Certificate of compliance

Applicant:	**KOSTAL Solar Electric GmbH** Hanferstraße 6 79108 Freiburg im Breisgau Germany
Product:	**Grid-tied photovoltaic (PV) inverter**
Model:	**PIKO CI 50** **PIKO CI 60**

Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with EN 50549-2:2019 for photovoltaic systems with a three-phase parallel coupling via an inverter in the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter.

Connection rule:	**EN 50549-2:2019:** Requirements for generating plants to be connected in parallel with distribution networks - Part 2: Connection to a MV distribution network - Generating plants up to and including Type B

The power generating units, stated in the certificate, were tested and certified according to the technical guidelines referenced to the grid connection regulation. The electrical characteristics fulfil the requirements of the grid connection regulation:

- 4.4 Normal operating range
- 4.5 Immunity to disturbances
- 4.6 Active response to frequency deviation
- 4.7 Power response to voltage changes
- 4.8 EMC and power quality
- 4.9 Interface protection
- 4.10 Connection and starting to generate electrical power
- 4.11 Ceasing and reduction of active power on set point

At the time of issue of this certificate, the safety concept of an aforementioned representative product corresponds to the valid safety specifications for the specified use in accordance with regulations.

Report number:	**20TH0372_EN50549-2_0**	**Certification scheme:**	**NSOP-0032-DEU-ZE-V01**
Certificate number:	**U20-0756**	**Date of issue:**	**2020-09-22**

Certification body

Thomas Lammel

DAkkS Deutsche Akkreditierungsstelle D-ZE-12024-01-00

Certification body of Bureau Veritas Consumer Products Services Germany GmbH accredited according to DIN EN ISO/IEC 17065

A partial representation of the certificate requires the written approval of Bureau Veritas Consumer Products Services Germany GmbH

Extract from test report according to EN 50549-2	Nr. 20TH0372_EN50549-2_0

Type Approval and declaration of compliance with the requirements of EN 50549-2	
Product description:	Grid-tied photovoltaic inverter

Unit / Type:	**PIKO CI 50**	**PIKO CI 60**
Input DC voltage range [V]:	200-1100	
Full-Load MPP DC voltage range [V]:	540-800	
Input DC current [A]:	max. 33 / 33 / 22 / 22	max. 33 / 33 / 33 / 33
Nominal output AC voltage [V]:	230 / 400, 3~ + N + PE; 50 Hz	
Max. output AC current [A]:	83,0	92,0
Nominal Output AC current [A]:	72,5	87,0
Nominal active output power [kW]:	50,0	60,0
Max. apparent output power [kVA]:	55,0	66,0
Firmware version:	V50KTLQ3	V60KTLQ3
Software version:	600101	

Description of the structure of the power generation unit:

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

Parameter Table

Parameter list of PIKO CI 50 / PIKO CI 60

1. Information regarding the power generating unit

Type designation	Rated power [kW]	Rated active current [A] (at cosφ = 1)
PIKO CI 50	50	72.5
PIKO CI 60	60	87

2. Parameter set during the measurement

If no noted otherwise the following standard parameters were used during the measurement.

All adaptations to the standard parameters used during the measurement were documented in the EN50549-2 test report.

3. Main Components of the regulating system

Main components of the control system with firmware and software	
Main component(s) of the control system	Control system integrated in the PGU
Firmware version	V50KTLQ3, V60KTLQ3
Software version	600101

4. Relevant parameters for the electrical behaviour

No.	Name	Description	Unit	Setting range		Default value (acc. to parameter set)
				Min.	Max.	
General parameter settings (rated values or reference values)						
1	Pn	Rated active power	kW	parameter not adjustable		50KTL: 50 60KTL: 60
2	Smax	Max apparent power	kVA	parameter not adjustable		50KTL: 55 60KTL: 66
3	Un	Rated voltage	V	parameter not adjustable		400
4	In	Rated current	A	parameter not adjustable		50KTL: 73 60KTL: 87
5	Fn	Rated frequency	Hz	parameter not adjustable		50
4.4.2 Operating frequency range						
6	47Hz – 49.0Hz duration	47Hz – 49.0Hz duration	---	Time period for operation is greater than 30min		
7	49Hz – 51.0Hz duration	49Hz –51.0Hz duration	---	Time period for operation is unlimited		
8	51Hz – 52.0Hz duration	51Hz –52.0Hz duration	---	Time period for operation is greater than 30min		

