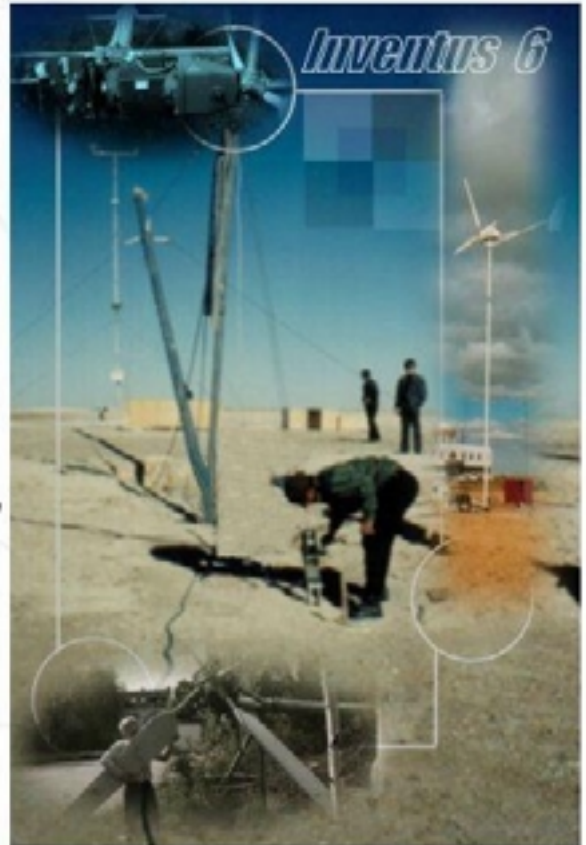


Inventus GmbH

fresh
wind
three *strong* *for*
models

- Grid-Connected-Version
- Stand-Alone-Version
- Roof-Version



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Company profile

The production of energy through wind power is future oriented and ecologically completely harmless. If your project is intended to produce between 4,000 and 20,000 kWh per annum then we are the right partner for you.

We support you getting your custom made power supply system up and running. On these pages you can get a picture of our wind energy system INVENTUS 6 and its various versions. We inform you of the range of applications and of the system's yield.

The new INVENTUS 6 is a consequent further development of the first generation of wind power plants which have proved their efficiency and durability in multiple ways under partially extreme operating conditions since 1987. The experiences gained over a period of 15 years came into play for this new construction and have thus led to considerable improvements, above all in the area of electronic connection and interfacing as well as the brake and safety systems.

The well-trying decisive components for certification and stability were, however, retained or improved and modified in such a way that we now possess a sophisticated machine concept which fulfills the increased requirements of profitability and reliability.

Even with an 20% increase of power it has a low specific power density (214 W/m²) and is therefore in combination with its dynamic passive pitch regulation well prepared for the difficult wind condition close to ground. This allows the rotor to swallow turbulences close to the ground easily. With a cut-in wind speed of 3-4m/s and 30 m/s (108km/h) of cut-out speed (through vibration sensor – only if the wind direction changes too fast) it has an operating behaviour similar to that of big wind turbines. This is reflected in 1.500 full load hours which gives you 9.000 kWh per year with an average windspeed of only 5m/s.

One of the main improvements is also the development of the whole unit into modules. All modules have clear connections which allows a Do-it-yourself setup within 4-5 hours.

The INVENTUS 6 has undergone severe and extensive tests and received a 'Certificate of the Germanic Lloyd' and a 'German Type Examination Attestation' as the only electric current generating wind power plant of its performance class. Thereby this machine also qualifies for operation in countries other than Germany and supplies entire villages in China under extreme environmental conditions (sand storms and temperatures of down to -40°C) with electric power since 1991.

Products

INVENTUS 6 Stand-Alone-Version

This version is equipped with a powerful (8 kW) and especially sturdy (brushless and encapsulated) synchronous generator which operates self-contained. Compounding (i.e. control of the magnetic flux) and speed-sensitive energizing render this generator extremely adaptable. Its low partial-load losses enable start and efficient operation of the plant already at unusually low wind speeds. At sufficient wind speed, however, the power plant can generate the very high turn-on currents for three-phase current motors. This version is also equipped with a disk brake, which is purely mechanical, manually operable and reacts automatically to inadmissible vibrations and similar malfunctions. The operation of this version is only possible in unison with a so-called load control which ensures a steady and defined power output and contributes to voltage and frequency stabilization. This first expansible stage delivers 3-phase-alternating current directly from the generator – however only at sufficient wind speed. Tapped but unused surplus-energy will be transformed to heat in the 3x2kW dump loads.



