

# RENEWABLE ENERGY & ENERGY SAVING

## Solar energy

PAGES 119 - 141



## Wind turbine energy

PAGES 142 - 146



## Control & energy saving

PAGES 147 - 150



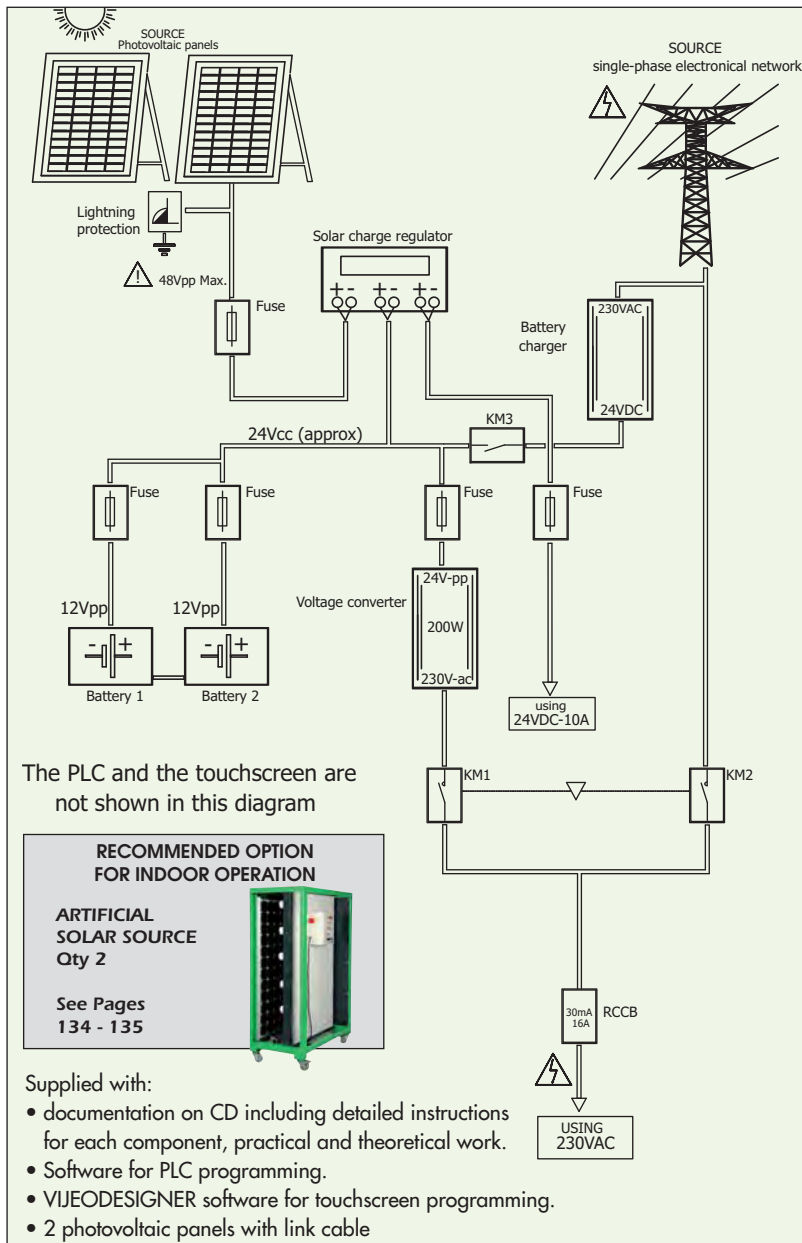
## Solar central unit with supervisor



ref. SOLHAB

ref. SOLHAB-N Sold without panel.

Contact us to check the compatibility of your own panels.



Supplied with:

- documentation on CD including detailed instructions for each component, practical and theoretical work.
- Software for PLC programming.
- VIJEODESIGNER software for touchscreen programming.
- 2 photovoltaic panels with link cable

### EDUCATIONAL OBJECTIVES

- Studying of a photovoltaic system in a isolated site.
- Creation of a PLC program.
- Creation of a supervision application of a touch screen.
- Using a clamp-on ammeter.
- Studying the efficiency of a photovoltaic system.

