



CERTIFICATE

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

Product: Hybrid Inverter (Battery/PV) with integrated automatic disconnection device between a generator and the public low-voltage grid

Model: PLENTICORE MP S G3
PLENTICORE MP M G3

Intended use:

Hybrid inverter in accordance with EN 50549-1 with single-phase parallel coupling to the distribution network. The automatic disconnection device is an integral part of the aforementioned inverter.

Applied standards and guidelines:

SOP-9-1_15 GCC Certification Program, 09/21

Based on:

EN 50549-1:2019

Requirements for generating plants to be connected in parallel with distribution networks Part 1:
Connection to a LV distribution network - Generating plants up to and including Type B

Tested according to:

EN 50549-10:2022

Requirements for generating plants to be connected in parallel with distribution networks Part 10:
Tests for conformity assessment of generating units

The generating plant(s) are also considered to be compliant with the relevant Articles of Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (NC RfG), provided, that all settings as provided by the DSO and the responsible party are complied with.

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.

Report No: 24PP489-05_0

Certificate No: 25-301-00

Date of issue: 2025-09-02

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Parameter table acc. EN50549-10:2022 (Parameters as declared by the manufacturer and not according to a specific grid code. Additional testing for deviation to a specific grid code can be necessary)						
Parameter setting name in the generating unit:		EN50549-1 2019 ≥SW3.05.00				
Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
4.4.2 Operating frequency range	47,0 – 47,5 Hz Duration		not configurable	unlimited	NA	47Hz
	47,5 – 48,5 Hz Duration		not configurable	unlimited	NA	
	48,5 – 49,0 Hz Duration		not configurable	unlimited	NA	
	49,0 – 51,0 Hz Duration		not configurable	unlimited	NA	
	51,0 – 51,5 Hz Duration		not configurable	unlimited	NA	
	51, 5 – 52 Hz Duration		not configurable	unlimited	NA	53Hz
4.4.3 Minimal requirement for active power delivery at underfrequency	Reduction threshold		not configurable	49.0 Hz	NA	
	Maximum reduction rate		not configurable	<1%/Hz	NA	<1%/Hz
4.4.4 Continuous operating voltage range	Upper limit		not configurable	120.0 % U _n	NA	120.0% U _n
	Lower limit		not configurable	80.0 % U _n	NA	80.0% U _n
4.5.2 Rate of change of frequency (ROCOF) immunity	ROCOF withstand capability (defined with a sliding measurement window of 500 ms) non-synchronous generating technology: synchronous generating technology:		not defined	≥ 4 Hz/s	NA	4 Hz/s
4.5.3.2 Under-voltage ride through (UVRT) Generating plant with non-synchronous generating technology	Maximum power resumption time	Service / Grid parametrization / UVRT/OVRT / General / Ramp time	0.3...15 s	0.5 s		
	Voltage-Time-Diagram		not configurable	Time [s]	U [p.u.]	
				0.0	0.0	NA
				1.0	0.0	NA
				5.0	0.8	NA
				> 5.0	0.8	NA



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value		Minimum step size	Considered value range
4.5.3.3 Under-voltage ride through (UVRT) Generating plant with synchronous generating technology	Maximum power resumption time		NA	NA		NA	
	Voltage-Time-Diagram		N/A	Time [s]	U [p.u.]		
				NA	NA	NA	
4.5.4 Over-voltage ride through (OVRT)	Voltage-Time-Diagram		not configurable	Time [s]	U [p.u.]		
				0.0	1.3	NA	
				0.6	1.3	NA	
				0.6	1.2	NA	
				> 0.6	1.2	NA	
4.5.5 Phase jump Immunity	Phase jump immunity		not configurable	50°			
4.6.1 Power response to overfrequency	Threshold frequency f1	Service / Grid parametrization / P(f) / Overfrequency characteristic curve / Start frequency	50.0...52.0 Hz	50.20 Hz enabled		0.01Hz	50.1Hz ... 51Hz
	Droop	Service / Grid parametrization / P(f) / Overfrequency characteristic curve / Droop	1.0...12.0 %	5.0 %		0.01%	1 % ... 12 %



