

TEST REPORT

FOR

DC to DC Converter

BRAND : 

MODEL : TEQ 20-2412WIR

SERIES MODEL : Refer to item 5.1 for more details

REPORT NUMBER: 4790626133A-EN-E0-V0

ISSUE DATE: Dec. 23, 2022

Prepared for

TRACO ELECTRONIC AG

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Prepared by

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Revision History

Rev.	Issue Date	Revisions	Revised By
--	Dec. 23, 2022	Initial Issue	Sally Lu

Summary of Test Results				
EMISSION				
Standard	Test Item	Limit	Result	Remark
EN 55032:2015 / A11: 2020	Conducted disturbance at mains terminals ports	Class B	PASS	N/A
	Conducted common mode (asymmetric mode) disturbance telecommunication ports	Class B	N/A	(Note 1)
	Radiated disturbance below 1GHz	Class B	PASS	N/A
	Radiated disturbance above 1 GHz	Class B	N/A	(Note 2)
EN IEC 61000-3-2: 2019/A1: 2021	Harmonic current disturbance	Class A	N/A	(Note 3)
EN 61000-3-3: 2013/A2: 2021	Voltage Fluctuations & Flicker	Refer to 6.5.1	N/A	(Note 3)

Note 1: Since the EUT does not contain asymmetric port, the test is unnecessary.

Note 2: Since the highest frequency of EUT is less than 108 MHz, the measurement above 1 GHz is unnecessary.

Note 3: Since the EUT does not connect to mains power network directly, the test is unnecessary.

Summary of Test Results				
IMMUNITY				
Basic Standard	Test Item	Class / Severity	Require Performance Criteria	Result
IEC 61000-4-2: 2008 EN 61000-4-2: 2009	Electrostatic discharge immunity	Contact ± 4 kV Air ± 8 kV	B	PASS
EN IEC 61000-4-3: 2020	Continuous RF electromagnetic field disturbances, swept test	80-1000MHz 3V/m 80%, 1kHz, AM	A	PASS
	Continuous RF electromagnetic field disturbances, spot test	1800 ;2600 ;3500 5000 MHz ($\pm 1\%$) 3V/m 80%, 1kHz, AM (Note 2)	A	PASS
	immunity levels to common wireless communication devices	See Table I.1	A	PASS
EN 61000-4-4: 2012	Electrical fast transient/burst immunity	1kV(AC Mains) 5/50ns, 5kHz	B	N/A (Note 3)
		0.5kV(DC Ports) 5/50ns, 5kHz	B	PASS
		0.5kV(Signal Lines) 5/50ns, 5kHz	B	N/A (Note 4)
EN 61000-4-5: 2014 / A1: 2017	Surge immunity	AC Mains 2.0kV(Common) 1.0kV(Differential) 1.2/50us	B	N/A (Note 3)
		DC Ports 0.5kV Line to Ground	B	PASS
		Signal port 1.0kV (w/o primary protector) 4.0kV (w primary protector) 1.2/50us or 10/700us (Note 1)	C	N/A (Note 4)
		0.5kV Coaxial or shielded to ground 1.2/50 (8/20) us	B	N/A (Note 5)

Summary of Test Results				
IMMUNITY				
Basic Standard	Test Item	Class / Severity	Require Performance Criteria	Result
EN 61000-4-6: 2014 / AC:2015	Continuous induced RF disturbances	AC Mains 0.15~10MHz, 3V 10~30MHz, 3~1V 30-80MHz, 1V with 1kHz 80% AM (Note 2)	A	N/A (Note 3)
		DC Ports 0.15~10MHz, 3V 10~30MHz, 3~1V 30-80MHz, 1V with 1kHz 80% AM (Note 2)	A	PASS
		Signal Line 0.15~10MHz, 3V 10~30MHz, 3~1V 30-80MHz, 1V with 1kHz 80% AM (Note 2)	A	N/A (Note 4)
EN 61000-4-8: 2010	Power frequency magnetic field immunity (Continuous)	50 Hz, 1 A/m(r.m.s)	A	PASS
	Power frequency magnetic field immunity (Short duration)	50Hz, 1000A/m, 1~3s (r.m.s) by client request	A	PASS
IEC 61000-4-11: 2020	Voltage dips, short interruptions and voltage variations immunity	Voltage dips, <5% residual with 0.5cycles	B	N/A (Note 3)
		Voltage dips, 70% residual with 25 cycles	C	
		Voltage interruptions, <5% residual with 250 cycles	C	

Note 1: Where the coupling network for the 10/700 μ s waveform affects the functioning of high speed data ports, the test shall be carried out using a 1,2/50 (8/20) μ s waveform and appropriate coupling network.

Note 2: The frequency range is scanned as specified. However, when specified in EN 55035, an additional EUT contains telephony functional test shall be carried out at a limited number of frequencies. The selected frequencies for conducted immunity tests are: 0,2; 1; 7,1; 13,56; 21; 27,12 and 40,68 MHz (± 1 %) and radiated immunity tests are 80; 120; 160; 230; 434; 460; 600; 863 and 900MHz (± 1 %).

Note 3: Since the EUT does not connect to mains power network directly, the test is unnecessary.

Note 4: Since the EUT does not contain signal port, the test is unnecessary

Note 5: Since the signal ports are not connected to outdoor directly or there are no coaxial or shielded port for EUT, the test is unnecessary.

**Table I.1 – Guidance on the selection of immunity levels
to common wireless communication devices**

Table clause	Approximate protection distance (m)	Calculated RF field strength in V/m for frequencies and protection distances simulating different radio transmission types, assuming a given ERP						
		LTE/UMTS (0,2 W)	GSM		WiMAX/3 G (1,26 W)	WiMAX (1,26 W)	Wi-Fi (1 W)	Maximum RF field strength at any frequency
			(2 W)	(1 W)				
		800 MHz	900 MHz	1,8 GHz	2,6 GHz	3,5 GHz	5 GHz	
I.1.1	3,0	0,6	1,8	1,3	1,5	1,5	1,3	3
I.1.2	1,5	1,2	3,7	2,6	2,9	2,9	2,6	4
I.1.3	1,0	1,7	5,5	3,9	4,4	4,4	3,9	6
I.1.4	0,5	3,3	10,5	10,5	11,8	11,8	10,5	12
I.1.5	0,2	8,3	26,4	26,4	29,6	29,6	26,4	30
The protection distance is not the test distance as defined in IEC 61000-4-3:2006/AMD1:2007/AMD2:2010, but the shortest expected operating distance between the EUT and the interfering wireless communication device at which the immunity performance criteria will be satisfied.								

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: TRACO ELECTRONIC AG
Sihlbruggstrasse 111 CH-6340 Baar Switzerland

MANUFACTURER: TRACO ELECTRONIC AG
Sihlbruggstrasse 111 CH-6340 Baar Switzerland

EUT DESCRIPTION: DC to DC Converter

BRAND:



MODEL: TEQ 20-2412WIR

SERIES MODEL : Refer to item 5.1 for more details

DATE of TESTED: Nov. 10, 2022 ~ Nov. 21, 2022

APPLICABLE STANDARDS	
STANDARDS	TEST RESULTS
EN 55032 :2015 / A11: 2020 EN 55035: 2017 / A11: 2020	PASS

Underwriters Laboratories Taiwan Co., Ltd. Tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. Based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. And all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. Will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

A handwritten signature in blue ink, appearing to read "Sally Lu".

Sally Lu
Project Handler

Date : Dec. 23, 2022

Approve and Authorized By:

A handwritten signature in black ink, appearing to read "Hank Yang".

Hank Yang
Laboratory Engineer Associate

Date : Dec. 23, 2022

2. TEST METHODOLOGY

All tests were performed in accordance with the procedures documented EN 55032, EN55035.

3. FACILITIES AND ACCREDITATION

Test Location	Underwriters Laboratories Taiwan Co., Ltd.,
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Description	All measurement facilities use to collect the measurement data are located at Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

4. CALIBRATION AND UNCERTAINTY

4.1. Measuring Instrument Calibration

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.

Electromagnetic interference:

Test Item	Measurement Frequency Range	K	U(dB)
Conducted disturbance at mains terminals ports	0.15MHz ~ 30MHz	2	3.2
966-1 Test Site			
Radiated disturbance below 1 GHz	30MHz ~ 1000MHz	2	5.9

Electromagnetic sensitivity:

Test Item	Measurement Frequency Range	K	U(dB)
Radiated, radio frequency electromagnetic field immunity	80MHz ~ 6000MHz	2	2.1
Immunity to conducted disturbances, induced by radio-frequency fields (CDN)	0.15MHz ~ 80MHz	2	2.4

Test Item	K	Voltage(%)	Rise Time(%)	First Peak Current (%)	Current @ 30ns (%)	Current @ 60ns (%)
Electrostatic discharge immunity	2	2.8	7.2	3.4	3.1	3.7


Test Item	K	Peak Voltage(%)	Rise Time(%)	Pulse width(%)	Burst Period (%)	Burst duration (%)	Repetition rate (%)
Electrical fast transient/burst immunity	2	3.6	3.7	1.7	0.94	0.47	0.29

Test Item	K	Phase Shifting (%)	Voltage (%)	Current (%)	Front Time (For waveform of the surge voltage)(%)	Duration (For waveform of the surge voltage)(%)	Front Time (For waveform of the surge current)(%)	Duration (For waveform of the surge current)(%)
Surge immunity	2	1.1	3.6	2.7	1.2	0.43	5.9	0.79

Test Item	K	Magnetic field Strength(%)
Power Frequency Magnetic Field Immunity Test	2	4.9%

5. EQUIPMENT UNDER TEST

5.1. Description of EUT

EUT Name:	DC to DC Converter
Brand:	
Model:	TEQ 20-2412WIR
Series Model:	TEQ 20-2411WIR, TEQ 20-2413WIR, TEQ 20-2415WIR, TEQ 20-2422WIR, TEQ 20-2423WIR, TEQ 20-4811WIR, TEQ 20-4812WIR, TEQ 20-4813WIR, TEQ 20-4815WIR, TEQ 20-4822WIR, TEQ 20-4823WIR, TEQ 20-7211WIR, TEQ 20-7212WIR, TEQ 20-7213WIR, TEQ 20-7215WIR, TEQ 20-7222WIR, TEQ 20-7223WIR, TEQ 40-2411WIR, TEQ 40-2412WIR, TEQ 40-2413WIR, TEQ 40-2415WIR, TEQ 40-2422WIR, TEQ 40-2423WIR, TEQ 40-2425WIR, TEQ 40-4811WIR, TEQ 40-4812WIR, TEQ 40-4813WIR, TEQ 40-4815WIR, TEQ 40-4822WIR, TEQ 40-4823WIR, TEQ 40-4825WIR, TEQ 40-7211WIR, TEQ 40-7212WIR, TEQ 40-7213WIR, TEQ 40-7215WIR, TEQ 40-7222WIR, TEQ 40-7223WIR, TEQ 40-7225WIR
Power Rating:	24Vdc from DC source
Highest Frequency within EUT:	Less than 108MHz
Condition of EUT:	Mass-Production Test sample
Sample ID:	4598463, 4598465
Date Of Receipt Of Sample:	Nov. 3, 2022

Note:

1. The models difference table as below:

Model Number	Input Range (VDC)	Output Voltage (VDC)
TEQ 20-2411WIR	9 ~ 36	5
TEQ 20-2412WIR	9 ~ 36	12
TEQ 20-2413WIR	9 ~ 36	15
TEQ 20-2415WIR	9 ~ 36	24
TEQ 20-2422WIR	9 ~ 36	±12
TEQ 20-2423WIR	9 ~ 36	±15
TEQ 20-4811WIR	18 ~ 75	5
TEQ 20-4812WIR	18 ~ 75	12
TEQ 20-4813WIR	18 ~ 75	15
TEQ 20-4815WIR	18 ~ 75	24
TEQ 20-4822WIR	18 ~ 75	±12
TEQ 20-4823WIR	18 ~ 75	±15
TEQ 20-7211WIR	43 ~ 160	5
TEQ 20-7212WIR	43 ~ 160	12
TEQ 20-7213WIR	43 ~ 160	15
TEQ 20-7215WIR	43 ~ 160	24
TEQ 20-7222WIR	43 ~ 160	±12
TEQ 20-7223WIR	43 ~ 160	±15
TEQ 40-2411WIR	9.5 ~ 36	5
TEQ 40-2412WIR	9.5 ~ 36	12
TEQ 40-2413WIR	9.5 ~ 36	15
TEQ 40-2415WIR	9.5 ~ 36	24
TEQ 40-2422WIR	9.5 ~ 36	±12
TEQ 40-2423WIR	9.5 ~ 36	±15
TEQ 40-2425WIR	9.5 ~ 36	±24
TEQ 40-4811WIR	18 ~ 75	5
TEQ 40-4812WIR	18 ~ 75	12
TEQ 40-4813WIR	18 ~ 75	15
TEQ 40-4815WIR	18 ~ 75	24
TEQ 40-4822WIR	18 ~ 75	±12
TEQ 40-4823WIR	18 ~ 75	±15
TEQ 40-4825WIR	18 ~ 75	±24
TEQ 40-7211WIR	43 ~ 160	5
TEQ 40-7212WIR	43 ~ 160	12
TEQ 40-7213WIR	43 ~ 160	15
TEQ 40-7215WIR	43 ~ 160	24
TEQ 40-7222WIR	43 ~ 160	±12
TEQ 40-7223WIR	43 ~ 160	±15
TEQ 40-7225WIR	43 ~ 160	±24

5.2. Test Mode

The Pre-test modes:

Mode	Description	Conducted Emission	Radiated Emission
Mode 1	Operation Mode (TEQ 20-2412WIR)	v	v
Mode 2	Operation Mode (TEQ 40-2412WIR)	-	v

Note: The customer only provided TEQ 20-2412WIR, TEQ 40-2412WIR for the “Radiated Emission” pretest and choose the worst mode do the EMI and EMS final test.

Test Items		Test Mode
Emission	Conducted Emission	Mode 1
	Radiated Emission	Mode 1
Immunity	Electrostatic Discharge	Mode 1
	Radio Frequency Electromagnetic Field	Mode 1
	Electrical Fast Transient	Mode 1
	Surge Immunity	Mode 1
	Immunity to conducted disturbances, induced by radio-frequency fields	Mode 1
	Power frequency magnetic field immunity	Mode 1

5.3. EUT Operation Test Setup

For Emission test

Mode 1:

- a. The EUT was linked to resistance load with full load during the testing.
- b. Power on the EUT and run test.

For Immunity test

Mode 1:

- a. The EUT was linked to resistance load with full load and the resistance load was connected with a meter during the testing.
- b. Power on the EUT and run test.

5.4. Monitoring of EUT for All Immunity Test

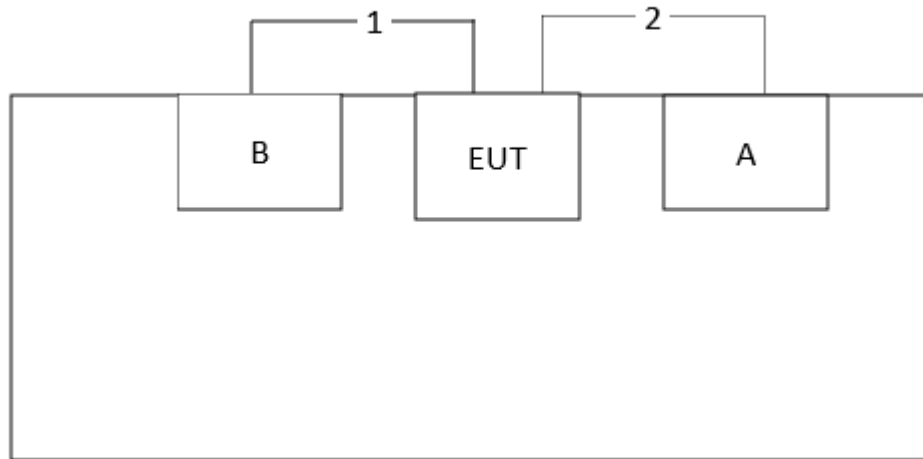
Audio	N/A
Visual	Monitor the output voltage through the meter.

5.5. Accessory

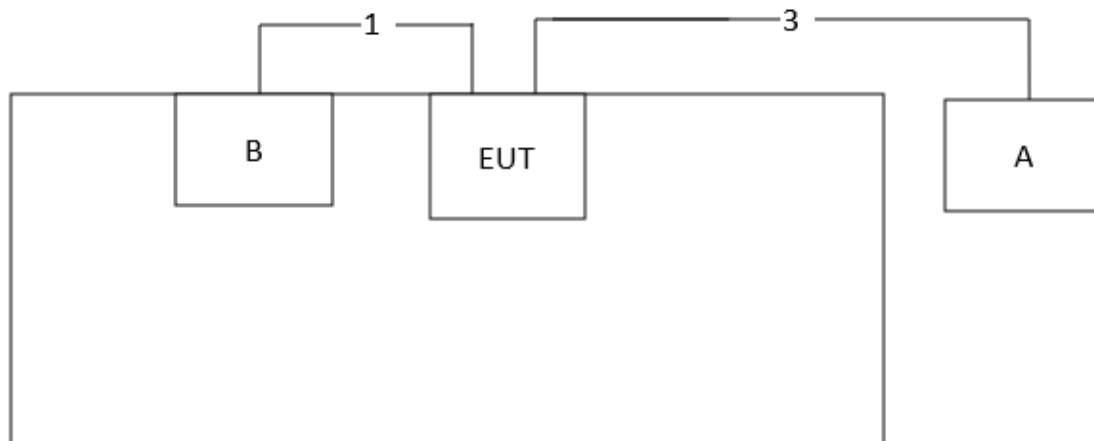
N/A

5.6. Block diagram showing the configuration of system tested

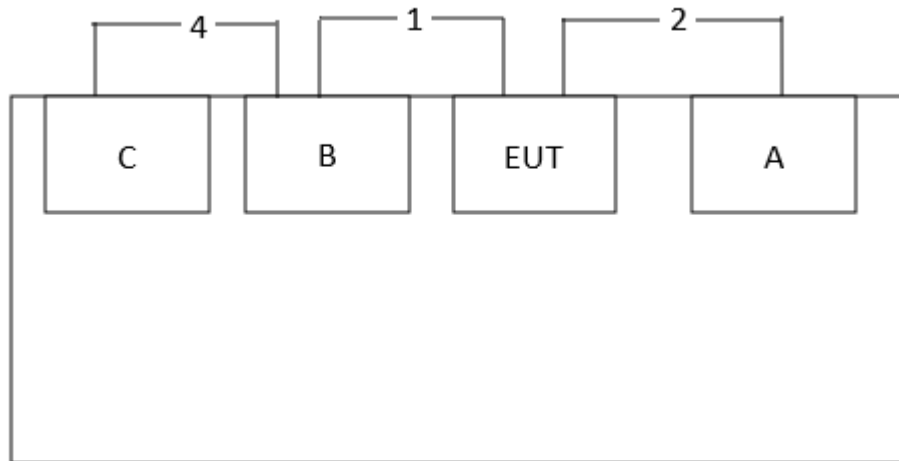
For Radiated Emission test:
Mode 1



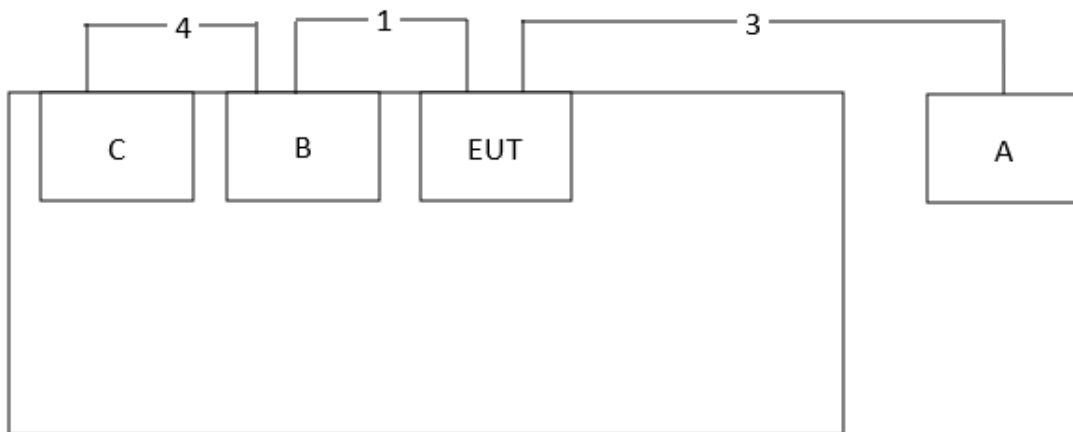
For Conducted Emission test
Mode 1



For Immunity - ESD, RS, PFMF test:
Mode 1



For Immunity - EFT, Surge, CS test:
Mode 1



5.7. 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.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	FCC ID	Note
A	Power supply	GW Instek	GPD-2303S	N/A	N/A	N/A
B	Resistance load	N/A	N/A	N/A	N/A	Provide by customer
C	Voltage Meter	N/A	SD-670	N/A	N/A	N/A

Item	Connection	Shielded Type	Note
1	Power Wire	Non-shielded	Provide by customer
2	Power Wire	Non-shielded	Provide by customer
3	Power Wire	Non-shielded	N/A
4	Power Wire	Non-shielded	N/A

5.8. Measuring Instrument List

Instrument					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Expired date
Conducted Disturbance					
EMI Test Receiver	Rohde & Schwarz	ESR7	101755	2021/12/6	2022/12/5
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	2022/8/29	2023/8/28
Two-Path V-LISN	SCHWARZBECK	NSLK 8127	8127-946	2022/11/10	2023/11/9
RF Current Probe	FCC	F-52	171502	2022/1/25	2023/1/24
Coupling and Decoupling Network	TESEQ	ISN ST08	45105	2022/2/9	2023/2/8
Impedance Stabilization Network	TESEQ	ISN T800	42830	2022/3/23	2023/3/22
Impedance Stabilization Network	TESEQ	ISN T8-Cat6	39923	2022/2/14	2023/2/13
Capacitive Voltage Probe	TESEQ	CVP 2200A	44922	2022/2/16	2023/2/15
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	2022/8/30	2023/8/29
Cable	TITAN	CFD200	T0732ACFD20020A300-2	2022/4/9	2023/4/8
Measurement Software	Farad	EZ-EMC Ver: UL-3A1.2	N/A	N/A	N/A
Radiated Disturbance					
966-1					
EMI Test Receiver	Rohde & Schwarz	ESR7	101755	2021/12/6	2022/12/5
Trilog-Broadband Antenna with 5dB Attenuator	SCHWARZBECK	VULB 9168 & N-6-05	774 & AT-N0538	2022/2/8	2023/2/7
Double Ridged Guide Horn Antenna	SCHWARZBECK	BBHA 9120 D	1686	2021/12/13	2022/12/12
Preamplifier	EMC Instrument	EMC330E	980404	2022/5/13	2023/5/12
Preamplifier	EMC Instrument	EMC051835BE	980407	2022/1/14	2023/1/13
Cables	UltraPhase&EMC Instrument	A1K50-UP0358-A1K50-1500&EMC106-NM-SM-2500/8000	170111-3&170104/170223	2022/1/18	2023/1/17
Measurement Software	Farad	EZ-EMC Ver: UL-3A1	N/A	N/A	N/A

Instrument					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Expired date
Electrostatic discharge					
ESD Generator	TESEQ	NSG 437	1125	2021/11/30	2022/11/29
Barometer	TFA	DIVA PLUS	35.1078.10.IT	2022/6/7	2023/6/6
Radio frequency electromagnetic field immunity					
RF and Microwave Signal Generator	Rohde & Schwarz	SMB100A	113793	2022/2/20	2023/2/19
Power amplifier	Milmega	80RF1000-300	1077558	N/A	N/A
Power amplifier	Milmega	AS0860B	1077559	N/A	N/A
Directional coupler	Werlatone	C10117-10	111786	N/A	N/A
Directional coupler	Werlatone	C8719-20	111759	N/A	N/A
Antenna	AR	ATR80M6G	346008	N/A	N/A
Antenna	SCHWARZBECK	STLP 9149	00441	N/A	N/A
RF switch	OSP	OSP	N/A	N/A	N/A
Power Meter	Rohde & Schwarz	NRP2	105524	2022/9/13	2023/9/12
Power Sensor	Rohde & Schwarz	NRP-Z91	103732	2022/9/13	2023/9/12
Power Sensor	Rohde & Schwarz	NRP-Z91	103733	2022/9/13	2023/9/12
Sound Calibrator	Bruel&Kjaer	Type 4231	3016784	2022/8/1	2023/7/31
Audio Analyzer	Rohde & Schwarz	UPV	104227	2021/11/25	2022/11/24
Pressure-field 1/2" Microphone	Bruel&Kjaer	Type 4192	3069928	2020/3/6	2023/3/5
Mouth Simulator	Bruel&Kjaer	Type 4227	3078961	2020/3/6	2023/3/5
GPS signal generator	Keysight Technologies	N5172B	MY56200315	2022/1/14	2023/1/13
Radio Communication Analyzer	Rohde & Schwarz	CMW500	161254	2021/12/13	2022/12/12
Microphone Adaptation Amplifier	Bruel&Kjaer	Type 5935	3070463	2022/8/1	2023/7/31
Measurement Software	Rohde & Schwarz	EMC32, VER.10.60.20	N/A	N/A	N/A
Electrical fast transient					
Ultra Compact Simulator	EM TEST	UCS 500N7	P1623180275	2021/11/30	2022/11/29
Capacitive Coupling Clamp	EM TEST	HFK	P1642185790	2021/11/30	2022/11/29
Measurement Software	TESEQ	IEC.control, VER.7.1.5	N/A	N/A	N/A

