

CE EMC Test Report

Report No.: CE191212C27

Test Model: THL 30-2410WI-HS, THL 30-2411WI-HS, THL 30-2423WI-HS,
THL 30-4810WI-HS, THL 30-4823WI-HS

Series Model: THL 30 Series- *Multiple listing see item 3.1*

Received Date: Oct. 9, 2019

Test Date: Oct. 14 to Dec. 1, 2019

Issued Date: Dec. 16, 2019

Applicant: TRACO ELECTRONIC AG

Address: SIHLBRUGGSTRASSE 111 CH-6340 BAAR, SWITZERLAND

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

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Release Control Record

Issue No.	Description	Date Issued
CE191212C27	Original release.	Dec. 16, 2019

1 Certificate of Conformity

Product: DC to DC Converter
Brand: TRACO
Test Model: THL 30-2410WI-HS, THL 30-2411WI-HS, THL 30-2423WI-HS,
THL 30-4810WI-HS, THL 30-4823WI-HS
Series Model: THL 30 Series- *Multiple listing see item 3.1*
Sample Status: Engineering sample
Applicant: TRACO ELECTRONIC AG
Test Date: Oct. 14 to Dec. 1, 2019
Standards: **EN 55032:2015 +AC:2016, Class A**
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
EN 61000-4-5:2014 +A1:2017 / IEC 61000-4-5:2014 +A1:2017 ED. 3.0
EN 61000-4-6:2014 +AC:2015 / IEC 61000-4-6:2013 ED. 4.0
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)
EN 55035:2017
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
EN 61000-4-5:2014 +A1:2017 / IEC 61000-4-5:2014 +A1:2017 ED. 3.0
EN 61000-4-6:2014 +AC:2015 / IEC 61000-4-6:2013 ED. 4.0
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)
Broadband impulse noise disturbances (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 , **Date:** Dec. 16, 2019
Celia Chen / Supervisor

Approved by : Kenny Meng , **Date:** Dec. 16, 2019
Kenny Meng / Assistant Manager

2 Summary of Test Results

Emission			
Standard	Test Item	Result/Remarks	Verdict
EN 55032:2015 +AC:2016	Conducted emission from the mains power port	Minimum passing Class A margin is -3.07 dB at 28.94875 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 A margin is -2.01 dB at 37.98 MHz	Pass
	Radiated emission above 1GHz	Not applicable because the EUT's highest frequency is below 108 MHz	N/A
EN 61000-3-2:2014	Harmonic current emissions	Test not applicable because port does not exist.	N/A
EN 61000-3-3:2013	Voltage fluctuations and flicker	Test not applicable because 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)	Performance Criterion A	Pass
4.2.5	EN 61000-4-5:2014 +A1:2017 / IEC 61000-4-5:2014 +A1:2017 ED. 3.0	Surges	Performance Criterion A	Pass
4.2.3.3	EN 61000-4-6:2014 +AC:2015 / IEC 61000-4-6:2013 ED. 4.0	Continuous conducted disturbances (CS)	Performance Criterion A	Pass
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	EUT consumes DC power	N/A

Immunity				
EN 55035 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
4.2.2.2	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
4.2.4	EN 61000-4-4:2012 / IEC 61000-4-4:2012 ED. 3.0	Electrical fast transients (EFT)	Performance Criterion A	Pass
4.2.5	EN 61000-4-5:2014 +A1:2017 / IEC 61000-4-5:2014 +A1:2017 ED. 3.0	Surges	Performance Criterion A	Pass
4.2.2.3	EN 61000-4-6:2014 +AC:2015 / IEC 61000-4-6:2013 ED. 4.0	Continuous conducted disturbances (CS)	Performance Criterion A	Pass
4.2.3	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	EUT consumes DC power	N/A
4.2.7	-	Broadband impulse noise disturbances, Repetitive (Applicable only to xDSL ports.)	Without CPE xDSL port of the EUT.	N/A
4.2.7	-	Broadband impulse noise disturbances, Isolated (Applicable only to xDSL ports.)	Without CPE xDSL port of the EUT.	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 disturbance at mains port using AMN, 150kHz ~ 30MHz	2.79 dB	3.4 dB (U_{CISPR})
Radiated disturbance, 30MHz ~ 1GHz	3.78 dB	6.3 dB (U_{CISPR})

The other instruments specified are routine verified to remain within the calibrated levels, no measurement uncertainty is required to be calculated.

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 Description of EUT

Product	DC to DC Converter
Brand	TRACO
Test Model	THL 30-2410WI-HS, THL 30-2411WI-HS, THL 30-2423WI-HS, THL 30-4810WI-HS, THL 30-4823WI-HS
Series Model	THL 30 Series- Multiple listing see below
Model Difference	Refer to note as below
Sample Status	Engineering sample
Operating Software	N/A
Power Supply Rating	Refer to note as below
Accessory Device	N/A
Data Cable Supplied	N/A

Note:

- This report is issued as a duplicate report of BV CPS report no.: CE191009C10. The difference compared with original report are changing applicant, brand and model for marketing purpose; therefore all test data was copied from the original test report.
- The EUT is a DC to DC Converter, the specifications of standard models were listed as below:

THL 30 Series

Model Number		Input Voltage (Range)	Output Voltage
Standard	With heatsink	VDC	VDC
THL 30-2410WI	THL 30-2410WI-HS	24 (9 ~ 36)	3.3
THL 30-2411WI	THL 30-2411WI-HS		5
THL 30-2412WI	THL 30-2412WI-HS		12
THL 30-2413WI	THL 30-2413WI-HS		15
THL 30-2415WI	THL 30-2415WI-HS		24
THL 30-2422WI	THL 30-2422WI-HS		±12
THL 30-2423WI	THL 30-2423WI-HS		±15
THL 30-4810WI	THL 30-4810WI-HS	48 (18 ~ 75)	3.3
THL 30-4811WI	THL 30-4811WI-HS		5
THL 30-4812WI	THL 30-4812WI-HS		12
THL 30-4813WI	THL 30-4813WI-HS		15
THL 30-4815WI	THL 30-4815WI-HS		24
THL 30-4822WI	THL 30-4822WI-HS		±12
THL 30-4823WI	THL 30-4823WI-HS		±15

During the test, the **Model No.: THL 30-2410WI-HS, THL 30-2411WI-HS, THL 30-2423WI-HS, THL 30-4810WI-HS, THL 30-4823WI-HS** were selected as the representative models for the test and therefore only their test data were recorded in this report.

3.2 Features of EUT

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

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

1. The EUT was pre-tested under operating and standby condition and the worst emission level was found under **operating condition**.
2. As client's requirement, test modes are presented in the report as below.

Mode	Model No.	Test Condition	Input Voltage	Output Voltage
			VDC	VDC
Conducted emission, Radiated emission, EFT & Surge tests with external filter according to item 3.6 (1) EMC Solution				
1	THL 30-2410WI-HS	Full Load	24Vdc	3.3
2	THL 30-2411WI-HS			5
3	THL 30-2423WI-HS			±15
4	THL 30-4810WI-HS		48Vdc	3.3
5	THL 30-4823WI-HS			±15
Immunity tests (EFT & Surge tests excluded)				
5	THL 30-4823WI-HS	Full Load	48Vdc	±15

3.4 Test Program Used and Operation Descriptions

◆ **For Conducted & Radiated tests:**

Set the EUT under full load.

◆ **For Immunity tests:**

Connected a resistor load to DC output port of EUT to make EUT have maximum power consumption and a multimeter was used to monitor voltage of output.

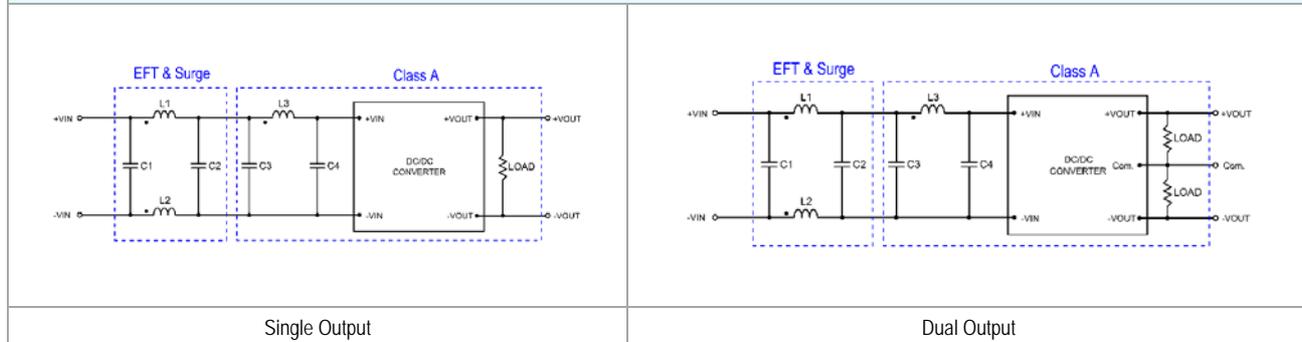
3.5 Primary Clock Frequencies of Internal Source

The highest frequency generated or used within the EUT or on which the EUT operates or tunes is 285kHz, provided by TRACO ELECTRONIC AG, for detailed internal source, please refer to the manufacturer's specifications.

3.6 Package Specifications by Manufacturer

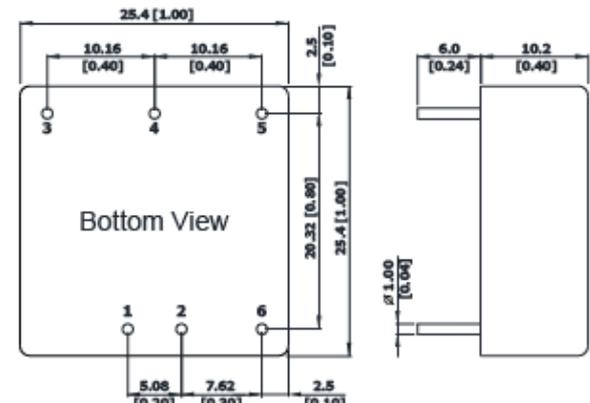
(1) EMC Solution :

External Filter meets EMI EN 55032 , class A



Model	EFT & Surge		Class A		
	C1, C2	L1, L2	C3	L3	C4
THL 30-24XXXX	470uF/50V CHEMI-CON KY Series	2.2uH/4.6A 744774022	10uF/50V 1210 X7R	2.2uH/4.6A 744774022	10uF/50V 1210 X7R
THL 30-48XXXX	220uF/100V CHEMI-CON KY Series	---	4.7uF/100V 1210 X7S	4.7uH/2.4A 7447745047	4.7uF/100V 1210 X7S

(2) Package Specifications :

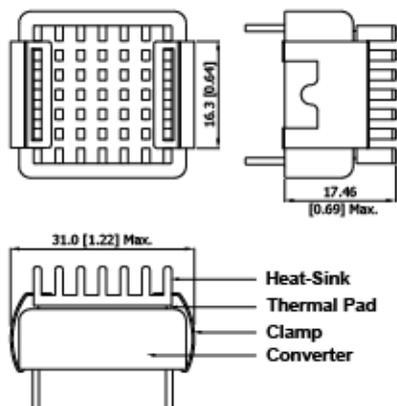
Package Specifications																							
Mechanical Dimensions		Pin Connections																					
 <p>Bottom View</p> <p>Dimensions: 25.4 [1.00] (total width), 10.16 [0.40] (pin spacing), 2.5 [0.10] (pin diameter), 20.32 [0.80] (case height), 25.4 [1.00] (total height), 5.08 [0.20] (pin 1 offset), 7.62 [0.30] (pin 2 offset), 2.5 [0.10] (pin 6 offset), 5.0 [0.24] (side view offset), 10.2 [0.40] (side view width), 1.00 [0.04] (pin diameter).</p>		<table border="1"> <thead> <tr> <th>Pin</th> <th>Single Output</th> <th>Dual Output</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>+Vin</td> <td>+Vin</td> </tr> <tr> <td>2</td> <td>-Vin</td> <td>-Vin</td> </tr> <tr> <td>3</td> <td>+Vout</td> <td>+Vout</td> </tr> <tr> <td>4</td> <td>Trim</td> <td>Common</td> </tr> <tr> <td>5</td> <td>-Vout</td> <td>-Vout</td> </tr> <tr> <td>6</td> <td>Remote On/Off</td> <td>Remote On/Off</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ▶ All dimensions in mm (inches) ▶ Tolerance: X.X±0.5 (X.XX±0.02) X.XX±0.25 (X.XXX±0.01) ▶ Pin diameter $\varnothing 1.0 \pm 0.05$ (0.04±0.002) 	Pin	Single Output	Dual Output	1	+Vin	+Vin	2	-Vin	-Vin	3	+Vout	+Vout	4	Trim	Common	5	-Vout	-Vout	6	Remote On/Off	Remote On/Off
Pin	Single Output	Dual Output																					
1	+Vin	+Vin																					
2	-Vin	-Vin																					
3	+Vout	+Vout																					
4	Trim	Common																					
5	-Vout	-Vout																					
6	Remote On/Off	Remote On/Off																					

Physical Characteristics

Case Size	: 25.4x25.4x10.2mm (1.0x1.0x0.4 inches)
Case Material	: Copper
Base Material	: FR4 PCB (flammability to UL 94V-0 rated)
Pin Material	: Tinned Copper
Weight	: 25g

Heatsink (Option -HS)

Mechanical Dimensions



Heatsink Material: Aluminum
 Finish: Anodic treatment (black)
 Weight: 2g

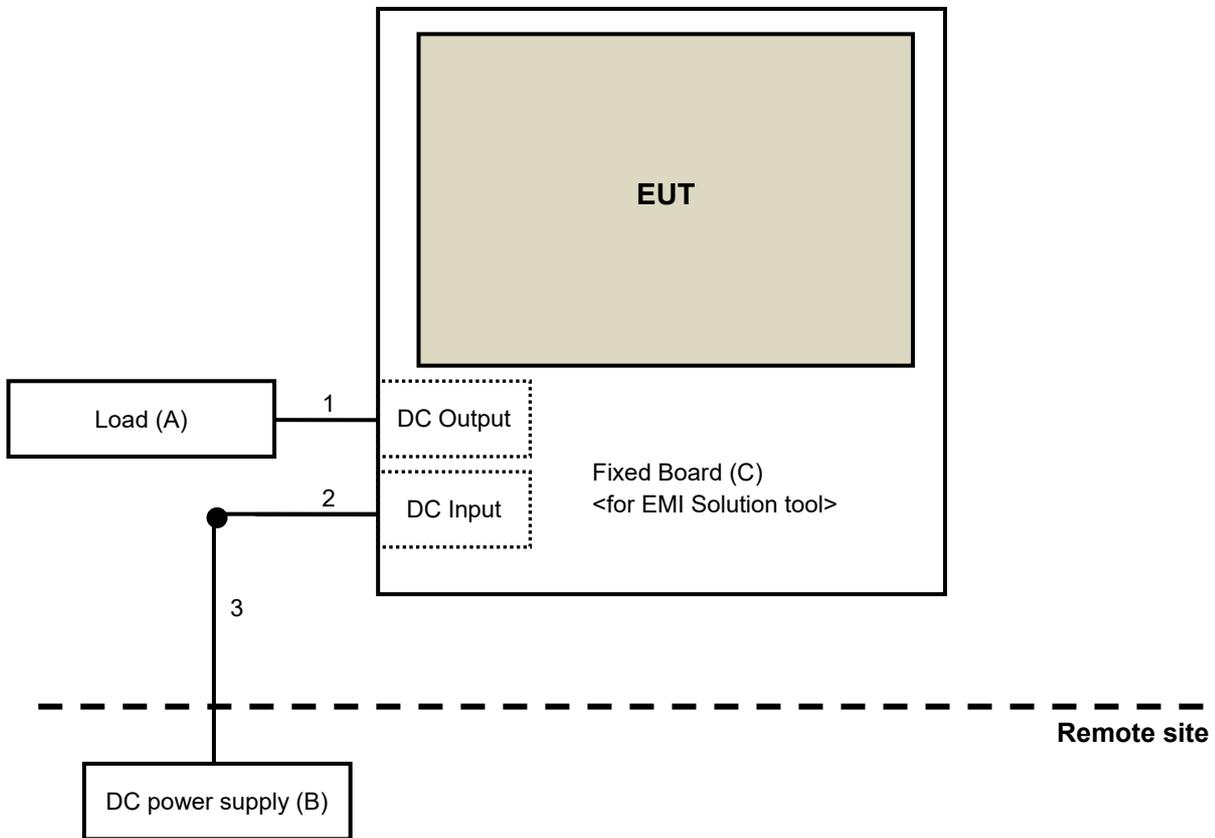
► The advantages of adding a heatsink are:

1. To improve heat dissipation and increase the stability and reliability of the DC-DC converters at high operating temperatures.
2. To increase operating temperature of the DC-DC converter, please refer to Derating Curve.

