CONFIRMED by

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Brief technical description

5 kW wind turbine

VDM-5 kW

Cypher «ВДМТ.566112.022»

2020

CONTENTS

1 MAIN INFORMATION. PURPOSE

5 kW wind turbine (VDM-5 kW) belongs to Class IV according to IEC 61400-2 and is designed for operating in the territories with the extended range of annual average wind speeds, including low wind speed from 3 to 6 m/s.

The wind turbine transforms the energy of the wind flow to the electric energy and may be used for:

1. Operating in course of the local energy supply system for the consumers (for example, communication facilities, military objects, households etc.).
2. Operating in parallel with the local or central network.

Terms of operation – 20 years.

2 MAIN TECHNICAL PARAMETERS OF VDM-5 KW

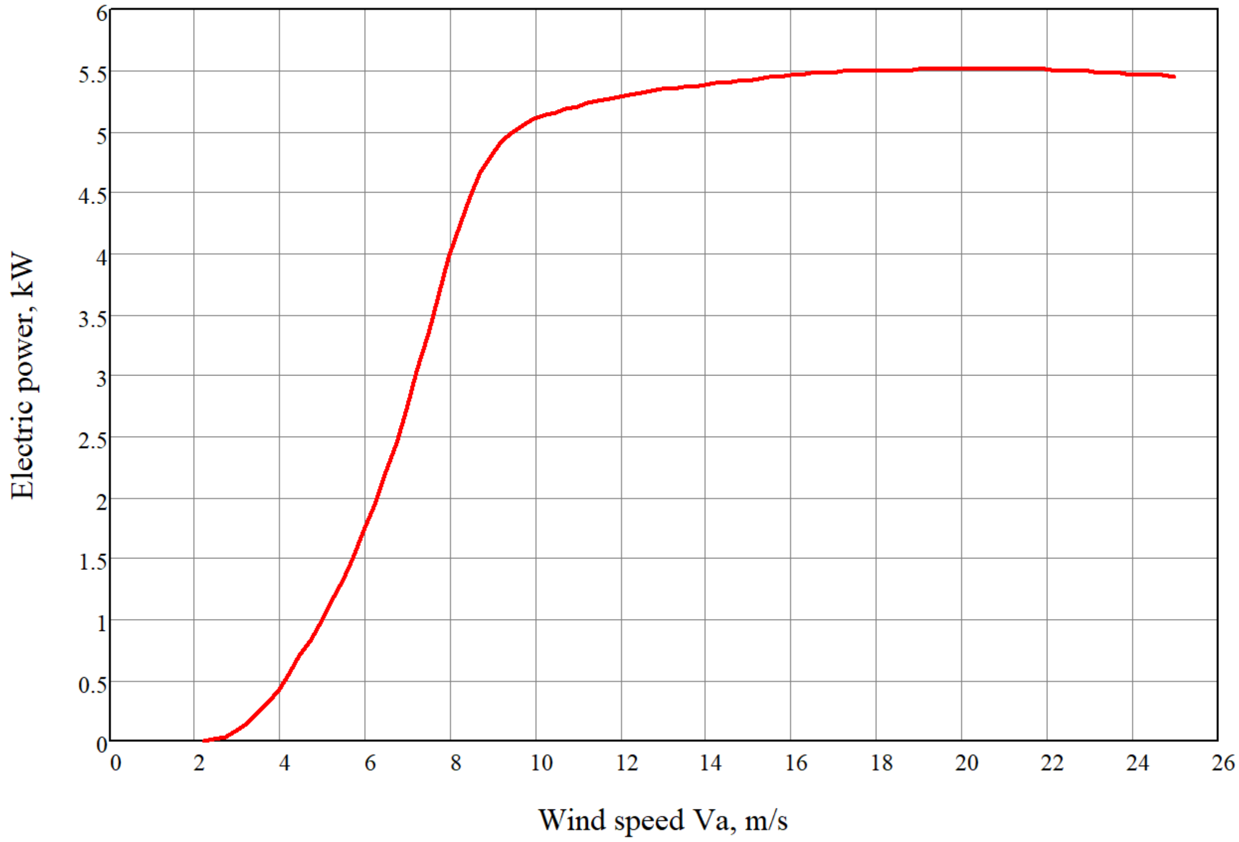
Main technical parameters of VDM-5 kW are shown in table 1.

