Prüfbericht - Produkte

Test Report - Products

Prüfbericht-Nr.: *Test Report No.*:	CN22DK54 001	**Auftrags-Nr.:** *Order No.*:	168398023	Seite 1 von 41 *Page 1 of 41*
Kunden-Referenz-Nr.: *Client Reference No.*:	2026754	**Auftragsdatum:** *Order date*:	2022.11.08	
Auftraggeber: *Client*:	**Guangzhou Sanjing Electric Co., Ltd.** No.9, Lizhishan Road, Science City, Guangzhou High-tech Zone, Guangdong P.R. China			
Prüfgegenstand: *Test item*:	PV Grid-connected Inverter			
Bezeichnung / Typ-Nr.: *Identification / Type No.*:	C6-50K-T6-LV, C6-60K-T9-LV, C6-70K-T12-LV			
Auftrags-Inhalt: *Order content*:	AK certificate			
Prüfgrundlage: *Test specification*:	IEC 61727: 2004, IEC 62116: 2014			

Wareneingangsdatum: *Date of receipt*:	2022.11.09
Prüfmuster-Nr.: *Test sample No.*:	Engineering samples
Prüfzeitraum: *Testing period*:	2022.11.09-2022.11.30
Ort der Prüfung: *Place of testing*:	See page 2
Prüflaboratorium: *Testing laboratory*:	TÜV Rheinland (Shenzhen) Co., Ltd.
Prüfergebnis*: *Test result**:	Pass

geprüft von: *tested by:*		**genehmigt von:** authorized by:	
Datum: 2022.11.30 Date:	Eric Zeng	**Datum**: 2022.11.30 Date:	Zhiwei Yan
Stellung / Position	Project Engineer	**Stellung** / Position	Reviewer

Sonstiges / *Other*:

This report consists of this cover page, 41 pages for IEC 61727: 2004 and IEC 62116:2014, 23 pages(excluding cover page) for photo document.

This report does not evidence compliance of the provided sample with the relevant standards but only with the referred tests. This test report documents the findings of examination conducted on the delivered product mentioned above only. This report does not entitle the applicant to carry any safety mark on this or similar products. Further for sales or other application purposes of the tested product, any reference to TüV Rheinland or a test through TüV Rheinland is only permissible with prior written consent of TüV Rheinland.

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*P(ass) = passed a.m. test specification(s)*	*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.

This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.

V05

TEST REPORT
IEC 61727: 2004
Photovoltaic (PV) systems– Characteristics of the utility interface
IEC 62116: 2014
Utility-interconnected photovoltaic inverters-Test procedure of islanding prevention measures

Report Reference No. ..... :	CN22DK54 001	
Tested by (name + signature)..... :	See cover page	.....
Witnessed by (name + signature).. :	See cover page	.....
Supervised by (name + signature). :	See cover page	.....
Approved by (name + signature) ... :	See cover page	.....
Date of issue..... :	See cover page	
Testing Laboratory ..... :	TÜV Rheinland (Shenzhen) Co., Ltd.	
Address ..... :	Guangzhou Sanjing Electric Co., Ltd. No.9, Lizhishan Road, Science City, Guangzhou High-tech Zone, Guangdong P.R. China	
Testing location/ procedure ..... :	CBTL☐ TMP☒ WMT☐ SMT☐ RMT☐ CCATL ☐	
Testing location/ address ..... :	As above	
Applicant's name..... :	See cover page	
Address ..... :	See cover page	
Test specification:		
Standard..... :	IEC 61727: 2004, IEC 62116: 2014	
Test procedure..... :	AK	
Non-standard test method……..:	N/A	
Test Report Form No. ..... :	IEC 61727A	
Test Report Form(s) Originator..... :	TÜV Rheinland Group	
Master TRF..... :	2014-02	

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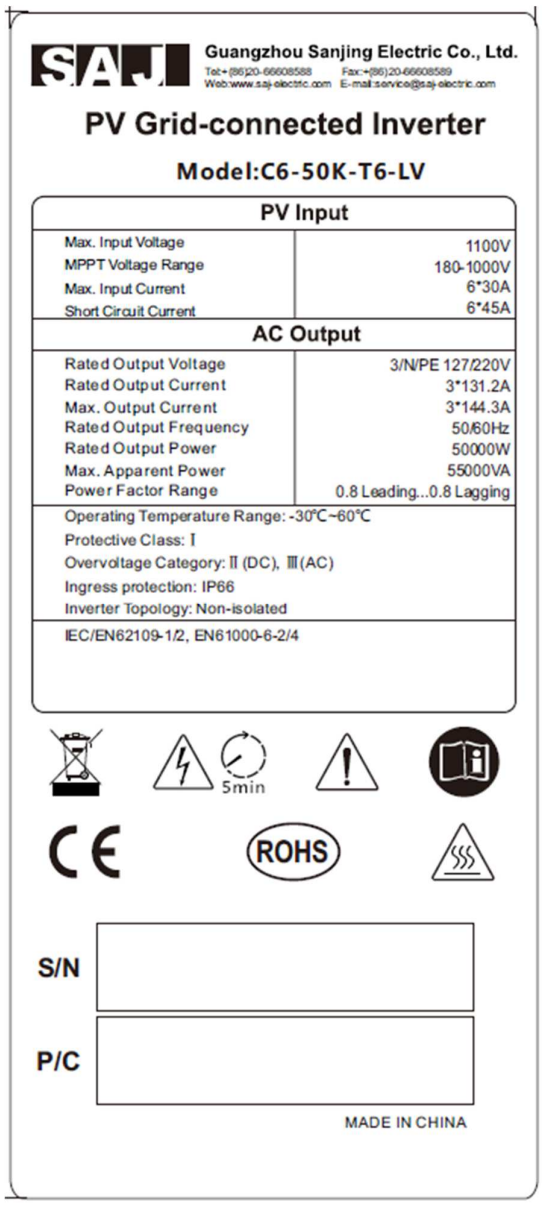
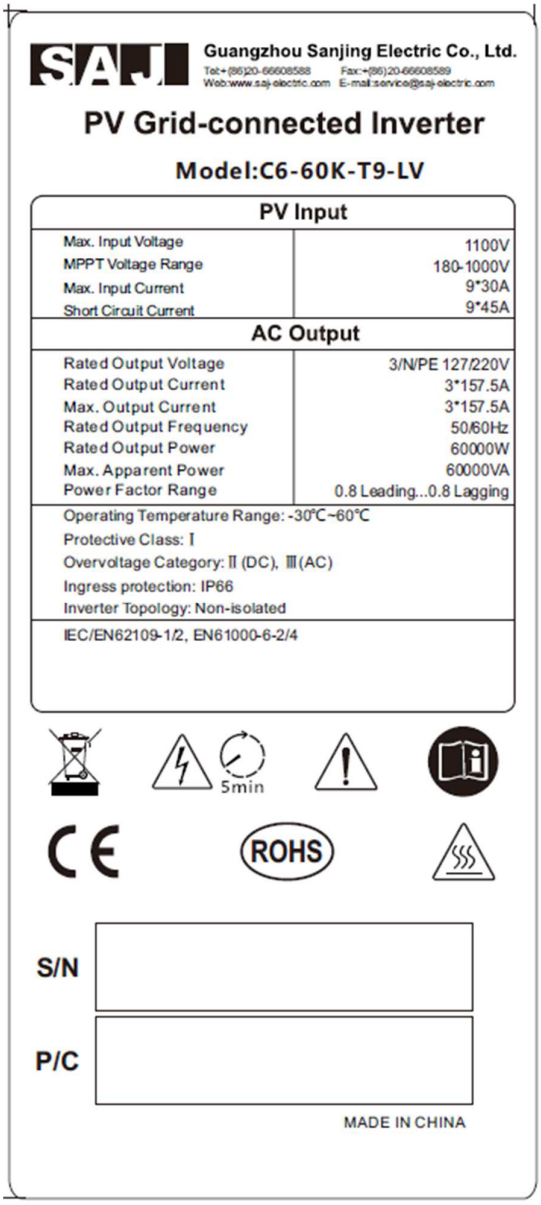
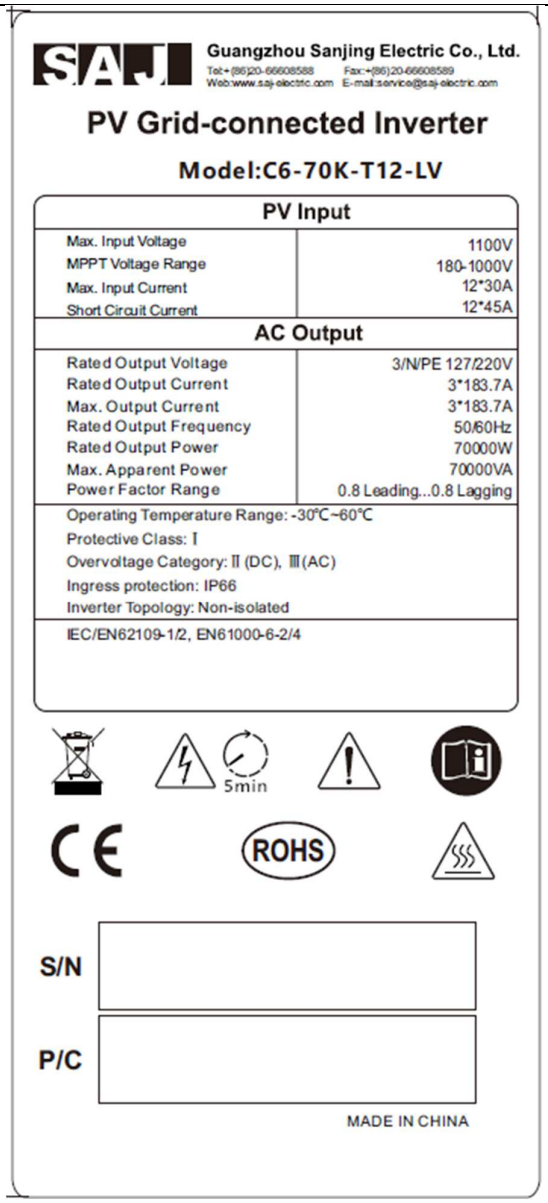
Test item description.....:	PV Grid-connected Inverter
Trade Mark.....:	SAJ
Manufacturer.....:	Same as applicant
Model/Type reference.....:	See cover page
Ratings.....:	See model list.

Testing procedure and testing location:		
☒ **Testing Laboratory:**	**TÜV Rheinland (Shenzhen) Co., Ltd.**	
☐ **Associated Test Laboratory:**		
Testing location/ address.....:		
Tested by (name + signature)..... :	See cover page	.....
Approved by (+ signature) ..... :	See cover page	.....
☒ Testing procedure: TMP		
Tested by (name + signature)..... :	See cover page	
Approved by (+ signature) ..... :	See cover page	
Testing location/ address.....:	Guangzhou Sanjing Electric Co., Ltd. No.9, Lizhishan Road, Science City, Guangzhou High-tech Zone, Guangdong P.R. China	
☐ Testing procedure: WMT		
Tested by (name + signature)..... :		
Witnessed by (+ signature)..... :		
Approved by (+ signature) ..... :		
Testing location/ address.....:		
☐ Testing procedure: SMT		
Tested by (name + signature)..... :		
Approved by (+ signature) ..... :		
Supervised by (+ signature)..... :		
Testing location/ address.....:		
☐ Testing procedure: RMT		
Tested by (name + signature)..... :		
Approved by (+ signature) ..... :		
Supervised by (+ signature)..... :		
Testing location/ address.....:		

Copy of marking plate:







SAJ

Guangzhou Sanjing Electric Co., Ltd.
Tel:+(86)20-66608588 Fax:+(86)20-66608589
Web:www.saj-electric.com E-mail:service@saj-electric.com

PV Grid-connected Inverter

Model:C6-70K-T12-LV

PV Input	
Max. Input Voltage	1100V
MPPT Voltage Range	180-1000V
Max. Input Current	12*30A
Short Circuit Current	12*45A
AC Output	
Rated Output Voltage	3/N/PE 127/220V
Rated Output Current	3*183.7A
Max. Output Current	3*183.7A
Rated Output Frequency	50/60Hz
Rated Output Power	70000W
Max. Apparent Power	70000VA
Power Factor Range	0.8 Leading...0.8 Lagging

Operating Temperature Range: -30℃~60℃
Protective Class: Ⅰ
Overvoltage Category: Ⅱ (DC), Ⅲ(AC)
Ingress protection: IP66
Inverter Topology: Non-isolated

IEC/EN62109-1/2, EN61000-6-2/4

5min

ROHS

S/N

P/C

MADE IN CHINA

List of Attachments (including a total number of pages in each attachment):

- ATTACHMENT 1 – Photo Documentation (23 pages)

Summary of testing

Tests performed (name of test and test clause):

☒ 4	Utility compatibility
☒ 4.1	Voltage, current and frequency
☒ 4.3	Flicker
☒ 4.4	DC injection
☒ 4.6	Harmonics and waveform distortion
☒ 4.7	Power factor
☒ 5	Personnel safety and equipment protection
☒ 5.2	Over/under voltage and frequency
☒ 5.2.1	Over/under voltage
☒ 5.2.2	Over/under frequency
☒ 5. 3	Islanding protection
☒ 5.4	Response to utility recovery

Testing location:

The laboratory described on page 2.

☒ The product fulfils the requirements of IEC 62116: 2014.

Equipment mobility .....:	☐ movable ☐ hand-held ☐ stationary ☒ fixed
Connection to the mains .....:	☐ pluggable equipment ☐ direct plug-in ☒ permanent connection ☐ for building-in
Operating condition.....:	☒ continuous ☐ short-time ☐ intermittent
Over voltage category .....:	☐ OVC I ☒ OVC II ☒ OVC III ☐ OVC IV
Mains supply tolerance (%).....:	According to specified supply range
Tested for IT power systems .....:	☐ Yes ☒ No
IT testing, phase-phase voltage (V) .....:	N/A
Class of equipment .....:	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg) .....:	See Table 2
Pollution degree .....:	☐ PD 1 ☐ PD 2 ☒ PD 3(internal reduced to PD 2)
IP protection class .....:	IP65

Possible test case verdicts:

- test case does not apply to the test object..... : N/A
- test object does meet the requirement..... : Pass (P)
- test object does not meet the requirement..... : Fail (F)

Testing:

Date of receipt of test items..... : See cover page

Date(s) of performance of tests..... : See cover page

General remarks:

"(see Attachment #)" refers to additional information appended to the report.

"(see appended table)" refers to a table appended to the report.

The tests results presented in this report relate only to the object tested.

This report shall not be reproduced except in full without the written approval of the testing laboratory.

List of test equipment must be kept on file and available for review.

Additional test data and/or information provided in the attach2116ments to this report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Determination of the test results includes consideration of measurement uncertainty from the test equipment and methods.

Manufacturer's Declaration per sub-clause 6.2.5 of IECEE 02:

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided :	☐ Yes ☒ Not applicable

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies)	:	**Guangzhou Sanjing Electric Co., Ltd.** No.9, Lizhishan Road, Science City, Guangzhou High-tech Zone, Guangdong P.R. China

General product information:

Brief description:

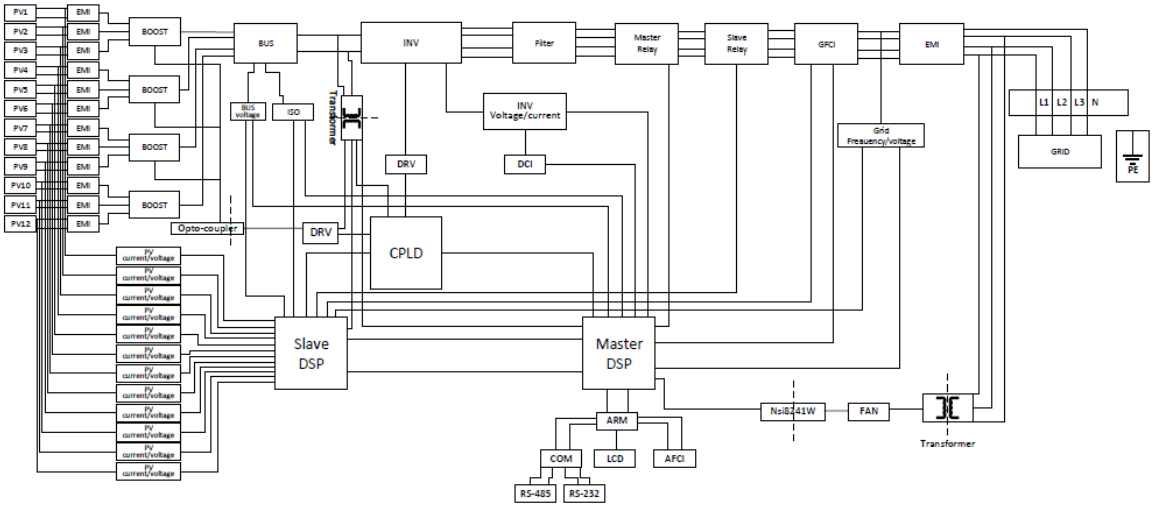
The equipment is a three-phase public interactive photovoltaic inverter, which will be installed and connected to the grid after installation.
It contains filters for smoothing output voltage and EMC, switching and control circuits. Electronic circuits are mounted on multiple PCBs interconnected by appropriate connectors and wires.
The power board including the electronic components is mounted on the radiator and grounded through metal screws and spring washers.
Communication ports include USB, DRM and RS485, which are connected to a monitor to monitor the status of the inverter through proprietary software.
PV input combiner with 6, 9 or 12 MPPT tracers, and each MPPT tracer includes 4 PV input terminals (2 PV+ and 2PV-).
The AC output is directly connected to the power grid, and the protective grounding is provided by a dedicated grounding terminal.
The grid-connected protection combines the two series of relays as a redundant construction to ensure that the inverter can independently disconnect from the grid when the relay fails.
In the case of a fault defined in this standard, after the DSP receives an abnormal signal from the relevant protection detection circuit, the relay will act to automatically disconnect the active circuit of the photovoltaic inverter from the grid, when any grid fault occurs, the master DSP and the slave DSP have the ability to disconnect from the grid independently.

Model difference:

The models C6-50K-T6-LV, C6-60K-T9-LV, C6-70K-T12-LV are same as the construction and hardware excepted the different as below table and the output voltage and output power are different with adjusted by software. Details can be found below:

Model / Parts	**C6-50K-T6-LV**	**C6-60K-T9-LV**	**C6-70K-T12-LV**
Power board version	C6.212100-212136.MPB-I1 V1.0		C6.212100-212136.MPB-V V1.0
Number of strings	2		
Number of MPPT tracers	6	9	12

The system diagram block is shown as below:



Block Diagram

1) Definition of circuits inside of Grid-connected PV Inverter.

I. PV input circuits

PV input circuits are directly connected to the PV array and the voltage can be up to 1100Vdc.

