

EMC Test Report

Application No. : TB210427871
Applicant : VEIKONG INDUSTRIAL CO., LTD/SHENZHEN VEIKONG ELECTRIC. CO. LTD

Equipment Under Test (EUT)

EUT Name : Solar pump inverter
Model No. : VFD500-40T00400-PV
Series Model No. : Please see the general description of EUT.
Brand Name : VEIKONG
Receipt Date : 2024-04-13
Test Date : 2024-04-14 to 2024-04-19
Issue Date : 2024-04-19
Standard : EN IEC 61800-3: 2018
Conclusions : **PASS**

In the configuration tested, the EUT complied with the standards specified above, The EUT technically complies with the 2014/30/EU directive requirements.

Test/Witness Engineer :

Rebecca

Engineer Supervisor :

Wan

Engineer Manager :

Ray Lai



This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

TABLE OF CONTENTS

- 1. GENERAL INFORMATION 5**
 - 1.1. Client Information 5
 - 1.2. General Description of EUT (Equipment Under Test) 5
 - 1.3. Description of Operating Mode 6
 - 1.4. Block Diagram Showing The Configuration of System Tested 6
 - 1.5. Description of Support Units 6
 - 1.6. Performance Criterion 7
 - 1.7. Measurement Uncertainty 7
 - 1.8. Test Facility 8
- 2. TEST RESULTS SUMMARY 9**
- 3. TEST SOFTWARE 10**
- 4. TEST EQUIPMENT USED 11**
- 5. CONDUCTED EMISSION TEST 13**
 - 5.1. Test Standard and Limit 13
 - 5.2. Test Setup 13
 - 5.3. Test Procedure 13
 - 5.4. Deviation From Test Standard 13
 - 5.5. Test Data 13
- 6. RADIATED EMISSION TEST 14**
 - 6.1 Test Standard and Limit 14
 - 6.2. Test Setup 14
 - 6.3. Test Procedure 14
 - 6.4 Deviation From Test Standard 14
 - 6.5 Test Data 14
- 7 HARMONIC CURRENT EMISSION TEST 15**
 - 7.2 Test Setup 15
 - 7.3 Test Procedure 16
 - 7.4 Deviation From Test Standard 16
 - 7.5 Test Data 16
- 8 VOLTAGE FLUCTUATION AND FLICKER TEST 17**
 - 8.1 Test Standard and Limit 17
 - 8.2 Test Setup 17
 - 8.3 Test Procedure 17
 - 8.4 Deviation From Test Standard 18
 - 8.5 Test Data 18
- 9 HARMONICS AND HARMONICS SHORT TERM (<15S) 19**
 - 9.1 Test Standard and Limit 19
 - 9.2 Test Setup 19
 - 9.3 Test Procedure 20
 - 9.4 Test Condition 20
 - 9.5 Test Data 20
- 10 VOLTAGE DEVIATIONS, VOLTAGE DIPS AND INTERRUPTIONS 21**
 - 10.1 Test Requirements 21
 - 10.2 Test Setup 21
 - 10.3 Test Procedure 22

10.4	Test Data	22
11	VOLTAGE UNBALANCE, FREQUENCY VARIATIONS AND FREQUENCY RATE OF CHANGE	23
11.1	Test Standard and Limit	23
11.2	Test Setup	23
11.3	Test Procedure	23
11.4	Test Condition	23
11.5	Test Data	24
12	ELECTROSTATIC DISCHARGE IMMUNITY TEST	25
12.1	Test Requirements	25
12.2	Test Setup	25
12.3	Test Procedure	25
12.4	Test Data	26
13	RADIATED ELECTROMAGNETIC FIELD IMMUNITY TEST	27
13.1.	Test Requirements	27
13.2	Test Setup	27
13.3	Test Procedure	27
13.4	Deviation From Test Standard	28
13.5	Test Data	28
14	ELECTRICAL FAST TRANSIENT/BURST TEST	29
14.1.	Test Requirements	29
14.2.	Test Setup	29
14.3.	Test Procedure	29
14.4	Deviation From Test Standard	30
14.5	Test Data	30
15	SURGE IMMUNITY TEST	31
15.1	Test Requirements	31
15.2.	Test Setup	31
15.3.	Test Procedure	32
15.4.	Deviation From Test Standard	32
15.5.	Test Data	32
16	CONDUCTED IMMUNITY TEST	33
16.1	Test Requirements	33
16.2	Test Setup	33
16.3	Test Procedure	33
16.4	Deviation From Test Standard	34
16.5	Test Data	34
17	PHOTOGRAPHS - CONSTRUCTIONAL DETAILS	35
	ATTACHMENT A--CONDUCTED EMISSION DATA (AC MAINS)	37
	ATTACHMENT B--RADIATED EMISSION TEST DATA (BELOW 1G)	40
	ATTACHMENT C--ELECTROSTATIC DISCHARGE TEST DATA	42
	ATTACHMENT D--RF FIELD STRENGTH SUSCEPTIBILITY TEST DATA	44
	ATTACHMENT E--ELECTRICAL FAST TRANSIENT/BURST TEST DATA	45
	ATTACHMENT F--SURGE IMMUNITY TEST DATA	46
	ATTACHMENT G--CONDUCTED IMMUNITY TEST DATA	48

Revision History

Report No.	Version	Description	Issued Date
TB-EMC179763	Rev.01	Initial issue of report	2024-04-19

1. General Information

1.1. Client Information

Applicant	:	VEIKONG INDUSTRIAL CO., LTD/SHENZHEN VEIKONG ELECTRIC. CO. LTD
Address	:	Block E01, first industrial park lingbei 5 road, phoenix community, fuyong street, Bao'an District, Shenzhen, China
Manufacturer	:	VEIKONG INDUSTRIAL CO., LTD/SHENZHEN VEIKONG ELECTRIC. CO. LTD
Address	:	Block E01, first industrial park lingbei 5 road, phoenix community, fuyong street, Bao'an District, Shenzhen, China

1.2. General Description of EUT (Equipment Under Test)

EUT Name	:	Solar pump inverter
Model(s)	:	VFD500-40T00400-PV, VFD500-20T00075-PV, VFD500-20T00150-PV, VFD500-20T00220-PV, VFD500-20T00400-PV, VFD500-20S00150-PV, VFD500-20S00220-PV, VFD500-20S00400-PV, VFD500-20S00550-PV, VFD500-20T00550-PV, VFD500-20T00750-PV, VFD500-20T01100-PV, VFD500-20T01500-PV, VFD500-20T01850-PV, VFD500-20T02200-PV, VFD500-20T03000-PV, VFD500-20T03700-PV, VFD500-20T04500-PV, VFD500-20T05500-PV, VFD500-20T07500-PV, VFD500-40T00075-PV, VFD500-40T00150-PV, VFD500-40T00220-PV, VFD500-40T00400-PV, VFD500-40T00550-PV, VFD500-40T00750-PV, VFD500-40T01100-PV, VFD500-40T01500-PV, VFD500-40T01850-PV, VFD500-40T02200-PV, VFD500-40T03000-PV, VFD500-40T03700-PV, VFD500-40T04500-PV, VFD500-40T05500-PV, VFD500-40T07500-PV, VFD500-40T09000-PV, VFD500-40T11000-PV, VFD500-40T13200-PV, VFD500-40T16000-PV, VFD500-40T18500-PV, VFD500-40T20000-PV, VFD500-40T22000-PV, VFD500-40T25000-PV.
Model Difference	:	All these models are identical in the same PCB layout and electrical circuit, the only difference is model name for commercial. therefore, EMI and EMS testing was performed with VFD500-40T00400-PV only.
Brand Name	:	VEIKONG
Power Supply	:	Input: VDC: 250V-800V/380-480VAC 3PH 50/60Hz Output: 0-480VAC 3PH 0-600Hz Power: 4.0KW/9.4A

1.3. Description of Operating Mode

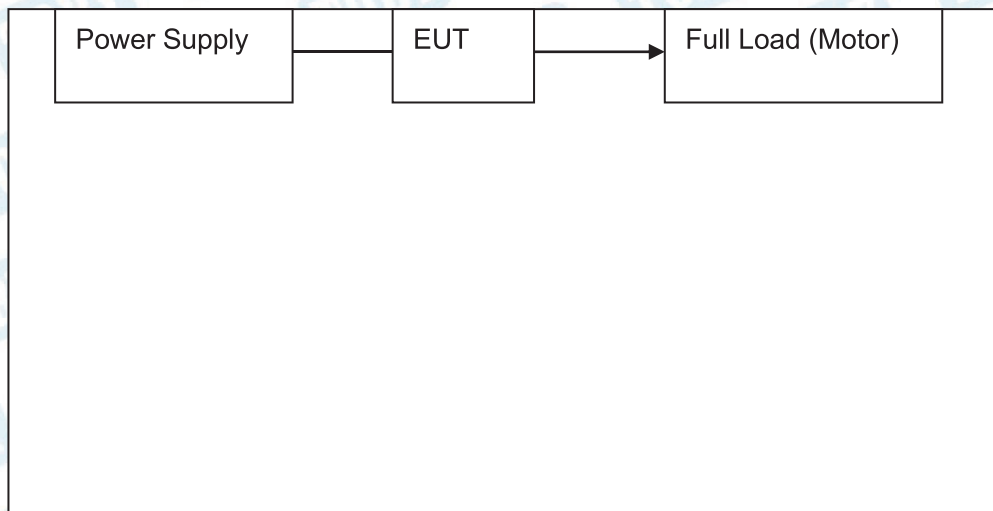
To investigate the maximum EMI emission characteristics generated from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	Full Load Mode

The EUT system operated these modes were found to be the worst case during the pre-scanning test as Following:

For EMI Test	
Final Test Mode	Description
Mode 1	Full Load Mode
For EMS Test	
Final Test Mode	Description
Mode 1	Full Load Mode

1.4. Block Diagram Showing The Configuration of System Tested



1.5. Description of Support Units

The EUT has been tested with electromotor unit.

