TEST REPORT

RD1699 / RD661

Sobre conexión de instalaciones fotovoltaicas a la red de baja tensión

Report reference number ..... :	**PVSP200511N080-5**
Date of issue ..... ……..:	2021-02-19
Total number of pages ..... ……..:	64
Testing laboratory name ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
Address ..... :	No. 96, Guantai Road (Houjie Section), Houjie Town, Dongguan City, Guangdong Province, 523942, People's Republic of China
Accrediation ..... :	ilac-MRA ACCREDITED Certificate # 2951.01
Applicant's name ..... :	**Shenzhen SOFARSOLAR Co., Ltd.**
Address ..... :	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China
Test specification	
Standard..... :	RD1699:2011, RD661:2007 With modification according to RD413:2014 for RD1699 Nota de interpretación técnica de la equivalencia de la separación galvanica de la conexión de instalaciones Generadoras en baja tension DIN V VDE V 0126-1-1:2006-02 DIN V VDE V 0126-1-1/A1:2012-02
Test Report Form No. ..... :	RD1699/RD661 VER 1
TRF Originator ..... :	Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Master TRF ..... :	Dated 2020-03-11
Test item description..... :	**Solar Grid-tied Inverter**
Trademark..... :	SOFAR SOLAR
Model / Type ..... :	SOFAR 15KTLX-G3, SOFAR 17KTLX-G3, SOFAR 20KTLX-G3, SOFAR 22KTLX-G3, SOFAR 24KTLX-G3,

This report is governed by, and incorporates by reference, CPS Conditions of Service as posted at the date of issuance of this report at http://www.bureauveritas.com/home/about-us/our-business/cps/about-us/terms-conditions/and is intended for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. Measurement uncertainty is only provided upon request for accredited tests. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence or if you require measurement uncertainty; provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute you unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents.

Ratings .....:	SOFAR 15KTLX-G3	SOFAR 17KTLX-G3	SOFAR 20KTLX-G3	SOFAR 22KTLX-G3	SOFAR 24KTLX-G3
Input DC voltage [V] ..... :	Max. 1100Vd.c.				
MPP DC voltage range [V] ..... :	140-1000Vd.c.				
Input DC current [A] ..... :	26,0A / 26,0A				
Isc PV [A] ..... :	36,0A / 36,0A				
Output AC voltage [V] ..... :	380/400Va.c., 3W+N+PE; 50/60Hz				
Rated Output AC current [A] ..... :	21,7	24,6	29,0	31,9	34,8
Max. Output AC current [A] ..... :	23,9	27,1	31,9	35,1	38,3
Rated Output power [kW] ..... :	15,0	17,0	20,0	22,0	24,0
Max Output power [kVA] ..... :	16,5	18,7	22,0	24,2	26,4

Testing Location ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
Address ..... :	No. 96, Guantai Road (Houjie Section), Houjie Town, Dongguan City, Guangdong Province, 523942, People's Republic of China
Tested by (name and signature) ..... :	Lukes Lin
Approved by (name and signature) ..... :	James Huang
Manufacturer's name ..... :	**Shenzhen SOFARSOLAR Co., Ltd.**
Manufacturer address ..... :	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China
Factory's name ..... :	**Dongguan SOFAR SOLAR Co.,Ltd.**
Factory address	1F - 6F, Building E, No. 1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City

Document History			
Date	**Internal reference**	**Modification / Change / Status**	**Revision**
2021-02-19	Lukes Lin	Initial report was written	0
Supplementary information:			

Test items particulars	
Equipment mobility ..... :	Permanent connection
Operating condition ..... :	Continuous
Class of equipment ..... :	Class I
Protection against ingress of water .. :	IP65 according to EN 60529
Mass of equipment [kg] ..... :	Approx. 20,0 kg for SOFAR 15KTLX-G3; Approx. 22,0 kg for SOFAR 17KTLX-G3, SOFAR 20KTLX-G3; Approx. 23,0 kg for SOFAR 22KTLX-G3, SOFAR 24KTLX-G3;
Test case verdicts	
Test case does not apply to the test object ..... :	N/A
Test item does meet the requirement ..... :	P(ass)
Test item does not meet the requirement ..... :	F(ail)
Testing	
Date of receipt of test item ..... :	2020-05-11
Date(s) of performance of test ..... :	2020-11-10 to 2021-02-03

General remarks:

The test result presented in this report relate only to the object(s) tested.
This report must not be reproduced in part or in full without the written approval of the issuing testing laboratory.

”(see Annex #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

Throughout this report a point is used as the decimal separator.

This Test Report consists of the following documents:

1. Test Results
2. Annex No. 1 – Pictures of the unit
3. Annex No. 2 –Test equipment list

Copy of marking plate

SOFAR SOLAR Solar Grid-tied Inverter

Model No:	SOFAR 15KTLX-G3
Max.DC Input Voltage	1100V
Operating MPPT Voltage Range	140~1000V
Max. Input Current	26A/26A
Max. PV Isc	36A/36A
Nominal Grid Voltage	3/N/PE,380/400V
Max.Output Current	3x23.9A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	15000W
Max.Output Power	16500VA
Power Factor	1(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-30℃~+60℃
Protective Class	Class I

Made in China

Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community,XinAn Street, BaoAn District, Shenzhen, China
VDE0126-1-1,VDE-AR-N4105,G99,IEC61727
IEC62116,UTE C15-712-1,AS4777

SOFAR SOLAR Solar Grid-tied Inverter

Model No:	SOFAR 17KTLX-G3
Max.DC Input Voltage	1100V
Operating MPPT Voltage Range	140~1000V
Max. Input Current	26A/26A
Max. PV Isc	36A/36A
Nominal Grid Voltage	3/N/PE,380/400V
Max.Output Current	3x27.1A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	17000W
Max.Output Power	18700VA
Power Factor	1(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-30℃~+60℃
Protective Class	Class I

Made in China

Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community,XinAn Street, BaoAn District, Shenzhen, China
VDE0126-1-1,VDE-AR-N4105,G99,IEC61727
IEC62116,UTE C15-712-1,AS4777

SOFAR SOLAR Solar Grid-tied Inverter

Model No:	SOFAR 20KTLX-G3
Max.DC Input Voltage	1100V
Operating MPPT Voltage Range	140~1000V
Max. Input Current	26A/26A
Max. PV Isc	36A/36A
Nominal Grid Voltage	3/N/PE,380/400V
Max.Output Current	3x31.9A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	20000W
Max.Output Power	22000VA
Power Factor	1(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-30℃~+60℃
Protective Class	Class I

Made in China

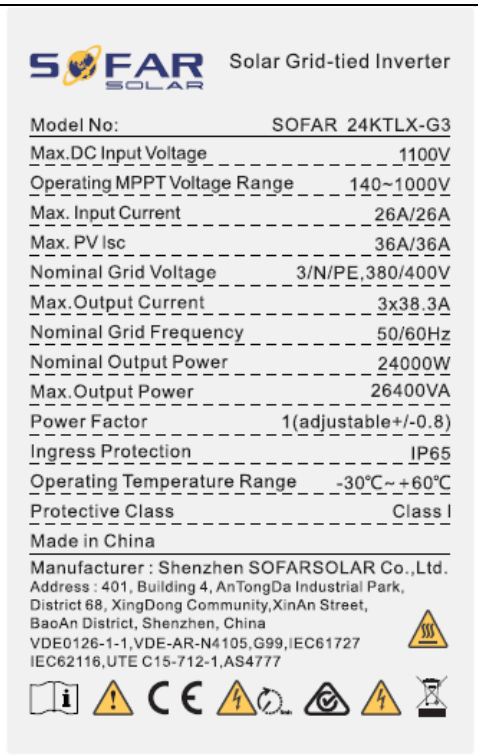
Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community,XinAn Street, BaoAn District, Shenzhen, China
VDE0126-1-1,VDE-AR-N4105,G99,IEC61727
IEC62116,UTE C15-712-1,AS4777

SOFAR SOLAR Solar Grid-tied Inverter

Model No:	SOFAR 22KTLX-G3
Max.DC Input Voltage	1100V
Operating MPPT Voltage Range	140~1000V
Max. Input Current	26A/26A
Max. PV Isc	36A/36A
Nominal Grid Voltage	3/N/PE,380/400V
Max.Output Current	3x35.1A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	22000W
Max.Output Power	24200VA
Power Factor	1(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-30℃~+60℃
Protective Class	Class I

Made in China

Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community,XinAn Street, BaoAn District, Shenzhen, China
VDE0126-1-1,VDE-AR-N4105,G99,IEC61727
IEC62116,UTE C15-712-1,AS4777


SOFAR SOLAR
Solar Grid-tied Inverter
Model No: SOFAR 24KTLX-G3
Max.DC Input Voltage 1100V
Operating MPPT Voltage Range 140~1000V
Max. Input Current 26A/26A
Max. PV Isc 36A/36A
Nominal Grid Voltage 3/N/PE,380/400V
Max.Output Current 3x38.3A
Nominal Grid Frequency 50/60Hz
Nominal Output Power 24000W
Max.Output Power 26400VA
Power Factor 1(adjustable+/-0.8)
Ingress Protection IP65
Operating Temperature Range -30℃~+60℃
Protective Class Class I
Made in China
Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community,XinAn Street,
BaoAn District, Shenzhen, China
VDE0126-1-1,VDE-AR-N4105,G99,IEC61727
IEC62116,UTE C15-712-1,AS4777

General product information:

The Solar Grid-tied Inverter converts DC voltage into AC voltage.
The DC input of Solar Grid-tied Inverter can be supplied from PV array.

The input and output are protected by Varistors to Earth. The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and a two relays. This assures that the opening of the output circuit will also operate in case of one error.

Description of the electrical circuit: (Figure 1):

The internal control is redundant built. It consists of Microcontroller Main DSP (U30) and slave DSP (U23).

The Main DSP (U30) control the relays by switching signals; measures the PV voltage, PV current, Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground. In addition it tests the current sensors and the RCMU circuit before each start up.

The slave DSP (U23) is measures the grid voltage, grid frequency, DCI and residual current, also can switch off the relays independently, and communicate with the Main DSP (U30) each other.

The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the Main DSP(U30). The Main DSP(U30) tests and calibrates before each start up all current sensors.

The unit provides two relays in series in all output conductors. When single fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the PV array and the mains. All the relays are tested before each start up.

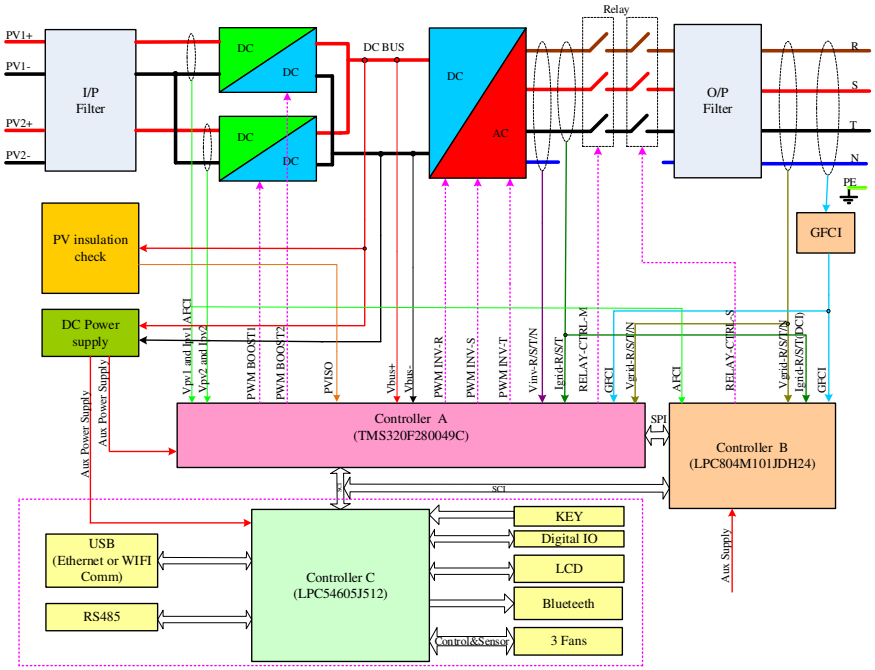


Figure 1 – Block diagram

Model difference:

The models SOFAR 15KTLX-G3, SOFAR 17KTLX-G3, SOFAR 20KTLX-G3, SOFAR 22KTLX-G3 and SOFAR 24KTLX-G3 are use the identical hardware platform, control unit, control system and software except the output power derated by software and in following table descripts for different.

	SOFAR 15KTLX-G3	SOFAR 17KTLX-G3	SOFAR 20KTLX-G3	SOFAR 22KTLX-G3	SOFAR 24KTLX-G3
Thin-film capacitor of BUS	4pcs (110uF, 550V)	6pcs (110uF, 550V)			
INV IGBT (Q60, Q67, Q71 Q72, Q75, Q76)	6pcs 40A, 1200V	6pcs 75A, 1200V			
External Fan	1		2		

The product was tested on:

Hardware version: V101

Software version: V010000

Test report

RD 1699/2011			
Clause/§	**Requirement:**	**Remark:**	**Verdict**
	CHAPTER III **Technical conditions of the facilities** **CAPÍTULO III** **Condiciones técnicas de las instalaciones**		
	Article 10. Obligations of the facility owner **Artículo 10. Obligaciones del titular de la instalación**		
		Article 10 is not part of this inspection. The facility owner is responsible in this case.	**N/A**
	Article 10. Connection conditions **Artículo 11. Condiciones técnicas de carácter general**		
1	The operation of the facilities shall cause no failures, reduced safety conditions or alterations above those admitted by the applicable legislation in the network. Likewise, the operation of such facilities shall not give rise to dangerous working conditions for the employees responsible for maintaining and operating the supply network.	Must be taken under consideration at the installation of the units.	**N/A**
2	In the event that the supply line is disconnected from the network, either due to maintenance work requested by the supply company or because a protective element has been activated in the line, the power in the facility's supply line shall be cut off.	The unit provides an integrated automatic disconnection device which opens in case of loss of voltage and frequency. See appended table.	**P**
3	For the purpose of establishing the connection point to the supply network, the following criteria shall be considered, which are set out in Annexe I of this Royal Decree.	See Annexe I.	**N/A**
4	No generation element other than the authorised facility or a storage element may be included between the generation circuit and the measuring equipment.	Must be observed by the installation. Not part of this inspection.	**N/A**
5	In the event of a facility being affected by disruptions in the supply network, the current legislation on service quality shall apply.	Considered.	**P**
	Article 12. Connection conditions **Artículo 12. Condiciones de conexión**		

RD 1699/2011			
Clause/§	**Requirement:**	**Remark:**	**Verdict**
1	The connection diagrams shall respond to the principle of reducing leaks in the system, favouring the maintenance of safety and quality in supply and enabling work to be carried out by blocks on own electricity consumption, without supplying other network users. The connection configurations shall ensure the reliability of the energy measurements generated and consumed.	Must be taken under consideration at the installation of the units.	**N/A**
2	If the nominal power of the generation facility to be connected to the supply network is more than 5 kW, connection of the facility to the network shall be three-phase with an imbalance between phases of less than 5 kW.	Due to the construction of the inverter, no imbalance of 5kW or more is possible.	**P**
3	The contribution of the generators to increasing or decreasing voltage in the low or medium voltage supply line between the transformation centre or substation of origin in which the voltage is regulated and the connection point, in the least favourable scenario, shall be no more than 2.5 per cent of the nominal low or medium voltage current, whichever applies.	Must be taken under consideration at the installation of the units.	**N/A**
4	The power factor of the energy supplied to the supply company network shall be as close as possible to the unit value and in all cases, greater than 0.98 if the facility is operating at powers of over 25 per cent of its nominal power.	See appended test table.	**P**
Article 13. Specific conditions for connection in internal networks **Artículo 13. Condiciones específicas para la conexión en redes interiores**			
1	The connection shall be made at the point of the internal network owned that is closest to the general protection box, such that it allows both facilities to be isolated simultaneously from the electrical system. In the event that the supply network connection is high voltage and there is a transformation station owned by the consumer, the connection from the production facility shall be made in the low voltage output control panel of the transformer.	Must be taken under consideration at the installation of the units.	**N/A**
2	The owner of the internal network shall be the same for all the consumption equipment and generation facilities connected in that network. In this case, a note shall be made in the margin of the final registration of the production facility in the regional registry and in the Government registry of power generation facilities that is attached to the Directorate General of Energy Policy and Mines.	Must be taken under consideration at the installation of the units.	**N/A**

