



Applicant: **Kostal Solar Electric GmbH**
Hanferstraße 6,
79108 Freiburg i. Br.
Germany

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

Model:	PIKO 10; PIKO 12; PIKO 15; PIKO 17; PIKO 20
Rating:	See Page 2

Intended use:

Solar Inverter with an automatic disconnection device with three phase mains surveillance in accordance with Engineering Recommendation G99-1 for photovoltaic systems with a three 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:

Engineering Recommendation G99 Issue 1 – Amendment 4 June 2019

Requirements for the connection of generation equipment in parallel with public distribution networks on or after 17 May 2019

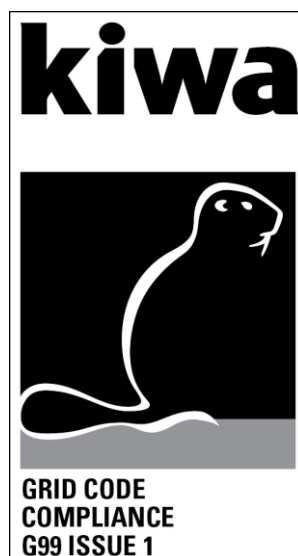
The safety concept of an aforementioned representative product corresponds at the time of issue of this certificate to the valid safety specifications for the specified use in accordance with regulations.

The units are only compliant with type A Power Generating Module requirements

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Electrical Ratings			
Model:	PIKO 20	PIKO 17	PIKO 15
Input Voltage:	345V-800Vdc 1000Vdc	290V-800Vdc 1000Vdc	260V-800Vdc 1000Vdc
Input current:	Symetrical: 3x20Adc. Max. Unsymetrical: 2x20Adc., 1x10Adc.max		
Output Voltage:	230/400Vac, 50Hz, 3PH+N+PE, cosφ 0,80ind, 0,80cap		
Output current:	3x29Aac Max. 3x32,2A	3x24,6Aac Max. 3x27,4A	3x21,7Aac Max. 24,2A
Output power:	Max. 20,0kVA	Max. 17,0kVA	Max. 15,0kVA
Model:	PIKO 12		PIKO 10
Input voltage:	345V-800Vdc 1000Vdc max.		290V-800Vdc 1000Vdc max.
Input current:	Symetrical: 2x18Adc max. Unsymetrical: 1x20Adc, 1x10Adc max.		
Output voltage:	230/400Vac, 50Hz, 3Ph+N+PE, cosφ 0,80ind, 0,80cap		
Output current:	3x17,4 Aac max. 3x19,3A		3x14,6Aac max3x16,2A
Output power:	Max.12,0kVA		Max. 10,0kVA



Power Quality – Continuous voltage operation range					
Continuous frequency operation range					
	U [V]	f [Hz]	Cos φ	P [kW]	Limit [%Sn]:
Test 1	85%Un 195,5V	47,00Hz	1,00	100%Sn	-
Measured 20s avg	195,3	47,00	-0,997	-11,49	-95,8
Test 2	85%Un 195,5V	47,50Hz	1,00	100%Sn	-
Measured 90min avg	195,6	47,50	-0,998	-11,48	-95,7
Test 3	110%Un 253V	51,50Hz	1,00	100%Sn	-
Measured 90min avg	253,1	51,50	-0,998	-12,06	-100,5
Test 4	110%Un 253V	52,00Hz	1,00	100%Sn	-
Measured 15min avg	253,2	52,00	-0,997	-12,06	-100,5
Test 5	Start frequency	Change	End frequency	Confirm no trip	
Positive frequency drift	49,5Hz	+1,0Hz/sec	50,0Hz	No trip	
Negative frequency drift	50,5Hz	-1,0Hz/sec	50,0Hz	No trip	



Power Quality – Harmonics						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)			4	kVA	Harmonics % = Measured Value (Amps) x 23 / rating per phase (kVA)	
Harmonic	At 45-55% of rated output		100% of rated output		Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps*	%	Measured Value (MV) in Amps*	%	1 phase	3 phase
2	0,04	0,23	0,21	1,22	8%	8%
3	0,11	0,61	0,13	0,75	21,6%	Not stated
4	0,02	0,10	0,04	0,25	4%	4%
5	0,12	0,67	0,12	0,70	10,7%	10,7%
6	0,01	0,07	0,04	0,21	2,67%	2,67%
7	0,08	0,46	0,10	0,55	7,2%	7,2%
8	0,01	0,07	0,11	0,64	2%	2%
9	0,09	0,52	0,15	0,86	3,8%	Not stated
10	0,01	0,08	0,12	0,69	1,6%	1,6%
11	0,09	0,53	0,15	0,86	3,1%	3,1%
12	0,01	0,08	0,15	0,89	1,33%	1,33%
13	0,09	0,53	0,18	1,04	2%	2%
THD	-	2,14	-	4,09	23%	13%
PWHD	-	6,55	-	12,5	23%	22%



Power Quality – Voltage Fluctuations and Flicker								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	0,71	0,24	0,71	1,58	0,24	1,58	0,32	0,32
Normalised to standard impedance	0,71	0,24	0,71	1,58	0,24	1,58	0,32	0,32
Normalised to required maximum impedance	-	-	-	-	-	-	-	-
Limit set under BS EN 61000-3-11	4,0%	3,3%	3,3%	4,0%	3,3%	3,3%	1,00	0,65
Test Impedance	R	0,24 * 0,4 ^	Ω	X	0,15* 0,25**	Ω		
Standard Impedance	R	0,24 * 0,4 ^	Ω	X	0,15 * 0,25 ^	Ω		
Maximum Impedance	R	-	Ω	X	-	Ω		
* Applies to three phase and split single phase Power Generating Modules. ^ Applies to single phase Power Generating Module and Power Generating Modules using two phases on a three phase system.								



