CE EMC
TEST REPORT

for

Industrial IoT Edge HMI
MODEL: IT412; IT412-22ST; NT412-22ST; MT412-22ST; KT412-22ST; RT412-22ST; PT412-22ST; FT412-22ST; GT412-22ST; HT412-22ST; OT412-22ST; VT412-22ST; PT2121-22ST; NT2121-22ST; MT2121-22ST; KT2121-22ST; RT2121-22ST; FT2121-22ST; GT2121-22ST; HT2121-22ST; OT2121-22ST; VT2121-22ST; IT2121-22ST; WOP-212T

Issued to:

Cermate Technologies Inc.

7F-1, No.168, Lien Cheng Rd., Chung-Ho District,
New Taipei City, Taiwan 235

Issued by:

Compliance Certification Services Inc.
Xindian Lab.
No.163-1, Jhongsheng Rd., Xindian Dist.,
New Taipei City, Taiwan.
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Issued Date: June 29, 2021

Note: This document may be altered or revised by Compliance Certification Services Inc. personnel only, and shall be noted in the revision section of the document. The client should not use it to claim product endorsement by TAF, A2LA, NIST or any government agencies.

Report No.: T210524D11-E

Revision History

Rev.		Issue Date		Revisions	Effect Page	Revised By
00		June 29, 2021		Initial Issue	ALL	Joy Hsiao

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Report No.: T210524D11-E

1 TEST CERTIFICATION

Product:	Industrial IoT Edge HMI
Model:	IT412; IT412-22ST; NT412-22ST; MT412-22ST; KT412-22ST; RT412-22ST; PT412-22ST; FT412-22ST; GT412-22ST; HT412-22ST; OT412-22ST; VT412-22ST; PT2121-22ST; NT2121-22ST; MT2121-22ST; KT2121-22ST; RT2121-22ST; FT2121-22ST; GT2121-22ST; HT2121-22ST; OT2121-22ST; VT2121-22ST; IT2121-22ST; WOP-212T
Brand:	Cermate
Applicant:	**Cermate Technologies Inc.** 7F-1, No.168, Lien Cheng Rd., Chung-Ho District, New Taipei City, Taiwan 235
Manufacturer:	**Cermate Technologies Inc.** 7F-1, No.168, Lien Cheng Rd., Chung-Ho District, New Taipei City, Taiwan 235
Tested:	May 28, 2021 & May 29, 2021
Applicable Standards:	**EN 61000-6-4: 2007 + A1: 2011** **EN 61000-3-2: 2014** **EN 61000-3-3: 2013** **EN 61000-6-2: 2005 / AC: 2005** IEC 61000-4-2: 2008 / EN 61000-4-2: 2009 IEC 61000-4-3: 2006 + A1: 2007 + A2: 2010 / EN 61000-4-3: 2006 + A1: 2008 + A2: 2010 IEC 61000-4-4: 2012 / EN 61000-4-4: 2012 IEC 61000-4-5: 2014 + A1: 2017 / EN 61000-4-5: 2014 + A1: 2017 IEC 61000-4-6: 2013 + COR1: 2015 / EN 61000-4-6: 2014 + AC: 2015 IEC 61000-4-8: 2009 / EN 61000-4-8: 2010 IEC 61000-4-11: 2004 + A1: 2017 / EN 61000-4-11: 2004 + A1: 2017

Note
This test report can be used for CE and UKCA marking application which is based on equivalent requirements between UK and EU. It is appropriate using designated standards to provide presumption of conformity with GB law.
Statements of Conformity
Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

The above equipment has been tested by Compliance Certification Services Inc., and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved by:

Sam Hu
Assistant Manager

Reviewed by:

Eva Fan
Supervisor of report document dept.

2 TEST RESULT SUMMARY

EMISSION			
Standard	**Item**	**Result**	**Remarks**
EN 61000-6-4: 2007 + A1: 2011			
CISPR 16-2-1, CISPR 16-1-2	Conducted (Power Port)	PASS	Meet limit
CISPR 22	Conducted (Telecom port)	PASS	Meet limit
CISPR 16-2-3	Radiated	PASS	Meet limit
EN 61000-3-2: 2014	Harmonic current emissions	N/A	Please see the page 32
EN 61000-3-3: 2013	Voltage fluctuations & flicker	N/A	Please see the page 34

IMMUNITY【 EN 61000-6-2: 2005 / AC: 2005 】			
Standard	**Item**	**Result**	**Remarks**
IEC 61000-4-2: 2008 / EN 61000-4-2: 2009	ESD	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-3: 2006 + A1: 2007 + A2: 2010 / EN 61000-4-3: 2006 + A1: 2008 + A2: 2010	RS	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-4: 2012 / EN 61000-4-4: 2012	EFT	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-5: 2014 + A1: 2017 / EN 61000-4-5: 2014 + A1: 2017	Surge	PASS	Meets the requirements of Performance Criterion B
IEC 61000-4-6: 2013 + COR1: 2015 / EN 61000-4-6: 2014 + AC: 2015	CS	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-8: 2009 / EN 61000-4-8: 2010	PFMF	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-11: 2004 + A1: 2017 / EN 61000-4-11: 2004 + A1: 2017	Voltage dips & voltage variations	N/A	Please see the page 59

3 EUT DESCRIPTION

Product	Industrial IoT Edge HMI
Brand Name	Cermate
Model	IT412; IT412-22ST; NT412-22ST; MT412-22ST; KT412-22ST; RT412-22ST; PT412-22ST; FT412-22ST; GT412-22ST; HT412-22ST; OT412-22ST; VT412-22ST; PT2121-22ST; NT2121-22ST; MT2121-22ST; KT2121-22ST; RT2121-22ST; FT2121-22ST; GT2121-22ST; HT2121-22ST; OT2121-22ST; VT2121-22ST; IT2121-22ST; WOP-212T
Applicant	Cermate Technologies Inc.
Housing material	Plastic w/ metal plate
Identify Number	T210524D11
Received Date	May 24, 2021
EUT Power Rating	24VDC from DC Power Supply
DC Power During Test	24VDC from DC Power Supply

Model Difference

Model Name	Difference	Tested (Checked)
IT412	Original	☒
IT412-22ST; NT412-22ST; MT412-22ST; KT412-22ST; RT412-22ST; PT412-22ST; FT412-22ST; GT412-22ST; HT412-22ST; OT412-22ST; VT412-22ST; PT2121-22ST; NT2121-22ST; MT2121-22ST; KT2121-22ST; RT2121-22ST; FT2121-22ST; GT2121-22ST; HT2121-22ST; OT2121-22ST; VT2121-22ST; IT2121-22ST; WOP-212T	For marketing purpose	☐

I/O PORT

I/O PORT TYPES	Q'TY	TESTED WITH
1. USB 2.0 Port	2	2
2. LAN Port	2	2
3. COM 1/2 Port	1	1
4. SD Card Slot	1	1

Note: Client consigns only one model sample to test (Model Number: IT412).

4 TEST METHODOLOGY

4.1. DECISION OF FINAL TEST MODE

The EUT was tested together with the below additional components, and a configuration, which produced the worst emission levels, was selected and recorded in this report.

The test configuration/ modes are as the following:

Conduction Mode (Power port):

1	**Normal Mode**	**24VDC**

Conduction Modes (Telecom port):

1	**LAN 1**	**10Mbps**
2		**100Mbps**
3	**LAN 2**	**100Mbps**

Radiation Mode:

1	**Normal Mode**	**24VDC**
	Normal Mode / 1-5GHz	

Worst:

Conduction (Power port): Mode 1

Conduction (Telecom port): Mode 1

Radiation: Mode 1

4.2. EUT SYSTEM OPERATION

1. Turn on EUT power.
2. Run Emctest.exe to activate all peripherals and display “H” pattern on monitor screen.
3. Run LANTEST.exe and type ping 192.168.10.10&11 –t (EUT), type ping 192.168.10.12&13 –t (Server Notebook).

Note: Test program is self-repeating throughout the test.

5 SETUP OF EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

EUT Devices:

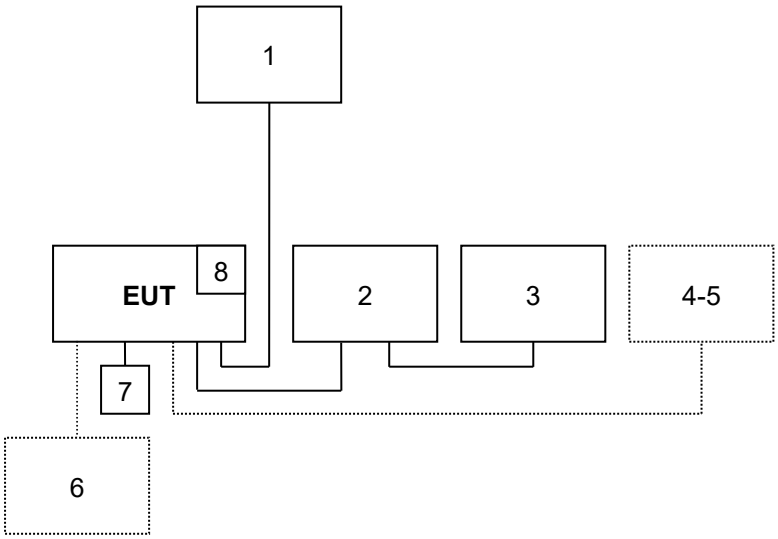
No.	Equipment	Model No.	Brand Name
1	MB	150H03-16	Cermate
2	CPU (360MHz)	NUC972DF71YC	NUVOTON
3	Memory (Built-in DDR2 64MByte)	N/A	Cermate
4	Storage (NAND FLASH 128MByte)	N/A	Cermate

Peripherals Devices:

No.	Equipment	Model No.	Serial No.	FCC ID / BSMI ID	Brand Name	Data Cable	Power Cord
1	USB Mouse	M-U0028	810-002181	BSMI: T41126	LOGITECH	Shielded, 1.8m	N/A
2	HMI	IT407	N/A	N/A	Cermate	Shielded, 2.0m	N/A
3	Adaptor	S-50-24	N/A	N/A	MW	N/A	Input: Unshielded, 1.8m Output: Unshielded, 1.5m
4-5	Server Notebook	TP00048X240	N/A	BSMI: R33B65	Lenovo	Unshielded, 20m	Unshielded, 1.8m
6	Adaptor	PMT-24V100W1AA	N/A	N/A	DELTA	N/A	Input: Unshielded, 1.8m Output: Unshielded, 1.5m
7	USB Cable	N/A	N/A	N/A	N/A	Shielded, 1.8m	N/A
8	SD Card	N/A	N/A	N/A	PQI	N/A	N/A

Note:
1) All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2) Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

5.2. CONFIGURATION OF SYSTEM UNDER TEST



6 FACILITIES AND ACCREDITATIONS

6.1. FACILITIES

All measurement facilities used to collect the measurement data are located at CCSrf Taiwan Xindian Lab. at No.163-1, Jhongsheng Rd., Xindian Dist., New Taipei City, Taiwan.

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR Publication 22. All receiving equipment conforms to CISPR 16-1-1, CISPR 16-1-2, CISPR 16-1-3, CISPR 16-1-4 and CISPR 16-1-5.

6.2. ACCREDITATIONS

Our laboratories are accredited and approved by the following accreditation body according to ISO/IEC 17025.

Taiwan	TAF
USA	A2LA

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada	Industry Canada
Japan	VCCI
Taiwan	BSMI
USA	FCC

Copies of granted accreditation certificates are available for downloading from our web site, http://www.ccsrf.com

6.3. 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	Frequency	Uncertainty
Conducted emissions (Power port)	0.15MHz ~ 30MHz	± 2.8
Conducted emissions (Telecom port)	0.15MHz ~ 30MHz	± 3.2
Radiated emissions	30MHz ~ 1000MHz	± 5.2
	1000MHz ~ 6000MHz	± 4.6

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Consistent with industry standard (e.g. CISPR 22: 2005, clause 11, Measurement Uncertainty) determining compliance with the limits shall be base on the results of the compliance measurement. Consequently the measure emissions being less than the maximum allowed emission result in this be a compliant test or passing test.

The acceptable measurement uncertainty value without requiring revision of the compliance statement is base on conducted and radiated emissions being less than U_{CISPR} which is 3.8dB(AMN); 5.0dB(AAN); 5.2dB(OATS) and 5.5 dB(1-6GHz) respectively. CCS values (called U_{Lab} in CISPR 16-4-2) is less than U_{CISPR} as shown in the table above. Therefore, MU need not be considered for compliance.

7 EMISSION TEST

7.1. CONDUCTED EMISSION MEASUREMENT

7.1.1. LIMITS

FREQUENCY (MHz)	dBuV	
	Quasi-peak	Average
0.15 - 0.5	79	66
0.50 - 5.0	73	60
5.0 - 30.0	73	60

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

7.1.2. TEST INSTRUMENTS

Conducted Emission room # B				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Attenuator	MCL	HAT-10	SD-C012	03/23/2022
BNC Cable	EMCI	CFD300-NL	BNC#B5	01/04/2022
EMI Test Receiver	R&S	ESR3	102166	04/12/2022
LISN	Schwarzbeck	NSLK 8127	8127382	04/13/2022
LISN(EUT)	Schwarzbeck	NSLK 8127	8127526	04/13/2022
Thermo-Hygro Meter	Wisewind	N/A	SD-S017	09/08/2021
Test S/W	EZ-EMC			

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. N.C.R = No Calibration Request.

7.1.3. TEST PROCEDURES (please refer to measurement standard or CCS SOP PA-031)

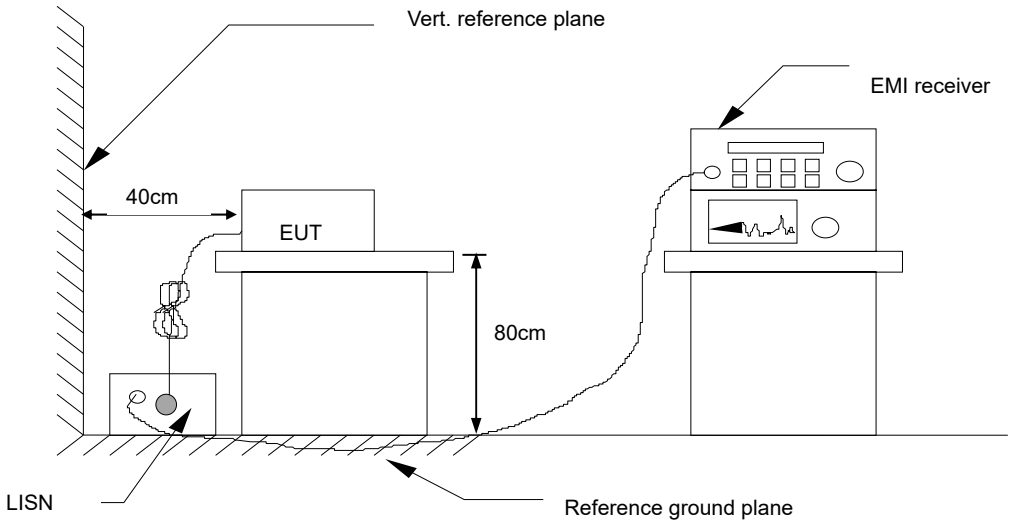
Procedure of Preliminary Test

- The EUT was set up as per the test configuration to simulate typical usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per CISPR 16-2-1, 7.4.1 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 15 cm non-conductive covering to insulate the EUT from the ground plane.
- Support equipment, if needed, was placed as per CISPR 16-2-1, 7.4.1.
- All I/O cables were positioned to simulate typical actual usage as per CISPR 16-2-1, 7.4.1.
- The test equipment EUT installed received AC main power, through a Line Impedance Stabilization Network (LISN), which supplied power source and was grounded to the ground plane.
- All support equipment received power from a second LISN.
- The EUT test program was started. Emissions were measured on each current carrying line of the EUT using an EMI Test Receiver connected to the LISN powering the EUT.
- The Receiver scanned from 150kHz to 30MHz for emissions in each of the test modes.
- During the above scans, the emissions were maximized by cable manipulation.
- The test mode(s) described in Item 4.1 were scanned during the preliminary test.
- After the preliminary scan, we found the test mode described in Item 4.1 producing the highest emission level.
- The EUT configuration and cable configuration of the above highest emission level were recorded for reference of the final test.

Procedure of Final Test

- EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test.
- A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit.
- The test data of the worst-case condition(s) was recorded.

