

Technical Documentation

TECHNICAL DATA

S97-2.1 MW

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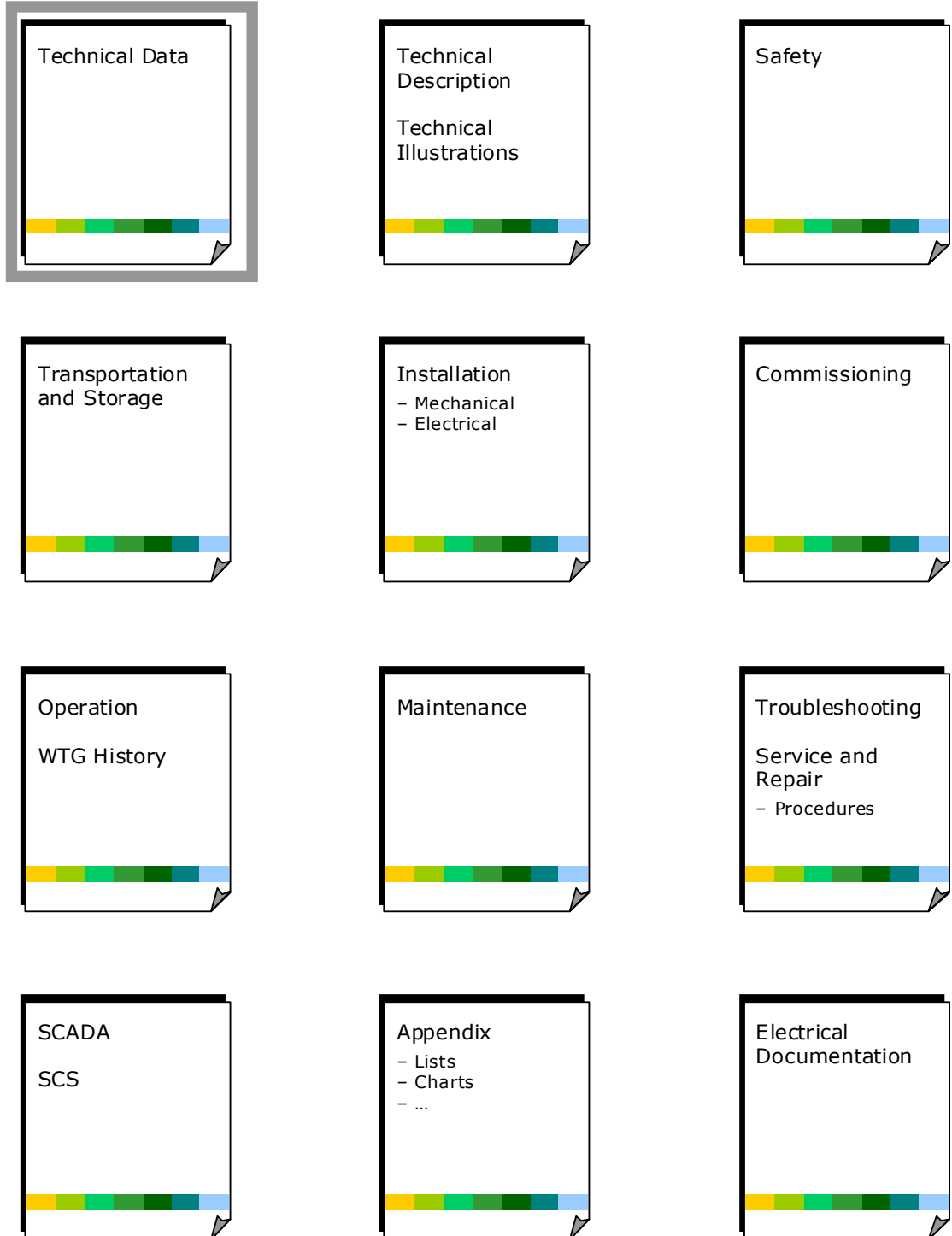
SUZLON Energy GmbH

