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BRAUN Windturbinen GmbH • Südstraße 19 • 57583 Nauroth

Installation & Operation Manual

For small-scale wind power plants (SWPP)
Antaris 6.5 kW
Antaris 9.5 kW

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Version: 28 March 2014

The present manual is intended to be used with the feed inverter's manual, the functional specification documents for implementation and maintenance, the documentation related to the pole, possible requirements stipulated in context with the building permit, and other technical documents related to this plant.

We reserve the right to technical modifications resulting from advancement. For the respectively latest version please refer to: www.braun-windturbinen.com

Specific works are generally to be performed by qualified electricians only. For all other works, we recommend participating in the training offered by us or our partners. Just contact us!

Application

Small-scale wind power station to supply private home grids with in order to optimize personal power requirements, electricity feed-in to the public grid and supply of isolated grids.
The plant has been designed for wind zone III as per DIN EN 61400-2 for an annual wind velocity average at hub height (v_{ave}) of 7.5 m/s.
Any use deviating from the designated one - e.g. offshore, at extreme heights, if there is any risk of icing, in seismic areas or areas probe to adverse weather conditions and/or regions prone to cyclones/hurricanes - is not permissible.
Special SWPP versions are available upon request. Please contact the manufacturer.
The plant's delivery scope comprises an ideally aligned feed converter and adequate breaking resistors. Any modifications of the system shall be agreed with the manufacturer in advance and require its approval.
The system's manipulation without the manufacturer's written approval shall result in any guarantee claims being forfeited and the declaration of conformity shall become invalid.

Antaris- small scale wind power stations are industrially made by applying state-of-the-art technology and corrosion-resistant materials. They comply with the relevant EU standards. Our systems require nearly no maintenance and work reliably throughout their long service life.

Safety Instructions

Please note that safety is the most important aspect for the wind power station's site planning, installation, and operation! Please ensure to observe all relevant and applicable safety and accident prevention regulations!

- Ensure to exclusively set up the plant at sites that reliably allow for excluding any harm to human beings and the environment!
- For your own safety, ensure to use appropriate equipment to protect you from falling off the pole while setting up and/or servicing the plant.
- Use utmost care when you set up the system - ensure the pole's direct surroundings to be cleared from human beings!
- Exclusively set up the wind power plant when there is no or little wind and in dry, ice-free weather!

- When you work with the plant, ensure to block the rotor blades by shorting out the generator or by affixing them to the pole. Fast-running rotor blades feature extremely high speed at the blades' tips and are thus very risky to touch!
- With respect to the electrical installation, please remember that the generator generates high voltage already at low speed. Therefore, ensure all installation works to be carried out while the rotor is blocked!
- Ensure to assemble the rotor blades after the entire electrical installation has been completed!
- Ensure to use cables of sufficient size and diameter in order to prevent overheat that might result in cable fires! Appropriately secure all supply cables! Do not install any fuse in between generator and main switch or main switch and feed converter, respectively.
- Please observe the "Provisions for Setting up Power Installations of up to 1000 Volts" as per DIN VDE 0100.
- Please remember that loose parts (e.g. ice formations in the event of hoarfrost, unfixed or damaged rotor blades) might be projected very far at high rotor speeds!
- In the event you observe heavy vibrations, please decelerate the generator and rectify possible imbalances (e.g. caused by ice formations) before restarting the system. Extended vibrations cause early fatigue and might even cause the entire system to collapse, which will result in its total loss!
- In the event of announced storms including severe weather, please ensure to slow your plant down as long as extreme wind velocities are observed warnings!