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
	Power reference	Service / Grid parametrization / P(f) / Overfrequency characteristic curve / Reference power relates to	$P_{\max} \mid P_{\text{mom}} \mid P_{\text{mom}} - P_{\text{ch,max}}$	P_{mom}		$P_{\max}$ P_{mom}
	Intentional delay	Service / Grid parametrization / P(f) / Delay time	0...600 s	0.0 s	10ms	0s ... 10s
	Deactivation threshold fstop	Service / Grid parametrization / P(f) / Conditions for returning to normal mode / Frequency range	47.5...52.0 Hz	50.20 Hz	0.01 Hz	50.0Hz ... 52.0Hz
	Deactivation time tstop	Service / Grid parametrization / P(f) / Conditions for returning to normal mode / Waiting time	0...900 s	30.0 s	0.1s	0s ... 900s
	Acceptance of staged disconnection		not configurable	N/A	NA	
4.6.2 Power response to underfrequency	Threshold frequency f1	Service / Grid parametrization / P(f) / Underfrequency characteristic	0.0...50.0 Hz	49.80 Hz enabled	0.01 Hz	49.0Hz ... 50.0Hz



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
		curve / Start frequency				
	Droop	Service menu / P(f) / Underfrequency characteristic curve / Droop	0.2...12.0 %	5.0 %	0.01%	1 ... 12 %
	Power reference	Service / Grid parametrization / P(f) / Underfrequency characteristic curve / Reference power relates to	$P_{\max} \mid P_{\text{mom}} \mid P_{\text{mom}} - P_{\text{disch,max}}$	$P_{\max}$		$P_{\max}$ P_{mom}
	Intentional delay	Service menu / P(f) / Delay time	0...600 s	0.0 s	0.01s	0s ... 10s
4.7.2.2 voltage support by reactive power - Capabilities	Active factor / Reactive power range overexcited		not configurable	$\cos \phi = 0.8 / 98.8 \% S_n$		
	Active factor / Reactive power range underexcited		not configurable	$\cos \phi = 0.8 / 98.8 \% S_n$		
4.7.2.3 voltage support by reactive power – Control modes	Enabled control mode	Service / Grid parametrization / Reactive power settings / Reactive power specification	Q setp. Q(U) $\cos \phi$ setp. $\cos \phi$ (P)	$\cos \phi$ setp.		
4.7.2.3.2 voltage support by reactive power - Set	Q setpoint and excitation	Service / Grid parametrization / Reactive power settings /	98.8 %* S_n oe ... 98.8 %* S_n ue	0.0 % disabled	0.01%	



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
point control modes		Reactive power specification /Reactive power Q				
	cos φ setpoint and excitation	Service / Grid parametrization / Reactive power settings / Reactive power specification / Displacement factor cos φ	0.8 oe ... 0.8 ue	1.00 enabled	0.01	
4.7.2.3.3 voltage support by reactive power – Voltage related control modes	Characteristic curve	Service / Grid parametrization / Reactive power settings / Reactive power specification / Reactive power/voltage characteristic curve Q(U)	(0...120 % U _n ; 98.8 %ue ... 98.8 %oe S _n)	(93.0 % ; 43.6 % oe) (97.0 % ; 0.0 %) (103.0 % ; 0.0 %) (107.0 % ; 43.6 % ue) disabled	U: 1% U _n Q: 0.01% S _n	80% ... 120% U _n ; 98.8%S _n ue ... 98.8%S _n oe
	Time constant	Service / Grid parametrization / Reactive power settings / Reactive power specification / Reactive power/voltage	0.2...60.0 s	10.0 s	0.01s	0.2 s ... 60 s



