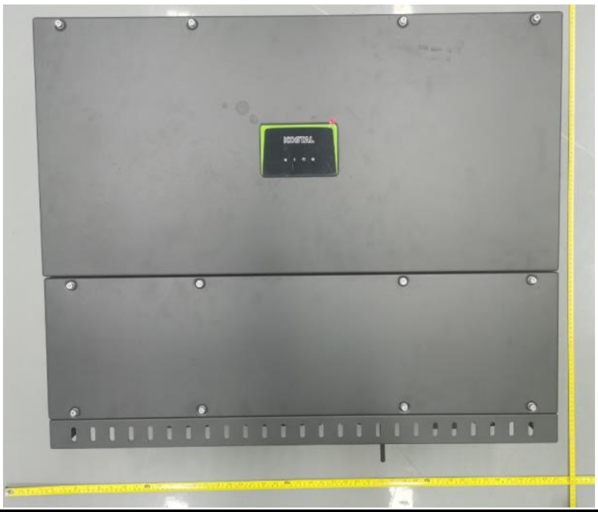
Prüfbericht-Nr.: *Test Report No.:*	CN216DF1 001	**Auftrags-Nr.:** *Order No.:*	168296968	Seite 1 von 26 *Page 1 of 26*
Kunden-Referenz-Nr.: *Client Reference No.:*	2263692	**Auftragsdatum:** *Order date:*	2020.12.29	
Auftraggeber: *Client:*	**KOSTAL Solar Electric GmbH** Hanferstr. 6, 79108 Freiburg Germany			
Prüfgegenstand: *Test item:*	Grid-connected PV inverter			
Bezeichnung / Typ-Nr.: *Identification / Type No.:*	PIKO CI 50, PIKO CI 60			
Auftrags-Inhalt: *Order content:*	AK certificate			
Prüfgrundlage: *Test specification:*	UNE 217001 IN: 2015, RD 244: 2019			
Wareneingangsdatum: *Date of sample receipt:*	2020.12.29			
Prüfmuster-Nr.: *Test sample No.:*	Engineering Samples			
Prüfzeitraum: *Testing period:*	2020.12.29–2021.01.07			
Ort der Prüfung: *Place of testing:*	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: *Test result*:*	Pass			
überprüft von: *reviewed by:*	Zhiwei Yan	**genehmigt von:** *authorized by:*	Corney Zhang	
Datum: *Date: 2021.01.25*		**Datum:** *Date: 2021.01.25*		
Stellung / *Position*	Project Engineer	**Stellung /** *Position*	Technical Certifier	

Sonstiges / *Other*:
1. For issuing grid connecting AK certificate.

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

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
**Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

V05

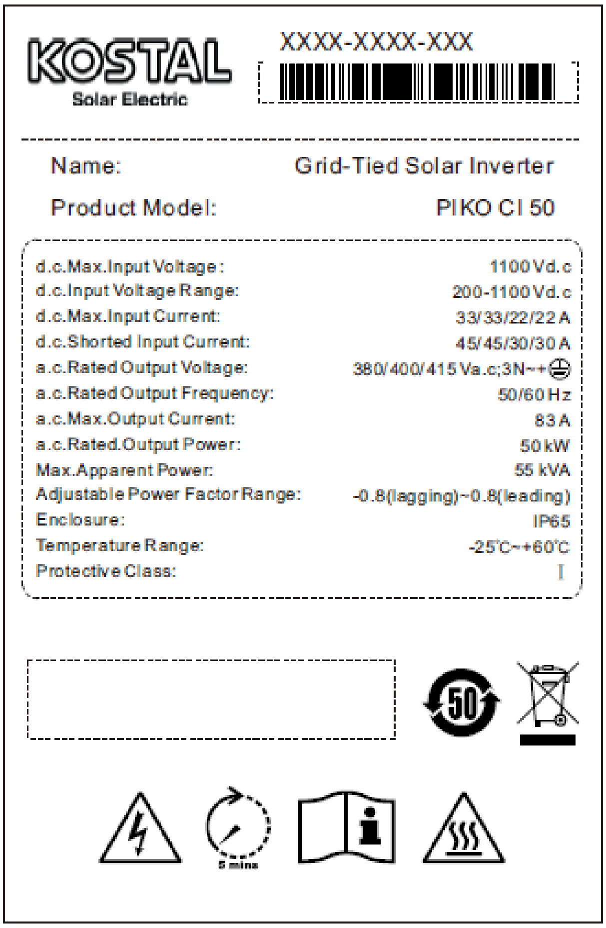
TEST REPORT
UNE 217001 IN:2015 RD244:2019
Requirements and tests for systems that prevent the discharge of energy to the distribution network

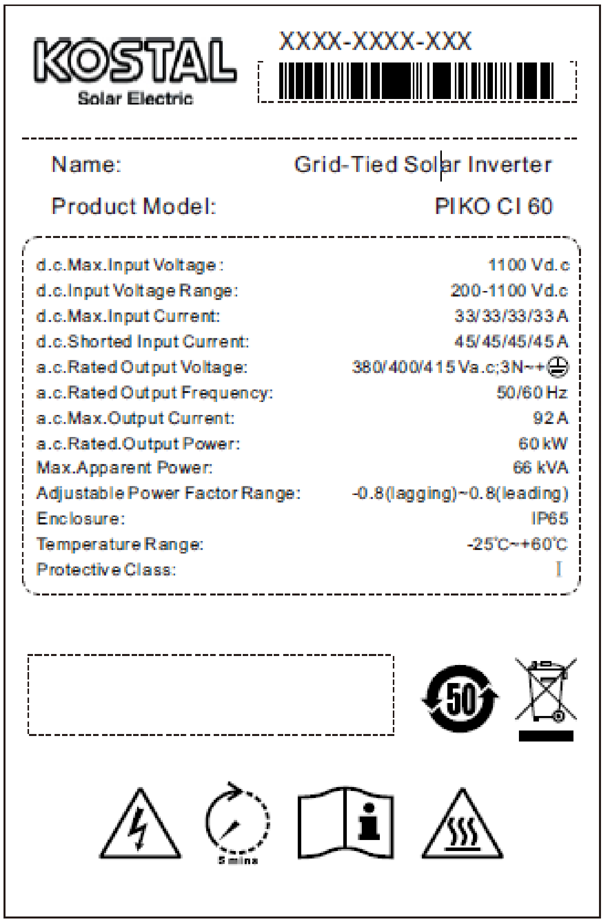
Report Reference No. :	CN216DF1 001	
Tested by (name + signature) .... :	See cover page	....
Witnessed by (name + signature) . :	See cover page	....
Supervised by (name + signature) . :	See cover page	....
Approved by (name + signature) ... :	See cover page	....
Date of issue .... :	See cover page	
Testing Laboratory...................... :	**TÜV Rheinland (Shenzhen) Co., Ltd.**	
Address .... :	1601 R&D Room, 1602-1604, 17-18F, Building 7 Site C, Vanke Cloud City Phase I, XingKe First Street, Xili Street, Xili Community, Nanshan District, Shenzhen 518052, P.R.China	
Testing location/ procedure .... :	CBTL☐ TMP☐ WMT☒ SMT☐ RMT☐ CCATL ☐	
Testing location/ address .... :	Shenzhen Senergy Technology Co., Ltd.	
	Room 405, Building A, Co-talent Creative Park, No.2, LiuXianRoad, Block 68, Xin an Street, 518101 Bao' an District, Shenzhen, Guangdong, P.R. China.	
Applicant's name .... :	KOSTAL Solar Electric GmbH	
Address .... :	Hanferstr. 6, Hochdorf, 79108 Freiburg Germany	
Test specification:		
Standard .... :	UNE 217001 IN:2015, RD244:2019	
Test procedure........................... :	AK	
Non-standard test method..........:	N/A	
Test Report Form No. .... :	UNE 217001 IN:2015	
Test Report Form(s) Originator ..... :	TÜV Rheinland Group	
Master TRF .... :	2019-08-16	

Test item description......................:	Grid-connected PV Inverter
Trade Mark...................................:	KOSTAL
Manufacturer ....:	KOSTAL Solar Electric GmbH
Model/Type reference ....:	PIKO CI 50, PIKO CI 60
Ratings ....:	See model list

Testing procedure and testing location:		
☒ See cover page	**TÜV Rheinland (Shenzhen) Co., Ltd.**	
Testing location/ address ....:	See cover page	
☐ **Associated CB 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) .. :		
Approved by (+ signature)........ :		
Testing location/ address ....:		
☒ Testing procedure: WMT		
Tested by (name + signature) .. :	See cover page	
Witnessed by (+ signature)...... :	See cover page	
Approved by (+ signature)........ :	See cover page	
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:





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

ATTACHMENT 1 – Photo documents (13 pages)

Tests performed (name of test and test clause):

Clause	Items
☒ 5.1	Tolerance of stable output
☒ 5.2	Response to load disconnection
☒ 5.3	Response to increases in power in the primary energy source
☒ 5.4	Action in case of loss of communications
☒ 5.5	Determination of the maximum number of generators

☒ The product fulfils the requirements of UNE 217001 IN :2015, RD244:2019

Test on model PIKO CI 60 to represent all models.

Testing location:

The laboratory described on page 3.

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 model list.
Pollution degree ....:	☐ PD 1 ☐ PD 2 ☒ PD 3
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) : APD Shenzhen DK Inc.
1-5/F, No.1, Fengwei Street, Dakang Community Henggang Subdistrict, Long Gang District, Shenzhen, China.

General product information:

Brief description:

The equipment with model names PIKO CI 50, PIKO CI 60 are three phase PV grid inverter which will be installed and connected to the grid network after installation. In final installation the equipment shall be fixed to suitable manner as specified in the installation instruction.

It contains filters for smoothing the output voltage and for EMC, switching and control circuits. Electronic circuits are mounted on a number of PCBs interconnected by appropriate connectors and wires. Power board including electronics components is mounted on the heat sink to earthing by metal screw and spring washer.

There are included a RS485 communication ports which are connected to the upper computer or network to monitor the status of the inverter by proprietary software.

AC output direct connected to grid and Protective Earthing are provided by dedicated earthing terminals. Grid is protected combination with a two series of relays for each phase conductor as redundant build for ensure the inverter can independent disconnected from gird while a relay was fault.

During fault condition defined in this standard, after the DSP receives the abnormal signal from the relevant protective detection circuit, the relays will operate to disconnect the PV inverter active lines from grid automatically.

The master DSP and slaver DSP has capacity independent disconnected from gird, when any grid fault had happened.