Delivery Scope - Wind Power Plant Components

When you unpack your system, please check its completeness and the individual parts' intactness. Apart from this manual, the pack should contain the below-listed parts:

- 1 main frame with generator and azimuth bearing, pre-mounted
- 1 wind vane
- 1 square tube as wind vane boom
- 1 nacelle cover
- 1 spinner cap
- 1 rotor hub
- 1 pressure plate rotor blades
- 15 screws M8x100 with locknuts and washers
- 6 screws M4x15 for affixing the spinner
- 3 rotor blades
- 1 generator feed line (only for the ring wheeled version)
- 1 feed converter Smart!wind SW7.5 or SW-10
- 1 brake resistor of 6 kW and 18 Ohm for Antaris 6.5 kW
- 2 brake resistors of 6 kW and 25 Ohm for Antaris 9.5 kW
- 1 manual
- 1 functional specification document for implementation and maintenance

Functional Principle

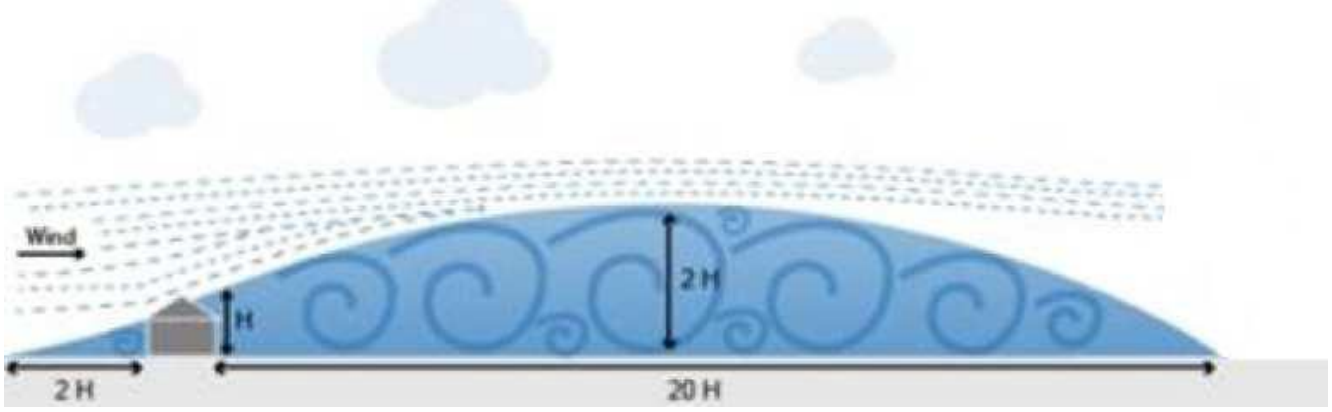
The rotor blades affixed to the generator convert the wind-borne kinetic energy to rotational energy. The generator converts this energy form to electricity, which is led to the terminal point on the main switch via the generator's supply line. In operation, the generator's supply line is transposed through directional tracking and has to be untwisted regularly if the azimuth bearing does not provide any abrasive rings. The generator produces variable voltage and variable frequencies, depending on respective rotor speeds. The feed converter rectifies and increases them in order to facilitate their feed in to the domestic/public/isolated grid connected.
The wind vane serves to automatically position the plant against the wind.

Safety Installations

- In the event of storms, the plant will tilt up into o-called "helicopter position" in order to decrease the windage and to thus limit the amount wind energy captured. This decelerating system also works if no consumer has been connected to the generator.
- When the alarm speed has been reached, the plant is automatically decelerated by the feed converter activating the brake resistor. If the nonconformance speed has been reached, the plant is decelerated to standstill. It is automatically reset after 2 hours.
- The key switch at the feed converter serves to decelerate the plant through the brake resistors. Once decelerated, the generator can be shorted directly via the main switch provided on the pole. Being shorted, the generator-induced braking action is high enough to prevent the rotor from reving up even in the event of heavy storm. Ensure to exclusively activate the main switch to short the generator at low rotor speed - generally decelerate the system by using the key switch provided at the feed converter first! In the event deceleration via the feed converter's key switch is unfeasible try to activate the main switch when the wind has abated for a moment. If it is impossible to bring the rotor to a low speed in heavy storm after maximum 2 minutes of deceleration via the main switch, turn the switch back off to prevent the generator from "blowing". Try to decelerate again after allowing the plant to cool down for 30 minutes.