7.1.4. TEST SETUP



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

7.1.5. DATA SAMPLE

Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector (P/Q/A)	Line (L1/L2)
x.xx	42.95	0.55	43.50	73	-29.50	Q	L1

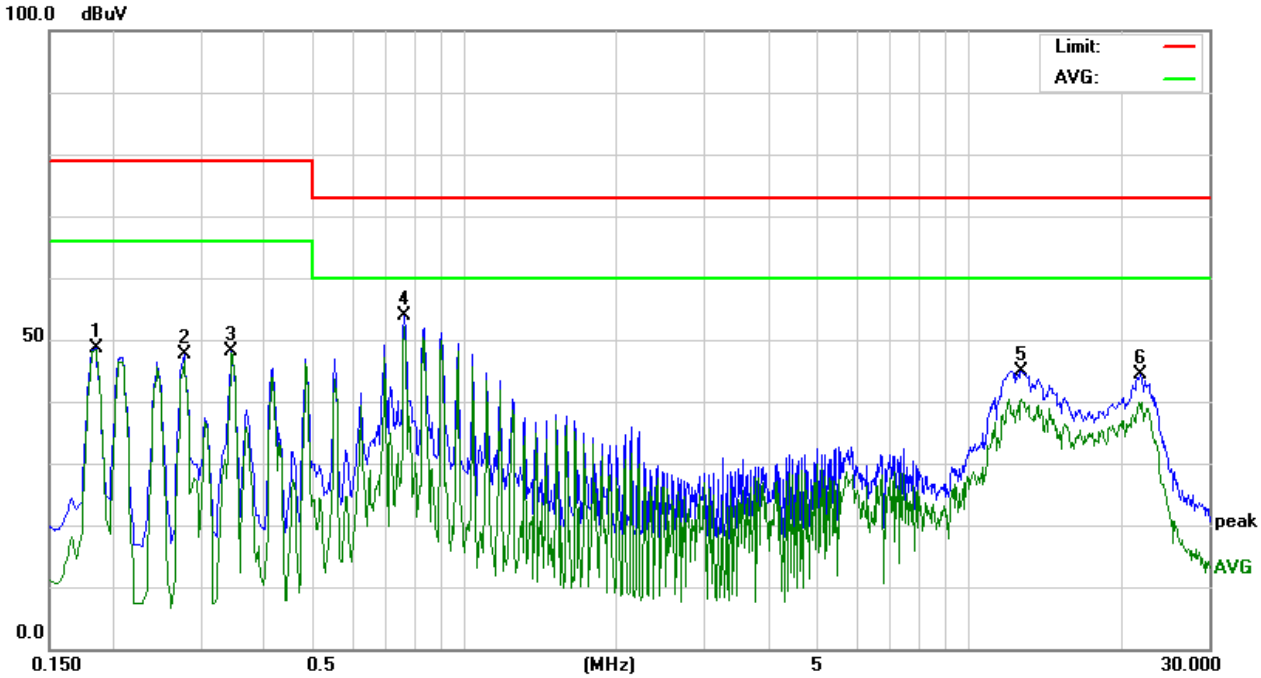
Freq. = Emission frequency in MHz
Reading = Uncorrected Analyzer/Receiver reading
Factor = Insertion loss of LISN + Cable Loss + Pulse Limit
Result = Read Level + Factor
Limit = Limit stated in standard
Margin = Reading in reference to limit
P = Peak Reading
Q = Quasi-peak Reading
A = Average Reading
L1 = Hot side
L2 = Neutral side

Calculation Formula

Margin (dB) = Result (dBuV) – Limit (dBuV)

7.1.6. TEST RESULTS

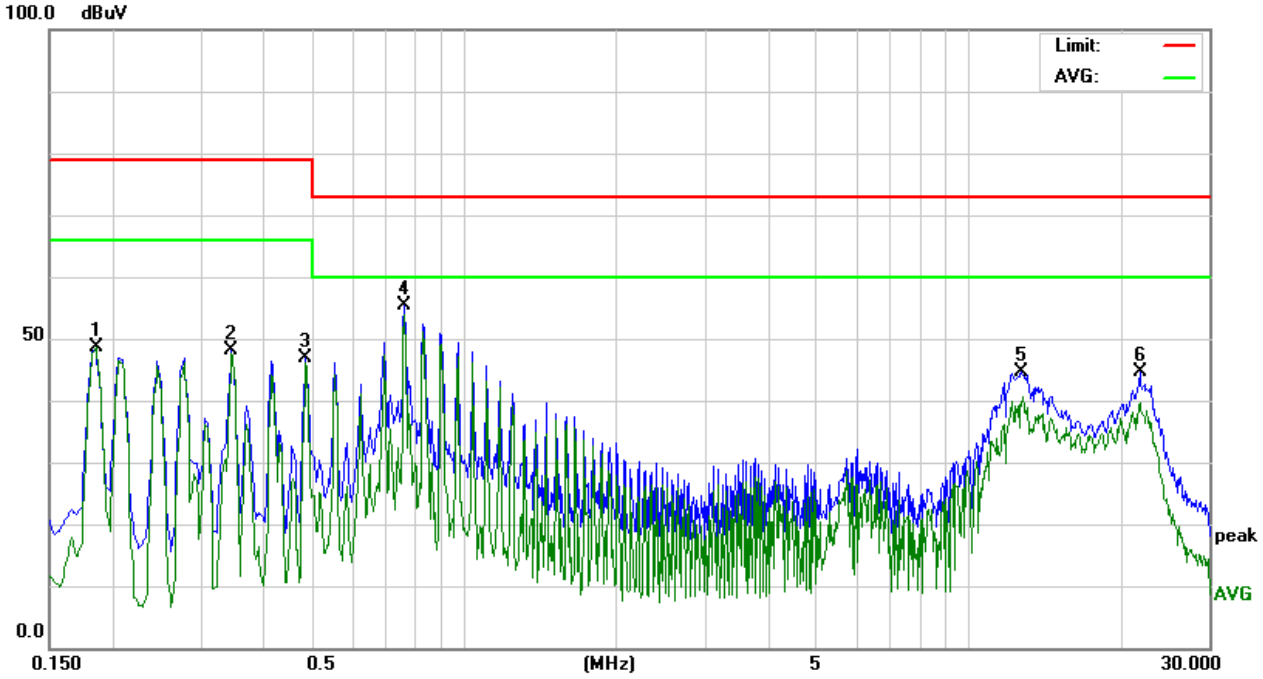
Model No.	IT412	**6dB Bandwidth**	9 kHz
Environmental Conditions	23ºC, 61% RH	**Test Mode**	Mode 1
Tested by	David Cheng	**Phase**	L1
Standard	EN 61000-6-4		



Conducted Emission Readings							
Frequency Range Investigated				**150 kHz to 30 MHz**			
Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector (P/Q/A)	Line (L1/L2)
0.1860	**38.52**	**10.09**	**48.61**	**79.00**	**-30.39**	**P**	**L1**
0.2779	**37.48**	**10.07**	**47.55**	**79.00**	**-31.45**	**P**	**L1**
0.3460	**38.11**	**10.09**	**48.20**	**79.00**	**-30.80**	**P**	**L1**
0.7620	**43.65**	**10.14**	**53.79**	**73.00**	**-19.21**	**P**	**L1**
12.7420	**34.20**	**10.70**	**44.90**	**73.00**	**-28.10**	**P**	**L1**
21.9100	**33.35**	**10.94**	**44.29**	**73.00**	**-28.71**	**P**	**L1**

Note: 1. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line).

Model No.	IT412	**6dB Bandwidth**	9 kHz
Environmental Conditions	23°C, 61% RH	**Test Mode**	Mode 1
Tested by	David Cheng	**Phase**	L2
Standard	EN 61000-6-4		



Conducted Emission Readings							
Frequency Range Investigated				**150 kHz to 30 MHz**			
Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector (P/Q/A)	Line (L1/L2)
0.1860	**38.64**	**10.09**	**48.73**	**79.00**	**-30.27**	**P**	**L2**
0.3460	**37.93**	**10.09**	**48.02**	**79.00**	**-30.98**	**P**	**L2**
0.4860	**36.68**	**10.10**	**46.78**	**79.00**	**-32.22**	**P**	**L2**
0.7620	**45.22**	**10.14**	**55.36**	**73.00**	**-17.64**	**P**	**L2**
12.7780	**33.91**	**10.62**	**44.53**	**73.00**	**-28.47**	**P**	**L2**
21.8580	**33.65**	**10.87**	**44.52**	**73.00**	**-28.48**	**P**	**L2**

Note: 1. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line).

7.2. CONDUCTED EMISSION MEASUREMENT AT TELECOMMUNICATION PORTS

7.2.1. LIMITS

FREQUENCY (MHz)	Voltage Limit (dBuV)		Current Limit (dBuA)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 ~ 0.5	97 ~ 87	84 ~ 74	53 ~ 43	40 ~ 30
0.5 ~ 30.0	87	74	43	30

NOTE: 1. At transitional frequencies the lower limit applies.
2. The limits decrease linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.
3. The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode (asymmetric mode) impedance of 150Ω to the telecommunication port under test (conversion factor is 20 $\log_{10}$ 150 / l = 44 dB).

7.2.2. TEST INSTRUMENTS

Conducted Emission room # B				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Attenuator	MCL	HAT-10	SD-C012	03/23/2022
BNC Cable	EMCI	CFD300-NL	BNC#B5	01/04/2022
EMI Test Receiver	R&S	ESR3	102166	04/12/2022
ISN	Teseq	ISN T800	30847	04/13/2022
LISN	Schwarzbeck	NSLK 8127	8127382	04/13/2022
LISN(EUT)	Schwarzbeck	NSLK 8127	8127526	04/13/2022
Thermo-Hygro Meter	Wisewind	N/A	SD-S017	09/08/2021
Test S/W	EZ-EMC			

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. N.C.R = No Calibration Request.

7.2.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-031)

- Selecting ISN for unscreened cable or a current probe for screened cable to take measurement.
- The port of the EUT was connected to the remote side support equipment through the ISN/Current Probe and communication in normal condition.
- Making a overall range scan by using the test receiver controlled by controller and record at least six highest emissions for showing in the test report.
- Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit.
- In case of measuring on the screened cable, the current limit shall be applied; otherwise the voltage limit should be applied.
- The following test modes was scanned during the preliminary test:

Modes:

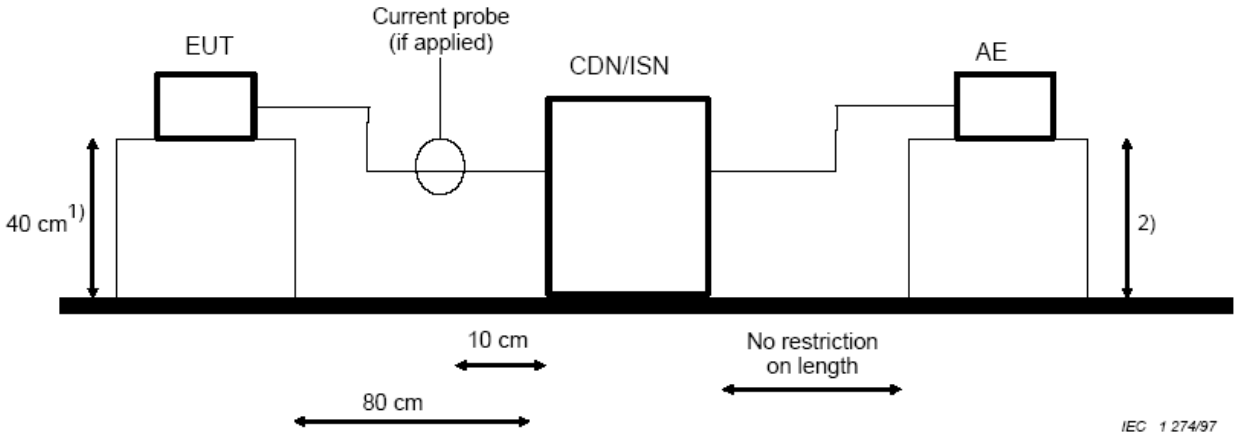
1	**LAN 1**	**10Mbps**
2		**100Mbps**
3	**LAN 2**	**100Mbps**

- After the preliminary scan, we found the following test mode(s) producing the highest emission level and test data of the worst case was recorded.

Mode: 1

7.2.4. TEST SETUP

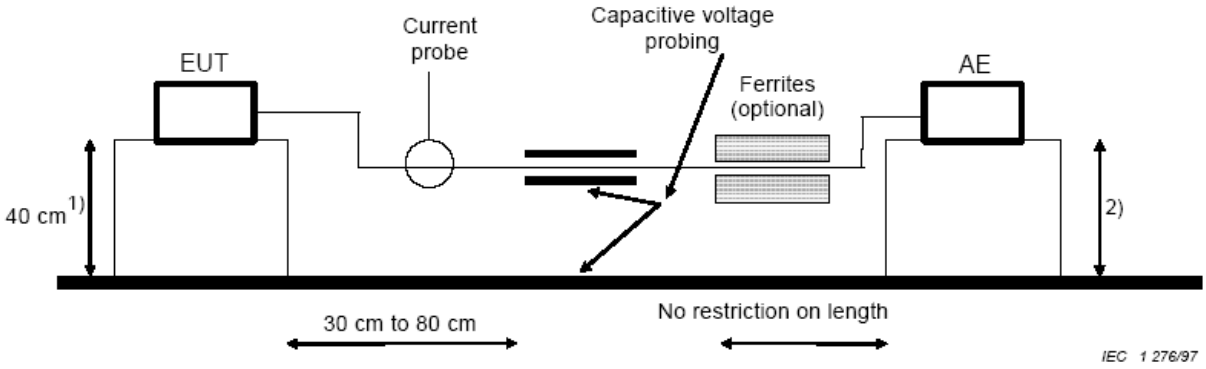
For ISN & Current Probe:



AE = Associated equipment
EUT = Equipment under test

1) Distance to the reference groundplane (vertical or horizontal).
2) Distance to the reference groundplane is not critical.

For Voltage & Current Probe:



AE = Associated equipment
EUT = Equipment under test

1) Distance to the reference groundplane (vertical or horizontal).
2) Distance to the reference groundplane is not critical.

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

7.2.5. DATA SAMPLE

Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector (P/Q/A)
x.xx	62.95	0.55	63.50	87	-23.50	Q

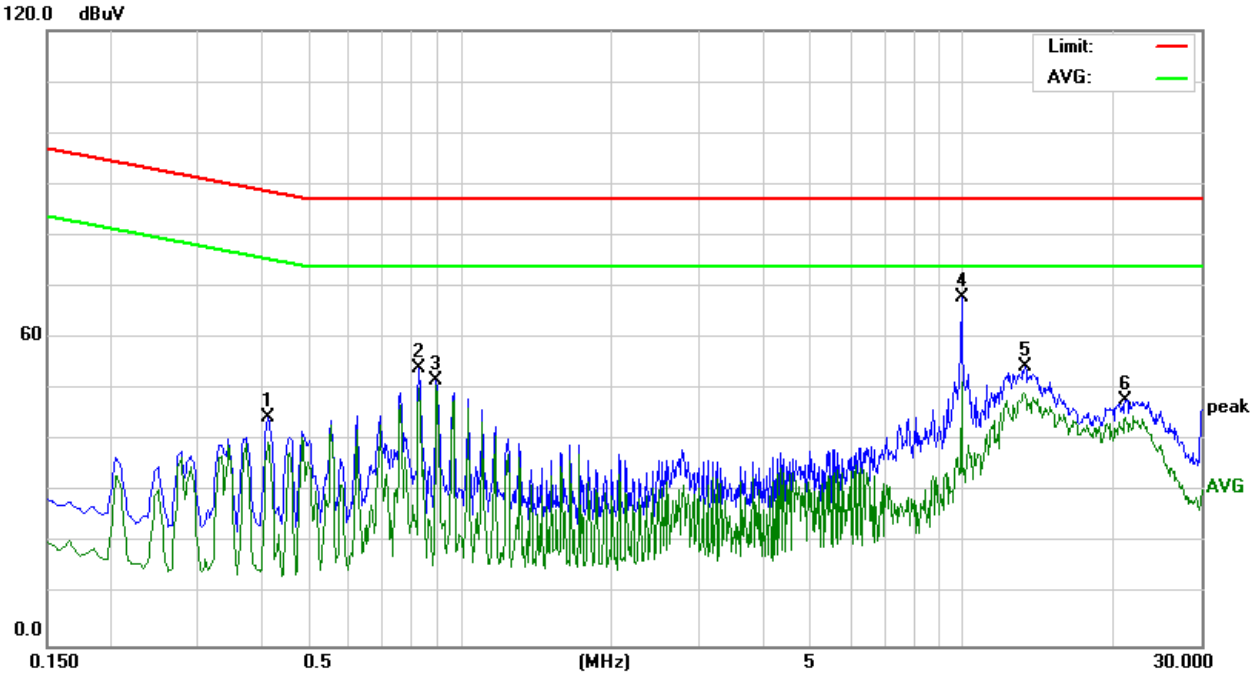
Freq. = Emission frequency in MHz
Reading = Uncorrected Analyzer/Receiver reading
Factor = Insertion loss of LISN + Cable Loss + Pulse Limit
Result = Reading + Factor
Limit = Limit stated in standard
Margin = Reading in reference to limit
P = Peak Reading
Q = Quasi-peak Reading
A = Average Reading

Calculation Formula

Margin (dB) = Result (dBuV) – Limit (dBuV)

7.2.6. TEST RESULTS

Model No.	IT412	6dB Bandwidth	9 kHz
Environmental Conditions	23ºC, 61% RH	Test Mode	Mode 1
Tested by	David Cheng	Standard	EN 61000-6-4



Conducted Emission Readings						
Frequency Range Investigated				150 kHz to 30 MHz		
Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector (P/Q/A)
0.4140	24.70	19.76	44.46	88.57	-44.11	P
0.8300	34.42	19.69	54.11	87.00	-32.89	P
0.8980	32.08	19.68	51.76	87.00	-35.24	P
10.0020	48.32	19.73	68.05	87.00	-18.95	P
13.3580	34.74	19.80	54.54	87.00	-32.46	P
21.2060	27.94	19.98	47.92	87.00	-39.08	P

7.3. RADIATED EMISSION MEASUREMENT

7.3.1. LIMITS

Below 1GHz

FREQUENCY (MHz)	dBuV/m (At 10m)
30 ~ 230	40
230 ~ 1000	47

Above 1GHz

FREQUENCY (MHz)	dBuV/m (At 3m)	
	Average	Peak
1000 ~ 3000	56	76
3000 ~ 6000	60	80

NOTE: The lower limit shall apply at the transition frequencies.