RD 1699/2011			
Clause/§	**Requirement:**	**Remark:**	**Verdict**
3	Power generation facilities connected to an internal network may not have powers that exceed 100 kW and in all cases, they shall not exceed the available capacity at the connection point to the supply network or the power assigned to the supply.	Must be taken under consideration at the installation of the units.	**N/A**
Article 14. Protections **Artículo 14. Protecciones**			
1	Regarding the protection system, in the case of any aspect not envisaged in the present Royal Decree, it shall comply with the terms of Royal Decree 661/2007 of 25 May 2007 and the respective operating procedures, the requirements set forth in current legislation, and in particular, with the Low Voltage Electrotechnical Regulations approved by Royal Decree 842/2002 of 2 August 2002, the Regulations governing technical conditions and assuring safety in electric power stations, substations and transformation stations, approved by Royal Decree 3275/1982 of 12 November 1982 and the Regulations governing technical conditions and assuring safety in high voltage lines, approved by Royal Decree 223/2008 of 15 February 2008. Such compliance shall be proved in sufficient measure in the documentation related to the characteristics of the facility to which reference is made in article 4, including the following:	Considered.	**P**
	a) A general cut-off element that provides the insulation required by Royal Decree 614/2001 of 8 June 2001, on minimum requirements for protecting the safety and health of workers from electrical risks. Eventually, the functions of the cut-off element may be covered by another device of the generation facility, which provides the indicated insulation between generator and network.	This is not part of the above mentioned inverter and shall be installed externally. An external over-current circuit breaker is required providing the according protection of the branch circuit. This is stated in the manual	**P**
	b) An automatic differential switch to protect people in the event of a shunt of any element to ground.	The inverter provides a residual current monitoring unit to detect and disconnect in case of an earth fault.	**P**
	c) An automatic connection switch for automatic disconnection-connection of the facility in the event of a network voltage or frequency anomaly, together with a locking relay. Eventually, the function of this switch may be performed by the switch or switches of the generator equipment. Eventually, the functions of the automatic connection switch and general cut-off switch may be performed by the same device.	The unit provides an integrated automatic disconnection device which opens in case of loss of voltage and frequency. See appended table.	**P**

RD 1699/2011			
Clause/§	**Requirement:**	**Remark:**	**Verdict**
	d) Maximum and minimum frequency connection protections and maximum and minimum voltage between phases as indicated in table 1 (RD 1699/2011), where the low voltage proposal is generalised for all other levels. In insular and extra-peninsular electrical systems, the above values shall be the ones indicated in the respective operating procedures. The voltage for measuring these values shall be taken from the network side of the general automatic switch for high voltage facilities or the main switches of the generators in low voltage networks. In the event of activating the maximum frequency protection, reconnection shall only be made when the frequency reaches a value that is less than or equal to 50 Hz.	With modification according to RD413:2014 for RD1699 Upper frequency: 51,0 Hz Lower frequency: 48,0 Hz Upper voltage (stage 2): Un +15% Upper voltage (stage 1): Un +10% Lower voltage: Un -15% Automatic reconnection after at least 180s according to IEC 61727:2004 once the grid conditions are within the limits of clause d) See appended tables. Parameters are adjustable only for the installer and protected via password.	**P**
	e) In addition, for voltages greater than 1 kV and up to 36 kV inclusive, the disconnection criteria for maximum homopolar voltage shall be added.	The inverter is designed for connection to the low voltage grid.	**P**
2	These protections may act on the general switch or on the switch or switches of the equipment or generators.	The unit provides an integrated automatic disconnection device which opens in case of an error.	**P**
3	The protections shall be sealed by the supply company, after the necessary checks on the switching system and on the integration of the protection functions into the generator equipment.	The values can be changed by authorised staff and are protected by password	**P**
4	In the event that the generator or inverter equipment have the above-described protections, these shall comply with current legislation, and in particular, the Low voltage electrotechnical regulations, approved by Royal Decree 842/2002 of 2 August 2002, the Regulations governing technical conditions and safety assurance in electric power stations, substations and transformation stations, approved by Royal Decree 3275/1982 of 12 November 1982 and the Regulations governing technical conditions and safety assurance in high voltage electrical lines, approved by Royal Decree 223/2008 of 15 February 2008, for facilities operating parallel to the supply network. In this case, there is no need for the protections to be duplicated.	Considered.	**P**
Article 15. Conditions for grounding the facilities **Artículo 15. Condiciones de puesta a tierra de las instalaciones**			

RD 1699/2011			
Clause/§	**Requirement:**	**Remark:**	**Verdict**
1	Grounding of interconnected facilities shall in all cases be done in such a way that the supply company network grounding conditions are not altered, ensuring that no faults are transferred to the supply network.	Must be taken under consideration at the installation of the units.	**N/A**
2	The facility shall have a galvanised separation between the supply network and the generator facilities, either by means of an insulation transformer or any other element that fulfils the same purpose, pursuant to the applicable industrial safety and quality regulations.	The inverter provides a residual current monitoring unit to detect and disconnect in case of an earth fault.	**P**
3	The earth connections of the generation facility shall be connected to a ground connection that is separate from the supply company neutral connection and comply with the indications set out in the applicable current industrial safety and quality regulations.	Must be taken under consideration at the installation of the units.	**N/A**
Article 16. Harmonics and electromagnetic compatibility **Artículo 16. Armónicos y compatibilidad electromagnética**			
	Emission (EN 61000-6-3) and Immunity (EN 61000-6-2) requirements have to be conform according to the respective actual and valid standards. Harmonics have to be conform according to EN 61000-3-2 (-3-12 for >16A/phase). The voltage fluctuations due to connection/disconnection to the public grid of less than 5%. This is covered by Flicker according to EN 61000-3-3 (-3-11 for >16A/phase)	Considered.	**P**
ANNEX I **Criteria for determining the maximum available power rating connection to determine the maximum rated power connection available, shall address the following criteria:** **ANEXO I** **Criterios para la determinación de la potencia nominal máxima disponible de conexión Para determinar la potencia nominal máxima disponible de conexión, se atenderá a los siguientes criterios:**			
1	For installations connect to a network point exceeding 1 kV (either directly or through a network installation of interior):		**N/A**
	a) The maximum rated power available at the connection point of a line is calculated as half the carrying capacity of the line at that point, defined as heat capacity of the line design at the point, less the sum of the powers of production facilities connected or existing connection point on the line.	Must be taken under consideration at the installation of the units.	**N/A**

RD 1699/2011			
Clause/§	**Requirement:**	**Remark:**	**Verdict**
	b) In the event that the connection point is a center of transformation, maximum rated power available at that point is calculated as half of the installed processing capacity for that level of voltage minus the sum of the powers of production facilities connected or connection point force at the center.	Must be taken under consideration at the installation of the units.	**N/A**
2	For installations connect to the network exceeding 1 kV but not exceeding 36 kV (either directly or through a network installation of interior):		**N/A**
	a) The maximum rated power available at the connection point is calculated as the power that can be injected at that point, taking into account the production facilities and connected to existing connection point and the simultaneous minimum consumption forecast.	Must be taken under consideration at the installation of the units.	**N/A**
	b) The methodology for calculating the expected simultaneous minimum consumption is set to the corresponding distribution operation procedure. As long as they are not under the above methodology, is taken as the minimum consumption data recorded simultaneously provided the minimum demand and in the absence of this, consider the 10 percent of the peak power of the processing.	Must be taken under consideration at the installation of the units.	**N/A**

RD 1699/2011		
Article	**Test**	**Result**
12	**Connection conditions:**	
	Power factor	**P**
14	**Protections:**	
	Monitoring of voltage	**P**
	Monitoring of frequency	**P**
	Reconnection condition over frequency	**P**
	Isolation measurement	**P**
	Monitoring of DC-injection	**P**
	Residual current monitoring	**P**
Additional requirements of DIN V VDE V 0126-1-1:2006-02 are fulfilled:		
6.1 (4.1)	Functional safety (Redundancy)	**P**
6.5 (4.5)	Detection of anti-islanding (only one method is necessary!)	
	6.5.1 Measurement of impedance	**N/A**
	6.5.2 Resonant circuit test	**P**
	6.5.3 3-phase grid-voltage monitoring	**P**

Test Results

Article 12. Connection conditions **Power factor**				**P**
SOFAR 15KTLX-G3				
Test conditions:	Udc = 600Vdc			
Output power **Test voltage (Vac)**	**~25%** **3,758kW**	**~50%** **7,521kW**	**~75%** **11,273kW**	**~100%** **15,011kW**
230 V	0,9971i	0,9993i	0,9996i	0,9996i
SOFAR 24KTLX-G3				
Test conditions:	Udc = 600Vdc			
Output power **Test voltage (Vac)**	**~25%** **6,045kW**	**~50%** **12,073kW**	**~75%** **18,063kW**	**~100%** **24,009kW**
230 V	0,9989i	0,9996i	0,9997i	0,9997i

Note:
The power factor of the energy supplied to the supply company network shall be as close as possible to the unit value and in all case, greater than 0,98 if the facility is operating at powers of over 25 per cent of its nominal power.

The tests had been performed on the SOFAR 24KTLX-G3 SOFAR 15KTLX-G3 are valid for the SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3 since it is same as in hardware and just power derated by software.

Article 14. Protections **Voltage monitoring**									**P**
Test conditions:									
	under voltage				**over voltage (stage 1)**				
Parameter	Voltage	Time [ms]			Voltage	Time [ms]			
Limit	**195,5 V**	**<= 1500 ms**			**253,0 V**	**<= 1500 ms**			
Trip value	*				*				
Disconnection time	**210V to 190V**	*	*	*	**240V to 255V**	*	*	*	
	230V to 190V	*	*	*	**230V to 255V**	*	*	*	
Reconnection time:	**>=180 s**	*			**>=180 s**	*			
	--				**over voltage (stage 2)**				
Parameter	--				Voltage	Time (ms)			
Limit	**--**				**264,5 V**	**<= 200 ms**			
Trip value	--				264,2				
Disconnection time	--				**245V to 265V**	*	*	*	
	--				**230V to 265V**	*	*	*	
Reconnection time:	--				**>=180 s**	*			

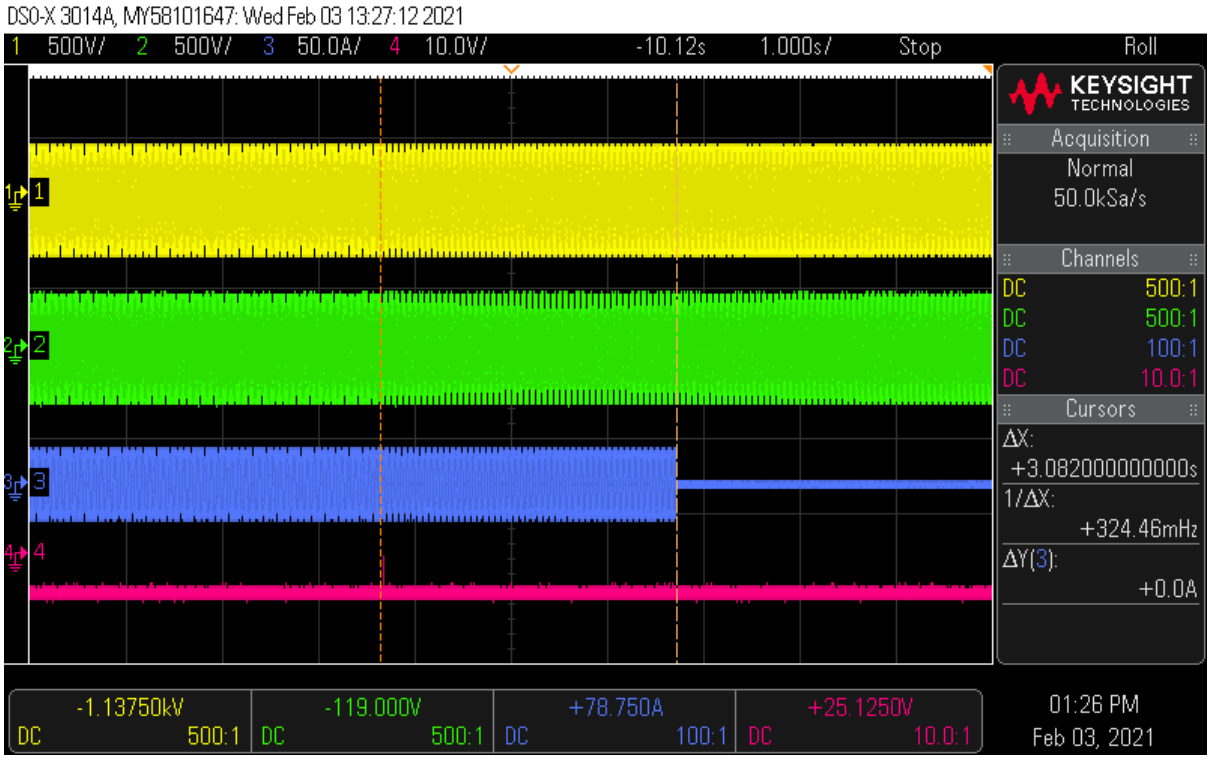
Note:
The maximum and minimum voltage connection protection must be set to Un +10% (stage 1), Un +15% (stage 2) and Un -15%. The accuracy for the voltage measurement must be in a range of +/-2,3V (1% $U_{nom.}$).
* Test results refer to the table 6.5.3.