Installation Site

The maximum energy yielded from the wind increases at the wind velocity's cube. That means if the wind velocity doubles, the energy yield is eight times as high. If the wind velocity is tripling, the outcome generated by the wind increases by 27 times! Therefore, it is essential to find an ideal installation site with good wind conditions for the wind power station.



Installation

Before you define an installation date, please ensure to thoroughly study the installation manual completely. Adjust the individual installation and assembly steps to the conditions on-site.

The plant's assembly and installation is easily made from a mobile crane or a lifting platform. If this is not possible you might set the plant onto the pole by using a swiveling auxiliary crane mounted to the head that provides a guide roller or hoist. If the use of cranes or lifting platforms is unfeasible, a foldable pole might be used. Alternatively you might deploy a braced pole that is mounted while being laid down on the surface and then hoisted through a tilt-pole.

For some screws, locknuts with plastic insert are being used. Suchlike nuts are intended for onetime use only! If used repeatedly, their locking properties are lost, which constitutes high safety risks. Therefore, ensure to generally use new nuts with intact plastic inserts free from visible thread marks.

Exclusively use non-corroding washers and nuts as well as suitable tools for antirust screws.

All kinds of work with electrical installations are to be performed by qualified staff only. The plant's installation is easy to do; however, it should only be carried out by people who are respectively experienced professionals.

On order to assemble or install the plant, you will actually not need more than standard tools and a torque wrench. The underground cable leading from the main switch in the pole's bottom section to the feed converter is not included with the delivery scope. The wrench diameters and locking torques for the pole's screws are specified in the respective documentation.

Usually, self-supporting poles will be used. Once the pole has been screwed to the foundation, main frame, generator and rotor will be mounted to the top of the pole one by one. If there is only one lifting platform, we recommend mounting main frame and generator separately for reasons related to the maximum load. If a crane is being used, the weight is an insignificant factor - therefore, main frame and generator should be linked to each other before being mounted to the pole. Alternatively, you might mount the entire system (without repeller blades and nacelle casing) to the pole while the latter is still lying on the surface and then be lift/hoist at all at once. Please define the assembly order in accordance with the conditions on-site. The below photos of various projects might provide some information on the different options.
The functional specification document for implementation and maintenance contains a checklist you please work off before putting the plant into service.

Foundation

Usually, the system will be mounted to a freestanding pole. You will receive the drawings related to the foundation together with the pole and the statics depending on individual wind conditions, soil properties, the pole type selected, and the pole's height.

Figure 1: ready-mounted freestanding pole

Figure 2: mounting the lower flange (ring beam) to the foundation with integrated ductwork for the cable that serves to connect the generator.

Ground strap serves to earth the pole. Also connect the foundation's reinforcement to the pole by using the screws in the foundation or a separate earthing connecting. If the earthing conditions are unclear, we recommend the grounding resistance's measurement and regular check.

Figure 3: complete foundation with screws for the pole and the ductwork for the generator's supply cables.

Before setting up the pole and putting the plant into service, ensure the foundation has hardened thoroughly. Depending on individual concrete additives and weather conditions, this might take a few weeks. Please also refer to the pole's assembly instruction.

Pole

Pull the underground cable to the inverter through the ductwork in front of the pole and allow about 3 meters of it to stick out of the foundation. Before the pole is set up on the foundation, the cable's unoccupied end is led through the assembly opening at the pole's bottom and secured against slipping back.
The freestanding pole is screwed to the foundation and vertically aligned as described in the respective assembly instructions.

Mounting the azimuth bearing to the generator and the cover

Before the wind power station is set up, the generator's connection cable is led through the pole from above. The wind power station's flange is put onto the pole's flange and affixed by 8 high-strength bolts M16, retaining washers, and nuts. Please use the hot-dip galvanized screws of strength category 10.9 and the corresponding pressure-resistant washers and nuts also of strength category 10 included with the delivery scope. Locknuts with plastic insert or lock washers are not suitable for this purpose. The nuts are greased with molybdenum disulfide or similar and consistently tightened at 250 Nm.
Now put the cover over the generator (large opening to the front) and screw it to the tilter's base plate. The generator with azimuth bearing must be freely movable to all directions. Vertically align the generator accurately.