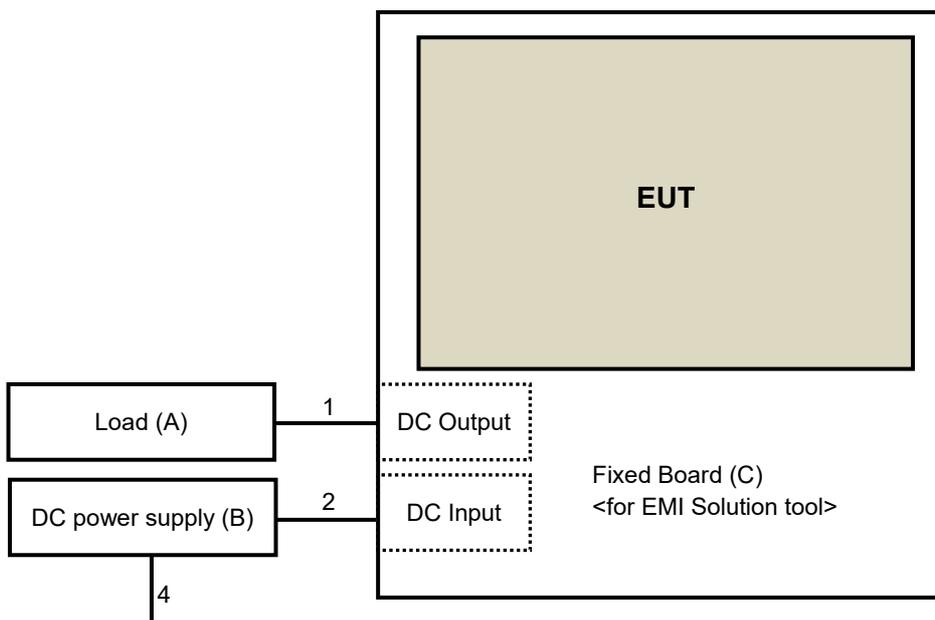
4 Configuration and Connections with EUT

4.1 Connection Diagram of EUT and Peripheral Devices

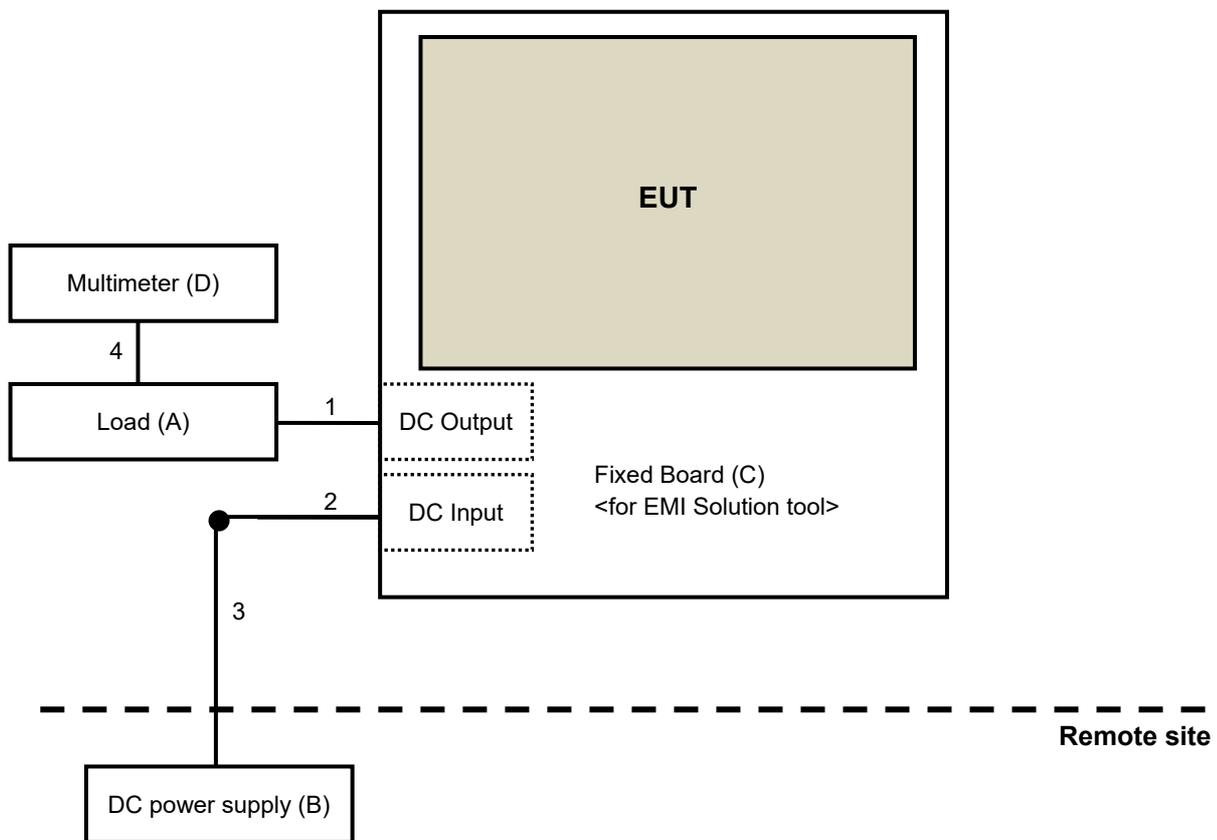
Conducted test:



Radiated test:



Immunity tests:



4.2 Configuration of Peripheral Devices and Cable Connections

Emission tests:

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Load	N/A	N/A	N/A	N/A	Supplied by client
B.	DC Power Supply	GWINSTEK	GPC-6030D	N/A	N/A	Supplied by client
C.	Fixed Board <for EMI Solution tool>	N/A	N/A	N/A	N/A	Supplied by client

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	DC power cable	1	0.2	N	0	Supplied by client
2.	DC power cable	1	0.25	N	0	Supplied by client
3.	DC power cable	1	10	N	0	Provided by Lab
4.	AC power cable	1	1.8	N	0	Provided by Lab

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

Immunity tests:

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Load	N/A	N/A	N/A	N/A	Supplied by client
B.	DC Power Supply	GWINSTEK	GPC-6030D	N/A	N/A	Supplied by client
C.	Fixed Board (ESD test excluded) <for EMI Solution tool>	N/A	N/A	N/A	N/A	Supplied by client
D.	Multimeter	YFE	YF-370A	N/A	N/A	Provided by Lab

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	DC power cable	1	0.2	N	0	Supplied by client
2.	DC power cable	1	0.25	N	0	Supplied by client
3.	DC power cable	1	1.8	N	0	Provided by Lab
4.	Data cable	1	1.0	N	0	Provided by Lab

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

5 Conducted Emission from the Mains Power Port <with external filter according to item 3.6 total solution>

5.1 Limits

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

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

5.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
ROHDE & SCHWARZ TEST RECEIVER	ESR3	102413	Feb. 18, 2019	Feb. 17, 2020
ROHDE & SCHWARZ Artificial Mains Network (for EUT)	ESH2-Z5	100104	Dec. 18, 2018	Dec. 17, 2019
LISN With Adapter (for EUT)	AD10	C09Ada-001	Dec. 18, 2018	Dec. 17, 2019
ROHDE & SCHWARZ Artificial Mains Network (for peripherals)	ESH3-Z5	847265/023	Nov. 5, 2018	Nov. 4, 2019
			Oct. 31, 2019	Oct. 30, 2020
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-C09.01	Aug. 15, 2019	Aug. 14, 2020
SUHNER Terminator (For ROHDE & SCHWARZ LISN)	65BNC-5001	E1-010789	May 13, 2019	May 12, 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. 9.

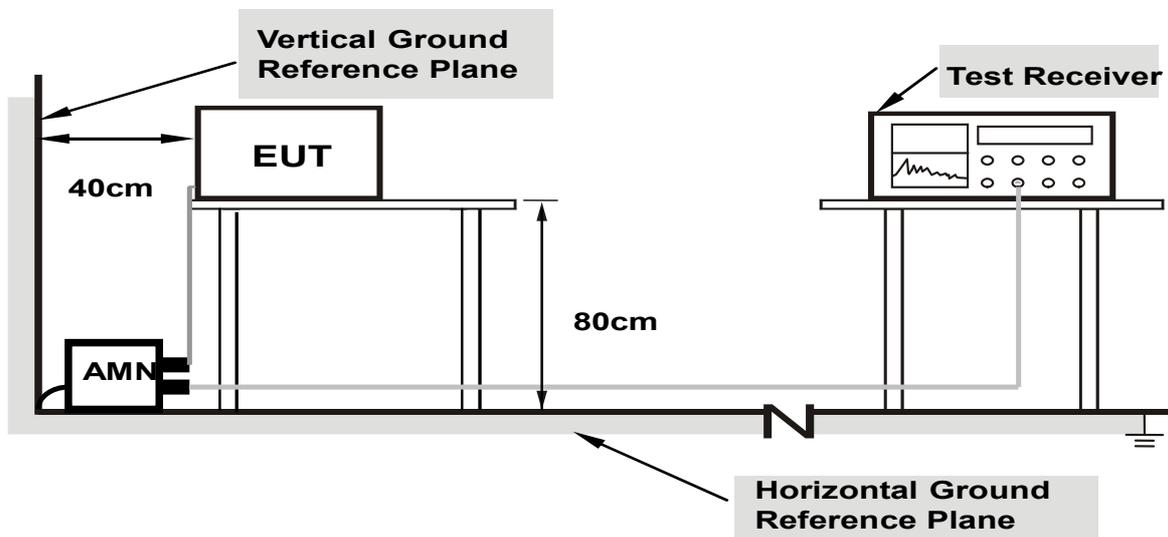
3. The VCCI Site Registration No. C-11312.

4. Tested Date: Oct. 14 to Nov. 5, 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 ≥ 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.

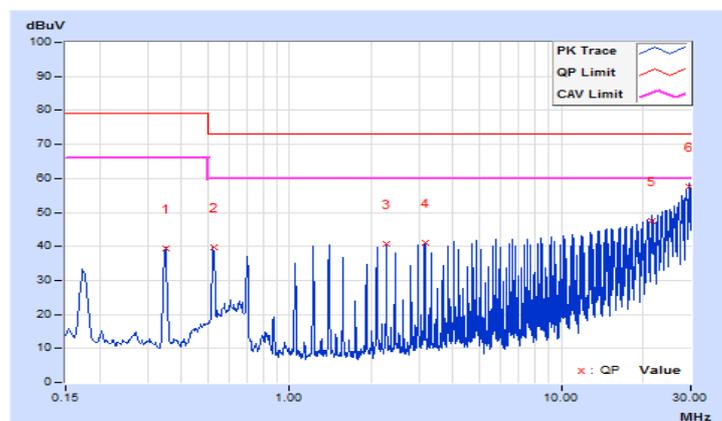
5.4 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	24Vdc	Environmental Conditions	24°C, 70%RH, 1010mbar
Tested by	Chenghan Wu		
Test Mode	Mode 1		

Phase Of Power : Positive (+)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.34941	10.40	28.98	27.06	39.38	37.46	79.00	66.00	-39.62	-28.54
2	0.52446	10.40	29.41	29.34	39.81	39.74	73.00	60.00	-33.19	-20.26
3	2.27223	10.42	30.18	29.25	40.60	39.67	73.00	60.00	-32.40	-20.33
4	3.14607	10.47	30.66	29.72	41.13	40.19	73.00	60.00	-31.87	-19.81
5	21.67133	10.99	36.44	35.25	47.43	46.24	73.00	60.00	-25.57	-13.76
6	29.71120	11.16	46.39	44.27	57.55	55.43	73.00	60.00	-15.45	-4.57

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

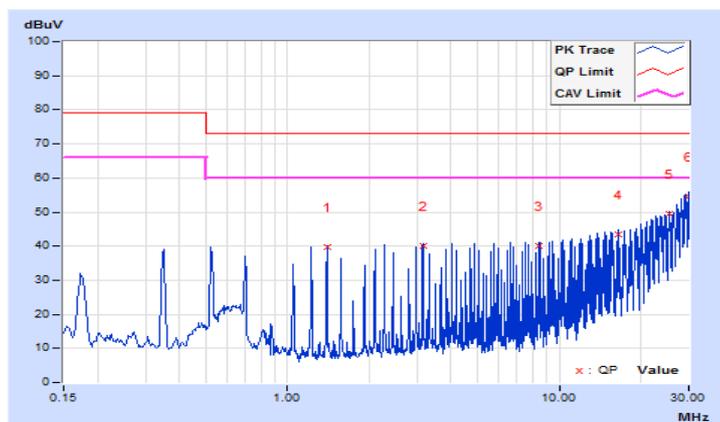


Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	24Vdc	Environmental Conditions	24°C, 70%RH, 1010mbar
Tested by	Chenghan Wu		
Test Mode	Mode 1		

Phase Of Power : Negative (-)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	1.39730	10.40	29.36	28.41	39.76	38.81	73.00	60.00	-33.24	-21.19
2	3.14607	10.48	29.75	28.81	40.23	39.29	73.00	60.00	-32.77	-20.71
3	8.38997	10.65	29.53	29.40	40.18	40.05	73.00	60.00	-32.82	-19.95
4	16.42893	10.93	32.48	31.92	43.41	42.85	73.00	60.00	-29.59	-17.15
5	25.51568	11.19	38.17	36.47	49.36	47.66	73.00	60.00	-23.64	-12.34
6	29.88715	11.27	43.13	40.93	54.40	52.20	73.00	60.00	-18.60	-7.80

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

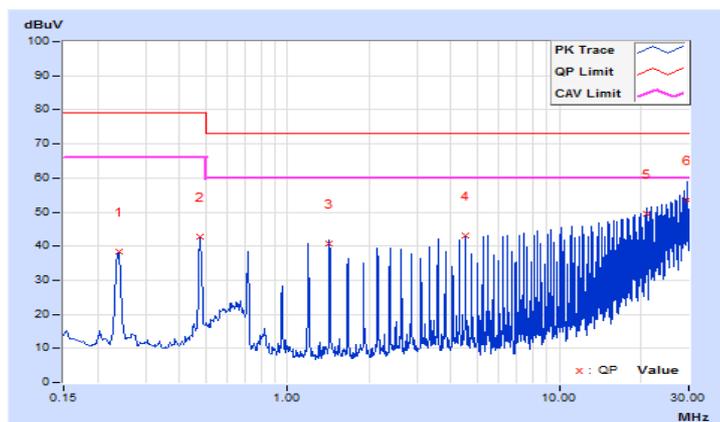


Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	24Vdc	Environmental Conditions	24°C, 70%RH, 1010mbar
Tested by	Chenghan Wu		
Test Mode	Mode 2		

Phase Of Power : Positive (+)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.23898	10.40	27.94	27.02	38.34	37.42	79.00	66.00	-40.66	-28.58
2	0.47688	10.40	32.23	32.16	42.63	42.56	79.00	66.00	-36.37	-23.44
3	1.43058	10.39	30.44	30.40	40.83	40.79	73.00	60.00	-32.17	-19.21
4	4.53021	10.52	32.61	32.60	43.13	43.12	73.00	60.00	-29.87	-16.88
5	20.98408	10.97	38.48	36.46	49.45	47.43	73.00	60.00	-23.55	-12.57
6	29.80504	11.17	42.49	38.11	53.66	49.28	73.00	60.00	-19.34	-10.72