The maximum ambient temperature permitted by the manufacturer's specification is 60°C and derate the output power from 45°C.

The inverter has a function that prevent the discharge of energy to the distribution network. When the function is enabled, the inverter read the power Pgrid to grid from meter, then calculate the percentage of output power by the formula(Pgrid/Prated). Finally send the percentage to the slave inverters(if slave inverters are available). The inverter increase or decrease output power according to the positive or negative of the percentage.
The specification of Meter used in sample as below,

Power limiter	1% accuracy Power
Meter Model: KOSTAL Smart Energy Meter	1% accuracy Max current:63A(Higher currents possible via converter.)

Note: In final installation, other power limiter or Meter may be used.

The example of diagram is shown on figure 1 in UNE 217001 IN:2015, RD244: 2019.

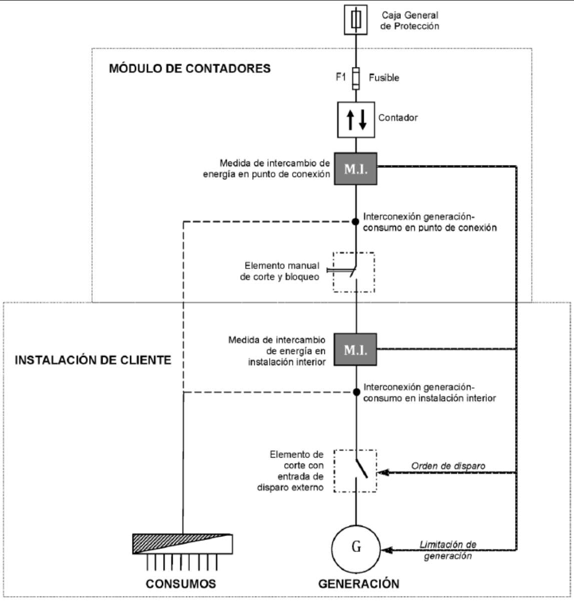


Figura 1 – Esquema con medida de intercambio de energía en instalaciones conectadas a redes de baja tensión

The example of diagram is shown on figure 3 in UNE 217001 IN:2015, RD244: 2019.

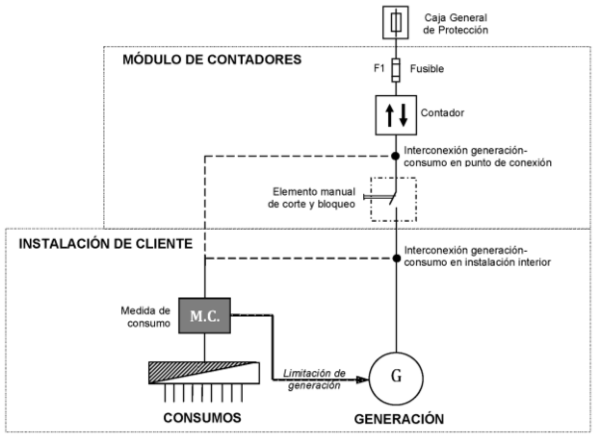


Figura 3 – Esquema con medida de consumo de energía en instalaciones conectadas a redes de baja tensión

<u>Block Diagram:</u>

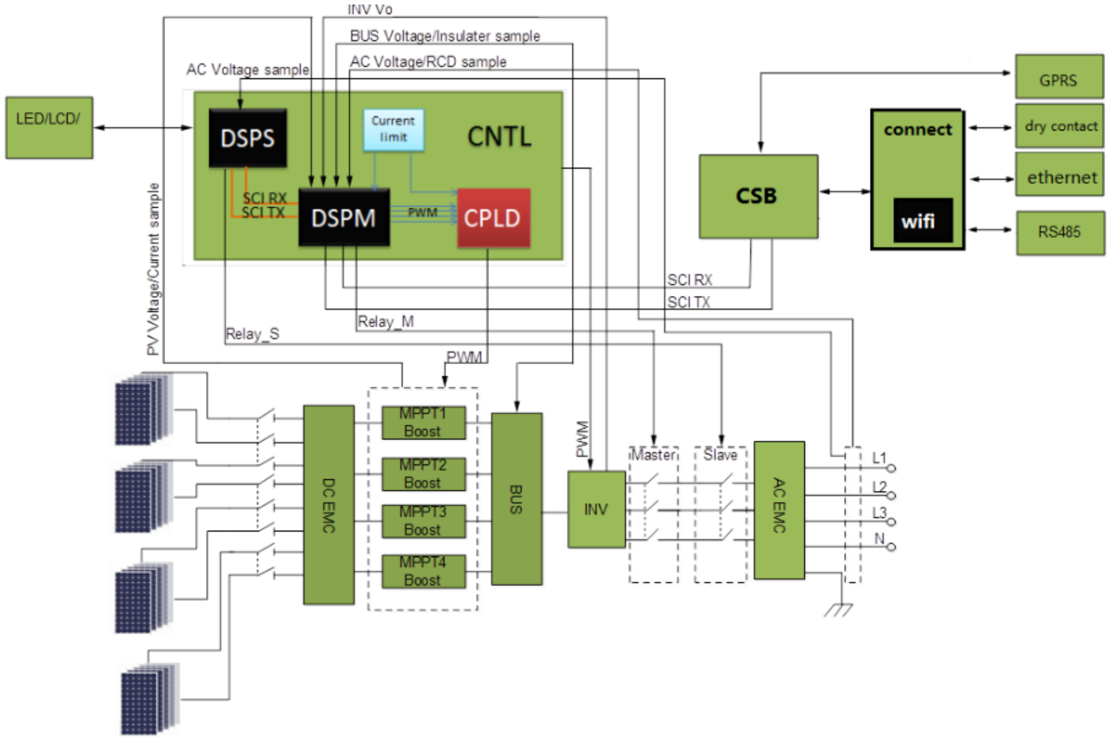


Figure 1 Block diagram

Table 1

Model list		PIKO CI 60	PIKO CI 50
PV INPUT	VMAX PV [Vdc]	1100	
	Isc PV [A]	45/45/45/45	45/45/30/30
	MPP Voltage Range VMPP [Vdc]	200-960	
	Max. Input Current IMAX [A]	33/33/33/33	33/33/22/22
	Overvoltage Category(OVC)	II	
Grid AC OUTPUT	Rated Output Voltage Ur [Vac]	3W+N+PE, 380/400	
	Rated Output Frequency F_{NETZ} [Hz]	50/60	
	Rated Output Power P_E [kW]	60	50
	Max. Output Current Imax [A]	92*3	83*3
	Power Factor cosφ [λ]	0.8Leading ~ 0.8 lagging	
	Overvoltage Category (OVC)	III	

CONSTRUCTION	Type of inverter	Non-transformer
	Type of NS Protection	Integrated
	Protective Class	I
	Enclosure Protection (IP)	IP65
	Operating Temperature Range [ºC]	-25 to 60 (> 45 derating)
	Pollution degree (PD)	PD 2(inside), PD3(outside)
	Firmware version	600101
	Altitude [m]	4000
	Size (WxHxD) [mm]	855mm×710mm×285mm
	Weight [kg]	83
Note:		

UNE 217001 IN:2015, RD244:2019			
Clause	Requirement – Test	Result - Remark	Verdict
4	**Requirements**	See below.	P
	The energy exchange limits indicated in this report, both in magnitude and in time, will apply in cases where the competent authorities do not establish a different requirement.		---
	There are two types of schemes. One in which the exchange of energy with the network is measured and another in which the consumption of all or part of the installation is measured. Maximum acceptable parameters are defined for each of them.	First type of scheme used.	P
	This system must not interfere with the technical requirements that the generator corresponds to meet at the point of connection to the distributor network, for which the generator will give priority to the requirements corresponding to the operation in disturbed regime, ignoring where appropriate change of power of the system that prevents the spillage of energy.		P
4.1	Measure of energy exchange with the network	See below.	P
	Figures 1 and 2 show the diagrams corresponding to this typology in installations connected to low or high voltage networks, respectively.	The diagram in Figure 1 used.	P
	In both cases there are two alternative measurement points, depending on whether the measurement is made at the network connection point or at an internal point. Figure 1 shows the two options mentioned in the introduction (disconnection of the network by means of a cut-off element or regulation of the power exchange), being able to select any of the two options. Additionally, there may be a team or set of teams that perform the control functions, which It is not represented in the figures. The control element can be independent or included in other devices of the installation, such as the power analyzer or the generator.	Test was performed at an internal point.	P
	The power at the selected interconnection point must always be of consumer balance, provided that there is sufficient internal consumption of at least the tolerance value of the measurement system, calculated as the sum of the tolerance of the power analyzer and the class of measurement transformers included in the system.		P
	Failure to comply with the previous requirement must be corrected in less than 2 s.		P
4.2	Consumption measurement	See below.	P

UNE 217001 IN:2015, RD244:2019			
Clause	Requirement – Test	Result - Remark	Verdict
	Figures 3 and 4 show the schemes corresponding to this typology in installations connected to low or high voltage networks, respectively. The consumption measurement may correspond to the total consumption of the installation or to part of its consumption. Additionally, there may be a team or set of teams that perform the control functions, which is not represented in the figures. The control element can be independent or included in other devices of the installation, such as the power analyzer or the generator.	The diagram in Figure 3 used.	P
	The generating installation may only generate when the power consumed at the measuring point exceeds the tolerance value of the measuring system, calculated as the sum of the tolerance of the power analyzer and the class of the measuring transformers included in the system. At all times, the power measured at the point of consumption must be greater than the power generated. The margin of difference between consumption and generation must exceed the tolerance value of the measuring system, calculated as the sum of the tolerance of the power analyzer and the class of the measuring transformers included in the system.		P
	Failure to comply with the previous requirement must be corrected in less than 2 s.		P
5	**Test**		P
	The tests will be carried out according to different regimes described below.		P
5.1	**Tolerance of stable output**		P
	The power limitation system must ensure that in a permanent regime the energy production complies with the requirements of section 3 depending on the type tested. The test must be repeated with the different type generators that will be approved for the system, each of which can be tested separately. To verify this condition, the following test is performed, following the scheme shown in the different figures:		P
	1 Connect the generator to a power source capable of supplying a power equal to or greater than the power of the generator to be tested.		P
	2 Connect the generator to the network to be tested.		P