Kurt-Dunkelmann-Str. 5
18057 Rostock | Germany

P +49 381 12884-0
F +49 381 12884-550
E germany-documentation@suzlon.com
I www.suzlon.de

Overview Technical Documentation

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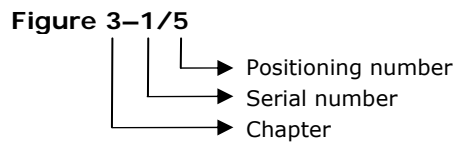
1 Notes on manual

This manual is part of the Technical Documentation of a SUZLON wind turbine generator (WTG). The document is meant for authorised and qualified staff only. It has to be carefully read and understood before performing the tasks.

In this manual consistent terminology is used resulting from SUZLON terminology work in order to avoid multiple designations. Furthermore, the document contains abbreviations. When used for the first time the term is written in full notation. The abbreviation stands in brackets behind the full notation term, e.g.: wind turbine generator (WTG).

Pages, tables and figures are cross-referenced and numbered consecutively. The document contains further cross references and bookmarks intended to guide the reader to more detailed information.

Figures may come with positioning numbers explaining determined components. The positioning number appears again behind the explained component in the text as follows:



This manual may contain special formatting to emphasise text fragments as follows:

- **bold** for e.g. instructions relating to tabs, buttons or menus in software documentation
- *italics* to emphasise reference designators
- asterisks (*) to emphasise software parameters, alarms or values

Photos and illustrations only give examples. Equipment and procedures may differ regarding the specific projects. Therefore, the content of the photos or illustrations is not to be considered as generally applicable. Contact the responsible logistic manager for project-specific information.

Dimensions and weights are given according to the "International System of Units" (SI). Project-specific these data may be completed with Anglo-American units.

If any suggestions or improvements are required please forward your comments to germany-documentation@suzlon.com.

As the SUZLON WTGs are continually improved and further developed, we reserve the right of modifications. Make sure that this document is available in the latest version according to the appropriate configuration of the WTG.

1.1 Scope

This manual is valid for the S97-2.1 MW WTG. Please note the following variant specification giving information on the documents content.

Feature	Variant/version
Frequency	<input checked="" type="checkbox"/> 50 Hz <input type="checkbox"/> 60 Hz
Temperature version	<input checked="" type="checkbox"/> Standard Temperature Version (STV) <input checked="" type="checkbox"/> Low Temperature Version (LTV)

Feature	Variant/version
Tower version	<input checked="" type="checkbox"/> Tubular tower (for hub height 80 m/90 m/100 m)

1.2 Related documents

Manual "Grid connection" (WD00419)

1.3 Copyright

The manufacturer has the copyright for this document.

Reproduction, copying, propagation or any other use by or information of a third party of this documentation – whether in parts or as a whole – for competition purposes requires prior written consent by the manufacturer.

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Address of the manufacturer:

SUZLON Energy Limited

One Earth,
Opp. Magarpatta City,
Hadapsar

Pune 411 0028
India

www.suzlon.com | info@suzlon.com

2 Specifications

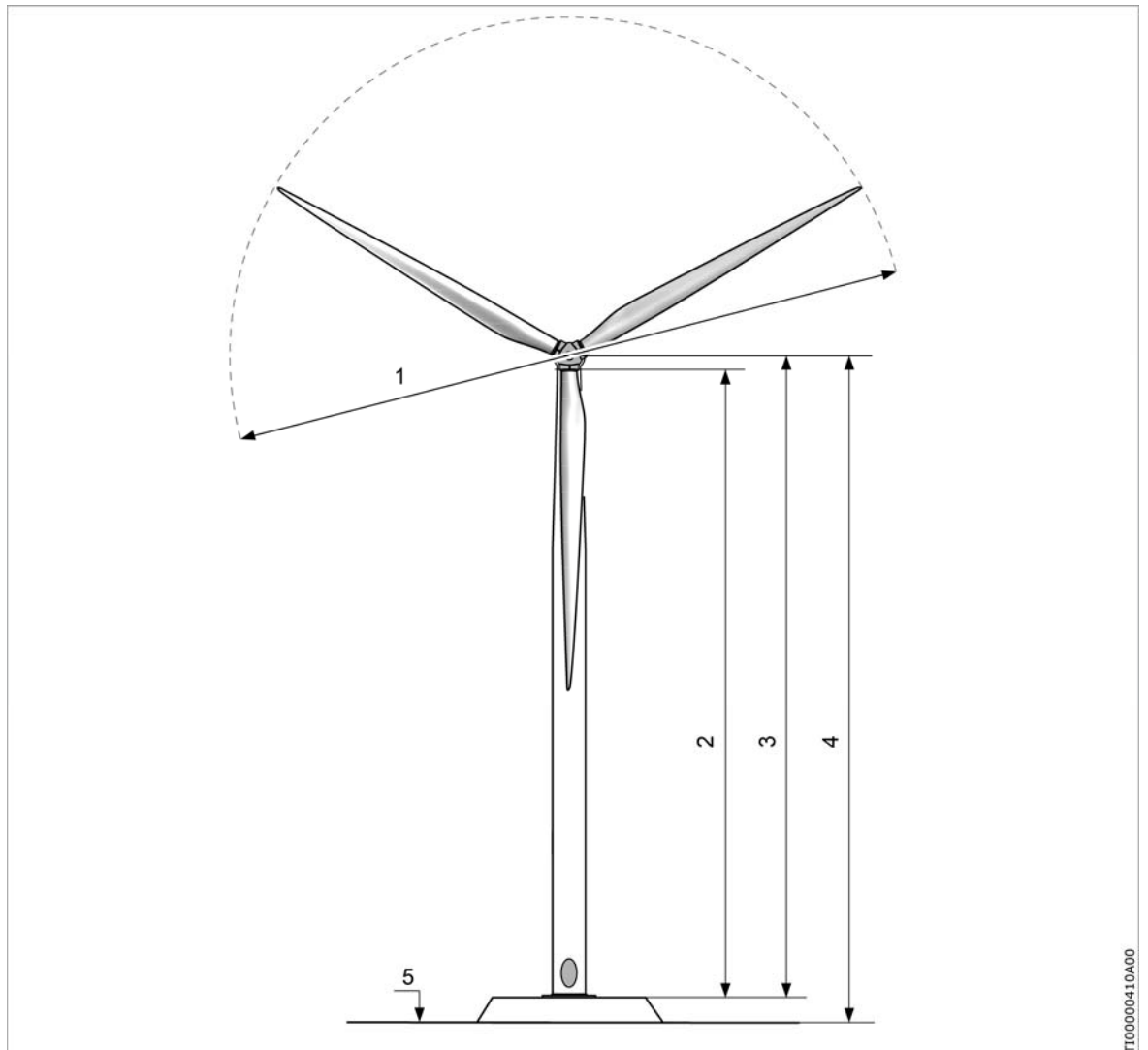


Figure 2-1: WTG overview

1	Rotor diameter			97.0 m
2	Tower height	77.5 m	87.6 m	96.2
3	Rotor height	79.0 m	89.0 m	97.7 m
4	Hub height	80.0 m	90.0 m	100.0 m
5	Ground top level			

