

Prüfbericht-Nr.: <i>Test Report No.:</i>	CN22DVK5 001	Auftrags-Nr.: <i>Order No.:</i>	168398023	Seite 1 von 33 <i>Page 1 of 33</i>
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	2026754	Auftragsdatum: <i>Order date:</i>	2022.11.08	
Auftraggeber: <i>Client:</i>	Guangzhou Sanjing Electric Co., Ltd. No.9, Lizhishan Road, Science City, Guangzhou High-tech Zone, Guannngdong P.R. China			
Prüfgegenstand: <i>Test item:</i>	PV Grid-connected Inverter			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	C6-50K-T6-LV, C6-60K-T9-LV, C6-70K-T12-LV			
Auftrags-Inhalt: <i>Order content:</i>	AK certificate			
Prüfgrundlage: <i>Test specification:</i>	IEC 61683: 1999, IEC 60068-2-1:2007, IEC 60068-2-2:2007, IEC 60068-2-14: 2009, IEC 60068-2-30: 2005			
Wareneingangsdatum: <i>Date of receipt:</i>	2022.11.09			
Prüfmuster-Nr.: <i>Test sample No.:</i>	Engineering samples			
Prüfzeitraum: <i>Testing period:</i>	2022.11.09-2022.11.30			
Ort der Prüfung: <i>Place of testing:</i>	See page 3			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>	genehmigt von: <i>authorized by:</i>			
Datum: 2022.11.30 <i>Date:</i>	Datum: 2022.11.30 <i>Date:</i>			
Stellung / Position	Project Engineer	Stellung / Position	Reviewer	
Sonstiges / Other: The report consists of 33 pages for IEC 61683 (including this cover page), besides: - ATTACHMENT 1 – Test report of IEC 60068 (18 pages) - ATTACHMENT 2 – Photo Documentation (23 pages excluding cover page) 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: <i>Condition of the test item at delivery:</i>		Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
* 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
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V05

TEST REPORT IEC 61683 Photovoltaic Systems – Power Conditioners – Procedure for Measuring Efficiency	
Report Number.	CN22DVK5 001
Date of issue	See cover page
Total number of pages	See cover page
Testing Laboratory	TÜV Rheinland (Shenzhen) Co., Ltd.
Address	1601-1604, 17-18F, Tower A Building 2, Shenzhen International Innovation Valley, Dashi 1st Road, Xili Street, Xili Community, Nanshan District, Shenzhen 518052, P. R. China
Applicant's name	Guangzhou Sanjing Electric Co., Ltd.
Address	No.9, Lizhishan Road, Science City, Guangzhou High-tech Zone, Guangdong P.R. China
Test specification:	
Standard	IEC 61683: 1999
Non-standard test method	N/A
Test Report Form No.	IEC 61683_A
Test Report Form(s) Originator	TÜV Rheinland Group
Master TRF	Dated 2013-12
Test item description	Grid-connected PV Inverter
Trade Mark	
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.
Testing location/ address		Guangzhou Sanjing Electric Co., Ltd. No.9, Lizhishan Road, Science City, Guangzhou High-tech Zone, GUANGDONG P.R. China
☐	Associated Laboratory:	
Testing location/ address		
Tested by (name + signature)		
Approved by (name + signature) ..		
☐	Testing procedure: TMP	
Testing location/ address		
Tested by (name + signature)		
Approved by (name + signature) ..		
☐	Testing procedure: WMT	
Testing location/ address		
Tested by (name + signature)		
Witnessed by (name + signature) ..		
Approved by (name + signature) ..		
☐	Testing procedure: SMT	
Testing location/ address		
Tested by (name + signature)		
Approved by (name + signature) ..		
Supervised by (name + signature):		
☐	Testing procedure: RMT	
Testing location/ address		
Tested by (name + signature)		
Approved by (name + signature) ..		
Supervised by (name + signature):		

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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: C6-50K-T6-LV	
PV Input	
Max. Input Voltage	1100V
MPPT Voltage Range	180-1000V
Max. Input Current	6*30A
Short Circuit Current	6*45A
AC Output	
Rated Output Voltage	3/N/PE 127/220V
Rated Output Current	3*131.2A
Max. Output Current	3*144.3A
Rated Output Frequency	50/60Hz
Rated Output Power	50000W
Max. Apparent Power	55000VA
Power Factor Range	0.8 Leading...0.8 Lagging
Operating Temperature Range: -30°C~60°C	
Protective Class: I	
Overvoltage Category: II (DC), III (AC)	
Ingress protection: IP66	
Inverter Topology: Non-isolated	
IEC/EN62109-1/2, EN61000-6-2/4	
    	
  	
S/N	
P/C	
MADE IN CHINA	

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: C6-60K-T9-LV	
PV Input	
Max. Input Voltage	1100V
MPPT Voltage Range	180-1000V
Max. Input Current	9*30A
Short Circuit Current	9*45A
AC Output	
Rated Output Voltage	3/N/PE 127/220V
Rated Output Current	3*157.5A
Max. Output Current	3*157.5A
Rated Output Frequency	50/60Hz
Rated Output Power	60000W
Max. Apparent Power	60000VA
Power Factor Range	0.8 Leading...0.8 Lagging
Operating Temperature Range: -30°C~60°C	
Protective Class: I	
Overvoltage Category: II (DC), III (AC)	
Ingress protection: IP66	
Inverter Topology: Non-isolated	
IEC/EN62109-1/2, EN61000-6-2/4	
    	
  	
S/N	
P/C	
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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°C~60°C	
Protective Class: I	
Overvoltage Category: II (DC), III (AC)	
Ingress protection: IP66	
Inverter Topology: Non-isolated	
IEC/EN62109-1/2, EN61000-6-2/4	



S/N

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List of Attachments (including a total number of pages in each attachment): ATTACHMENT 1 – TEST REPORT IEC 60068 Environmental Testing (18 pages) ATTACHMENT 2 – Photo documents (23 pages)
Test item particulars :
Possible test case verdicts: - test case does not apply to the test object : N/A - test object does meet the requirement : P (Pass) - test object does not meet the requirement : F (Fail)
Testing..... : Date of receipt of test item..... : See cover page Date (s) of performance of tests : See cover page
General remarks: The test 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 Issuing testing laboratory. "(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report. Throughout this report a ☐ comma / ☒ point is used as the decimal separator. Determination of the test result includes consideration of measurement uncertainty from the test equipment and methods.

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.

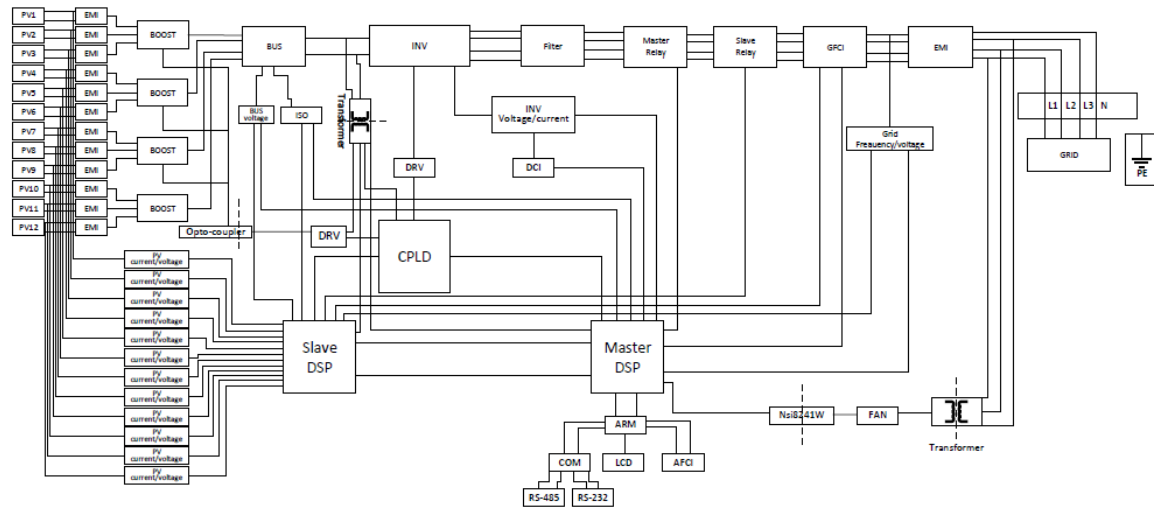
In the case of a fault defined in this standard, after the DSP receives an abnormal signal from the relevant protection detection circuit, the relay will act to automatically disconnect the active circuit of the photovoltaic inverter from the grid, when any grid fault occurs, the master DSP and the slave 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 $U_r [V_{ac}]$	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 $I_r [A]$	131.2	157.5	183.7
	Max. Output Current $I_{max} [A]$	144.3	157.5	183.7
	Power Factor $\cos\phi [\lambda]$	0.8 leading~0.8 lagging		
	Efficiency max. η_{max}	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 board:V1.2, IO board:V1.0, Main power board:V1.0, Boost drive board:V1.0, INV drive board:V1.0 ARM board:V1.4, PV Input board:V1.2, AC output board:V1.4 Electric capacity board:V1.0, Lightning protection board:V1.0, Communication board: 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	-30°C to +60°C (45°C to 60°C with derating)		

	[°C]	
	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 61683			
Clause	Requirement - Test	Result - Remark	Verdict

4	Efficiency measurement conditions		P
	Efficiency shall be measured under the matrix of conditions as described in the following clauses and table 1. Specific conditions may be excluded by mutual agreement when those conditions are outside the manufacturer's allowable operating range. The resulting data shall be presented in tabular form and may also be presented graphically.	(See test data record)	P
4.1	DC power source for testing		P
	For power conditioners operating with fixed input voltage, the d.c. power source shall be a storage battery or constant voltage power source to maintain the input voltage.		N/A
	For power conditioners that employ maximum power point tracking (MPPT) and shunt-type power conditioners, either a photovoltaic array or a photovoltaic array simulator shall be utilized.	PV array simulator used.	P
4.2	Temperature		P
	All measurements are to be made at an ambient temperature of $25\text{ °C} \pm 2\text{ °C}$. Other ambient temperatures may be allowed by mutual agreement. However, the temperature used must be clearly stated in all documentation.	(See test data record)	P
4.3	Output voltage and frequency		P
	The output voltage and frequency shall be maintained at the manufacturer's stated nominal values.	(See test data record)	P
4.4	Input voltage		P
	Measurements performed in each of the following tests shall be repeated at three power conditioner input voltages:		P
	a) manufacturer's minimum rated input voltage;	(See test data record)	P
	b) the inverter's nominal voltage or the average of its rated input range;	(See test data record)	P
	c) 90 % of the inverter's maximum input voltage.	(See test data record)	P
	In the case where a power conditioner is to be connected with a battery at its input terminals, only the nominal or rated input voltage may be applied.		N/A
4.5	Ripple and distortion		P
	Record input voltage and current ripple for each measurement. Also record output voltage and current distortion (if a.c.) or ripple (if d.c.). Ensure that these measurements remain within the manufacturer's specified values. Note that ripple and distortion may not be specified at low power levels, but readings shall be recorded.		P

IEC 61683			
Clause	Requirement - Test	Result - Remark	Verdict
4.6	Resistive loads/utility grid		P
	At unity power factor, or at the intrinsic power factor of grid-connected inverters without power factor adjustment, measure the efficiency for power levels of 10 %, 25 %, 50 %, 75 %, 100 % and 120 % of the inverter's rating. Stand-alone inverters shall also be measured at a power level of 5 % of rated. The power conditioner test should be conducted with a specified resistive and reactive grid impedance.	(See test data record)	P
4.7	Reactive loads		N/A
	For stand-alone inverters, measure the efficiency with a load which provides a power factor equal to the manufacturer's specified minimum level (or 0,25, whichever is greater) and at power levels of 25 %, 50 % and 100 % of rated VA. Repeat for power factors of 0,5 and 0,75 (do not go below the manufacturer's specified minimum PF) and power levels of 25 %, 50 %, and 100 % of rated VA.	Only utility grid inverter.	N/A
4.8	Resistive plus non-linear loads		N/A
	For stand-alone inverters, measure the efficiency with a fixed non-linear load (total harmonic distortion (THD) = $(80 \pm 5) \%$) equal to $(25 \pm 5) \%$ of the inverter's rated VA plus sufficient resistive load in parallel to achieve a total load of 25 %, 50 % and 100 % of rated VA. Repeat the measurements with a fixed non-linear load equivalent to $(50 \pm 5) \%$ of the inverter's rated VA plus sufficient resistive load in parallel to achieve a total load of 50 % and 100 % of rated VA. The type of non-linear load must be clearly stated in all documentation.		N/A
4.9	Complex loads		N/A
	When a non-linear plus a sufficient reactive load condition is specified for stand-alone inverters, measure the efficiency with a fixed non-linear load (THD = $(80 \pm 5) \%$) equal to $(50 \pm 5) \%$ of the inverter's rated VA plus a sufficient reactive load (PF = 0, 5) in parallel to achieve a total load of 50 % and 100 % of rated VA. The type of complex load shall be clearly stated in all documentation.		N/A
5	Efficiency calculations		P
5.1	Rated output efficiency		P
	Rated output efficiency shall be calculated from measured data as follows: $\eta_R = (P_o / P_i) \times 100$	(See test data record)	P
5.2	Partial output efficiency		P
	Partial output efficiency shall be calculated from measured data as follows: $\eta_{par} = (P_{op} / P_{ip}) \times 100$	(See test data record)	P

IEC 61683			
Clause	Requirement - Test	Result - Remark	Verdict
5.3	Energy efficiency		P
	Energy efficiency shall be calculated from measured data as follows: $\eta_E = (W_o / W_i) \times 100$	(See test data record)	P
5.4	Efficiency tolerances		P
	When an efficiency value has been guaranteed, the tolerance of this value shall be within the value at rated conditions indicated in table 2.		P
6	Efficiency test circuits		P
6.1	Test circuits		P
	Figure 1 shows recommended test circuits for power conditioners which have a single-phase a.c. output or d.c. output. It can as well be regarded as a single-phase representation of a test set-up for multiphase power conditioners.		P
	Figures 1a and 1b shall be applied to stand-alone and utility-interactive power conditioners respectively.		P
	The proposed test circuits in figure 1 are not mandatory, but together with the test descriptions, are intended to establish a base for mutual agreement between user and manufacturer.		P
	The type of power source shall be indicated on all tests and shall adhere to the requirements of 4.1.		P
6.2	Measurement procedure		P
	a) Efficiency is calculated with equation (1) or (2) using measured P_i , P_o or P_{ip} , P_{op} . DC input power P_i , P_{ip} can be measured by wattmeter W1, or determined by multiplying the d.c. voltmeter V1 and d.c. ammeter A1 readings. Output power P_o , P_{op} is measured with wattmeter W2.		P
	b) DC input voltage, which is measured by d.c. voltmeter V1, shall be varied in the defined range where the output current, which is measured with a.c. ammeter A2, is varied from low output to the rated output.		P
	c) An average indicating instrument shall be used for the d.c. voltmeter and d.c. ammeter. A true r.m.s. type of indicating instrument shall be used for the a.c. voltmeter and a.c. ammeter. The d.c. wattmeter W1 shall be a d.c. measuring type. The wattmeter W2 shall be an a.c. or d.c. measuring type according to the output.		P
	d) Power factor (PF in per cent) can be measured by a power factor meter PF , or calculated from the readings of V2, A2, W2 and as follows: $PF = (W2 / (V2 \times A2)) \times 100$		P

IEC 61683			
Clause	Requirement - Test	Result - Remark	Verdict
	e) Each meter may be an analogue type or a digital type. The measurement accuracy shall be better than $\pm 0,5\%$ of the full-scale value for each power measured. Digital power instruments for W1 and W2 are also recommended.		P
	f) An MPPT dynamically adjusts the input voltage so as to maximize the output power. In principle, the monitoring equipment shall sample all of the electrical parameters, such as input voltage and current, output power and current, within the update period of the MPPT. If the MPPT and input source (PV array or PV array simulator) interact in such a way that the input voltage varies by less than 5 %, then averaging of readings is acceptable. The averaging period shall be 30 s or longer.		P
7	Loss measurement		P
7.1	No-load loss		N/A
	No-load loss shall be measured as follows.		N/A
	If the power conditioner is a stand-alone type, the reading of d.c. input voltage, output voltage and frequency is given with meters V1, V2 and F respectively in figure 1a, and shall be adjusted to the rated values.		N/A
	The no-load loss is thus the indicated value of d.c. input wattmeter, W1, when the load is disconnected from the power conditioner.		N/A
	If the power conditioner is a utility-interactive type, the reading of d.c. input voltmeter V1, a.c. output voltmeter V2 and frequency meter F in figure 1b shall be adjusted to meet the specified voltages and frequency.		N/A
	No-load loss is thus the indicated value of d.c. input wattmeter, W1, when a.c. wattmeter, W2, indicates a zero value. For the measurement, allow the power conditioner time to transfer to its no-load operating state, if applicable.		N/A
7.2	Standby loss		P
	Standby loss shall be measured as follows.		P
	If the power conditioner is a utility-interactive type, standby loss is defined as the consumption of utility power when the power conditioner is not operating but is under standby condition. Standby loss is indicated with a.c. wattmeter, W2 in figure 1b at the rated a.c. output voltage.		P
	If the power conditioner is a stand-alone type, standby loss is defined as the consumption from the d.c. source when the power conditioner is not operating but is under standby condition. Standby loss is indicated with d.c. wattmeter, W1 in figure 1a (without a.c. or d.c. output voltage).		P
Annex A	Power conditioner description		P

IEC 61683			
Clause	Requirement - Test	Result - Remark	Verdict
	A power conditioner is defined in IEC 61277.		P
	Some types of photovoltaic system configurations relate to their purpose and size. Figure A.1 shows the generic system configuration proposed in IEC 61277. In figure A.1, the power conditioner (PC) is inside the dotted line. The power conditioner may consist of one or more of the following: d.c. conditioner, d.c./d.c. interface, inverter, a.c./a.c. interface, a.c. utility interface, and a part of master control and monitoring (MCM) subsystem. The power flows are indicated by the arrows. When a PV system has a d.c. storage subsystem, it is assumed that the storage is connected to the input of the power conditioner in parallel with the array (see figures A.2 and A.3).		P
	Under normal conditions, the power conditioner a.c. output voltage and frequency are constant value when the system is connected to the utility grid (in a utility-interactive type) or to the a.c. loads (in a stand-alone type). However, when a.c. loads consist of pumps or blowers with variable speed induction motors, the a.c. voltage and frequency may be variable.		P
	In this standard, systems with a constant a.c. output voltage and frequency as well as systems with a d.c. output are discussed. Figures A.2 and A.3 show the configuration of the PV system and the power conditioner described in this standard.		P
Annex B	Power efficiency and conversion factor		P
	There are two types of efficiencies shown in IEC 60146-2; one is a power efficiency, the other is a conversion factor. Power efficiency is defined as the ratio of active output power and active input power. Conversion factor is the ratio between output and input fundamental power levels. The formulae for these two parameters: $\eta_P = (P_{aAC} / P_{aDC}) \times 100 \quad (\%)$ $\eta_C = (P_{fAC} / P_{fDC}) \times 100 \quad (\%)$ η_P is the power efficiency; P_{aAC} is the a.c. active power; P_{aDC} is the d.c. active power; η_C is the conversion factor; P_{fAC} is the a.c. fundamental power; P_{fDC} is the d.c. mean power (mean voltage $\times$ mean current).	(See test data record)	P
	Active power P_a is calculated as $P_a = \frac{1}{T} \int_0^T v(t)i(t)dt \quad \text{or} \quad = \frac{1}{T} \int_0^T p(t)dt$	(See test data record)	P