UNE 217001 IN:2015, RD244:2019			
Clause	Requirement – Test	Result - Remark	Verdict
	3 Set the load value according to the values indicated in table 1.		P
	4 Wait a time of at least two seconds before beginning the measurement.		P
	5 Measure the power exchanged at the test point, with an accuracy of at least 0.2%, making averages of 50 ms.		P
	The test is considered valid if, in a 2-minute test, none of the 50 ms values of the injected power, upstream of the interconnection point between generation and consumption, in each of the phases does not meet the requirements indicated in the sections 4.1 or 4.2, as appropriate.	See appended table 5.1	P
5.2	**Response to load disconnections**		P
	The power limitation system must ensure that in the event of a load disconnection, the generator resets its production again reaching the permanent regime in less than 2 s. The test must be repeated with the different type generators that will be approved for the system, each of which can be tested separately. To verify this condition, the following test is performed, following the scheme that corresponds to the system to be tested, shown in Figures 1 to 4:		P
	1 Connect the generator to a power source capable of supplying a power equal to or greater than the power of the generator to be tested.		P
	2 Connect the generator to the network to be tested.		P
	3 Make the load disconnections proposed in table 2.		P
	4 Measure the power exchanged with the network, with an accuracy of at least 0.2%, making 50 ms averages in a 2 min time window that includes at least one minute before and after the load disconnection.		P
	Repeat each test three times. The test is considered valid if, for each of the loading steps, the generator resets the power produced, reaching the permanent regime, so that the energy injected upstream of the interconnection point between generation and consumption meets the requirements indicated in the sections 4.1 or 4.2, as appropriate. For this, the previous condition must be verified in each of the 50 ms values during the 2 min of the	See appended table 5.2	P

UNE 217001 IN:2015, RD244:2019			
Clause	Requirement – Test	Result - Remark	Verdict
	test.		
	During the disconnection tests it must be verified that the frequency is maintained at all times between 49.5 Hz and 50.2 Hz, tolerance margins indicated in the Technical Report CEN / TR 50549-1 for operation without power modification.		P
5.3	**Response to increases in power at the primary energy source**	See appended table 5.3	P
	The power limitation system must ensure that in the event of an increase in power at the primary energy source, for example a rise in irradiance in a photovoltaic installation, leading to a situation where there is more energy available than consumption, the generator resets its production coming back to the permanent regime in less than 2 s. The test must be repeated with the different type generators that will be approved for the system, each of which can be tested separately. To verify this condition, the following test is performed, following the scheme shown in Figures 1 to 4:		P
	1 Connect the generator to a power source that supplies between 40% and 50% of the power of the generator to be tested.		P
	2 Connect the generator to the network to be tested.		P
	3 Connect a load that consumes between 60% and 70% of the generator power to be tested.		P
	4 Increase by one step the power available in the power source above 90% of the nominal power of the generator to be tested.		P
	5 Measure the power exchanged with the network, with an accuracy of at least 0.2%, making 50 ms averages in a 2 min time window that comprises at least one minute before and after the generator power increase .		P
	Repeat each test three times.		P
	The test is considered valid if for each of the steps the generator resets the power produced by reaching the permanent regime, so that the energy injected upstream of the interconnection point between generation and consumption meets the requirements indicated in sections 4.1 or 4.2 , as appropriate. For this, the previous condition must be verified in		P

UNE 217001 IN:2015, RD244:2019			
Clause	Requirement – Test	Result - Remark	Verdict
	each of the 50 ms values during the 2 min of the test.		
5.4	**Action in case of loss of communications**	See appended table 5.4	P
	The generator must stop generating in case of loss of communication between the different elements of the system in less than 2 s. In case the control element is integrated in one of the minimum required devices (power analyzer or generator) it will not be necessary to check the communication between the elements integrated in the same device.		P
	To verify this condition, the following test is performed, following the scheme shown in Figures 1 to 4:		P
	1 Connect the generator to a power source capable of supplying a power equal to or greater than the power of the generator to be tested.		P
	2 Connect the generator to the internal network to be tested.		P
	3 Set a load of 60% and 70% of the nominal power of the generator.		P
	4 Cut off the communication between the control element and the power analyzer.		P
	5 Measure the time elapsed between the communication cut-off and the disconnection of the generator or total generator power limitation (0%).		P
	6 Measure the power generated by the generator, with an accuracy of at least 0.2%, making averages of 50 ms.		P
	The test will be repeated 3 times.		P
	The test is considered valid if the generator is disconnected or totally limits its generated power in less than 2 s. Repeat the test by cutting off the communication between the control element and the generator.		P
5.5	**Determination of the maximum number of generators**	See appended table 5.5	P
	In the event that the power reduction system can be used with more than one generator, the following tests will be repeated with two generators working in parallel, each contributing between 40% and 60% of the total load power , so that both cover 100% of consumption.		P

UNE 217001 IN:2015, RD244:2019			
Clause	Requirement – Test	Result - Remark	Verdict
	1 Tolerance in permanent regime.		
	2 Response to load disconnections.		P
	In this case, the response times of the system will be measured and compared with the times obtained in the case of a single generator. The resulting time difference will allow to determine the maximum number of generators that can be connected in the installation according to:		P
	$t_1 + t_r \cdot (N-1) \leq 2\ s$ $N \leq \frac{2 - t_1}{t_r} + 1$ N maximum number of generators that can be included in the system; t1 Response time with a single generator. the maximum response time obtained will be taken tr difference between the maximum response time with one and two generators		P
6	**Report form**		P
	The test report must include at least the following:		P
	1 Basic scheme of the system.	As figure 1.	P
	2 Power analyzer and class of measurement transformers for power measurement.	Power limiter model KOSTAL Smart Energy Meter used. The specification see general product information.	P
	3 Control element. If it is included in any of the system devices, for example in the Power analyzer or generator, should be reflected.	Controlled relay included in the inverter. Model: 511H/HF172F/ HF167F/HE1aN/CHAR Manufacturer: Song Chuan/HF /Panasonic/Churod Coil:12Vdc,<0.5A Contact: 90/100A,690Vac	P
	4 Type of communications used between the different elements.	RS 485	P
	5 Generators type for which the system is valid.	PV inverter.	P
	6 Power of the type generator tested and similar	See general product	P

UNE 217001 IN:2015, RD244:2019			
Clause	Requirement – Test	Result - Remark	Verdict
	generators / analyzers.	information.	
	7 Control algorithm.	See general product information.	P
	8 Electrical characteristics of the generator.	See general product information.	P
	9 Maximum number of generators to connect.	Meter on grid:30 Meter on load:7	P

5.1	TABLE: Tolerance of stable output			P
Load condition	Voltage(V)	Current from grid to load(A)	Power from grid to load(kW)	Limited Power from grid to load) (kW)
PIKO CI 60				
Meter on grid				
Three phase inverter（1）				
90-100%(R)	230	8.4	1.35	>0
90-100%(S)	230	8.4	1.39	>0
90-100%(T)	230	8.6	1.46	>0
Three phase inverter（2）				
10-20%(R)	230	6.2	1.31	>0
10-20%(S)	230	6.2	1.35	>0
10-20%(T)	230	6.3	1.39	>0
Three phase inverter（3）				
90-100%(R)	230	32.4	7.41	>0
60-70%(S)	230	6.5	1.44	>0
60-70%(T)	230	6.5	1.42	>0
Three phase inverter（4）				
30-40%(R)	230	6.6	1.46	>0
60-70%(S)	230	30.4	6.97	>0
60-70%(T)	230	30.2	6.88	>0
Three phase inverter（5）				
0	230	1.9	0.09	>0
60-70%(S)	230	47.7	10.92	>0
60-70%(T)	230	47.4	11.07	>0

Meter on load				
Three phase inverter（1）				
90-100%(R)	230	4.6	0.54	>0
90-100%(S)	230	3.4	0.28	>0
90-100%(T)	230	3.7	0.47	>0
Three phase inverter（2）				
10-20%(R)	230	3.1	0.31	>0
10-20%(S)	230	2.6	0.24	>0
10-20%(T)	230	2.9	0.32	>0
Three phase inverter（3）				
90-100%(R)	230	29.1	6.56	>0
60-70%(S)	230	2.6	0.29	>0
60-70%(T)	230	2.9	0.39	>0
Three phase inverter（4）				
30-40%(R)	230	3.2	0.28	>0
60-70%(S)	230	27.8	6.34	>0
60-70%(T)	230	28.4	6.53	>0
Three phase inverter（5）				
0	230	2.1	0.05	>0
60-70%(S)	230	49.3	11.31	>0
60-70%(T)	230	49.9	11.42	>0

Note:

1. The Generator connected to a Power Source capable of providing a Power equal to or exceeding the power of the Generator test.

2. Connect the Generator to the network to test.

3. Set the value of load according to the values shown in Table 1.

4. Wait for a time of at least two seconds before the start of the measure.

5. Measuring the Power exchanged at the test Point, with an accuracy of at least 0.2%, making stockings 50 ms.

5.2	TABLE: Response to load disconnection					P
Load condition	Power from grid to load(kW)			Limited Power from grid to load) (kW)	Time of feed into grid(s)	Time limit(s)
PIKO CI 60						
Meter on grid						
90-100% to 60-70%						
90-100% (1st)	R:1.43	S:1.46	T:1.51	>0	0.40	2
60-70%(1st)	R:1.48	S:1.53	T:1.59	>0		
90-100%(2nd)	R:1.35	S:1.42	T:1.47	>0	0.45	2
60-70%(2nd)	R:1.59	S:1.64	T:1.70	>0		
90-100%(3rd)	R:1.48	S:1.53	T:1.58	>0	0.75	2
60-70%(3rd)	R:1.54	S:1.61	T:1.68	>0		
90-100% to 30-40%						
90-100% (1st)	R:1.46	S:1.53	T:1.65	>0	0.50	2
30-40%(1st)	R:1.34	S:1.41	T:1.47	>0		
90-100%(2nd)	R:1.42	S:1.48	T:1.61	>0	0.40	2
30-40%(2nd)	R:1.35	S:1.42	T:1.49	>0		
90-100%(3rd)	R:1.48	S:1.47	T:1.62	>0	0.55	2
30-40%(3rd)	R:1.47	S:1.52	T:1.57	>0		
90-100% to 0%						
90-100% (1st)	R:1.48	S:1.56	T:1.64	>0	1.10	2
0%(1st)	R:0.09	S:0.09	T:0.09	>0		
90-100%(2nd)	R:1.45	S:1.50	T:1.59	>0	1.65	2
0%(2nd)	R:0.09	S:0.09	T:0.09	>0		
90-100%(3rd)	R:1.47	S:1.52	T:1.60	>0	0.65	2
0%(3rd)	R:0.09	S:0.09	T:0.09	>0		

