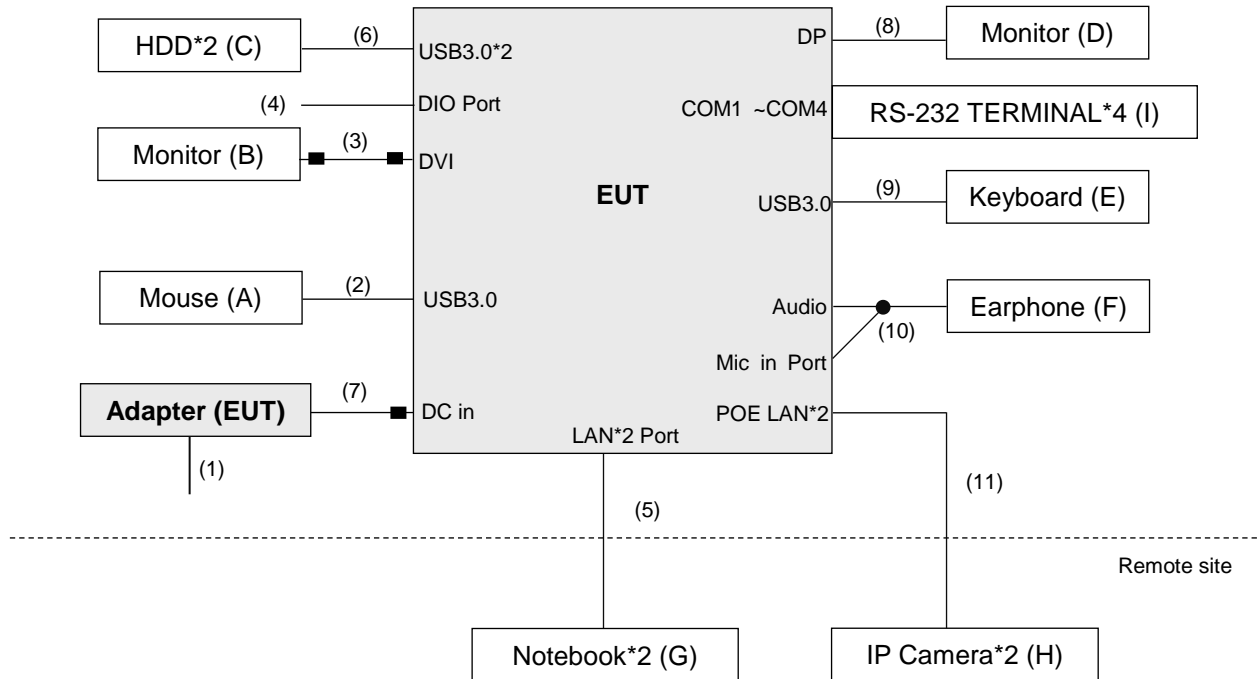
Conducted Emission



Radiated Emission



Harmonics, Flicker, Immunity tests:



4.2 Configuration of Peripheral Devices and Cable Connections

Emission tests (Harmonics & Flicker excluded):

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Mouse	DELL	MOCZUL	CN-049TWY-PRC00-77B-007Q	N/A	For Conducted
		DELL	MOCZUL	CN-049TWY-PRC00-79E-02F8	N/A	For Radiated Emission
B.	Monitor	DELL	U2410	CN082WXD728720CC0 KVL	Doc	For Conducted
		DELL	U2410	CN-0J257M-72872-0A6-02YL	Doc	For Radiated Emission
C.	3.0 HDD	WD	WDBK VX5120PSL	1922JG401229	FCC Doc	For Conducted
		TOSHIBA	DTB305	45TGCN0IT3ZB	N/A	For Radiated Emission
		TOSHIBA	DTB305	45U6CMSPT3ZB	N/A	
D.	MICROPHONE	Labtec	mic-333	N/A	N/A	For Conducted
		Labtec	LVA7313	N/A	N/A	For Radiated Emission
E.	Monitor	ASUS	MX27U	K1LMRS022996	N/A	For Conducted
		ASUS	MX27U	N/A	N/A	For Radiated Emission
F.	Keyboard	Dell	KB216t	CN-0W33XP-LO300-7CL-1909	N/A	For Conducted
		DELL	KB4021	CN-05V23T-71581-1AK-01Q2-A01	FCC DoC Approved	For Radiated Emission
G.	Earphone	PHILIPS	SBC HL150	H2010147	N/A	For Conducted
		PHILIPS	SBC HL150	NA	N/A	For Radiated Emission
H.	Notebook	Dell	E7440	3TLJL12	N/A	For Conducted
		Dell	E5420	FHNW4S1	N/A	For Radiated Emission
		DELL	E6440	FMLNM32	N/A	
		DELL	E6440	FNLNM32	N/A	
I.	IP Camera*2	N/A	N/A	N/A	N/A	Provided by client
J.	RS-232 TERMINAL*4	N/A	N/A	N/A	N/A	Provided by client
K.	Printer	EPSON	LQ-300+II	G88Y125418	FCC DoC Approved	--

Note:

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

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	AC Power Cable	1	1.8	N	0	--
2.	Mouse Cable	1	1.8	Y	0	For Conducted
		1	1.8	Y	0	For Radiated Emission
3.	DVI Cable	1	1.8	Y	2	--
4.	DIO Cable	1	0.2	N	0	Provided by client
5.	LAN Cable	2	10	Y	0	For Conducted, Cat5e
		2	10	N	0	For Radiated Emission, Cat5e
6.	3.0 HDD Cable	1	0.5	Y	0	For Conducted
		2	0.5	Y	0	For Radiated Emission
7.	Mic Cable	1	1.5	Y	0	For Conducted
		1	1.5	Y	0	For Radiated Emission
8.	DP Cable	1	1.8	Y	0	--
9.	Keyboard Cable	1	1.8	Y	0	For Conducted
		1	1.8	Y	0	For Radiated Emission
10.	Earphone Cable	1	1.2	Y	0	For Conducted
		1	1.2	Y	0	For Radiated Emission
11.	LAN Cable	2	10	Y	0	For Conducted
		2	10	N	0	For Radiated Emission
12.	USB Cable	1	1.8	Y	0	For Conducted
13.	DC Cable	1	1.2	N	1	Provided by client

Note:

1. The core(s) is(are) originally attached to the cable(s).
2. The test condition of setup was according to manufacturer's requirement.

Harmonics, Flicker, Immunity tests:

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Mouse	DELL	MS111-P	CN-011D3V-71581-1CJ-093M	FCC DoC Approved	--
B.	Monitor	DELL	P2314Ht	CN-0G9D5T-74445-592-526S	N/A	--
C.	3.0 HDD*2	Transcend	TS1TSJ25M3	N/A	N/A	
D.	Monitor	DELL	U2410	CN-0J257M-72872-0A6-02NL	Doc	
E.	Keyboard	DELL	KB4021	CN-05V23T-71581-1AK-01KM-A01	FCC DoC Approved	
F.	Earphone	PHILIPS	SHM2100U	01	N/A	
G.	Notebook	Dell	E5420	55CF4S1	N/A	
		DELL	E6440	H4FNM32	N/A	
H.	IP Camera*2	N/A	N/A	N/A	N/A	Provided by client
I.	RS-232 TERMINAL*4	N/A	N/A	N/A	N/A	Provided by client

Note:

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

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	AC Power Cable	1	1.8	N	0	--
2.	Mouse Cable	1	1.8	Y	0	
3.	DVI Cable	1	1.8	Y	2	--
4.	DIO Cable	1	0.2	N	0	Provided by client
5.	LAN Cable	2	3	N	0	Cat5e
6.	HDD Cable	2	0.4	Y	0	--
7.	DC Cable	1	1.2	N	1	Provided by client
8.	DP Cable	1	1.8	Y	0	--
9.	Keyboard Cable	1	1.8	Y	0	
10.	Earphone Cable	1	1.3	Y	0	
11.	LAN Cable	2	3	N	0	Cat5e

Note:

1. The core(s) is(are) originally attached to the cable(s).
2. The test condition of setup was according to manufacturer's requirement.