TEACHING RESOURCES STUDENT & TEACHER

### Feasible practical works

- Theoretical work on the positioning of solar panels.
- Studying the sizing of photovoltaic components in a isolated site.
- Understanding of the wiring.
- Calculation of powers.
- Programming of the PLC and the touch screen.
- Producing or modification of a supervision application.

### Possible scenarios

Alterable by the programming software of the PLC and the touch screen

- Using of the energy provided by the solar panels.
- Batteries recharging by the charger.
- Automatic sources switching.
- Use of solar energy during the day and electrical network at night.
- Use of the energy provided by the electrical network.

### Technical characteristics

#### On the top surface:

- 1 main ON/OFF switch + 1 emergency stop button.
- 1 24VDC batteries charging switch.
- 1 touchscreen 3x4" colour QVGA, 320 x 240 pixels, Ethernet socket. Control interface between the user and the system, it displays electrical parameters necessary for the understanding of the functioning. It allows a simple and complete supervision, monitoring and control.
- 1 solar load regulator.
- 1 set of signalling indicator lamps.
- 2 synoptics / complete diagram of the system with terminals and indicator lamps.
- Safety terminals for 230V-AC use output.

#### On the side:

- 2 safety terminals for voltage input from the solar panel.
- 1 main isolating switch from the public network.
- 1 solar panel isolating safety switch
- 1 RJ45 Ethernet connector.

#### In the cabinet

- 2 batteries 12VDC-12Ah + 1 battery charger 24V.
- 1 pure sine inverter 24VDC/230VAC-50Hz - 300W.
- 1 PLC Ethernet.
- 1 analogue board 2 Inputs 0-10V/4-20mA and 1 Output 0-10V/4-20mA
- 1 4-port Ethernet coupler.
- 1 set of protection devices included 1 open door safety device.



#### Photovoltaic solar panel on tilting frame

- Useful surface area of the cells 1.5m<sup>2</sup>.
- Open circuit voltage: 57V DC, Optimum operating voltage: 47V DC
- Short-circuit current: 4.6A
- Optimum operating current: 4.3A
- Maximum power: 200Wc (variation of ± 10% depending on the series)
- Device for measuring the tilt angle
- Tilt adjustable from 5° to 70°
- Light and easy to move.

Dimensions:

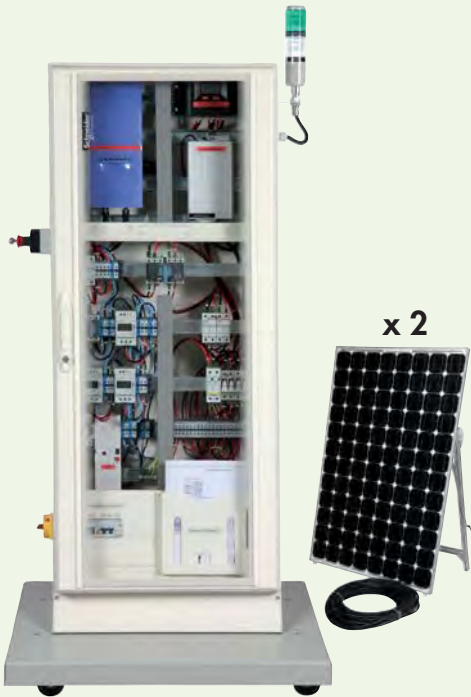
Folded position: 1620 x 1060 x 100mm

Unfolded to 70° position: 2100 x 1060 x 700mm

System power by plug. 2P+E. 230VAC 50/60Hz

Choose your solution for studying photovoltaic energy

## SOLAR CENTRAL UNIT WITH NETWORK INJECTION AND ISOLATED SITE

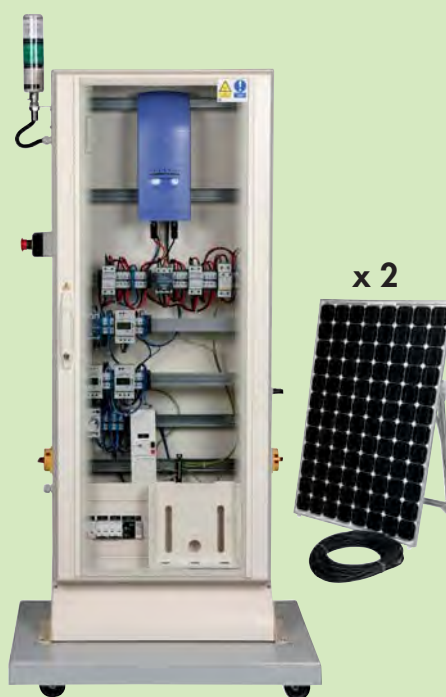


Complete solution comprising an electrical cabinet, 2 portable photovoltaic panels (on frames), and all the accessories required for studying solar energy on the network and an isolated site.

REF. SOL-1

SEE PAGE 122

## SOLAR CENTRAL UNIT WITH NETWORK INJECTION



Partial solution. Supplied with 2 portable photovoltaic panels (on frames), and all the accessories required for studying solar energy on the network.

REF. SOL-2

SEE PAGE 123

## SOLAR CENTRAL UNIT WITH ISOLATED SITE



Partial solution. Supplied with 2 portable photovoltaic panels (on frames), and all the accessories required for studying solar energy on an isolated site.