Figure 4: nacelle screwed to the lying pole.

Mounting the wind vane

The wind vane is screwed to the main frame's stationary part through a rectangular tube.

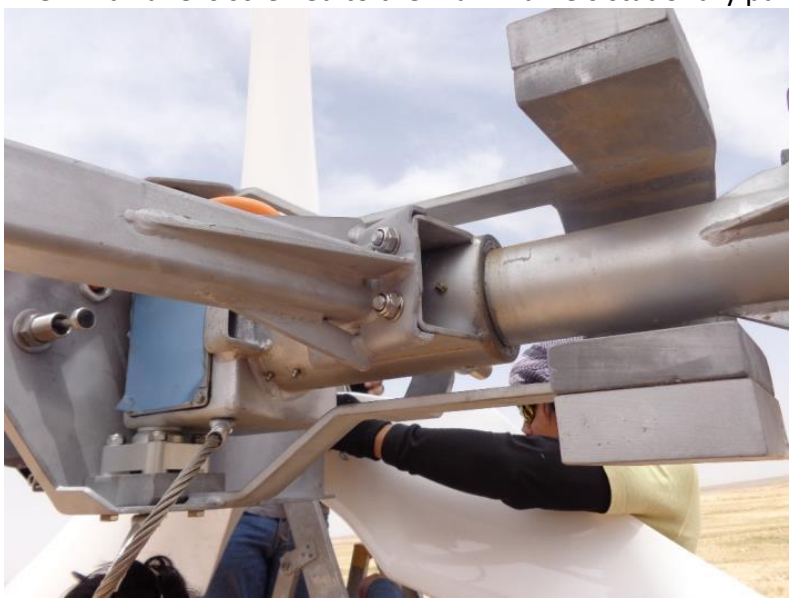


Figure 5: tube to the wind vane screwed to the main frame. The 4 screws M12 are tightened at 50 Nm.

The wind vane is connected to the tube by using 4 screws M8x70 with washers and locknuts.

Mounting rotor blades and spinner

Now affix the rotor blades to the aluminum hub. Ensure the hollow side of the blades to face to the front (downwind). Then use the screws included with the delivery scope to lightly fix the blades. Adjust the blades to feature identical distances to each other, measured from blade tip to blade tip. The blades can then be tightened.

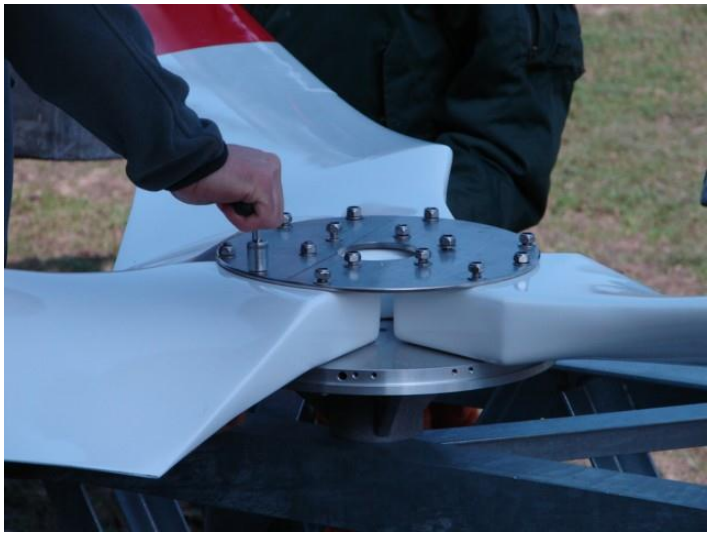


Figure 6: mounting the rotor blades by using 15 blots M8, washers and locknuts in between the hub provided at the generator shaft and the pressure disk. Looking onto the rotor, the rotational direction is to the right. The rotor blade's reinforced round edge (guide edge with tape) cuts the wind. As detailed in the maintenance book, use the torque wrench to consistently tighten the nuts at 15 Nm.