5 Conducted Disturbance at Auxiliary a.c. Power Ports

5.1 Limits

Frequency (MHz)	Quasi-peak, (dBuV)
0.15 - 0.5	99
0.5 - 30	93

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

5.2 Test Instruments

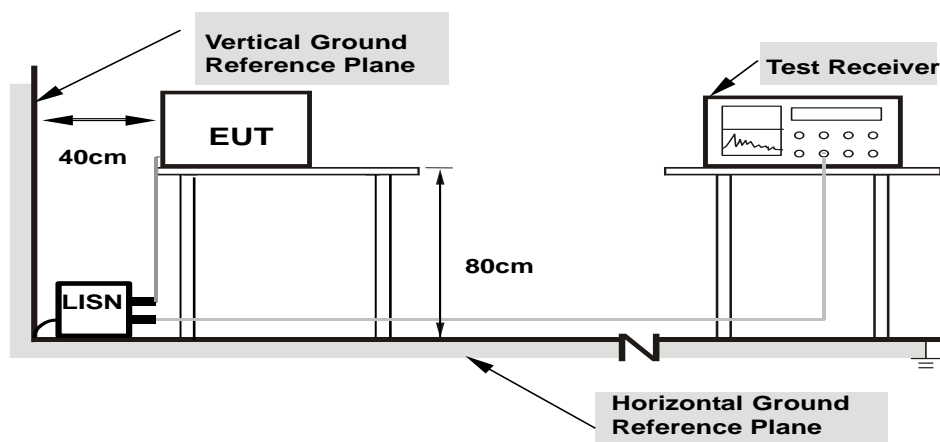
Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
ROHDE & SCHWARZ TEST RECEIVER	ESCS 30	838251/021	Oct. 30, 2019	Oct. 29, 2020
ROHDE & SCHWARZ Artificial Mains Network (For EUT)	ENV216	101195	May 15, 2020	May 14, 2021
LISN With Adapter(for EUT)	101195	N/A	May 15, 2020	May 14, 2021
EMCO L.I.S.N. (For peripherals)	3825/2	9504-2359	Jul. 31, 2019	Jul. 30, 2020
SCHWARZBECK Artificial Mains Network (For EUT)	NNLK8129	8129229	May 14, 2020	May 13, 2021
SCHWARZBECK Artificial Mains Network (for EUT)	NNLK 8121	8121-808	Apr. 10, 2020	Apr. 09, 2021
Software	Cond_V7.3.7.4	NA	NA	NA
RF cable (JYEBAO) With 10dB PAD	5D-FB	Cable-C03-01	Sep. 17, 2019	Sep. 16, 2020
LYNICS Terminator (For EMCO LISN)	0900510	E1-01-300	Jan. 20, 2020	Jan. 19, 2021
LYNICS Terminator (For EMCO LISN)	0900510	E1-01-301	Jan. 20, 2020	Jan. 19, 2021
ROHDE & SCHWARZ Artificial Mains Network (For TV EUT)	ENV216	101196	Apr. 20, 2020	Apr. 19, 2021
LISN With Adapter (for TV EUT)	101196	NA	Apr. 20, 2020	Apr. 19, 2021

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 Lin Kou Shielded Room No. 3.
3. The VCCI Site Registration No. C-10274.

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 a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- 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: 1.Support units were connected to second LISN.

2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

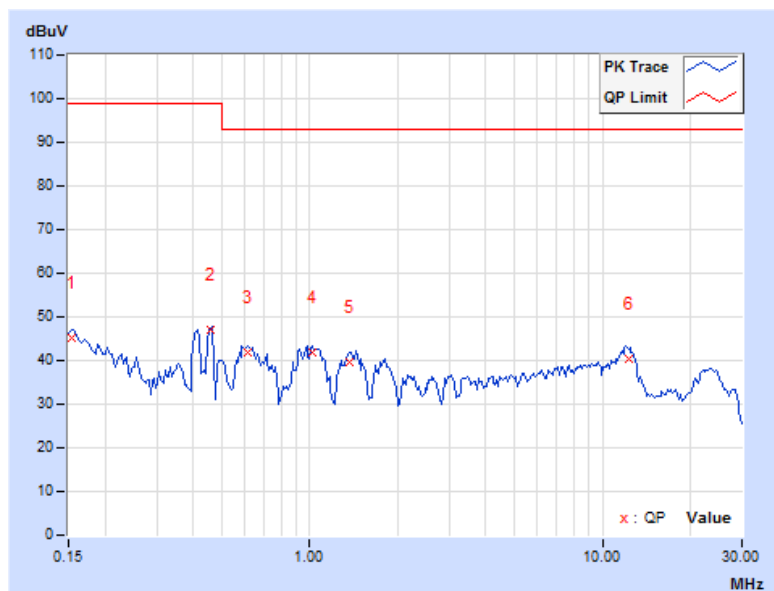
5.4 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	230Vac, 50Hz	Environmental Conditions	25°C, 69%RH
Tested by	John Liao	Test Date	2020/5/21
Test Mode	SKU B (EUT sample no.013-002)		

Phase Of Power : Line (L)						
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)
			Q.P.	Q.P.	Q.P.	Q.P.
1	0.15391	9.68	35.56	45.24	99.00	-53.76
2	0.46122	9.68	37.33	47.01	99.00	-51.99
3	0.61483	9.69	32.16	41.85	93.00	-51.15
4	1.02735	9.70	32.28	41.98	93.00	-51.02
5	1.36719	9.72	29.85	39.57	93.00	-53.43
6	12.39023	9.89	30.63	40.52	93.00	-52.48

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

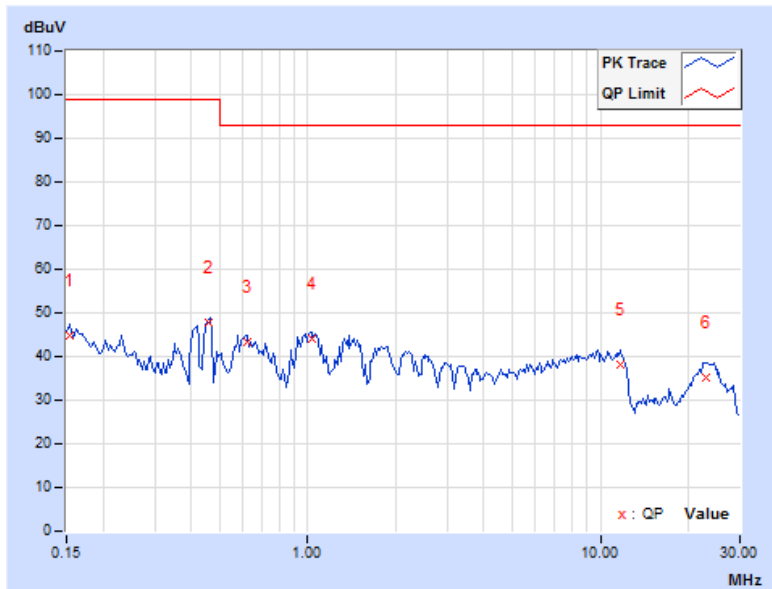


Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	230Vac, 50Hz	Environmental Conditions	25°C, 69%RH
Tested by	John Liao	Test Date	2020/5/21
Test Mode	SKU B (EUT sample no.013-002)		

Phase Of Power : Neutral (N)						
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)
			Q.P.	Q.P.	Q.P.	Q.P.
1	0.15391	9.67	35.23	44.90	99.00	-54.10
2	0.46005	9.67	38.27	47.94	99.00	-51.06
3	0.61875	9.68	33.56	43.24	93.00	-49.76
4	1.03125	9.70	34.52	44.22	93.00	-48.78
5	11.74219	9.89	28.19	38.08	93.00	-54.92
6	23.09766	10.01	25.36	35.37	93.00	-57.63

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 Disturbance up to 1 GHz

6.1 Limits

Frequency (MHz)	dBuV/m (at 10m) / quasi-peak
30 - 230	40
230 - 1000	47

- Notes:
1. The lower limit shall apply at the transition frequencies.
 2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
 3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

6.2 Test Instruments

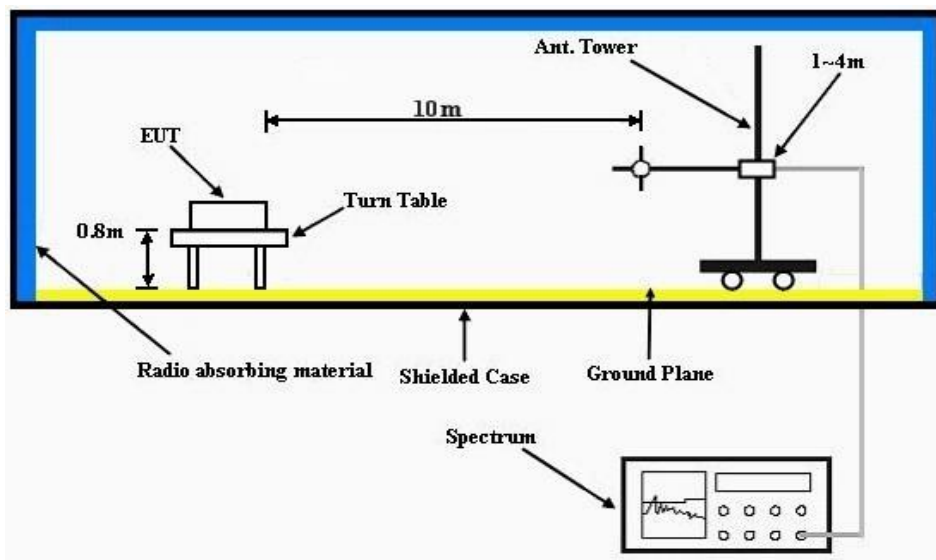
Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ (V)	ESR	101240	Oct. 31, 2019	Oct. 30, 2020
Test Receiver ROHDE & SCHWARZ (H)	ESR	101264	Apr. 16, 2020	Apr. 15, 2021
BILOG Antenna SCHWARZBECK (V)	VULB9168	9168-148	Nov. 08, 2019	Nov. 07, 2020
BILOG Antenna SCHWARZBECK (H)	VULB9168	9168-156	Nov. 08, 2019	Nov. 07, 2020
Preamplifier Sonoma (V)	310N	352924	Jun. 11, 2019	Jun. 10, 2020
Preamplifier Sonoma (H)	310N	352923	Jun. 11, 2019	Jun. 10, 2020
RF signal cable (with 5dB PAD) Times (V)	LMR-600 (18M) +LMR- 400 (7M)	CABLE-CH1 (VER) -01	Sep. 05, 2019	Sep. 04, 2020
RF signal cable (with 5dB PAD) Times (H)	LMR-600 (11.8M) +LMR-400 (7M)	CABLE-CH1 (HOR) -01	Sep. 05, 2019	Sep. 04, 2020
Software BV ADT	BV ADT_Radiated_ V8.7.08	NA	NA	NA
Antenna Tower (V)	MFA-440	9707	NA	NA
Antenna Tower (H)	MFA-440	970705	NA	NA
Turn Table	DS430	50303	NA	NA
Controller (V)	MF7802	074	NA	NA
Controller (H)	MF7802	08093	NA	NA

- 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 HwaYa Chamber 1.
 3. The VCCI Site Registration No. is R-11893.

