

Certificate

No. ESY 075386 0302 Rev. 02

Holder of Certificate: **Shenzhen Kstar New Energy Company Limited**

The 9th Floor, R&D Building
Kstar Industrial Park, Guangming Hi-tech Industrial Zone
518107 Shenzhen, Guangdong Province
PEOPLE'S REPUBLIC OF CHINA

Product: **Converter**
(Hybrid Inverter & Energy Storage Inverter)

Model(s): Hybrid Inverter:
KAC50DP2, KAC49.9DP2, KAC40DP2, KAC30DP2,
KAC29.9DP2, KAC25DP2, KAC20DP2,
KAC50DP2-S0, KAC49.9DP2-S0, KAC40DP2-S0,
KAC30DP2-S0, KAC29.9DP2-S0, KAC25DP2-S0,
KAC20DP2-S0
Energy Storage Inverter:
KAC50D2, KAC49.9D2, KAC40D2, KAC30D2,
KAC29.9D2, KAC25D2, KAC20D2, KAC50D2-S0,
KAC49.9D2-S0, KAC40D2-S0, KAC30D2-S0,
KAC29.9D2-S0, KAC25D2-S0, KAC20D2-S0

Parameters: See page 4 to 11

Applicable standards: EN 50549-1:2019/A1:2023
RfG:2016
NC RfG:2025
PTPIREE:2024

This Certificate confirms the compliance with the above listed standards on a voluntary basis. It refers only to the sample submitted to TÜV SÜD Product Service GmbH and does not certify the quality or safety of the serial products. It was issued according to TÜV SÜD Product Service certification program Photovoltaics and Grid Integration. For details see: www.tuvsud.com/ps-cert

Test report no.: 64290253044003

Date, 2026-03-10

(Billy Qiu)

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Technical Certifier (Billy Qiu) appointed by Certification Body TÜV SÜD Product Service GmbH performed assessment of the products listed in this certification in the place: Ridlerstraße 65, 80339 Munich, Germany.

Test requirement	The certification complies with the requirements of the following documents and standards for Type A/B PGM installations: EN 50549-1:2019/A1:2023 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 RfG:2016 Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for the connection of generating units to the Network (OJ EU L 112/1 of 27.4.2016) NC RfG:2025(WOS 2025) General applicability requirements resulting from EU commission regulation 2016/631 of 14 April 2016 establishing a network code concerning the requirements for with regard to the connection of generating units to the grid (NC RfG May 2025)- approved by the Decision of the President of the Energy Regulatory Office 744.18.15.2024.WŻ.MKo4 dated 15 May 2025. PTPiREE:2024 Conditions and procedures for the use of certificates in the process of connecting modules generation modules to the power grid V1.3 And Set of protection settings and criteria and configuration parameters for regulatory characteristics of type A and B MWE (Bank setting for Poland) V1.1	
Type of certification programme	1(a) according to EN ISO/IEC 17067 Based on Photovoltaics and Grid Integration Certification Program (Revision 6, Dated 5 Dec 2021) for Poland Grid Code	
Manufacturer & Address of manufacturing site	Shenzhen Kstar New Energy Company Limited The 9th Floor, R&D Building, Kstar Industrial Park, Guangming Hi-tech Industrial Zone, 518107 Shenzhen, Guangdong Province, PEOPLE'S REPUBLIC OF CHINA	
Name & address of product manufactured factory	Shenzhen KSTAR Science & Technology Co., Ltd. Guangming Branch Kstar High Tech Park, 7th Road, Western Area, Hi-Tech Industrial Zone, Tianliao Community, Yutang Street, Guangming District, 518107 Shenzhen City, Guangdong Province, PEOPLE'S REPUBLIC OF CHINA	
Software version	DSP: V040B000D110, ARM: V040B000D110	
Communication potocol	Interface Type	SunSpec RTU
	SunSpec information model	1, 703, 704
	Inverter function	INV1, INV2, and INV3
	Firmware Version Tested	V040B000D110
	Firmware Checksum (in hex)	c38c60cb3bb4592ae8c8766a706a2462

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	"The RS-485 input port of the device supports the SunSpec communication protocol . Remote control via RS485 (Modbus RTU) is implemented at the device level and works correctly, including the following functions: • Remote cessation of active power generation (INV1 for model 703), • Active power control (INV2 for model 704), • Change of reactive power generation/cos fi value setting (INV3 for model 704)."
Certificate expiry date	2031-03-09

