Capability Curves: ZCS Azzurro 250-350KTL-HV Z0

Product name .....:	Solar Grid-tied Inverter
Trademark .....:	
Factory's name .....:	Guangdong Sofar Smart Solar Technology Co., Ltd.
Factory address.....:	No.1, Dongsheng North Road, Chenjiang Street, Zhongkai High-tech Zone, Huizhou City (One license multiple addresses), China

Device topology				
☐ Interface device (DDI)	☐ Interface protection (PI)	☒ Static conversion device	☐ Storage system	☐ Rotary generating device
User-side connection:	☐ Three-phase with neutral ☒ Three-phase without neutral Frequency [Hz]: 50 Voltage[V]: 800			
Primary energy used:	☒ Solar (testing acc. Annex N) ☐ Storage (testing acc. Annex Nbis) ☐ Wind (testing acc. Annex N/Nter) ☐ Hydroelectric (testing acc. Annex N/Nter) ☐ CHP (testing acc. Annex N/Nter) ☐ Other:			

The generator(s):	☒ is suitable for installation in systems with a power ≤ 400kW ☒ is suitable for installation in systems with a power > 400kW

Characteristics of the static converter			
Model / Type reference:	**AZZURRO 3PH 250KTL-HV Z0**	**AZZURRO 3PH 330KTL-HV Z0** **AZZURRO 3PH 330KTL-HV Z1**	**AZZURRO 3PH 350KTL-HV Z0** **AZZURRO 3PH 350KTL-HV Z1**
Firmware version:	V1.1.1		
AC Output Rated Power P_{NINV} [kW]:	250	330	352
User-side connection:	☐ Three-phase with neutral ☒ Three-phase without neutral Frequency [Hz]: 50 Voltage[V]: 800		

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N.6 Verification of construction requirements regarding reactive power exchange	P

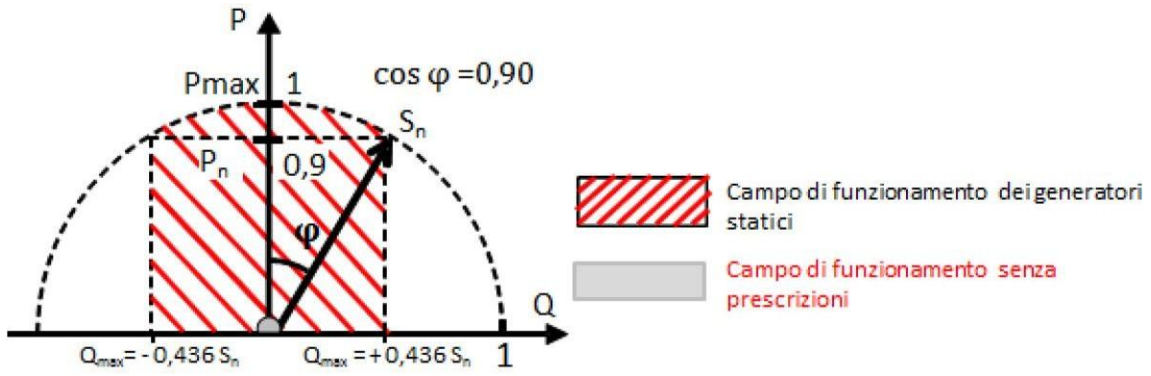
Conditions for laboratory tests

The following tests were performed in laboratory environment under the following conditions:

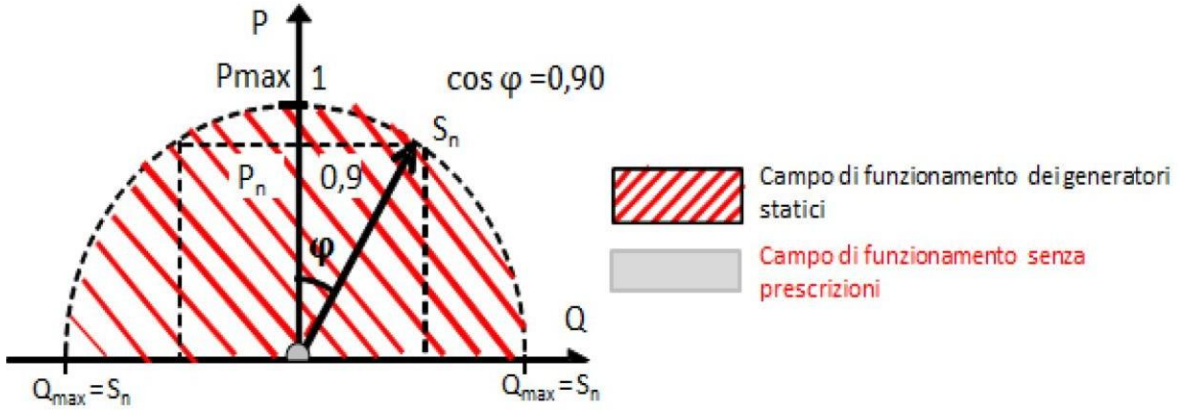
Influencing factors	Reference value	Remarks
Ambient temperature	25°C ± 5°C	Average value during testing: 24,5°C
Atmospheric pressure	96kPa ± 10kPa	Average value during testing: 102 kPa
Relative humidity	65%RH ±10%RH	Average value during testing: 66%RH
Equipment location	According to the manufacturer's statement	Testing done in laboratory environment, see *Testing Location* on p.1
Frequency	50 Hz (in the range 47,5 Hz - 51,5 Hz, where applicable)	50 Hz
Waveform of the reference voltage	Compliant with CEI EN 50160	Stable AC source (see *Annex 5 – Test equipment list*) used for testing. Requirements of CEI EN 50160 are met.