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

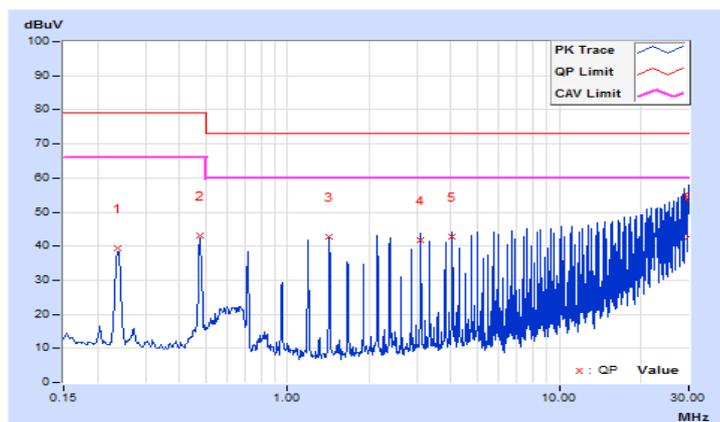


Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	24Vdc	Environmental Conditions	24°C, 70%RH, 1010mbar
Tested by	Chenghan Wu		
Test Mode	Mode 2		

Phase Of Power : Negative (-)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.23798	10.40	28.83	28.81	39.23	39.21	79.00	66.00	-39.77	-26.79
2	0.47653	10.41	32.52	32.46	42.93	42.87	79.00	66.00	-36.07	-23.13
3	1.42904	10.40	32.47	32.43	42.87	42.83	73.00	60.00	-30.13	-17.17
4	3.09724	10.47	31.34	31.26	41.81	41.73	73.00	60.00	-31.19	-18.27
5	4.04937	10.52	32.40	32.38	42.92	42.90	73.00	60.00	-30.08	-17.10
6	29.99663	11.27	31.48	25.85	42.75	37.12	73.00	60.00	-30.25	-22.88

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

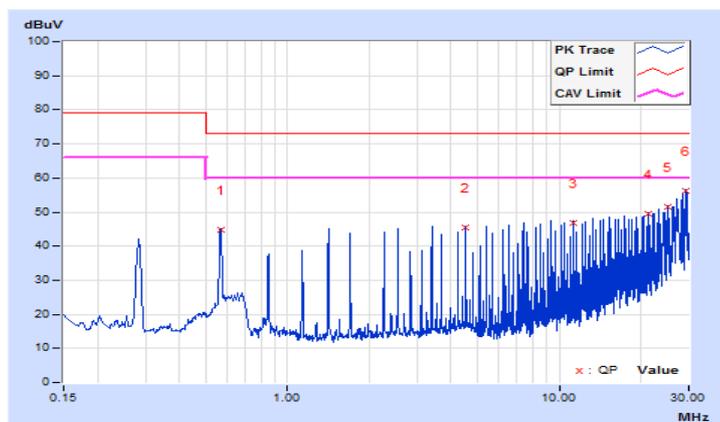


Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	24Vdc	Environmental Conditions	23°C, 75%RH, 1007mbar
Tested by	ED. Lin		
Test Mode	Mode 3		

Phase Of Power : Positive (+)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.56647	10.39	34.45	34.39	44.84	44.78	73.00	60.00	-28.16	-15.22
2	4.53473	10.52	34.78	34.73	45.30	45.25	73.00	60.00	-27.70	-14.75
3	11.33811	10.71	36.22	35.56	46.93	46.27	73.00	60.00	-26.07	-13.73
4	21.26178	10.98	38.62	37.76	49.60	48.74	73.00	60.00	-23.40	-11.26
5	25.23452	11.08	40.39	39.65	51.47	50.73	73.00	60.00	-21.53	-9.27
6	29.19517	11.15	45.10	44.04	56.25	55.19	73.00	60.00	-16.75	-4.81

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

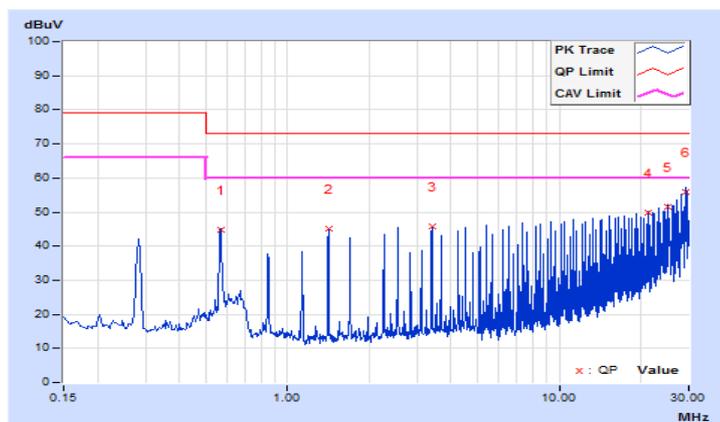


Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	24Vdc	Environmental Conditions	23°C, 75%RH, 1007mbar
Tested by	ED. Lin		
Test Mode	Mode 3		

Phase Of Power : Negative (-)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.56647	10.40	34.34	34.28	44.74	44.68	73.00	60.00	-28.26	-15.32
2	1.41594	10.40	34.87	34.64	45.27	45.04	73.00	60.00	-27.73	-14.96
3	3.39931	10.49	35.35	35.13	45.84	45.62	73.00	60.00	-27.16	-14.38
4	21.24732	11.09	38.84	38.26	49.93	49.35	73.00	60.00	-23.07	-10.65
5	25.21615	11.18	40.49	39.64	51.67	50.82	73.00	60.00	-21.33	-9.18
6	29.16389	11.25	44.73	41.84	55.98	53.09	73.00	60.00	-17.02	-6.91

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

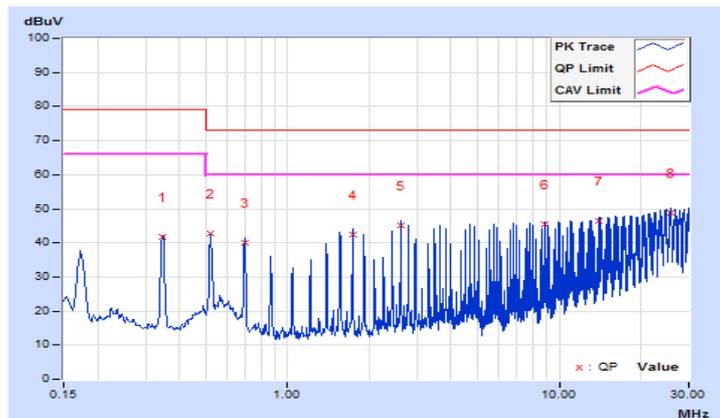


Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	48Vdc	Environmental Conditions	24°C, 73%RH, 104mbar
Tested by	Chenghan Wu		
Test Mode	Mode 4		

Phase Of Power : Positive (+)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.34826	10.40	31.32	31.19	41.72	41.59	79.00	66.00	-37.28	-24.41
2	0.52155	10.40	32.29	32.16	42.69	42.56	73.00	60.00	-30.31	-17.44
3	0.69550	10.39	29.72	29.24	40.11	39.63	73.00	60.00	-32.89	-20.37
4	1.73847	10.40	32.17	32.02	42.57	42.42	73.00	60.00	-30.43	-17.58
5	2.60749	10.44	34.74	34.22	45.18	44.66	73.00	60.00	-27.82	-15.34
6	8.86799	10.64	34.86	34.73	45.50	45.37	73.00	60.00	-27.50	-14.63
7	14.08293	10.78	35.84	34.51	46.62	45.29	73.00	60.00	-26.38	-14.71
8	25.73682	11.09	37.71	35.86	48.80	46.95	73.00	60.00	-24.20	-13.05

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

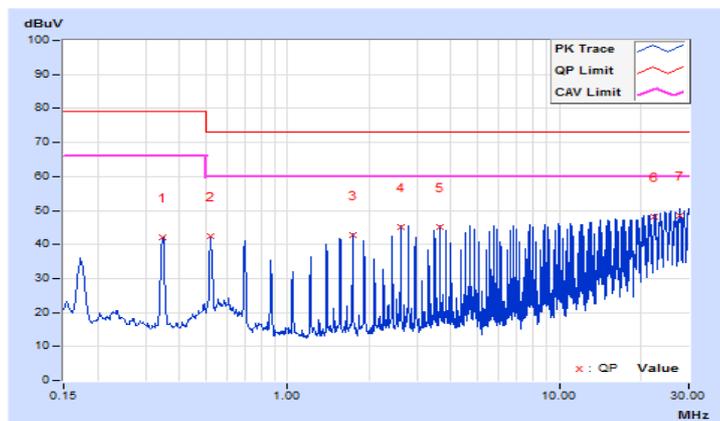


Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	48Vdc	Environmental Conditions	24°C, 73%RH, 104mbar
Tested by	Chenghan Wu		
Test Mode	Mode 4		

Phase Of Power : Negative (-)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.34741	10.41	31.52	31.41	41.93	41.82	79.00	66.00	-37.07	-24.18
2	0.52267	10.40	31.99	31.94	42.39	42.34	73.00	60.00	-30.61	-17.66
3	1.73947	10.41	32.44	32.16	42.85	42.57	73.00	60.00	-30.15	-17.43
4	2.60949	10.45	34.80	34.52	45.25	44.97	73.00	60.00	-27.75	-15.03
5	3.65146	10.50	34.47	34.36	44.97	44.86	73.00	60.00	-28.03	-15.14
6	22.43869	11.12	36.91	35.71	48.03	46.83	73.00	60.00	-24.97	-13.17
7	27.83158	11.23	37.40	35.43	48.63	46.66	73.00	60.00	-24.37	-13.34

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

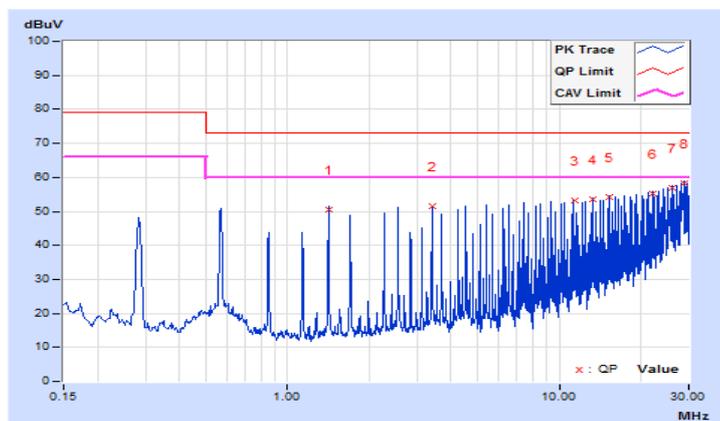


Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	48Vdc	Environmental Conditions	24°C, 73%RH, 104mbar
Tested by	Chenghan Wu		
Test Mode	Mode 5		

Phase Of Power : Positive (+)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	1.41878	10.39	40.01	39.92	50.40	50.31	73.00	60.00	-22.60	-9.69
2	3.40513	10.48	41.09	41.00	51.57	51.48	73.00	60.00	-21.43	-8.52
3	11.35084	10.71	42.63	42.46	53.34	53.17	73.00	60.00	-19.66	-6.83
4	13.33903	10.76	42.83	42.50	53.59	53.26	73.00	60.00	-19.41	-6.74
5	15.32431	10.82	43.40	43.00	54.22	53.82	73.00	60.00	-18.78	-6.18
6	22.13553	11.00	44.34	43.65	55.34	54.65	73.00	60.00	-17.66	-5.35
7	26.11009	11.10	45.94	44.66	57.04	55.76	73.00	60.00	-15.96	-4.24
8	28.94875	11.15	47.12	45.78	58.27	56.93	73.00	60.00	-14.73	-3.07

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

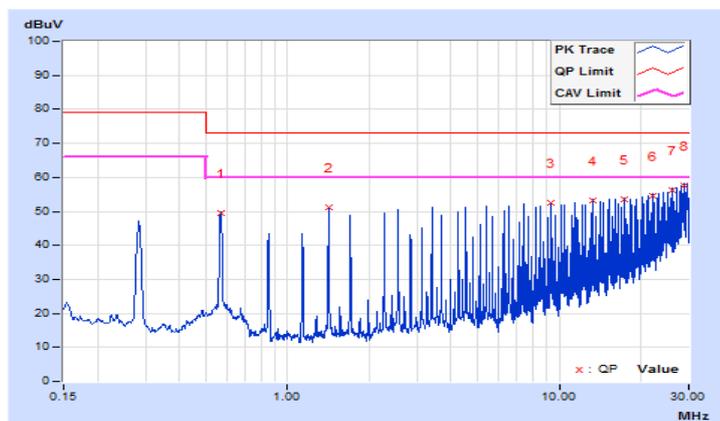


Frequency Range	150kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	48Vdc	Environmental Conditions	24°C, 73%RH, 104mbar
Tested by	Chenghan Wu		
Test Mode	Mode 5		

Phase Of Power : Negative (-)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.56747	10.40	39.14	39.08	49.54	49.48	73.00	60.00	-23.46	-10.52
2	1.41878	10.40	40.68	40.41	51.08	50.81	73.00	60.00	-21.92	-9.19
3	9.36747	10.68	41.75	41.66	52.43	52.34	73.00	60.00	-20.57	-7.66
4	13.34194	10.82	42.31	42.05	53.13	52.87	73.00	60.00	-19.87	-7.13
5	17.31550	10.96	42.48	41.99	53.44	52.95	73.00	60.00	-19.56	-7.05
6	22.14335	11.11	43.47	42.53	54.58	53.64	73.00	60.00	-18.42	-6.36
7	26.11591	11.20	44.88	43.39	56.08	54.59	73.00	60.00	-16.92	-5.41
8	28.95457	11.25	46.31	44.46	57.56	55.71	73.00	60.00	-15.44	-4.29

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 <with external filter according to item 3.6 total solution>

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 Preamplifier	EMC9135	980326	Feb. 20, 2019	Feb. 19, 2020
EMCI Preamplifier	EMC9135	980327	Feb. 20, 2019	Feb. 19, 2020
Agilent Test Receiver	N9038A	MY50010158	Oct. 8, 2019	Oct. 7, 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. 27, 2019	Sep. 26, 2020
JYEBAO RF cable With 5dB PAD	LMR-600	CABLE-CH8-02.H	Sep. 27, 2019	Sep. 26, 2020
WOKEN RF cable With 5dB PAD	8D	CABLE-CH8-03.3M	Sep. 27, 2019	Sep. 26, 2020

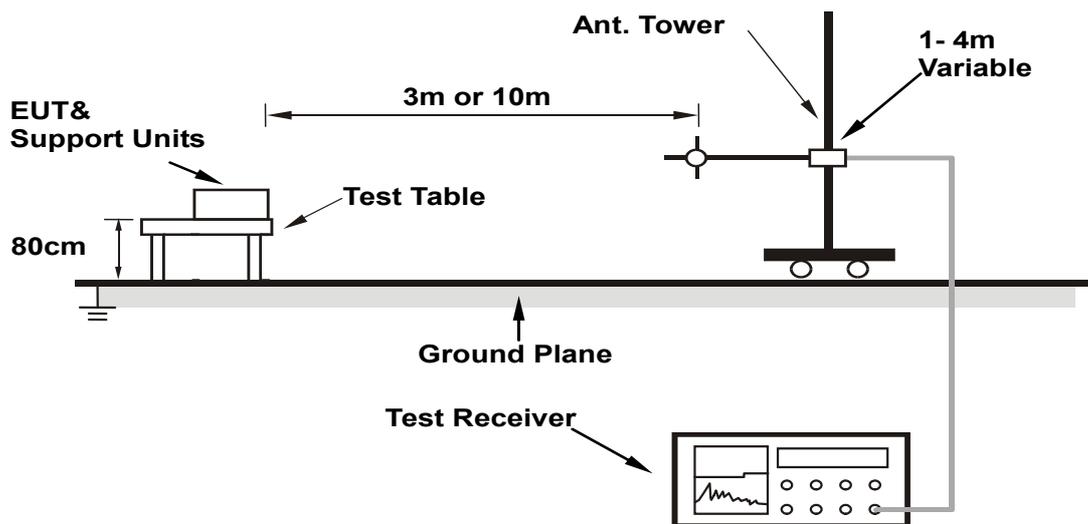
- Note:
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
 2. The test was performed in Chamber No. 8.
 3. The VCCI Site Registration No. R-12946.
 4. Tested Date: Oct. 25 to 29, 2019

