EMC TEST REPORT

Report No.:	SET2015-17457
Product:	SOLAR OFF-GRID INVERTER
Model No:	GF500, GF1000, GF1500, GF2000
Applicant:	EAST Group Co., Ltd.
Address:	No 6 Northern Industry Road, Songshan Lake SCI&TECH Industry Park,DongGuan,P.R.China
Issued by:	CCIC Southern Electronic Product Testing (Shenzhen)CO., Ltd.
Lab location:	Electronic Testing Building, No. 43 Shahe Road, Xili Jiedao, Nanshan District, 518055 Shenzhen, Guangdong, China
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Query No. :SH8AC50S

Report

Product.....:	SOLAR OFF-GRID INVERTER
Model No. .....:	GF500, GF1000, GF1500, GF2000
Brand Name.....:	----
Applicant.....:	EAST Group Co., Ltd.
Applicant Address.....:	No 6 Northern Industry Road, Songshan Lake SCI&TECH Industry Park,DongGuan,P.R.China
Manufacturer.....:	EAST Group Co., Ltd.
Manufacturer Address.....:	No 6 Northern Industry Road, Songshan Lake SCI&TECH Industry Park,DongGuan,P.R.China
Test Standards.....:	**EN 61000-6-2:2005** Electromagnetic compatibility (EMC) -- Part 6-2: Generic standards - Immunity for industrial environments **EN 61000-6-4:2007+A1:2011** Electromagnetic compatibility (EMC) -- Part 6-4: Generic standards - Emission standard for industrial environments **EN61000-3-2:2006+A1:2009+A2:2009** Electromagnetic compatibility (EMC) -- Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase) **EN61000-3-3:2008** Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection
Test Result.....:	Pass
Tested by .....:	Chen Weichang Dec. 01, 2015 Signature, Date
Reviewed by.....:	Zhu Qi Dec. 01, 2015 Signature, Date
Approved by.....:	Wu Lian Dec. 01, 2015 Signature, Date

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1 General Information

1.1 Description of EUT

Product: SOLAR OFF-GRID INVERTER

Model No.: GF500, GF1000, GF1500, GF2000

Brand Name: ----

Serial No.: /

Rating:

GF2000:
DC Input: PV - voltage range: DC45-90 d.c. V
PV current: 80d.c. A max
DC input: 48d.c.V
AC Input: 220 a.c.V,50/60Hz
AC Output: 220 a.c.V,50/60Hz
AC Current: 9.1 a.c. A ,Max. AC current:20a.c.A
Power :2000W.

GF1500:
DC Input: PV - voltage range: DC45-90 d.c.V
PV current: 60d.c.A max
DC input: 48 d.c.V
AC Input: 220 a.c.V, 50/60Hz
AC Output: 220 a.c.V,50/60Hz
AC Current: 6.8 a.c. A, Max. AC current: 15 a.c.A
Power :1500W.

GF1000:
DC Input: PV - voltage range: DC45-90 d.c.V
PV current: 60d.c.A max,
DC input: 48d.c.V
AC Input: 220 a.c.V,50/60Hz
AC Output: 220 a.c.V,50/60Hz
AC Current: 4.5 a.c. A , Max. AC current:10 a.c.A
Power :1000W.

GF500:
DC Input: PV - voltage range: DC22-45d.c.V
PV current: 60d.c.A max
DC input: 24d.c.V
AC Input: 220 a.c.V,50/60Hz
AC Output: 220 a.c.V,50/60Hz
AC Current: 2.3 a.c. A, Max. AC current:5 a.c.A
Power :500W.

Accessories: /

NOTE:

1. For more detailed features description about the EUT, please refer to User's Manual.

2. Model GF500, GF1000, GF1500 and GF2000 are a serious of solar off-grid inverter which converts direct current generated from the PV array field and batteries to alternating current, and it is intended to be connected in parallel with the mains to supply common load. It is intended for professional incorporation into PV system, and it is assessed on a component test basis. Models listed above differ only on their structure and reactor. All tests were performed on Model GF2000. Mains terminal disturbance voltage and Radiated disturbance were performed on the model GF500 and GF1000.

1.2 Objective

Perform ElectroMagnetic Interference (EMI) and ElectroMagnetic Susceptibility (EMS) tests for CE Marking.

2 Test Facilities and Configuration

2.1 Environmental Conditions

During the measurement the environmental conditions were within the listed ranges:

- Temperature: 15-25ºC
- Humidity: 30-60 %
- Atmospheric pressure: 86-106 kPa

2.2 Measurement Uncertainty

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.

- Uncertainty of Conducted Emission, Uc = ±3.6dB
- Uncertainty of Radiated Emission, Uc = ±4.7dB

2.3 Test Standards and Results

The EUT has been tested according to the following specifications:

EMISSION		
Standard	**Test Type**	**Result**
EN 61000-6-4:2007+A1:2011	Mains terminal disturbance voltage	PASS
	Radiated disturbance	PASS
EN61000-3-2: 2006+A1:2009+A2:2009	Harmonic current emissions	PASS
EN61000-3-3: 2008	Voltage fluctuation & flicker	PASS

IMMUNITY (EN61000-6-2:2005)		
Basic Standard	**Test Type**	**Result**
IEC 61000-4-2	Electrostatic discharge immunity	PASS
IEC 61000-4-3	Radiated, radio frequency electromagnetic field immunity	PASS
IEC 61000-4-4	Electrical fast transient/burst immunity	PASS
IEC 61000-4-5	Surge immunity	PASS
IEC 61000-4-6	Immunity to conducted disturbances induced by RF fields	PASS
IEC 61000-4-8	Power frequency magnetic field immunity	PASS
IEC 61000-4-11	Voltage dips and short interruptions immunity	PASS

NOTE: The latest versions of basic standards are applied.

2.4 List of Equipments Used

Description	Manufacturer	Model No.	Calibration Due Date	Serial No.
Test Receiver	ROHDE&SCHWARZ	ESCS30	Jun.10, 2013	A0304260
Test Receiver	ROHDE&SCHWARZ	ESIB26	Jun.10, 2013	A0304218
LISN	SCHWARZBECK	ESH2-Z5	Jun.10, 2013	A0304221
Broadband Ant.	ROHDE&SCHWARZ	HL562	Jun.10, 2013	A0304262
Antenna	Amplifier Research	AR AT1080	Jun.10, 2013	A0304249
Antenna	Amplifier Research	AT4002A	Jun.10, 2013	A0304250
ESD Test System	EM TEST	ESD30C	Jul.03, 2013	A0712513
EFT Test System	Hangzhou Yuanfang	EMS61000-4A	Feb.19, 2013	YY106898N 1010005
Surge Test System	EM TEST	VCS500M10	Jun.10, 2013	A0712509
Signal Generator	ROHDE&SCHWARZ	SML01	Jun.10, 2013	A0502382
Signal Generator	ROHDE&SCHWARZ	SMR27	Jun.10, 2013	A0304219
Power Amplifier	Amplifier Research	150W1000	/	A0304247
Power Amplifier	Amplifier Research	25S1g4AM1	/	A0304248
Signal Generator	ROHDE&SCHWARZ	SML01	Jun.10, 2013	1090.3000.11
Power Amplifier	Amplifier Research	75A250AM	/	A0304255
CDN	ROHDE&SCHWARZ	M3	/	A0304258
Anechoic Chamber	Albatross	EMC 12.8*6.8*6.4(m)	Mar.09, 2014	A0802520
Magnetic Field Tester	HAEFELY	MAG 100.1	Jun.10, 2013	A0103109
Power Quality Analyzer	Fluke	F435	Jun.10, 2013	--
Power Frequency Test System	CI	15003iX-400-CTS	Aug.10, 2013	A0801521

NOTE: Equipments above have been calibrated and are in the period of validation.

3 Emission Test

3.1 EUT Setup and Operating Conditions

The EUT was powered by 230V 50Hz AC mains and continuously operated.
Environment Condition:
Temperature: 20°C; Relative Humidity: 54%; Pressure:101kPa
Test Date: 2012-11-16~2012-11-30
Test Engineer: Zeng Wenying
Test Site: EMC Lab

3.2 Mains Terminal Disturbance Voltage Measurement

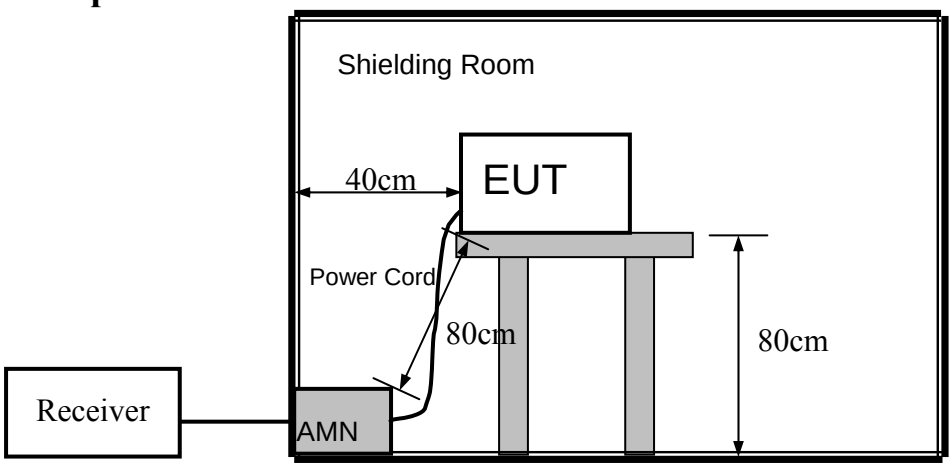
3.2.1 Limits of Mains Terminal Disturbance Voltage

Frequency range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 - 0.5	79	66
0.5 - 30	73	60

NOTE:

1. The lower limit shall apply at the transition frequencies.

3.2.2 Test Setup



3.2.3 Test Result

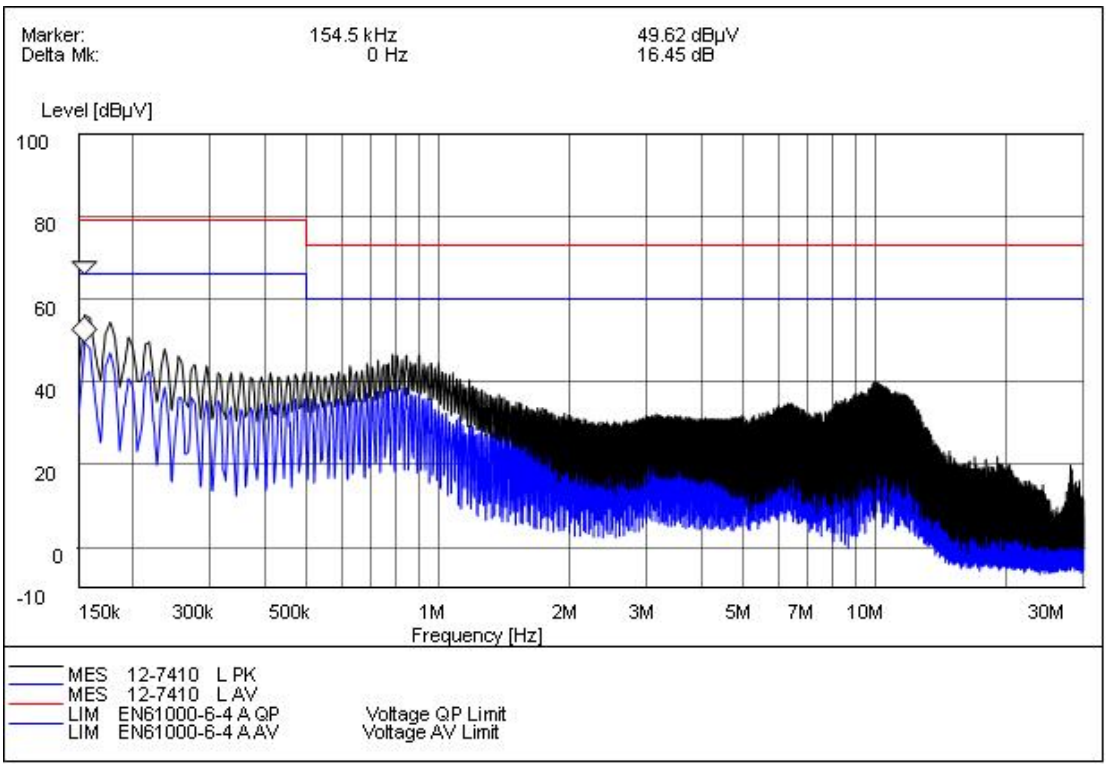
No.	Freq. (MHz)	Limit Value (dBμV)		Emission Level (dBμV)	
		QP	AV	QP	AV
GF500					
1	0.1545	79.0	66.0	53.80	NOTE(2)
2	0.1590	79.0	66.0	55.70	NOTE(2)
3	0.1770	79.0	66.0	54.10	NOTE(2)
4	0.8025	73.0	60.0	45.70	NOTE(2)
GF1000					
1	0.1770	79.0	66.0	56.60	NOTE(2)
2	6.5075	73.0	60.0	50.80	NOTE(2)
3	7.5470	73.0	60.0	45.20	NOTE(2)
4	8.0375	73.0	60.0	54.40	NOTE(2)
GF2000					
1	0.15 – 0.5	79	66	< 40	NOTE(2)
2	0.5 – 30	73	60	< 40	NOTE(2)

NOTE:

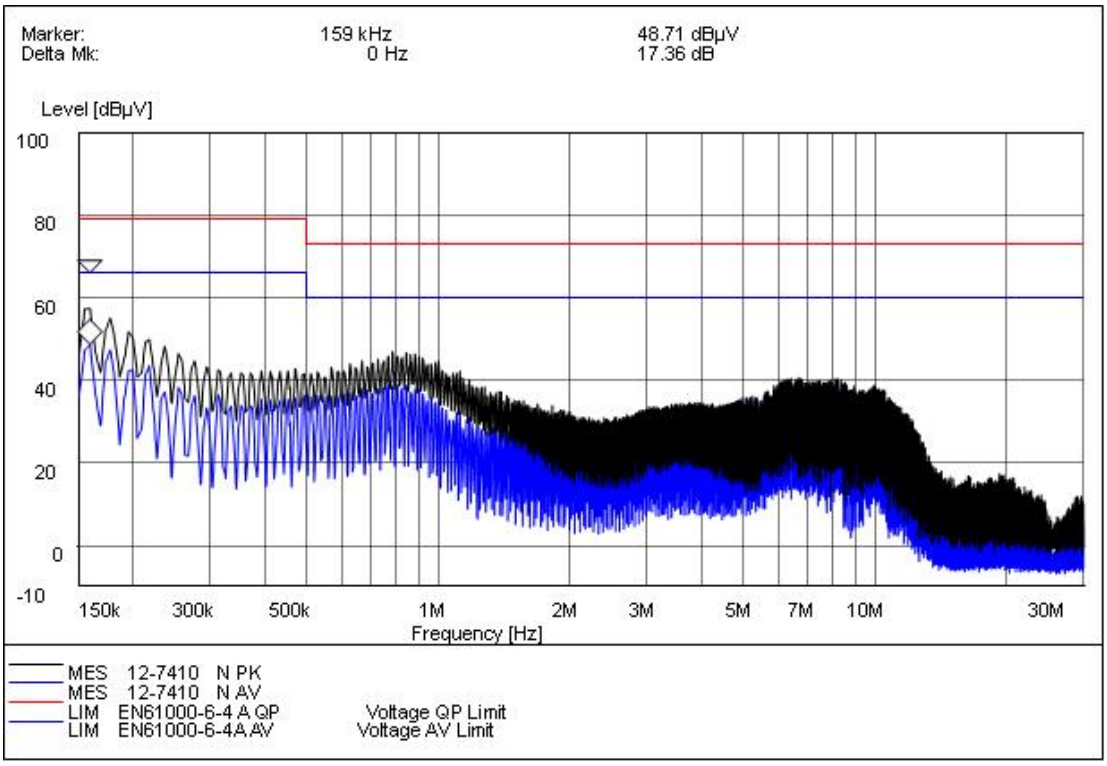
1. QP and AV are abbreviations of the quasi-peak and average individually.
2. If the emission levels measured with QP detector are lower than AV limits, there is unnecessary to measure with AV detector.
3. The emission levels recorded above is the larger ones of each phase.