Instrument					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Expired date
Surge					
Ultra Compact Simulator	EM TEST	UCS 500N7	P1623180275	2021/11/30	2022/11/29
Telecom Surge Generator	EM TEST	TSurge7	P1620180015	2021/11/29	2022/11/28
Coupling and Decoupling Network	EM TEST	CNV 508T5	P1637184038	2021/11/29	2022/11/28
Coupling and Decoupling Network	TESEQ	CDN HSS-2	45091	2021/11/29	2022/11/28
Measurement Software	TESEQ	IEC.control, VER.7.1.5	N/A	N/A	N/A
Immunity to conducted disturbances, induced by radio-frequency fields					
Signal Generator	Rohde & Schwarz	SMC100A	105811	2022/9/26	2023/9/25
Power amplifier	Rohde & Schwarz	BBA150-A125B125	102340	N/A	N/A
Coupling and Decoupling Network	TESEQ	CDN M016	45073	2022/3/18	2023/3/17
Coupling and Decoupling Network	TESEQ	CDN T2-10	45003	2022/3/18	2023/3/17
Coupling and Decoupling Network	TESEQ	CDN T4-10	44939	2022/3/18	2023/3/17
Coupling and Decoupling Network	TESEQ	CDN T8-10	49203	2021/12/10	2022/12/9
Coupling and Decoupling Network	TESEQ	CDN ST08A	57417	2022/6/27	2023/6/26
EM Injection Clamp	TESEQ	CAL 801A & KEMZ 801A	75454.1, 75454.2 & 45181	2022/4/13	2023/4/12
Current Injection Probe	TESEQ	CIP 9136A	44618	2022/10/26	2023/10/25
Power - Sensor	Rohde & Schwarz	NRP-Z91	103730	2021/12/8	2022/12/7
Power - Sensor	Rohde & Schwarz	NRP-Z91	103731	2021/12/8	2022/12/7
Sound Calibrator	Bruel&Kjaer	Type 4231	3016784	2022/8/1	2023/7/31
Pressure-field 1/2" Microphone	Bruel&Kjaer	Type 4192	3069928	2022/8/26	2023/8/25
Mouth Simulator	Bruel&Kjaer	Type 4227	3078961	2020/3/6	2023/3/5
Audio Analyzer	Rohde & Schwarz	UPV	104227	2021/11/25	2022/11/24
Microphone Adaptation Amplifier	Bruel&Kjaer	Type 5935	3070463	2022/8/1	2023/7/31
Measurement Software	Rohde & Schwarz	EMC32, VER.10.20.01	N/A	N/A	N/A

Instrument					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Expired date
Power frequency magnetic field immunity					
Ultra Compact Simulator	EM TEST	UCS 500N7	P1623180275	2021/11/30	2022/11/29
Current Transformer	EM TEST	MC 2630	P1644186773	2022/8/22	2023/8/21
Magnetic Field Test Antena	EM TEST	MS 100N	P1627181324	2022/8/22	2023/8/21
Current Transformer	EM TEST	MFT100	P2025241594	2022/8/22	2023/8/21
Motorized Variac	EM TEST	MV 2616 (varic NX1-260-16)	P1643186426	2021/12/1	2022/11/30

6. EMISSION TEST

6.1. Conducted Disturbance Measurement

6.1.1. Limits of conducted disturbance voltage and common mode disturbance.

AC mains port:

FREQUENCY (MHz)	<input type="checkbox"/> Class A (dBμV)		<input checked="" type="checkbox"/> Class B (dBμV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 -0.5	79.00	66.00	66 - 56 *	56 - 46*
0.50 -5.0	73.00	60.00	56.00	46.00
5.0 -30.0	73.00	60.00	60.00	50.00

Telecommunications/network port:

FREQUENCY (MHz)	<input type="checkbox"/> Class A			
	Voltage limit (dBμV)		Current limit(dBμA)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 -0.5	97 - 87 *	84 - 74*	53 - 43 *	40 - 30*
0.50 -30.0	87.00	74.00	43.00	30.00
FREQUENCY (MHz)	<input type="checkbox"/> Class B			
	Voltage limit (dBμV)		Current limit(dBμA)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 -0.5	84 - 74 *	74 - 64*	40 - 30 *	30 - 20*
0.50 -30.0	74.00	64.00	30.00	20.00

Note:

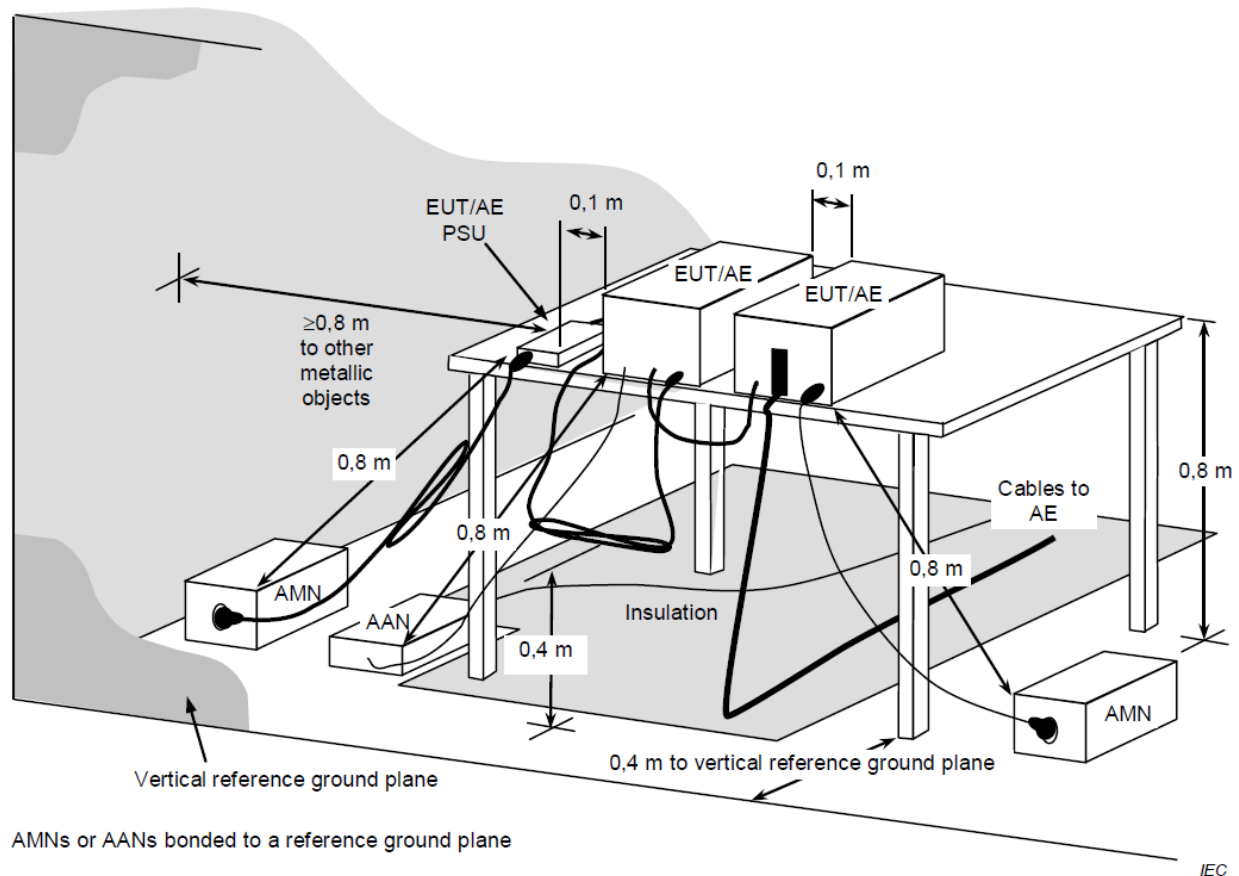
- (1) The tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.
- (3) The test result calculated as following:
Measurement Value = Reading Level + Correct Factor
Correct Factor = Insertion Loss + Cable Loss + Attenuator Factor(if use)
Margin Level = Measurement Value - Limit Value

The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

- a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/50uH of coupling impedance for the measuring instrument.
- b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall at least 1 m.
- d. LISN at least 80 cm from nearest part of EUT chassis.
- e. For the actual test configuration, please refer to the related Item:EUT Test Photos.

6.1.3. Test Setup



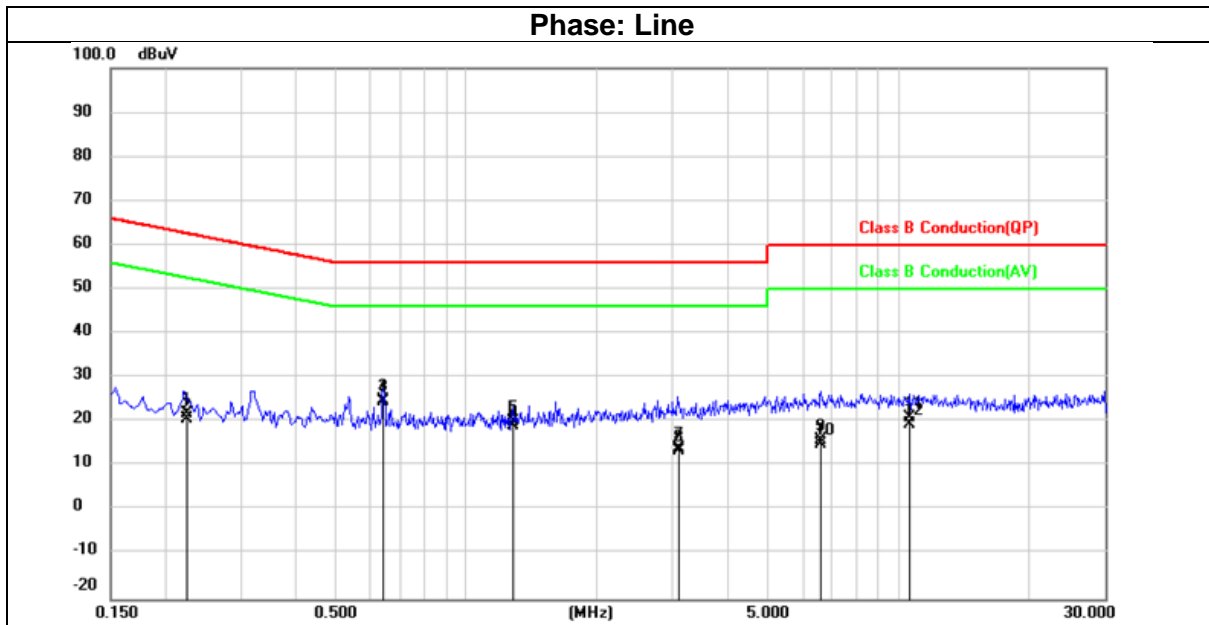
The 0,8 m distance specified between EUT/AE/PSU and AMN/AAN, is applicable only to the EUT being measured. If the device is AE then it shall be $\geq 0,8$ m.

For the actual test configuration, please refer to Appendix I: Photographs of the Test Configuration.

6.1.4. Test Result

Mode 1 ; LISN (150k-30MHz)

Test Mode:	Mode 1	Temperature:	23℃
Test Voltage:	DC 24V from DC source	Humidity:	59%RH
Tested By:	Rupert Huang	Test Date:	Nov. 10, 2022



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.2250	2.35	19.53	21.88	62.63	-40.75	QP
2	0.2250	1.08	19.53	20.61	52.63	-32.02	AVG
3	0.6415	5.21	19.54	24.75	56.00	-31.25	QP
4	0.6415	4.90	19.54	24.44	46.00	-21.56	AVG
5	1.2837	0.41	19.56	19.97	56.00	-36.03	QP
6	1.2837	-0.41	19.56	19.15	46.00	-26.85	AVG
7	3.1068	-5.70	19.61	13.91	56.00	-42.09	QP
8	3.1068	-6.18	19.61	13.43	46.00	-32.57	AVG
9	6.6003	-3.80	19.68	15.88	60.00	-44.12	QP
10	6.6003	-4.63	19.68	15.05	50.00	-34.95	AVG
11	10.5903	1.07	19.74	20.81	60.00	-39.19	QP
12	10.5903	-0.32	19.74	19.42	50.00	-30.58	AVG

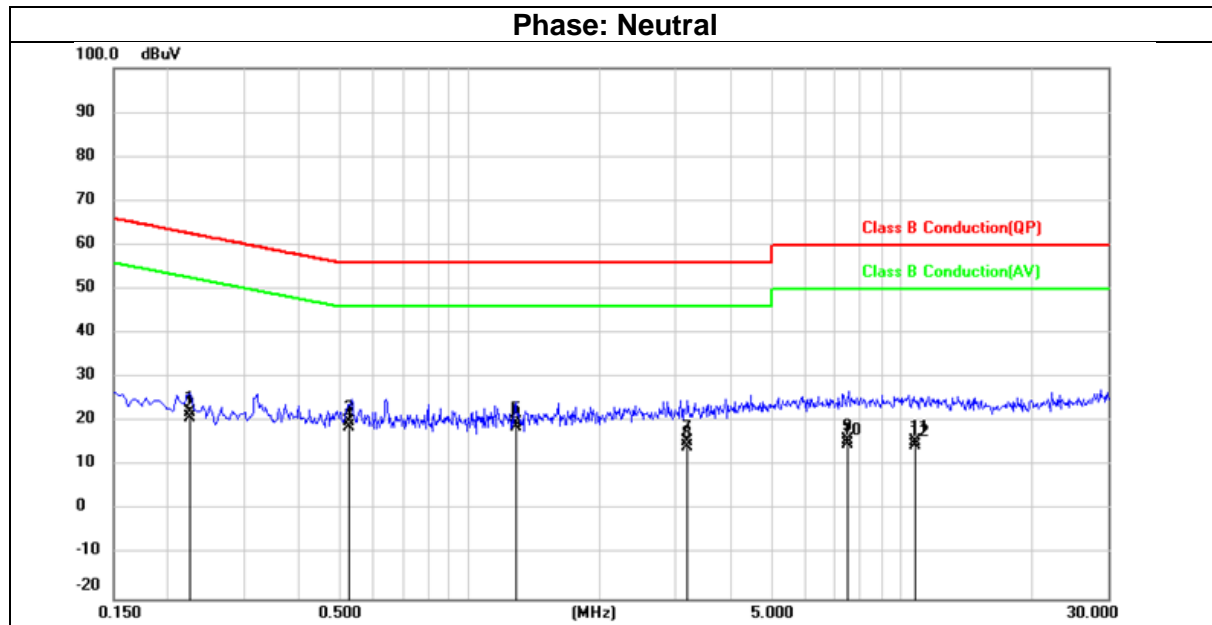
Remark:

Result = Reading +Correct.

Correct = Insertion Loss + Cable Loss + Attenuator Factor.

Margin = Result - Limit.

Test Mode:	Mode 1	Temperature:	23℃
Test Voltage:	DC 24V from DC source	Humidity:	59%RH
Tested By:	Rupert Huang	Test Date:	Nov. 10, 2022



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.2239	2.61	19.54	22.15	62.67	-40.52	QP
2	0.2239	1.33	19.54	20.87	52.67	-31.80	AVG
3	0.5230	0.44	19.55	19.99	56.00	-36.01	QP
4	0.5230	-0.72	19.55	18.83	46.00	-27.17	AVG
5	1.2834	0.15	19.56	19.71	56.00	-36.29	QP
6	1.2834	-0.81	19.56	18.75	46.00	-27.25	AVG
7	3.2086	-3.93	19.61	15.68	56.00	-40.32	QP
8	3.2086	-5.32	19.61	14.29	46.00	-31.71	AVG
9	7.4895	-3.98	19.71	15.73	60.00	-44.27	QP
10	7.4895	-4.84	19.71	14.87	50.00	-35.13	AVG
11	10.7216	-4.35	19.78	15.43	60.00	-44.57	QP
12	10.7216	-5.07	19.78	14.71	50.00	-35.29	AVG

Remark:

Result = Reading +Correct.

Correct = Insertion Loss + Cable Loss + Attenuator Factor.

Margin = Result - Limit.

6.2. Radiated Disturbance Measurement(below 1GHz)

6.2.1. Limits of radiated disturbance measurement

FREQUENCY (MHz)	<input type="checkbox"/> Class A		<input checked="" type="checkbox"/> Class B	
	<input type="checkbox"/> At 10m	<input type="checkbox"/> At 3m	<input type="checkbox"/> At 10m	<input checked="" type="checkbox"/> At 3m
	dBμV/m	dBμV/m	dBμV/m	dBμV/m
30 – 230	40	50	30	40
230 – 1000	47	57	37	47

NOTE:

- (1) The limit for radiated test was performed according to EN55032, CISPR 32.
- (2) The tighter limit applies at the band edges.
- (3) The test result calculated as following:

Measurement Value = Reading Level + Correct Factor,

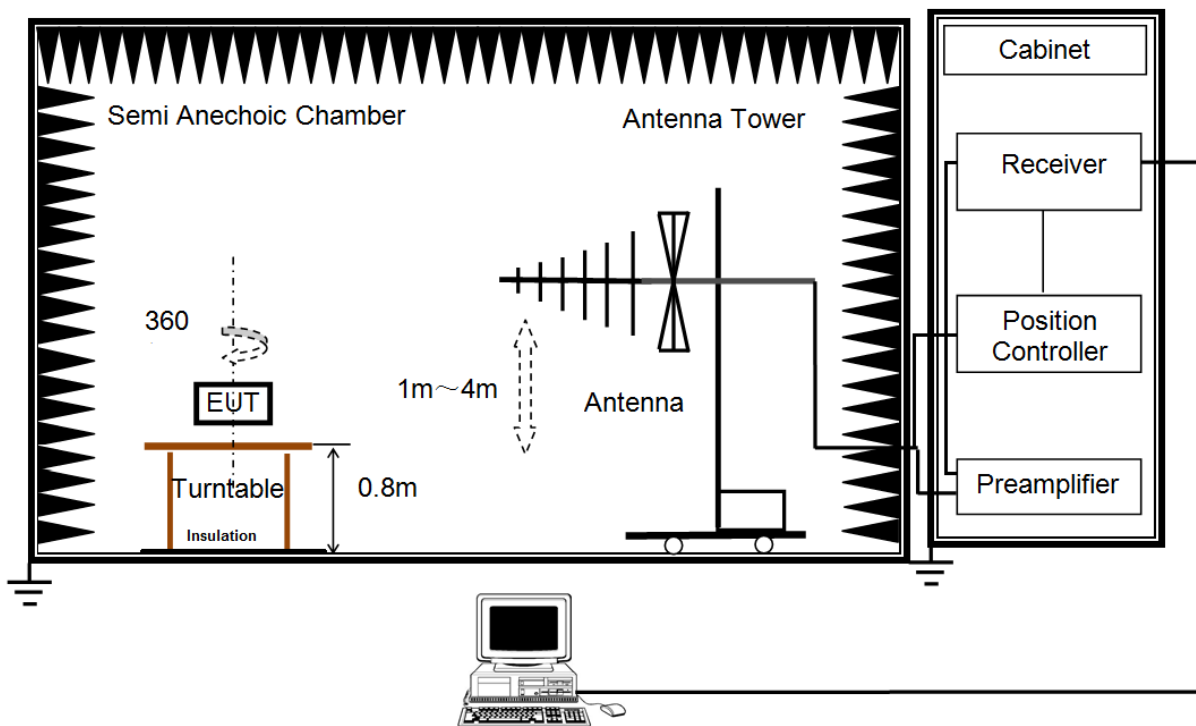
Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain(if use),

Margin Level = Measurement Value - Limit Value.

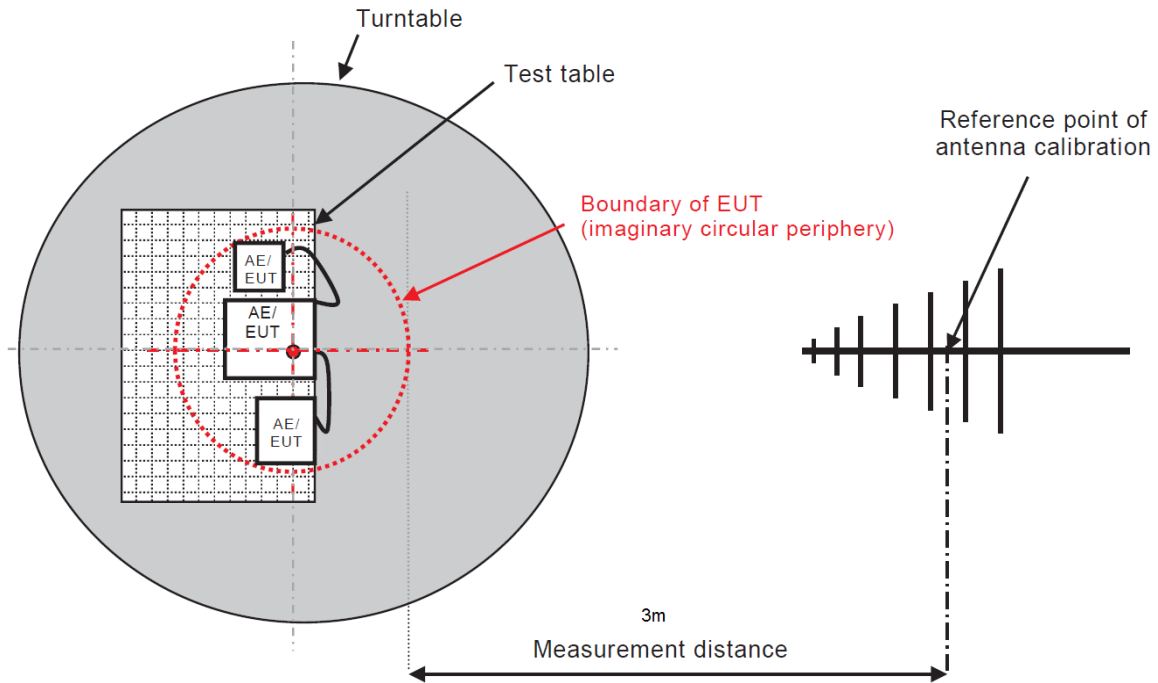
6.2.2. Test Procedure

- The measuring distance of at 3m shall be used for measurements at frequency from 30 to 1000MHz.
- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The height of the equipment shall be set at 0.8 m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- The initial step in collecting radiated emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- For the actual test configuration, please refer to the related Item:EUT Test Photos.

6.2.3. Test Setup



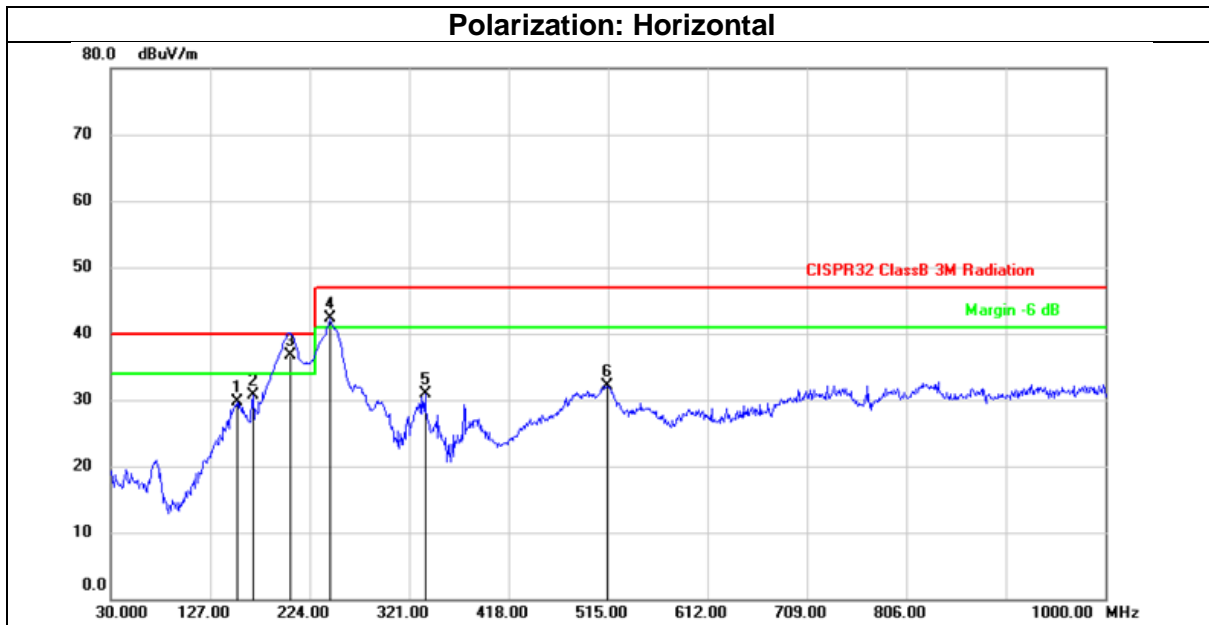
For the actual test configuration, please refer to Appendix I: Photographs of the Test Configuration.