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

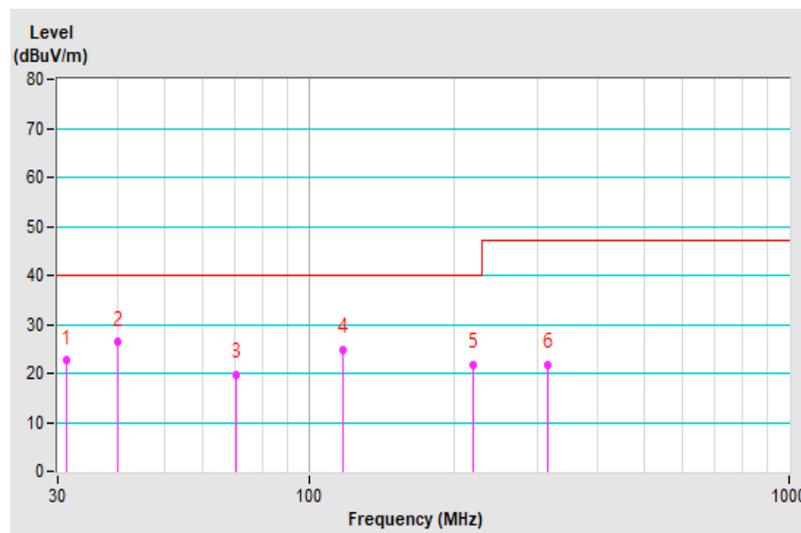
Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	24Vdc	Environmental Conditions	25°C, 68%RH, 1008mbar
Tested by	Vhenson Huang		
Test Mode	Mode 1		

Antenna Polarity & Test Distance : Horizontal at 10 m

No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	31.33	22.55 QP	40.00	-17.45	4.00 H	74	41.79	-19.24
2	40.09	26.29 QP	40.00	-13.71	4.00 H	39	44.39	-18.10
3	70.79	19.63 QP	40.00	-20.37	4.00 H	120	38.97	-19.34
4	117.37	24.83 QP	40.00	-15.17	4.00 H	54	43.66	-18.83
5	219.34	21.80 QP	40.00	-18.20	4.00 H	59	40.04	-18.24
6	313.34	21.70 QP	47.00	-25.30	3.36 H	198	36.35	-14.65

Remarks:

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

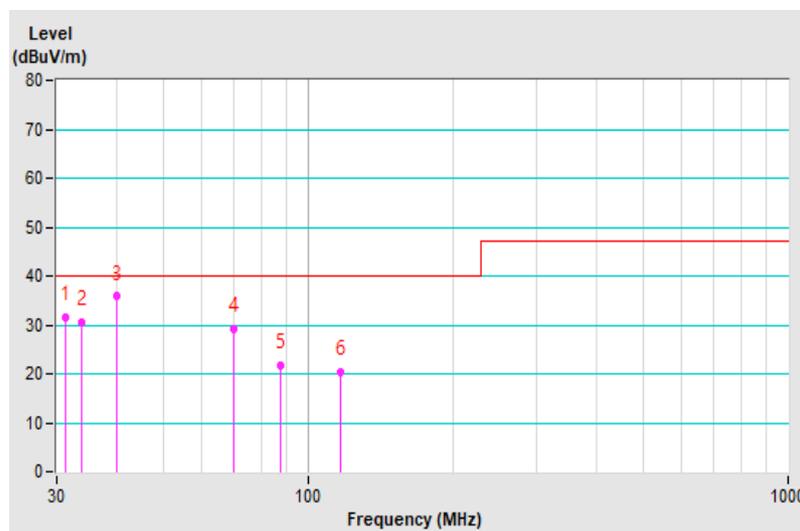


Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	24Vdc	Environmental Conditions	25°C, 68%RH, 1008mbar
Tested by	Vhenson Huang		
Test Mode	Mode 1		

Antenna Polarity & Test Distance : Vertical at 10 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	31.31	31.54 QP	40.00	-8.46	1.11 V	212	51.56	-20.02
2	33.90	30.59 QP	40.00	-9.41	1.52 V	91	50.11	-19.52
3	40.11	35.81 QP	40.00	-4.19	1.28 V	49	54.60	-18.79
4	70.23	29.32 QP	40.00	-10.68	2.06 V	189	49.22	-19.90
5	87.86	21.70 QP	40.00	-18.30	1.60 V	146	44.46	-22.76
6	116.81	20.41 QP	40.00	-19.59	1.00 V	150	39.93	-19.52

Remarks:

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

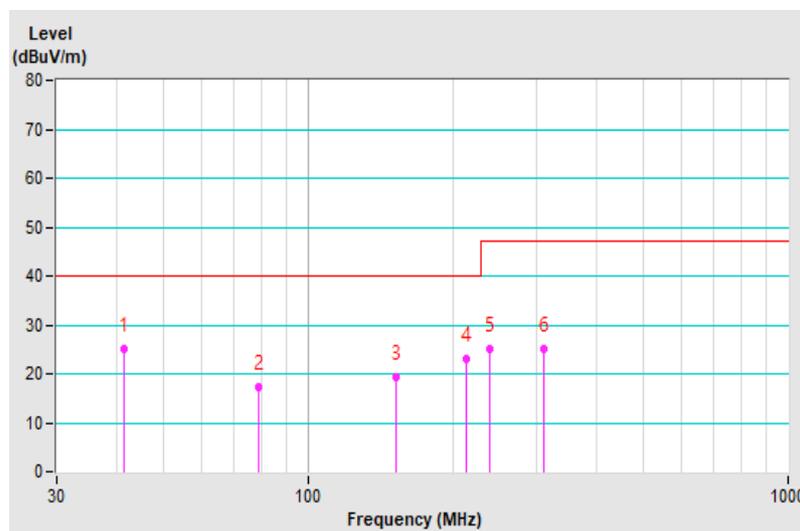


Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	24Vdc	Environmental Conditions	25°C, 65%RH, 1007mbar
Tested by	Vincent Lin		
Test Mode	Mode 2		

Antenna Polarity & Test Distance : Horizontal at 10 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	41.30	25.06 QP	40.00	-14.94	4.00 H	205	42.87	-17.81
2	79.23	17.45 QP	40.00	-22.55	3.00 H	173	38.73	-21.28
3	152.85	19.32 QP	40.00	-20.68	4.00 H	16	35.63	-16.31
4	214.30	23.15 QP	40.00	-16.85	4.00 H	193	41.51	-18.36
5	239.54	25.02 QP	47.00	-21.98	3.00 H	177	42.14	-17.12
6	310.40	25.17 QP	47.00	-21.83	4.00 H	167	39.91	-14.74

Remarks:

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

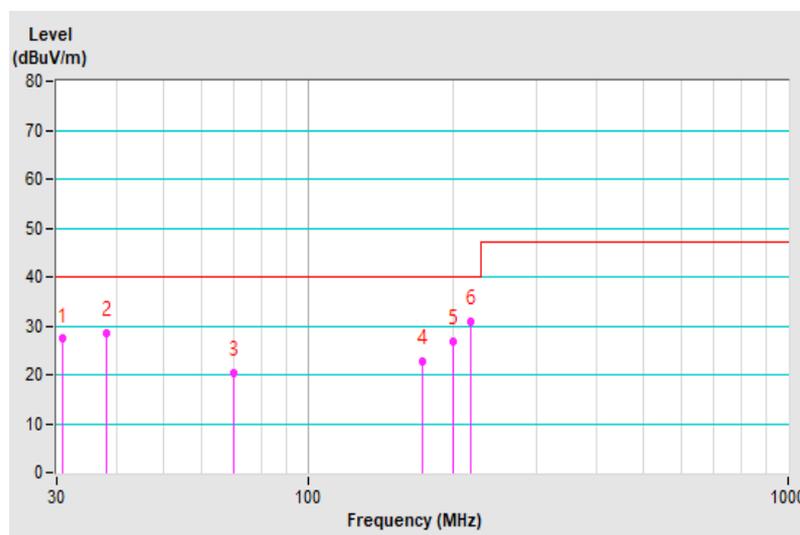


Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	24Vdc	Environmental Conditions	25°C, 65%RH, 1007mbar
Tested by	Vincent Lin		
Test Mode	Mode 2		

Antenna Polarity & Test Distance : Vertical at 10 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	31.04	23.08 QP	40.00	-16.92	1.00 V	22	43.15	-20.07
2	41.30	33.27 QP	40.00	-6.73	1.00 V	70	51.77	-18.50
3	121.08	17.02 QP	40.00	-22.98	1.00 V	278	35.91	-18.89
4	161.27	15.85 QP	40.00	-24.15	2.00 V	283	32.40	-16.55
5	239.67	20.39 QP	47.00	-26.61	1.00 V	132	38.00	-17.61
6	340.01	21.13 QP	47.00	-25.87	1.00 V	116	35.78	-14.65
7	340.01	21.13 QP	47.00	-25.87	1.00 V	116	35.78	-14.65

Remarks:

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

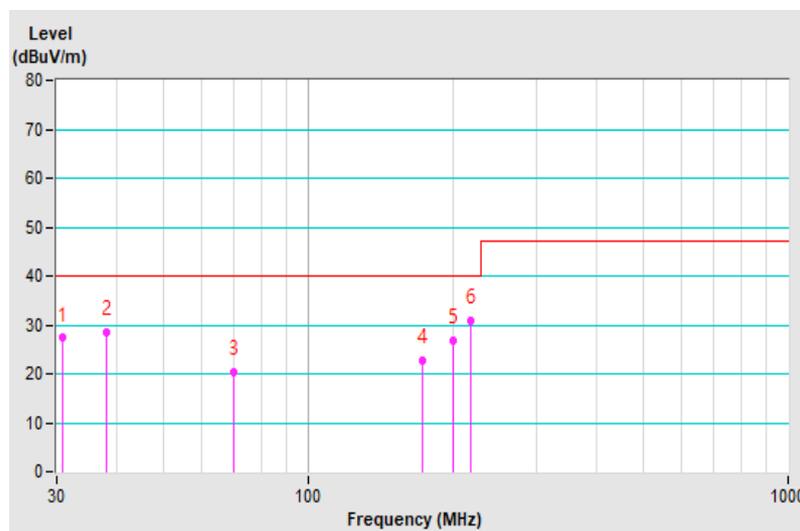


Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	24Vdc	Environmental Conditions	25°C, 68%RH, 1008mbar
Tested by	Vhenson Huang		
Test Mode	Mode 3		

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	30.80	27.36 QP	40.00	-12.64	4.00 H	38	46.63	-19.27
2	37.98	28.61 QP	40.00	-11.39	4.00 H	7	46.94	-18.33
3	70.13	20.38 QP	40.00	-19.62	4.00 H	261	39.58	-19.20
4	173.34	22.87 QP	40.00	-17.13	4.00 H	48	39.53	-16.66
5	200.62	26.83 QP	40.00	-13.17	4.00 H	186	45.34	-18.51
6	217.79	30.81 QP	40.00	-9.19	4.00 H	307	49.09	-18.28

Remarks:

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

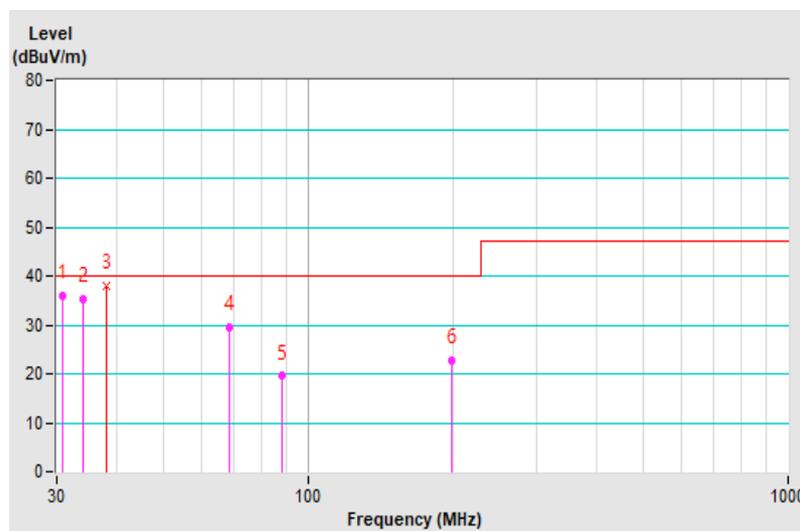


Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	24Vdc	Environmental Conditions	25°C, 68%RH, 1008mbar
Tested by	Vhenson Huang		
Test Mode	Mode 3		

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	30.80	35.91 QP	40.00	-4.09	1.36 V	132	55.96	-20.05
2	33.98	35.28 QP	40.00	-4.72	1.24 V	30	54.77	-19.49
3	37.98	37.99 QP	40.00	-2.01	1.11 V	44	57.02	-19.03
4	68.53	29.49 QP	40.00	-10.51	2.07 V	354	49.21	-19.72
5	88.64	19.53 QP	40.00	-20.47	1.53 V	275	42.25	-22.72
6	199.00	22.64 QP	40.00	-17.36	1.00 V	10	41.70	-19.06

Remarks:

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

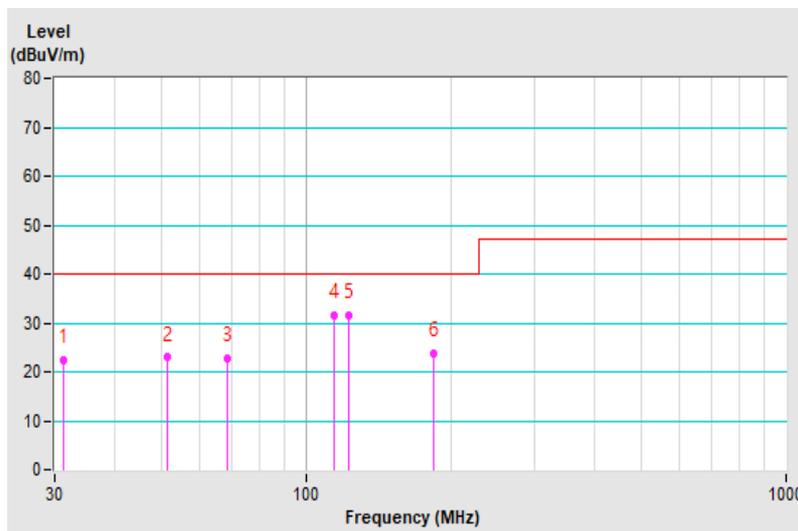


Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	48Vdc	Environmental Conditions	25°C, 68%RH, 1008mbar
Tested by	Vhenson Huang		
Test Mode	Mode 4		

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	31.24	22.30 QP	40.00	-17.70	4.00 H	74	41.56	-19.26
2	51.34	22.94 QP	40.00	-17.06	4.00 H	27	40.27	-17.33
3	68.51	22.66 QP	40.00	-17.34	4.00 H	238	41.70	-19.04
4	114.61	31.54 QP	40.00	-8.46	4.00 H	74	50.67	-19.13
5	123.10	31.67 QP	40.00	-8.33	4.00 H	42	49.97	-18.30
6	183.96	23.74 QP	40.00	-16.26	4.00 H	51	41.56	-17.82

Remarks:

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

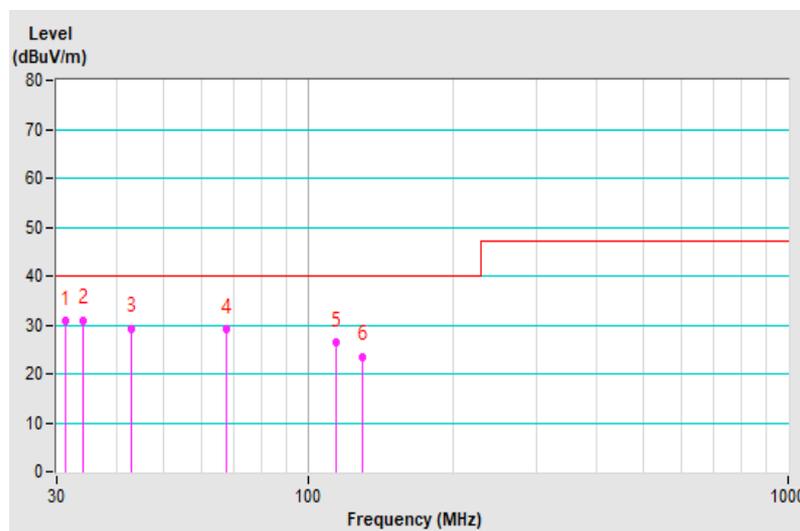


Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	48Vdc	Environmental Conditions	25°C, 68%RH, 1008mbar
Tested by	Vhenson Huang		
Test Mode	Mode 4		