Measurement Plots of GF500

Test Curve : Mains terminal disturbance voltage，L phase

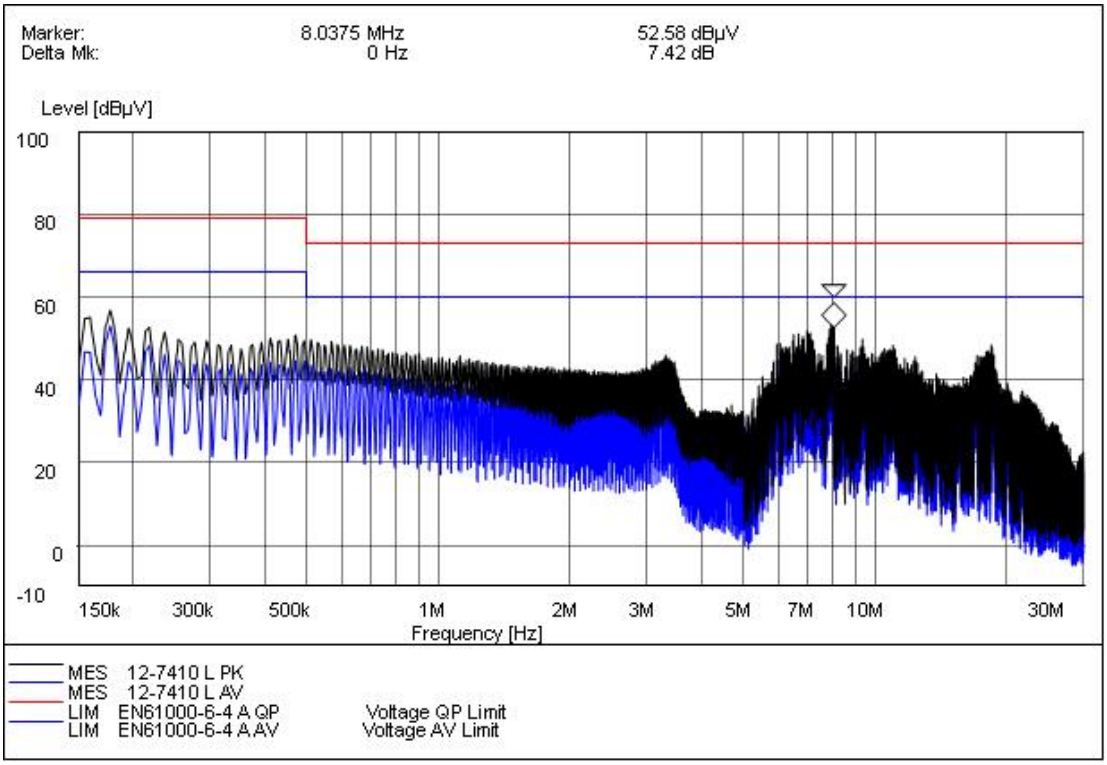


Mains terminal disturbance voltage，N phase

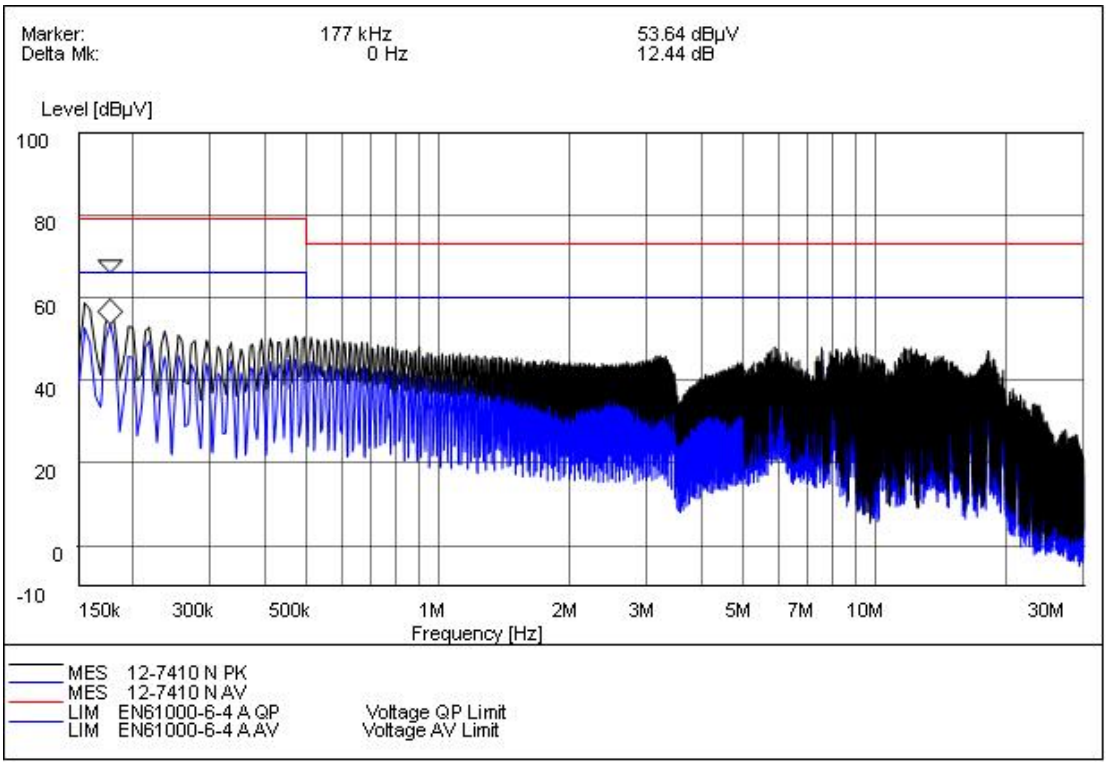


Measurement Plots of GF1000

Test Curve : Mains terminal disturbance voltage，L phase

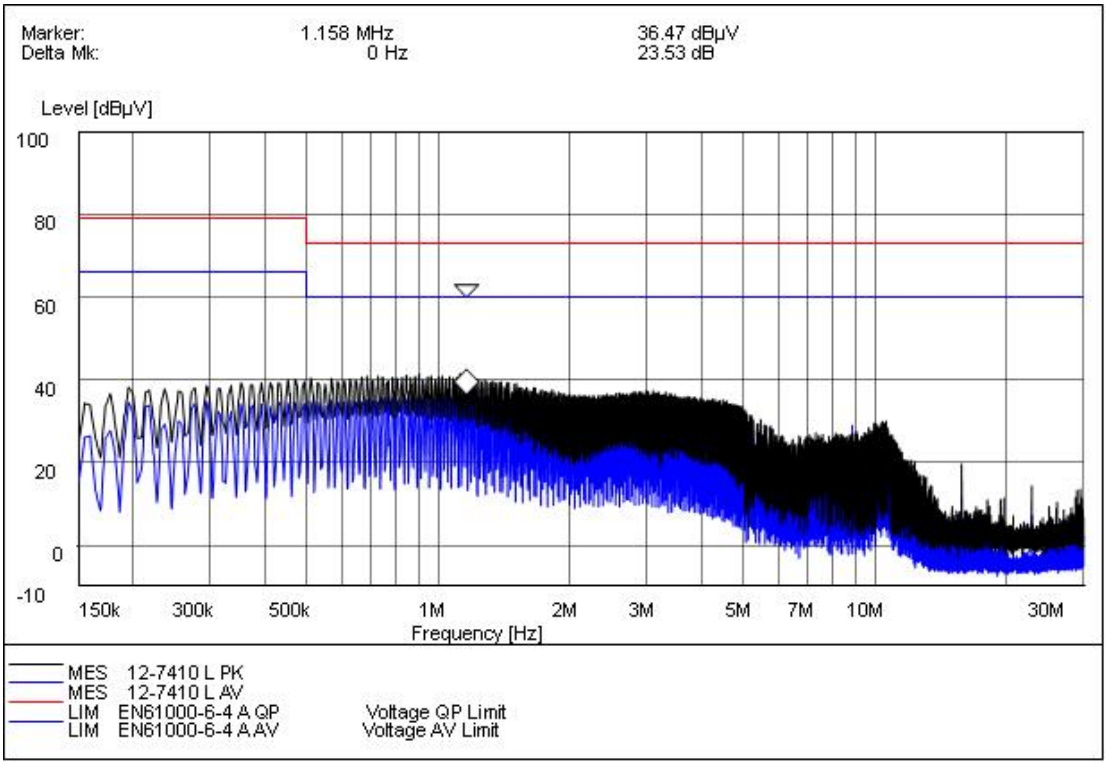


Mains terminal disturbance voltage，N phase

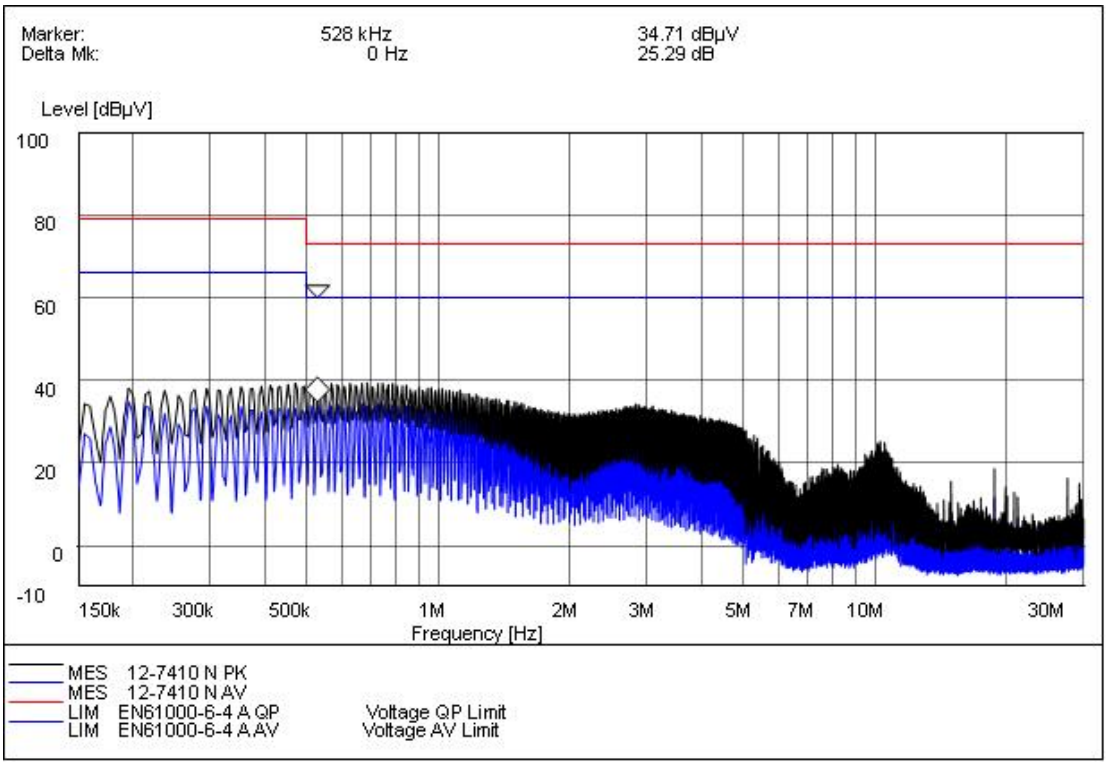


Measurement Plots of GF2000

Test Curve : Mains terminal disturbance voltage，L phase



Mains terminal disturbance voltage，Nphase



3.3 Radiated Disturbance Measurement

3.3.1 Limits of Radiated Disturbance

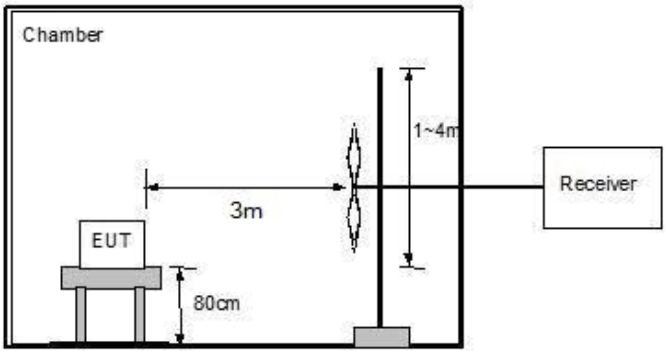
Frequency range (MHz)	Quasi peak limits(dBμV/m), at 3m measurement distance
30 – 230	50
230 - 1000	57

Notes:

(1) The lower limit shall apply at the transition frequency.

(2) Additional provisions may be required for cases where interference occurs.

3.3.2Test Setup



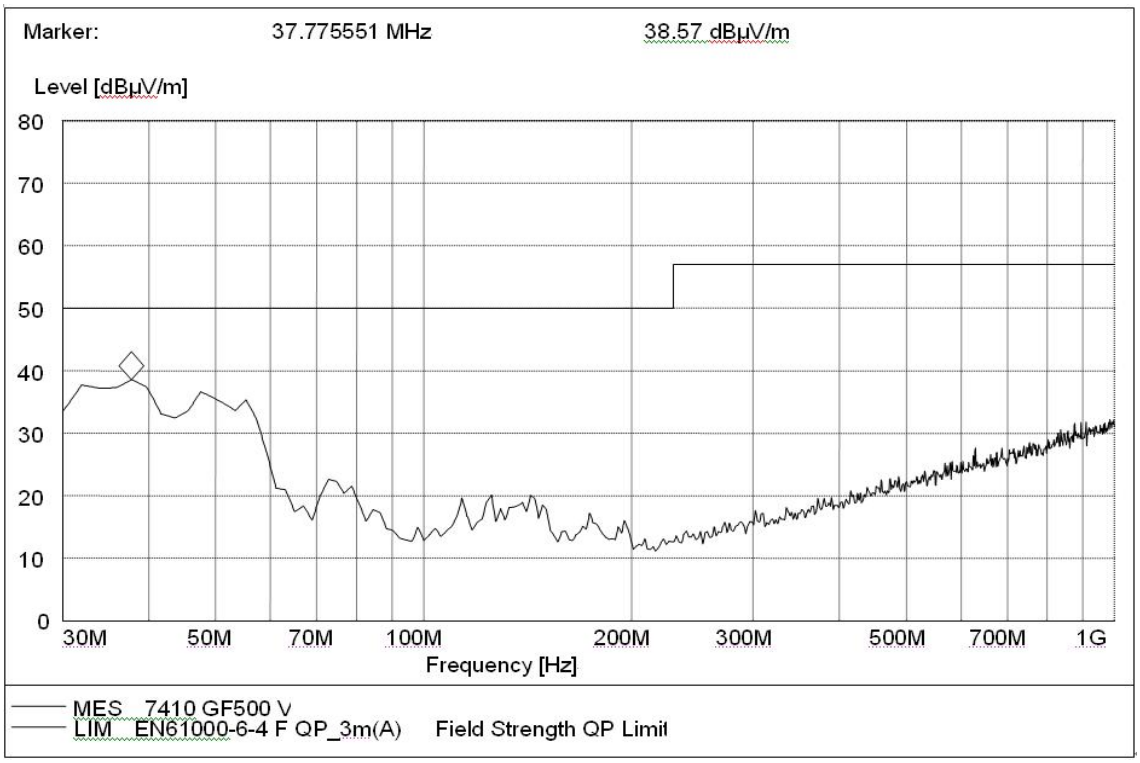
3.3.3 Test Result

No.	Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Table Angle (Degree)	QP Limits (dBμV/m)	Emission Level (dBμV/m)
GF500						
1	30 - 230	H/V	100~400	0~360	50	< 40
2	230 - 1000	H/V	100~400	0~360	57	< 40
GF1000						
1	39.47	V	100	0	50	44.75
2	53.73	V	100	0	50	37.27
3	30 - 230	H	100~400	0~360	50	< 40
4	230 - 1000	H/V	100~400	0~360	57	< 40
GF2000						
1	30 - 230	H/V	100~400	0~360	50	< 40
2	230 - 1000	H/V	100~400	0~360	57	< 40