Article 14 Protections **Frequency monitoring RD1699/ update RD1699 in RD413**									**P**
	under frequency				**over frequency**				
Parameter	Frequency [Hz]	Time [ms]			Frequency [Hz]	Time [ms]			
Output Voltage		**~85%U_N**	**U_N**	**~110%U_N**		**~85%U_N**	**U_N**	**~110%U_N**	
Limit	**48,0 Hz**	**at least 3 s**			**51,0 Hz**	**<= 500 ms**			
Trip value (Hz)		47,99	47,98	47,98		51,00	51,00	51,00	
Disconnection time (s)	48,1Hz to 47,9Hz	3,078	3,060	3,082	50,9Hz to 51,1Hz	0,444	0,456	0,458	
		3,080	3,080	3,070		0,446	0,440	0,452	
Reconnection time (s)	**>=180 s**	190 s			**>=180 s**	189 s			

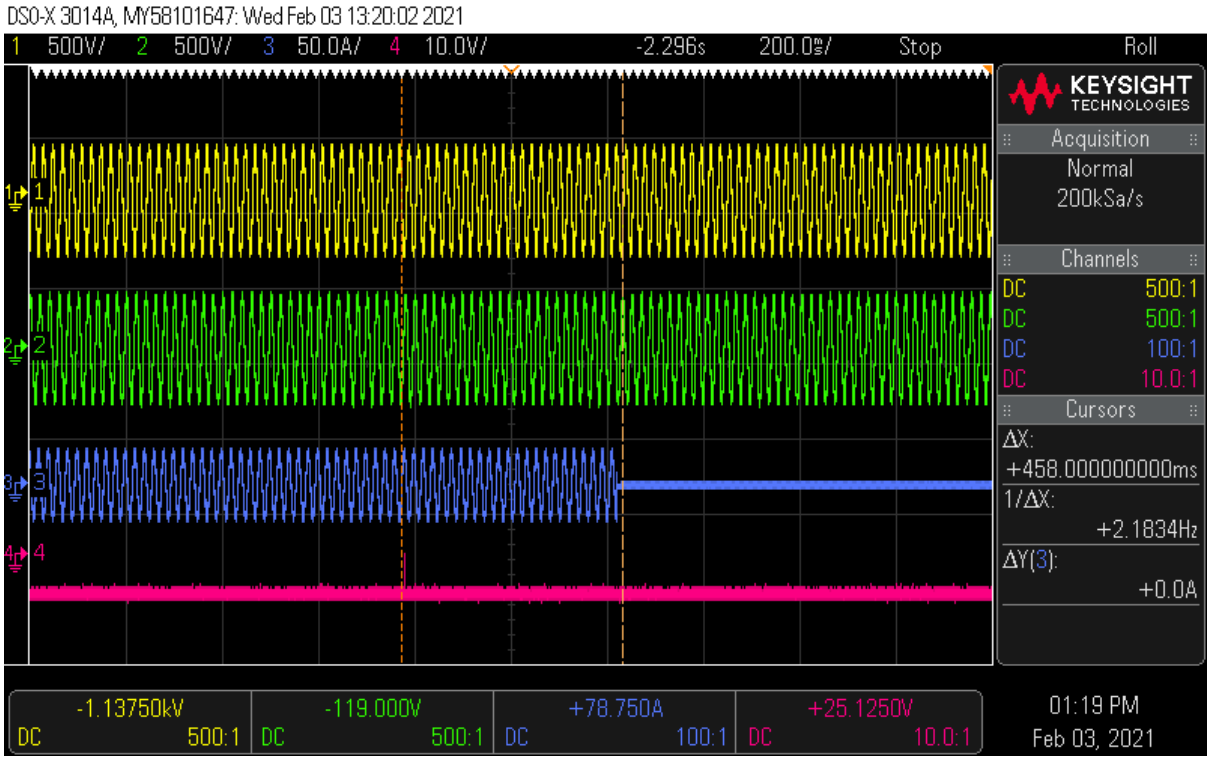
Note:
The maximum and minimum frequency connection protection must be set to 50,5 Hz and 48,0 Hz. For an under frequency failure the inverter has to stay connect for at least 3 s. After the 3 s the inverter has to disconnect immediately from the grid. The accuracy for the frequency measurement must be in a range of +/- 0,05 Hz.

The tests had been performed on the SOFAR 24KTLX-G3 is valid for the SOFAR 15KTLX-G3,SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3 since it is same as in hardware and just power derated by software.

under frequency:



over frequency:



Article 14 Protections **Reconnection condition over frequency**			**P**
Setting values reconnection	Setting $T_{reconnection}$ ≥ 180s:		180 s
	Setting $f_{reconnection}$ ≤ 50,00Hz:		50 Hz
Connecting conditions for frequencies:			
a)	50,00 Hz		inverter running
	f_{ist}	**Reset time:**	**Limit:**
	Switch to b) for ≥ Setting $T_{reconnection}$:		
b)	≥ 50,50 Hz	No connection	inverter has to disconnect, no resetting allowed
	Switch to c) for ≥ Setting $T_{reconnection}$:		
c)	50,05 Hz	No connection	no resetting allowed
	Switch to d) for ≥ Setting $T_{reconnection}$:		
d)	≤ 50,00 Hz	189s	resetting allowed after ≥ Setting $T_{reconnection}$

Test:
see points a) to d) for the test process.
The measurement was carried out with a programmable AC source.
e.g. connecting conditions for frequencies:
a) AC source was programmed in such a way that the AC output is set to 230 V / 50 Hz
b) AC source is set for ≥ Setting $T_{reconnection}$ to 230 V / 50,5 Hz, switching on again is not permitted
c) AC source is set to 230 V / 50,05 Hz for ≥ Setting $T_{reconnection}$, reconnection is not permitted
d) AC source is set back to 230 V / 50,0 Hz, reconnection is allowed after ≥ Setting $T_{reconnection}$.

Note:
In the event of activating the maximum frequency protection, reconnection shall only be made when the frequency reaches a value that is less than or equal to 50 Hz. The accuracy for the frequency measurement must be in a range of +/-0,05 Hz (0,1% $f_{nom.}$).

The tests had been performed on the SOFAR 24KTLX-G3 and SOFAR 15KTLX-G3 are valid for the SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3 since it is same as in hardware and just power derated by software.

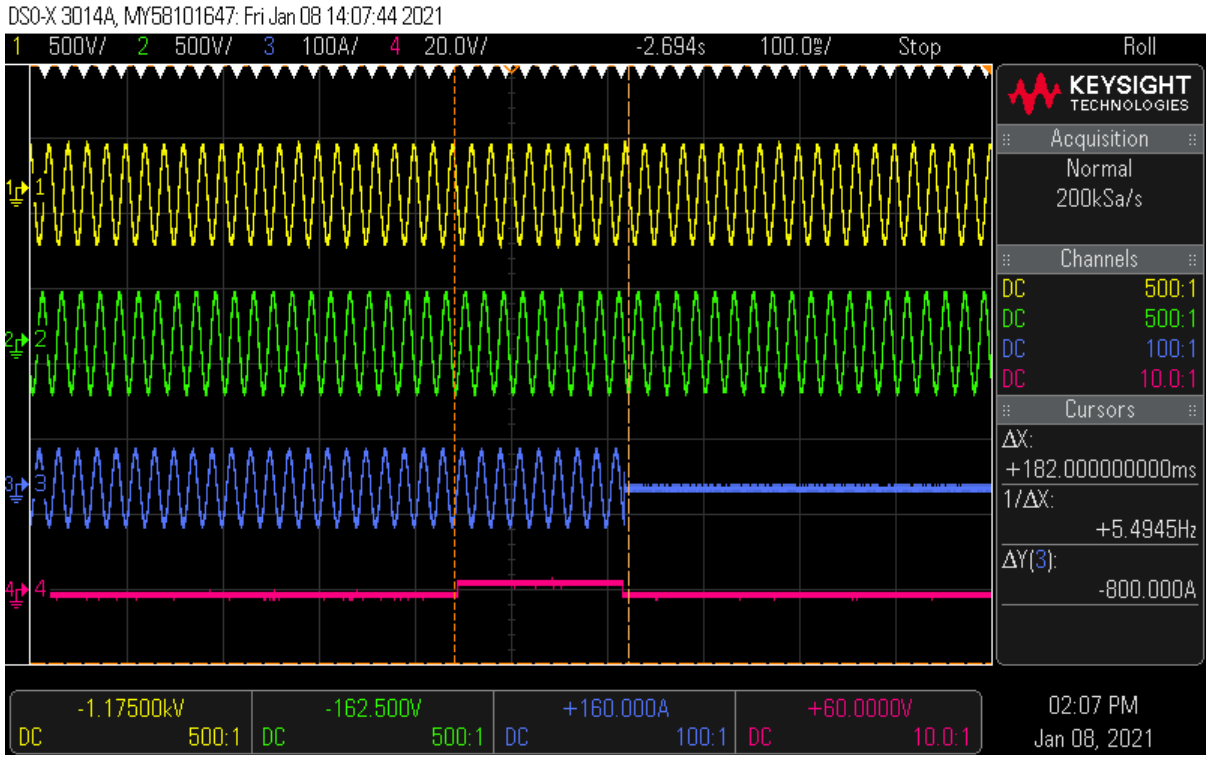
Article 14 Protections **Monitoring of DC-Injection** according DIN V VDE V 0126-1-1:2006-02, clause 6.4 (4.4)	**P**

SOFAR 24KTLX-G3

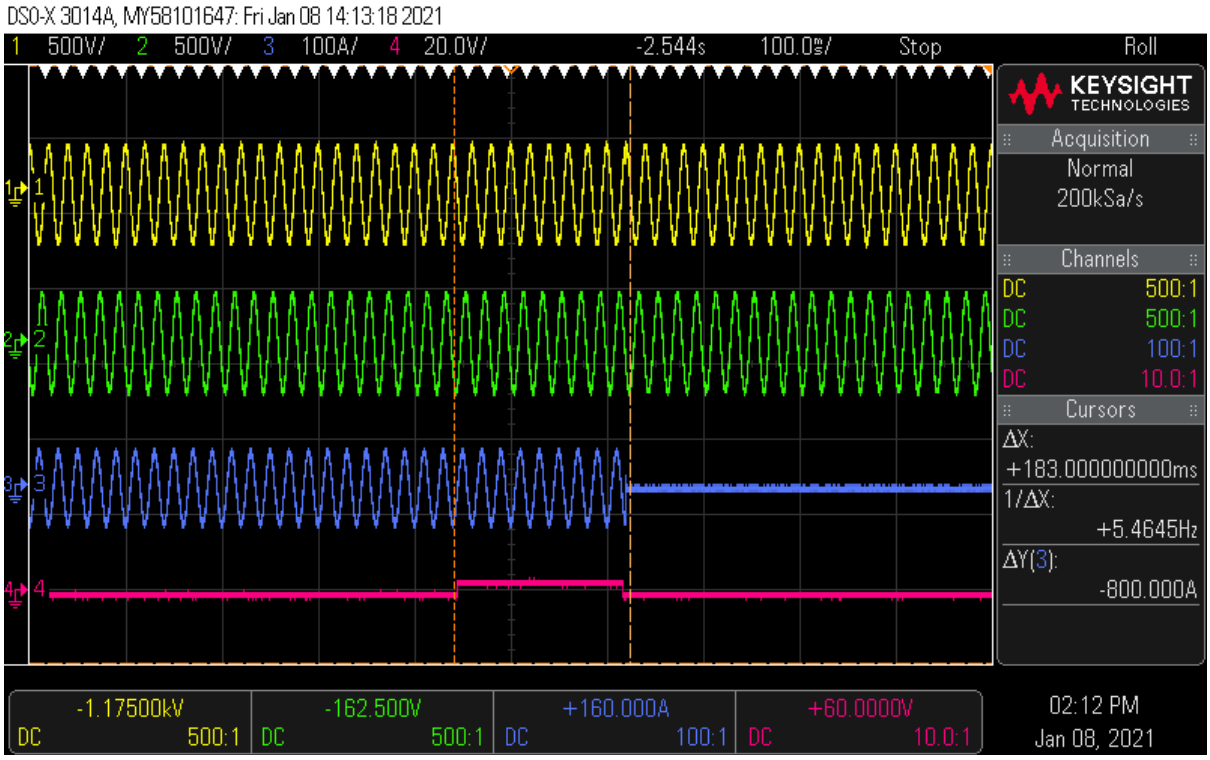
DC Injection (A)	Limits	Trip Time - L1(ms)	Trip Time - L2(ms)	Trip Time - L3(ms)
+0,174 A	I_{DC}:>0,5%Ir than disconnection within 0,2 sec	180	183	162
-0,174 A	I_{DC}:> 0,5%Ir than disconnection within 0,2 sec	182	160	160

Note:
The tests had been performed on the SOFAR 24KTLX-G3 is valid for the SOFAR 15KTLX-G3, SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3 since it is same as in hardware and just power derated by software.

Negative DC-Injection:



Positive DC-Injection:



NOTA DE INTERPRETACIÓN TECNICA DE LA EQUIVALENCIA DE LA SEPARACIÓN GALVÁNICA DE LA CONEXIÓN DE INSTALACIONES GENERADORAS EN BAJA TENSIÓN	P

Diagram of permanent DC-Injection:

dc-injection <0,5% of Iac, nom.

SOFAR 15KTLX-G3

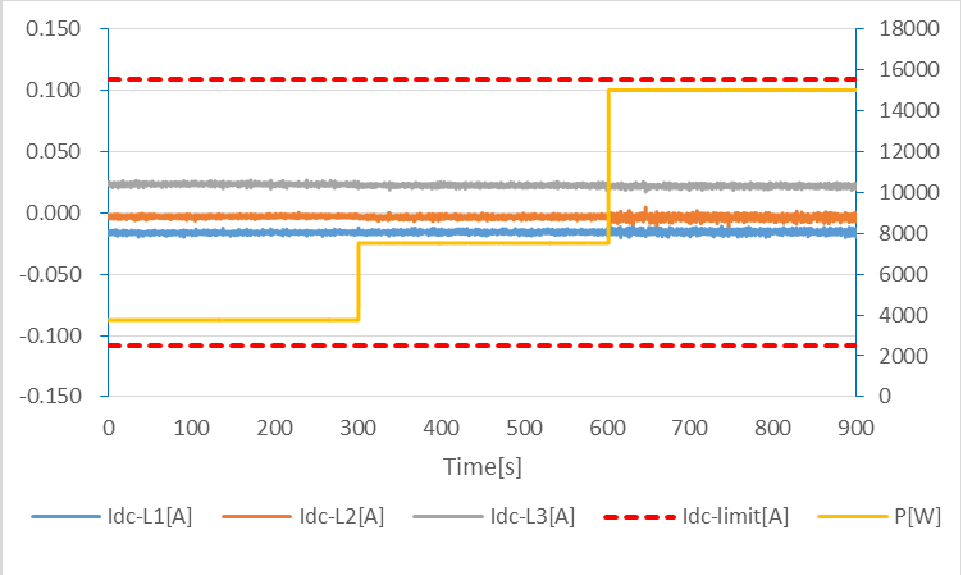
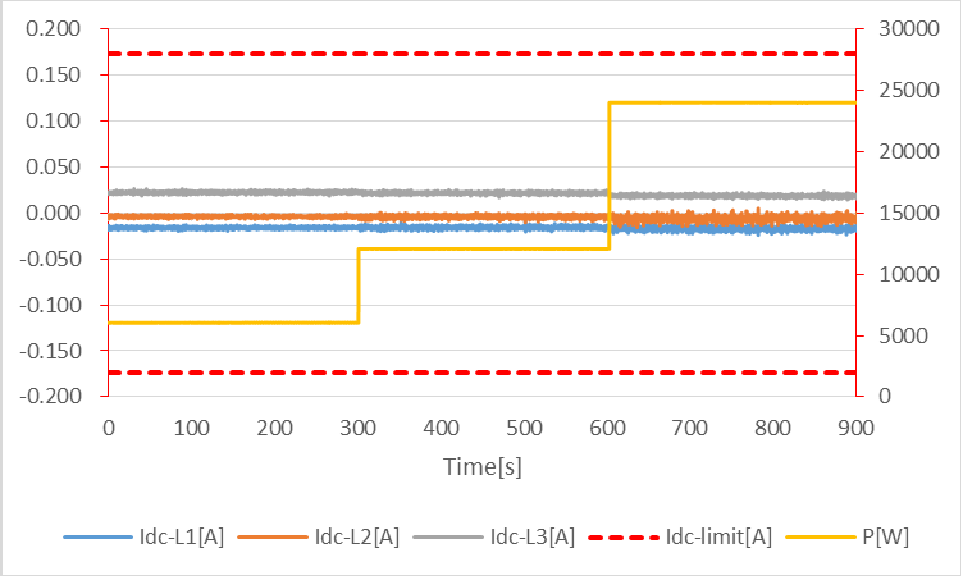


Diagram of permanent DC-Injection:

dc-injection <0,5% of Iac, nom.

SOFAR 24KTLX-G3



Note:

Article 14 Protections **Isolation measurement before feeding in** according DIN V VDE V 0126-1-1:2006-02, clause 6.6 (4.7)			**P**
DC+			
V_+, the higher array voltage	1000	500 KΩ	Error message:" Error:"ID56"(The insulation resistance is too low)" PV inverter does not start-up.
$V_{critical}$, the voltage level analysed to be difficult to detect	400		
$V_{arbitrary}$, any voltage within the range V_- V_+	570		
V_-, the lower array voltage	140		
DC-			
V_+, the higher array voltage	1000	500 KΩ	Error message:" Error:"ID56"(The insulation resistance is too low)" PV inverter does not start-up.
$V_{critical}$, the voltage level analysed to be difficult to detect	400		
$V_{arbitrary}$, any voltage within the range V_- V_+	570		
V_-, the lower array voltage	140		
Note: The array insulation resistance to ground shall be not less than 1 kΩ / V with respect to the maximum dc input voltage as specified by the manufacturer, with a minimum of 500 kΩ The tests had been performed on the SOFAR 24KTLX-G3 is valid for the SOFAR 15KTLX-G3,SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3 since it is same as in hardware and just power derated by software.			