Figure 7: pre-mounted rotor

Figure 8: main frame and rotor being separately mounted to a freestanding pole by using crane and lifting platform. If the lifting platform features sufficient load capacities, the components can also be transported to the pole's tip one by one by using the lifting platform.

Ensure the wiring to be complete before the rotor blades are being mounted. At least the generator's supply cable has to be connected to the main switch and the generator has to be shorted via the main switch. Turn the generator shaft to check if there is any significant resistance when being shorted.
In case any further electrical installation works are still required, please ensure to tie one rotor blade to the pole as soon as the rotor has been mounted. This serves to prevent the rotor from turning and the generator from producing voltage.

Electrical connection

The generator is connected to the feed converter through a three-core cable NYY-O 3x4.0 mm (for cables of up to 30 meters length from the main switch on-site) or NYY-O 3x6.0 mm (for cables of up to 80 meters length from the main switch on-site). Please do not install any line safety switch or any other circuit breaker on this wire. The generator casing is connected to the pole and grounded with the same. Connection the pole's ground to the feed converter's ground is not recommended.
Secure the grid connector in accordance with the provisions defined by the feed converter's operating manual and with local regulations.

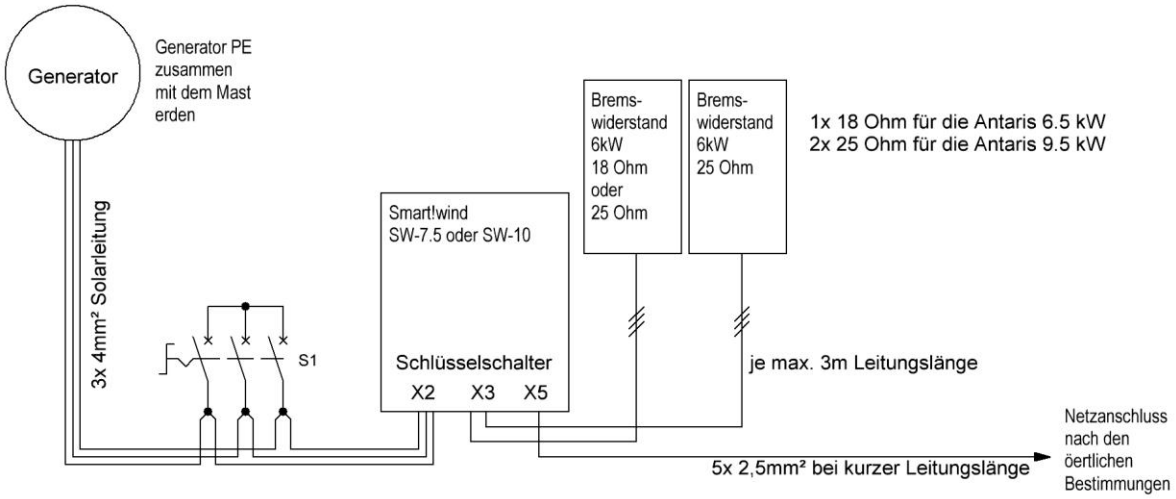


Figure 9: overview circuit diagram

Legende: Generator = generator / Generator PE zusammen mit dem Mast erden = ground generator PE with the pole / Solarleitung = solar cable / oder = or / Bremswiderstand = braking resistance/ für die Antaris = for Antaris / Schlüsselschalter = key switch / je max. 3 m Leitungslänge = per each max. 3 meters of line length / bei kurzer Leitungslänge = for short line lengths / Netzanschluss nach den örtlichen Bestimmungen = grid connection in accordance with local regulations

Initial operation

The feed converter has been readily parameterized ex-works. First perform the tests described in the functional specification document for implementation and maintenance and check the electrical connection.
First set the main switch provided at the pole to *AUS (OFF)* (generator shorted) and loosen the tied rotor blade, if necessary. The key switch at the feed converter has to be set to *Aus (Off)*.
The rotor should be initially set into motion when there is little wind. Set the system's main switch to *Ein (On)*, then set the key switch to *Ein (On)* and check how the rotor starts to move. Now immediately check deceleration by key switch.
If the key switch is set to *AUS (OFF)*, the system should decelerate. If that is not the case, immediately set the main switch provided at the pole to *AUS (OFF)*.