5.2(Continue)	TABLE: Response to load disconnection					P
Load condition	Power from grid to load(kW)			Limited Power from grid to load) (kW)	Time of feed into grid(s)	Time limit(s)
60-70% to 30-40%						
60-70%(1st)	R:1.34	S:1.44	T:1.52	>0	0.50	2
30-40%(1st)	R:1.36	S:1.43	T:1.54	>0		
60-70%(2nd)	R:1.50	S:1.55	T:1.62	>0	0.45	2
30-40%(2nd)	R:1.41	S:1.45	T:1.50	>0		
60-70%(3rd)	R:1.33	S:1.43	T:1.52	>0	0.55	2
30-40%(3rd)	R:1.40	S:1.46	T:1.50	>0		
60-70% to 0%						
60-70%(1st)	R:1.47	S:1.51	T:1.57	>0	1.05	2
0%(1st)	R:0.09	S:0.09	T:0.09	>0		
60-70%(2nd)	R:1.40	S:1.43	T:1.50	>0	1.10	2
0%(2nd)	R:0.09	S:0.09	T:0.09	>0		
60-70%(3rd)	R:1.41	S:1.46	T:1.53	>0	0.95	2
0%(3rd)	R:0.09	S:0.09	T:0.09	>0		
30-40% to 0%						
30-40%(1st)	R:1.33	S:1.43	T:1.46	>0	1.10	2
0%(1st)	R:0.09	S:0.09	T:0.09	>0		
30-40%(2nd)	R:1.32	S:1.43	T:1.46	>0	1.35	2
0%(2nd)	R:0.09	S:0.09	T:0.09	>0		
30-40%(3rd)	R:1.33	S:1.43	T:1.46	>0	1.20	2
0%(3rd)	R:0.09	S:0.09	T:0.09	>0		

5.2(Continue)	TABLE: Response to load disconnection					P
Load condition	Power from grid to load(kW)			Limited Power from grid to load) (kW)	Time of feed into grid(s)	Time limit(s)
Meter on load						
90-100% to 60-70%						
90-100% (1st)	R:0.35	S:0.12	T:0.37	>0	0.66	2
60-70%(1st)	R:0.09	S:0.04	T:0.08	>0		
90-100%(2nd)	R:0.50	S:0.24	T:0.54	>0	0.58	2
60-70%(2nd)	R:0.48	S:0.28	T:0.48	>0		
90-100%(3rd)	R:0.53	S:0.27	T:0.57	>0	0.50	2
60-70%(3rd)	R:0.49	S:0.30	T:0.50	>0		
90-100% to 30-40%						
90-100% (1st)	R:0.56	S:0.31	T:0.59	>0	0.40	2
30-40%(1st)	R:0.31	S:0.21	T:0.39	>0		
90-100%(2nd)	R:0.54	S:0.27	T:0.58	>0	0.66	2
30-40%(2nd)	R:0.29	S:0.19	T:0.37	>0		
90-100%(3rd)	R:0.54	S:0.28	T:0.59	>0	0.48	2
30-40%(3rd)	R:0.29	S:0.20	T:0.38	>0		
90-100% to 0%						
90-100% (1st)	R:0.51	S:0.25	T:0.56	>0	0.60	2
0%(1st)	R:0.10	S:0.04	T:0.09	>0		
90-100%(2nd)	R:0.52	S:0.26	T:0.57	>0	0.64	2
0%(2nd)	R:0.09	S:0.03	T:0.08	>0		
90-100%(3rd)	R:0.52	S:0.26	T:0.57	>0	0.56	2
0%(3rd)	R:0.10	S:0.04	T:0.09	>0		

5.2(Continue)	TABLE: Response to load disconnection					P
Load condition	Power from grid to load(kW)			Limited Power from grid to load) (kW)	Time of feed into grid(s)	Time limit(s)
60-70% to 30-40%						
60-70%(1st)	R:0.42	S:0.31	T:0.47	>0	0.50	2
30-40%(1st)	R:0.29	S:0.20	T:0.37	>0		
60-70%(2nd)	R:0.42	S:0.32	T:0.48	>0	0.48	2
30-40%(2nd)	R:0.29	S:0.20	T:0.37	>0		
60-70%(3rd)	R:0.34	S:0.22	T:0.40	>0	0.48	2
30-40%(3rd)	R:0.28	S:0.18	T:0.36	>0		
60-70% to 0%						
60-70%(1st)	R:0.37	S:0.26	T:0.43	>0	0.60	2
0%(1st)	R:0.09	S:0.03	T:0.08	>0		
60-70%(2nd)	R:0.41	S:0.30	T:0.47	>0	0.60	2
0%(2nd)	R:0.09	S:0.03	T:0.08	>0		
60-70%(3rd)	R:0.39	S:0.28	T:0.45	>0	0.66	2
0%(3rd)	R:0.09	S:0.03	T:0.08	>0		
30-40% to 0%						
30-40%(1st)	R:0.44	S:0.39	T:0.48	>0	0.44	2
0%(1st)	R:0.09	S:0.04	T:0.09	>0		
30-40%(2nd)	R:0.43	S:0.32	T:0.47	>0	0.46	2
0%(2nd)	R:0.08	S:0.03	T:0.07	>0		
30-40%(3rd)	R:0.44	S:0.33	T:0.49	>0	0.50	2
0%(3rd)	R:0.08	S:0.03	T:0.07	>0		

Note:

1. The Generator connected to a Power Source capable of providing a Power equal to or exceeding the power of the

Generator test.

2. Connect the Generator to the network to test

3. Perform the intended load proposed in Table 2.

4. Measuring the Power exchanged with the Network, with a precision of at least 0.2%, with average of 50 ms in a Time window of 2 min at least one minute before and after load shedding.

5.3	TABLE: Response to increases in power in the primary energy source					P
Transfer of power condition	Power from grid to load(kW)			Limited Power from grid to load) (kW)	Time of feed into grid(s)	Time limit(s)
PIKO CI 60						
Meter on grid						
40-50% (1st)	R:3.41	S:3.44	T:3.47	>0	0.25	2
>90%(1st)	R:1.57	S:1.54	T:1.59	>0		
40-50% (2nd)	R:3.38	S:3.43	T:3.44	>0	0.55	2
>90%(2nd)	R:1.55	S:1.55	T:1.59	>0		
40-50% (3rd)	R:3.37	S:3.40	T:3.42	>0	0.55	2
>90%(3rd)	R:1.53	S:1.50	T:1.55	>0		
Meter on load						
40-50% (1st)	R:4.03	S:3.91	T:3.99	>0	0.50	2
>90%(1st)	R:0.46	S:0.31	T:0.39	>0		
40-50% (2nd)	R:4.05	S:3.94	T:4.01	>0	0.14	2
>90%(2nd)	R:0.45	S:0.29	T:0.37	>0		
40-50% (3rd)	R:4.03	S:3.92	T:3.98	>0	0.26	2
>90%(3rd)	R:0.45	S:0.28	T:0.37	>0		

Note:

1. Connect the generator to an energy source that provides 40% to 50% of the power of the generator for testing.

2. Connect the Generator to the network to test.

3. Connect a load to consume between 60% and 70% of the Power Generator to be tested.

4. A Step increase in available Power in the Energy Source, above 90% of the potencianominal Generator test.

5. Measure the Power exchanged with the Network, with a precision of at least 0.2%, with average of 50 ms in a Time window of 2 min at least one minute before and after the increme Much of the power of the Generator.

5.4	TABLE: Action in case of loss of communications					P
Communication status	Power from grid to load(kW)			Limited Power from grid to load) (kW)	Time of cease output power(s)	Time limit(s)
PIKO CI 60						
Meter on grid						
Normal(1st)	R:1.39	S:1.48	T:1.53	>0	0.75	2
Loss(1st)	R:10.6	S:10.7	T:10.8	>0		
Normal(2nd)	R:1.44	S:1.52	T:1.58	>0	0.67	2
Loss(2nd)	R:10.5	S:10.6	T:10.8	>0		
Normal(3rd)	R:1.33	S:1.45	T:1.53	>0	0.74	2
Loss(3rd)	R:10.4	S:10.6	T:10.8	>0		
Meter on load						
Normal(1st)	R:0.48	S:0.31	T:0.40	>0	0.72	2
Loss(1st)	R:13.1	S:13.0	T:13.0	>0		
Normal(2nd)	R:0.45	S:0.47	T:0.39	>0	1.00	2
Loss(2nd)	R:13.1	S:13.0	T:13.0	>0		
Normal(3rd)	R:0.48	S:0.32	T:0.41	>0	1.14	2
Loss(3rd)	R:13.1	S:13.0	T:13.0	>0		

Note:

1. The Generator connected to a Power Source capable of providing a Power equal to or exceeding the power of the Generator test

2. Connect the Generator to the network to test.

3. Establish a load of 60% and 70% of the nominal Power of the Generator.

4. Cut Off the communication between the control Element and the Power Analyzer

5. Measure the elapsed time between the Cutting of the communication and disconnection of the generator or total limit of generator Power (0%).