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
		characteristic curve Q(U) / Settling time				
	Min cos ϕ	Service / Grid parametrization / Reactive power settings / Reactive power specification / Reactive power/voltage characteristic curve Q(U) / Minimum cos ϕ	0.16...1.0	0.90	0.01	0.16 ... 0.95
	Lock in power	Service / Grid parametrization / Reactive power settings / Reactive power specification / Reactive power/voltage characteristic curve Q(U) / Activation power	0...100 % P _n	disabled	0.01%	0% ... 20%
	Lock out power	Service / Grid parametrization / Reactive power settings / Reactive power specification / Reactive	0...100 % P _n	disabled	0.01%	0% ... 20%



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
		power/voltage characteristic curve Q(U) / Deactivation power				
4.7.2.3.4 voltage support by reactive power – Power related control mode	Characteristic curve	Service / Grid parametrization / Reactive power settings / Reactive power specification / Displacement factor/power curve cos φ (P)	(0...100 % P _n ; 0.8 %ue ... 0.8 %oe)	(50.00 ; 1.00) (50.00 ; 1.00) (50.00 ; 1.00) (100.00 ; 0.90 ue) disabled	P: 1% P _n cos φ: 0.01	
4.7.3 Voltage related active power reduction	Enabling	Service / Grid parametrization / P(U)/ Activation	enabled disabled	disabled		
	Characteristic curve	Service / Grid parametrization / P(U)/ Reduction Curve	0...200 % U _n	(110.0 %U _n ; 100 %P _n) (112.0 %U _n ; 0 %P _n)	0.01%U _n	100% ... 120%
	Control Logic	Service / Grid parametrization / P(U)/ Reduction Curve /Limitation Process	absolute limitation relative limitation	absolute limitation		
	Time constant	Service / Grid parametrization / P(U) / Settling Time	0.2...60 s	1.0 s	0.01s	0.2 s ... 60 s



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
only EN 50549-2:2019, 4.7.4.2.1 Voltage support during faults and voltage steps – General / Generating Plant with non-synchronous generator	Enabling		NA	NA		
	Static voltage range overvoltage		NA	NA		
	Static voltage range undervoltage		NA	NA		
	Insensitivity range of $\Delta U_{50\text{per}}$		NA	NA		
	Gradient k1		NA	NA		
	Gradient k2		NA	NA		
only EN 50549-2:2019, 4.7.4.2.1.2 Optional Modes / Generating Plant with non-synchronous generator	Active power priority		NA	NA		
	Reactive current limitation [% rated current]		NA	NA		
	Zero current threshold		NA	NA		
4.7.4.2.2 Zero current mode for converter connected generating technology / Generating Plant with non-synchronous generator	Enabling	Service / Grid parametrization / UVRT/OVRT / Activate UVRT/OVRT	enabled disabled	disabled		
	Static voltage range overvoltage	Service / Grid parametrization / UVRT/OVRT / OVRT / Entry threshold	105...150 % U_n	120.0 % - disabled	0.1 %	105 % ... 125 %
	Static voltage range undervoltage	Service / Grid parametrization / UVRT/OVRT /	0...95 % U_n	50.0 % - disabled	0.1 %	10 % ... 95 %



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
		UVRT / Entry threshold				
4.9.2 Requirements on voltage and frequency protection	Threshold for protection as dedicated device [in A or kW, kVA]	NA	16 A – 250 kVA	NA	NA	
	Undervoltage threshold stage 1	Service / Grid parametrization / Grid and system protection / Shutdown limits for voltage / Lower limits / L-N min.	0.0...310.5 V	195.5 V	0.01 V	30.0V ... 230.0V
	Undervoltage operate time stage 1	Service / Grid parametrization / Grid and system protection / Shutdown limits for voltage / Lower limits / Time	0.0...1000 s	1.50 s	0.01 s	0.05s ... 100.0s
	Undervoltage threshold stage 2	Service / Grid parametrization / Grid and system protection / Shutdown limits for voltage / Lower limits / L-N min.	0.0...310.5 V	disabled	0.01 V	30.0V ... 230.0V
	Undervoltage operate time stage 2	Service / Grid parametrization /	0.0...1000 s	disabled	0.01 s	0.05s ... 100.0s