Decisive voltage C considered for the PV voltage side.

II. AC output to the AC mains

AC output 127Vac (L-N).

Decisive voltage C considered for the AC voltage side.

III. Communication

The communication terminal (RS485/DRM/USB) can be communicated to COM-port.

Decisive voltage A considered for the communication side.

2) Isolation used in the product

Protective separation applied between decisive voltage A and decisive voltage C with corresponding overvoltage category.

3) Cooling method

Physical cooling by metal heat sink and internal fans as well as external fans.

4) Isolation between decisive voltage A and decisive voltage C

Reinforced insulation provided in the product to separate those two parts.

Model list		C6-50K- T6-LV	C6-60K- T9-LV	C6-70K- T12-LV
PV INPUT	VMAX PV [V_{dc}]	1100		
	ISC PV [A]	6*45	9*45	12*45
	MPPT Voltage Range VMPP [V_{dc}]	180-1000		
	Max. Input Current I_{MAX} [A] (A/B) (each MPPT if more than 1)	6*30	9*30	12*30
	MPPT Full Power Voltage Range [V_{dc}]	520-850		
	Number of MPPT	6	9	12

	String per MPPT	2		
	Backfeed Current [A]	0		
	Overvoltage Category(OVC)	II		
AC Side(ON-Grid)	Rated Output Voltage Ur [V_{ac}]	3/N/PE, 127/220		
	Rated Output Frequency FNETZ [Hz]	50/60		
	Rated Output Power PE [W]	50	60	70
	Max. Apparent power SEmax [VA]	55	60	70
	Rated Output Current Ir [A]	131.2	157.5	183.7
	Max. Output Current I_{max} [A]	144.3	157.5	183.7
	Power Factor cosφ [λ]	0.8 leading~0.8 lagging		
	Efficiency max. ηmax	98.8%		
	Efficiency Euro	98.5%		
	THD [V / I] (100% full power)	<3%		
	Acoustic Noise [dB]	<50		
	Overvoltage Category (OVC)	III		
CONSTRUCTION	Hardware [Version]	Control broad:V1.2, IO broad:V1.0, Main power broad:V1.0, Boost drive broad:V1.0, INV drive broad:V1.0 ARM broad:V1.4, PV Input broad:V1.2, AC output broad:V1.4 Electric capacity broad:V1.0, Lightning protection broad:V1.0, Communication broad: V1.1,		
	Firmware [Version]	V0.082		
	Array Insulation Resistance Detection [Ω]	150K		
	Type of inverter	Non-isolated		
	Separated by	Transformer less		
	Type of NS Protection	Integrated		
	Protective Class	Class I		
	Enclosure Protection (IP)	IP66		
	Operating Temperature Range [°C]	-30°C to +60°C (45°C to 60°C with derating)		

	Pollution degree (PD)	PD3	
	Altitude [m]	2000	
	Size [mm]	1045*660*364	
	Weight [kg]	93	98

General Test Conditions are:
All tests of Grid-connected PV Inverter were carried out under the most unfavourable combination within the manufacturer's operating specifications of the following parameters:
-PV input voltage Max. 1100Vd.c.
-operating temperature, Max. Ambient temperature 60°C by the client.
-operating mode: continuous.
- AC output:
Rated
voltage:
127V for C6-50K-T6-LV, C6-60K-T9-LV, C6-70K-T12-LV
The highest output power is 100% at the rated voltage.
-MPPT Full Power Voltage Range: 520-850Vdc

IEC 61727: 2004			
Clause	Requirement – Test	Result - Remark	Verdict
4	**Utility compatibility**	See below.	P
	The quality of power provided by the PV system for the on-site AC loads and for power delivered to the utility is governed by practices and standards on voltage, flicker, frequency, harmonics and power factor. Deviation from these standards represents out-of-bounds conditions and may require the PV system to sense the deviation and properly disconnect from the utility system.	Compliance.	P
	All power quality parameters (voltage, flicker, frequency, harmonics, and power factor) must be measured at the utility interface/ point of common coupling unless otherwise specified. NOTE Balancing phase currents in multiphase systems is desirable.		P
4.1	**Voltage, current and frequency**	See below.	P
	The PV system AC voltage, current and frequency shall be compatible with the utility system.	See appended table 4.1.	P
4.2	**Normal voltage operating range**	See below.	P
	Utility-interconnected PV systems do not normally regulate voltage, they inject current into the utility. Therefore, the voltage operating range for PV inverters is selected as a protection function that responds to abnormal utility conditions, not as a voltage regulation function.	Compliance.	P
4.3	**Flicker**	See below.	P
	The operation of the PV system should not cause voltage flicker in excess of limits stated in the relevant sections of IEC 61000-3-3 for systems less than 16 A or IEC 61000-3-5 for systems with current of 16 A and above.	See appended table 4.3.	P
4.4	**DC injection**	See appended table 4.4.	P
	The PV system shall not inject DC current greater than 1% of the rated inverter output current, into the utility AC interface under any operating condition.		P
4.5	**Normal frequency operating range**	See below.	P
	The PV system shall operate in synchronism with the utility system, and within the frequency trip limits defined in 5.2.2.	Compliance.	P
4.6	**Harmonics and waveform distortion**	See below.	P
	Low levels of current and voltage harmonics are desirable; the higher harmonic levels increase the potential for adverse effects on connected equipment.	Compliance.	P

IEC 61727: 2004			
Clause	Requirement – Test	Result - Remark	Verdict
	Acceptable levels of harmonic voltage and current depend upon distribution system characteristics, type of service, connected loads/apparatus, and established utility practice.	Compliance.	P
	The PV system output should have low current-distortion levels to ensure that no adverse effects are caused to other equipment connected to the utility system.	Compliance.	P
	Total harmonic current distortion shall be less than 5% at rated inverter output. Each individual harmonic shall be limited to the percentages listed in Table 1.	See appended table 4.6.	P
	Even harmonics in these ranges shall be less than 25% of the lower odd harmonic limits listed.	See appended table 4.6.	P
	Table 1-Current distortion limits **Odd harmonics** / **Distortion limit** 3rd through 9th / Less than 4.0% 11th through 15th / Less than 2.0% 17th through 21st / Less than 1.5% 23rd through 33rd / Less than 0.6% **Even harmonics** / **Distortion limit** 2rd through 8th / Less than 1.0% 10th through 32nd / Less than 0.5% NOTE Testing harmonics is very problematic, since voltage distortion may feed to enhanced current distortion. The harmonic current injection should be exclusive of any harmonic currents due to harmonic voltage distortion present in the utility grid without the PV system connected. Type tested inverters meeting the above requirements should be deemed to comply without further testing.		P
4.7	**Power factor**	See below.	P
	The PV system shall have a lagging power factor greater than 0.9 when the output is greater than 50% of the rated inverter output power. NOTE 1 Specially designed systems that provide reactive power compensation may operate outside of this limit with utility approval. NOTE 2 Most PV inverters designed for utility-interconnected service operate close to unity power factor.	See appended table 4.7.	P
5	**Personnel safety and equipment protection**	See below.	P
	This Clause provides information and considerations for the safe and proper operation of the utility-connected PV systems. NOTE 1 The protection function may be provided as an internal or external device in the system. NOTE 2 IEC 60364-5-55 or national or local codes may be applicable.	Installation, operation and maintain manual provided in English.	P

IEC 61727: 2004			
Clause	Requirement – Test	Result - Remark	Verdict
5.1	**Loss of utility voltage**	See below.	P
	To prevent islanding, a utility connected PV system shall cease to energize the utility system from a de-energized distribution line irrespective of connected loads or other generators within specified time limits.	See clause 5.3.	P
	A utility distribution line can become de-energized for several reasons. For example, a substation breaker opening due to fault conditions or the distribution line switched out during maintenance.		N/A
	If inverters (single or multiple) have DC SELV input and have accumulated power below 1 kw then no mechanical disconnect (relay) is required.		N/A
5.2	**Over/under voltage and frequency**	See below.	P
	Abnormal conditions can arise on the utility system that require a response from the connected photovoltaic system. This response is to ensure the safety of utility maintenance personnel and the general public, as well as to avoid damage to connected equipment, including the photovoltaic system. The abnormal utility conditions of concern are voltage and frequency excursions above or below the values stated in this Clause, and the complete disconnection of the utility, presenting the potential for a distributed resource island.	Compliance.	P
5.2.1	**Over/under voltage**	See below.	P
	When the interface voltage deviates outside the conditions specified in Table 2, the photovoltaic system shall cease to energize the utility distribution system. This applies to any phase of a multiphase system.	See appended table 5.2.1.	P
	All discussions regarding system voltage refer to the local nominal voltage.	Compliance.	P
	The system shall sense abnormal voltage and respond. The following conditions should be met, with voltages in RMS and measured at the point of utility connection.	Compliance.	P

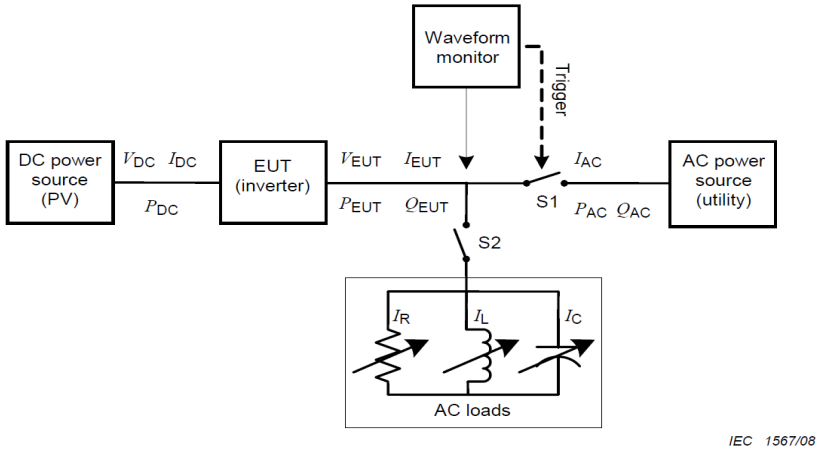
<table>
<tr><th colspan="4">IEC 61727: 2004</th></tr>
<tr><th>Clause</th><th>Requirement – Test</th><th>Result - Remark</th><th>Verdict</th></tr>
<tr><td></td><td>

Table 2 – Response to abnormal voltages

<table>
<tr><th>Voltage (at point of utility connection)</th><th>Maximum trip time*</th></tr>
<tr><td>V < 0,5 x Vnominal</td><td>0,1 s</td></tr>
<tr><td>50 % ≤ V < 85 %</td><td>2,0 s</td></tr>
<tr><td>85 % ≤ V ≤ 110 %</td><td>Continuous operation</td></tr>
<tr><td>110 % < V < 135 %</td><td>2,0 s</td></tr>
<tr><td>135 % ≤ V</td><td>0,05 s</td></tr>
<tr><td colspan="2">* Trip time refers to the time between the abnormal condition occurring and the inverter ceasing to energize the utility line. The PV system control circuits shall actually remain connected to the utility to allow sensing of utility electrical conditions for use by the "reconnect" feature.</td></tr>
</table>

</td><td></td><td></td></tr>
<tr><td></td><td>The purpose of the allowed time delay is to ride through short-term disturbances to avoid excessive nuisance tripping. The unit does not have to cease to energize if the voltage returns to the normal utility continuous operation condition within the specified trip time.
NOTE The voltage drop between the inverter terminals and the point of connection with the utility should be taken into consideration.</td><td>Compliance.</td><td>P</td></tr>
<tr><td>5.2.2</td><td>Over/under frequency</td><td>See below.</td><td>P</td></tr>
<tr><td></td><td>When the utility frequency deviates outside the specified conditions the photovoltaic system shall cease to energize the utility line. The unit does not have to cease to energize if the frequency returns to the normal utility continuous operation condition within the specified trip time.</td><td>See appended table 5.2.1.</td><td>P</td></tr>
<tr><td></td><td>When the utility frequency is outside the range of ±1Hz, the system shall cease to energize the utility line within 0.2 s. The purpose of the allowed range and time delay is to allow continued operation for short-term disturbances and to avoid excessive nuisance tripping in weak-utility system conditions.</td><td>Compliance.</td><td>P</td></tr>
<tr><td>5.3</td><td>Islanding protection</td><td>See below.</td><td>P</td></tr>
<tr><td></td><td>The PV system must cease to energize the utility line within 2s of loss of utility.
NOTE The issues of non-islanding inverter are the subject of another standard under consideration.</td><td>The test procedure fulfill IEC 62116. See appended table 6.1.</td><td>P</td></tr>
<tr><td>5.4</td><td>Response to utility recovery</td><td>See below.</td><td>P</td></tr>
<tr><td></td><td>Following an out-of-range utility condition that has caused the photovoltaic system to cease energizing, the photovoltaic system shall not energize the utility line for 20s to 5min after the utility service voltage and frequency have recovered to within the specified ranges.
NOTE The energizing delay is dependent on local conditions.</td><td>The recovery time has measured after voltage or frequency out of the range.</td><td>P</td></tr>
<tr><td>5.5</td><td>Earthing</td><td></td><td>P</td></tr>
</table>

IEC 61727: 2004			
Clause	Requirement – Test	Result - Remark	Verdict
	The utility interface equipment shall be earthed/ grounded in accordance with IEC 60364-7-712.	Compliance.	P
5.6	**Short circuit protection**		P
	The photovoltaic system shall have short- circuit protection in accordance with IEC 60364-7-712.	Circuit breakers are installed on both DC and AC sides to protect short circuit.	P
5.7	**Isolation and switching**		P
	A method of isolation and switching shall be provided in accordance with IEC 60364-7-712.		P

IEC/EN 62116: 2014			
Clause	Requirement – Test	Result - Remark	Verdict
4	**Testing circuit**	Compliance.	P
			P

5	**Testing equipment**	See below.	P
5.1	**Measuring instruments**	Compliance.	P
	Waveform observation shall be measured by a device with memory function, for example, a storage or digital oscilloscope or a high speed data acquisition system. The waveform measurement/capture device shall be able to record the waveform from the beginning of the islanding test until the EUT ceases to energize the island. For multi-phase EUT, all phases shall be monitored. A waveform monitor designed to detect and calculate the run-on time may be used.		P
	For multi-phase EUT, the test and measurement equipment shall record each phase current and each phase-to-neutral or phase-to-phase voltage,	Compliance.	P

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Clause	Requirement – Test	Result - Remark	Verdict
	as appropriate, to determine fundamental frequency active and reactive power flow over the duration of the test. A sampling rate of 10 kHz or higher is recommended. The minimum measurement accuracy shall be 1 % or less of rated EUT nominal output voltage and 1 % or less of rated EUT output current. Current, active power, and reactive power measurements through switch S1 used to determine the circuit balance conditions shall report the fundamental (50 Hz or 60 Hz) component.		
5.2	**DC power source**	See below.	P
5.2.1	**General**		P
	A DC power source, such as a PV array simulator, a PV array, or a current and voltage limited DC power supply with series resistance may be used. If the EUT can operate in utility-interconnected mode from a storage battery, a DC power source may be used in lieu of a battery as long as the DC power source shall not be the limiting device as far as the maximum EUT input current is concerned. The DC power source shall provide voltage and current necessary to meet the testing requirements described in Clause 6.		P
5.2.2	**PV array simulator**	Compliance.	P
	A unit intended to be energized directly from a photovoltaic source shall be energized from a supply that simulates the current-voltage characteristics and time response of a photovoltaic array. The tests shall be conducted at the input voltage defined in Table 2 below, and the current shall be limited to 1,5 times the rated photovoltaic input current, except when specified otherwise by the test requirements.		P
5.2.3	**Current and voltage limited DC power supply with series resistance**		N/A
	A DC power source used as the EUT input source shall be capable of EUT maximum input power (so as to achieve EUT maximum output power) at minimum and maximum EUT input operating voltage.		N/A
	The power source should provide adjustable current and voltage limit, set to provide the desired short circuit current and open circuit voltage when combined with the series and shunt resistance described below.		N/A
	A series resistance (and, optionally, a shunt resistance) should be selected to provide a fill factor within the range shown in Table 2.		N/A
5.2.4	**PV array**		N/A

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Clause	Requirement – Test	Result - Remark	Verdict
	A PV array used as the EUT input source shall be capable of EUT maximum input power at minimum and maximum EUT input operating voltage (see Table 3). Testing is limited to times when the irradiance varies by no more than 2 % over the duration of the test as measured by a silicon-type pyranometer or reference device. It may be necessary to adjust the array configuration to achieve the input voltage and power levels prescribed in 6.1.		N/A
5.3	**AC power source**	Compliance.	P
			P

Items	Conditions
Voltage	Nominal ± 2,0 %
Voltage THD	< 2,5 %
Frequency	Nominal ± 0,1 Hz
Phase angle distance [a]	120° ± 1,5°
[a] Three-phase case only.	

5.4	**AC loads**	See below.	P
	On the AC side of the EUT, variable resistance, capacitance, and inductance shall be connected in parallel as loads between the EUT and the AC power source. Other sources of load, such as electronic loads, may be used if it can be shown that the source does not cause results that are different than would be obtained with passive resistors, inductors, and capacitors.	Compliance.	P
	All AC loads shall be rated for and adjustable to all test conditions. The equations for Q_f are based upon an ideal parallel RLC circuit. For this reason, non-inductive resistors, low loss (high Q_f) inductors, and capacitors with low effective series resistance and effective series inductance shall be utilized in the test circuit. Iron core inductors, if used, shall not exceed a current THD of 2 % when operated at nominal voltage. Load components should be conservatively rated for the voltage and power levels expected. Resistor power ratings should be chosen so as to minimize thermally-induced drift in resistance values during the course of the test.	Compliance.	P
	Active and reactive power should be calculated (using the measurements provided in Table 1) in each of the R, L and C legs of the load so that these parasitic parameters (and parasitics introduced by variacs or autotransformers) are properly accounted for when calculating Q_f.	Calculated. See appended table for detail.	P

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Clause	Requirement – Test	Result - Remark	Verdict
6	**Test for single or multi-phase inverter**	See below.	P
6.1	**Test procedure**	Compliance.	P
	The following test is designed for an EUT consisting of a single or multi-phase inverter[1]. The test uses an RLC load, resonant at the EUT nominal frequency (50 Hz or 60 Hz) and matched to the EUT output power. For a multi-phase EUT, the load shall be balanced across all phases and the switch S1 as in Figure 1 shall open all phases[2]. This test shall be performed with the EUT conditions as in Table 5, where power and voltage values are given as a percent of EUT full output rating.	50Hz, three phase EUT.	P
	EUT settings for voltage and frequency trip parameters (magnitude and timing) can affect the measured run-on time. Passing this test verifies that the unit will provide adequate islanding protection for the settings tested as well as for tighter settings (e.g., an EUT that passes the test with frequency trip settings of ± 1,5 Hz of nominal should also trip within the maximum measured run-on time for settings of, say, ± 0,5 Hz.) Conversely, when adjusted to settings outside of those tested, the EUT may experience extended run-on times. Frequency settings of ±1,5 Hz around nominal frequency and voltage settings of ± 15 % around nominal voltage, for the purposes of this test procedure, should be wide enough to address the majority of utility requirements. Note that as trip settings are widened, more aggressive active antiislanding schemes may be required that could negatively impact power quality.	Voltage and frequency trip parameters are set according to the requirements of IEC 61727: 2004.	P

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Clause	Requirement – Test	Result - Remark	Verdict
			P

Condition	EUT output power, P_{EUT}	EUT input voltage [c]	EUT trip settings [d]
A	Maximum [a]	> 75 % of rated input voltage range	Voltage and frequency trip settings according to National standards and/or local code
B	50 % to 66 % of maximum	50 % of rated input voltage range, ±10 %	Voltage and frequency trip settings according to National standards and/or local code
C	25 % to 33 % [b] of maximum	< 20 % of rated input voltage range	Voltage and frequency trip settings according to National standards and/or local code

[a] Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.