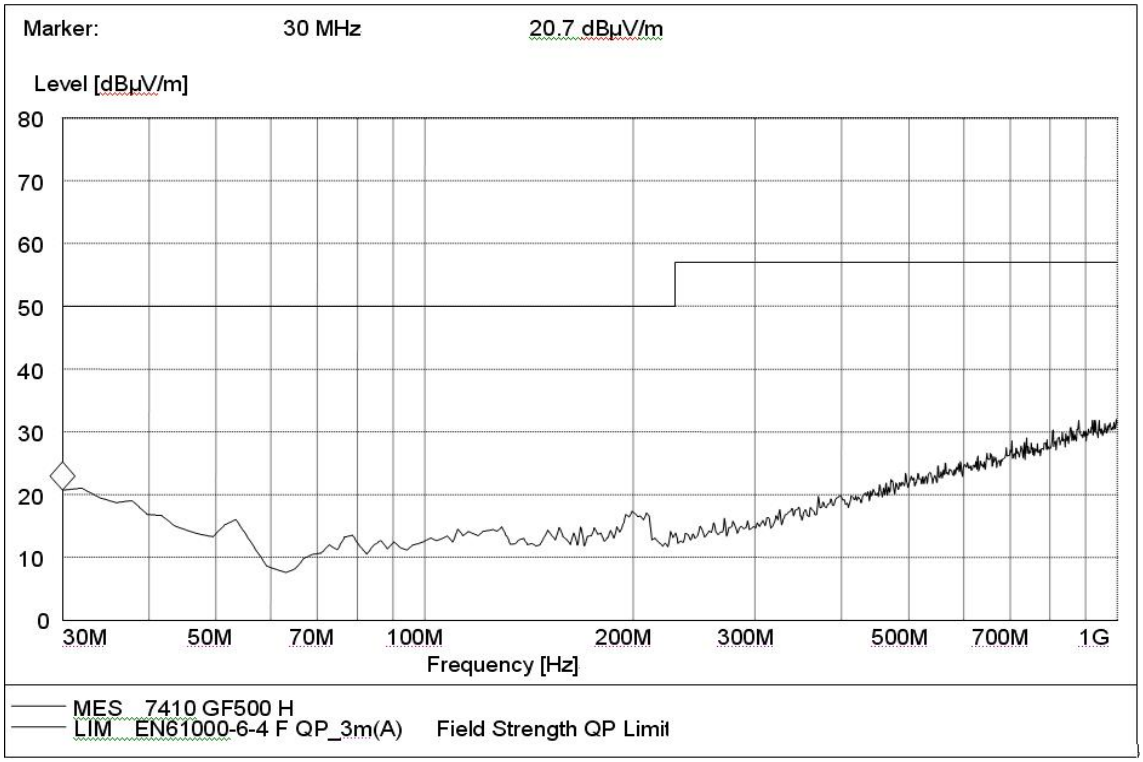
Measurement Plots of GF500

Test Curve

1. Electromagnetic radiation disturbances, max peak detector, antenna polarization: Vertical



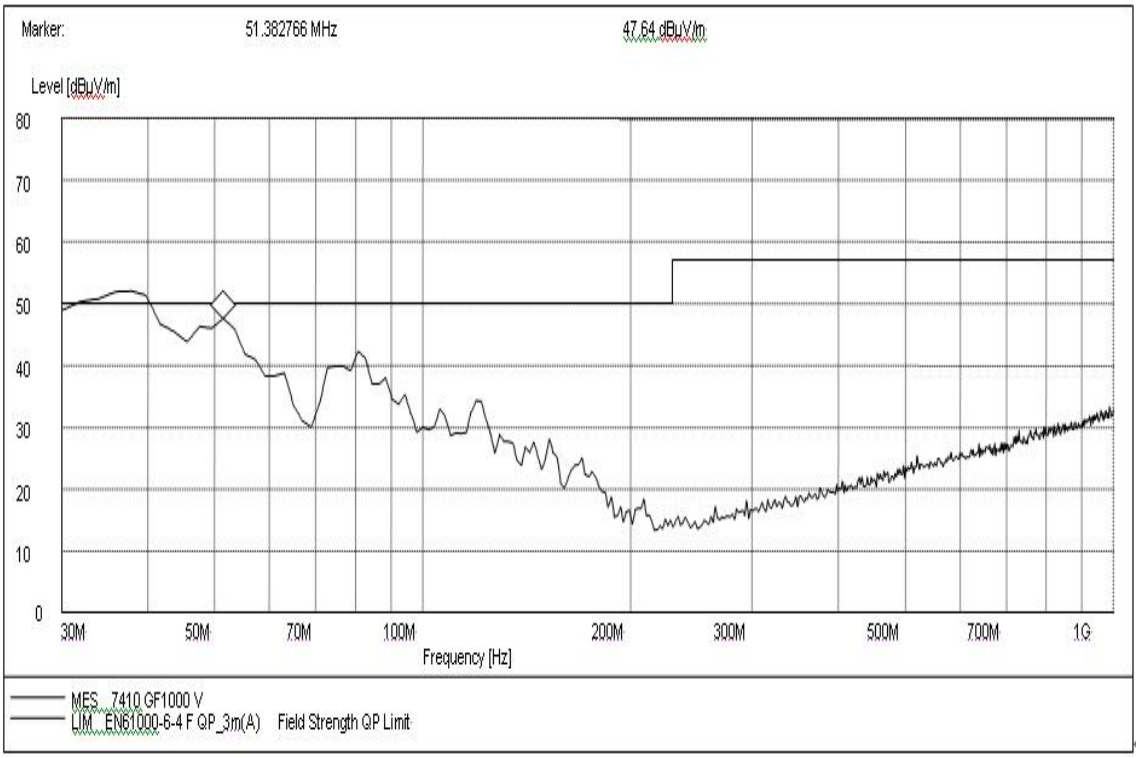
2. Electromagnetic radiation disturbances, max peak detector, antenna polarization: Horizontal



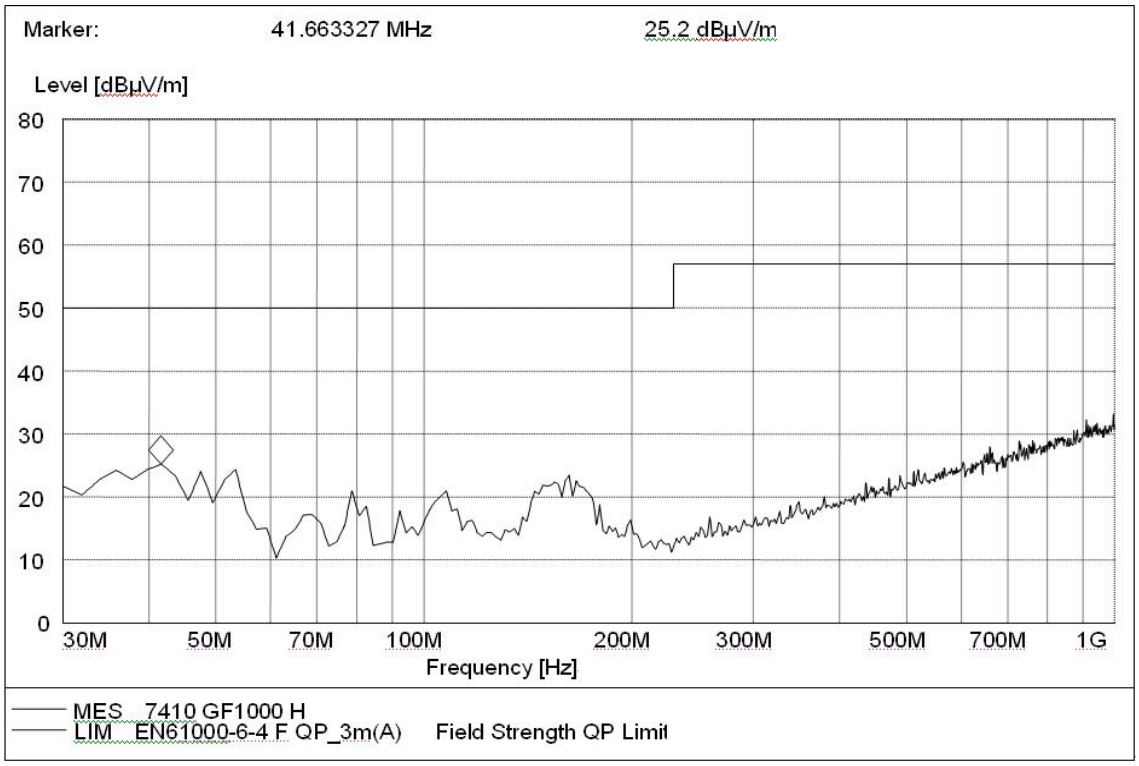
Measurement Plots of GF1000

Test Curve

1. Electromagnetic radiation disturbances, max peak detector, antenna polarization: Vertical



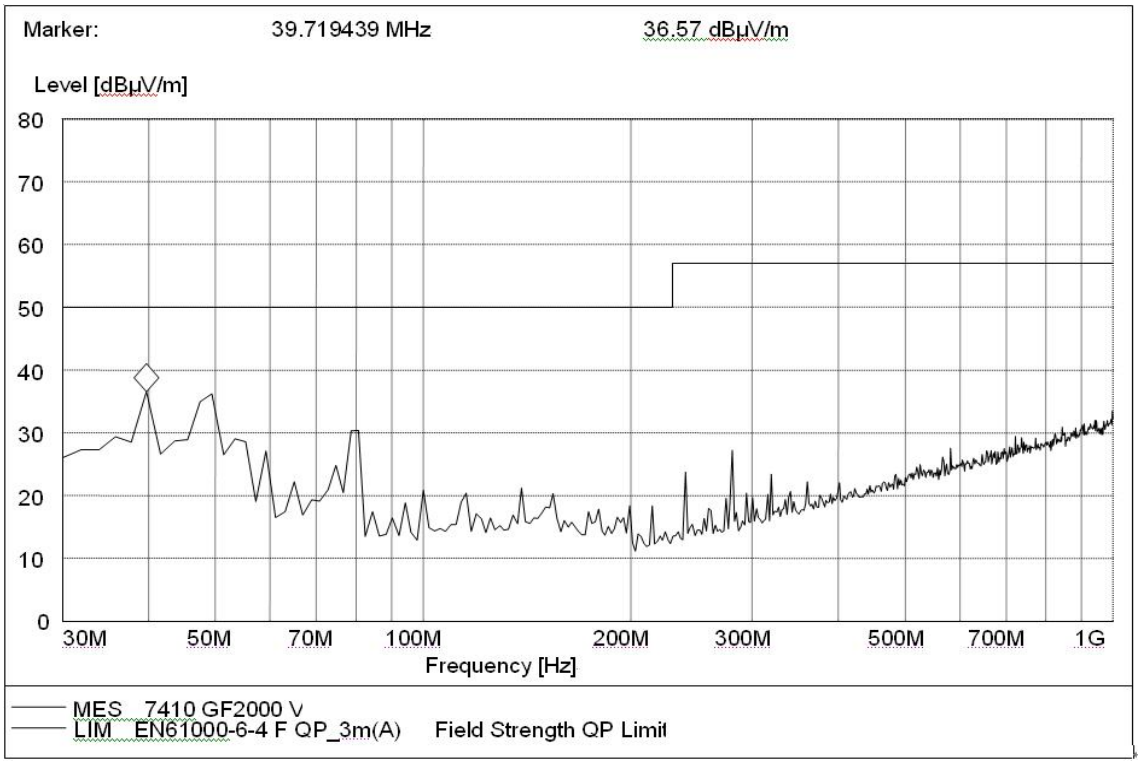
2. Electromagnetic radiation disturbances, max peak detector, antenna polarization: Horizontal