Continuous power supply even with no wind at all can be obtained by a second extension stage exclusively via battery storage. For this operation, we offer a module with load control and integrated 48V/6kW charger which is perfectly adjusted to the plant and does not produce any inactivity losses. In the third extension stage the module contains an additional 120 or 230V/5kW sinus dc/ac-converter which enables operation of one-phase domestic and other electrical equipment around the clock.

INVENTUS 6 Stand-Alone-Version – Data Sheet

Rotor

Diameter	6 Meter/19,7 feet
Number of rotor blades	4
Position	luvside
Speed	80 – 145 rpm
Design of blades	steel/fiberglass composite
Design of hub	rigid, solid steel

Drive assembly

Gear unit	spur gear 2-steps $i = 10,1$
Type of generator	synchronous, self-contained
Nominal power	8,0 kW / 10 kW
Speed	0-1500 rpm
Rated voltage	400 V, 3-phase, 50 Hz

Power characteristics

Rated power	6 kW
Cut-in wind speed	3 m/s (7 mph)
Rated wind speed	10,5 m/s (23.6 mph)
Cu-out wind speed	> 30m/s through vibration sensor only if wind direction changes too fast due to severe storms
Survival wind speed	60 m/s (135 mph)

Control systems

Power control	- aerodynamic - electrical	passive blade pitch change pole change, electr. monitored load resistors 3 x 2 kW
Yawing control by		wind vane

Safety systems

- aerodynamical - mechanical	blade pitch change disk brake, spring-loaded, manual operation from tower base
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Tower

Design	hot-galvanized steel tube braced on 4 sides
Hub height	13 m (42 ft) oder 19 m (62 ft)

Weights

Rotorblade (3 meter long)	4 x 12 kg (105 lbs)
Machine nacelle, complete	approx. 208 kg (458 lbs)
Mast, 2 parts, hub height 13 m (42ft.)	approx. 220 kg (485 lbs)
Mast, 3 parts, hub height 19 m (62ft.)	approx. 330 kg (727 lbs)

INVENTUS 6 Grid-Connected-Version

The special electrical features of the asynchronous generator used require a sufficiently dimensioned (16A) three-phase alternating current connection (400V, 50Hz). In case of a current interruption, the unit will be stopped immediately by an electromechanical brake system and will only be operational when the voltage supply is resumed.

In order to make efficient power generation possible even at lowest wind speeds, the generator has been in a pole-changeable version, i.e. at low wind speed the small stage with low r.p.m. will be switched in. When the wind rises, the high stage is switched on. An electronic generator control, which is attached to the tower base as a complete module, takes over the necessary switching, control and monitoring functions.

Aside from the current generation for residential buildings, agriculture and small industries on the public grid, this plant may also be integrated into island networks as a so-called "fuel-saver" and thus offers an economically interesting alternative to electric power generation by diesel engines.

The connection of a wind power plant to the power grid generally requires additional safety equipment (for monitoring voltage, frequency, error current etc.) which can be obtained from us as a complete module (house connection box).



INVENTUS 6 Grid-Connected-Version – Data Sheet

Rotor

Diameter	6 Meter/19,7 feet
Number of rotor blades	4
Position	luvside
Speed	83/124 rpm
Design of blades	steel/fiberglass composite
Design of hub	rigid, solid steel

Drive assembly

Gear unit design	spur gear 2-steps $i = 12,1$
Type of generator	asynchronous, pole-changeable
Nominal power	1.5 kW/6.0 kW
Speed	1.000/1.500 rpm
Rated voltage	400 V, 3-phase, 50Hz

Power characteristics

Rated power	6 kW
Cut-in wind speed	3 m/s (7 mph)
Rated wind speed	10,5 m/s (23.6 mph)
Cu-out wind speed	> 30m/s through vibration sensor only if wind direction changes too fast due to severe storms
Survival wind speed	60 m/s (135 mph)

