Heliocentris

Hybrid Renewable Energy Trainer

Wind energy, Solar energy, Hydrogen - Modular System with 5 versions

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System Overview

The Hybrid Renewable Energy Trainer is a computer-assisted training system designed for technical colleges, universities and scientific training institutions. It enables hands-on experiments covering solar energy, wind energy and hydrogen & fuel cell technology.

Training Scope

The planned activities are suitable for both **basic and advanced levels** of training and are designed with user safety in mind in compliance with current standards.

Modular Design

The system consists of individual modules that can be easily inserted or removed, depending on the type of experiment to be performed.
All components used to produce the modules are the same as those found in **real industrial equipment**, ensuring students work with industry-relevant hardware.

Main Structure

The primary workstation is built on a robust **aluminium frame**, approximately **180 cm high**, with a **110 × 60 cm work surface** and three support bars for mounting the experiment modules. The interlocking design allows quick and easy reconfiguration of the system. All connections between modules are made with the supplied cable set, keeping every connection clearly visible to the students. A separate **static storage stand** provides organised storage for modules not currently in use.

Energy Source Simulators

Solar simulation – A dedicated stand houses two 10 W monocrystalline photovoltaic panels together with an adjustable LED projectorto simulate varying solar irradiance conditions in a controlled lab environment.
Wind simulation – A separate floor-standing unit contains a wind turbine driven by a 150 W DC motor with variable speed control, replicating different wind speed scenarios.

Software & System Requirements

The accompanying control and data acquisition software requires a PC (not included) meeting the following minimum specifications:

- Operating system: **Windows 10** or higher
- Memory: **4 GB RAM** minimum
- Processor: **Intel i3** class or higher

System Overview

35 Hands-on Experiments across 3 Energy Domains

The Hybrid Renewable Energy Trainer includes **35 structured experiments** across three energy domains. Each experiment is designed for progressive learning — from basic component characterisation to complete system integration.

Solar Energy Experiments

01 The photovoltaic panel

02 Open-circuit voltage measurement

03 Short-circuit current measurement

04 Current-voltage characteristic

05 Daily trend in panel voltage without load

06 Daily trend in panel voltage under load

07 Seasonal trend of panel voltage without load

08 Seasonal trend of panel voltage under load

09 Series-connected photovoltaic panels

10 Photovoltaic panels connected in parallel

11 Photovoltaic panel simulator

12 Effect of shading on photovoltaic panels

13 Bypass diode operation

14 Effect of asymmetry on photovoltaic panels

15 Effect of the blocking diode on photovoltaic panels

16 Photovoltaic panel emulator

17 Direct load connection of photovoltaic panels

18 Off-grid inverter start-up (without load)

19 Installation of a basic photovoltaic system (DC load)

20 Installation of a basic photovoltaic system (AC load)

21 Off-grid inverter output signal — data acquisition module

22 Off-grid inverter output signal — energy analysis module

23 Energy absorbed by the off-grid inverter

24 Power output and efficiency of the off-grid inverter

25 SCADA application of the off-grid inverter

26 On-grid inverter examination

Wind Energy Experiments

1 Turbine speed vs. output voltage (no load)

2 Turbine speed vs. output voltage (under load)

3 Effect of turbine controller on speed vs. voltage (no load)

4 Effect of turbine controller on speed vs. voltage (under load)

5 Turbine output voltage examination

6 Turbine output voltage — data acquisition module

7 Wind power system examination

Hydrogen Technology & Fuel Cell Experiments

1 Fuel cell output voltage — oscilloscope

2 Fuel cell output voltage — data acquisition

Hybrid Renewable Energy Trainer

Module Overview — 36 Components

RES-001 – RES-007

RES-001 Mobile Module Stand

The mobile module stand is the centrepiece of all experiments. Modules can be easily inserted and removed. A built-in shelf provides space for notes and working materials.

