

Certificate

Applicant: **KOSTAL Solar Electric GmbH**
Hanferstr. 6
79108 Freiburg i. Br.
Germany

Product: **Photovoltaic Inverter with integrated automatic disconnection device between a generator and the public low-voltage grid**

Model:	PIKO MP plus 1.5-1	PIKO MP plus 2.0-1	PIKO MP plus 2.5-1	PIKO MP plus 3.0-1	PIKO MP plus 3.6-1	PIKO MP plus 3.0-2	PIKO MP plus 3.6-2
Rating:	1500W	2000W	2500W	3000W	3680W	3000W	3680W

Intended use:

An automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G83/2 for photovoltaic systems with a single-phase parallel coupling via an inverter to the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter.

Applied standards and guidelines:

SOP-9-1_11 GCC Certification Program, 04/18

Based on:

Engineering Recommendation G83/2

Issue 2 – August 2012

Recommendations for the connection of small-scale embedded generators in parallel with public low-voltage distribution networks.

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

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Tanja Rottach
Certification Engineer



Power Quality. Harmonics.

Equipment Phases: Single-Phase

PIKO MP plus 3.6-2

Harmonic:	At 45-55% of rated output	At 100% of rated output	Harmonic Limit (A)
	Measured Value (A)		
2nd	0,011	0,066	1,080
3rd	0,030	0,062	2,300
4th	0,003	0,019	0,430
5th	0,010	0,035	1,140
6th	0,003	0,016	0,300
7th	0,005	0,019	0,770
8th	0,002	0,011	0,230
9th	0,005	0,024	0,400
10th	0,002	0,008	0,184
11th	0,003	0,018	0,330
12th	0,002	0,008	0,153
13th	0,003	0,014	0,210
14th	0,002	0,006	0,131
15th	0,003	0,011	0,150
16th	0,002	0,005	0,115
17th	0,003	0,010	0,132
18th	0,002	0,005	0,102
19th	0,003	0,010	0,118
20th	0,002	0,005	0,092
21st	0,003	0,008	0,107
22nd	0,002	0,005	0,084
23rd	0,003	0,008	0,098
24th	0,002	0,005	0,077
25th	0,002	0,006	0,090
26th	0,002	0,005	0,071
27th	0,002	0,006	0,083
28th	0,002	0,005	0,066
29th	0,002	0,006	0,078
30th	0,002	0,005	0,061
31st	0,002	0,006	0,073
32nd	0,002	0,005	0,058
33rd	0,003	0,006	0,068
34th	0,002	0,005	0,054
35th	0,002	0,006	0,064
36th	0,002	0,005	0,051
37th	0,003	0,006	0,061
38th	0,002	0,003	0,048
39th	0,002	0,005	0,058
40th	0,002	0,005	0,046

PIKO MP plus 2.5-1

Harmonic:	At 45-55% of rated output	At 100% of rated output	Harmonic Limit (A)
	Measured Value (A)		
2nd	0,019	0,027	1,080
3rd	0,068	0,076	2,300
4th	0,006	0,010	0,430
5th	0,025	0,049	1,140
6th	0,004	0,006	0,300
7th	0,019	0,029	0,770
8th	0,004	0,006	0,230
9th	0,004	0,023	0,400
10th	0,004	0,004	0,184
11th	0,004	0,016	0,330
12th	0,004	0,004	0,153
13th	0,004	0,008	0,210
14th	0,002	0,004	0,131
15th	0,010	0,010	0,150
16th	0,004	0,004	0,115
17th	0,008	0,014	0,132
18th	0,002	0,004	0,102
19th	0,004	0,008	0,118
20th	0,002	0,004	0,092
21st	0,006	0,008	0,107
22nd	0,002	0,004	0,084
23rd	0,004	0,010	0,098
24th	0,002	0,004	0,077
25th	0,004	0,006	0,090
26th	0,002	0,004	0,071
27th	0,004	0,004	0,083
28th	0,002	0,004	0,066
29th	0,004	0,006	0,078
30th	0,002	0,004	0,061
31st	0,002	0,004	0,073
32nd	0,002	0,002	0,058
33rd	0,002	0,004	0,068
34th	0,002	0,004	0,054
35th	0,004	0,004	0,064
36th	0,002	0,004	0,051
37th	0,002	0,004	0,061
38th	0,002	0,004	0,048
39th	0,004	0,004	0,058
40th	0,004	0,004	0,046

Power Quality. Voltage Fluctuations and Flicker.
PIKO MP plus 3.6-2

	Starting			Stopping			Running	
	dmax	dc	d(t)	Dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	-3,95	-3,16	-	4,37	3,03	10	0,15	0,15
Normalised to standard impedance	-3,61	-2,89	-	4,00	2,77	-	0,14	0,14
Limits	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

PIKO MP plus 2.5-1

	Starting			Stopping			Running	
	dmax	dc	d(t)	Dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	-2,48	-1,82	-	4,04	2,21	10	0,10	0,10
Normalised to standard impedance	-2,463	-1,80	-	4,00	2,19	-	0,10	0,10
Limits	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Power Quality. DC Injection.

Test power level	10%	55%	100%
Recorded Value	-0,003	-0,006	-0,012
As % of rated AC current	-0,02	-0,04	-0,08
Limit	0,25%		

Power Quality. Power Factor.

Output Voltage	216,2V	230V	253V
Measured Value	1,000	1,000	1,000
Limit	>0,95		

Protection. Frequency Tests.

Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,54Hz	20,22s	47,7Hz 25s	No trip
U/F stage 2	47,0Hz	0,5s	47,04Hz	0,75s	47,2Hz 19,98s	No trip
					46,8Hz 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,46Hz	90,21s	51,3Hz 95s	No trip
O/F stage 2	52,0Hz	0,5s	51,95Hz	0,72s	51,8Hz 89,98s	No trip
					52,2Hz 0,48s	No trip

Protection. Voltage Tests.

Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage time	Confirm no trip
U/V stage 1	200,1V	2,5s	201,9V	2,75s	204,1V 3,5s	No trip
U/V stage 2	184,0V	0,5s	186,3V	0,75s	188V 2,48s	No trip
					180V 0,48s	No trip
O/V stage 1	262,2V	1,0s	260,1V	1,24s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	271,6V	0,75s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

Protection. Loss of Mains Test according BS EN 62116 for Inverters.

Test Power and imbalance	33% -5% Q	66% -5% Q	100% -5% Q	33% +5% Q	66% +5% Q	100% +5% Q
Trip time (s)	0,09	0,16	0,15	0,12	0,09	0,11

Protection. Reconnection Timer.

Reconnection Time	Under/Over voltage		Under/over frequency		Loss of mains	
Minimum value	20 seconds					
Actual settings (sec)	20s		20s		20s	
Recorded value (sec)	75,4		75,5		77,4	
	At 266,2V		At 196,1V		At 47,4Hz	
Confirmation that the unit does not re-connect.	No connection to grid		No connection to grid		No connection to grid	

Fault Level Contribution.

For an inverter SEEG

Parameter	Symbol	Time after fault	Volts	Amps
Peak short circuit current	i_p	20ms	40,3	14,99
Initial Value of aperiodic current	A	100ms	22,5	0,03
Initial symmetrical short-circuit current	I_k	250ms	22,2	0,03
Decaying (aperiodic) component of short-circuit current	i_{DC}	500ms	22,3	0,03

As SSEGs (small-scale embedded generators) for PV are inverter-connected the max. short circuit current is the max. AC current.