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	31.29	30.76 QP	40.00	-9.24	2.18 V	281	50.78	-20.02
2	34.10	30.97 QP	40.00	-9.03	1.86 V	116	50.46	-19.49
3	42.76	29.15 QP	40.00	-10.85	1.06 V	1	47.56	-18.41
4	67.76	28.99 QP	40.00	-11.01	2.25 V	213	48.41	-19.42
5	114.80	26.30 QP	40.00	-13.70	1.00 V	332	46.07	-19.77
6	129.69	23.36 QP	40.00	-16.64	1.00 V	332	41.44	-18.08

Remarks:

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

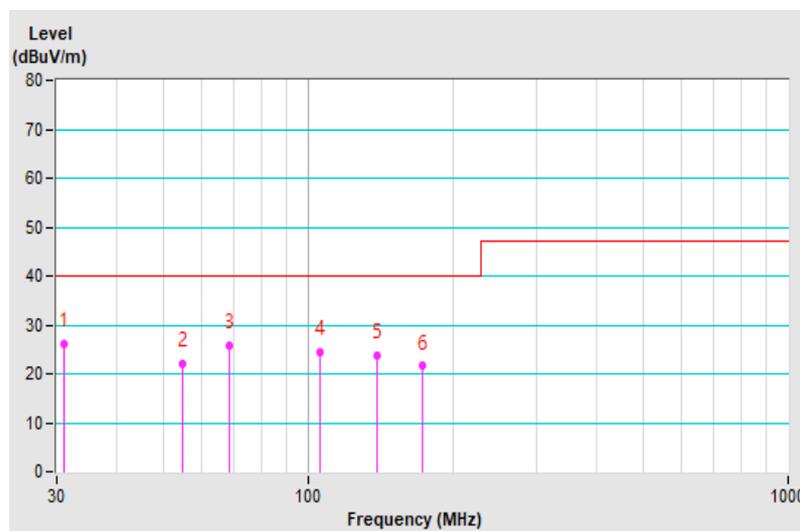


Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	48Vdc	Environmental Conditions	25°C, 68%RH, 1008mbar
Tested by	Vhenson Huang		
Test Mode	Mode 5		

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	30.97	26.22 QP	40.00	-13.78	4.00 H	38	45.52	-19.30
2	54.76	21.95 QP	40.00	-18.05	4.00 H	46	39.35	-17.40
3	68.48	25.72 QP	40.00	-14.28	4.00 H	38	44.75	-19.03
4	105.73	24.56 QP	40.00	-15.44	4.00 H	24	44.62	-20.06
5	139.54	23.78 QP	40.00	-16.22	4.00 H	193	40.72	-16.94
6	173.24	21.56 QP	40.00	-18.44	4.00 H	193	38.22	-16.66

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

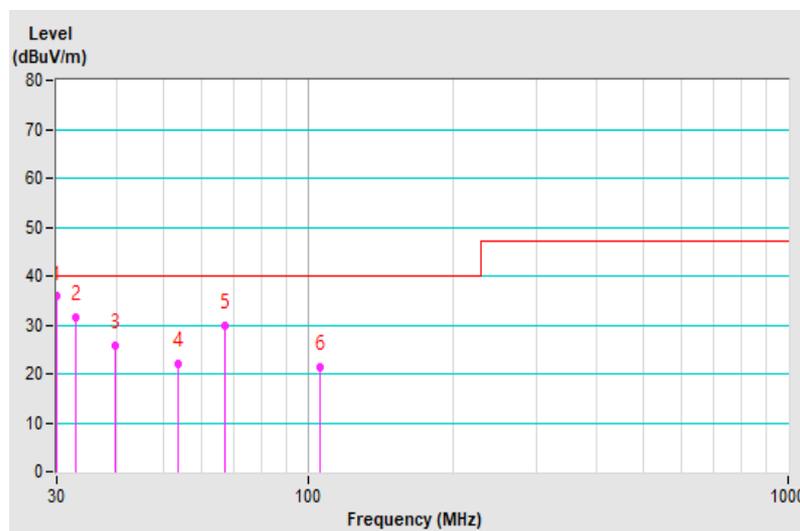


Frequency Range	30MHz ~ 1GHz	Detector Function & Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	48Vdc	Environmental Conditions	25°C, 68%RH, 1008mbar
Tested by	Vhenson Huang		
Test Mode	Mode 5		

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	30.10	35.80 QP	40.00	-4.20	1.13 V	122	55.72	-19.92
2	32.93	31.46 QP	40.00	-8.54	1.68 V	132	51.33	-19.87
3	39.72	25.74 QP	40.00	-14.26	1.39 V	124	44.56	-18.82
4	53.67	21.99 QP	40.00	-18.01	2.23 V	111	40.10	-18.11
5	67.30	29.90 QP	40.00	-10.10	1.97 V	207	49.17	-19.27
6	105.73	21.36 QP	40.00	-18.64	1.00 V	348	42.09	-20.73

Remarks:

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



7 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
4.2.2	EN/IEC 61000-4-4 EFT	2.3	Signal ports and telecommunication ports: xDSL equipment: ±0.5kV, 5/50 (T _r /T _h) ns, 100kHz others: ±0.5kV, 5/50 (T _r /T _h) ns, 5kHz	B
		3.3	Input DC power port: ±0.5kV, 5/50 (T _r /T _h) ns, 5kHz	
		4.5	Input AC Power ports: ±1kV, 5/50 (T _r /T _h) ns, 5kHz	
4.2.5	EN/IEC 61000-4-5 Surge	2.2	Signal and telecommunication ports (direct to outdoor cables): 10/700 (5/320) (T _r /T _h) μs w/o primary protectors: ±1kV, or with primary protectors fitted: ±4kV	C
		3.2	Input DC power port (direct to outdoor cables): 1.2/50 (8/20) (T _r /T _h) μs Line to earth: ±0.5kV	B
		4.4	Input AC Power ports: 1.2/50 (8/20) (T _r /T _h) μs, Line to line: ±1kV Line to earth: ±2kV	
4.2.3.3	EN/IEC 61000-4-6 CS	2.1	Signal and telecommunication ports(cable length > 3m): 0.15-80 MHz, 3V, 80% AM (1kHz)	A
		3.1	Input DC power port: 0.15-80 MHz, 3V, 80% AM (1kHz)	
		4.1	Input AC Power ports: 0.15-80 MHz, 3V, 80% AM (1kHz)	
4.2.4	EN/IEC 61000-4-8 PFMF	1.1	Enclosure port: 50 or 60 Hz, 1A/m	A

EN 55035:2017, Immunity requirements		
Reference standard	Test specification	Performance Criterion
EN/IEC 61000-4-2 ESD	Enclosure port: ±8kV Air discharge, ±4kV Contact discharge	B
EN/IEC 61000-4-3 RS	Enclosure port: Swept freq. test : 80-1000 MHz, 3V/m, 80% AM (1kHz), Spot freq. test : 1800, 2600, 3500, 5000 MHz (±1 %), 3V/m, 80% AM (1kHz)	A
EN/IEC 61000-4-4 EFT	Analogue/digital data ports (cable length > 3m): xDSL equipment: ±0.5kV, 5/50 (T _r /T _h) ns, 100kHz others: ±0.5kV, 5/50 (T _r /T _h) ns, 5kHz	B
	DC network power port (cable length > 3m): ±0.5kV, 5/50 (T _r /T _h) ns, 5kHz	
	AC mains power ports: ±1.0kV, 5/50 (T _r /T _h) ns, 5kHz	
EN/IEC 61000-4-5 Surge	Analogue/digital data ports (direct to outdoor cables): Port type: unshielded symmetrical 10/700(5/320) (T _r /T _h) μs, w/o primary protectors (line to ground): ±1.0kV, or with primary protectors (line to ground): ±1.0kV, ±4.0kV Port type: coaxial or shielded 1.2/50 (8/20) (T _r /T _h) μs, shield to ground: ±0.5kV	C
	DC network power port (direct to outdoor cables): 1.2/50(8/20) (T _r /T _h) μs, Line to ground: ±0.5kV	B
	AC mains power ports: 1.2/50(8/20) (T _r /T _h) μs, Line to line: ±1kV, Line to ground: ±2kV	B
EN/IEC 61000-4-6 CS	Analogue/digital data ports (cable length > 3m) ; DC network power ports (cable length > 3m) ; AC mains power ports 0.15-10 MHz, 3V, 80% AM (1kHz), 10-30 MHz, 3V-1V, 80% AM (1kHz), 30-80 MHz, 1V, 80% AM (1kHz)	A
EN/IEC 61000-4-8 PFMF	Enclosure port: 50 or 60 Hz, 1A/m	A

7.1 Specific Immunity Requirements by Manufacturer

Additional Test		
Reference standard	Test specification	Performance Criterion
EN/IEC 61000-4-2 ESD	Enclosure port: ±6kV Contact discharge	A
EN/IEC 61000-4-3 RS	Enclosure port: 80-1000 MHz, 10V/m, 80% AM (1kHz), Spot freq. test : 1800, 2600, 3500, 5000 MHz (±1 %), 10V/m, 80% AM (1kHz)	A
EN/IEC 61000-4-4 EFT	Input DC power port: ±2kV, 5/50 (T _r /T _h) ns, 5kHz	A
EN/IEC 61000-4-5 Surge	Input DC Power ports: 1.2/50 (8/20) (T _r /T _h) μs, Line to line: ±2kV	A
EN/IEC 61000-4-6 CS	Input DC Power ports: 0.15-80 MHz, 10V, 80% AM (1kHz)	A
EN/IEC 61000-4-8 PFMF	Enclosure port: 50 Hz, 100A/m & 1000A/m	A

7.2 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.

Product Specific Performance Criteria

The particular performance criteria which are specified in the normative annexes of EN 55024 / EN 55035 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.

8 Electrostatic Discharge Immunity Test (ESD)

8.1 Test Specification

Product Standard:	EN 55024
Basic Standard:	EN/IEC 61000-4-2
Discharge Impedance:	330 ohm / 150 pF
Discharge Voltage:	Air Discharge: $\pm 2, \pm 4, \pm 8$ kV (Direct) Contact Discharge: $\pm 2, \pm 4, \pm 6$ kV (Indirect/ Direct)
Number of Discharge:	Air – Direct: 10 discharges per location (each polarity) Contact – Direct & Indirect: 25 discharges per location (each polarity) and min. 200 times in total
Discharge Mode:	Single Discharge
Discharge Period:	1-second minimum

Product Standard:	EN 55035
Basic Standard:	EN/IEC 61000-4-2
Discharge Impedance:	330 ohm / 150 pF
Discharge Voltage:	Air Discharge: $\pm 2, \pm 4, \pm 8$ kV (Direct) Contact Discharge: $\pm 2, \pm 4, \pm 6$ kV (Indirect/ Direct)
Number of Discharge:	Air – Direct: 10 discharges per location (each polarity) Contact – Direct & Indirect: 10 discharges per location (each polarity)
Discharge Mode:	Single Discharge
Discharge Period:	1-second minimum

8.2 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: Dec. 1, 2019

8.3 Test Arrangement

The discharges shall be applied in two ways: (For EN 55024 only)

- 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:

- Electrostatic discharges were applied only to those points and surfaces of the EUT that are accessible to users during normal operation.
- The test was performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.
- The time interval between two successive single discharges was at least 1 second.
- 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.
- Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.
- 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.
- 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**.
- 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.

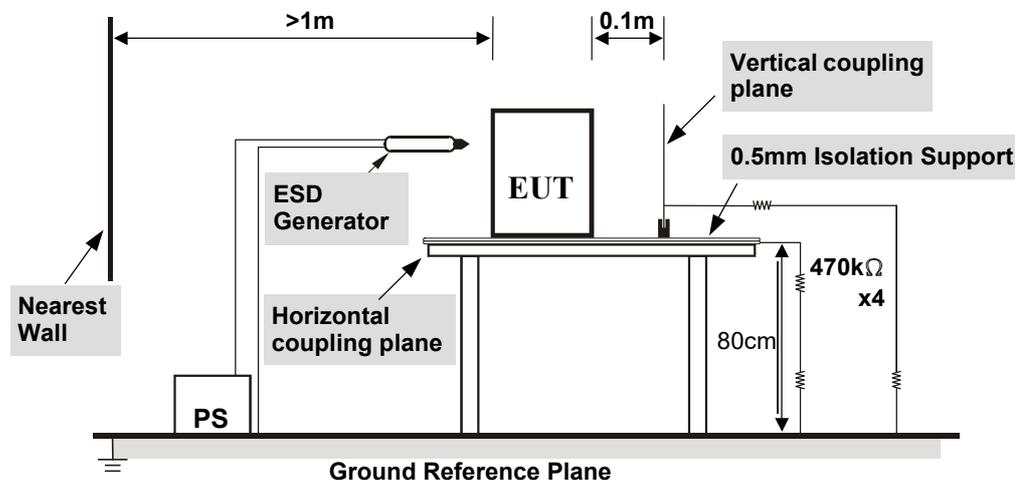


TABLE-TOP EQUIPMENT

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.

8.4 Supplementary Information

The requirement followed by the client's specification. (Refer to item 7.1)

8.5 Test Results

For EN 55024 & EN 55035

Test mode	Mode 5	Input Voltage	48Vdc
Environmental Conditions	21 °C, 46% RH 1008mbar	Tested by	Thomas Cheng

Test Results of Direct Application

Discharge Level (kV)	Polarity (+/-)	Test Point	Contact Discharge	Air Discharge	Performance Criterion
2, 4, 6	+/-	1	Note	NA	A
2, 4, 8	+/-	2	NA	Note	A