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
		Grid and system protection / Shutdown limits for voltage / Lower limits / Time				
	Overvoltage threshold stage 1	Service / Grid parametrization / Grid and system protection / Shutdown limits for voltage / Upper limits / L-N max.	0.0...310.5 V	disabled	0.01 V	230.0V ... 310.5V
	Overvoltage operate time stage 1	Service / Grid parametrization / Grid and system protection / Shutdown limits for voltage / Upper limits / L-N max.	0.0...1000 s	disabled	0.01 s	0.05s ... 100.0s
	Overvoltage threshold stage 2	Service / Grid parametrization / Grid and system protection / Shutdown limits for voltage / Upper limits / L-N max.	0.0...310.5 V	264.5 V	0.01 V	230.0V ... 310.5V
	Overvoltage operate time stage 2	Service / Grid parametrization /	0.0...1000 s	0.20 s	0.01 s	0.05s ... 100.0s



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
		Grid and system protection / Shutdown limits for voltage / Upper limits / Time				
	Overvoltage threshold 10 min mean protection	Service / Grid parametrization / Grid and system protection / Shutdown limits for voltage / Use 10-minute average value	0.0...310.5 V	253.0 V	0.01 V	230.0V ... 310.5V
	Underfrequency threshold stage 1	Service / Grid parametrization / Grid and system protection / Shutdown limits for frequency / Lower limits / L-N min.	0.0...65.0 Hz	47.50 Hz	0.01 Hz	47.0Hz ... 50.0Hz
	Underfrequency operate time stage 1	Service / Grid parametrization / Grid and system protection / Shutdown limits for frequency / Lower limits / Time	0.0...1000 s	0.50 s	0.01 s	0.05s ... 100.0s
	Underfrequency threshold stage 2	Service / Grid parametrization / Grid and system	0.0...65.0 Hz	disabled	0.01 Hz	47.0Hz ... 50.0Hz



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
		protection / Shutdown limits for frequency / Lower limits / L-N min.				
	Underfrequency operate time stage 2	Service / Grid parametrization / Grid and system protection / Shutdown limits for frequency / Lower limits / Time	0.0...1000 s	disabled	0.01 s	0.05s ... 100.0s
	Overfrequency threshold stage 1	Service / Grid parametrization / Grid and system protection / Shutdown limits for frequency / Lower limits / Time	0.0...65.0 Hz	52.00 Hz	0.01 Hz	50.0Hz ... 53.0Hz
	Overfrequency operate time stage 1	Service / Grid parametrization / Grid and system protection / Shutdown limits for frequency / Upper limits / Time	0.0...1000 s	0.50 s	0.01 s	0.05s ... 100.0s
	Overfrequency threshold stage 2	Service / Grid parametrization / Grid and system	0.0...65.0 Hz	disabled	0.01 Hz	50.0Hz ... 53.0Hz



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
		protection / Shutdown limits for frequency / Upper limits / L-N max.				
	Overfrequency operate time stage 2	Service / Grid parametrization / Grid and system protection / Shutdown limits for frequency / Upper limits / Time	0.0...1000 s	disabled	0.01 s	0.05s ... 100.0s
only EN 50549-2:2019, 4.9.3 Requirements on voltage and frequency protection	Positive sequence under-voltage protection threshold	NA	NA			
	Positive sequence under-voltage protection operate time	NA	NA			
	Negative sequence over-voltage protection threshold	NA	NA			
	Negative sequence over-voltage protection operate time	NA	NA			
	Zero sequence overvoltage protection threshold	NA	NA			
	Zero sequence overvoltage	NA	NA			



