HRET

Heliocentris

HYBRID RENEWABLE ENERGY TRAINER

The Renewable Energy Training Set is prepared for the purpose of experimenting in solar, wind and hydrogen based electricity production. The experiment set is designed in accordance with the curricula of all institutions requiring technical education which can be listed as technical universities, technical high schools and any institution in need of technical education. In the experiment set, user safety is prioritized in accordance with legal regulations. Laser technology is used to draw the symbols and write the technical briefs on the modules.

The content of the training set is applicable for advanced technical training, including basic training as well. The entire set of experiment unit consists of modules that can be easily attached to and removed from the main unit, depending on the experimental work to be carried out. All of the components used in the modules are authentic products or their counterparts which are produced for industrial purposes.

Solar Energy Experiments

- Photovoltaic Panel Experiments
- Measurement of Photovoltaic Panel Open Circuit Voltage
- Measurement of Photovoltaic Panel Short Circuit Current
- Photovoltaic Panel Current Voltage Characterization
- Examination of Photovoltaic Panels No-load Output Voltage Relative to the Whole-Day Movement
- Examination of Photovoltaic Panels Loaded Output Voltage Relative to the Whole-Day Movement
- Examination of Photovoltaic Panels Seasonal No-load Output Voltage
- Examination of Photovoltaic Panels Seasonal Loaded Output Voltage
- Series Connection of Photovoltaic Panels

Examination of Parallel Connection of Photovoltaic Panels

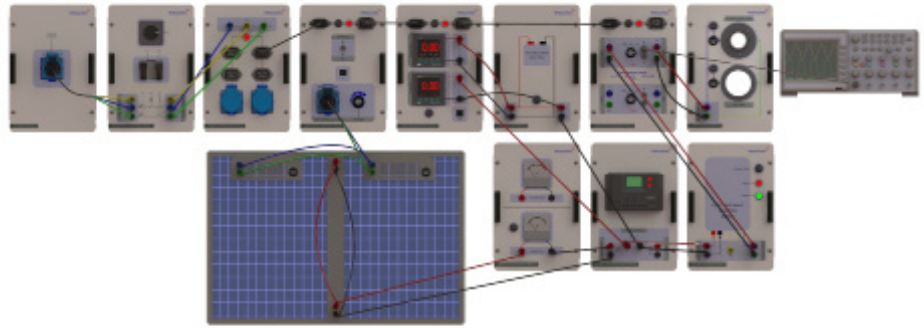
- Examination of Photovoltaic Panel Simulator
- Examination of Shadow Effect on Photovoltaic Panels
- Examination of Bypass Diode Effect on Photovoltaic Panels
- Examination of Mismatching Effect on Photovoltaic Panels
- Examination of the Effect of Blocking Diodes on Photovoltaic Panels
- Photovoltaic Panel Emulator Examination
- Photovoltaic System Experiments
- Directly Connecting Photovoltaic Panel to Load
- OFF GRID Inverter Startup (No-Load)
- Installation of the Basic Photovoltaic System (DC Load)
- Installation of Basic Photovoltaic System (AC Load)
- Examination of OFF GRID Inverter Output Signal with DAQ Module
- OFF GRID Inverter Output Signal Measurement by Energy Analyzer
- Measurement of Energy Taken from OFF GRID Inverter
- Measurement of OFF GRID Inverter Output Power and its Efficiency
- OFF GRID Inverter SCADA Application
- Examination of ON GRID Inverter

Wind Power Experiments

- Examination of the Relationship between Turbine Speed and Wind Turbine Output Voltage (No-load Operation)
- Examination of the Relationship between Turbine Speed and Wind Turbine Output Voltage (Loaded Operation)
- Examining Wind Turbine Controller Effect on the Relation Between Turbine Speed and Turbine Output Voltage (No Load Operation)
- Examining Wind Turbine Controller Effect on the Relation Between Turbine Speed and Turbine Output Voltage (Loaded Operation)
- Examination of Wind Turbine Output Voltage
- Examination of Wind Turbine Output Voltage with DAQ Module
- Examination of Wind Energy System