1.6. Performance Criterion

Criterion A: The equipment shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer when the equipment is used as intended.

Criterion B: After the test, the equipment shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed, after the application of the phenomena below a performance level specified by the manufacturer, when the equipment is used as intended.

Criterion C: Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions.

1.7. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

Test	Parameters	Expanded Uncertainty (U_{Lab})	Expanded Uncertainty (U_{Cispr})
Conducted Emission	Level Accuracy: 9kHz~150kHz 150kHz to 30MHz	± 3.50 dB ± 3.10 dB	± 4.0 dB ± 3.6 dB
Radiated Emission	Level Accuracy: 9kHz to 30 MHz	± 4.60 dB	N/A
Radiated Emission	Level Accuracy: 30MHz to 1000 MHz	± 4.50 dB	± 5.2 dB
Radiated Emission	Level Accuracy: Above 1000MHz	± 4.20 dB	N/A
Mains Harmonic	Voltage	$\pm 3.11\%$	N/A
Voltage Fluctuations & Flicker	Voltage	$\pm 3.25\%$	N/A

1.8. Test Facility

The testing was performed by the Shenzhen Toby Technology Co., Ltd., in their facilities located at:1A/F., Building 6, Rundongsheng Industrial Zone, Longzhu, Xixiang, Bao'an District, Shenzhen, Guangdong, China.

At the time of testing, the following bodies accredited the Laboratory:

CNAS (L5813)

The Laboratory has been accredited by CNAS to ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories for the competence in the field of testing. And the Registration No.: CNAS L5813.

A2LA Certificate No.: 4750.01

The laboratory has been accredited by American Association for Laboratory Accreditation(A2LA) to ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories for the technical competence in the field of Electrical Testing. And the A2LA Certificate No.: 4750.01. FCC Accredited Test Site Number: 854351.

IC Registration No.: (11950A)

The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing. The site registration: Site# 11950A.

2. TEST Results Summary

EN IEC 61800-3: 2018		
EMISSION		
Description of test items	Standards	Results
Conducted disturbance at mains terminals	EN IEC 61800-3: 2018	Pass
Radiated Disturbance	EN IEC 61800-3: 2018	Pass
Harmonic current emissions	IEC 61000-3-2: 2018	Pass
Voltage fluctuation and flicker	IEC 61000-3-3: 2017	Pass
IMMUNITY		
Description of test items	Standards	Results
Harmonics(THD and individual harmonic orders)	IEC 61000-2-2: 2002 + A1: 2017 +A2: 2018	Pass
Harmonics short term (<15s)	IEC 61000-2-2: 2002 + A1: 2017 +A2: 2018	Pass
Voltage deviations	IEC 61000-2-2: 2002 + A1: 2017 +A2: 2018	Pass
Voltage dips and short interruptions	IEC/TR 61000-2-1:1990	Pass
Voltage unbalance	IEC 61000-2-2: 2002 + A1: 2017 +A2: 2018	Pass
Frequency variations	IEC 61000-2-2: 2002 + A1: 2017 +A2: 2018	Pass
Frequency rate of change	IEC 61000-2-2: 2002 + A1: 2017 +A2: 2018	Pass
Electrostatic Discharge (ESD)	IEC 61000-4-2: 2008	Pass
Radio-frequency, Continuous radiated disturbance	IEC 61000-4-3: 2020	Pass
EFT/B Immunity	IEC 61000-4-4: 2012	Pass
Surge Immunity	IEC 61000-4-5: 2014 +A1: 2017	Pass
Conducted RF Immunity	IEC 61000-4-6: 2013 Edition 2.0	Pass
Note: (1) N/A is an abbreviation for Not Applicable.		
(2) During testing the power line length between the electromotor unit and the EUT is 10 meters.		

3. Test Software

Test Item	Test Software	Manufacturer	Version No.
Conducted Emission	EZ-EMC	EZ	CDI-03A2
Radiation Emission	EZ-EMC	EZ	FA-03A2RE
Harmonic Current	CTS4	CI	4.24.0
Voltage Fluctuation and Flicker	CTS4	CI	4.24.0
Conducted Immunity	IEC/EN 61000-6-4 Application	FRANKONIA	1.1.1
Electrical Fast Transient	lec.control	Nemtest	5.1.1.0
Surge	lec.control	Nemtest	5.1.1.0
Voltage Dip and Interruption	lec.control	Nemtest	5.1.1.0

4. Test Equipment Used

Conducted Emission Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
EMI Test Receiver	Rohde & Schwarz	ESCI	100321	Mar.01,2024	Feb.24,2024
RF Switching Unit	Compliance Direction Systems Inc	RSU-A4	34403	Mar.01,2024	Feb.24,2024
AMN	SCHWARZBECK	NNBL 8226-2	8226-2/164	Mar.01,2024	Feb.24,2024
LISN	Rohde & Schwarz	ENV216	101131	Mar.01,2024	Feb.24,2024
Radiation Emission Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Spectrum Analyzer	Agilent	E4407B	MY45106456	Mar.01,2024	Feb.24,2024
EMI Test Receiver	Rohde & Schwarz	ESCI	101165	Mar.01,2024	Feb.24,2024
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar.01,2024	Feb.24,2024
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar.01,2024	Feb.24,2024
Pre-amplifier	HP	11909A	185903	Mar.01,2024	Feb.24,2024
Pre-amplifier	HP	8449B	3008A00849	Mar.01,2024	Feb.24,2024
Cable	HUBER+SUHNER	100	SUCOFLEX	Mar.01,2024	Feb.24,2024
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A
Harmonic Current and Voltage Fluctuation and Flicker Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Harmonic Flicker Test System	CI	5001ix-CTS-400	100321	Mar.01,2024	Feb.24,2024
5K VA	CI	500liX	59468	Mar.01,2024	Feb.24,2024
Discharge Immunity Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
ESD Tester	TESEQ	NSG437	304	Mar.01,2024	Feb.24,2024
Radiated Immunity Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Vector Signal Generator	Agilent	E4438C	US44271917	Mar.01,2024	Feb.24,2024
Power meter	Agilent	E4419B	GB40202122	Mar.01,2024	Feb.24,2024
Power Sensor	Agilent	E9300A	MY41496625	Mar.01,2024	Feb.24,2024
Power Sensor	Agilent	E9300A	MY41496628	Mar.01,2024	Feb.24,2024
RF power Amplifier	OPHIR	5225R	1045	Mar.01,2024	Feb.24,2024
RF power Amplifier	OPHIR	5273R	1018	Mar.01,2024	Feb.24,2024

Antenna	SCHWARZBECK	STLP9128E-special	STLP9128Es#139	Mar.01,2024	Feb.24,2024
Antenna	SCHWARZBECK	STLP 9149	STLP 9149#456	Mar.01,2024	Feb.24,2024
Electrical Fast Transient/ Surge/ Voltage Dip and Interruption Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Simulator	EMTEST	UCS500N5	V0948105575	Mar.01,2024	Feb.24,2024
Auto-transformer	EMTEST	V4780S2	0109-41	Mar.01,2024	Feb.24,2024
Coupling Clamp	EMTEST	HFK	1109-04	Mar.01,2024	Feb.24,2024
Conducted Immunity Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
RF Generator	FRANKONIA	CIT-10/75	126B1126	Mar.01,2024	Feb.24,2024
Attenuator	FRANKONIA	59-6-33	A413	Mar.01,2024	Feb.24,2024
M-CDN	LUTHI	L-801 M2/M3	2599	Mar.01,2024	Feb.24,2024
EM Injection Clamp	LUTHI	EM101	35958	Mar.01,2024	Feb.24,2024

5. Conducted Emission Test

5.1. Test Standard and Limit

5.1.1. Test Standard

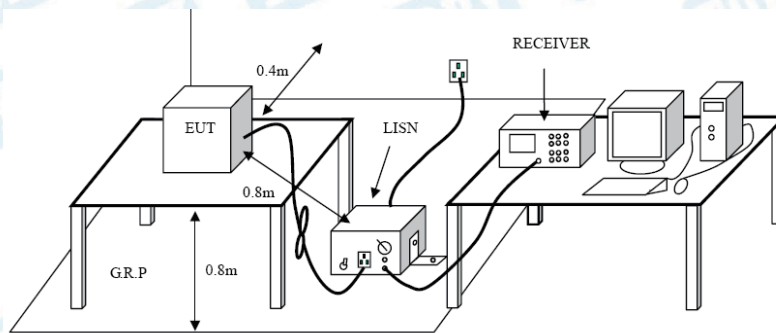
EN IEC 61800-3: 2018

5.1.2. Test Limit

Conducted Disturbance Test Limit (Category C3)

Frequency	Maximum RF Line Voltage (Db μ V)	
	Quasi-peak Level	Average Level
150kHz~500kHz	130 *	120*
500kHz~5MHz	125	115
5MHz~30MHz	115	105

5.2. Test Setup



5.3. Test Procedure

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.

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.

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 not exceed 1 m.

LISN at least 80 cm from nearest part of EUT chassis.

The bandwidth of EMI test receiver is set at 9kHz, and the test frequency band is from 0.15MHz to 30MHz.

5.4. Deviation From Test Standard

No deviation

5.5. Test Data

Please refer to the Attachment A.

6. Radiated Emission Test

6.1 Test Standard and Limit

6.1.1. Test Standard

EN IEC 61800-3: 2018

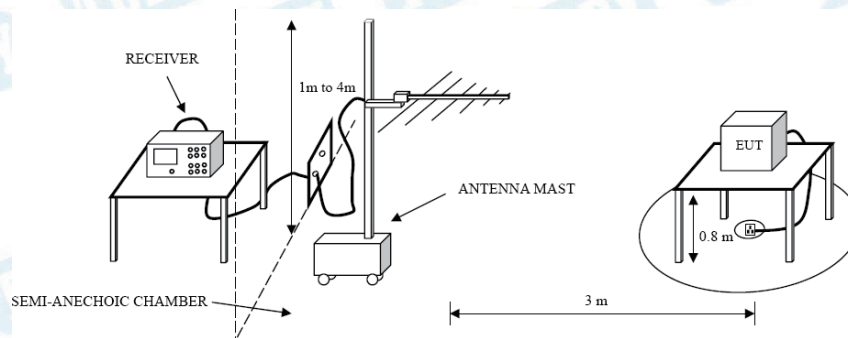
6.1.2. Test Limit

Radiated Disturbance Test Limit (Category C3)

Frequency	Limit (Db μ V/m)
	Quasi-peak Level
30MHz~230MHz	60
230MHz~1000MHz	70

Remark: 1. The lower limit shall apply at the transition frequency.
2. The test distance is 3m.

