

MATRIX | RENEWABLES

Advanced Wind Energy

SAMPLE



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CP0237

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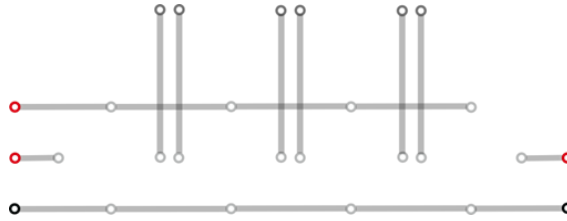
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Introduction

Components

Base unit Professional 1400-13



The base unit is a breadboard where up to 4 components can be plugged in a series and parallel connection. The current flows along the wires on the bottom side. At the head there are bypass slots to connect the components in the desired way.

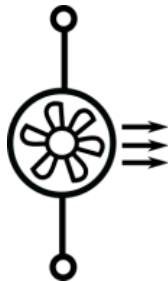
Wind machine 1400-19

The wind machine is used to control the wind conditions during an experiment with the wind turbine. For those experiments the wind machine has to be connected to the PowerModule (voltage source). For this the negative (positive) pole of the PowerModule has to be connected to the black (red) connection. Towards the connections there is also a separate on/off-switch. The wind direction is marked with arrows on the upside. The use of the wind machine is only permitted with the PowerModule or a stabilized voltage source. Misuse leads to termination of warranty.

Specifications:

Maximum voltage: 12 V DC (stabilized)

Wind speed: 0 – 7 m/s



Wind rotor set 1400-12



Introduction

Components

With the available components, rotors with 2, 3 or 4 blades and with a flat or an optimized profile can be created. There is a hub for 4 blades with a pitch angle of 25° and hubs for 3 blades with pitch angles of 20°, 25°, 30°, 50° und 90°. To assemble you should proceed in the following way:



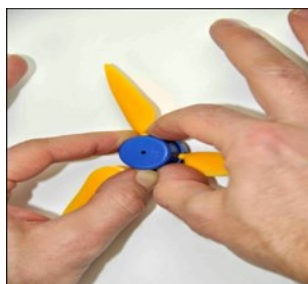
First, a hub with the desired rotor blade pitch and the number of blades should be selected. (The hubs are labelled on the back.) The Two-blade rotor and the Four-blade rotor can both be constructed with the Four-blade hub.



After that, the rotor blades are installed. During the insertion of the blades, make sure that they are installed with the rounded side up.



After installation of the rotor blades, the hub-cap will be mounted and lightly pressed against the hub.



To replace the blades, a small nose is located on the head of the hub. If the nose is pressed lightly on a hard surface, the hub-cap can be removed easily.

Wind turbine module 1118-03



Introduction

Components

At first the blue wind turbine has to be plugged into the module. The rotor has to be racked at the generator shaft to get a model of a wind turbine. The rotor must not touch the casing to avoid friction, which would considerably impede its rotation. The generator produces a direct current, with its polarity marked on the module. Additionally an angle scale is printed on the module, so it is possible to adjust a certain wind angle.

It is not allowed to touch the rotor during movement due to risk of injury. The rotor may only be touched, when it does not turn!

Handling of the fingerguard:



The wind turbine has three small retainers to fix the fingerguard

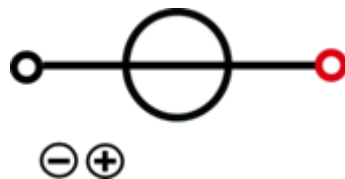


The fingerguard will be attached at the top of the wind turbine and pressed firmly at the lower retainers



Afterwards, the wind rotor will be fixed at the wind turbine

PowerModule 9100-05

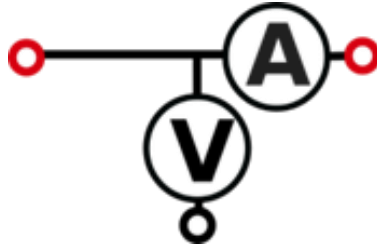


The PowerModule is a compact and intuitively usable voltage source. First, the attached power adapter has to be connected to a power outlet and to the top right input jack. The voltage can be chosen with the „+“ - and „-“ -buttons and will be displayed by LEDs. When the desired voltage is chosen, the voltage will be applied by using the yellow on/off- button. In case of a short circuit or currents greater than 2 A the PowerModule will switch off immediately.