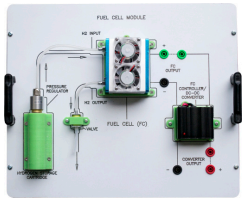
Hydrogen Energy Experiments

- Examination of Hydrogen Fuel Cell Output Voltage with Oscilloscope
- Examination of Hydrogen Fuel Cell Output Voltage with DAQ Module

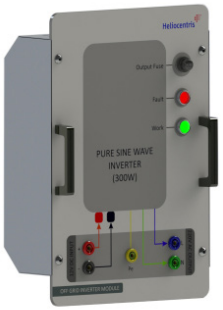


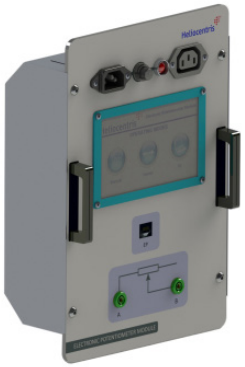
Technical Data - HRET HYBRID RENEWABLE ENERGY

Movable Main Unit	
Mobile stand made of 45x90 sigma aluminum profile	
140x80x3 cm table suitable for laboratory conditions	
5 corrugated cable holder with 40 cable capacity	
3 aluminum areas where the modules can be located in the main unit	
Mobile casters	
SOLAR	
1) SOLAR CHARGE REGULATOR MODULE 2) WIND SIMULATOR MODULELIGHT ANGLE ADJUSTABLE SOLAR PANEL 3) SOLAR PANEL SIMULATOR MODULE	3 Mobile stand made of 45x45 sigma aluminum 3 12/24V automatic input 3 2 pieces 10W polycrystalline panel 3 10A charging/Decharging current 3 3 different settings for solar position simulation 3 Scale indicating the setting value 3 500W Projector 3 Connection terminals 4mm safety sockets
WIND	
1)WIND TURBINE MODULE 2)WIND TURBINE CHARGE CONTROLLER MODULE	3 Aluminum body 3 200W 3 200W driven by DC motor 3 Connection terminals: 4mm safety sockets

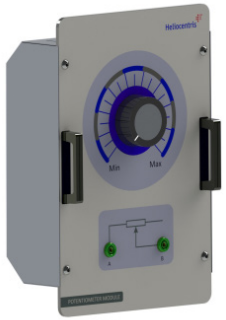


FUEL CELL MODULE	
Type of fuel cell	PEM
Number of cells	14
Rated power	30W
Rated performance	8.4V@3.6A
Purging valve voltage	6V
Blower voltage	5V
Reactants	Hydrogen and Air
Ambient temperature	5-30°C (41-86°F)
Max stack temperature	55°C (131°F)
Hydrogen pressure	0.45-0.55Bar
Humidification	Self-humidified
Cooling	Air (integrated cooling fan)
Stack weight (with fan & casing)	280g(±30g)
Stack size	80x47x75mm
Flow rate at max output	0.42L/min
Hydrogen purity	≥99.995% dry H2
Start up time	≤30s (ambient temp.)
Efficiency of system	40% at full power
ELECTROLYZE	
Model number	LWH22-10L-5
Capacity	10 L hydrogen
Hydrogen purity	≥99.995%
Cartridge size	ø22x88mm
Weight	Approx. 105g
Storage material	AB5 metal hydride
Rated charging pressure	3.0MPa
Working temperature	0-55°C (0-131°F)
Service life	10 years



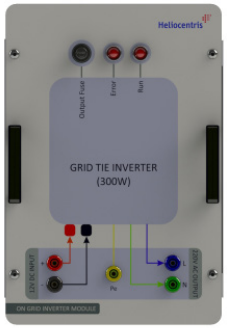


OFF-GRID INVERTER MODULE	
Model number	RESI-01
Weight	3,50 kg
Input voltage / Output voltage	12V DC / 230V AC
Output voltage / Output power	Full sine/ 300W
Thermal and overload protection	
Protection of short circuit and reverse connection	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)
ELECTRONIC LOAD MODULE	
Model number	RESL-03
Weight	3,1 kg
Touch screen	5”
Input voltage	230V AC
Power	100W
Adjustable via PC	
Thermal and overload protection	
Protection of short circuit and reverse connection	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)
ANALOG MEASUREMENT MODULE	
Model number	RESM-02
Weight	2,8 kg
Analog ammeter	0-5A
Analog voltmeter at least	0-20V
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)