6. To measure the Power generated by the Generator, with a precision of at least 0.2%, with average of 50 ms.

5.5	TABLE: Determination of the maximum number of generators					P
Transfer of power condition	Power from grid to load(kW)			Limited Power from grid to load) (kW)	Time of feed into grid(s)	Time limit(s)
PIKO CI 60						
Meter on grid						
Single generators						
100%	R:1.48	S:1.47	T:1.62	>0	0.55	2
33%	R:1.47	S:1.52	T:1.57	>0		
Two generators						
100%	R:2.87	S:2.94	T:3.20	>0	0.50	2
33%	R:2.78	S:2.86	T:3.19	>0		
t1=0.55s t_r=0.55-0.50=0.05s N≤(2-t1)/t_r+1=[(2-0.55)/0.05]+1 N≤30						
Meter on load						
Single generators						
100%	R:1.48	S:1.47	T:1.62	>0	0.66	2
33%	R:1.47	S:1.52	T:1.57	>0		
Two generators						
100%	R:0.54	S:0.27	T:0.58	>0	0.46	2
33%	R:0.29	S:0.19	T:0.37	>0		
t1=0.66s t_r=0.66-0.46=0.20s N≤(2-t1)/t_r+1=[(2-0.66)/0.20]+1 N≤7						
Note: $t_1 + t_r \cdot (N-1) \leq 2\ s$ $N \leq \frac{2-t_1}{t_r} + 1$ N Maximum number of generators that can be included in the system; t1 Response time with a single generator. the maximum response time obtained will be taken tr Difference between the maximum response time with one and two generators						

End of test report

PHOTO DOCUMENTATION

CN216DF1 001 attachment 1

for

Grid-connected PV inverter

PIKO CI 50, PIKO CI 60

KOSTAL Solar Electric GmbH

This documentation consists of 13 pages (excluding this cover page)