Power Quality – DC injection			
Test power level	10%	55%	100%
Recorded value in Amps	12mA	19mA	20mA
As % of rated AC current	0,02%	0,04%	0,04%
Limit	0,25%	0,25%	0,25%

Power Factor			
Voltage	0,94 pu (216.2 V)	1,0 pu (230 V)	1,1 pu (253 V)
Measured Value	0,999	0,999	0,999
Power Factor 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	47,5 Hz	20 s	47,49 Hz	20,16 s	47,7Hz 30s	No trip
U/F stage 2	47,0 Hz	0,5 s	46,90 Hz	0,580 s	47,2 Hz 19,5s	No trip
					46,8 Hz 0,45 s	No trip
O/F	52,0 Hz	0,5 s	52,00 Hz	0,562 s	51,8 Hz 120 s	No trip
					52,2Hz 0,45s	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	0,8 pu (184V)	2,5s	183,7 V	2,570s	188 V 5 s	No trip
					180V 2,45 s	No trip
O/V stage 1	1,14 pu (262,2V)	1,0s	262,2 V	1,073s	258,2 V 5,0 s	No trip
O/V stage 2	1,19 pu (273,7V)	0,5s	273,7 V	0,586s	269,7 V 0,95 s	No trip
					277,7 V 0,45 s	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 (ms)	414	202	320	364	252	342
Protection – Frequency change, Vector Shift Stability test.						
	Start frequency		Change	Confirm no trip		
Positive vector shift	49,5Hz		+50 dregrees	No Trip		
Negative vector shift	50,5Hz		- 50 dregrees	No Trip		
Protection – Frequency Change, RoCoF Stability Test						
Ramp range	Test frequency ramp		Test duration	Confirm no Trip		
49,0 Hz to 51,0 Hz	+0,95 Hzs ⁻¹		2,1 s	No trip		
51,0 Hz to 49,0 Hz	-0,95 Hzs ⁻¹		2,1 s	No trip		
Protection – Limited Frequency Sensitive Mode – Over frequency Test						
Active Power response to rising frequency/time plots are attached						N
Test sequence at regis-tered capacity >80%	Measured Active Power output [kW]	Frequency [Hz]	Primary power source (if applica-ble)	Active Power Gra- dient		
Step a) 50,00Hz ± 0,01Hz	-12,07	50,00	—	—		
Step b) 50,45Hz ± 0,05Hz	-11,84	50,44		—		
Step c) 50,70Hz ± 0,10Hz	-11,25	50,70		—		
Step d) 51,15Hz ± 0,05Hz	-10,18	51,14		—		
Step e) 51,70Hz ± 0,10Hz	-11,21	50,71		—		
Step f) 50,45Hz ± 0,05Hz	-11,83	50,45		—		
Step g) 50,00Hz ± 0,01Hz	-12,02	50,01		≤10,0%P _n /min		
Test sequence at regis-tered capacity 40% - 60%	Measured Active Power output [kW]	Frequency [Hz]	Primary power source (if applica-ble)	Active Power Gra- dient		
Step a) 50,00Hz ± 0,01Hz	-6,00	50,00	—	—		
Step b) 50,45Hz ± 0,05Hz	-5,90	50,45		—		
Step c) 50,70Hz ± 0,10Hz	-5,60	50,70		—		
Step d) 51,15Hz ± 0,05Hz	-5,07	51,15		—		
Step e) 50,70Hz ± 0,01Hz	-5,60	50,70		—		
Step f) 50,45 Hz ± 0,05Hz	-5,90	50,45		≤10,0%P _n /min		
Step g) 50,00 Hz ± 0,01Hz	-5,98	50,00		≤10,0%P _n /min		



Protection – Reconnection Timer					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
20 s	30,0 s	At 1,16 pu (266,2V)	At 0,78pu (180,0V)	At 47,4 Hz	At 52,1 Hz
Confirmation that the Power Generating Module does not re-connect.		No reconnection	No reconnection	No reconnection	No reconnection
Fault Level Contribution					
For Inverter Output					
Time after fault	Volts		Amps		
20ms	30,40		18,66		
100ms	30,40		11,64		
250ms	30,40		11,60		
500ms	18,81		0,04		
Time to trip	0,28		In seconds		
As SSEGs (small-scale embedded generators) for PV are inverter-connected the max. short circuit current is the max. AC current.					
Self-Monitoring Solid state switching					
It has been verified that in the event of the solid state switching device failing to disconnect the Power Park Module, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.					NA*
*there are no solid state switching devices in the unit, mechanical relays are provided					
Wiring functional Tests					
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)					N/A*
*All relevant components are integrated to the inverter					
Logic interface (input port)					
Confirm that an input port is provided and can be used to shut down the module.					YES*
*An input port is available and can be used to shut down the module					
Additional Comments					
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