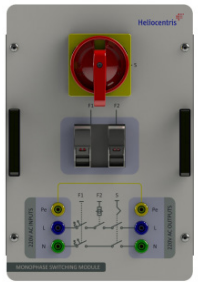


LINEER POTENTIOMETER MODUL	
Model number	RESL-01
Weight	3,1 kg
Variable resistor range	0-1 kΩ
0-50 Ohm maximum 6A	
51-200 Ohm maximum 2A	
201-1K Ohm max 0.6A	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)

AC ENERGY ANALYSER MODULE	
Model number	RESL-03
Weight	3 kg
Touch screen	5”
Input current	5A
Input voltage	230V AC
Measurement accuracy:	± 1%
PC connection	
Thermal and overload protection	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)



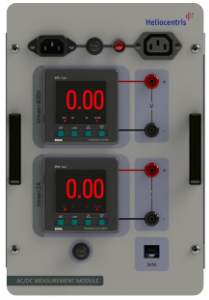
ON-GRID INVERTER MODUL	
Model number	RESI-02
Weight	3,5 kg
Input voltage / Output voltage	12V DC / 230V AC
Maximum input current	4A
Output power	300W
Electrical safety	Fuse protection
Working temperature	0-55°C (0-131°F)



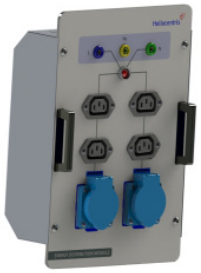
MONOPHASE SWITCHING MODULE	
Model number	RESMS
Weight	3 kg
Protection of leakage current and fuse	
0-1 switch	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)

ISOLATED MEASUREMENT MODULE	
Model number	RESM-04
Weight	3,5 kg
Measuring voltage	0-500V
Measuring ranges	0-500V, 0-50V, 0-5V
Measuring current	0-5A
Number of channels	2
Electrical safety	Fuse protection
Thermal and overload protection	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)

HYDROGEN STORAGE	
Model number	LWH22-10L-5
Capacity	10 L hydrogen
Hydrogen purity	≥99.995%
Cartridge size	ø22x88mm
Weight	Approx. 105g
Storage material	AB5 metal hydride
Rated charging pressure	3.0MPa
Working temperature	0-55°C (0-131°F)
Service life	10 years

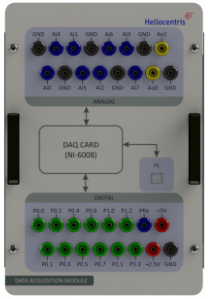


DIODE MODULE	
Model number	RESS-04
Weight	2,1 kg
6 pcs high-current diodes	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)
ACCUMULATOR MODULE	
Model number	RESM-01
Weight	4,8 kg
Voltage	12V
Capacity	7Ah
Maintenance-free type	
Overcurrent protection	
Thermal and overload protection	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)
AC-DC MEASUREMENT MODULE	
Model number	RESM-01
Weight	3,2 kg
Operation voltage	230V, 50Hz
Ammeter	0-5A, AC and DC
Voltmeter	0-500 V, AC and DC
Communicating with the training set software via RS 485 port	
Electrical safety	Fuse protection
Working temperature	0-55°C (0-131°F)



ENERGY DISTRIBUTION MODULE	
Model number	RESED
Weight	2,8 kg
4 pcs IEC sockets	
2 pcs grounded sockets	
Connection terminals	4mm safety sockets
PC INTERFACE MODULE	
Model number	RESPCI
Weight	2,7 kg
Input Voltage	220V
2 pcs independent analog signal outputs (0-5V)	
1 pcs USB terminal	
2 pcs RS 485 ports	
1 pcs RS 232 port	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)
ELECTRONIC POTENTIOMETER MODULE	
Model number	RESL-02
Weight	4,9 kg
Touch screen	5”
0-1K / 100W linear adjustable resistance	
1 Ohm adjustment range	
Screening feature for different time intervals and resistance levels	
Connection terminals	4mm safety sockets