Control systems

Power control	- aerodynamic - electrical	passive blade pitch change pole change, electr. monitored load resistors 3 x 2 kW
Yawing control by		wind vane

Safety systems

- aerodynamical - mechanical	blade pitch change disk brake, spring-loaded, electromechanically ventilated
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Tower

Design	hot-galvanized steel tube braced on 4 sides
Hub height	13 m (42 ft) oder 19 m (62 ft)

Weights

Rotorblade (3 meter long)	4 x 12 kg (105 lbs)
Machine nacelle, complete	approx. 198 kg (435 lbs)
Mast, 2 parts, hub height 13 m (42ft.)	approx. 220 kg (485 lbs)
Mast, 3 parts, hub height 19 m (62ft.)	approx. 330 kg (727 lbs)

INVENTUS 6 Roof-Version

We move on your roof!

If you have a lack of space but a suitable rooftop, you are able to use that space economically by generating renewable energy.

Our lightweight structure is based on a 6 meter tower as well as a special designed steel support that suppresses the vibrations created by the wind.

All you need is the necessary static as well as 13 x 11 m of space for the erection of the unit. The necessary German Government approval is available.

The technical specifications are the ones of the Stand Alone Unit or the Grid Connected Unit depending on the needs of your application.

We have designed for that purpose a special steel foundation consisting of a steel cross and 4 steel beams which are joined together. Without any anchor or further modifications on the standing area, this "instant foundation" can be set up everywhere and anytime. It allows the erection of an 13m tower within 4-5 hours.

It is designed for severe storms and takes its strength from its own weight (1,991 lbs), the standing area of 5,2 x 5,2m in combination with its pitch regulation. The max. pressure point is 6kN at time of erection.



Advantages of the INVENTUS 6 Systems

The new series of the INVENTUS 6 distinguishes itself as follows:

Innovations/Patents

The INVENTUS 6 is equipped with a patented passive pitch regulation for power and r.p.m limitations. It works similar to the shock absorber in your car. The 4 blades are movable and adjust their angle according to the wind pressure on the blades. This allows you a continuous operation of your unit - even under severe wind storms. The unit only switches off if vibrations (due to fast changes in wind directions) cause an automatic stop to halt the turbine.



The INVENTUS 6 has undergone severe and extensive tests and received a "Certificate of the Germanic Lloyd" and a "German Examination Attestation" as the only electric current generating wind power plant of its performance class. Thereby this machine was also qualified for operation in countries other than Germany and has supplied entire villages in China under extreme environmental conditions (sand storms and temperatures of up to -40 Degree Celsius) with electric power since 1991.

Economics of the INVENTUS 6

The INVENTUS 6 is designed for heavy duty operations with minimal dynamic stresses and strains and moderate running speed. In combination with its very good low wind qualities it allows you to operate at near 100% and therefore is able to generate the highest power output possible.



With a low spec of 214W/m² the turbine reaches at 5m/s (11.2mph) already 1.500 full load hours which gives you 9.000 kWh per year. This makes the INVENTUS 6 very competitive with other 10kW units in low wind conditions as they are only able to achieve fewer full load hours due to their higher W/m² specs.

Due to the abandonment of concrete and other complex structures but the usage of properly designed poles, we are able to reduce the cost as well as the weight for the structure significantly. The easy selfmounting of our units saves on top the costs for cranes and other heavy duty equipment for installation as well as maintenance.

All this allows you a quick amortisation of your investment. (See graphics at back).

Modular design

The INVENTUS 6 is designed to allow any person to set them up.



This is achieved by designing modules that can only be mounted together in a unmistakable way. This allows the setup without technical personal from us. This is also true in case of maintenance.

All modules of the electrical system are equipped with different connectors to avoid any mistake in the build up.



Assembly

The INVENTUS 6 is designed in a way that allows the erection at any given place without heavy duty equipment but with 2 persons within 4 hours (heaviest module weights 308lbs). The machine is assembled completely on the ground and lifted by a winch.



Noise Level

Due to a moderate high speed value of the rotor and decoupling of structure-borne sound of the machine body as well as aerodynamic designed rotor blades, the INVENTUS 6 runs extremely smooth and quiet. This allows you the use in close proximity of neighbours. (see Graphics at the back).