6.2.4. Test Result

Mode 1 ; 30M-1GHz

Test Mode:	Mode 1	Temperature:	24℃
Test Voltage:	24Vdc from DC source	Humidity:	70%RH
Tested By:	Duncan Wang	Test Date:	Nov. 18, 2022



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	153.6426	41.79	-12.10	29.69	40.00	-10.31	PK
2	168.7100	43.26	-12.53	30.73	40.00	-9.27	PK
3	205.0203	51.98	-15.23	36.75	40.00	-3.25	QP
4	244.7257	55.60	-13.20	42.40	47.00	-4.60	PK
5	337.4253	40.92	-10.01	30.91	47.00	-16.09	PK
6	514.3857	37.81	-5.62	32.19	47.00	-14.81	PK

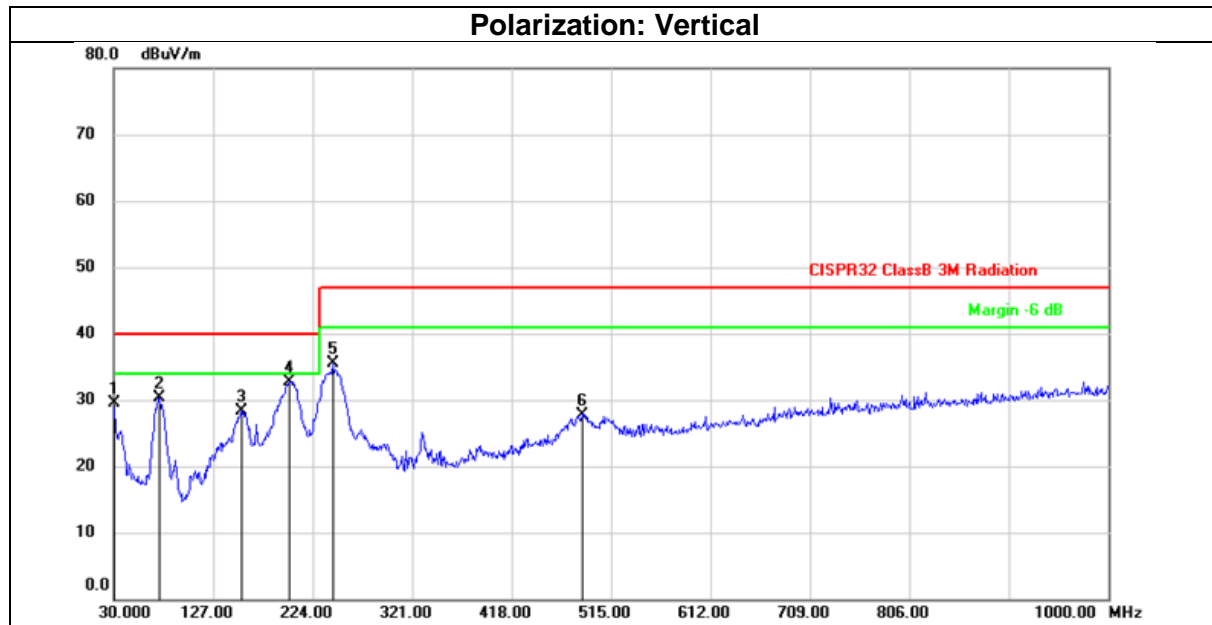
Remark:

Result = Reading +Correct.

Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain.

Margin = Result - Limit.

Test Mode:	Mode 1	Temperature:	24°C
Test Voltage:	24Vdc from DC source	Humidity:	70%RH
Tested By:	Duncan Wang	Test Date:	Nov. 18, 2022



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	30.4850	43.38	-13.88	29.50	40.00	-10.50	PK
2	74.7493	45.96	-15.58	30.38	40.00	-9.62	PK
3	154.7743	40.26	-11.90	28.36	40.00	-11.64	PK
4	201.5283	47.78	-15.04	32.74	40.00	-7.26	PK
5	243.4970	48.68	-13.26	35.42	47.00	-11.58	PK
6	487.2903	33.98	-6.18	27.80	47.00	-19.20	PK

Remark:

Result = Reading +Correct.

Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain.

Margin = Result - Limit.

7. IMMUNITY TEST

7.1. Performance Criteria

According to EN 55035 standard, the general performance criteria as following:

Criteria A	<p>The equipment shall continue to operate as intended without operator intervention. No degradation of performance, loss of function or change of operating state is allowed below a performance level specified by the manufacturer when the equipment is used as intended.</p> <p>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.</p>
Criteria B	<p>During the application of the disturbance, degradation of performance is allowed. However, no unintended change of actual operating state or stored data is allowed to persist after the test.</p> <p>After the test, 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.</p> <p>If the minimum performance level (or the permissible performance loss), or recovery time, 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.</p>
Criteria C	<p>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. A reboot or re-start operation is allowed.</p> <p>Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.</p>

7.2. Electrostatic Discharge Immunity Test

7.2.1. Test Specification

Standard:	EN 55035 (refer to IEC/EN 61000-4-2)
Discharge Impedance:	330(1±10%)Ω / 150(1±10%)pF
Discharge Voltage:	Air Discharge: ±2kV/±4kV/±8kV (Direct)
Polarity:	Contact Discharge: ±2kV/±4kV (Direct/Indirect) Positive and Negative
Discharge Mode of Operation:	Single discharges
Discharge Period:	1 second minimum

7.2.2. Test Procedure

The test generator necessary to perform direct and indirect application of discharges to the EUT in the following manner:

- Contact discharge was applied to conductive surfaces and coupling planes of the EUT. During the test, it was performed with single discharges. For the single discharge time between successive single discharges was at least 1 second. On each pre-selected point at least 10 single discharges (at each polarity) shall be applied. Test shall be performed at a maximum repetition rate of one discharge per second.

Vertical Coupling Plane (VCP):

The coupling plane, of dimensions 0.5m x 0.5m, is placed parallel to, and positioned at a distance 0.1m from, the EUT, with the Discharge Electrode touching the coupling plane. The four faces of the EUT will be performed with electrostatic discharge.

Horizontal Coupling Plane (HCP):

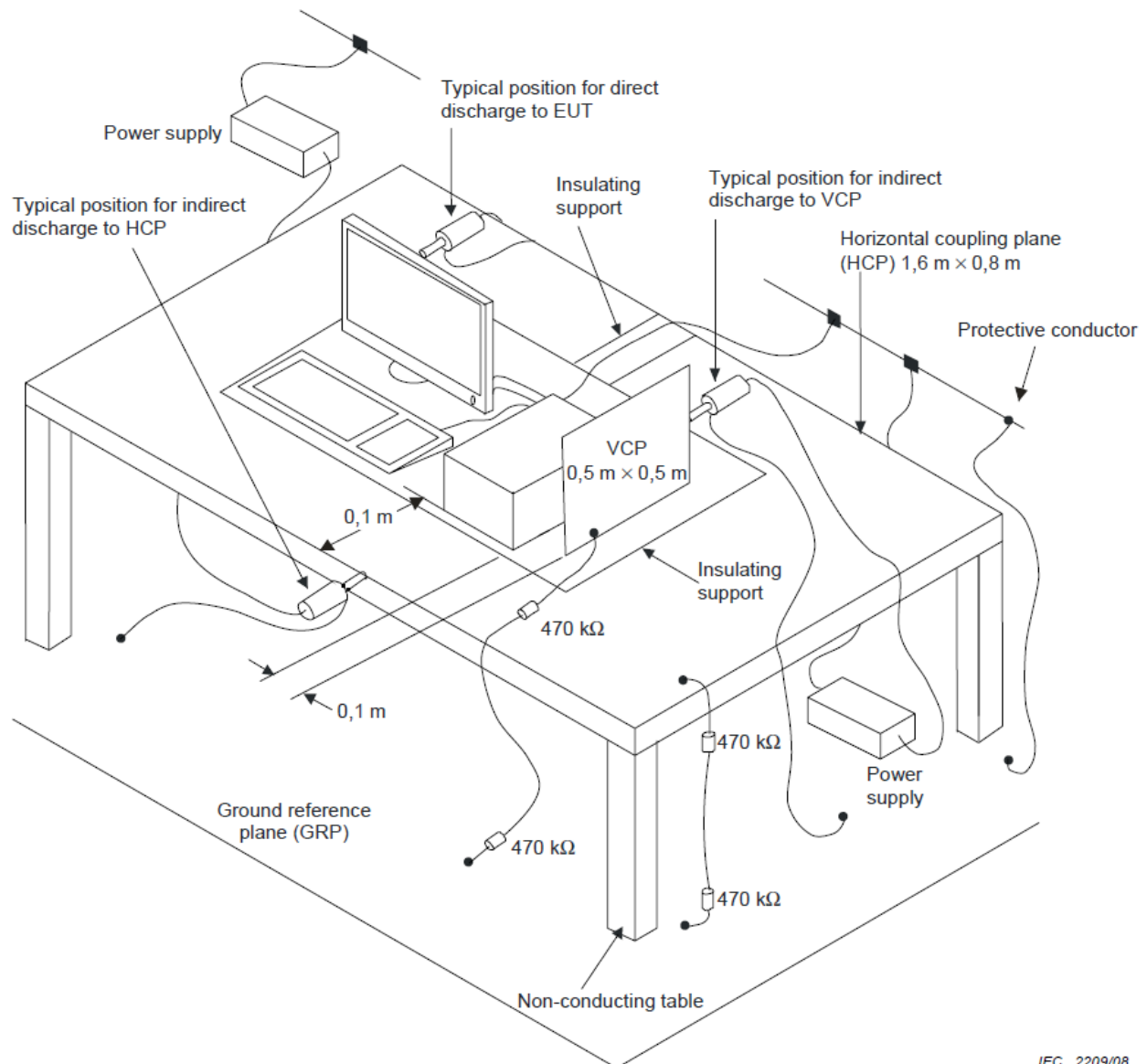
The coupling plane is placed under to the EUT. The generator shall be positioned vertically at a distance of 0.1m from the EUT, with the Discharge Electrode touching the coupling plane. The four faces of the EUT will be performed with electrostatic discharge.

- Air discharges at insulation surfaces of the EUT.

It was at least 10 single discharges with positive and negative at the same selected point.

- For the actual test configuration, please refer to the related Item :EUT Test Photos.

7.2.3. Test Setup



IEC 2209/08

A distance of 0,8 m minimum shall be provided between the EUT and the walls of the laboratory and any other metallic structure.

For the actual test configuration, please refer to Appendix I: Photographs of the Test Configuration.

7.2.4. Test Result

Test Mode:	Mode 1	Temperature:	24°C
Test Voltage:	24Vdc from DC source	Humidity:	42%RH
Discharge of times:	Air: 10 times Contact: 10 times	ATM pressure:	1013 hpa
Tested By:	Eric T. Fan	Test Date:	Nov. 21, 2022

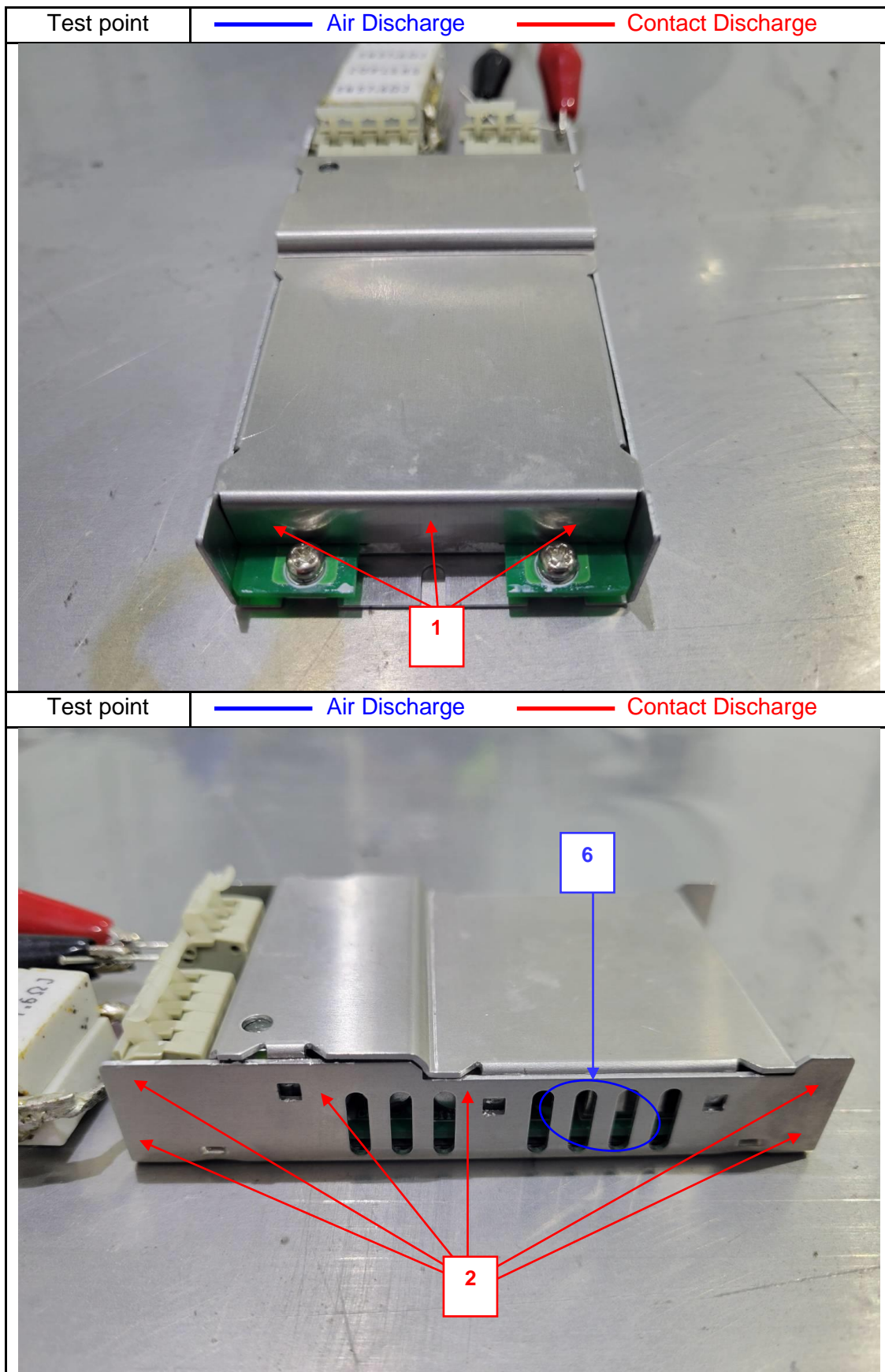
Mode	Air Discharge								Contact Discharge							
	2kV		4kV		8kV		-kV		2kV		4kV		-kV		-kV	
Location	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
1~5	-	-	-	-	-	-	-	-	A	A	A	A	-	-	-	-
6~10	A	A	A	A	A	A	-	-	-	-	-	-	-	-	-	-
Criterion	B								B							
Results	A								A							
Judgment	PASS															
Note	There was no abnormal situation during the test compared with initial operation.															

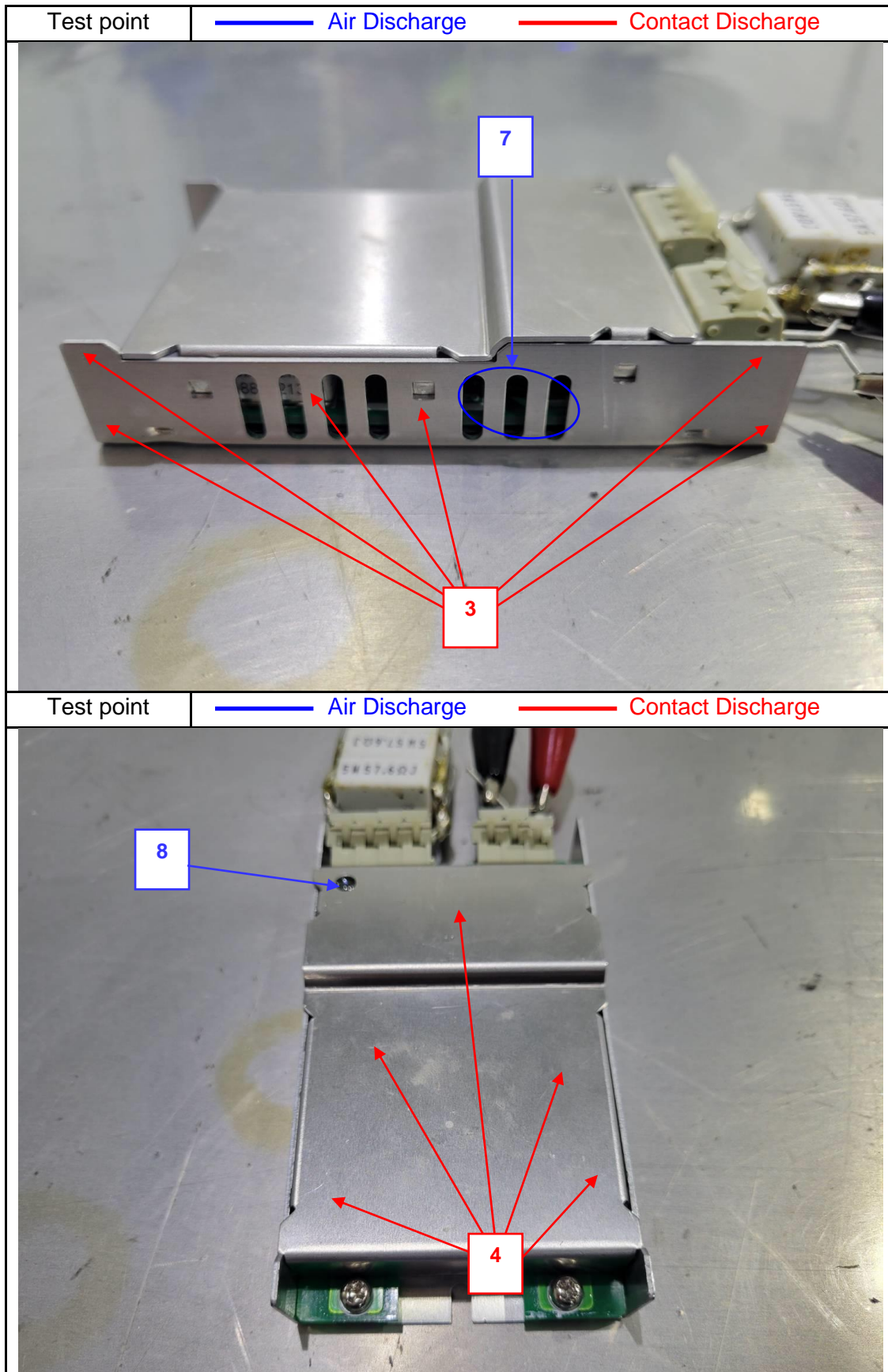
Mode	HCP Discharge								VCP Discharge							
	2kV		4kV		-kV		-kV		2kV		4kV		-kV		-kV	
Location	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
front	A	A	A	A	-	-	-	-	A	A	A	A	-	-	-	-
rear	A	A	A	A	-	-	-	-	A	A	A	A	-	-	-	-
left	A	A	A	A	-	-	-	-	A	A	A	A	-	-	-	-
right	A	A	A	A	-	-	-	-	A	A	A	A	-	-	-	-
Criterion	B				-				B				-			
Results	A				-				A				-			
Judgment	PASS															
Note	There was no abnormal situation during the test compared with initial operation.															

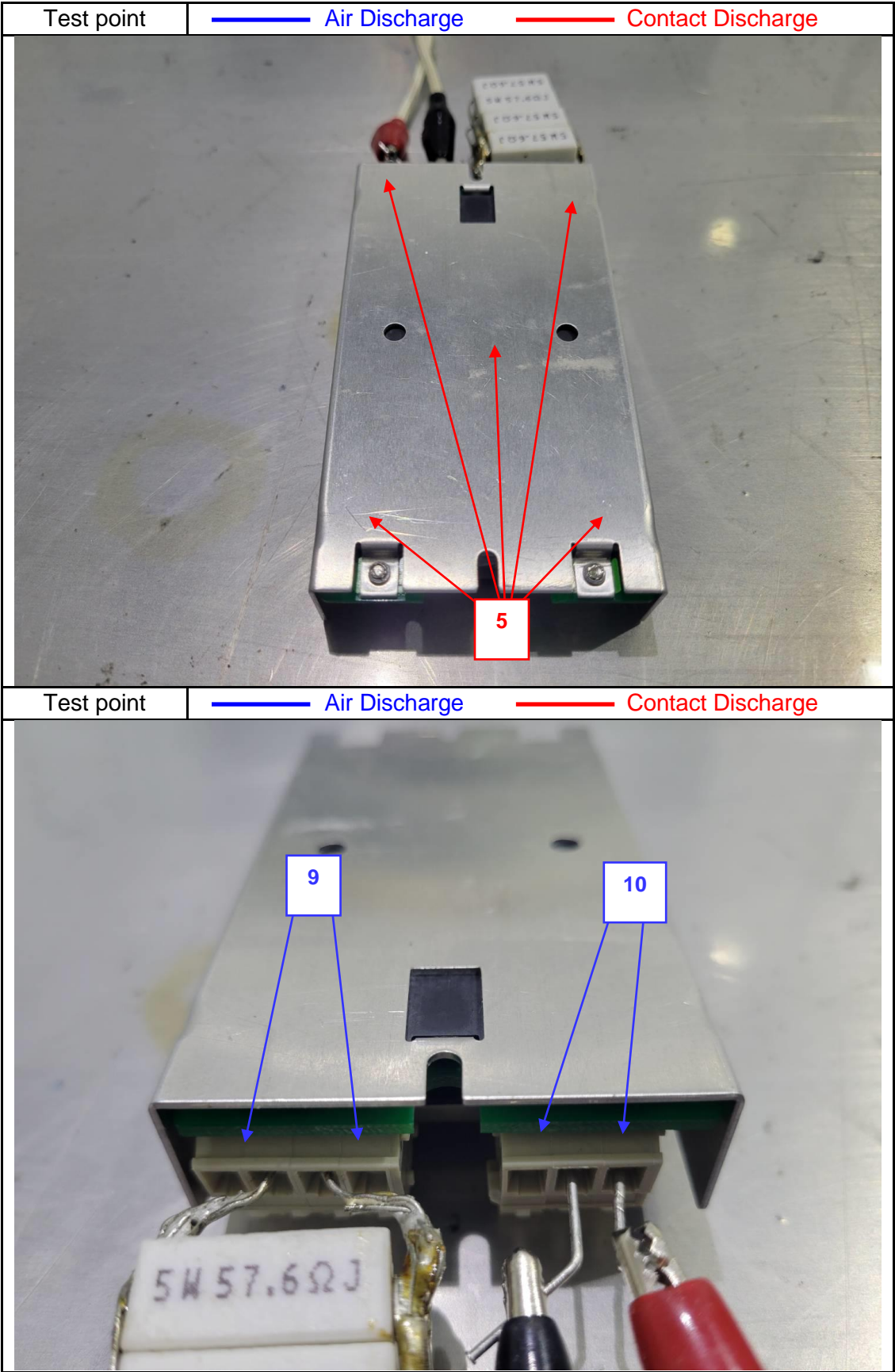
Customer request:

Mode	Air Discharge								Contact Discharge							
	2kV		4kV		8kV		15kV		2kV		4kV		6kV		-kV	
Location	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
1~5	-	-	-	-	-	-	-	-	-	-	-	-	A	A	-	-
Criterion	B								B							
Results	-								A							
Judgment	PASS															
Note	There was no abnormal situation during the test compared with initial operation.															

Mode	HCP Discharge								VCP Discharge							
	2kV		4kV		6kV		-kV		2kV		4kV		6kV		-kV	
Location	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
front	-	-	-	-	A	A	-	-	-	-	-	-	A	A	-	-
rear	-	-	-	-	A	A	-	-	-	-	-	-	A	A	-	-
left	-	-	-	-	A	A	-	-	-	-	-	-	A	A	-	-
right	-	-	-	-	A	A	-	-	-	-	-	-	A	A	-	-
Criterion	-				B				-				B			
Results	-				A				-				A			
Judgment	PASS															
Note	There was no abnormal situation during the test compared with initial operation.															