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Parameters:

Model	KAC50DP2	KAC49.9DP2	KAC40DP2	KAC30DP2
PV terminal parameters				
Maximum input voltage [V _{DC}]	1000	1000	1000	1000
Rated input voltage [V _{DC}]	720	720	720	720
MPPT voltage range [V _{DC}]	620 ÷ 800	620 ÷ 800	500 ÷ 800	400 ÷ 800
MPPT tracker number	4	4	4	4
Maximum operating PV input current [A _{DC}]	45/45/45/45	45/45/45/45	45/45/45/45	45/45/45/45
Maximum PV short circuit current [A _{DC}]	60/60/60/60	60/60/60/60	60/60/60/60	60/60/60/60
Battery input/output parameters				
Battery type	Lithium-ion	Lithium-ion	Lithium-ion	Lithium-ion
Maximum voltage [V _{DC}]	900	900	900	900
Battery rated voltage [V _{DC}]	720	720	720	720
Battery voltage range [V _{DC}]	150 ÷ 900	150 ÷ 900	150 ÷ 900	150 ÷ 900
Maximum charge power [W]	50000	49900	40000	30000
Maximum discharge power [W]	50000	49900	40000	30000
Maximum charge current [A _{DC}]	80/80	80/80	72/72	65/65
Maximum discharge current [A _{DC}]	80/80	80/80	72/72	65/65
Grid terminal input parameters				
Rated input voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated input frequency [Hz]	50	50	50	50
Maximum continuous input current from grid to battery [A _{AC}]	80	72	64	48
Maximum continuous input current [A _{AC}]	160	144	128	96
Maximum continuous input power from grid to battery [W]	50000	49900	40000	30000
Maximum continuous input active power [W]	100000	99800	80000	60000
Maximum continuous input apparent power [VA]	110000	99800	88000	66000
Grid terminal output parameters				
Rated output voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated output frequency [Hz]	50	50	50	50
Rated output current [A _{AC}]	72	72	58	43
Maximum continuous output current [A _{AC}]	80	72	64	48
Rated output active power [W]	50000	49900	40000	30000
Maximum output active power [W]	50000	49900	40000	30000
Maximum continuous output apparent power [VA]	55000	49900	44000	33000
Power factor	0.9 inductive ÷ 0.9 capacitive			

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Model	KAC29.9DP2	KAC25DP2	KAC20DP2
PV terminal parameters			
Maximum input voltage [V _{DC}]	1000	1000	1000
Rated input voltage [V _{DC}]	720	720	720
MPPT voltage range [V _{DC}]	400 ÷ 800	350 ÷ 800	300 ÷ 800
MPPT tracker number	4	4	4
Maximum operating PV input current [A _{DC}]	45/45/45/45	45/45/45/45	45/45/45/45
Maximum PV short circuit current [A _{DC}]	60/60/60/60	60/60/60/60	60/60/60/60
Battery input/output parameters			
Battery type	Lithium-ion	Lithium-ion	Lithium-ion
Maximum voltage [V _{DC}]	900	900	900
Battery rated voltage [V _{DC}]	720	720	720
Battery voltage range [V _{DC}]	250 ÷ 900	210 ÷ 900	200 ÷ 900
Maximum charge power [W]	29900	25000	20000
Maximum discharge power [W]	29900	25000	20000
Maximum charge current [A _{DC}]	65/65	60/60	55/55
Maximum discharge current [A _{DC}]	65/65	60/60	55/55
Grid terminal input parameters			
Rated input voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated input frequency [Hz]	50	50	50
Maximum continuous input current from grid to battery [A _{AC}]	43	40	32
Maximum continuous input current [A _{AC}]	87	80	64
Maximum continuous input power from grid to battery [W]	29900	25000	20000
Maximum continuous input active power [W]	59800	50000	40000
Maximum continuous input apparent power [VA]	59800	55000	44000
Grid terminal output parameters			
Rated output voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated output frequency [Hz]	50	50	50
Rated output current [A _{AC}]	43	36	29
Maximum continuous output current [A _{AC}]	43	40	32
Rated output active power [W]	29900	25000	20000
Maximum output active power [W]	29900	25000	20000
Maximum continuous output apparent power [VA]	29900	27500	22000
Power factor	0.9 inductive ÷ 0.9 capacitive		