6.2. Test Setup



6.3. Test Procedure

The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3m. The table was rotated 360 degrees to determine the position of the highest radiation.

The height of the equipment or of the substitution antenna shall be 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.

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.

6.4 Deviation From Test Standard

No deviation

6.5 Test Data

Please refer to the Attachment B.

7 Harmonic Current Emission Test

7.1.1. Test Standard

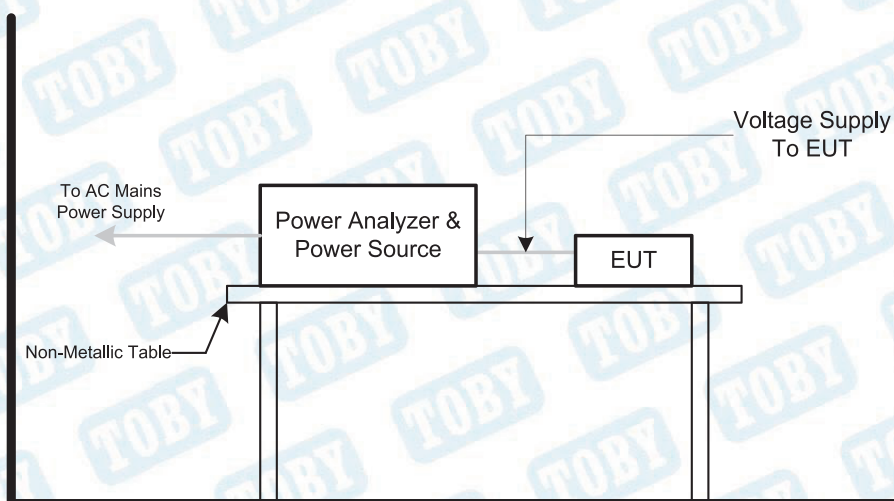
IEC 61000-3-2: 2018

7.1.2. Limits

Harmonic Current Test Limit (Class A)

Harmonic order (n)	Maximum permissible harmonic current (A)
Odd harmonics	
3	2.30
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
$15 \leq n \leq 39$	$0.15 \times 15/n$
Even harmonics	
2	1.08
4	0.43
6	0.30
$8 \leq n \leq 40$	$0.23 \times 8/n$

7.2 Test Setup



7.3 Test Procedure

The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the maximum harmonic components under normal operating conditions.

The classification of EUT is according to section 5 of EN 61000-3-2. The EUT is classified as follows:

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

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

Class C: Lighting equipment.

Class D: Equipment having a specified power less than or equal to 600W of the following types: Personal computers and personal computer monitors and television receivers.

7.4 Deviation From Test Standard

No deviation

7.5 Test Data

Test Result: PASS

8 Voltage Fluctuation and Flicker Test

8.1 Test Standard and Limit

8.1.1. Test Standard

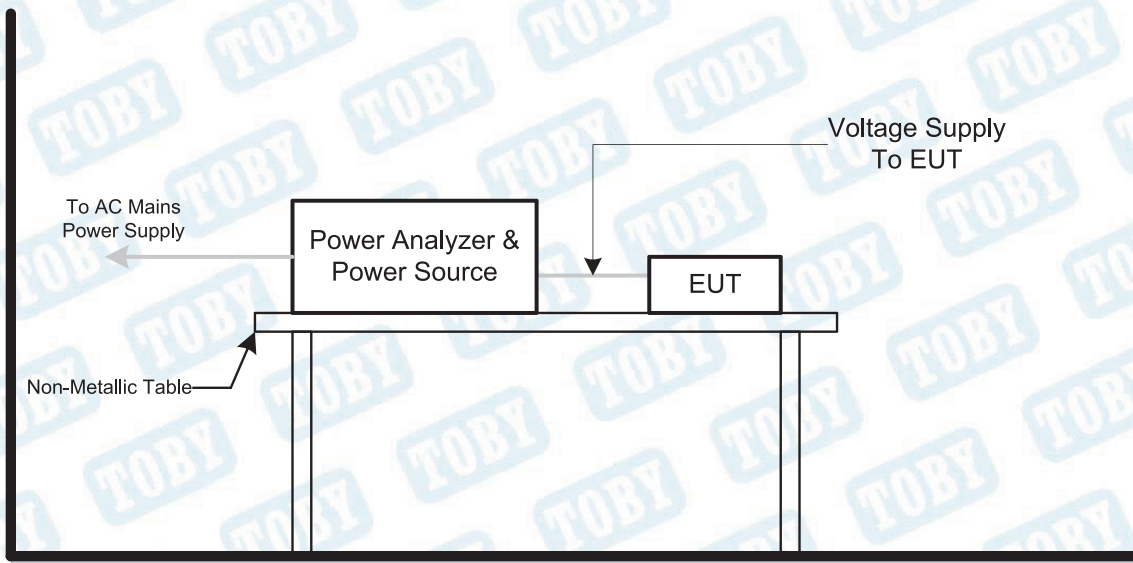
IEC 61000-3-3:2017

8.1.2. Limit

Voltage Fluctuation and Flicker Test Limit

Test Items	Limits
Pst	1.0
dc	3.3%
dmax	4.0%
dt	Not exceed 3.3% for 500ms

8.2 Test Setup



8.3 Test Procedure

8.3.1 Harmonic Current Test

Test was performed according to the procedures specified in Clause 5.0 of IEC555-2 and/or Sub-clause 6.2 of IEC/EN 61000-3-2 depend on which standard adopted for compliance measurement.

8.3.2 Fluctuation and Flickers Test:

Tests was performed according to the Test Conditions/Assessment of Voltage Fluctuations specified in Clause 5.0/6.0 of IEC555-3 and/or Clause 6.0/4.0 of IEC/EN 61000-3-3 depend on which standard adopted for compliance measurement.

All types of harmonic current and/or voltage fluctuation in this report are assessed by direct measurement using flicker-meter.

For the actual test configuration, please refer to the related Item –Block Diagram of system tested (please refer to 1.3).

8.4 Deviation From Test Standard

No deviation

8.5 Test Data

Test Result: PASS

9 Harmonics and Harmonics short term (<15s)

9.1 Test Standard and Limit

9.1.1. Test Standard

IEC 61000-2-2: 2002 + A1: 2017 +A2: 2018

9.1.2. Limit

Odd harmonics non-multiple of 3		Odd harmonics multiple of 3 ^a		Even harmonics	
Harmonic order (n)	Harmonic Voltage %	Harmonic order (n)	Harmonic Voltage %	Harmonic order (n)	Harmonic Voltage %
5	6	3	5	2	2
7	5	9	1.5	4	1
11	3.5	15	0.4	6	0.5
13	3	21	0.3	8	0.5
17≤n≤49	2.27×(17/n)-0.27	21≤n≤45	0.2	10≤n≤50	0.25×(10/n)+0.25

a: the levels given for odd harmonics that are multiples of three apply to zero sequence harmonics. Also, on a three-phase network without a neutral conductor or without load connected between line and ground. The values of the 3rd and 9th harmonics may be much lower than the compatibility levels, depending on the unbalance of the system.

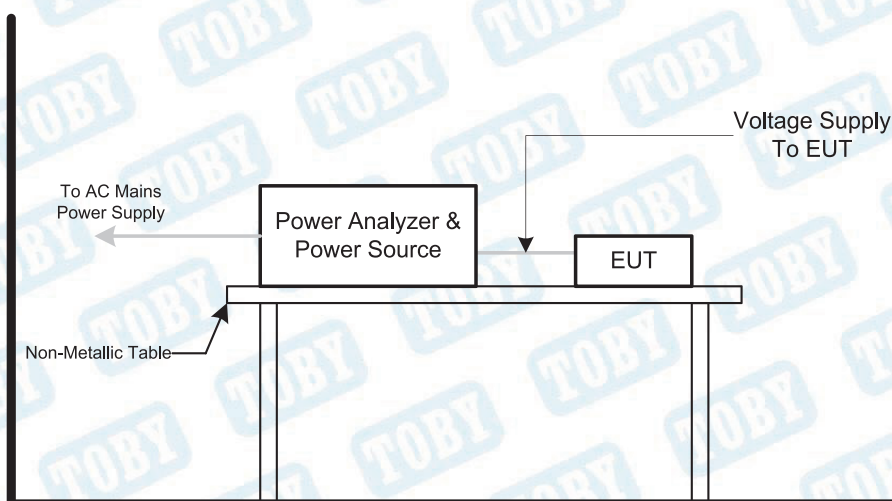
The corresponding compatibility level for the total harmonic distortion is THD=8%

The corresponding compatibility level is 1.5 times the value of the permanent compatibility levels

The corresponding compatibility level for the total harmonic distortion is THD=11%

- 9.1.3. Performance criterion: 1. Harmonic: **A**
 2. Harmonic short term (<15s): **B**

9.2 Test Setup



9.3 Test Procedure

The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the 8.1.2 operating conditions.