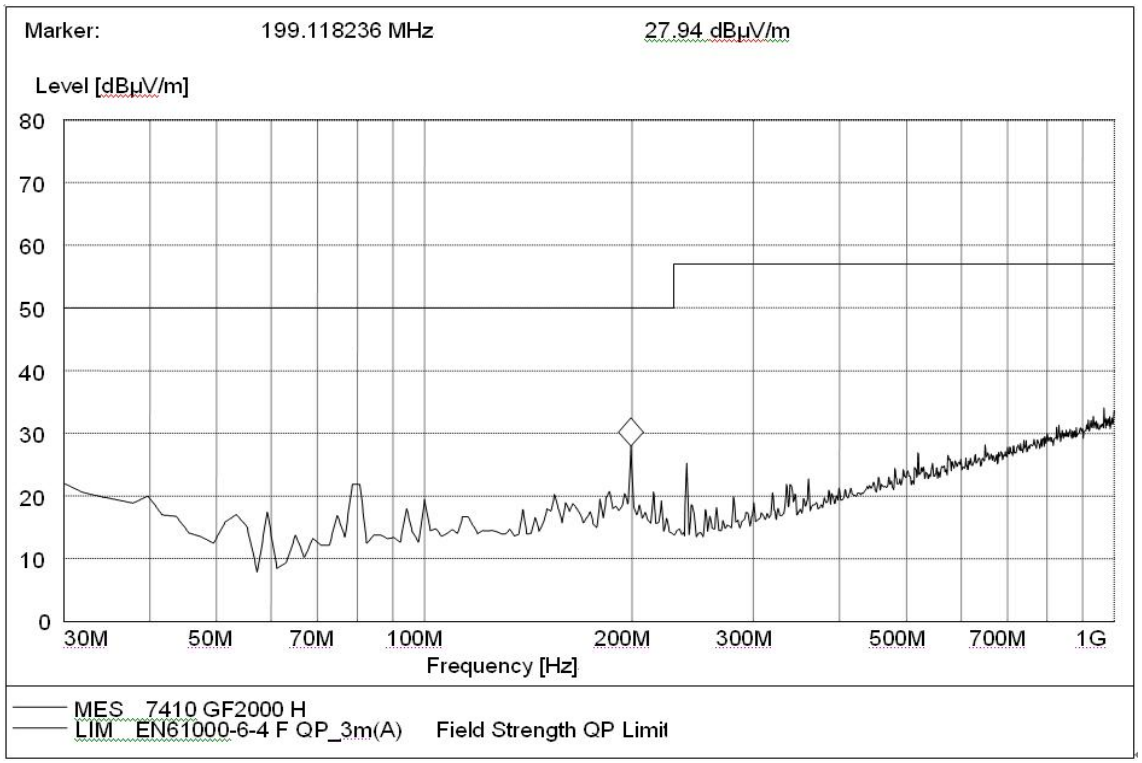
Measurement Plots of GF2000

Test Curve

1. Electromagnetic radiation disturbances, max peak detector, antenna polarization: Vertical



2. Electromagnetic radiation disturbances, max peak detector, antenna polarization: Horizontal



3.4 Harmonic Current Measurement

3.4.1 Limits of Harmonic Current

Limits for Class A Equipment	
Harmonics Order n	**Max. 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≤n≤39	0.15×15/n
Even harmonics	
2	1.08
4	0.43
6	0.30
8≤n≤40	0.23×8/n

NOTE:

1. According to section 5 of EN61000-3-2, the EUT is Class A equipment.
2. The above limits are for all applications having an active input power>75W. No limits apply for equipment with an active input power up to and including 75W.

3.4.2 Test Procedure

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

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

Test Result

The active input power of the EUT is 2010W.
The circuit power factor of the EUT is 0.995.

Harmonics Order	Harmonics Current (A)	Limit (A)		Harmonics Order	Harmonics Current (A)	Limit (A)
1	--	--		2	0.030	1.08
3	0.125	2.3		4	0.010	0.43
5	0.039	1.14		6	0.002	0.3
7	0.013	0.77		8	0.001	0.23
9	0.004	0.4		10	0.001	0.184
11	0.002	0.33		12	0.001	0.153
13	0.001	0.21		14	0.000	0.131
15	0.001	0.15		16	0.001	0.115
17	0.001	0.132		18	0.001	0.102
19	0.001	0.118		20	0.001	0.092
21	0.001	0.107		22	0.00	0.084
23	0.000	0.098		24	0.000	0.077
25	0.001	0.09		26	0.001	0.071
27	0.001	0.083		28	0.000	0.066
29	0.000	0.078		30	0.000	0.061
31	0.000	0.073		32	0.000	0.058
33	0.000	0.068		34	0.000	0.054
35	0.000	0.064		36	0.000	0.051
37	0.000	0.061		38	0.000	0.048
39	0.000	0.058		40	0.000	0.046

3.5 Voltage Fluctuation and Flick Measurement

3.5.1 Limits of Voltage Fluctuation and Flick

Test Item	Limit	Note
P_{st}	1.0	P_{st} means Short-term flicker indicator
P_{lt}	0.65	P_{lt} means long-term flicker indicator
T_{dt}	500mS	T_{dt} means maximum time that d_t exceeds 3%
d_{max}(%)	4%	d_{max} means maximum relative voltage change.
d_c(%)	3.3%	d_c means relative steady-state voltage change.

3.5.2 Test Procedure

a. The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the most unfavorable sequence of voltage changes under normal conditions

b. During the flick measurement, the measure time shall include that part of whole operation changes. The observation period for short-term flicker indicator is 10 minutes and the observation period for long-term flicker indicator is 2 hours.

3.5.3 Test Result

Test Specification

Test Frequency:	50Hz	**Test Voltage:**	230Vac
Waveform:	Sine	**Test Time:**	10 minutes(P_{st}); 2 hours (P_{lt})

Test Result

Test Parameter	Measurement Value	Limit	Remarks
P_{st}	0.064	1.0	Pass
P_{lt}	0.028	0.65	Pass
$T_{dt(s)}$	0.0	500mS	Pass
d_{max}(%)	0.18%	4%	Pass
d_c(%)	0.22%	3.3%	Pass

4 Immunity Test

4.1 EUT Setup and Operating Conditions

The EUT was powered by 230V 50Hz AC mains and continuously operated.
Environment Condition:
Temperature: 22°C; Relative Humidity: 56%; Pressure:101kPa
Test Date: 2012-12-1~2012-12-12
Test Engineer: Li Xiaojun
Test Site: EMC Lab

4.2 Performance Criteria

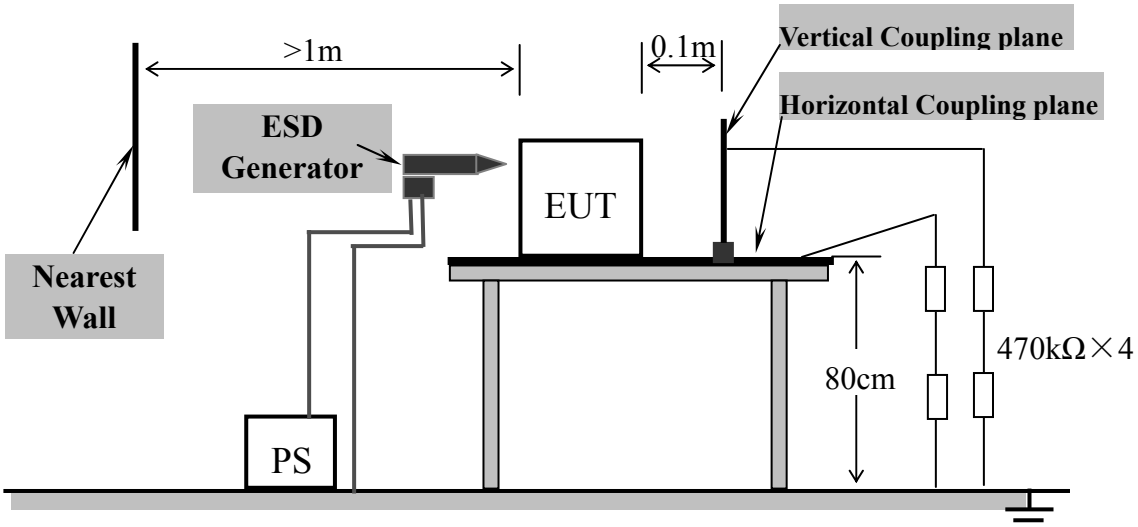
Criterion A	The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended.
Criterion B	The apparatus shall continue to operate as intended after the test. 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.
Criterion C	Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

4.3 Electrostatic Discharge Immunity Test

4.3.1 Test Specification

Basic Standard:	IEC 61000-4-2
Discharge Impedance	330Ω / 150 pF
Discharge Voltage:	Air Discharge : 8 kV Contact Discharge : 4kV
Polarity:	Positive / Negative
Number of Discharge:	Minimum 20 times at each test point
Discharge Mode:	Single discharge
Discharge Period:	1-second minimum

4.3.2 Test Setup



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

4.3.3 Test Result

Test Points	Discharge Level (kV)	Discharge Mode	Observation	Comply with Criterion
Aperture of the cover	±8	Air	Note(1)	A
Screen	±8	Air	Note(1)	A
Button	±8	Air	Note(1)	A
Metallic shell of connecters	±4	Contact	Note(1)	A
HCP	±4	Contact	Note(1)	A
VCP	±4	Contact	Note(1)	A

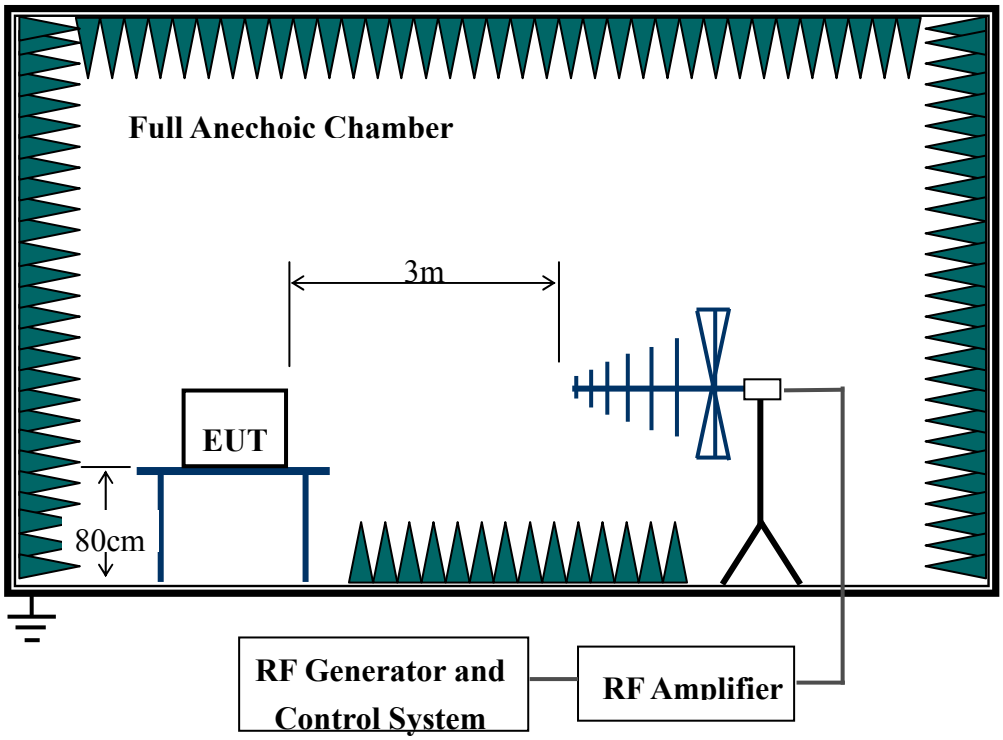
NOTE:
(1). The EUT continued to operate as intended. No degradation of performance was observed.

