EMC Test Report

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Applicant: V-TAC EXPORTS LIMITED

Address: ROOM NO.301, KAM ON BUILDING 176A QUEENS ROAD CENTRAL, CENTRAL, HONGKONG

Product: Grid-tied Solar Inverter

Model: VT-6605310, VT-6608310, VT-6610310, VT-6615310

COMMERCIAL-IN-CONFIDENCE

Report Number: 64.772.22.30406.01A

RESPONSIBLE FOR	NAME	SIGNATURE	DATE
Prepared by	Charlie Wu	Charlie Wu	2022-08-31
Approved by	Samuel Zhang	Samuel Zhang	2022-08-31

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service control rules.

EXECUTIVE SUMMARY A sample of this product was tested and found to be in compliance with	EN IEC 61000-6-1:2019, EN IEC 61000-6-2:2019, EN IEC 61000-6-3:2021.

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	2022-08-31

1.2 Introduction

The information contained in this report is intended to show verification of the EMC Qualification Approval Testing of the requirements of the standards for the tests listed in Section 1.3.

Applicant	:	V-TAC EXPORTS LIMITED
Address	:	ROOM NO.301, KAM ON BUILDING 176A QUEENS ROAD CENTRAL, CENTRAL, HONGKONG
Manufacturer	:	Same as the applicant
Address	:	Same as the applicant
Model Number(s)	:	VT-6605310, VT-6608310, VT-6610310, VT-6615310
Product Type	:	Grid-tied Solar Inverter
Trademark	:	V-TAC®
Date of Receipt of EUT	:	2022-07-15
Start of Test	:	2022-07-15
Finish of Test	:	2022-08-02
Name of Engineer(s)	:	Charlie Wu

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with EN IEC 61000-6-1:2019, EN IEC 61000-6-2:2019 and EN IEC 61000-6-3:2021 is shown below.

Specification	Clause	Test Description	Result	Remark
EN IEC 61000-6-3:2021	11	Emission - Low voltage AC mains port	Pass	/
EN IEC 61000-6-3:2021	11	Emission – DC power port	Pass	/
EN IEC 61000-6-3:2021	11	Emission – Telecommunications / network port	N/A	/
EN IEC 61000-6-3:2021	11	Emission - Enclosure port	Pass	/
EN 61000-3-12:2011	11	Harmonic Current	N/A	/
EN 61000-3-11:2000	11	Flicker	N/A	/
EN IEC 61000-6-1:2019 EN IEC 61000-6-2:2019 IEC 61000-4-2:2008	9	Electrostatic discharge immunity test	Pass	/
EN IEC 61000-6-1:2019 EN IEC 61000-6-2:2019 IEC 61000-4-3:2006+A1:2007+A2:2020	9	Radiated, radio-frequency, electromagnetic field immunity test	Pass	/
EN IEC 61000-6-1:2019 EN IEC 61000-6-2:2019 IEC 61000-4-4:2012	9	Electrical fast transient /burst immunity test	Pass	/
EN IEC 61000-6-1:2019 EN IEC 61000-6-2:2019 IEC 61000-4-5:2014	9	Surge immunity test	Pass	/
EN IEC 61000-6-1:2019 EN IEC 61000-6-2:2019 IEC 61000-4-6:2013	9	Immunity to conducted disturbances, induced by radio-frequency fields	Pass	/
EN IEC 61000-6-1:2019 EN IEC 61000-6-2:2019 IEC 61000-4-8:2009	9	Immunity - Enclosure port - Power-frequency magnetic field	Pass	/
EN IEC 61000-6-1:2019 EN IEC 61000-6-2:2019 IEC 61000-4-11:2004	9	Voltage dips, short interruptions and voltage variations immunity tests	Pass	/

1.4 Test Conditions

1.4.1 Environmental Conditions

The climatic conditions during the tests are within the limits specified by the manufacturer for the operation of the EUT and the test equipment.

The climatic conditions during the tests were within the following limits:

Temperature	Humidity	Atmospheric pressure
15 °C – 35 °C	30 % - 60 %	860 hPa – 1060 hPa

If explicitly required in the basic standard or applied product standard the climatic values are recorded and documented separately in this test report.

1.4.2 Performance Criteria

Performance criterion A: The apparatus shall continue to operate as intended during 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. 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 from what the user may reasonable expect from the apparatus if used as intended.

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

Performance criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls, or by any operation specified in the instruction for use.

1.5 Product Information and general remarks

1.5.1 Technical Description

DC Input
MPPT Range : 180V-1000V
Max. Current : 14A/28A
AV Output
Nominal Voltage : 3/N/PE,230/400V
Max. Current : 23.9A
Rated Power : 15000W
Protection class : Class I

1.5.2 Test Configuration

Configuration	Description
DC Powered	850Vdc
AC Powered	400Vac

1.5.3 Modes of Operation

Mode	Description
TM1	Full load
TM2	Half load

1.5.4 General remark:

Please refer to report 64.772.22.30406.01 for complete information.

Change applicant, model name and appearance in this report. By evaluation, no test is needed to perform.

Co-license Model	is technically identical to	Main Certificate Model
VT-6605310	is technically identical to	iMars XG5KTR
VT-6608310	is technically identical to	iMars XG8KTR
VT-6610310	is technically identical to	iMars XG10KTR
VT-6615310	is technically identical to	iMars XG15KTR1- S

Model list

Model:	VT-6605310	VT-6608310	VT-6610310	VT-6615310
PV input terminal parameters:				
Vmax PV	1100 Vd.c.	1100 Vd.c.	1100 Vd.c.	1100 Vd.c.
Rated input voltage	600 Vd.c.	600 Vd.c.	600 Vd.c.	600 Vd.c.

MPPT voltage range	180-1000 Vd.c.	180-1000 Vd.c.	180-1000 Vd.c.	180-1000 Vd.c.
MPPT voltage range (full load)	250-850 Vd.c.	320-850 Vd.c.	450-850 Vd.c.	450-850 Vd.c.
Maximum continue input current	14/14 Ad.c.	14/14 Ad.c.	14/14 Ad.c.	18/18 Ad.c.
Isc PV	18/18 Ad.c.	18/18 Ad.c.	18/18 Ad.c.	25/25 Ad.c.
AC output rating				
Rated output voltage	3/N/PE, 230/400 Va.c.			
Rated output frequency	50/60 Hz			
Maximum continuous output current	8 Aa.c.	12.8 Aa.c.	15.9 Aa.c.	23.9 Aa.c.
Rate output active power	5 kW	8 kW	10 kW	15 kW
Maximum output apparent power	5.5 kVA	8.8 kVA	11 kVA	16.5 kVA
Power factor	0.8 leading ~ 0.8 lagging			
General				
Operating temperature range	-30°C ~+60°C (derating at 45°C)			
Protection class	I			
Ingress protection	IP66			
Operating altitude range	≤4000m			

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 Test Location

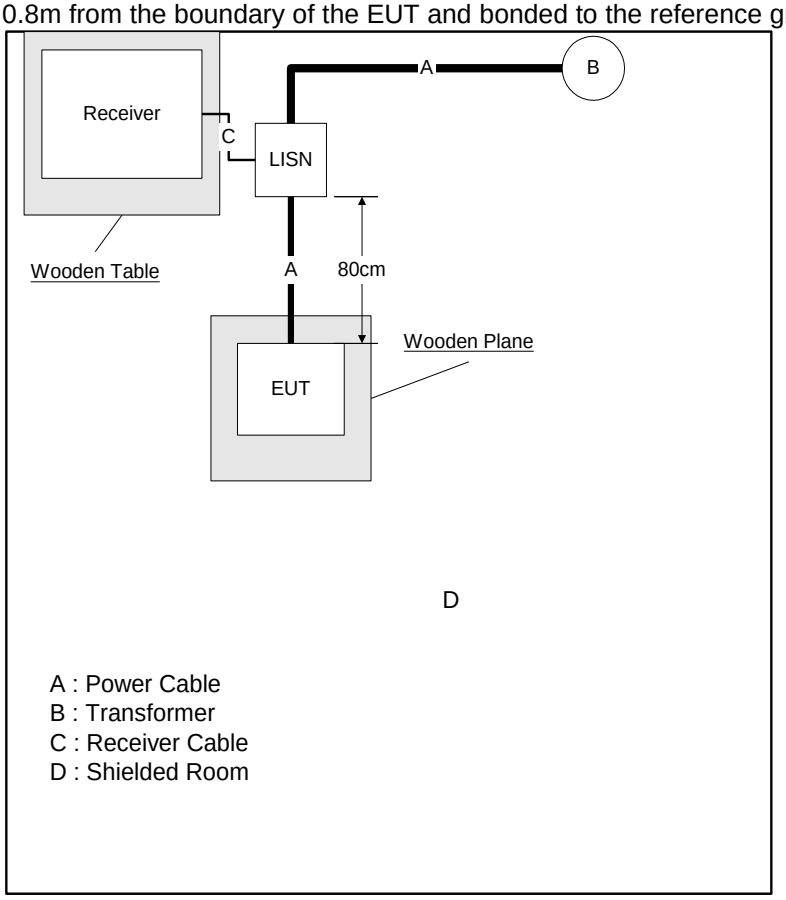
Test Site:
INVT Solar Technology (ShenZhen) Co., Ltd.
Address:
6th Floor, Block A, INVT Guangming Technology Building, Kejie Fourth Road, Shutianpu Community, Matian Guangming District, 518000 Shenzhen, PEOPLE'S REPUBLIC OF CHINA
Test Site:
EMTEK (SHENZHEN) CO., LTD.
Address:
Bldg 69, Majialong Industry Zone Nanshan DistrictShenzhen Guangdong, China

2 Test Details

2.1 Conducted Disturbance at Mains Terminals

2.1.1 Test Method

The EUT was placed on a 0.8 m non-conductive table for table-top equipment and on a 0.12 m insulated support for floor standing equipment above a ground reference plane all within a test laboratory.
All power was connected to the EUT through an Artificial Mains Network (AMN). Conducted disturbance voltage measurements on mains lines were made at the output of the AMN. The AMN was placed 0.8m from the boundary of the EUT and bonded to the reference ground plane.



2.1.2 Specification Limits

Requirement for conducted emissions		
Frequency range	AC mains port dB(μV)	
MHz	Quasi-peak	Average
0.15 to 0.5	66-56	56-46
0.5 to 5	56	46
5 to 30	60	50

Requirement for conducted emissions		
Frequency range	DC power port dB(μV)	
MHz	Quasi-peak	Average
0.15 to 0.5	79	66
0.5 to 30	73	60

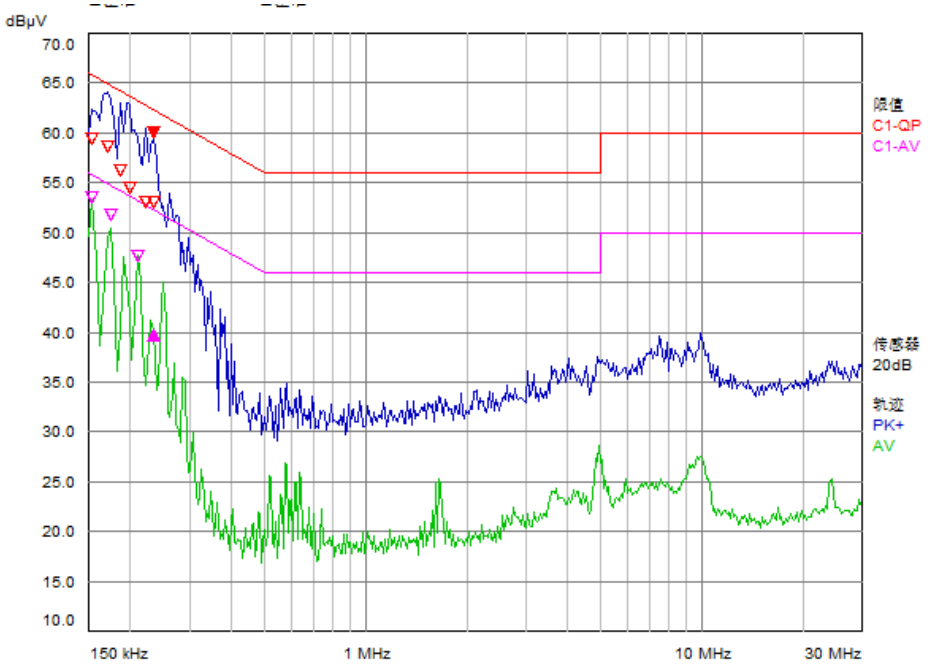
Remark for test data:
*Level=Reading Level + Correction Factor
**Correction Factor=Cable Loss + LISN Factor
(The Reading Level is recorded by software which is not shown in the sheet)

2.1.3 Test Results

Results for Configuration and Mode: TM1, TM2.

Performance assessment of the EUT made during this test: Pass.