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

Test Results of Indirect Application

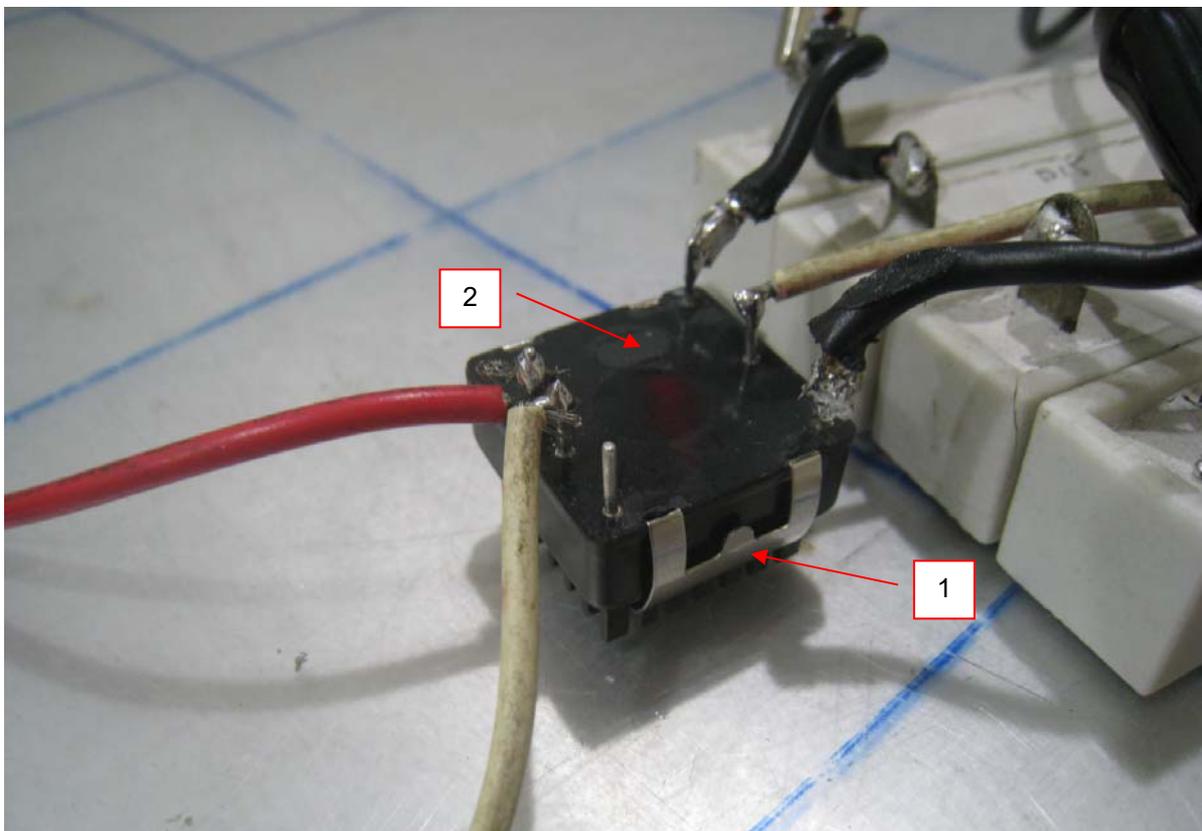
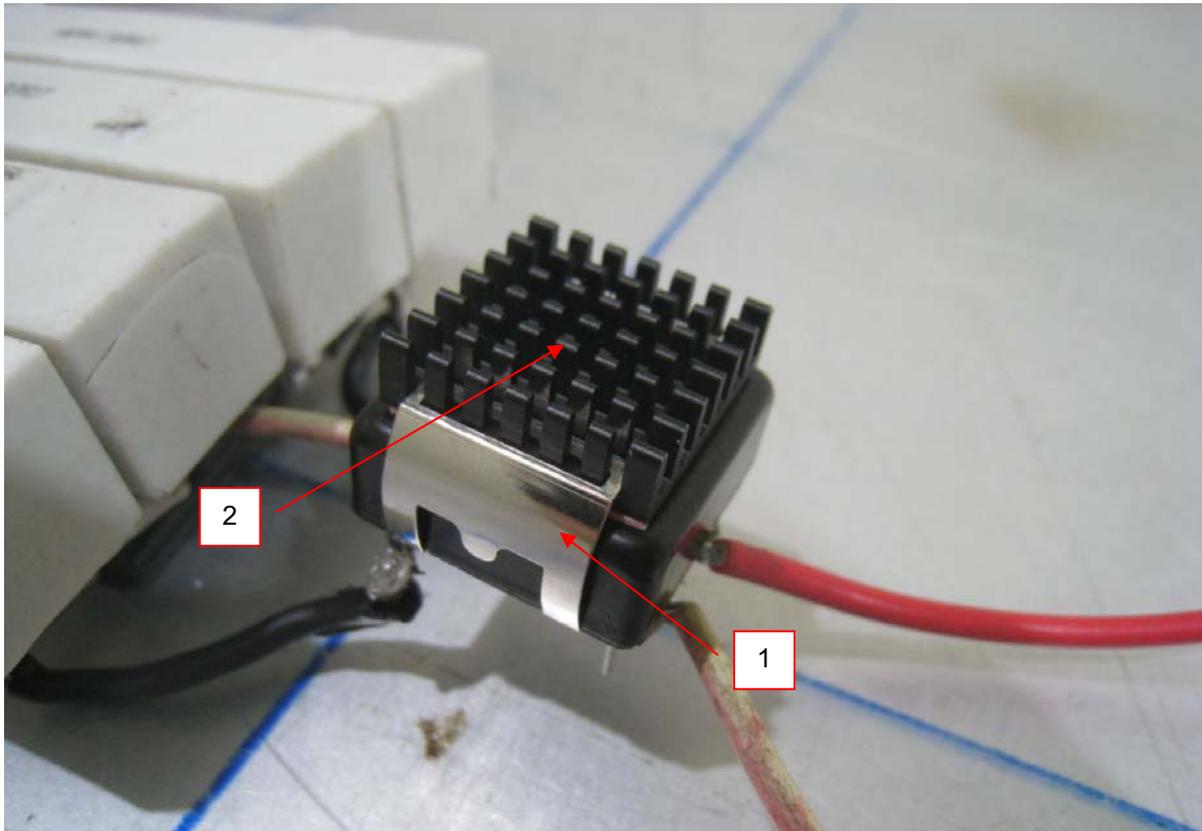
Discharge Level (kV)	Polarity (+/-)	Test Point	Horizontal Coupling Plane	Vertical Coupling Plane	Performance Criterion
2, 4, 6	+/-	Four Sides	Note	Note	A

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.

Description of Test Points



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

9.1 Test Specification

Product Standard:	EN 55024
Basic Standard:	EN/IEC 61000-4-3
Frequency Range:	80 MHz - 1000 MHz
Field Strength:	3 V/m, 10 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

Product Standard:	EN 55035
Basic Standard:	EN/IEC 61000-4-3
Swept Frequency Range:	80 MHz - 1000 MHz
Spot Frequencies:	1800, 2600, 3500, 5000 MHz (± 1 %)
Field Strength:	3 V/m, 10 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

9.2 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. 16, 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. Tested Date: Nov. 7, 2019

9.3 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. **(For EN 55024)**
- c. The swept frequency range is from 80 MHz to 1000 MHz and the spot frequencies are 1800, 2600, 3500, 5000 MHz ($\pm 1\%$), with the signal 80% amplitude modulated with a 1kHz sine wave. **(For EN 55035)**
- d. The dwell time of the amplitude modulated carrier was applied in 3 s at each of the frequencies during the scan. The sensitive frequencies (e.g. clock frequencies or frequencies identified by the manufacturer or obtained as outcome of the test) shall be analyzed in addition to the stepped frequencies. **(For EN 55035)**
- e. The field strength level was 3 V/m, 10 V/m
- f. The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.

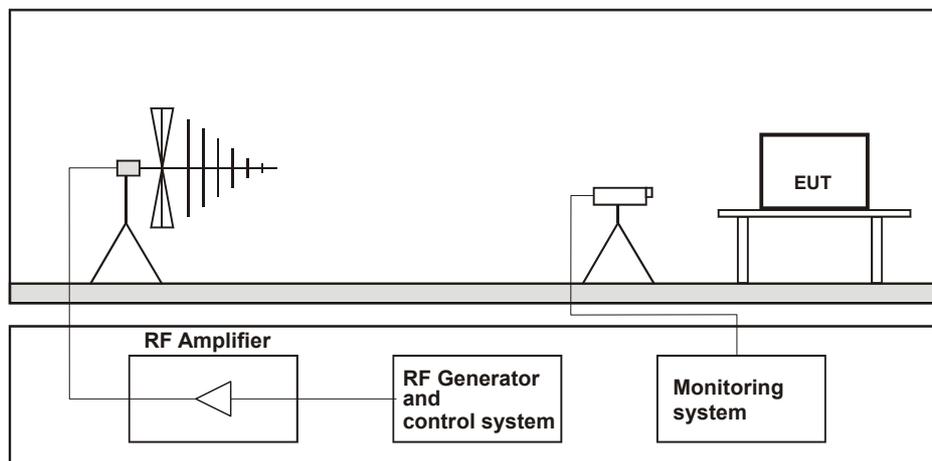


Table-top Equipment

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.

9.4 Supplementary Information

The requirement followed by the client's specification. (Refer to item 7.1)

9.5 Test Results

For EN 55024

Test mode	Mode 5	Input Voltage	48Vdc
Environmental Conditions	25°C, 61% RH	Tested by	Michael Cheng

Frequency (MHz)	Polarity	Azimuth (°)	Test Distance (m)	Applied Field Strength		Observation	Performance Criterion
				(V/m)	Modulation		
80 -1000	V&H	0	3	3	80% AM (1kHz)	Note	A
80 -1000	V&H	90	3	3	80% AM (1kHz)	Note	A
80 -1000	V&H	180	3	3	80% AM (1kHz)	Note	A
80 -1000	V&H	270	3	3	80% AM (1kHz)	Note	A
80 -1000	V&H	0	3	10	80% AM (1kHz)	Note	A
80 -1000	V&H	90	3	10	80% AM (1kHz)	Note	A
80 -1000	V&H	180	3	10	80% AM (1kHz)	Note	A
80 -1000	V&H	270	3	10	80% AM (1kHz)	Note	A

Note: The EUT function was correct during the test.

For EN 55035

Test mode	Mode 5	Input Voltage	48Vdc
Environmental Conditions	25°C, 61% RH	Tested by	Michael Cheng

Frequency (MHz)	Polarity	Azimuth(°)	Applied Field Strength		Observation	Performance Criterion
			(V/m)	Modulation		
80 - 1000	V&H	0	3, 10	80% AM (1kHz)	Note	A
		90	3, 10	80% AM (1kHz)	Note	A
		180	3, 10	80% AM (1kHz)	Note	A
		270	3, 10	80% AM (1kHz)	Note	A
1800, 2600, 3500, 5000 MHz (±1 %)	V&H	0	3, 10	80% AM (1kHz)	Note	A
		90	3, 10	80% AM (1kHz)	Note	A
		180	3, 10	80% AM (1kHz)	Note	A
		270	3, 10	80% AM (1kHz)	Note	A

Note: The EUT function was correct during the test.

10 Electrical Fast Transient/Burst Immunity Test (EFT) <with external filter according to item 3.6 total solution>

10.1 Test Specification

Product Standard:	EN 55024
Basic Standard:	EN/IEC 61000-4-4
Test Voltage:	Signal / telecommunication port: N/A Input DC power port: $\pm 0.5\text{kV}$, $\pm 2\text{kV}$ Input AC power port: N/A
Impulse Repetition Frequency:	xDSL telecommunication port: 100kHz others: 5kHz
Impulse Wave Shape:	5/50 ns
Burst Duration:	0.75 ms for 100kHz Repetition Frequency 15 ms for 5kHz Repetition Frequency
Burst Period:	300 ms
Test Duration:	1 min.

Product Standard:	EN 55035
Basic Standard:	EN/IEC 61000-4-4
Test Voltage:	Analogue/digital data port (cable length > 3m): N/A DC network power port (cable length > 3m): $\pm 0.5\text{kV}$, $\pm 2\text{kV}$ AC mains power port: N/A
Impulse Repetition Frequency:	100kHz : applicable only to xDSL port 5kHz : others
Impulse Wave Shape :	5/50 ns
Burst Duration:	0.75 ms for 100kHz Repetition Frequency 15 ms for 5kHz Repetition Frequency,
Burst Period:	300 ms
Test Duration:	1 min.

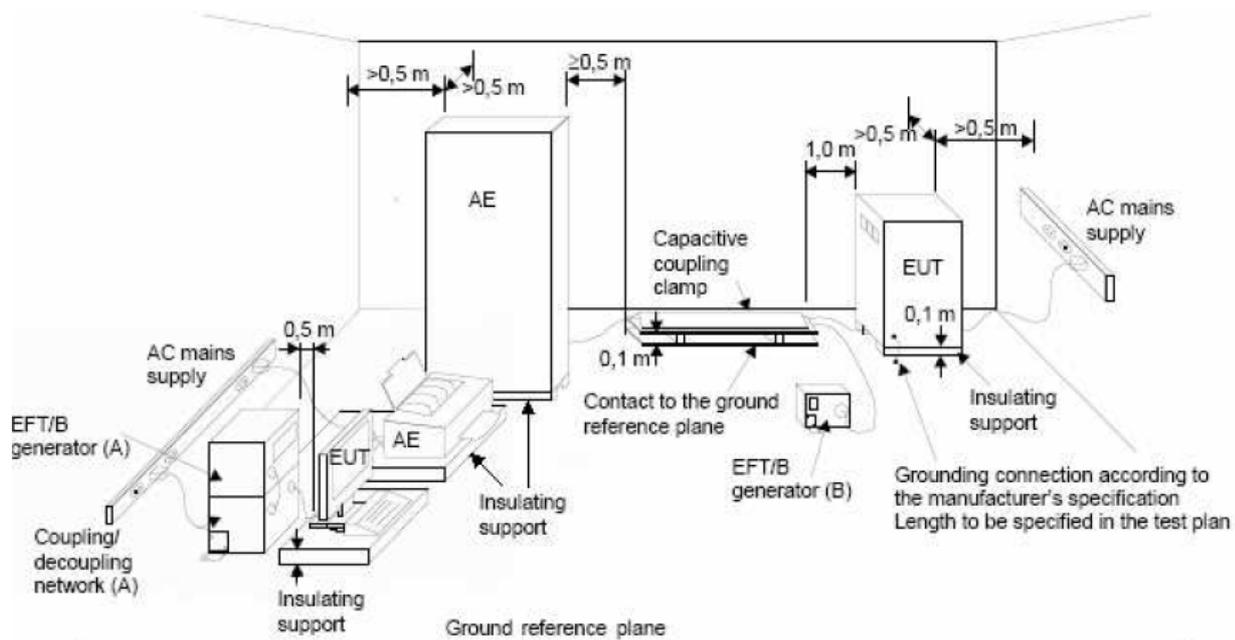
10.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
TESEQ, EFT Simulator	NSG 3060	1572	May 22, 2019	May 21, 2020
TESEQ, CDN	CDN 3083-B100	303	May 22, 2019	May 21, 2020
Haefely, Capacitive Clamp	IP4A	155173	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. 2.
 3. Tested Date: Nov. 6, 2019

10.3 Test Arrangement

- Both positive and negative polarity discharges were applied.
- The distance between any coupling devices and the EUT should be 0.5 m for table-top equipment testing, and 1.0 m for floor standing equipment. **(For EN 55024)**
- The distance between any coupling devices and the EUT should be $(0.5 - 0/+0.1)$ m for table-top equipment testing, and (1.0 ± 0.1) m for floor standing equipment. **(For EN 55035)**
- The duration time of each test sequential was 1 minute.
- The transient/burst waveform was in accordance with EN/IEC 61000-4-4, 5/50 ns.



NOTE:

- location for supply line coupling
- location for signal lines coupling

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

10.4 Supplementary Information

The requirement followed by the client's specification. (Refer to item 7.1)

10.5 Test Results

For EN 55024 & EN 55035

Test mode	Mode 1 & 2 & 3	Input Voltage	24Vdc
Environmental Conditions	23°C, 66% RH	Tested by	Chiming Li

Input DC power port

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

Note: The EUT function was correct during the test.

Test mode	Mode 4 & 5	Input Voltage	48Vdc
Environmental Conditions	23°C, 66% RH	Tested by	Chiming Li

Input DC power port

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

Note: The EUT function was correct during the test.

11 Surge Immunity Test <with external filter according to item 3.6 total solution>

11.1 Test Specification

Product Standard:	EN 55024
Basic Standard:	EN/IEC 61000-4-5
Wave-Shape:	Signal / telecommunication port (direct to outdoor cables*): 10/700 μ s Open Circuit Voltage 5/320 μ s Short Circuit Current Input DC power port (direct to outdoor cables*): 1.2/50 μ s Open Circuit Voltage 8/20 μ s Short Circuit Current Input AC power port: 1.2/50 μ s Open Circuit Voltage 8/20 μ s Short Circuit Current
Test Voltage:	Signal and telecommunication ports**: w/o primary protectors: N/A with primary protectors fitted: N/A Input DC power port: Line to earth or ground: ± 0.5 kV, ± 1 kV, ± 2 kV Input AC power ports: Line to line: N/A Line to earth or ground: N/A
AC Phase Angle (degree):	0°, 90°, 180°, 270°
Pulse Repetition Rate:	1 time / 20 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.

Product Standard:	EN 55035
Basic Standard:	EN/IEC 61000-4-5
Wave-Shape:	Analogue/digital data ports (direct to outdoor cables*): Port type: unshielded symmetrical 10/700 μ s Open Circuit Voltage 5/320 μ s Short Circuit Current Port type: coaxial or shielded 1.2/50 μ s Open Circuit Voltage 8/20 μ s Short Circuit Current DC network power port (direct to outdoor cables*): 1.2/50 μ s Open Circuit Voltage 8/20 μ s Short Circuit Current AC mains power port: 1.2/50 μ s Open Circuit Voltage 8/20 μ s Short Circuit Current
Test Voltage:	Analogue/digital data ports: Port type: unshielded symmetrical** w/o primary protectors (line to ground): N/A with primary protectors (line to ground): N/A Port type: coaxial or shielded shield to ground: N/A DC network power port: ± 0.5 kV, ± 1 kV, ± 2 kV AC mains power ports: Line to line : N/A Line to ground : N/A
AC Phase Angle (degree):	90° / 270°
Pulse Repetition Rate:	1 time / 20 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. 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
TESEQ, Surge Simulator	NSG 3060	1572	May 22, 2019	May 21, 2020
TESEQ, CDN	CDN 3083-100	1215	May 22, 2019	May 21, 2020
Coupling Decoupling Network	CDN-UTP8	045	Aug. 27, 2019	Aug. 26, 2020
TESEQ Coupling Decoupling Network	CDN HSS-2	41009	May 22, 2019	May 21, 2020
TESEQ Coupling Decoupling Network	CDN 118-T8	40386	Sep. 12, 2019	Sep. 11, 2020
TESEQ CDN for Unshielded Unsymmetrical Signal & Data Lines	CDN117	40144	Sep. 12, 2019	Sep. 11, 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. 2.
 3. Tested Date: Nov. 6, 2019

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.