Model: as cover

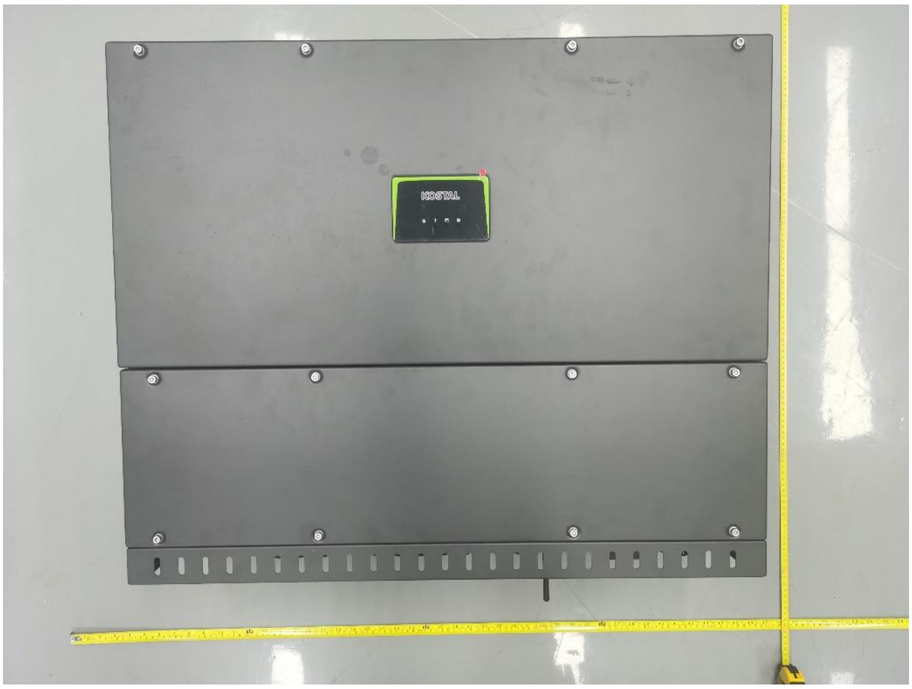


Figure 1. Rear view

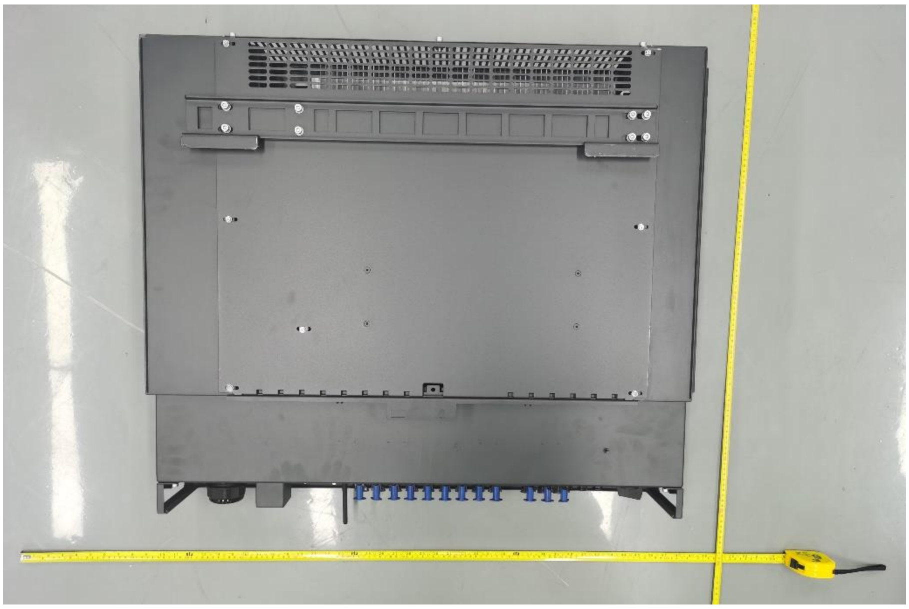


Figure 2. Rear view

Model: as cover

Figure 3. Top view

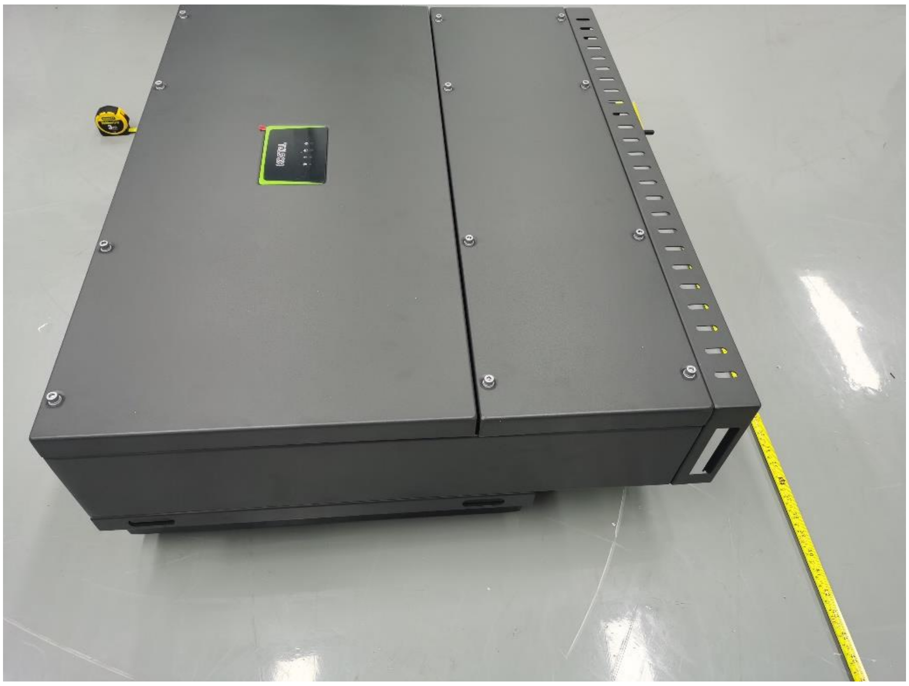


Figure 4. Left view

Model: as cover

Figure 5. Bottom view

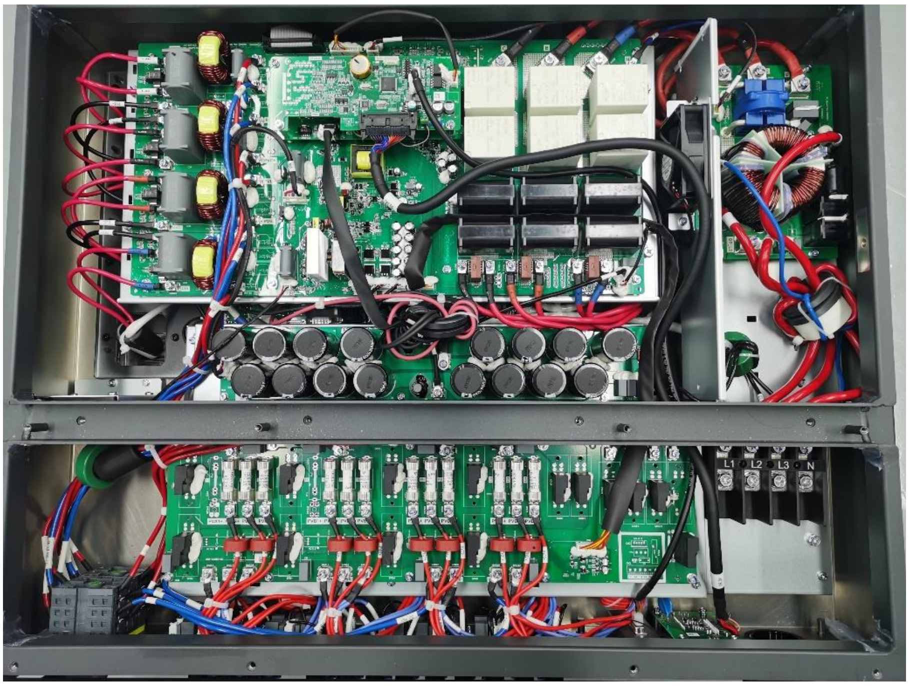


Figure 6. Internal view

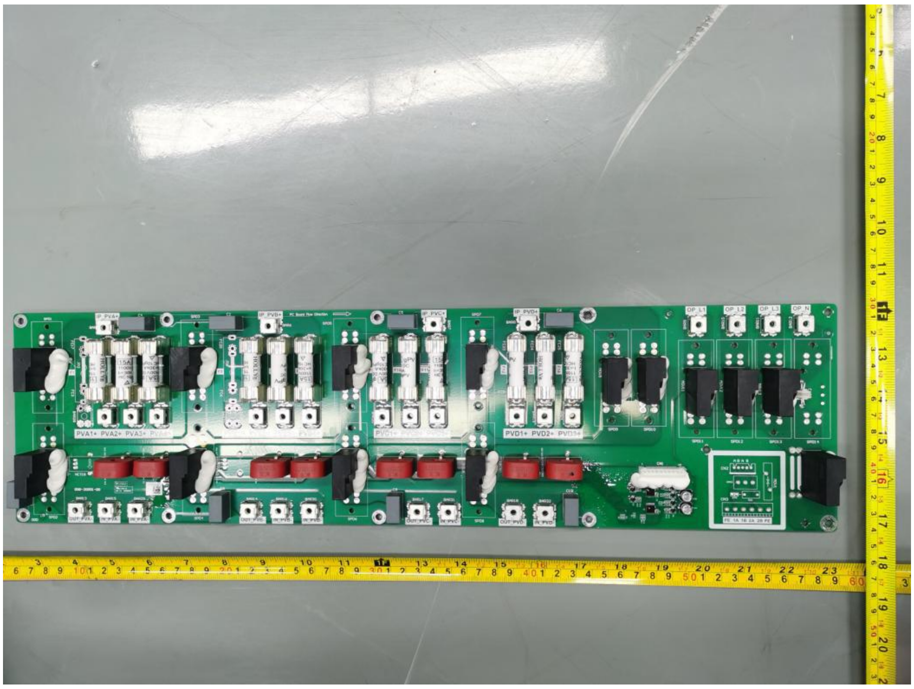


Figure 7. Input board component side view

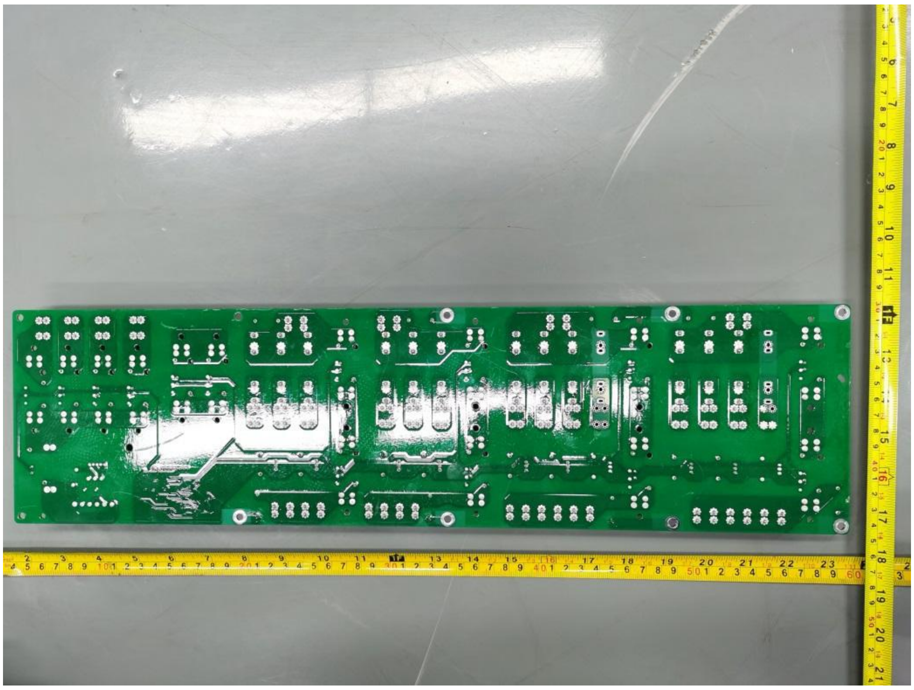


Figure 8. Input board solder side view

Model: as cover

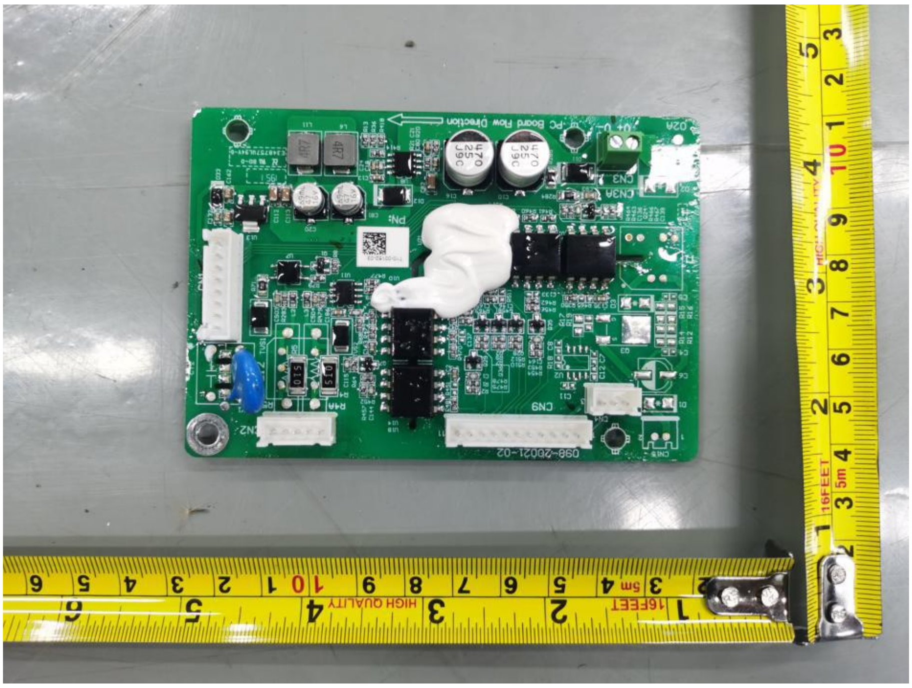


Figure 9. Communication board component side view

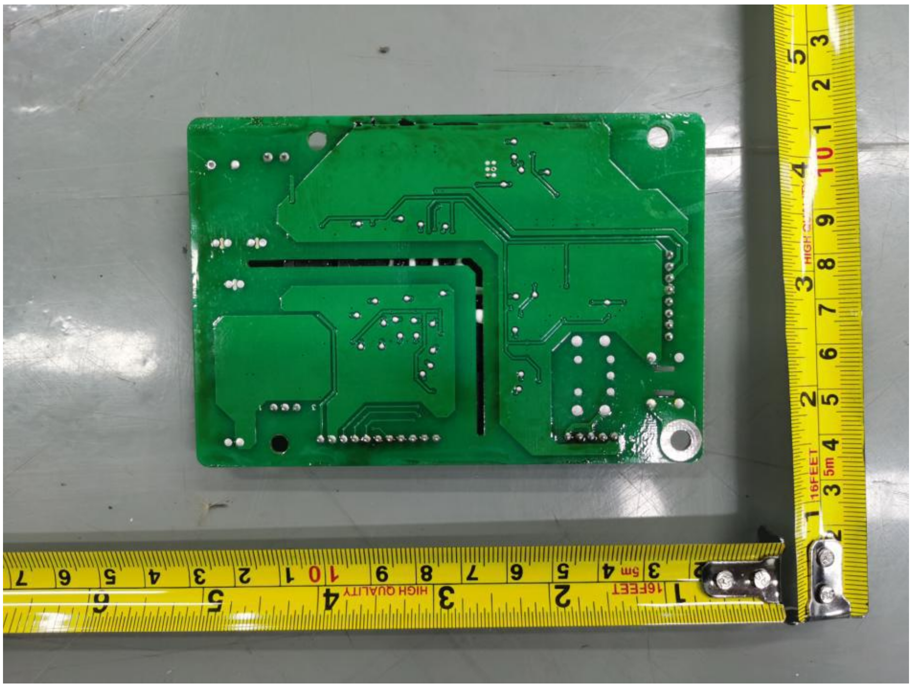