7.3. Radio Frequency Electromagnetic Field Immunity Test

7.3.1. Test Specification

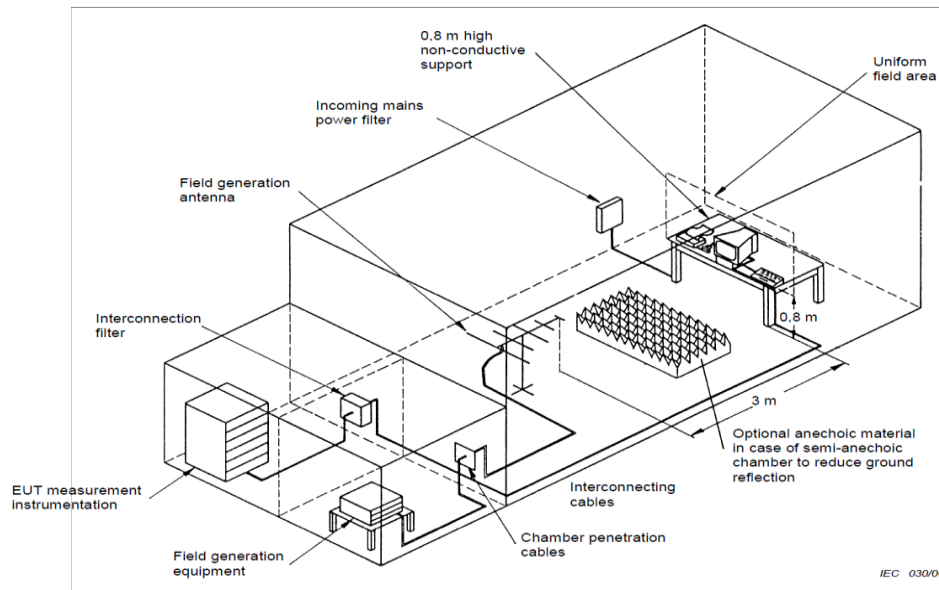
Standard:	EN 55035 (refer to IEC/EN 61000-4-3)
Frequency Range:	80 MHz to 1000MHz
Spot Frequency:	1800, 2600, 3500, 5000 ($\pm 1\%$)
Field Strength:	3V/m (unmodulated)
Immunity level to common wireless communication:	See Table I.1 for test frequency and level
Modulation:	80%, AM(1kHz)
Frequency Step:	1%
Polarity of Antenna	Vertical and Horizontal
Test Distance:	3 meters
Antenna Height:	1.55 meters
Dwell Time:	3 s

7.3.2. Test Procedure

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

- The testing was performed in a fully anechoic chamber. The transmit antenna was located at a distance of 3 meters from the EUT.
- The frequency range is swept from 80 MHz to 1000MHz with the signal 80% amplitude modulated with a 1kHz sine wave. The rate of sweep did not exceed 1.5×10^{-3} decade/s. Where the frequency range is swept incrementally, the step size was 1% of fundamental.
- The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.
- The field strength level from 80 MHz to 1000MHz was 3V/m.
- A special spot frequency test point are 1800, 2600, 3500 and 5000MHz ($\pm 1\%$)
- Immunity level to common wireless communication test distance is base on client requirement.
- The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.

7.3.3. Test Setup



For the actual test configuration, please refer to Appendix I: Photographs of the Test Configuration.

7.3.4. Test Result

Test Mode:	Mode 1	Temperature:	24°C
Test Voltage:	24Vdc from DC source	Humidity:	68%RH
Tested By:	Duncan Wang	Test Date:	Nov. 16, 2022

Freq. Range (MHz)	Position (Face)	Polarity (H or V)	Field Strength (V/m)	Criterion	Results	Judgement
80-1000	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
1800(±1%)	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
2600(±1%)	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
3500(±1%)	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
5000(±1%)	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
Note	There was no abnormal situation during the test compared with initial operation.					

Immunity Level to common wireless communication						
Freq. Range (MHz)	Position (Face)	Polarity (H or V)	Field Strength (V/m)	Criterion	Results	Judgement
800(±1%)	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
900(±1%)	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
1800(±1%)	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
2600(±1%)	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
3500(±1%)	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
5000(±1%)	Front / Left / Right / Rear	H / V	3V/m	A	A	PASS
Note	There was no abnormal situation during the test compared with initial operation.					

Customer request:

Freq. Range (MHz)	Position (Face)	Polarity (H or V)	Field Strength (V/m)	Criterion	Results	Judgement
80-1000	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
1800(±1%)	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
2600(±1%)	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
3500(±1%)	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
5000(±1%)	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
Note	There was no abnormal situation during the test compared with initial operation.					

Immunity Level to common wireless communication						
Freq. Range (MHz)	Position (Face)	Polarity (H or V)	Field Strength (V/m)	Criterion	Results	Judgement
800(±1%)	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
900(±1%)	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
1800(±1%)	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
2600(±1%)	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
3500(±1%)	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
5000(±1%)	Front / Left / Right / Rear	H / V	10V/m	A	A	PASS
Note	There was no abnormal situation during the test compared with initial operation.					

7.4. Electrical Fast Transient/Burst Immunity Test

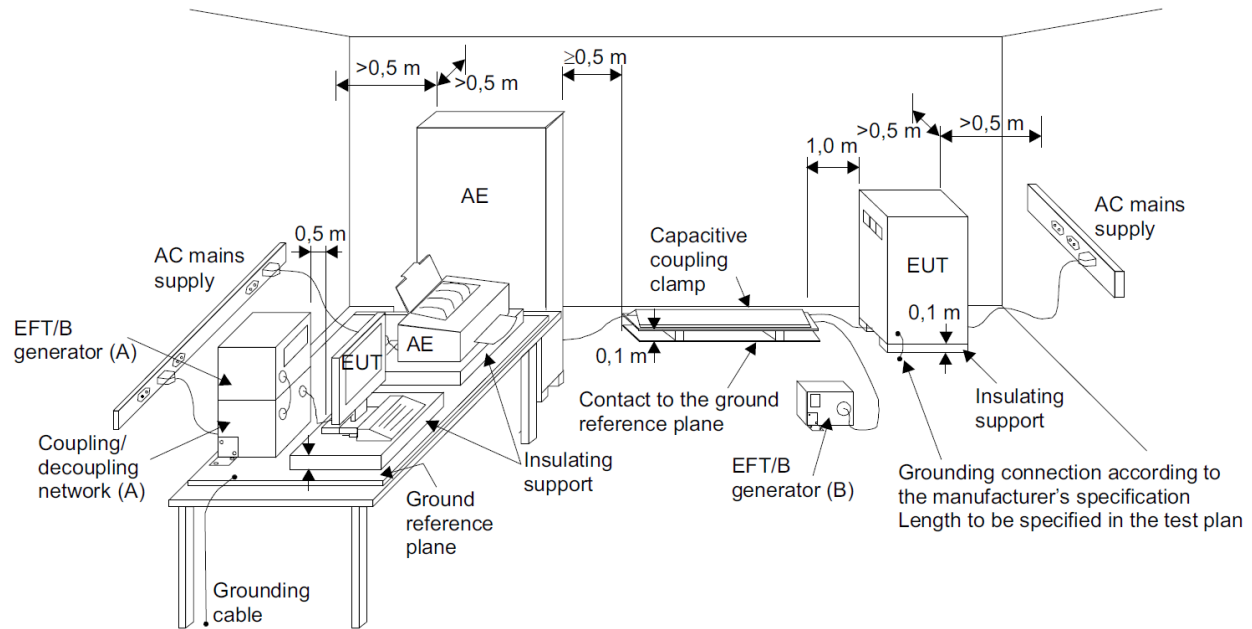
7.4.1. Test Specification

Standard:	EN 55035 (refer to IEC/EN 61000-4-4)
Test Voltage:	0.5,1 kV(Peak)
Polarity:	Positive and Negative
Impulse Frequency:	5 kHz
Impulse wave shape:	5/50 Tr/Th ns
Burst Duration:	15ms
Burst Period:	300ms
Test Duration:	1 Minute

7.4.2. Test Procedure

- The EUT was tested with 1000 volt discharges to the AC power input leads, 500 volt discharges to the signal/control ports.
- Both positive and negative polarity discharges were applied.
- Table-top equipment and equipment normally mounted on ceilings or walls as well as built-in equipment shall be tested with the EUT located $(0,1 \pm 0,01)$ m above the ground reference plane.
- The EUT and the auxiliary equipment were placed on a table of 0.8 m heights above a metal ground reference plane. The size of ground plane is greater than 0.8m×1m and project beyond the EUT by at least 0.1m on all sides. The ground plane is connected to the protective earth. The minimum distance between the EUT and all other conductive structures (including the generator, AE and the walls of a shielded room), except the ground reference plane, shall be more than 0,5 m.
- The duration time of each test sequential was 1 minute.
- The transient/burst waveform was in accordance with IEC/EN 61000-4-4, 5/50ns.

7.4.3. Test Setup



IEC 645/12

- (A) location for supply line coupling
- (B) location for signal lines coupling

For the actual test configuration, please refer to Appendix I: Photographs of the Test Configuration.

7.4.4. Test Result

Test Mode:	Mode 1	Temperature:	23°C
Test Voltage:	24Vdc from DC source	Humidity:	66%RH
Tested By:	Eric T. Fan	Test Date:	Nov. 21, 2022

Repetition Frequency					5kHz					
Test Port		Test Levels (kV)						Criterion	Results	Judgment
		+0.5	-0.5	+1.0	-1.0	-	-			
DC Port	+	A	A	-	-	-	-	B	A	PASS
	-	A	A	-	-	-	-			
	+ & -	A	A	-	-	-	-			
Note		There was no abnormal situation during the test compared with initial operation.								

Customer request:

Repetition Frequency						5kHz				
Test Port		Test Levels (kV)						Criterion	Results	Judgment
		+0.5	-0.5	+1.0	-1.0	+2.0	-2.0			
DC Port	+	-	-	-	-	A	A	B	A	PASS
	-	-	-	-	-	A	A			
	+ & -	-	-	-	-	A	A			
Note		There was no abnormal situation during the test compared with initial operation.								

7.5. Surge Immunity Test

7.5.1. Test Specification

Standard:	EN 55035 (refer to IEC/EN 61000-4-5)
Waveform:	1.2/50 (8/20) Tr/Th μ s , 10/700 Tr/Th μ s
Test Voltage:	0.5,1 kV(Line to Line) 0.5,1,2 kV(Line to Earth)
Polarity:	Positive and Negative
Phase Angle:	90°/270°
Repetition Rate:	1 per minute
Times:	5 times each polarity

7.5.2. Test Procedure

- The EUT and the auxiliary equipment were placed on a table of 0.8m heights above a metal ground reference plane. The size of ground plane is greater than 1m×1m and project beyond the EUT by at least 0.1m on all sides. The ground plane is connected to the protective earth. The length of power cord between the coupling device and the EUT shall not exceed 2 meters (provided by the manufacturer).
- The EUT was connected to the power mains through a coupling device that directly couples the surge interference signal. The surge noise was applied synchronized to the voltage phase at the zero crossing and the peak value of the AC voltage wave (positive and negative).
- The surges were applied line to line and line(s) to earth. When testing line to earth the test voltage was applied successively between each of the lines and earth. Steps up to the test level specified increased the test voltage. All lower levels including the selected test level were tested. The polarity of each surge level included positive and negative test pulses.
- If EUT was included telecom port and connected to outdoor directly, test shall be applied to line to earth test using 10/700 surge wave form. If the wave form affects the functioning of high speed data port, the test shall be carried out using 1.2/50 wave form do the test.

7.5.3. Test Result

Test Mode:	Mode 1	Temperature:	22°C
Test Voltage:	24Vdc from DC source	Humidity:	66%RH
Tested By:	Eric T. Fan	Test Date:	Nov. 21, 2022

Wave Form EUT Ports Tested	1.2/50(8/20)Ti/Th us						Criterion	Results	Judgement
	Polarity	Phase	Voltage						
			0.5kV	1kV	2kV	4kV			
DC power port + to -	+	-	A	-	-	-	B	A	PASS
	-	-	A	-	-	-			
Note	There was no abnormal situation during the test compared with initial operation.								

Customer request:

Wave Form EUT Ports Tested	1.2/50(8/20)Ti/Th us						Criterion	Results	Judgement
	Polarity	Phase	Voltage						
			0.5kV	1kV	2kV	4kV			
DC power port + to -	+	-	-	A	-	-	B	A	PASS
	-	-	-	A	-	-			
Note	There was no abnormal situation during the test compared with initial operation.								

7.6. Immunity to Conducted Disturbances Induced by RF Fields

7.6.1. Test Specification

Standard:	EN 55035 (refer to IEC/EN 61000-4-6)
Frequency Range:	0.15-10; 10-30; 30-80MHz
Field Strength:	3V; 3 to 1V; 1V (unmodulated, r.m.s.)
Modulation:	80% AM (1 kHz)
Frequency Step:	1%
Dwell Time:	3s

7.6.2. Test Procedure

- a. The EUT shall be tested within its intended operating and climatic conditions.
- b. The test shall be 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.
- c. The frequency range is swept from 150 kHz to 80 MHz, using the signal level established during the setting process and with a disturbance signal of 80% amplitude. The signal is modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or the switch coupling devices as necessary. The step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency value where the frequency is swept incrementally.
- d. The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies such as clock frequencies and harmonics or frequencies of dominant interest, shall be analyzed separately.
- e. Attempts should be made to fully exercise the EUT during test, and to fully interrogate all exercise modes selected for susceptibility.

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7.6.4. Test Result

Test Mode:	Mode 1	Temperature:	24°C
Test Voltage:	24Vdc from DC source	Humidity:	64%RH
Tested By:	Eric T. Fan	Test Date:	Nov. 14, 2022

Test Ports (Mode)	Freq. Range (MHz)	Field Strength	CDN	Criterion	Results	Judgement
DC Power Port	0.15 --- 10	3V	M016(M2)	A	A	PASS
	10 --- 30	3 to 1V		A	A	PASS
	30 --- 80	1V		A	A	PASS
Note	There was no abnormal situation during the test compared with initial operation.					

Customer request:

Test Ports (Mode)	Freq. Range (MHz)	Field Strength	CDN	Criterion	Results	Judgement
DC Power Port	0.15 --- 80	10V	M016(M2)	A	A	PASS
Note	There was no abnormal situation during the test compared with initial operation.					

7.7. Power frequency magnetic field immunity Test

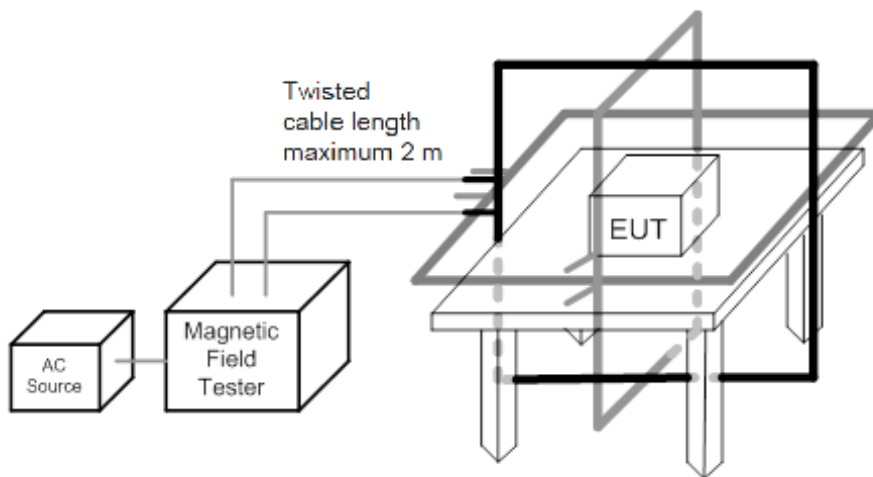
7.7.1. Test Specification

Standard:	EN 55035 (refer to IEC/EN 61000-4-8)
Frequency Range:	50 Hz
Field Strength:	1 A/m 100 A/m for Continuous (Client request) 1000 A/m for short duration (Client request)
Observation Time:	1 minute for continuous 1s to 3s for short duration
Inductance Coil:	Rectangular type, 1mx1m

7.7.2. Test Procedure

- The EUT and support equipment, are placed on a table that is 0.8 meter above a metal ground plane measured 1m*1m min. and 0.65mm thick min.
- The equipment cabinets shall be connected to the safety earth directly on the GRP via the earth terminal of the EUT.
- 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.
- The EUT with coil shall be leave all magnetic material and wall 1m away in any axis during the test.
- The cable length from generator to coil shall be less than 2m
- The background noise shall be 20dB less than test field strength.
- Test shall be applied to three axis X, Y, Z and disturbance over 1 minute and short term disturbance over 1 to 3 seconds.
- All cables shall be exposed to the magnetic field for 1m of their length.
- For magnetic field strength less than or equal to 30A/m the transformer shall be used MC 2630, for magnetic strength greater than 30A/m, the transformer shall be used MFT 100.

7.7.3. Test Setup



Note:

TABLE-TOP 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.

For the actual test configuration, please refer to Appendix I: Photographs of the Test Configuration.

7.7.4. Test Results

Test Mode:	Mode 1	Temperature:	22°C
Test Voltage:	24Vdc from DC source	Humidity:	66%RH
Tested By:	Eric T. Fan	Test Date:	Nov. 21, 2022

Level	Magnetic Field Strength (A/m)	Criterion	Results			Judgement
			X	Y	Z	
1	1	A	A	A	A	PASS
2	3	/	/	/	/	
3	10	/	/	/	/	
4	30	/	/	/	/	
5	100	/	/	/	/	
X	Special	/	/	/	/	
Note	There was no abnormal situation during the test compared with initial operation.					

Customer request:

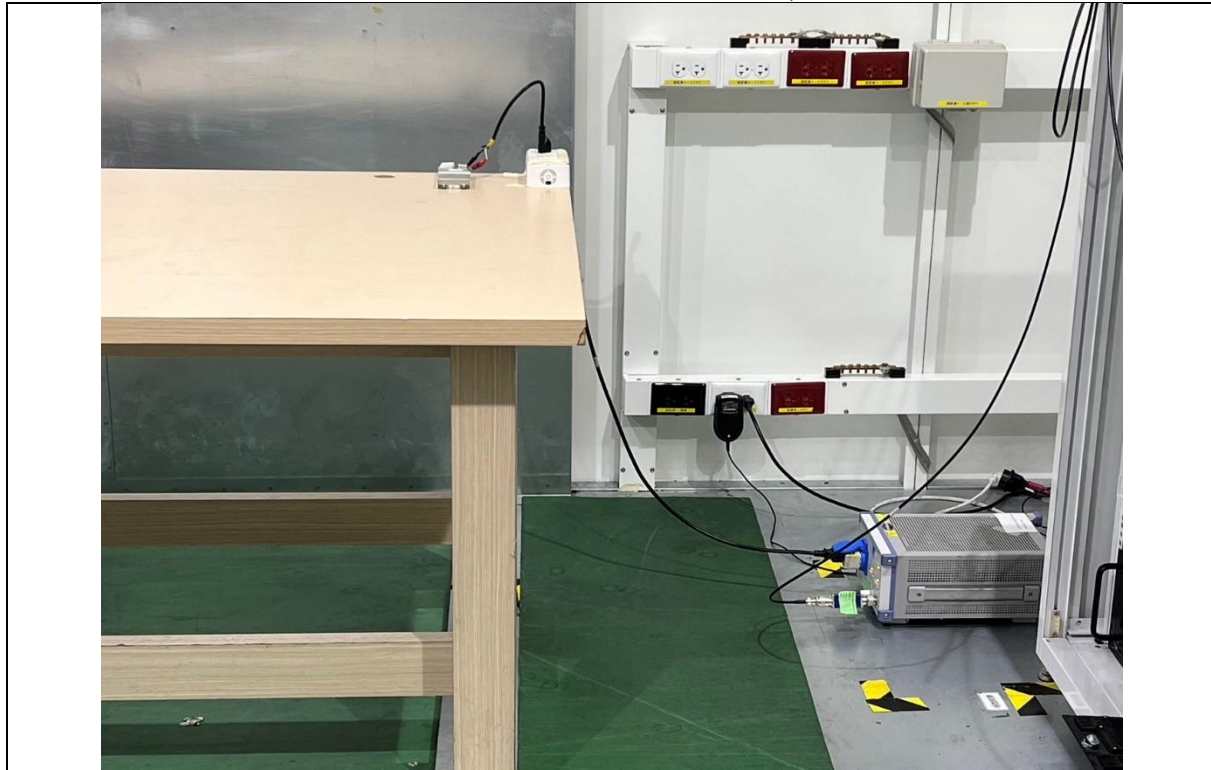
Level	Magnetic Field Strength (A/m)	Criterion	Results			Judgement
			X	Y	Z	
1	1	/	/	/	/	PASS
2	3	/	/	/	/	
3	10	/	/	/	/	
4	30	/	/	/	/	
5	100	A	A	A	A	
X	Special	/	/	/	/	
Note	There was no abnormal situation during the test compared with initial operation.					

(Short Term: 1 s)

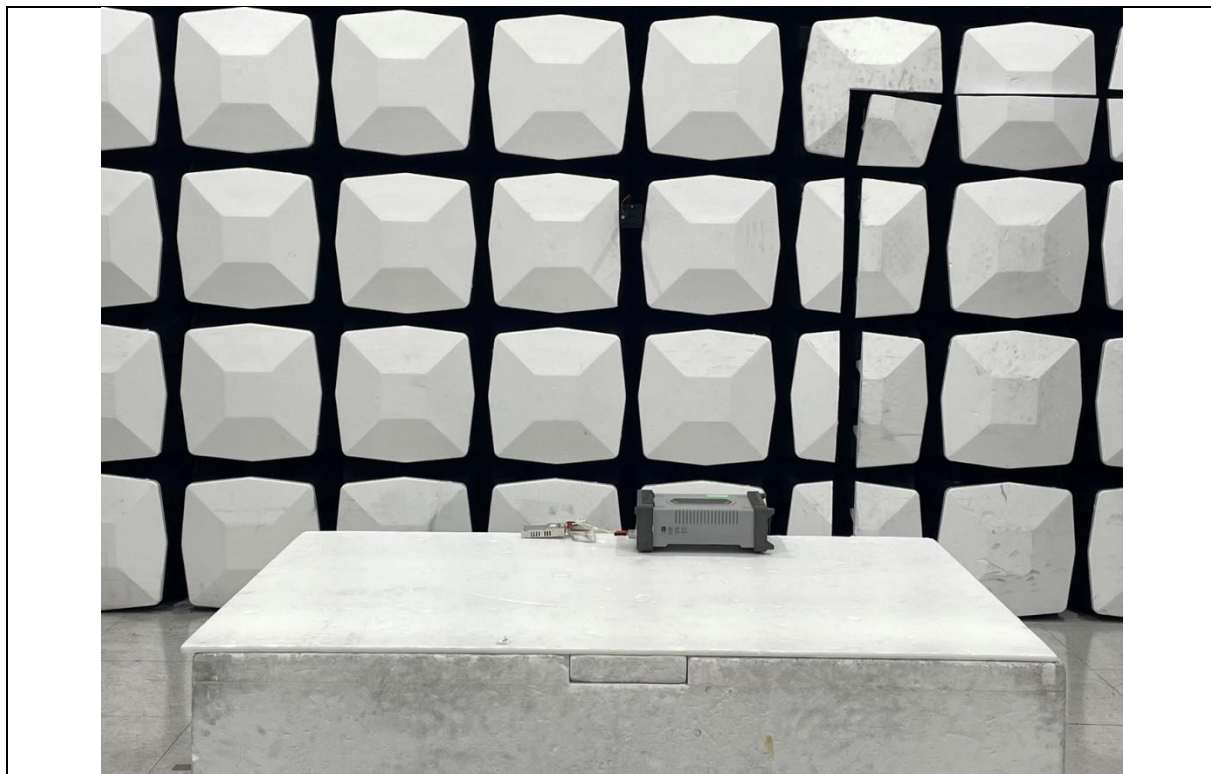
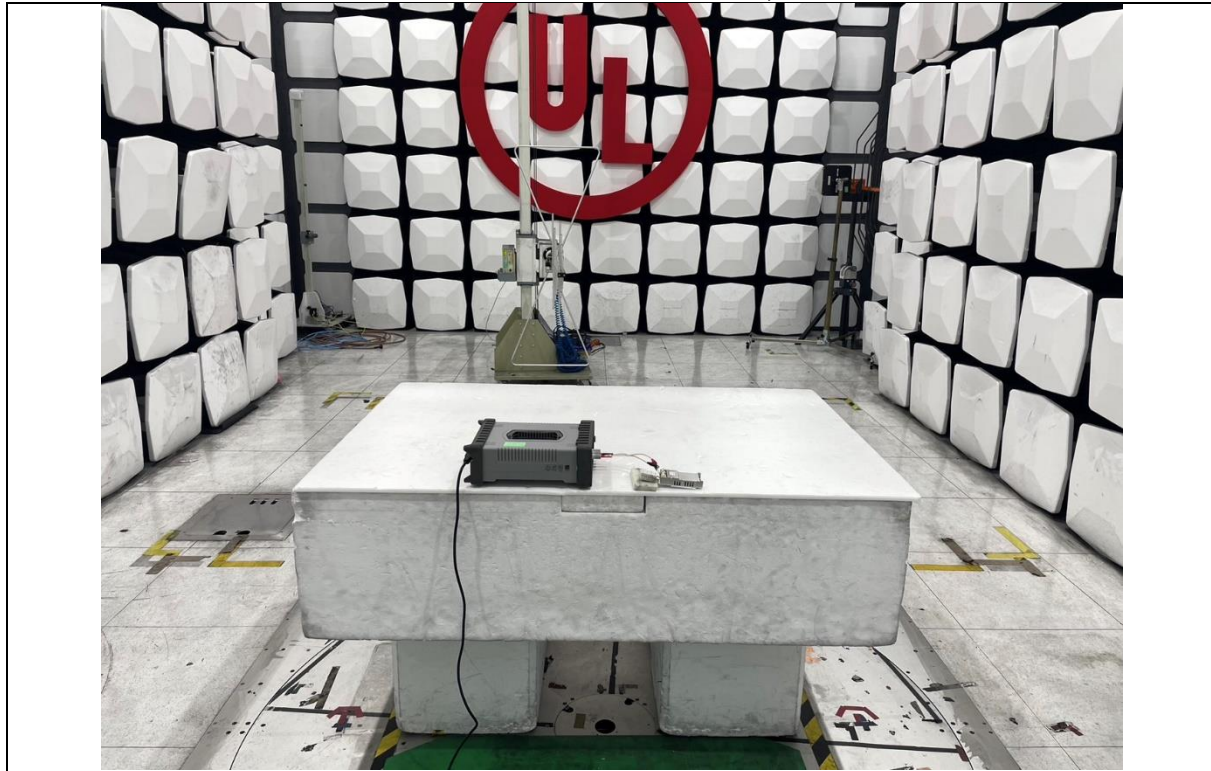
Level	Magnetic Field Strength (A/m)	Criterion	Results			Judgement
			X	Y	Z	
4	300	/	/	/	/	PASS
5	1000	A	A	A	A	
X	Special	/	/	/	/	
Note	There was no abnormal situation during the test compared with initial operation.					