[b] Or minimum allowable EUT output level if greater than 33 %.

[c] Based on EUT rated input operating range. For example, if range is between X volts and Y volts, 75 % of range = $X + 0{,}75 \times (Y - X)$. 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.

[d] The manufacturer shall specify the applicable standard, code or utility based trip settings with which the unit shall be tested. The manufacturer may also choose more stringent trip settings to demonstrate compatibility with a greater number of utility requirements. The recommended settings shown below should address the majority of utility requirements.

Parameter	Magnitude	Timing s
Over voltage	115 % of nominal voltage	2
Under voltage	85 % of nominal voltage	2
Over frequency	1,5 Hz above nominal frequency	1
Under frequency	1,5 Hz below nominal frequency	1

If fast over and under voltage and frequency settings are provided, similarly extended values should also be specified by the manufacturer.

6.2	**Pass/fail criteria**	See below.	P
	An EUT is considered to comply with the requirements for islanding protection when each case of recorded run-on time is less than 2 s or meets the requirements of local codes.	Compliance.	P

7	**Documentation**		P

Annex A (informative)	**Islanding as it applies to PV systems**		P
A.1	General		P
A.2	Impact of distortion on islanding		P
Annex B (informative)	**Test for independent islanding detection device (relay)**	Test with inverter.	N/A
B.1	General		N/A
B.2	Testing circuit		N/A
B.3	Testing equipment		N/A

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Clause	Requirement – Test	Result - Remark	Verdict
B.3.1	General		N/A
B.3.2	AC input source		N/A
B.4	Testing procedure		N/A
B.5	Documentation		N/A
Annex C (informative)	Gate blocking signal		N/A
C.1	General		N/A
C.2	Gate blocking signal used in photovoltaic systems		N/A
C.3	Monitoring the gate blocking signal		N/A

4.1	TABLE: Voltage, current and frequency								P
Power conditions	I/P rated	PV / DC Input			O/P rated	Grid / AC Output			
	I [A]	U [V]	I [A]	P [kW]	I [A]	U [V]	I [A]	P [kW]	Fre. [Hz]
C6-70K-T12-LV									
(10±5)%	--	598.4	4.52	7456.3	183.7	127.1	18.71	2366.2	60
						127.1	18.81	2372.7	60
						127.1	18.37	2320.8	60
(50±5)%	--	599.4	20.92	37035.7	183.7	127.2	91.95	11678.3	60
						127.1	92.37	11730.3	60
						127.2	92.33	11726.3	60
(100±5)%	--	585.7	42.24	73321	183.7	127.2	182.83	23231.9	60
						127.2	183.20	23286.0	60
						127.1	183.98	23360.4	60
C6-50K-T6-LV									
(10±5)%	--	599.2	4.63	5361.5	131.2	127.1	13.51	1702.9	60
						127.1	13.46	1695.5	60
						126.9	13.35	1682.0	60
(50±5)%	--	602.6	22.71	26140.7	131.2	127.4	65.27	8293.2	60
						127.3	66.21	8411.5	60
						127.3	65.94	8371.9	60
(100±5)%	--	599.2	44.13	52740.6	131.2	127.5	130.67	16638.8	60
						127.5	132.27	16847.9	60
						127.6	132.83	16812.6	60

Note(s):
Test on model C6-70K-T12-LV and C6-50K-T6-LV to represent all the other models.

4.3	TABLE: Flicker	P

For Model C6-70K-T12-LV

PHASE A

	Pst	dc(%)	dmax(%)	d(t)
Limit	1.000	3.300	4.000	500
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Plt=___0.258____, Limit=0.65

PHASE B

	Pst	dc(%)	dmax(%)	d(t)
Limit	1.000	3.300	4.000	500
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Plt=___0.353____, Limit=0.65

PHASE C

	Pst	dc(%)	dmax(%)	d(t)
Limit	1.000	3.300	4.000	500
1				
2				
3				
4				
5				
6				
7				
8				
9				

	10	
	11	
	12	

Plt=__0.383____, Limit=0.65

For Model C6-50K-T6-LV

		Pst	dc(%)	dmax(%)	d(t)
	Limit	1.000	3.300	4.000	500
PHASE A	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				

Plt=___0.046___, Limit=0.65

		Pst	dc(%)	dmax(%)	d(t)
	Limit	1.000	3.300	4.000	500
PHASE B	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				

	11	
	12	

Plt=___0.048___, Limit=0.65

		Pst	dc(%)	dmax(%)	d(t)
	Limit	1.000	3.300	4.000	500
PHASE C	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				

Plt=__0.028___, Limit=0.65

Note(s):
1. Maximum permissible voltage fluctuation (expressed as a percentage of nominal voltage at 100% power) and flicker. More than 16 A per phase according to IEC61000-3-11.
2. Test on model C6-70K-T12-LV and C6-50K-T6-LV to represent all the other models.

4.4	TABLE: DC Injection						P
For model R6-30K-T4-32-LV							
Power conditions		33%		66%		100%	
Limits		1%					
Measurement		[A]	[%]	[A]	[%]	[A]	[%]
Test value	PHASE A	0.283	0.154	0.347	0.189	0.620	0.338
	PHASE B	0.361	0.197	0.371	0.202	0.494	0.269
	PHASE C	0.193	0.105	0.413	0.225	0.665	0.362
For model R6-5K-T2-32-LV							
Power conditions		33%		66%		100%	
Limits		1%					
Measurement		[A]	[%]	[A]	[%]	[A]	[%]
Test value	PHASE A	0.315	0.240	0.422	0.322	0.501	0.382
	PHASE B	0.259	0.197	0.201	0.153	0.509	0.388
	PHASE C	0.115	0.088	0.299	0.228	0.383	0.292

Note(s):
If the inverter does not incorporate a mains frequency isolating transformer, it shall be type tested to ensure the dc output current at the ac terminals of the inverter is below the above limits at all power levels. Test on model C6-70K-T12-LV and C6-50K-T6-LV to represent all the other models.

4.6	TABLE: Harmonics and waveform distortion (Current)				P
C6-70K-T12-LV					
Phase A					
Harmonics	Measurements (At Rated Current) [%]			Limits [%]	Verdict
	33%	66%	100%		
THD (to the 50th)	1.02	0.783	0.693	5	P
2nd	0.726	0.616	0.630	1	P
3rd	0.378	0.243	0.173	4	P
4th	0.070	0.063	0.066	1	P
5th	0.627	0.390	0.233	4	P
6th	0.016	0.021	0.025	1	P
7th	0.129	0.143	0.099	4	P
8th	0.022	0.010	0.007	1	P
9th	0.022	0.006	0.008	4	P
10th	0.003	0.002	0.004	0.5	P
11th	0.018	0.049	0.034	2	P
12th	0.004	0.003	0.002	0.5	P

13th	0.012	0.016	0.014	2	P
14th	0.007	0.005	0.003	0.5	P
15th	0.003	0.001	0.001	2	P
16th	0.001	0.001	0.001	0.5	P
17th	0.007	0.007	0.007	1.5	P
18th	0.001	0.000	0.000	0.5	P
19th	0.009	0.004	0.004	1.5	P
20th	0.001	0.001	0.001	0.5	P
21th	0.001	0.000	0.001	1.5	P
22th	0.001	0.001	0.000	0.5	P
23th	0.005	0.002	0.002	0.6	P
24th	0.001	0.000	0.000	0.5	P
25th	0.004	0.001	0.001	0.6	P
26th	0.001	0.000	0.000	0.5	P
27th	0.001	0.000	0.000	0.6	P
28th	0.000	0.000	0.000	0.5	P
29th	0.001	0.001	0.001	0.6	P
30th	0.000	0.000	0.000	0.5	P
31th	0.001	0.001	0.000	0.6	P
32th	0.000	0.000	0.000	0.5	P
33th	0.000	0.000	0.000	0.6	P
Phase B					
Harmonics	Measurements (At Rated Current) [100%]			Limits [%]	Verdict
	33%	66%	100%		
THD (to the 40th)	1.158	0.898	0.777	5	P
2nd	0.959	0.790	0.731	1	P
3rd	0.147	0.033	0.069	4	P
4th	0.104	0.098	0.085	1	P
5th	0.626	0.393	0.230	4	P
6th	0.015	0.013	0.019	1	P
7th	0.153	0.141	0.094	4	P
8th	0.027	0.012	0.009	1	P
9th	0.009	0.005	0.004	4	P
10th	0.012	0.007	0.003	0.5	P
11th	0.023	0.051	0.035	2	P
12th	0.005	0.003	0.001	0.5	P

13th	0.016	0.019	0.016	2	P
14th	0.008	0.006	0.003	0.5	P
15th	0.004	0.001	0.000	2	P
16th	0.001	0.001	0.001	0.5	P
17th	0.005	0.008	0.007	1.5	P
18th	0.001	0.000	0.000	0.5	P
19th	0.008	0.004	0.004	1.5	P
20th	0.001	0.001	0.001	0.5	P
21th	0.001	0.000	0.000	1.5	P
22th	0.001	0.000	0.000	0.5	P
23th	0.005	0.002	0.002	0.6	P
24th	0.001	0.000	0.000	0.5	P
25th	0.003	0.001	0.001	0.6	P
26th	0.001	0.000	0.000	0.5	P
27th	0.001	0.000	0.000	0.6	P
28th	0.001	0.000	0.000	0.5	P
29th	0.002	0.001	0.001	0.6	P
30th	0.001	0.000	0.000	0.5	P
31th	0.001	0.001	0.001	0.6	P
32th	0.001	0.000	0.000	0.5	P
33th	0.000	0.000	0.000	0.6	P
Phase C					
Harmonics	Measurements (At Rated Current) [100%]			Limits [%]	Verdict
	33%	66%	100%		
THD (to the 40th)	0.774	0.974	0.794	5	P
2nd	0.579	0.689	0.627	1	P
3rd	0.224	0.283	0.223	4	P
4th	0.086	0.080	0.132	1	P
5th	0.461	0.644	0.421	4	P
6th	0.032	0.026	0.043	1	P
7th	0.072	0.187	0.154	4	P
8th	0.026	0.018	0.006	1	P
9th	0.018	0.015	0.009	4	P
10th	0.013	0.009	0.007	0.5	P
11th	0.038	0.036	0.046	2	P
12th	0.004	0.006	0.004	0.5	P

13th	0.041	0.014	0.018	2	P
14th	0.004	0.002	0.004	0.5	P
15th	0.002	0.003	0.002	2	P
16th	0.001	0.003	0.002	0.5	P
17th	0.022	0.005	0.008	1.5	P
18th	0.002	0.001	0.000	0.5	P
19th	0.012	0.004	0.004	1.5	P
20th	0.002	0.002	0.001	0.5	P
21th	0.002	0.001	0.001	1.5	P
22th	0.001	0.001	0.000	0.5	P
23th	0.007	0.002	0.002	0.6	P
24th	0.000	0.001	0.000	0.5	P
25th	0.005	0.003	0.001	0.6	P
26th	0.000	0.001	0.000	0.5	P
27th	0.001	0.001	0.000	0.6	P
28th	0.000	0.000	0.000	0.5	P
29th	0.003	0.002	0.000	0.6	P
30th	0.000	0.000	0.000	0.5	P
31th	0.002	0.001	0.000	0.6	P
32th	0.001	0.000	0.000	0.5	P
33th	0.001	0.000	0.000	0.6	P
C6-50K-T6-LV					
Phase A					
Harmonics	Measurements (At Rated Current) [%]			Limits [%]	Verdict
	33%	66%	100%		
THD (to the 40th)	0.774	0.974	0.794	5	P
2nd	0.579	0.689	0.627	1	P
3rd	0.224	0.283	0.223	4	P
4th	0.086	0.080	0.132	1	P
5th	0.461	0.644	0.421	4	P
6th	0.032	0.026	0.043	1	P
7th	0.072	0.187	0.154	4	P
8th	0.026	0.018	0.006	1	P
9th	0.018	0.015	0.009	4	P
10th	0.013	0.009	0.007	0.5	P
11th	0.038	0.036	0.046	2	P

12th	0.004	0.006	0.004	0.5	P
13th	0.041	0.014	0.018	2	P
14th	0.004	0.002	0.004	0.5	P
15th	0.002	0.003	0.002	2	P
16th	0.001	0.003	0.002	0.5	P
17th	0.022	0.005	0.008	1.5	P
18th	0.002	0.001	0.000	0.5	P
19th	0.012	0.004	0.004	1.5	P
20th	0.002	0.002	0.001	0.5	P
21th	0.002	0.001	0.001	1.5	P
22th	0.001	0.001	0.000	0.5	P
23th	0.007	0.002	0.002	0.6	P
24th	0.000	0.001	0.000	0.5	P
25th	0.005	0.003	0.001	0.6	P
26th	0.000	0.001	0.000	0.5	P
27th	0.001	0.001	0.000	0.6	P
28th	0.000	0.000	0.000	0.5	P
29th	0.003	0.002	0.000	0.6	P
30th	0.000	0.000	0.000	0.5	P
31th	0.002	0.001	0.000	0.6	P
32th	0.001	0.000	0.000	0.5	P
33th	0.001	0.000	0.000	0.6	P
Phase B					
Harmonics	Measurements (At Rated Current) [%]			Limits [%]	Verdict
	33%	66%	100%		
THD (to the 50th)	1.076	1.100	0.936	5	P
2nd	0.980	0.930	0.845	1	P
3rd	0.117	0.113	0.067	4	P
4th	0.050	0.109	0.141	1	P
5th	0.426	0.539	0.365	4	P
6th	0.012	0.016	0.032	1	P
7th	0.066	0.225	0.175	4	P
8th	0.015	0.020	0.007	1	P
9th	0.013	0.005	0.007	4	P
10th	0.019	0.013	0.008	0.5	P
11th	0.038	0.037	0.041	2	P

12th	0.003	0.004	0.003	0.5	P
13th	0.037	0.018	0.022	2	P
14th	0.006	0.003	0.004	0.5	P
15th	0.004	0.001	0.001	2	P
16th	0.002	0.004	0.003	0.5	P
17th	0.021	0.007	0.008	1.5	P
18th	0.001	0.001	0.001	0.5	P
19th	0.013	0.003	0.005	1.5	P
20th	0.002	0.002	0.001	0.5	P
21th	0.001	0.001	0.000	1.5	P
22th	0.002	0.002	0.001	0.5	P
23th	0.007	0.003	0.002	0.6	P
24th	0.000	0.000	0.000	0.5	P
25th	0.005	0.002	0.001	0.6	P
26th	0.001	0.001	0.000	0.5	P
27th	0.000	0.000	0.000	0.6	P
28th	0.000	0.001	0.000	0.5	P
29th	0.002	0.001	0.001	0.6	P
30th	0.000	0.000	0.000	0.5	P
31th	0.002	0.001	0.000	0.6	P
32th	0.001	0.000	0.000	0.5	P
33th	0.000	0.000	0.000	0.6	P
Phase C					
Harmonics	Measurements (At Rated Current) [%]			Limits [%]	Verdict
	33%	66%	100%		
THD (to the 50th)	1.056	0.995	0.778	5	P
2nd	0.920	0.774	0.642	1	P
3rd	0.268	0.234	0.188	4	P
4th	0.102	0.133	0.165	1	P
5th	0.436	0.557	0.347	4	P
6th	0.024	0.021	0.037	1	P
7th	0.091	0.206	0.156	4	P
8th	0.028	0.025	0.008	1	P
9th	0.026	0.015	0.009	4	P
10th	0.012	0.011	0.005	0.5	P
11th	0.029	0.038	0.042	2	P

12th	0.004	0.003	0.001	0.5	P
13th	0.034	0.016	0.019	2	P
14th	0.004	0.003	0.004	0.5	P
15th	0.004	0.002	0.002	2	P
16th	0.001	0.001	0.001	0.5	P
17th	0.022	0.006	0.007	1.5	P
18th	0.001	0.001	0.001	0.5	P
19th	0.013	0.004	0.004	1.5	P
20th	0.002	0.002	0.000	0.5	P
21th	0.001	0.001	0.001	1.5	P
22th	0.001	0.002	0.000	0.5	P
23th	0.006	0.002	0.002	0.6	P
24th	0.000	0.000	0.000	0.5	P
25th	0.004	0.002	0.001	0.6	P
26th	0.001	0.001	0.000	0.5	P
27th	0.001	0.000	0.000	0.6	P
28th	0.000	0.001	0.000	0.5	P
29th	0.003	0.001	0.001	0.6	P
30th	0.000	0.000	0.000	0.5	P
31th	0.002	0.001	0.001	0.6	P
32th	0.001	0.000	0.000	0.5	P
33th	0.001	0.000	0.000	0.6	P

Note(s):

Test on model C6-70K-T12-LV and C6-50K-T6-LV to represent all the other models.