Description	Information
Wind class	IIIa
Estimated service life	20 years
Ambient temperature range – operation	STV: -10 °C to +40 °C LTV: -30 °C to +40 °C Beyond the temperature ranges stated above, a WTG may derate or shut itself down if any of its core equipment moves outside its safe operating range. This is dependent on WTG load as well as external conditions.
Ambient temperature range – general	STV: -20 °C to +50 °C LTV: -40 °C to +50 °C The WTG always has to be connected to the grid.
Ice/snow on blades	Considered in calculation of structural design
A-factor	8.46 m/s
Form factor, c	2.0
Annual average wind speed	7.5 m/s
Vertical wind shear exponent	0.2
Extreme wind speed	37.5 m/s (10-minute average)
Survival wind speed	52.5 m/s (3-second average)
Automatic stop limit	20 m/s (10-minute average)
Characteristic turbulence intensity according to IEC 61400-1 (15 m/s)	18.0%
Air density	1.225 kg/m ³
Humidity conditions	
Permissible relative ambient humidity	30 to 99%
Permissible relative humidity during operation (outside cabinet, inside WTG)	30 to 99% (no precipitation)
Permissible relative humidity during operation (inside cabinet)	20 to 80% (no precipitation)

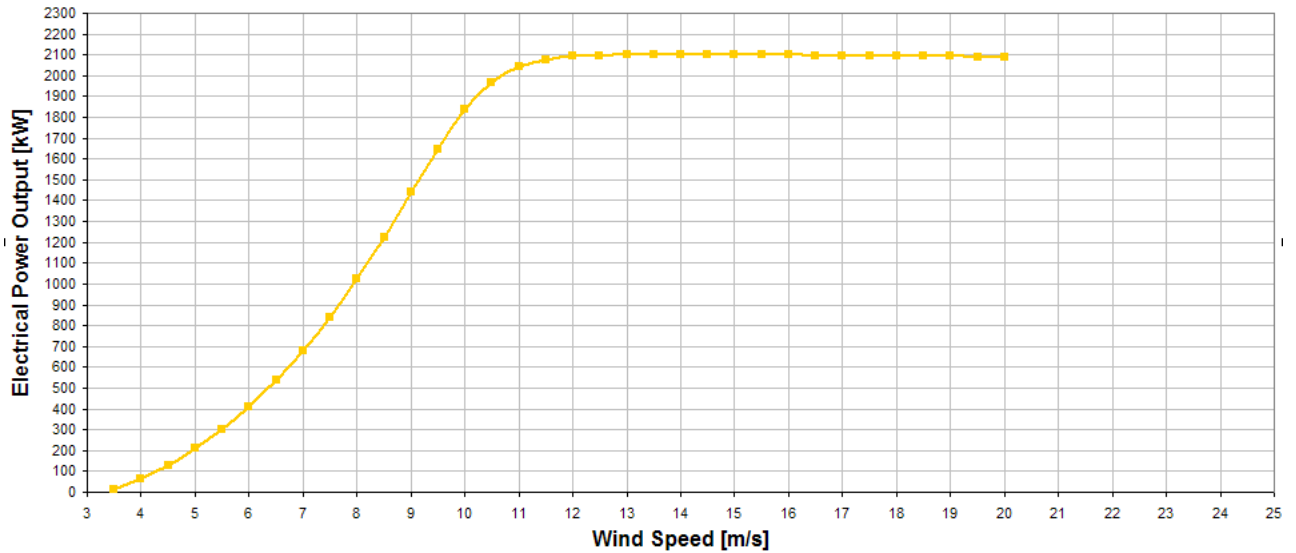
Description	Information
Corrosion protection	
The corrosion protection applies in accordance with ISO 12944-2.	
Corrosion protection class	C4 (high)
Corrosion protection	Anti-corrosion paint
Lightning protection	
The lightning protection applies in accordance with IEC 61400-24, 62305-1, 3, 4 and DIN EN 50164-1, 2. The lightning protection system is based on the lightning protection zone concept.	
Rotor	Lightning rod
Blades	Lightning receptors at blade surface, spark gap for protection of blade bearing
Nacelle	Spark gaps, lightning rods, EMC protection mesh
Altitude	
Maximum height altitude	1000 m above sea level
	<i>If the altitude exceeds 1000 m above sea level, this has to be agreed by contract with SUZLON considering the possible consequences regarding e.g. power reduction, higher maintenance and spare part costs as well as supplier warranty restriction.</i>