Highest frequency generated or used within the EUT or on which the EUT operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Less than 108	1000
108-500	2000
500-1000	5000
Above 1000	If the highest internal frequency of the EUT is above 1 GHz, the measurement shall be made up to 6 GHz

7.3.2. TEST INSTRUMENTS

Open Area Test Site # H				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Bilog Antenna	Teseq	CBL 6112D	40529	08/23/2021
Cable	EMEC	CFD400NL-LW	N-Type#H11	08/13/2021
EMI Test Receiver	R&S	ESCI	101340	02/25/2022
Pre-Amplifier	HP	8447D	1937A01554	09/25/2021
Thermo-Hygro Meter	Wisewind	201A	No. 03	05/19/2022
Test S/W	EZ-EMC			
Chamber #E (Above 1GHz Used)				
Horn Antenna	ETS	3117	00139062	07/21/2021
Microflex Cable	EMCI	EMC107-NM-NM-7000	200701	07/19/2021
K-Type Cable	EMCI	EMC101G-KM-KM-1000	200702	07/19/2021
Pre-Amplifier	Com-Power	PAM-118A	551041	07/19/2021
Signal Analyzer	R&S	FSV40	101269	07/19/2021
Test S/W	EZ-EMC			

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. N.C.R = No Calibration Request.

7.3.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-031)

Procedure of Preliminary Test

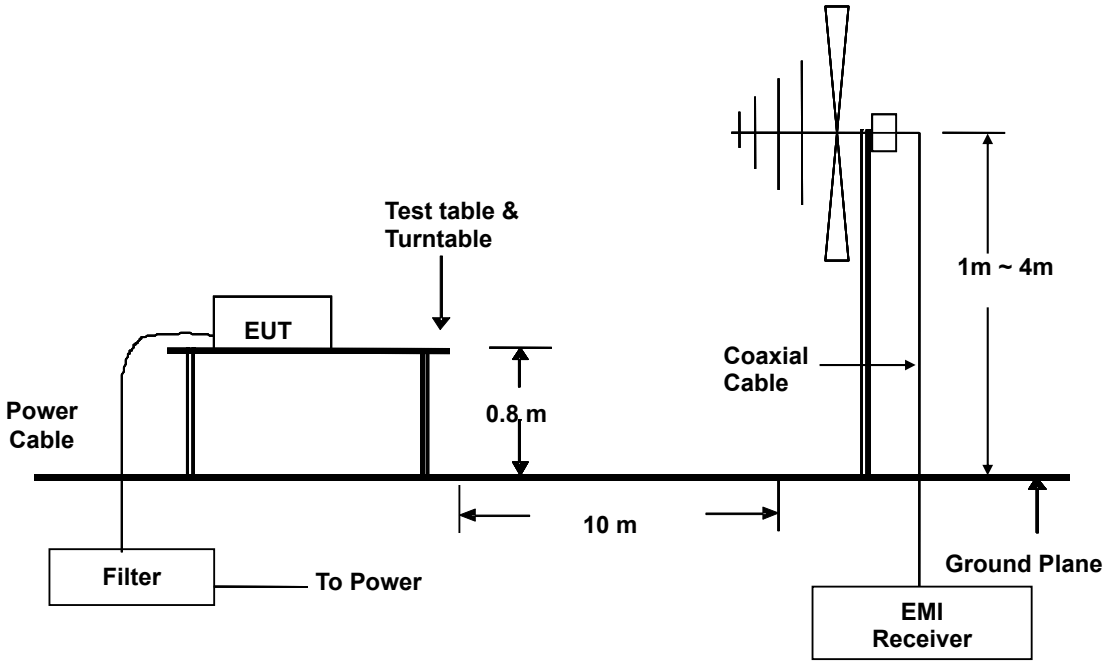
- The equipment was set up as per the test configuration to simulate typical usage per the user's manual. When the EUT is a tabletop system, a wooden turntable with a height of 0.8 meters is used which is placed on the ground plane. When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 15 cm non-conductive covering to insulate the EUT from the ground plane.
- Support equipment, if needed, was placed as per CISPR 16-2-3.
- All I/O cables were positioned to simulate typical usage as per CISPR 16-2-3.
- The EUT received AC power source from the outlet socket under the turntable. All support equipment power received from another socket under the turntable.
- The antenna was placed at 3 or 10 meter away from the EUT as stated in CISPR 16-2-3. The antenna connected to the Spectrum Analyzer via a cable and at times a pre-amplifier would be used.
- The Analyzer / Receiver quickly scanned from 30MHz to 6000MHz. The EUT test program was started. Emissions were scanned and measured rotating the EUT to 360 degrees and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.
- The test mode(s) described in Item 4.1 were scanned during the preliminary test:
- After the preliminary scan, we found the test mode described in Item 4.1 producing the highest emission level.
- The EUT and cable configuration, antenna position, polarization and turntable position of the above highest emission level were recorded for the final test.

Procedure of Final Test

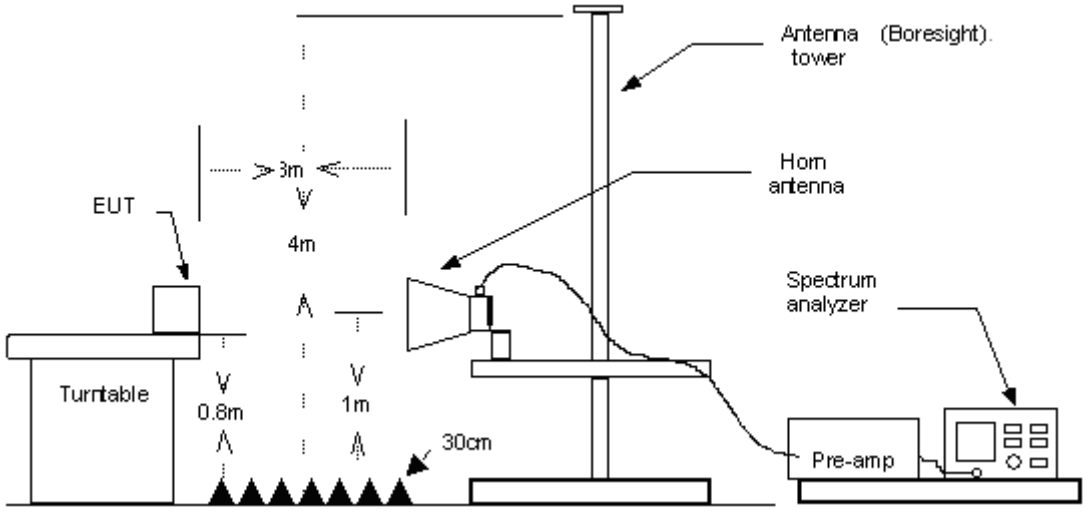
- EUT and support equipment were set up on the turntable as per the configuration with highest emission level in the preliminary test.
- The Analyzer / Receiver scanned from 30MHz to 6000MHz. Emissions were scanned and measured rotating the EUT to 360 degrees, varying cable placement and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.
- Recorded at least the six highest emissions. Emission frequency, amplitude, antenna position, polarization and turntable position were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. Below 1GHz the Q.P. reading and above 1GHz the Peak and Average reading are presented.
- The test data of the worst-case condition(s) was recorded.

7.3.4. TEST SETUP

Below 1GHz



Above 1GHz



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

7.3.5. DATA SAMPLE

Below 1GHz

Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (P/Q)	Pol. (H/V)
x.xx	14.0	12.2	26.2	40	-13.8	Q	H

Above 1GHz

Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (P/A)	Pol. (H/V)
x.xx	42.95	0.55	43.50	60	-16.50	A	H

Freq. = Emission frequency in MHz
Reading = Uncorrected Analyzer/Receiver reading
Factor = Antenna Factor + Cable Loss - Amplifier Gain
Result = Reading + Factor
Limit = Limit stated in standard
Margin = Reading in reference to limit
P = Peak Reading
Q = Quasi-peak Reading
A = Average Reading
H = Antenna Polarization: Horizontal
V = Antenna Polarization: Vertical

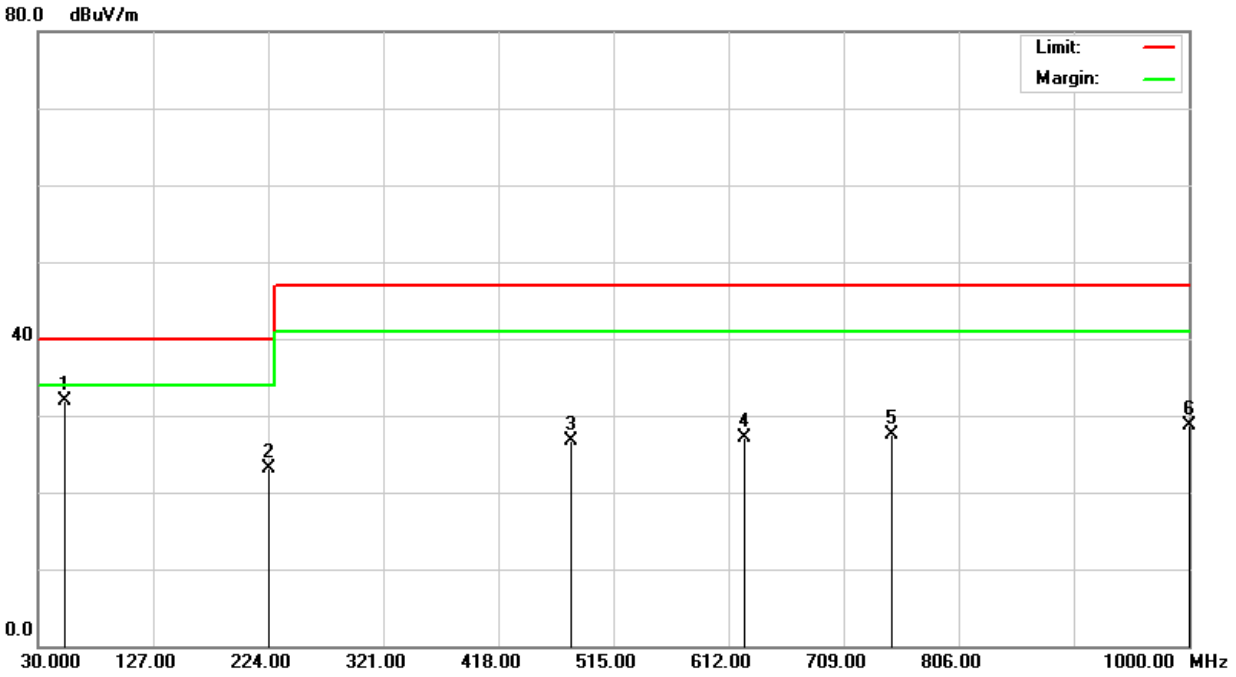
Calculation Formula

Margin (dB) = Result (dBuV/m) – Limit (dBuV/m)

7.3.6. TEST RESULTS

Below 1GHz

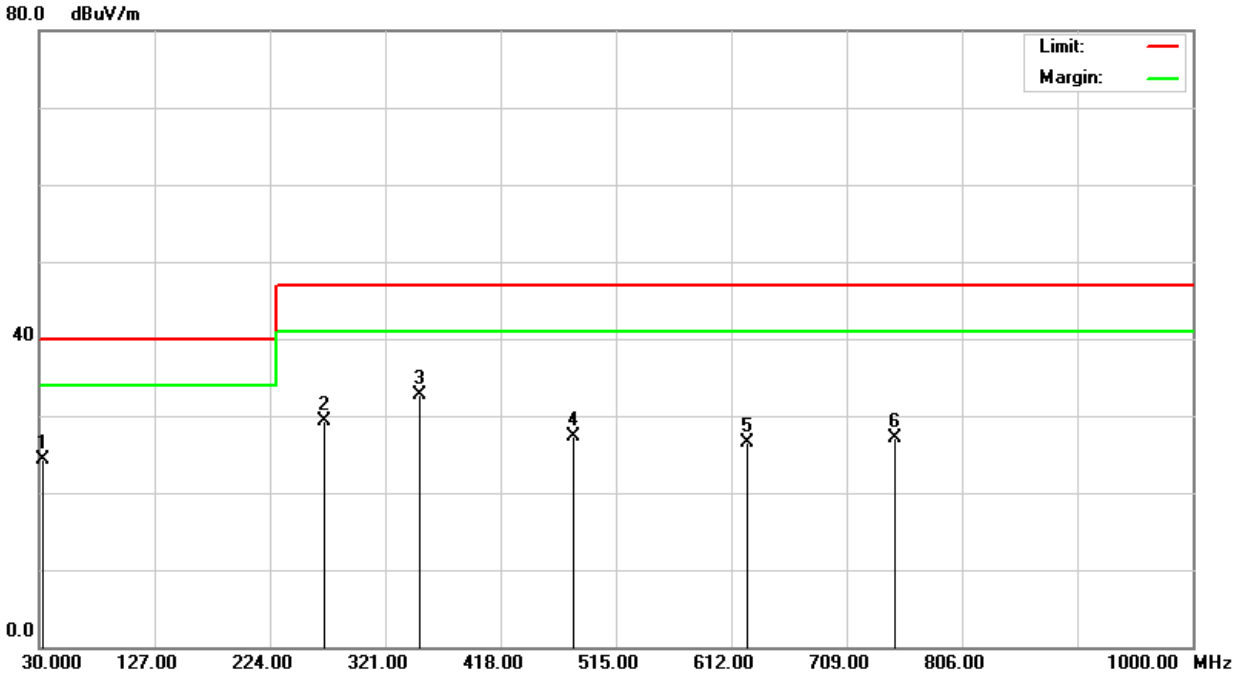
Model No.	IT412	Test Mode	Mode 1
Environmental Conditions	27°C, 73% RH	6dB Bandwidth	120 kHz
Antenna Pole	Vertical	Antenna Distance	10m
Detector Function	Quasi-peak.	Tested by	David Cheng
Standard	EN 61000-6-4		



Radiated Emission Readings									
Frequency Range Investigated				30 MHz to 1000 MHz at 10m					
Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Detector (P/Q)	Pol. (H/V)
53.1500	45.20	-13.39	31.81	40.00	-8.19	100	102	Q	V
224.9900	32.49	-9.45	23.04	40.00	-16.96	100	328	Q	V
480.0200	27.40	-0.79	26.61	47.00	-20.39	400	78	Q	V
625.0100	25.30	1.89	27.19	47.00	-19.81	400	114	Q	V
750.0100	24.10	3.42	27.52	47.00	-19.48	400	245	Q	V
1000.0000	22.30	6.39	28.69	47.00	-18.31	400	132	Q	V

Note: 1. P= Peak Reading; Q= Quasi-peak Reading.

Model No.	IT412	Test Mode	Mode 1
Environmental Conditions	27°C, 73% RH	6dB Bandwidth	120 kHz
Antenna Pole	Horizontal	Antenna Distance	10m
Detector Function	Quasi-peak.	Tested by	David Cheng
Standard	EN 61000-6-4		

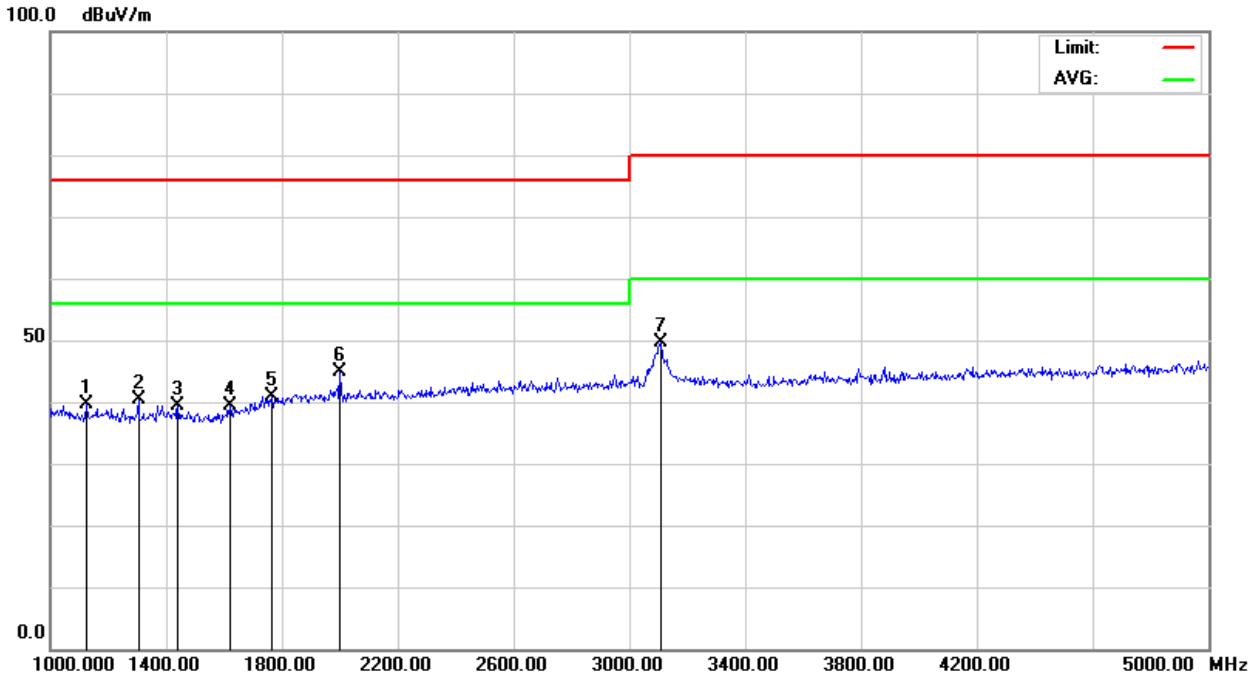


Radiated Emission Readings									
Frequency Range Investigated				30 MHz to 1000 MHz at 10m					
Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Detector (P/Q)	Pol. (H/V)
33.1900	28.10	-3.86	24.24	40.00	-15.76	400	156	Q	H
269.7800	35.50	-6.24	29.26	47.00	-17.74	400	327	Q	H
350.0100	36.80	-4.17	32.63	47.00	-14.37	400	45	Q	H
480.0200	28.10	-0.79	27.31	47.00	-19.69	100	115	Q	H
625.0100	24.60	1.89	26.49	47.00	-20.51	100	265	Q	H
750.0500	23.70	3.42	27.12	47.00	-19.88	100	191	Q	H

Note: 1. P= Peak Reading; Q= Quasi-peak Reading.