Table 1

Parameter	Measure	Value
Class of the wind turbine	IEC	IV
Rated power output	kW	5,0
Maximum power output	kW	5,5
Rated wind speed	m/s	9,0
Minimum operational wind speed	m/s	2,0
Maximum operational wind speed	m/s	25,0
Basic (extreme) wind speed	m/s	50,0
Number of blades	pcs	3
Diameter of the wind wheel	m	6,5
Type of the drive	–	direct drive
Type of the generator	–	synchronous generator with permanent magnets
Direction according to the wind	–	downwind
Control over the wind wheel operations	–	passive pitch–control by the centrifugal-spring regulator
Two-stage forcible braking	–	– forcible feathering; – connecting the ballast load and shorting of the windings of the generator
Rated output voltage of BU-5	V DC	48-96, 200-300, 400-450, 650-700
Option: one-phase net inverter	V AC	230
Height of the hub	m	15,0
Weight of the wind turbine (excluding the mast) (maximum)	Kg	350
Operational air temperature	°C	from – 40 to +60
Protection class according to IEC 60529:2013	–	IP53
Technical maintenance	–	1 time a year
Terms of operation	Years	20

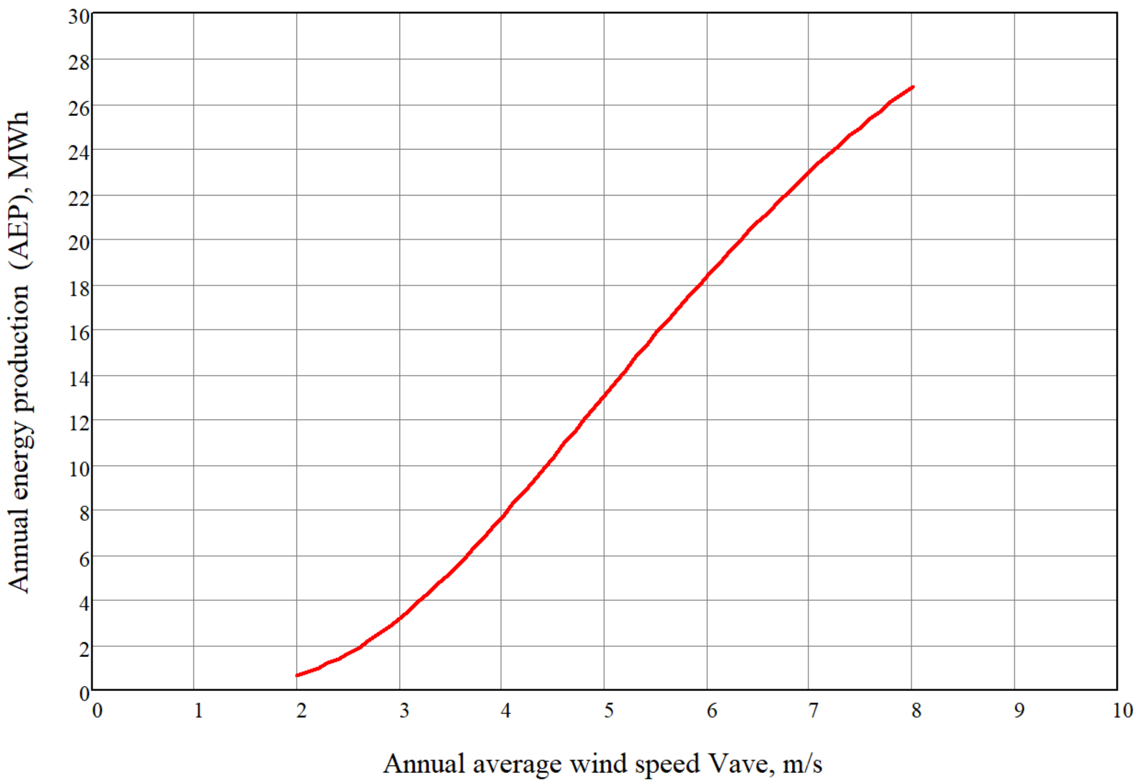
Technical decisions ensure operations of the wind turbine VDM-5 kW with the regulated rotation speed, control over the torque on the shaft of the generator and usage of efficient power take-off algorithms.

Picture 1 shows calculated dependence of the power of VDM-5 kW from the wind speed.



Picture 1 – Dependence of power of VDM-5 kW from wind speed

Picture 2 shows dependence of the annual energy production (AEP) from the annual average wind speed in the specific territory.



Picture 2 – Dependence of AEP from the annual average wind speed in the specific territory

For the territories with the average annual wind speed of 5,0 m/s and more, the power coefficient of VDM-5kW is no less than 0,30.

3 CONSTRUCTION OF VDM-5 KW

Specific features of the construction of VDM-5 kW.