IEC 61683			
Clause	Requirement - Test	Result - Remark	Verdict
	The difference between the above two efficiencies is due to the evaluation of the harmonic components. IEC 60146 unifies them into power efficiency. Their differences depend on their voltage and current waveforms as shown in table B.1 and are only meaningful in case 5. Considering the purpose of IEC standards and the illustration in table B.1, the power efficiency is used as the efficiency of power conditioners.		P
	As shown in table B.1, case 1 or case 4, the difference between η_C and η_P is only 0,1% when the d.c. voltage and current ripple are 10 %pp, or when a.c. 5th r.m.s. voltage content is 2 % and the 5th current content is 5 %. This means that the conversion factor is practically the same as the power efficiency. It shall, however, be noted that in the case of a square wave, as in case 5, the power efficiency shall be used because the difference is large, i.e., $\eta_C/\eta_P = 0,81$.		P
	The integration time (duration of one cycle) T shall be 30 s or more and the resultant mean power efficiency value shall be used as the efficiency of the power conditioner.		P
Annex C	Weighted-average energy efficiency		P
	The energy of a power conditioner depends on both the irradiance profile and the load profile. The energy efficiency of a power conditioner shall be calculated by the ratio of the output to the input energy actually measured over a certain period (such as a month or a year).		P
	For reference, a method of estimating the energy efficiency using a weighted-average energy efficiency is described.		P
	The weighted-average energy efficiency, η_{WT} , is calculated as the sum of the products of each power level efficiency and related weighting coefficient.		P
	When the system is a utility-interactive type without a storage subsystem, the weighting coefficients depend on a regional irradiance duration curve.		P
	When the system is a stand-alone type with a storage subsystem, the weighting coefficients depend on the load duration curve.		P
	Clauses C.1 and C.2 show the calculation procedures for η_{WT} for utility-interactive systems and stand-alone systems.		P
C.1	η_{WT} of power conditioner for utility-interactive PV systems		P
	Utility-interactive PV systems, which have no storage and for which reverse-power flow is accepted, are described. In this case, d.c. power generated by the PV array is supplied direct into the power conditioner (PC). Almost all of the input power to the PC is converted to a.c. power. A part of it is dissipated as the PC loss.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	The weighted-average energy efficiency, η_{WT}, is an index to evaluate annual energy efficiency in which a weighting coefficient, K_i, is used for each input power level. Here, the irradiance is divided into several discrete levels. By using a duration time T_i, d.c. input power level, P_{li}, output power level, P_{Oi}, and PC efficiency, η_i, for each level i, η_{WT} is defined as follows: $\eta_{WT} = \frac{\sum P_{Oi} \cdot T_i}{\sum P_{li} \cdot T_i} = \frac{P_{l1} \cdot \eta_1 \cdot T_1 + \dots + P_{ln} \cdot \eta_n \cdot T_n}{P_{l1} \cdot T_1 + \dots + P_{ln} \cdot T_n}$ $= K_1 \cdot \eta_1 + K_2 \cdot \eta_2 + \dots + K_n \cdot \eta_n$		P
	If the irradiance duration curve is given as shown in figure C.1, equation (C.1) can be rewritten as follows: $\eta_{WT} = \frac{1T_1}{T_{WT}} \eta_{1/4} + \frac{2T_2}{T_{WT}} \eta_{2/4} + \frac{3T_3}{T_{WT}} \eta_{3/4} + \frac{4T_4}{T_{WT}} \eta_{4/4} \geq \eta_{ER}$ $T_{WT} = 1T_1 + 2T_2 + 3T_3 + 4T_4$		P
C.2	η_{WT} of power conditioner for stand-alone PV systems	Non stand-alone PV systems	N/A
	In stand-alone PV systems with a storage subsystem, power generated from the PV array is stored and stabilized by the batteries. DC power is converted into regulated d.c. power or constant-voltage and constant-frequency a.c. power by a power conditioner (PC) and supplied to the load. In this case, some fraction of the generated power is dissipated as a loss in the batteries and power conditioner.		N/A
	The calculation of the weighted-average energy efficiency, η_{WT} , for stand-alone PV systems requires weighting coefficients for respective load levels.		N/A
	By using a load duration time T_i, d.c. input power P_{li}, a.c. output power P_{Oi} and PC efficiency for respective load level η_i, η_{WT} is defined as follows: $\eta_{WT} = \frac{\sum P_{Oi} \cdot T_i}{\sum P_{li} \cdot T_i} = \frac{\sum P_{O1} \cdot T_1 + \dots + P_{On} \cdot T_n}{P_{l0} \cdot T_0 + P_{O1} \cdot T_1 / \eta_1 + P_{On} \cdot T_n / \eta_n}$ $= \frac{1}{K_0 + K_1 / \eta_1 + \dots + K_n / \eta_n}$ $K_0 = P_{l0} \cdot T_0 / \sum (P_{Oi} \cdot T_i)$ $K_i = P_{Oi} \cdot T_i / \sum (P_{Oi} \cdot T_i), \sum K_i = 1$		N/A
	If the load profile and its duration curve are given as shown in figures C.2 and C.3, equation (C.3) can be rewritten as follows: $\eta_{WT} = \frac{1}{K_0 + 1T_1 / T_{WT} / \eta_{1/4} + 2T_2 / T_{WT} / \eta_{2/4} + 3T_3 / T_{WT} / \eta_{3/4} + 4T_4 / T_{WT} / \eta_{4/4}} \geq \eta_{ER}$		N/A
Annex D	Derivation of efficiency tolerance		P

Table 1		Efficiency measurement before the environment test						--	
Model: C6-70K-T12-LV									
Ambient temperature: 25°C									
Standby loss power: 20W									
Total load,% of rated VA		5	10	20	30	50	75	100	
V _m ppm ax	P _{ac} /P _{ac,r} [%]		4.718	9.552	19.257	29.181	50.097	75.391	100.821
	Output efficiency								
	V _{ac} [V]	L1	127.01	127.03	127.06	127.10	127.28	127.48	127.70
		L2	127.14	127.14	127.18	127.21	127.39	127.55	127.73
		L3	126.90	126.92	126.95	127.01	127.22	127.45	127.71
	I _{ac} [A]	L1	8.660	17.448	35.273	53.388	91.608	137.782	184.210
		L2	9.324	17.863	35.562	53.843	92.287	138.653	184.765
		L3	9.025	17.910	35.587	53.917	92.258	138.260	184.482
	P _{op} [W]		3334.73	6700.02	13484.7 7	20429.42	35069.9 9	52785.38	70597.92
	PF		0.991	0.998	1.000	1.000	1.000	1.000	1.000
	V _{dc} [V]		845.49	847.14	847.57	846.92	847.66	846.48	848.32
	I _{dc} [A]		4.606	8.605	17.000	25.246	43.081	65.243	87.712
	P _{ip} [W]		3791.86	7246.24	14378.9 1	21204.00	36272.8 5	54116.29	72876.61
	η _{par} [%]		87.94	92.46	93.78	96.35	96.68	97.54	96.87
	Power efficiency								
	P _{aAC} [W]		3302.91	6686.60	13479.6 8	20426.63	35067.5 8	52773.44	70574.81
	P _{aDC} [W]		3791.86	7246.24	14378.9 1	21204.00	36272.8 5	54116.29	72876.61
	η _P [%]		87.11	92.28	93.75	96.33	96.68	97.52	96.84
	Conversion factor								
	P _{fAC} [W]		3300.07	6684.21	13475.3 9	20420.62	35055.3 6	52751.36	70555.09
	P _{fDC} [VA]		3791.86	7246.24	14378.9 1	21204.00	36272.8 5	54116.29	72876.61
	η _C [%]		87.03	92.24	93.72	96.31	96.64	97.48	96.81
	Energy efficiency								
	W _o [W _h](3min)		164.806	336.437	683.648	1044.092	1743.85 2	2611.532	3482.752
	W _i [W _h] ()		187.006	365.835	728.197	1082.123	1794.81 4	2681.182	3584.224
	η _E =(W _o /W _i)×10 0		88.13	91.96	93.88	96.49	97.16	97.40	97.17
Total load,% of rated VA		5	10	20	30	50	75	100	
V _{dc} , nominal	P _{ac} /P _{ac,r} [%]		4.858	9.973	19.977	28.692	49.743	75.825	100.393
	Output efficiency								
	V _{ac} [V]	L1	127.01	127.03	127.11	127.09	127.27	127.48	127.63
		L2	127.14	127.14	127.19	127.21	127.39	127.55	127.72
		L3	126.90	126.93	126.99	127.01	127.19	127.41	127.66
	I _{ac} [A]	L1	8.728	18.175	36.492	52.417	90.908	138.670	183.304

		L2	9.377	18.437	36.761	52.947	91.617	139.061	184.127
		L3	9.110	18.659	36.962	52.968	91.525	139.164	183.657
	P _{op} [W]		3418.36	6988.75	13986.0 ₈	20086.30	34823.6 ₂	53089.81	70306.08
	PF		0.995	0.999	1.000	1.000	1.000	1.000	1.000
	V _{dc} [V]		594.50	596.91	596.51	575.27	598.14	598.25	598.15
	I _{dc} [A]		6.766	12.783	26.212	40.675	61.292	91.901	121.837
	P _{ip} [W]		3780.25	7514.53	14984.6 ₇	20888.57	35867.7 ₅	54494.66	72509.07
	η _{par} [%]		90.43	93.00	93.34	96.16	97.09	97.42	96.96
	Power efficiency								
	P _{aAC} [W]		3400.66	6981.33	13983.8 ₈	20084.18	34820.2 ₅	53077.63	70274.80
	P _{aDC} [W]		3780.25	7514.53	14984.6 ₇	20888.57	35867.7 ₅	54494.66	72509.07
	η _p [%]		89.96	92.90	93.32	96.15	97.08	97.40	96.92
	Conversion factor								
	P _{fAC} [W]		3399.07	6980.24	13981.6 ₈	20080.30	34811.3 ₂	53063.89	70258.75
	P _{fDC} [VA]		3780.25	7514.53	14984.6 ₇	20888.57	35867.7 ₅	54494.66	72509.07
	η _c [%]		89.92	92.89	93.31	96.13	97.05	97.37	96.90
	Energy efficiency								
	W _o [W _h](3min.)		164.489	344.218	677.015	1041.779	1739.94 ₇	2611.035	3474.275
	W _i [W _h] (3min.)		181.821	374.332	718.591	1079.218	1790.11 ₇	2680.013	3575.194
	η _E =(W _o /W _i)×10 ₀		90.47	91.96	94.21	96.53	97.20	97.43	97.18
Total load,% of rated VA		5	10	20	30	50	75	100	
V _{mp} pmin	P _{ac} /P _{ac,r} [%]		4.738	9.782	19.391	30.290	49.943	75.231	100.054
	Output efficiency								
	V _{ac} [V]	L1	127.04	127.04	127.08	127.21	127.29	127.51	127.74
		L2	127.17	127.16	127.19	127.33	127.40	127.58	127.75
		L3	126.94	126.96	126.99	127.12	127.23	127.51	127.74
	I _{ac} [A]	L1	8.566	17.832	35.425	55.356	91.396	137.560	182.821
		L2	9.220	18.098	35.714	55.711	91.675	137.934	183.104
		L3	8.921	18.281	35.857	55.941	92.021	137.991	183.016
	P _{op} [W]		3339.44	6855.25	13575.8 ₅	21204.78	34963.0 ₀	52677.40	70061.43
	PF		0.995	0.999	1.000	1.000	1.000	1.000	1.000
	V _{dc} [V]		512.52	517.59	517.26	518.51	518.64	518.40	518.43
	I _{dc} [A]		9.729	15.982	32.224	45.454	76.854	109.573	143.347
	P _{ip} [W]		3656.22	7420.12	14510.2 ₃	22027.18	36045.0 ₁	54071.10	72122.71

$\eta_{\text{par}}[\%]$	91.34	92.39	93.56	96.27	97.00	97.42	97.14
Power efficiency							
$P_{\text{aAC}} [\text{W}]$	3316.83	6847.62	13573.4 ₁	21203.07	34959.7 ₆	52662.04	70037.55
$P_{\text{aDC}} [\text{W}]$	3656.22	7420.12	14510.2 ₃	22027.18	36045.0 ₁	54071.10	72122.71
$\eta_{\text{P}}[\%]$	90.72	92.28	93.54	96.26	96.99	97.39	97.11
Conversion factor							
$P_{\text{fAC}} [\text{W}]$	3314.88	6845.97	13571.2 ₅	21198.67	34952.6 ₂	52647.37	70031.52
$P_{\text{fDC}} [\text{VA}]$	3656.22	7420.12	14510.2 ₃	22027.18	36045.0 ₁	54071.10	72122.71
$\eta_{\text{C}}[\%]$	90.66	92.26	93.53	96.24	96.97	97.37	97.10
Energy efficiency							
$W_o [W_h](3\text{min.})$	164.034	340.532	672.380	1033.358	1739.01 ₂	2620.723	3491.159
$W_i [W_h] (3\text{min.})$	180.337	367.090	716.702	1079.134	1789.24 ₂	2690.065	3595.067
$\eta_E = (W_o/W_i) \times 100$	90.96	92.77	93.82	95.76	97.19	97.42	97.11
Note: η_R is the rated output efficiency. η_{par} is the partial output efficiency. η_E is the energy efficiency. *) see test report CN22DVK5 001 attachment 1							

Table 2		Efficiency measurement before the environment test						--	
Model: C6-60K-T9-LV									
Ambient temperature: 25°C									
Standby loss power: 20W									
Total load,% of rated VA		5	10	20	30	50	75	100	
V _m ppm ax	P _{ac} /P _{ac,r} [%]		5.163	10.073	19.706	30.349	49.961	75.302	100.471
	Output efficiency								
	V _{ac} [V]	L1	127.02	127.04	127.08	127.11	127.28	127.48	127.60
		L2	127.16	127.16	127.19	127.22	127.39	127.54	127.61
		L3	126.92	126.95	126.98	127.04	127.24	127.49	127.57
	I _{ac} [A]	L1	8.149	15.736	31.023	47.567	78.272	117.945	157.410
		L2	8.832	16.208	31.260	48.037	78.922	118.695	158.043
		L3	8.475	16.247	31.274	48.016	78.905	118.429	157.768
	P _{op} [W]		3134.43	6059.78	11830.08	18212.39	29978.71	45184.40	60295.84
	PF		0.989	0.998	1.000	1.000	1.000	1.000	1.000
	V _{dc} [V]		847.10	848.50	848.03	847.63	838.96	847.40	847.00
	I _{dc} [A]		4.168	7.747	14.933	22.347	37.255	55.071	73.684

	P_{ip} [W]		3471.37	6521.16	12628.68	18908.40	30969.69	46425.11	62132.38
	η_{par} [%]		90.29	92.92	93.68	96.32	96.80	97.33	97.04
	Power efficiency								
	P_{aAC} [W]		3097.76	6043.95	11823.85	18209.56	29976.81	45181.16	60282.42
	P_{aDC} [W]		3471.37	6521.16	12628.68	18908.40	30969.69	46425.11	62132.38
	η_P [%]		89.24	92.68	93.63	96.30	96.79	97.32	97.02
	Conversion factor								
	P_{fAC} [W]		3094.88	6041.44	11819.09	18204.86	29967.55	45165.68	60260.95
	P_{fDC} [VA]		3471.37	6521.16	12628.68	18908.40	30969.69	46425.11	62132.38
	η_C [%]		89.15	92.64	93.59	96.28	96.76	97.29	96.99
	Energy efficiency								
	W_o [W _h](3min)		150.284	297.508	597.196	911.306	1535.684	2288.702	2985.984
	W_i [W _h] ()		166.315	318.931	637.650	942.604	1590.499	2354.594	3078.694
	$\eta_E = (W_o/W_i) \times 100$		90.36	93.28	93.66	96.68	96.55	97.20	96.99
	Total load, % of rated VA		5	10	20	30	50	75	100
	$P_{ac}/P_{ac,r}$ [%]		4.882	9.948	19.775	30.034	49.820	75.660	100.260
	Output efficiency								
V _{dc} , nominal	V _{ac} [V]	L1	127.01	127.02	127.05	127.10	127.28	127.46	127.58
		L2	127.13	127.13	127.15	127.21	127.38	127.55	127.60
		L3	126.88	126.91	126.94	127.03	127.22	127.42	127.58
	I _{ac} [A]	L1	7.583	15.546	30.994	47.029	78.043	118.509	157.073
		L2	8.284	15.934	31.263	47.442	78.533	119.099	157.637
		L3	7.921	15.930	31.409	47.582	78.713	119.013	157.342
	P_{op} [W]		2966.77	5984.76	11871.54	18024.10	29893.79	45401.66	60175.89
	PF		0.988	0.997	0.999	1.000	1.000	1.000	1.000
	V _{dc} [V]		598.18	597.57	598.71	599.19	598.33	598.70	598.10
	I _{dc} [A]		6.152	11.047	21.317	31.832	51.907	78.134	103.960
	P_{ip} [W]		3311.70	6431.05	12667.60	18669.72	30830.84	46639.87	62055.06
	η_{par} [%]		89.58	93.06	93.72	96.54	96.96	97.35	96.97
	Power efficiency								
	P_{aAC} [W]		2929.09	5968.66	11864.80	18020.18	29891.95	45396.18	60156.12
	P_{aDC} [W]		3311.70	6431.05	12667.60	18669.72	30830.84	46639.87	62055.06
	η_P [%]		88.45	92.81	93.66	96.52	96.95	97.33	96.94
	Conversion factor								
	P_{fAC} [W]		2928.72	5967.77	11862.99	18017.36	29885.96	45385.17	60139.81
	P_{fDC} [VA]		3311.70	6431.05	12667.60	18669.72	30830.84	46639.87	62055.06
	η_C [%]		88.44	92.80	93.65	96.51	96.94	97.31	96.91
	Energy efficiency								
	W_o [W _h](3min.)		153.293	296.447	604.140	903.616	1526.076	2290.984	2950.862
	W_i [W _h] (3min.)		171.464	320.247	645.169	932.540	1568.230	2348.590	3046.922

	$\eta_E = (W_o/W_i) \times 100$	89.40	92.57	93.64	96.90	97.31	97.55	96.85
Total load, % of rated VA		5	10	20	30	50	75	100
V _{mp} pmin	P _{ac} /P _{ac,r} [%]	4.812	10.036	20.116	30.437	50.852	75.172	100.192
	Output efficiency							
	V _{ac} [V]	L1	127.01	127.02	127.06	127.11	127.30	127.53
		L2	127.13	127.13	127.16	127.18	127.35	127.52
		L3	126.88	126.92	126.95	127.01	127.31	127.47
	I _{ac} [A]	L1	7.573	15.682	31.517	47.641	79.654	117.711
		L2	8.268	16.065	31.803	48.093	80.140	118.279
		L3	7.903	16.071	31.942	48.240	80.306	118.237
	P _{op} [W]	2934.60	6037.64	12076.40	18266.82	30513.08	45107.31	60127.55
	PF	0.990	0.997	0.999	1.000	1.000	1.000	1.000
	V _{dc} [V]	505.96	518.99	519.54	517.89	518.66	518.00	518.65
	I _{dc} [A]	8.843	14.249	25.770	37.500	62.778	91.101	120.914
	P _{ip} [W]	3192.63	6502.18	12856.36	18976.32	31439.15	46315.81	61923.60
	η _{par} [%]	91.92	92.86	93.93	96.26	97.05	97.39	97.10
	Power efficiency							
	P _{aAC} [W]	2887.10	6021.63	12069.39	18262.21	30511.33	45103.07	60115.34
	P _{aDC} [W]	3192.63	6502.18	12856.36	18976.32	31439.02	46315.81	61923.60
	η _p [%]	90.43	92.61	93.88	96.24	97.05	97.38	97.08
	Conversion factor							
	P _{fAC} [W]	2883.82	6020.70	12067.46	18258.58	30505.66	45093.48	60105.72
	P _{fDC} [VA]	3192.63	6502.18	12856.36	18976.32	31439.02	46315.81	61923.60
	η _c [%]	90.33	92.60	93.86	96.22	97.03	97.36	97.06
	Energy efficiency							
	W _o [W _h] (3min.)	142.005	304.634	608.622	909.182	1533.446	2301.794	2964.806
	W _i [W _h] (3min.)	156.956	329.982	651.226	939.892	1574.642	2354.834	3052.700
	η _E = (W _o /W _i) × 100	90.47	92.32	93.46	96.73	97.38	97.75	97.12
Note: η _R is the rated output efficiency. η _{par} is the partial output efficiency. η _E is the energy efficiency. *) see test report CN22DVK5 001 attachment 1								