4.4 Radiated, Radio Frequency Electromagnetic Field Immunity Test

4.4.1 Test Specification

Basic Standard:	IEC 61000-4-3		
Frequency Range:	80 MHz – 1000MHz	1.4GHz – 2.0GHz	2.0GHz – 2.7GHz
Field Strength:	10V/m	3V/m	1V/m
Modulation:	1kHz sine wave, 80%, AM modulation		
Frequency Step:	1% of fundamental		
Polarity of Antenna	Horizontal and Vertical		
Test Distance:	3m		
Antenna Height:	1.5m		
Dwell Time:	3 seconds		

4.4.2 Test Setup



4.4.3 Test Result

Frequency	Polarity	Azimuth	Field Strength (V/m)	Observation	Comply with Criterion
80-1000 MHz	V&H	0,90,180, 270	10	Note(1)	A
1.4-2.0GHz	V&H	0,90,180, 270	3	Note(1)	A
2.0-2.7GHz	V&H	0,90,180, 270	1	Note(1)	A

NOTE:

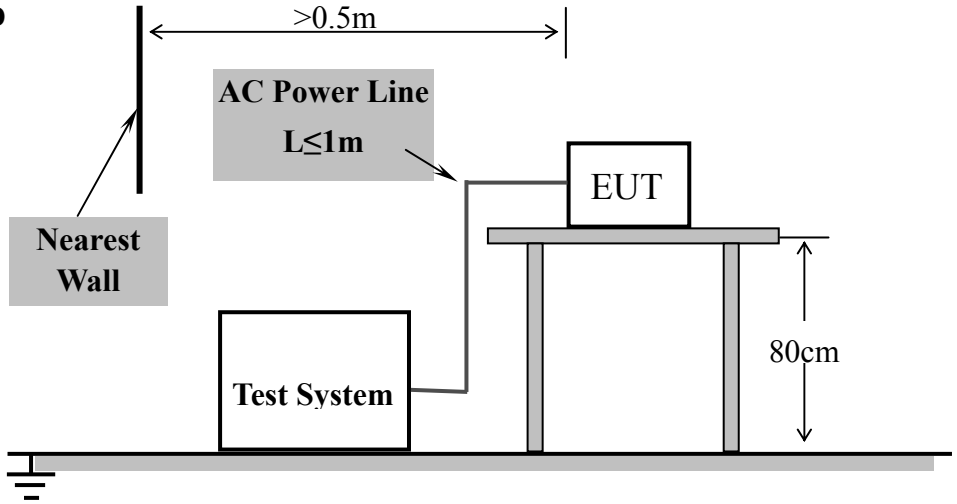
(1). The EUT continued to operate as intended. No degradation of performance was observed.

4.5 Electrical Fast Transient/Burst Immunity Test

4.5.1 Test Specification

Basic Standard:	IEC 61000-4-4
Test Voltage:	AC. power port:2 kV
Polarity:	Positive/Negative
Impulse Frequency:	5kHz
Impulse wave shape:	5/50ns
Burst Duration:	15ms
Burst Period:	300ms
Test Duration:	Not less than 1 min.

4.5.2 Test Setup



4.5.3 Test Result

Test Point	Polarity	Test Level (kV)	Observation	Comply with Criterion
AC Power Port	+/-	2	Note (1)	B

NOTE:

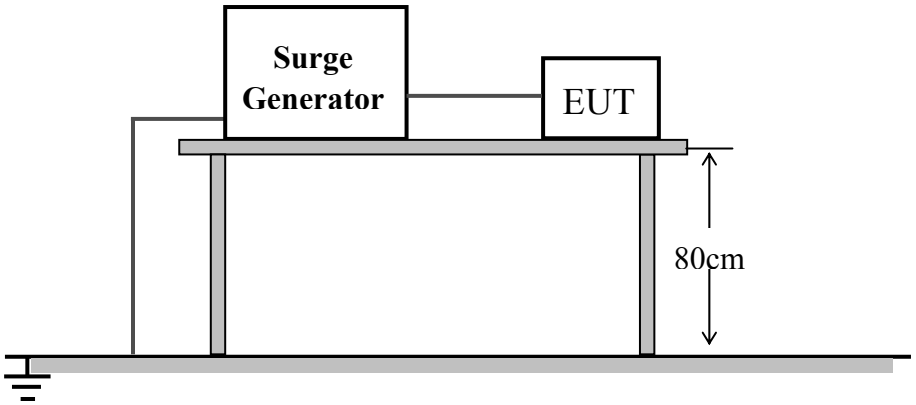
(1). The EUT continued to operate as intended. No degradation of performance was observed.

4.6 Surge Immunity Test

4.6.1 Test Specification

Basic Standard:	IEC 61000-4-5
Waveform:	Voltage 1.2/50 μs; Current 8/20 μs
Test Voltage:	a.c. power port, line to line 1 kV, line to earth 2kV
Polarity:	Positive/Negative
Phase Angle:	0°, 90°, 180°, 270°
Repetition Rate:	60sec
Times:	5 time/each condition.

4.6.2 Test Setup



4.6.3 Test Result

Coupling Line	Polarity	Voltage (kV)	Observation	Comply with Criterion
AC power, Line-Line	+/-	1	Note (1)	B
AC power, Line-Earth	+/-	2	Note (1)	B

NOTE:

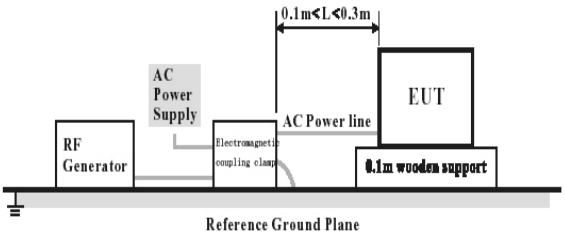
(1). The EUT continued to operate as intended. No degradation of performance was observed.

4.7 Immunity to Conducted Disturbances Induced by RF Fields

4.7.1 Test Specification

Basic Standard:	IEC 61000-4-6
Frequency Range:	0.15 MHz – 80 MHz
Field Strength:	10V
Modulation:	1 kHz Sine Wave, 80%, AM Modulation
Frequency Step:	1% of fundamental
Coupled Cable:	AC. power line
Coupling Device:	Electromagnetic coupling clamp

4.7.2 Test Setup



4.7.3 Test Result

Test Point	Frequency	Field Strength (Vrms)	Observation	Comply with criterion
AC. power line	0.15 – 80 MHz	10	Note(1)	A

NOTE:

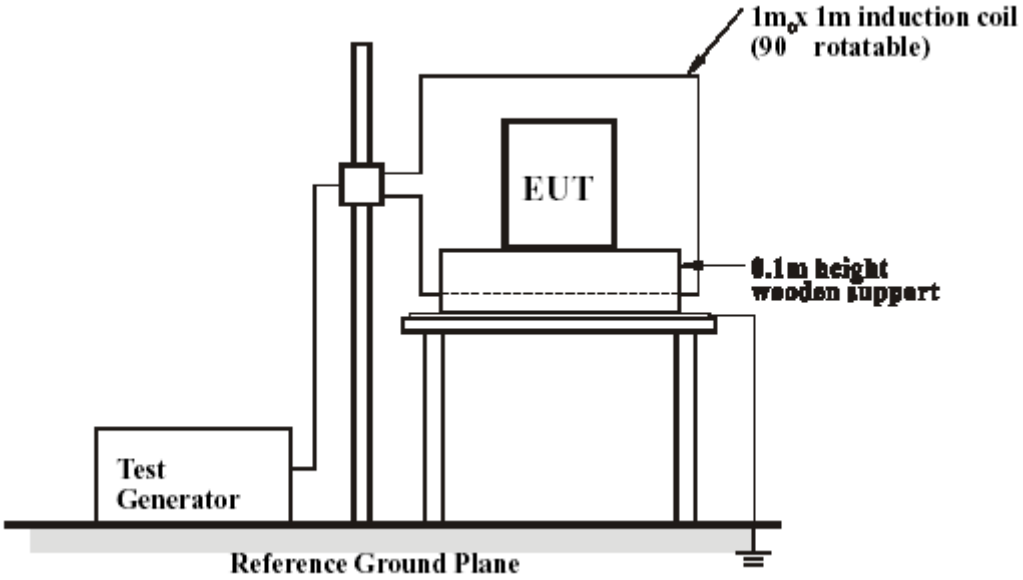
(1). The EUT continued to operate as intended. No degradation of performance was observed.

4.8 Power Frequency Magnetic Field Immunity Test

4.8.1 Test Specification

Basic Standard:	IEC 61000-4-8
Frequency Range:	50Hz
Field Strength:	30A/m
Observation Time:	2 minute
Inductance Coil:	Rectangular type, 1m×1m

4.8.2 Test Setup



4.8.3 Test Resut

Direction	Field Strength(A/m)	Observation	Comply with Criterion
X	30	Note(1)	A
Y	30	Note(1)	A
Z	30	Note(1)	A

NOTE:

(1). The EUT continued to operate as intended. No degradation of performance was observed

4.9 Voltage Dips and Short Interruptions Immunity Test

4.9.1 Test Specification

Basic Standard:	IEC 61000-4-11
Voltage Dips:	100% reduction, 0.5 period 60% reduction, 10 periods 30% reduction, 25 periods
Voltage Interruptions:	100% reduction, 250 periods
Voltage Phase Angle:	0°

4.9.2 Test Procedure

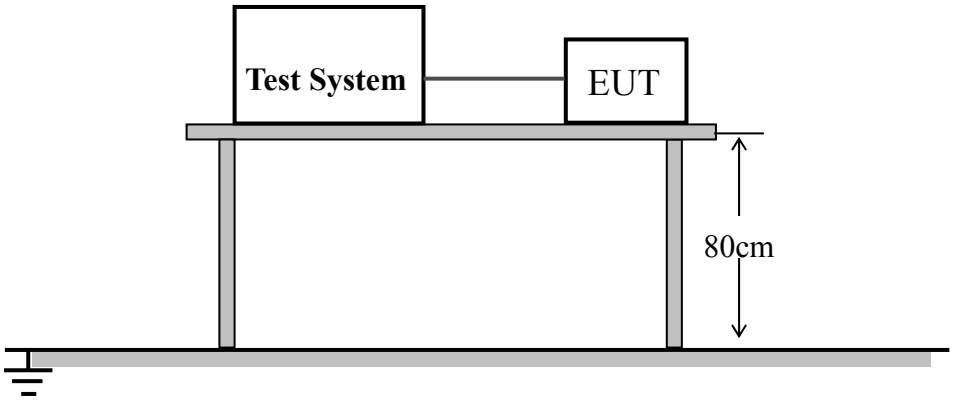
a. The power cord was used as supplied by the manufacturer. The EUT was connected to the line output of the Voltage Dips and Interruption Generator.

b. The EUT was tested for (I) 100% voltage dip of supplied voltage with duration of 10ms, (II)60% voltage dip of supplied voltage and duration 200ms, (Ш)30% voltage dip of supplied voltage and duration 500ms.

c. 100% voltage interruption of supplied voltage with duration of 5000ms was followed, which was a sequence of three voltage interruptions with intervals of 10 seconds.

d. Voltage reductions occur at 0 degree crossover point of the voltage waveform. The performance of the EUT was checked after the voltage dip or interruption.