Article 14 Protections **Residual Current Monitoring** according DIN V VDE V 0126-1-1:2006-02, clause 6.6 (4.7)	**P**
Test conditions:	Output power: 15kW V_{DC}: 550V Frequency: 50Hz Current measuring devices: min. class 0,5
DIN V VDE V 0126-1-1:2006-02, 6.6.2.2.2 **Test for correct disconnection in case of a continuously rising residual current**	**P**

+ PV1 to N:	
	Fault Current (mA)
Limit (mA)	U_N
<=300	257
<=300	262
<=300	252
<=300	254
<=300	252
- PV1 to N:	
	Fault Current (mA)
Limit (mA)	U_N
<=300	255
<=300	254
<=300	254
<=300	254
<=300	254

Note:
Comparing test circuit at 6.6.2.1, pic. 4. Fault current will rise up to 300mA within 30s. 5 values will be measured and listed.

The tests had been performed on the SOFAR 24KTLX-G3 is valid for the SOFAR 15KTLX-G3,SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3 since it is same as in hardware and just power derated by software.

The test results refer to the report LD200511N080 issued by Bureau Veritas Shenzhen Co.,Ltd.Dongguan Branch on 2020-12-17.

DIN V VDE V 0126-1-1:2006-02, 6.6.2.2.2 **Test for correct disconnection in case of an abrupt appearing residual current >300mA**	**P**
+ PV1 to N:	
Fault Current > 300mA	
Limit (ms)	U_N
300	268
300	266
300	272
300	264
300	272
- PV1 to N:	
Fault Current > 300mA	
Limit (ms)	U_N
300	276
300	266
300	274
300	272
300	266

Note:

The test results refer to the report LD200511N080 issued by Bureau Veritas Shenzhen Co.,Ltd.Dongguan Branch on 2020-12-17.

The tests had been performed on the SOFAR 24KTLX-G3 is valid for the SOFAR 15KTLX-G3,SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3 since it is same as in hardware and just power derated by software.

DIN V VDE V 0126-1-1:2006-02, 6.6.2.2.3 Test for correct disconnection in case of a suddenly occurring residual current		**P**
+PV to N		
Limit (mA)	Disconnection time (ms) U_N	Limit (ms)
30	220	300
30	215	300
30	223	300
30	232	300
30	234	300
60	136	150
60	128	150
60	129	150
60	111	150
60	113	150
150	36	40
150	36	40
150	29	40
150	33	40
150	34	40
-PV to N		
Limit (mA)	Disconnection time (ms) U_N	Limit (ms)
30	241	300
30	237	300
30	236	300
30	231	300
30	239	300
60	132	150
60	133	150
60	120	150
60	126	150
60	117	150
150	30	40
150	32	40
150	34	40
150	35	40
150	32	40

Note:
The capacitive current is risen until disconnection.
Test condition: I_c + 30/60/150mA <= I_{cmax}. R_1 is set that 30/60/150mA Flow and switch S is closed.

The tests had been performed on the SOFAR 24KTLX-G3 is valid for the SOFAR 15KTLX-G3, SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3, since it is identical in hardware and software construction except output power derated by software.
The test results refer to the report LD200511N080 issued by Bureau Veritas Shenzhen Co.,Ltd.Dongguan Branch on 2020-12-17.

6.1 (4.1) Functional safety - fault condition tests	P

component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
PV inverter current monitoring defect R3	Short	230V 35A	850V 29A	10min.	--	230V 0,1A	850V <1A	Inverter disconnected from grid immediately. Error message:" HwPVOCP". No damaged. No hazard.
PV current monitoring defect R852	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" HwPVOCP". No damaged.No hazard
PV inverter current monitoring defect U1 pin1-3	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" HwPVOCP". No damaged.No hazard.
Relay detect RL1	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
Relay detect RL2	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
Relay detect RL3	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
Relay detect RL4	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
Relay detect RL5	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
Relay detect RL6	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
AC Voltage monitoring defect R56	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
AC Voltage monitoring defect R58	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.

AC Voltage monitoring defect R95	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
AC Voltage monitoring defect R96	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
AC Voltage monitoring defect R97	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
AC Voltage monitoring defect R101	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
AC Voltage monitoring defect R102	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
AC Voltage monitoring defect R103	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
ISO detect R168	short before start-up	230V 0,1A	850V 0,1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R169	short before start-up	230V 0,1A	850V 0,1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R22	Open before start-up	230V 0,1A	850V 0,1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R23	short before start-up	230V 0,1A	850V 0,1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R186	Open before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R188	Short before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R193	Open before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.

ISO detect R194	Short before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R174	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R175	Short before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R212	Open before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R207	Short before start-up	230V 35A	850V 29A	10min.	--	230V 35A	850V 29A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
GFCI monitoring defect R421	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect R426	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect C275	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect C270	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect R413	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect U5-D pin12-14	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect U5-C pin10-8	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect C252	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.

GFCI protect R411	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
PV voltage monitor defect R515	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvOVP" No damaged.No hazard.
PV voltage monitor defect R517	Open	230V 17A	850V 15A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvUVP" No damaged.No hazard.
PV voltage monitor defect R522	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvOVP" No damaged.No hazard.
PV voltage monitor defect R524	Open	230V 17A	850V 15A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvUVP" No damaged.No hazard.
PV voltage monitor defect R529	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvOVP" No damaged.No hazard.
PV voltage monitor defect R531	Open	230V 17A	850V 15A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvUVP" No damaged.No hazard.
PV voltage monitor defect R538	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvOVP" No damaged.No hazard.
PV voltage monitor defect R540	Open	230V 17A	850V 15A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvUVP" No damaged.No hazard.
Bus voltage detect R547	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R549	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.

Bus voltage detect R552	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R554	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R557	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R559	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R562	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R564	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Grid voltage monitor defect R601	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R602	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R589	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R590	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R597	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.

Grid voltage monitor defect R596	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R569	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R836	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R574	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R839	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R578	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R841	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R583	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R587	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
BUS voltage monitoring defect R613	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" BUS voltage is low". No damaged.No hazard.
BUS voltage monitoring defect R614	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" Inverter bus hardware overvoltage". No damaged.No hazard.
ISO monitoring defect R189	Open before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.

ISO monitoring defect R510	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO monitoring defect R799	Open before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO monitoring defect R801	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
Communication defect U13 pin82	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" BluetoothFault". No damaged.No hazard.
Communication defect U13 pin95	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" BluetoothFault". No damaged.No hazard.
PV inverter current monitoring defect R3	Short	230V 35A	850V 29A	10min.	--	230V 0,1A	850V <1A	Inverter disconnected from grid immediately. Error message:" HwPVOCP". No damaged. No hazard.
PV current monitoring defect R852	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" HwPVOCP". No damaged.No hazard
PV inverter current monitoring defect U1 pin1-3	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" HwPVOCP". No damaged.No hazard.
Relay detect RL1	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
Relay detect RL2	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
Relay detect RL3	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
Relay detect RL4	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.

Relay detect RL5	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
Relay detect RL6	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter did not start-up. Error message:" RelayTestFail". No damage.No hazard.
AC Voltage monitoring defect R56	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
AC Voltage monitoring defect R58	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
AC Voltage monitoring defect R95	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
AC Voltage monitoring defect R96	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
AC Voltage monitoring defect R97	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
AC Voltage monitoring defect R101	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
AC Voltage monitoring defect R102	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
AC Voltage monitoring defect R103	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
ISO detect R168	short before start-up	230V 0,1A	850V 0,1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R169	short before start-up	230V 0,1A	850V 0,1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.

ISO detect R22	Open before start-up	230V 0,1A	850V 0,1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R23	short before start-up	230V 0,1A	850V 0,1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R186	Open before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R188	Short before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R193	Open before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R194	Short before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R174	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R175	Short before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R212	Open before start-up	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO detect R207	Short before start-up	230V 35A	850V 29A	10min.	--	230V 35A	850V 29A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
GFCI monitoring defect R421	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect R426	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.

GFCI protect C275	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect C270	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect R413	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect U5-D pin12-14	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect U5-C pin10-8	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect C252	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
GFCI protect R411	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" AFCIFault". No damaged.No hazard.
PV voltage monitor defect R515	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvOVP" No damaged.No hazard.
PV voltage monitor defect R517	Open	230V 17A	850V 15A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvUVP" No damaged.No hazard.
PV voltage monitor defect R522	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvOVP" No damaged.No hazard.
PV voltage monitor defect R524	Open	230V 17A	850V 15A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvUVP" No damaged.No hazard.
PV voltage monitor defect R529	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvOVP" No damaged.No hazard.

PV voltage monitor defect R531	Open	230V 17A	850V 15A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvUVP" No damaged.No hazard.
PV voltage monitor defect R538	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvOVP" No damaged.No hazard.
PV voltage monitor defect R540	Open	230V 17A	850V 15A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" InvUVP" No damaged.No hazard.
Bus voltage detect R547	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R549	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R552	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R554	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R557	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R559	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Bus voltage detect R562	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.

Bus voltage detect R564	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" VbusRmsUnbalance". No damaged.No hazard.
Grid voltage monitor defect R601	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R602	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R589	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R590	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R597	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R596	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R569	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R836	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R574	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R839	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R578	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.

Grid voltage monitor defect R841	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
Grid voltage monitor defect R583	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridOVP". No damaged.No hazard.
Grid voltage monitor defect R587	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" GridUVP". No damaged.No hazard.
BUS voltage monitoring defect R613	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" BUS voltage is low". No damaged.No hazard.
BUS voltage monitoring defect R614	Short	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" Inverter bus hardware overvoltage". No damaged.No hazard.
ISO monitoring defect R189	Open before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO monitoring defect R510	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO monitoring defect R799	Open before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
ISO monitoring defect R801	Short before start-up	230V <1A	850V <1A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" IsoFault". No damaged.No hazard.
Communication defect U13 pin82	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" BluetoothFault". No damaged.No hazard.
Communication defect U13 pin95	Open	230V 35A	850V 29A	10min.	--	230V <1A	850V <1A	Inverter disconnected from grid immediately. Error message:" BluetoothFault". No damaged.No hazard.

Note(s):

The errors in the control circuit simulate that the safety is even under one error ensured.

The conditions and testing is performed according to VDE V 0124-100, 5.4.5.2

The tests had been performed on the SOFAR 24KTLX-G3 is valid for the SOFAR 15KTLX-G3, SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3, since it is identical in hardware and software construction except output power derated by software.
The test results refer to the report PV200511N080-7 issued by Bureau Veritas Shenzhen Co.,Ltd.Dongguan Branch on 2020-12-18.

6.5 (4.5) Detection of Anti-Islanding **DIN V VDE V 0126-1-1:2006-02**	**P**

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} 1) [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) 1]	P_{AC} 2) [% of nominal]	Q_{AC} 3) [% of nominal]	I_{AC} 4) [A]	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	100	100	0	0	0,237	8005	734	1,001	**501**	BL
2	100	100	-5	-5	1,932	8005	734	1,027	449	IB
3	100	100	-5	0	1,977	8005	734	1,054	379	IB
4	100	100	-5	+5	1,931	8005	734	1,080	437	IB
5	100	100	0	-5	0,280	8005	734	0,976	438	IB
6	100	100	0	+5	0,281	8005	734	1,026	395	IB
7	100	100	+5	-5	2,018	8005	734	0,930	397	IB
8	100	100	+5	0	1,977	8005	734	0,954	469	IB
9	100	100	+5	+5	2,019	8005	734	0,977	416	IB

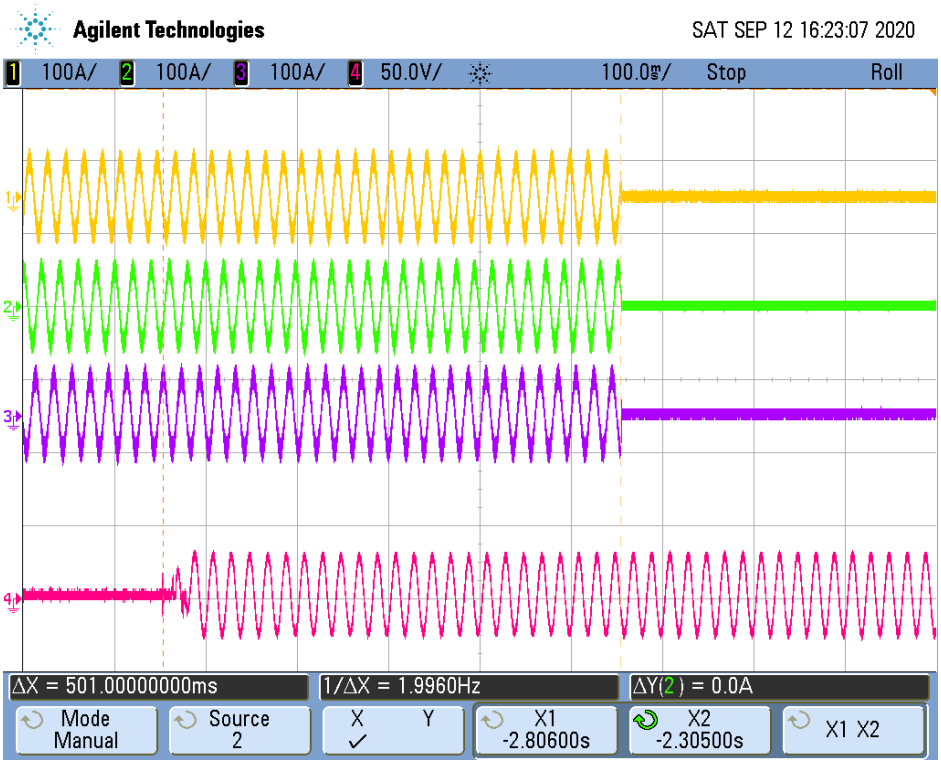
Parameter at 0% per phase	L= 21,01 mH	R= 6,61 Ω	C= 482,16 µF

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) P_{EUT}: EUT output power
2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) Fundamental of I_{AC} when RLC is adjusted
5) BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum 6)
EUT input voltage 6) = >75% of rated input voltage range
6) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
7) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 75 % of range =X + 0,75 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

The tests had been performed on the SOFAR 24KTLX-G3 and SOFAR 15KTLX-G3 is valid for the SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3, since it is identical in hardware and software construction except output power derated by software.

The test results refer to the report PV200511N080-1-R1 issued by Bureau Veritas Shenzhen Co.,Ltd.Dongguan Branch on 2020-11-20.