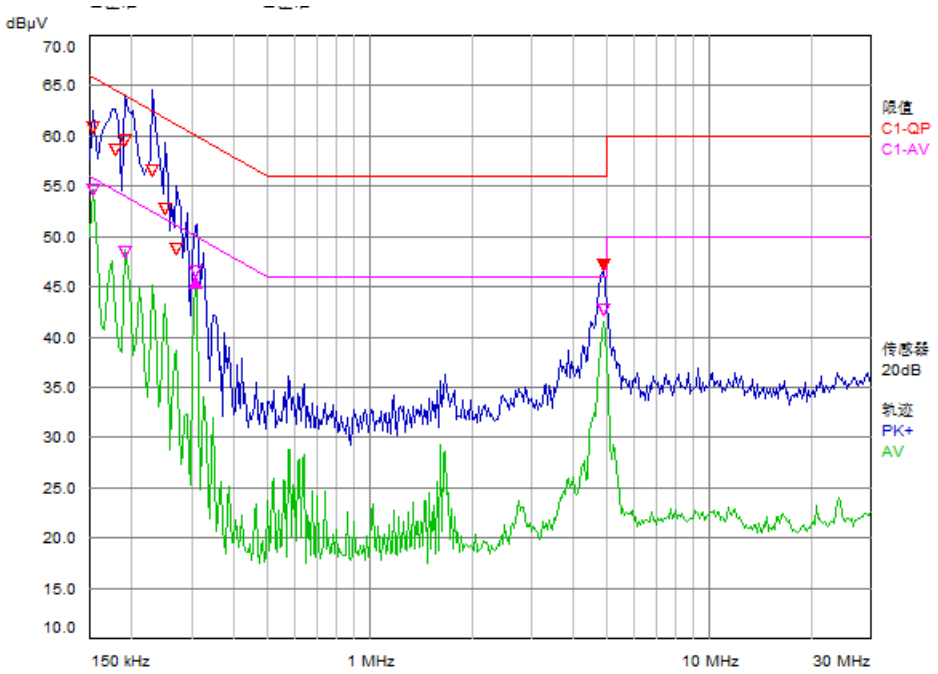
Detailed results are shown below.



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.154	58.88	---	65.78	6.90
0.154	---	52.99	55.78	2.79
0.170	58.08	---	64.96	6.88
0.174	---	51.18	54.77	3.59
0.186	55.74	---	64.21	8.47
0.198	53.91	---	63.69	9.78
0.210	---	47.15	53.21	6.06
0.222	52.57	---	62.74	10.17
0.234	52.52	---	62.31	9.79

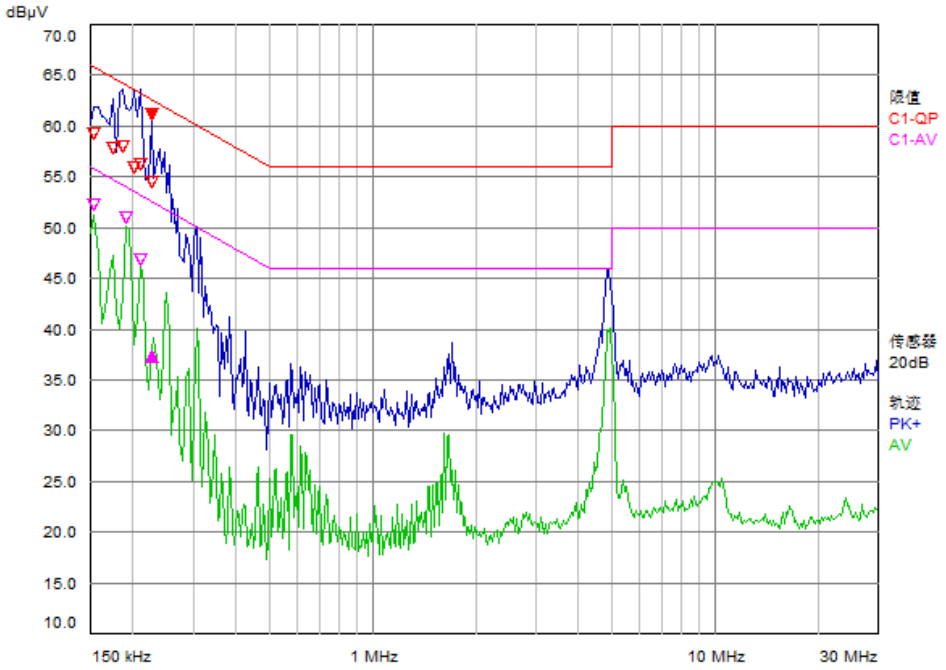
Model	:	iMars XG15KTR1-S
Test Mode	:	TM1, AC port
Test Voltage	:	400V, 50Hz
Remark	:	L1
Test Date	:	2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.154	60.25	---	65.78	5.53
0.154	---	54.03	55.78	1.75
0.178	58.03	---	64.58	6.55
0.190	58.95	---	64.04	5.09
0.190	---	47.93	54.04	6.11
0.230	0.23	---	62.45	6.44
0.250	0.25	---	61.76	9.60
0.270	0.27	---	61.12	13.00
0.306	---	45.90	50.08	4.18
4.878	---	42.13	46.00	3.87

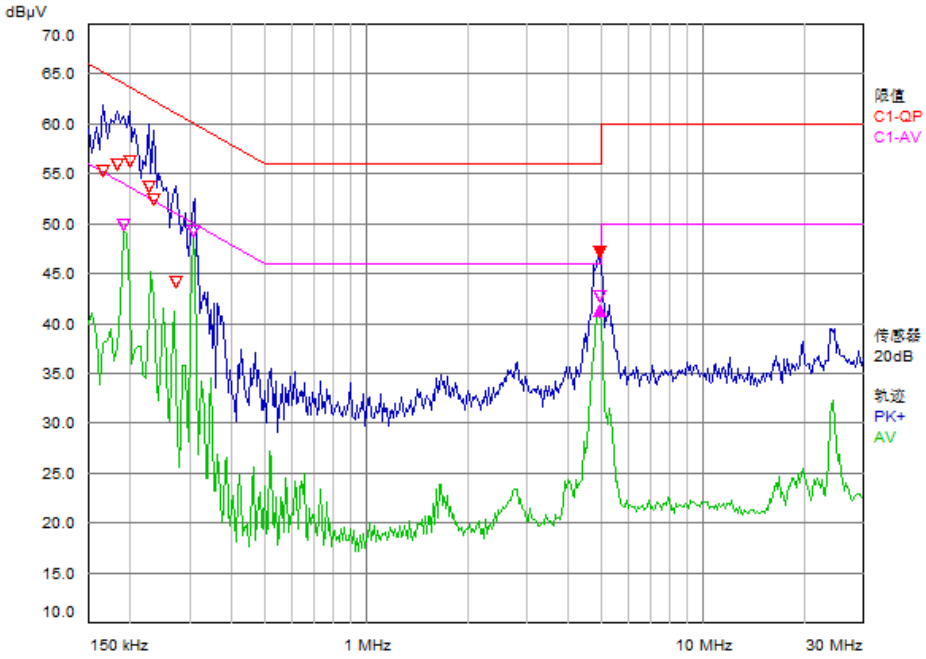
Model : iMars XG15KTR1-S
Test Mode : TM1, AC port
Test Voltage : 400V, 50Hz
Remark : L2
Test Date : 2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.154	58.74	---	65.78	7.04
0.154	---	51.70	55.78	4.08
0.174	57.30	---	64.77	7.47
0.186	57.50	---	64.21	6.71
0.190	---	50.44	54.04	3.60
0.202	55.39	---	63.53	8.14
0.210	55.70	---	63.21	7.51
0.210	---	46.23	53.21	6.98
0.226	53.86	---	62.60	8.74

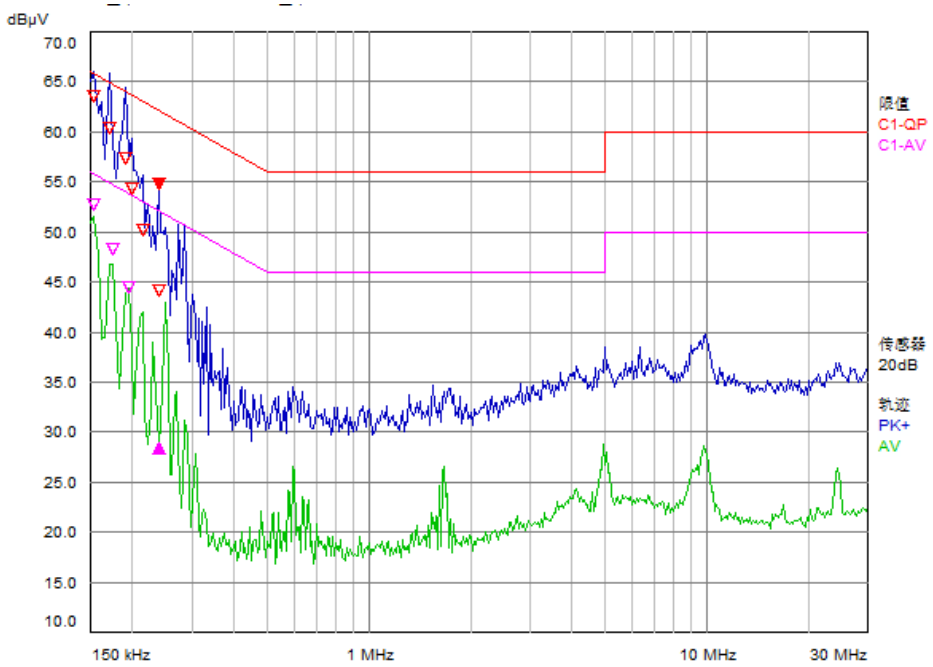
Model : iMars XG15KTR1-S
Test Mode : TM1, AC port
Test Voltage : 400V, 50Hz
Remark : L3
Test Date : 2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.166	54.72	---	65.16	10.44
0.182	55.28	---	64.39	9.11
0.190	---	49.30	54.04	4.74
0.198	55.63	---	63.69	8.06
0.226	53.20	---	62.60	9.40
0.234	51.78	---	62.31	10.53
0.274	43.59	---	61.00	17.41
0.306	---	48.74	50.08	1.34
4.954	---	42.20	46.00	3.80

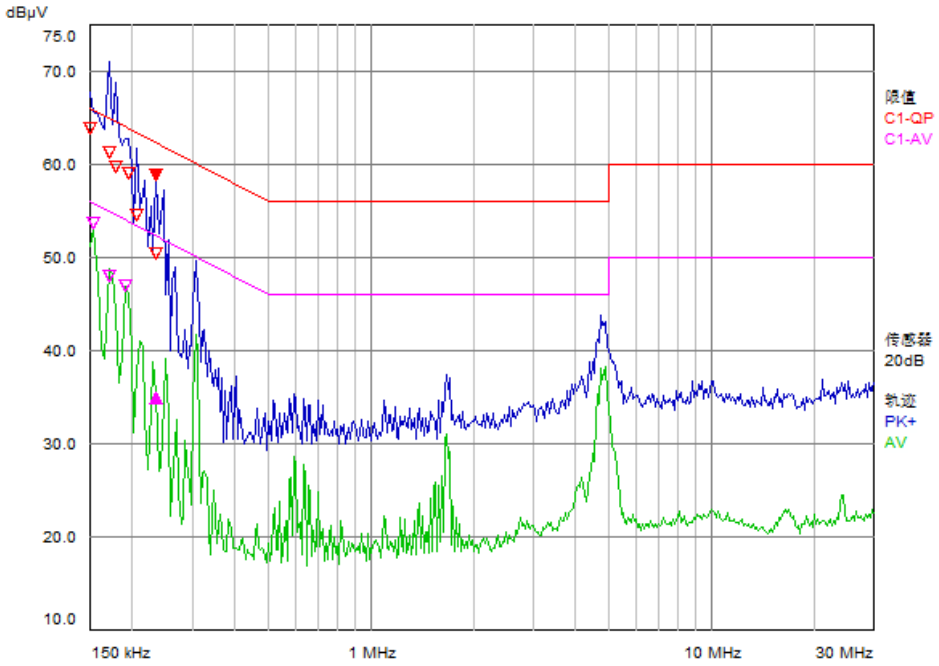
Model : iMars XG15KTR1-S
Test Mode : TM1, AC port
Test Voltage : 400V, 50Hz
Remark : N
Test Date : 2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.154	62.96	---	65.78	2.82
0.154	---	52.16	55.78	3.62
0.170	59.86	---	64.96	5.10
0.174	---	47.68	54.77	7.09
0.190	56.82	---	64.04	7.22
0.194	---	43.90	53.86	9.96
0.198	53.77	---	63.69	9.92
0.214	49.64	---	63.05	13.41
0.238	43.52	---	62.17	18.65