Appendix I: Photographs of EMC Test Configuration

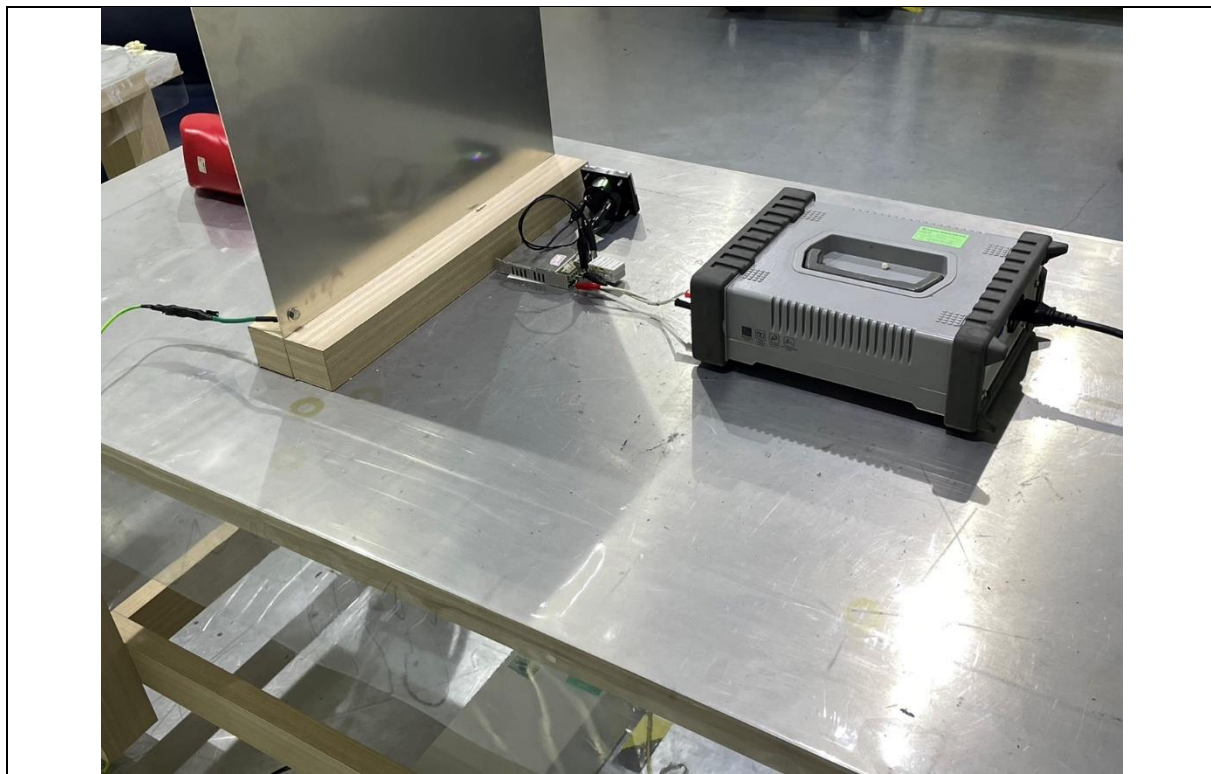
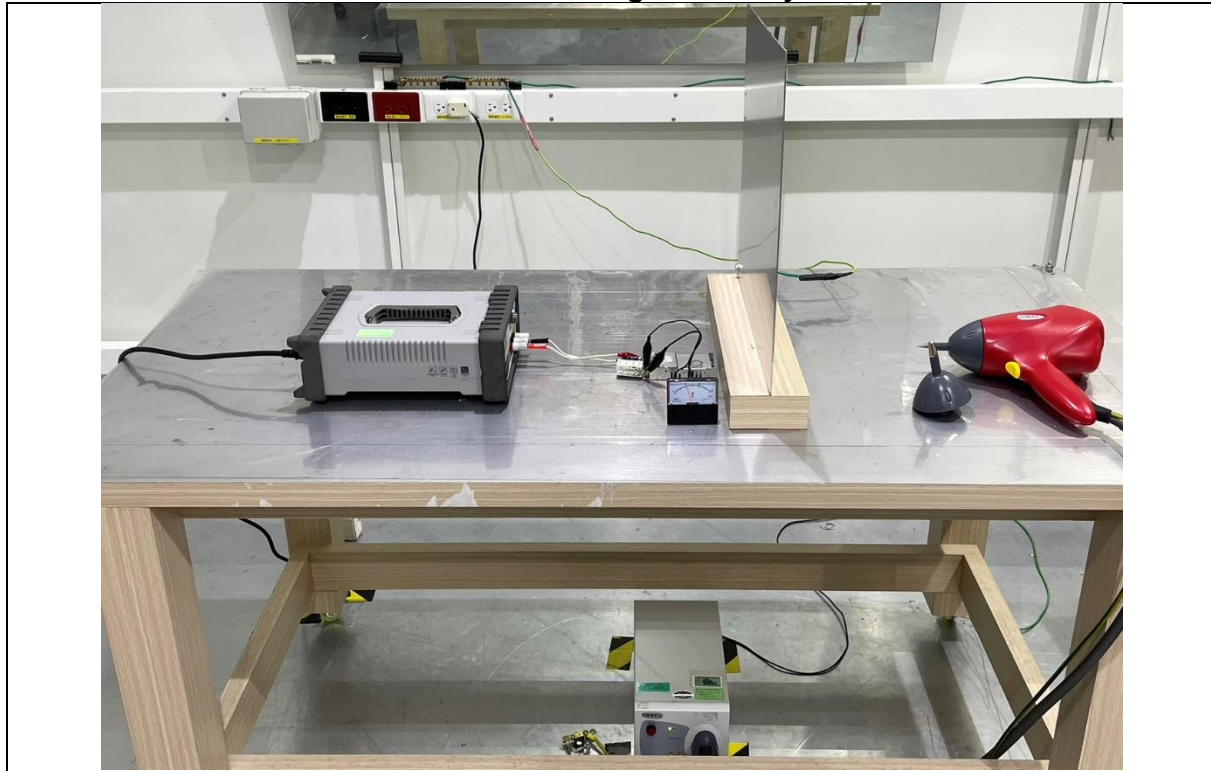
Conducted Disturbance: Cond, Mode 1



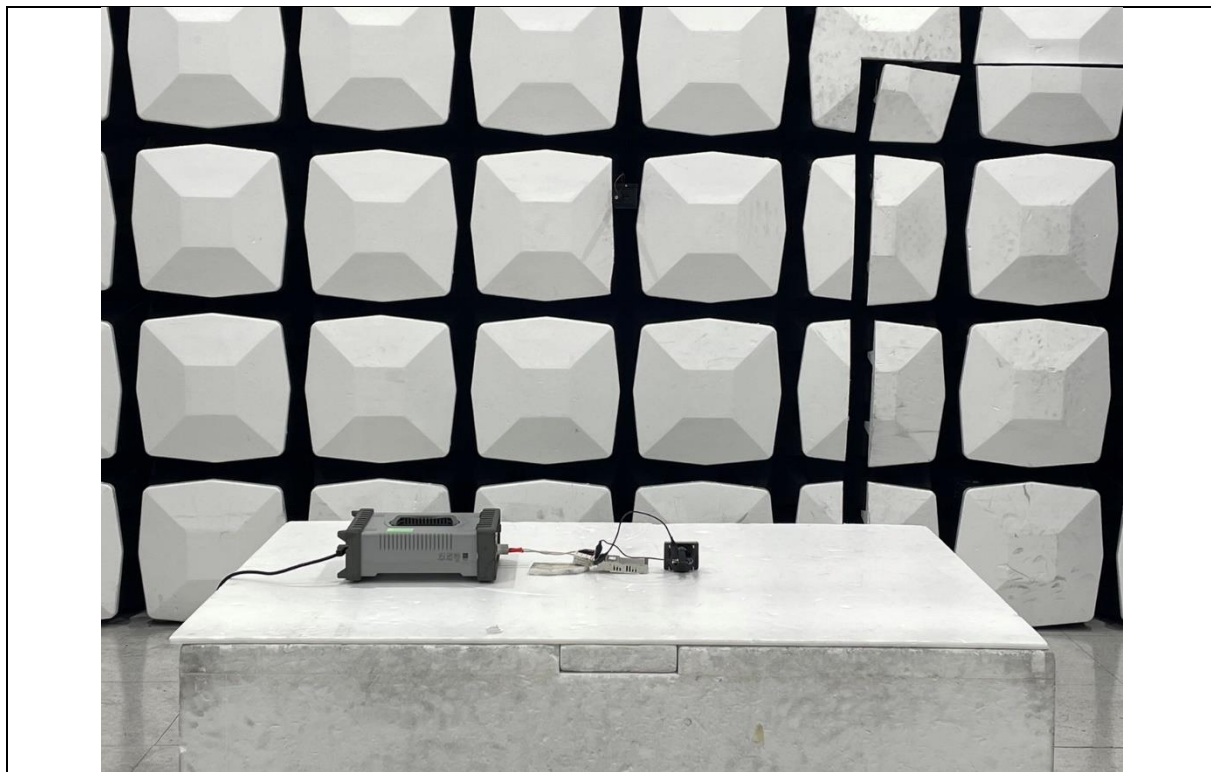
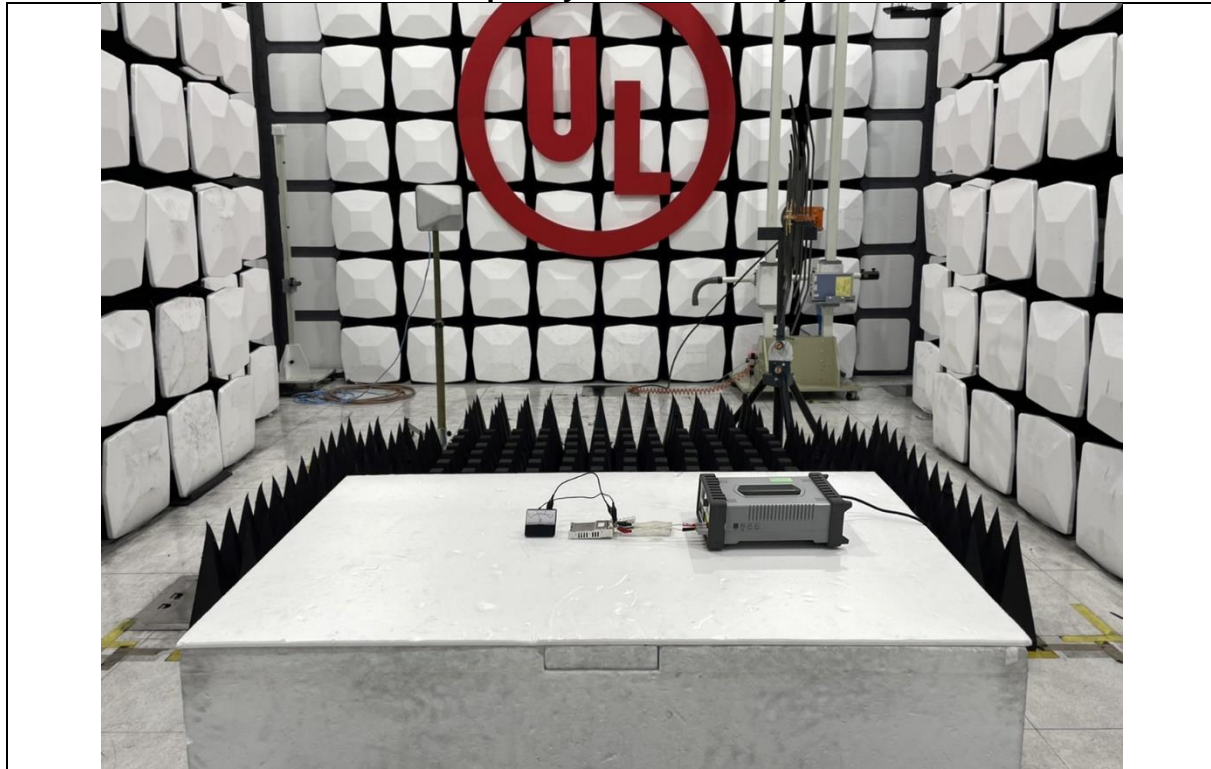
Radiated Disturbance: Mode 1, 30M-1GHz



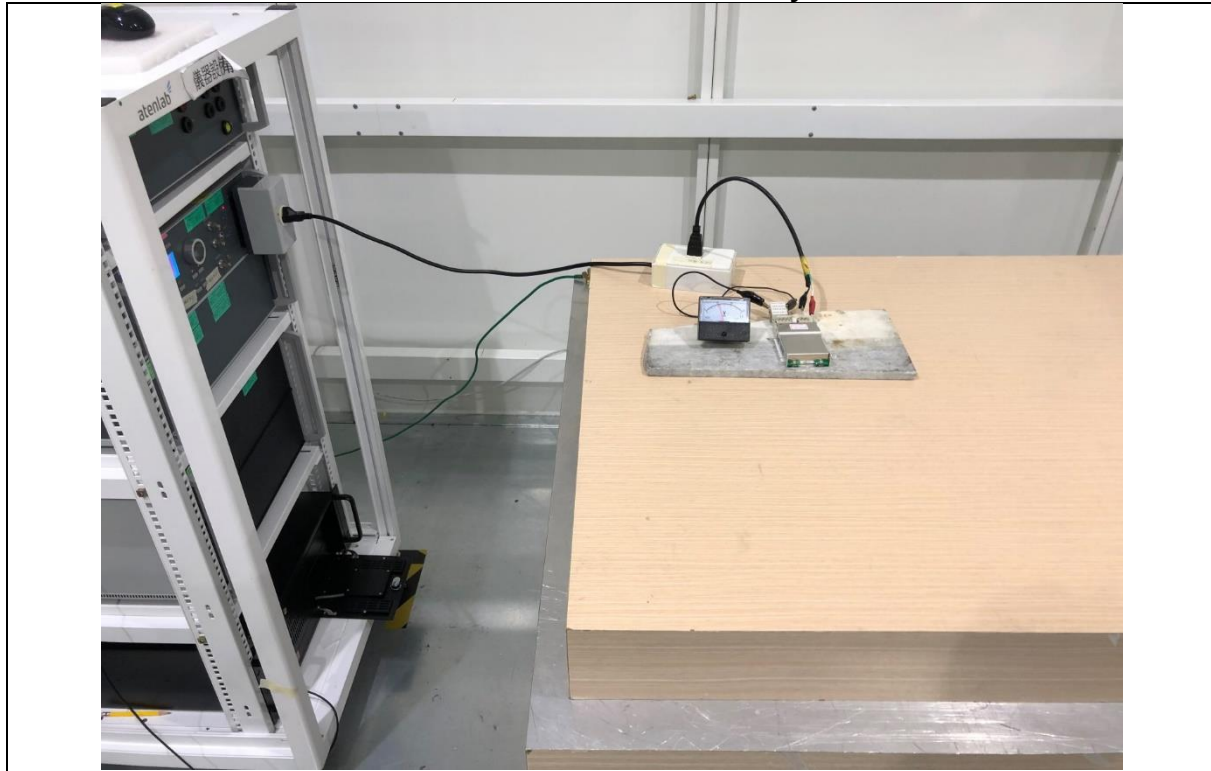
Electrostatic Discharge Immunity: Mode 01



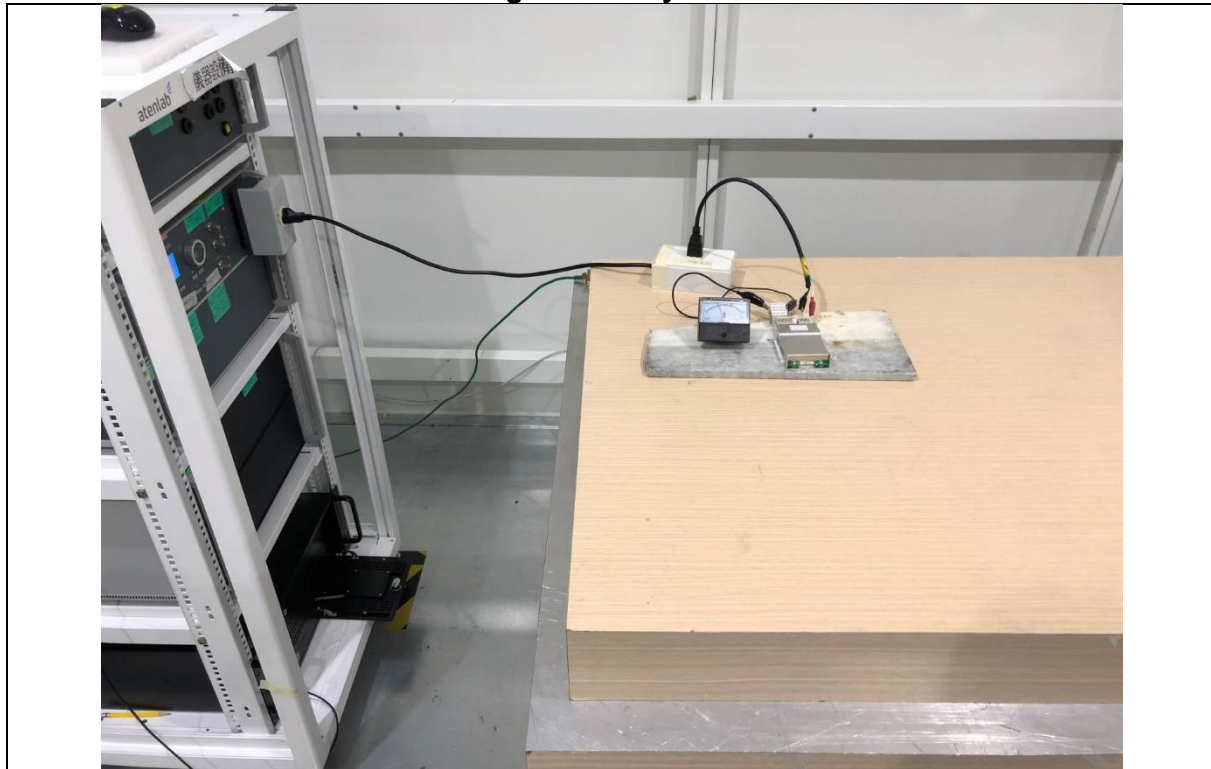
Radio Frequency Field Immunity: Mode 01



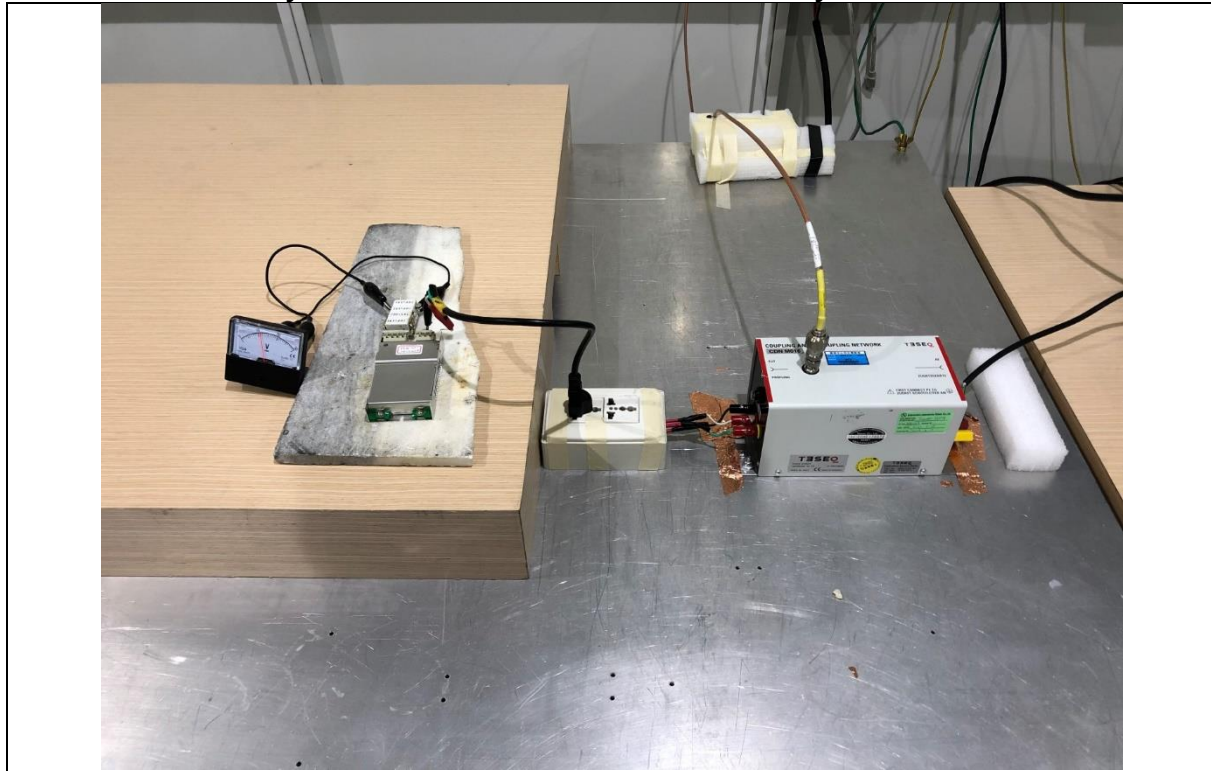
Electrical Fast Transient Immunity: Mode 01