9.4 Test Condition

Temperature	:	23°C
Relative Humidity	:	52%
Pressure	:	1010 hPa
Test Power	:	AC 380V/50Hz

9.5 Test Data

- Test Result :
1. Harmonic: **PASS**
 2. Harmonic short term (<15s): **PASS**

10 Voltage Deviations, Voltage Dips and Interruptions

10.1 Test Requirements

10.1.1. Test Standard

IEC 61000-2-2: 2002 + A1: 2017 +A2: 2018; IEC/TR 61000-2-1:1990

10.1.2. Level

1. Voltage deviations: the corresponding compatibility level for the nominal voltage $\pm 10\%$ of EUT
2. Test Level for Voltage Dips and Interruptions: see the following table

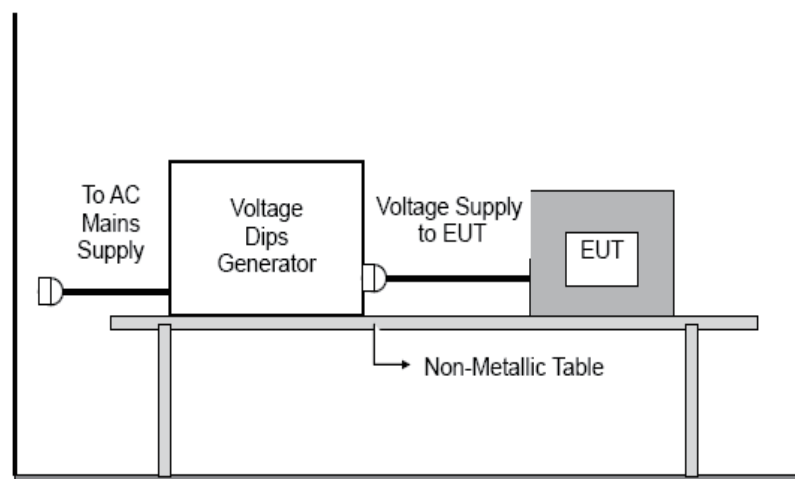
Voltage dip and short interruptions %U _T	Duration (in period)
0	0.5
0	1
40	10
70	25
80	250
100	250

Remark: U_T is the nominal voltage for the equipment.

10.1.3. Performance criterion: 1. Voltage deviations: **A**

2. Test Level for Voltage Dips and Interruptions: **C**

10.2 Test Setup



10.3 Test Procedure

Set up the EUT and test generator as shown above, and operated to produce the 9.1.2 operating conditions.

10.4 Test Data

Test result: 1. Voltage deviations: **PASS**

2. Test Level for Voltage Dips and Interruptions: **PASS**

11 Voltage unbalance, Frequency variations and Frequency rate of change

11.1 Test Standard and Limit

11.1.1. Test Standard

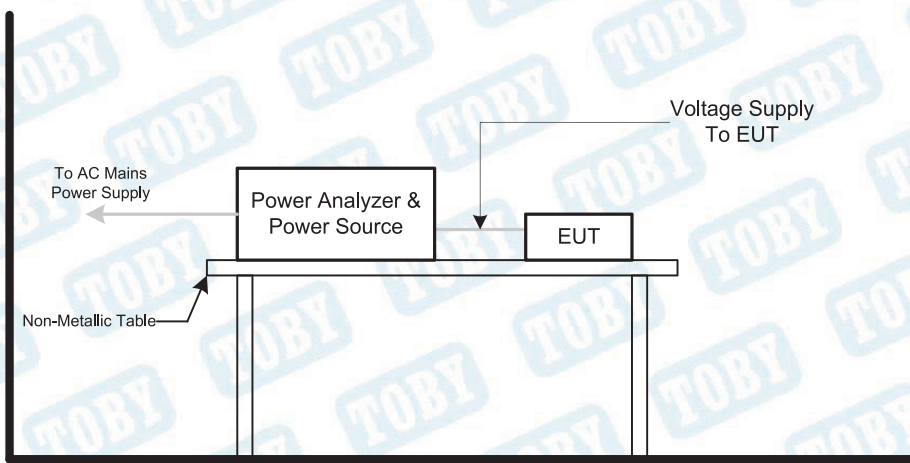
IEC 61000-2-2: 2002 + A1: 2017 +A2: 2018

11.1.2. Limit

1. Voltage unbalance: the corresponding compatibility level is 2% negative sequence component.(Not relevant for single phase PDSs)
2. Frequency variations: the corresponding compatibility level is the nominal Frequency $\pm 2\%$ of EUT.
3. Frequency rate of change: the corresponding compatibility level is 1%/second.

- ### 11.1.3. Performance criterion:
1. Voltage unbalance: **A**
 2. Frequency variations: **A**
 3. Frequency rate of change: **A**

11.2 Test Setup



11.3 Test Procedure

The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the 10.1.2 operating conditions.

11.4 Test Condition

Temperature	:	23°C
Relative Humidity	:	52%
Pressure	:	1010 hPa
Test Power	:	AC 380V/50Hz

11.5 Test Data

Test result:

1. Voltage unbalance: **PASS**
2. Frequency variations: **PASS**
3. Frequency rate of change: **PASS**

12 Electrostatic Discharge Immunity Test

12.1 Test Requirements

12.1.1 Test Standard

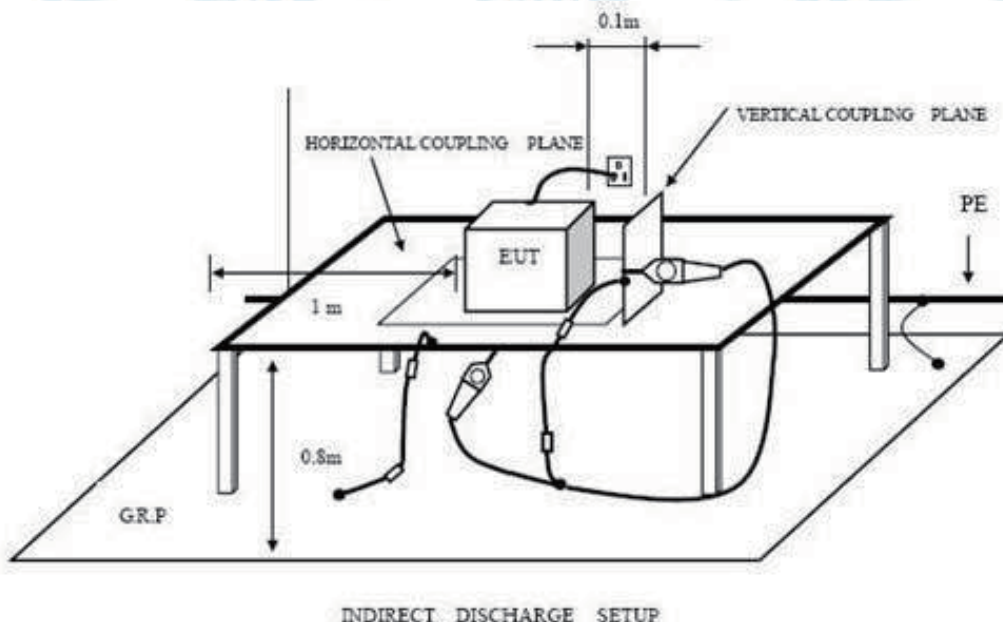
IEC 61000-4-2: 2008

12.1.2. Test Level

Discharge Impedance:	330 ohm/ 150pF
Discharge Voltage:	Air Discharge: 8kV(Direct) Contact Discharge: 4kV (Direct /Indirect)
Polarity:	Positive& Negative
Number of Discharge:	Air Discharge: min.20 times at each test point Contact Discharge: min.200 times in total
Discharge Mode:	Single Discharge
Discharge Period:	1second minimum

12.1.3. Performance criterion: B

12.2 Test Setup



12.3 Test Procedure

12.3.1 Air Discharge:

This test is done on a non-conductive surface. The round discharge tip of the discharge electrode shall be approached as fast as possible to touch the EUT. After each discharge,

the discharge electrode shall be removed from the EUT. The generator is then re-triggered for a new single discharge and repeated 10 times for each pre-selected test point. This procedure shall be repeated until all the air discharge completed.

12.3.2 Contact Discharge:

All the procedure shall be same as air discharge. Except that the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.

12.3.3 Indirect discharge for horizontal coupling plane

At least 10 single discharges (in the most sensitive polarity) shall be applied at the front edge of each HCP opposite the center point of each unit (if applicable) of the EUT and 0.1m from the front of the EUT. The long axis of the discharge electrode shall be in the plane of the HCP and perpendicular to its front edge during the discharge.

12.3.4 Indirect discharge for vertical coupling plane

At least 10 single discharges (in the most sensitive polarity) shall be applied to the center of one vertical edge of the coupling plane. The coupling plane, of dimensions 0.5m X 0.5m, is placed parallel to, and positioned at a distance of 0.1m from the EUT. Discharges shall be applied to the coupling plane, with this plane in sufficient different positions that the four faces of the EUT are completely illuminated.

12.4 Test Data

Please refer to the Attachment C.