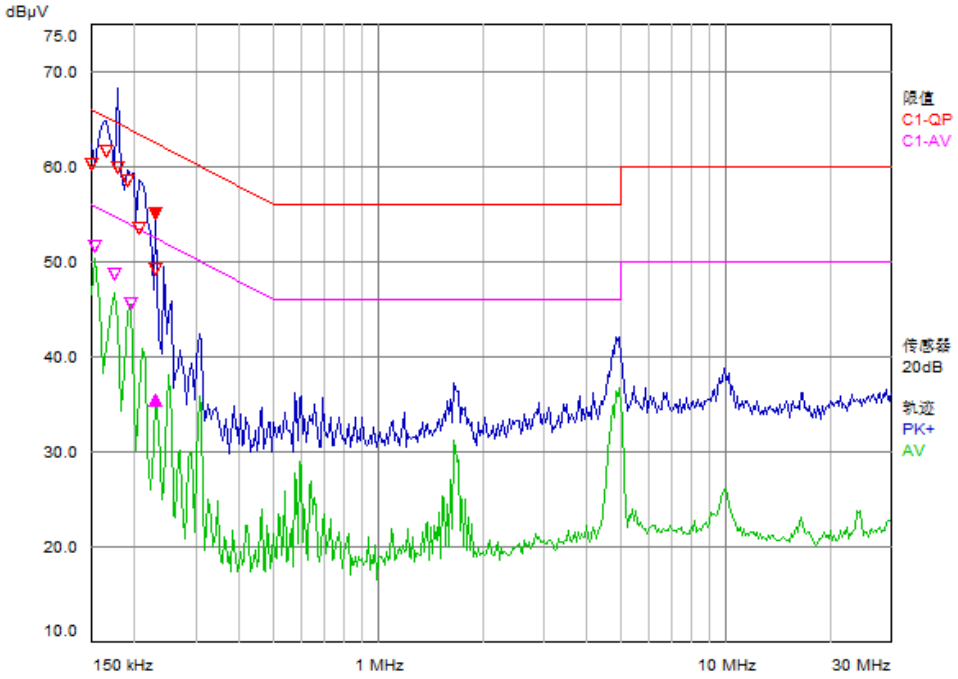
Model : iMars XG15KTR1-S
Test Mode : TM2, AC port
Test Voltage : 400V, 50Hz
Remark : L1
Test Date : 2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.150	63.31	---	66.00	2.69
0.154	---	53.19	55.78	2.59
0.170	60.74	---	64.96	4.22
0.170	---	47.41	54.96	7.55
0.178	59.15	---	64.58	5.43
0.190	---	46.38	54.04	7.66
0.194	58.44	---	63.86	5.42
0.206	53.91	---	63.37	9.46
0.234	49.87	---	62.31	12.44

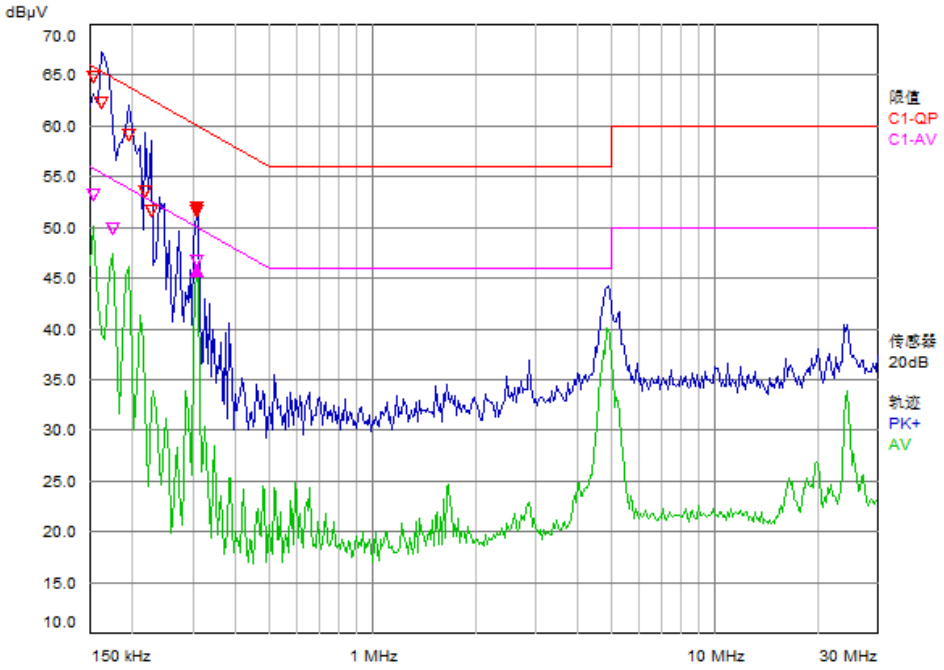
Model : iMars XG15KTR1-S
Test Mode : TM2, AC port
Test Voltage : 400V, 50Hz
Remark : L2
Test Date : 2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.150	59.65	---	66.00	6.35
0.154	---	50.96	55.78	4.82
0.166	60.96	---	65.16	4.20
0.174	---	48.08	54.77	6.69
0.178	59.35	---	64.58	5.23
0.190	57.98	---	64.04	6.06
0.194	---	45.05	53.86	8.81
0.206	52.91	---	63.37	10.46
0.230	48.55	---	62.45	13.90

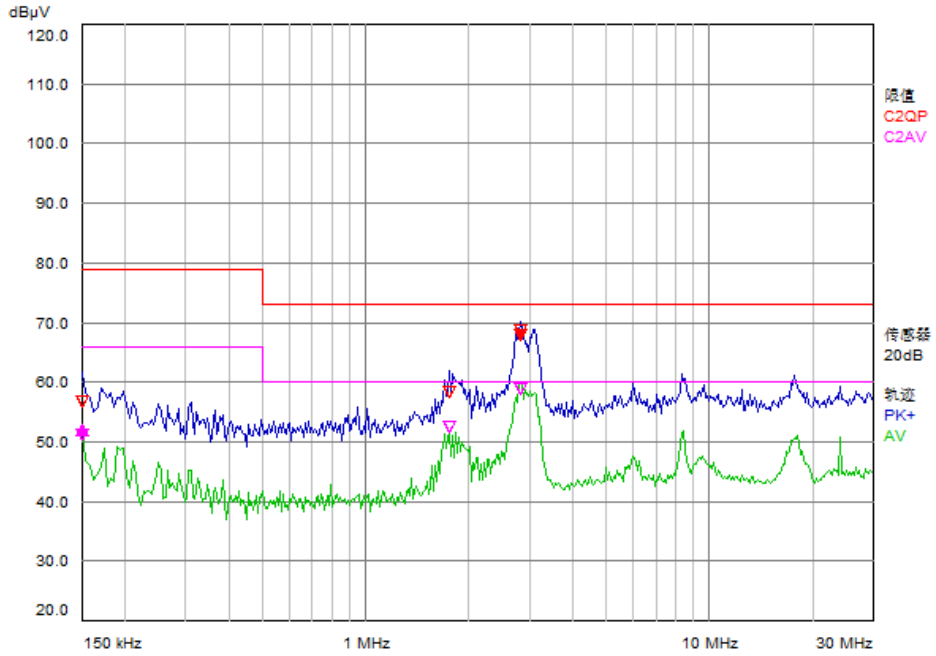
Model	:	iMars XG15KTR1-S
Test Mode	:	TM2, AC port
Test Voltage	:	400V, 50Hz
Remark	:	L3
Test Date	:	2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.154	64.25	---	65.78	1.53
0.154	---	52.66	55.78	3.12
0.162	61.70	---	65.36	3.66
0.174	---	49.28	54.77	5.49
0.194	58.49	---	63.86	5.37
0.218	52.96	---	62.89	9.93
0.226	51.11	---	62.60	11.49
0.306	51.08	---	60.08	9.00
0.306	---	46.15	50.08	3.93

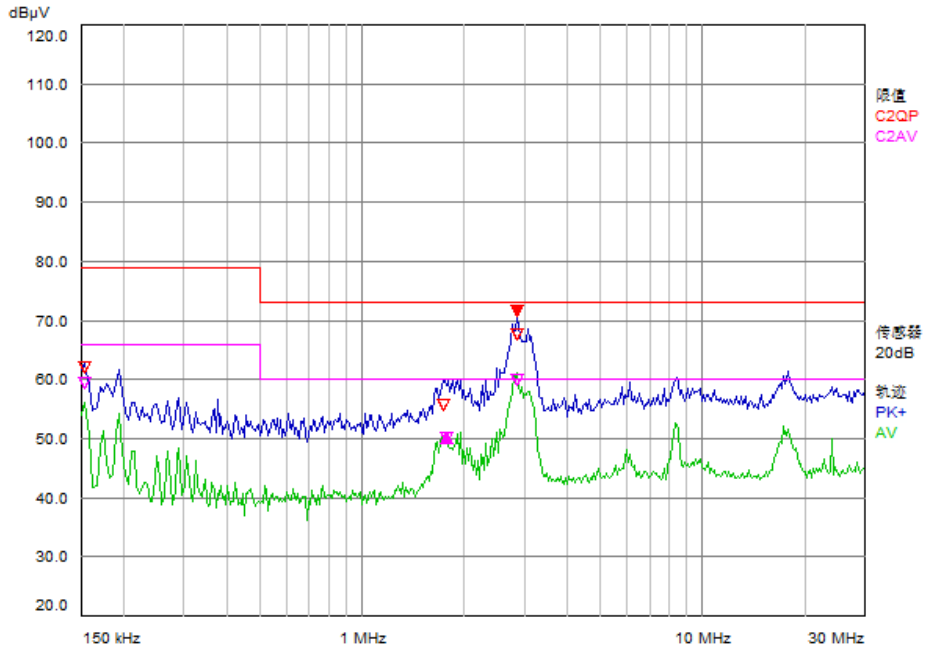
Model	:	iMars XG15KTR1-S
Test Mode	:	TM2, AC port
Test Voltage	:	400V, 50Hz
Remark	:	N
Test Date	:	2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.15	55.71	---	79.00	23.29
0.15	---	50.33	66.00	15.67
1.746	57.49	---	73.00	15.51
1.746	---	51.47	60.00	8.53
2.822	67.78	---	73.00	5.22
2.826	---	57.92	60.00	2.08

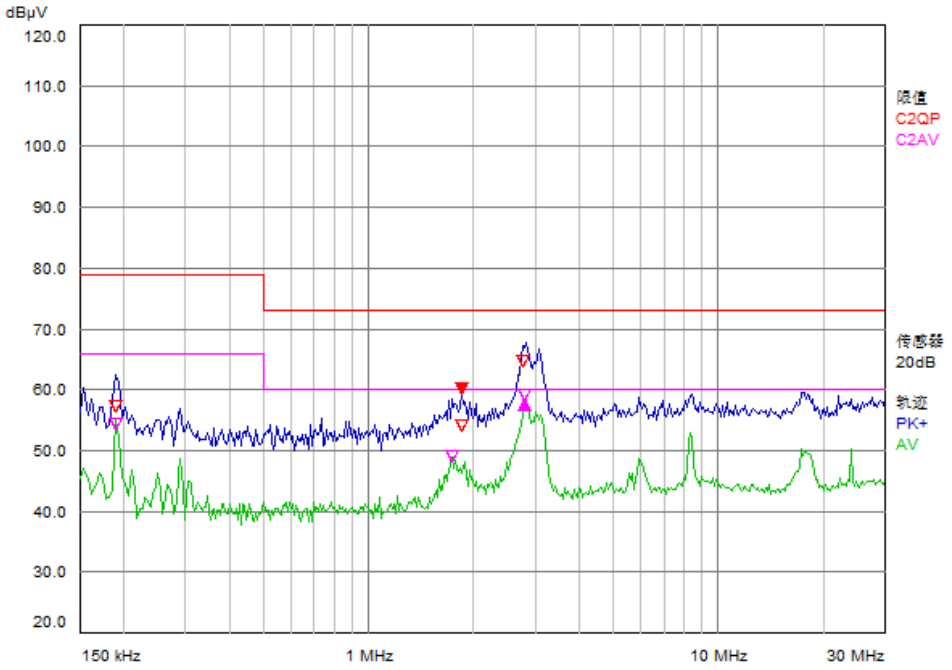
Model	:	iMars XG15KTR1-S
Test Mode	:	TM1, DC port
Test Voltage	:	850V
Remark	:	D+
Test Date	:	2022-08-02



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
0.154	61.22	---	79.00	17.78
0.154	---	58.44	66.00	7.56
1.730	54.86	---	73.00	18.14
1.770	---	49.18	60.00	10.82
2.842	66.69	---	73.00	6.31
2.842	---	58.91	60.00	1.09

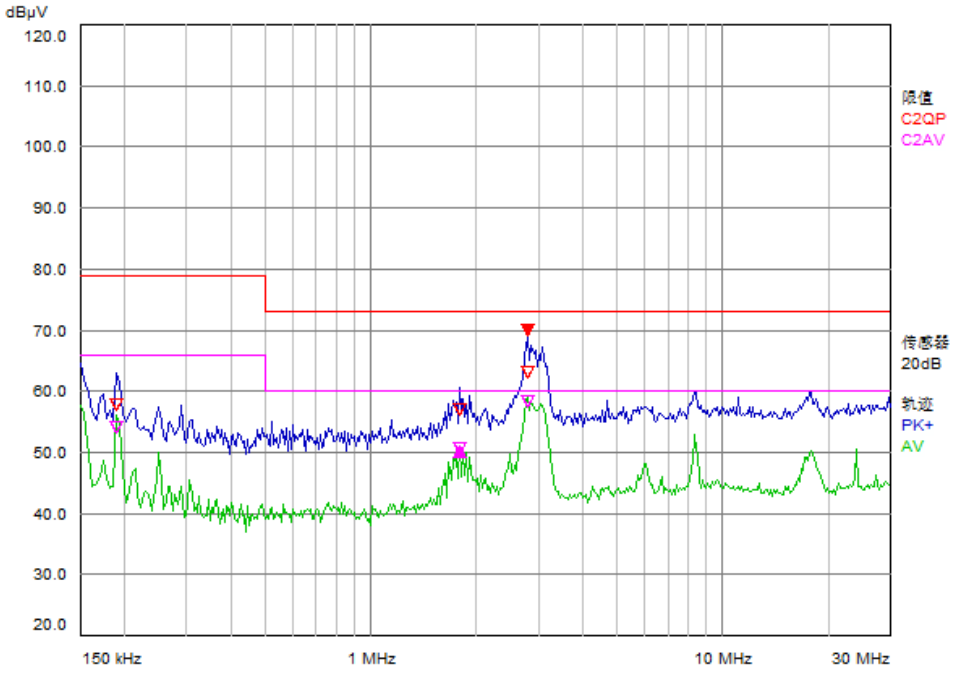
Model	:	iMars XG15KTR1-S
Test Mode	:	TM1, DC port
Test Voltage	:	850V
Remark	:	D-
Test Date	:	2022-08-02