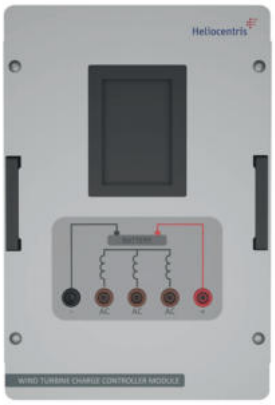
RES-002a Wind Turbine Module

DC Motor	**24V / 1400rpm**
Dynamo	**24V / 300W**
Nom. Wind Speed	**13m/s**
Weight	**16kg**

RES-002b Wind Simulator Module

Control Power	**200W**
Output V	**0-20V**
Mode	**Manual / PC**
Weight	**3kg**

RES-002c Wind Turbine Charge Ctrl.



Battery V	**12 / 24V**
Brake V	**15 / 30V**
Weight	**2,6kg**

RES-003 Solar Panel (Adj. Angle)

VOC	**2×23,8V**
ISC	**2×0,6A**
LED Projector	**300W / 0-36V**
Weight	**2,8kg**

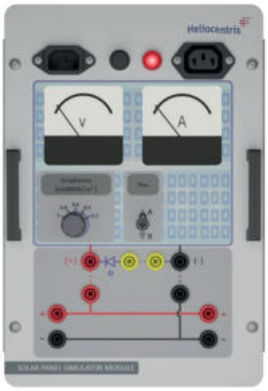
RES-004 Electronic Potentiometer

Resistance	**0-1000Ω ±1Ω**
Max Power	**50W**
Display	**5" TFT**
Weight	**4,5kg**

RES-005 Potentiometer Module

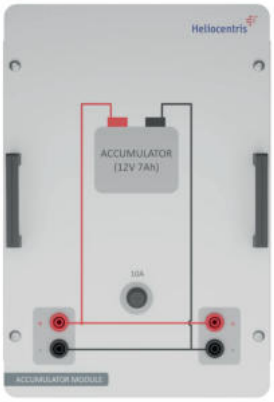
Resistance	**0-1kΩ**
Max Power	**200W**
Weight	**3,1kg**

RES-006 Solar Panel Simulator (2 Units)



ISC	**2A**
VOC	**12-18V**
Irradiance	**5 Stage**
Weight	**2,9kg**

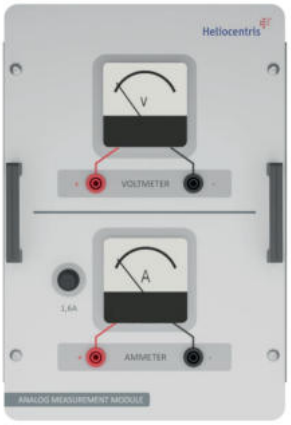
RES-007 Accumulator Module



Voltage	**12V**
Capacity	**10Ah**
BMS	**Integrated**
Weight	**2kg**

RES-008 – RES-016

RES-008 Analog Measurement

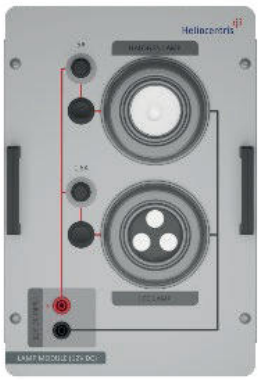


Voltmeter	**0-30V**
Ammeter	**0-5A**
Weight	**3kg**

RES-009 Lamp Module (220V AC)

Bulbs	**Saving + LED**
Socket	**E27**
Operating	**220V / 50Hz**
Weight	**2,8kg**

RES-010 Lamp Module (12V DC)

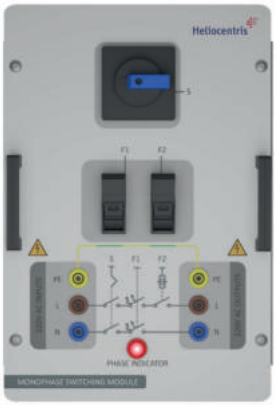


Halogen	**20W**
LED	**2W**
Operating	**12VDC**
Weight	**2,9kg**

RES-011 Isolated Measurement

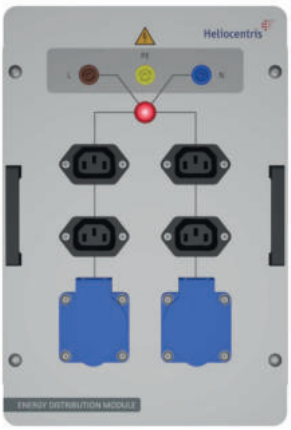
V Range	**0-500V**
I Range	**0-5A**
Channels	**2**
Weight	**3,5kg**