REF. SOL-3

SEE PAGE 124

## LOADING ZONE FOR USE ON SITE WITH ELECTRICITY NETWORK OR ISOLATED SITE



REF. HABITAT-1

SEE PAGE 125

## LOADING ZONE FOR USE ON SITE WITH ELECTRICITY NETWORK



REF. HABITAT-2

SEE PAGE 125

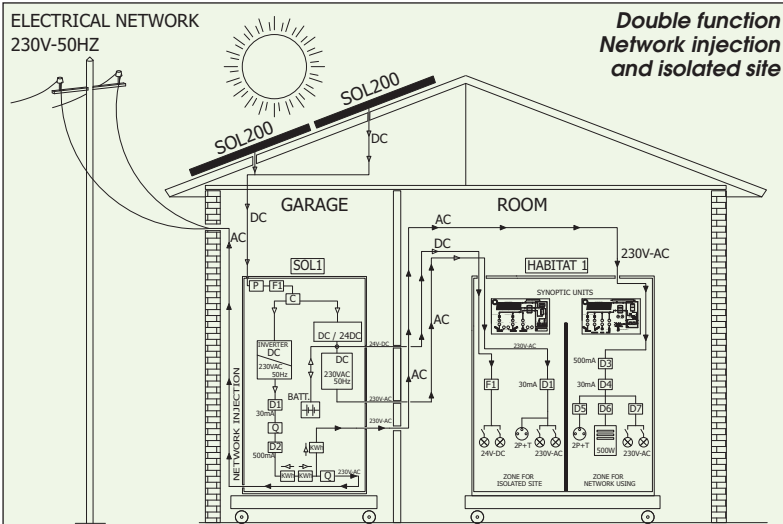
## LOADING ZONE FOR ISOLATED SITE USE



REF. HABITAT-3

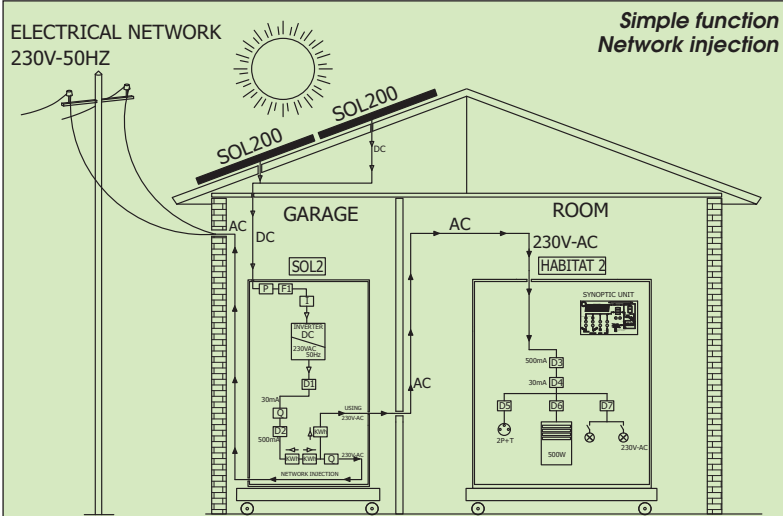
SEE PAGE 125

## Acquisition for central unit



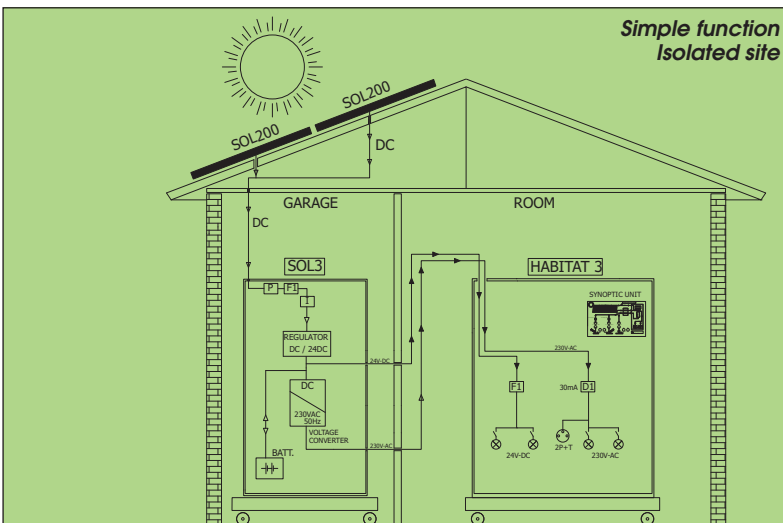
**Double function  
Network injection  
and isolated site**

USING SOLAR ENERGY WITH PUBLIC NETWORK INJECTION AND ISOLATED SITE  
CHOOSE SOL-1 + HABITAT-1



**Simple function  
Network injection**

USING SOLAR ENERGY WITH PUBLIC NETWORK INJECTION  
CHOOSE SOL-2 + HABITAT-2

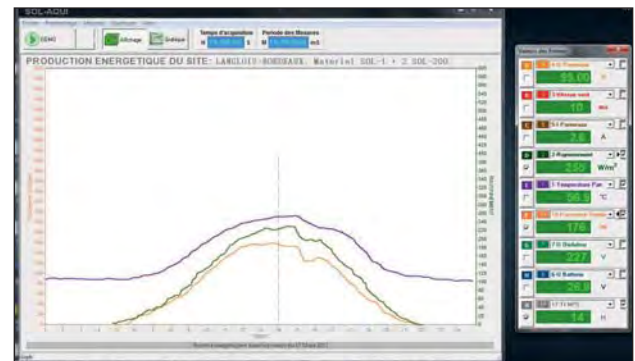


**Simple function  
Isolated site**

USING SOLAR ENERGY ON AN ISOLATED SITE  
WITHOUT PUBLIC NETWORK ACCESS - CHOOSE SOL-3 + HABITAT-3



ref. ACQUI-SOL



Set of sensors, interfaces and software for the real time data monitoring of a photovoltaic installation.

### COMPRISES

- Three 4-20mA sensors for reading wind speed (m/s), solar irradiation (W/m<sup>2</sup>) and the temperature of the solar panel (°C).
- 1 sealed "solar panel power interface" box for reading the voltage and current supplied by the photovoltaic panels.  
This interface transmits information (U / I / Wind speed / temperature / irradiance) to the data interface as 4-20mA signals. Voltage 250VDC Max./Current 25A Max.
- 1 "inverter power interface" box to be installed near the inverter reads the voltage and current supplied to the installation. U/I information is transmitted to the data interface as 4-20mA signals. Voltage 250VDC Max./Current 20A Max
- 1 "battery power interface" box to be installed near the batteries reads the voltage supplied to the installation. U information is transmitted to the data interface as 4-20mA signals. Voltage 250VDC.
- 1 "data interface" box collects the 4-20mA signals from the different power interfaces to transmit them to your PC. Mains power supply 230VAC - PC link by USB lead supplied.
- 1 Software for monitoring photovoltaic settings and data  
Allows:
  - you to create your photovoltaic installation.
  - real time display as curves and numeric blocks of the different data of: wind speed, solar irradiation, panel temperature; U / I supplied by the solar panel; U / I supplied by the inverter; U supplied by the battery
  - the display, after acquisition, of the curves of electrical power supplied by the solar panels, electrical power supplied by the inverter, installation efficiency
  - selection of the sampling frequency for data acquisition (1 to 60 minutes), the acquisition period (1 minute to 24H), the display scales of the curves and their colours, data export to a spreadsheet like Excel®.