Above 1GHz

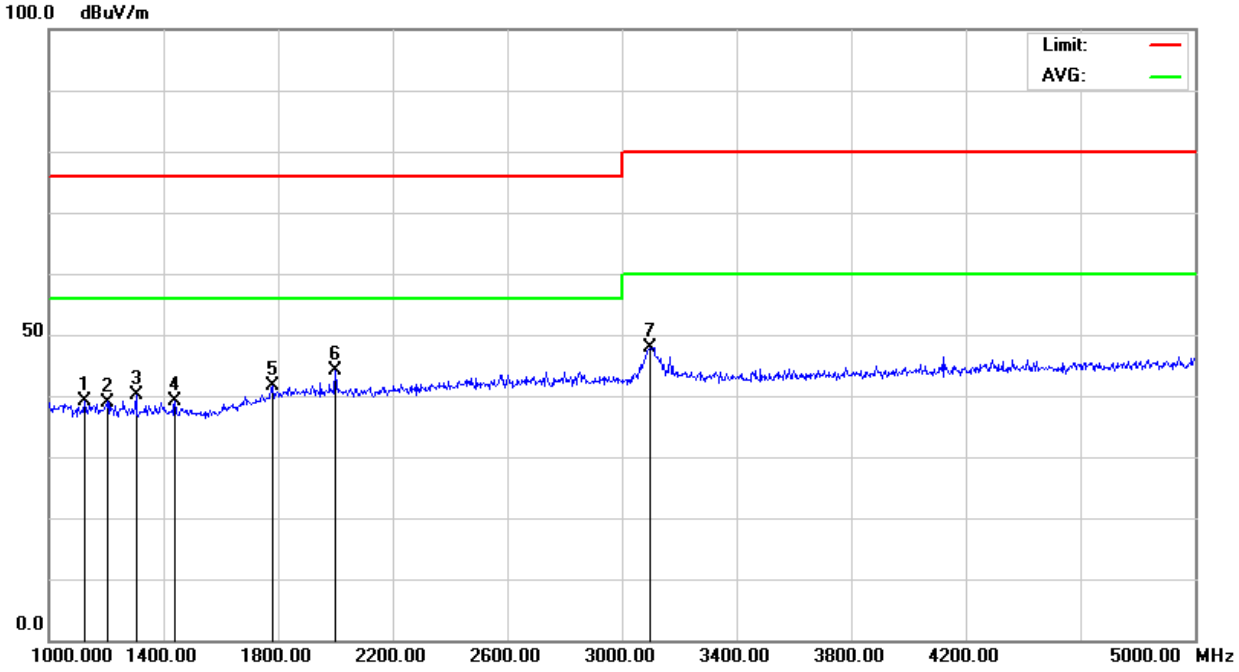
Model No.	IT412	**Test Mode**	Mode 1
Environmental Conditions	23°C, 61% RH	**6dB Bandwidth**	1 MHz
Antenna Pole	Vertical	**Antenna Distance**	3m
Highest frequency generated or used	360MHz	**Upper frequency**	5000MHz
Detector Function	Peak and average.	**Tested by**	David Cheng
Standard	EN 61000-6-4		



Radiated Emission Readings							
Frequency Range Investigated				**Above 1GHz at 3m**			
Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (P/A)	Pol. (H/V)
1124.000	**47.92**	**-8.20**	**39.72**	**76.00**	**-36.28**	**P**	**V**
1304.000	**48.83**	**-8.37**	**40.46**	**76.00**	**-35.54**	**P**	**V**
1440.000	**47.75**	**-8.38**	**39.37**	**76.00**	**-36.63**	**P**	**V**
1620.000	**47.57**	**-8.30**	**39.27**	**76.00**	**-36.73**	**P**	**V**
1764.000	**47.47**	**-6.50**	**40.97**	**76.00**	**-35.03**	**P**	**V**
2000.000	**50.25**	**-5.43**	**44.82**	**76.00**	**-31.18**	**P**	**V**
3108.000	**48.83**	**0.68**	**49.51**	**80.00**	**-30.49**	**P**	**V**

Note: 1. P= Peak Reading; A= Average Reading.

Model No.	IT412	Test Mode	Mode 1
Environmental Conditions	23°C, 61% RH	6dB Bandwidth	1 MHz
Antenna Pole	Horizontal	Antenna Distance	3m
Highest frequency generated or used	360MHz	Upper frequency	5000MHz
Detector Function	Peak and average.	Tested by	David Cheng
Standard	EN 61000-6-4		

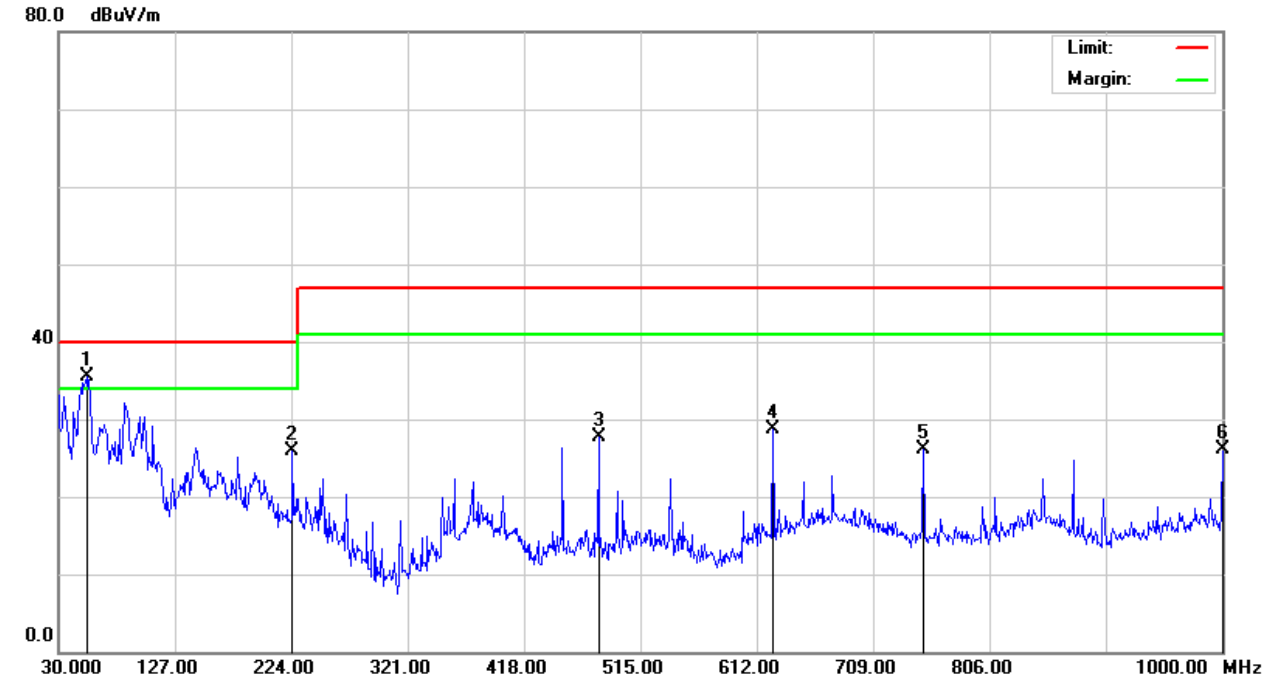


Radiated Emission Readings							
Frequency Range Investigated				Above 1GHz at 3m			
Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (P/A)	Pol. (H/V)
1124.000	47.32	-8.20	39.12	76.00	-36.88	P	H
1204.000	46.96	-7.96	39.00	76.00	-37.00	P	H
1304.000	48.53	-8.37	40.16	76.00	-35.84	P	H
1440.000	47.57	-8.38	39.19	76.00	-36.81	P	H
1780.000	47.84	-6.24	41.60	76.00	-34.40	P	H
2000.000	49.60	-5.43	44.17	76.00	-31.83	P	H
3096.000	47.02	0.97	47.99	80.00	-32.01	P	H

Note: 1. P= Peak Reading; A= Average Reading.

1066 Chamber Test Data

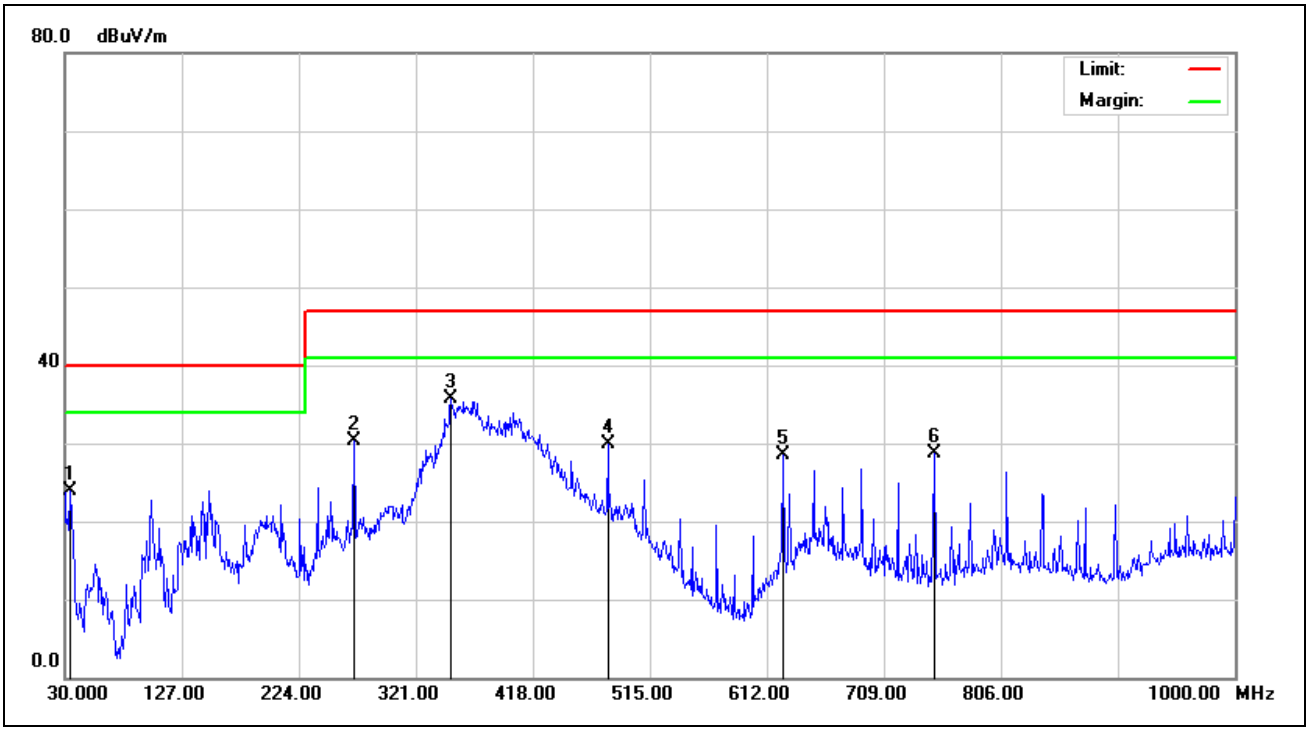
Job No.:	**T210524D11**	**Polarization:**	**Vertical**
Standard:	**EN 61000-6-4**	**Power Source:**	**24VDC**
Test item:	**Radiation Test**	**Date:**	**2021/5/28**
Company:	**Cermate Technologies Inc.**	**Time:**	**PM 09:28:28**
Model:	**IT412**	**Temp.(℃)/Hum.(%):**	**23(℃)/61%**
Description:	**Normal Mode**	**Engineer Signature:**	**David Cheng**



No.	Frequency	Reading	Factor	Result	Limit	Margin	Detector	Remark
	(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)		
1	53.2800	60.86	-25.31	35.55	40.00	-4.45	peak	
2	224.9700	43.10	-17.26	25.84	40.00	-14.16	peak	
3	480.0800	42.43	-14.78	27.65	47.00	-19.35	peak	
4	625.5800	39.91	-11.12	28.79	47.00	-18.21	peak	
5	750.7100	36.48	-10.46	26.02	47.00	-20.98	peak	
6	1000.0000	34.11	-8.09	26.02	47.00	-20.98	peak	

Report No.: T210524D11-E

Job No.:	**T210524D11**	**Polarization:**	**Horizontal**
Standard:	**EN 61000-6-4**	**Power Source:**	**24VDC**
Test item:	**Radiation Test**	**Date:**	**2021/5/28**
Company:	**Cermate Technologies Inc.**	**Time:**	**PM 09:25:22**
Model:	**IT412**	**Temp.(℃)/Hum.(%):**	**23(℃)/61%**
Description:	**Normal Mode**	**Engineer Signature:**	**David Cheng**



No.	Frequency	Reading	Factor	Result	Limit	Margin	Detector	Remark
	(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)		
1	33.8800	33.76	-9.89	23.87	40.00	-16.13	peak	
2	269.5900	51.98	-21.58	30.40	47.00	-16.60	peak	
3	350.1000	54.63	-18.91	35.72	47.00	-11.28	peak	
4	480.0800	44.42	-14.48	29.94	47.00	-17.06	peak	
5	625.5800	41.89	-13.35	28.54	47.00	-18.46	peak	
6	750.7100	41.88	-13.22	28.66	47.00	-18.34	peak	

7.4. HARMONICS CURRENT MEASUREMENT

7.4.1. LIMITS OF HARMONICS CURRENT MEASUREMENT

Limits for Class A equipment	
Harmonics Order n	Max. permissible harmonics current A
Odd harmonics	
3	2.30
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
15<=n<=39	0.15x15/n
Even harmonics	
2	1.08
4	0.43
6	0.30
8<=n<=40	0.23x8/n

Limits for Class D equipment		
Harmonics Order n	Max. permissible harmonics current per watt mA/W	Max. permissible harmonics current A
Odd Harmonics only		
3	3.4	2.30
5	1.9	1.14
7	1.0	0.77
9	0.5	0.40
11	0.35	0.33
13	0.30	0.21
15<=n<=39	3.85/n	0.15x15/n

NOTE: 1. Class A and Class D are classified according to item 7.4.3.
2. According to section 7 of EN 61000-3-2, the above limits for all equipment except for lighting equipment having an active input power > 75 W and no limits apply for equipment with an active input power up to and including 75 W.

7.4.2. TEST INSTRUMENTS

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due

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

7.4.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-029)

- The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the maximum harmonic components under normal operating conditions for each successive harmonic component in turn.
- The classification of EUT is according to section 5 of EN 61000-3-2.
- The EUT is classified as follows:

  Class A: Balanced three-phase equipment, Household appliances excluding equipment as Class D, Tools excluding portable tools, Dimmers for incandescent lamps, audio equipment, equipment not specified in one of the three other classes.

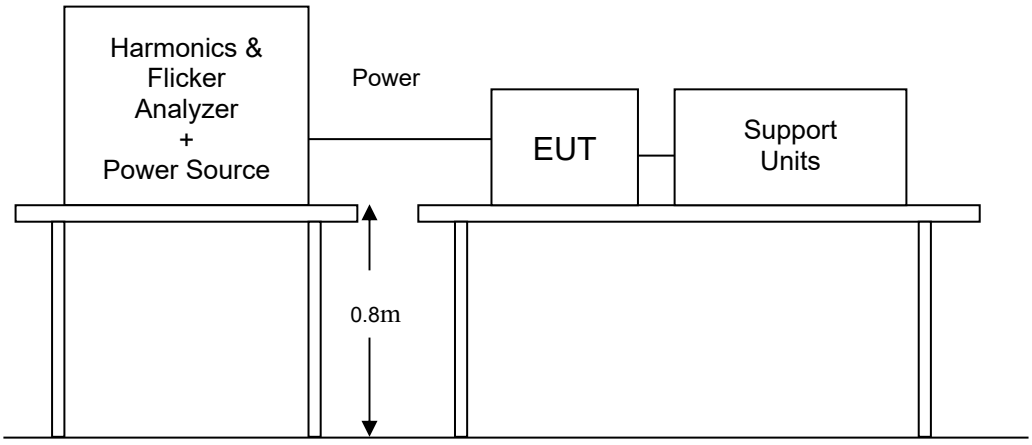
  Class B: Portable tools; Arc welding equipment which is not professional equipment.