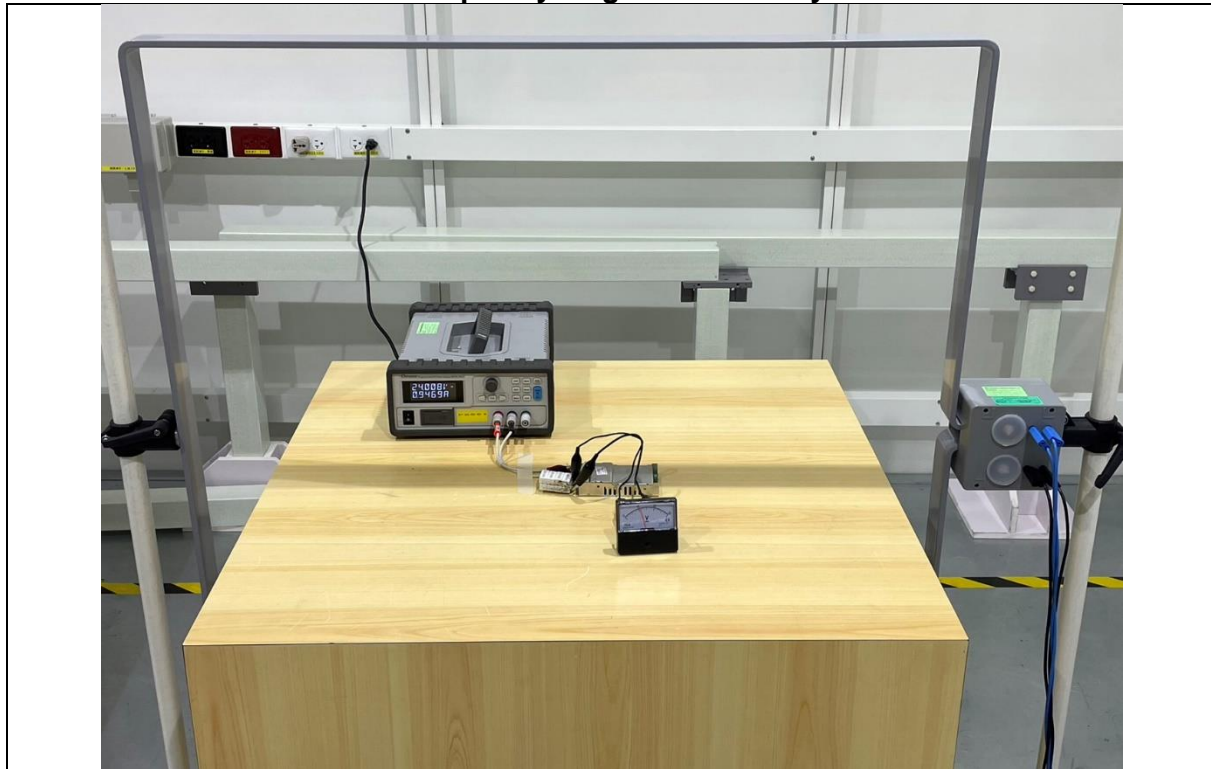
Surge Immunity: Mode 01



Immunity to conducted disturbance induced by RF fields: Mode 01

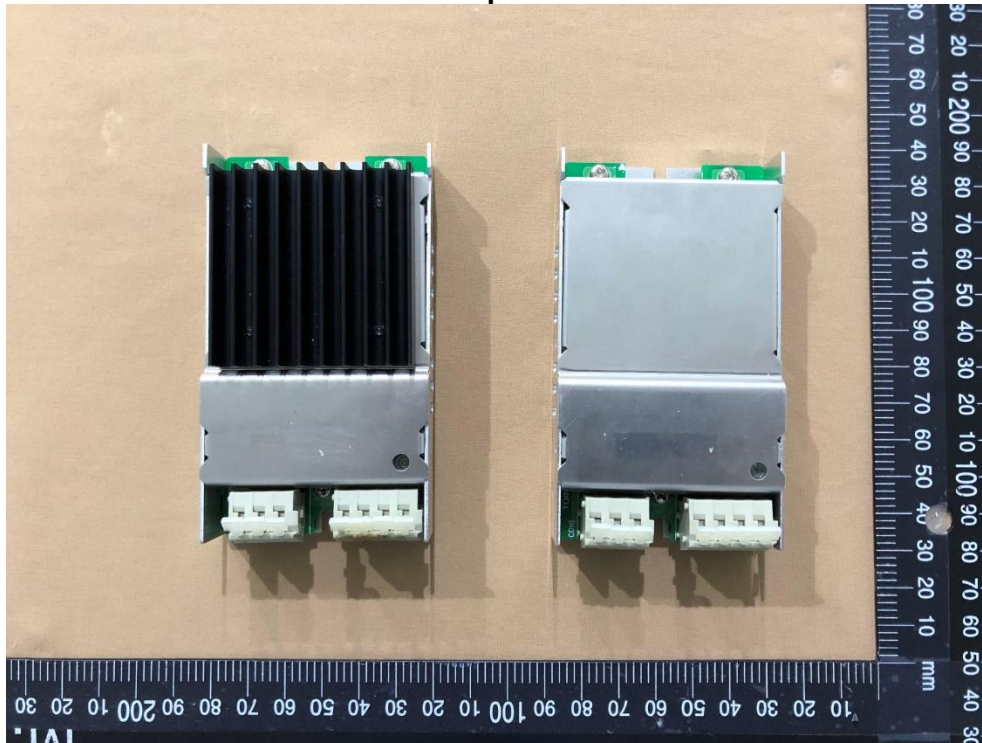


Power Frequency Magnetic Immunity: Mode 01

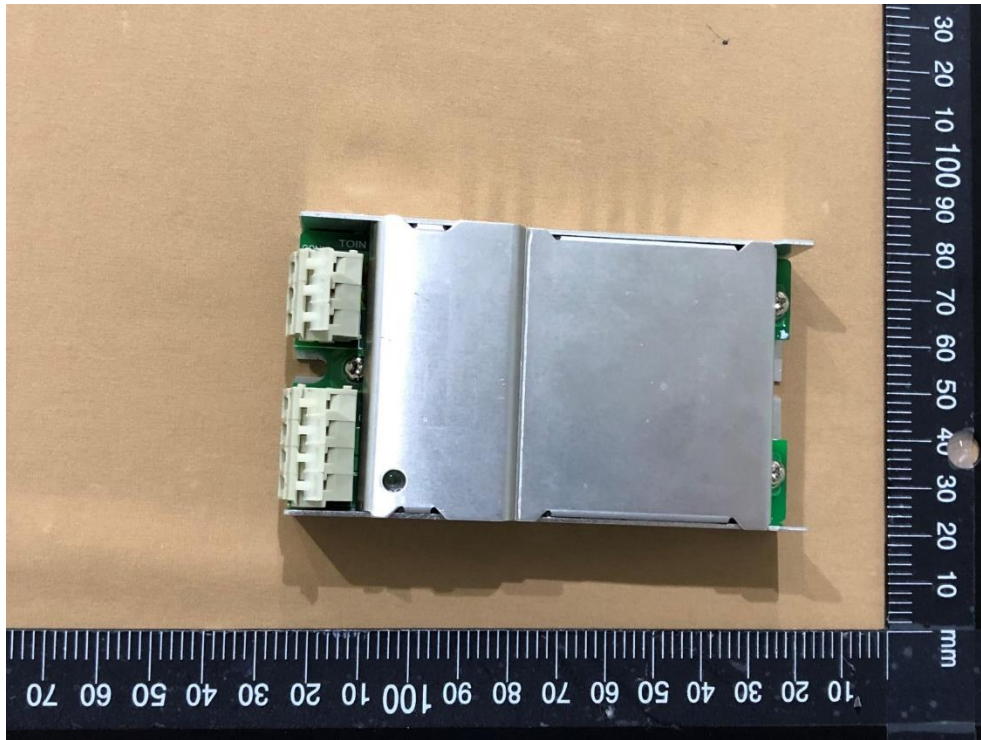


Appendix II: Photographs of the EUT

External Photos
Group Pic 1



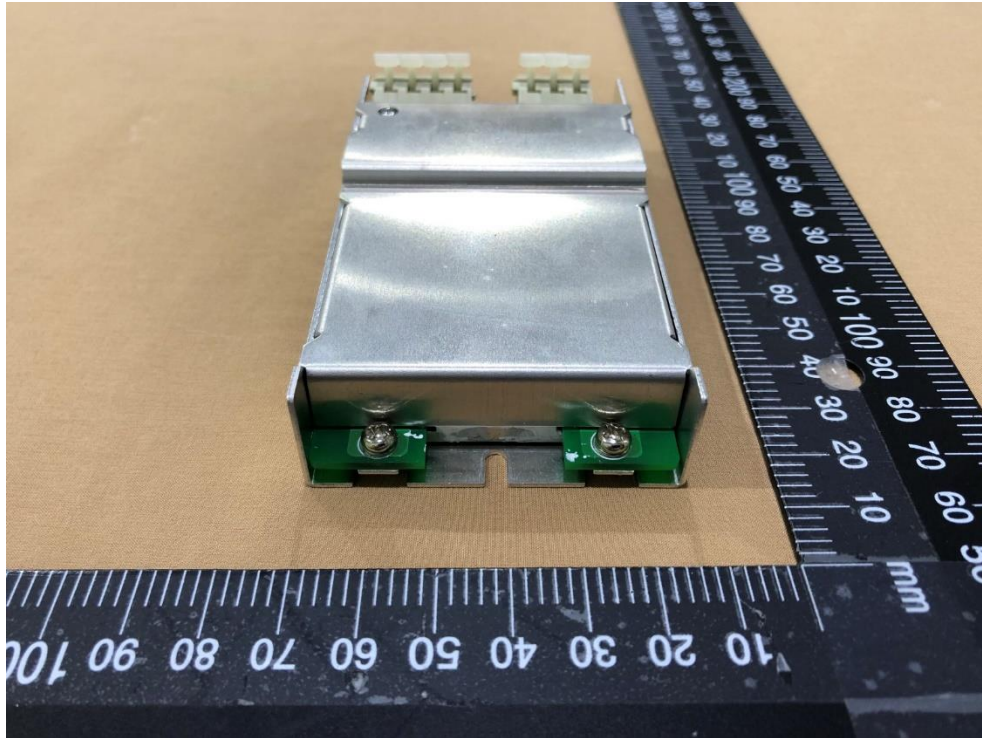
Outview: TEQ 20-2412WIR Pic 1



Outview: TEQ 20-2412WIR Pic 2



Outview: TEQ 20-2412WIR Pic 3



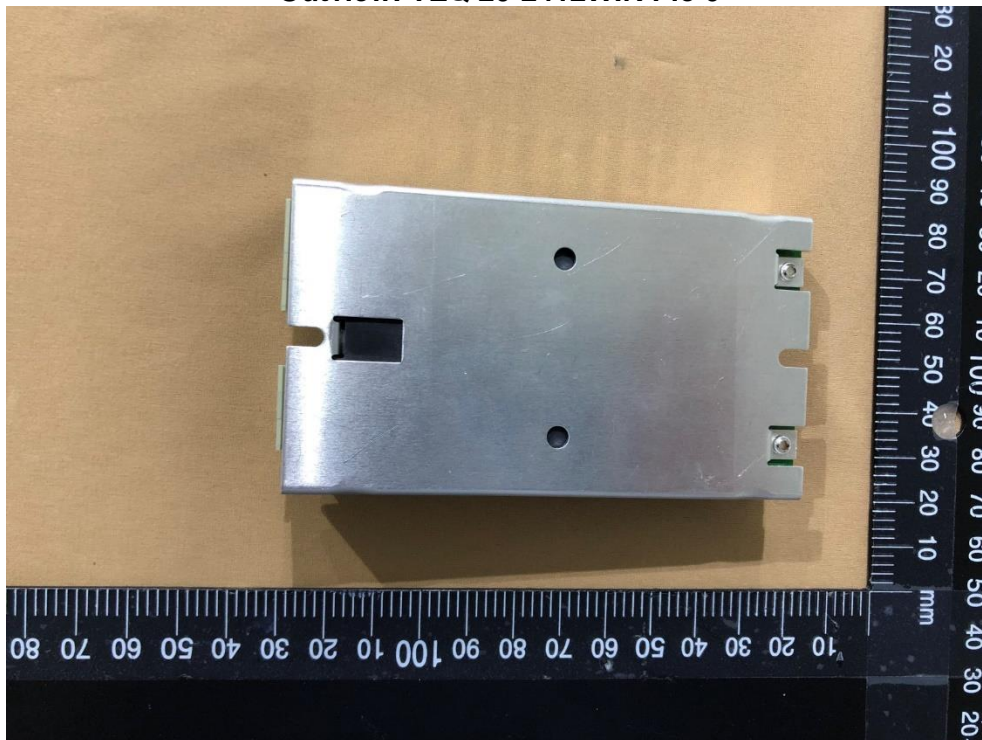
Outview: TEQ 20-2412WIR Pic 4



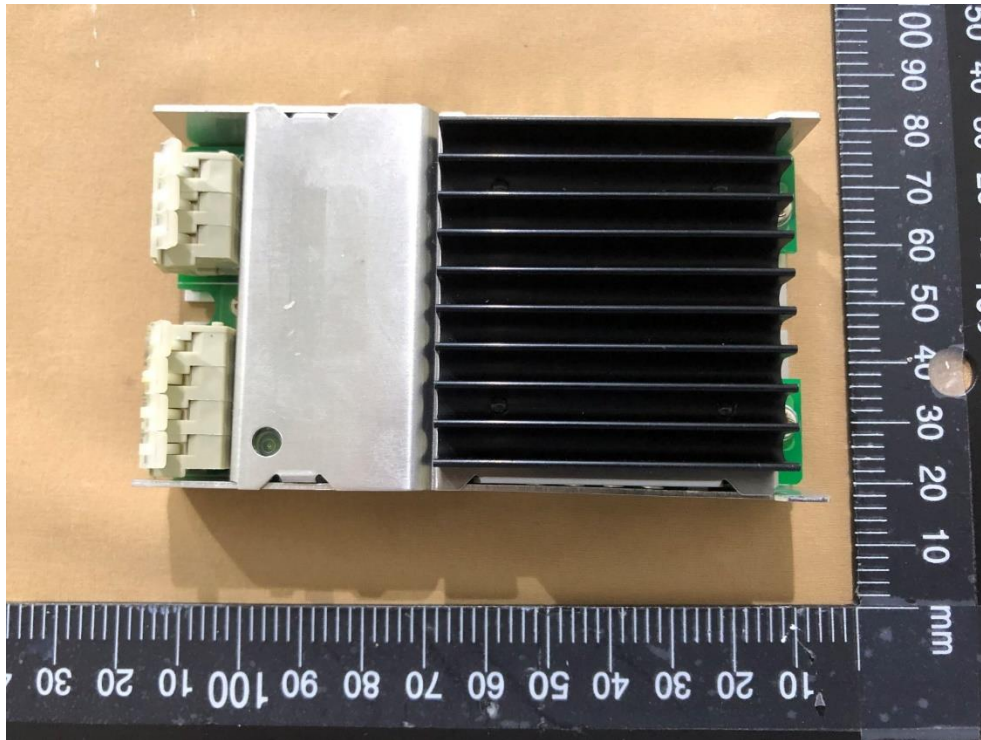
Outview: TEQ 20-2412WIR Pic 5



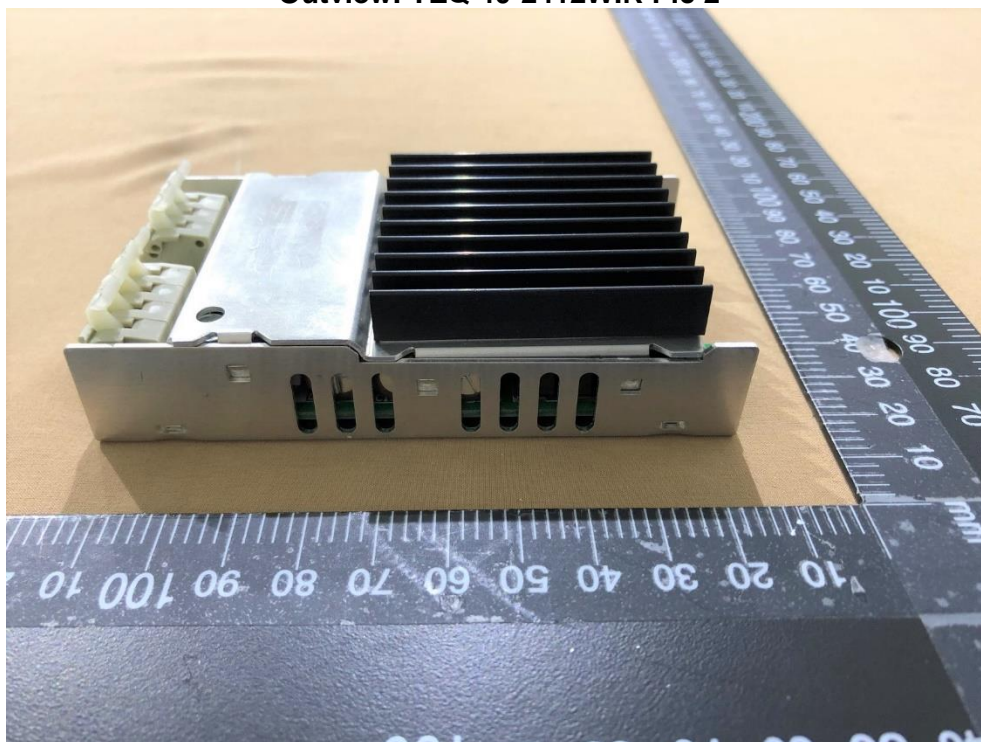
Outview: TEQ 20-2412WIR Pic 6



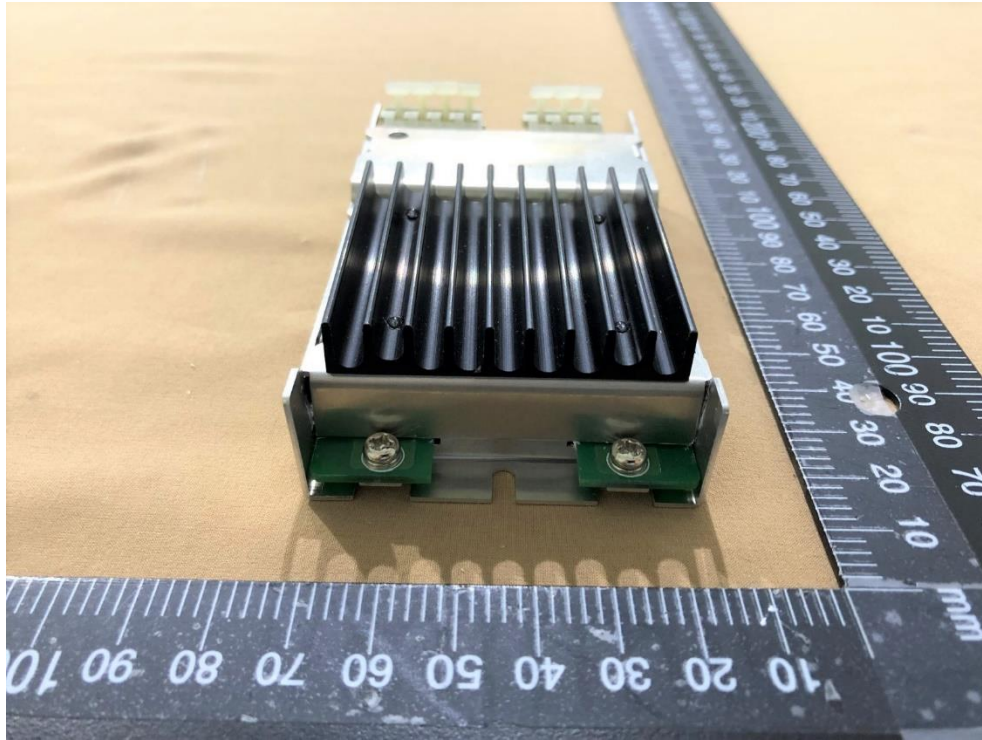
Outview: TEQ 40-2412WIR Pic 1



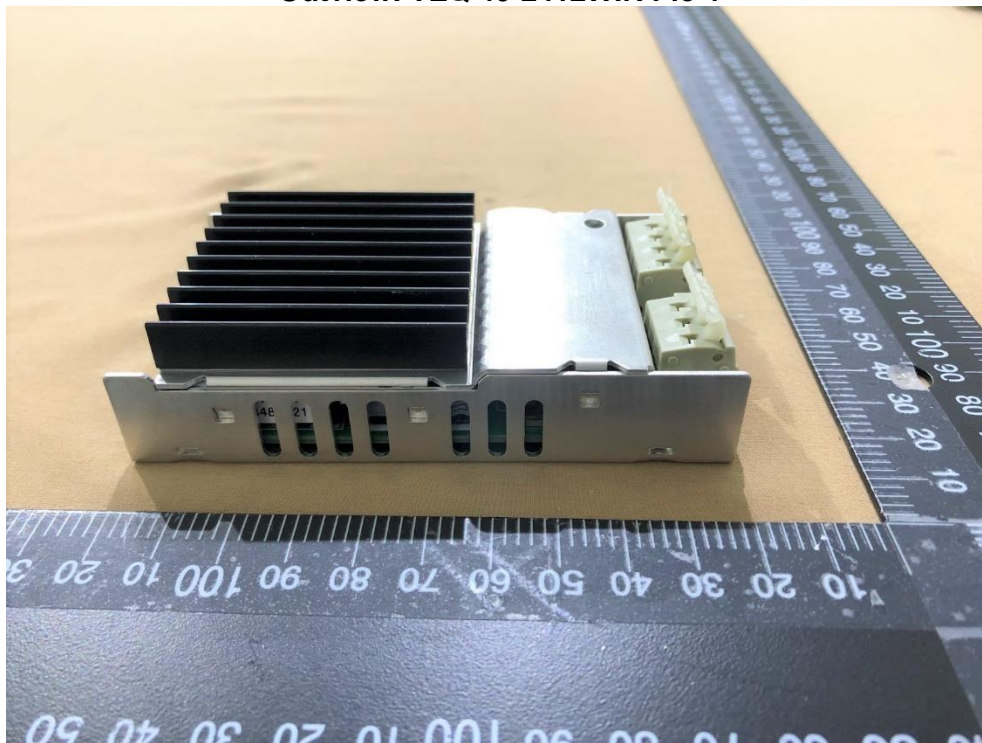
Outview: TEQ 40-2412WIR Pic 2



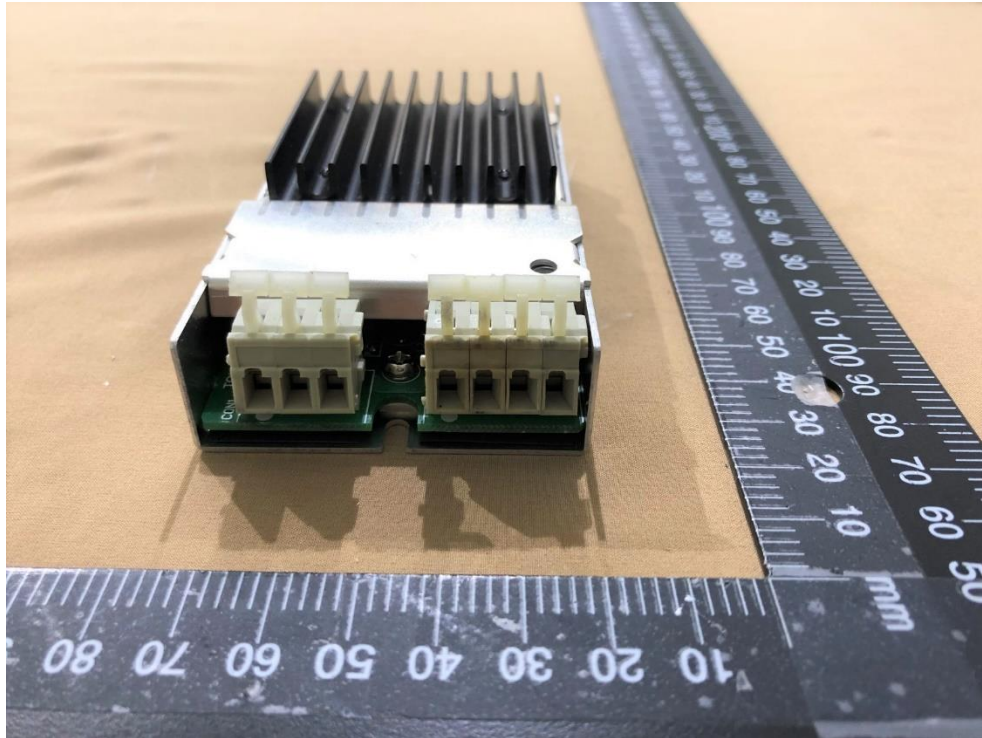
Outview: TEQ 40-2412WIR Pic 3



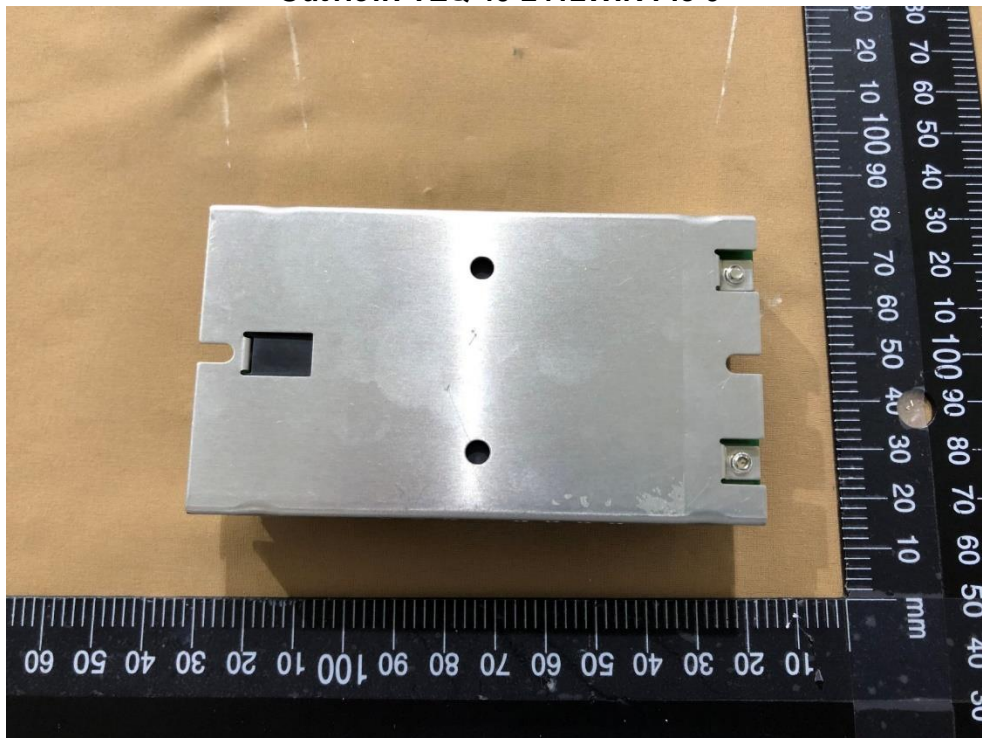
Outview: TEQ 40-2412WIR Pic 4



Outview: TEQ 40-2412WIR Pic 5



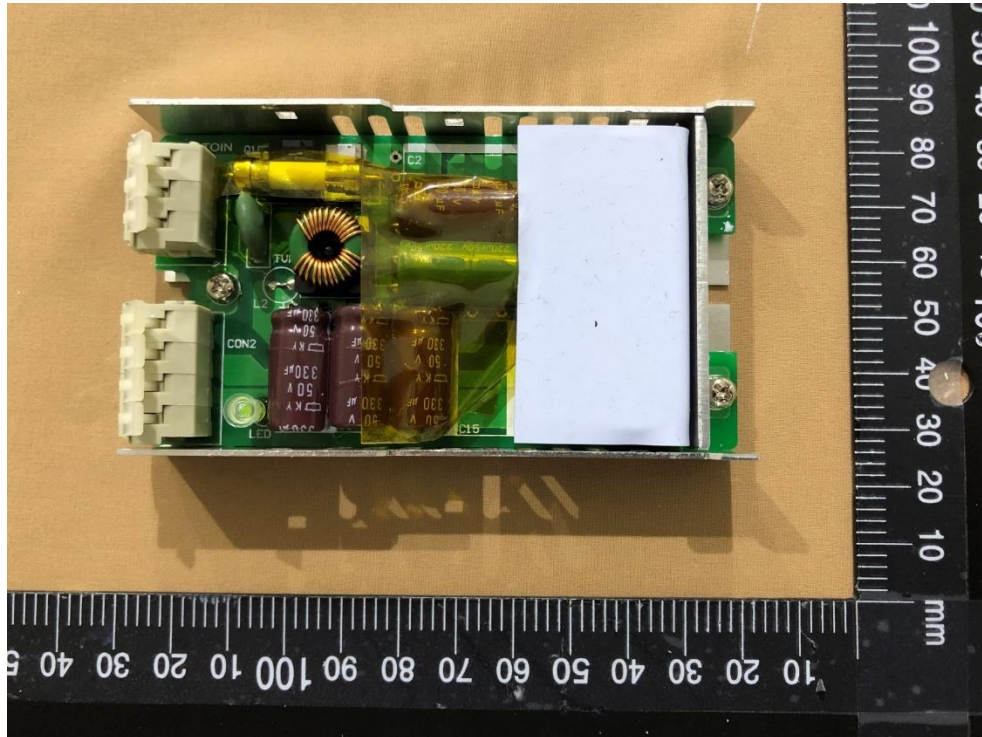
Outview: TEQ 40-2412WIR Pic 6



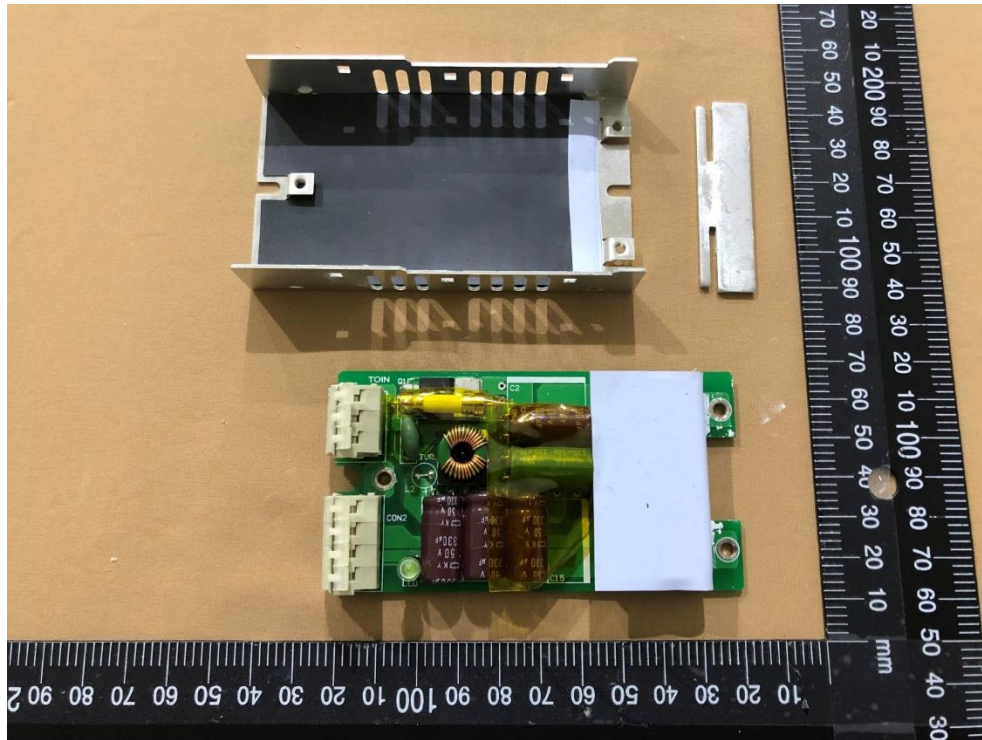
Internal Photos
TEQ 20-2412WIR Pic 1



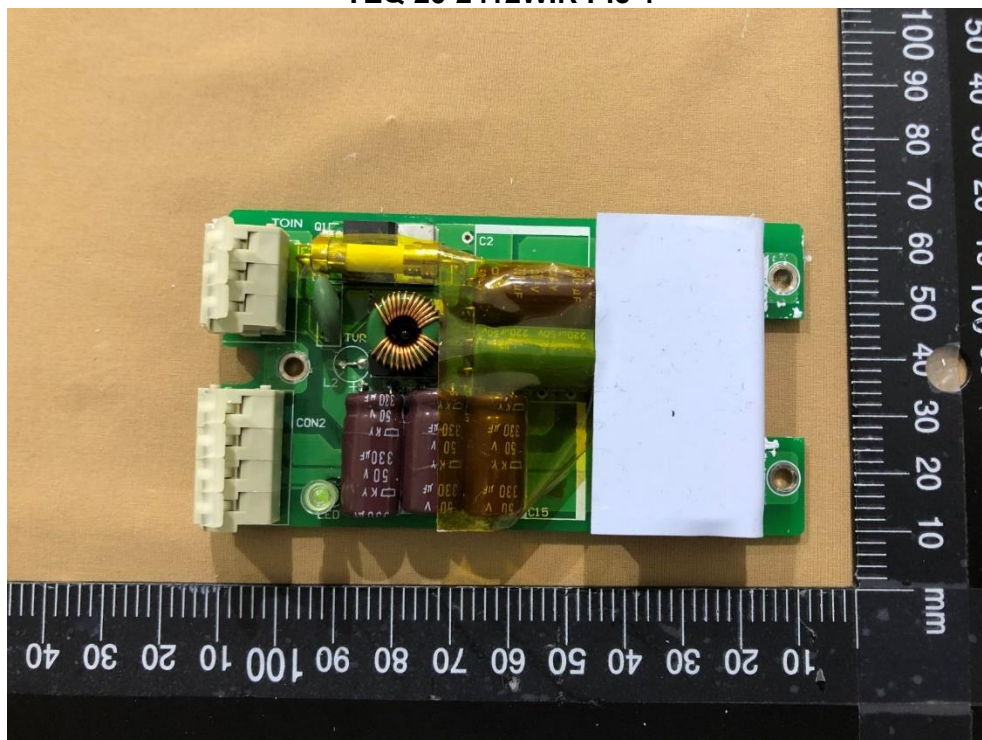
TEQ 20-2412WIR Pic 2



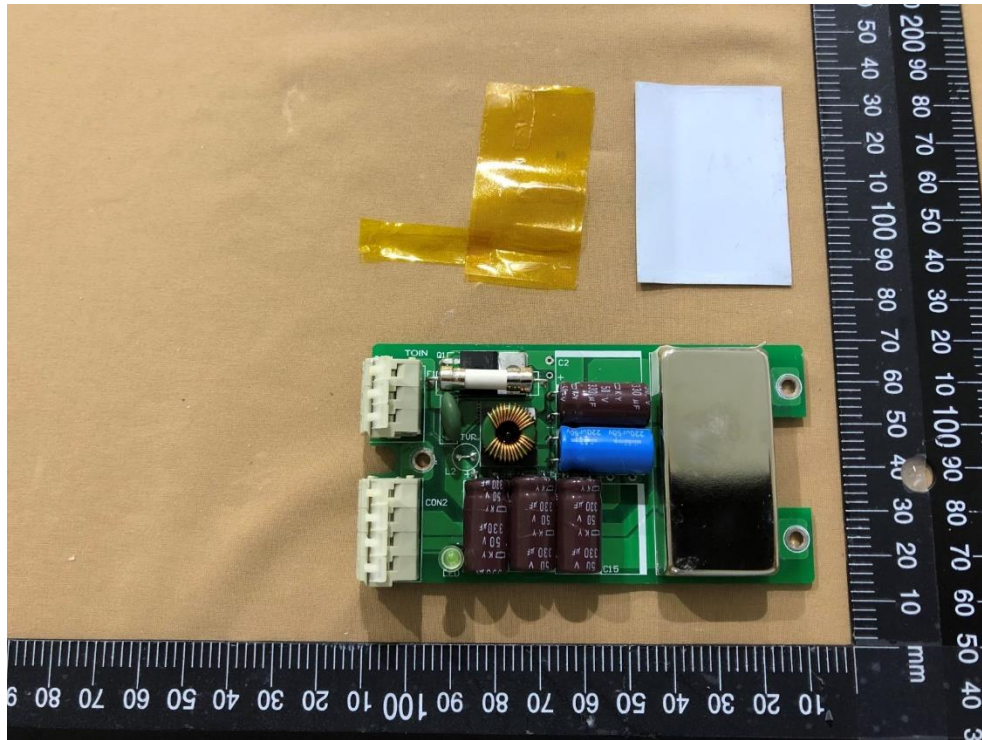
TEQ 20-2412WIR Pic 3



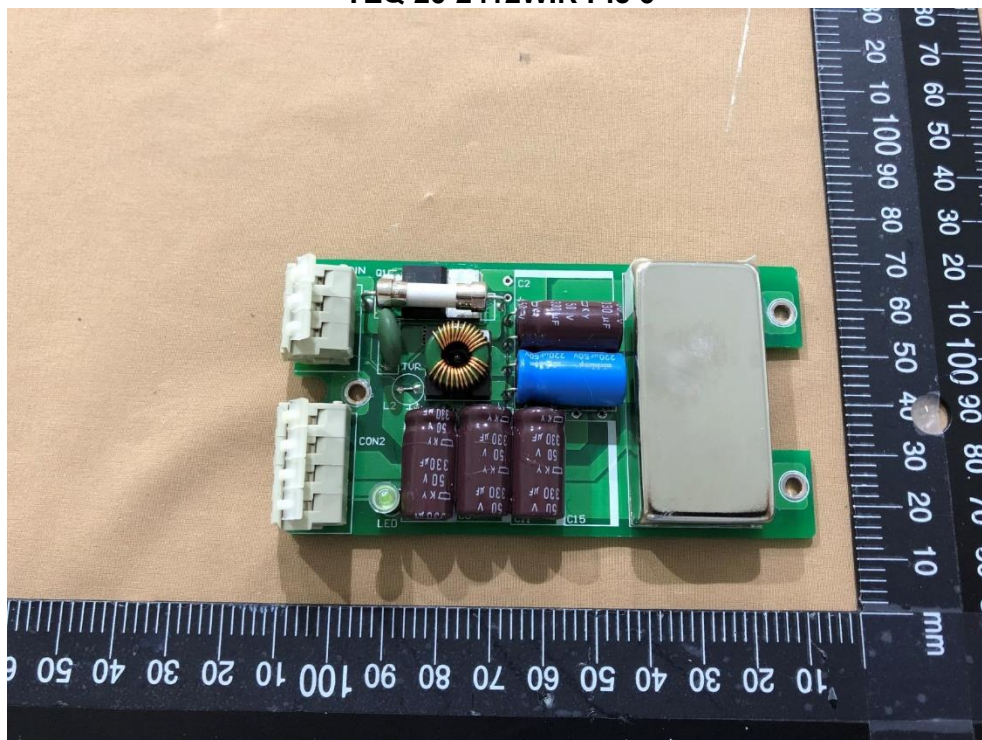
TEQ 20-2412WIR Pic 4



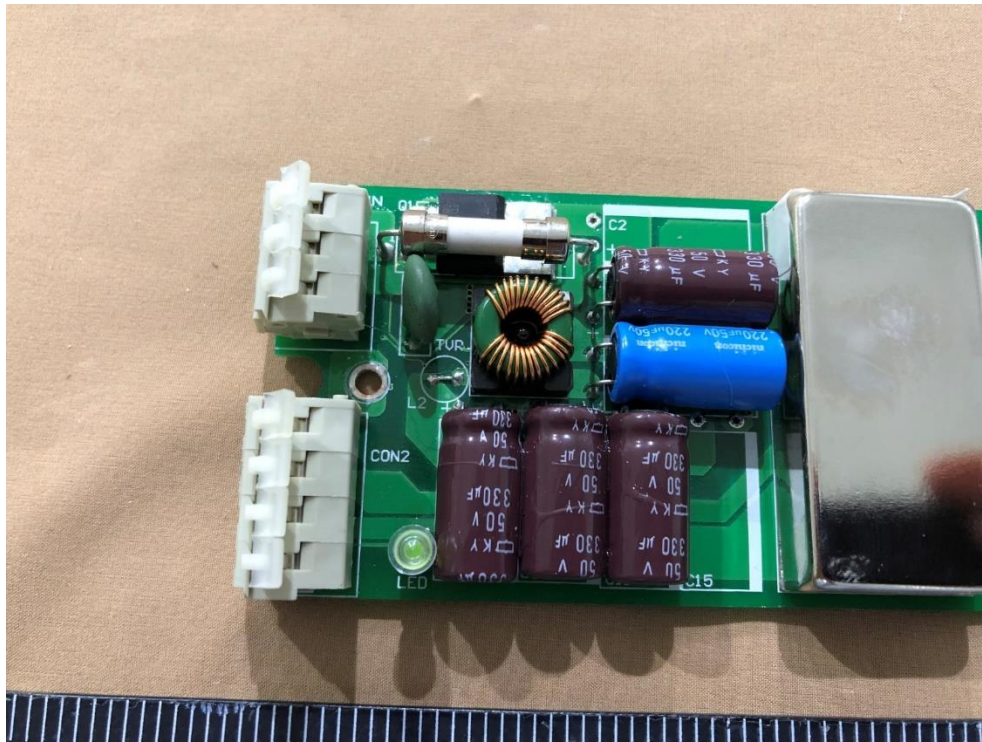
TEQ 20-2412WIR Pic 5



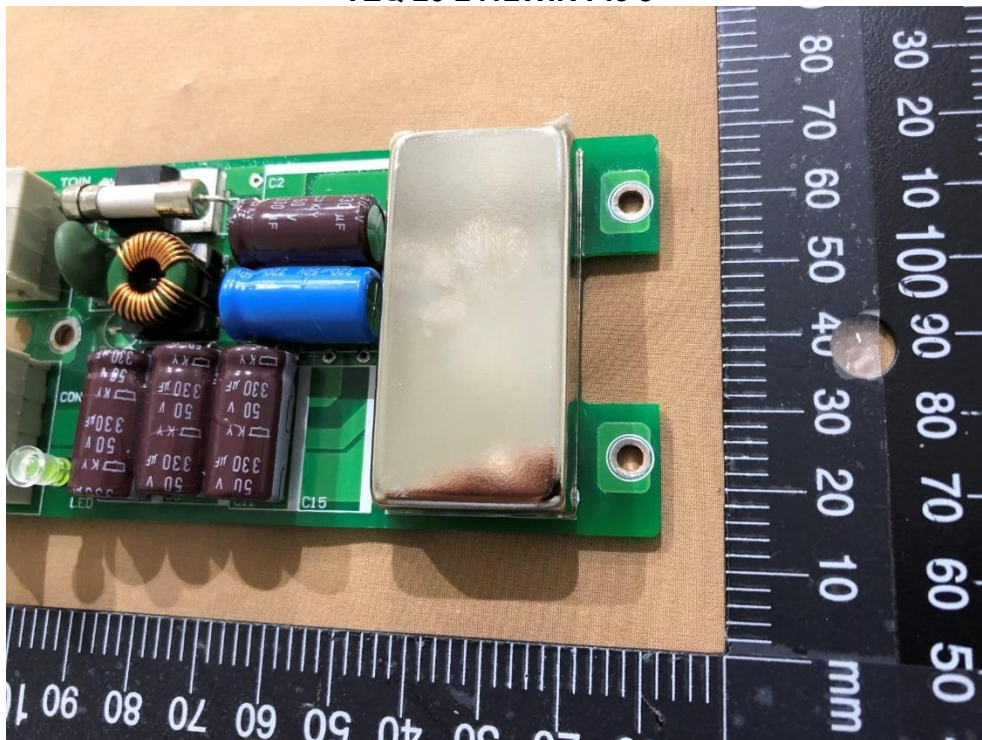
TEQ 20-2412WIR Pic 6



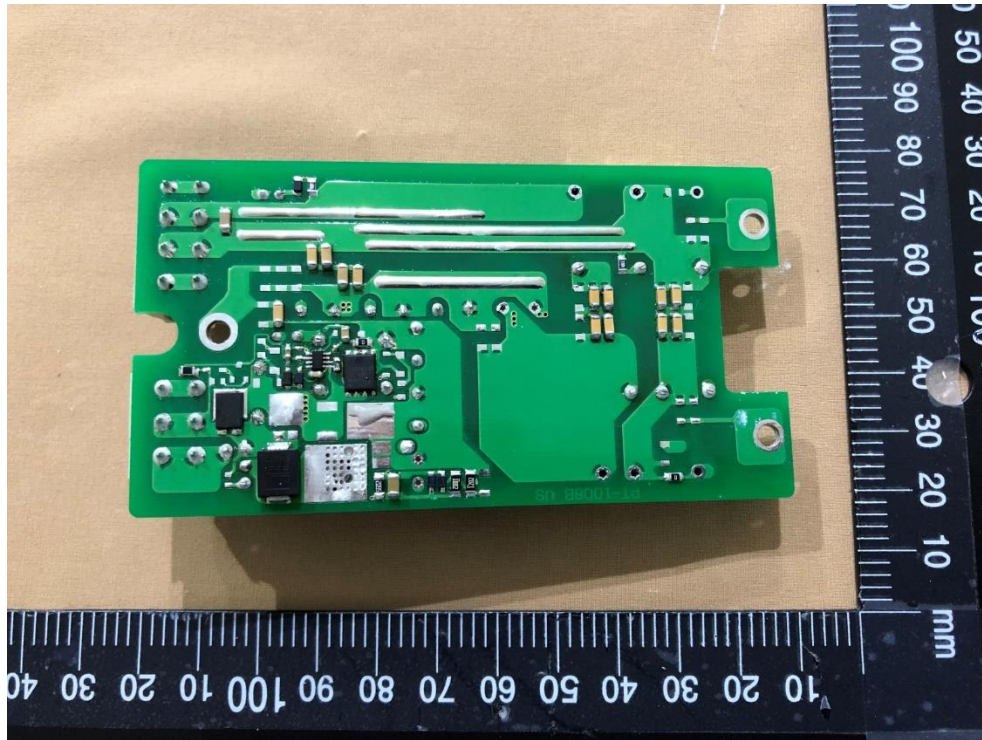
TEQ 20-2412WIR Pic 7



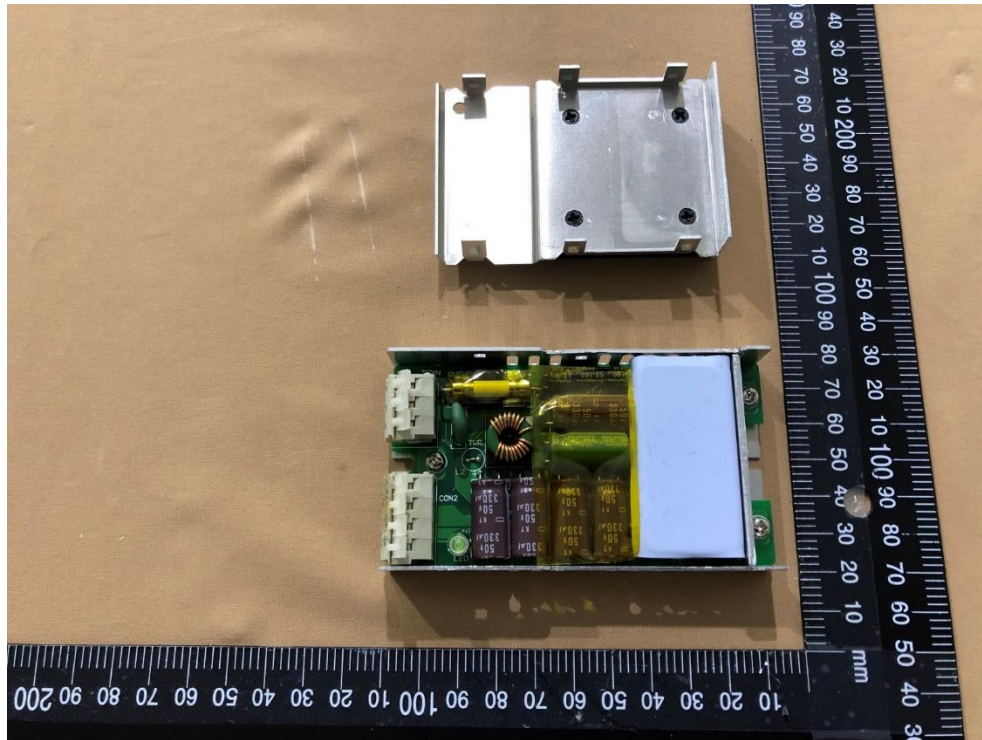
TEQ 20-2412WIR Pic 8