No.	Name	Description	Unit	Setting range		Default value (acc. to parameter set)
				Min.	Max.	
4.4.3 Minimal requirement for active power delivery at underfrequency						
9	Minimal active power at underfrequency	Minimal active power at underfrequency Not derating at underfrequency	% Pn	parameter not adjustable		100%Pn
4.4.4 Continuous operating voltage range						
10	Voltage Range Lower limit	Voltage Range Lower limit	p.u	parameter not adjustable		0.85Un
11	Voltage Range Upper limit	Voltage Range Upper limit	p.u	parameter not adjustable		1.1Un
4.5.2 Rate of change of frequency (ROCOF) immunity						
12	ROCOF immunity	ROCOF immunity	Hz/s	parameter not adjustable		2Hz/s
4.5.3 Low voltage ride through(LVRT) **4.5.4 Over-voltage ride through (OVRT)** **4.7.4 Zero current mode for converter connected generating plants**						
12	FRT function Enable/Disable	FRT function setting	---	Enable/Disable		Enable
13	FRT Mode	FRT Mode setting	---	0: zero current mode 1: full grid support mode		Full grid support mode
14	K_Factor_pos	K_factor for positive sequence	0.1	0	6.0	2.0
15	K_Factor_neg	K_factor for negative sequence	0.1	0	6.0	2.0
16	Grid voltage protection shield	Enable or disable grid voltage protection during FRT	---	Enable/Disable		Enable
17	LVRT triggering shreshold	LVRT triggering shreshold	p.u.	0.1Un	Un	0.85Un
18	HVRT triggering shreshold	HVRT triggering shreshold	p.u.	Un	1.4Un	1.15Un
19	Zero current mode triggering threshold	Triggering threshold When zero current mode activation	p.u.	0	1.5Un	0.7Un
20	Grid voltage jump triggering threshold	Triggering threshold when voltage sudden change	p.u.	0.05Un	1.0Un	0.05Un
21	FRT exit hysteresis threshold	FRT exit hysteresis threshold	---	parameter not adjustable		0.01Un

No.	Name	Description	Unit	Setting range		Default value (acc. to parameter set)	
				Min.	Max.		
22	LVRT diagram	LVRT volt-time diagram	---	parameter not adjustable		Time(s), 0.5 8 180	U(p.u.) 0.2 0.85 0.9
23	HVRT diagram	HVRT volt-time diagram	---	parameter not adjustable		Time(s), 0.5 8 180	U(p.u.) 1.2 1.15 1.1
4.6.1 Power response to overfrequency							
24	P(f) curve function	Enable or disable power response of overfrequency	---	Enable/Disable		Enable	
25	Droop	Power droop gradient. (over frequency power reduction use the samp droop value) $(s = \frac{\Delta f}{f_n} / \frac{\Delta P}{P_{ref}})$	0.1%	2.0% (means 100%Pref/Hz)	12% (means 16.67%Pref/Hz)	5 % (means 40%Pref/Hz)	
26	Start frequency P(f) (Start of frequency regulation - power reduction)	Start frequency P(f) (Start of frequency regulation - power reduction)	Hz	50.0Hz	55.0Hz	50.2Hz	
27	Quit frequency of overfrequency derating	Quit frequency of overfrequency derating	Hz	50.0Hz	55.0Hz	50.2Hz	
29	Power recovery gradient of P(f)	Active power gradient after deactivation of P(f) curve	---	parameter not adjustable		9%/min	
30	Over frequency regulation Pref	Pref of over frequency regulation	---	parameter not adjustable		Pmom	
4.7.2 Capabilities							
32	Q_Mode	Reactive power control mode	---	0x00:pure active power 0x01: Cos phi specifications 0x02: Q specifications 0x03: Cos phi(P) characteristic 0x04: Q(U) characteristic 0x09: Q(P) characteristic		Cos phi specifications	