  Class C: Lighting equipment.

  Class D: Equipment having a specified power less than or equal to 600 W of the following types: Personal computers and personal computer monitors; television receivers and refrigerators and freezers having one or more variable-speed drives to control compressor motor(s).

- The correspondent test program of test instrument to measure the current harmonics emanated from EUT is chosen. The measure time shall be not less than the time necessary for the EUT to be exercised.

7.4.4. TEST SETUP



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

7.4.5. TEST RESULTS

Power Consumption	N/A	**Test Results**	N/A
Environmental Conditions	N/A	**Limits**	Class ☐ A ☐ B ☐ C ☐ D
Test Mode	N/A	**Tested by**	N/A

NOTE: The subject equipment is not intended to be connected to AC mains supply. Therefore, this test is not applicable.

7.5. VOLTAGE FLUCTUATION AND FLICKER MEASUREMENT

7.5.1. LIMITS OF VOLTAGE FLUCTUATION AND FLICKER MEASUREMENT

TEST ITEM	LIMIT	REMARK
P_{st}	1.0	P_{st} means short-term flicker indicator.
P_{lt}	0.65	P_{lt} means long-term flicker indicator.
T_{dt} (ms)	500	T_{dt} means maximum time that dt exceeds 3 %.
d_{max} (%)	4%	d_{max} means maximum relative voltage change.
dc (%)	3.3%	dc means relative steady-state voltage change

7.5.2. TEST INSTRUMENTS

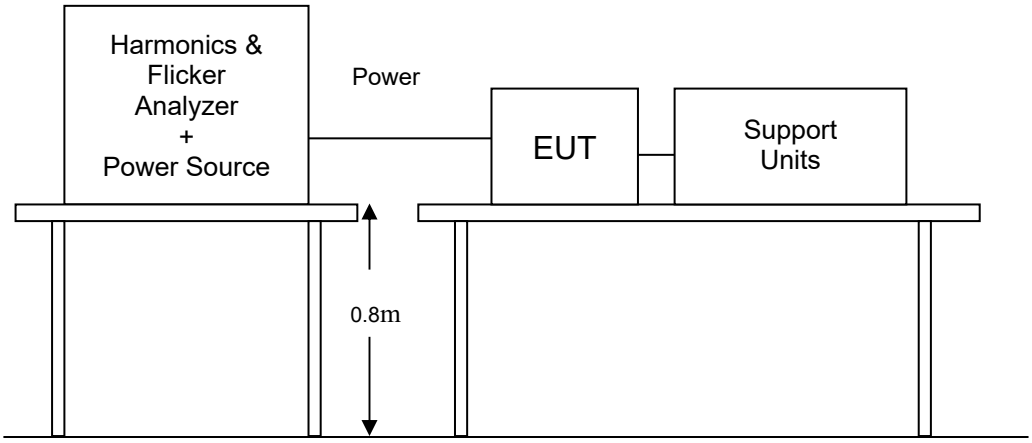
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due

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

7.5.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-030)

- The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the most unfavorable sequence of voltage changes under normal operating conditions.
- During the flick measurement, the measure time shall include that part of whole operation cycle in which the EUT produce the most unfavorable sequence of voltage changes. The observation period for short-term flicker indicator is 10 minutes and the observation period for long-term flicker indicator is 2 hours.

7.5.4. TEST SETUP



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

7.5.5. TEST RESULTS

Observation Period (Tp)	N/A	Test Mode	N/A
Environmental Conditions	N/A	Tested by	N/A

TEST PARAMETER	MEASUREMENT VALUE	LIMIT	REMARK
P_{st}	N/A	1.0	N/A
P_{lt}	N/A	0.65	N/A
T_{dt} (ms)	N/A	500	N/A
d_{max} (%)	N/A	4%	N/A
dc (%)	N/A	3.3%	N/A

NOTE: The subject equipment is not intended to be connected to AC mains supply. Therefore, this test is not applicable.

8 IMMUNITY TEST

8.1. GENERAL DESCRIPTION

Product Standard	EN 61000-6-2: 2005 / AC: 2005	
	Test Type	Minimum Requirement
Basic Standard, Specification, and Performance Criterion required	IEC/EN 61000-4-2	Electrostatic Discharge – ESD: 8kV air discharge, 4kV Contact discharge, Performance Criterion B
	IEC/EN 61000-4-3	Radio-Frequency Electromagnetic Field Susceptibility Test – RS: 80 ~1000 MHz, 10V/m, 80% AM(1kHz), 1400 ~2000 MHz, 3V/m, 80% AM(1kHz), 2000 ~2700 MHz, 1V/m, 80% AM(1kHz) Performance Criterion A
	IEC/EN 61000-4-4	Electrical Fast Transient/Burst - EFT, AC / DC Power Port: 2kV, Signal Port: 1kV Performance Criterion B
	IEC/EN 61000-4-5	Surge Immunity Test: 1.2/50 μs Open Circuit Voltage, 8 /20 μs Short Circuit Current, AC Power Port ~ line to line: 1kV, line to earth: 2kV DC Power Port ~ line to line and line to earth: 0.5kV Signal Port ~ line to earth: 1kV Performance Criterion B
	IEC/EN 61000-4-6	Conducted Radio Frequency Disturbances Test – CS, AC Power Port; DC Power Port; Signal Port: 0.15 ~ 80 MHz, 10Vrms, 80% AM, 1kHz, Performance Criterion A
	IEC/EN 61000-4-8	Power frequency magnetic field immunity test 50Hz/60Hz, 30A/m Performance Criterion A
	IEC/EN 61000-4-11	Voltage Dips: i) 0% residual for 1 cycle, Performance Criterion B ii) 40% residual for 10/12 cycles at 50/60Hz, Performance Criterion C iii) 70% residual for 25/30 cycles at 50/60Hz, Performance Criterion C Voltage Interruptions: 0% residual for 250/300 cycles at 50/60Hz Performance Criterion C

8.2. GENERAL PERFORMANCE CRITERIA DESCRIPTION

Criteria 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 what the user may reasonably expect from the apparatus if used as intended.
Criteria 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 what the user may reasonably expect from the apparatus if used as intended.
Criteria C:	Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

8.3. ELECTROSTATIC DISCHARGE (ESD)

8.3.1. TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-2
Discharge Impedance:	330 ohm / 150 pF
Discharge Voltage:	Air Discharge: 2 ; 4 ; 8 kV (Direct) Contact Discharge: 2 ; 4 kV (Direct/Indirect)
Polarity:	Positive & Negative
Number of Discharge:	Minimum 10 times at each test point
Discharge Mode:	Single Discharge 1 second minimum

8.3.2. TEST INSTRUMENT

IMMUNITY SHIELDED ROOM				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Aneroid Barometer	SATO	7610-20	89090	08/31/2021
ESD Simulator	Teseq	NSG 437	1189	04/18/2022
Thermo-Hygro Meter	Wisewind	201A	No. 04	05/31/2021

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

8.3.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-022)

The discharges shall be applied in two ways:

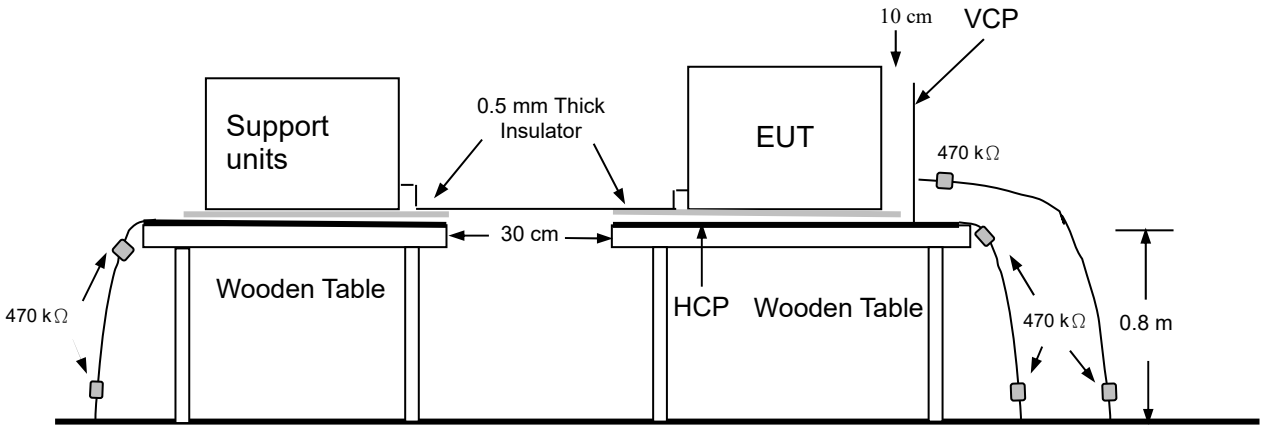
a) Contact discharges to the conductive surfaces and coupling planes:
The EUT shall be exposed to at least 20 discharges, 10 each at negative and positive polarity, at a minimum of four test points. One of the test points shall be subjected to at least 10 indirect discharges to the center of the front edge of the **H**orizontal **C**oupling **P**lane (**HCP**). The remaining three test points shall each receive at least 10 direct contact discharges. If no direct contact test points are available, then at least 20 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 IEC/EN 61000-4-2:

a) The EUT was located 0.1 m minimum from all side of the **HCP** (dimensions 1.6m x 0.8m).
b) The support units were located another table 30 cm away from the EUT, but direct support unit was/were located at same location as EUT on the HCP and keep at a distance of 10 cm with EUT.
c) The time interval between two successive single discharges was at least 1 second.
d) Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.
e) 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.
f) At least ten single discharges (in the most sensitive polarity) were applied at the front edge of each **HCP** opposite the center point of each unit of the EUT and 0.1 meters from the front of the EUT. The long axis of the discharge electrode was in the plane of the **HCP** and perpendicular to its front edge during the discharge.
g) At least ten single discharges (in the most sensitive polarity) were applied to the center of one vertical edge of the **V**ertical **C**oupling **P**lane (**VCP**) 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.

8.3.4. TEST SETUP



Ground Reference Plane

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

NOTE:

TABLE-TOP EQUIPMENT

The configuration consisted of a wooden table 0.8 meters high standing on the **G**round **R**eference **P**lane. The **GRP** consisted of a sheet of aluminum at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system. A **H**orizontal **C**oupling **P**lane (1.6m x 0.8m) was placed on the table and attached to the **GRP** by means of a cable with 940k ohm total impedance. The equipment under test, was installed in a representative system as described in section 7 of IEC/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.

FLOOR-STANDING EQUIPMENT

The equipment under test was installed in a representative system as described in section 7 of IEC/EN 61000-4-2, and its cables were isolated from the Ground Reference Plane by an insulating support of 0.1-meter thickness. The GRP consisted of a sheet of aluminum that is at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system and extended at least 0.5 meters from the EUT on all sides.

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8.3.5. TEST RESULTS

Temperature	17°C	**Humidity**	50% RH
Pressure	1008mbar	**Tested By**	Rax Chen
Required Passing Performance		**Criterion B**	

Air Discharge							
Test Points	**Test Levels**			**Results**			
	± 2 kV	**± 4 kV**	**± 8 kV**	**Pass**	**Fail**	**Performance Criterion**	**Observation**
Front	☒	☒	☒	☒	☐	☒A ☐B	Note ☐1 ☒2
Back	☒	☒	☒	☒	☐	☒A ☐B	Note ☒1 ☐2
Bottom	☒	☒	☒	☒	☐	☒A ☐B	Note ☒1 ☐2

Contact Discharge							
Test Points	**Test Levels**			**Results**			
	± 2 kV	**± 4 kV**	**± 8 kV**	**Pass**	**Fail**	**Performance Criterion**	**Observation**
Front	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Back	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Left	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Right	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Top	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Bottom	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2

Discharge To Horizontal Coupling Plane							
Side of EUT	**Test Levels**			**Results**			
	± 2 kV	**± 4 kV**	**± 8 kV**	**Pass**	**Fail**	**Performance Criterion**	**Observation**
Front	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Back	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Left	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Right	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2

Discharge To Vertical Coupling Plane							
Side of EUT	**Test Levels**			**Results**			
	± 2 kV	**± 4 kV**	**± 8 kV**	**Pass**	**Fail**	**Performance Criterion**	**Observation**
Front	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Back	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Left	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2
Right	☒	☒	☐	☒	☐	☒A ☐B	Note ☒1 ☐2

NOTE: 1. There was no change compared with initial operation during the test.
2. No discharge point.

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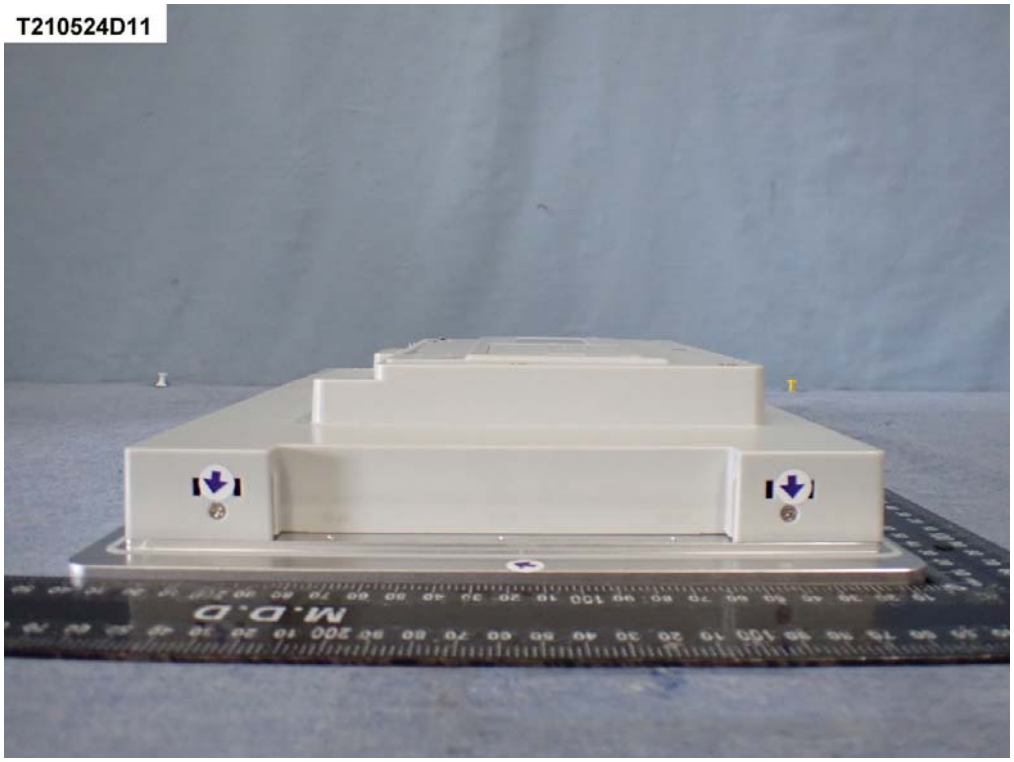
The Photo for Discharge Points of EUT