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
2.766	63.67	---	73.00	9.33
2.806	---	58.16	60.00	1.84

Model	:	iMars XG15KTR1-S
Test Mode	:	TM2, DC port
Test Voltage	:	850V
Remark	:	D+
Test Date	:	2022-08-02



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)
2.802	62.28	---	73.00	10.72
2.802	---	57.52	60.00	2.48

Model	:	iMars XG15KTR1-S
Test Mode	:	TM2, DC port
Test Voltage	:	850V
Remark	:	D-
Test Date	:	2022-08-02

2.1.4 Test Setup



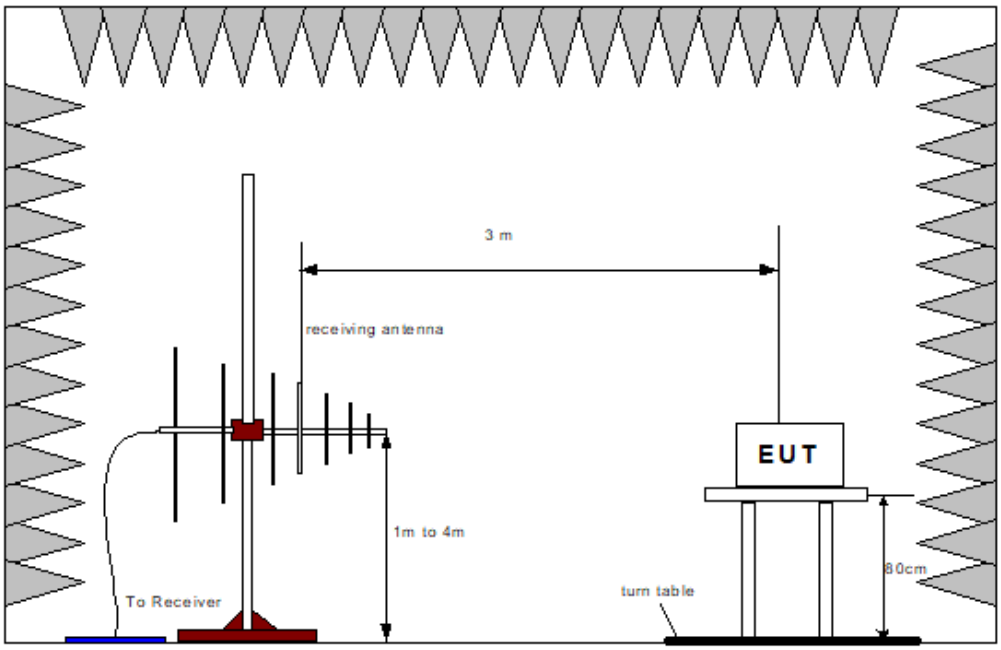
2.1.5 Test Location

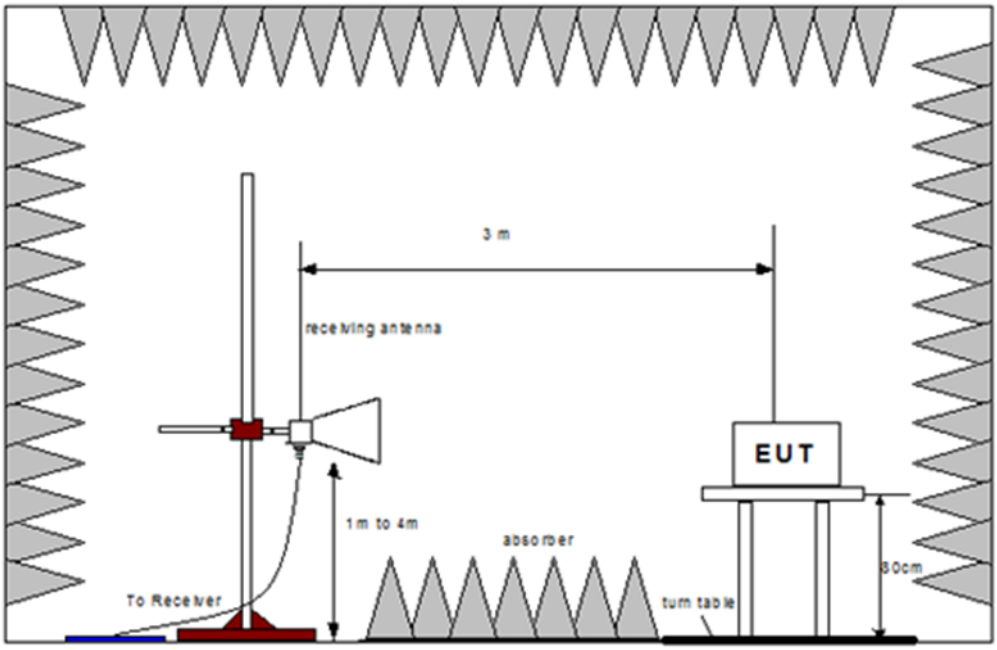
This test was carried out in shielded room.

2.2 Radiated Disturbance (30MHz to 6000MHz)

2.2.1 Test Method

The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive
< floor 0.1 m above a reference ground plane>
< support 0.1 m above a reference ground plane>
A prescan of the EUT emissions profile was made while varying the antennae-to-EUT azimuth and antenna-to-EUT polarization using a peak detector; measurements were taken at a 3m distance. Using the prescan list of the highest emissions detected, their bearing and associated antenna polarization, the EUT was then formally measured using Quasi-Peak and Average detectors, as appropriate. The readings were maximized by adjusting the antenna height, polarization and turntable azimuth, in accordance with the specification.





2.2.2 Specification Limits

Below 1 GHz

Required Specification Limits (Class A @ 3m)	
Frequency Range (MHz)	Quasi-peak (dBµV/m)
30 to 230	40
230 to 1000	47

Above 1 GHz

Required Specification Limits (Class A @ 3m)		
Frequency Range (MHz)	Average (dBµV/m)	Peak (dBµV/m)
1000 to 3000	50	70
3000 to 6000	54	74

Below 1 GHz

Required Specification Limits (Class A @ 10m)	
Frequency Range (MHz)	Quasi-peak (dBµV/m)
30 to 230	30
230 to 1000	37

Above 1 GHz

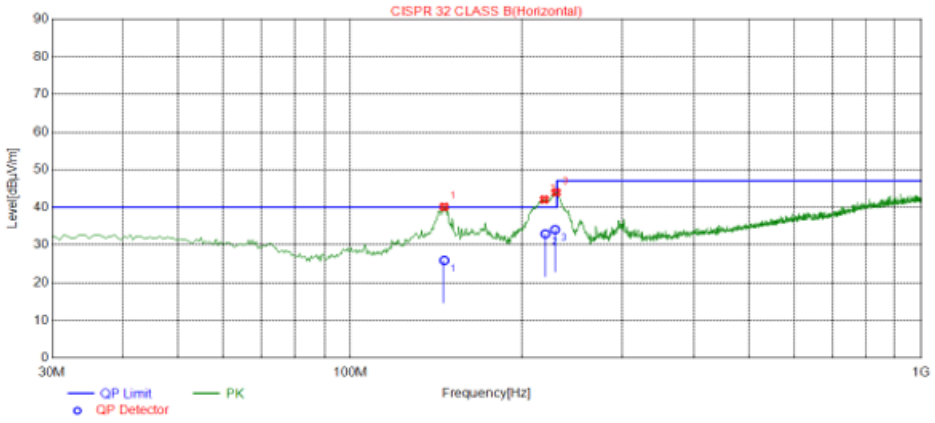
Required Specification Limits (Class A @ 10m)		
Frequency Range (MHz)	Average (dBµV/m)	Peak (dBµV/m)
1000 to 3000	40	60
3000 to 6000	44	64

2.2.3 Test Results

Results for Configuration and Mode: TM1, TM2

Performance assessment of the EUT made during this test: Pass.

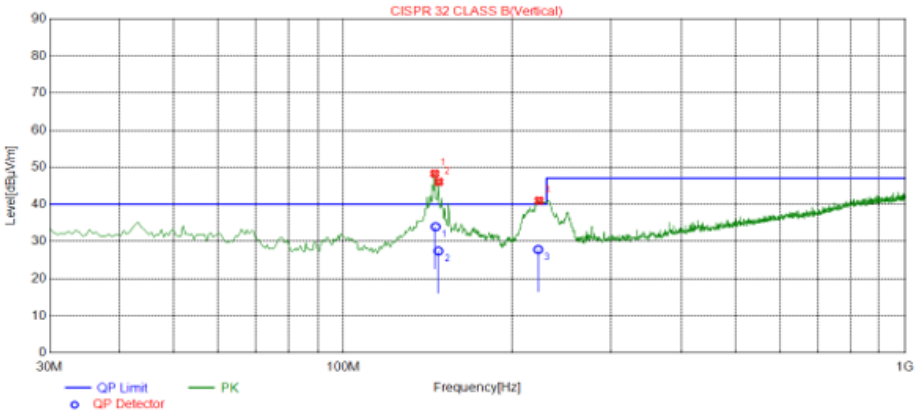
Detailed results are shown below.



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
146.0406	25.89	40.00	14.11
219.6490	32.96	40.00	7.04
228.2925	34.09	40.00	5.91

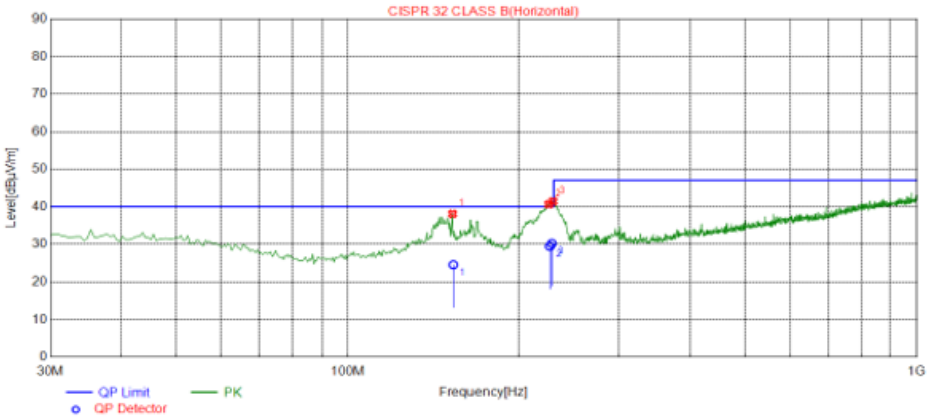
Model	:	iMars XG15KTR1-S
Operating Mode	:	TM1
Antenna polarization	:	Horizontal ☒ Vertical☐
Test Date	:	2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
145.9552	33.98	40.00	6.02
147.6443	27.42	40.00	12.58
222.2806	27.81	40.00	12.19

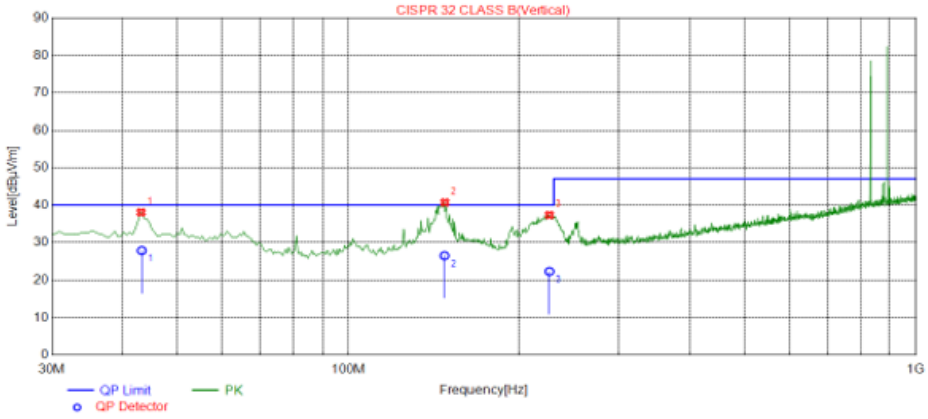
Model	:	iMars XG15KTR1-S
Operating Mode	:	TM1
Antenna polarization	:	Horizontal ☐ Vertical☒
Test Date	:	2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
153.2528	24.56	40.00	15.44
226.4733	29.46	40.00	10.54
228.3058	30.22	40.00	9.78

Model	:	iMars XG15KTR1-S
Operating Mode	:	TM2
Antenna polarization	:	Horizontal ☒ Vertical☐
Test Date	:	2022-07-15



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
43.2226	27.86	40.00	12.14
147.6485	26.50	40.00	13.50
226.0053	22.30	40.00	17.70

Model	:	iMars XG15KTR1-S
Operating Mode	:	TM2
Antenna polarization	:	Horizontal ☐ Vertical☒
Test Date	:	2022-07-15

2.2.4 Test Setup



Test Setup (30MHz-1GHz)

2.2.5 Test Location

This test was carried out in 3m anechoic chamber.