Quality

All components of our INVENTUS 6 are assembled in precisely defined processes and run through extensive testing periods before leaving our factory.



Flexibility

The INVENTUS 6 allows the assembly on a special design steel foundation which could be used on roof tops or very remote areas where no heavy equipment can go but also no concrete foundation is desired.

Longevity

The INVENTUS 6 is designed and equipped for severe storms and weather conditions. It has minimal dynamic stresses and strains and a moderate speed. This reduces the need for maintenance and repairs to an absolute minimum. The INVENTUS 6 is designed to last at least 20 years.

Transportation

Simple transportation (e.g. by car with trailer) thanks to the lightweight design. The longest element is 6.5 m (21ft) long.

Warranty

Due to the new modular design we are able to offer a 3 year warranty on our unit parts.



What else you should know for your wind energy project

By your decision to use wind energy you have selected a future oriented and ecologically sound way of energy generation. In order to do justice also to the economic aspects of your enterprise, we take the liberty of offering you the following little guide:

Concerning the size of your wind power plant, several aspects play a role. On principle, the following rule applies: The bigger an energy producing system the more economical will be the power generation. A large-scale power station gains considerably lower prices per kW-hour than a small diesel generator, and thus a big wind power plant operates more economically than a small one. For this reason, there generally prevails a tendency to big machines. An individual operator, however, may have several reasons to select a small unit.

Aside from the lower investment costs, the simplified procedure to obtain the installation permit could be decisive. You may base your considerations on the fact that INVENTUS 6 will in each case be classified as a secondary auxiliary plant of your residential or industrial object according to Article 14, Section 1, Clause 1 of the Federal German Building Law (BauNVO). For it must be assumed that with an annual production between 400 and 8000 kWh, depending on the wind conditions, the predominant part will be consumed on site and only a relatively small surplus will be fed into the public power supply network.

This aspect can be of special significance for manufacturers or craftsmen-enterprises which have to pay a high price for electrical power, instead of the feed-in reimbursement guaranteed by law, one can consider the significantly higher purchase price in the calculations. Strictly speaking, this can only be done with the proportion of electrical current that is really used as industrial power. Here a rule is valid which at first sight seems paradoxical: The smaller the wind power plant the higher the proportional part of its energy output consumed on site. It would be ideal, if you succeed in adapting, at least in part, your consumption to the momentarily available wind energy.

On the contrary, it will be much easier to choose between the grid-connected and stand-alone versions. On principle, the following rule is valid here: The prospective buyer disposing of a grid-connection should at any rate select the mains-parallel version, thereby all costs of storage (charging equipment, batteries) and the reprocessing (dc/ac-converter) of the current will become unnecessary.

For profitability of the stand-alone system other measures apply: The prospective buyer without grid-connection has to take into account considerably higher energy costs, as he has to calculate considerable connecting costs or he has to put into the balance self-produced diesel or solar current. For such cases we offer especially attractive and flexible solutions.

In the case of new and first installations for the supply of mountain huts, week-end cottages, farms and projects in newly industrialised countries, we recommend the stand-alone systems with completely equipped load-charge dc/ac converter module. Due to standardization and contraction to a single control cabinet, we can offer this module at an especially advantageous price. Error-safe connectors simplify the installation. The application of equipment for 48V battery voltage is optimal for this size of system, for on the one hand this voltage is sufficiently high to keep the transformation losses within narrow limits and on the other hand below 50V no special expensive measures have to be taken for ensuring electrical safety (touch insulation).

The 230V / 5kW sinus dc/ac-converter fulfills all requirements and concerns for standard one-phase power supply thanks to its current quality, performance and safety features, i.e. all commercial one-phase power units can be operated with this converter. If despite this bottlenecks should appear, special equipment can be included on demand.

For battery storage we recommend a basic equipment of so called traction batteries for drive and illumination, which are produced in great quantities as 12V battery blocks for 230Ah (corresponds to 2.75 kWh energy storage) and employed in fork lifts and electric vehicles of all kinds. Four of such batteries connected in series provide a group of 48V and 11kWh storage capacity. The storage capacity should, of course, be adjusted judiciously to the functional capability of the energy generating system. Approx. 10 full-load hours of the charging set, i.e. approx. 44kWh, can be recommended as guide value. In this example there would be 4 groups of each 4 batteries. According to the planned operational purpose and the supply requirements, smaller but also considerable bigger storage units with so-called stationary batteries (also submarine batteries) could be useful.