RES-012 Monophase Switching



Breaker	**10A**
RCD Relay	**25A / 30mA**
Weight	**3kg**

RES-013 Energy Distribution



Output	**4x C14; 2x CEE 7/4**
Weight	**2,8kg**

RES-014 Light Source Control

Output Power	**0-300W**
Output V	**0-36V**
Mode	**Manual / PC**
Weight	**3,1kg**

RES-015 AC Energy Analyser

Voltage	**230V**
Current	**5A**
Accuracy	**±1%**
Weight	**3kg**

RES-016 PC Interface Module

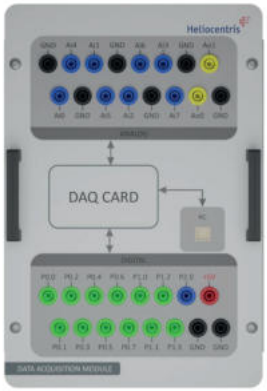
PC	**USB**
Data	**5× RS485 / RJ45**
Analog Out	**LS + WS**
Weight	**2,7kg**

RES-017 – RES-025

RES-017 AC/DC Measurement

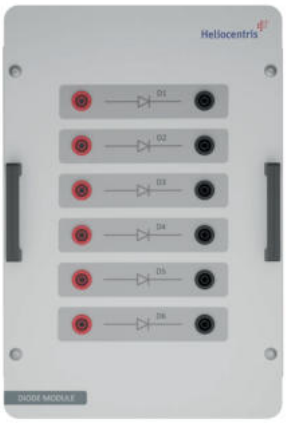
Ammeter	**0-5000mA ±4mA**
Voltmeter	**0-500V ±400mV**
Display	**5" TFT**
Weight	**3,2kg**

RES-018 Data Acquisition Module



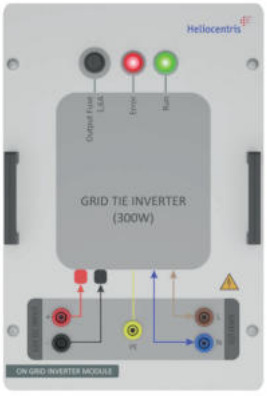
Analog In	**8× (14bit, 20kS/s)**
Analog Out	**2× (12bit)**
Digital I/O	**12**
Interface	**USB**

RES-019 Diode Module



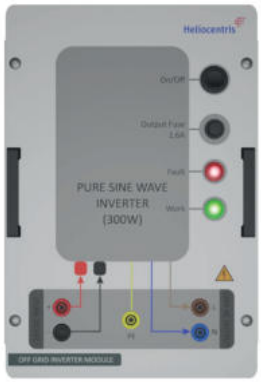
Diodes	**6× Schottky**
Rating	**40V / 3A**
Weight	**2,1kg**

RES-020 On-Grid Inverter



Input	**11-32VDC**
MPPT	**15-22V**
Output	**230V AC**
Power	**Max. 330W**

RES-021 Off-Grid Inverter



Input	**12VDC**
Output	**220-240V AC ±5%**
Power	**300W Sine**
Weight	**3,5kg**

RES-022 Solar Charge Regulator

System	**12V / 24V Auto**
Charge I	**10A**
Weight	**2,5kg**

RES-023 AC Power Module

Note	**For grids ≠ 220V AC**

RES-024 LCD Monitor

Typ	**LED**
Size	**21,5"**
Weight	**3,5kg**

RES-025 Cable Holder

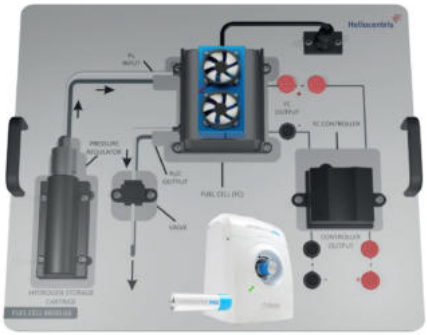
The cable holder is mounted on the side of the module stand and provides convenient storage for your cables.

RES-026 – RES-OSC

RES-026 Cable Set (40 pcs.)