Specifications

Wind class as per EN IEC 61400-2:2006 ..... :	III	
Annual wind velocity average at hub height (v_{ave}) ..... :	7.5	m/s
Reference wind velocity averaged over 10 minutes (v_{ref}) ..... :	37.5	m/s
Turbulence intensity (I_{15}) ..... :	0.18	

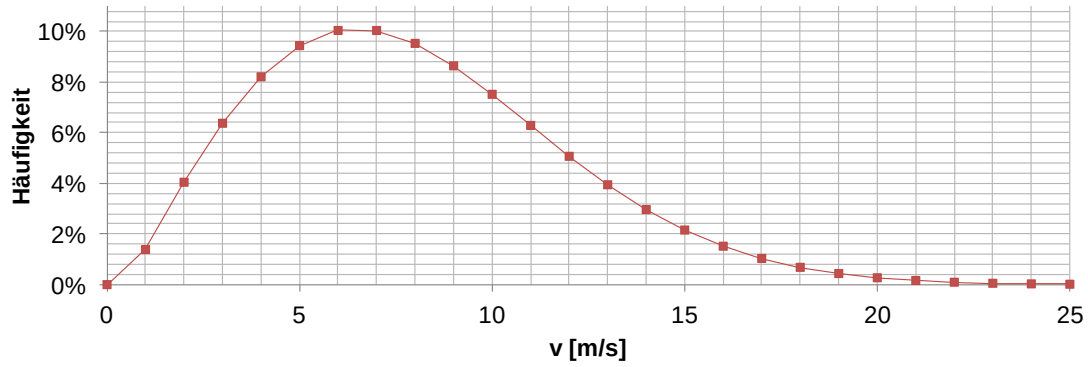


Figure 10: calculated frequency distribution of wind velocities for class III according to the Rayleigh scale.

Legende: Häufigkeit = frequency

According to the above figure, wind velocities of more than 20 m/s will be observed 33 hours per year; wind velocities of more than 25 m/s only within 1.4 hours per year.

Cut-in wind velocity ..... :	approx. 2.1	m/s
Overspeed control at more than ..... :	12… 13	m/s

Rotor

Manually laminated profile made from fiberglass and carbon fiber, dynamically and statically balanced, hub connection realized by aluminum flange and pressure disk. GRP spinner cap.

Number of rotor blades ..... :	3	
Rotational direction ..... :	to the right	
Rotor surface at a diameter of 5.3 m ..... :	22.1	m²
Weight per rotor blade ..... :	9.3	kg
Weight rotor hub ..... :	5	kg
Rotor surface at a diameter of 6.5 m ..... :	33.2	m²
Weight per rotor blade ..... :	14	kg
Weight rotor hub ..... :	15	kg
Country of make rotor blades ..... :	Serbia	

Generator

Rated output (Antaris 6.5 kW) ..... :	7,500	W
Rated output (Antaris 9.5 kW) ..... :	9,500	W
Maximum output (Antaris 6.5 kW) ..... :	12,500	W

Maximum output (Antaris 9.5 kW) ..... :	18,000	W
Rated speed (Antaris 6.5 kW)..... :	330	min^{-1}
Rated speed (Antaris 9.5 kW)..... :	250	min^{-1}
Weight (Antaris 6.5 kW)..... :	87	kg
Weight (Antaris 9.5 kW)..... :	150	kg
Rated voltage ..... :	350	V_{AC}