For retrofitting into already existing systems, the module can also be delivered without dc/ac converter. On demand and against a price surcharge the charge regulator can be adapted to differing battery voltages. For optimizing the charging procedure and extension of the battery life, the charge regulator operates according to the I/U procedure in combination with battery sensing, i.e. up to reaching the gassing voltage the full charging current (120A) is available. From there on a battery temperature dependent voltage regulation takes over.

In special cases operation of the stand-alone version can be useful without any battery storage unit. Whoever can do without the comfort of a continuous power supply and is willing to wait for wind, can also operate the INVENTUS 6 with load control alone. The easily driven rotor provides approx. 90% of the rated voltage and frequency already from wind speeds of 5m/s on. The few hundred watts power of the rotor can then still maintain some illumination or a TV-set in operation.

At higher wind speeds the INVENTUS 6 transforms itself into a strong work horse, for as of 9m/s the robust and especially overload-resistant generator produces on one phase up to 3.5 kW / 230V ac (e.g. for welding equipment or an electric separating tool) or as of 11m/s on three phases up to 6 kW /400V for three-phase motors.

Especially centrifugal pumps are suitable for the direct drive, as they are able to adapt their power absorption within wide limits to the momentary wind energy by r.p.m. reduction. The INVENTUS 6, which had been tested by Germanic Lloyd, was operated in a wind-driven water pump system. Amazingly high operating efficiency of the system and great extraction performances (e.g. 2800 kWh hydraulic annual work at 5m/s yearly average, i.e. 17 000 t per year from a well depth of 60 m or 180 ft) were ascertained thereby.

Pump systems as well as other applications as e.g. sea water desalination systems can principally be operated with INVENTUS 6. Such systems, however, require careful planning and design and in general also additional monitoring facilities, if they are to be operated fully automatically. We will be glad to assist you with our experience and know-how for projects of this kind.

The above mentioned direct drive is possible for all variations of the stand-alone module. The charging unit can be switched off manually at any time in order to make the entire power of the wind plant available to a direct user.

Moreover, for all variation – irrespective with or without charge regulator – the fact applies that unconsumed power is automatically conducted to the dump loads via the load control. This ensures that even at strong winds the values of the rated power (230/400V) and frequency (50Hz) will not be surpassed. 230V/2kW heat radiators are employed as dump loads for transforming the surplus energy into heat. As it is nearly unavoidable that a certain proportion of the power generated by the INVENTUS 6 becomes surplus energy (e.g. when all storage units are full and the wind continues), a practical use therefor offers itself in the form of nondrinking water heating or room heating support. In this case a warm water boiler with three heating elements (230V/2kW) will be connected to the load control unit.

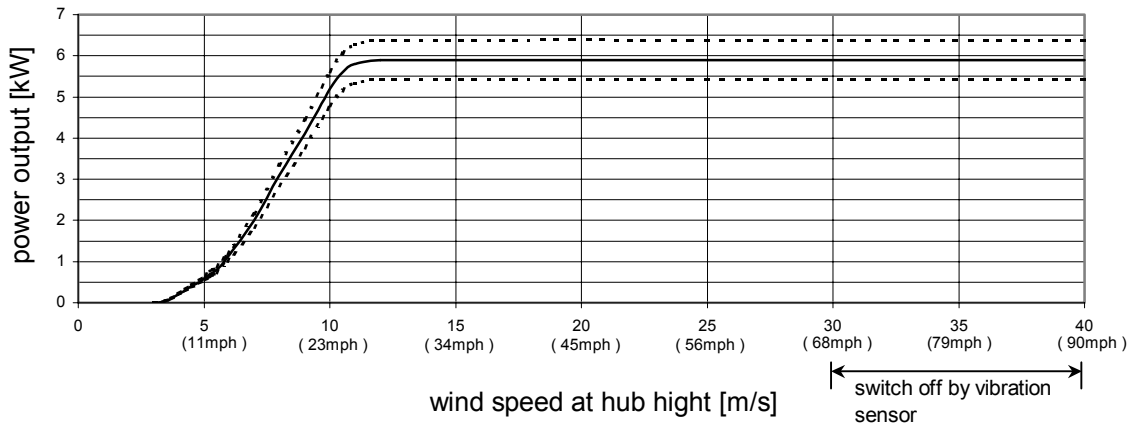
INVENTUS 6 stand-alone systems are extendable into several wind power plants with accompanying load/charge regulating module on the dc side can be connected parallel to a suitably enlarged battery storage unit. Also supplementation by solar cells is feasible (in his case voltage adjustment with the battery storage unit is required. From this combination a considerably more uniform energy supply can be expected.

