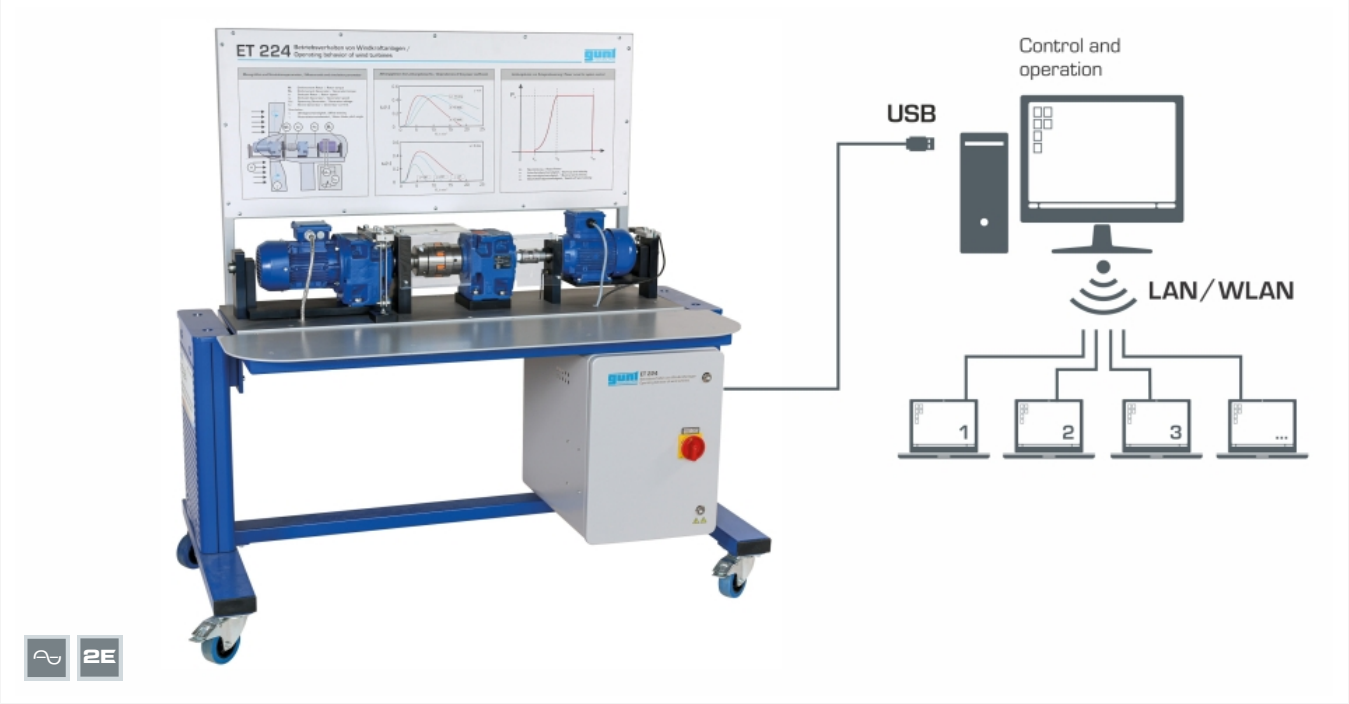
ET 224
Operating behaviour of wind turbines



Network capable GUNT software: control and operation via 1 PC. Observation, acquisition, analysis of the experiments at any number of workstations via the customer's own LAN/WLAN network.

Description

- **low speed drive unit simulates wind rotor**
- **GUNT measurement and simulation software with control function for electronic load**
- **automated capture of characteristic diagrams as a function of wind speed, rotor blade angle and rotor speed**
- **network capability: observe, acquire, analyse experiments via customer's own network**

The performance of wind power plants depends on mechanical and electrical components, and on an efficient turbine control system. Therefore, it is essential that the influence of the effective parameters under all relevant operating conditions be known.

ET 224 looks at the components of a wind power drive train. To aid understanding, the main turbine parameters are studied in experiments with simulated characteristic diagrams. An adjustable speed gear motor simulates the typical slowly rotating wind rotor with high torque. A three-stage spur gear is located between the slow-rotating drive side and the fast-rotating generator side. A three-phase synchronous generator with rectifier converts the mechanical energy into electrical energy. The electrical energy is transferred to an electronic load.

This electronic load can be controlled directly or via the simulation module in the supplied GUNT software.

The operation and control are carried out via a PC (not included in the scope of delivery) connected via a USB interface. Using the GUNT software, simulated characteristic diagrams of the wind rotor are investigated as a function of wind velocity and rotor blade angle. The power available at the generator, as well as torques at the drive train, can be measured under the chosen operating or simulation parameters. Additionally, the network capable GUNT software makes it possible to observe, acquire, and analyse the experiments at any number of workstations via the customer's own network with just one licence.

The speed of the generator and the drive-side and generator torques are measured by sensors and displayed digitally in the GUNT software. Various operating windows are available in the GUNT software for carrying out experiments. It is possible to perform single measurements, automated capture of characteristic curves and characteristic diagrams, as well as measurements in autonomous wind-guided turbine mode.