13 Radiated Electromagnetic Field Immunity Test

13.1. Test Requirements

13.1.1. Test Standard

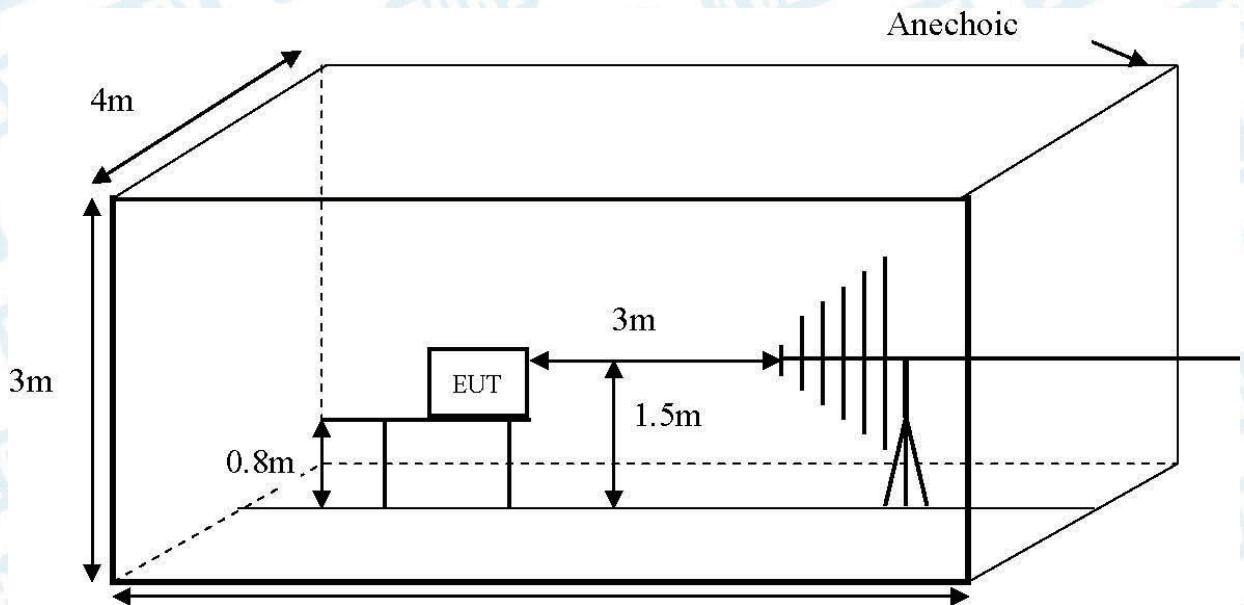
IEC 61000-4-3: 2020

13.1.2. Test Level

Port	Test Specification
Enclosure Port	80-1000MHz 10 V/m 80 AM (1kHz)

13.1.3. Performance criterion: A

13.2 Test Setup



13.3 Test Procedure

The EUT are placed on a table, which is 0.8 meter high above the ground. The EUT is set 3 meters away from the transmitting antenna, which is mounted on an antenna tower. Both horizontal and vertical polarization of the antenna is set on test. Each of the four sides of the EUT must be faced this transmitting antenna and measured individually.

In order to judge the EUT performance, a camera is used to monitor its screen.

All the scanning conditions are as following:

Condition of Test	Remark
Fielded strength	10V/m
Radiated signal	Modulated
Scanning frequency	80-1000MHz
Dwell time	2Sec.

13.4 Deviation From Test Standard

No deviation

13.5 Test Data

Please refer to the Attachment D.

14 Electrical Fast Transient/Burst Test

14.1. Test Requirements

14.1.1. Test Standard

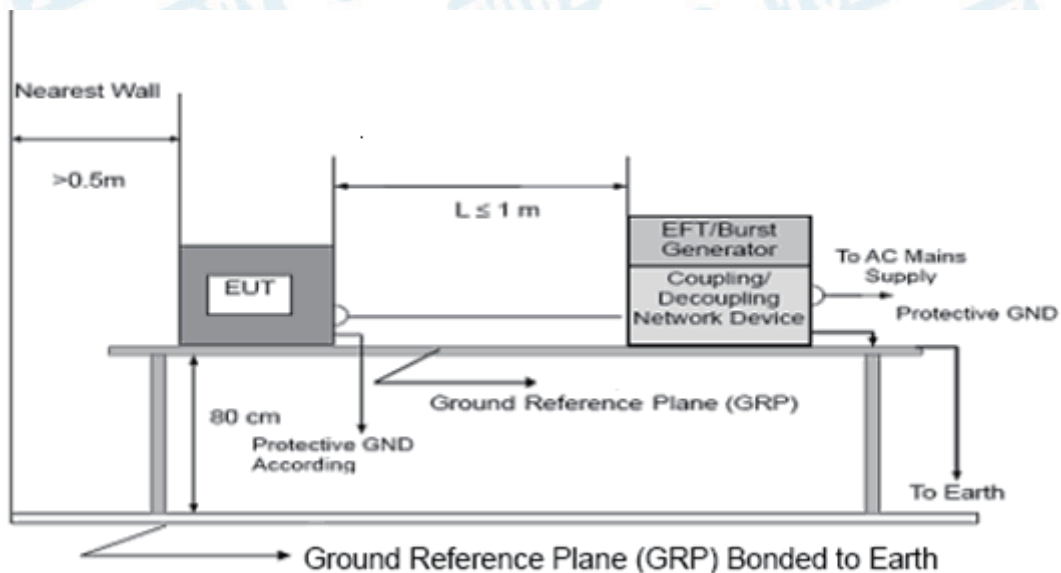
IEC 61000-4-4:2012

14.1.2. Level

	On Switching Adapter Lines	On I/O (Input/Output) Signal data and DC Port
Test Voltage:	2 KV	1 KV
Polarity:	Positive&Negative	
Impulse Wave Shape:	5/50ns	
Burst Duration:	15ms	
Burst Period:	300ms	
Test Duration:	Not less than 1 min	

14.1.3. Performance criterion: **B**

14.2. Test Setup



14.3. Test Procedure

14.3.1 For input and output AC power ports:

The EUT is connected to the power mains by using a coupling device which couples the EFT interference signal to AC power lines. Both polarities of the test voltage should be applied during compliance test and the duration of the test is 1 minute.

14.3.2 For signal lines and control lines ports:

A coupling clamp is use to couple the EFT interference signal to the signal and control lines. Both polarities of the test voltage should be applied during compliance test and the duration of the test is 1 minute.

14.3.3 For DC input and DC output power ports:

The EUT is connected to the power mains by using a coupling device which couples the EFT interference signal to AC power lines. Both polarities of the test voltage should be applied during compliance test and the duration of the test is 1 minute.

14.4 Deviation From Test Standard

No deviation

14.5 Test Data

Please refer to the Attachment E.

15 Surge Immunity Test

15.1 Test Requirements

15.1.1. Test Standard

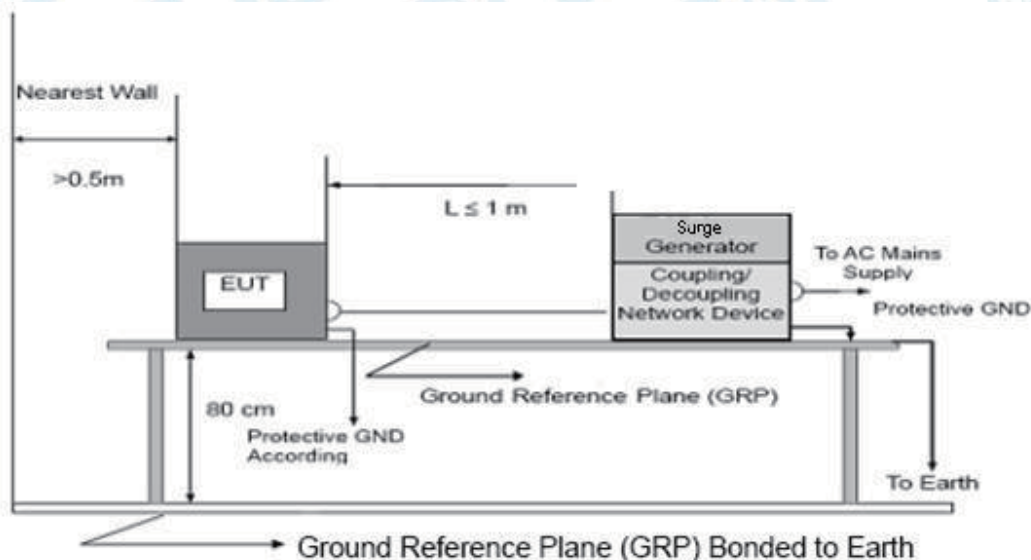
IEC 61000-4-5: 2014 +A1: 2017

15.1.2. Level

Surge test for DC power ports		
Characteristics		Test Level
Wave-shape data		1.2/50 (8/20) us
Injected Level	Line to line	± 0.5 kV
	Line to earth or ground	± 1 kV
Surge test for AC power ports		
Characteristics		Test Level
Wave-shape data		1.2/50 (8/20) us
Injected Level	Line to line	± 1 kV
	Line to earth or ground	± 2 kV

15.1.3. Performance criterion: **B**

15.2. Test Setup



15.3. Test Procedure

15.3.1. Set up the EUT and test generator as shown on Section 11.1.2.

15.3.2. For line to line coupling mode, provide a 1.0 KV 1.2/50us voltage surge
(at open-circuit condition) and 8/20us current surge to EUT selected points.

15.3.3. At least 5 positive and 5 negative (polarity) tests with a maximum 1/min repetition rate are conducted during test.

15.3.4. Different phase angles are done individually.

15.3.5. Record the EUT operating situation during compliance test and decide the EUT immunity criterion for above each test.

15.4. Deviation From Test Standard

No deviation

15.5. Test Data

Please refer to the Attachment F.

16 Conducted Immunity Test

16.1 Test Requirements

16.1.1 Test Standard

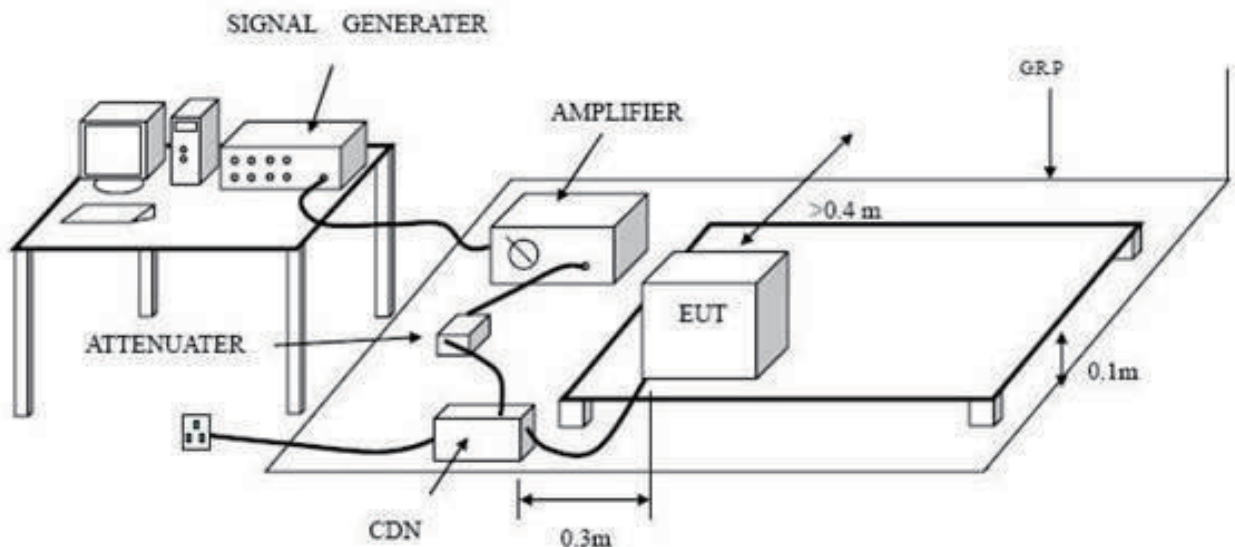
IEC 61000-4-6:2013

16.1.2 Level

Radio-frequency continuous conducted immunity test		
Signal and Control lines	DC Power Ports	AC Power Ports
0.15 MHz to 80 MHz		
10V r.m.s 1 kHz, 80% AM, sine wave		