Diesel generators and other emergency units could also be a useful complement, as detailed analyses have shown that a non-regenerative energy proportion of 10 to 20% could considerably improve the exploitation rate and the profitability of the system. On demand, the load/charge regulating module could be equipped with an additional entrance for diesel generators, so that no additional charger unit will be necessary.

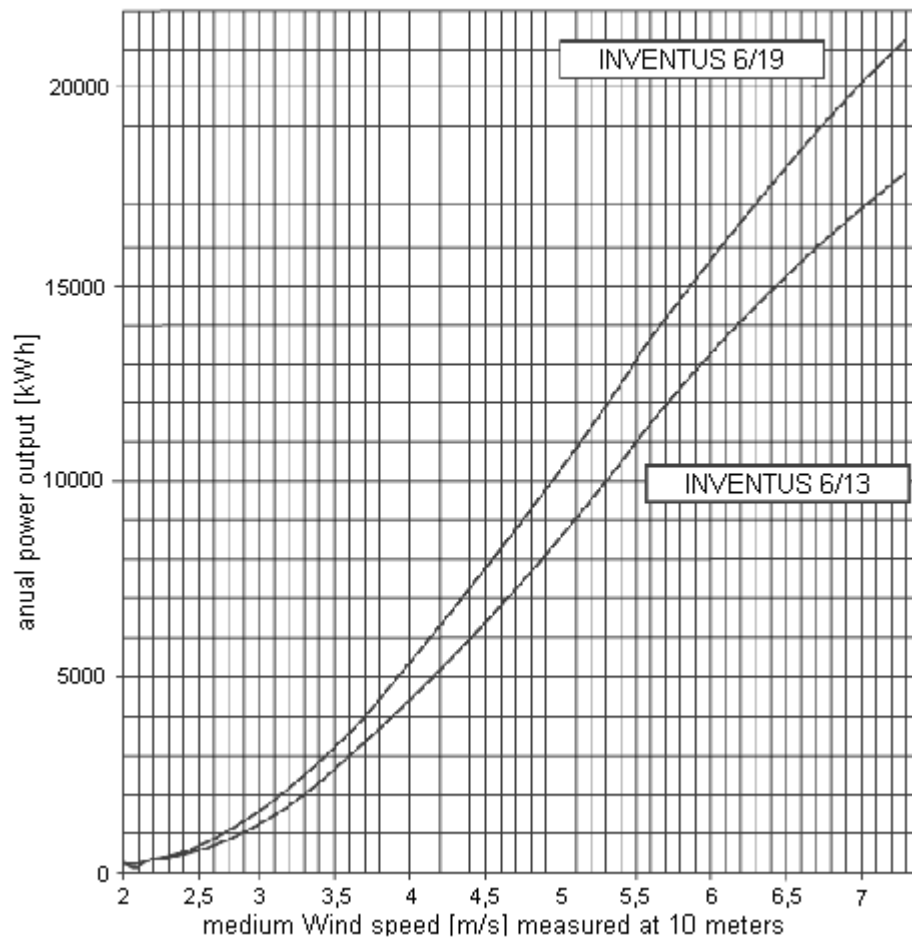
In the planning of self-sufficient electrical power supply systems many factors play a role. Beside your wishes and requirements as operator the climatic conditions as well as the spatial-topographic situation of your project will have to be taken into account.

If your intended project is aimed at a power range of 4000 to 20 000 kWh annually, we are the right partner for you, as our flexible and technically high-grade components, our experience and well-tryed know-how allows us to assist you extensively in the realization of a custom-made power supply system.

Power Output INVENTUS 6



Annual Power Output INVENTUS 6



SOUND IMMISSION