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Model	KAC50DP2-S0	KAC49.9DP2-S0	KAC40DP2-S0	KAC30DP2-S0
PV terminal parameters				
Maximum input voltage [V _{DC}]	1000	1000	1000	1000
Rated input voltage [V _{DC}]	720	720	720	720
MPPT voltage range [V _{DC}]	620 ÷ 800	620 ÷ 800	500 ÷ 800	400 ÷ 800
MPPT tracker number	4	4	4	4
Maximum operating PV input current [A _{DC}]	45/45/45/45	45/45/45/45	45/45/45/45	45/45/45/45
Maximum PV short circuit current [A _{DC}]	60/60/60/60	60/60/60/60	60/60/60/60	60/60/60/60
Battery input/output parameters				
Battery type	Lithium-ion	Lithium-ion	Lithium-ion	Lithium-ion
Maximum voltage [V _{DC}]	900	900	900	900
Battery rated voltage [V _{DC}]	720	720	720	720
Battery voltage range [V _{DC}]	150 ÷ 900	150 ÷ 900	150 ÷ 900	150 ÷ 900
Maximum charge power [W]	50000	49900	40000	30000
Maximum discharge power [W]	50000	49900	40000	30000
Maximum charge current [A _{DC}]	80/80	80/80	72/72	65/65
Maximum discharge current [A _{DC}]	80/80	80/80	72/72	65/65
Grid terminal input parameters				
Rated input voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated input frequency [Hz]	50	50	50	50
Maximum continuous input current from grid to battery [A _{AC}]	80	72	64	48
Maximum continuous input current [A _{AC}]	80	72	64	48
Maximum continuous input power from grid to battery [W]	50000	49900	40000	30000
Maximum continuous input active power [W]	50000	49900	40000	30000
Maximum continuous input apparent power [VA]	55000	49900	44000	33000
Grid terminal output parameters				
Rated output voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated output frequency [Hz]	50	50	50	50
Rated output current [A _{AC}]	72	72	58	43
Maximum continuous output current [A _{AC}]	80	72	64	48
Rated output active power [W]	50000	49900	40000	30000
Maximum output active power [W]	50000	49900	40000	30000
Maximum continuous output apparent power [VA]	55000	49900	44000	33000
Power factor	0.9 inductive ÷ 0.9 capacitive			

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Model	KAC29.9DP2-S0	KAC25DP2-S0	KAC20DP2-S0
PV terminal parameters			
Maximum input voltage [V _{DC}]	1000	1000	1000
Rated input voltage [V _{DC}]	720	720	720
MPPT voltage range [V _{DC}]	400 ÷ 800	350 ÷ 800	300 ÷ 800
MPPT tracker number	4	4	4
Maximum operating PV input current [A _{DC}]	45/45/45/45	45/45/45/45	45/45/45/45
Maximum PV short circuit current [A _{DC}]	60/60/60/60	60/60/60/60	60/60/60/60
Battery input/output parameters			
Battery type	Lithium-ion	Lithium-ion	Lithium-ion
Maximum voltage [V _{DC}]	900	900	900
Battery rated voltage [V _{DC}]	720	720	720
Battery voltage range [V _{DC}]	150 ÷ 900	150 ÷ 900	150 ÷ 900
Maximum charge power [W]	29900	25000	20000
Maximum discharge power [W]	29900	25000	20000
Maximum charge current [A _{DC}]	65/65	60/60	55/55
Maximum discharge current [A _{DC}]	65/65	60/60	55/55
Grid terminal input parameters			
Rated input voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated input frequency [Hz]	50	50	50
Maximum continuous input current from grid to battery [A _{AC}]	43	40	32
Maximum continuous input current [A _{AC}]	43	40	32
Maximum continuous input power from grid to battery [W]	29900	25000	20000
Maximum continuous input active power [W]	29900	25000	20000
Maximum continuous input apparent power [VA]	29900	27500	22000
Grid terminal output parameters			
Rated output voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated output frequency [Hz]	50	50	50
Rated output current [A _{AC}]	43	36	29
Maximum continuous output current [A _{AC}]	43	40	32
Rated output active power [W]	29900	25000	20000
Maximum output active power [W]	29900	25000	20000
Maximum continuous output apparent power [VA]	29900	27500	22000
Power factor	0.9 inductive ÷ 0.9 capacitive		