N.6.1 Verification of reactive power capability	P

For static generators, there are different capabilities depending on the total power of the installation:



CEI 0-16:2022-03, Figure 74, Capability for static generators in power plants <400 kW (limited semicircular characteristic)



CEI 0-16:2022-03, Figure 74, Capability for static generators in power plants ≥400 kW (semi-circular characteristic)

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Legend:

S_n = rated apparent power at rated voltage U_n

P_n = active power at cosφ = 0,9 at rated voltage U_n

P_{max} = maximum active power at rated voltage Un (with cosφ = 1)

Q_{max} = maximum reactive power at rated voltage Un (with cosφ = 0,9)

N.6.1.1 Procedure for performing and recording the test for static generators	**P**

Test conditions

Test setup	See section *General remarks for testing*
Operating mode of the PGU during the measurement	Normal operation, MPP-Tracking active
Q-Setpoint	According to test requirements

Requirements on testing and recording:

- The converter must be set so that it can respectively absorb (inductive behaviour) and deliver (capacitive behaviour) the maximum available reactive power at each level of the active power delivered according to its capability.
- At this point, the DC source is adjusted so that at least the entire rated active power of the generator under test is available; further adjustments are possible during the test, so that the source is not limiting for the performance to be measured.
- Adjust (either by adjustment of the source or by adjustment in the con trol system of the converter under test), the active power for values in the 11 ranges [0±5]%; [10±5]%; ...; [100±5]% of the nominal apparent power; measure the active power under steady-state conditions, approx. 1 min after adjustment (average values at 1 min calculated from the values measured at the fundamental frequency over a 200 ms window).
- For each of the 11 active power levels, one value for the inductive reactive power and one for the capacitive reactive power must be recorded, as average values at 1 min calculated based on measurements at the fundamental frequency over a 1s window. The power factor must also be recorded and reported as a 1-minute average.
- In addition to the measurements at the reactive power setting limit values, the measured values should be recorded by setting the reactive power output to 0 (cosφ = 1).

The maximum capability in absorption (Q_{min}) and delivery (Q_{max}) of reactive power resulting from the above sequence of measurements and that for Q = 0 must be documented in tabular form by showing, for each level of delivered active power between 0% and 100% of the rated apparent power, the corresponding level of absorbed (and delivered) reactive power, expressed both in absolute value and in p.u. of the rated apparent power and in terms of cosφ.

Assessment criterion:

- For each measured point, a maximum deviation of the reactive power $\Delta Q \leq \pm 5\% S_n$
- For values of $P \leq 10\% S_n$
  - Power plants <400 kW:
    maximum deviation of the reactive power $\Delta Q \leq \pm 10\% S_n$
  - Power plants ≥400 kW:
    recording of the available capability values for delivered active power values lower than $10\% S_n$ is required, but the results do not constitute a prescriptive performance constraint.

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Test results							
☒ static generator in power plants <400 kW ☒ static generator in power plants ≥400 kW							
-Q_{max} (inductive)							
Power-Bin (based S_n)	Active power		Reactive power		DC power		Power factor (cosφ)
	[kW]	p.u. (based S_n)	[kvar]	p.u. (based S_n)	[kW]	p.u. (based S_n)	
0% ± 5%	6,324	0,018	-352,751	-1,002	6,818	0,019	0,018
10% ± 5%	35,449	0,101	-350,224	-0,995	36,236	0,103	0,101
20% ± 5%	70,723	0,201	-344,739	-0,979	71,684	0,204	0,201
30% ± 5%	106,050	0,301	-335,554	-0,953	107,571	0,306	0,301
40% ± 5%	141,522	0,402	-322,013	-0,915	143,378	0,407	0,402
50% ± 5%	176,785	0,502	-304,385	-0,865	178,362	0,507	0,502
60% ± 5%	211,348	0,600	-281,080	-0,799	214,723	0,61	0,601
70% ± 5%	246,337	0,700	-251,302	-0,714	249,828	0,71	0,700
80% ± 5%	281,726	0,800	-210,235	-0,597	284,634	0,809	0,801
90% ± 5%	317,151	0,901	-151,055	-0,429	322,027	0,915	0,903
100% ± 5%	352,062	1,000	-1,511	-0,004	361,096	1,026	0,999
+Q_{max} (capacitive)							
Power-Bin (based S_n)	Active power		Reactive power		DC power		Power factor (cosφ)
	[kW]	p.u. (based S_n)	[kvar]	p.u. (based S_n)	[kW]	p.u. (based S_n)	
0% ± 5%	6,371	0,018	352,127	1,000	7,336	0,021	0,018
10% ± 5%	36,091	0,103	350,009	0,994	37,122	0,105	0,103
20% ± 5%	71,284	0,203	344,659	0,979	72,282	0,205	0,203
30% ± 5%	106,433	0,302	335,275	0,952	107,399	0,305	0,303
40% ± 5%	141,520	0,402	322,215	0,915	142,864	0,406	0,402
50% ± 5%	176,502	0,501	303,713	0,863	178,900	0,508	0,502
60% ± 5%	211,194	0,600	281,391	0,799	214,321	0,609	0,600
70% ± 5%	246,162	0,699	251,571	0,715	249,567	0,709	0,699
80% ± 5%	281,214	0,799	210,575	0,598	285,092	0,81	0,800
90% ± 5%	316,383	0,899	154,517	0,439	320,976	0,912	0,899
100% ± 5%	352,062	1,000	-1,511	-0,004	361,096	1,026	0,999