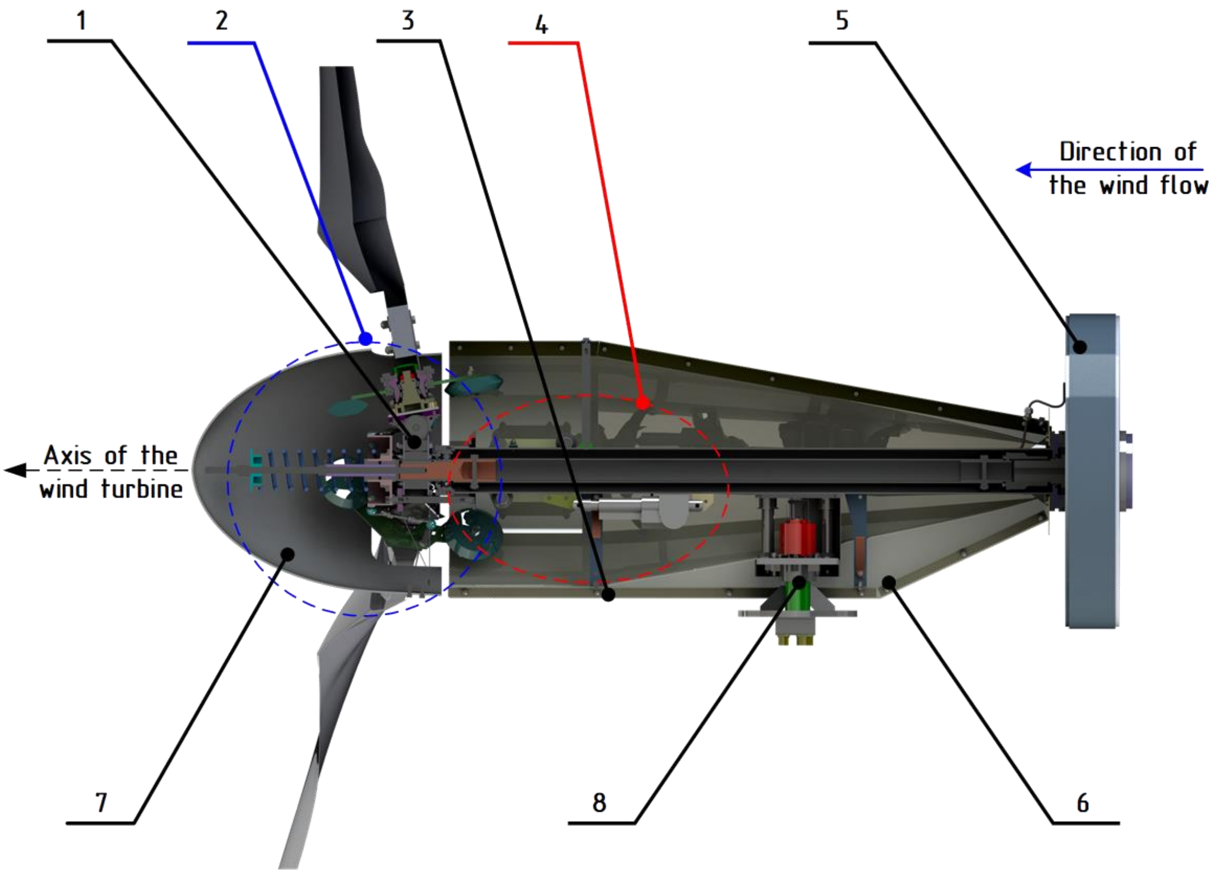
1. Direct drive gearless wind turbine.
2. Synchronous generator with permanent magnets.
3. Wind wheel with three blades and horizontal rotation axis is downwind.
4. Control over the wind wheel operating by the centrifugal-spring regulator (passive pitch-control).
5. Orientation to the wind is executed by the aerodynamic forces, affecting the wind wheel (passive yaw system).
6. Prevention of the cable twisting is executed by the current collector.
7. First braking stage includes turning of the blades to the feathering position by the actuator. Second braking stage includes connecting the ballast load and electrical braking by shorting of the windings of the generator.
8. Type of mast is tubular.

Main units of VDM-5 kW are listed in table 2 and are shown in picture 3.