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Model	KAC50D2	KAC49.9D2	KAC40D2	KAC30D2
Battery input/output parameters				
Battery type	Lithium-ion	Lithium-ion	Lithium-ion	Lithium-ion
Maximum voltage [V _{DC}]	900	900	900	900
Battery rated voltage [V _{DC}]	720	720	720	720
Battery voltage range [V _{DC}]	150 ÷ 900	150 ÷ 900	150 ÷ 900	150 ÷ 900
Maximum charge power [W]	50000	49900	40000	30000
Maximum discharge power [W]	50000	49900	40000	30000
Maximum charge current [A _{DC}]	80/80	80/80	72/72	65/65
Maximum discharge current [A _{DC}]	80/80	80/80	72/72	65/65
Grid terminal input parameters				
Rated input voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated input frequency [Hz]	50	50	50	50
Maximum continuous input current from grid to battery [A _{AC}]	80	72	64	48
Maximum continuous input current [A _{AC}]	160	144	128	96
Maximum continuous input power from grid to battery [W]	50000	49900	40000	30000
Maximum continuous input active power [W]	100000	99800	80000	60000
Maximum continuous input apparent power [VA]	110000	99800	88000	66000
Grid terminal output parameters				
Rated output voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated output frequency [Hz]	50	50	50	50
Rated output current [A _{AC}]	72	72	58	43
Maximum continuous output current [A _{AC}]	80	72	64	48
Rated output active power [W]	50000	49900	40000	30000
Maximum output active power [W]	50000	49900	40000	30000
Maximum continuous output apparent power [VA]	55000	49900	44000	33000
Power factor	0.9 inductive ÷ 0.9 capacitive			

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Model	KAC29.9D2	KAC25D2	KAC20D2
Battery input/output parameters			
Battery type	Lithium-ion	Lithium-ion	Lithium-ion
Maximum voltage [V _{DC}]	900	900	900
Battery rated voltage [V _{DC}]	720	720	720
Battery voltage range [V _{DC}]	150 ÷ 900	150 ÷ 900	150 ÷ 900
Maximum charge power [W]	29900	25000	20000
Maximum discharge power [W]	29900	25000	20000
Maximum charge current [A _{DC}]	65/65	60/60	55/55
Maximum discharge current [A _{DC}]	65/65	60/60	55/55
Grid terminal input parameters			
Rated input voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated input frequency [Hz]	50	50	50
Maximum continuous input current from grid to battery [A _{AC}]	43	40	32
Maximum continuous input current [A _{AC}]	87	80	64
Maximum continuous input power from grid to battery [W]	29900	25000	20000
Maximum continuous input active power [W]	59800	50000	40000
Maximum continuous input apparent power [VA]	59800	55000	44000
Grid terminal output parameters			
Rated output voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated output frequency [Hz]	50	50	50
Rated output current [A _{AC}]	43	36	29
Maximum continuous output current [A _{AC}]	43	40	32
Rated output active power [W]	29900	25000	20000
Maximum output active power [W]	29900	25000	20000
Maximum continuous output apparent power [VA]	29900	27500	22000
Power factor	0.9 inductive ÷ 0.9 capacitive		