Specifications:

- Output voltage: 0-12 V
- Output power: max. 24 W
- Adjustable in 0.5 V steps
- Overcurrent detection >2 A and automatic shutoff
- Input voltage: 110-230 V, 50-60 Hz (with enclosed power adapter)

AV-Module 9100-03



The AV-Module is a combined voltage and current meter. It holds 3 buttons, whose features are described in the display respectively. By pushing a random button the module will switch on. When the display does not show anything or the word „Bat“ is shown, it is necessary to change the batteries in the back (2 x AA batteries 1.2 to 1.5V; Take care of the polarity marked on the bottom of the battery case! Do not touch the button while inserting the batteries).

With the top right button the measuring mode can be switched between voltage mode, current mode or combined voltage-current mode. Both measurement mode and required cable connection will be indicated by the circuit symbols on the display. Take care that in voltage mode no current is applied to the right jack. In the combined mode the voltage can be measured with the right jack as well as with the left one. The influence of the internal resistance of the current measurement is compensated internally. The measured values are signed. When the positive pole is connected to a red jack and the negative pole is connected to the black jack, the value of the voltage will be positive. When current is applied from the left to the right, the current value will be positive, as well. The other way around, the algebraic sign changes. After 30 min without pushing a button or after 10 min of measuring a constant value, the module will switch off automatically. It can measure voltages up to 12 V and currents up to 2 A. In case of exceeding one of the values, the module interrupts the current flow and shows “overcurrent“ or “overvoltage“. This error message can be confirmed by touching a button. The module will resumes measuring, when the values attain acceptable values.

Specifications:

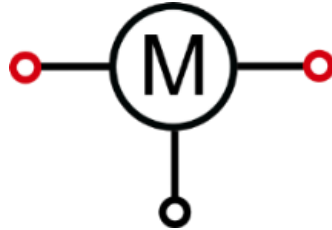
Voltage metering:

- range: 0...12 V
- accuracy: 1 mV
- automatic shutoff in case of overvoltage >12 V

Current metering:

- range: 0...2 A
- accuracy: 0,1 mA (0...199 mA) und 1mA (200 mA...1 A)
- automatic shutoff in case of overcurrent >2 A
- internal resistance <0,5 Ohm (0...200 mA); <0,2 Ohm (200 mA...2 A)

Motor module (1118-02) with yellow propeller (L2-02-017)



The motor module acts as a consumer in Wind experiments.

Potentiometer module 1118-04



The potentiometer module holds a 0-100-Ω-potentiometer and a 0-1-kΩ-potentiometer. Both are serially connected, so that the potentiometer can attain resistances between 0 Ω bis 1100 Ω. The measuring error amounts to 5 Ω for the small resistor and 20 Ω at other one. The maximum current amounts to 200 mA.

Resistor module (triple) with resistor plug elements 1800-01



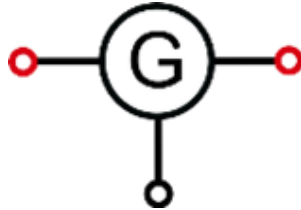
Parallel connection and series connection of resistors are possible. For parallel connection use one resistor module (triple) with three slots. For series connection use two resistor modules (triple). The following resistor plug elements are included:

- 2 x R=10Ω 1800-05
- 1 x R=33Ω 1800-06
- 3 x R=100Ω 1800-04

Introduction

Components

Savonius rotor (with generator module) 1118-14



Start-up wind speed: ca. 3.3 m/s

Nominal voltage at wind speed of 5 m/s: 0.4 V

Wind force transducer with mount 1400-20



Wind speed: 1.1-30.0 m/s

Resolution: 0.001m/s

R.p.m. counter_L2-06-062



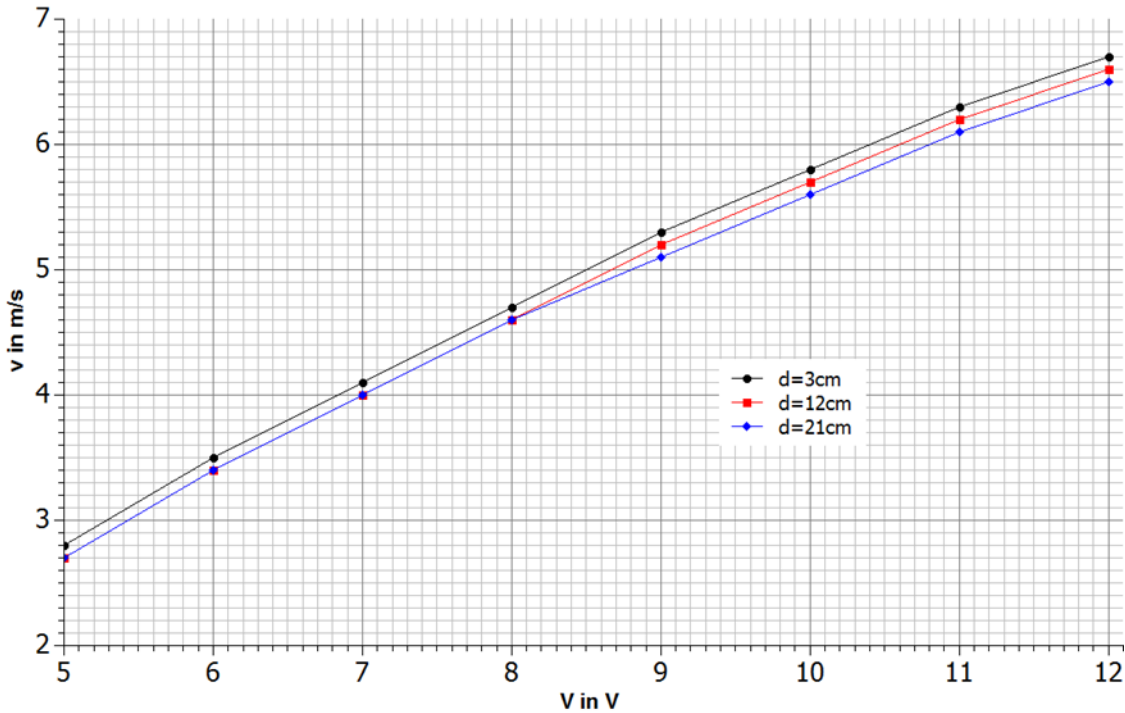
Laser class: 2
Output: < 1 mW
Wavelength: 630 - 670 nm

Measuring range: 2 ... 99999 BpM; 0.1 (2...999 BpM); 1
(1000...99999 BpM) \pm 0.05 % + 1 dgt.

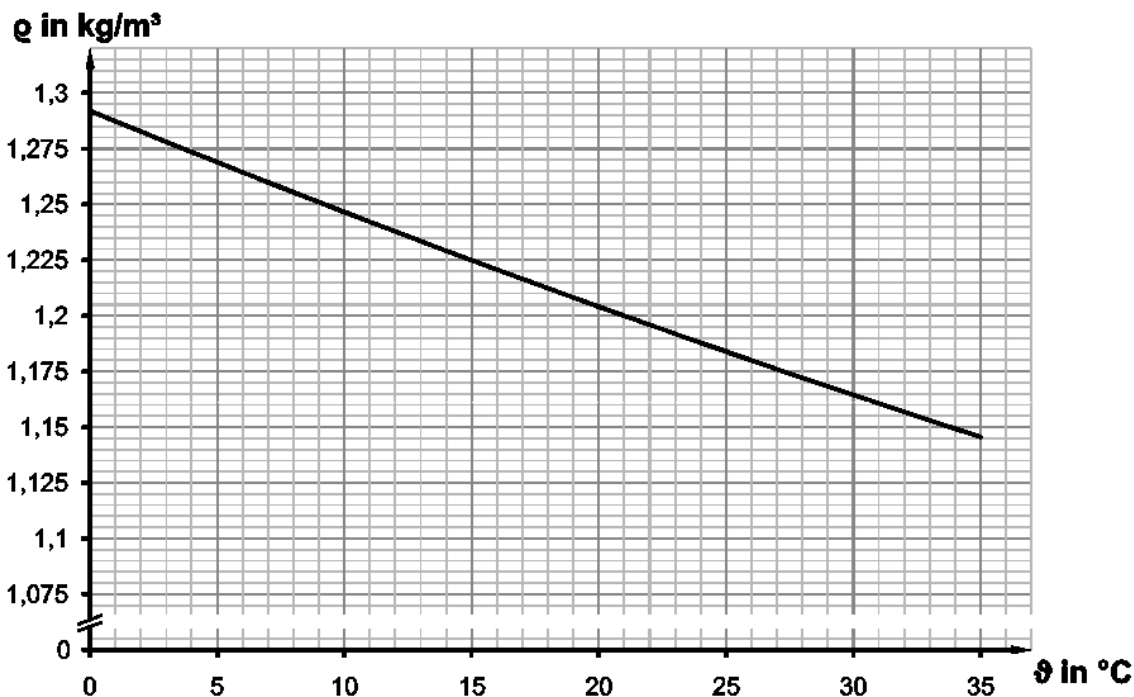
Measuring sequence: 2x/sec. over 120 BpM
Measuring distance: 50 mm ... 500 mm
Total Bpm: 1 ... 19 999 BpM; 0.1 BpM