Disconnection at No. 1



5.6 Islanding protection according Table 7 – Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)	**P**

Test conditions	Frequency: 50+/-0.1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} 1) [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) 1]	P_{AC} 2) [% of nominal]	Q_{AC} 3) [% of nominal]	I_{AC} 4) [A]	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	66	66	0	-5	0,226	5036	470	0,974	413	IB
2	66	66	0	-4	0,216	5036	470	0,979	481	IB
3	66	66	0	-3	0,208	5036	470	0,985	469	IB
4	66	66	0	-2	0,202	5036	470	0,990	463	IB
5	66	66	0	-1	0,198	5036	470	0,995	384	IB
6	66	66	0	0	0,197	5036	470	1,000	**511**	BL
7	66	66	0	1	0,198	5036	470	1,005	480	IB
8	66	66	0	2	0,201	5036	470	1,010	500	IB
9	66	66	0	3	0,207	5036	470	1,015	484	IB
10	66	66	0	4	0,215	5036	470	1,019	489	IB
11	66	66	0	5	0,225	5036	470	1,024	474	IB

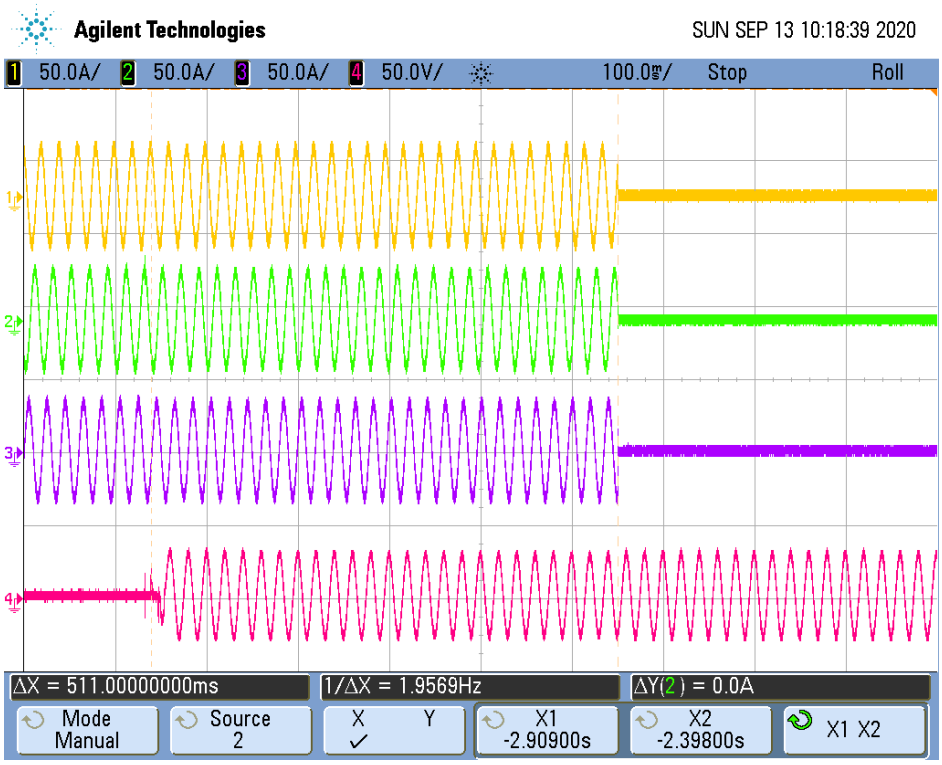
Parameter at 0% per phase	L= 31,74 mH	R= 9,97 Ω	C= 319,27 µF

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) P_{EUT}: EUT output power
2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) Fundamental of I_{AC} when RLC is adjusted
5) BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power P_{EUT} = 50 % – 66 % of maximum
EUT input voltage 6) = 50 % of rated input voltage range, ±10 %
6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 50 % of range =X + 0,5 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

The tests had been performed on the SOFAR 24KTLX-G3 and SOFAR 15KTLX-G3 is valid for the SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3, since it is identical in hardware and software construction except output power derated by software.

The test results refer to the report PV200511N080-1-R1 issued by Bureau Veritas Shenzhen Co.,Ltd.Dongguan Branch on 2020-11-20.

Disconnection at No. 6



5.6 Islanding protection according Table 7 – Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)	**P**

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	2s (IEC 62116)

No	P_{EUT} 1) [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) 1]	P_{AC} 2) [% of nominal]	Q_{AC} 3) [% of nominal]	I_{AC} 4) [A]	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	33	33	0	-5	0,128	2635	206	0,977	411	IB
2	33	33	0	-4	0,123	2635	206	0,982	487	IB
3	33	33	0	-3	0,119	2635	206	0,987	368	IB
4	33	33	0	-2	0,116	2635	206	0,992	418	IB
5	33	33	0	-1	0,114	2635	206	0,997	410	IB
6	33	33	0	0	0,113	2635	206	1,002	**497**	BL
7	33	33	0	1	0,113	2635	206	1,007	372	IB
8	33	33	0	2	0,115	2635	206	1,012	439	IB
9	33	33	0	3	0,118	2635	206	1,017	348	IB
10	33	33	0	4	0,122	2635	206	1,022	455	IB
11	33	33	0	5	0,127	2635	206	1,027	414	IB

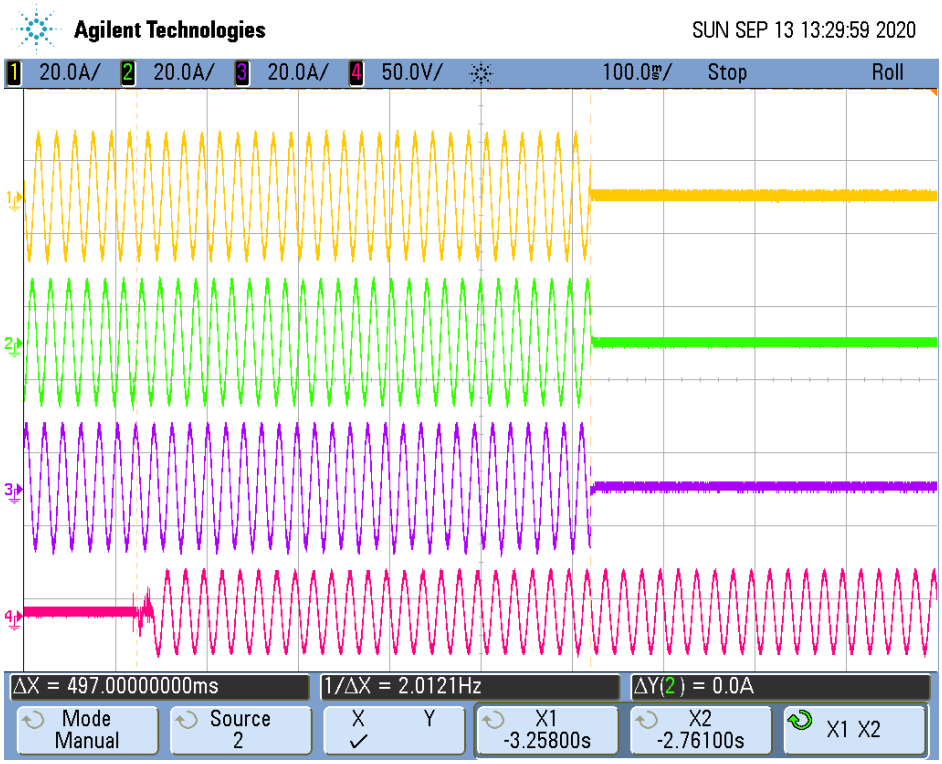
Parameter at 0% per phase	L= 63,78 mH	R= 20,08 Ω	C= 158,87 µF

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) P_{EUT}: EUT output power
2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) Fundamental of I_{AC} when RLC is adjusted
5) BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power PEUT = 25 % – 33 % 6) of maximum
EUT input voltage 7) = <20 % of rated input voltage range
6) Or minimum allowable EUT output level if greater than 33 %.
7) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 10 % of range =X + 0,2 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

The tests had been performed on the SOFAR 24KTLX-G3 and SOFAR 15KTLX-G3 is valid for the SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3, since it is identical in hardware and software construction except output power derated by software.

The test results refer to the report PV200511N080-1-R1 issued by Bureau Veritas Shenzhen Co.,Ltd.Dongguan Branch on 2020-11-20.

Disconnection at No. 6



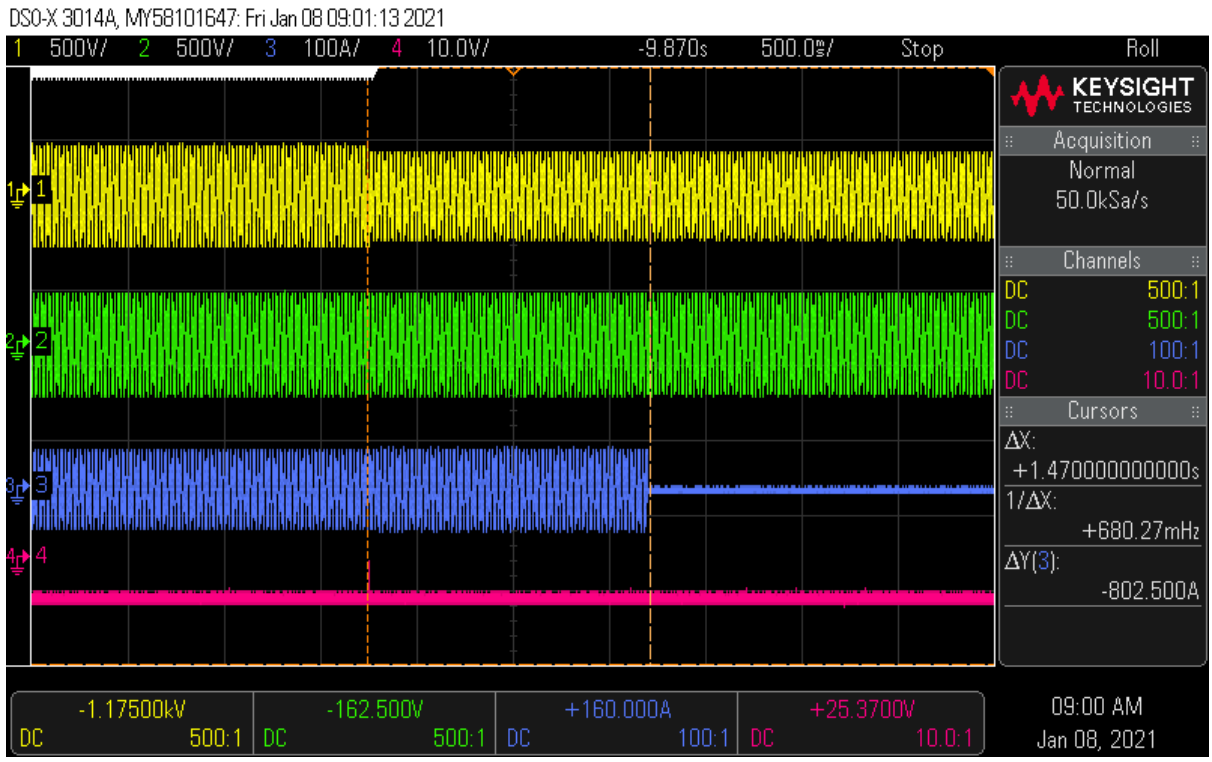
6.5.3 3-phase grid-voltage monitoring	P

Test Condition:			Frequency: 50+/-0,2Hz U_N=230Vac				
Phase	**Limit:**	**Voltage step: (to min, 184,1 or max, 281,5)**	**Trip value (V):**	**Reconnection time if <=3s (s):**	**Reconnection time if >3s (s):**	**Disconnection time (ms):**	**Limit (ms):**
L1 to N	~85% of Un	230V->190V	196,4	N/A	192	1450	1500
		230V->190V				1470	
	~110% of Un	230V->260V	254,5	N/A	193	1454	1500
		230V->260V				1454	
	~115% of Un	230V->270V	265,9	N/A	191	176	200
		230V->270V				185	
L2 to N	~85% of Un	230V->190V	196,5	N/A	193	1460	1500
		230V->190V				1450	
	~110% of Un	230V->260V	254,5	N/A	193	1444	1500
		230V->260V				1456	
	~115% of Un	230V->270V	266,0	N/A	194	184	200
		230V->270V				189	
L3 to N	~85% of Un	230V->190V	196,7	N/A	193	1452	1500
		230V->190V				1460	
	~110% of Un	230V->260V	254,4	N/A	191	1460	1500
		230V->260V				1446	
	~115% of Un	230V->270V	265,8	N/A	193	188	200
		230V->270V				186	

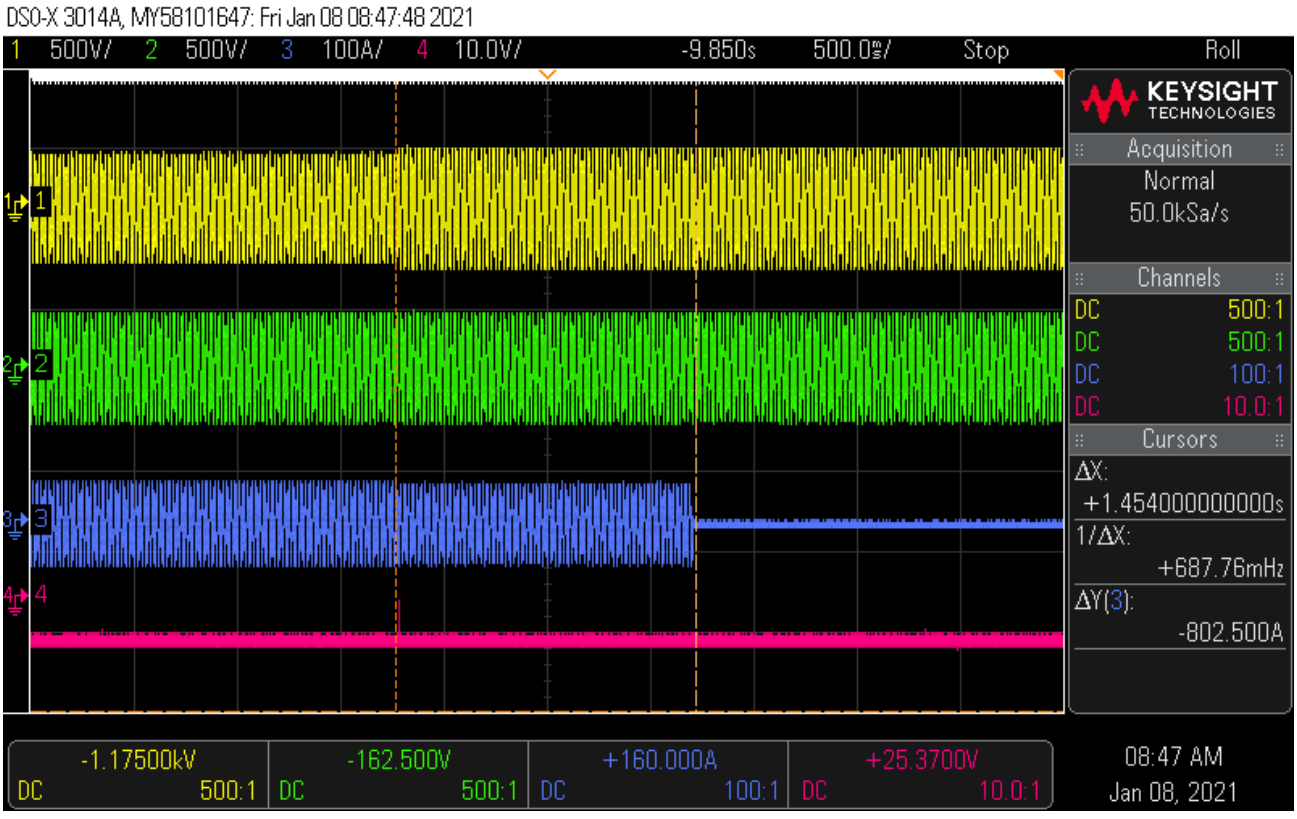
Note:

The tests had been performed on the SOFAR 24KTLX-G3 and SOFAR 15KTLX-G3 is valid for the SOFAR 17KTLX-G3, SOFAR 20KTLX-G3 and SOFAR 22KTLX-G3, since it is identical in hardware and software construction except output power derated by software.