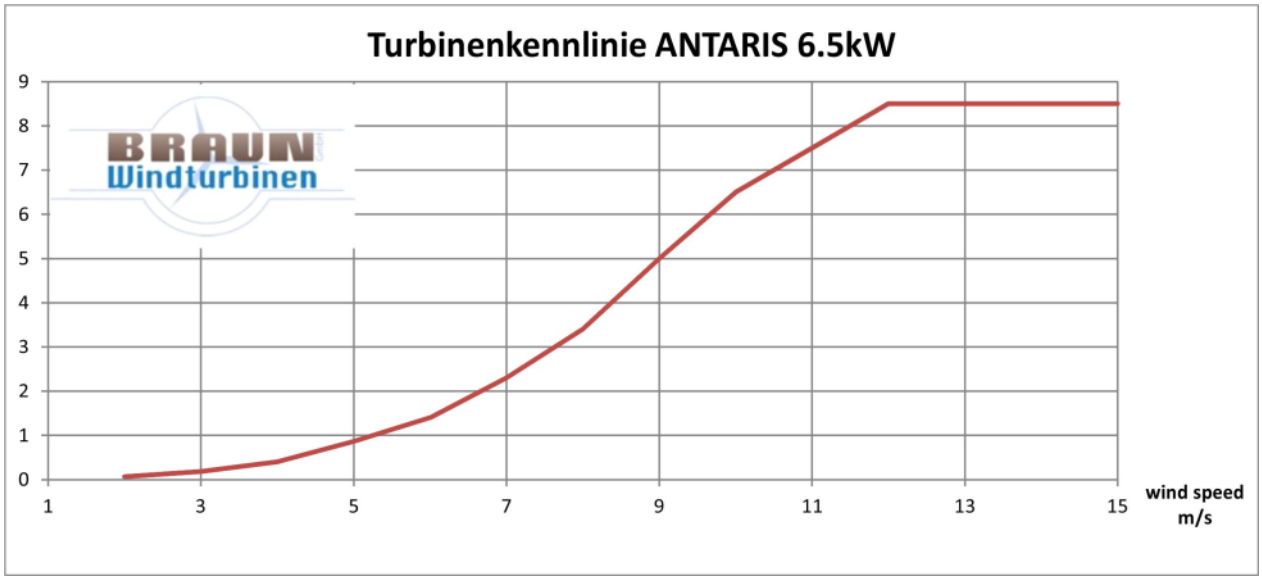
Main frame plus wind vane, without generator and without rotor

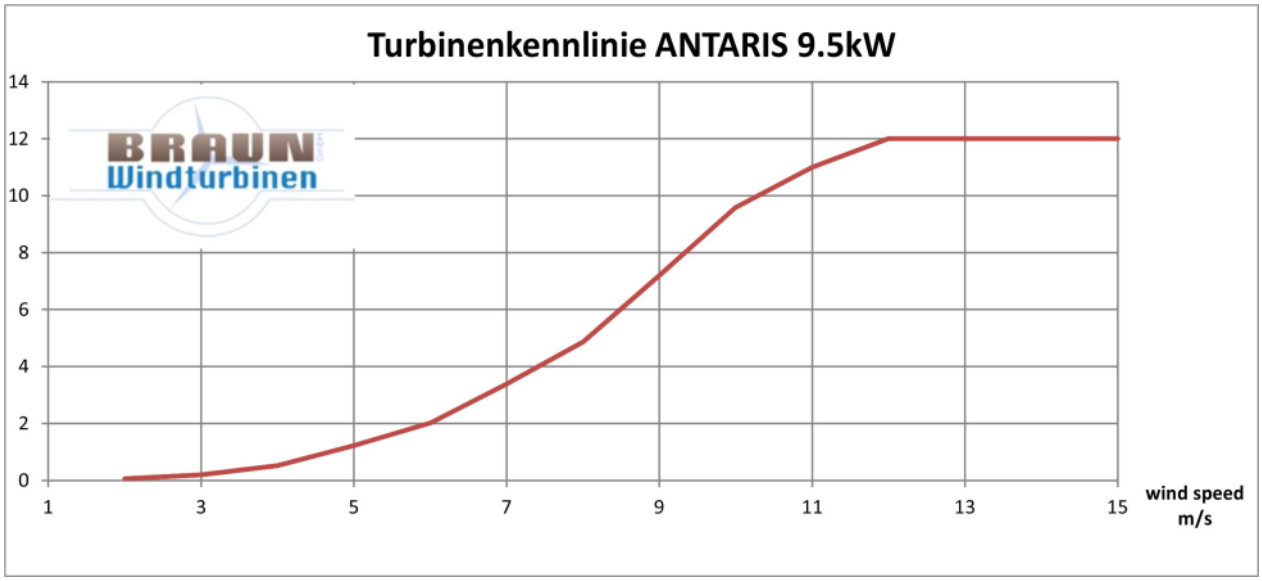
Weight (Antaris 6.5 kW)..... :	108	kg
Weight (Antaris 9.5 kW)..... :	235	kg