Table 3		Efficiency measurement before the environment test						--	
Model: C6-50K-T6-LV									
Ambient temperature: 25°C									
Standby loss power: 20W									
Total load,% of rated VA		5	10	20	30	50	75	100	
V _m ppm ax	P _{ac} /P _{ac,r} [%]		4.893	9.868	19.528	30.207	50.560	75.090	100.864
	Output efficiency								
	V _{ac} [V]	L1	127.02	127.03	127.06	127.08	127.23	127.31	127.49
		L2	127.13	127.15	127.16	127.19	127.35	127.39	127.54
		L3	126.90	126.93	126.96	127.00	127.18	127.32	127.49
	I _{ac} [A]	L1	6.543	12.821	25.572	39.490	66.053	98.139	131.776
		L2	7.248	13.410	25.804	39.814	66.504	98.640	132.288
		L3	6.836	13.314	26.020	39.856	66.673	98.742	132.192
	P _{op} [W]		2494.80	4955.44	9772.93	15106.28	25281.65	37547.39	50436.95
	PF		0.982	0.996	0.999	1.000	1.000	1.000	1.000
	V _{dc} [V]		845.39	843.66	847.89	848.29	844.97	841.42	845.81
	I _{dc} [A]		3.360	6.351	12.320	18.493	31.593	46.098	61.658
	P _{ip} [W]		2770.95	5312.21	10411.70	15657.99	26060.17	38595.71	51946.78
	η _{par} [%]		90.03	93.28	93.86	96.48	97.01	97.28	97.09
	Power efficiency								
	P _{aAC} [W]		2446.66	4933.89	9763.85	15103.43	25279.94	37544.88	50431.76
	P _{aDC} [W]		2770.95	5312.21	10411.70	15657.99	26060.17	38595.71	51946.78
	η _p [%]		88.30	92.88	93.78	96.46	97.01	97.28	97.08
	Conversion factor								
	P _{fAC} [W]		2444.85	4931.25	9761.83	15100.78	25272.98	37531.71	50414.31
	P _{fDC} [VA]		2770.95	5312.21	10411.70	15657.99	26060.17	38595.71	51946.78
	η _C [%]		88.23	92.83	93.76	96.44	96.98	97.24	97.05
	Energy efficiency								
	W _o [W _h](3min)		123.354	252.401	500.401	750.256	1293.374	1890.490	2530.022
	W _i [W _h] ()		138.815	270.718	531.389	777.006	1338.896	1942.936	2609.636
	η _E =(W _o /W _i)×10 0		88.86	93.23	94.17	96.56	96.60	97.30	96.95
Total load,% of rated VA		5	10	20	30	50	75	100	
V _{dc} , nominal	P _{ac} /P _{ac,r} [%]		4.956	9.568	19.628	30.349	50.204	76.098	101.066
	Output efficiency								
	V _{ac} [V]	L1	127.01	127.04	127.06	127.10	127.25	127.33	127.50
		L2	127.13	127.15	127.17	127.19	127.35	127.40	127.55
		L3	126.90	126.95	126.97	127.02	127.20	127.34	127.52
	I _{ac} [A]	L1	6.460	12.353	25.696	39.571	65.509	99.384	131.913
		L2	7.149	12.947	25.948	39.983	65.991	99.904	132.515
		L3	6.744	12.823	26.084	40.069	66.158	99.960	132.353

	P _{op} [W]		2522.62	4805.89	9822.25	15178.87	25103.62	38051.86	50541.77
	PF		0.983	0.996	0.999	1.000	1.000	1.000	1.000
	V _{dc} [V]		597.67	1195.02	599.04	599.03	598.72	598.88	599.12
	I _{dc} [A]		4.817	9.113	17.719	26.450	43.601	65.541	87.095
	P _{ip} [W]		2803.78	5225.64	10505.85	15767.84	25834.97	39091.83	52036.31
	η _{par} [%]		89.97	91.97	93.49	96.26	97.17	97.34	97.13
	Power efficiency								
	P _{aAC} [W]		2478.01	4784.19	9814.02	15174.32	25101.83	38048.92	50533.03
	P _{aDC} [W]		2803.78	5225.64	10505.85	15767.84	25834.97	39091.83	52036.31
	η _p [%]		88.38	91.55	93.41	96.24	97.16	97.33	97.11
	Conversion factor								
	P _{fAC} [W]		2477.13	4783.38	9813.03	15172.39	25098.30	38040.33	50520.57
	P _{fDC} [VA]		2803.78	5225.64	10505.85	15767.84	25834.97	39091.83	52036.31
	η _c [%]		88.35	91.54	93.41	96.22	97.15	97.31	97.09
	Energy efficiency								
	W _o [W _h] (3min.)		124.334	254.512	499.404	750.180	1274.324	1874.390	2482.760
	W _i [W _h] (3min.)		140.070	277.421	532.084	773.844	1304.196	1926.950	2560.066
	η _E =(W _o /W _i)×10 ₀		88.77	91.74	93.86	96.94	97.71	97.27	96.98
	Total load,% of rated VA		5	10	20	30	50	75	100
V _{mp} pmin	P _{ac} /P _{ac,r} [%]		5.069	9.692	19.658	29.704	49.394	74.782	101.051
	Output efficiency								
	V _{ac} [V]	L1	127.03	127.05	127.08	127.10	127.25	127.34	127.51
		L2	127.15	127.16	127.17	127.18	127.36	127.42	127.58
		L3	126.92	126.95	126.98	127.00	127.19	127.31	127.52
	I _{ac} [A]	L1	6.599	12.512	25.728	38.748	64.474	97.707	131.932
		L2	7.310	13.115	25.980	39.126	64.862	98.091	132.431
		L3	6.893	12.979	26.117	39.222	65.113	98.278	132.338
	P _{op} [W]		2580.42	4868.85	9837.89	14857.70	24698.47	37393.04	50532.56
	PF		0.983	0.996	0.999	1.000	1.000	1.000	1.000
	V _{dc} [V]		518.82	1034.08	518.14	517.47	518.39	517.69	518.35
	I _{dc} [A]		6.401	12.156	21.501	33.808	51.777	81.293	106.081
	P _{ip} [W]		2824.33	5223.42	10526.93	15419.34	25447.80	38411.07	52143.71
	η _{par} [%]		91.36	93.21	93.45	96.36	97.06	97.35	96.91
	Power efficiency								
	P _{aAC} [W]		2534.44	4845.95	9828.98	14852.24	24696.88	37390.99	50525.56
	P _{aDC} [W]		2824.33	5223.42	10526.93	15419.34	25447.80	38411.07	52143.71
	η _p [%]		89.74	92.77	93.37	96.32	97.05	97.34	96.90
	Conversion factor								
	P _{fAC} [W]		2532.77	4844.14	9827.19	14849.49	24692.80	37384.30	50516.81
	P _{fDC} [VA]		2824.33	5223.42	10526.93	15419.34	25447.80	38411.07	52143.71

$\eta_c[\%]$	89.68	92.74	93.35	96.30	97.03	97.33	96.88
Energy efficiency							
$W_o [W_h](3min.)$	126.278	257.903	506.988	1405.976	1283.392	1860.572	2480.668
$W_i [W_h] (3min.)$	138.956	277.130	538.890	1464.745	1313.084	1911.830	2557.786
$\eta_E = (W_o/W_i) \times 100$	90.88	93.06	94.08	95.99	97.74	97.32	96.98
Note: η_R is the rated output efficiency. η_{par} is the partial output efficiency. η_E is the energy efficiency. *) see test report CN22DVK5 001 attachment 1							

Table 4		Efficiency measurement after the environment test					--		
Model: C6-70K-T12-LV									
Ambient temperature: 25°C									
Standby loss power: 20W									
Total load,% of rated VA		5	10	20	30	50	75	100	
V _{mp} max	P _{ac} /P _{ac,r} [%]		5.094	10.063	19.811	29.362	50.958	75.574	100.218
	Output efficiency								
	V _{ac} [V]	L1	127.01	127.02	127.06	127.10	127.28	127.48	127.69
		L2	127.14	127.14	127.17	127.21	127.39	127.55	127.72
		L3	126.90	126.92	126.94	127.06	127.19	127.40	127.69
	I _{ac} [A]	L1	9.309	18.411	36.280	53.728	93.228	138.231	183.136
		L2	9.968	18.797	36.571	54.153	93.834	138.858	183.688
		L3	9.703	18.831	36.613	54.247	93.857	138.672	183.359
	P _{op} [W]		3596.10	7056.86	13872.64	20555.89	35672.69	52913.8 2	70178.22
	PF		0.992	0.998	1.000	1.000	1.000	1.000	1.000
	V _{dc} [V]		847.90	846.62	847.81	847.77	847.21	847.56	844.02
	I _{dc} [A]		4.791	9.003	17.396	25.217	43.736	66.632	86.799
	P _{ip} [W]		4012.20	7581.11	14718.82	21345.18	36798.71	54503.1 5	72315.91
	η _{par} [%]		89.63	93.08	94.25	96.30	96.94	97.08	97.04
	Power efficiency								
	P _{aAC} [W]		3565.66	7044.06	13867.45	20553.10	35670.56	52901.7 9	70152.33
	P _{aDC} [W]		4012.20	7581.11	14718.82	21345.18	36798.71	54503.1 5	72315.91
	η _P [%]		88.87	92.92	94.22	96.29	96.93	97.06	97.01
	Conversion factor								
	P _{fAC} [W]		3562.31	7041.54	13862.58	20546.66	35658.44	52878.0 9	70128.91
	P _{fDC} [VA]		4012.20	7581.11	14718.82	21345.18	36798.71	54503.1 5	72315.91
	η _C [%]		88.79	92.88	94.18	96.26	96.90	97.02	96.98
	Energy efficiency								
	W _o [W _h](3min.)		165.355	336.422	688.322	1043.450	1743.026	2611.95 2	3489.080
	W _i [W _h] (3min.)		185.197	365.627	727.864	1081.017	1793.757	2682.08 5	3591.343
	η _E =(W _o /W _i)×100		89.29	92.01	94.57	96.52	97.17	97.39	97.15
Total load,% of rated VA		5	10	20	30	50	75	100	
	P _{ac} /P _{ac,r} [%]	4.999	9.968	19.515	30.861	49.382	74.928	100.549	

V _{dc} , nomin al	Output efficiency								
	V _{ac} [V]	L1	127.01	127.03	127.06	127.21	127.29	127.48	127.70
		L2	127.14	127.14	127.17	127.33	127.39	127.55	127.71
		L3	126.91	126.94	126.98	127.15	127.24	127.50	127.74
	I _{ac} [A]	L1	9.033	18.179	35.644	56.373	90.278	136.915	183.713
		L2	9.707	18.493	35.991	56.820	90.811	137.549	184.168
		L3	9.414	18.658	36.094	56.972	90.923	137.406	183.853
	P _{op} [W]		3530.90	6991.69	13665.90	21605.51	34569.61	52457.9 1	70410.61
	PF		0.991	0.998	1.000	1.000	1.000	1.000	1.000
	V _{dc} [V]		597.73	598.15	597.91	598.80	598.81	598.40	598.76
	I _{dc} [A]		7.385	12.826	24.561	37.938	61.470	90.835	121.774
	P _{ip} [W]		3969.64	7537.68	14607.84	22377.32	35893.03	53841.6 4	72559.53
	η _{par} [%]		88.95	92.76	93.55	96.55	96.31	97.43	97.04
	Power efficiency								
	P _{aAC} [W]		3499.26	6977.79	13660.46	21602.96	34567.64	52449.9 5	70384.58
	P _{aDC} [W]		3969.64	7537.68	14607.84	22377.32	35893.03	53841.6 4	72559.53
	η _P [%]		88.15	92.57	93.51	96.54	96.31	97.42	97.00
	Conversion factor								
	P _{fAC} [W]		3497.12	6976.45	13658.37	21599.58	34560.33	52439.7 4	70372.65
	P _{fDC} [VA]		3969.64	7537.68	14607.84	22377.32	35893.03	53841.6 4	72559.53
	η _C [%]		88.10	92.55	93.50	96.52	96.29	97.40	96.99
	Energy efficiency								
	W _o [W _h](3min.)		164.963	344.229	676.727	1039.222	1740.535	2617.66 4	3482.766
	W _i [W _h] (3min.)		183.927	371.300	722.661	1076.474	1790.950	2685.58 5	3582.733
	η _E =(W _o /W _i)×1 00		89.69	92.71	93.64	96.54	97.18	97.47	97.21
	Total load,% of rated VA		5	10	20	30	50	75	100
V _{mpp} min	P _{ac} /P _{ac,r} [%]		4.831	10.309	19.248	29.970	51.099	75.404	100.979
	Output efficiency								
	V _{ac} [V]	L1	127.01	127.02	127.05	127.13	127.28	127.47	127.70
		L2	127.13	127.12	127.15	127.26	127.38	127.55	127.71
		L3	126.88	126.92	126.95	127.11	127.22	127.48	127.73
	I _{ac} [A]	L1	8.778	18.807	35.152	54.785	93.446	137.863	184.516
		L2	9.447	19.100	35.507	55.191	93.943	138.417	184.981
		L3	9.148	19.305	35.622	55.355	94.092	138.223	184.589
	P _{op} [W]		3405.88	7229.40	13478.45	20981.49	35771.39	52789.9 9	70710.16

	PF	0.994	0.998	1.000	1.000	1.000	1.000	1.000
	V _{dc} [V]	509.10	518.33	518.63	518.93	519.19	518.53	518.44
	I _{dc} [A]	9.818	16.507	28.759	45.014	77.986	109.604	144.683
	P _{ip} [W]	3730.40	7756.27	14403.73	21832.48	36775.38	54173.7 ₂	72882.27
	η _{par} [%]	91.30	93.21	93.58	96.10	97.27	97.45	97.02
	Power efficiency							
	P _{aAC} [W]	3381.80	7216.19	13473.41	20979.03	35769.20	52782.8 ₇	70685.46
	P _{aDC} [W]	3730.40	7756.27	14403.73	21832.48	36775.38	54173.7 ₂	72882.27
	η _P [%]	90.66	93.04	93.54	96.09	97.26	97.43	96.99
	Conversion factor							
	P _{fAC} [W]	3391.42	7215.27	13472.00	20975.64	35761.90	52773.7 ₄	70672.88
	P _{fDC} [VA]	3730.40	7756.27	14403.73	21832.48	36775.38	54173.7 ₂	72882.27
	η _c [%]	90.91	93.03	93.53	96.08	97.24	97.42	96.97
	Energy efficiency							
	W _o [W _h](3min.)	163.879	341.196	689.315	1039.742	1743.869	2610.50 ₃	3466.267
	W _i [W _h] (3min.)	178.427	362.484	735.048	1077.573	1795.934	2678.70 ₄	3564.617
	η _E =(W _o /W _i)×100	91.85	94.13	93.78	96.49	97.10	97.45	97.24
Note: η _R is the rated output efficiency. η _{par} is the partial output efficiency. η _E is the energy efficiency. *) see test report CN22DVK5 001 attachment 1								

Table 5		Efficiency measurement after the environment test					--		
Model: C6-60K-T9-LV									
Ambient temperature: 25°C									
Standby loss power: 20W									
Total load,% of rated VA		5	10	20	30	50	75	100	
V _{mp} max	P _{ac} /P _{ac,r} [%]		5.188	10.157	19.743	30.458	49.351	74.865	100.441
	Output efficiency								
	V _{ac} [V]	L1	127.02	127.03	127.07	127.11	127.27	127.47	127.58
		L2	127.15	127.16	127.18	127.22	127.39	127.54	127.61
		L3	126.91	126.94	126.96	127.02	127.20	127.43	127.58
	I _{ac} [A]	L1	8.176	15.853	31.084	47.755	77.368	117.312	157.355
		L2	8.870	16.340	31.312	48.168	77.874	117.910	158.059
		L3	8.524	16.395	31.337	48.223	78.016	117.851	157.707

	P _{op} [W]		3148.80	6110.43	11852.45	18277.69	29612.45	44922.16	60286.15
	PF		0.989	0.998	0.999	1.000	1.000	1.000	1.000
	V _{dc} [V]		846.28	846.45	848.36	848.19	847.88	836.70	843.72
	I _{dc} [A]		4.187	7.793	14.956	22.351	36.259	55.327	73.859
	P _{ip} [W]		3486.84	6554.01	12655.33	18926.03	30547.34	46107.26	62056.64
	η _{par} [%]		90.31	93.23	93.66	96.57	96.94	97.43	97.15
	Power efficiency								
	P _{aAC} [W]		3112.88	6094.28	11845.86	18274.54	29610.84	44919.24	60264.87
	P _{aDC} [W]		3486.84	6554.01	12655.33	18926.03	30547.34	46107.26	62056.64
	η _P [%]		89.28	92.99	93.60	96.56	96.93	97.42	97.11
	Conversion factor								
	P _{fAC} [W]		3110.69	6091.40	11841.00	18270.06	29601.74	44905.14	60238.72
	P _{fDC} [VA]		3486.84	6554.01	12655.33	18926.03	30547.34	46107.26	62056.64
	η _C [%]		89.21	92.94	93.57	96.53	96.90	97.39	97.07
	Energy efficiency								
	W _o [W _h](3min.)		151.244	293.310	604.582	905.362	1496.506	2263.766	2951.250
	W _i [W _h] (3min.)		167.449	314.531	644.263	936.810	1539.392	2323.884	3034.790
	η _E =(W _o /W _i)×100		90.32	93.25	93.84	96.64	97.21	97.41	97.25
	Total load, % of rated VA		5	10	20	30	50	75	100
V _{dc, nominal}	P _{ac} /P _{ac,r} [%]		4.862	9.918	19.774	30.449	49.266	75.635	100.466
	Output efficiency								
	V _{ac} [V]	L1	127.02	127.03	127.06	127.10	127.27	127.46	127.58
		L2	127.15	127.16	127.18	127.21	127.37	127.53	127.58
		L3	126.90	126.93	126.96	127.01	127.20	127.46	127.57
	I _{ac} [A]	L1	7.560	15.486	30.985	47.668	77.177	118.482	157.410
		L2	8.250	15.905	31.267	48.111	77.688	119.047	157.934
		L3	7.886	15.868	31.397	48.250	77.839	118.958	157.711
	P _{op} [W]		2955.08	5968.09	11870.65	18272.02	29561.92	45384.88	60294.34
	PF		0.988	0.997	1.000	1.000	1.000	1.000	1.000
	V _{dc} [V]		598.05	598.04	597.88	598.87	598.27	598.41	597.53
	I _{dc} [A]		6.142	11.017	21.278	32.331	51.276	78.103	104.054
	P _{ip} [W]		3301.71	6423.88	12637.86	18975.13	30448.91	46593.72	62054.16
	η _{par} [%]		89.50	92.90	93.93	96.29	97.09	97.41	97.16
	Power efficiency								
	P _{aAC} [W]		2917.27	5951.07	11864.23	18269.27	29559.88	45380.70	60279.82
	P _{aDC} [W]		3301.71	6423.88	12637.86	18975.13	30448.91	46593.72	62054.16
	η _P [%]		88.36	92.64	93.88	96.28	97.08	97.40	97.14
	Conversion factor								
	P _{fAC} [W]		2916.63	5949.63	11862.60	18267.57	29553.40	45371.95	60267.17