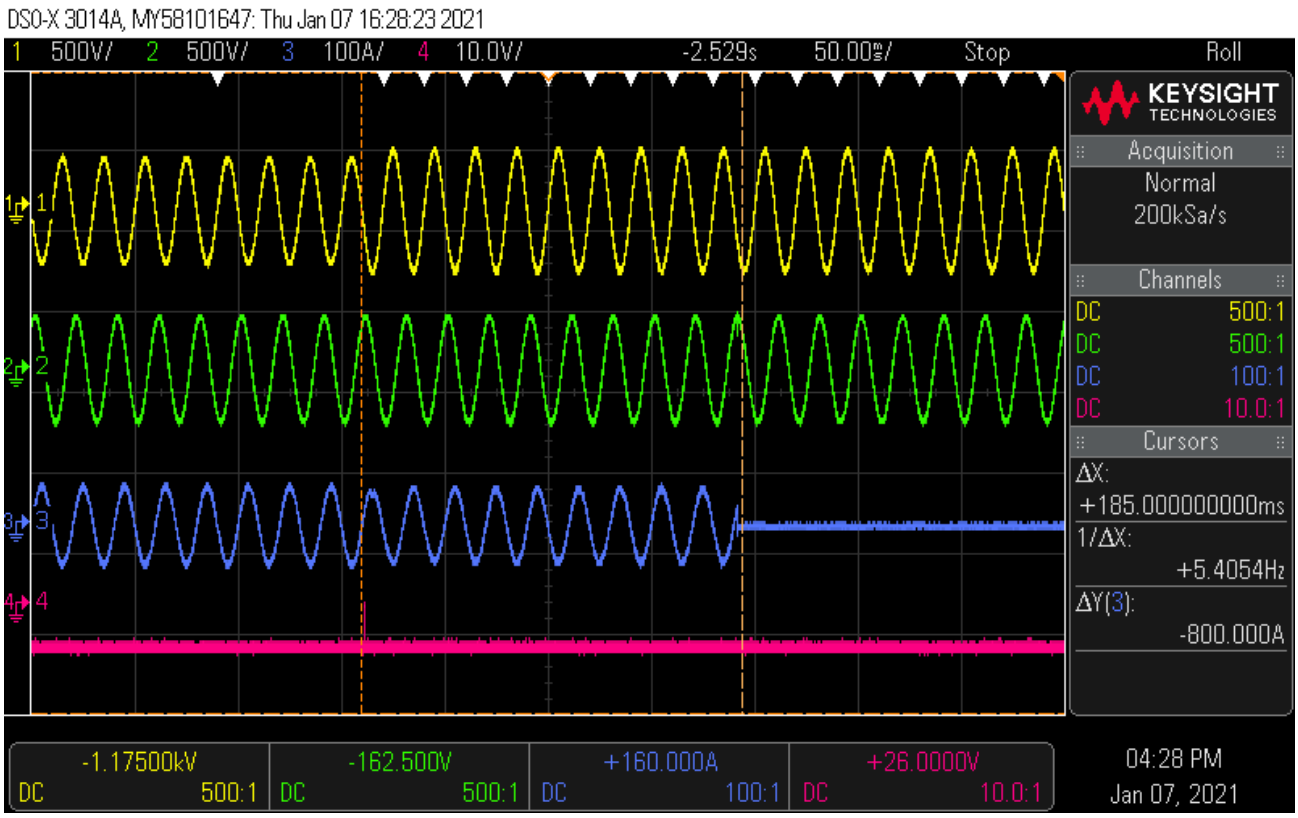
under voltage: L1 to N



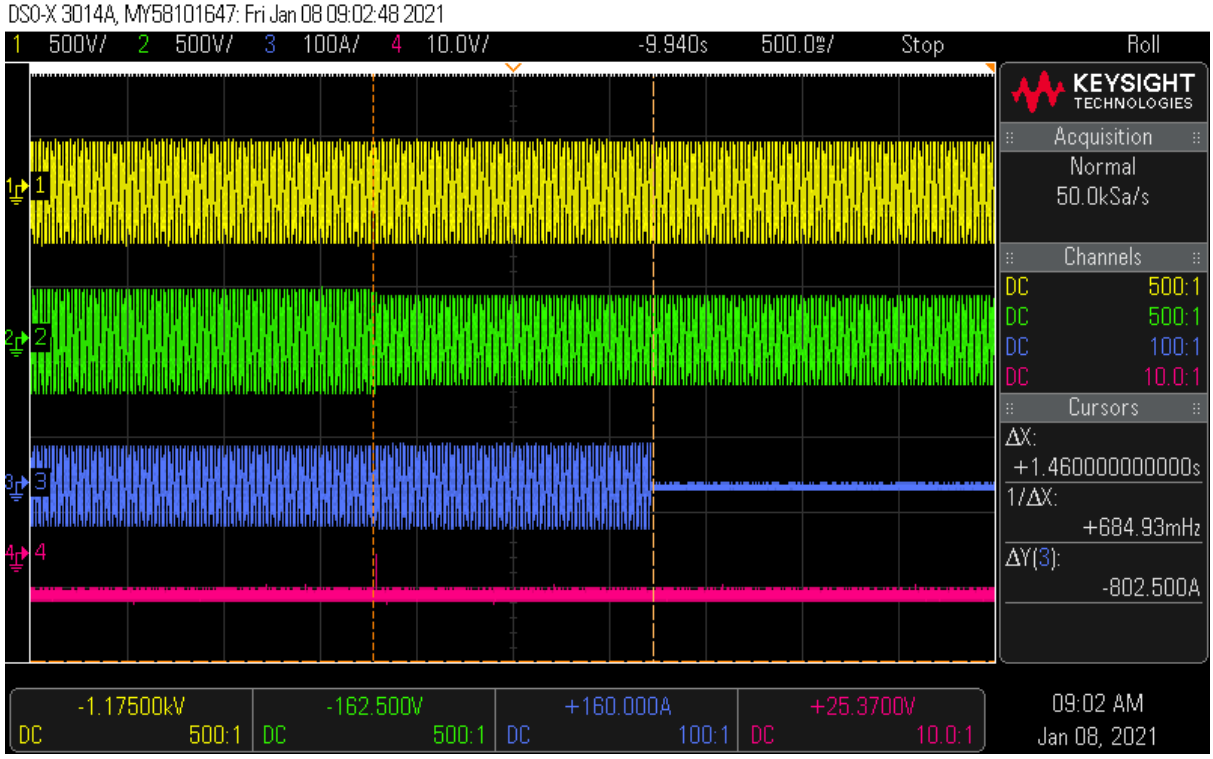
over voltage (stage 1): L1 to N



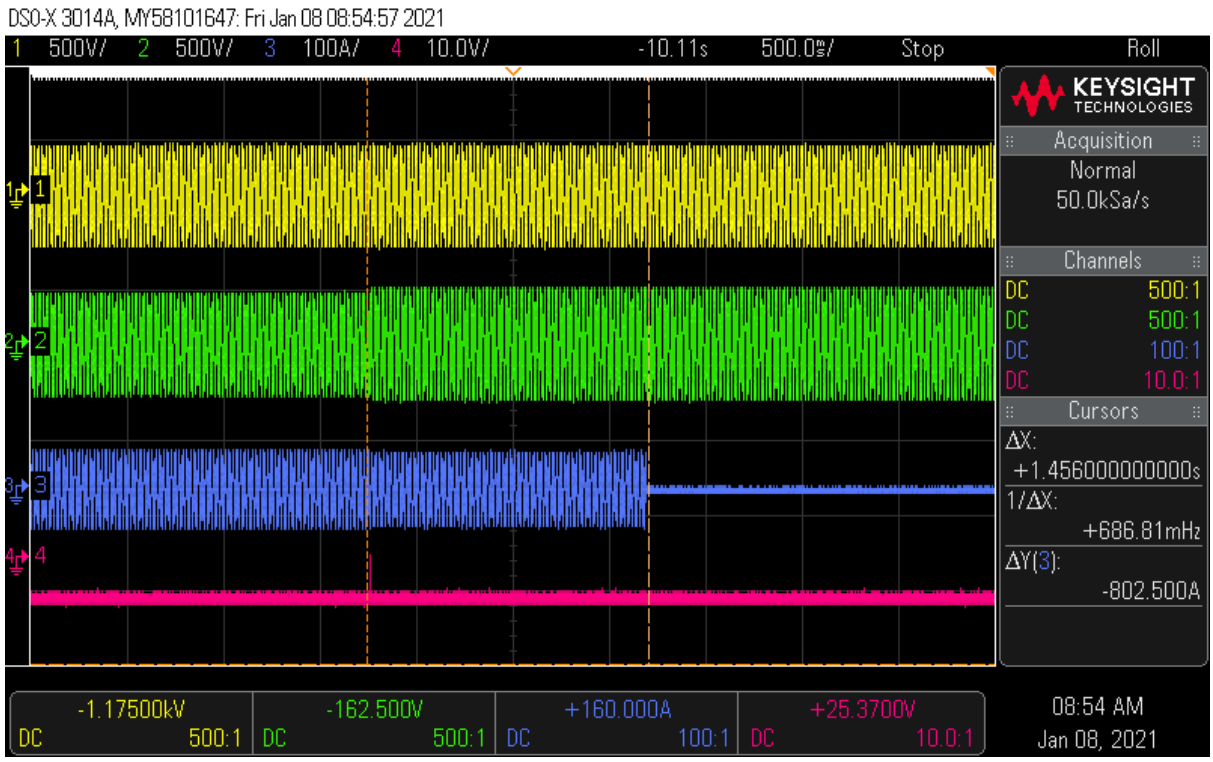
over voltage (stage 2): L1 to N



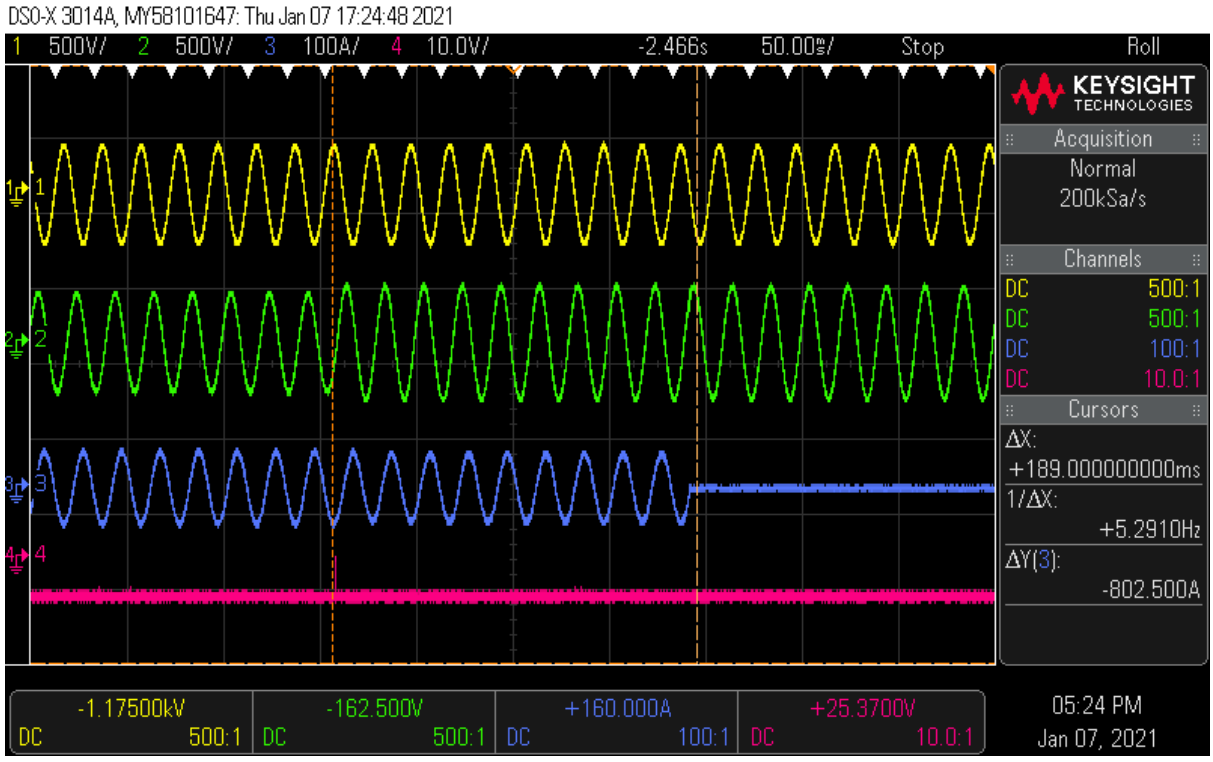
under voltage: L2 to N



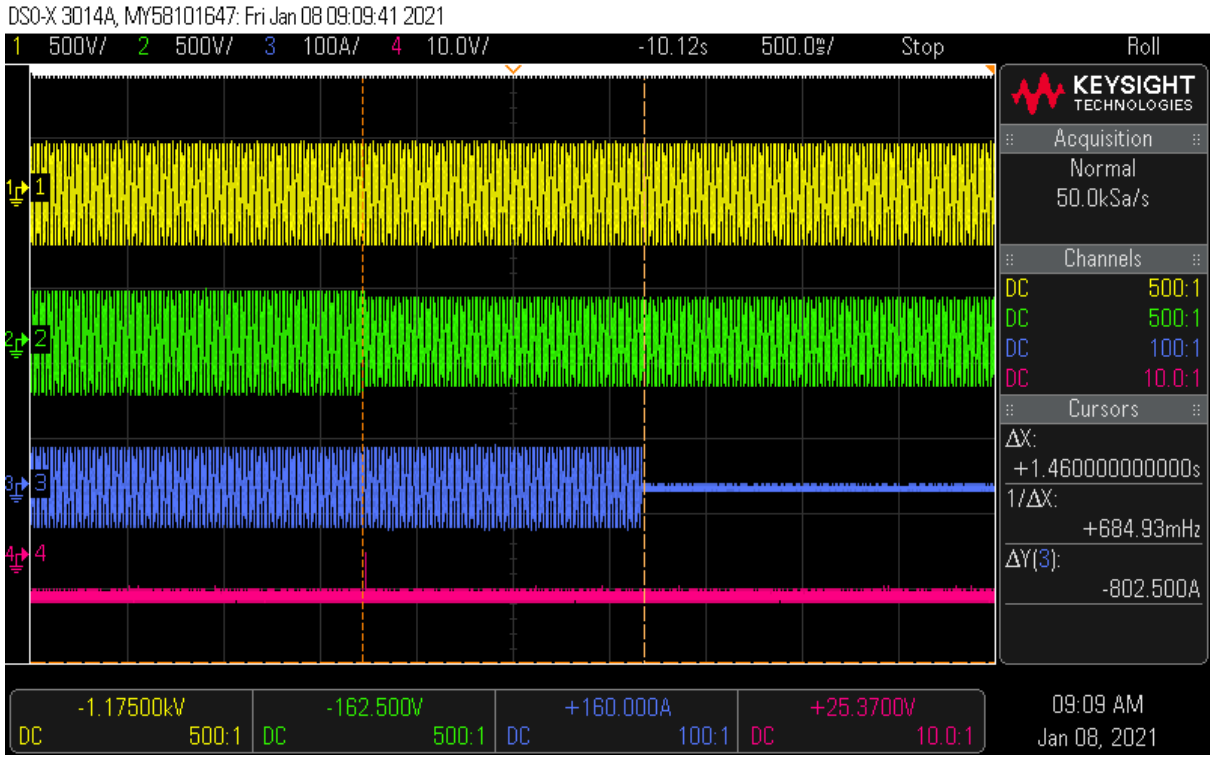
over voltage (stage 1): L2 to N



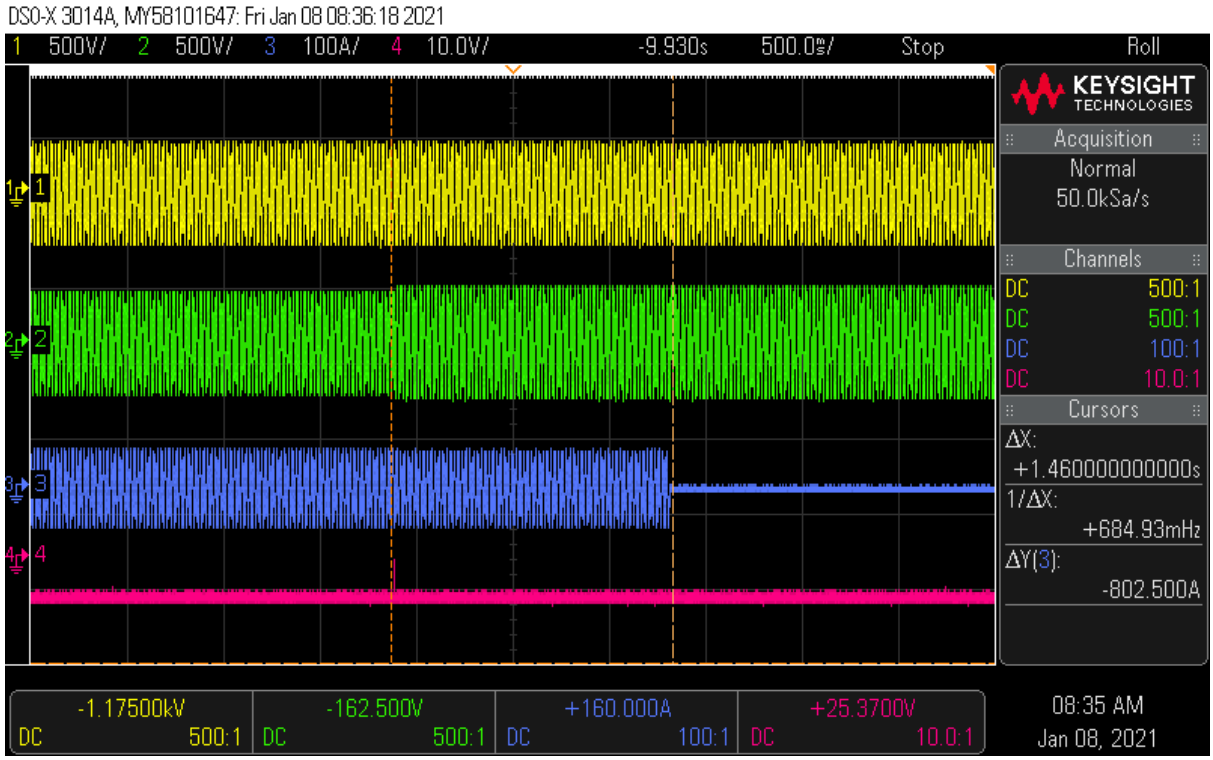
over voltage (stage 2): L2 to N



