

Type Certificate (GCC)



GL Wind No. **TC-GL-003A-2008**

This Type Certificate for Grid Connection Compatibility of the Wind Turbine

Skystream 3.7, 50 Hz

is issued to **Southwest Windpower
1801 West Route 66
Flagstaff, AZ 86001, USA.**

This certificate attests compliance with the normative references stated below concerning the Grid Connection Compatibility in Germany, France and UK as named in Annex 3.

The certificate is based on the test bench tests and documentation listed in the Certification Report given below. The test results are given in attached Annex 2 and technical specifications in Annex 1.

Certification Report number and title:

73129-13 13.06.2008 Grid Code Compliance


Normative references:


- GL Wind Technical Note 065, "Grid connection compatibility of wind turbines according to Grid Codes (NAR), Certification Procedure", Rev. 5, dated 06.06.2005, Hamburg, Germany
- Grid Codes from Germany, UK and France as given in Annex 3

Changes in design are to be approved by Germanischer Lloyd, otherwise this certificate loses its validity.

Hamburg, 13th June 2008
Poll/TBu

Germanischer Lloyd Industrial Services GmbH


i. V. Mike Woebeking


i. V. Andreas Anders

By DAP German Accreditation System for Testing
accredited Certification Body for products
The accreditation is valid for the fields of certification
listed in the certificate



Germanischer Lloyd Industrial Services GmbH
Business Segment Wind Energy
Steinhof 9
20459 Hamburg
Germany

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Annex 1

General Data

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General

Type: horizontal axis wind turbine
Power regulation: stall regulation control
Rated power: 1,800 W
Hub height: 10.4 m
Rated rotational speed: 330 rpm
Operating range rotational speed: 50 ... 370 rpm
Cut-in wind speed: 3.5 m/s
Rated wind speed: 9.4 m/s
Cut-out-wind speed (instantaneous): 25 m/s
50-year extreme wind speed
(10 min mean): 42.5 m/s
Annual average wind speed: 8.5 m/s
SWT Class acc. to IEC 61400-2: II_A

Rotor

Cone angle: 6°
Tilt: 3°
Power control: stall
Orientation: downwind

Rotor Blades

Diameter: 3.72 m
Number of blades: 3
Blade type: Skystream Blade
Blade material: Fibreglas reinforced composite
Manufacturer: Southwest Windpower
Documentation by: Southwest Windpower
Drawing No.: 3-CMBP-3010, Rev. NC, 8 sheets

Rotor Hub

Type: cast
Material: modified A356-T6 aluminium alloy
Drawing No.: 3-CNBP-3042, rev.B, 4 sheets

Main Shaft

Type: cold drawn
Material: AISI 1026
Drawing No.: 3-CMBP-3013, rev. C, 1 sheet

Braking System

Design: Electronic stall regulation with
redundant relay (rev. D)
Drawing No.: Block Diagram, Rev. XB

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Generator

Manufacturer:
Type:

Southwest Windpower
brushless 3-phase generator with
permanent magnet rotor and slotless
toroidal stator

Rated power: 1,800 W (2,400 W peak)
Rated voltage: 230 V
Rated grid frequency: 50 Hz
Rated speed: 330 rpm
Stator type: RAD-BB1/3,
Nippon Serbig Co., Ltd.
Isolation class: F
Degree of protection: IP54

Nacelle Frame

Type: cast
Material: A383 aluminium alloy
Drawing No. face: 3-CMBP-3003, rev. H, 4 sheets
Drawing No. nacelle: 3-CMBP-3001, rev. M, 6 sheets
Drawing No. hatchcover: 3-CMBP-3005, rev. I, 2 sheets

Yaw System

Type: passive
Drawing No. yaw shaft: 3-CMBP-3038, rev. C, 2 sheets

Tower 10.4 m Hub Height

Type: tubular steel tower
Length: 10.23 m
Drawing No.: WE0146A, rev. J

Main frequency converter

Manufacturer: Southwest Windpower
Type: IGBT
Max. voltage dc link: 400 V
Rated output: 1,800 W (2,400 W peak)
Rated output voltage: 230 V
Rated frequency: 50 Hz
Rated output current: 10 A

Signature

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Control and safety system

Manufacturer
PLC software release

Southwest Windpower
2.0

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Annex 2

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Results of Wind Turbine Grid Connection Compatibility tests:

All tests are passed successfully compared to the requirements of the Grid Codes mentioned in Annex 3 and as shown exemplarily on the table below.