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 120 kHz for quasi-peak detection (QP) at frequency up to 1 GHz.



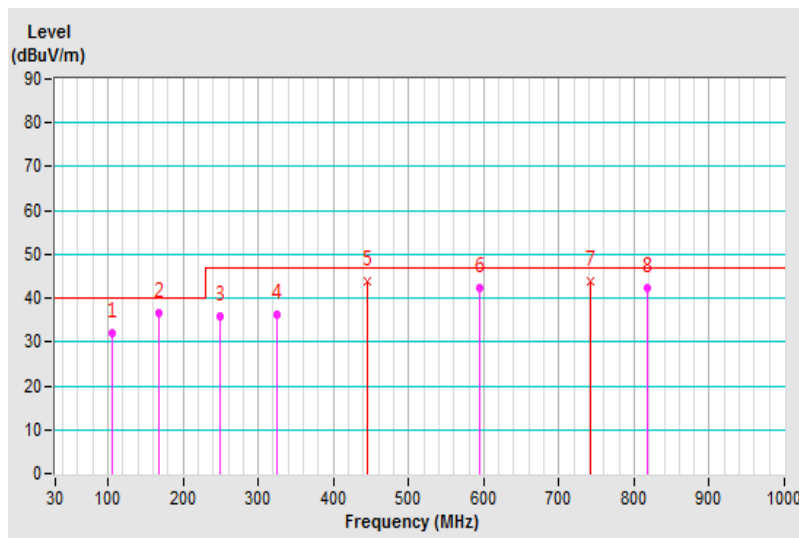
6.4 Test Results

Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Test Mode	SKU B (EUT sample no.013-002)	Environmental Conditions	22°C, 62%RH
Tested by	Daniel Lin	Test Date	2020/5/26

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	106.25	32.05 QP	40.00	-7.95	4.00 H	108	48.94	-16.89
2	167.99	36.52 QP	40.00	-3.48	4.00 H	119	49.85	-13.33
3	249.91	35.86 QP	47.00	-11.14	4.00 H	82	49.67	-13.81
4	325.43	36.30 QP	47.00	-10.70	3.50 H	317	47.45	-11.15
5	445.47	43.96 QP	47.00	-3.04	2.50 H	90	51.54	-7.58
6	593.99	42.39 QP	47.00	-4.61	1.50 H	165	47.37	-4.98
7	742.50	43.85 QP	47.00	-3.15	1.00 H	10	47.19	-3.34
8	816.76	42.29 QP	47.00	-4.71	1.00 H	177	44.95	-2.66

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

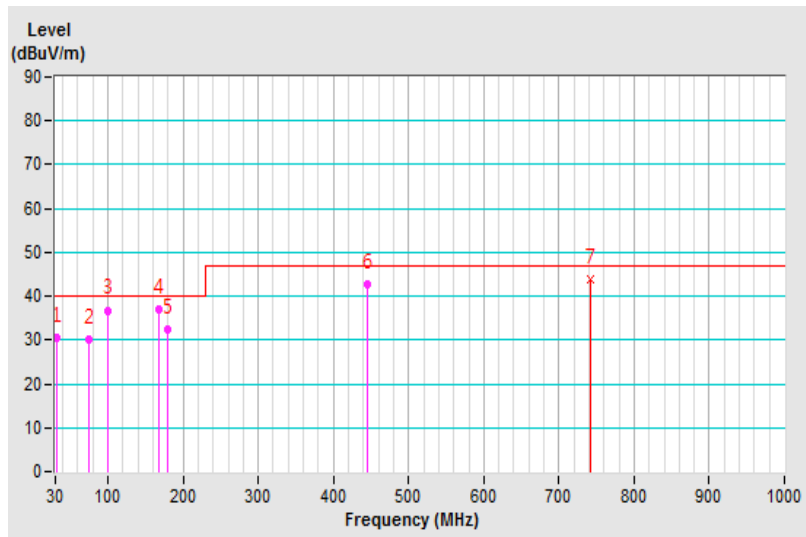


Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Test Mode	SKU B (EUT sample no.013-002)	Environmental Conditions	22°C, 62%RH
Tested by	Daniel Lin	Test Date	2020/5/26

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	31.41	30.41 QP	40.00	-9.59	1.00 V	351	45.11	-14.70
2	74.23	30.04 QP	40.00	-9.96	3.50 V	8	45.93	-15.89
3	98.87	36.80 QP	40.00	-3.20	1.50 V	143	54.66	-17.86
4	167.99	36.93 QP	40.00	-3.07	1.00 V	343	50.22	-13.29
5	178.90	32.56 QP	40.00	-7.44	1.00 V	343	46.93	-14.37
6	445.47	42.74 QP	47.00	-4.26	2.50 V	293	51.30	-8.56
7	742.50	43.88 QP	47.00	-3.12	2.50 V	137	47.36	-3.48

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 Disturbance above 1 GHz

7.1 Limits

Frequency (GHz)	(dBuV/m) (at 3 m)	
	Average	Peak
1 to 3	56	76
3 to 6	60	80

Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

Frequency Range (For unintentional radiators)

Highest frequency generated or used in the EUT or on which the EUT operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 108	1000
108-500	2000
500-1000	5000
Above 1000	Up to 5 times of the highest frequency or 6 GHz, whichever is less

7.2 Test Instruments

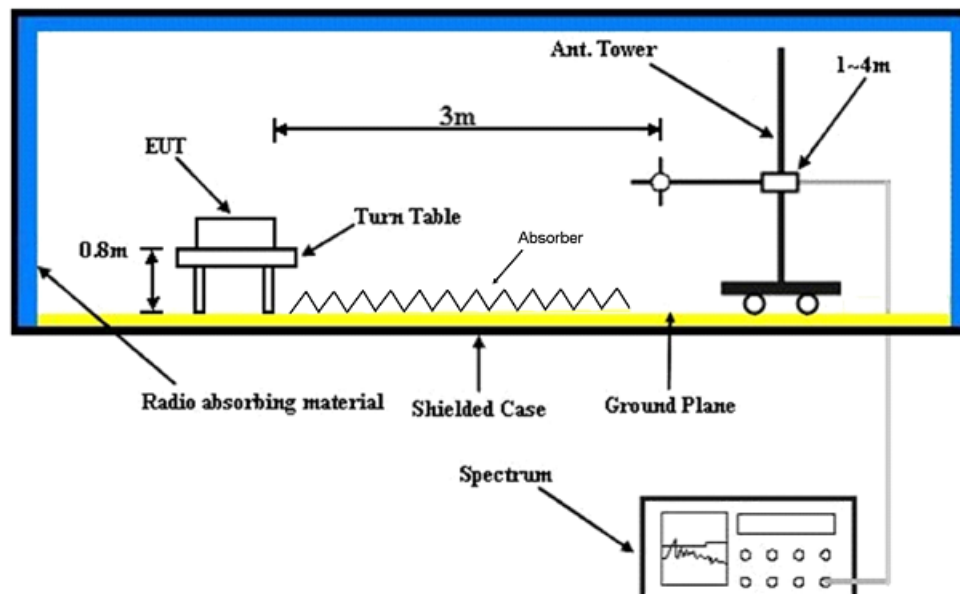
Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ (Above 1GHz)	ESR7	101471	Mar. 07, 2019	Mar. 06, 2020
Spectrum Analyzer Agilent	E4446A	MY51100039	Sep. 05, 2019	Sep. 04, 2020
RF signal cable (with 5dB PAD) Times	LMR-400 (18M)	CABLE-CH2-01	Mar. 25, 2019	Mar. 24, 2020
HORN Antenna (with 4dB PAD) SCHWARZBECK	BBHA 9120 D	9120D-405	Nov. 24, 2019	Nov. 23, 2020
Pre-Amplifier Agilent (Above 1GHz)	8449B	3008A01961	Sep. 05, 2019	Sep. 04, 2020
RF Coaxial Cable JUNFLON+EMC	JUNFLON+EMC104- SM-SM-6000	Cable-CH2- 02(MWX3221308G003+ 130710)	Jun. 11, 2019	Jun. 10, 2020
Software BV ADT	BV ADT_Radiated_ V8.7.08	NA	NA	NA
Software BV ADT	BV ADT_Radiated_ V8.7.08	NA	NA	NA
Antenna Tower BV ADT	AT100	AT93021702	NA	NA
Turn Table BV ADT	TT100	TT93021702	NA	NA
RF Coaxial Cable EMCI	EMC102-KM-KM-1000	170819	Oct. 08, 2019	Oct. 07, 2020
RF Coaxial Cable Rosnol	K1K50-UP0279- K1K50-3000	181129-1	Oct. 08, 2019	Oct. 07, 2020

- 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 3 dB beamwidth of the horn antenna is minimum 30 degree (or $w = 1.6$ m at 3 m distance) for 1~6 GHz.
3. The test was performed in HwaYa Chamber 2.
4. The VCCI Site Registration No. is G-10018.