2.3 Electrostatic discharge immunity test

2.3.1 Test Method

The equipment under test including associated cabling was configured on but insulted from, using a 0.5mm isolator, a horizontal coupling plane fitted to the top of a 0.8 m non-conductive floor for Floor-Stand equipment; and on a 0.1 m insulated support for floor standing equipment; above a ground reference plane all within a test laboratory.

Using the air discharge method for non-metallic parts, contact discharge method for metallic parts with both vertical and horizontal couple plane discharge methods for the sides of the equipment under test, the required electrostatic discharge voltage levels in both voltage polarities were applied at the detailed pulse repartition rate.

During this testing any anomalies in the equipment under tests performance was recorded.

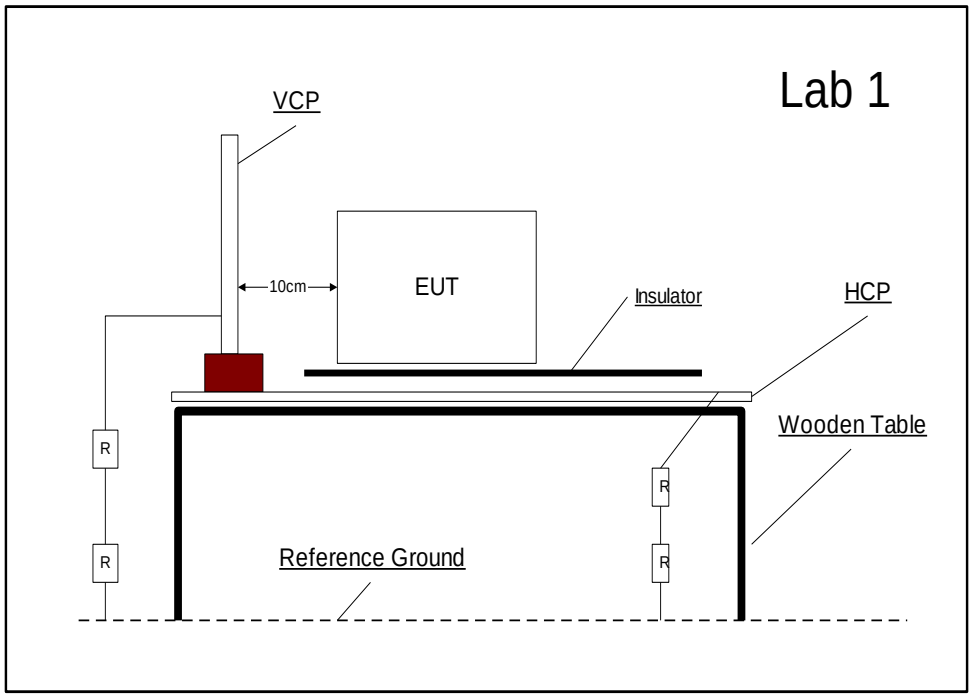


Table-Stand equipment

VCP: Vertical Coupling Plane 0.5 x 0.5 m HCP: Horizontal Coupling Plane 0.95 x 1.6 m

R. Ground: 2 x 2 m R: 470 KΩ

2.3.2 Specification Limits

Required Test Levels				Performance Criteria
Discharge type	Discharge Level (kV)		Number of discharges per location (each polarity)	
	Positive	Negative		
Air – Direct	8	8	see note 1	B
Contact – Direct	4	4	see note 1	B
Contact – Indirect	4	4	see note 1	B
Supplementary information: Note 1. The EUT shall be exposed to at least 200 discharges, 100 each at negative and positive polarity, at a minimum of four test points. For Floor-Stand equipment one of the test points shall be the centre front edge of the horizontal coupling plane, which shall be subjected to at least 50 indirect discharges (25 of each polarity).				

2.3.3 Test Results

Results for Configuration and Mode: TM1, TM2

Performance assessment of the EUT made during this test: Pass

Detailed results are shown below.

Test date: 2022-07-15

ID	Test Point	Discharge	Results									
			2kV		4kV		6kV		8kV		15kV	
			+	-	+	-	+	-	+	-	+	-
	HCP	Contact	N/A	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A
	VCP	Contact	N/A	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A
	All plastic seams	Air	N/A	N/A	N/A	N/A	N/A	N/A	A	A	N/A	N/A
	All metal seams	Contact	N/A	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A
	LAN port	Contact	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A: Not applicable												

2.3.4 Test Setup



2.3.5 Test Location

This test was carried out in EMS Test Location.

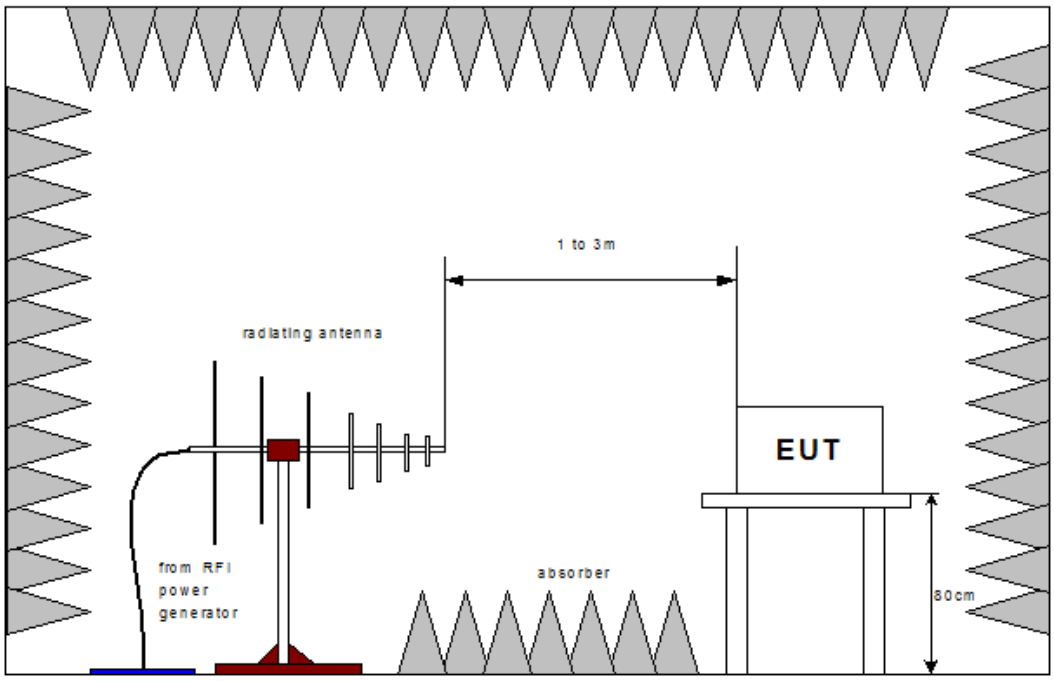
2.4 Enclosure Port - Radio-frequency electromagnetic field Amplitude modulated

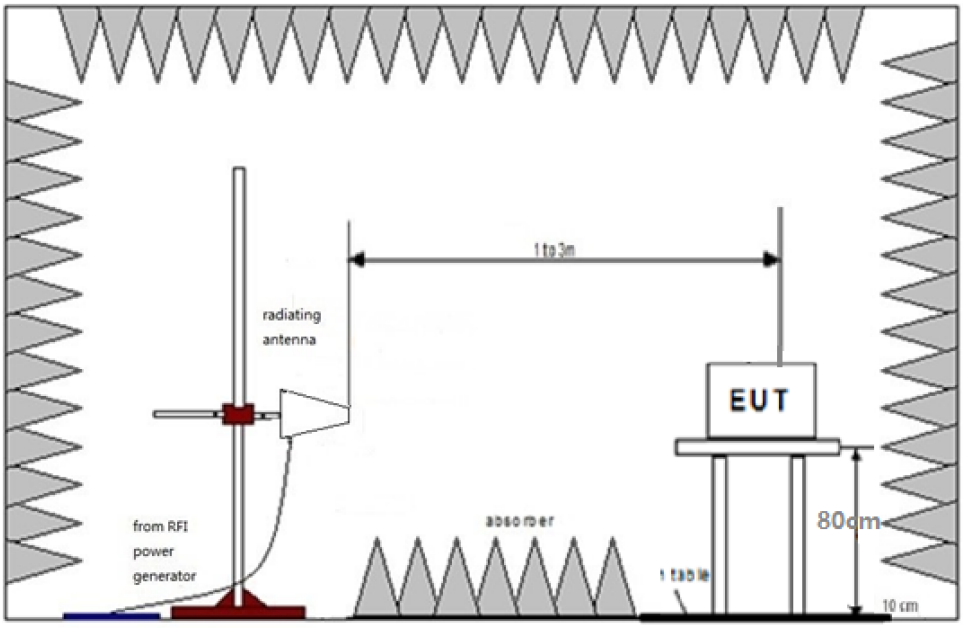
2.4.1 Test Method

The equipment under test including associated cabling was configured, on a 0.1 m non-conductive floor for Floor-Stand equipment and on a 0.1 m insulated support for floor standing equipment; with a pre-calibrated semi anechoic chamber.

All four sides of the equipment under test were subjected to the required RF field strength, modulated as described, swept over the frequency range of test with the antenna positioned in both horizontal and vertical polarizations.

During this testing any anomalies in the equipment under tests performance was recorded.





2.4.2 Specification Limits

Required Test Levels					Performance Criteria
Frequency Range (MHz)	Level (V/m)	Modulation	Step Size (%)	Dwell (s)	
80 to 1000	10	AM (80 %,1 kHz, sine wave)	1	>=1	A
1400 to 6000	3	AM (80 %,1 kHz, sine wave)	1	>=1	A
Supplementary information: Note 1. EUT powered at one of the Nominal input voltages and frequencies					

2.4.3 Test Results

Results for Configuration and Mode: TM1, TM2.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

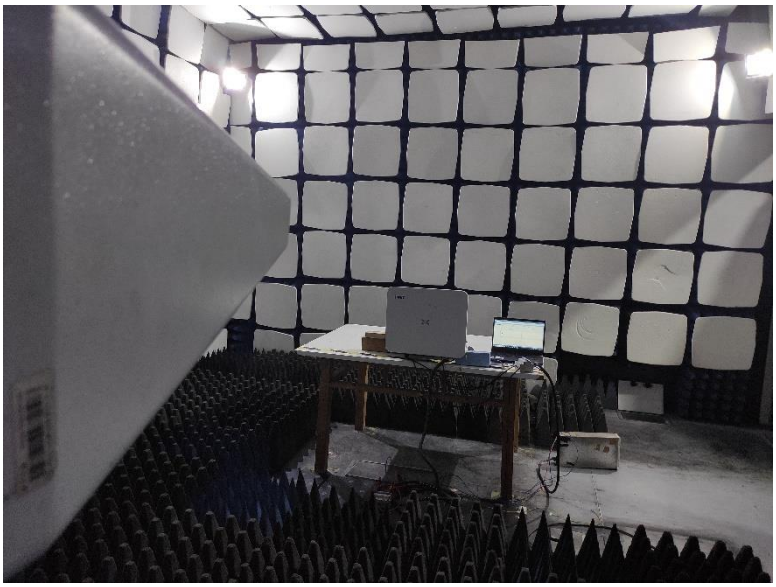
Test date: 2022-07-15

Tabulated Results for RF Electromagnetic Field 80 - 1000 MHz					
Side of the equipment under test	Antenna polarization	Test Level	Dwell Time	Measuring distance	Results
All sides	Horizontal	10 V/m	1 s	3 m	A
All sides	Vertical	10 V/m	1 s	3 m	A

Tabulated Results for RF Electromagnetic Field 1400 - 6000 MHz					
Side of the equipment under test	Antenna polarization	Test Level	Dwell Time	Measuring distance	Results
All sides	Horizontal	3 V/m	1 s	3 m	A
All sides	Vertical	3 V/m	1 s	3 m	A

2.4.4 Test Setup





2.4.5 Test Location

This test was carried out in EMS Test Location.