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Model	KAC50D2-S0	KAC49.9D2-S0	KAC40D2-S0	KAC30D2-S0
Battery input/output parameters				
Battery type	Lithium-ion	Lithium-ion	Lithium-ion	Lithium-ion
Maximum voltage [V _{DC}]	900	900	900	900
Battery rated voltage [V _{DC}]	720	720	720	720
Battery voltage range [V _{DC}]	150 ÷ 900	150 ÷ 900	150 ÷ 900	150 ÷ 900
Maximum charge power [W]	50000	49900	40000	30000
Maximum discharge power [W]	50000	49900	40000	30000
Maximum charge current [A _{DC}]	80/80	80/80	72/72	65/65
Maximum discharge current [A _{DC}]	80/80	80/80	72/72	65/65
Grid terminal input parameters				
Rated input voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated input frequency [Hz]	50	50	50	50
Maximum continuous input current from grid to battery [A _{AC}]	80	72	64	48
Maximum continuous input current [A _{AC}]	80	72	64	48
Maximum continuous input power from grid to battery [W]	50000	49900	40000	30000
Maximum continuous input active power [W]	50000	49900	40000	30000
Maximum continuous input apparent power [VA]	55000	49900	44000	33000
Grid terminal output parameters				
Rated output voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated output frequency [Hz]	50	50	50	50
Rated output current [A _{AC}]	72	72	58	43
Maximum continuous output current [A _{AC}]	80	72	64	48
Rated output active power [W]	50000	49900	40000	30000
Maximum output active power [W]	50000	49900	40000	30000
Maximum continuous output apparent power [VA]	55000	49900	44000	33000
Power factor	0.9 inductive ÷ 0.9 capacitive			

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Model	KAC29.9D2-S0	KAC25D2-S0	KAC20D2-S0
Battery input/output parameters			
Battery type	Lithium-ion	Lithium-ion	Lithium-ion
Maximum voltage [V _{DC}]	900	900	900
Battery rated voltage [V _{DC}]	720	720	720
Battery voltage range [V _{DC}]	150 ÷ 900	150 ÷ 900	150 ÷ 900
Maximum charge power [W]	29900	25000	20000
Maximum discharge power [W]	29900	25000	20000
Maximum charge current [A _{DC}]	65/65	60/60	55/55
Maximum discharge current [A _{DC}]	65/65	60/60	55/55
Grid terminal input parameters			
Rated input voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated input frequency [Hz]	50	50	50
Maximum continuous input current from grid to battery [A _{AC}]	43	40	32
Maximum continuous input current [A _{AC}]	43	40	32
Maximum continuous input power from grid to battery [W]	29900	25000	20000
Maximum continuous input active power [W]	29900	25000	20000
Maximum continuous input apparent power [VA]	29900	27500	22000
Grid terminal output parameters			
Rated output voltage [V _{AC}]	3P+N+PE, 230/400	3P+N+PE, 230/400	3P+N+PE, 230/400
Rated output frequency [Hz]	50	50	50
Rated output current [A _{AC}]	43	36	29
Maximum continuous output current [A _{AC}]	43	40	32
Rated output active power [W]	29900	25000	20000
Maximum output active power [W]	29900	25000	20000
Maximum continuous output apparent power [VA]	29900	27500	22000
Power factor	0.9 inductive ÷ 0.9 capacitive		

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Evaluated parameter and parameter range according to the Bank of Settings for Poland:

Specific technical requirements (e.g. network codes)		Bank of Settings for Poland		
Requirement	Parameters	Notes/Additional Information	List of Possible Values (Configurable Range)	Evaluation Result
For type A generation module:				
Software version	DSP: V040B000D110, ARM: V040B000D110			
Confirmation of the existence of an irremovable and unmodifiable register of changes made to the product/device settings, along with the assignment of information about the change made and the date of its introduction.	--	--	--	Positive
Interface protection	Undervoltage protection $U<$	--	--	85% $U_n=195.5 V_{AC}$
	Undervoltage protection with time delay $U<$	--	0ms -10000ms	1200 ms
	Undervoltage protection with time delay $U<$	--	--	110% $U_n=253 V_{AC}^*$
	First-stage overvoltage protection with time delay $U>$	--	0ms -10000ms	3000 ms
	Second-stage overvoltage protection $U>>$	--	--	115% $U_n=264.5 V_{AC}$
	Second-stage overvoltage protection with time delay $U>>$	--	0ms -10000ms	100 ms
	Underfrequency protection $f<$	--	--	47.5 Hz
	Underfrequency protection with time delay $f<$	--	0ms -10000ms	1000 ms
	Overfrequency protection $f>$	--	--	51.5 Hz
	Overfrequency protection with time delay $f>$	--	0ms -10000ms	300 ms