Figure 10. Communication board solder side view

Model: as cover

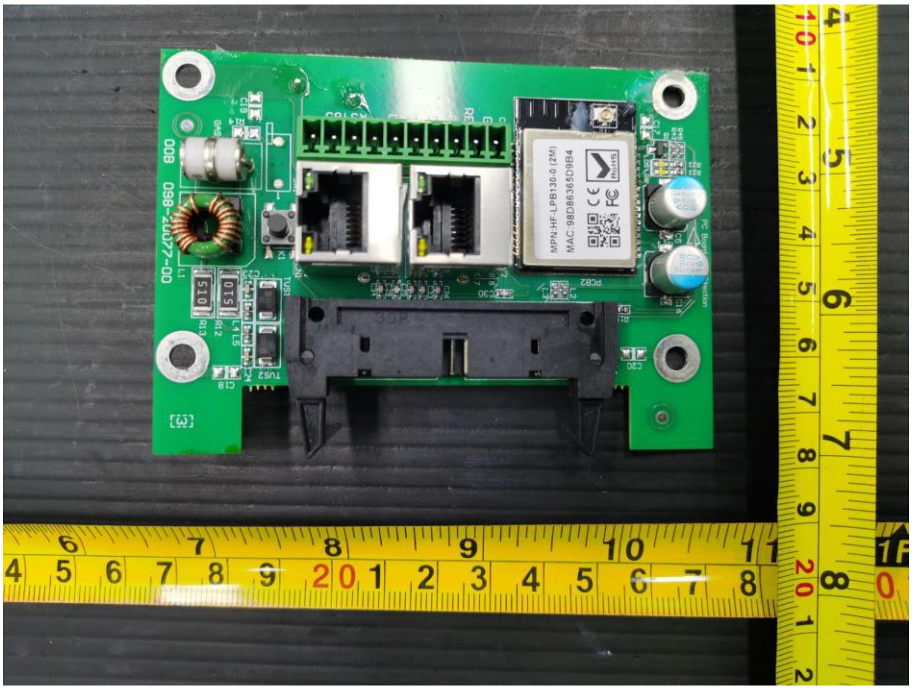


Figure 11. Communication board component side view

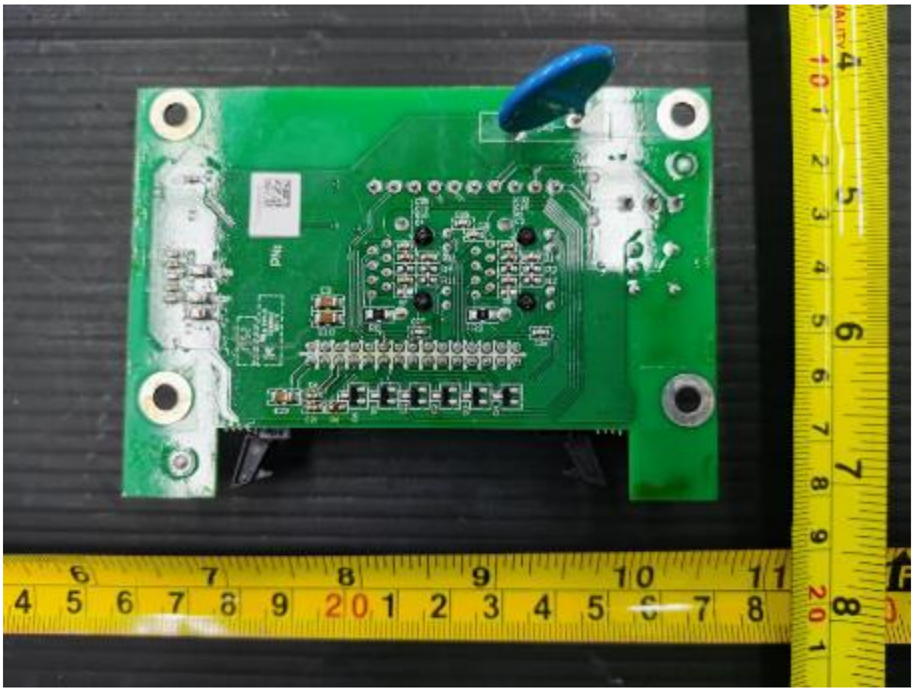


Figure 12. Communication board solder side view

Figure 13. Control board component side view

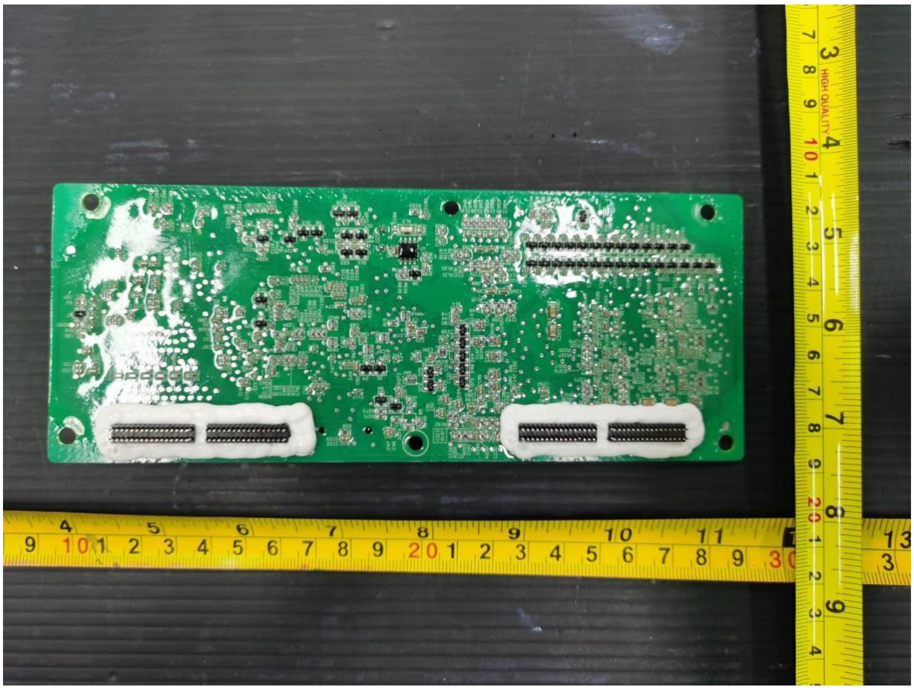


Figure 14. Control board solder side view

Model: as cover

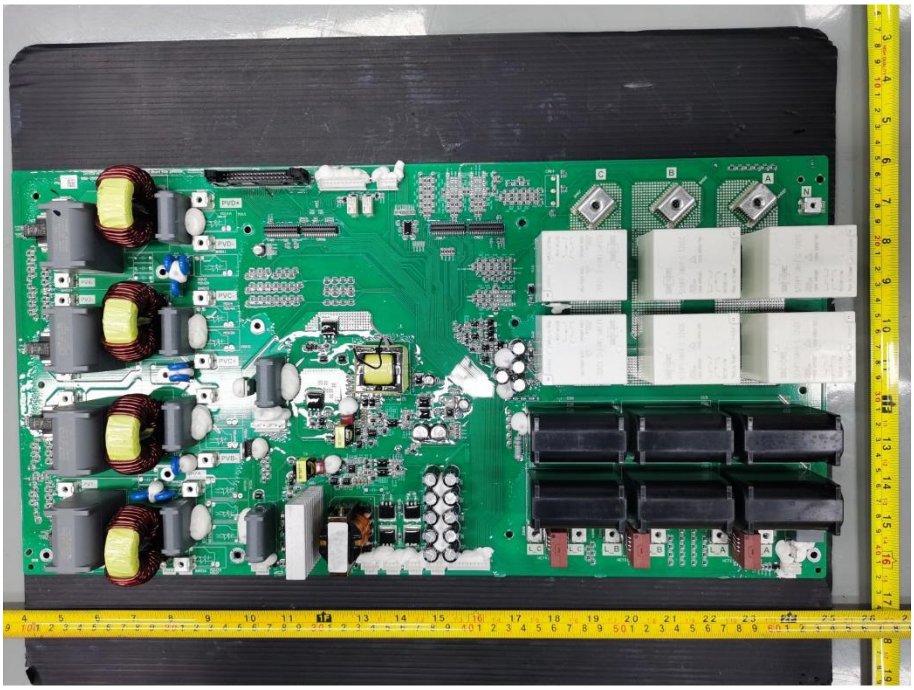


Figure 15. AC board component side view

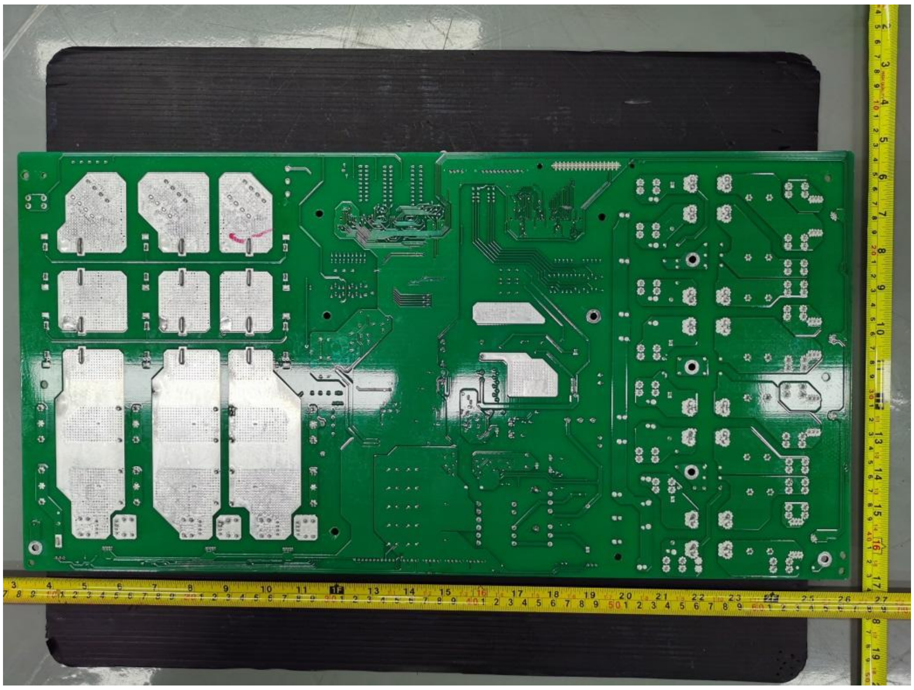


Figure 16. AC board solder side view

Model: as cover

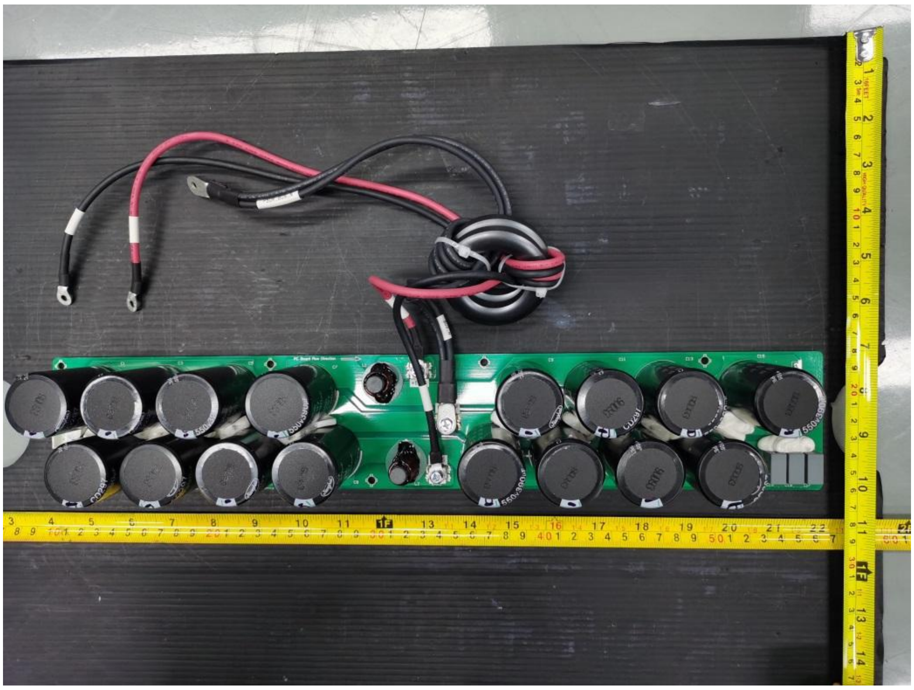


Figure 17. Capacitor board component side view