4.7	**TABLE: Power Factor**						**P**
C6-70K-T12-LV							
Power conditions		(50±5) %	(60±5) %	(70±5) %	(80±5) %	(90±5) %	(100±5) %
Limits		0.9 (leading / lagging)					
U [V]	L1-N	127.1	127.1	127.2	127.2	127.2	127.3
U [V]	L2-N	127.2	127.2	127.2	127.2	127.2	127.3
U [V]	L3-N	127.0	127.1	127.1	127.1	127.1	127.1
I [A]	L1-N	91.85	110.17	128.46	146.7	165.01	183.47
I [A]	L2-N	92.16	110.50	128.80	147.1	165.41	183.86
I [A]	L3-N	92.33	110.82	129.25	147.7	166.12	184.75

Fre. [Hz]		60.0	60.0	60.0	60.0	60.0	60.0
P [W]		35062.2	42080.3	49080.7	56086.0	63093.6	70175.4
Q [VA]		375.8	362.7	354.9	341.2	333.7	339.6
S [VA]		35064.2	42081.8	49082.0	56087.1	63094.7	70176.5
PF [λ]		1.000	1.000	1.000	1.000	1.000	1.000
C6-50K-T6-LV							
Power conditions		(50±5) %	(60±5) %	(70±5) %	(80±5) %	(90±5) %	(100±5) %
Limits		0.9 (leading / lagging)					
U [V]	L1-N	127.1	127.0	127.1	127.1	127.1	127.2
U [V]	L2-N	127.1	127.1	127.2	127.2	127.1	127.1
U [V]	L3-N	127.1	127.0	127.1	127.1	127.2	127.1
I [A]	L1-N	65.16	78.42	91.50	104.43	117.52	130.54
I [A]	L2-N	65.73	79.01	92.11	105.06	118.17	131.17
I [A]	L3-N	66.00	79.34	92.46	105.49	118.65	131.74
Fre. [Hz]		60.0	60.0	60.0	60.0	60.0	60.0
P [W]		24977.3	30035.7	35048.9	39999.9	45002.4	49970.9
Q [VA]		329.6	450.3	363.51	336.9	451.4	338.6
S [VA]		24980	30039.9	35051.5	40002.4	40005.9	49973.9
PF [λ]		1.000	1.000	1.000	1.000	1.000	1.000
Note(s): Test on model C6-70K-T12-LV and C6-50K-T6-LV to represent all the other models.							

5.2.1	**TABLE: Over / Under Voltage**			**P**
C6-70K-T12-LV				
Rated voltage [Vrms]:	127	Voltage accuracy [△V]:	1%Un	
Frequency [Hz]	60	Rated recover time [s]:	20-300	
Power condition:	☒ 100%	☐ (50-66)%	☐ (25-33)%	

Setting value U_N [Vrms]	Threshold / Trip value U [Vrms]			
	Measurements			Limits
	M1	M2	M3	
L1-N: 63.5	63.08	62.91	63.11	$U < 50\%U_O$
L2-N: 63.5	63.05	63.05	63.08	
L3-N: 63.5	63.10	63.09	63.06	
L1-N: 107.95	107.64	107.62	107.60	$50\%U_O \le U < 85\%U_O$
L2-N: 107.95	107.60	107.31	107.65	
L3-N: 107.95	107.80	107.64	107.60	

L1-N: 139.7	140.14	140.11	140.00	110%U_O< U < 135%U_O
L2-N: 139.7	140.14	139.98	140.13	
L3-N: 139.7	140.31	140.16	140.32	
L1-N: 171.5	172.14	172.13	172.12	135%U_O ≤ U
L2-N: 171.5	172.22	172.23	172.25	
L3-N: 171.5	172.43	172.37	172.29	

Note(s): Increasing / Decreasing value ramp of 0.1V. (Voltage veracity < 0.1V).

Trip U_O → U	Trip time [ms]					Recover time [s]	
	Measurements				Limits	Measurement	Limits
	Phases	M1	M2	M3			
U<50%U_O	L1-N:	88.5	87.0	84.5	100	71.1	20≤t≤300
	L2-N:	72.5	75.0	76.0		71.3	
	L3-N:	66.5	83.5	83.3		71.3	
50%U_O≤U < 85%U_O	L1-N:	900.0	900.0	902.5	2000	71.0	20≤t≤300
	L2-N:	915.0	905.0	907.5		71.3	
	L3-N:	847.5	845.0	842.5		71.0	
110%U_O < U < 135%U_O	L1-N:	855.0	852.5	857.5	2000	71.0	20≤t≤300
	L2-N:	857.5	857.5	862.5		71.0	
	L3-N:	847.5	845.0	842.5		71.0	
135%U_O ≤ U	L1-N:	18.5	17.5	18.7	50	70.8	20≤t≤300
	L2-N:	25.3	24.8	22.5		70.8	
	L3-N:	29.0	28.8	32.5		70.8	

Note(s):

Test on model model C6-70K-T12-LV to represent all the other models.

5.2.2	TABLE: Over / Under Frequency	P

C6-70K-T12-LV

Rated voltage [Vrms]:	127	Frequency accuracy [△F]:	0.05Hz
Frequency [Hz]	60	Rated recover time [s]:	20-300

Power condition: ☒ 100% ☐ (50-66)% ☐ (25-33)%

Setting value F_N [Hz]	Threshold / Trip value F [Hz]			
	Measurements			Limits
	M1	M2	M3	
59.00	59.03	59.02	59.04	59.00
61.00	60.97	60.98	60.98	61.00

Note(s): Increasing / Decreasing value ramp of 0.01Hz, (Frequency veracity < 10 mHz).

Trip $F_O \rightarrow F$	Trip time [ms]				Recover time [s]	
	Measurements			Limits	Measurement	Limits
	M1	M2	M3			
F_N +△F→F_N -△F (F<59.0)	68.0	47.6	50.8	200	40.90	20≤t≤300
F_N -△F→F_N +△F(F>51.0)	176.0	80.4	103.2	200	30.96	20≤t≤300

Note(s):

Test on model C6-70K-T12-LV to represent all the other models.

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5.3	TABLE: Islanding Protection									
Power 100%										
Conditions	P_W [kW]		Q_L [kVA]		Q_C [kVA]		Q_f	Trip time [ms]	Limitation [ms]
PR: 90% PQ: 110%	L1:	20.145	L1:	21.015	L1:	23.340	1.084	335	2000
	L2:	20.850	L2:	21.900	L2:	24.285	1.118		2000
	L3:	19.545	L3:	21.480	L3:	23.820	1.088		2000
PR: 90% PQ: 105%	L1:	20.340	L1:	21.075	L1:	19.950	0.991	520	2000
	L2:	20.835	L2:	21.465	L2:	20.355	1.013		2000
	L3:	19.710	L3:	21.375	L3:	20.235	0.998		2000
PR: 90% PQ: 100%	L1:	20.385	L1:	21.060	L1:	21.060	1.016	1064	2000
	L2:	20.865	L2:	21.480	L2:	21.465	1.039		2000
	L3:	19.740	L3:	21.345	L3:	21.345	1.023		2000
PR: 90% PQ: 95%	L1:	20.250	L1:	21.150	L1:	22.245	1.056	474	2000
	L2:	20.880	L2:	21.870	L2:	23.085	1.087		2000
	L3:	19.605	L3:	21.525	L3:	22.695	1.062		2000
PR: 90% PQ: 90%	L1:	20.145	L1:	21.015	L1:	23.340	1.084	335	2000
	L2:	20.850	L2:	21.900	L2:	24.285	1.118		2000
	L3:	19.545	L3:	21.480	L3:	23.820	1.088		2000
PR: 95% PQ: 110%	L1:	21.495	L1:	21.840	L1:	19.530	0.946	662	2000
	L2:	21.990	L2:	22.065	L2:	19.740	0.956		2000
	L3:	20.820	L3:	21.070	L3:	19.410	0.935		2000
PR: 95% PQ: 90%	L1:	21.210	L1:	21.555	L1:	23.910	1.056	596	2000
	L2:	21.975	L2:	22.230	L2:	24.525	1.073		2000
	L3:	20.685	L3:	21.525	L3:	23.805	1.031		2000
PR: 100% PQ: 110%	L1:	22.680	L1:	22.470	L1:	20.145	0.924	1280	2000
	L2:	23.130	L2:	22.800	L2:	20.505	0.942		2000
	L3:	21.900	L3:	23.085	L3:	20.760	0.946		2000
PR: 95% PQ: 105%	L1:	21..135	L1:	21.975	L1:	20.835	0.998	866	2000
	L2:	21.840	L2:	22.350	L2:	21.225	1.006		2000
	L3:	20.595	L3:	22.005	L3:	20.850	0.979		2000
PR: 95% PQ: 100%	L1:	21.570	L1:	22.350	L1:	22.350	1.018	1328	2000
	L2:	22.080	L2:	22.620	L2:	22.590	1.031		2000
	L3:	20.715	L3:	22.275	L3:	22.260	1.017		2000
PR: 95%	L1:	21.705	L1:	22.005	L1:	23.130	1.023	860	2000

PQ: 95%	L2:	22.230	L2:	22.305	L2:	23.430	1.036		2000
	L3:	20.925	L3:	21.795	L3:	22.905	1.011		2000
PR: 100% PQ: 105%	L1:	22.710	L1:	22.260	L1:	21.150	1.110	1604	2000
	L2:	23.190	L2:	23.340	L2:	22.215	0.986		2000
	L3:	21.930	L3:	23.100	L3:	22.005	0.973		2000
PR: 100% PQ: 100%	L1:	22.755	L1:	22.530	L1:	22.530	0.975	1804	2000
	L2:	23.250	L2:	23.115	L2:	23.130	1.000		2000
	L3:	21.945	L3:	23.220	L3:	23.175	1.001		2000
PR: 100% PQ: 95%	L1:	22.785	L1:	22.320	L1:	23.400	0.988	1512	2000
	L2:	23.280	L2:	22.905	L2:	24.060	1.015		2000
	L3:	21.990	L3:	23.115	L3:	24.240	1.019		2000
PR: 105% PQ: 105%	L1:	23.910	L1:	22.470	L1:	21.315	0.901	861	2000
	L2:	24.435	L2:	22.845	L2:	21.690	0.917		2000
	L3:	23.040	L3:	23.205	L3:	22.035	0.932		2000
PR: 105% PQ: 100%	L1:	23.955	L1:	22.260	L1:	22.215	0.915	1360	2000
	L2:	24.480	L2:	23.100	L2:	23.055	0.949		2000
	L3:	23.070	L3:	23.475	L3:	23.490	0.965		2000
PR: 105% PQ: 95%	L1:	24.000	L1:	22.185	L1:	23.325	0.934	874	2000
	L2:	24.510	L2:	22.920	L2:	24.045	0.964		2000
	L3:	23.205	L3:	23.655	L3:	24.780	0.990		2000
PR: 100% PQ: 90%	L1:	22.845	L1:	22.125	L1:	24.465	1.003	1312	2000
	L2:	23.325	L2:	22.695	L2:	25.020	1.029		2000
	L3:	22.020	L3:	22.785	L3:	25.140	1.029		2000
PR: 105% PQ: 110%	L1:	23.880	L1:	22.425	L1:	20.040	0.875	588	2000
	L2:	24.375	L2:	23.340	L2:	21.015	0.913		2000
	L3:	23.100	L3:	23.700	L3:	21.390	0.925		2000
PR: 105% PQ: 90%	L1:	23.835	L1:	21.825	L1:	24.135	0.950	764	2000
	L2:	24.420	L2:	22.455	L2:	24.765	0.972		2000
	L3:	23.070	L3:	23.055	L3:	25.335	0.994		2000
PR: 110% PQ: 110%	L1:	24.810	L1:	22.140	L1:	19.845	0.834	317	2000
	L2:	25.305	L2:	23.205	L2:	20.190	0.876		2000
	L3:	24.045	L3:	23.265	L3:	21.030	0.874		2000
PR: 110% PQ: 105%	L1:	25.065	L1:	22.425	L1:	21.240	0.858	456	2000
	L2:	25.500	L2:	23.340	L2:	22.155	0.897		2000
	L3:	24.225	L3:	23.700	L3:	22.575	0.908		2000
PR: 110%	L1:	25.140	L1:	21.810	L1:	21.795	0.856	1128	2000

PQ: 100%	L2:	25.530	L2:	22.350	L2:	22.380	0.882		2000
	L3:	24.270	L3:	23.535	L3:	23.595	0.924		2000
PR: 110% PQ: 95%	L1:	25.185	L1:	22.515	L1:	23.655	0.904	528	2000
	L2:	25.590	L2:	23.430	L2:	24.615	0.942		2000
	L3:	24.315	L3:	23.265	L3:	24.405	0.933		2000
PR: 110% PQ: 90%	L1:	24.810	L1:	22.215	L1:	24.540	0.929	343	2000
	L2:	25.455	L2:	23.055	L2:	25.395	0.956		2000
	L3:	24.120	L3:	23.040	L3:	25.380	0.952		2000
Power 66%									
Conditions	P_W [kW]		Q_L [kVA]		Q_C [kVA]		Q_f	Trip time [ms]	Limitation [ms]
PR: 100% PQ: 95%	L1:	14.910	L1:	14.835	L1:	15.570	1.007	636	2000
	L2:	15.480	L2:	14.925	L2:	15.660	1.003		2000
	L3:	14.460	L3:	15.540	L3:	16.290	1.036		2000
PR: 100% PQ: 96%	L1:	14.910	L1:	15.015	L1:	15.615	1.014	792	2000
	L2:	15.465	L2:	15.000	L2:	15.600	1.005		2000
	L3:	14.460	L3:	15.525	L3:	16.140	1.030		2000
PR: 100% PQ: 97%	L1:	15.090	L1:	15.225	L1:	15.705	1.011	932	2000
	L2:	15.555	L2:	15.180	L2:	15.645	1.004		2000
	L3:	14.565	L3:	15.630	L3:	16.125	1.029		2000
PR: 100% PQ: 98%	L1:	14.895	L1:	15.195	L1:	15.510	1.017	1100	2000
	L2:	15.465	L2:	15.435	L2:	15.750	1.023		2000
	L3:	14.445	L3:	15.525	L3:	15.840	1.022		2000
PR: 100% PQ: 99%	L1:	15.090	L1:	15.435	L1:	15.585	1.013	1200	2000
	L2:	15.555	L2:	15.480	L2:	15.645	1.014		2000
	L3:	14.565	L3:	15.660	L3:	15.810	1.020		2000
PR: 100% PQ: 100%	L1:	15.090	L1:	15.570	L1:	15.510	1.015	1224	2000
	L2:	15.555	L2:	15.435	L2:	15.480	1.007		2000
	L3:	14.565	L3:	15.660	L3:	15.690	1.016		2000
PR: 100% PQ: 101%	L1:	15.090	L1:	15.705	L1:	15.510	1.018	1112	2000
	L2:	15.555	L2:	15.615	L2:	15.480	1.012		2000
	L3:	14.565	L3:	15.825	L3:	15.690	1.021		2000
PR: 100% PQ: 102%	L1:	15.075	L1:	15.825	L1:	15.510	1.024	1000	2000
	L2:	15.555	L2:	15.780	L2:	15.465	1.017		2000
	L3:	14.550	L3:	15.960	L3:	15.645	1.025		2000
PR: 100%	L1:	14.940	L1:	15.795	L1:	15.330	1.026	836	2000

PQ: 103%	L2:	15.480	L2:	16.035	L2:	15.615	1.035		2000
	L3:	14.475	L3:	15.990	L3:	15.540	1.024		2000
PR: 100% PQ: 104%	L1:	15.075	L1:	16.170	L1:	15.570	1.036	752	2000
	L2:	15.540	L2:	16.530	L2:	15.945	1.057		2000
	L3:	14.550	L3:	16.245	L3:	15.645	1.034		2000
PR: 100% PQ: 105%	L1:	15.075	L1:	116.320	L1:	15.570	1.040	608	2000
	L2:	15.540	L2:	16.710	L2:	15.945	1.062		2000
	L3:	14.535	L3:	16.380	L3:	15.645	1.039		2000
Power 33%									
Conditions	P_W [w]		Q_L [VA]		Q_C [VA]		Q_f	Trip time [ms]	Limitation [ms]
PR: 100% PQ: 95%	L1:	7.380	L1:	7.605	L1:	7.995	1.038	800	2000
	L2:	7.395	L2:	7.125	L2:	7.515	0.976		2000
	L3:	7.275	L3:	7.950	L3:	8.340	1.073		2000
PR: 100% PQ: 96%	L1:	7.335	L1:	7.500	L1:	7.815	1.025	852	2000
	L2:	7.380	L2:	7.155	L2:	7.470	0.977		2000
	L3:	7.245	L3:	7.845	L3:	8.160	1.058		2000
PR: 100% PQ: 97%	L1:	7.365	L1:	7.485	L1:	7.725	1.014	944	2000
	L2:	7.395	L2:	7.215	L2:	7.470	0.979		2000
	L3:	7.275	L3:	7.785	L3:	8.025	1.041		2000
PR: 100% PQ: 98%	L1:	7.380	L1:	7.410	L1:	7.575	0.997	1136	2000
	L2:	7.395	L2:	7.260	L2:	7.425	0.979		2000
	L3:	7.275	L3:	7.665	L3:	7.845	1.024		2000
PR: 100% PQ: 99%	L1:	7.365	L1:	7.500	L1:	7.575	1.005	1276	2000
	L2:	7.395	L2:	7.350	L2:	7.425	0.985		2000
	L3:	7.275	L3:	7.590	L3:	7.680	1.008		2000
PR: 100% PQ: 100%	L1:	7.365	L1:	7.515	L1:	7.530	1.003	1380	2000
	L2:	7.395	L2:	7.500	L2:	7.500	1.000		2000
	L3:	7.275	L3:	7.650	L3:	7.620	1.008		2000
PR: 100% PQ: 101%	L1:	7.350	L1:	7.590	L1:	7.515	1.009	1150	2000
	L2:	7.380	L2:	7.560	L2:	7.485	1.005		2000
	L3:	7.260	L3:	7.680	L3:	7.620	1.012		2000
PR: 100% PQ: 102%	L1:	7.320	L1:	7.605	L1:	7.485	1.010	1104	2000
	L2:	7.365	L2:	7.605	L2:	7.455	1.008		2000
	L3:	7.230	L3:	7.725	L3:	7.590	1.015		2000
PR: 100%	L1:	7.320	L1:	7.695	L1:	7.485	1.018	864	2000

PQ: 103%	L2:	7.380	L2:	7.695	L2:	7.485	1.014		2000
	L3:	7.230	L3:	7.815	L3:	7.590	1.021		2000
PR: 100% PQ: 104%	L1:	7.365	L1:	7.830	L1:	7.530	1.022	804	2000
	L2:	7.395	L2:	7.785	L2:	7.500	1.017		2000
	L3:	7.260	L3:	7.935	L3:	7.620	1.027		2000
PR: 100% PQ: 105%	L1:	7.365	L1:	7.905	L1:	7.530	1.027	574	2000
	L2:	7.395	L2:	7.875	L2:	7.500	1.023		2000
	L3:	7.260	L3:	7.995	L3:	7.620	1.030		2000
Note(s): Test on model C6-70K-T12-LV to represent all the other models.									

End of test report

P H O T O D O C U M E N T A T I O N

CN22DK54 001 attachment 1

for

Grid-connected PV Inverter

C6-50K-T6-LV, C6-60K-T9-LV, C6-70K-T12-LV
Guangzhou Sanjing Electric Co., Ltd.