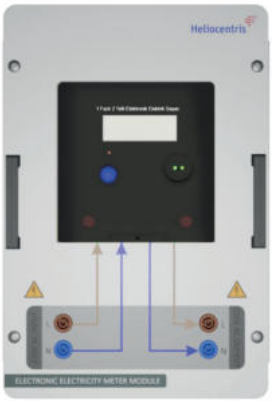
The cable set comprises 66 pieces – including banana cables in various colours and lengths, power cables, Ethernet and USB cables, as well as specialty cables and selected accessories for immediate use in all experiments.

RES-027 Fuel Cell Module



Tank Pressure	30 Bar
F.C. Input	0,4-0,55 Bar
F.C. Out	14VDC
Con. Out	11,8VDC
Weight	3kg

RES-028 Electronic Elec. Meter



Nominal V	220/230V
Ref. I	5A
Max I	100A
Display	LCD 9(6+3)

RES-029 Static Module Stand

The static module stand serves as storage for all modules not currently needed in an experiment.

RES-030 Monitor Holder

The monitor holder allows secure attachment of the display to the module stand.

RES-031 Electronic Load Module

Input V	Max. 24V DC
Current	1-1000mA
Max Power	24W
Weight	3,1kg

RES-032 DC Power Supply

Output V	0-32VDC ±10mV
Output I	0-5,1A ±1mA
Power	0-160W
Weight	5kg

RES-SW Software

The intuitive experiment software is supplied on a USB stick and offers a wide range of experiments.

RES-OSC Oscilloscope (Owon)

The Owon oscilloscope enables precise display and analysis of electrical signals in real time.

Heliocentris

Article Number	Module Description	2010 Solar Energy	2020 Wind Energy	2040 Solar + Wind	2000 Solar + Wind + H2-BZ	2050 Solar + H2-FC
RES-002a	Wind Turbine Module	—	●	●	●	—
RES-002b	Wind Simulator Module	—	●	●	●	—
RES-002c	Wind Turbine Charge Ctrl.	—	●	●	●	—
RES-027	Fuel Cell Module (incl. H2-Generator & 2x H2-Storage)	—	—	—	●	●
RES-001	Mobile Module Stand	●	●	●	●	●
RES-003	Solar Panel (Adj. Angle)	●	—	●	●	●
RES-007	Accumulator Module	●	●	●	●	●
RES-009	Lamp Module (220V AC)	●	●	●	●	●
RES-010	Lamp Module (12V DC)	●	●	●	●	●
RES-013	Energy Distribution	●	●	●	●	●
RES-014	Light Source Control	●	—	●	●	●
RES-016	PC Interface Module	●	●	●	●	●
RES-017	AC/DC Measurement	●	●	●	●	●
RES-019	Diode Module	●	—	●	●	●
RES-021	Off-Grid Inverter	●	●	●	●	●
RES-022	Solar Charge Regulator	●	—	●	●	●
RES-SW	Software	●	●	●	●	●
RES-025	Cable Holder	●	●	●	●	●
RES-026	Cable Set (40 pcs.)	●	●	●	●	●
RES-031	Electronic Load Module	●	●	●	●	●
RES-004	Electronic Potentiometer	●	●	●	●	●
RES-006	Solar Panel Simulator (2 Units)	●	—	●	●	●
RES-008	Analog Measurement	●	●	●	●	●
RES-005	Potentiometer Module	●	●	●	●	●
RES-011	Isolated Measurement	●	●	●	●	●
RES-012	Monophase Switching	●	●	●	●	●
RES-015	AC Energy Analyser	●	●	●	●	●
RES-018	Data Acquisition Module	●	●	●	●	●
RES-020	On-Grid Inverter	●	●	●	●	●
RES-023	AC Power Module *	●	●	●	●	●
RES-028	Electronic Elec. Meter	●	—	●	●	●
RES-032	DC Power Supply	●	●	●	●	●
RES-029	Static Module Stand	—	—	●	●	●
RES-OSC	Oscilloscope (Owon)	●	●	●	●	●
RES-030	Monitor Holder	—	—	—	●	—
RES-024	LCD Monitor	—	—	—	●	—

● Included — Not included

*** RES-023 AC Power Module:** Required where grid voltage differs from 220V AC

subject to change

V26.04EN