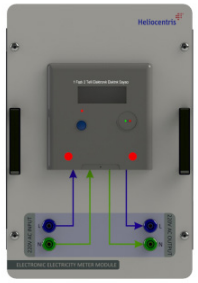
WIND SIMULATOR MODULE	
Model number	RESW-02
Weight	3 kg
Input voltage	220 V AC 50 hz
Cotrol Power	200W
Selection switch for manual and PC operation	
Ability to adjust DC motor rpm with computer	
Manually adjusting the DC engine rpm	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)
WIND TURBINE CHARGE CONTROL MODULE	
Model number	RESW-03
Weight	2,6 kg
Rated voltage of the battery	12 / 24V
Wind turbine braking voltage	15 / 30V
Aluminum body with coolant specification	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)
WIND TURBINE MODULE	
Model number	RESW-01
Weight	19,5 kg
Power	200W
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)



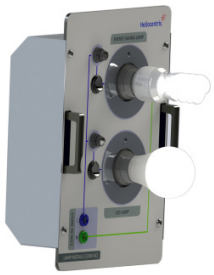
DATA ACQUISITION MODULE	
Model number	RESDAQ
Weight	3 kg
8 pcs analog inputs (14 bits, 20 kS/s)	
2 pcs static analog outputs (12 bit, 9.1 mV)	
12 pcs digital inputs / outputs	
Digital counter	
USB connection	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)

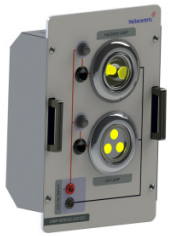
LIGHT SOURCE CONTROL MODULE	
Model number	RESS-02
Weight	3,1 kg
Output Power	1000W
Analog input connector for manual control	
PC and manual adjustment options	
Working temperature	0-55°C (0-131°F)

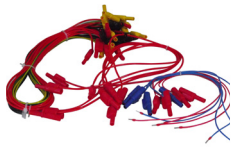
DC POWER SUPPLY MODULE	
Model number	RESPS-01
Weight	5 kg
0-30V adjustable short circuit and over current protection, programmable power supply	
The DC source current can be set in the range 0-5A	
Power supply with color LCD monitor shows current, voltage and instantaneous power values	
The front panel of the energy unit is made of 4 mm compact laminate	
Text and figures on the panel are formed by mechanical scraping	
The body of the energy unit is made of 0.8 mm sheet metal and painted with electrostatic paint	
Connection terminals	4mm safety sockets



SOLAR PANEL EMULATOR MODULE	
Model number	RESS-05
Weight	2,9 kg
Operation voltage	88-264 VAC, 47 ... 63 Hz
Short circuit current	2 A
Output voltage	20V
Bypass diode connection	
The connection of blocking diode	
Connection terminals	4mm safety sockets
LIGHT ANGLE ADJUSTABLE SOLAR PANEL	
Model number	RESS-01
Weight	29 kg
Mobile Stand	45x45 sigma aluminum
2 pieces 10W polycrystalline panel	
3 different settings for solar position simulation	
Scale indicating the setting value	
500W Projector	
Connection terminals	4mm safety sockets
Working temperature	0-55°C (0-131°F)
ELECTRONIC METER MODULE	
Model number	RESEM-01
Weight	2.7 kg
Rated voltage	220/400V 50 hz
Operation current	0.2 - 5 A
3 phase measurement specifications	
The body of the energy unit is made of 0.8 mm sheet metal and painted with electrostatic paint	
Connection terminals	4mm safety sockets







220V AC LAMP MODULE	
Model number	RESL-04
Weight	2,8 kg
Operation voltage	220 V AC
Lamp	Energy saving lamp, LED lamp
Lamp holder	E24 or E14
Connection terminals	4mm safety sockets
12V DC LAMP MODULE	
Model number	RESL-05
Weight	2,9 kg
Operation voltage	12 V DC
Halogen Lamp 20W	20W
LED lamp	2W
Connection terminals	4mm safety sockets
CABLE SET	
Model number	RESCBL-01
Isolated cable suitable for 4mm born jack	
Cable sizes are 50 cm and 100 cm	50 cm and 100 cm

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