16.1.3 Performance criterion: A

16.2 Test Setup



16.3 Test Procedure

16.3.1 Set up the EUT, CDN and test generators.

16.3.2 Let the EUT work in test mode and test it.

16.3.3 The EUT are placed on an insulating support 0.1m high above a ground reference plane. CDN (coupling and decoupling device) is placed on the ground plane about 0.3m from EUT. Cables between CDN and EUT are as short as possible, and their height above the ground reference plane shall be between 30 and 50 mm (where possible).

16.3.4 The disturbance signal description below is injected to EUT through CDN.

16.3.5 The EUT operates within its operational mode(s) under intended climatic conditions after power on.

16.3.6 The frequency range is swept from 0.150MHz to 80MHz using 3V signal level, and with the disturbance signal 80% amplitude modulated with a 1KHz sine wave.

16.3.7 The rate of sweep shall not exceed $1.5 \cdot 10^{-3}$ decades/s. Where the frequency is swept incrementally, the step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency value.

16.3.8 Recording the EUT operating situation during compliance testing and decide the EUT immunity criterion.

16.4 Deviation From Test Standard

No deviation

16.5 Test Data

Please refer to the Attachment G.

17 Photographs - Constructional Details

Photo 1 Appearance of EUT

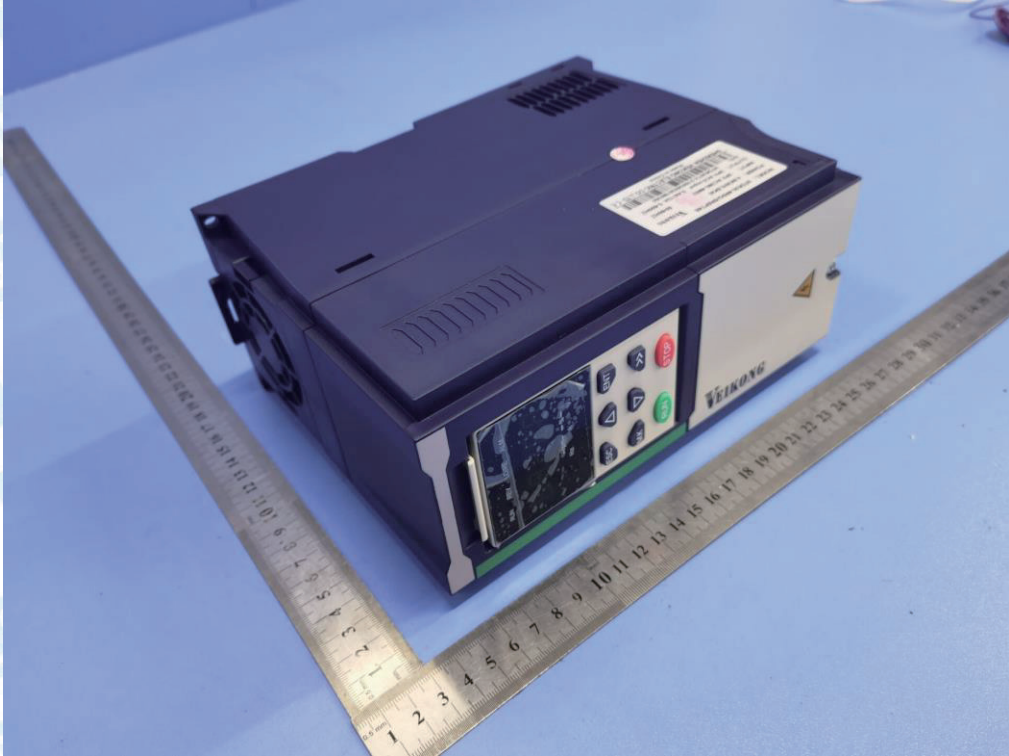


Photo 2 Appearance of EUT

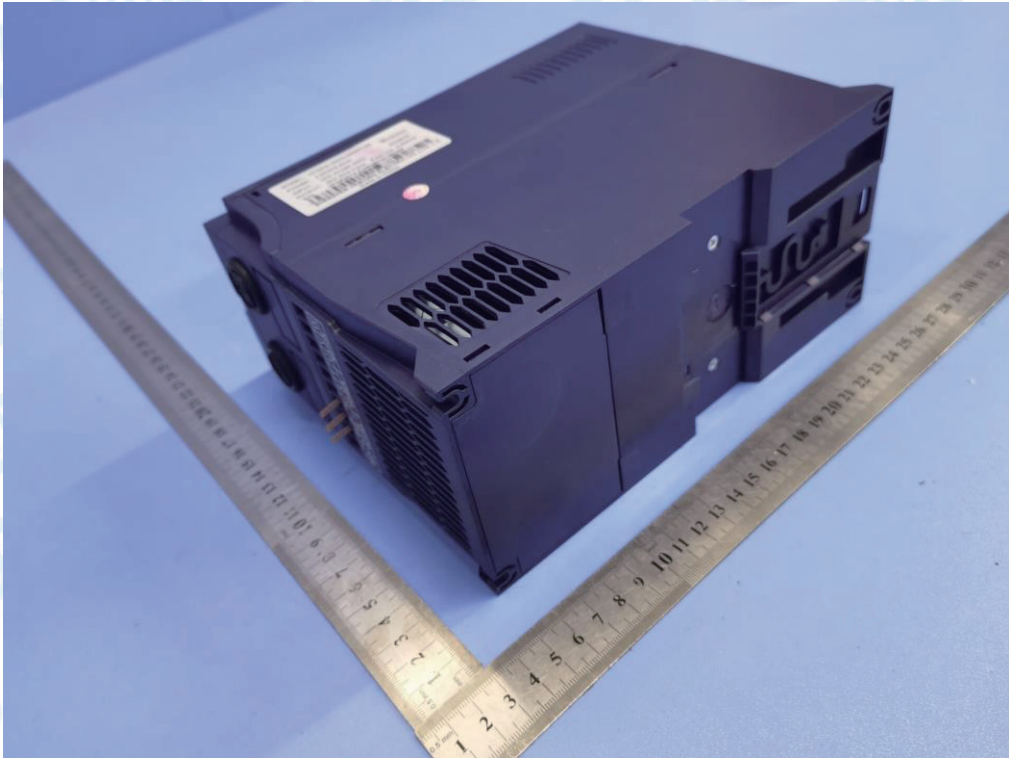
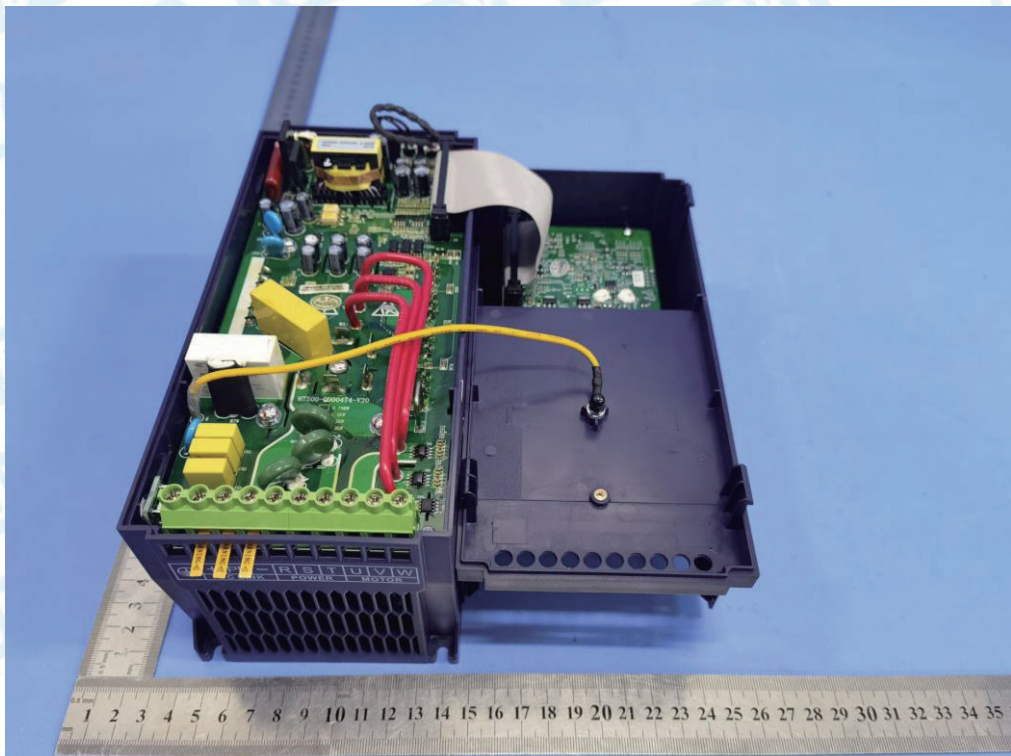