This documentation consists of 23 pages (excluding this cover page)

Model: as cover

Figure 1. Front view

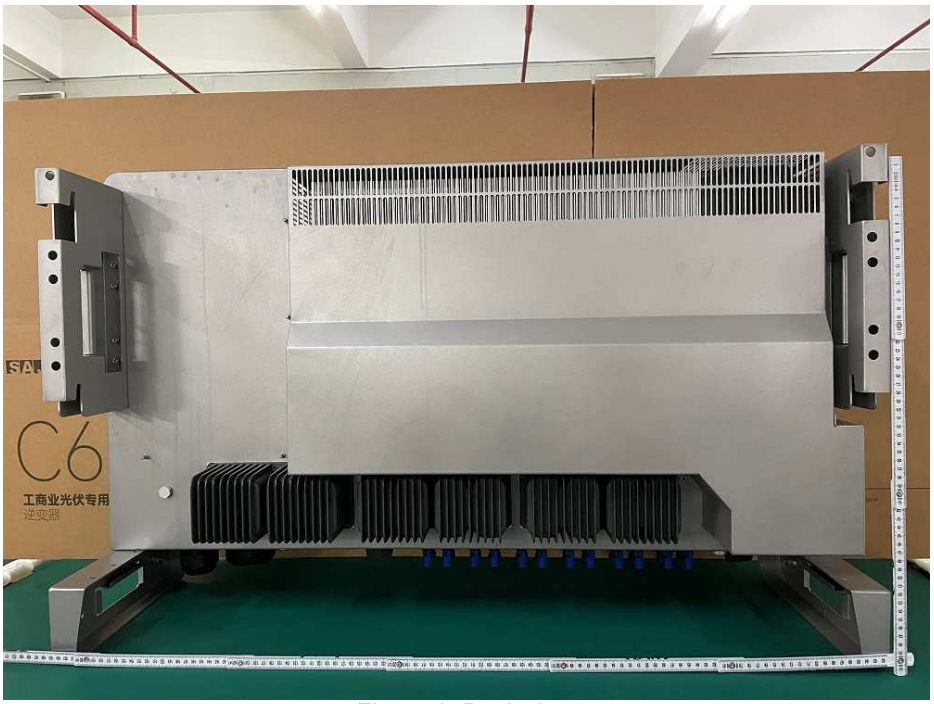

Figure 2. Back view

Model: as cover

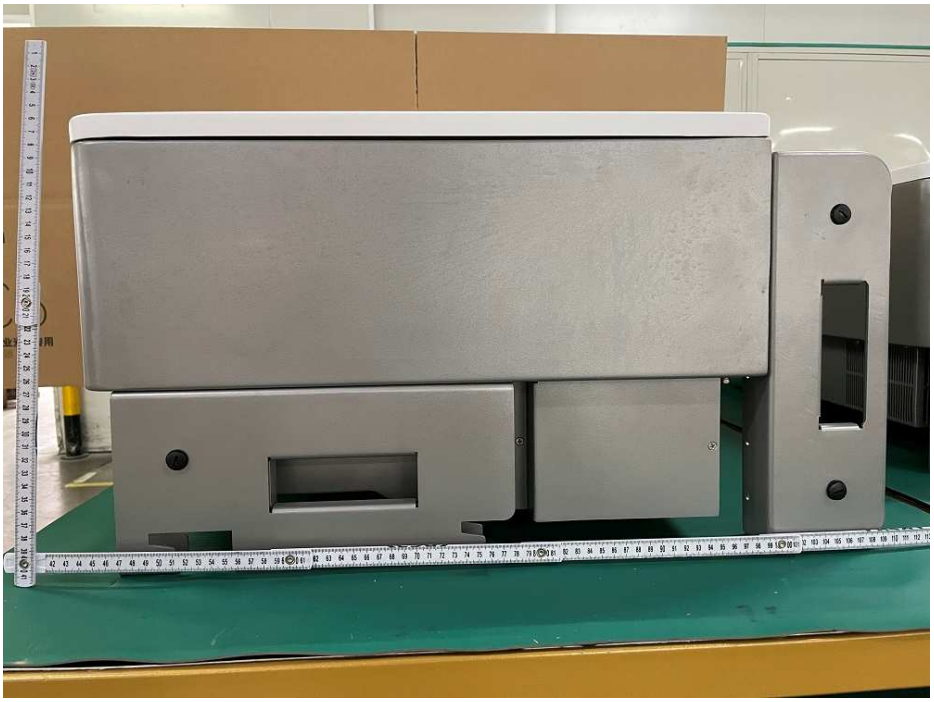

Figure 3. Left view

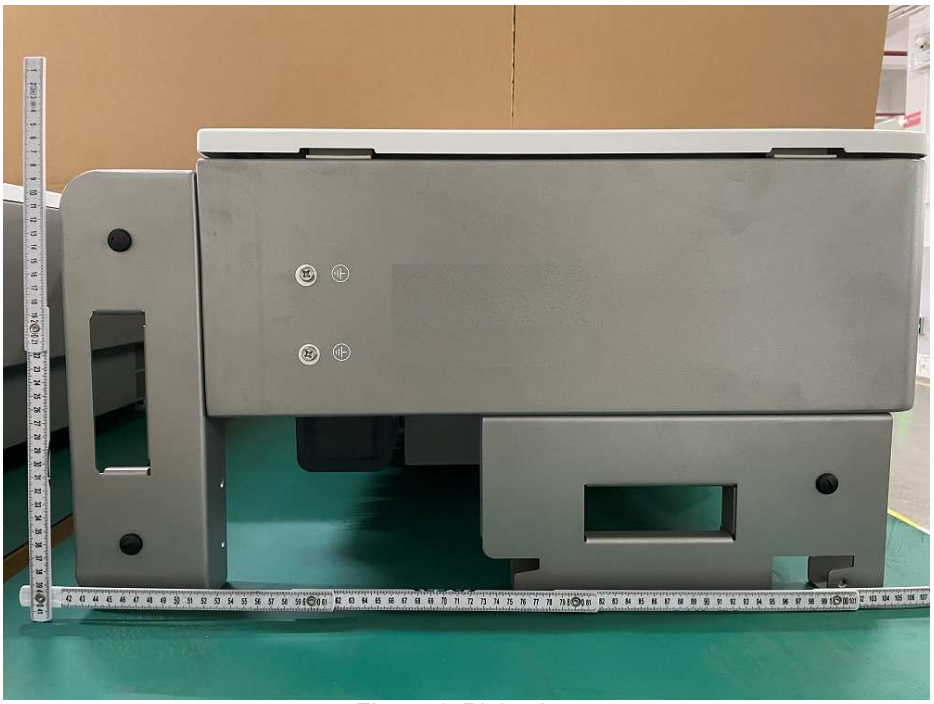

Figure 4. Right view

Model: as cover

Figure 5. Top view

Figure 6. Terminal view C6-50K-T6-LV

Model: as cover

Figure 7. Terminal view of C6-60K-T9-LV

Figure 8. Terminal view of C6-70K-T12-LV

Model: as cover

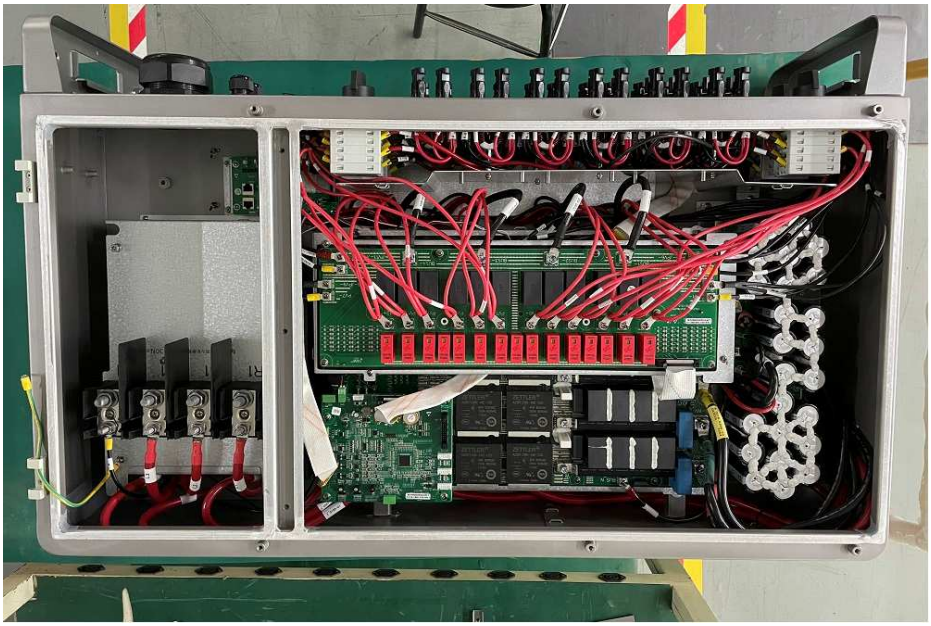

Figure 9. Terminal view 1 of C6-70K-T12-LV

Figure 10. Internal view 2 of C6-70K-T12-LV

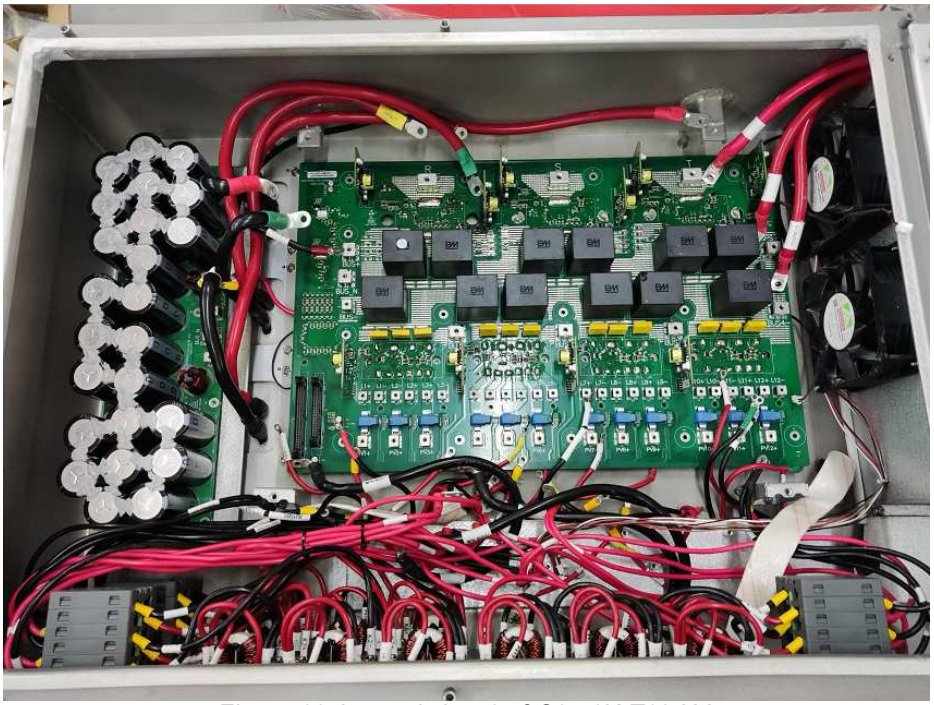

Figure 11. Internal view 3 of C6-70K-T12-LV

Figure 12. Internal view 1 of C6-50K-T6-LV, C6-60K-T9-LV

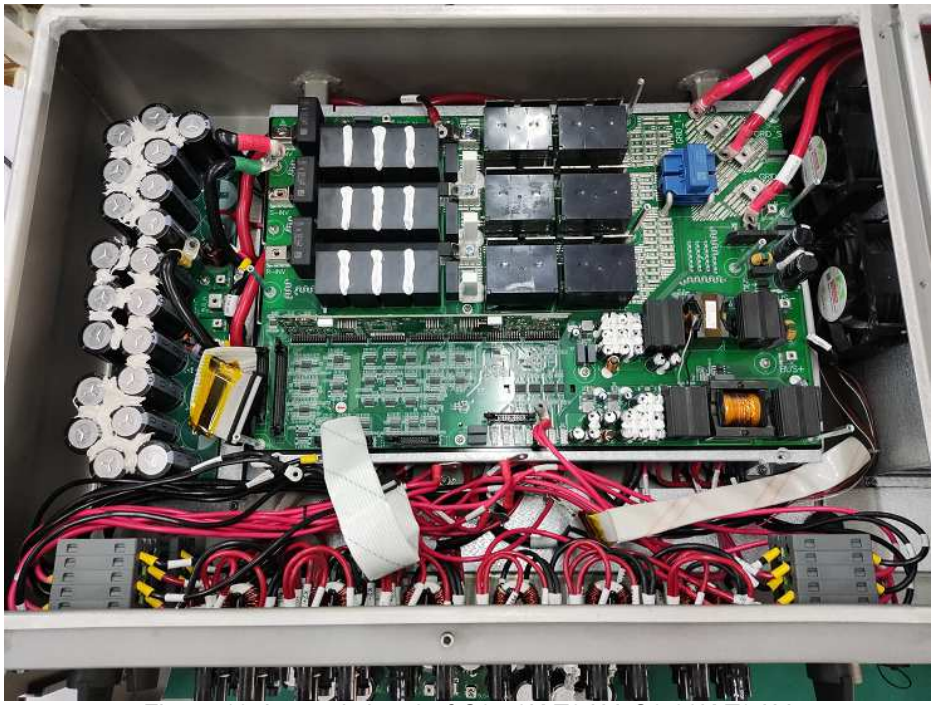

Figure 13. Internal view 2 of C6-50K-T6-LV, C6-60K-T9-LV

Figure 14. Internal view 3 of C6-50K-T6-LV, C6-60K-T9-LV