	P _{fDC} [VA]		3301.71	6423.88	12637.86	18975.13	30448.91	46593.72	62054.16
	η _{cl} [%]		88.34	92.62	93.87	96.27	97.06	97.38	97.12
	Energy efficiency								
	W _o [W _h](3min.)		153.048	293.310	604.582	908.254	1506.794	2258.296	2951.250
	W _i [W _h] (3min.)		170.639	316.669	643.862	936.810	1544.244	2309.276	3034.790
	η _E =(W _o /W _i)×100		89.69	92.62	93.90	96.95	97.57	97.79	97.25
Total load,% of rated VA			5	10	20	30	50	75	100
V _{mpp} min	P _{ac} /P _{ac,r} [%]		4.913	9.896	19.926	30.431	50.897	75.784	100.610
	Output efficiency								
	V _{ac} [V]	L1	127.02	127.03	127.06	127.10	127.27	127.48	127.59
		L2	127.15	127.15	127.17	127.19	127.36	127.53	127.59
		L3	126.91	126.95	126.99	127.06	127.31	127.49	127.59
	I _{ac} [A]	L1	7.684	15.445	31.231	47.635	79.756	118.683	157.579
		L2	8.367	15.862	31.497	48.081	80.215	119.281	158.212
		L3	8.001	15.842	31.633	48.215	80.352	119.168	157.880
	P _{op} [W]		2985.58	5955.10	11961.79	18261.38	30540.29	45474.49	60382.81
	PF		0.990	0.997	1.000	1.000	1.000	1.000	1.000
	V _{dc} [V]		508.33	519.11	519.09	518.46	519.02	518.68	518.66
	I _{dc} [A]		9.178	14.065	25.538	37.477	62.805	91.778	121.617
	P _{ip} [W]		3337.45	6395.76	12727.59	18988.75	31458.25	46724.35	62282.29
	η _{par} [%]		89.46	93.11	93.98	96.17	97.08	97.33	96.95
	Power efficiency								
	P _{aAC} [W]		2948.05	5937.54	11955.87	18258.71	30538.43	45470.38	60365.99
	P _{aDC} [W]		3330.84	6395.75	12727.59	18988.75	31458.25	46724.35	62282.29
	η _P [%]		88.51	92.84	93.94	96.16	97.08	97.32	96.92
	Conversion factor								
	P _{fAC} [W]		2948.97	5935.51	11954.76	18256.81	30532.76	45461.97	60353.18
	P _{fDC} [VA]		3330.84	6395.75	12727.59	18988.75	31458.25	46724.35	62282.29
	η _{cl} [%]		88.54	92.80	93.93	96.15	97.06	97.30	96.90
	Energy efficiency								
	W _o [W _h](3min.)		149.879	295.880	604.510	903.012	1535.888	2300.392	2964.986
	W _i [W _h] (3min.)		168.221	317.726	641.757	931.450	1574.358	2354.700	3054.274
	η _E =(W _o /W _i)×100		89.10	93.12	94.20	96.95	97.56	97.69	97.08
Note:									
η _R is the rated output efficiency.									
η _{par} is the partial output efficiency.									
η _E is the energy efficiency.									
*) see test report CN22DVK5 001 attachment 1									

Table 6		Efficiency measurement after the environment test					--		
Model: C6-50K-T6-LV									
Ambient temperature: 25°C									
Standby loss power: 20W									
Total load,% of rated VA		5	10	20	30	50	75	100	
V _{mp} p _{max}	P _{ac} /P _{ac,r} [%]		4.889	9.973	19.638	29.708	50.371	75.326	99.967
	Output efficiency								
	V _{ac} [V]	L1	127.02	127.03	127.06	127.09	127.25	127.34	127.55
		L2	127.14	127.15	127.17	127.19	127.35	127.39	127.54
		L3	126.91	126.94	126.96	127.00	127.18	127.31	127.50
	I _{ac} [A]	L1	6.525	12.961	25.713	38.842	65.802	98.451	130.584
		L2	7.216	13.546	25.946	39.155	66.251	98.971	131.115
		L3	6.815	13.451	26.169	39.191	66.419	99.008	130.968
	P _{op} [W]		2491.42	5007.22	9827.03	14857.91	25187.32	37666.50	49989.84
	PF		0.982	0.996	0.999	1.000	1.000	1.000	1.000
	V _{dc} [V]		845.36	846.19	847.26	848.25	848.76	846.78	847.22
	I _{dc} [A]		3.416	6.397	12.399	18.247	31.080	45.960	61.028
	P _{ip} [W]		2818.16	5366.80	10469.25	15447.25	25988.46	38705.80	51482.43
	η _{par} [%]		88.41	93.30	93.87	96.18	96.92	97.31	97.10
	Power efficiency								
	P _{aAC} [W]		2444.53	4986.59	9818.78	14853.81	25185.38	37663.12	49983.38
	P _{aDC} [W]		2818.16	5366.80	10469.25	15447.25	25988.46	38705.80	51482.43
	η _p [%]		86.74	92.92	93.79	96.16	96.91	97.31	97.09
	Conversion factor								
	P _{fAC} [W]		2441.55	4984.40	9816.88	14850.00	25177.62	37648.99	49965.60
	P _{fDC} [VA]		2818.16	5366.80	10469.25	15447.25	25988.46	38705.80	51482.43
	η _c [%]		86.64	92.87	93.77	96.13	96.88	97.27	97.05
	Energy efficiency								
	W _o [W _h](3min.)		131.676	251.549	500.854	752.790	1275.604	1897.174	2525.598
	W _i [W _h] (3min.)		152.868	270.867	530.532	777.096	1311.306	1941.622	2599.112
	η _E =(W _o /W _i)×100		86.14	92.87	94.41	96.87	97.28	97.71	97.17
Total load,% of rated VA		5	10	20	30	50	75	100	
V _{dc} , nomi nal	P _{ac} /P _{ac,r} [%]		5.074	9.764	19.730	30.460	50.241	76.456	100.499
	Output efficiency								
	V _{ac} [V]	L1	127.01	127.02	127.05	127.08	127.24	127.34	127.54
		L2	127.13	127.14	127.15	127.18	127.34	127.40	127.55
		L3	126.90	126.93	126.96	127.00	127.20	127.34	127.50
	I _{ac} [A]	L1	6.607	12.606	25.836	39.724	65.567	99.836	131.166

		L2	7.299	13.212	26.070	40.128	66.029	100.371	131.766
		L3	6.898	13.089	26.223	40.224	66.216	100.446	131.608
	P _{op} [W]		2580.86	4904.21	9873.59	15234.62	25122.33	38230.07	50254.84
	PF		0.984	0.996	0.999	1.000	1.000	1.000	1.000
	V _{dc} [V]		598.90	597.44	597.96	598.16	598.27	598.18	598.54
	I _{dc} [A]		4.914	9.398	17.843	26.567	43.554	65.679	86.591
	P _{ip} [W]		2865.24	5297.57	10559.93	15817.87	25828.34	39127.51	51695.23
	η _{par} [%]		90.08	92.57	93.50	96.31	97.27	97.71	97.21
	Power efficiency								
	P _{aAC} [W]		2537.21	4882.00	9865.13	15229.92	25120.36	38228.11	50249.36
	P _{aDC} [W]		2865.24	5297.57	10559.93	15817.87	25828.34	39127.51	51695.23
	η _p [%]		88.55	92.16	93.42	96.28	97.26	97.70	97.20
	Conversion factor								
	P _{fAC} [W]		2536.78	4880.92	9863.57	15228.01	25116.97	38220.61	50239.68
	P _{fDC} [VA]		2865.24	5297.57	10559.93	15817.87	25828.34	39127.51	51695.23
	η _c [%]		88.54	92.13	93.41	96.27	97.25	97.68	97.18
	Energy efficiency								
	W _o [W _h](3min.)		124.908	257.265	501.091	749.690	1258.792	1888.086	2508.308
	W _i [W _h] (3min.)		140.009	277.575	537.649	774.348	1291.342	1929.214	2576.010
	η _E =(W _o /W _i)×10 ₀		89.21	92.68	93.20	96.82	97.48	97.87	97.37
Total load,% of rated VA		5	10	20	30	50	75	100	
V _{mp} pmin	P _{ac} /P _{ac,r} [%]		4.998	9.920	19.743	30.569	75.186	75.186	100.227
	Output efficiency								
	V _{ac} [V]	L1	127.02	127.03	127.06	127.09	127.36	127.36	127.55
		L2	127.14	127.15	127.16	127.18	127.40	127.40	127.55
		L3	126.90	126.94	126.97	127.01	127.33	127.33	127.52
	I _{ac} [A]	L1	6.515	12.816	25.842	39.854	98.164	98.164	130.803
		L2	7.216	13.398	26.092	40.270	98.712	98.712	131.408
		L3	6.806	13.285	26.233	40.372	98.772	98.772	131.224
	P _{op} [W]		2545.20	4980.78	9880.82	15288.97	37594.55	37594.55	50120.30
	PF		0.983	0.996	0.999	1.000	1.000	1.000	1.000
	V _{dc} [V]		518.63	518.26	519.21	518.50	517.88	517.88	518.55
	I _{dc} [A]		6.334	10.879	21.519	31.508	76.270	76.270	101.313
	P _{ip} [W]		2788.38	5336.52	10576.28	15872.10	38528.62	38528.62	51687.69
	η _{par} [%]		91.28	93.33	93.42	96.33	97.58	97.58	96.97
	Power efficiency								
	P _{aAC} [W]		2498.94	4960.14	9871.55	15284.54	37592.80	37592.80	50113.47
	P _{aDC} [W]		2788.38	5336.52	10576.28	15872.10	38528.62	38528.62	51687.69
	η _p [%]		89.62	92.95	93.34	96.30	97.57	97.57	96.95
Conversion factor									

P_{fAC} [W]	2497.74	4959.31	9869.63	15283.04	37584.80	37584.80	50102.66
P_{fDC} [VA]	2788.38	5336.52	10576.28	15872.10	38528.62	38528.62	51687.69
η_C [%]	89.58	92.93	93.32	96.29	97.55	97.55	96.93
Energy efficiency							
W_o [W_h](3min.)	123.503	254.687	498.320	758.630	1880.434	1880.434	2551.446
W_i [W_h] (3min.)	137.296	273.589	533.849	782.274	1921.008	1921.008	2617.044
$\eta_E = (W_o/W_i) \times 100$	89.95	93.09	93.34	96.98	97.89	97.89	97.49
Note: η_R is the rated output efficiency. η_{par} is the partial output efficiency. η_E is the energy efficiency. *) see test report CN22DVK5 001 attachment 1							

-End of report-

TEST REPORT IEC 60068 Environmental Testing

Report Number. : CN22DVK5 001 attachment 1

Date of issue..... : See cover page

Total number of pages : See cover page

Testing Laboratory : **TÜV Rheinland (Shenzhen) Co., Ltd.**

Address : 1601-1604, 17-18F, Tower A Building 2, Shenzhen International Innovation Valley, Dashi 1st Road, Xili Street, Xili Community, Nanshan District, Shenzhen 518052, P. R. China

Applicant's name..... : Guangzhou Sanjing Electric Co., Ltd.

Address..... : No.9, Lizhishan Road, Science City, Guangzhou High-tech Zone, Guanngdong P.R. China

Test specification:

Standard..... : IEC 60068-2-1: 2007
IEC 60068-2-2: 2007
IEC 60068-2-14: 2009
IEC 60068-2-30: 2005

Non-standard test method.....: N/A

Test Report Form No. : IEC 60068_A

Test Report Form(s) Originator.... : TÜV Rheinland Group

Master TRF..... : Dated 2013-12

Test item description..... :

Trade Mark : See report No. CN22DVK5 001

Manufacturer..... : See report No. CN22DVK5 001

Model/Type reference..... : See report No. CN22DVK5 001

Ratings..... : See report No. CN22DVK5 001

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



Copy of marking plate

See test report CN22DVK5 001.

Test item particulars	:
Classification of installation and use	:
Supply Connection	:
.....	:
Possible test case verdicts:	
- test case does not apply to the test object	: N/A
- test object does meet the requirement	: P (Pass)
- test object does not meet the requirement	: F (Fail)
Testing	:
Date of receipt of test item	: See cover page
Date (s) of performance of tests	: See cover page
General remarks:	
The test 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 Issuing testing laboratory. "(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report. Throughout this report a ☐ comma / ☒ point is used as the decimal separator. Determination of the test result includes consideration of measurement uncertainty from the test equipment and methods.	

General product information:

See test report CN22DVK5 001.

Summary of test:

All the tests are conducted on model C6-50K-T6-LV, C6-60K-T9-LV, C6-70K-T12-LV.

IEC 60068-2-1															
Clause	Requirement - Test	Result - Remark	Verdict												
5	Test description		P												
5.1	General Tests Ab, Ad, and Ae are similar. Differences are noted in 5.2.2, 5.3.2 and 5.4.2. All other portions of the test are the same, starting with Clause 6.		P												
5.2	Test Ab: Cold for non heat-dissipating specimens with gradual change of temperature		N/A												
5.3	Test Ad: Cold for heat-dissipating specimens with gradual change of temperature that are powered after initial temperature stabilization		N/A												
5.4	Test Ae: Cold for heat-dissipating specimens with gradual change of temperature that are required to be powered throughout the test		P												
6	Test procedure		P												
6.1	Confirmation of performance IEC 60068-3-5 provides guidance for the confirmation of performance of temperature test chambers.		P												
6.2	Working space The dimensions of the test sample shall be such that it is entirely within the working space of the test chamber. The temperature of incident air delivered to the test specimen shall be within ± 2 K of test severity temperature during the steady-state condition. The air temperature in the working space shall be measured in accordance with 4.5.		P												
6.3	Thermal radiation The ability of the specimen to transfer heat by thermal radiation shall be minimized.		P												
6.4	Specimen with artificial cooling The relevant specification shall define the characteristics of the coolant supplied to the specimen. When the coolant is air, care shall be taken that the air is not contaminated by oil and dry enough to avoid moisture problems.		P												
6.5	Mounting Thermal conduction and other relevant characteristics of the mounting and connections of the test specimen should be specified in the relevant specification. When the test specimen is intended for use with specific mounting devices, these shall be used for testing.		P												
6.6	Severities 6.6.1 Temperature <table border="1" data-bbox="342 1780 985 1862"> <tr> <td>- 65 °C</td><td>- 40 °C</td><td>- 20 °C</td><td>+ 5 °C</td></tr> <tr> <td>- 55 °C</td><td>- 33 °C</td><td>- 10 °C</td><td></td></tr> <tr> <td>- 50 °C</td><td>- 25 °C</td><td>- 5 °C</td><td></td></tr> </table>	- 65 °C	- 40 °C	- 20 °C	+ 5 °C	- 55 °C	- 33 °C	- 10 °C		- 50 °C	- 25 °C	- 5 °C		-25°C	P
- 65 °C	- 40 °C	- 20 °C	+ 5 °C												
- 55 °C	- 33 °C	- 10 °C													
- 50 °C	- 25 °C	- 5 °C													

IEC 60068-2-1								
Clause	Requirement - Test		Result - Remark	Verdict				
	6.6.2 Duration <table border="1"><tr><td>2 h</td><td>72 h</td></tr><tr><td>16 h</td><td>96 h</td></tr></table>		2 h	72 h	16 h	96 h	16 h	P
2 h	72 h							
16 h	96 h							
6.7	Preconditioning			P				
6.8	Initial measurements The initial state of the specimen shall be known. This may be achieved by visual inspection, and/or functional tests as required by the relevant specification.		Test according IEC 61683 was performed before the environment test, see test data table.	P				
6.9	Conditioning The specimen shall be exposed to the low temperature conditions for the duration, as detailed in the relevant specification.			P				
6.10	Intermediate measurements The relevant specification may call for loading and/or measurements during or at the end of conditioning while the specimen is still in the chamber.			P				
6.11	Final temperature ramp If the specimen remains in operating or loaded condition during the test, it shall be switched off or unloaded before the temperature is raised with the exception of Test Ae in which the specimen shall remain operational throughout the recovery period.			P				
6.12	Recovery The specimen shall be subjected to the recovery procedure in the chamber or otherwise, as deemed suitable. Appropriate steps may be taken to remove droplets of water, as required, without damaging the specimen.			P				
6.13	Final measurements The specimen shall be visually inspected and such performance checks made as are required by the relevant specification.		Test according IEC 61683 was performed after the environment test, see test data table.	P				

IEC 60068-2-2

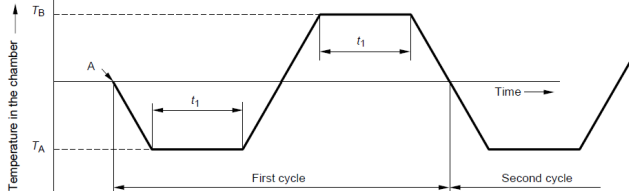
Clause	Requirement - Test	Result - Remark	Verdict
5	Test description		P
5.1	General Tests Bb, Bd, and Be are similar. Differences are noted in 5.2.2, 5.3.2 and 5.4.2. All other portions of the test are the same, starting with Clause 6.		P
5.2	Test Bb: Dry heat for non heat-dissipating specimens with gradual change of temperature		N/A
5.3	Test Bd: Dry heat for heat-dissipating specimens with gradual change of temperature that are not powered during the conditioning period		N/A
5.4	Test Be: Dry heat for heat-dissipating specimens with gradual change of temperature that are required to be powered throughout the test		P
6	Test procedure		P
6.1	Confirmation of performance IEC 60068-3-5 provides guidance for the confirmation of performance of temperature test chambers.		P
6.2	Working space The dimensions of the test sample shall be such that it is entirely within the working space of the test chamber. The temperature of incident air delivered to the test specimen shall be within ± 2 K of test severity temperature during the steady-state condition. The air temperature in the working space shall be measured in accordance with 4.5.		P
6.3	Thermal radiation The ability of the specimen to transfer heat by thermal radiation shall be minimized.		P
6.4	Mounting Thermal conduction and other relevant characteristics of the mounting and connections of the test specimen should be specified in the relevant specification. When the test specimen is intended for use with specific mounting devices, these shall be used for testing.		P
6.5	Severities 6.5.2 Temperature +1 000 °C +250 °C +85 °C +45 °C +800 °C +200 °C +70 °C +40 °C +630 °C +175 °C +65 °C +35 °C +500 °C +155 °C +60 °C +30 °C +400 °C +125 °C +55 °C +315 °C +100 °C +50 °C	+60°C	P
	6.5.3 Duration 2 h 72 h 168 h 336 h 16 h 96 h 240 h 1 000 h	16 h	P
6.6	Preconditioning		P