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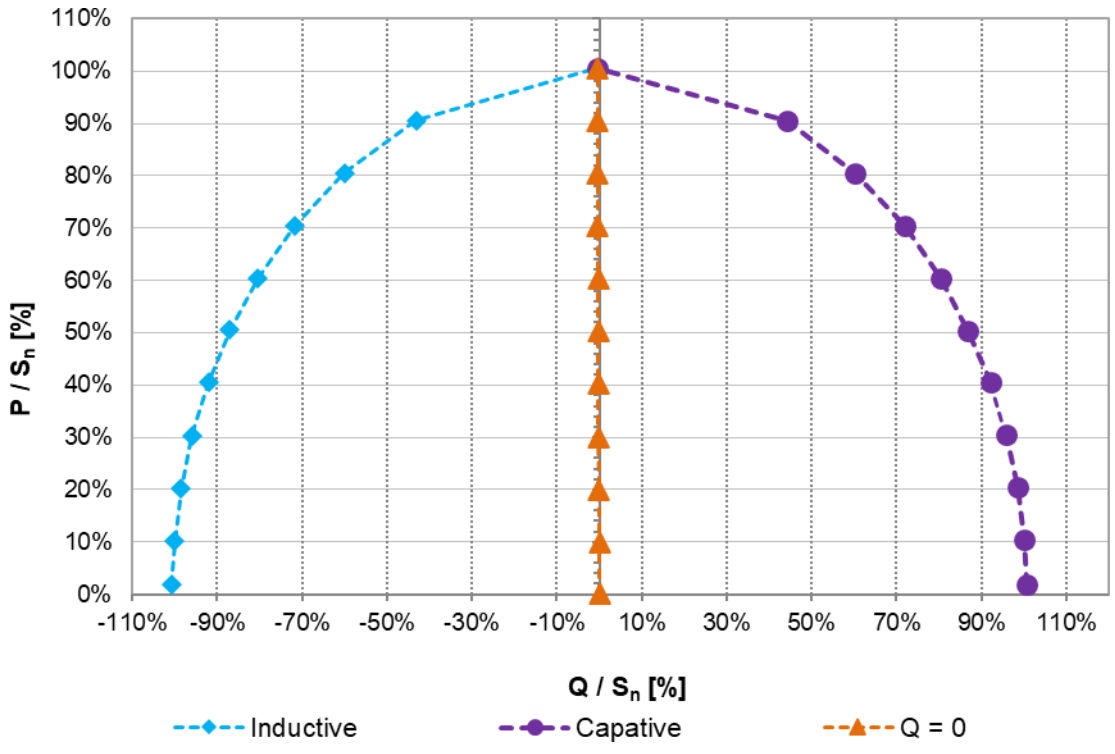
Q = 0							
Power-Bin (based S_n)	Active power		Reactive power		DC power		Power factor (cosφ)
	[kW]	p.u. (based S_n)	[kvar]	p.u. (based S_n)	[kW]	p.u. (based S_n)	
0% ± 5%	0,837	0,002	0,189	0,001	1,222	0,003	0,975
10% ± 5%	35,041	0,100	-0,005	0,000	36,031	0,102	0,999
20% ± 5%	70,032	0,199	-0,552	-0,002	71,645	0,204	0,999
30% ± 5%	105,255	0,301	-0,674	-0,002	107,564	0,307	0,999
40% ± 5%	140,809	0,400	-0,687	-0,002	143,884	0,409	0,999
50% ± 5%	176,274	0,501	-0,728	-0,002	180,175	0,512	0,999
60% ± 5%	211,176	0,600	-0,925	-0,003	215,984	0,614	0,999
70% ± 5%	246,399	0,700	-1,092	-0,003	252,123	0,716	0,999
80% ± 5%	281,616	0,800	-1,244	-0,004	288,343	0,819	0,999
90% ± 5%	316,686	0,900	-1,352	-0,004	324,621	0,922	0,999
100% ± 5%	352,062	1,000	-1,511	-0,004	361,096	1,026	0,999



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