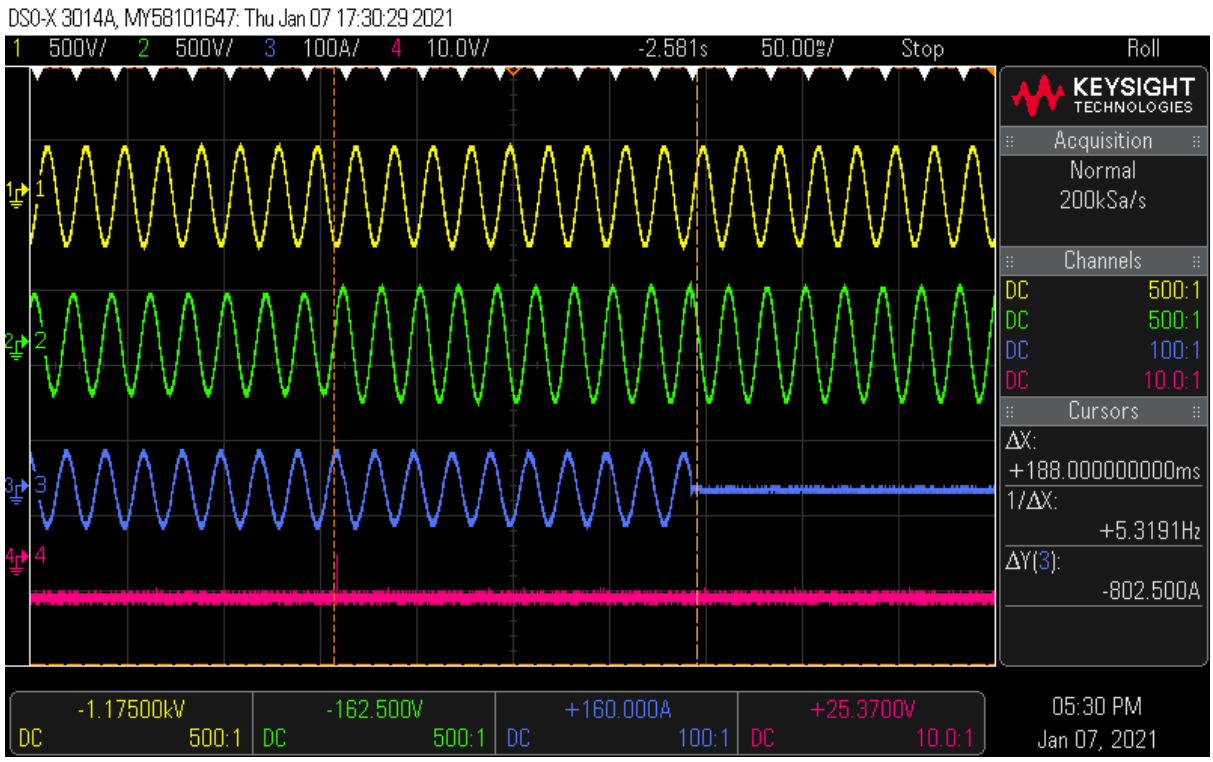
under voltage: L3 to N



over voltage (stage 1): L3 to N



over voltage (stage 2): L3 to N



Annex 1

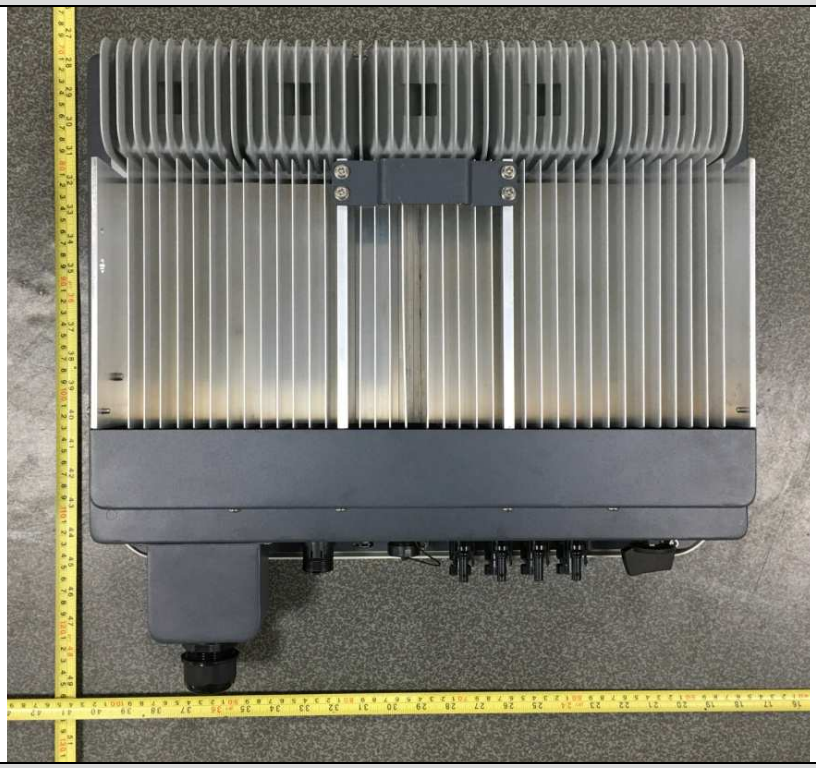
Pictures of the unit

Enclosure front view

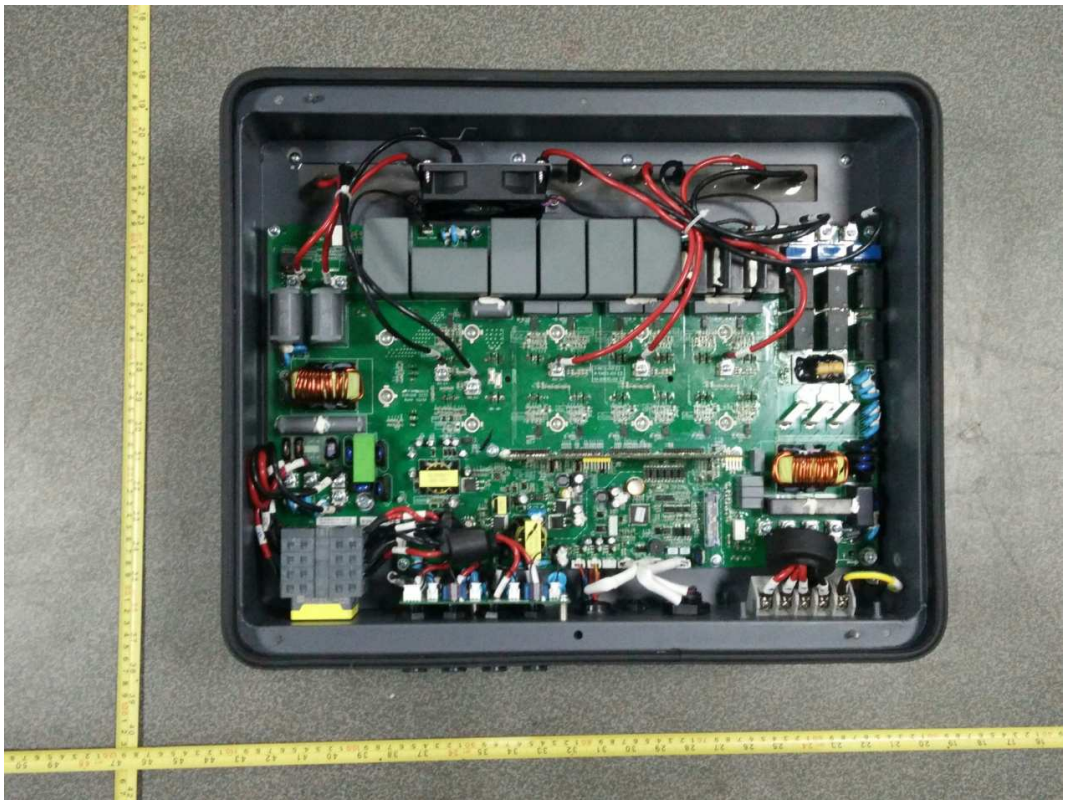
Enclosure side view

Enclosure bottom view SOFAR 15KTLX-G3, SOFAR 17KTLX-G3
Enclosure bottom view SOFAR 20KTLX-G3, SOFAR 22KTLX-G3, SOFAR 24KTLX-G3