Photo 3 Appearance of EUT

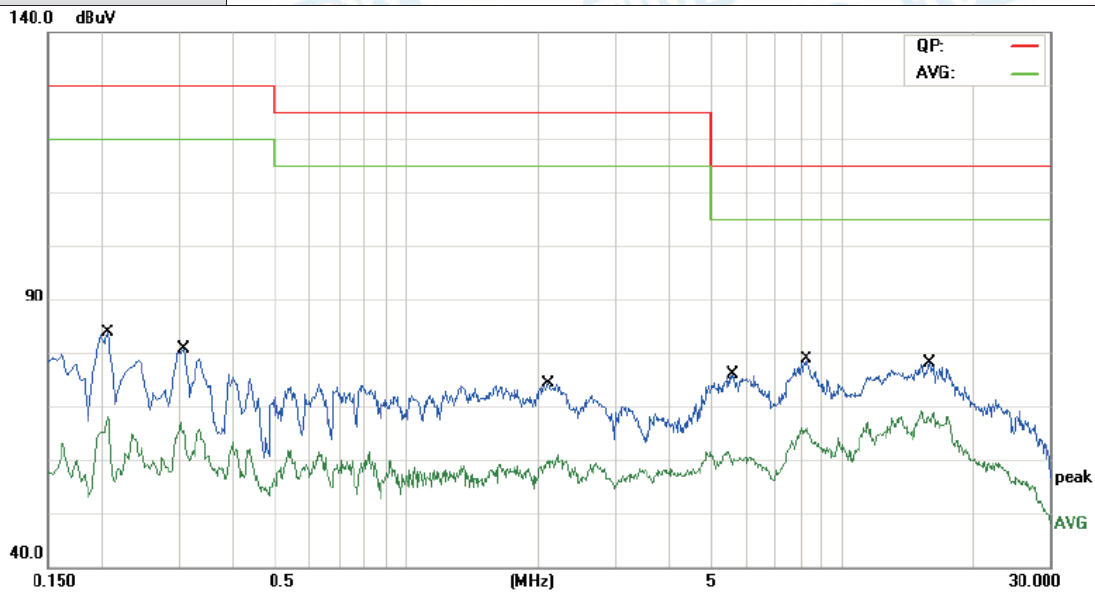


Photo 4 Internal of EUT



Attachment A--Conducted Emission Data (AC Mains)

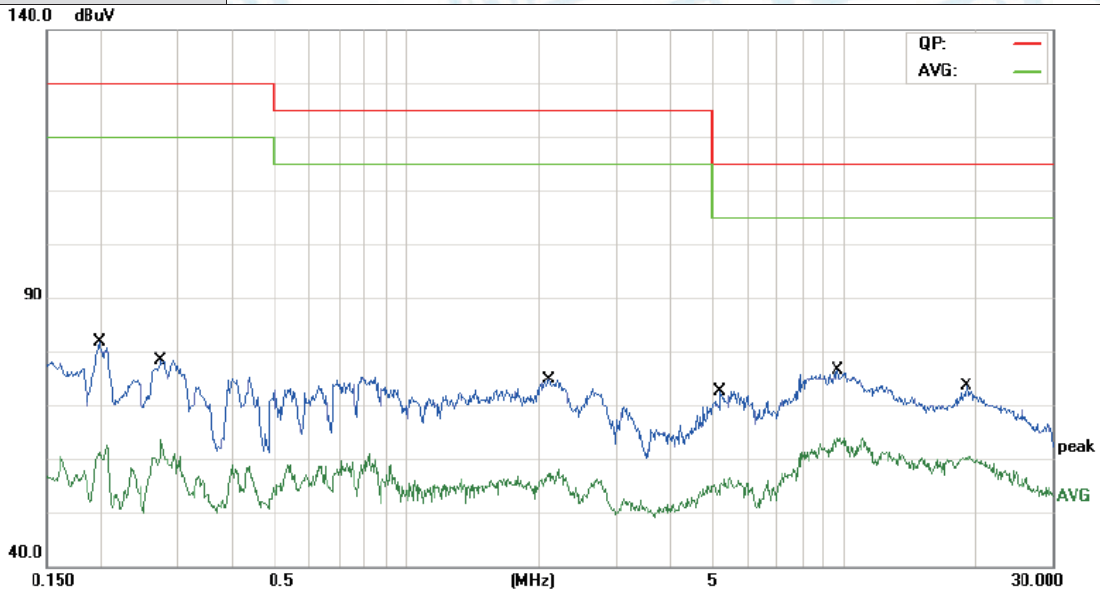
Temperature:	25 °C	Relative Humidity:	55%
Pressure:	1010 hPa		
Test Voltage:	AC 380V/50 Hz		
Terminal:	L1		
Test Mode:	Mode 1		
Remark:	N/A		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.2060	70.57	9.78	80.35	130.0	-49.65	QP
2		0.2060	58.25	9.78	68.03	120.0	-51.97	AVG
3		0.3067	65.96	9.85	75.81	130.0	-54.19	QP
4		0.3067	57.31	9.85	67.16	120.0	-52.84	AVG
5		2.1180	60.61	9.84	70.45	125.0	-54.55	QP
6		2.1180	51.23	9.84	61.07	115.0	-53.93	AVG
7		5.5658	62.09	9.85	71.94	115.0	-43.06	QP
8		5.5658	51.81	9.85	61.66	105.0	-43.34	AVG
9		8.2418	63.97	9.82	73.79	115.0	-41.21	QP
10		8.2418	56.34	9.82	66.16	105.0	-38.84	AVG
11		15.8099	64.41	9.83	74.24	115.0	-40.76	QP
12	*	15.8099	59.28	9.83	69.11	105.0	-35.89	AVG

Emission Level= Read Level+ Correct Factor

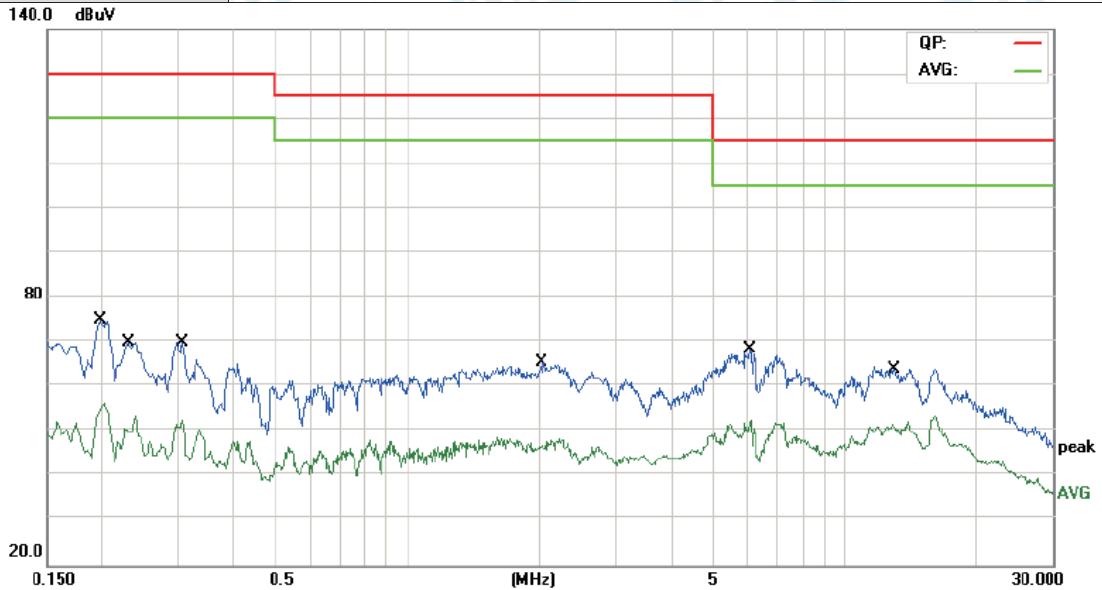
Temperature:	25 °C	Relative Humidity:	55%
Pressure:	1010 hPa		
Test Voltage:	AC 380V/50 Hz		
Terminal:	L2		
Test Mode:	Mode 1		
Remark:	N/A		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1980	67.21	9.78	76.99	130.0	-53.01	QP
2		0.1980	52.75	9.78	62.53	120.0	-57.47	AVG
3		0.2740	63.55	9.82	73.37	130.0	-56.63	QP
4		0.2740	53.73	9.82	63.55	120.0	-56.45	AVG
5		2.1179	61.01	9.84	70.85	125.0	-54.15	QP
6		2.1179	48.23	9.84	58.07	115.0	-56.93	AVG
7		5.2058	58.81	9.86	68.67	115.0	-46.33	QP
8		5.2058	46.71	9.86	56.57	105.0	-48.43	AVG
9		9.7018	62.71	9.82	72.53	115.0	-42.47	QP
10	*	9.7018	54.12	9.82	63.94	105.0	-41.06	AVG
11		19.1178	59.99	9.86	69.85	115.0	-45.15	QP
12		19.1178	50.73	9.86	60.59	105.0	-44.41	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25 °C	Relative Humidity:	55%
Pressure:	1010 hPa		
Test Voltage:	AC 380V/50 Hz		
Terminal:	L3		
Test Mode:	Mode 1		
Remark:	N/A		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1980	65.50	9.56	75.06	130.0	-54.94	QP
2		0.1980	46.78	9.56	56.34	120.0	-63.66	AVG
3		0.2300	60.37	9.64	70.01	130.0	-59.99	QP
4		0.2300	43.85	9.64	53.49	120.0	-66.51	AVG
5		0.3060	60.27	9.70	69.97	130.0	-60.03	QP
6		0.3060	42.92	9.70	52.62	120.0	-67.38	AVG
7		2.0260	55.53	9.86	65.39	125.0	-59.61	QP
8		2.0260	37.01	9.86	46.87	115.0	-68.13	AVG
9		6.0658	58.57	9.84	68.41	115.0	-46.59	QP
10	*	6.0658	58.57	9.84	68.41	105.0	-36.59	AVG
11		12.9900	52.08	9.86	61.94	115.0	-53.06	QP
12		12.9900	41.26	9.86	51.12	105.0	-53.88	AVG