The following are the charts needed to determine the wind speed of individual experiments if the anemometer is not in use.

Wind speed at the wind generator



Air density (depending on the ambient temperature)



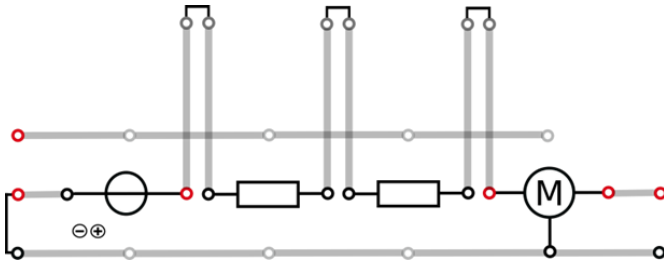
Basic Electronic Experiments

Setup of a simple circuit

Task

Set up a simple electrical circuit.

Setup



Required Devices

- base unit
- 1 PowerModule (V=5V)
- 2 resistor module, triple
- 2 resistor plug elements (R=100Ω)
- 1 motor module

Execution

1. Set up the experiment according to the circuit diagram.
2. Open and close the electrical circuit by:
 - a) Plug in/plug off a cable.
 - b) Plug in/plug off a current bridge.
 - c) Plug in/plug off a resistor
3. Note your observations.

Observation

Evaluation

1. Formulate reasons for the behaviour motor

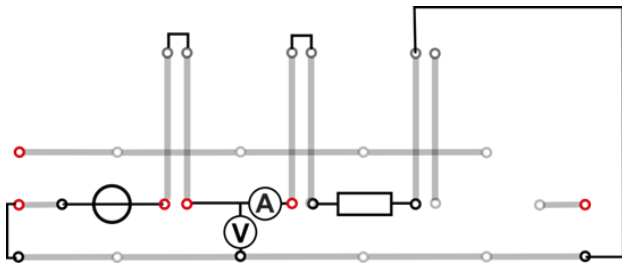
Basic Electronic Experiments

Ohm's law

Task

Investigate Ohm's law with several resistors.

Setup



Required Devices

- base unit
- 1 PowerModule (6V)
- 1 resistor module, triple
- 3 resistor plug elements (R=100Ω, R=33Ω, R=10Ω)
- 1 AV-Module

Execution

1. Set up the experiment according to the circuit diagram.
2. Measure voltage and current for various resistances. Use the AV-Module in voltage-current-mode.
 - R=100Ω
 - R=33Ω
 - R=10Ω
3. Note your measured data in the table and calculate each the ratio V/I.

Measurement

R (Ω)	100	33	10
V (V)			
I (mA)			
V/I (Ω)			

Evaluation

1. Deduce a connection between resistance R and ratio V/I. Which lawfulness can be derived?

The full version of this curriculum is available upon purchase of the kit.

Please see contents for a full list of experiments from the full version.