IEC 60068-2-2

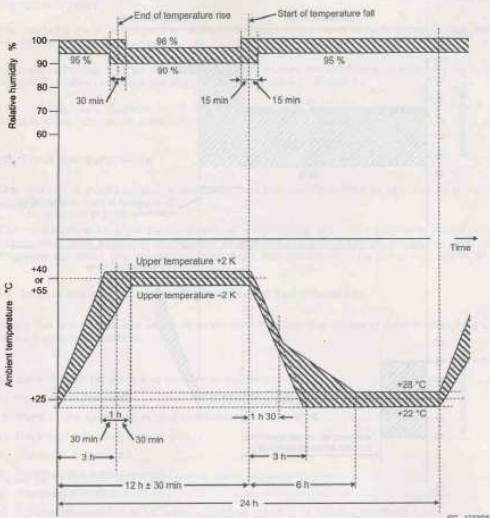
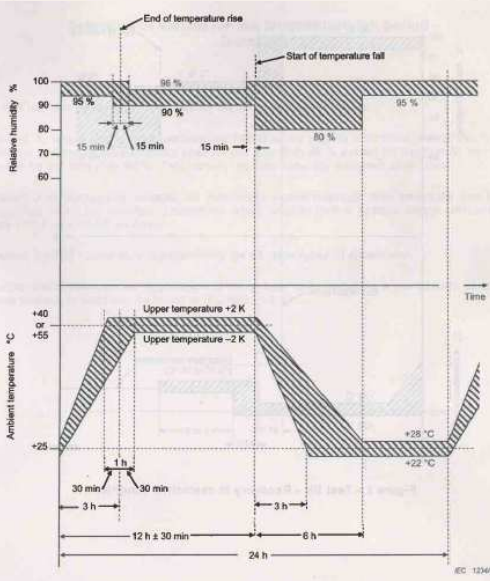
Clause	Requirement - Test	Result - Remark	Verdict
6.7	Initial measurements The initial state of the specimen shall be known. This may be achieved by visual inspection, and/or functional tests as required by the relevant specification.	Test according IEC 61683 was performed before the environment test, see test data table.	P
6.8	Conditioning 6.8.1 Steady state conditions The specimen shall then be exposed to the high temperature conditions for the duration as detailed in the relevant specification.		P
	6.8.2 Absolute humidity The absolute humidity shall not exceed 20 g of water vapour per cubic metre of air (corresponding to approximately 50 % relative humidity at 35 °C) the relative humidity shall not exceed 50 %.		P
6.9	Intermediate measurements The relevant specification may call for loading and/or measurements during or at the end of conditioning while the specimen is still in the chamber.		P
6.10	Final temperature ramp If the specimen remains in operating or loaded condition during the test, it shall be switched off or unloaded before the temperature is raised with the exception of Test Ae in which the specimen shall remain operational throughout the recovery period.		P
6.11	Recovery The specimen shall be subjected to the recovery procedure in the chamber or otherwise, as deemed suitable. Appropriate steps may be taken to remove droplets of water, as required, without damaging the specimen.		P
6.12	Final measurements The specimen shall be visually inspected and such performance checks made as are required by the relevant specification.	Test according IEC 61683 was performed after the environment test, see test data table.	P

IEC 60068-2-14			
Clause	Requirement - Test	Result - Remark	Verdict
8	Test Nb: Change of temperature with specified rate of change		P
8.1	General description of the test This test determines the ability of components, equipment or other articles to withstand and/or function during changes of ambient temperature.		P
8.2	Testing procedure		P
8.2.1	Testing chamber The chamber for this test shall be so designed that in the working space where the specimen under test is placed a temperature cycle can be performed in such a manner that: a) the low temperature required for the test can be maintained, b) the high temperature required for the test can be maintained, c) the change rate required for the test from low temperature to high temperature or vice versa can be performed at the required rate of change.		P
8.2.2	Mounting or supporting of the test specimen Unless otherwise specified in the relevant specification, the thermal conduction of the mounting or support shall be low, such that for practical purposes the specimen is thermally isolated.		P
8.2.3	Severities The severity of the test is defined by the combination of the two temperatures, the rate of temperature change, the exposure time of the specimen and the number of cycles.		P
	The lower temperature TA shall be specified in the relevant specification and should be chosen from the test temperatures of IEC 60068-2-1 and IEC 60068-2-2.	-25°C	P
	The higher temperature TB shall be specified in the relevant specification and should be chosen from the test temperatures of IEC 60068-2-1 and IEC 60068-2-2.	+60°C	P
	The air temperature shall be lowered or raised between 90 % and 10 % of D = TB - TA within a tolerance of 20 % of the temperature change rate. Preferred values are (1 ± 0,2) K/min, (3 ± 0,6) K/min, (5 ± 1) K/min, (10 ± 2) K/min, or (15 ± 3) K/min,	1 K/min	P
	The exposure time, t1, to each of the two temperatures depends upon the heat capacity of the specimen. It may be 3 h, 2 h, 1 h, 30 min, or 10 min, or as specified in the relevant specification.	3 h	P

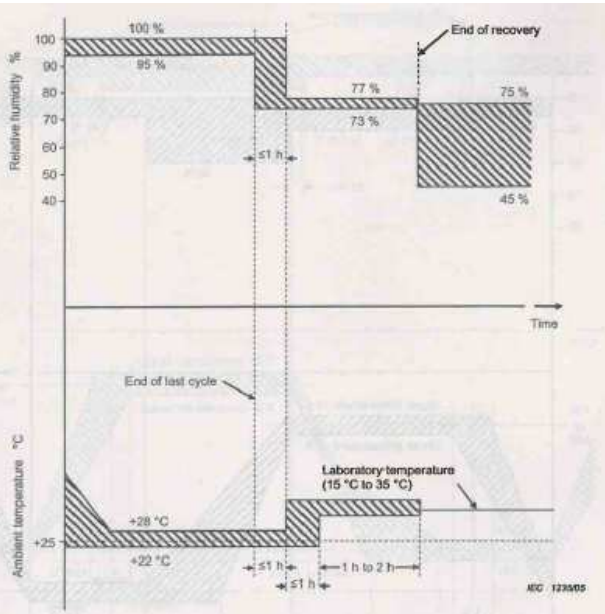
IEC 60068-2-14

Clause	Requirement - Test	Result - Remark	Verdict
8.2.4	Conditioning The specimen and the temperature in test chamber shall be at the ambient temperature of the laboratory, +25 °C ±5 K. If required by the relevant specification, the specimen shall be brought into operating condition.		P
8.2.5	Test cycle 		P

IEC 60068-2-30			
Clause	Requirement - Test	Result - Remark	Verdict
3	General description This test comprises one or more temperature cycles in which the relative humidity is maintained at high level.		P
4	Testing chamber-Construction requirements		P
4.1	The temperature can be varied cyclically between 25°C +/- 3 K and the appropriate upper temperature specified with the tolerance and rate of change specified in 7.3 and Figures 2a or 2b, as applicable.		P
4.2	The relative humidity in the working space can be maintained within the limits given in 7.3 and in Figures 2a or 2b, as applicable.		P
4.3	Care shall be taken to ensure that the conditions prevailing at any point in the working space are uniform and are as similar as possible to those prevailing in the immediate vicinity of suitably located temperature and humidity sensing devices. The chamber shall meet the performance criteria as detailed in IEC 60068-3-6.		P
4.4	The specimens under test shall not be subjected to radiant heat from the chamber conditioning processes.		P
4.5	Water used for the maintenance of chamber humidity shall have a resistivity of not less than 500mΩ.		P
4.6	The dimensions, properties and/or electrical loading of the specimens under test shall not appreciably influence conditions within the chamber.		P
5	Severities The severity shall be chosen from the following: a) Upper temperature: 40°C Number of cycles: 2, 6, 12, 21, 56; b) Upper temperature: 55°C Number of cycles: 1, 2, 6	55°C, 1 cycle	P
6	Initial measurements The specimens shall be visually inspected, and functionally tested, as required by the relevant specification.		P

Clause	Requirement - Test	Result - Remark	Verdict
7	Conditioning The specimens shall be introduced into the chamber either in the unpacked, switched-off, ready-for-use state, or as otherwise specified in the relevant specification.  Figure 2a – Test Db – Test cycle – Variant 1  Figure 2b – Test Db – Test cycle – Variant 2 Figure 2 – Test Db – Test cycle – Variants 1 and 2	Variant 1 was used.	P
8	Intermediate measurements The relevant specification may require functional tests during the conditioning programmer.		P

IEC 60068-2-30

Clause	Requirement - Test	Result - Remark	Verdict
9	Recovery The relevant specification shall prescribe whether recovery shall be made at standard atmospheric conditions for testing, or at controlled recovery conditions. If controlled recovery conditions are required (see Figure 3), the specimen may be transferred to another chamber for this recovery period or may remain in the damp heat chamber.  Figure 3 – Test Db – Recovery at controlled conditions		P
10	Final measurements The specimens shall be visually inspected, and functionally tested as required by the relevant specification.	Test according IEC 61683 was performed after the environment test, see test data table.	P

Part 2-1	TABLE : Cold test (Test A)		P
	Condition:.....:	working	—
IEC 60068-2-1: 2007 Environmental testing - Part 2-1: Tests - Test A: Cold			
Specimen type:		heat dissipating, powered throughout	
Temperature change:		gradual	
Specimen cooling type:		without artificial cooling	
Air circulation:		forced air	
Measured temperature:		-25.3 °C	
Duration:		16 h	
Preconditioning: Verification of correct device functionality			
Initial measurement: Verification of correct device functionality, see test report CN22DVK5 001			
Intermediate measurement: Verification of correct device functionality			
Final measurement (after thermal cycle): Verification of correct device functionality, see test report CN22DVK5 001			
Particular test condition: Device operative (powered)			

Part 2-2	TABLE : Dry Heat		P
	Condition:.....:	working	—
IEC 60068-2-2: 2007 Environmental testing - Part 2-2: Tests - Test B: Dry heat			
Specimen type:		heat dissipating, powered throughout	
Temperature change:		gradual	
Specimen cooling type:		without artificial cooling	
Air circulation:		forced air	
Measured temperature:		59.8 °C	
Duration:		16 h	
Preconditioning: Verification of correct device functionality			
Initial measurement: Verification of correct device functionality, see test report CN22DVK5 001			
Intermediate measurement: Verification of correct device functionality			
Final measurement (after thermal cycle): Verification of correct device functionality, see test report CN22DVK5 001			
Particular test condition: Device operative (powered)			

Part 2-14	TABLE : Change of temperature		P
	Condition:.....:	working	—
IEC 60068-2-14: 2007			
Part 2-14: Tests – Test N: Change of temperature			
Suffix letter		Nb	
Variant 1 or Variant 2		1	
Specimen type:		heat dissipating, powered throughout	
Temperature change:		gradual	
Specimen cooling type:		without artificial cooling	
Air circulation:		forced air	
Temperature measured TA and TB:		-25.1 °C and 60.3 °C	
Rate of change of temperature:		1k /min	
Duration t1:		3 h	
Cycle		5 cycle	
Preconditioning: Verification of correct device functionality			
Initial measurement: Verification of correct device functionality, see test report CN22DVK5 001			
Intermediate measurement: Verification of correct device functionality			
Final measurement (after thermal cycle): Verification of correct device functionality, see test report CN22DVK5 001			
Particular test condition: Device operative (powered)			

Part 2-30	TABLE : Damp heat, cycle		P
	Condition:.....:	working	—
IEC 60068-2-30: 2005 Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12h +12h cycle)			
Suffix letter		Db	
Variant 1 or Variant 2		1	
Specimen type:		heat dissipating, powered throughout	
Temperature change:		gradual	
Specimen cooling type:		without artificial cooling	
Air circulation:		forced air	
Temperature measured:		55.3 °C	
Humidity measure:		95.2 %	
Duration:		24 h	
Cycle		1 cycle	
Preconditioning: Verification of correct device functionality			
Initial measurement: Verification of correct device functionality, see test report CN22DVK5 001			
Intermediate measurement: Verification of correct device functionality			
Final measurement (after thermal cycle): Verification of correct device functionality, see test report CN22DVK5 001			
Particular test condition: Device operative (powered)			

-End of report-

PHOTO DOCUMENTATION

CN22DVK5 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)