No.	Name	Description	Unit	Setting range		Default value (acc. to parameter set)
				Min.	Max.	
33	Reactive control settling time (PT1 Behaviour)	Reactive power settling time (3τ)	s	1s	120s	10s
Q_mode: Cos phi specifications						
34	Cos phi set point	Cos phi setpoint (+) over-excited (-) under-excited	0.001	0.8pf	1.0pf	1.0pf
Q_mode: Q specifications						
35	Q specifications	Set reactive power percentage (Q/Pn) (+) over-excited (-) under-excited	%Pn	0%	110%	0%
Q_mode: Cos phi(P)						
36	*Cos phi(P)* Node 1 Power percentage	cosφ(P) characteristic Node 1 Power percentage (P/Pn)	% Pn	0%	100%	0%
37	*Cos phi(P)* Node 1 cosφ	cosφ(P) characteristic Node 1 cosφ	0.001 pf	0.8pf (-) under-excited	1.0pf	1.0pf
38	*Cos phi(P)* Node 2 Power percentage	cosφ(P) characteristic Node 2 Power percentage (P/Pn)	% Pn	0%	100%	20%
39	*Cos phi(P)* Node 2 cosφ	cosφ(P) characteristic Node 2 cosφ	0.001 pf	0.8pf (-) under-excited	1.0pf	1.0pf
40	*Cos phi(P)* Node 3 Power percentage	cosφ(P) characteristic Node 3 Power percentage (P/Pn)	% Pn	0%	100%	50%
41	*Cos phi(P)* Node 3 cosφ	cosφ(P) characteristic Node 3 cosφ	0.001 pf	0.8pf (-) under-excited	1.0pf	1.0pf
42	*Cos phi(P)* Node 4 Power percentage	cosφ(P) characteristic Node 4 Power percentage (P/Pn)	% Pn	0%	100%	100%
43	*Cos phi(P)* Node 4 cosφ	cosφ(P) characteristic Node 4 cosφ	0.001 pf	0.8pf (-) under-excited	1.0pf	0.9pf (-) under-excited

No.	Name	Description	Unit	Setting range		Default value (acc. to parameter set)
				Min.	Max.	
Q_mode: Q(U)						
44	*Q(U)* Node 1 reactive power percentage	Q(U) characteristic node 1 Q percentage (Q/Pn)	% Pn	0%	60% (+) over-excited	48.4% (+) over-excited
45	*Q(U)* Node 1 voltage percentage	Q(U) characteristic node 1 U percentage (U/Un)	% Un	0%	100%	93%
46	*Q(U)* Node 2 reactive power percentage	Q(U) characteristic node 2 Q percentage (Q/Pn)	% Pn	0%	60% (+) over-excited	0%
47	*Q(U)* Node 2 voltage percentage	Q(U) characteristic node 2 U percentage (U/Un)	% Un	0%	100%	97%
48	*Q(U)* Node 3 reactive power percentage	Q(U) characteristic node 3 Q percentage (Q/Pn)	% Pn	-60% (-) under-excited	0%	0%
49	*Q(U)* Node 3 voltage percentage	Q(U) characteristic node 3 U percentage (U/Un)	% Un	100%	140%	103%
50	*Q(U)* Node 4 reactive power percentage	Q(U) characteristic node 4 Q percentage (Q/Pn)	% Pn	-60% (-) under-excited	0	-48.4% (-) under-excited
51	*Q(U)* Node 4 voltage percentage	Q(U) characteristic node 4 U percentage (U/Un)	% Un	100%	140%	107%
Q_mode: Q(P)						
52	Q(P) node 1 reactive power percentage	Q(P) characteristic node 1 Q percentage (Q/Pn)	% Pn	-60% (-) under-excited	0%	0%
53	Q(P) node 1 Power percentage	Q(P) characteristic node 1 P percentage (P/Pn)	% Pn	0%	100%	50%
54	Q(P) node 2 reactive power percentage	Q(P) characteristic node 2 Q percentage (Q/Pn)	% Pn	-60% (-) under-excited	0%	-5% (-) under-excited
55	Q(P) node 2 Power percentage	Q(P) characteristic node 2 P percentage (P/Pn)	% Pn	0%	100%	60%
56	Q(P) node 3 reactive power percentage	Q(P) characteristic node 3 Q percentage (Q/Pn)	% Pn	-60% (-) under-excited	0%	-33% (-) under-excited