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



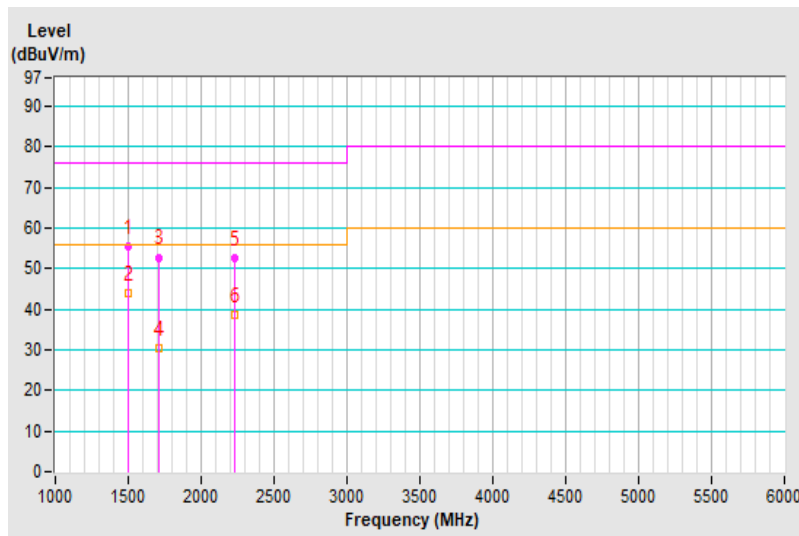
7.4 Test Results

Frequency Range	1GHz ~ 6GHz	Detector Function & Bandwidth	Peak (PK) / Average (AV), 1MHz
Test Mode	SKU B (EUT Sample no. 013-002)	Environmental Conditions	25°C, 64%RH
Tested by	Pon Tsai	Test Date	2020/1/15

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	1500.05	55.49 PK	76.00	-20.51	1.00 H	159	58.25	-2.76
2	1500.05	43.83 AV	56.00	-12.17	1.00 H	159	46.59	-2.76
3	1710.54	52.76 PK	76.00	-23.24	1.99 H	216	55.45	-2.69
4	1710.54	30.39 AV	56.00	-25.61	1.99 H	216	33.08	-2.69
5	2227.57	52.50 PK	76.00	-23.50	1.23 H	131	51.61	0.89
6	2227.57	38.67 AV	56.00	-17.33	1.23 H	131	37.78	0.89

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

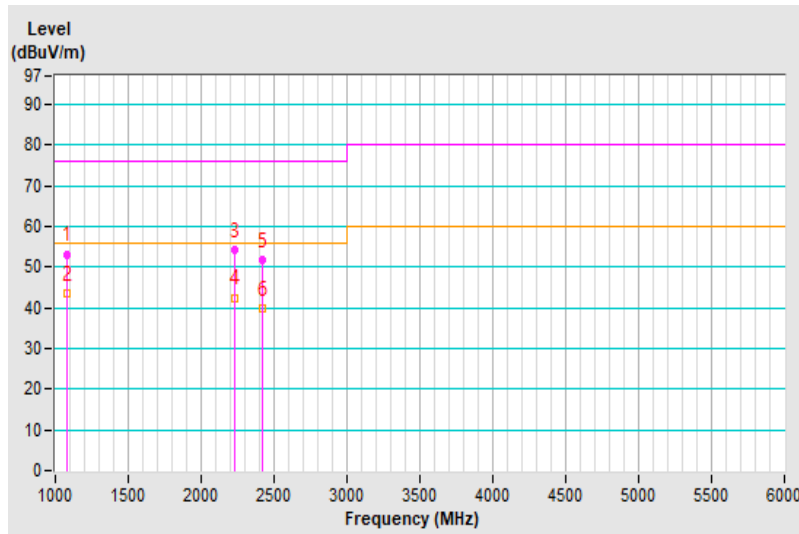


Frequency Range	1GHz ~ 6GHz	Detector Function & Bandwidth	Peak (PK) / Average (AV), 1MHz
Test Mode	SKU B (EUT Sample no. 013-002)	Environmental Conditions	25°C, 64%RH
Tested by	Pon Tsai	Test Date	2020/1/15

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	1076.74	53.19 PK	76.00	-22.81	1.72 V	307	57.07	-3.88
2	1076.74	43.54 AV	56.00	-12.46	1.72 V	307	47.42	-3.88
3	2227.54	54.11 PK	76.00	-21.89	1.94 V	111	53.22	0.89
4	2227.54	42.48 AV	56.00	-13.52	1.94 V	111	41.59	0.89
5	2415.17	51.61 PK	76.00	-24.39	2.23 V	163	51.36	0.25
6	2415.17	39.84 AV	56.00	-16.16	2.23 V	163	39.59	0.25

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 Electrostatic Discharge Immunity Test (ESD)

8.1 Test Specification

Basic Standard:	EN 61000-4-2
Discharge Impedance:	330 ohm / 150 pF
Discharge Voltage:	Air Discharge: ± 2 , ± 4 , ± 8 kV (Direct) Contact Discharge: ± 2 , ± 4 , ± 6 kV (Direct/Indirect)
Number of Discharge:	Minimum 20 times at each test point
Discharge Mode:	Single Discharge
Discharge Period:	1-second minimum

8.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
ELECTROSTATIC DISCHARGE (EMTEST)	Dito	V0701102114	Dec. 02, 2019	Dec. 01, 2020

- Notes:
1. The test was performed in Hwa Ya ESD Room 1.
 2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

8.3 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 **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.

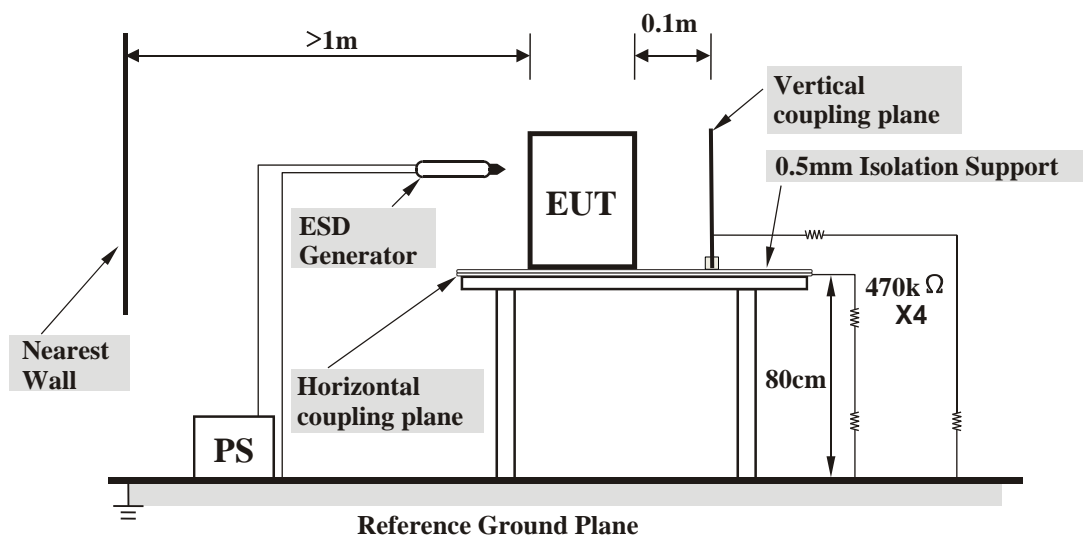


Table-top Equipment

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 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.

8.4 Test Results

Input Power	230 Vac, 50 Hz	Tested by	Ryan Cheng
Environmental Conditions	24 °C, 40 % RH 986 mbar	Test Date	2020/05/29
Test Mode	SKU B (EUT Sample no. 013-002)		

Test Results of Direct Application					
Discharge Level (kV)	Polarity (+/-)	Test Point	Contact Discharge	Air Discharge	Performance Criterion
2, 4, 8	+/-	7-10	NA	Note 1	A
2, 4	+/-	1-6	Note 1	NA	A
6	+/-	1-6	Note 2	NA	B

Description of test points of direct application: Please refer to following page for representative mark only.