Figure 1. Front view

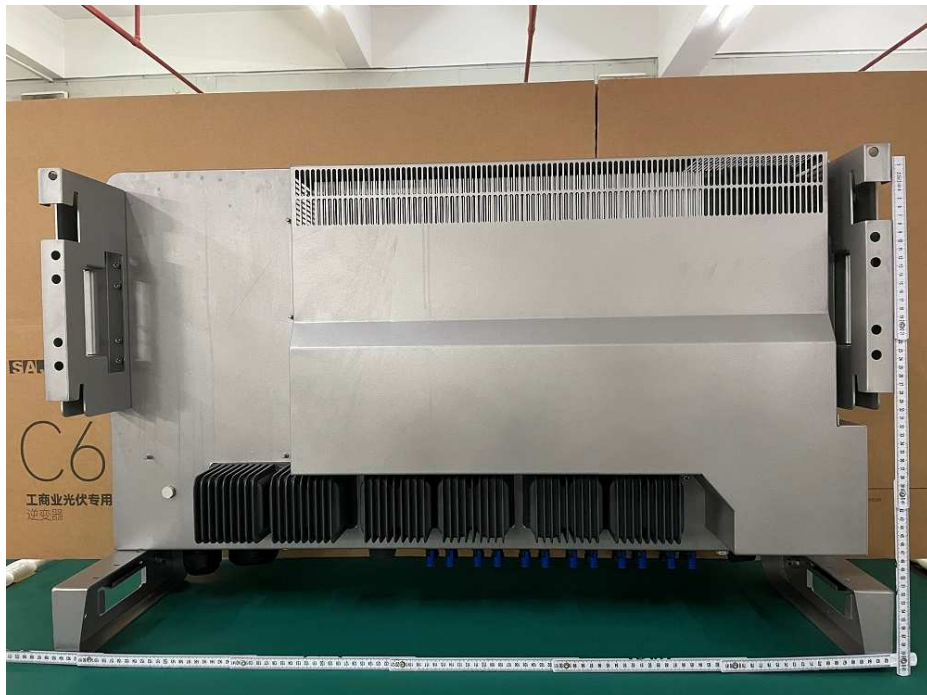


Figure 2. Back view

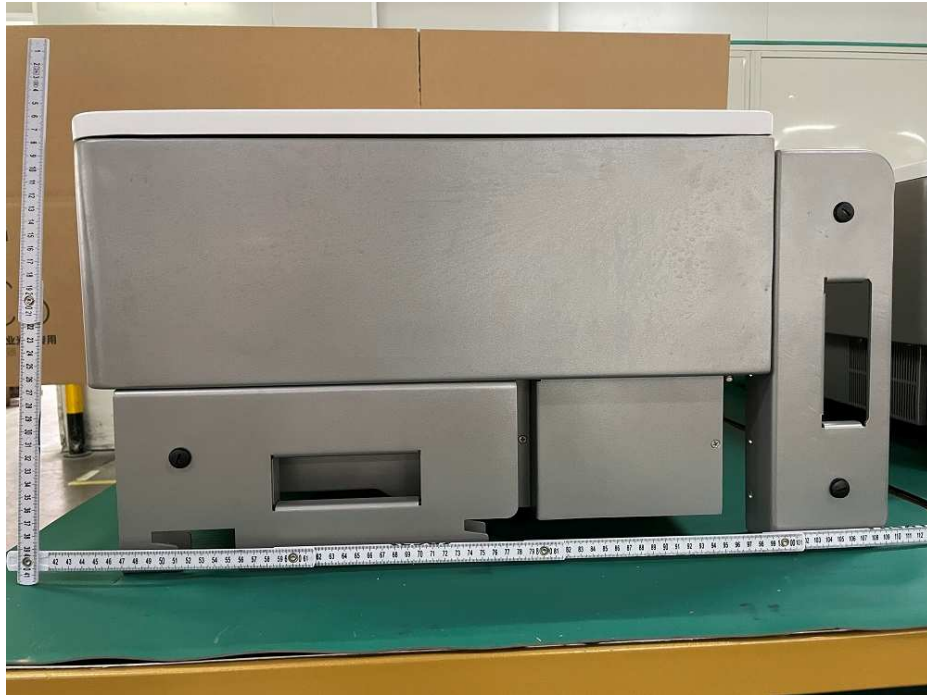


Figure 3. Left view



Figure 4. Right view



Figure 5. Top view



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



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



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

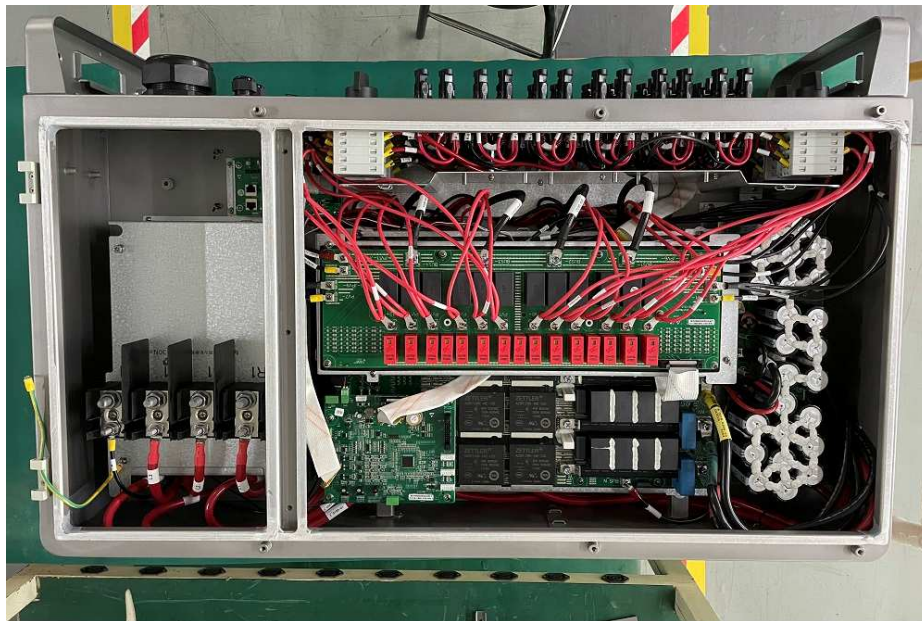


Figure 9. Terminal view 1 of C6-70K-T12-LV



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

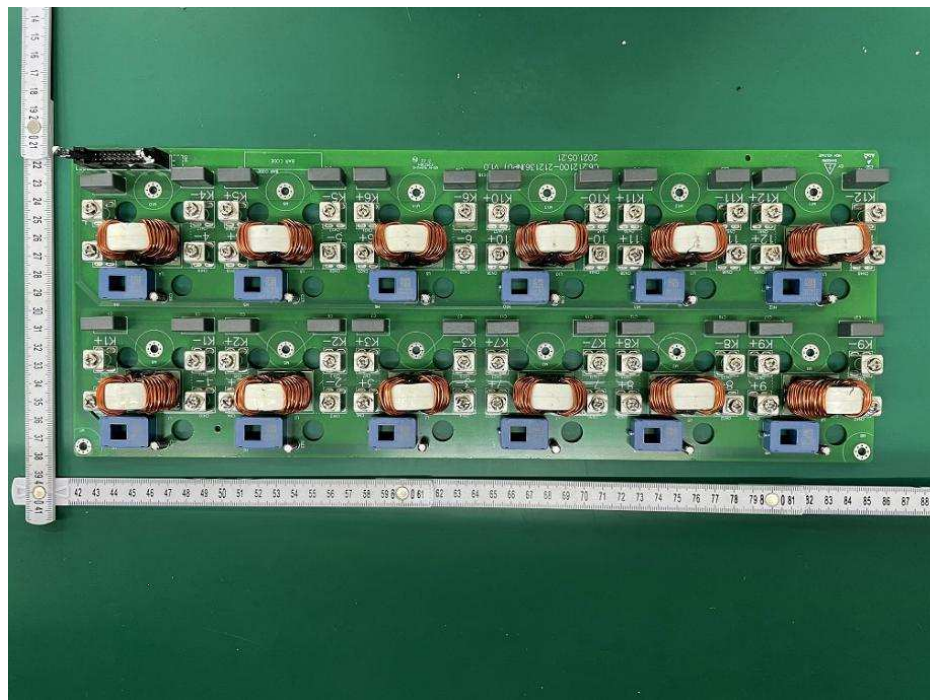


Figure 15. Front view of PV input board for C6-70K-T12-LV

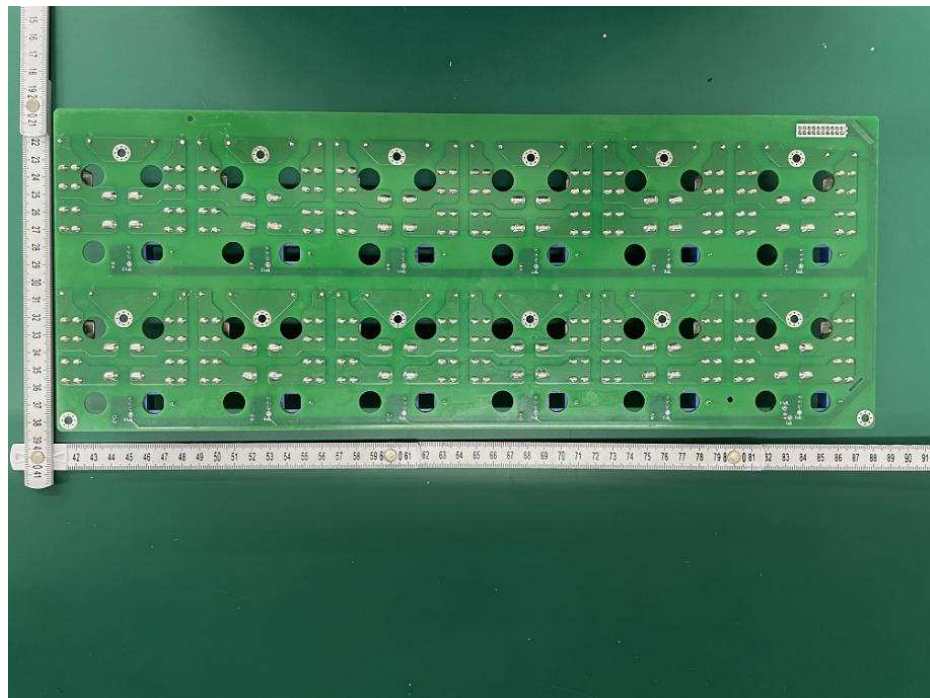


Figure 16. Back view of PV input board for C6-70K-T12-LV

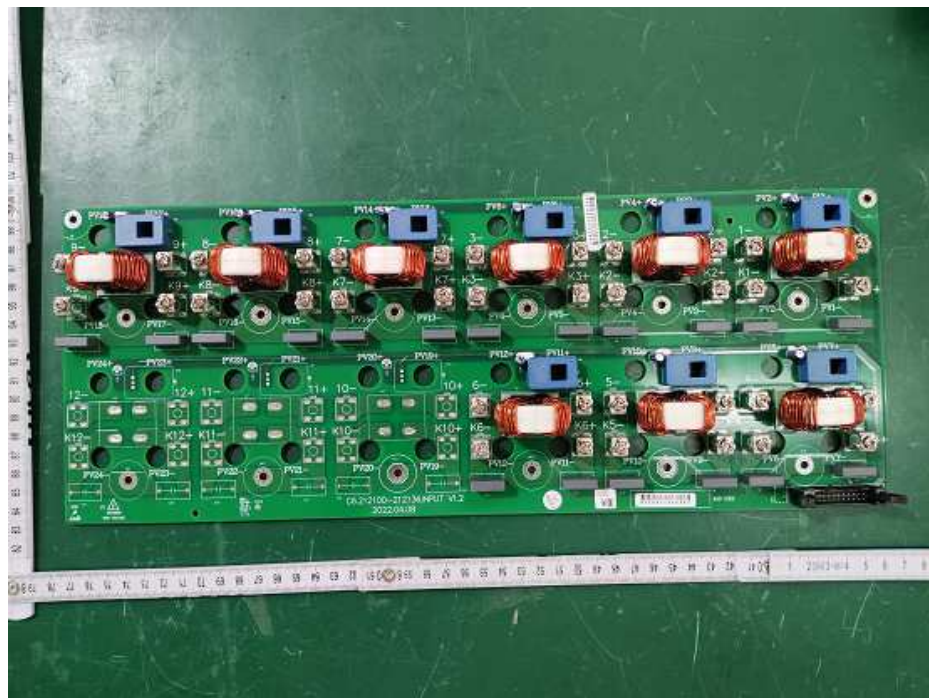


Figure 17. Front view of PV input board for C6-60K-T9-LV

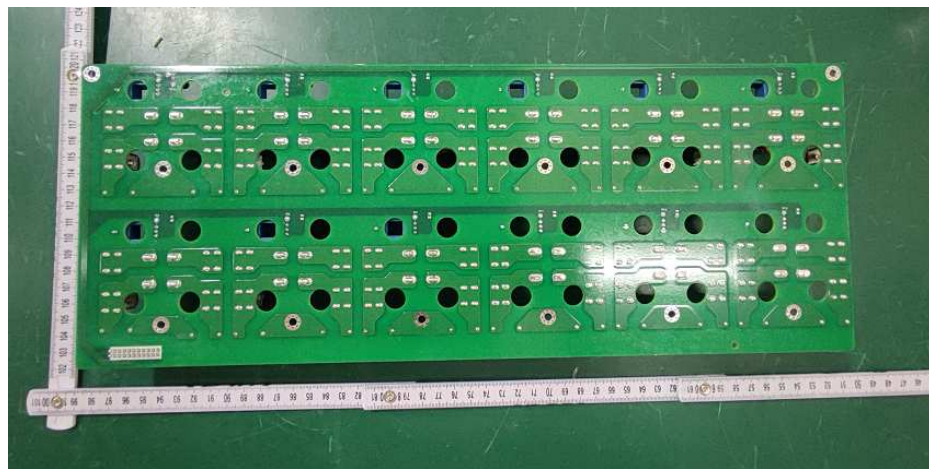


Figure 18. Back view of PV input board for C6-60K-T9-LV

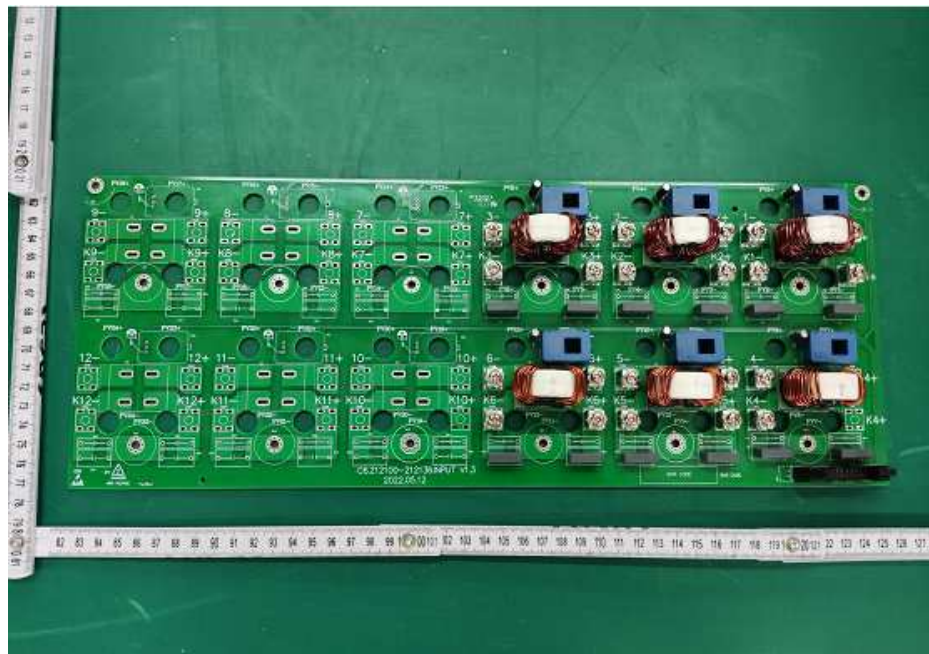


Figure 19. Front view of PV input board for C6-50K-T6-LV

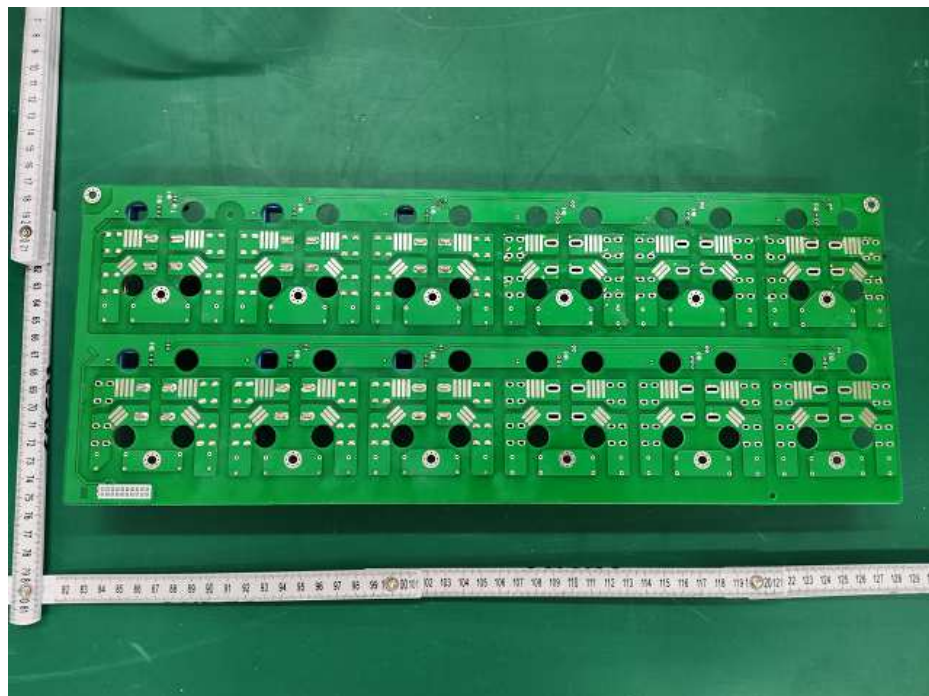