Model: as cover

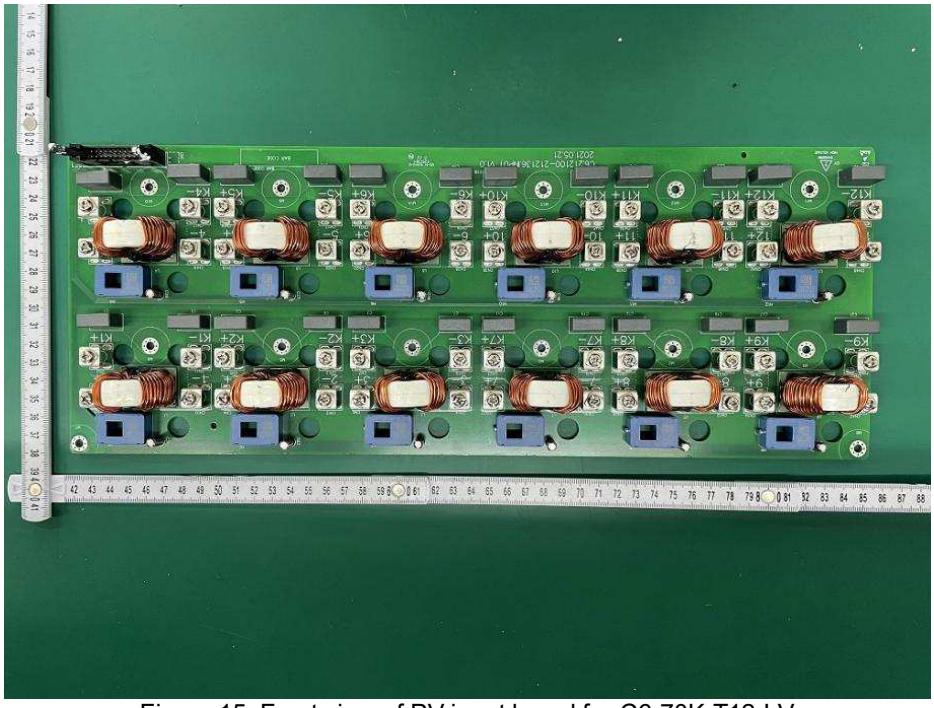

Figure 15. Front view of PV input board for C6-70K-T12-LV

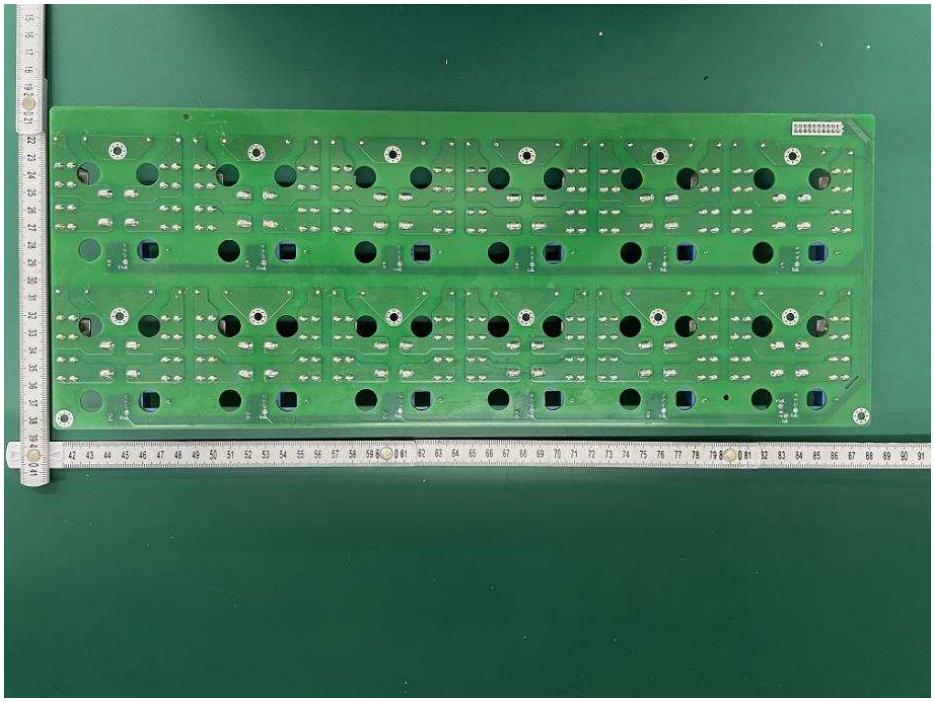

Figure 16. Back view of PV input board for C6-70K-T12-LV

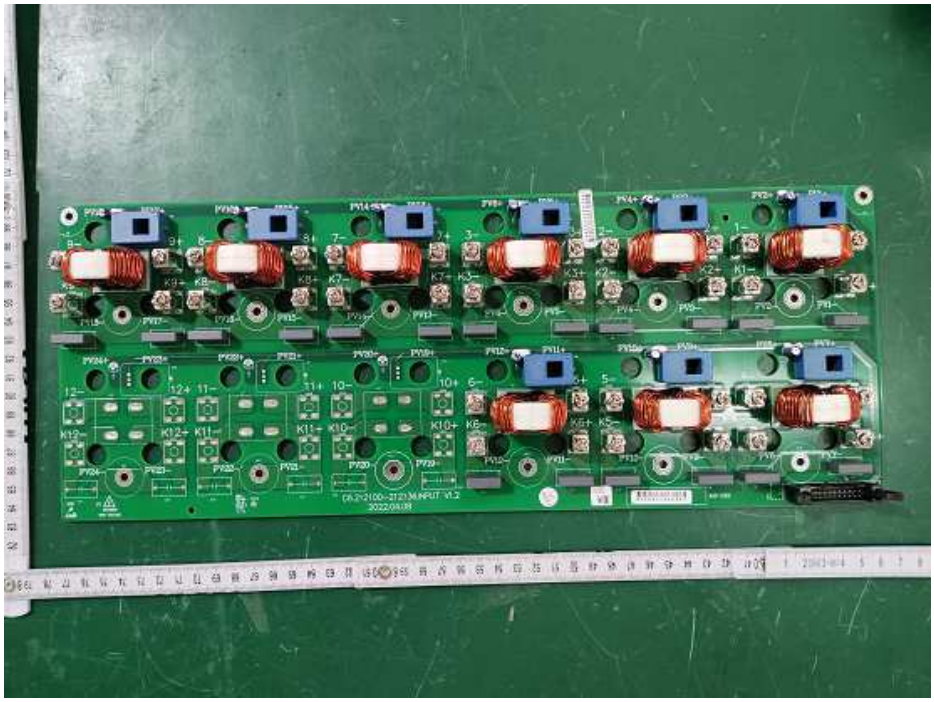

Figure 17. Front view of PV input board for C6-60K-T9-LV

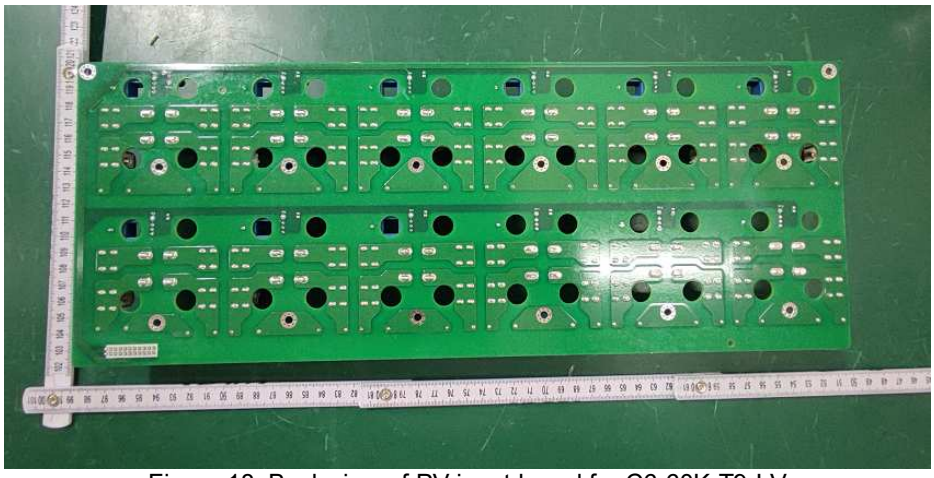

Figure 18. Back view of PV input board for C6-60K-T9-LV

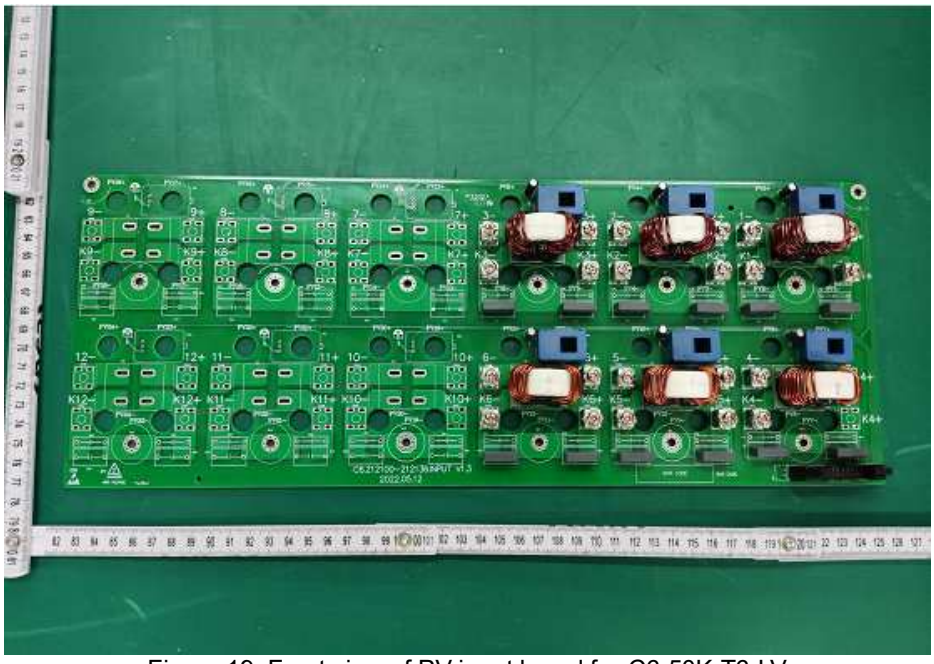

Figure 19. Front view of PV input board for C6-50K-T6-LV

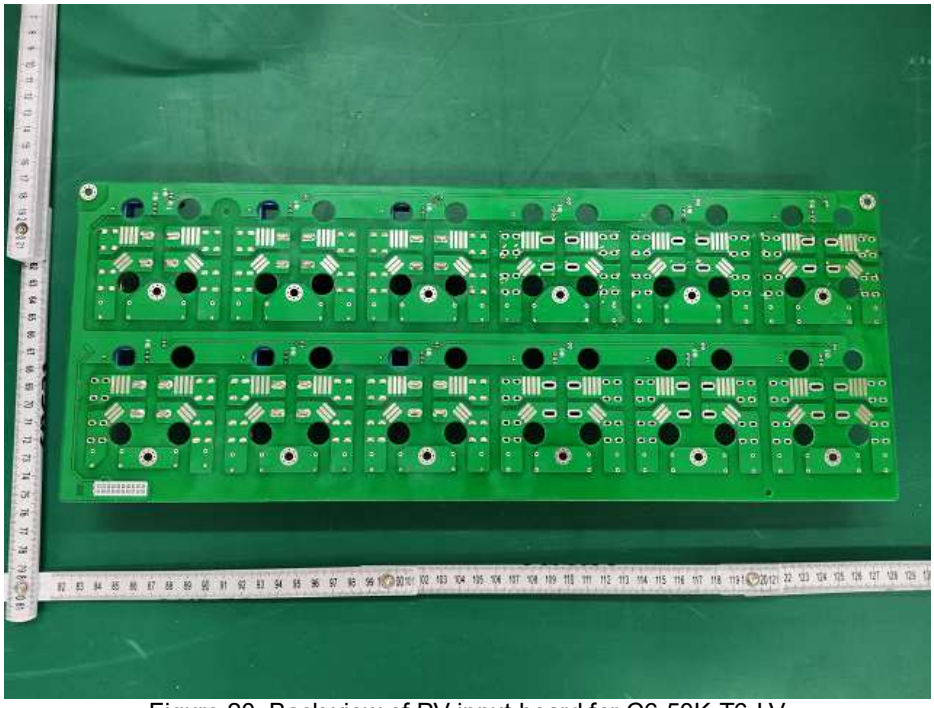

Figure 20. Back view of PV input board for C6-50K-T6-LV

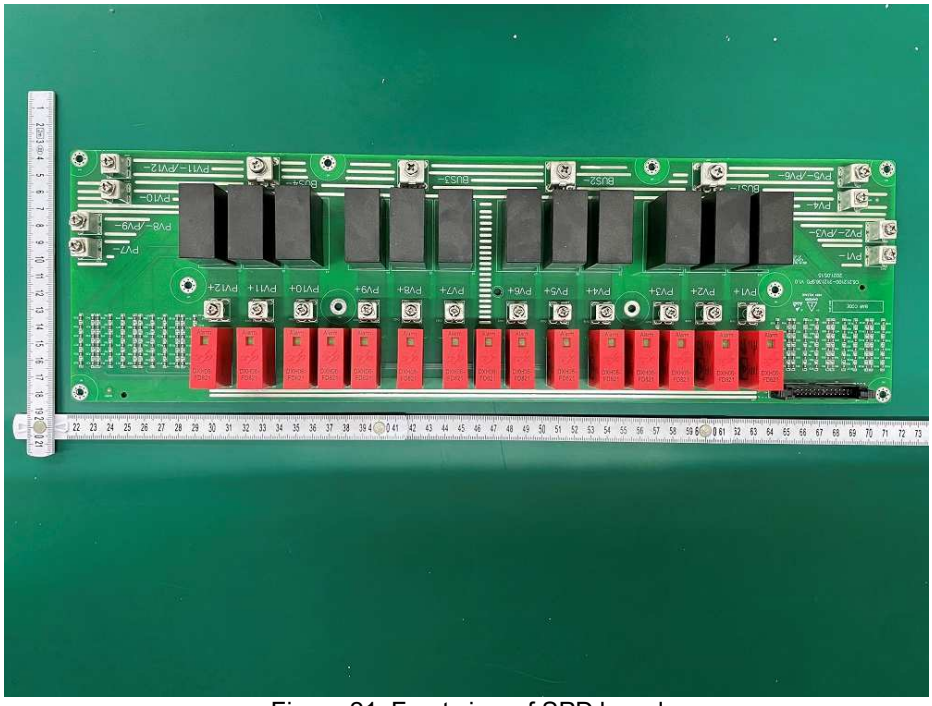

Figure 21. Front view of SPD board

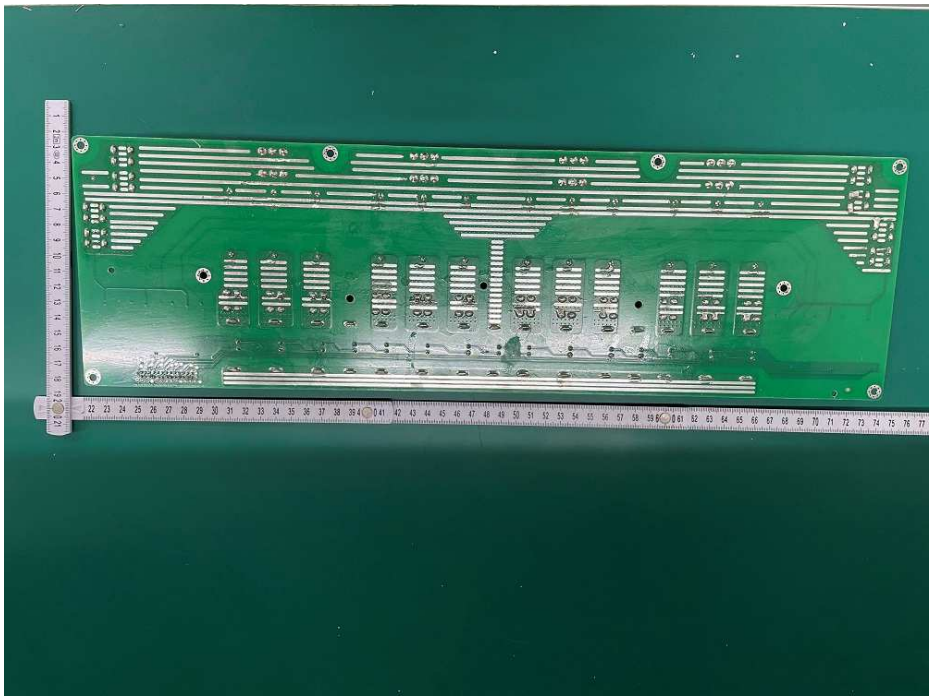

Figure 22. Back view of SPD board

Figure 23. Front view of CAP board

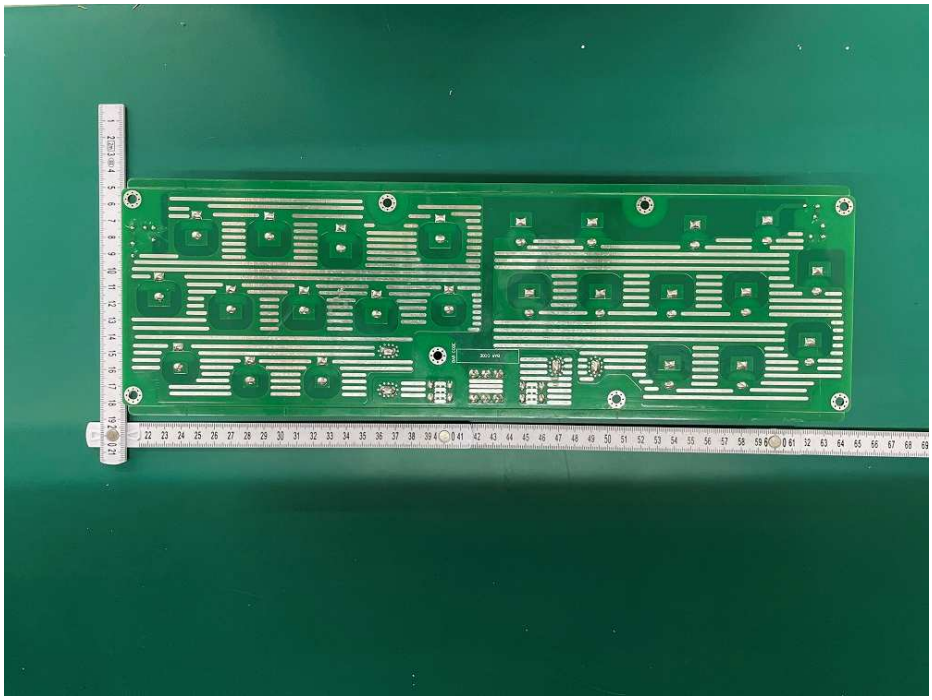

Figure 24. Back view of CAP board