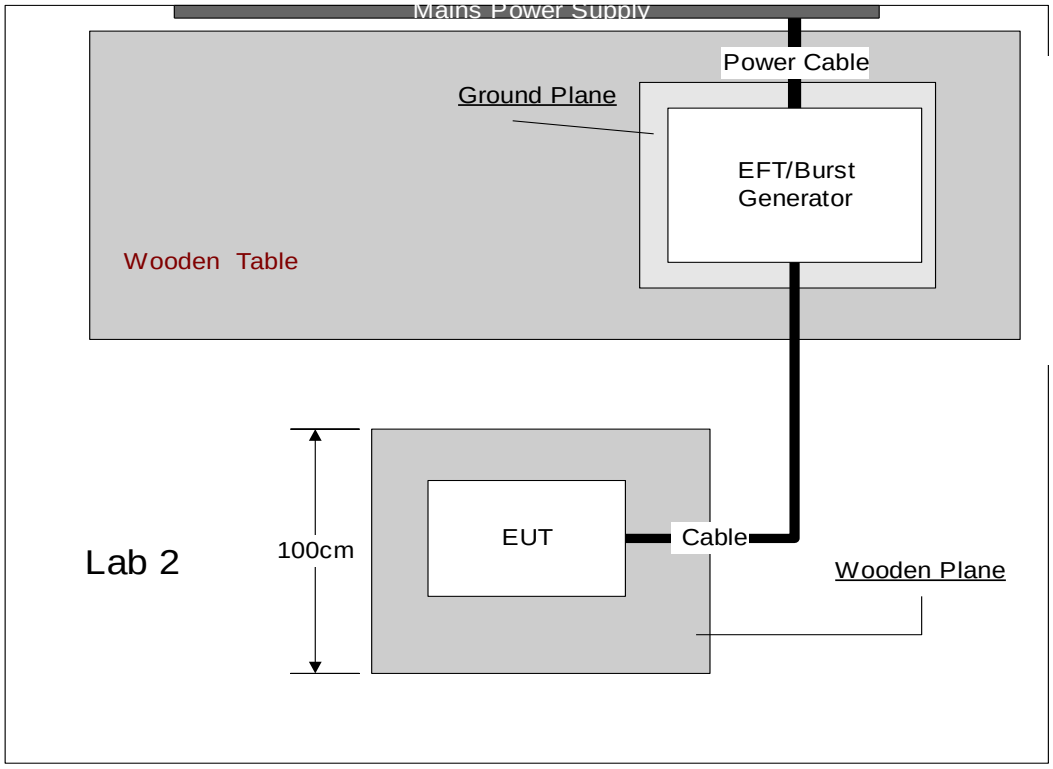
2.5 Electrical fast transient /burst immunity test

2.5.1 Test Method

The equipment under test including associated cabling was configured on but insulated from, using a 0.1 m isolator, a horizontal coupling plane fitted to the top of a 0.8 m non-conductive table for table-top equipment; and on a 0.1 m insulated support for floor standing equipment; above a ground reference plane all within a test laboratory.

Using a CDN for power ports, capacitive coupling clamp for signal and control ports and a 33nF coupling capacitor for earth ports, the required fast transient burst voltage levels in both voltage polarities were applied at the detailed pulse repartition rate and duration of test.

During this testing any anomalies in the equipment under tests performance was recorded.



2.5.2 Specification Limits

Required Test Levels Input and output a.c. power ports					
Line Under Test	Level (kV)	Repetition Rate (kHz)	Test Duration	Coupling Method	Performance Criteria
Input and output a.c. power ports	± 2.0	5 kHz/ 100kHz	2 min per polarity	Direct	B
For extra low voltage a.c. ports and output a.c. ports, this testing is only applicable to ports interfacing with cables whose total length may exceed 3 m according to the manufacturer's functional specification.					

Required Test Levels ports for DC Power Port					
Line Under Test	Level (kV)	Repetition Rate (kHz)	Test Duration	Coupling Method	Performance Criteria
DC Power port	± 1.0	5 kHz/ 100kHz	2 min per polarity	Direct	B
Not applicable to input ports intended for connection to a battery or a rechargeable battery which shall be removed or disconnected from the equipment for recharging. Equipment with a DC power input port intended for use with a dedicated AC–DC power adaptor shall be tested on the AC power input of the AC–DC power adaptor specified by the manufacturer (see the test level of Table 4). Where no adaptor is specified, the test shall be done on the DC power port using the test level of Table 4. Where an adaptor is specified, the test is applicable to DC power input ports only when intended to be connected permanently to cables longer than 3 m. The test may be performed at one or at both repetition frequencies. The use of 5 kHz repetition frequency is traditional; however, 100 kHz is closer to reality.					

Required Test Levels ports for signal and control lines					
Line Under Test	Level (kV)	Repetition Rate (kHz)	Test Duration	Coupling Method	Performance Criteria
Signal and control lines	± 1.0	5 kHz/ 100kHz	2 min per polarity	Direct	B
Applicable only to ports interfacing with cables whose total length can exceed 3m according to the manufacturer’s function specification.					

2.5.3 Test Results

Results for Configuration and Mode: TM1, TM2.

Performance assessment of the EUT made during this test: Pass.

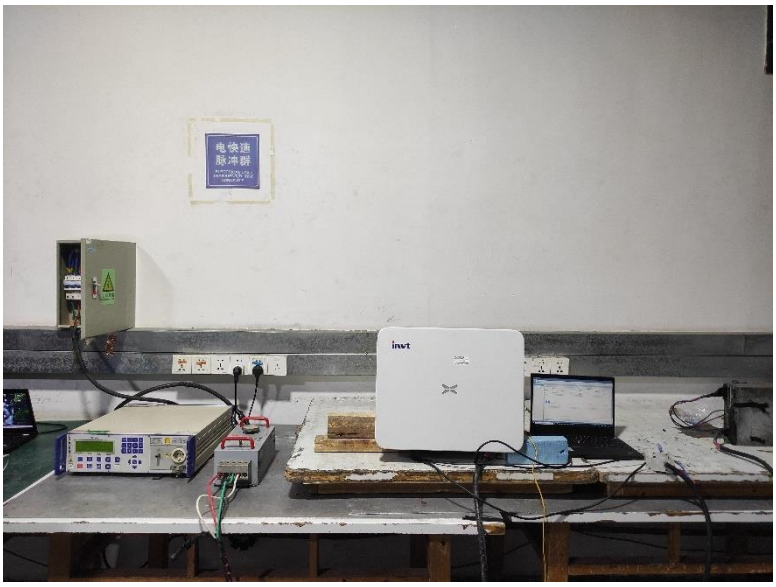
Detailed results are shown below.

Test date: 2022-07-20

Tabulated Results for Fast Transient Burst Immunity					
Line under test	Test Level (V/m)	Repetition Rate	Test Duration	Coupling Method	Result
AC power ports	± 2 kV	5 kHz/ 100kHz	2 min	CDN	A
DC Power port	± 1 kV	5 kHz/ 100kHz	2 min	CLAMP	A

Remark: No observable change.

2.5.4 Test Setup



2.5.5 Test Location

This test was carried out in EMS Test Location.

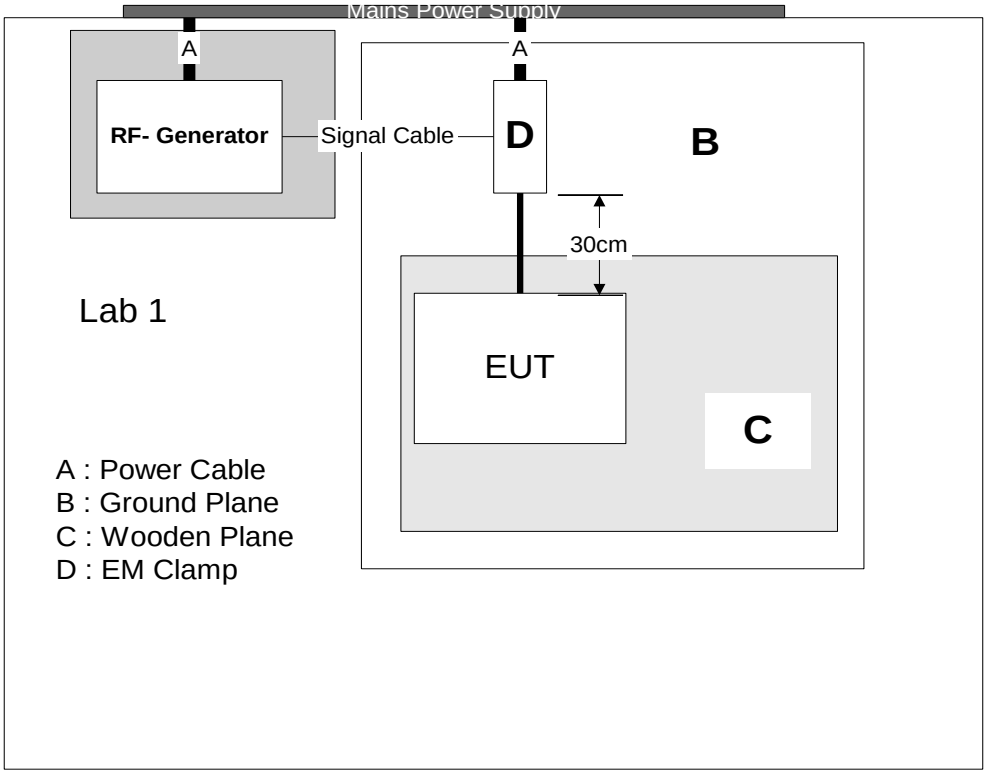
2.6 Immunity to conducted disturbances, induced by radio-frequency fields

2.6.1 Test Method

The equipment under test was configured, on but insulated from, using a 0.1 m isolator, a horizontal coupling plane fitted to the top of a 0.1 m non-conductive table for table-top equipment, above a ground reference plane all within a test laboratory.

All associated cabling was configured, on but insulated from, using a 50 mm isolator, the same horizontal coupling plane as the equipment under test.

Using CDNs, EM Clamps or current clamps as appropriate, the power ports and applicable signal and control ports were subjected to the required, pre calibrated RF injected signal strength, modulated as described, swept over the frequency range of test.
During this testing any anomalies in the equipment under tests performance was recorded.



2.6.2 Specification Limits

Required Test Levels Input and output a.c. power ports						
Line Under Test	Frequency Range (MHz)	Level (V/m)	Modulation	Step Size (%)	Dwell (s)	Performance Criteria
Input and output a.c. power ports	0.15 to 80	10	AM (80 %,1 kHz, sine wave)	1	3	A
For extra low voltage a.c ports and output a.c. ports, this testing is only applicable to ports interfacing with cables whose total length may exceed 3 m according to the manufacturer's functional specification.						

Required Test Levels Input and output D.C. power ports						
Line Under Test	Frequency Range (MHz)	Level (V/m)	Modulation	Step Size (%)	Dwell (s)	Performance Criteria
Input and output d.c. power ports	0.15 to 80	10	AM (80 %,1 kHz, sine wave)	1	3	A
For extra low voltage a.c ports and output a.c. ports, this testing is only applicable to ports interfacing with cables whose total length may exceed 3 m according to the manufacturer's functional specification.						

Required Test Levels Ports for signal lines and control lines						
Line Under Test	Frequency Range (MHz)	Level (V/m)	Modulation	Step Size (%)	Dwell (s)	Performance Criteria
Signal and control port	0.15 to 80	10	AM (80 %,1 kHz, sine wave)	1	3	A
Applicable only to ports interfacing with cables whose total length may exceed 3m according to the manufacturer’s function specification.						

2.6.3 Test Results

Results for Configuration and Mode: TM1, TM2.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Test date: 2022-07-16

Tabulated Results for Injected current						
Line and sensitive frequency under test	Test Level	Step	Dwell Time	Coupling Method	Modulation	Result
AC. power ports	10V	1%	3s	CDN	1kHz, 80%	A
DC. power ports	10V	1%	3s	CLAMP	1kHz, 80%	A

Remark: No observable change.

2.6.4 Test Setup



2.6.5 Test Location

This test was carried out in EMS Test Location.

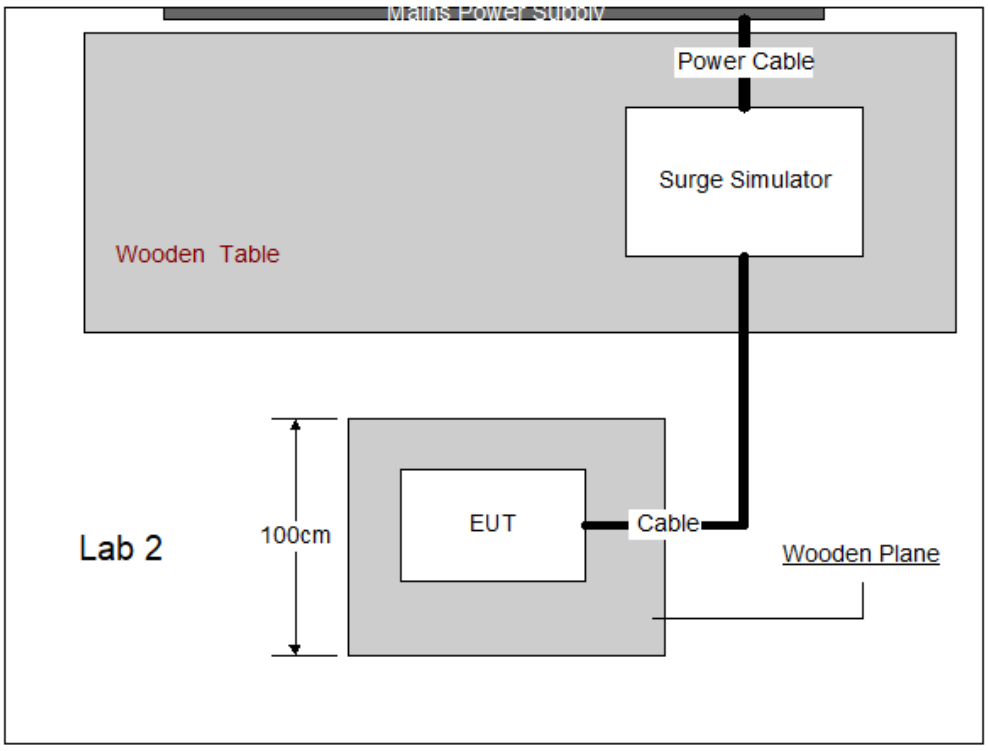
2.7 Surge immunity test

2.7.1 Test Method

The equipment under test including associated cabling was configured, on a 0.8 m non-conductive table for table-top equipment and on a 0.1 m insulated support for floor standing equipment above a ground reference plane all within a test laboratory.