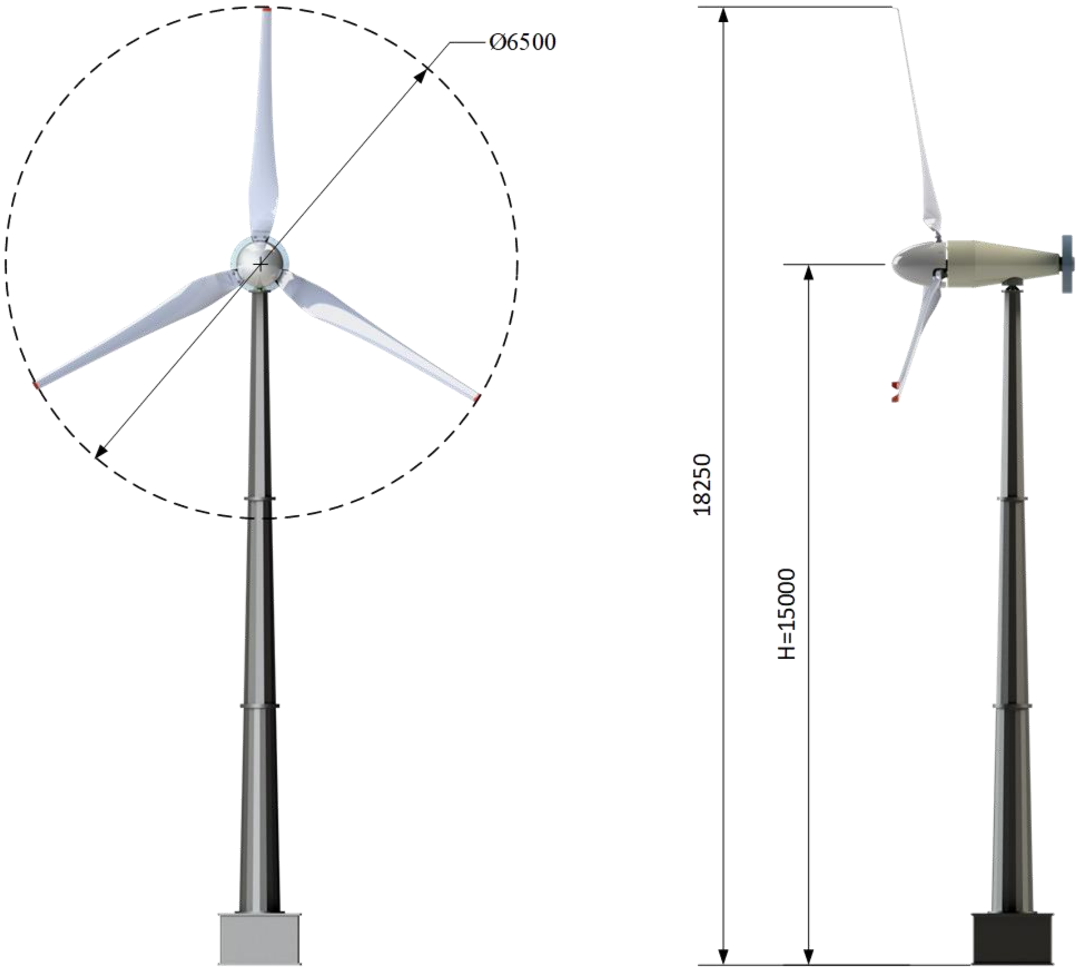
Table 2

№	Title	Quantity	Notes
1	Wind wheel with the hub	1	
2	Centrifugal-spring regulation mechanism	1	
3	Nacelle	1	
4	Forcible feathering mechanism	1	
5	Synchronous generator	1	
6	Nacelle cowling	1	
7	Hub cowling	1	
8	Slewing gear	1	
9	Mast (option: self-lifting tower)	1	Is shown in picture 4
10	Controller of the wind turbine	1	Optional

Composition of the main units of VDM-5 kW is shown in picture 3.



Picture 3 – Composition of the main units of VDM-5 kW



Picture 4 – Appearance of VDM-5 kW with the mast (height of 15 m)

4 MAIN COMPETITIVE ADVANTAGES

1. Using the passive pitch-control with the centrifugal-spring regulator allows to raise reliability, to reduce the cost of the wind turbine, to reduce consumption of the electrical energy by the exclusion of electric drive and controller of the pitch-control.
2. Passive yaw system allows to raise reliability, to reduce costs and to reduce consumption of the electrical energy for your own needs by the exclusion of the following units: a slewing gear with the gearbox, an intermediate gearbox, the electric drive, the controller of the electric drive, wind speed sensors and wind direction sensors.
3. The absence of gearboxes and hydraulic systems and also the absence of control electronics in the nacelle allows to raise reliability of wind turbine operations in the conditions of the cold climate.
4. Using rubber hinges of the blades in the construction of the hub allows to reduce vibrations and loads of the construction of the wind turbine, to decline the weight of the wind wheel and the costs for the hub and the shaft of the wind turbine and for the slewing gear.
5. Using domestic automobile components in the construction of the wind turbine allows to raise reliability and to reduce costs, because these components are produced at wholesale, have been tested by high loads and low temperatures.

5 ACTIVITIES FOR ADAPTATION TO THE COLD CLIMATE

In order to adapt the wind turbine to the conditions of the cold climate we suggest the following steps:

1. Using specific steel grades for the construction of the wind turbine.
2. Using frost-resistant components (bearings, sealings etc.).
3. Using the special coating for the blades of the wind turbine.
4. Using an optional temperature sensor for issuing signal about braking of the wind turbine at the temperature below 40°C (for example).
5. Using optional sensors for issuing signal about braking of the wind turbine, when the blades are iced up.