Emission Level= Read Level+ Correct Factor

Attachment B--Radiated Emission Test Data (Below 1G)

Temperature:	23.6°C	Relative Humidity:	42%
Pressure:	1010 hPa		
Test Voltage:	AC 380V/50 Hz		
Ant. Pol.	Horizontal		
Test Mode:	Mode 1		
Remark:			



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1	*	33.7986	47.76	-15.78	31.98	60.00	-28.02	peak
2		40.5591	48.65	-19.27	29.38	60.00	-30.62	peak
3		175.6516	44.13	-20.28	23.85	60.00	-36.15	peak
4		256.5211	50.54	-17.11	33.43	70.00	-36.57	peak
5		385.2805	45.13	-12.98	32.15	70.00	-37.85	peak
6		699.3046	35.65	-6.78	28.87	70.00	-41.13	peak

Emission Level= Read Level+ Correct Factor

Temperature:	23.6°C	Relative Humidity:	42%
Pressure:	1010 hPa		
Test Voltage:	AC 380V/50 Hz		
Ant. Pol.	Vertical		
Test Mode:	Mode 1		
Remark:			



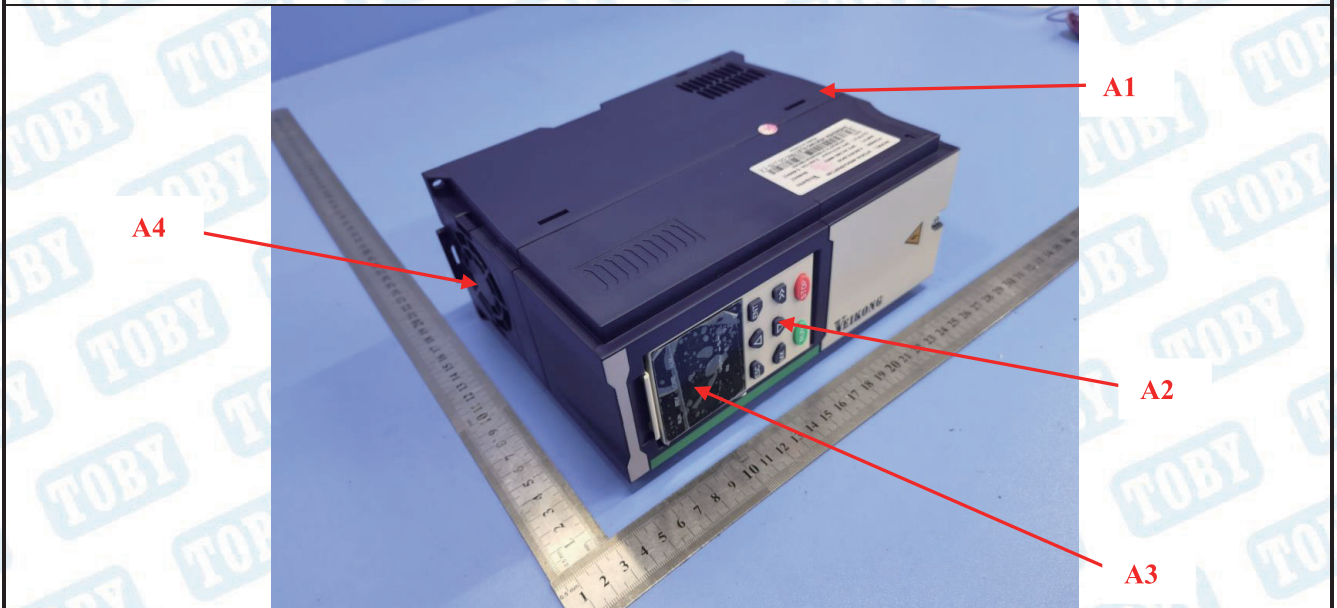
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1	*	40.2757	61.11	-19.13	41.98	60.00	-18.02	peak
2		52.9453	51.56	-23.39	28.17	60.00	-31.83	peak
3		65.8031	50.86	-23.74	27.12	60.00	-32.88	peak
4		112.1305	44.16	-22.27	21.89	60.00	-38.11	peak
5		282.9852	49.81	-16.60	33.21	70.00	-36.79	peak
6		369.4047	49.56	-13.74	35.82	70.00	-34.18	peak

Emission Level= Read Level+ Correct Factor

Attachment C--Electrostatic Discharge Test Data

Temperature : 22°C		Humidity : 50%	
Power supply : AC 380V/50Hz		Test Mode : Mode 1	
Required Performance Criteria: B			
Air Discharge:±8kV Contact Discharge:±4kV			
Location	Test Level (kV)	Judgment	Result
A1	±8kV	A	PASS
A2		A	
A3		A	
A4		A	
/	±4kV	/	
/		/	
/		/	
HCP	±4kV	A	
VCP	±4kV	A	
Note: "/" Representative the test not applicable			

Test Location Photos



Note:

- 1) Criteria A: There was no change operated with initial operating during the test.
- 2) Criteria B: The EUT function loss during the test, but self-recoverable after the test.
- 3) Criteria C: The system shut down during the test.

Attachment D--RF Field Strength Susceptibility Test Data

Temperature : 22°C Humidity : 50%

Power supply : AC 380V/50Hz Test Mode : Mode 1

Required Performance Criteria: A

Position	Frequency Range 1		Frequency Range 2		Frequency Range 3		Result
	80~1000MHz		1400~2000MHz		2000~2700MHz		
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
Front	A	A	A	A	A	A	PASS
Right	A	A	A	A	A	A	
Rear	A	A	A	A	A	A	
Left	A	A	A	A	A	A	

Remark:

- 1) Criteria A: There was no change operated with initial operating during the test.
- 2) Criteria B: The EUT function loss during the test, but self-recoverable after the test.
- 3) Criteria C: The system shut down during the test.

Attachment E--Electrical Fast Transient/Burst Test Data

Temperature : 22°C		Humidity : 50%				
Power supply : AC 380V/50Hz		Test Mode : Mode 1				
Required Performance Criteria: B						
Line : <input checked="" type="checkbox"/> AC Mains Coupling : <input type="checkbox"/> Direct						
Line : <input type="checkbox"/> Signal <input type="checkbox"/> I/O Cable Coupling : <input type="checkbox"/> Capacitive						
Line	Voltage(kV)	Required Performance Criteria		Actual Performance Criteria		Result
		(+)	(-)	(+)	(-)	
L1	2.0	B	B	A	A	PASS
L2	2.0	B	B	A	A	PASS
L3	2.0	B	B	A	A	PASS
PE	2.0	B	B	A	A	PASS
L1-PE	2.0	B	B	A	A	PASS
L2-PE	2.0	B	B	A	A	PASS
L3-PE	2.0	B	B	A	A	PASS
L1-L2	2.0	B	B	A	A	PASS
L1-L3	2.0	B	B	A	A	PASS
L2-L3	2.0	B	B	A	A	PASS
L1-L2-L3	2.0	B	B	A	A	PASS
L1-L2-L3-PE	2.0	B	B	A	A	PASS
DC Port	1.0	B	B	/	/	/
Signal Port	1.0	B	B	/	/	/
Remark:						
1) Criteria A: There was no change operated with initial operating during the test.						
2) Criteria B: The EUT function loss during the test, but self-recoverable after the test.						
3) Criteria C: The system shut down during the test.						

Attachment F--Surge Immunity Test Data

 Temperature : 22°C Humidity : 50%

 Power supply : AC 380V/50Hz Test Mode : Mode 1
Required Performance Criteria: B

Injected Line	Voltage (kV)	Phase	Actual Performance Criteria		Result	
			(+)	(-)	(+)	(-)
L1-L2	1.0	0°	A	A	PASS	PASS
		90°	A	A	PASS	PASS
		180°	A	A	PASS	PASS
		270°	A	A	PASS	PASS
L1-L3	1.0	0°	A	A	PASS	PASS
		90°	A	A	PASS	PASS
		180°	A	A	PASS	PASS
		270°	A	A	PASS	PASS
L2-L3	1.0	0°	A	A	PASS	PASS
		90°	A	A	PASS	PASS
		180°	A	A	PASS	PASS
		270°	A	A	PASS	PASS
L1-GND	2.0	0°	A	A	PASS	PASS
		90°	A	A	PASS	PASS
		180°	A	A	PASS	PASS
		270°	A	A	PASS	PASS
L2-GND	2.0	0°	A	A	PASS	PASS
		90°	A	A	PASS	PASS
		180°	A	A	PASS	PASS
		270°	A	A	PASS	PASS

L3-GND	2.0	0°	A	A	PASS	PASS
		90°	A	A	PASS	PASS
		180°	A	A	PASS	PASS
		270°	A	A	PASS	PASS
DC Port (Line-Line)	0.5	+/-	/	/	/	/
DC Port (Line- Earth)	1.0	+/-	/	/	/	/
Signal Port (Line-Earth)	1.0	+/-	/	/	/	/

Remark:

- 1) Criteria A: There was no change operated with initial operating during the test.
- 2) Criteria B: The EUT function loss during the test, but self-recoverable after the test.
- 3) Criteria C: The system shut down during the test.

Attachment G--Conducted Immunity Test Data

Temperature : 22°C Humidity : 50%

Power supply : AC 380V/50Hz Test Mode : Mode 1

Required Performance Criteria: A

Frequency Range (MHz)	Injected Position	Voltage Level (e.m.f.)	Required Performance Criteria	Actual Performance Criteria	Result
0.15 ~ 80	AC Mains	10V(rms), AM 80% Modulated with 1 kHz	A	A	PASS
0.15 ~ 80	DC Mains	10V(rms), AM 80% Modulated with 1 kHz	A	/	/
0.15 ~ 80	Signal Line	10V(rms), AM 80% Modulated with 1 kHz	A	/	/

Remark:

- 1) Criteria A: There was no change operated with initial operating during the test.
- 2) Criteria B: The EUT function loss during the test, but self-recoverable after the test.
- 3) Criteria C: The system shut down during the test.

----END OF REPORT----