Test Results of Indirect Application					
Discharge Level (kV)	Polarity (+/-)	Test Point	Horizontal Coupling Plane	Vertical Coupling Plane	Performance Criterion
2, 4, 6	+/-	Four Sides	Note 1	Note 1	A

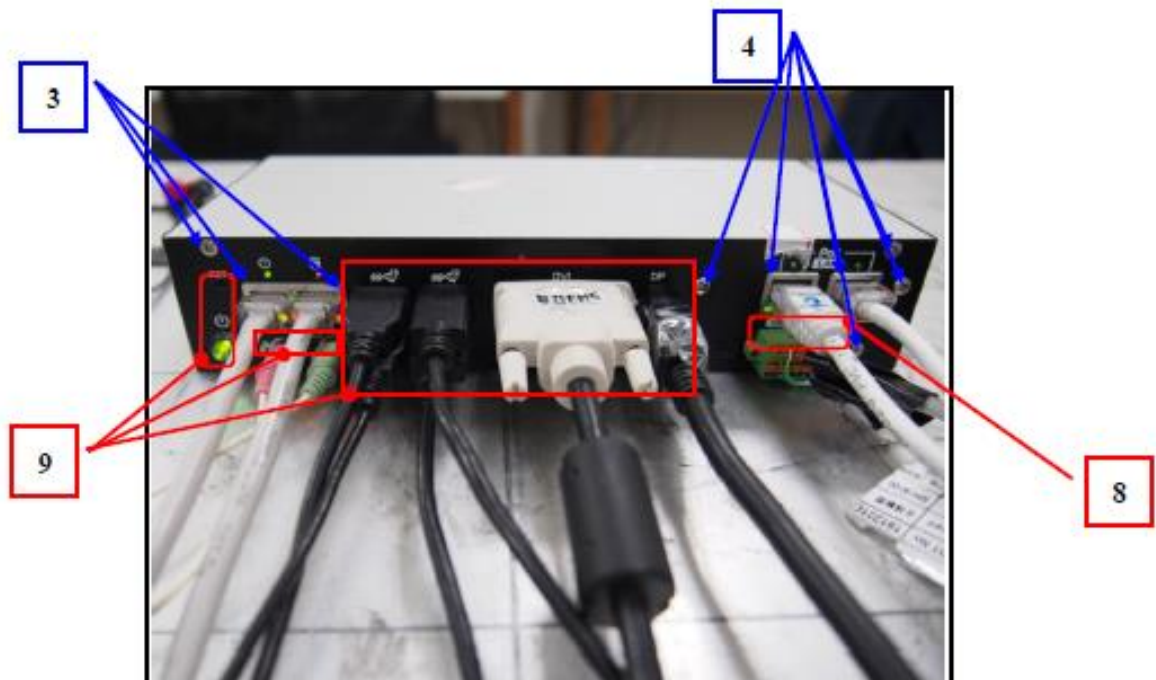
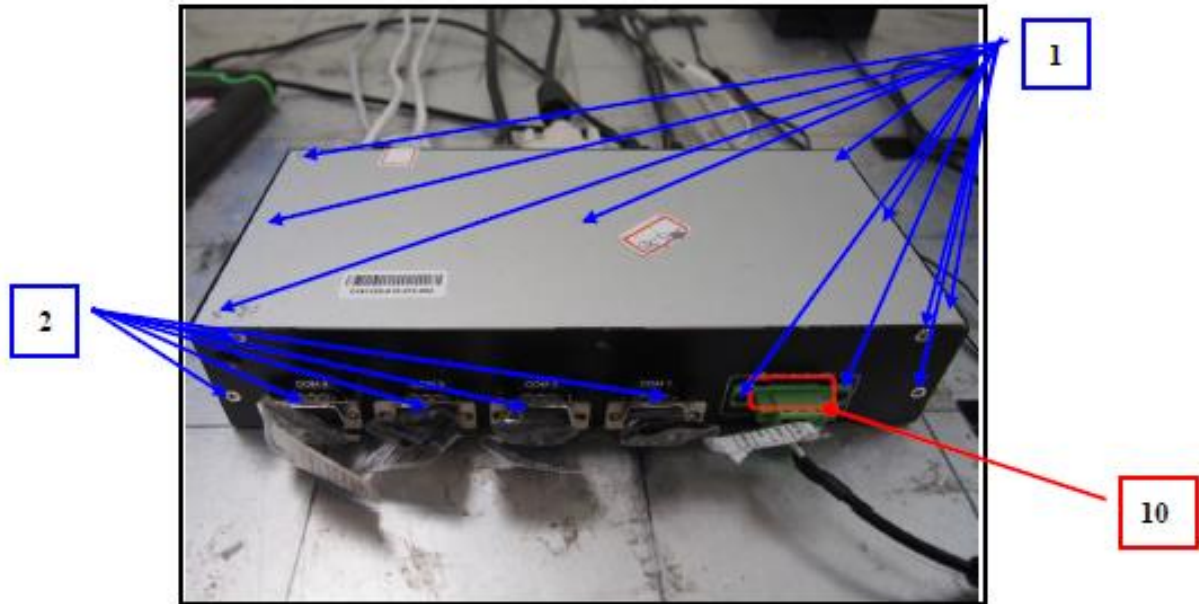
Description of test points of indirect application:

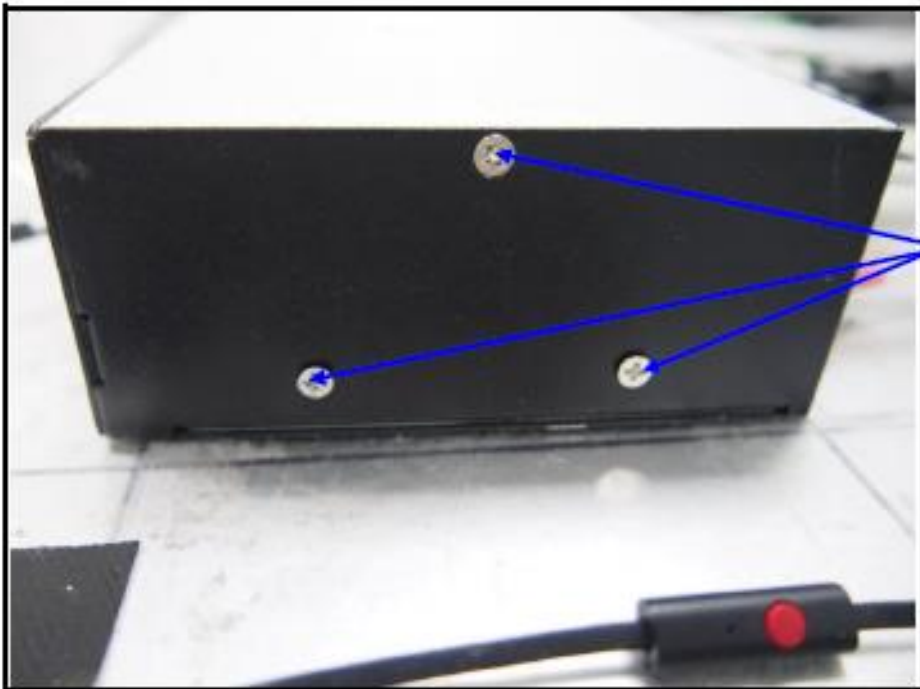
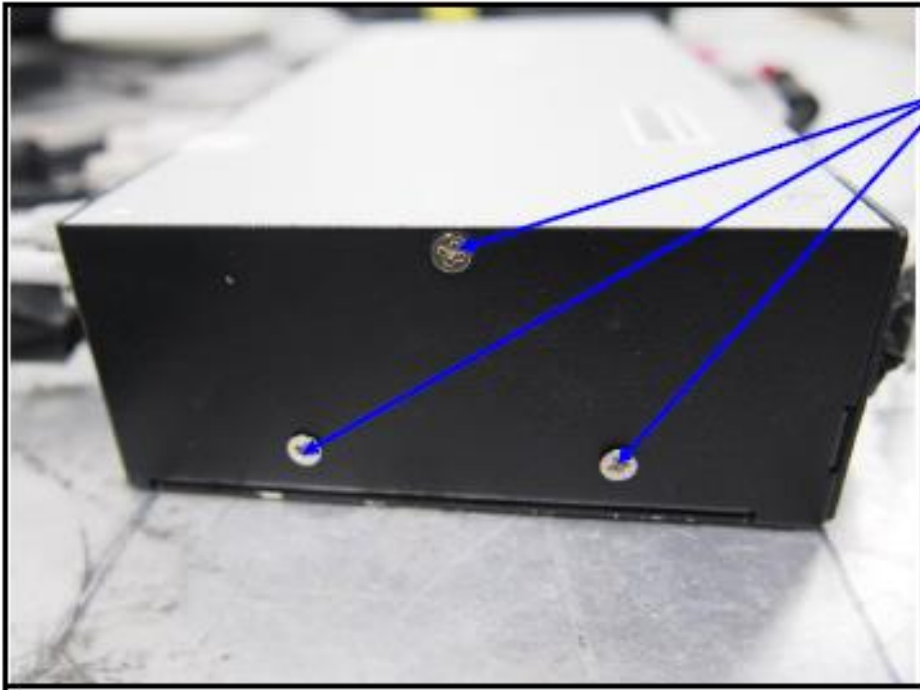
1. Front side 2. Rear side 3. Right side 4. Left side