Using CDNs for power ports and appropriate coupling methods for applicable signal and control ports, the required number of surges was applied for each surge voltage level using both positive and negative surge voltage polarities. Surges were applied at the power line frequency phase angles and repartition rates detailed.

During this testing any anomalies in the equipment under tests performance was recorded.



2.7.2 Specification Limits

Required Test Levels Input and output a.c. power ports		
Characteristics	Test Levels	Performance Criteria
Wave-shape data Test levels line to line with 2Ω impedance line to earth with 12Ω impedance	1.2/50 µs ± 1.0 kV ±2.0 kV	B
Note in addition to the specified test level, all lower levels as detailed in IEC 61000-4-5 should also be satisfied**.**		

Required Test Levels Input and output d.c. power ports		
Characteristics	Test Levels	Performance Criteria
Wave-shape data Test levels line to line with 2Ω impedance line to earth with 12Ω impedance	1.2/50 µs ± 0.5 kV ±1.0 kV	B
Note in addition to the specified test level, all lower levels as detailed in IEC 61000-4-5 should also be satisfied**.**		

Required Test Levels Signal ports		
Characteristics	Test Levels	Performance Criteria
Wave-shape data Test levels line to earth with 12Ω impedance	1.2/50 µs ± 1.0 kV	B
Note in addition to the specified test level, all lower levels as detailed in IEC 61000-4-5 should also be satisfied**.**		

2.7.3 Test Results

Results for Configuration and Mode: TM1, TM2.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Test date: 2022-07-20

Tabulated Results for Surge Immunity (Power Ports)							
Line Name	Coupling	Level	Polarity	Phase Angle	No of Pulses	Repetition Rate	Result
AC Power Cord	Line to Line	-1.0kV	NEGATIVE	0,90,180 ,270 deg	5	60 sec	A
AC Power Cord	Line to Line	+1.0kV	POSITIVE	90 deg	5	60 sec	A
AC Power Cord	Line to Neutral	-2.0kV	NEGATIVE	0,90,180 ,270 deg	5	60 sec	A
AC Power Cord	Line to Neutral	+2.0kV	POSITIVE	90 deg	5	60 sec	A
AC Power Cord	Line to Earth	-2.0kV	Negative	0,90,180 ,270 deg	5	60 sec	A
AC Power Cord	Line to Earth	+2.0kV	Positive	90 deg	5	60 sec	A
AC Power Cord	Neutral to Earth	-2.0kV	Negative	0,90,180 ,270 deg	5	60 sec	A
AC Power Cord	Neutral to Earth	+2.0kV	Positive	90 deg	5	60 sec	A
DC Power Cord	DC+	-0.5kV	Negative	0,90,180 ,270 deg	5	60 sec	A
DC Power Cord	DC-	-0.5kV	Positive	90 deg	5	60 sec	A

Remark: No observable change.

2.7.4 Test Setup



2.7.5 Test Location

This test was carried out in EMS Test Location.

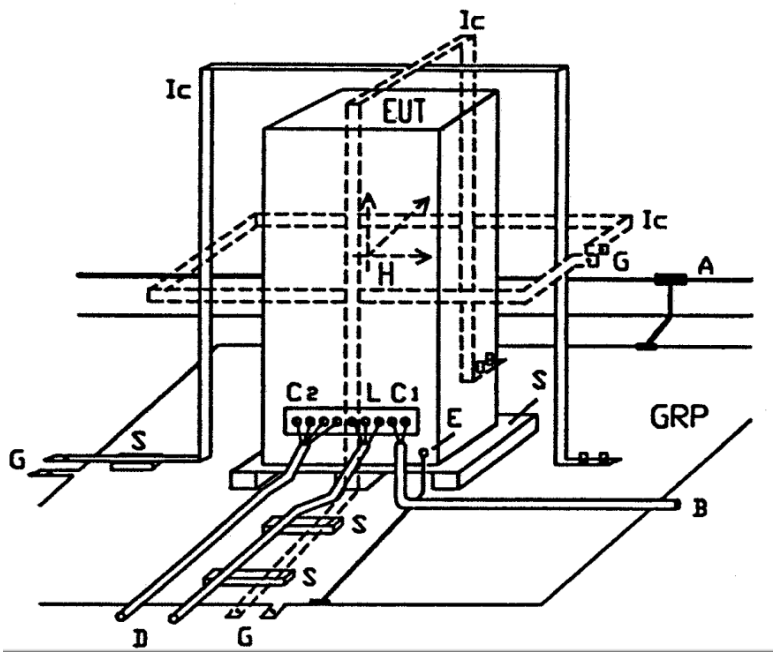
2.7.6 Enclosure Port - Power-frequency magnetic field

2.7.7 Test Method

The equipment under test including associated cabling was configured on a non-conductive support at the volumetric center of the immunity coils. A pre calibrated input level was then applied to magnetic immunity coils at the detailed frequency and level for the required test period.

The EUT was retested with the magnetic field applied in all 3 orthogonal planes of the EUT.

During this testing any anomalies in the equipment under tests performance was recorded.



2.7.8 Specification Limits

Required Test Levels			Performance Criteria
Application	Level (A/m)	Duration	
Continuous Field	30	dependent on EUT operating cycle	A
Supplementary information: Note 1. EUT powered at one of the Nominal input voltages and frequencies			

2.7.9 Test Results

Results for Configuration and Mode: TM1, TM2.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Test date: 2022-07-20

Tabulated Results for Power Frequency Magnetic Immunity					
Orientation	Operating Frequency	Test Frequency	Test Level	Duration	Result
X axis	50 Hz	50 Hz	30 A/m	1 min	A
Y axis	50 Hz	50 Hz	30 A/m	1 min	A
Z axis	50 Hz	50 Hz	30 A/m	1 min	A

Tabulated Results for Power Frequency Magnetic Immunity					
Orientation	Operating Frequency	Test Frequency	Test Level	Duration	Result
X axis	60 Hz	60 Hz	30 A/m	1 min	A
Y axis	60 Hz	60 Hz	30 A/m	1 min	A
Z axis	60 Hz	60 Hz	30 A/m	1 min	A

2.7.10 Test Setup



2.7.11 Test Location

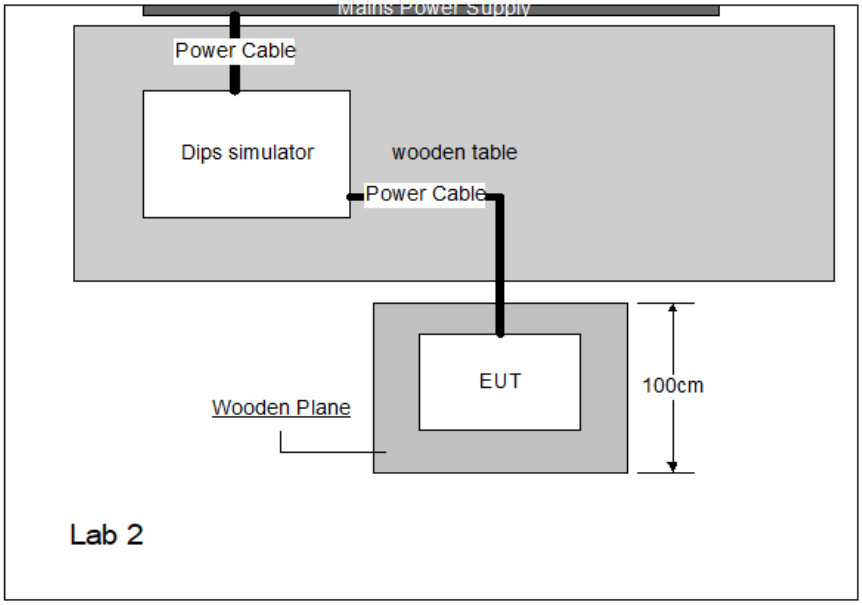
This test was carried out in EMS Test Location.

2.8 Voltage dips, short interruptions and voltage variations immunity tests

2.8.1 Test Method

The equipment under test including associated cabling was configured, on a 0.8 m non-conductive table for table-top equipment and on a 0.1 m insulated support for floor standing equipment above a ground reference plane all within a test laboratory.

Using a programmable power supply the equipment under test was subjected to the detailed supply voltage dips and interruptions. The required supply phase synchronization and test repetition rate, detailed, was controlled by the programmable power supply.
During this testing any anomalies in the equipment under tests performance was recorded.



2.8.2 Specification Limits

Voltage Dips				
Voltage Dips in % UT	Test level in % UT	Duration		Performance Criteria
		50Hz	60Hz	
100	0	1 cycle	1 cycle	B
60	40	10 cycles	12 cycles	B
30	70	25 cycles	30 cycles	C
100	0	250 cycles	300 cycles	C
UT is the rated voltage of the Equipment Under Test				

2.8.3 Test Results

Results for Configuration and Mode: TM1, TM2.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Test date: 2022-07-20

Tabulated Results for Voltage Dip and Short Interruption					
Line under test	Vnom	Operating Frequency	Test Level	Duration	Result
Power line	400 V~	50 Hz	0% of Vnom	1cycle	A
Power line	400 V~	50 Hz	40% of Vnom	10 cycles	A
Power line	400 V~	50 Hz	70% of Vnom	25 cycles	A
Power line	400 V~	50 Hz	0% of Vnom	250 cycles	B

Tabulated Results for Voltage Dip and Short Interruption					
Line under test	Vnom	Operating Frequency	Test Level	Duration	Result
Power line	400 V~	60 Hz	0% of Vnom	1cycle	A
Power line	400 V~	60 Hz	40% of Vnom	10 cycles	A
Power line	400 V~	60 Hz	70% of Vnom	25 cycles	A
Power line	400 V~	60 Hz	0% of Vnom	250 cycles	B

Remark: No observable change.

2.8.4 Test Setup



2.8.5 Test Location

This test was carried out in EMS Test Location.

3 Test Equipment Information

3.1 General Test Equipment Used

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Generator	HAEFELY	PEFT4010	080981-16	2023/5/15
EFT Clamp	HAEFELY	IP-4A	147147	2023/5/15
Signal Generator 1.2/50us 10kV	HAEFELY	PIM 100	174124	2023/5/15
Signal Generator 10/700us 7.5kV	HAEFELY	PIM 120	174435	2023/5/15
Signal Generator	HAEFELY	PCDN8	190422	2023/5/15
Coupling and decoupling network	HAEFELY	PCD 130	172181	2023/5/15
Signal Generator	Teseq	NSG 1007-45/45KVA	1305A02873	2023/5/15
Power Frequency MagneticField Generator	HAEFELY	Coil 1*1	SPZ	2023/5/15
Power magnetic coil	HAEFELY	ESCI	101384	2023/5/14
ESD equipment	3Ctest	EDS 30V	ES0121808	2023/06/15
Signal Generator	Rohde & Schwarz	SMB100B	IT-RD-745	2022/10/28
Power Amplifier	Rohde & Schwarz	NTWPA-00810600E	IT-RD-746	2023/03/10
Microwave Log-Periodic Antenna	Schwarzbeck	STLP9128E Special	IT-RD-748	2022/11/07
Average Power Sensor	Rohde & Schwarz	U2004A	IT-RD-897	2023/01/04
Signal generator	FRANKONIA	CIT-10	126AB19/2015	2023/08/07
Signal amplifier	AR	75A250AM1	330606	2023/04/10
Electromagnetic clamp	BIDR	EMCL-20	1318169	2023/08/07
attenuator	FRANKONIA	75W 6dB	132A1208/2015	2022/08/11
CDN	Frankonia	CDN-M5-32A	A2520078/2015	2023/01/04
EMI test receiver	RS	ESR3	1164.6407K03	2023/01/06
EMI test receiver	RS	ESR3	102030	2022/08/11
Amplitude limiting attenuator	RS	ESH3-Z2	102044	2022/08/11
Amplitude limiting attenuator	RS	ESH3-Z2	102795	2022/08/11
LINS	schwarzbeck	NNLK 8121	NNLK8121-520	2022/09/08
RF receiving antenna	schwarzbeck	VULB9168	VULB9168-341	2023/03/11
High Voltage Probe	Schwarzbeck	TK9420	IT-RD-612	2022/08/11

4 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 4.78dB; Vertical: 4.86dB;
Uncertainty for Radiated Emission in 10m chamber 30MHz-1000MHz	Horizontal: 4.70dB; Vertical: 4.82dB;
Uncertainty for Radiated Emission in 3m chamber 1000MHz-18000MHz	Horizontal: 4.96dB; Vertical: 5.04dB;
Uncertainty for Radiated Emission in 10m chamber 1000MHz-18000MHz	Horizontal: 4.90dB; Vertical: 5.00dB;
Uncertainty for Conducted Emission 9kHz-150KHz	3.52dB
Uncertainty for Conducted Emission 150kHz-30MHz	3.21dB
Uncertainty for Radiated Electromagnetic Disturbance 9KHz-30MHz	3.20dB
Uncertainty for RS test	49%, K=2
Uncertainty for CS test	28%, K=2 (CDN)
Uncertainty for ESD test	The immunity measurement system uncertainty is within standard requirement and is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%.
Uncertainty for EFT test	
Uncertainty for Surges test	
Uncertainty for PFMF test	
Uncertainty for Voltage Dips, Voltage Variations and Short Interruptions Test	