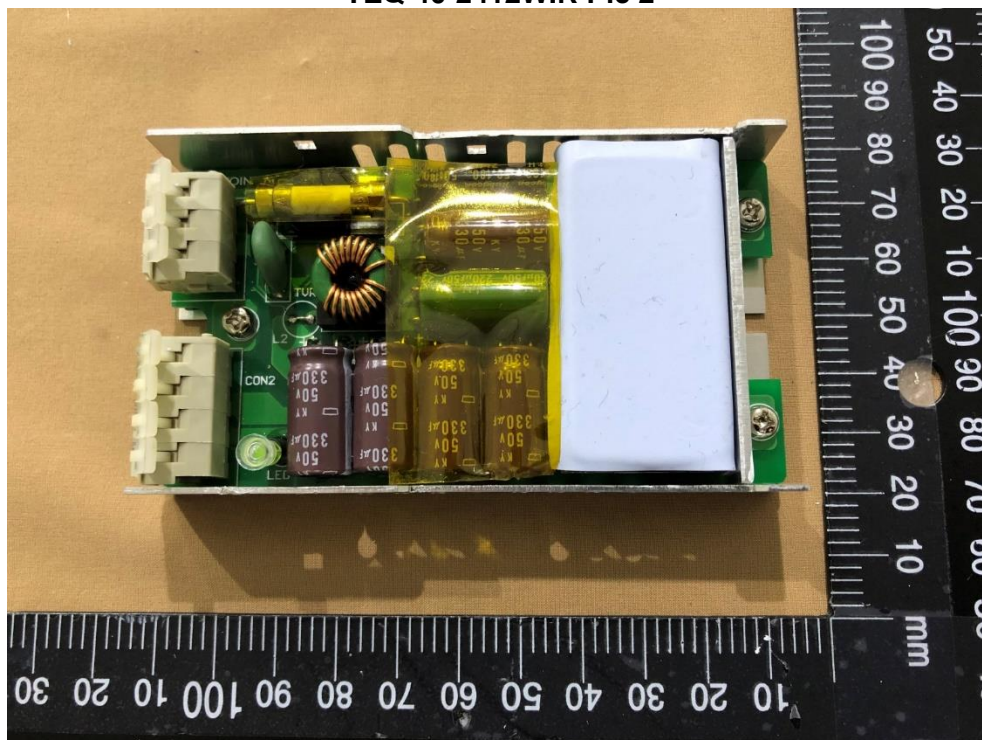
TEQ 20-2412WIR Pic 9



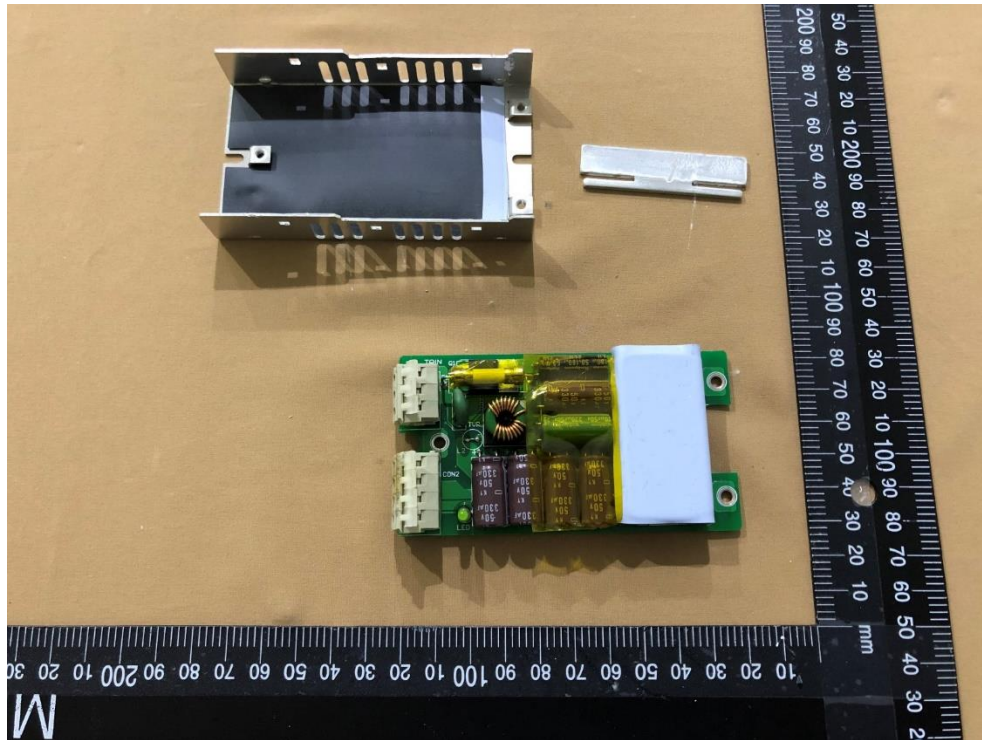
TEQ 40-2412WIR Pic 1



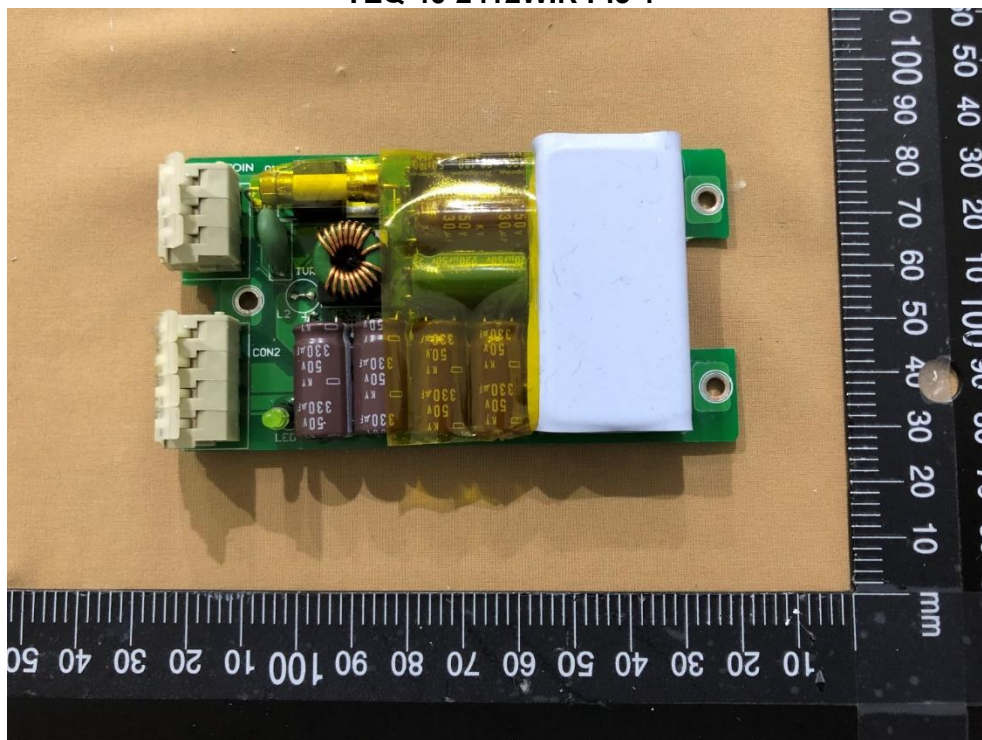
TEQ 40-2412WIR Pic 2



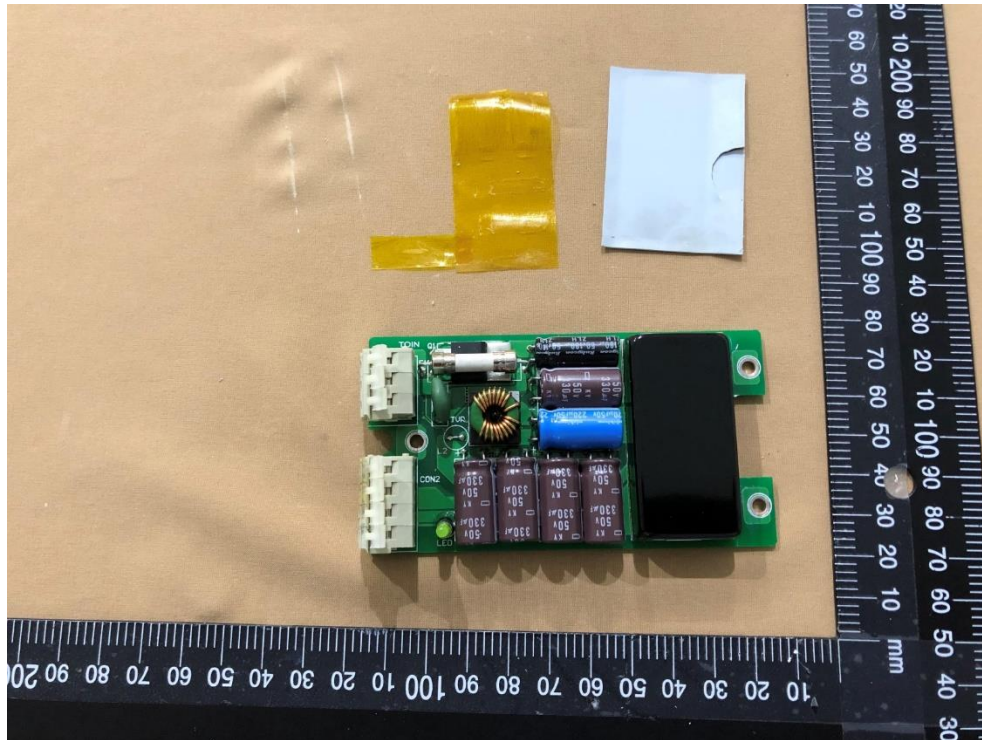
TEQ 40-2412WIR Pic 3



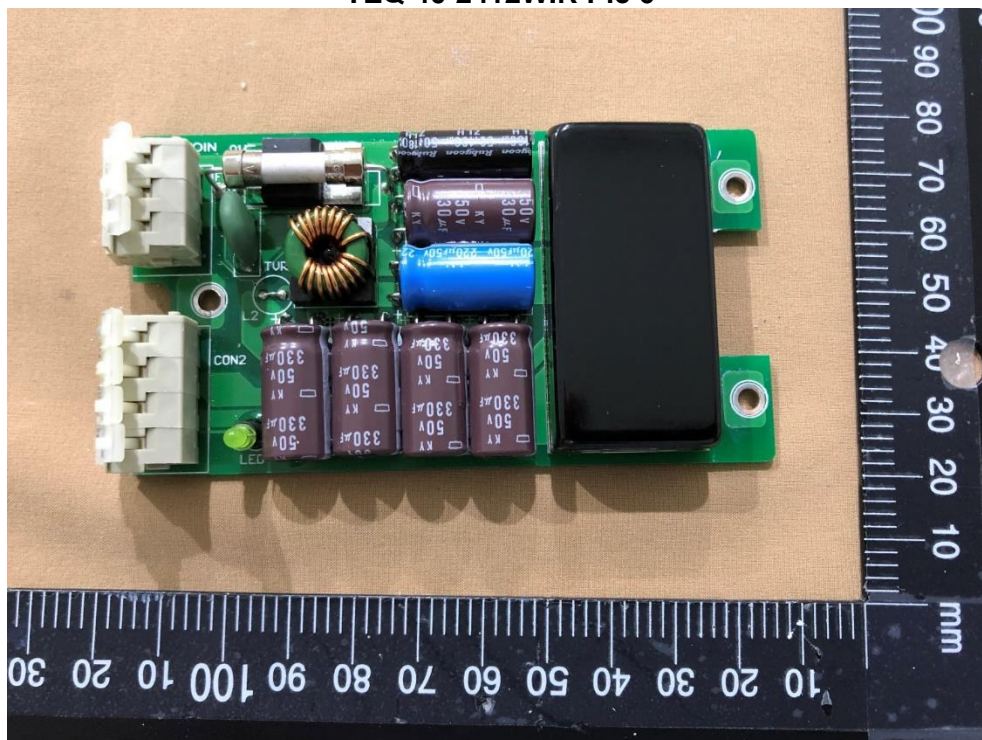
TEQ 40-2412WIR Pic 4



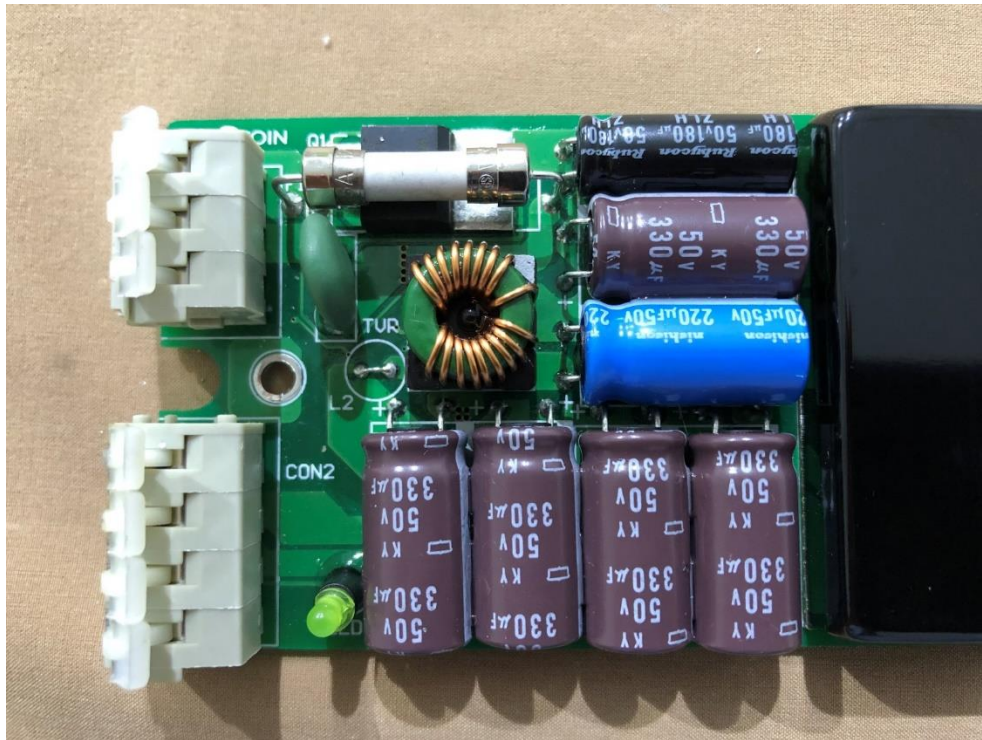
TEQ 40-2412WIR Pic 5



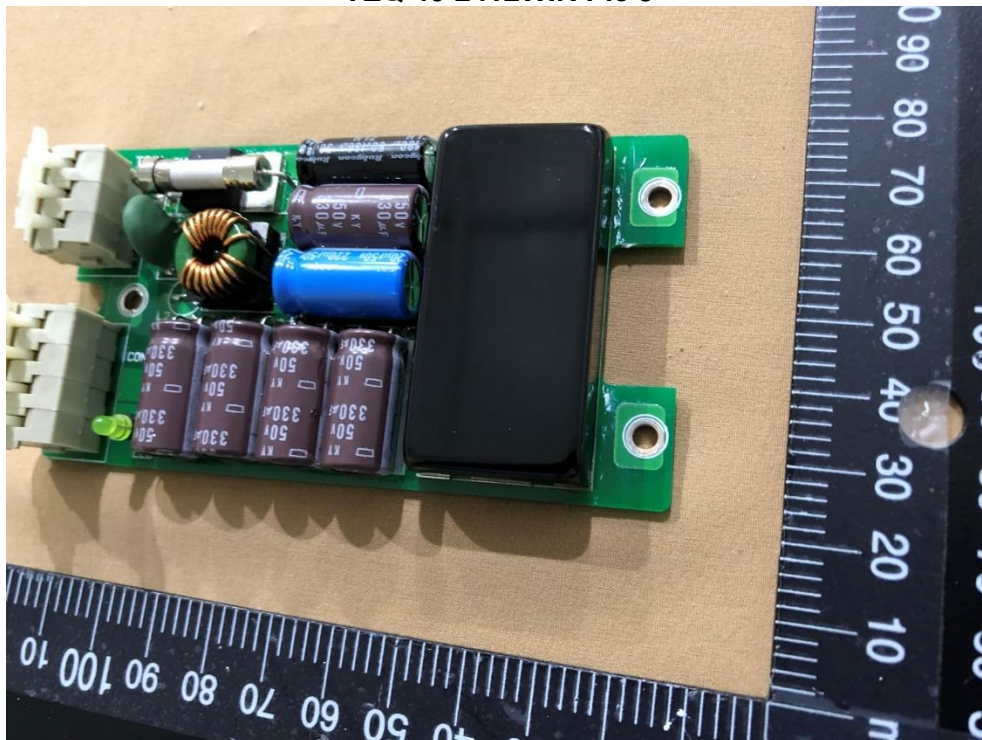
TEQ 40-2412WIR Pic 6



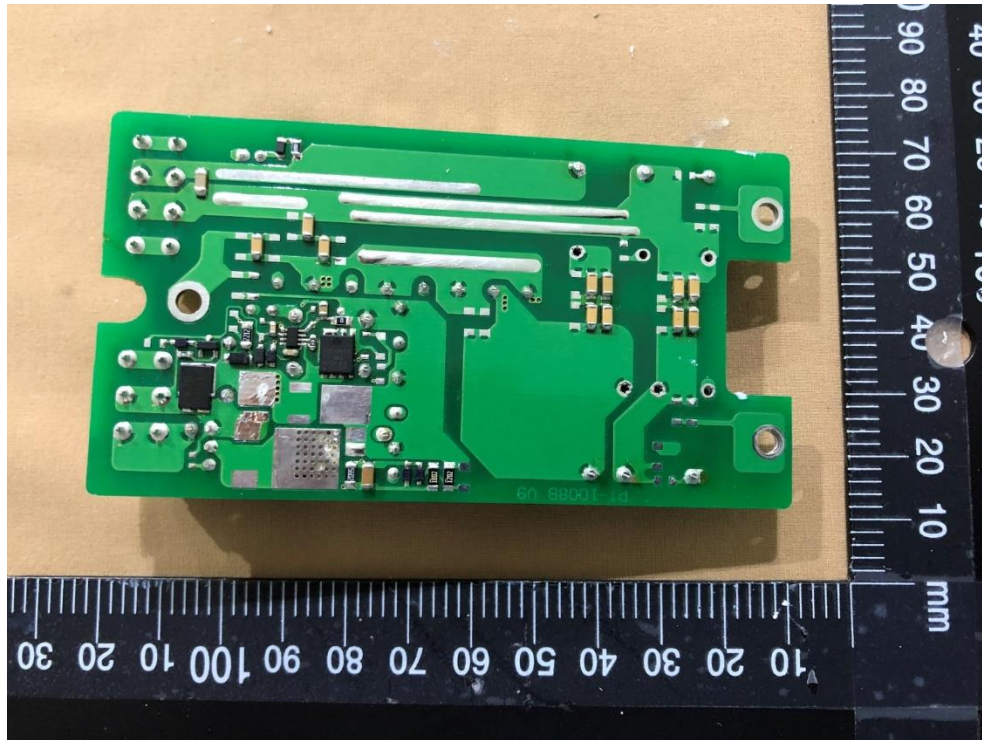
TEQ 40-2412WIR Pic 7



TEQ 40-2412WIR Pic 8



TEQ 40-2412WIR Pic 9

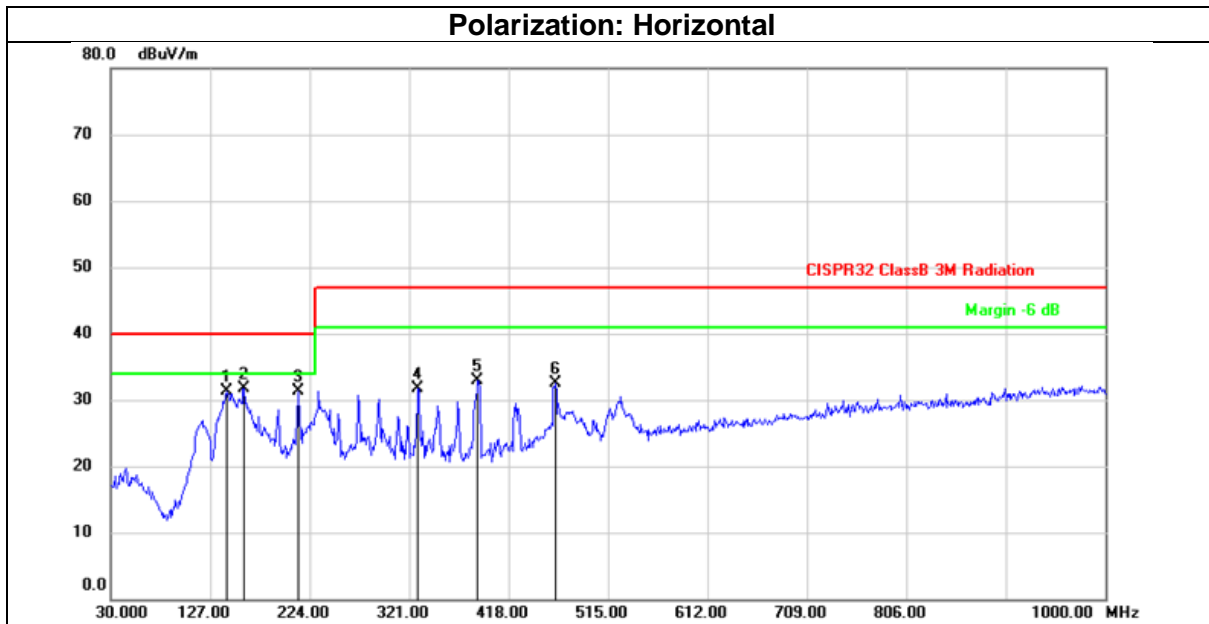


END OF REPORT

Appendix III: Preliminary Test Raw Data

Mode 2 ; 30M-1GHz

Test Mode:	Mode 2	Temperature:	24℃
Test Voltage:	24Vdc from DC source	Humidity:	70%RH
Tested By:	Duncan Wang	Test Date:	Nov. 18, 2022



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	143.2313	43.95	-12.61	31.34	40.00	-8.66	PK
2	159.9800	43.78	-12.02	31.76	40.00	-8.24	PK
3	213.4593	46.63	-15.38	31.25	40.00	-8.75	PK
4	329.9887	41.90	-10.11	31.79	47.00	-15.21	PK
5	388.2857	41.55	-8.55	33.00	47.00	-14.00	PK
6	463.6547	39.02	-6.56	32.46	47.00	-14.54	PK

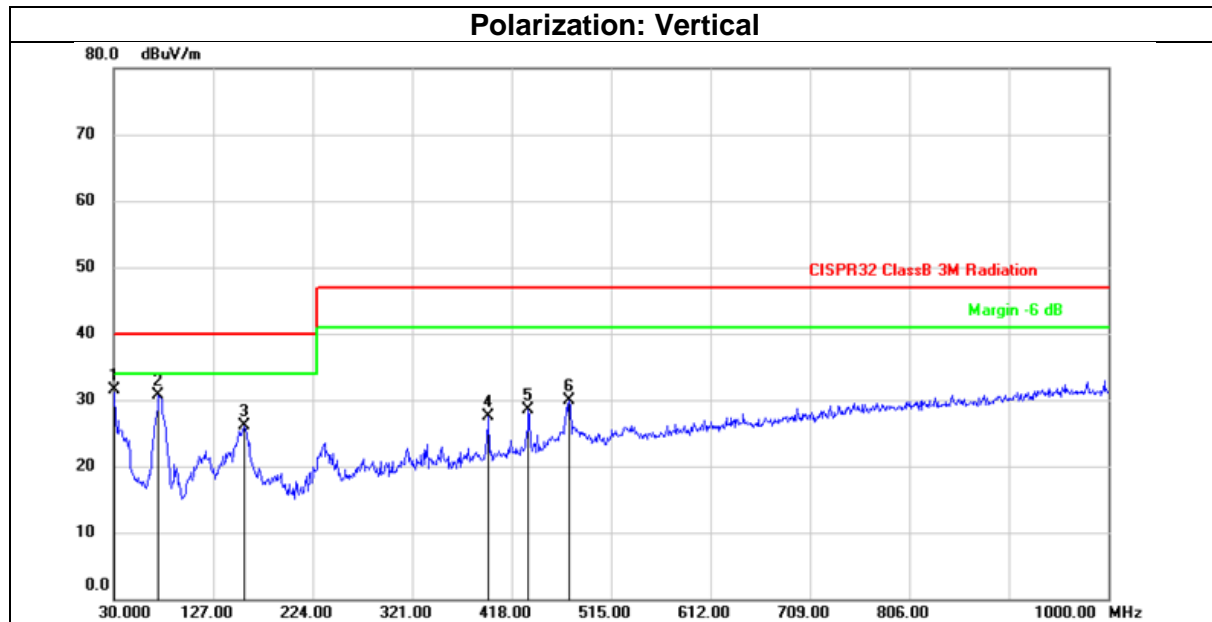
Remark:

Result = Reading +Correct.

Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain.

Margin = Result - Limit.

Test Mode:	Mode 2	Temperature:	24°C
Test Voltage:	24Vdc from DC source	Humidity:	70%RH
Tested By:	Duncan Wang	Test Date:	Nov. 18, 2022



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	30.3880	45.31	-13.88	31.43	40.00	-8.57	PK
2	74.5877	46.26	-15.59	30.67	40.00	-9.33	PK
3	157.9753	38.13	-12.03	26.10	40.00	-13.90	PK