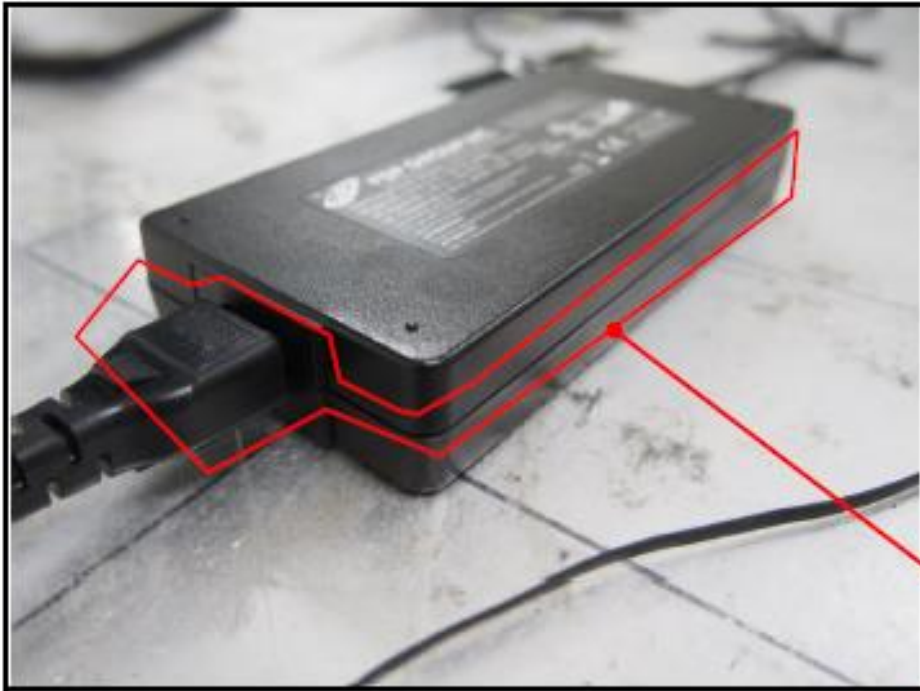
Note: 1. The EUT function was correct during the test.

2. The screen showed flickering line during the test, but could self-recover to the initial operation after the test.

Description of Test Points







7



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

9.1 Test Specification

Basic Standard:	EN 61000-4-3
	80-800 MHz, 20V/m ¹
Frequency Range, Field Strength:	800-1000 MHz, 20V/m
	1400-2000 MHz, 10V/m
	2000-2700 MHz, 5V/m
	5100-6000 MHz, 3V/m
Modulation:	1kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of preceding frequency value
Polarity of Antenna:	Horizontal and Vertical
Antenna Height:	1.55m
Dwell Time:	3 seconds

Note 1: This limit applies to equipment mounted in the passenger compartments, drivers cab or external to the rolling stock (roof, underframe). For equipment mounted in all other areas a severity level of 10 V/m may be used.

9.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
BONN Power Amp	BLMA 1060-100/50D	118694	NA	NA
BBA Power Amp	B250C125	101011	NA	NA
Power Sensor	NRP-Z91	101572	May 22, 2020	May 21, 2021
Power Sensor	NRP-Z91	101573	May 22, 2020	May 21, 2021
Signal Generator	SMB100A	105801	Dec. 03, 2019	Dec. 02, 2020
R&S Software	EMC32 Version 8.52.0	NA	NA	NA
Stacked Log-Per Antenna	STLP9149	9149-141	NA	NA
High GAIN LOG-Periodic Antenna	HL046E	100114	NA	NA

- Notes:
1. The test was performed in Hwa Ya RS Room 2.
 2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
 3. The transmit antenna was located at a distance of 1.5 meters / 3 meters from the EUT.

9.3 Test Arrangement

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

- The testing was performed in a modified semi-anechoic chamber.
- The frequency ranges and field strength levels are 80-800 MHz, 20V/m, 800-1000 MHz, 20V/m, 1000-2200 MHz, 10V/m, 2200-2700 MHz, 5V/m and 5100-6000 MHz, 3V/m with the signal 80% amplitude modulated with a 1kHz sine wave.
- The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.
- For 80 MHz to 1000 MHz, 20V/m, UFA size is in 0.5m*0.5m grid steps.

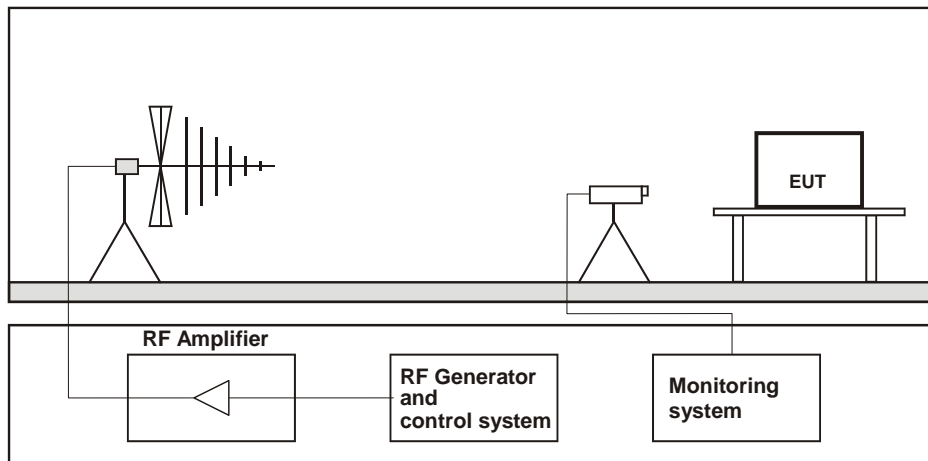


Table-top Equipment

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.

9.4 Test Results

Input Power	230 Vac, 50 Hz	Tested by	Koma Kuo
Environmental Conditions	23 °C, 52% RH	Test Date	2020/05/28
Test Mode	SKU B (EUT Sample no. 013-002)		

Frequency (MHz)	Polarity	Azimuth(°)	Applied Field Strength		Test Distance (m)	Observation	Performance Criterion
			(V/m)	Modulation			
80 - 800	V&H	0, 90, 180, 270	20	80% AM (1kHz)	1.5	Note 1	A
800 - 1000	V&H	0, 90, 180, 270	20	80% AM (1kHz)	1.5	Note 1	A
1400 - 2000	V&H	0, 90, 180, 270	10	80% AM (1kHz)	3	Note 1	A
2000 - 2700	V&H	0, 90, 180, 270	5	80% AM (1kHz)	3	Note 1	A
5100 - 6000	V&H	0, 90, 180, 270	3	80% AM (1kHz)	3	Note 1	A

Note: 1. The EUT function was correct during the test.

10 Electrical Fast Transient/Burst Immunity Test (EFT)

10.1 Test Specification

Basic Standard:	EN 61000-4-4
Test Voltage:	Signal & communication, process measurement & control ports: $\pm 2\text{kV}$, Capacitive clamp Battery referenced ports (except at the output of energy sources), Auxiliary a.c. power input ports (rated voltage $\leq 400\text{ Vrms}$): $\pm 2\text{kV}$
Impulse Repetition Frequency:	5kHz
Impulse Wave Shape:	5/50 (T_r/T_h) ns
Burst Duration:	15 ms
Burst Period:	300 ms
Test Duration:	1 min.

10.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
EFT Generator TESEQ	NSG 3040	2251	Mar. 20, 2020	Mar. 19, 2021
Capacitive Coupling clamp EMC-Partner	CN-EFT1000	364	Mar. 20, 2020	Mar. 19, 2021
EFT Adapter WONPRO	WA	EF1Ada-001	NA	NA
Three-phase coupling decoupling network TESEQ	CDN 3043-C32	5007	Mar. 20, 2020	Mar. 19, 2021

- Notes: 1. The test was performed in Hwa Ya EFT Room 1.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

10.5 Test Results

Input Power	230 Vac, 50 Hz	Tested by	Koma Kuo
Environmental Conditions	25 °C, 55 % RH	Test Date	2020/06/01
Test Mode	SKU B (EUT Sample no. 013-002)		

Input AC power port

Voltage (kV)	Test Point	Polarity (+/-)	Observation	Performance Criterion
2	L1	+/-	Note 1	PASS
2	L2	+/-	Note 1	PASS
2	PE	+/-	Note 1	PASS
2	L1-L2-PE	+/-	Note 1	PASS

Signal / telecommunication port

Voltage (kV)	Test Point	Polarity (+/-)	Observation	Performance Criterion
2	POE LAN 1	+/-	Note 1	PASS
2	LAN 1	+/-	Note 1	PASS

Note: 1. The EUT found disturbance on earphone and mic during the test, but could be self-recoverable after the test. (Test results meets the requirements of manufacturer's Performance Criterion)

11 Surge Immunity Test

11.1 Test Specification

Basic Standard:	EN/IEC 61000-4-5
Wave-Shape:	Auxiliary a.c. power input ports (rated voltage ≤ 400 Vrms): 1.2/50 μ s Open Circuit Voltage 8/20 μ s Short Circuit Current
Test Voltage:	Line to line: ± 0.5 kV, ± 1 kV, Line to ground: ± 0.5 kV, ± 1 kV, ± 2 kV output impedance of 42 Ω (40 Ω and 2 Ω generator) and a coupling capacitance of 0,5 μ F
AC Phase Angle (degree):	0°, 90°, 180°, 270°
Pulse Repetition Rate:	1 time / 60 sec.
Number of Tests:	5 positive and 5 negative at selected points

* This test is only applicable only to ports, which according to the manufacturer's specification, may connect directly to outdoor cables.