2.1 Operating data

Description	Information
Rated power	2.1 MW
Rotor speed	11.8 to 17.2 rpm
Power regulation	Active pitch regulated
Rated wind speed	11 m/s (without turbulence intensity according to GL guideline)
Cut in wind speed	3.5 m/s (30-second average)
Cut out wind speed	30 m/s (3-second average)
	20 m/s (10-minute average)
Restart wind speed	18 m/s (10-minute average)

Description	Information
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Power curve (theoretic, calculated)



Own consumption

Average values of WTG	n/a
Additional average values	n/a
Peak values	n/a

Control

Type	Programmable Logic Controller with SUZLON CONTROL SYSTEM software
Communication system	Internal: CAN-bus External: Ethernet; optional: MODBUS, OPC
Access	Multi-level, user authenticated

2.2 Tower

Description	Information		
Material	Welded steel plate according to EN10025		
Internals	Ladder, platforms, anchorage points, cabling, lights, emergency light, climbing assistance (optional), service lift (optional)		
Foundation	project-specific		
Tower height	77.5 m	87.6 m	96.2 m
Top end diameter	3.02 m	3.02 m	3.02 m
Bottom end diameter	4.30 m	4.55 m	4.30 m
Converter section (bottom cabinet)			
Technology	IGBT		
Operation range of the converter/generator: slip range	±20%		
Nominal slip	Depends on power curve		
Protection class	IP54		
Cooling	Liquid		
Temperature range of coolant inlet	25 °C to 60 °C (operation)		
Maximum flow of coolant	Approx. 120 l/min with approx. 1 bar pressure drop		
Maximum IGBT power loss in form of heat during continuous operation	18 kW		
Rated current	Line side converter: 500 A, machine side converter: 435 A		
Rated voltage	Line side converter: 690 V, machine side converter: 690 V		
Voltage range	Line side converter: 690 V/±10%, machine side converter: 0 to 760 V		
Rated frequency	Line side converter: 50 Hz, machine side converter: 10 Hz		
Switching frequency	Line side converter: 4500 Hz, machine side converter: 2250 Hz (≥1.2 Hz), 1125 Hz (<1.2 Hz)		
Frequency variation capability	-6% to +5%		

2.3 Nacelle

Description	Information	
Main frame		
Type	Cast frame	
Material	EN-GJS-350-22U-LT	
Main bearing		
Bearing type	Spherical roller bearing	
Housing type	Cast housing, flanged feet	
Housing material	EN-GJS-350-22U-LT	
Heating	STV: no fan heater	LTV: one fan heater, power: 9 kW
Lubrication	Automatic lubrication system	
	Reservoir capacity: 8 l	
Main shaft		
Type	Forged shaft and flange	
Material	42CrMo4/42CrMoS4	
Gear box		
Type	1 planetary stage, 2 helical stages	
Housing material	Cast	
Gear box mount material	STV: EN-GJS-400-18U-LT	LTV: EN-GJS-350-22U-LT
Shaft seals	Maintenance-free labyrinth seal	
Cooling	Forced oil cooling lubrication system	
Mechanical power	2.250 MW	
Heating	STV: no fan heater	LTV: two fan heaters, power: 9 kW each
Gear ratio	1:98.8 ($\pm 0.5\%$)	
Gear box – electric oil pump		
Voltage (phase to phase)	3 × 690 V	