5 Photographs

Details of: General view



Details of: General view



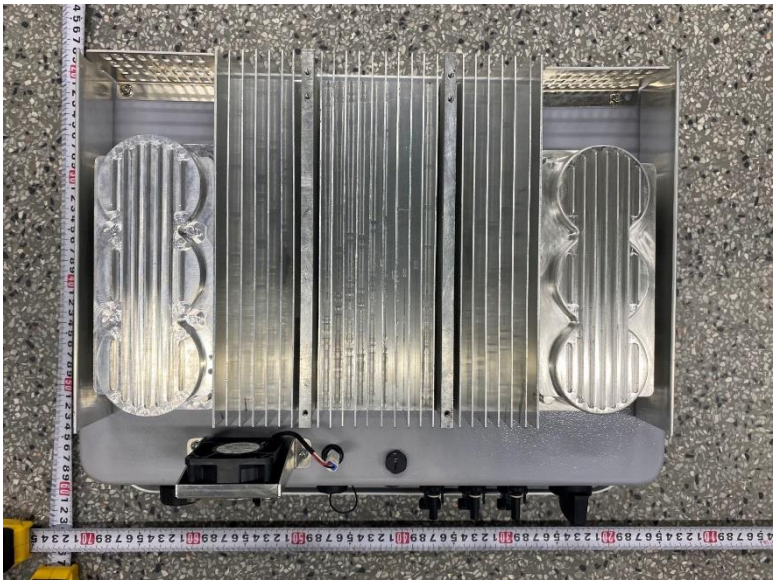
Details of: General view



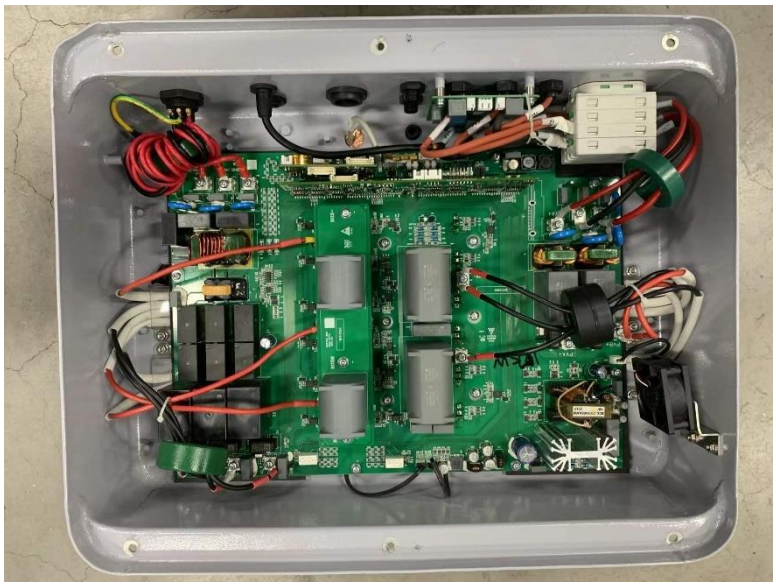
Details of: General view



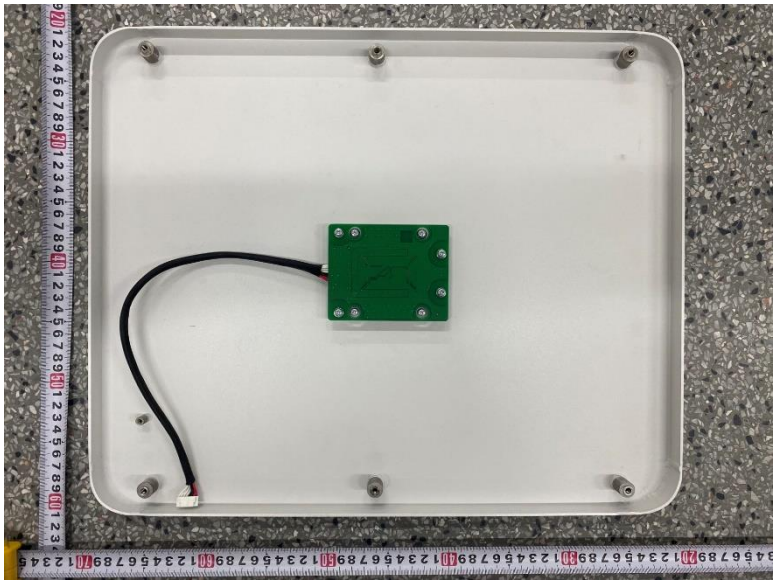
Details of: General view



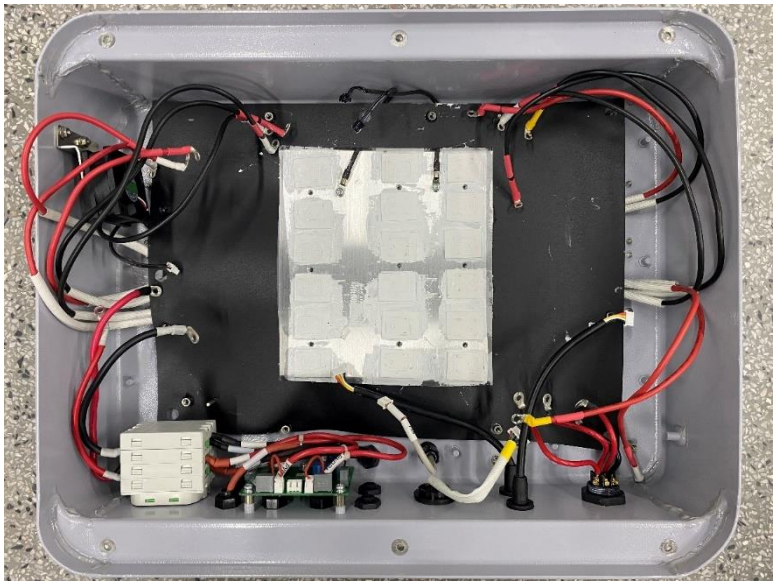
Details of: Inside view



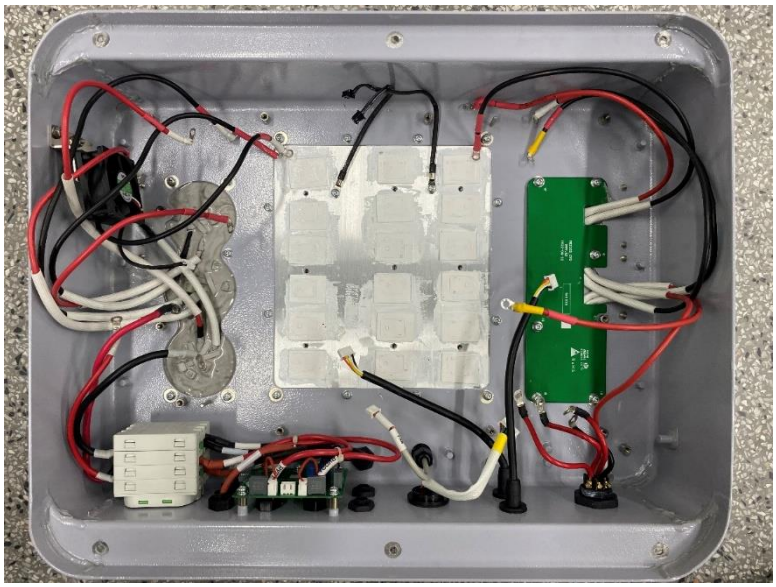
Details of: Inside view



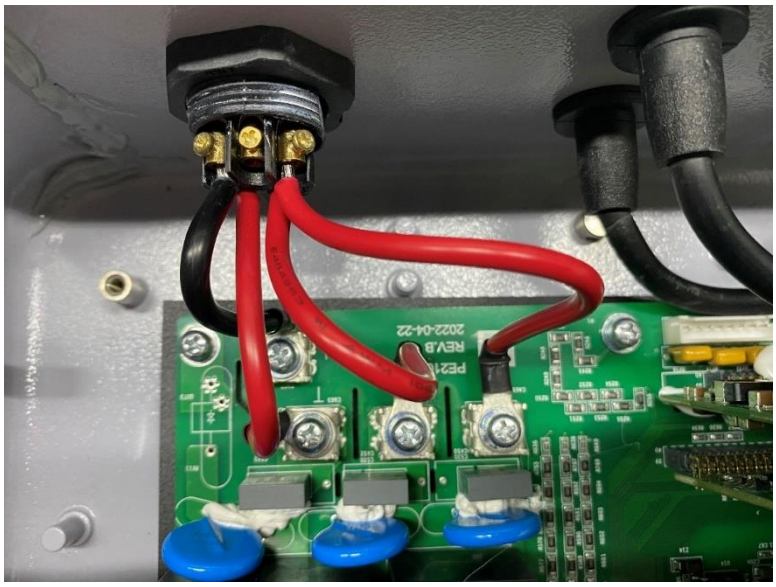
Details of: Inside view



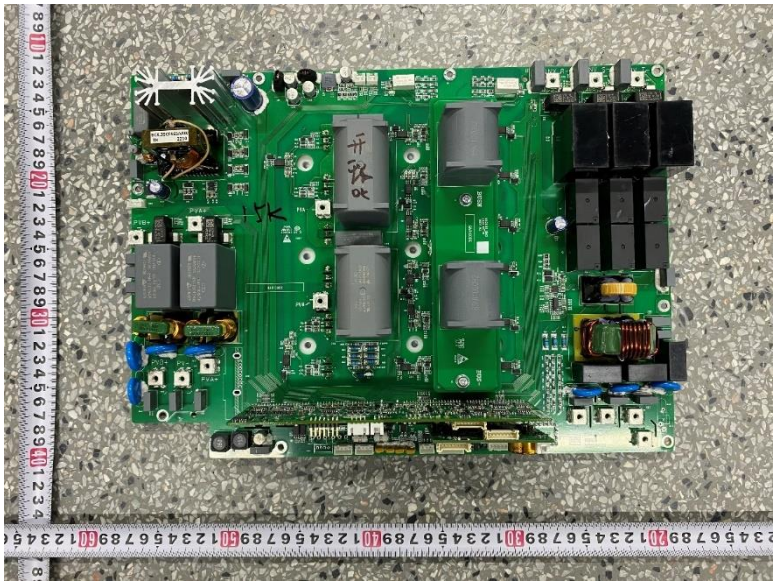
Details of: Inside view



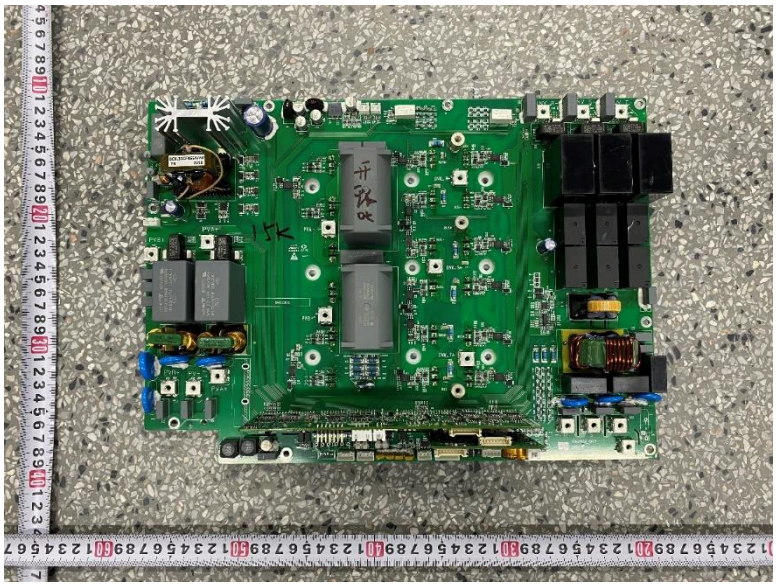
Details of: Inside view



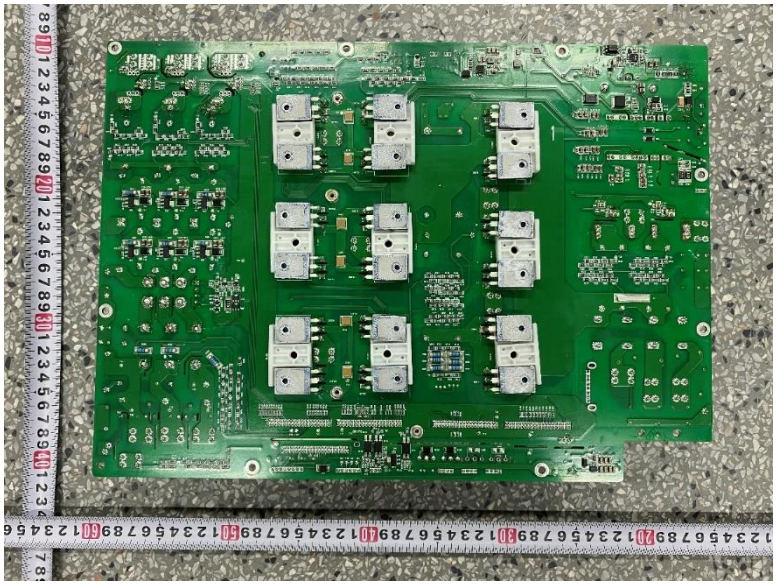
Details of: Inside view



Details of: Inside view



Details of: Inside view



END