Learning objectives/experiments

- conversion of kinetic energy into electrical energy
- power coefficient and tip-speed ratio
- study how torque and speed affect the efficiency of the gear unit and generator
- study how wind speed and rotor blade angle affect the typical torque characteristic of a wind rotor
- power limitation by controlling speed and rotor blade angle
- familiarisation with wind-guided turbine control in autonomous mode

- GUNT E-Learning
  - multi-media online course on the fundamentals of wind power
  - learning independent of time and place
  - access via Internet browser
  - check through targeted review of the learning objectives

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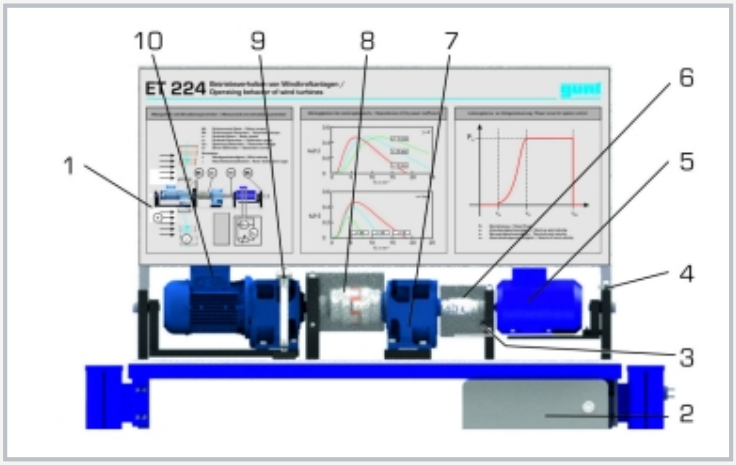
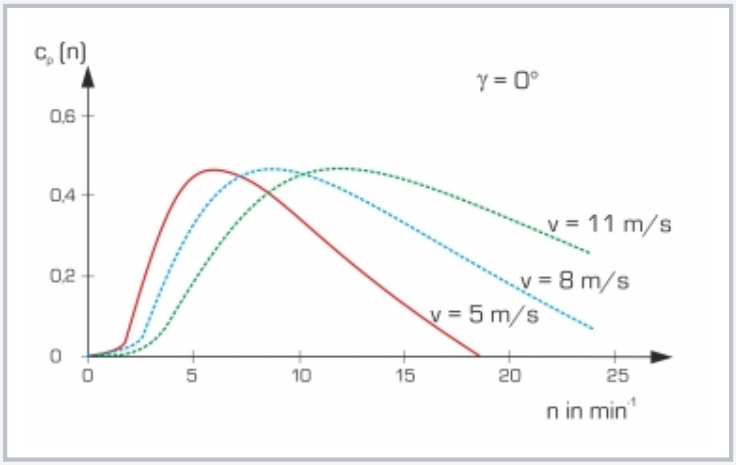
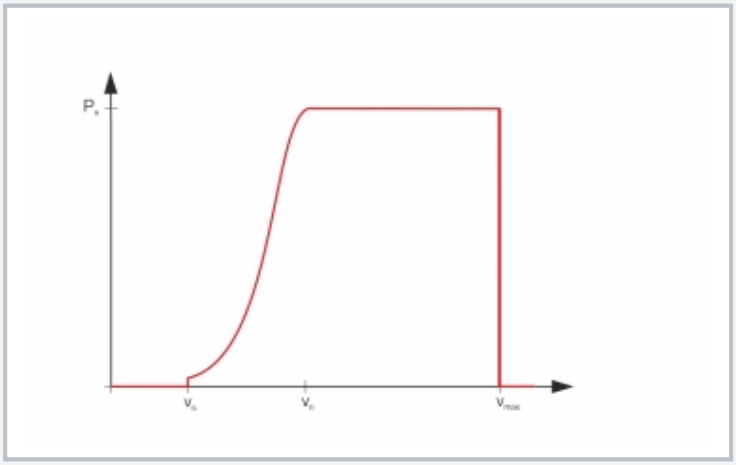


1 panel, 2 switch cabinet with electrical load and plant control, 3 speed sensor, 4 generator torque sensor, 5 three-phase current generator, 6 coupling, 7 spur gear, 8 coupling, 9 drive torque sensor, 10 drive motor



Power coefficient as a function of rotor speed: simulation of typical characteristic diagrams at different wind velocities and rotor blade angles



Power curve for autonomous mode with increasing wind velocity: power output is limited by the turbine control system by adjusting rotor speed and rotor blade angle

Specification

[1] measurements and simulation of typical characteristic values on a wind power drive train
[2] remote learning: detailed E-Learning course on the basics of wind power accessible online
[3] low-speed drive motor with adjustable speed simulates wind rotor
[4] drive train with spur gear
[5] three-phase synchronous generator with integrated rectifier
[6] sensor for generator speed and drive-side and generator torques
[7] adjustable electronic load with interface for software connection
[8] GUNT software for turbine control and acquisition of measured values, successive operating windows for user guidance
[9] simulation of characteristic diagrams as a function of wind velocity, rotational speed and rotor blade angle
[10] simulation of autonomous turbine operation with specified wind velocity
[11] network capability: observe, acquire, analyse experiments at any number of workstations with GUNT software via the customer's own LAN/WLAN network
[12] GUNT software via USB under Windows 10

Technical data

Three-phase synchronous generator
- rated speed: 1800min^{-1}
- max. power: 250W
- max. current: 4A
- max. voltage: 280V

Spur gear
- transmission ratio: 1:53
- rated load capacity: 335Nm
- rated efficiency: 94%

Drive motor
- rated speed: 22min^{-1}
- speed range: 3...22min^{-1}
- rated power: 0,37kW
- max. torque: 153Nm

Measuring ranges
- speed: 0...2800min^{-1}
- torque: 0...200Nm (drive)
- torque: 0...10Nm (generator)
- current: 0,005...25A
- voltage: 0...300V

230V, 50Hz, 1 phase
120V, 60Hz, 1 phase, 230V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 1480x780x1500mm
Weight: approx. 105kg

Required for operation

PC with Windows

Scope of delivery

1 experimental unit, 1 GUNT software + USB cable
1 set of instructional material