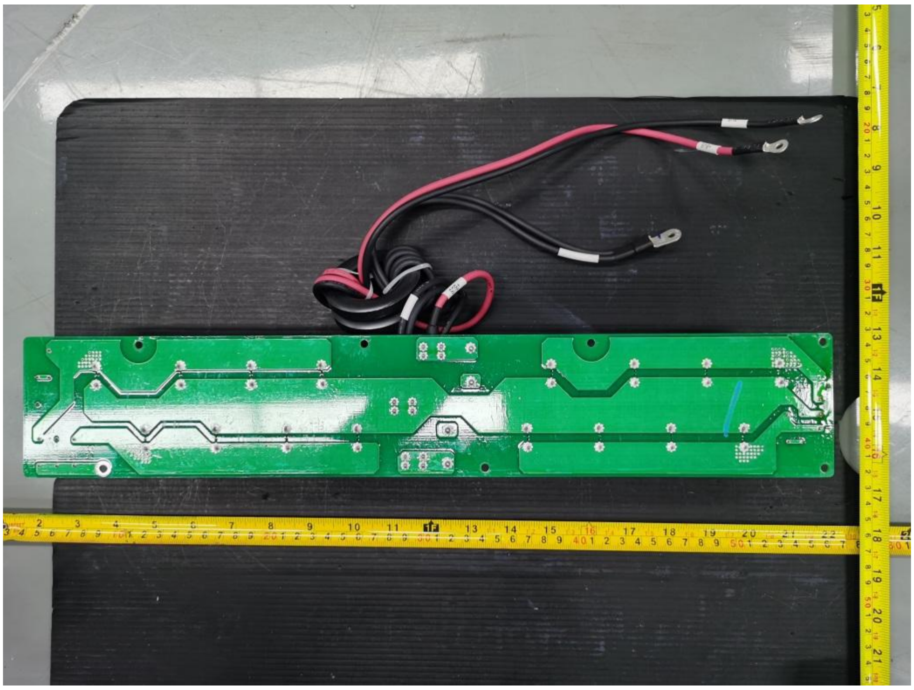


Figure 18. Capacitor board solder side view

Model: as cover

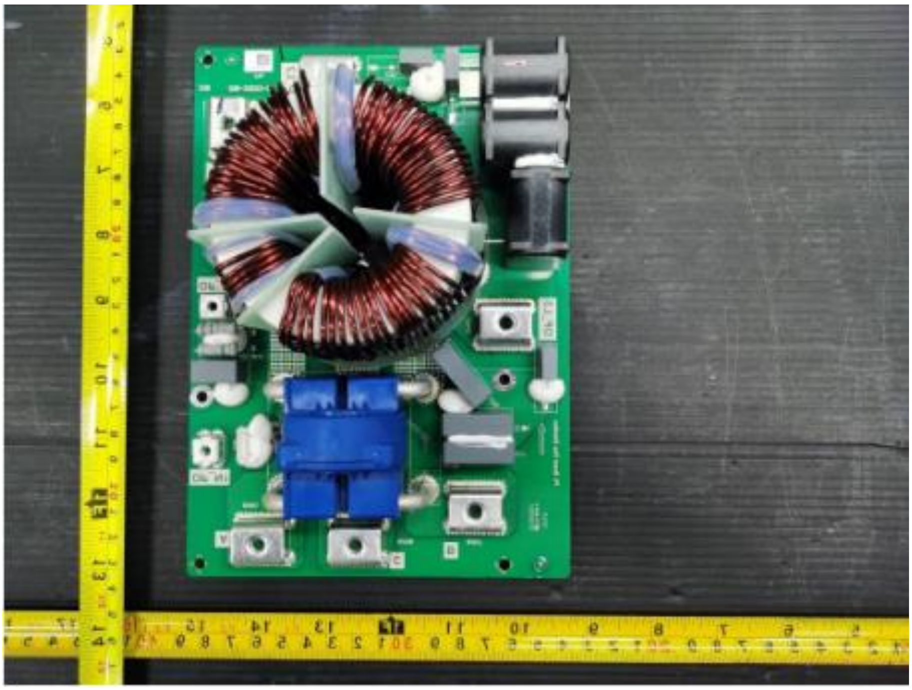


Figure 19. Output board component side view

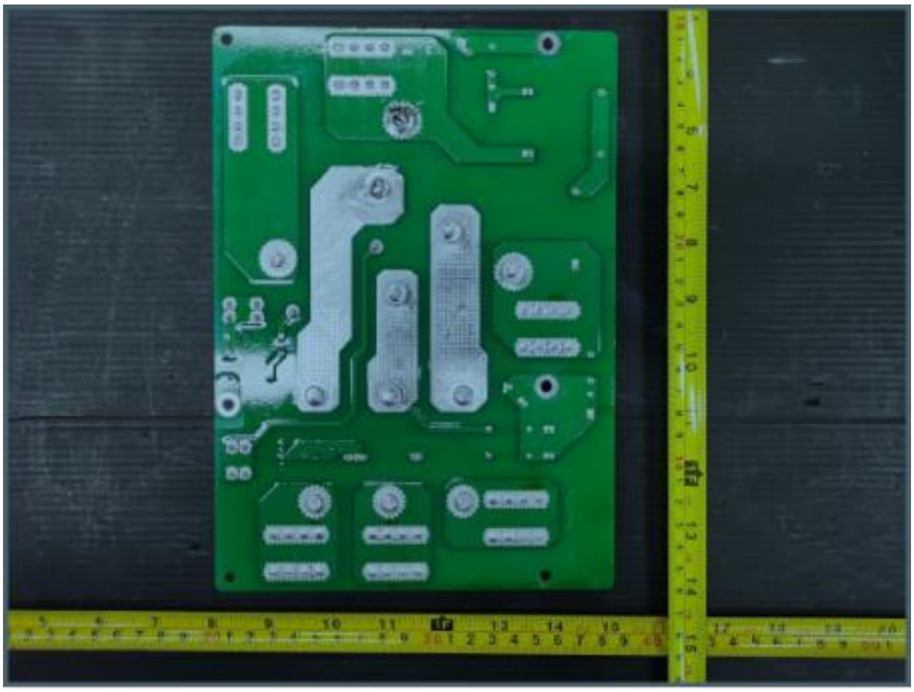


Figure 20. Output board component solder view

Figure 21. Inverter board component side view

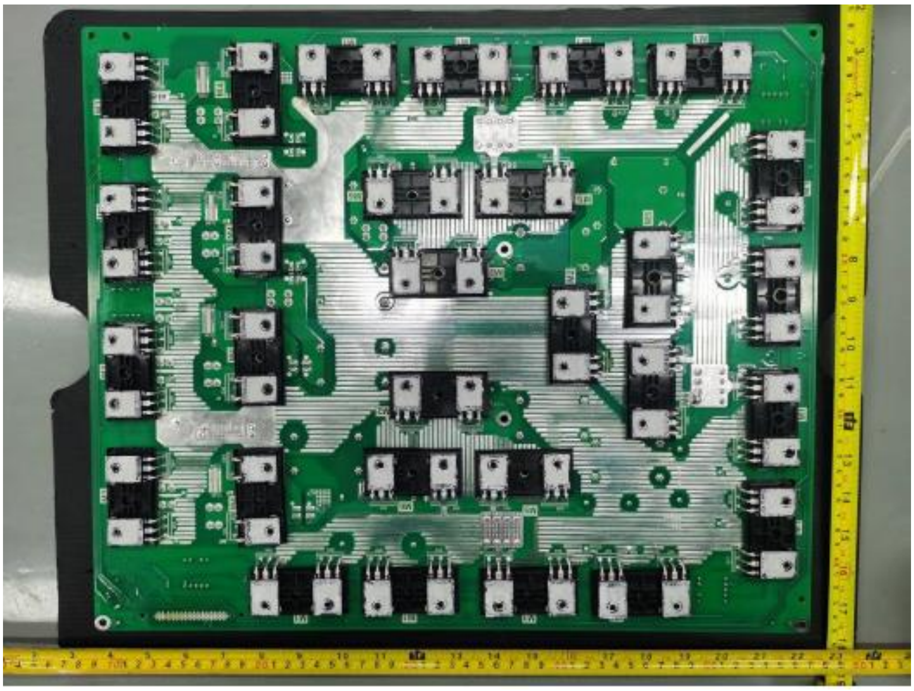


Figure 22. Inverter board component solder view

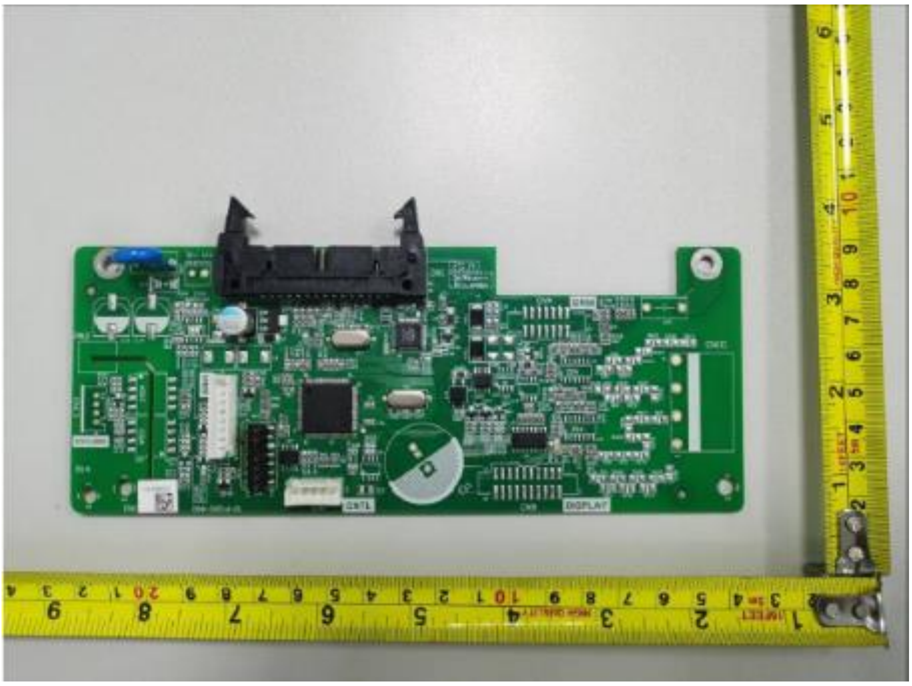


Figure 23.CSB board component side view

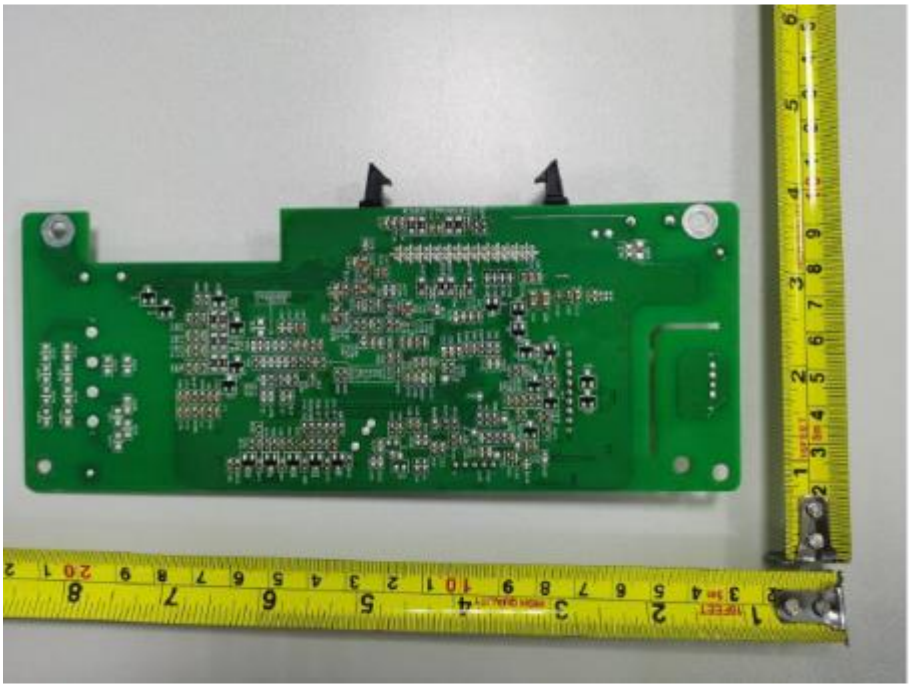


Figure 24.CSB board solder side view

Model: as cover

Figure 25. General Earthing terminal view

Figure 26. DC switch view