4.9.3 Test Setup



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

4.9.4 Test Result

Test Mode	Voltage Reduction	Duration (ms)	Times	Interval (Sec)	Observation	Comply with Criterion
Voltage dips	100%	10	3	10	Note (1)	B
	60%	200	3	10	Note (2)	C
	30%	500	3	10	Note (2)	C
Voltage interruptions	100%	5000	3	10	Note (3)	C

Note:

(1). The EUT continued to operate as intended. No degradation of performance was observed.

(2). The output voltage shift of the EUT was larger than 10% during the voltage dips test. After the test, the EUT output restored automatically.

(3). The voltage output of the EUT became zero during the voltage interruption test. After the test, the EUT output restored automatically.

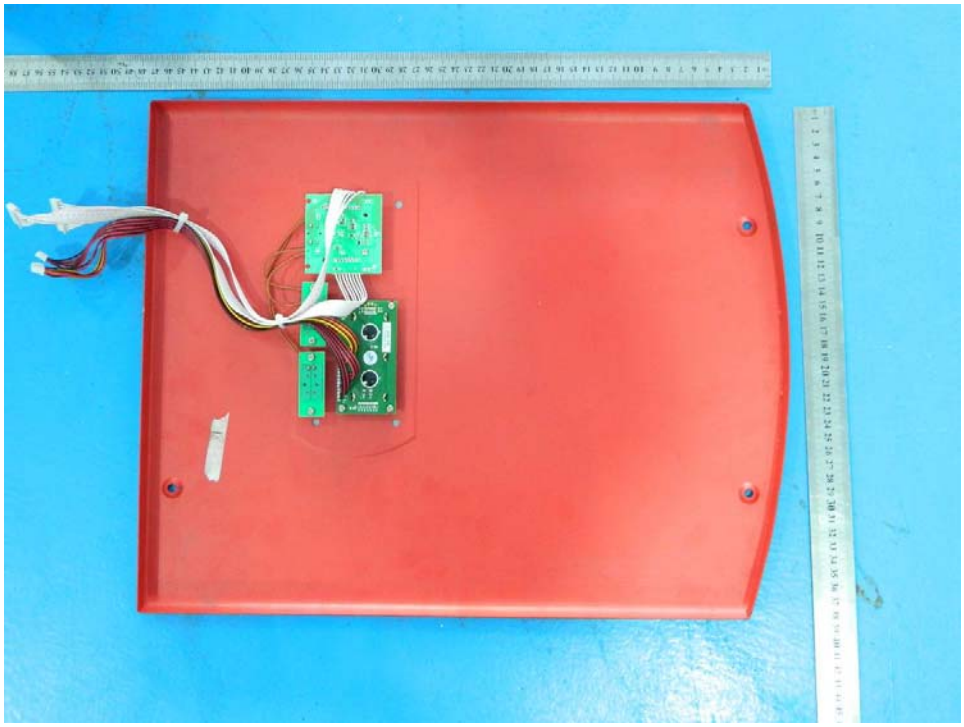
Appendix I: Photographs of the EUT

1. Appearance

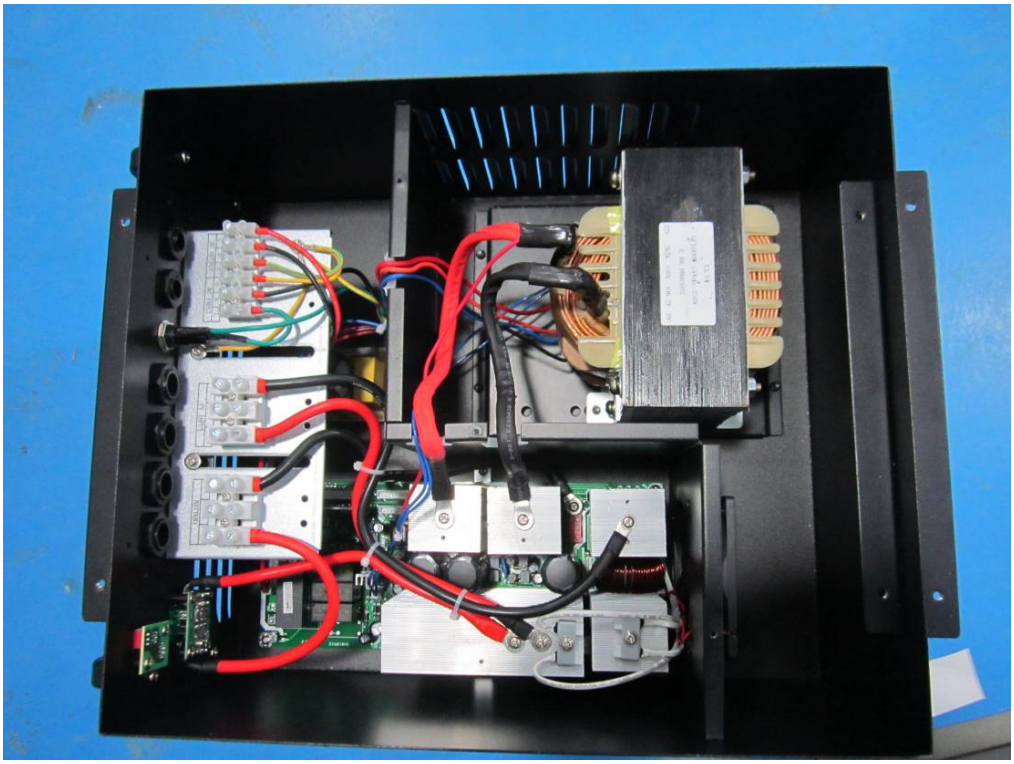
Front view

Bottom view

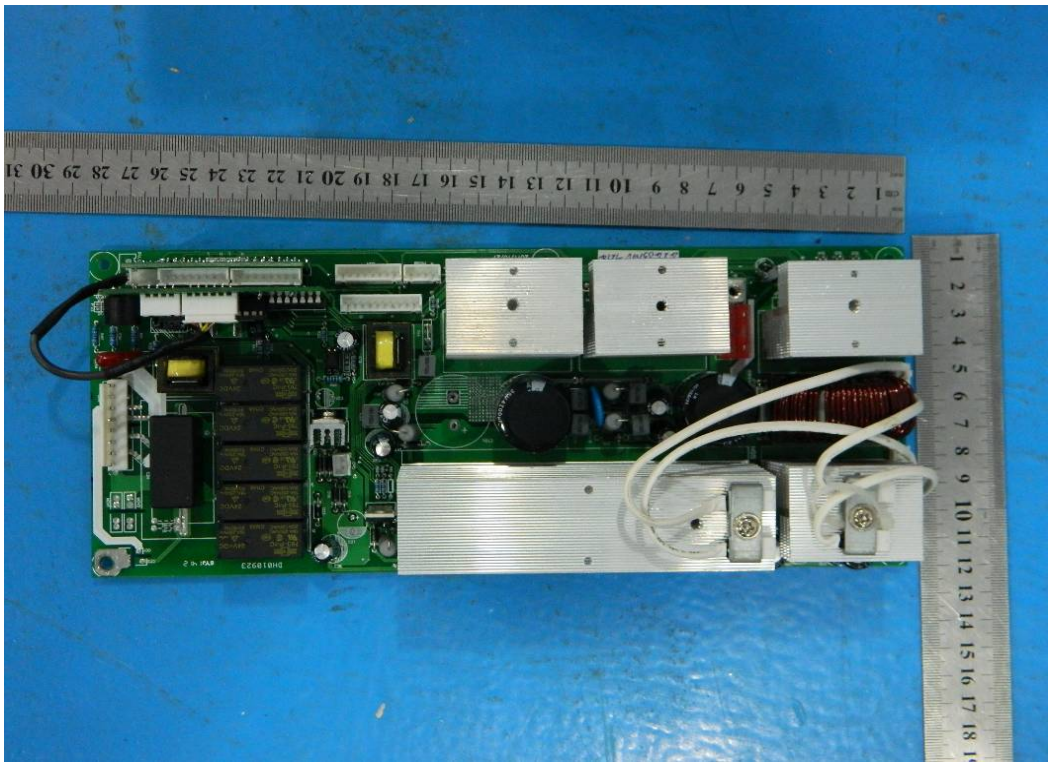
2, Inside