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
	protection operate time					
4.9.4 Means to detect island situation RoCoF Detection	Enabling	Service / Grid parametrization / Grid and system protection / Rate of change of frequency / active	enabled disabled	disabled		
	Threshold	Service / Grid parametrization / Grid and system protection / Rate of change of frequency / Rate	0.0...3.0 Hz/s	2.00 Hz/s	0.001Hz/s	1.0Hz/s ... 5.0Hz/s
	Operate time	Service / Grid parametrization / Grid and system protection / Rate of change of frequency / time	0...5 s	2.00 s	0.01s	0.1s ... 5.0s
	Evaluation window		not configurable	0.50 s		
4.9.4.2 Active methods tested with a resonant circuit	Active Loss of mains detection according EN 62116		enabled disabled	enabled		
	Operate time		not configurable	<2s		
4.10.2 Automatic reconnection after tripping	Lower frequency	Service / Grid parametrization / Grid and system protection /	0.0...65.0 Hz	49.50 Hz	0.001 Hz	47.0Hz ... 50.0Hz



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
		Conditions for starting up after a grid error / Starting min.				
	Upper frequency	Service / Grid parametrization / Grid and system protection / Conditions for starting up after a grid error / Starting max.	0.0...65.0 Hz	50.20 Hz	0.001 Hz	50.0Hz ... 53.0Hz
	Lower voltage	Service / Grid parametrization / Grid and system protection / Conditions for starting up after a grid error / Starting L-N min	0.0...310.5 V	195.5 V	0.01 V	184.0V ... 230.0V
	Upper voltage	Service / Grid parametrization / Grid and system protection / Conditions for starting up after a grid error / Starting L-N max.	0.0...310.5 V	253.0 V	0.01 V	230.0V ... 264.5V
	Observation time	Service / Grid parametrization / Grid and system protection /	0.0...3600 s	60.0 s	0.01 s	10s 600s



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
		Conditions for starting up after a grid error / Waiting time				
	Active power increase gradient	Service / Grid parametrization / Start-up ramp / Ramp after grid error / Gradient	1...6000 %/min	10.0 %/min	0.001%/min	5%/min ... 6000%/min
4.10.3 Starting to generate electrical power	Lower frequency	Service / Grid parametrization / Grid and system protection / Start-up conditions / Starting min.	0.0...65.0 Hz	49.50 Hz	0.001 Hz	47.0Hz ... 50.0Hz
	Upper frequency	Service / Grid parametrization / Grid and system protection / Start-up conditions / Starting max.	0.0...65.0 Hz	50.10 Hz	0.001 Hz	50,0Hz ... 53.0Hz
	Lower voltage	Service / Grid parametrization / Grid and system protection / Start-up conditions / Starting L-N min.	0.0...310.5 V	195.5 V	0.01 V	184.0V ... 230.0V



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
	Upper voltage	Service / Grid parametrization / Grid and system protection / Start-up conditions / Starting L-N max.	0.0...310.5 V	253.0 V	0.01 V	230.0V ... 264.5V
	Observation time	Service / Grid parametrization / Grid and system protection / Start-up conditions / Waiting time	0.0...3600 s	60.0 s	0.01 s	10s 600s
	Active power increase gradient	Service / Grid parametrization / Start-up ramp / Ramp after normal start / Gradient	1...6000 %/min	disabled	0.001%/min	5%/min ... 6000%/min
4.11.1 Ceasing active power	Remote operation of the logic interface		yes Digital Input; ModBus; Sunspec (TCP)			
4.11.2 Reduction of active power on set point	Remote operation		yes Digital Input; ModBus; Sunspec (TCP)			
	Active power gradient high priority	Service / Grid parametrization / settling time / high priority / Max. power gradient	0.001...6000 %/s	Ramp: 0.5 %/s enabled	0.001%/s	



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Clause(s) / subclause(s) of EN50549-1 or EN 50549-2:2019	Parameter	Parameter name in the generating unit	Configurable range	Default value	Minimum step size	Considered value range
	Active power gradient low priority	Service / Grid parametrization / settling time / low priority / Max. power gradient	0.001...100 %/s	Ramp: 0.5 %/s enabled	0.001%/s	
4.12 Remote information exchange	Remote information exchange required		yes ModBus; Sunspec (TCP)			