Figure 20. Back view of PV input board for C6-50K-T6-LV

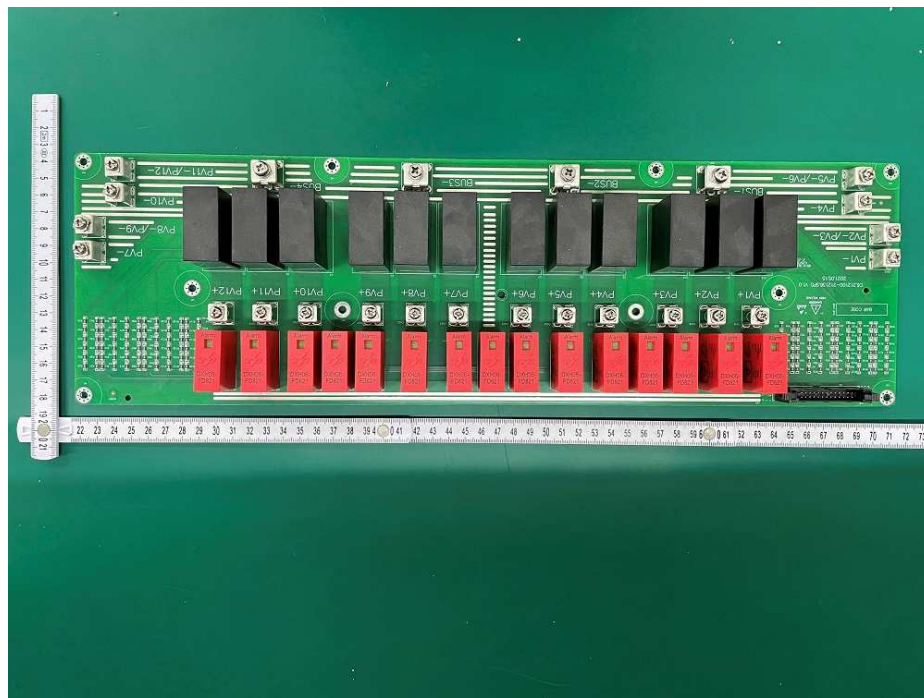


Figure 21. Front view of SPD board

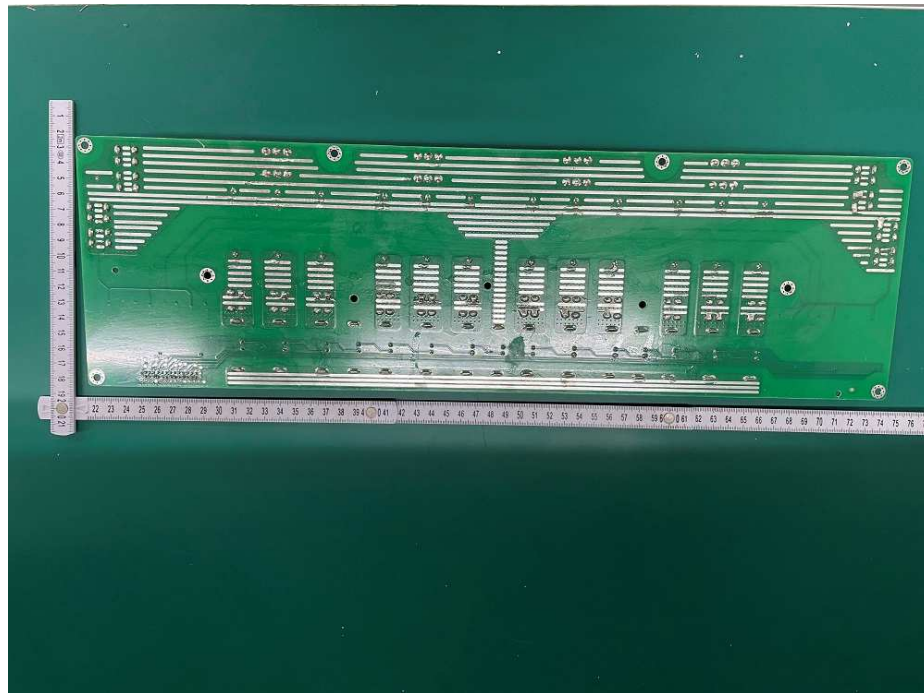


Figure 22. Back view of SPD board



Figure 23. Front view of CAP board

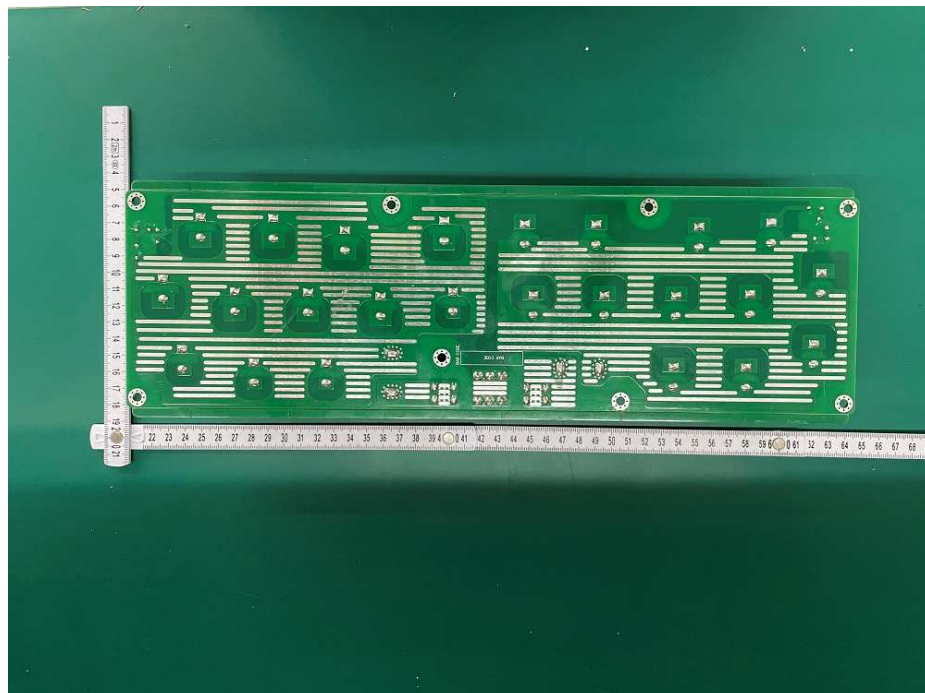


Figure 24. Back view of CAP board

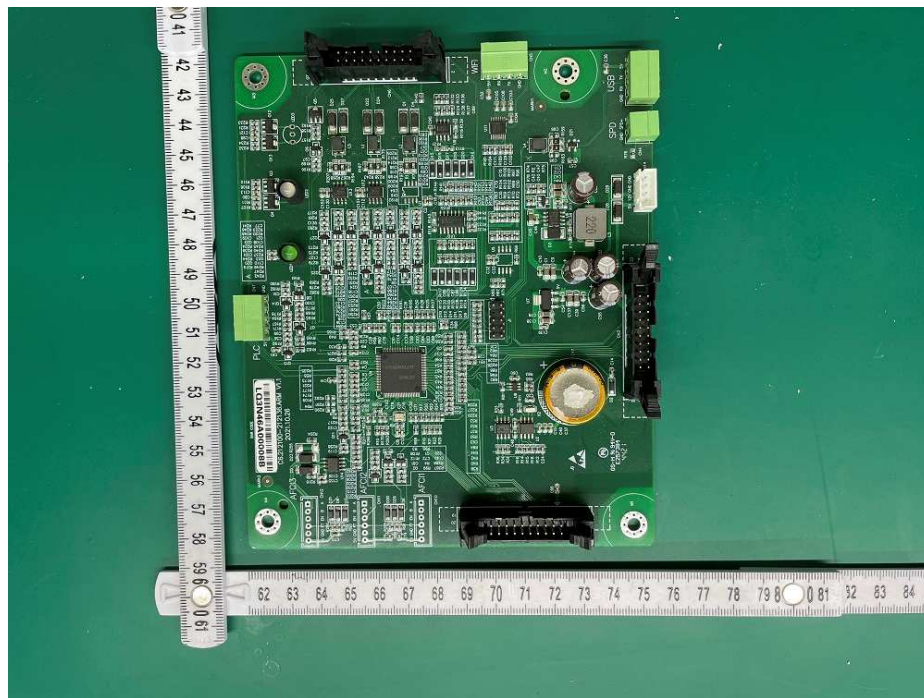


Figure 25. Front view of ARM board

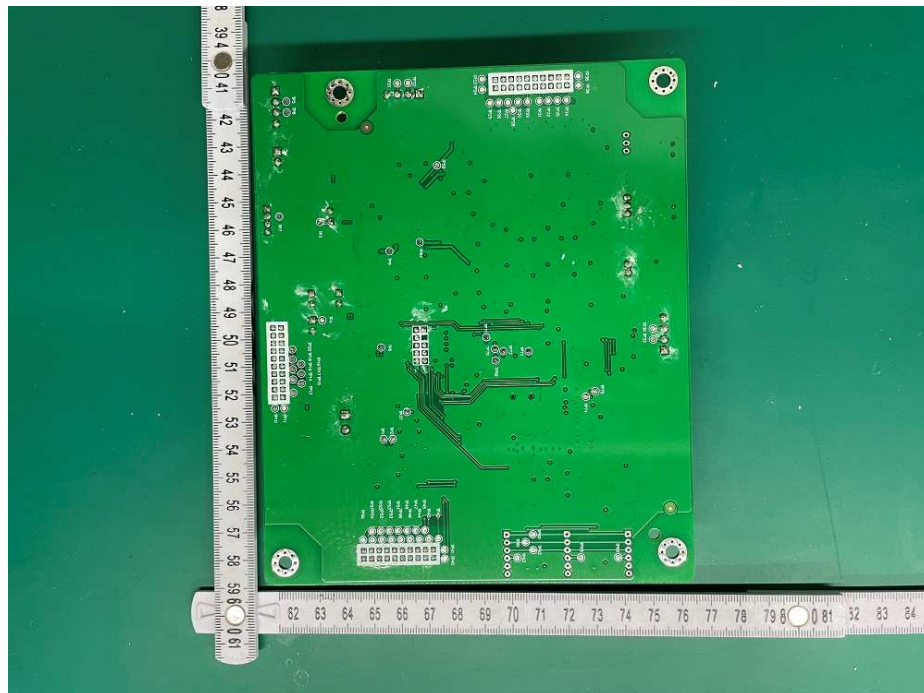


Figure 26. Back view of ARM board

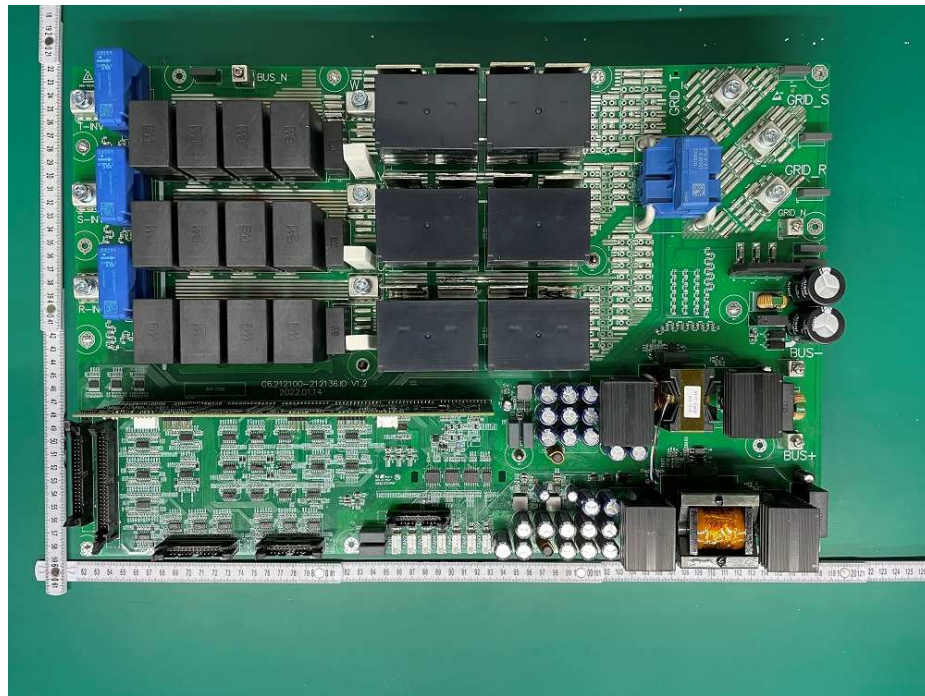


Figure 27. Front view of IO board

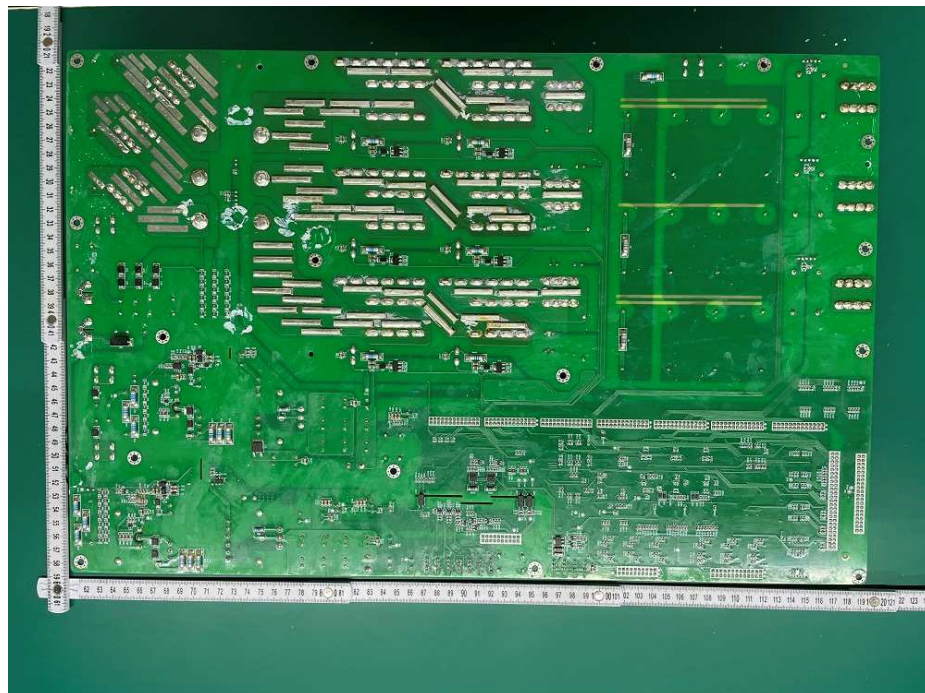


Figure 28. Back view of IO board

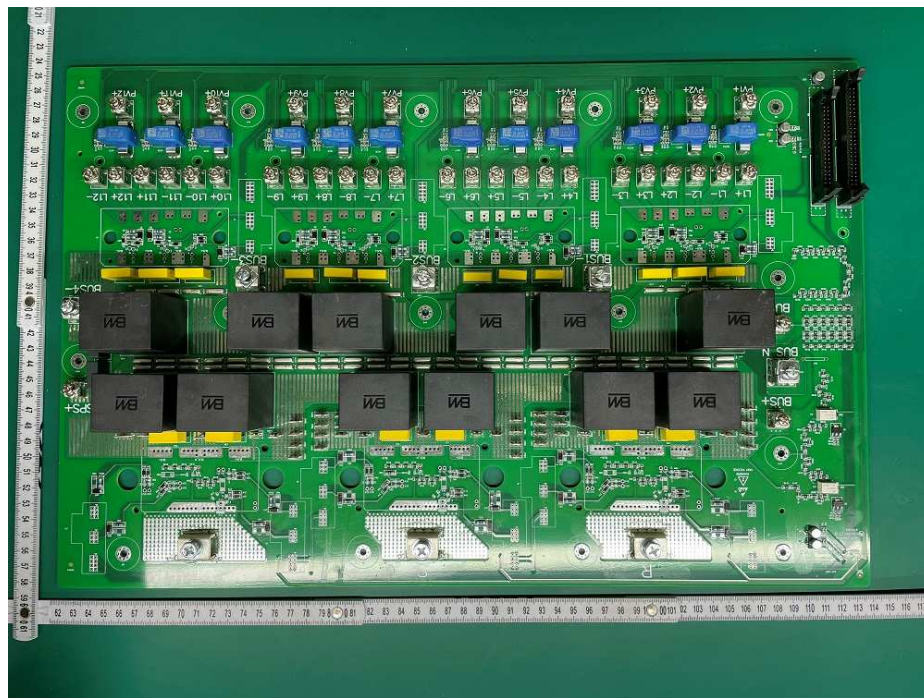


Figure 29. Front view of Main power board for C6-70K-T12-LV

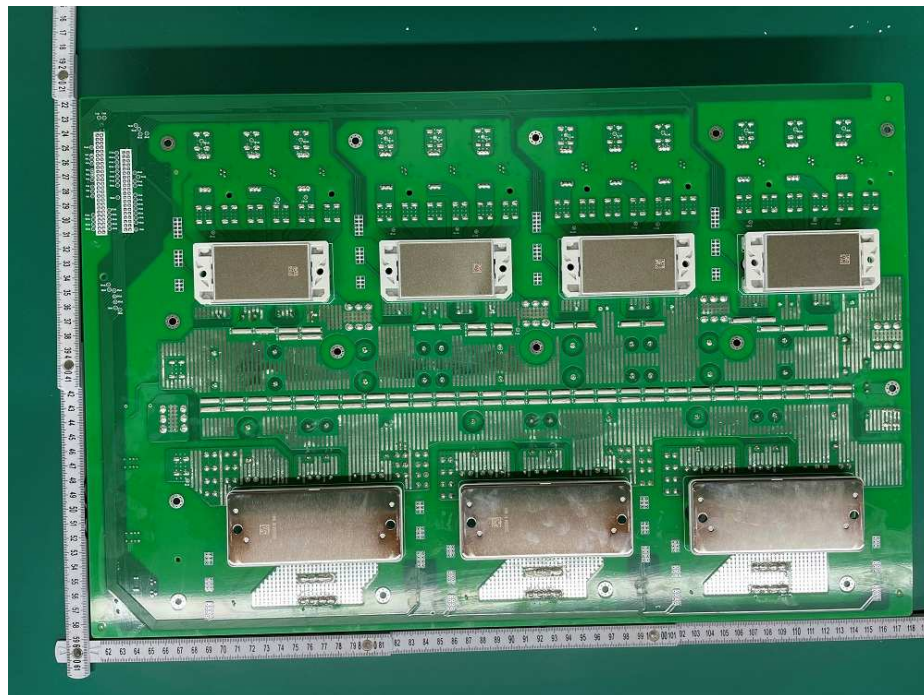


Figure 30. Back view of Main power board for C6-70K-T12-LV

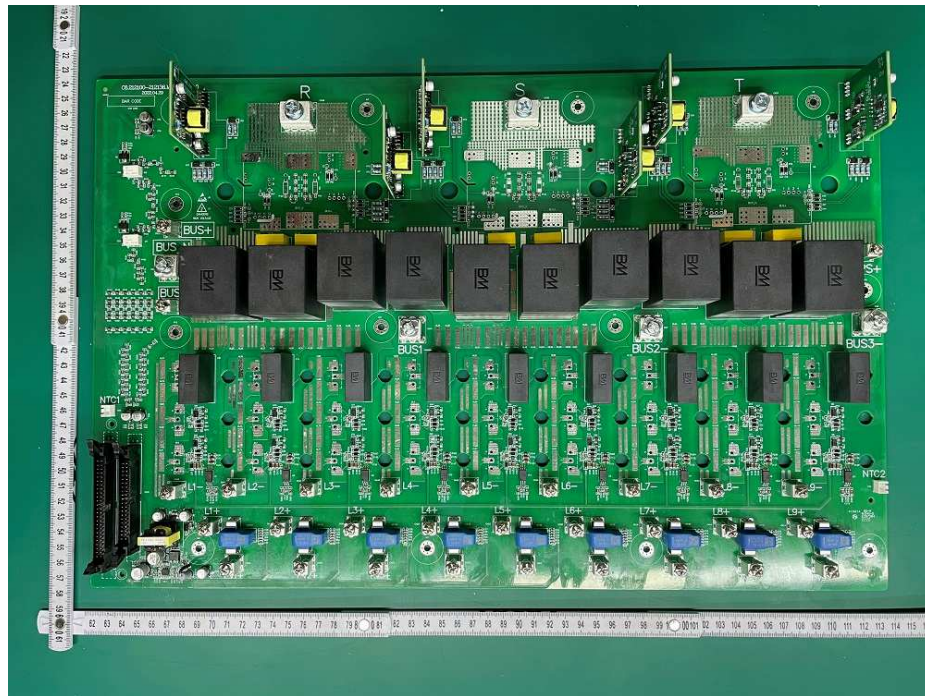


Figure 31. Front view of Main power board for C6-50K-T6-LV, C6-60K-T9-LV

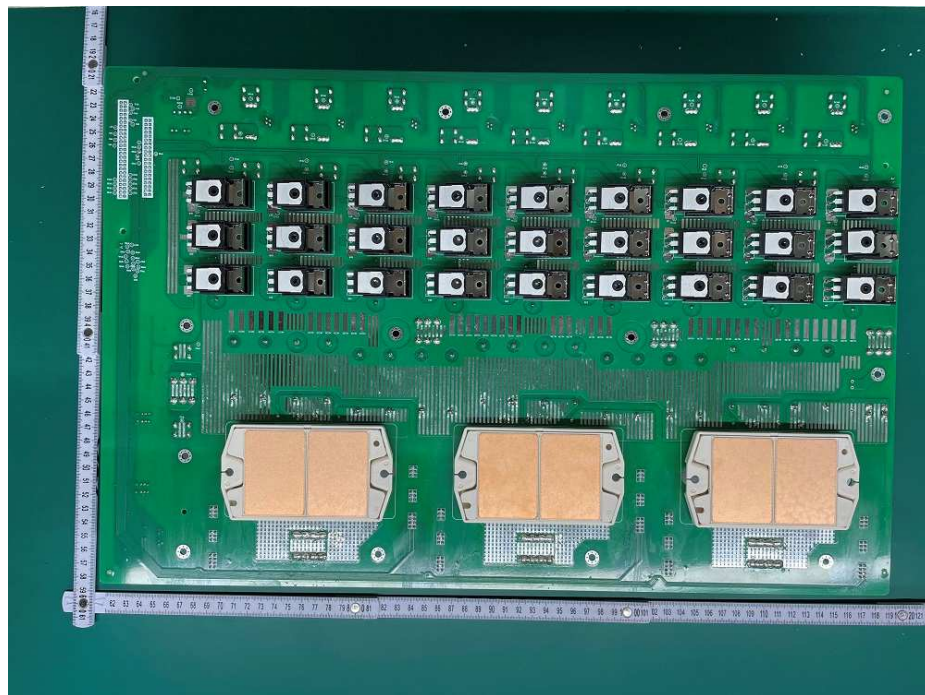


Figure 32. Back view of Main power board for C6-50K-T6-LV, C6-60K-T9-LV