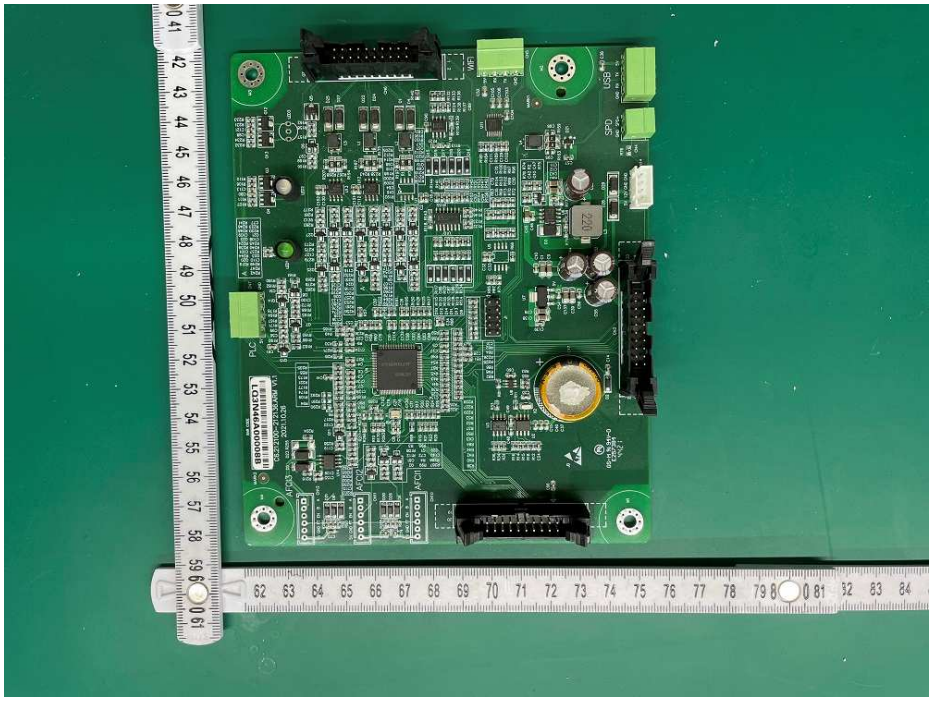

Figure 25. Front view of ARM board

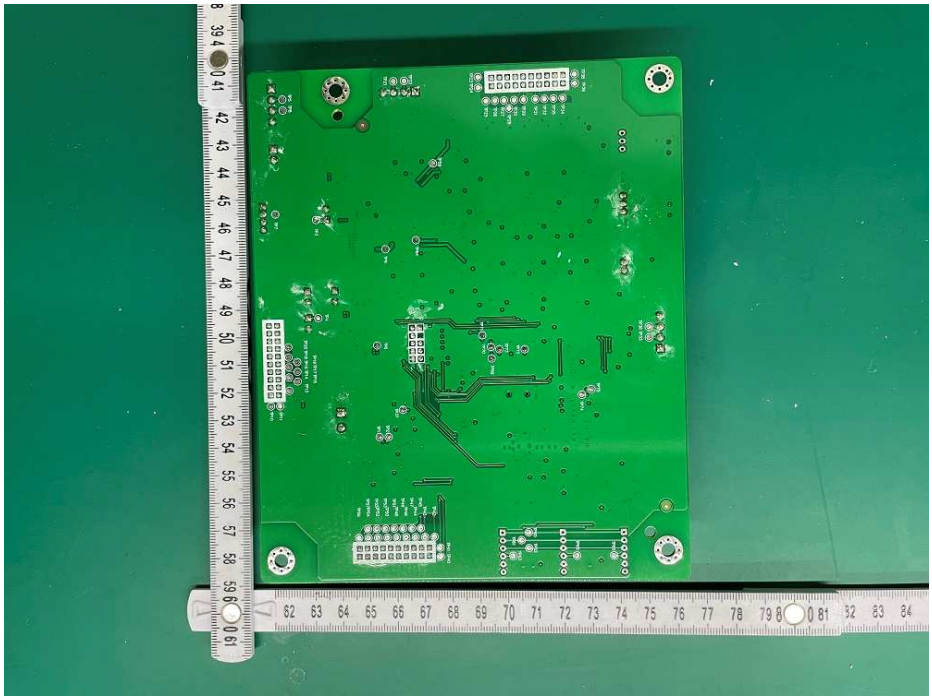

Figure 26. Back view of ARM board

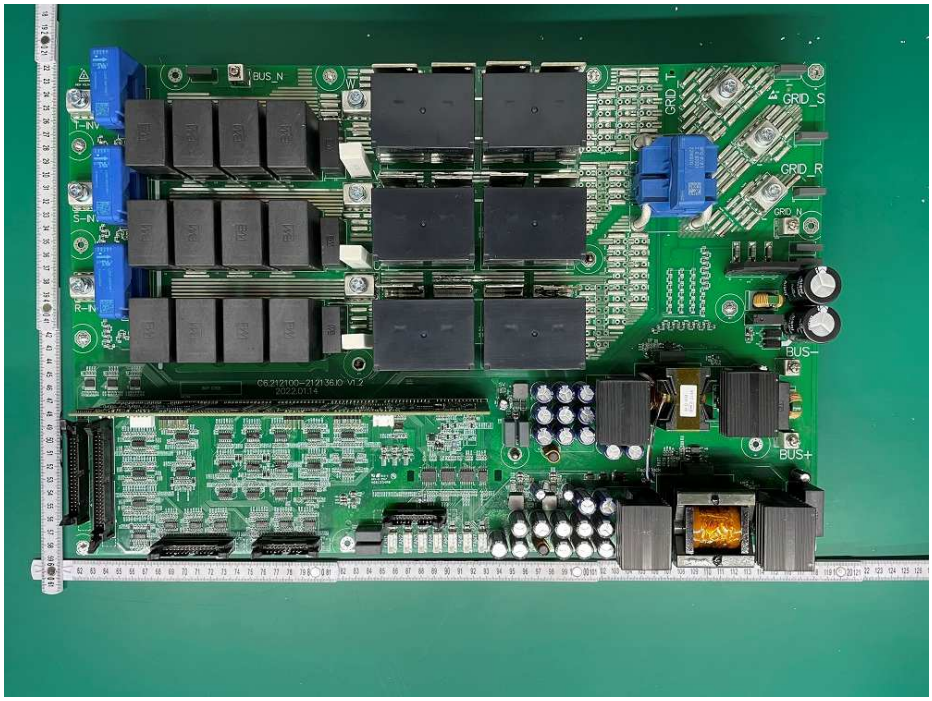

Figure 27. Front view of IO board

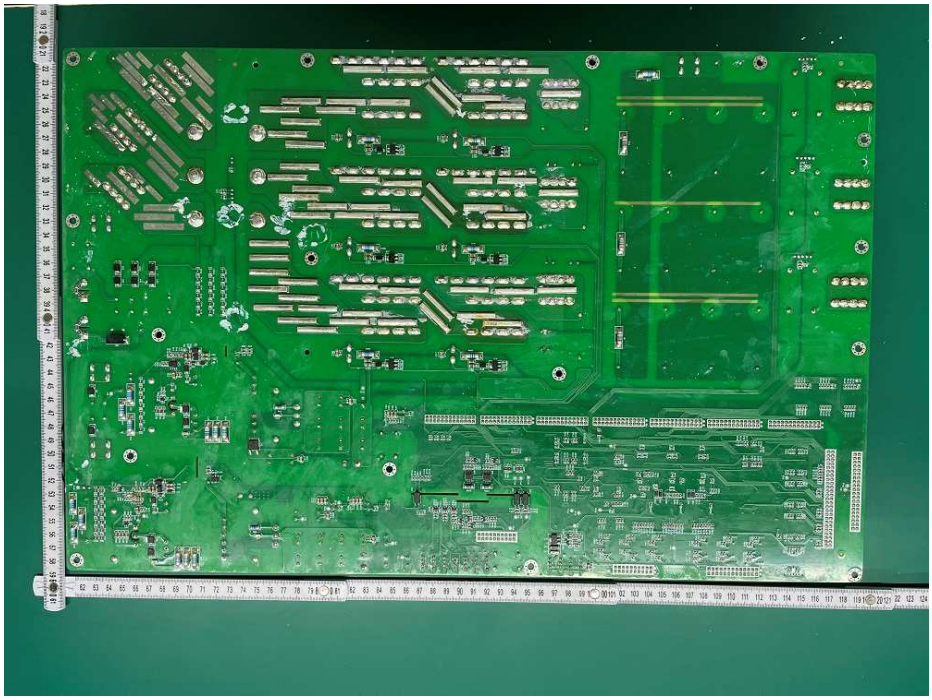

Figure 28. Back view of IO board

Model: as cover

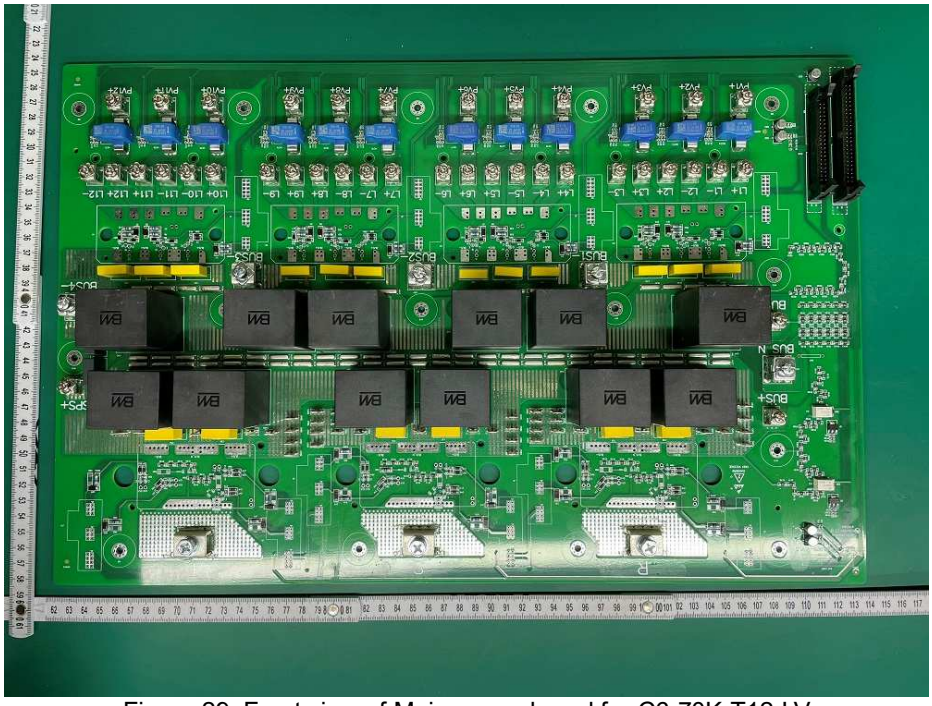

Figure 29. Front view of Main power board for C6-70K-T12-LV

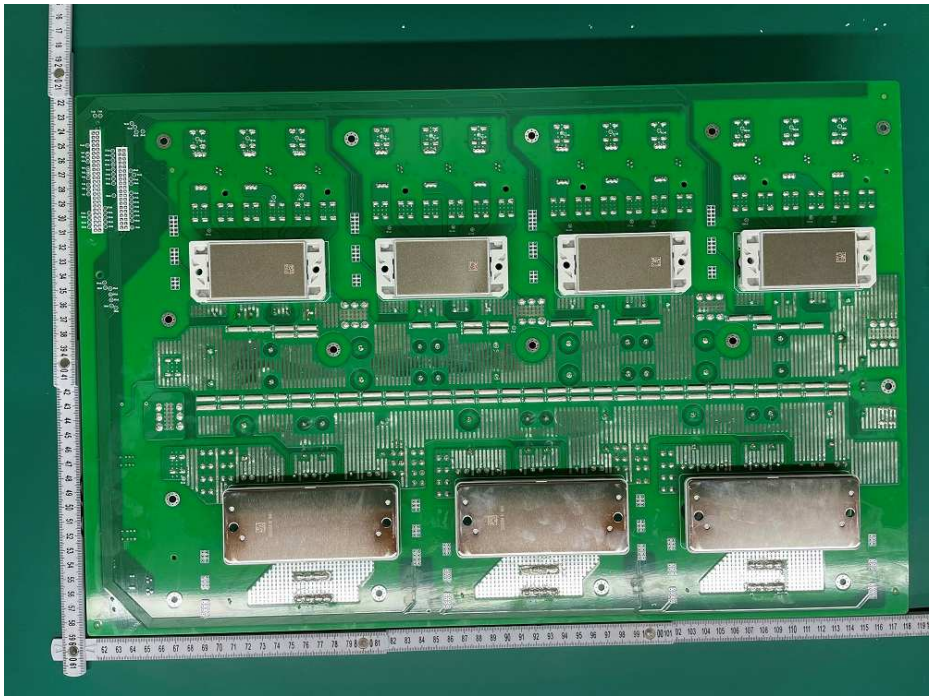

Figure 30. Back view of Main power board for C6-70K-T12-LV

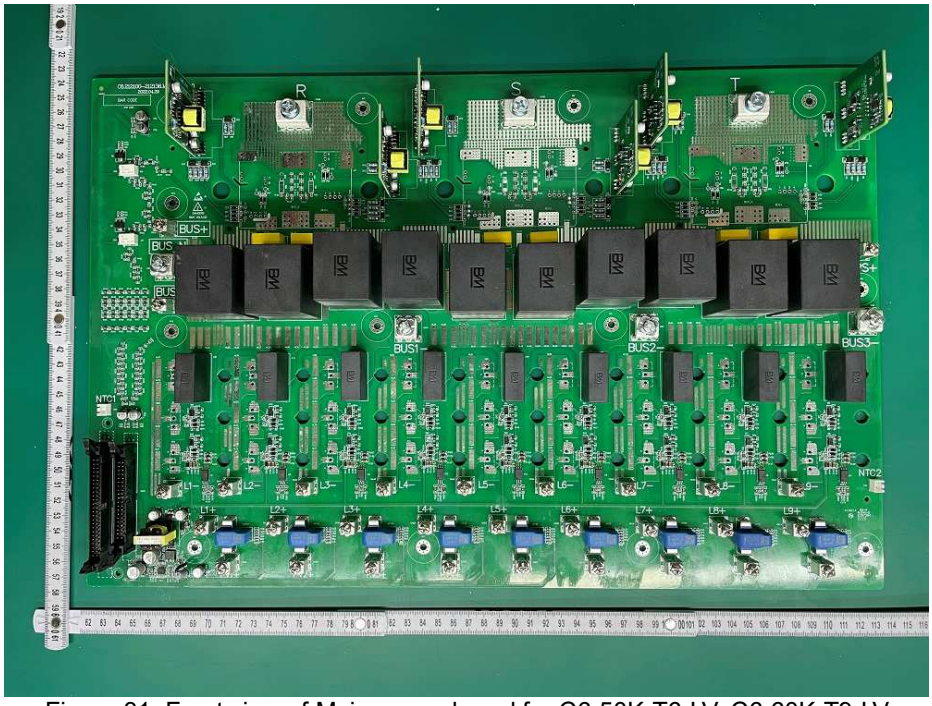

Figure 31. Front view of Main power board for C6-50K-T6-LV, C6-60K-T9-LV

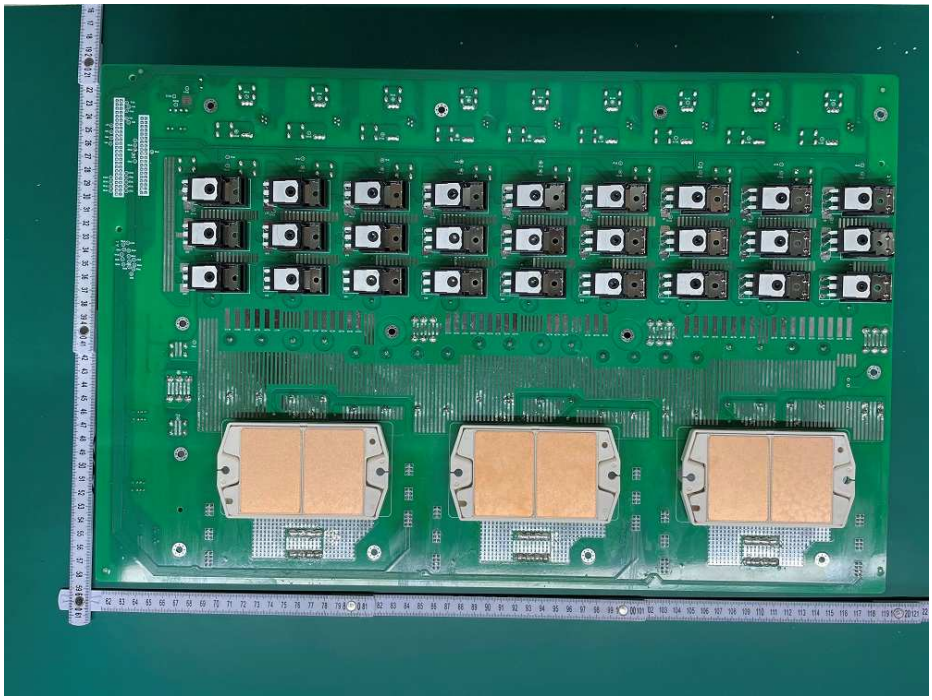

Figure 32. Back view of Main power board for C6-50K-T6-LV, C6-60K-T9-LV

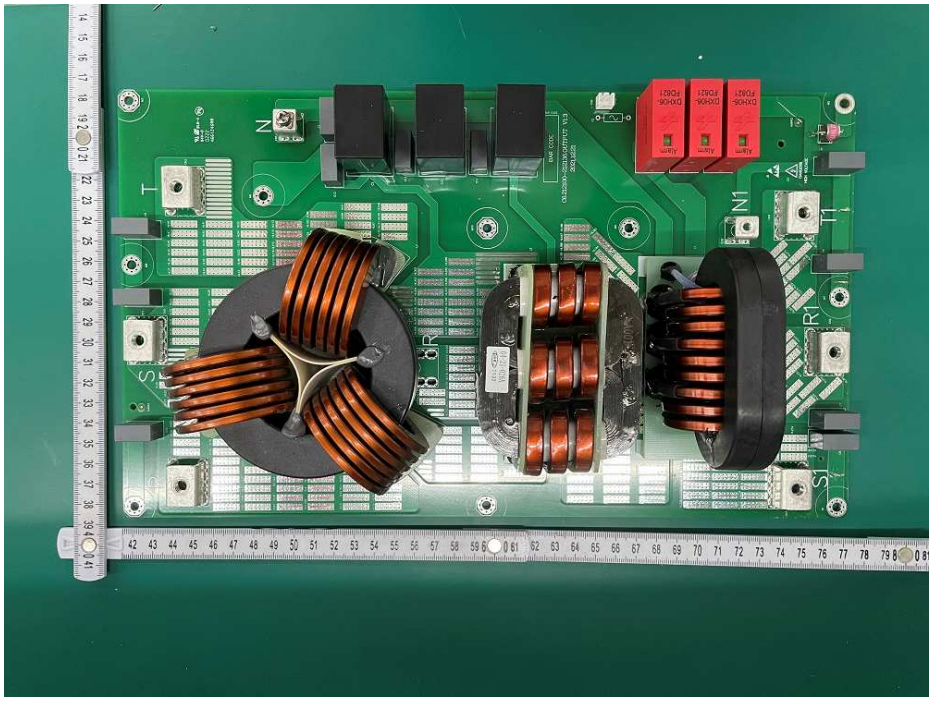

Figure 33. Front view of AC output board

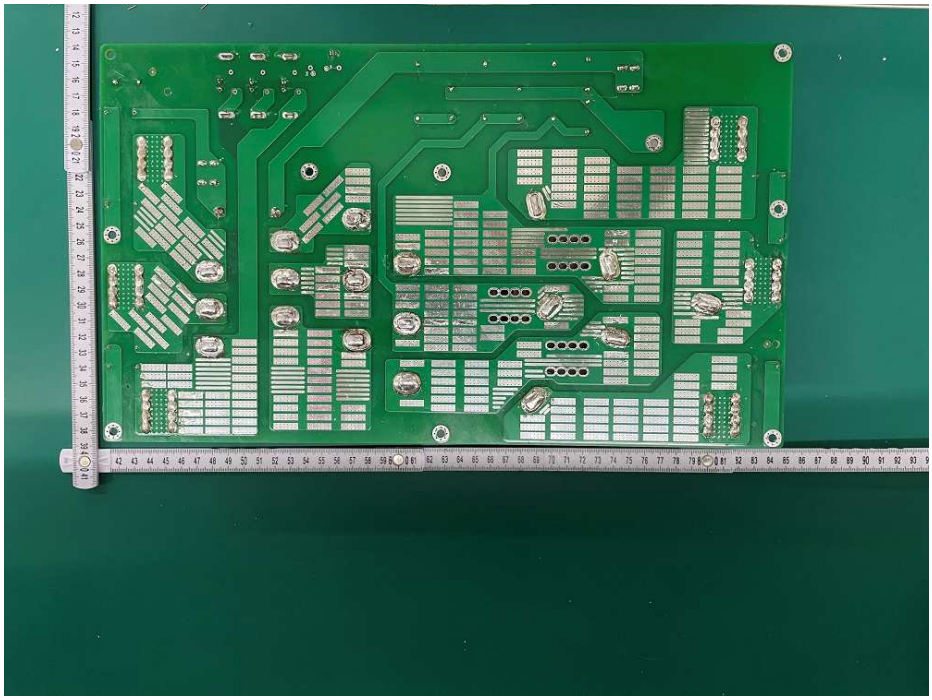

Figure 34. Back view of AC output board