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	Loss of mains protection - RoCoF df/dt criterion	--	--	2.5Hz/s
LFSM-O characteristic	Starting Value	--	50.2 Hz - 50.5 Hz	50.2 Hz
	Drop Value	--	2 % - 12 %	5 %
	Power Reference Pref	--	--	Actual active power output when the LFSM-O threshold is reached
Allowable generation reduction characteristic	Reduction threshold fr	--	Not configurable	49.0 Hz
	Maximum Reduction Rate	--	Not configurable	Maximum allow 2% of P_{max} per 1 Hz
Voltage support by reactive power - Control modes	Enabled control mode	--	Q set-up (Q setpoint) Q(U)	Q set-up (Q setpoint)
Reactive power control as a function of generator terminal voltage (Q(U) mode)	Network connection	--	1-phase/ 3-phase	3-phase
	Low voltage U_{min}	--	--	92% $U_n=211.6 V_{AC}$
	Low voltage U_{prog1}	--	--	94% $U_n=216.2 V_{AC}$
	High voltage U_{prog2}	--	--	106% $U_n=243.8 V_{AC}$
	High voltage U_{max}	--	--	108% $U_n=248.4 V_{AC}$
	MaxQpob	--	--	-48% P_n
	MaxQgen	--	--	48% P_n
Active power control as a function of voltage (P(U) mode)	Points on the characteristic: Upr	--	--	108% $U_n=248.4 V_{AC}$
	Droop	--	--	2.5
Conditions for automatic reconnection of a power generating module to the network (network resynchronization)	Lower frequency	--	--	49.0 Hz
	Upper frequency	--	--	50.05 Hz
	Lower voltage	--	--	85% $U_n=195.5 V_{AC}$
	Upper voltage	--	--	110% $U_n=253 V_{AC}$
	Observation time	--	--	60 s
	Active power increase gradient	--	--	10 % P_{max}/min

Remark:

*measured as a 10-minute average in a sliding window - in accordance with EN 50160. Detailed requirements for measuring the average value are contained in EN 50549.

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For a type B generation module connected to the LV network:				
Software version	DSP: V040B000D110, ARM: V040B000D110			
Confirmation of the existence of an irremovable and unmodifiable register of changes made to the product/device settings, along with the assignment of information about the change made and the date of its introduction.	--	--	--	Positive
Interface protection	Undervoltage protection $U<$	--	--	80% $U_n=184 V_{AC}$
	Undervoltage protection with time delay $U<$	--	0ms -10000ms	3000 ms
	Undervoltage protection with time delay $U<$	--	--	110% $U_n=253 V_{AC}^*$
	First-stage overvoltage protection with time delay $U>$	--	0ms -10000ms	3000 ms
	Second-stage overvoltage protection $U>>$	--	--	115% $U_n=264.5 V_{AC}$
	Second-stage overvoltage protection with time delay $U>>$	--	0ms -10000ms	100 ms
	Underfrequency protection $f<$	--	--	47.5 Hz
	Underfrequency protection with time delay $f<$	--	0ms -10000ms	1000 ms
	Overfrequency protection $f>$	--	--	51.5 Hz
	Overfrequency protection with time delay $f>$	--	0ms -10000ms	300 ms
	Loss of mains protection - RoCoF df/dt criterion	--	--	2.0Hz/s
	Starting Value	--	50.2 Hz - 50.5 Hz	50.2 Hz
LFSM-O characteristic	Drop Value	--	2 % - 12 %	5 %
	Power Reference Pref	--	--	Actual active power output when the LFSM-O threshold is reached

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Allowable generation reduction characteristic	Reduction threshold fr	--	Not configurable	49.0 Hz	
	Maximum Reduction Rate	--	Not configurable	Maximum allow 2% of P_{max} per 1 Hz	
Fault Ride Through characteristic – the voltage-against-time profile characterizing the power generating module capability of staying connected to the network during fault conditions *** & Ability to generating additional fast fault current & Conditions for resiliency (active power recovery after fault)	Maximum time for post-fault active power recovery (times counted from fault removal)	--	5 second	Defaults setting 1 second	
	Voltage-Time-Diagram	--	--	Time [s]	U [p.u.]
				0.00	0.05
				0.25	0.05
				2.50	0.85
	Static voltage range undervoltage U_{trig}	--	80% U_n to 100% U_n	85% $U_n=195.5 V_{AC}$	
	Gradient k1	--	From 2 to 6 in steps of 0.5	2	
	Gradient k2	--	From 2 to 6 in steps of 0.5	2	
Conditions for automatic reconnection of a power generating module to the network (network resynchronization)	Lower frequency	--	--	49.0 Hz	
	Upper frequency	--	--	50.05 Hz	
	Lower voltage	--	--	80% $U_n=184 V_{AC}$	
	Upper voltage	--	--	110% $U_n=253 V_{AC}$	
	Observation time	--	--	60 s	
	Active power increase gradient	--	--	10 % P_{max} /min	
Voltage Support Through Reactive Power - Control Modes	Control mode enabled	--	Q set-up (Q setpoint)	Q set-up (Q setpoint)	
Voltage Support Through Reactive Power - Control Modes for the Set-Up Point	Q set-up (Q setpoint)	--	-48% P_{max} - 48% P_{max}	Default 0% P_{max} . **	