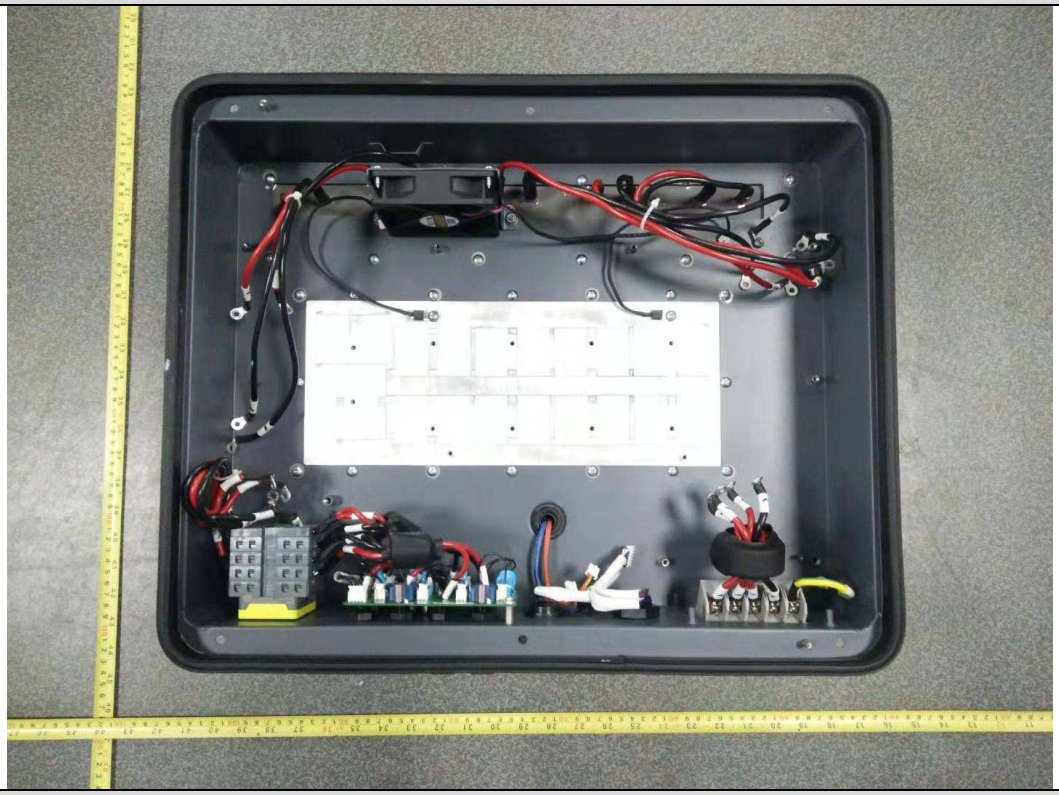
Enclosure rear view



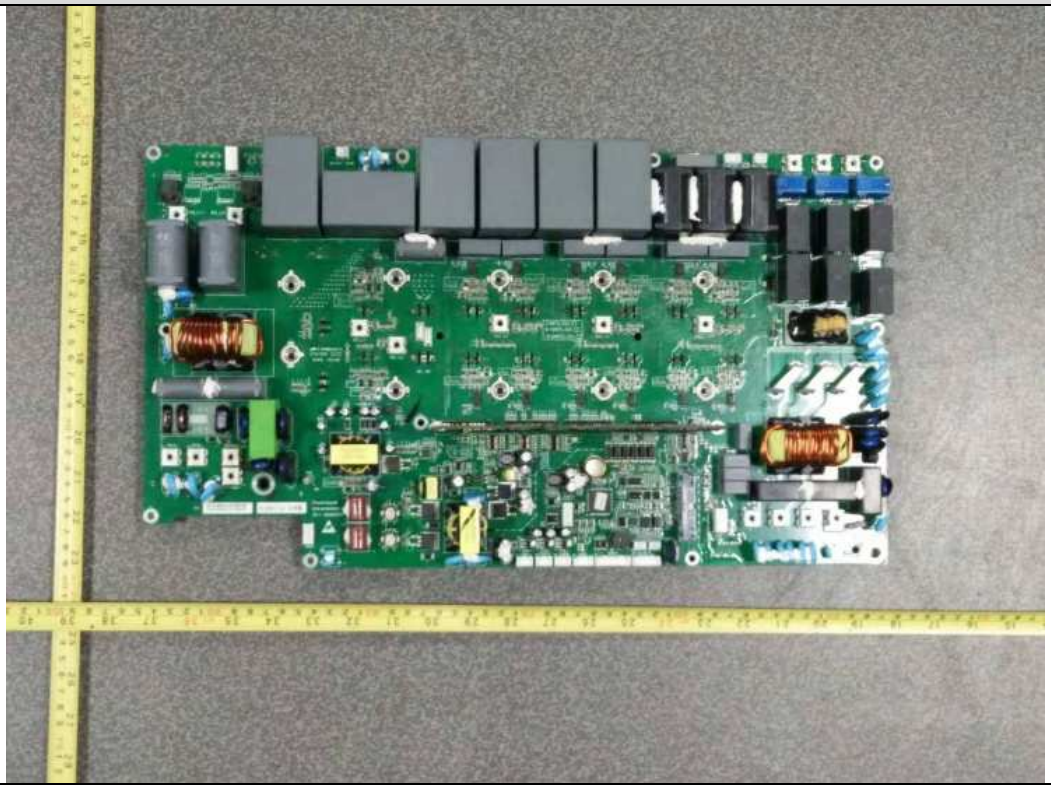
Internal view



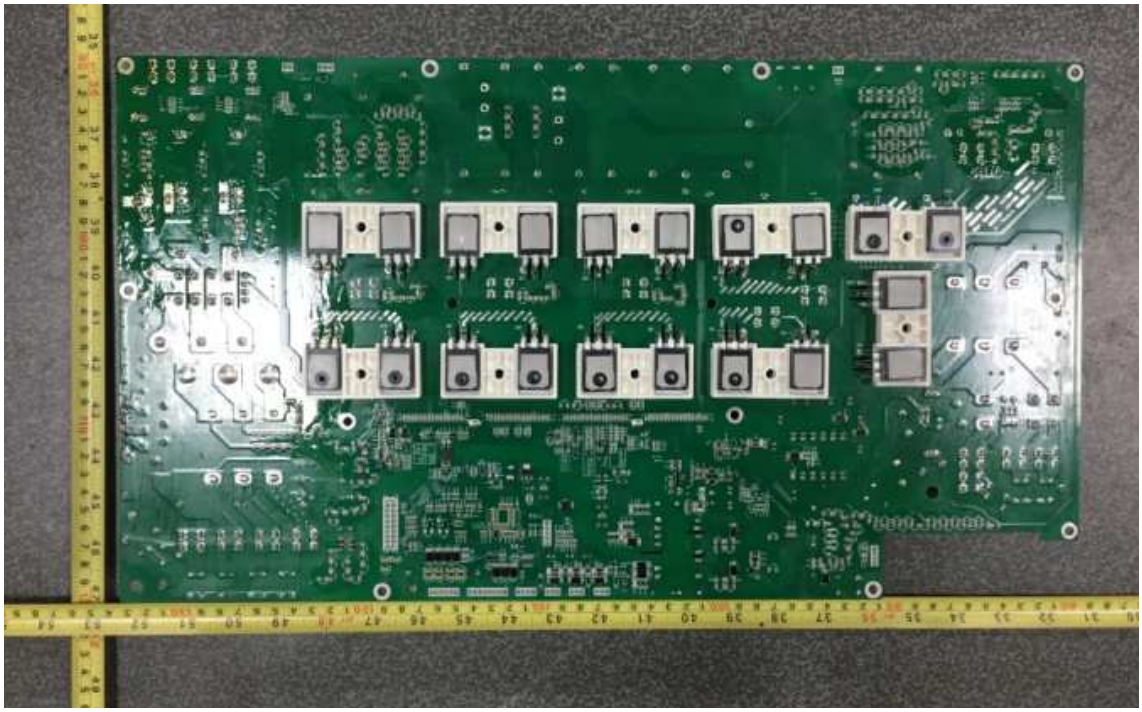
Internal view



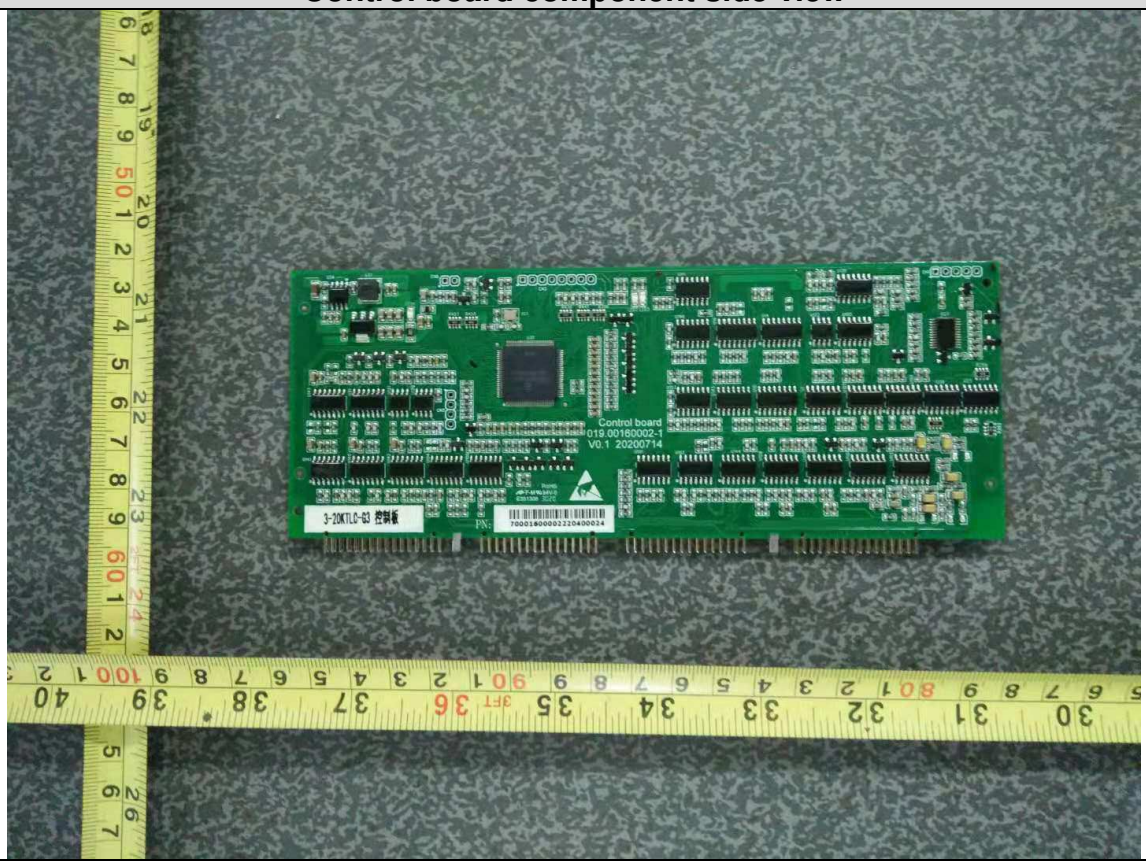
Power board component side view



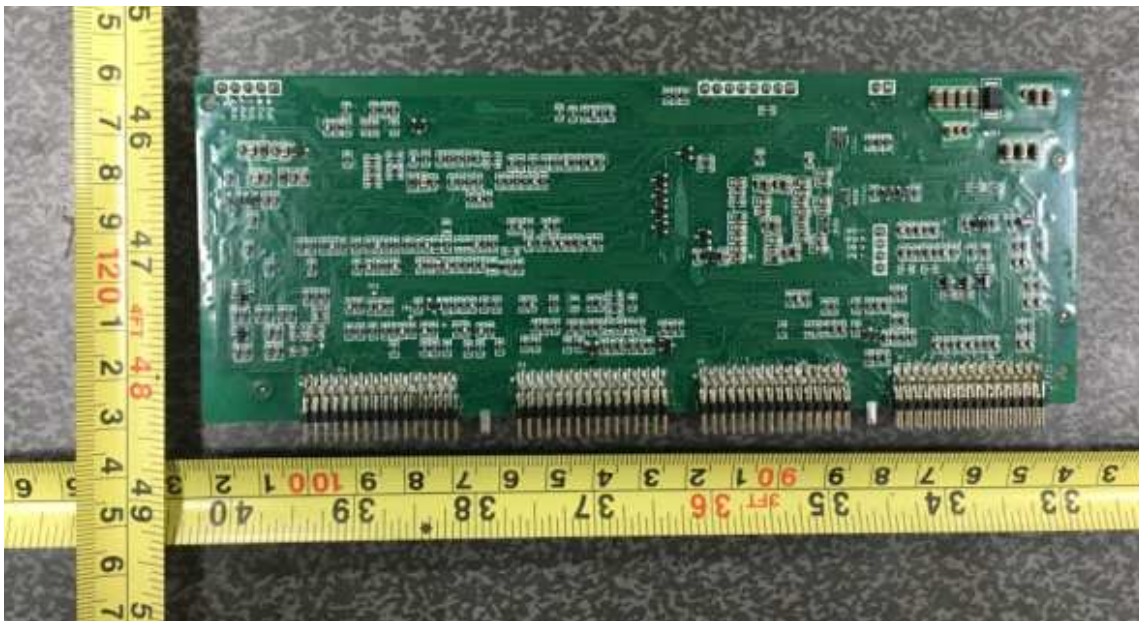
Power board solder side view



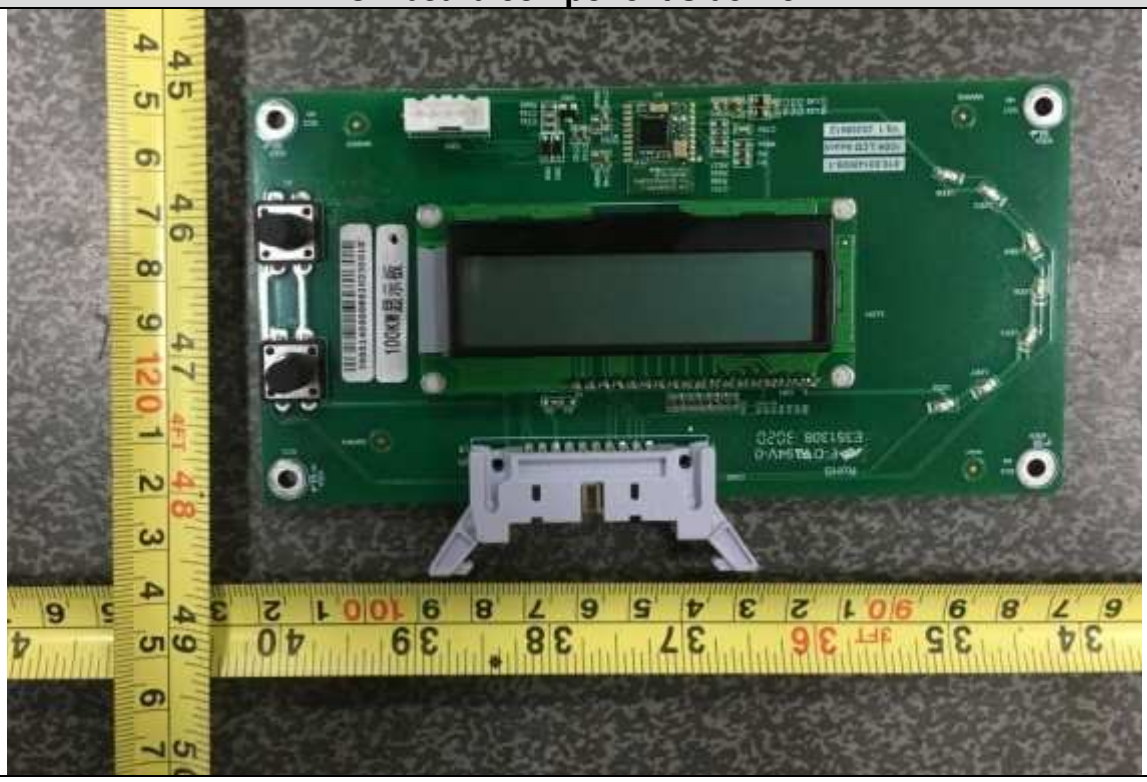
Control board component side view



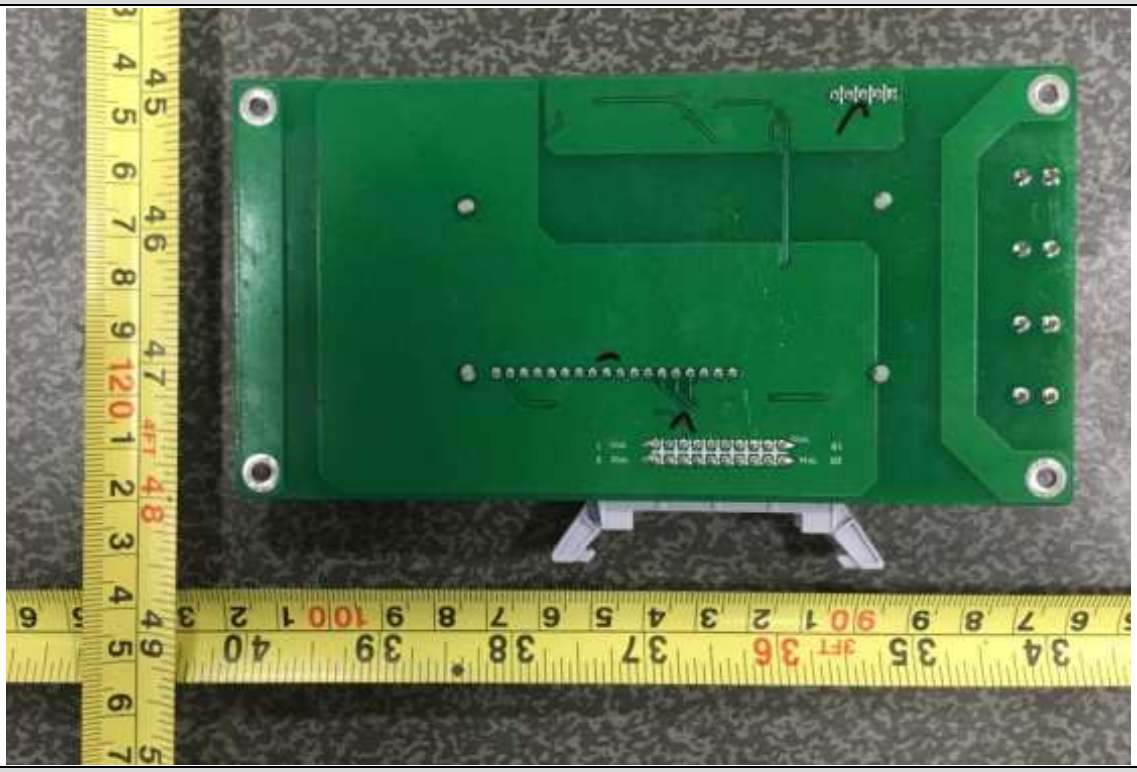
Control board solder side view



LCD board component side view



LCD board solder side view



General view of Grouding point

Annex 2
Test equipment list

Dates of performance test: 2020-11-20 to 2021-02-03

Equipment	Internal No.	Manufacturer	Type	Serial No.	Next Calibration date
Power Analyser	A4080002DG	YOKOGAWA	WT3000	91M210852	Jun. 16, 2021
AC Source	A7040019DG	Chroma	61512	61512000439	Monitored by Power Analyser
	A7040020DG	Chroma	61512	61512000438	
DC Simulation Power Supply	A7040015DG	Chroma	62150H-1000S	62150EF00488	
	A7040016DG	Chroma	62150H-1000S	62150EF00490	
	A7040017DG	Chroma	620028	620028EF00120	
RLC Load	A7150027DG	Qunling	ACLT-3803H	93VOO2869	
Eight Channel Digital Phosphor Oscilloscope	A4089017DG	YOKOGAWA	DL850	91N726247	Sep. 24, 2020
Oscilloscope probe	A4089008DG	Tektronix	TPP1000	C008230	Aug. 10, 2021
	A4089010DG	Tektronix	TPP1000	C008228	Aug. 10, 2021
	A4089011DG	Tektronix	TPP1000	C008229	Aug. 10, 2021
Current transducer	A1060007DG	YOKOGAWA	CT200	1130700012	Sep. 02, 2021
	A1060008DG	YOKOGAWA	CT200	1130700017	Sep. 02, 2021
	A1060012DG	YOKOGAWA	CT200	1130700018	Sep. 02, 2021
Power Analyser	//	ZLG	PA5000H	C820290908200 2110001	Mar. 02, 2021
Oscilloscope	//	Agilent	DS05014A	MY50070266	Jan. 05, 2022
Oscilloscope current probe	//	FLUKE	i1000S	29503223	Jan. 05, 2022
	//	FLUKE	iL000S	30413448	Jan. 05, 2022
	//	CYBERTEK	CP1000A	C181000929	Jan. 05, 2022
	//	CYBERTEK	CP1000A	C181000922	Jan. 05, 2022
	//	CYBERTEK	CP1000A	C191000141	Jan. 05, 2022
Oscilloscope voltage probe	//	SANHUA	SI-9110	152655	Jan. 05, 2022
	//	SANHUA	SI-9110	111134	Jan. 05, 2022
	//	SANHUA	SI-9110	111539	Jan. 05, 2022
	//	SIGLENT	DPB5150A	D15A150052	Jan. 05, 2022
	//	SIGLENT	DPB5150A	D15A200317	Jan. 05, 2022
	//	SIGLENT	DPB5150A	D15A200314	Jan. 05, 2022
	//	SIGLENT	DPB5150A	D15A150047	Jan. 05, 2022