Frequency protection

	Under frequency		Over frequency	
	Frequency	Time	Frequency	Time
UK Limit	47 Hz	0,5 s	50,5 Hz	0,5 s
Trip value	46,96 Hz	0.178 s	50.504 Hz	0.403 s
	Frequency	Time	Frequency	Time
Germany Limit	47,5 Hz	0,2 s	50,2 Hz	0,2 s
Trip value	47.62 Hz	0.154 s	50.209 Hz	0.09 s

Voltage protection

	Under voltage		Over voltage	
	Voltage	Time	Voltage	Time
Limit UK	207 V	1,5 s	264 V	1,5 s
Trip value	206.73 V	1.024 s	264.56 V	0.690 s
	Voltage	Time	Voltage	Time
Limit Germany	184 V	0,2 s	264.5 V	0,2 s
Trip value	183.93 V	0.190 s	264.20 V	0.185 s

Loss of mains test

Method used	Resonant circuit test		
	25%	55%	100%
Output power level	25%	55%	100%
Trip value	< 1 s	< 1 s	< 1 s

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Reconnection times

	Under / Over voltage	Under / Over frequency	Loss of mains
Minimum value	180 s	180 s	180 s
Recorded value	181.76 s	181.76 s	182.06 s

DC Injection into the grid

Recommended Limit UK	20mA, tested at three power levels		
Power level	10%	55%	100%
Results	10 mA	10 mA	10 mA

Power factor

Power level	at three voltage levels		
	212V	230V	248V
10%	0.801	0.743	0.685
55%	0.999	0.998	0.996
100%	0.997	0.999	0.999

Voltage Fluctuations

	Starting	Result	Stopping	Result
Limit Germany	3%	0,07%	3%	0,03%
Limit UK	4%	0,07%	4%	0,03%

Flicker

Network impedance phase angle, ψ_k	30°	50°	70°	90°
Annual average wind speed, v_a (m/s)	Flicker coefficient $c(\psi_k, v_a)$			
6.0	0,91	0,75	0,68	0,67
7.5	0,91	0,78	0,68	0,67
8.5	0,91	0,78	0,68	0,67
10.0	0,95	0,79	0,68	0,68

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Harmonics

Order	Power output [kW]	Harmonic current (% from I_N)	Harmonic current [A]	Harmonic current Limit ¹⁾ [A]
2	2,599	0,431	0,045	1,08
3	2,096	2,476	0,2584	2,3
4	2,599	0,258	0,027	0,43
5	2,723	1,180	0,1231	1,14
6	2,335	0,197	0,0205	0,3
7	2,723	0,776	0,081	0,77
8	2,599	0,112	0,0117	0,23
9	2,242	0,537	0,0560	0,4
10	2,599	0,196	0,0205	0,184
11	2,723	0,662	0,0691	0,2
12	2,559	0,100	0,0104	0,153
13	2,242	0,400	0,0418	0,173
14	2,018	0,169	0,0176	0,131
15	2,723	0,334	0,0348	0,15
16	2,599	0,096	0,0101	0,115
17	2,599	0,354	0,0369	0,132
18	2,599	0,090	0,0099	0,1
19	2,723	0,212	0,0222	0,12
20	2,599	0,071	0,0074	0,09

¹⁾ Maximum permissible harmonic current as per EN 61000-3-2 Class A

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Annex 3

References

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Normative references:

- Verband der Elektrizitätswirtschaft – VDEW – e.V. "Eigenerzeugungsanlagen am Niederspannungsnetz" (generation units at low voltage level), 4th Edition, 2001, Germany
- ENA Energy Networks Association "Engineering Recommendations G83/1 – Recommendations for the connection of small-scale embedded generators (up to 16 A per phase) in parallel with the public low-voltage distribution networks", September 2003
- EDF Référentiel Technique "Modèle de Contrat de raccordement, d'accès et d'exploitation pour une installation de production de puissance ≤ 36 kVA raccordée au Réseau Public de Distribution basse tension Conditions Générales" / "Standard Form Agreement for the Connection, Access and Operation of Power Generating Stations ≤ 36 kVA Connected to the Public Low-Voltage Distribution Network General Terms and Conditions", Référentiel technique – NOP-RES_55E, Version V6, 2006, France
- DIN V VDE V 0126-1-1 (VDE V 0126-1-1) "Automatic disconnection device between a generator and the public low voltage grid", February 2006, Germany

End of Annex 3