** For ports where primary protection is intended, surges are applied at voltages up to 4 kV with the primary protectors fitted. Otherwise the 1 kV test level is applied without primary protection in place.

11.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Universal Surge Coupling De-Coupling Network em test	CNV 508T5	P1508149592	Aug. 20, 2019	Aug. 19, 2020
Universal Surge Coupling De-Coupling Network TESEQ	CDN HSS-2	41008	Aug. 19, 2019	Aug. 18, 2020
Modular Impulse Generator TESEQ	NSG 3060 / CDN 3061	1796 / 1554	Mar. 19, 2020	Mar. 18, 2021
Telecom surge module TESEQ	NSG 3060	1799	Mar. 19, 2020	Mar. 18, 2021

Notes: 1. The test was performed in Hwa Ya Surge Room 1.

2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

11.3 Test Arrangement

a. Input AC/DC Power ports:

The surge is to be applied to the EUT power supply terminals via the capacitive coupling network. Decoupling networks are required in order to avoid possible adverse effects on equipment not under test that may be powered by the same lines, and to provide sufficient decoupling impedance to the surge wave. The power cord between the EUT and the coupling/decoupling networks shall be 2 meters in length (or shorter).

For double-insulated products without PE or external earth connections, the test shall be done in a similar way as for grounded products but without adding any additional external grounded connections. If there are no other possible connections to earth, line-to-ground tests may be omitted.

b. Signal and telecommunication ports,

- Unshielded unsymmetrical interconnection lines:

The surge is applied to the lines via the capacitive coupling. The coupling / decoupling networks shall not influence the specified functional conditions of the EUT. The interconnection line between the EUT and the coupling/decoupling networks shall be 2 meters in length.

- Unshielded symmetrical interconnections communication lines:

The surge is applied to the lines via gas arrestors coupling. Test levels below the ignition point of the coupling arrestor cannot be specified. The interconnection line between the EUT and the coupling/decoupling networks shall be 2 meters in length.

- High speed communications lines

Prior to the test, the correct operation of the port shall be verified; the external connection shall then be removed and the surge applied directly to the port's terminals with no coupling /decoupling network. After the surge, the correct operation of the port shall again be verified.

- Shielded lines:

- Direct application,

The EUT is isolated from ground and the surge is applied to its metallic enclosure; the termination (or auxiliary equipment) at the port(s) under test is grounded. This test applies to equipment with single or multiple shielded cables.

Rules for application of the surge to shielded lines:

- a) Shields grounded at both ends

- The surge injection on the shield.

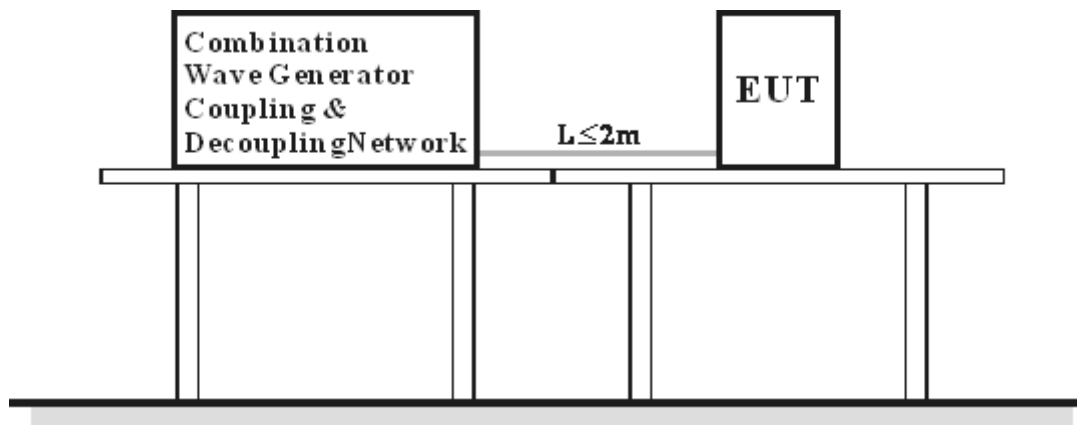
- b) Shields grounded at one end

- If in the installation the shield is connected only at the auxiliary equipment, test shall be done in that configuration but with the generator still connected to the EUT side. If cable lengths allow, the cables shall be on insulated supports 0,1 m above the ground plane or cable tray.

For products which do not have metallic enclosures, the surge is applied directly to the shielded cable.

- Alternative coupling method for testing single cables in a multi-shield configuration,

Surges are applied in close proximity to the interconnection cable under test by a wire. The length of the cable between the port(s) under test and the device attached to the other end of the cable shall be the lesser of: the maximum length permitted by the EUT's specification, or 20 m. Where the length exceeds 1 m, excess lengths of cables shall be bundled at the approximate centre of the cables with the bundles 30 cm to 40 cm in length.



11.4 Test Results

Input Power	230 Vac, 50 Hz	Tested by	Vincent Yang
Environmental Conditions	25 °C, 55 % RH	Test Date	2020/05/28
Test Mode	SKU B (EUT Sample no. 013-002)		

Input AC power port

Voltage (kV)	Test Point	Polarity (+/-)	Observation	Performance Criterion
0.5, 1	L1-L2	+/-	Note 1	A
0.5, 1, 2	L1-PE	+/-	Note 1	A
0.5, 1, 2	L2-PE	+/-	Note 1	A

Note: 1. The EUT function was correct during the test.

12 Immunity to Conducted Disturbances Induced by RF Fields (CS)

12.1 Test Specification

Basic Standard:	EN 61000-4-6
Frequency Range:	0.15 MHz - 80 MHz
Voltage Level:	Battery referenced ports (except at the output of energy sources), Auxiliary a.c. power input ports (rated voltage ≤ 400 Vrms), Signal & communication, process measurement & control ports: 10 V
Modulation:	1kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of preceding frequency value
Dwell Time	3 seconds

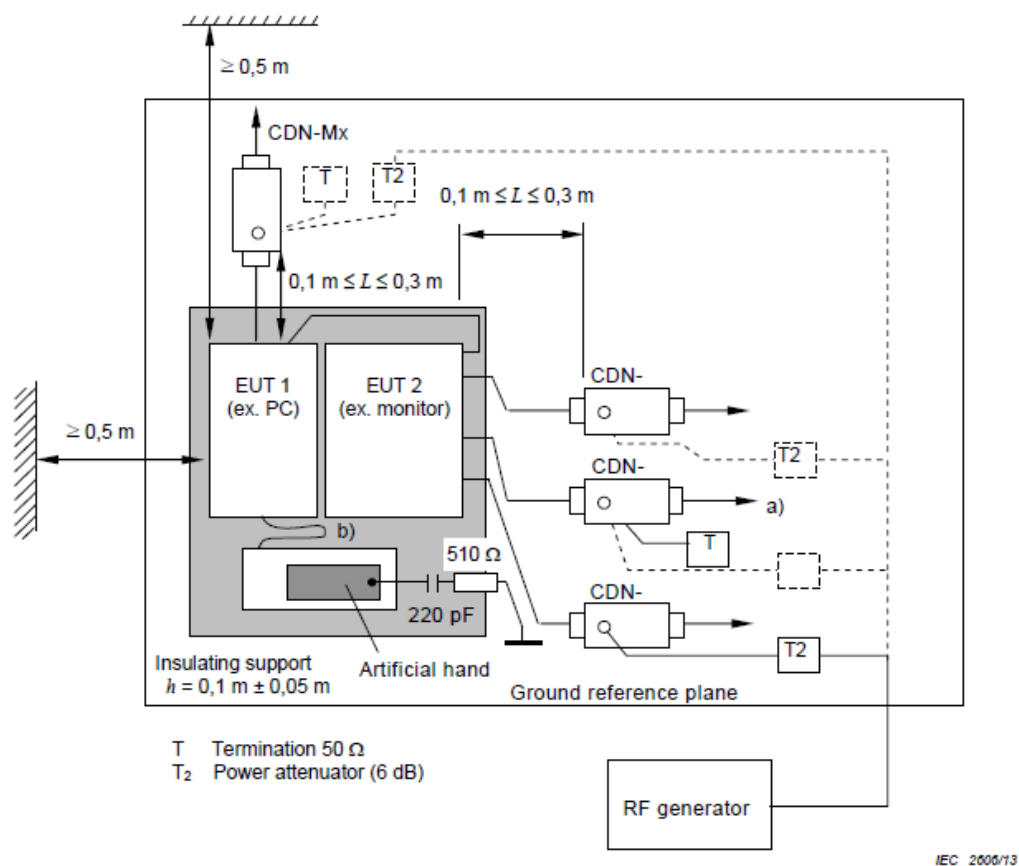
12.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
FCC POWER LINE COUPLING DECOUPLING NETWORK	FCC-801-M3-25A	03056	Mar. 04, 2020	Mar. 03, 2021
FCC SIGNAL LINE POWER LINE COUPLING DECOUPLING NETWORK	F-090407-1004-1	100923	Mar. 05, 2020	Mar. 04, 2021
Coupling Decoupling Network TESEQ	CDN T8-10	43230	Mar. 04, 2020	Mar. 03, 2021
Coupling Decoupling Network TESEQ	CDN T8-10	43229	Mar. 05, 2020	Mar. 04, 2021
Coupling Decoupling Network TESEQ	CDN S751S	35791	Mar. 05, 2020	Mar. 04, 2021
EMI Injection Clamp	F203I-23MM	434	Mar. 31, 2020	Mar. 30, 2021
Amplifier Research Power Amplifier	75A250AM2	307804	NA	NA
Signal Generator ROHDE & SCHWARZ	SMB 100A	105489	Aug. 21, 2019	Aug. 20, 2020
POWER METER BOONTON	4232A	107402	Jul. 08, 2019	Jul. 07, 2020
POWER SENSOR BOONTON	51011-EMC	33105	Jul. 08, 2019	Jul. 07, 2020
POWER SENSOR BOONTON	51011-EMC	33107	Jul. 08, 2019	Jul. 07, 2020
Software	ADT_CS_V37	NA	NA	NA
6dB Attenuator	6NFNF150ATT	NA	NA	NA