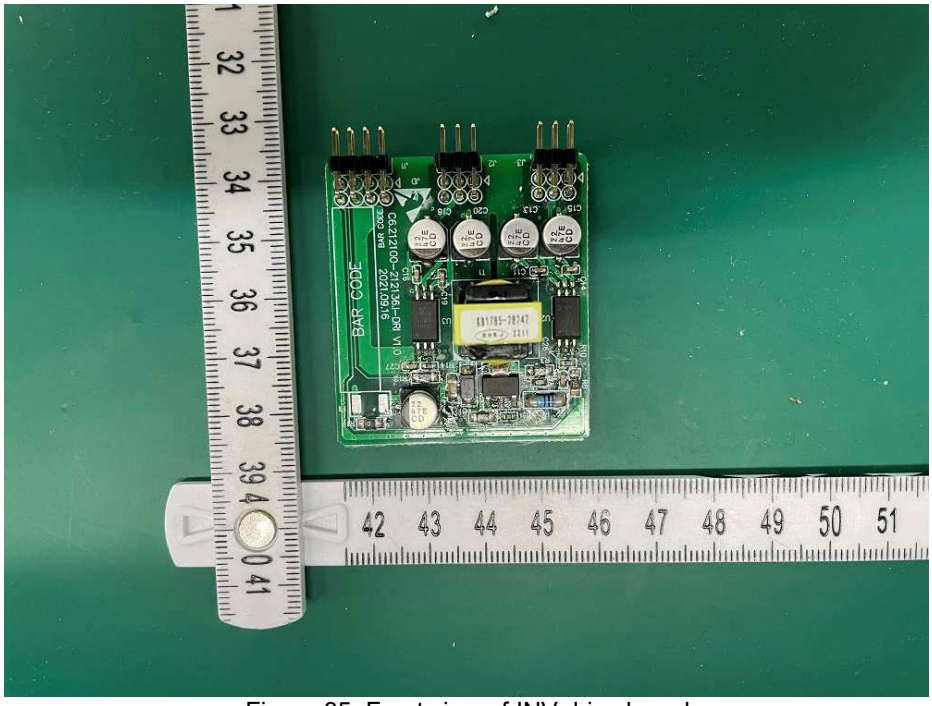

Figure 35. Front view of INV drive board

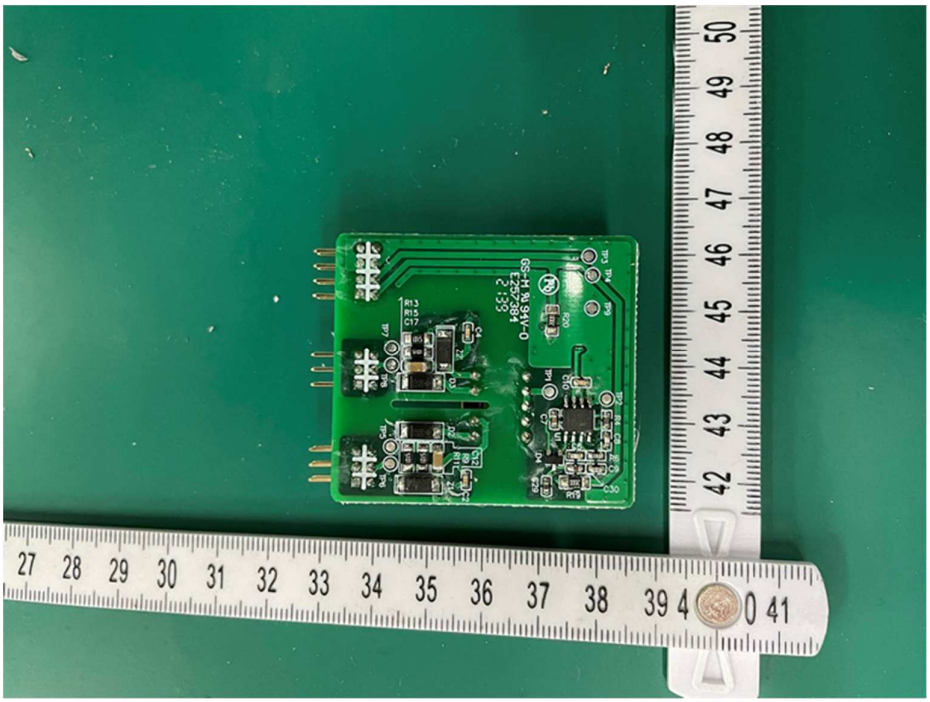

Figure 36. Back view of INV drive board

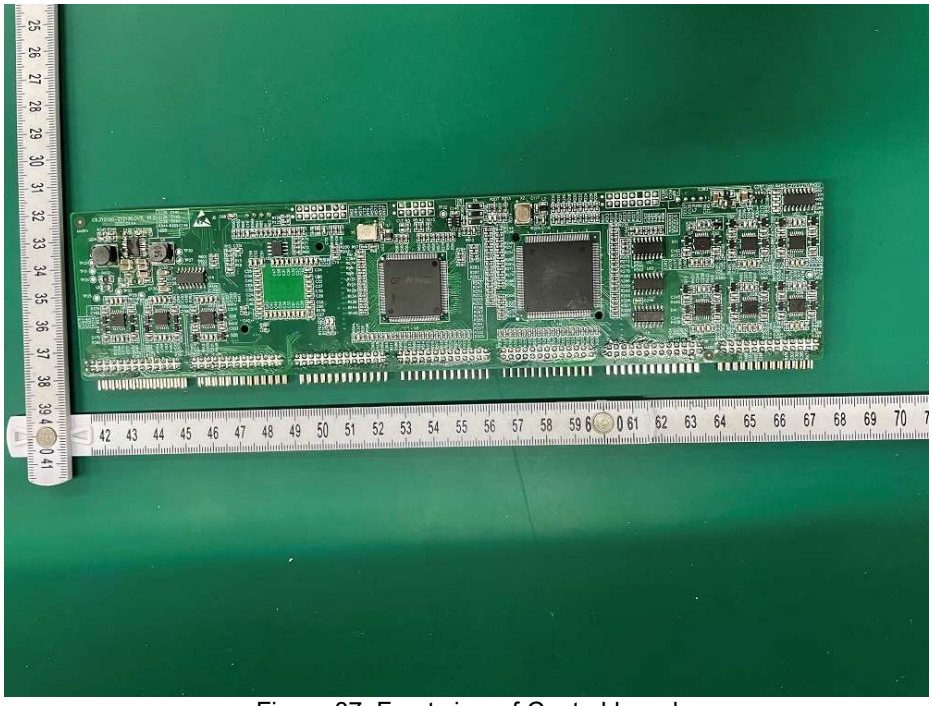

Figure 37. Front view of Control board

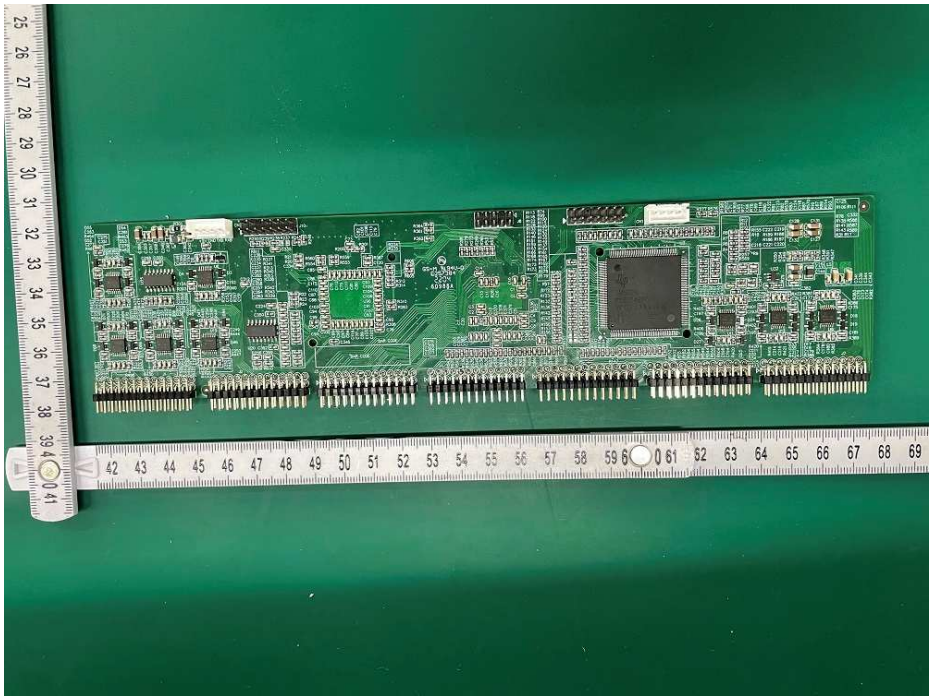

Figure 38. Back view of Control board

Model: as cover

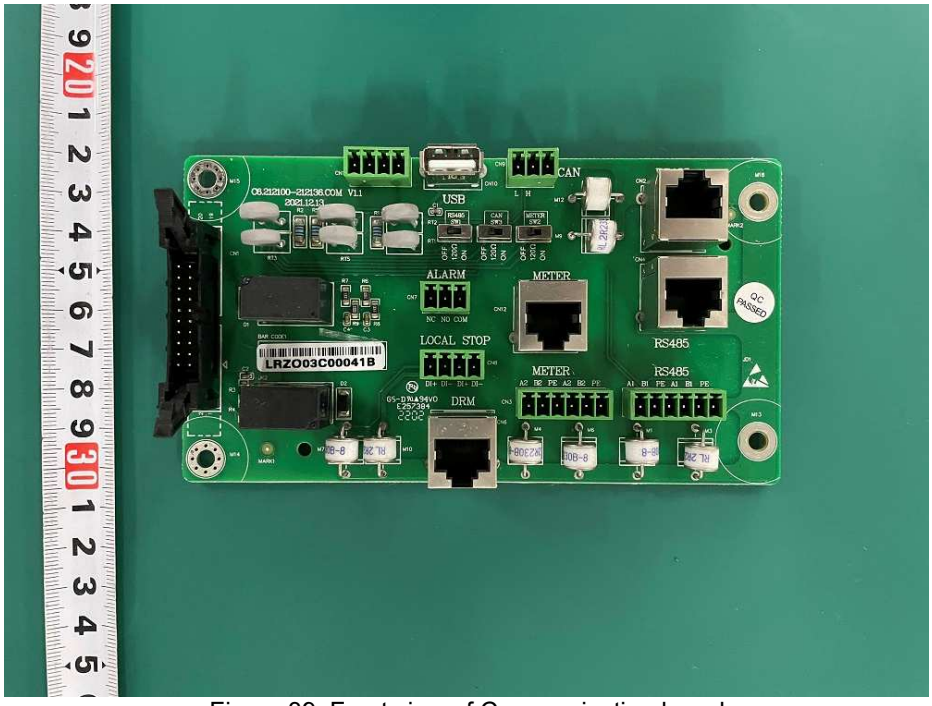

Figure 39. Front view of Communication board

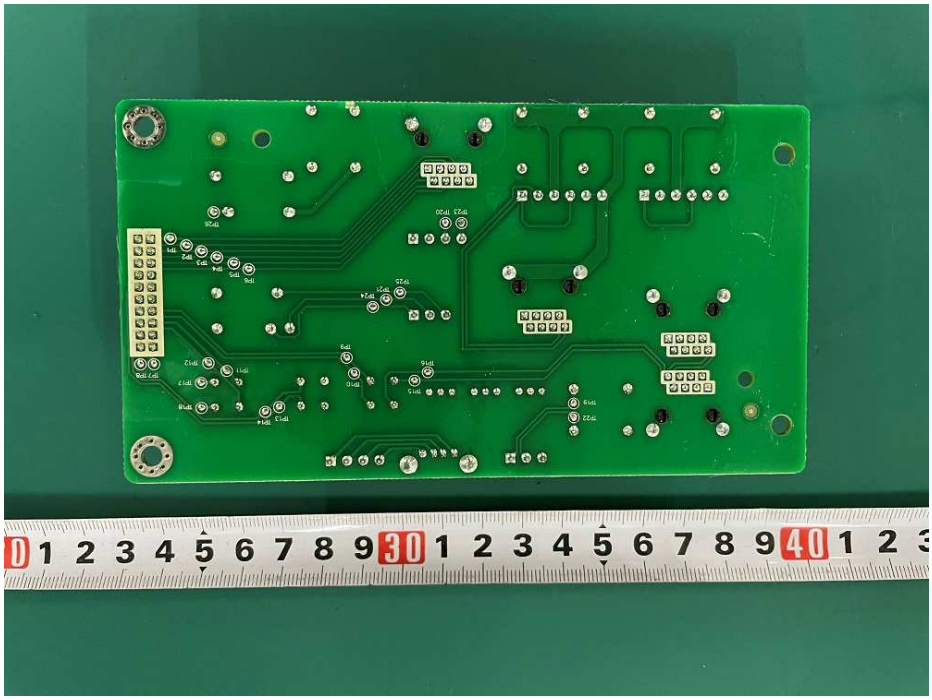

Figure 40. Back view of Communication board

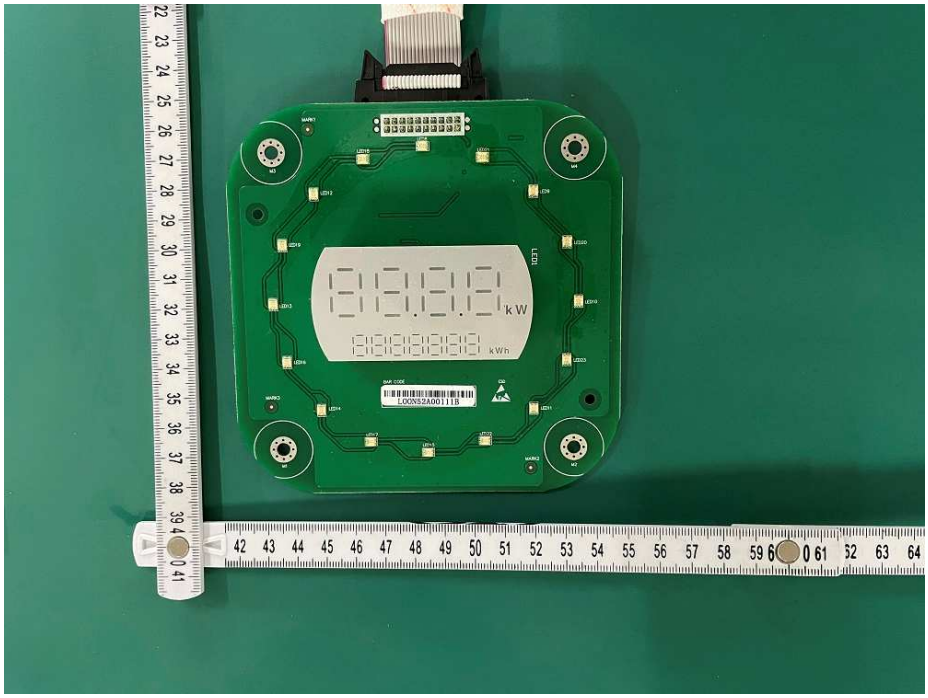

Figure 41. Front view of Display board

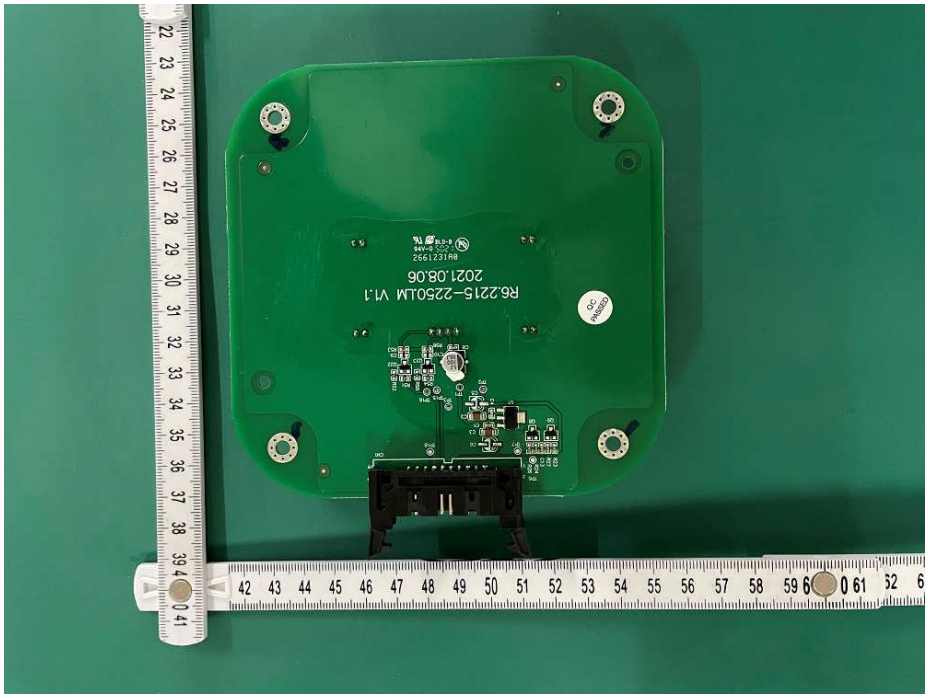

Figure 42. Back view of Communication board

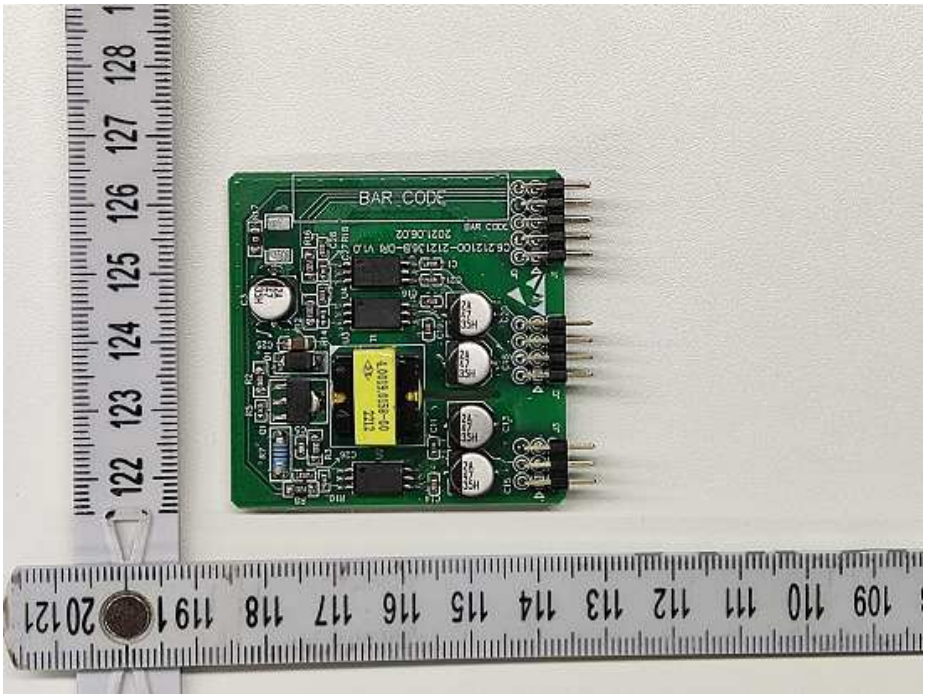

Figure 43. Front view of Boost drive board

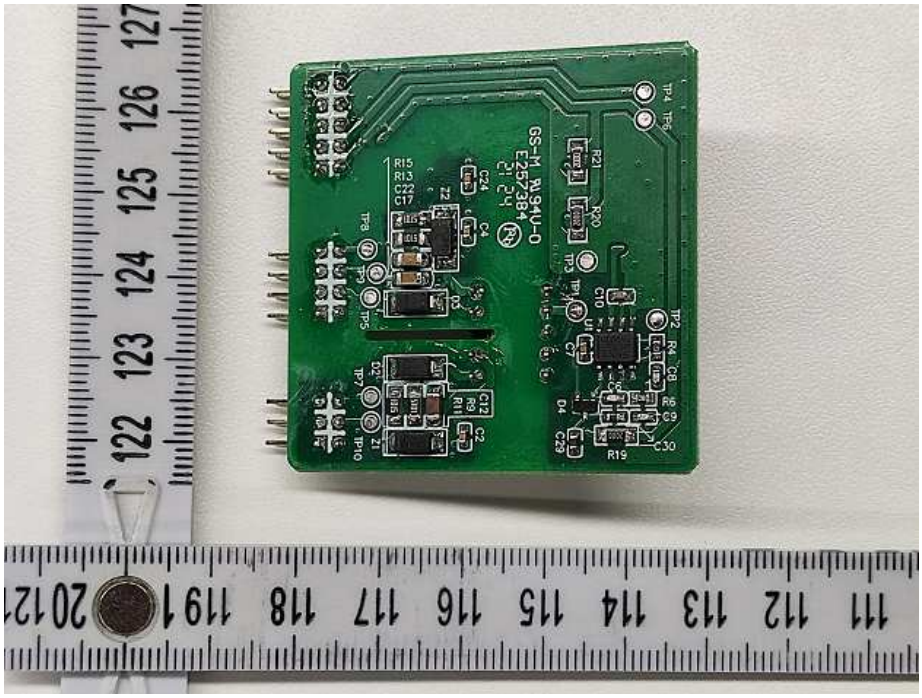

Figure 44. Back view of Boost drive board

Figure 45. Internal ground view

Figure 46. External ground view