No.	Name	Description	Unit	Setting range		Default value (acc. to parameter set)
				Min.	Max.	
57	Q(P) node 3 Power percentage	Q(P) characteristic node 3 P percentage(P/Pn)	% Pn	0%	100%	90%
58	Q(P) node 4 reactive power percentage	Q(P) characteristic node 4 Q percentage (Q/Pn)	% Pn	-60% (-) under-excited	0	-33% (-) under-excited
59	Q(P) node 4 Power percentage	Q(P) characteristic node 4 P percentage (P/Pn)	% Pn	0%	100%	100%
4.7.3 Voltage related active power reduction(P(U) function)						
60	P(U) curve enable/disable	Enable or disable P(U) curve	---	Enable/Disable		Enable
61	P(U) curve triggering shreshold	P(U) curve triggering shreshold	p.u.	Un	1.4Un	1.1Un
62	P(U) curve active power derating	P(U) curve active power percentage(P/Pn)	%Pn	0%	100%	15%
4.9.3 Requirements on voltage and frequency protection						
63	OV Level1 threshold	OV Level1 threshold	p.u.	1.0Un	1.4Un	1.15Un
64	OV Level1 operate time	OV Level1 operate time	ms	0	600000	150
65	UV Level1 threshold	UV Level1 threshold	p.u.	0.1Un	1.0Un	0.85Un
66	UV Level1 operate time	UV Level1 operate time	ms	0	600000	1300
67	OV Level2 threshold	OV Level2 threshold	p.u.	1.0Un	1.4Un	1.15Un
68	OV Level2 operate time	OV Level2 operate time	ms	0	60000	150
69	UV Level2 threshold	UV Level2 threshold	p.u.	0.1Un	1.0Un	0.85Un
70	UV Level2 operate time	UV Level2 operate time	ms	0	60000	1300
71	OV threshold of 10min moving average	OV threshold of 10min moving average	p.u.	1.0Un	1.4Un	1.1Un
72	OF Level1 threshold	OF Level1 threshold	Hz	50Hz	60Hz	52Hz
73	OF Level1 operate time	OF Level1 operate time	ms	0	600000	400

No.	Name	Description	Unit	Setting range		Default value (acc. to parameter set)
				Min.	Max.	
74	UF Level1 threshold	UF Level1 threshold	Hz	40Hz	50Hz	47.5Hz
75	UF Level1 operate time	UF Level1 operate time	ms	0	600000	400
76	OF Level2 threshold	OF Level2 threshold	Hz	50Hz	60Hz	52Hz
77	OF Level2 operate time	OF Leve2 operate time	ms	0	6000	400
78	UF Level2 threshold	UF Level2 threshold	Hz	40Hz	50Hz	47.5Hz
79	UF Level2 operate time	UF Level2 operate time	ms	0	60000	400
4.10.2 Automatic reconnection after tripping						
80	Reconnection grid voltage upper limit	Limit value reconnection U<	p.u.	1.0Un	1.4Un	1.1Un
81	Reconnection grid voltage lower limit	Limit value reconnection U>	p.u.	0.1Un	1.0Un	0.9Un
82	Reconnection grid frequency upper limit	Limit value reconnection f<	Hz	50Hz	60Hz	50.2Hz
83	Reconnection grid frequency lower limit	Limit value reconnection f>	Hz	40Hz	50Hz	49.5Hz
84	Active power gradient of reconnection after tripping	Active power gradient when Reconnection after grid trip	%Pn/min	0%	100%	9%
85	Reconnect delay time	Reconnect delay time after protection trigger	s	10s	600s	60s
4.10.3 Starting to generate electrical power						
86	Connection grid voltage upper limit	Limit value connection U<	---	parameter not adjustable		1.1Un
87	Connection grid voltage lower limit	Limit value connection U>	---	parameter not adjustable		0.9Un
88	Connection grid frequency upper limit	Limit value connection f<	---	parameter not adjustable		50.1Hz
89	Connection grid frequency lower limit	Limit value connection f>	---	parameter not adjustable		49.5Hz

No.	Name	Description	Unit	Setting range		Default value (acc. to parameter set)
				Min.	Max.	
90	Active power gradient of connection	Active power gradient when first connect to the grid	%Pn /min	0%	100%	100%
91	First connect delay time	connection time without previous protection trigger	s	10s	600s	60s
4.11.1 Ceasing active power						
92	Reaction time of remote tripping	Reaction time of remote tripping	s	parameter not adjustable		0
4.11.2 Reduction of active power on set point						
93	Max active power	Max active power feed in	W	0	Pmax	Pmax
94	Power Derating	Active power Derating (P/Pn)	% Pn	0	110%	110%
95	Active power change gradient	Active power change gradient	%Pn/s	0.01%Pn/s	2.0%Pn/s	0.50%Pn/s