Front

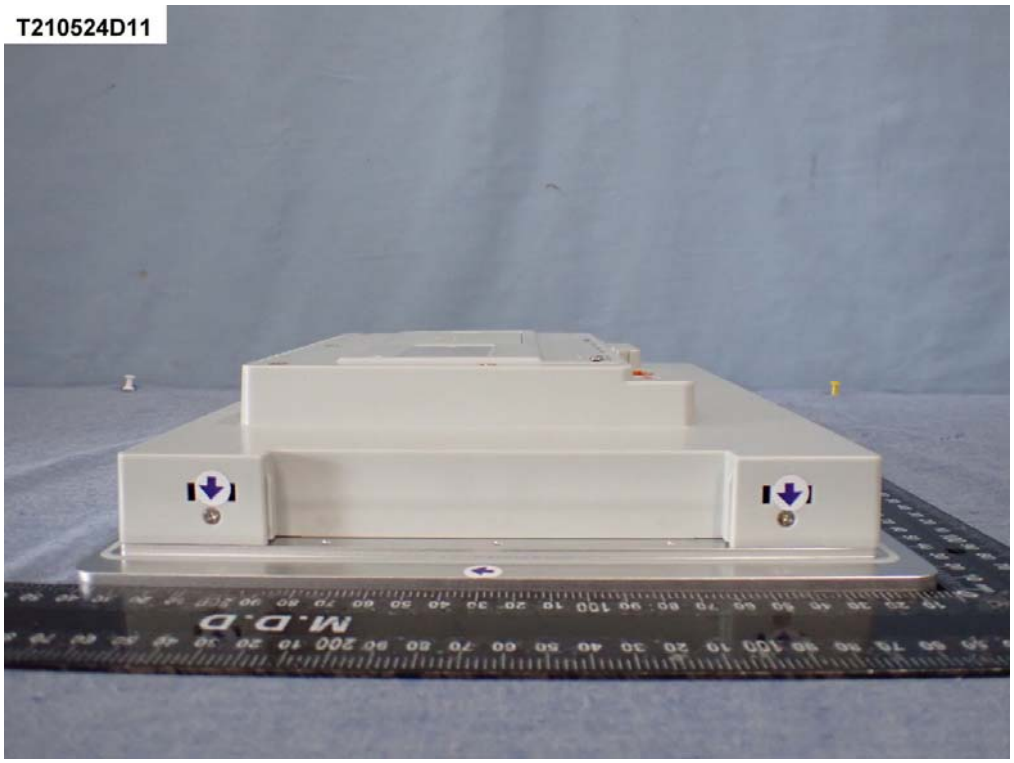
Back

Red Dot —Air Discharged
Blue Dot —Contact Discharged

Left



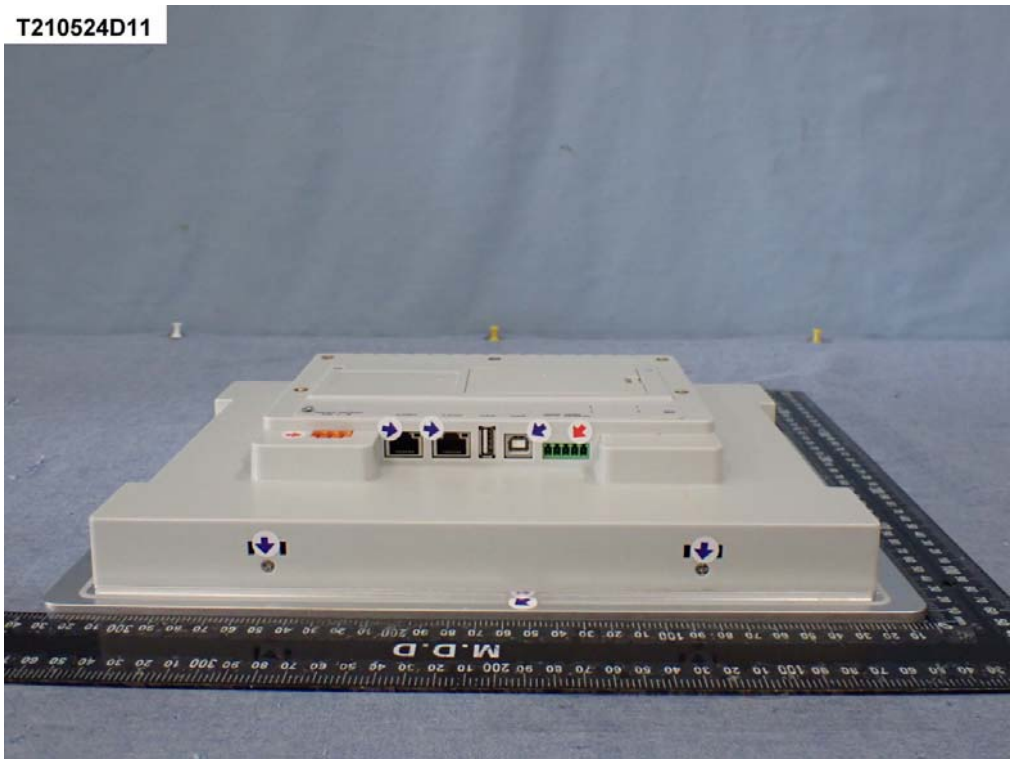
Right



Red Dot —Air Discharged
Blue Dot —Contact Discharged

Top

Bottom



Red Dot —Air Discharged
Blue Dot —Contact Discharged

8.4. RADIATED, RADIO-FREQUENCY, ELECTROMAGNETIC FIELD (RS)

8.4.1. TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-3
Frequency Range:	80 ~ 1000 MHz, 1400 ~ 2000 MHz, 2000 ~ 2700 MHz
Field Strength:	10 V/m, 3 V/m, 1 V/m
Modulation:	1kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of preceding frequency value
Polarity of Antenna:	Horizontal and Vertical
Test Distance:	3 m
Antenna Height:	1.5 m

8.4.2. TEST INSTRUMENT

844 RS Chamber				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Electric Field Probe	AR	FL7006	0338955	06/01/2021
Field of Calibration	CCS	Chamber#RS	80-1000MHz	02/25/2022
RF Power Meter	Boonton	4242	17419	03/16/2022
Power Sensor	Boonton	51011A-EMC	36833	03/16/2022
Power Sensor	Boonton	51011A-EMC	36834	03/16/2022
Thermo-Hygro Meter	Wisewind	N/A	SD-S019	10/18/2021
Broadband Antenna	AR	AT1080	311819	N.C.R
Power Amplifier	Milmega	80RF1000-600	1079361	N.C.R
Signal Generator	Agilent	N5181A	MY47421336	11/14/2021
Direction Coupler	AR	DC7144A	306217	N.C.R
Horn Antenna	EMCO	3115	5761	N.C.R
Power Amplifier	AR	60S1G3	302728	N.C.R
Power Amplifier	Milmega	AS1860-100	1075832	N.C.R
Power Amplifier	Teseq	CBA6G-100D	1087370	N.C.R
Software	Emcware Ver. 2.6.0.16			

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. N.C.R.= No Calibration required.

8.4.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-023)

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

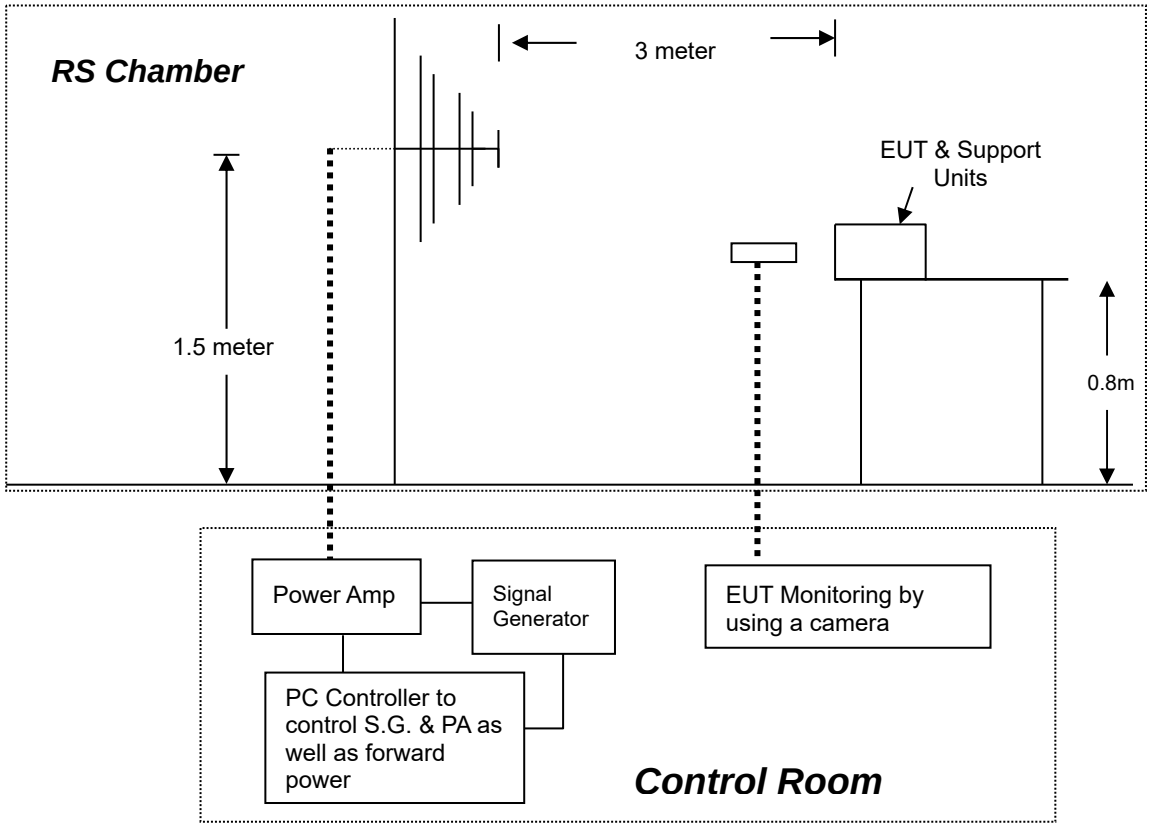
a) The testing was performed in a fully anechoic chamber. The transmit antenna was located at a distance of 3 meter from the EUT.

b) The frequency range is swept from 80 MHz to 2700 MHz, with the signal 80% amplitude modulated with a 1kHz sine-wave. The rate of sweep did not exceed 1.5 x 10^{-3} decade/s, where the frequency range is swept incrementally, the step size was 1% of preceding frequency value.

c) The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.

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

8.4.4. TEST SETUP



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

NOTE:

TABLETOP EQUIPMENT

The EUT installed in a representative system as described in section 7 of IEC/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.

FLOOR STANDING EQUIPMENT
The EUT installed in a representative system as described in section 7 of IEC/EN 61000-4-3 was placed on a non-conductive wood support 0.1 meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.

8.4.5. TEST RESULTS

Temperature	22°C	**Humidity**	52% RH
Pressure	1007mbar	**Dwell Time**	3 sec.
Tested By	Rax Chen	**Required Passing Performance**	**Criterion A**

Frequency (MHz)	Polarity	Azimuth	Field Strength (V/m)	Performance Criterion	Observation	Result
80 ~ 1000	V&H	0	10	☒A ☐B	Note ☒1 ☐2	PASS
80 ~ 1000	V&H	90	10	☒A ☐B	Note ☒1 ☐2	PASS
80 ~ 1000	V&H	180	10	☒A ☐B	Note ☒1 ☐2	PASS
80 ~ 1000	V&H	270	10	☒A ☐B	Note ☒1 ☐2	PASS
1400 ~ 2000	V&H	0	3	☒A ☐B	Note ☒1 ☐2	PASS
1400 ~ 2000	V&H	90	3	☒A ☐B	Note ☒1 ☐2	PASS
1400 ~ 2000	V&H	180	3	☒A ☐B	Note ☒1 ☐2	PASS
1400 ~ 2000	V&H	270	3	☒A ☐B	Note ☒1 ☐2	PASS
2000 ~ 2700	V&H	0	1	☒A ☐B	Note ☒1 ☐2	PASS
2000 ~ 2700	V&H	90	1	☒A ☐B	Note ☒1 ☐2	PASS
2000 ~ 2700	V&H	180	1	☒A ☐B	Note ☒1 ☐2	PASS
2000 ~ 2700	V&H	270	1	☒A ☐B	Note ☒1 ☐2	PASS

NOTE: 1. There was no change compared with the initial operation during the test.

8.5. ELECTRICAL FAST TRANSIENT (EFT)

8.5.1. TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-4
Test Voltage:	DC Power Port: 2kV Signal Port: 1kV
Polarity:	Positive & Negative
Impulse Frequency:	5 kHz
Impulse Wave-shape:	5/50 ns
Burst Duration:	15 ms
Burst Period:	300 ms
Test Duration:	Not less than 1 min.

8.5.2. TEST INSTRUMENT

Immunity Shield Room				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Capacitive Clamp	EMC-Partner	CN-EFT1000	589	06/18/2021
EMC Test System	Teseq	NSG 3060	1718	12/14/2021
Software	WIN 3000Ver. 1.3.2			

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. N.C.R.= No Calibration required.

8.5.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-024)

a) All types of cables, including their length, and the interface port of the EUT to which they were connected.

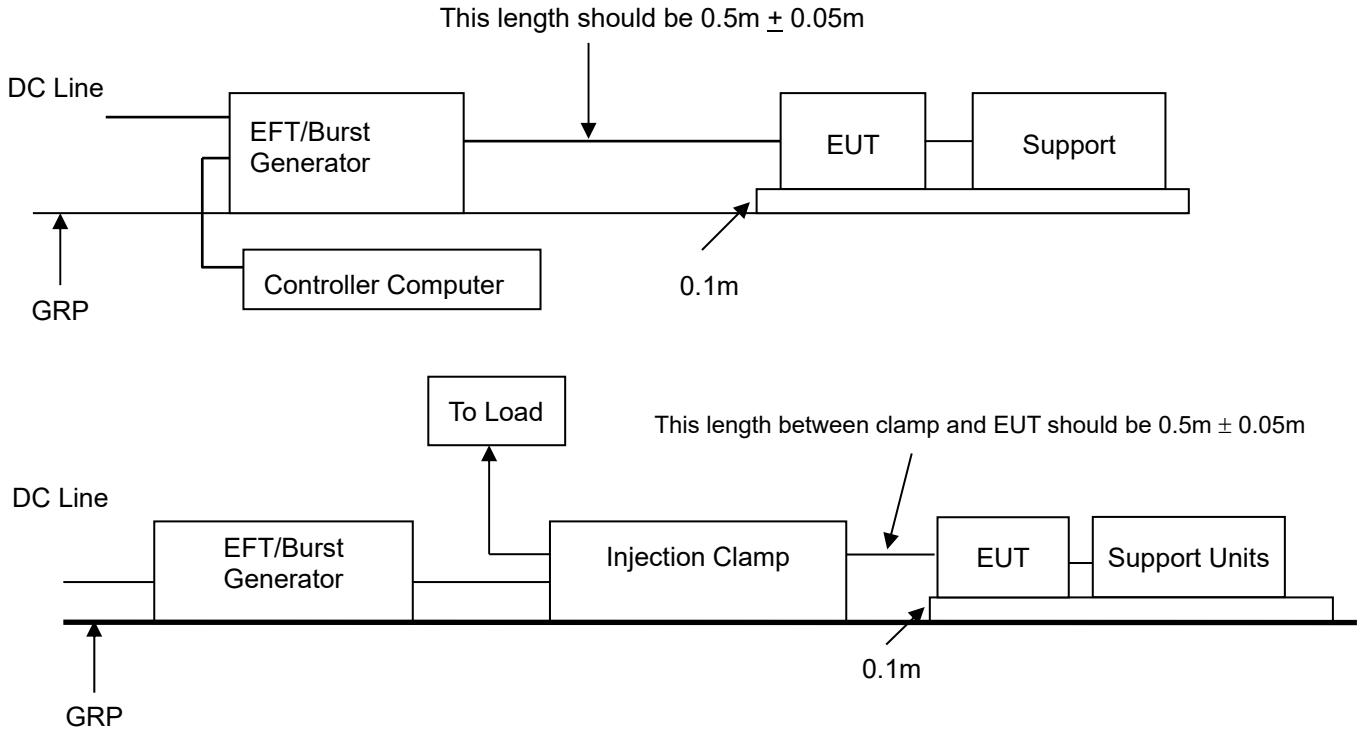
b) Both positive and negative polarity discharges were applied.

c) The length of the “hot wire” from the coaxial output of the EFT generator to the terminals on the EUT should not exceed 0.5 meter.

d) The duration time of each test sequential was 1 minute.

e) The transient/burst waveform was in accordance with IEC/EN 61000-4-4, 5/50ns.

8.5.4. TEST SETUP



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

NOTE:

TABLETOP EQUIPMENT

The configuration consisted of a wooden table (0.1m high) standing on the Ground Reference Plane. The GRP consisted of a sheet of aluminum (at least 0.25mm thick and 2.5m square) connected to the protective grounding system. A minimum distance of 0.5m was provided between the EUT and the walls of the laboratory or any other metallic structure.

FLOOR STANDING EQUIPMENT

The EUT installed in a representative system as described in section 7 of IEC/EN 61000-4-4 and its cables, were isolated from the Ground Reference Plane by an insulating support that is 0.1-meter thick. The GRP consisted of a sheet of aluminum (at least 0.25mm thick and 2.5m square) connected to the protective grounding system.

8.5.5. TEST RESULTS

Temperature	23°C	Humidity	54% RH
Pressure	1010mbar	Tested By	Rax Chen
Required Passing Performance		Criterion B	

Test Point	Polarity	Test Level (kV)	Performance Criterion	Observation	Result
L	+/-	2	☒A ☐B	Note ☒1 ☐2	PASS
N	+/-	2	☒A ☐B	Note ☒1 ☐2	PASS
L – N	+/-	2	☒A ☐B	Note ☒1 ☐2	PASS
PE	+/-	2	☒A ☐B	Note ☒1 ☐2	PASS
L - PE	+/-	2	☒A ☐B	Note ☒1 ☐2	PASS
N - PE	+/-	2	☒A ☐B	Note ☒1 ☐2	PASS
L - N - PE	+/-	2	☒A ☐B	Note ☒1 ☐2	PASS
RJ45	+/-	1	☒A ☐B	Note ☒1 ☐2	PASS
COM 1/2	+/-	1	☒A ☐B	Note ☒1 ☐2	PASS

NOTE: 1. There was no change compared with initial operation during the test.

8.6. SURGE IMMUNITY TEST

8.6.1. TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-5
Wave-Shape:	Combination Wave 1.2/50 μs Open Circuit Voltage 8/20 μs Short Circuit Current
Test Voltage:	DC Power Port ~ line to line and line to earth: 0.5kV Signal Port ~ line to earth: 1kV
Surge Input/Output:	DC Power Line: L-N / L-PE / N-PE Signal Line: L-G
Generator Source Impedance:	2 ohm between networks 12 ohm between network and ground 42 ohm between network and ground
Polarity:	Positive/Negative
Phase Angle:	0°
Pulse Repetition Rate:	1 time / min. (maximum)
Number of Tests:	5 positive and 5 negative at selected points

8.6.2. TEST INSTRUMENT

Immunity Shield Room				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
CDN	EMC-Partner	CDN-UTP8	1505	12/14/2021
EMC Test System	Teseq	NSG 3060	1718	12/14/2021
Software	WIN 3000Ver. 1.3.2			

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. N.C.R.= No Calibration required.

8.6.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-025)

a) For EUT power supply:

The surge is 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 was shorter than 2 meters in length.