4	396.2397	35.97	-8.42	27.55	47.00	-19.45	PK
5	435.2660	35.49	-7.05	28.44	47.00	-18.56	PK
6	474.4540	36.34	-6.39	29.95	47.00	-17.05	PK

Remark:

Result = Reading + Correct.

Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain.

Margin = Result - Limit.

Annex : Additional test request by client.

RS TEST RESULT FORM

Project No.: 4790626133

Applicant	TRACO	Product Name	DC to DC Converter
Model Name	TEQ 20-2412WIR	Standard	EN 55035

Test Mode:	Mode 1	Temperature:	24°C
Test Voltage:	24Vdc from DC source	Humidity:	68%RH
Tested By:	Duncan Wang	Test Date:	Nov. 16, 2022

Freq. Range (MHz)	Position (Face)	Polarity (H or V)	Field Strength (V/m)	Criterion	Results	Judgment
80-1000	Front	H / V	20	A	A	Pass
	Left	H / V	20	A	A	
	Right	H / V	20	A	A	
	Rear	H / V	20	A	A	
1800(±1%)	Front / Left / Right / Rear	H / V	20	A	A	Pass
2600(±1%)	Front / Left / Right / Rear	H / V	20	A	A	Pass
3500(±1%)	Front / Left / Right / Rear	H / V	20	A	A	Pass
5000(±1%)	Front / Left / Right / Rear	H / V	20	A	A	Pass
Note	There was no abnormal situation during the test compared with initial operation.					

Immunity Level to common wireless communication						
Freq. Range (MHz)	Position (Face)	Polarity (H or V)	Field Strength (V/m)	Criterion	Results	Judgment
800	Front / Left / Right / Rear	H / V	20	A	A	Pass
900	Front / Left / Right / Rear	H / V	20	A	A	Pass
1800(±1%)	Front / Left / Right / Rear	H / V	20	A	A	Pass
2600(±1%)	Front / Left / Right / Rear	H / V	20	A	A	Pass
3500(±1%)	Front / Left / Right / Rear	H / V	20	A	A	Pass
5000(±1%)	Front / Left / Right / Rear	H / V	20	A	A	Pass
Note	There was no abnormal situation during the test compared with initial operation.					