- Notes: 1. The test was performed in Hwa Ya CS Room 1.
 2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

12.3 Test Arrangement

- The EUT shall be tested within its intended operating and climatic conditions.
- An artificial hand was placed on the hand-held accessory and connected to the ground reference plane.
- One of the CDNs not used for injection was terminated with 50 ohm, providing only one return path. All other CDNs were coupled as decoupling networks.
- The frequency range is swept from 150 kHz to 80 MHz, using the signal level established during the setting process and with a disturbance signal of 80 % amplitude. The signal is modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or the switch coupling devices as necessary. Where the frequency is swept incrementally, the step size shall not exceed 1 % of the preceding frequency value.
- Attempts should be made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.



- Only one of the CDNs not used for injection shall be terminated with 50 Ω , providing only one return path. All other CDNs shall be configured as decoupling networks.
- Interconnecting cables (≤ 1 m) belonging to the EUT shall remain on the insulating support.

12.4 Test Results

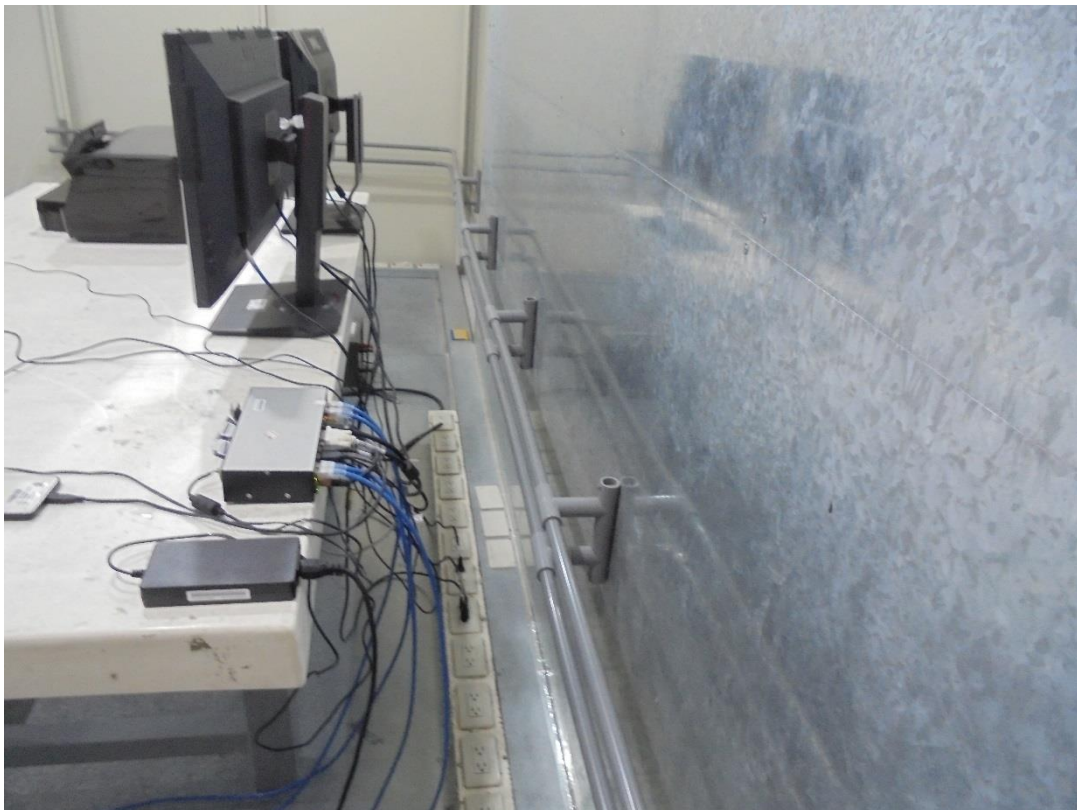
Input Power	230 Vac, 50 Hz	Tested by	Vison Tseng
Environmental Conditions	25 °C, 55 % RH	Test Date	2020/05/28
Test Mode	SKU B (EUT Sample no. 013-002)		

Frequency (MHz)	Level (Vrms)	Tested Line	Injection Method	Return Path	Observation	Performance Criterion
0.15 – 80	10	AC Power	CDN-M3	CDN-T8	Note 1	A
0.15 – 80	10	POE LAN 1	CDN-T8	CDN-M3	Note 1	A
0.15 – 80	10	LAN 1	CDN-T8	CDN-M3	Note 1	A

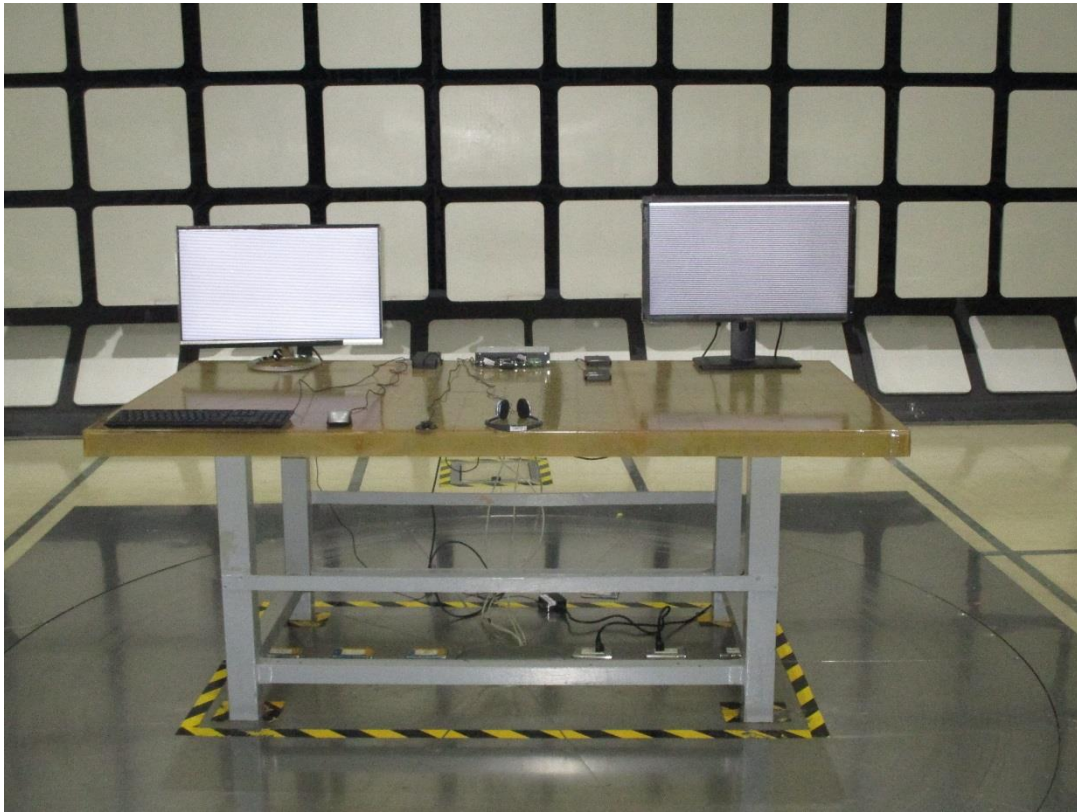
Note: 1. The EUT function was correct during the test.

13 Pictures of Test Arrangements

13.1 Conducted Disturbance at Auxiliary a.c. power ports



13.2 Radiated Disturbance up to 1 GHz



13.3 Radiated Disturbance above 1 GHz



13.4 Electrostatic Discharge Immunity Test (ESD)



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



13.6 Electrical Fast Transient/Burst Immunity Test (EFT)

Mains ports



Signal ports



13.7 Surge Immunity Test



13.8 Conducted Disturbances Induced by RF Fields (CS)

Mains ports



Signal ports



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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