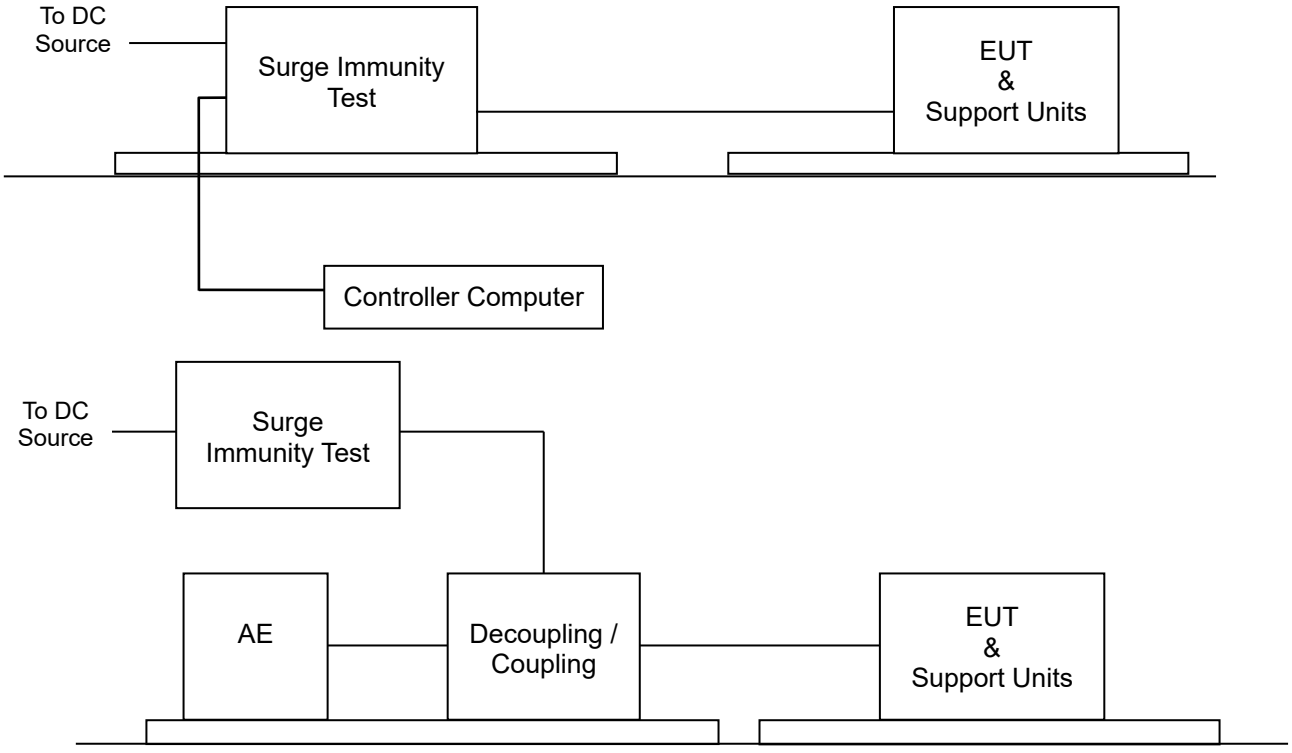
b) For test applied to unshielded un-symmetrically operated interconnection lines of EUT:

The surge was applied to the lines via the capacitive coupling. The coupling / decoupling networks didn't influence the specified functional conditions of the EUT. The interconnection line between the EUT and the coupling/decoupling networks was shorter than 2 meters in length.

c) For test applied to unshielded symmetrically operated interconnection / telecommunication lines of EUT:

The surge was applied to the lines via gas arrestors coupling. Test levels below the ignition point of the coupling arrestor were not specified. The interconnection line between the EUT and the coupling/decoupling networks was shorter than 2 meters in length.

8.6.4. TEST SETUP



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

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8.6.5. TEST RESULTS

Temperature	23°C	**Humidity**	54% RH
Pressure	1010mbar	**Tested By**	Rax Chen
Required Passing Performance		**Criterion B**	

Test Point	Polarity	Test Level (kV)	Performance Criterion	Observation	Result
L - N	+/-	0.5	☒A ☐B	Note ☒1 ☐2	PASS
L - PE	+/-	0.5	☒A ☐B	Note ☒1 ☐2	PASS
N - PE	+/-	0.5	☒A ☐B	Note ☒1 ☐2	PASS
RJ45	+/-	1	☐A ☒B	Note ☐1 ☒2	PASS

NOTE: 1. There was no change compared with initial operation during the test.
2. During the test, data accessing via RJ45 port was paused. It could become normal after test stopped.

8.7. CONDUCTED RADIO FREQUENCY DISTURBANCES (CS)

8.7.1. TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-6
Frequency Range:	0.15 MHz ~ 80 MHz
Field Strength:	10 Vrms
Modulation:	1kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of preceding frequency value
Coupled cable:	Power Mains, Unshielded; RJ45 Line, Unshielded; COM 1/2 Line, Shielded
Coupling device:	CDN-M3 (3 wires); CDN-T4; EM-Clamp

8.7.2. TEST INSTRUMENT

CS Room				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
CDN	TESEQ	CDN S751A	37469	06/10/2021
CDN	Teseq	CDN S751A	46649	11/15/2021
CDN	Teseq	CDN M016	35821	11/15/2021
CDN	TESEQ	CDN T400A	28547	11/15/2021
CDN	FCC	FCC-801-M3-25A	9973	11/15/2021
Compact Immunity Test System	TESEQ	NSG 4070	39581	11/19/2021
Software	NSG 4070 Control Program V1.2.0			

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. N.C.R.= No Calibration required.

8.7.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-026)

The EUT shall be tested within its intended operating and climatic conditions.

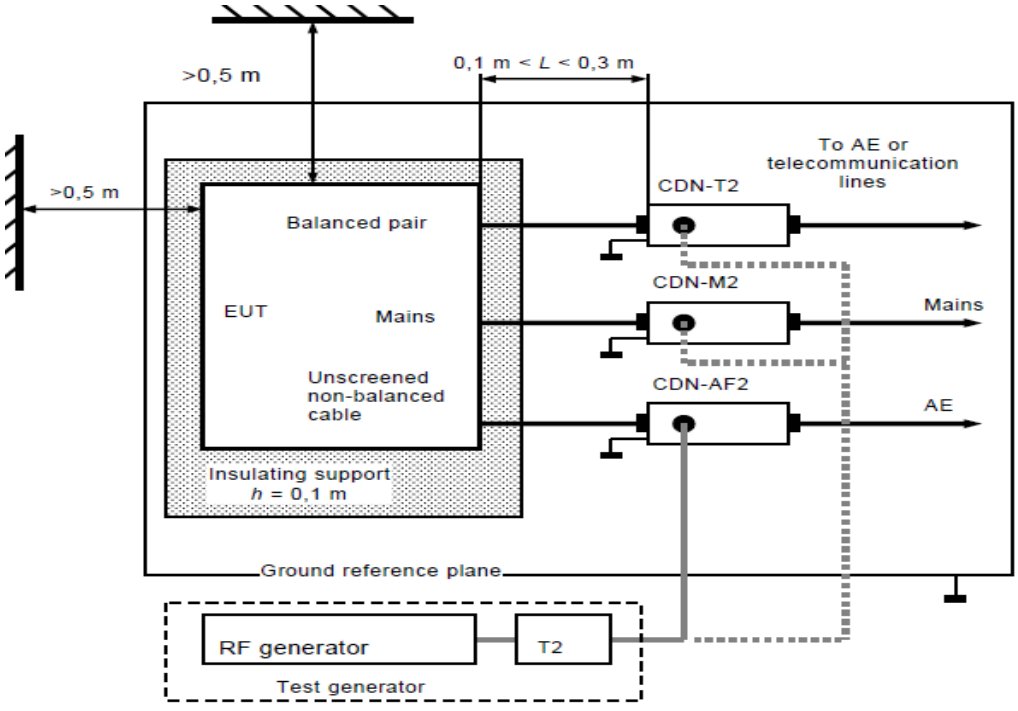
The test shell performed with the test generator connected to each of the coupling and decoupling devices in turn, while the other non-excited RF input ports of the coupling devices are terminated by a 50-ohm load resistor.

The frequency range was 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 was modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or the switch coupling devices as necessary. The sweep rate was 1.5 x 10^{-3} decades/s. Where the frequency range is swept incrementally, the step size was 1 % of preceding frequency value from 150 kHz to 80 MHz.

The dwell time at each frequency was less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies such as clock frequency(ies) and harmonics or frequencies of dominant interest, was analyzed separately.

Attempts was made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.

8.7.4. TEST SETUP



Note: 1. The CDNs and / or EM clamp used for real test depends on ports and cables configuration of EUT.
2. The EUT clearance from any metallic obstacles shall be at least 0.5m

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

NOTE:

TABLE-TOP AND FLOOR-STANDING EQUIPMENT

The equipment to be tested is placed on an insulating support of 0.1 meters height above a ground reference plane. All relevant cables shall be provided with the appropriate coupling and decoupling devices at a distance between 0.1 meters and 0.3 meters from the projected geometry of the EUT on the ground reference plane.

8.7.5. TEST RESULTS

Temperature	25°C	**Humidity**	53% RH
Pressure	1009mbar	**Dwell Time**	3 sec.
Tested By	Rax Chen	**Required Passing Performance**	**Criterion A**

Frequency Band (MHz)	Field Strength (Vrms)	Cable	Injection Method	Performance Criterion	Observation	Result
0.15 ~ 80	10	DC Power Line (0.3m)	CDN-M3	☒A ☐B	Note ☒1 ☐2	PASS
0.15 ~ 80	10	RJ45 Line (0.3m)	CDN-T4	☒A ☐B	Note ☒1 ☐2	PASS
0.15 ~ 80	10	COM 1/2 Line (0.3m)	EM-Clamp	☒A ☐B	Note ☒1 ☐2	PASS

NOTE: 1. There was no change compared with initial operation during the test.

8.8. POWER FREQUENCY MAGNETIC FIELD

8.8.1. TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-8
Frequency Range:	50Hz/60Hz
Field Strength:	30 A/m
Observation Time:	1 minute
Inductance Coil:	Rectangular type, 1mx1m

8.8.2. TEST INSTRUMENT

Immunity Shield Room				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
5kVA Power Source	Teseq	5001IX-208-TSQ	1207A03643	02/25/2022
AC/DC Clamp Meter	Fluke	353	33360025	07/13/2021
Magnetic Field Coil	Teseq	INA 703 W/ 2141	1976 / 1413	02/25/2022
Magnetic Field Meter	Sypris	4080	0247	05/10/2022
Software	Win2120Ver. 5.0			

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. N.C.R.= No Calibration required.

8.8.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-027)

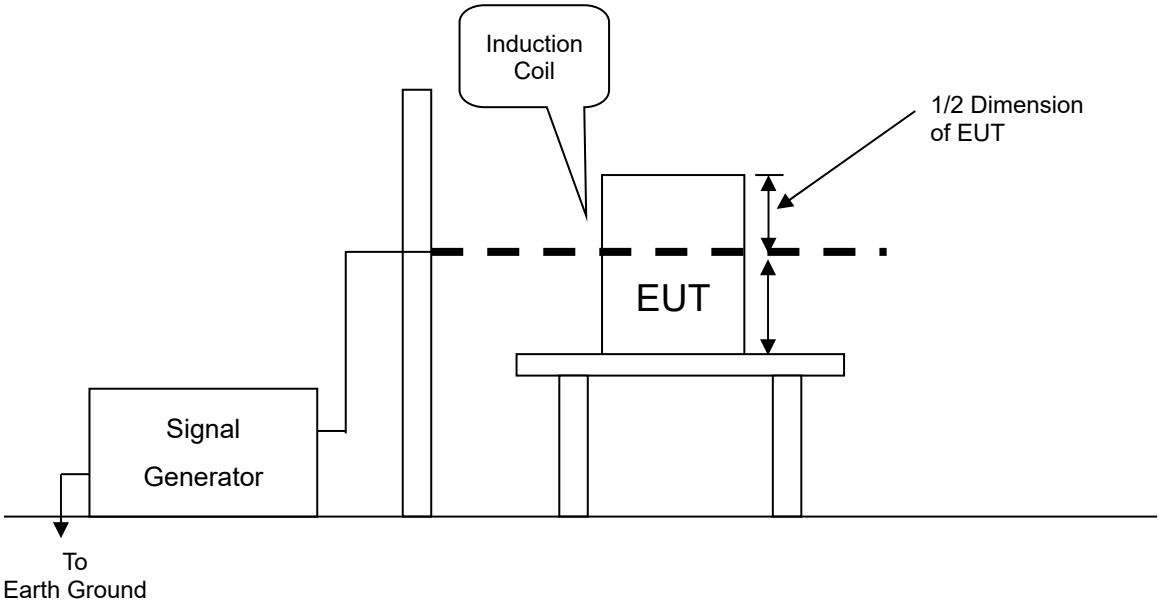
a. The equipment is configured and connected to satisfy its functional requirements. It shall be placed on the GRP with the interposition of a 0.1m-thick insulating support.

b. The equipment cabinets shall be connected to the safety earth directly on the GRP via the earth terminal of the EUT.

c. The power supply, input and output circuits shall be connected to the sources of power supply, control and signal.

d. 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.

8.8.4. TEST SETUP



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

NOTE:
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.
FLOOR-STANDING EQUIPMENT
The equipment shall be subjected to the test magnetic field by using induction coils of suitable dimensions. The test shall be repeated by moving and shifting the induction coils, in order to test the whole volume of the EUT for each orthogonal direction. The test shall be repeated with the coil shifted to different positions along the side of the EUT, in steps corresponding to 50 % of the shortest side of the coil. The induction coil shall then be rotated by 90 degrees in order to expose the EUT to the test field with different orientations.

8.8.5. TEST RESULTS

Temperature	25°C	**Humidity**	53% RH
Pressure	1009mbar	**Tested By**	Rax Chen
Required Passing Performance		**Criterion A**	

DIRECTION	Field Strength (A/m)	Performance Criterion	OBSERVATION	RESULTS
X	30	A	Note	PASS
Y	30	A	Note	PASS
Z	30	A	Note	PASS

NOTE: There was no change compared with initial operation during the test.

8.9. VOLTAGE DIPS & VOLTAGE INTERRUPTIONS

8.9.1. TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-11
Test duration time:	Minimum three test events in sequence
Interval between event:	Minimum 10 seconds
Phase Angle:	0° / 180°
Test cycle:	3 times

8.9.2. TEST INSTRUMENT

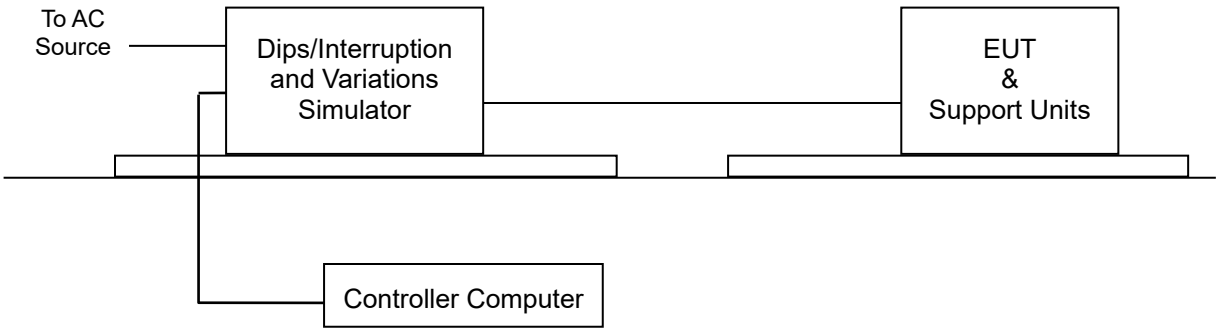
Immunity shielded room				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**

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. N.C.R.= No Calibration required.

8.9.3. TEST PROCEDURE (please refer to measurement standard or CCS SOP PA-028)

1. The EUT and support units were located on a wooden table, 0.8 m away from ground floor.
2. Setting the parameter of tests and then perform the test software of test simulator.
3. Conditions changes to occur at 0 degree crossover point of the voltage waveform.
4. Recording the test result in test record form.