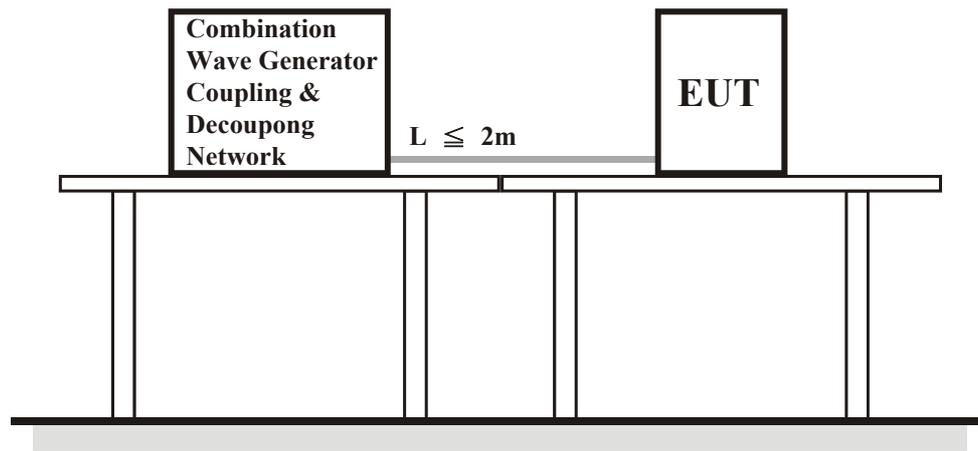
b) Shields grounded at one end

- 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.



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

11.4 Supplementary Information

The requirement followed by the client's specification. (Refer to item 7.1)

11.5 Test Results

For EN 55024 & EN 55035

Test mode	Mode 1 & 2 & 3	Input Voltage	24Vdc
Environmental Conditions	23°C, 66% RH	Tested by	Chiming Li

Input DC power port

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

Note: The EUT function was correct during the test.

Test mode	Mode 4 & 5	Input Voltage	48Vdc
Environmental Conditions	23°C, 66% RH	Tested by	Chiming Li

Input DC power port

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

Note: The EUT function was correct during the test.

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

12.1 Test Specification

Product Standard:	EN 55024
Basic Standard:	EN/IEC 61000-4-6
Frequency Range:	0.15 MHz - 80 MHz
Voltage Level:	3 V, 10 V
Modulation:	1kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of preceding frequency value
Dwell Time	3 seconds

Product Standard:	EN 55035
Basic Standard:	EN/IEC 61000-4-6
Frequency Range:	0.15 MHz - 80 MHz
Voltage Level:	0.15 MHz - 80 MHz: 10V 0.15 MHz - 10 MHz: 3V 10 MHz - 30 MHz: 3-1 V 30 MHz - 80 MHz: 1V
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
ROHDE & SCHWARZ Signal Generator	SML03	101801	Jan. 14, 2019	Jan. 13, 2020
Digital Sweep Function Generator	8120	984801	NA	NA
AR Power Amplifier	75A250AM1	306331	NA	NA
FCC Coupling Decoupling Network	FCC-801-M2-16A	01047	Jun. 19, 2019	Jun. 18, 2020
FISCHER CUSTOM COMMUNICATIONS EM Injection Clamp	F-203I-23mm	455	NA	NA
FISCHER CUSTOM COMMUNICATIONS Current Injection Clamp	F-120-9A	361	Jul. 31, 2019	Jul. 30, 2020
B&K Ear Simulator	4185	2553594	NA	NA
EM TEST Coupling Decoupling Network	CDN M1/32A	306508	Jun. 19, 2019	Jun. 18, 2020
TESEQ Coupling Decoupling Network	CDN T800	34428	Jun. 19, 2019	Jun. 18, 2020
TESEQ Coupling Decoupling Network	CDN T800	29459	Jun. 19, 2019	Jun. 18, 2020
FCC Coupling Decoupling Network	FCC-801-T4	02031	Jun. 19, 2019	Jun. 18, 2020
EM TEST Coupling Decoupling Network	CDN T2	306509	Jun. 19, 2019	Jun. 18, 2020
R&S Power Sensor	NRV-Z5	837878/039	Nov. 10, 2018	Nov. 9, 2019
R&S Power Meter	NRVD	837794/040	Nov. 10, 2018	Nov. 9, 2019
TESEQ Coupling Decoupling Network	CDN M232	37702	Jun. 19, 2019	Jun. 18, 2020
TESEQ Coupling Decoupling Network	CDN M332	41258	Jun. 19, 2019	Jun. 18, 2020
TESEQ Coupling Decoupling Network	CDN M332	41256	Jun. 19, 2019	Jun. 18, 2020
TESEQ Coupling Decoupling Network	CDN T8-10	40376	Jun. 19, 2019	Jun. 18, 2020
TESEQ Coupling Decoupling Network	ISN ST08	41212	Jun. 19, 2019	Jun. 18, 2020
FCC Coupling Decoupling Network	FCC-801-M5-50A	100018	Jan. 21, 2019	Jan. 20, 2020
Software	CS_V7.4.2	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 CS Room No. 1.
 3. Tested Date: Nov. 7, 2019

12.5 Test Results

For EN 55024

Test mode	Mode 5	Input Voltage	48Vdc
Environmental Conditions	22 °C, 69% RH	Tested by	Michael Cheng

Frequency (MHz)	Level (Vrms)	Tested Line	Injection Method	Return Path	Observation	Performance Criterion
0.15 – 80	3, 10	DC power	CDN-M2	N/A	Note	A

Note: The EUT function was correct during the test.

For EN 55035

Test mode	Mode 5	Input Voltage	48Vdc
Environmental Conditions	22 °C, 69% RH	Tested by	Michael Cheng

Frequency (MHz)	Level (Vrms)	Tested Line	Injection Method	Return Path	Observation	Performance Criterion
0.15 – 80	10	DC power	CDN-M2	N/A	Note	A
0.15 – 10	3	DC power	CDN-M2	N/A	Note	A
10 – 30	3 – 1	DC power	CDN-M2	N/A	Note	A
30 – 80	1	DC power	CDN-M2	N/A	Note	A

Note: The EUT function was correct during the test.

13 Power Frequency Magnetic Field Immunity Test

13.1 Test Specification

Product Standard:	EN 55024
Basic Standard:	EN/IEC 61000-4-8
Frequency Range:	50Hz
Field Strength:	1A/m, 100A/m, 1000A/m
Observation Time:	1 minute for Field Strength 1A/m, 100A/m 1 second for Field Strength 1000A/m
Inductance Coil:	Rectangular type, 1 m x 1 m

Product Standard:	EN 55035
Basic Standard:	EN/IEC 61000-4-8
Frequency Range:	50Hz
Field Strength:	1A/m, 100A/m, 1000A/m
Observation Time:	1 minute for Field Strength 1A/m, 100A/m 1 second for Field Strength 1000A/m
Inductance Coil:	Rectangular type, 1 m x 1 m

13.2 Test Instruments

For Field Strength: 1A/m, 100A/m

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: Nov. 6, 2019

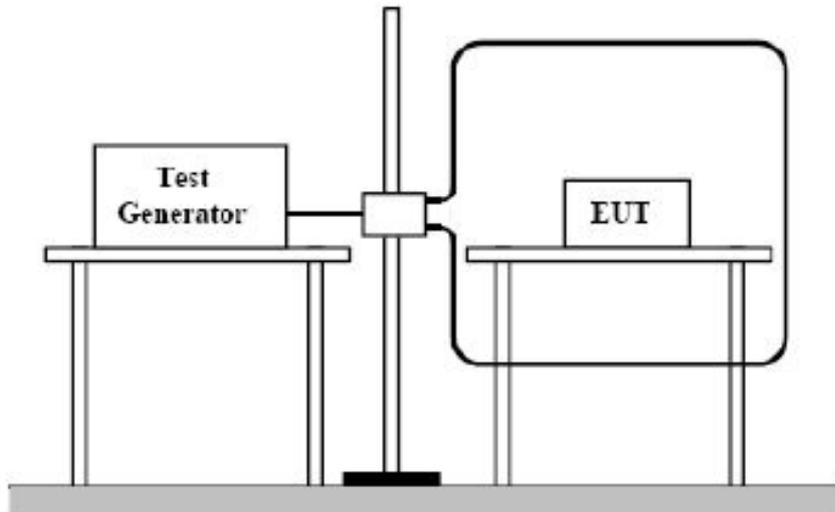
For Field Strength: 1000A/m

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Triaxial Elf Magnetic Field Meter BELL	4090	NA	Apr. 10, 2019	Apr. 9, 2020
Power frequency magnetic filed coil 3ctest	TCX30	EC1281401	Apr. 25, 2019	Apr. 24, 2020
Power frequency magnetic filed generator 3ctest	PFMF-1200G	EC0111401	Apr. 25, 2019	Apr. 24, 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 test was performed in EMS-1 room. (TAF No.: 2022)
 3. Tested Date: Nov. 14, 2017

13.3 Test Arrangement

- The equipment is configured and connected to satisfy its functional requirements.
- The power supply, input and output circuits shall be connected to the sources of power supply, control and signal.
- 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.

13.4 Supplementary Information

The requirement followed by the client's specification. (Refer to item 7.1)

13.5 Test Results

For EN 55024 & EN 55035

For Field Strength: 1A/m, 100A/m

Test mode	Mode 5	Input Voltage	48Vdc
Environmental Conditions	22°C, 69% RH	Tested by	Chiming Li

Application	Frequency (Hz)	Test Duration	Field Strength (A/m)	Observation	Performance Criterion
X - Axis	50	1 min.	1	Note	A
Y - Axis	50	1 min.	1	Note	A
Z - Axis	50	1 min.	1	Note	A
X - Axis	50	1 min.	100	Note	A
Y - Axis	50	1 min.	100	Note	A
Z - Axis	50	1 min.	100	Note	A

Note: The EUT function was correct during the test.

For EN 55024 & EN 55035

For Field Strength: 1000A/m

Test mode	Mode 5	Input Voltage	48Vdc
Environmental Conditions	25°C, 67% RH	Tested by	Leon Wu

Application	Frequency (Hz)	Test Duration	Field Strength (A/m)	Observation	Performance Criterion
X - Axis	50	1 sec.	1000	Note	A
Y - Axis	50	1 sec.	1000	Note	A
Z - Axis	50	1 sec.	1000	Note	A

Note: The EUT function was correct during the test.

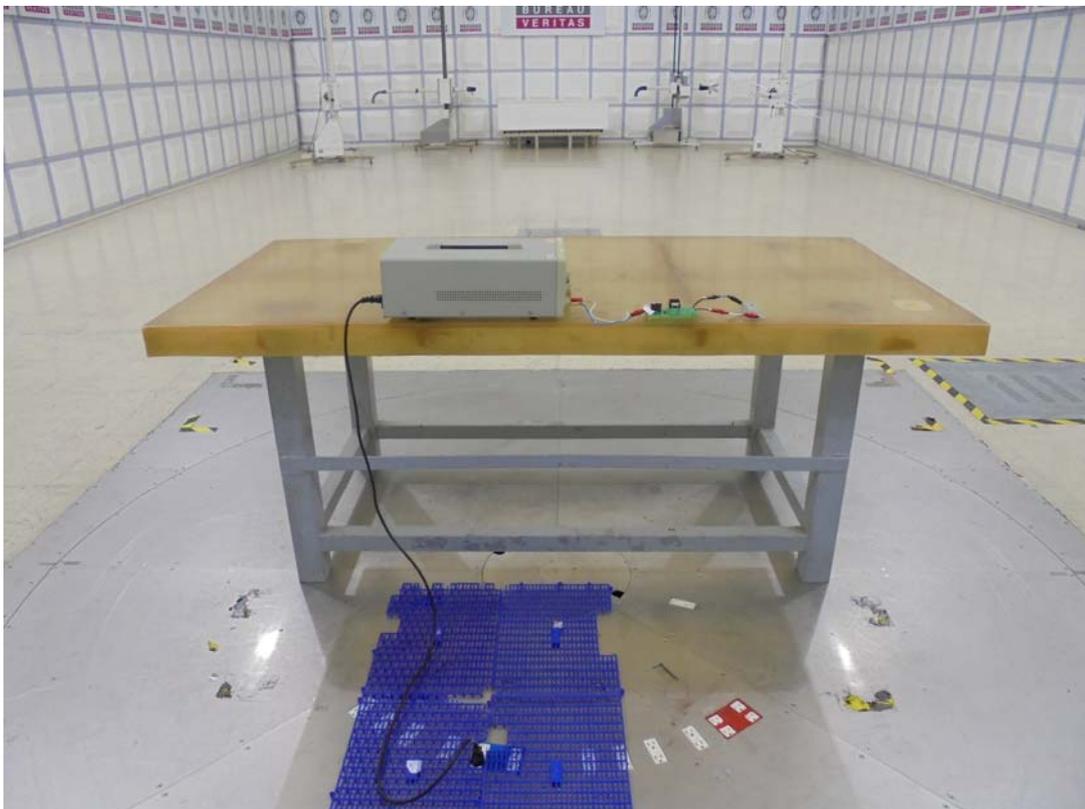
Remark: The test, calibration and test results are compliance with the TAF (TAF code: 2022).

14 Pictures of Test Arrangements

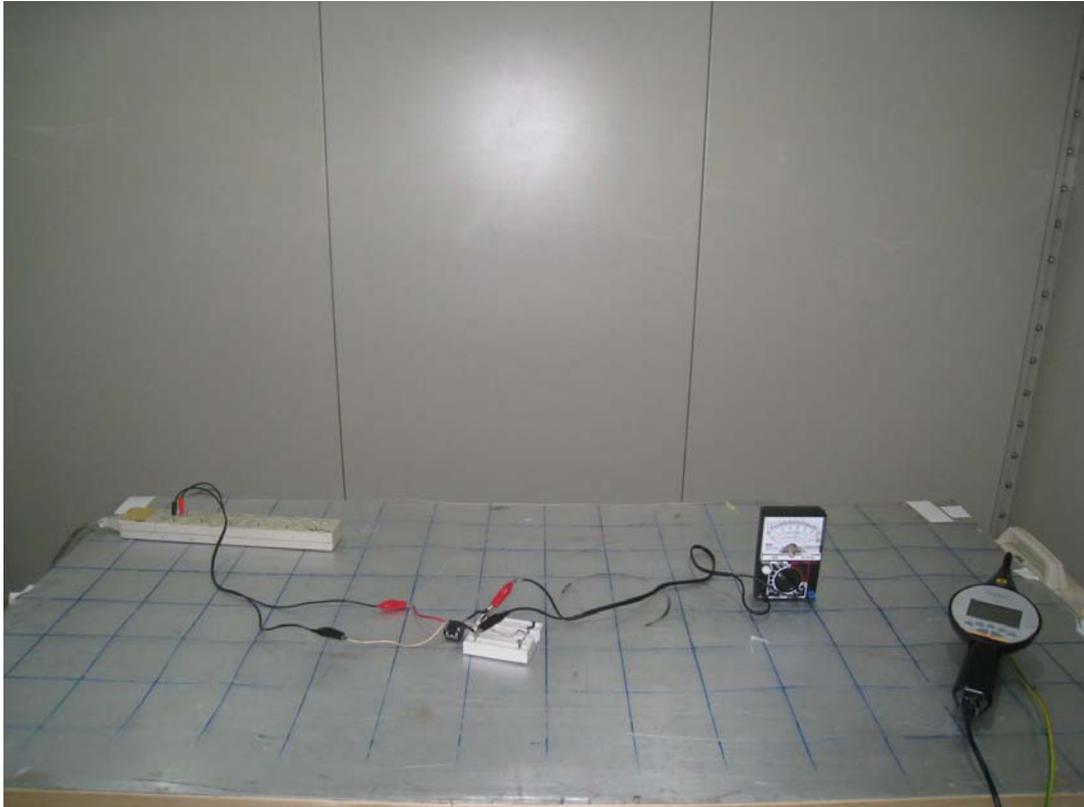
14.1 Conducted Emission from the Mains Power Port