Total plant on pole

Weight (Antaris 6.5 kW)..... :	225	kg
Weight (Antaris 9.5 kW)..... :	450	kg

Power curve:





Legende: Turbinenkennlinie = turbine power curve

Feed-in

via Smart Power Electronics Smart!wind SW-7.5 and SW-10

Grid connection ..... :	400	$V_{Conductor-Conductor}$
Number of phases ..... :	3	
Power output, maximum (Antaris 6.5 kW) ..... :	7,500	W
Power output, maximum (Antaris 9.5 kW) ..... :	10,000	W
Output current, nominal value (Antaris 6.5 kW) ..... :	0…11	A
Output current, nominal value (Antaris 9.5 kW) ..... :	0…16	A
Output frequency, nominal value ..... :	50	Hz
Output frequency, permissible range ..... :	47.5 … 51.5	Hz
Isolation design ..... :	transformerless, no galvanic isolation	
Grid / plant protection – ENS ..... :	VDE AR-N 4105	

Miscellaneous ambient conditions

Temperature..... :	-30 … +55	°C
Suitability for ice-formation ..... :	upon request	

Maintenance

In order to ensure safe and reliable serviceability for many years, the wind power station is to be controlled, serviced and maintained at regular intervals.
Required service and maintenance activities have been specified in the *functional specification document for implementation and maintenance*. Respective activities are to be recorded; templates are provided as annex to the maintenance documentation and at www.braun-windturbinen.com.

Guarantee

In the interest of technical progress, ANTARIS - Wind Power Stations are continuously advanced and improved. However, in the event your system should turn out to be defective within the guarantee term, please contact the sales partner you bought the plant from.
The failure to carry out and record the system's commissioning and regular servicing as described within the *functional specification document for implementation and maintenance* causes any and all guarantee claims to be forfeited. In order to request our provision of the mandatory commissioning report, please mail to info@braun-windturbinen.com, fax to +49 (0)2747 / 914053 or write to our postal address.

Warranty Period

The warranty period for ANTARIS - Wind Power Stations with inverter is 24 months as from the date of commissioning or 30 months as from delivery date.

Limitation of Guarantee

Your ANTARIS - Wind Power Station comes with a guarantee for material defects. However, this guarantee does not include any accessories or other plant components within the scope of repair works. Moreover, the guarantee shall lapse if the plant is improperly installed and/or used inadequately.

Guarantee Terms

Our guarantee services shall exclusively be granted if the commissioning report has been completed correctly and returned to us. The guarantee hereunder shall not include the replacement of defective parts at our premises if respective damage has occurred as a consequence of the plant's improper use. Suchlike parts shall be sent to our factory in order to repair or replace them. The respectively arising shipping costs shall be borne by the customer.
Our guarantee services shall furthermore not include any transport costs. Wind power stations exempt from the guarantee services shall also be repaired and returned. However, we shall be entitled to invoice the related repair costs.