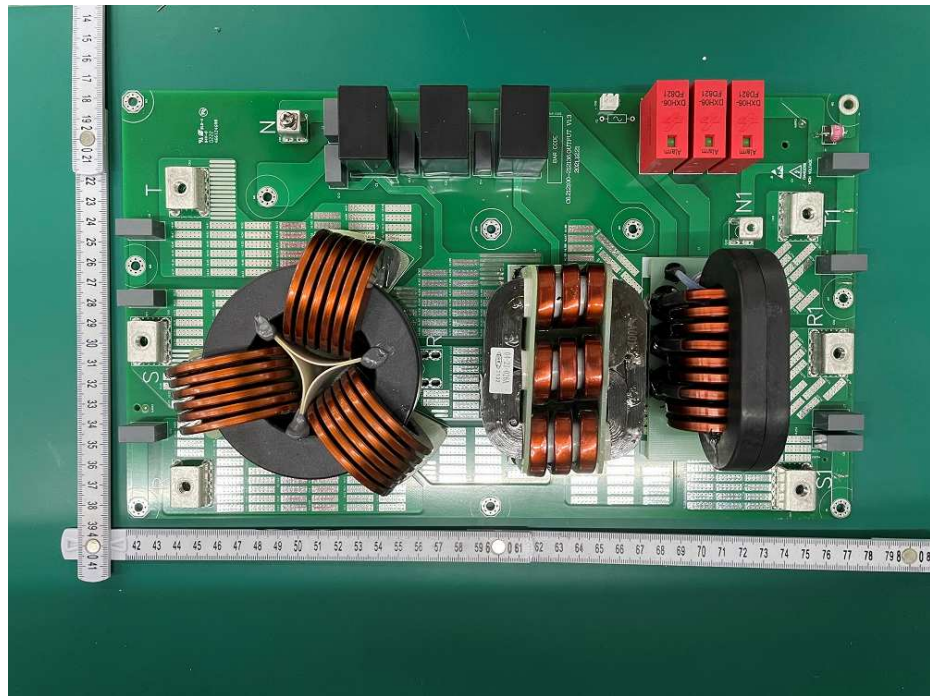


Figure 33. Front view of AC output board

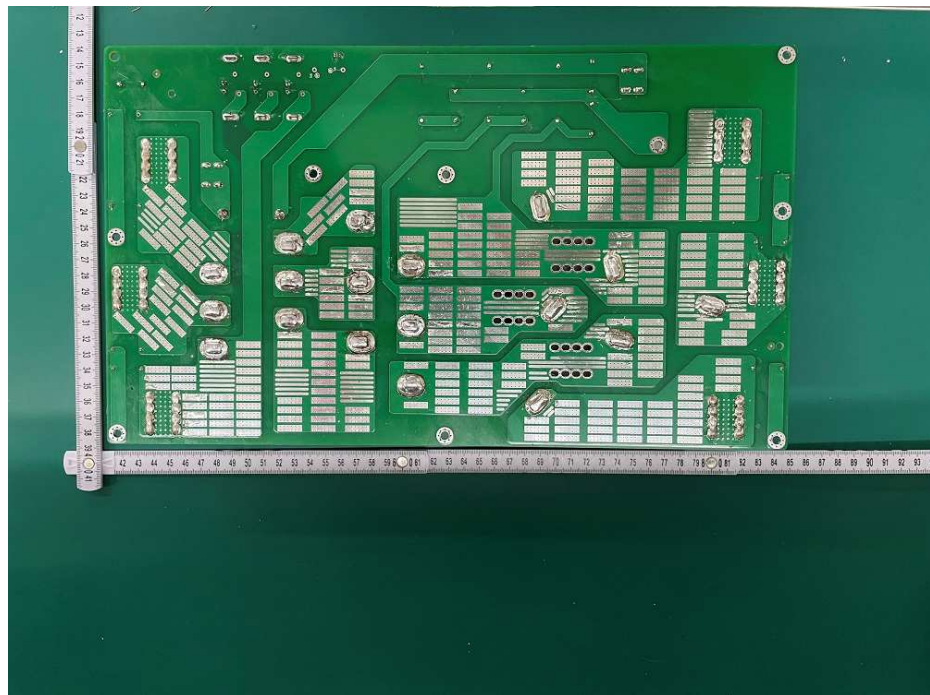


Figure 34. Back view of AC output board

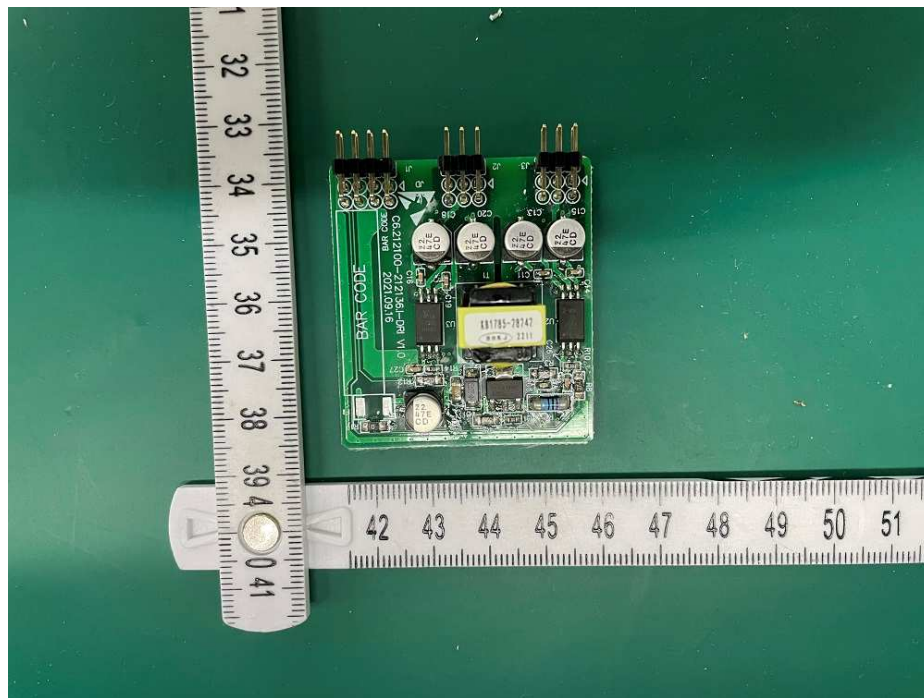


Figure 35. Front view of INV drive board

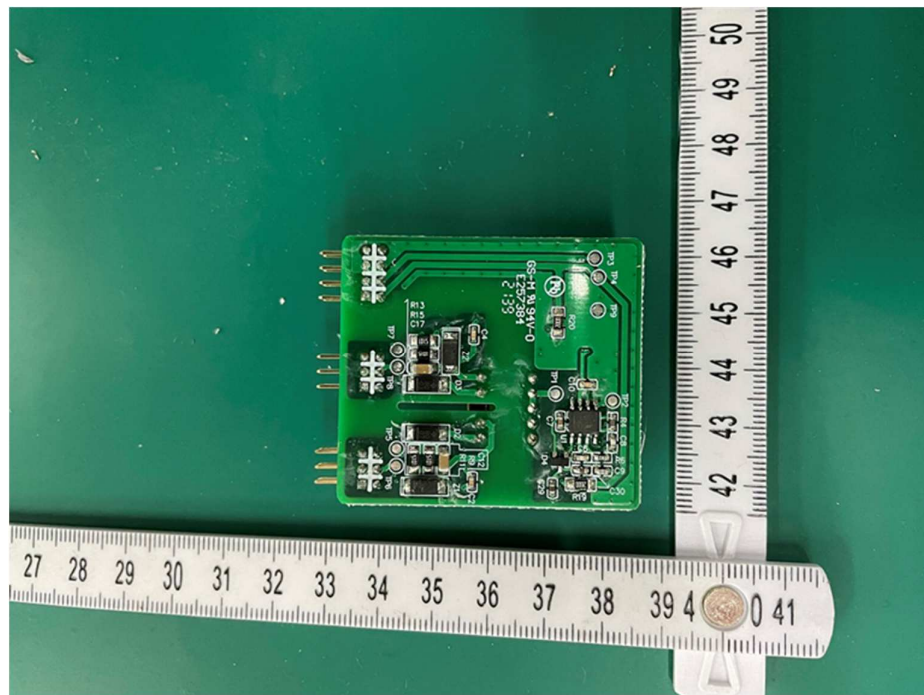


Figure 36. Back view of INV drive board

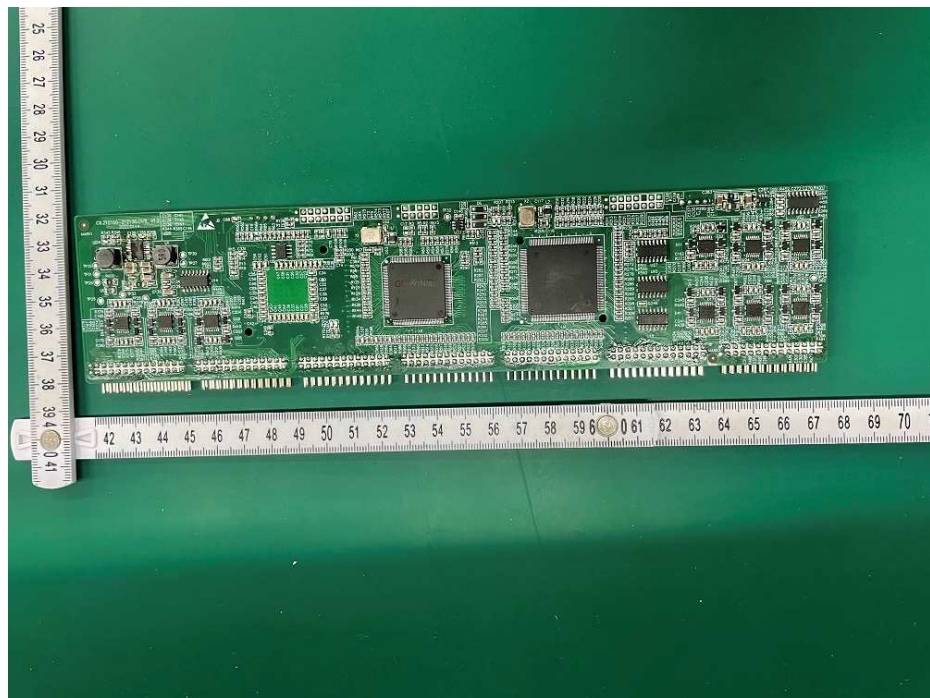


Figure 37. Front view of Control board

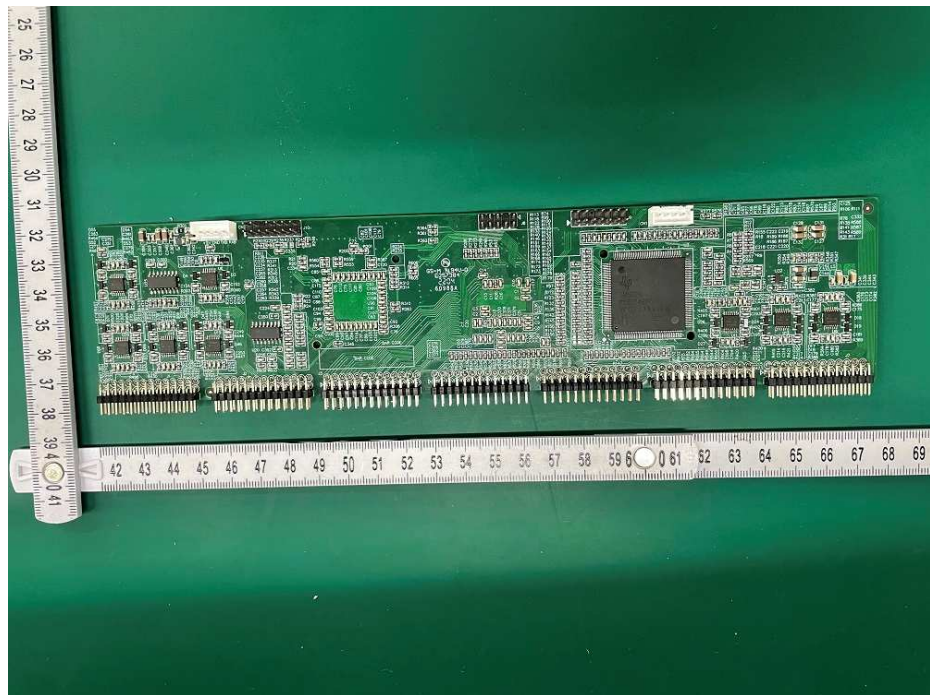


Figure 38. Back view of Control board

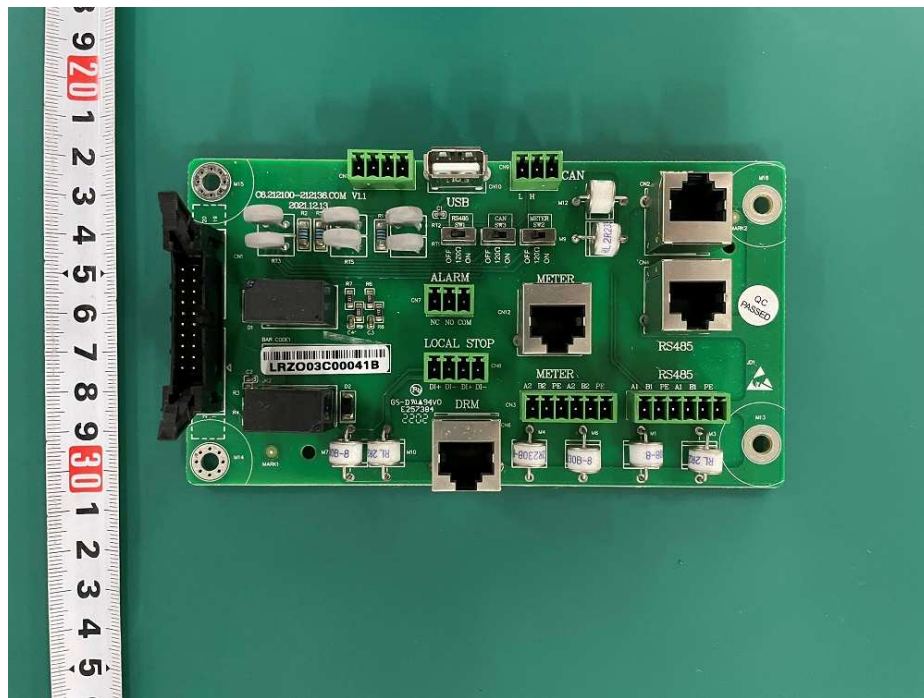


Figure 39. Front view of Communication board

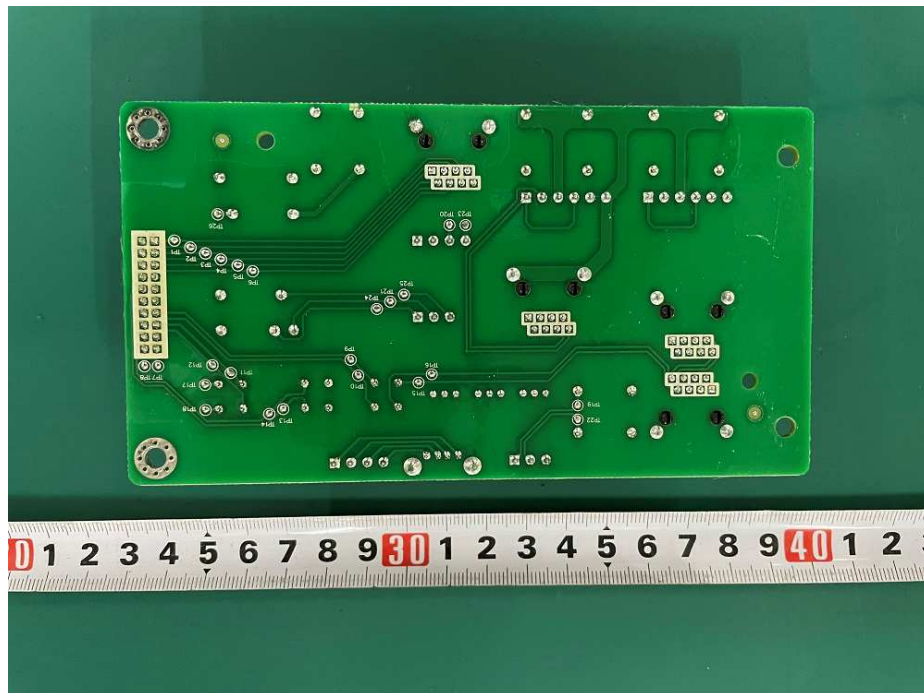


Figure 40. Back view of Communication board

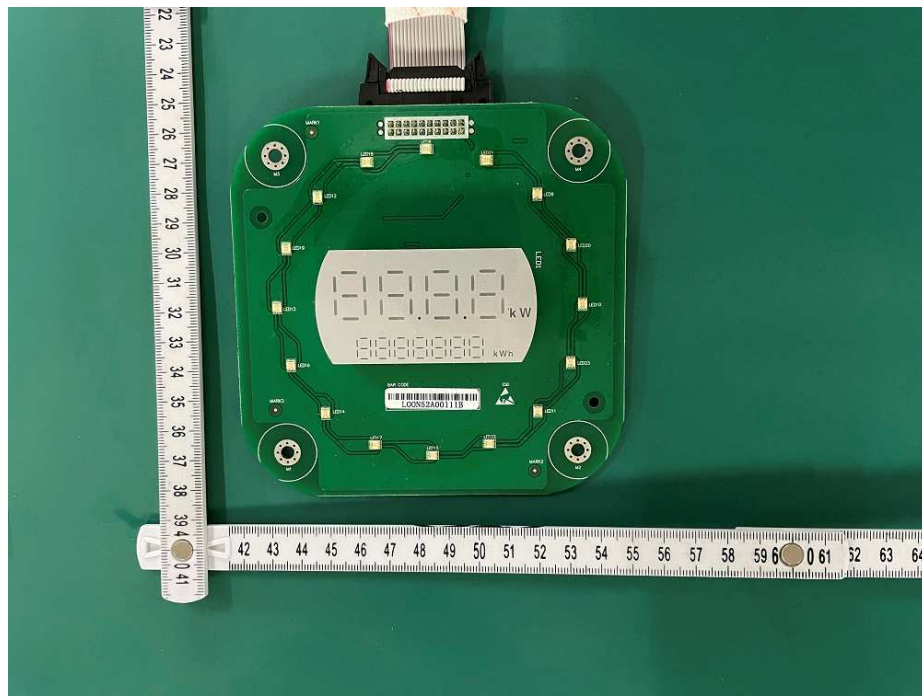


Figure 41. Front view of Display board

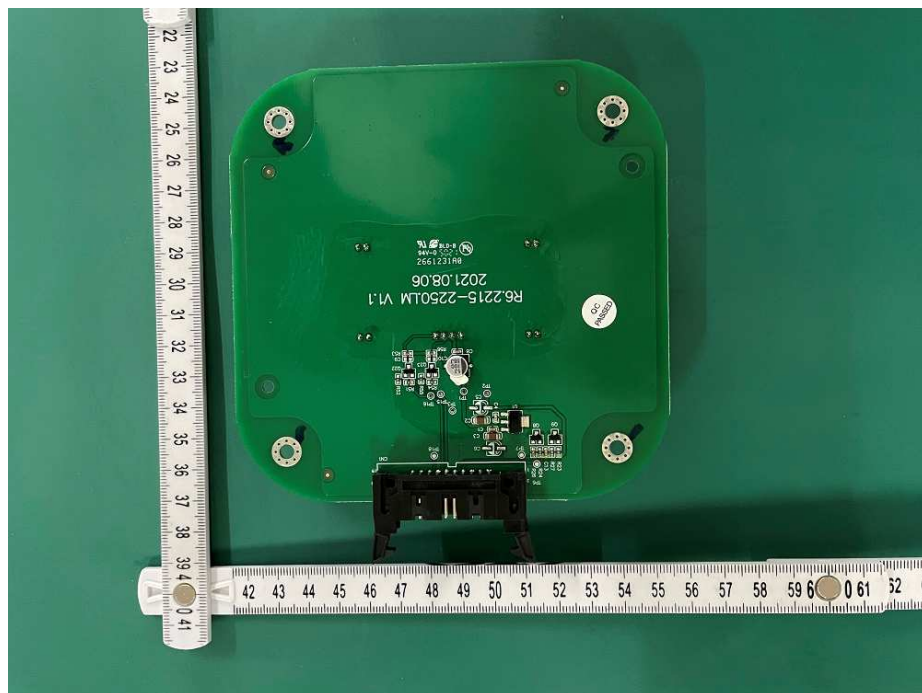


Figure 42. Back view of Communication board

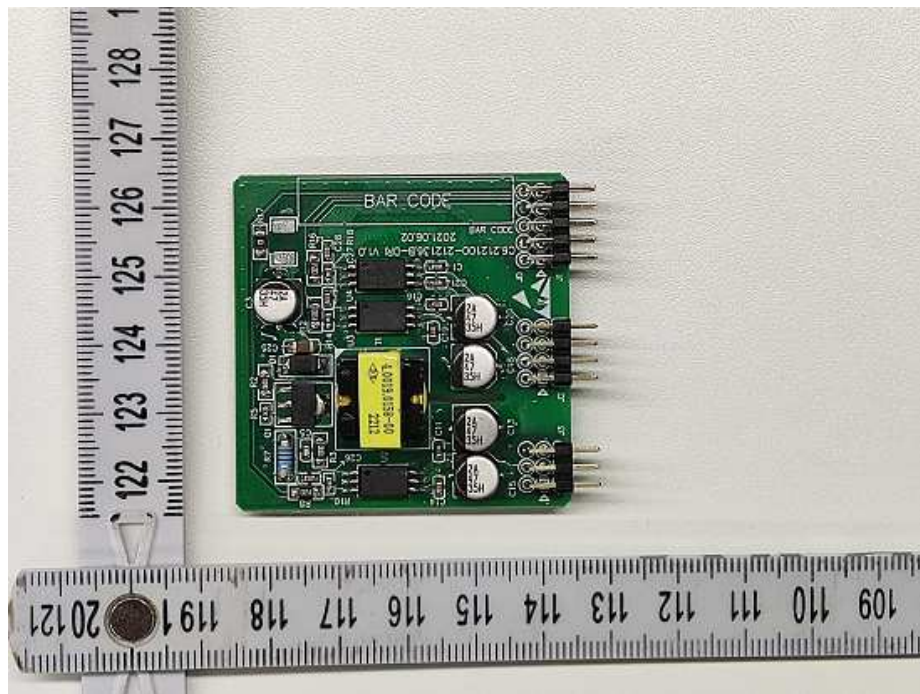


Figure 43. Front view of Boost drive board

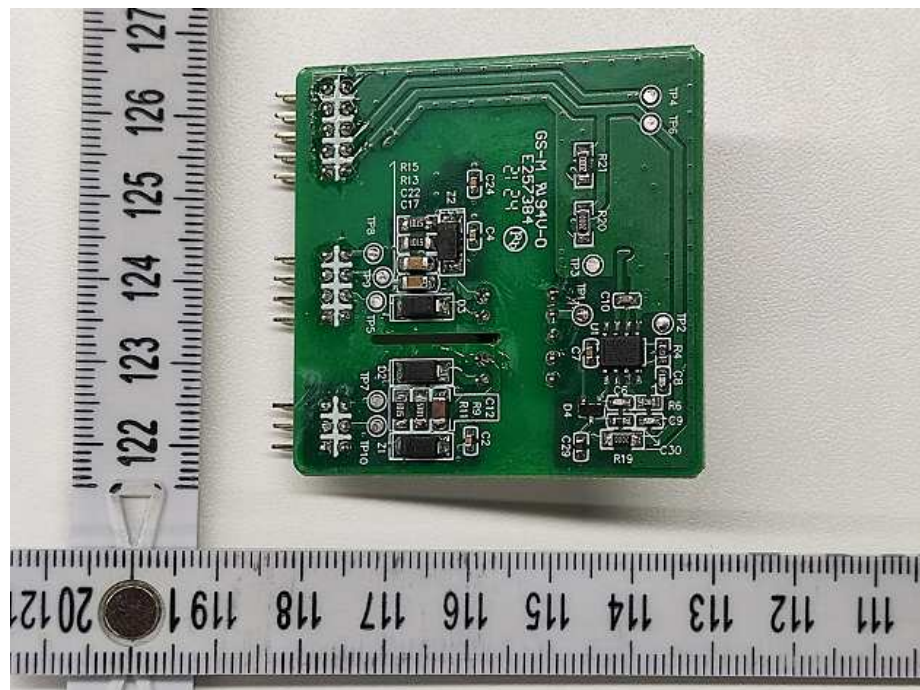


Figure 44. Back view of Boost drive board



Figure 45. Internal ground view



Figure 46. External ground view