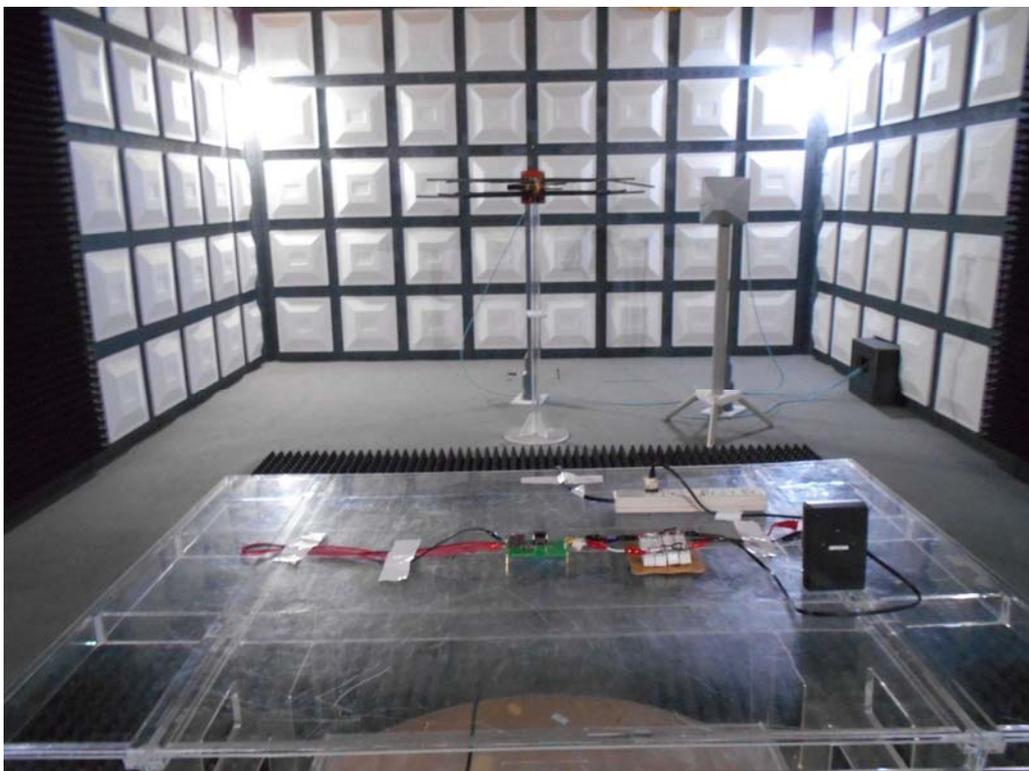
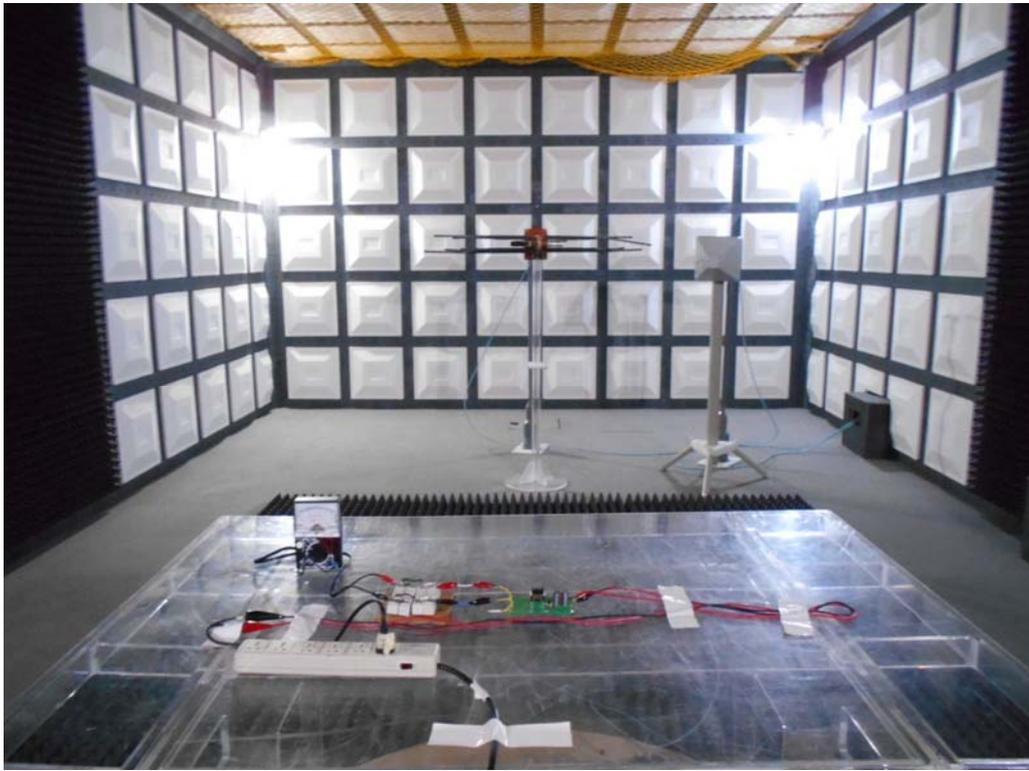
14.2 Radiated Emission at Frequencies up to 1GHz



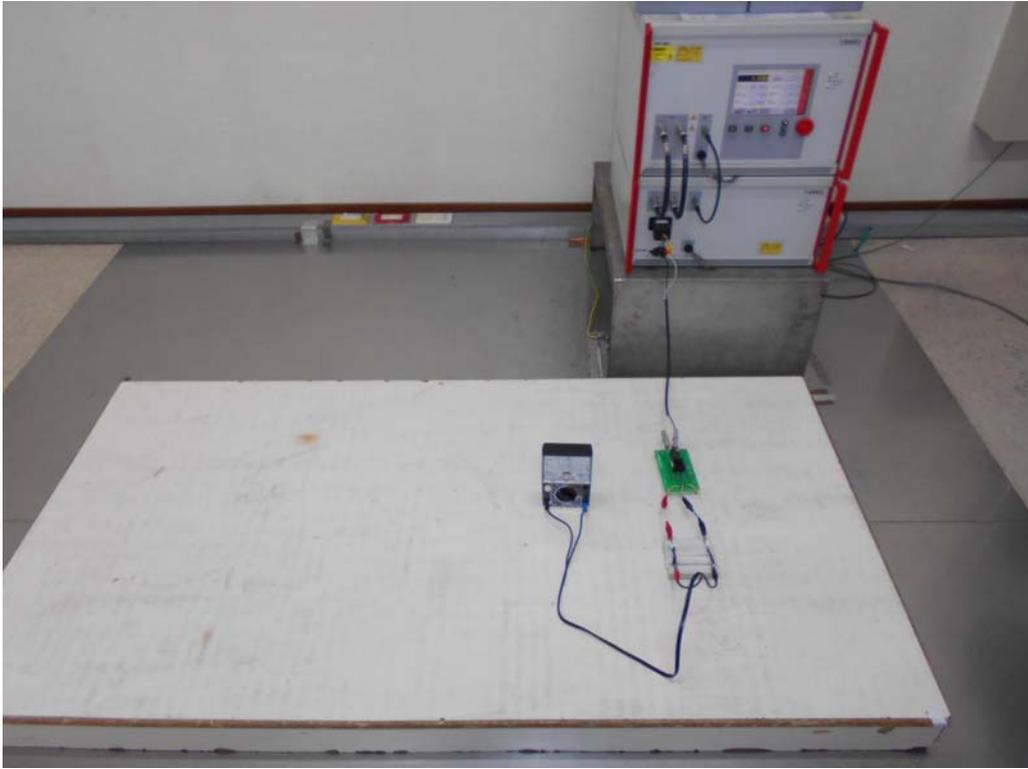
14.3 Electrostatic Discharge Immunity Test (ESD)



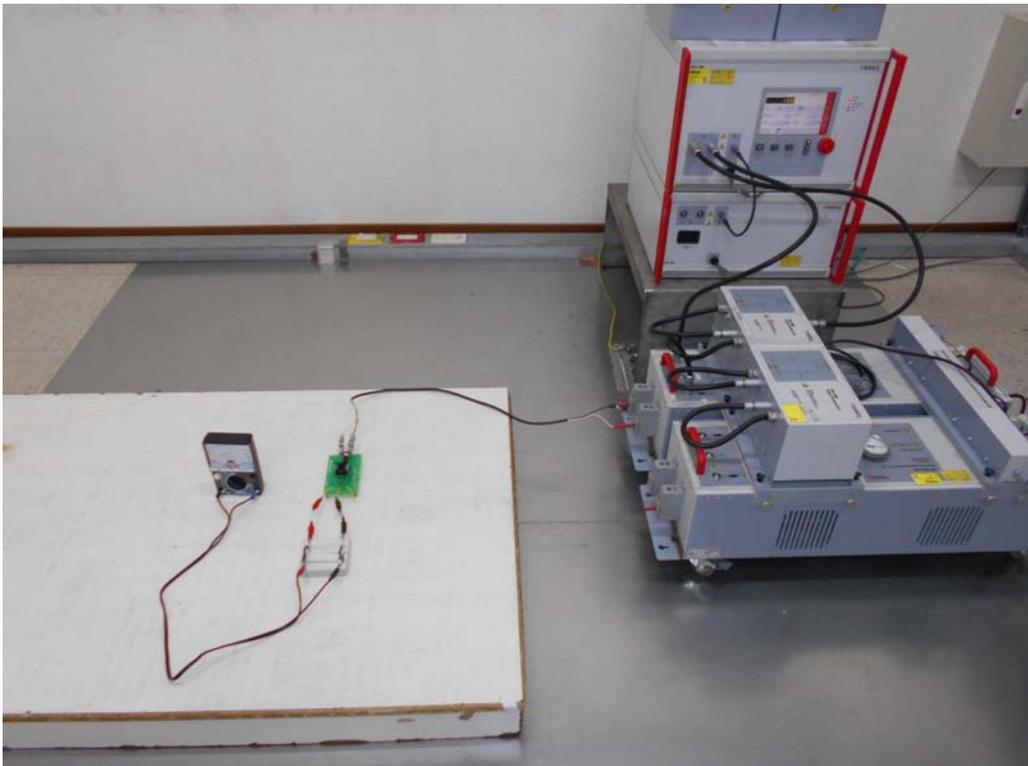
14.4 Radio-frequency, Electromagnetic Field Immunity Test (RS)



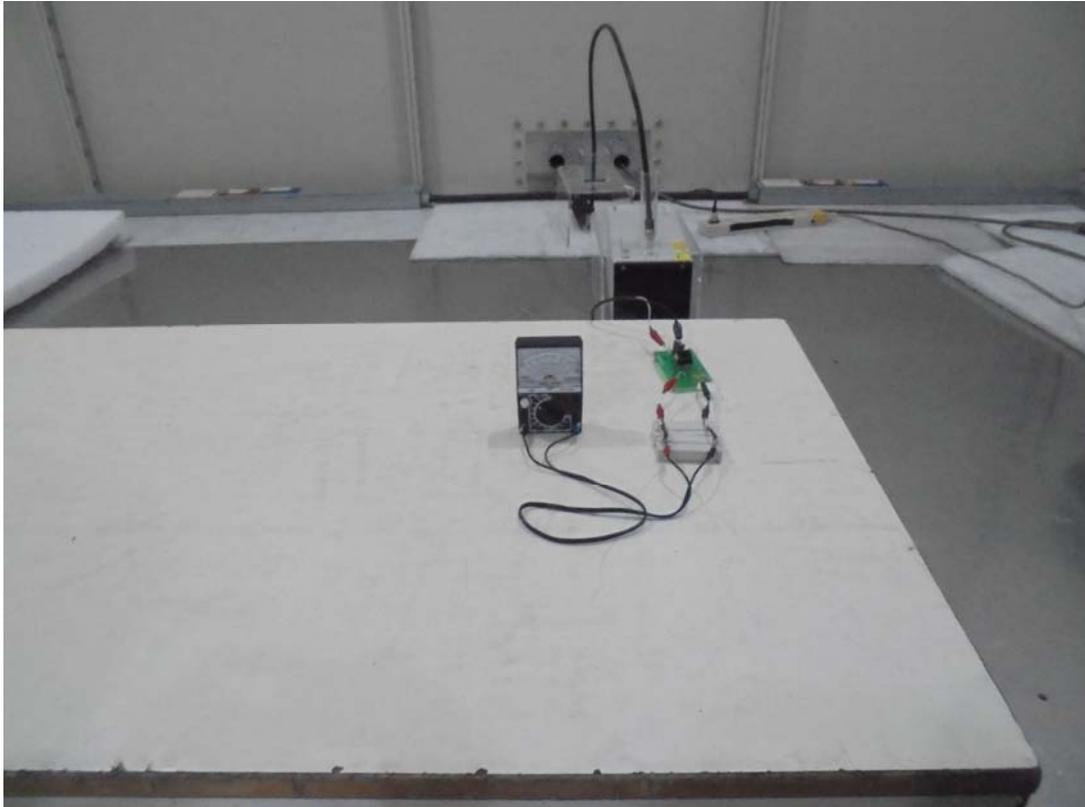
14.5 Electrical Fast Transient/Burst Immunity Test (EFT)



14.6 Surge Immunity Test



14.7 Conducted Disturbances Induced by RF Fields (CS)

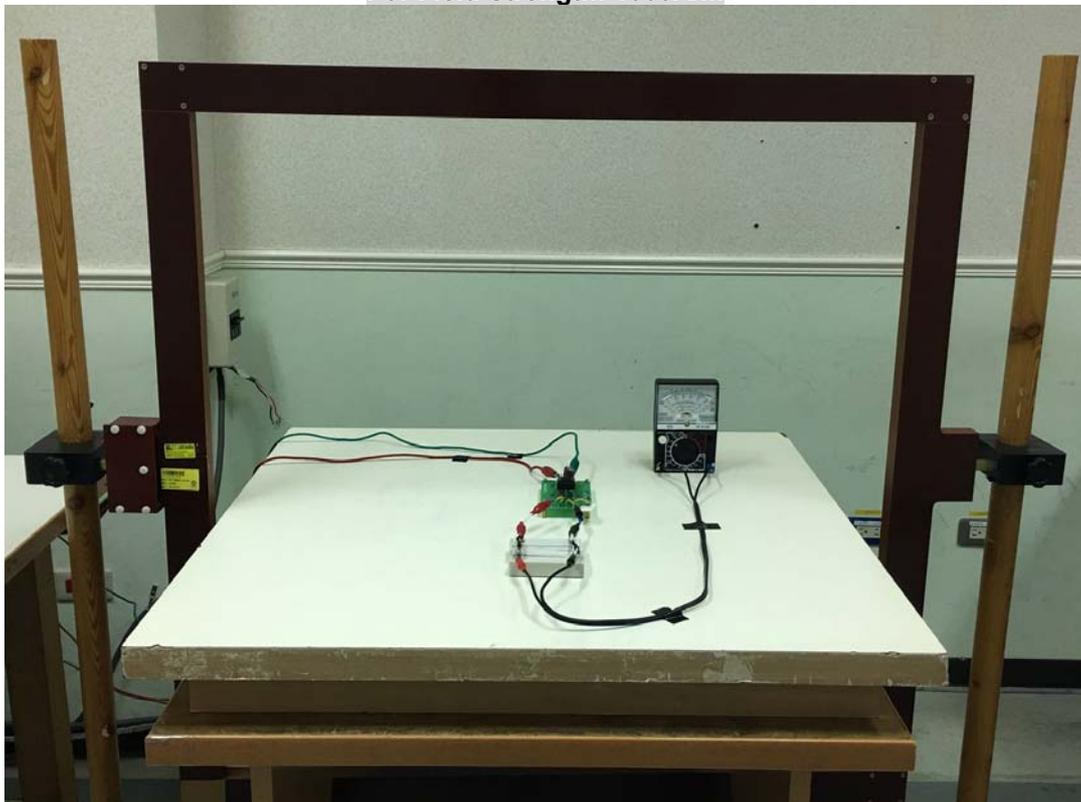


14.8 Power Frequency Magnetic Field Immunity Test (PFMF)

For Field Strength: 1A/m, 100A/m



For Field Strength: 1000A/m



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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Web Site: www.bureauveritas-adt.com

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

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