8.9.4. TEST SETUP



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

8.9.5. TEST RESULTS

Temperature	N/A	**Humidity**	N/A
Pressure	N/A	**Tested By**	N/A
Required Passing Performance	**Criterion B: 0% residual 1 cycle** **Criterion C: i) 40% residual 10/12 cycles at 50/60Hz** **ii) 70% residual 25/30 cycles at 50/60Hz** **iii) 0% residual for 250/300 cycles at 50/60Hz**		

Test Power: 230Vac, 50Hz				
Voltage (% Reduction)	**Duration (Cycle)**	**Performance Criterion**	**Observation**	**Test Result**
0	1	☐A ☐B ☐C	**Note** ☒1 ☐2	N/A
40	10	☐A ☐B ☐C	**Note** ☒1 ☐2	N/A
70	25	☐A ☐B ☐C	**Note** ☒1 ☐2	N/A
0	250	☐A ☐B ☐C	**Note** ☒1 ☐2	N/A

Test Power: 230Vac, 60Hz				
Voltage (% Reduction)	**Duration (Cycle)**	**Performance Criterion**	**Observation**	**Test Result**
40	12	☐A ☐B ☐C	**Note** ☒1 ☐2	N/A
70	30	☐A ☐B ☐C	**Note** ☒1 ☐2	N/A
0	300	☐A ☐B ☐C	**Note** ☒1 ☐2	N/A

NOTE: 1. The subject equipment is not intended to be connected to AC mains supply. Therefore, this test is not applicable

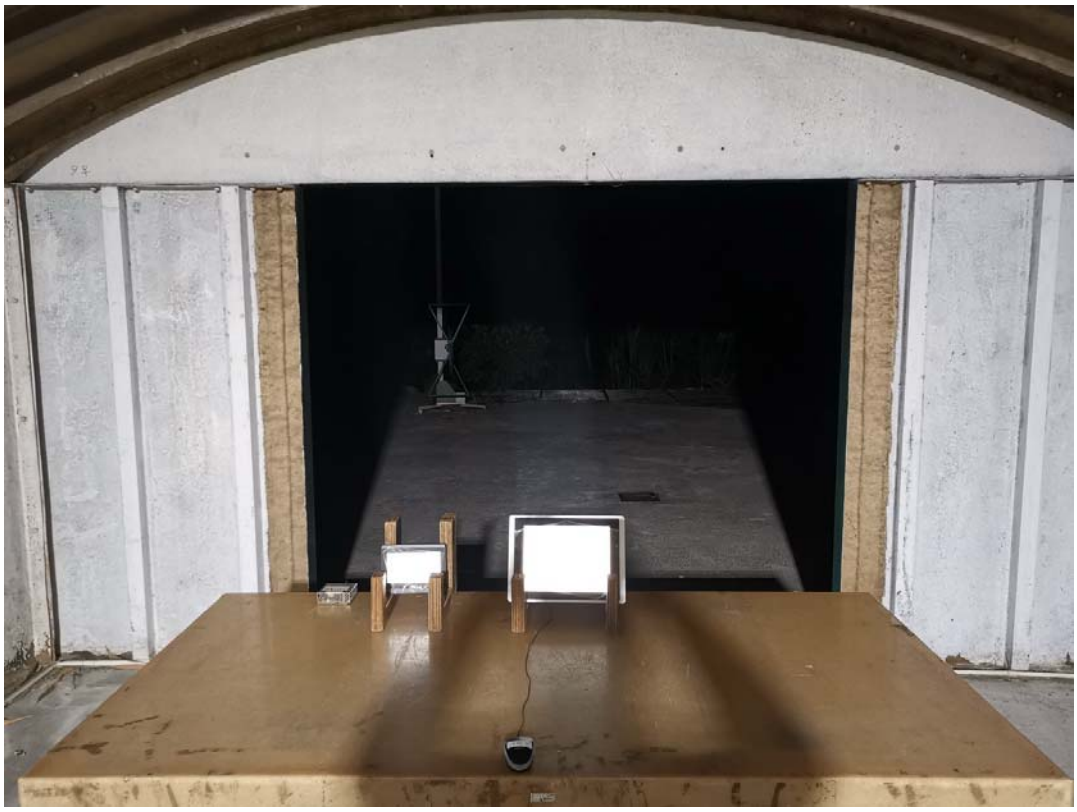
9 PHOTOGRAPHS OF THE TEST CONFIGURATION

CONDUCTED EMISSION TEST

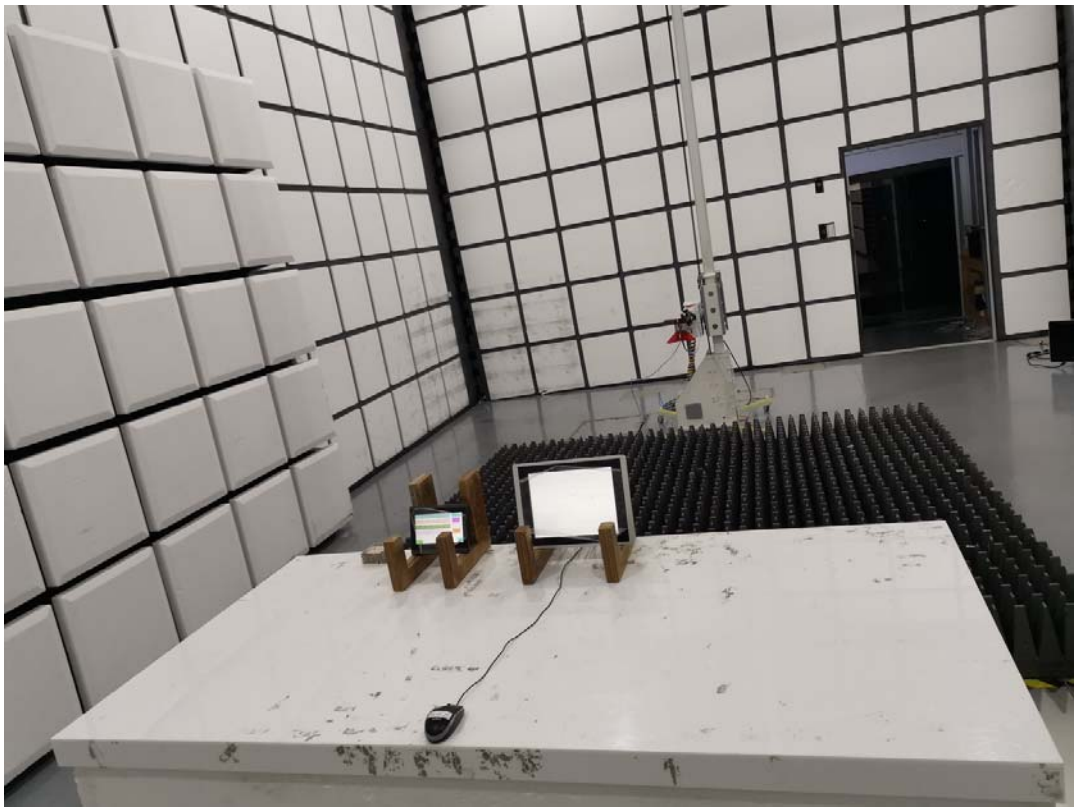
CONDUCTED EMISSION TEST FOR ASYMMETRIC MODE PORTS

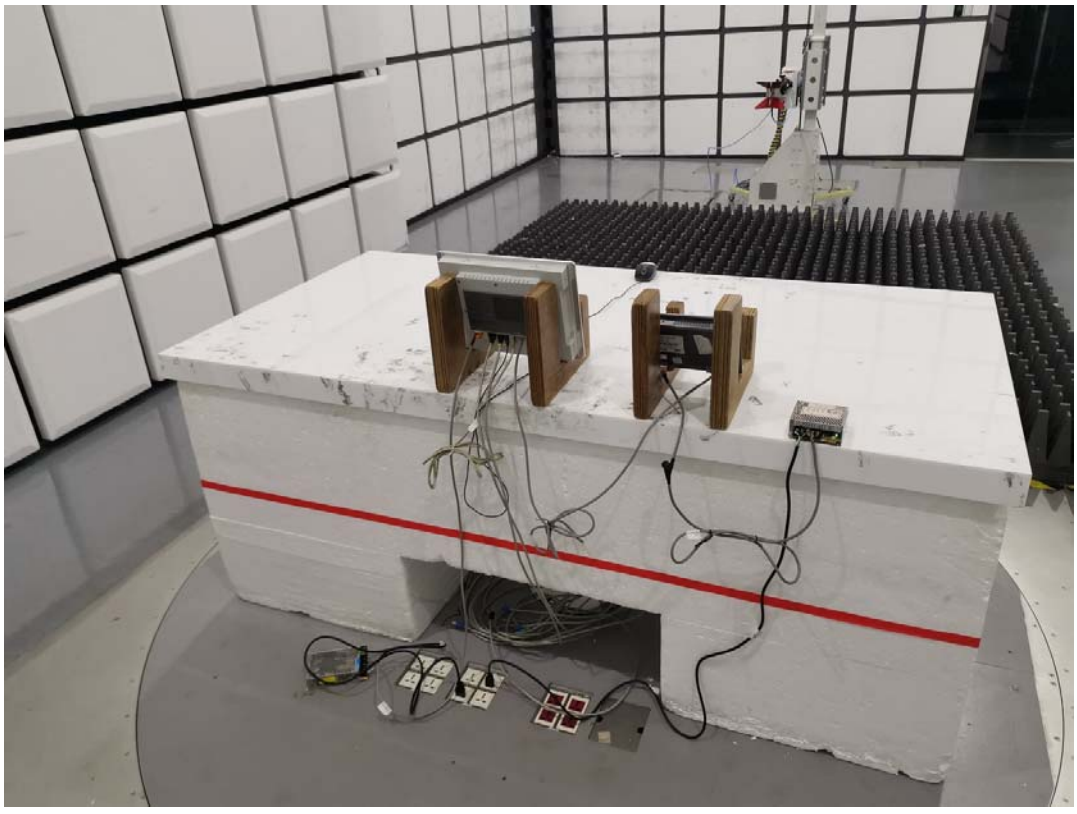
with ISN (10Mbps & 100Mbps)

RADIATED EMISSION TEST (Below 1GHz)

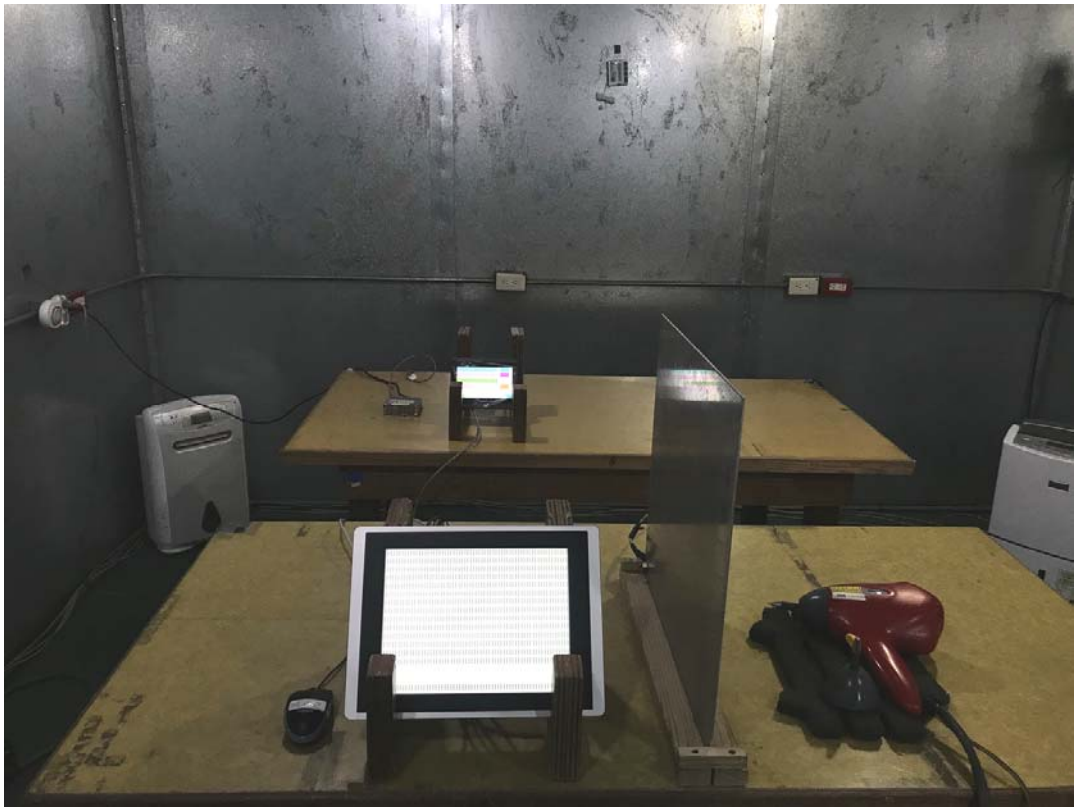


RADIATED EMISSION TEST (Above 1GHz)

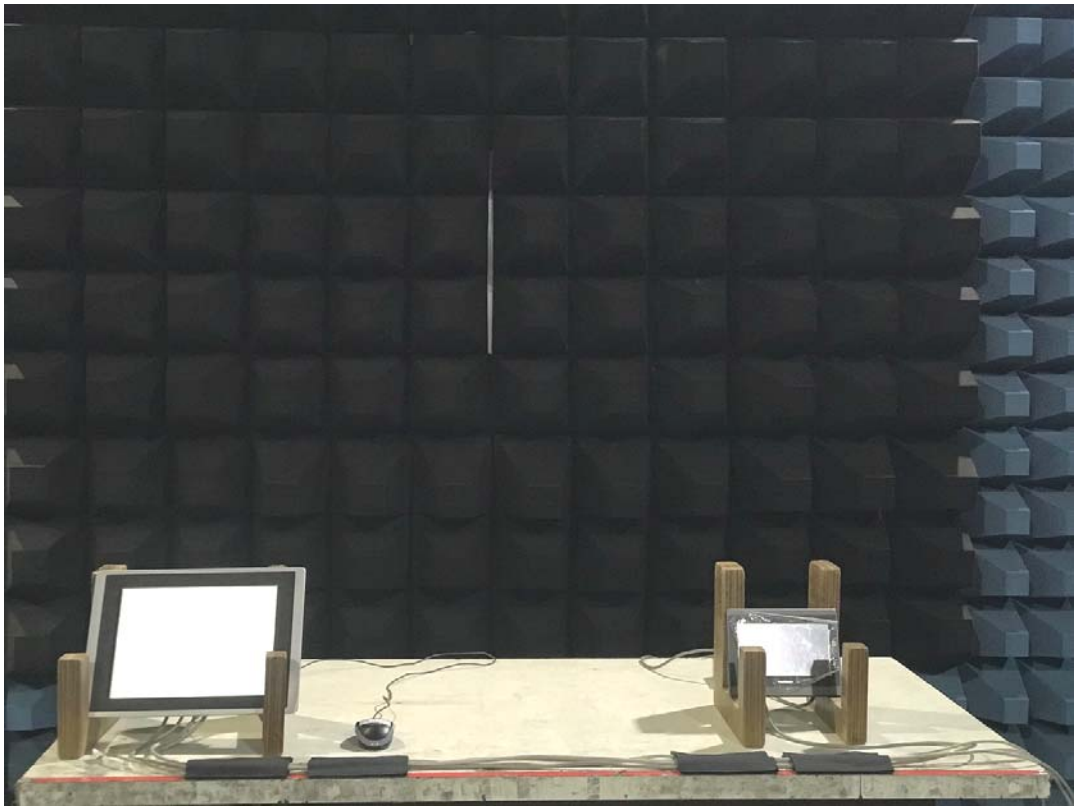




ESD Test



RS Test



EFT Test

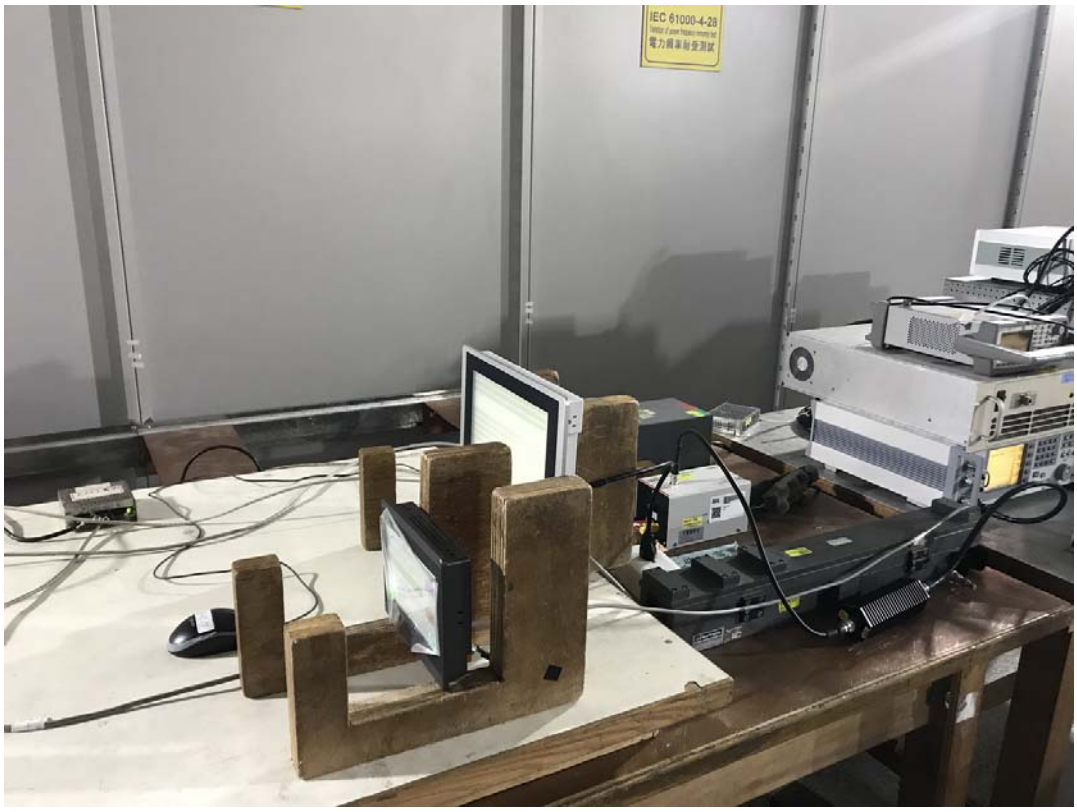
EFT For RJ45 Test

EFT For COM 1/2 Test

Surge Test

Surge For RJ45 Test

CS Test



CS For RJ45 Test

CS For COM 1/2 Test

PFMF Test