Description	Information
Oil capacity	410 l
Mechanical brake	
Type	Hydraulic disc brake, activated by hydraulic pressure (active brake)
Brake disc	Steel
	Mounted on high speed shaft (HSS)
Hydraulic power unit	
Voltage (phase to phase)	3 × 400 V
Power	1.5 kW
Maximum hydraulic pressure	Hydraulic brake: 115 bar
	Rotor lock system: 700 bar
Oil capacity	0.0045 m ³ (4.5 litres)
Heating	STV: no fan heater
	LTV: one fan heater, power: 9 kW
Coupling	
Type	Flexible coupling
Yaw system – yaw bearing	
Type	Friction bearing with gear rim
Yaw system – yaw drives	
Type	Electric asynchronous motor, electric motor brake (spring-applied), 5-stage planetary gear box with output pinion
Quantity	4
Yaw speed	22.0 °/min
Voltage (phase to phase)	3 × 690 V
Rated output power	3.0 kW per drive
Generator	
Type	Asynchronous 3-phase induction generator with slip rings operated with rotor circuit inverter system (DFIG)
Rated power	2.1 MW

Description	Information
Voltage stator (phase to phase)	690 V
Frequency	50 Hz
Number of poles/Synchronous speed	4/1500 rpm
Speed at rated power rotor short-circuited	1511 rpm
Operation speed range	1200 to 1800 rpm
Rated generator speed	1528 rpm
Rated current	1895 A
Efficiency	96.7%
Max. rotor slip	±20.0%
Power factor (compensated)	0.94 lagging to 0.94 leading
Cooling	IC6A1A6 (as per IEC 60034-6), air cooled; forced air-air cooled
Winding connection of stator/rotor	Delta (Δ)/Star (Y)
Protection class	IP 54 (slip ring IP 23)
Thermal classification	Class H
Lubrication	Automatic lubrication system
	Reservoir capacity: 1 l

2.4 Rotor

Description	Information
Rotor cone angle	5°
Rotor speed at rated power	15.46 rpm
Tip speed at rated power	78.8 m/s
Main shaft tilt angle	5°
Power regulation	DFIG inverter system

Description	Information
Rotor orientation	Upwind
Hub	
Type	Cast spherical hub
Material	EN-GJS-350-22U-LT
Blades	
Type	LM47.5 P
Quantity	3
Length	47.5 m
Material	Blade main structure: Glass-fibre reinforced polyester Blade flange: Stainless steel SAF 2205
Type of aerodynamic brake	Pitch/full blade
Profiles	n/a
Lubrication	Blade bearing/teeth: automatic lubrication system Blade bearing: 8 l, teeth: 4 l
Pitch system	
Type	Electric asynchronous motor with forced ventilation unit, electric motor brake (spring-applied), 3-stage planetary gear box with output pinion, frequency converter and batteries
Pitch angle range	-5 to 95°
Pitch system – pitch bearing	
Type	Double row ball slewing bearing
Lubrication	Automatic lubrication system
Pitch system – pitch drives	
Type	Electric motor, gear box and electric brake
Quantity	3 (1 per blade)
Pitch speed	0 to 8 °/s
Emergency pitch speed	8 °/s

Description	Information
Rated output power	7.5 kW per drive
Pitch system – pitch batteries	
Quantity	1 battery box per blade
Service life	2 to 4 years
Rated voltage per battery	12 V
Rated capacity (20 hour rate)	7.2 Ah
Heater	Each battery box equipped with 4 heaters (120 W each) and 2 fans.
Thermal insulation	Thermal insulation tiles

2.5 Transformer



The scope of supply of the transformer is agreed by contract. If the transformer is supplied by the customer the below values are to be referenced as recommendations.

Description	Information
Type	Oil filled transformer
Winding connection	Delta (Δ)/Star (Y)
Vector group	Dyn5/Dyn11 (grid-dependent)
Rated apparent power	2500 kVA
Tapping	At HV $\pm 5\%$ in 2.5% steps India: At HV $\pm 6\%$ in 3.0% steps
Reactance	6% India: 6.25%
No-load losses	~ 2500 W
Full load losses	~ 22500 W
Total losses	~ 25000 W
Rated winding ratio	(XX) kV/0.69 kV
	Voltage level at line side depends on supply voltage level.