Inside instruction



Inside instruction



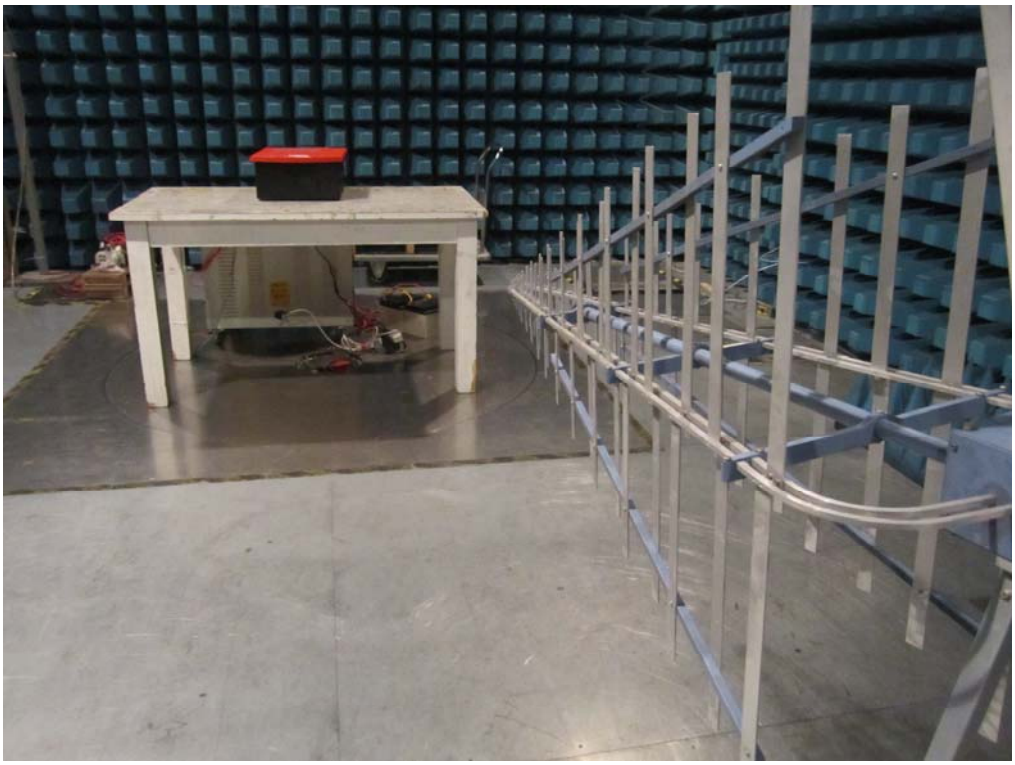
Power board

RS232 board

Appendix II：Photographs of EMC Test Configuration

1. Mains Terminal Disturbance Voltage Measurement

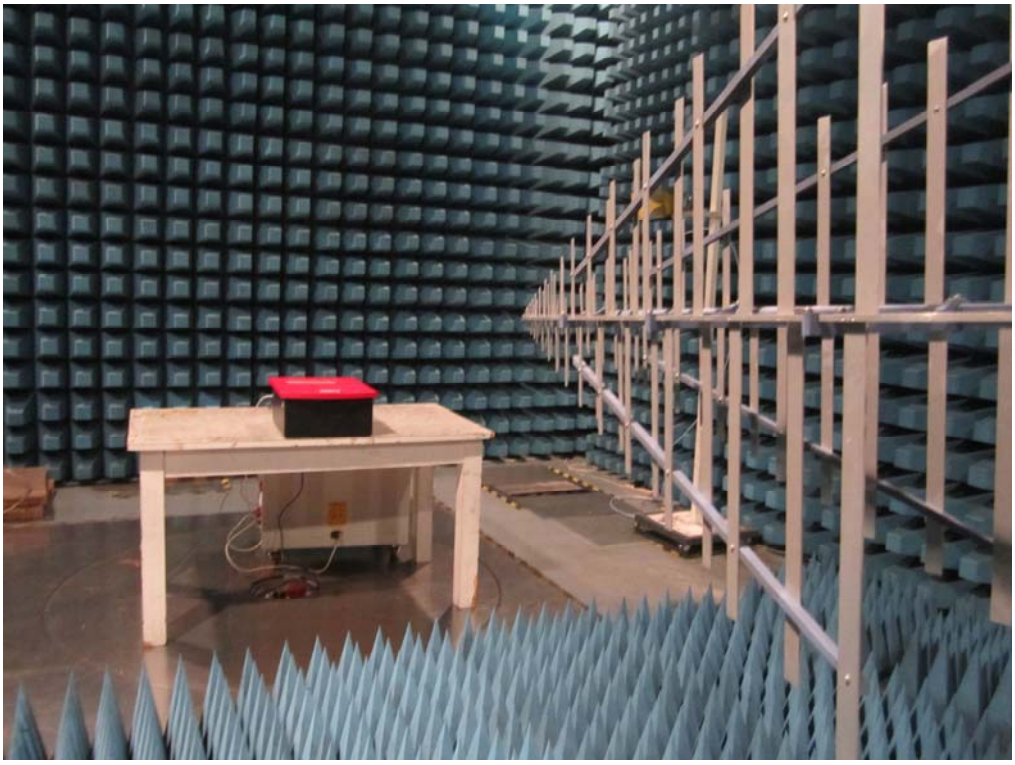
2. Radiated Field Strength Measurement



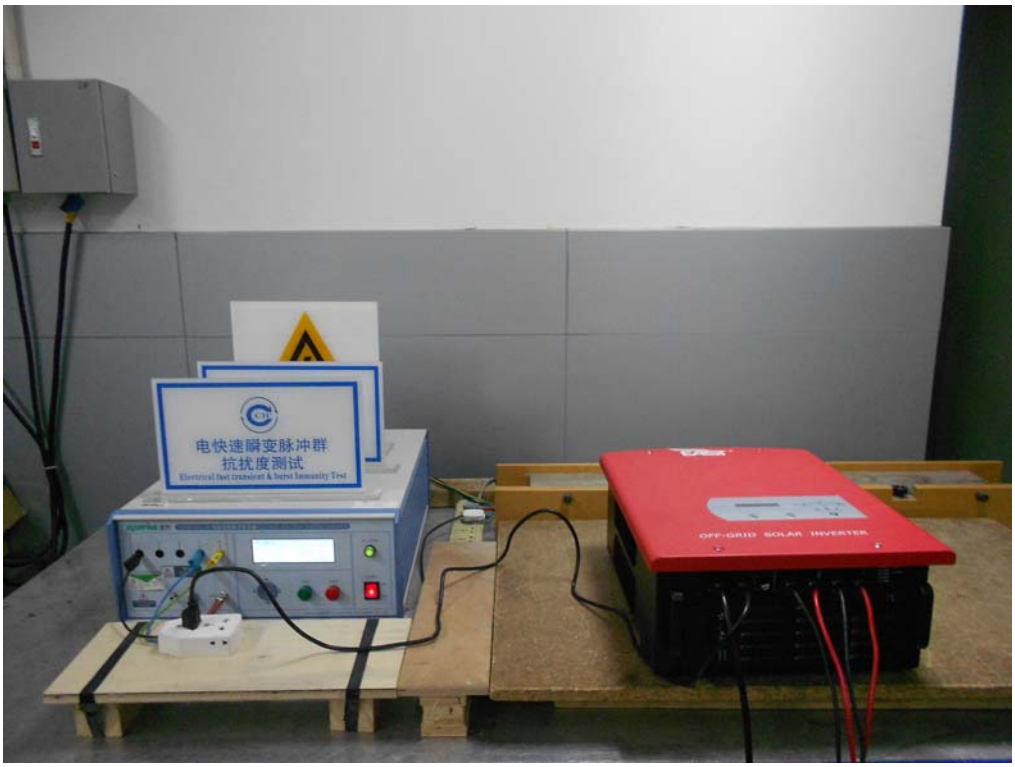
3. Harmonics Current Measurement, and Voltage Fluctuation and Flick Measurement, and Voltage Dips and Short Interruptions Immunity Test

4. Electrostatic Discharge Immunity Test

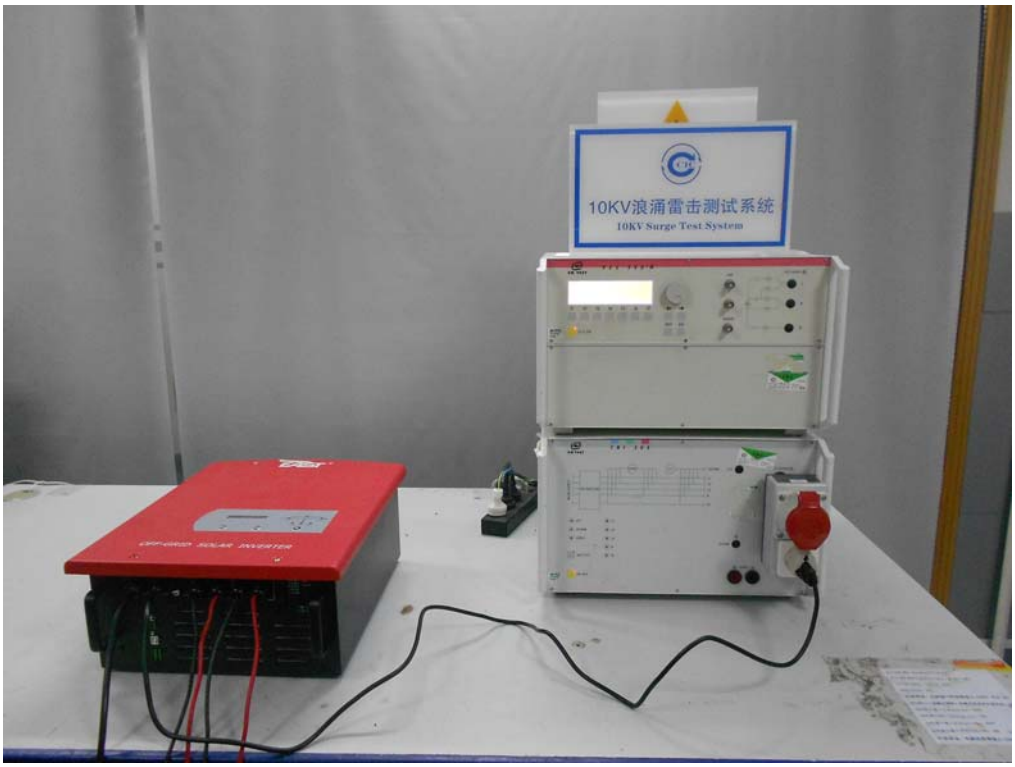
5. Radiated, Radio Frequency Electromagnetic Field Immunity Test (below 1GHz)



6. Electrical Fast Transient/Burst Immunity Test

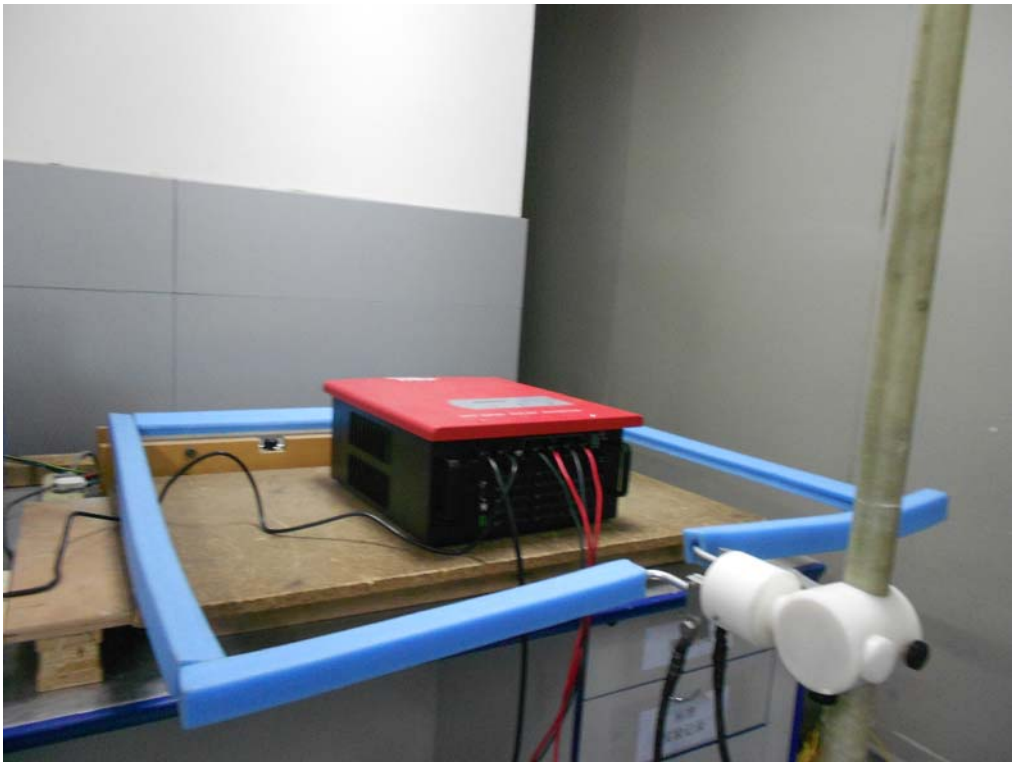


7. Surge Immunity Test



8. Immunity to Conducted Disturbances Induced by RF Fields

9. Power Frequency magnetic Field Immunity



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