Remark:

*measured as a 10-minute average in a sliding window - in accordance with EN 50160. Detailed requirements for average measurement are contained in EN 50549.

** When the voltage is 100% U_n to 110% U_n and the active power is 100% P_{max} , the setting range is -48% P_{max} to 48% P_{max} .

When the voltage is 90% U_n to 100% U_n , the setting range for reactive power is -48% P_{max} to 48% P_{max} . In this case, due to the maximum current and maximum power limits, the active power will not reach 100% P_{max} .

*** unless otherwise specified by the relevant OS.

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Scope of assessment and results

Requirement	Clause of RfG:2016	Clause of NC RfG: 2025	Type A	Type B	Type C	Type D	Evaluation result
Frequency range	Article 13.1 (a)	Article 13.1 (a) (i)	Y	Y	N/A	N/A	Positive
Ability to withstand the rate of change of frequency (RoCoF) df/dt	Article 13.1 (b)	Article 13.1 (b)	Y	Y	N/A	N/A	Positive
Power generating module operating mode in which the generated active power decreases in response to an increase in system frequency above a specified value (LFSM-O)	Article 13.2(*)	Article 13.2 (a) (b) (f)	Y	Y	N/A	N/A	Positive
Maximum power capability reduction with falling frequency	Article 13.4 & 13.5	Article 13.4	Y	Y	N/A	N/A	Positive
Remote ceasing active power generation	Article 13.6	Article 13.6	Y	Y	N/A	N/A	Positive
Automatic connection to the network	Article 13.7 & 14.4	Article 13.7 & 14.4 (a)	Y	Y	N/A	N/A	Positive
Remote control of active power	Article 14.2	Article 14.2 (b)	N/A	Y	N/A	N/A	Positive
Automatic power control & Manual power control	Article 15.2 (a) (b)	Article 15.2 (a) (b)	N/A	Y	N/A	N/A	Positive
Ability to withstand voltage dips for terminals below 110 kV	Article 14.3	Article 14.3 (a) (i) (b)	N/A	Y	N/A	N/A	Positive
Ability to withstand voltage dips for terminals above 110 kV	Article 16.3	Article 16.3 (a) (i) (c)	N/A	N/A	N/A	N/A	N/A
Introduction of fast current & symmetrical and asymmetrical disturbances	Article 20.2 (b) (c) & Article 21.3 (e)	Article 20.2 (b) (c) & Article 21.3 (e)	N/A	Y	N/A	N/A	Positive
Post interference recovery of active power	Article 20.3	Article 20.3 (a)	N/A	Y	N/A	N/A	Positive

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The operating mode of the power generating module in which the generated active power increases following a drop in system frequency below a specified value (LFSM-U)	Article 15.2 (c)	Article 15.2 (c) (i)	N/A	N/A	N/A	N/A	N/A
FSM mode	Article 15.2 (d) (i)	Article 15.2 (d) (i)	N/A	N/A	N/A	N/A	N/A
Speed of power changes	Article 15.6 (e)	Article 15.6 (e)	N/A	N/A	N/A	N/A	N/A
Voltage conditions	Article 16.2 (a)	Article 16.2 (a) (i)	N/A	N/A	N/A	N/A	N/A
Reactive power - Capabilities	Article 20.2 (a) & 21.3 (b) (i) (c) (d)	Article 20.2 (a) & 21.3 (b) (i) (c) (d)	Y	Y	N/A	N/A	Positive
Remark: * Article 13.2 lit. b) only applies to PGM type A according to the RfG:2016.							