The Software is compatible with Windows XP, W7. Supplied on CD.  
All the connection cables and mounting accessories are supplied.

## Solar central unit with network injection and isolated site

### RECOMMENDED OPTION FOR INDOOR OPERATION

ARTIFICIAL SOLAR SOURCE  
Qty 2

See Pages  
134 - 135



### EDUCATIONAL OBJECTIVES

- Understanding the different elements of a photovoltaic system.
- Understanding the safety components involved in the system.
- Electrical measurements of different parameters.
- Analyzing and interpreting results.
- Studying the efficiency and impacts related to the positioning of the solar panels.
- Studying of the chain of solar energy (production, storage, consumption, resale, energetic behavior).
- Wiring of a photovoltaic system.

### TEACHING RESOURCES STUDENT & TEACHER

#### 1. ELECTRICAL CABINET

Technical cabinet of standardized solar central unit on wheeled frame.

Dimensions: 810 x 600 x 1890mm

##### Comprises

- 2 disconnectors
- 1 500mA -30A differential
- 1 30mA differential
- 1 lightning arrester + fuses
- 3 100 Wh resolution meters
- 1 Mushroom head emergency stop
- 1 source inverter
- 1 charging controller 12/24VDC-20A
- 2 batteries 12V-12Ah
- 1 set of photovoltaic connectors
- 1 500W inverter for network synchronisation
- 1 Voltage converter 24VDC/230VAC-200W

#### 2. LINK CABLE

30-m cable for connecting the solar panels to any type of solar system.

#### 3. PHOTOVOLTAIC SOLAR PANEL 200WC ON TILTING FRAME (FOR EACH PANEL)

- Open circuit voltage: 57V DC
- Short-circuit current: 4.6A
- Optimum operating voltage: 47V DC
- Optimum operating current: 4.3A
- Maximum power: 200Wc (variation of  $\pm 10\%$  depending on the series)
- Sealed connections IP65 – 1000V on the rear of the panel.
- Type of cells: Monocrystalline silicon
- Robust aluminium frame.
- Useful surface area of the cells 1.5m<sup>2</sup>.
- Output 47VDC – 4.2A – 200Wc per panel on 2 photovoltaic terminals.
- Device for measuring the tilt angle
- Tilt adjustable from 5° to 70°
- Two ball joints with clamping levers for positioning the panel to the required tilt angle.
- Light and easy to move.  
Folded position: 1620 x 1060 x 100mm  
Unfolded to 70° position: 2100 x 1060 x 700mm



Supplied with  
1 pyranometer

ref. SOL-1 electrical cabinet + 2 photovoltaic solar panels + 1 link cable

ref. SOL-1-N electrical cabinet

Sold without panel. Contact us to check the compatibility of your own panels.

### PARTIAL OR TOTAL RESALE OPERATION

In the cabinet a DC/AC inverter converts the DC from the photovoltaic panels to AC 220VAC 50Hz, and injects its power in synchronism into the network through an isolation transformer. This inverter is protected against any polarity reversal and any overload on the DC or AC side. When the panels are not lit, the inverter consumes no current.

#### Technical characteristic for the inverter coupled to the public network.

INVERTER	Voltage	Max current	Power
INPUT	65~125VDC	8A	
OUTPUT	230VAC-50Hz	2,25A	500W

### OPERATION IN ISOLATED SITE WITH NO RESALE

The photovoltaic current charges two 12V sealed batteries cabled in series through a charging controller. This DC voltage is used directly by low energy consumption lamps 24VDC, and/or converted to 250VAC 50Hz by a 200W voltage converter.

#### Technical characteristics for the isolated site converter

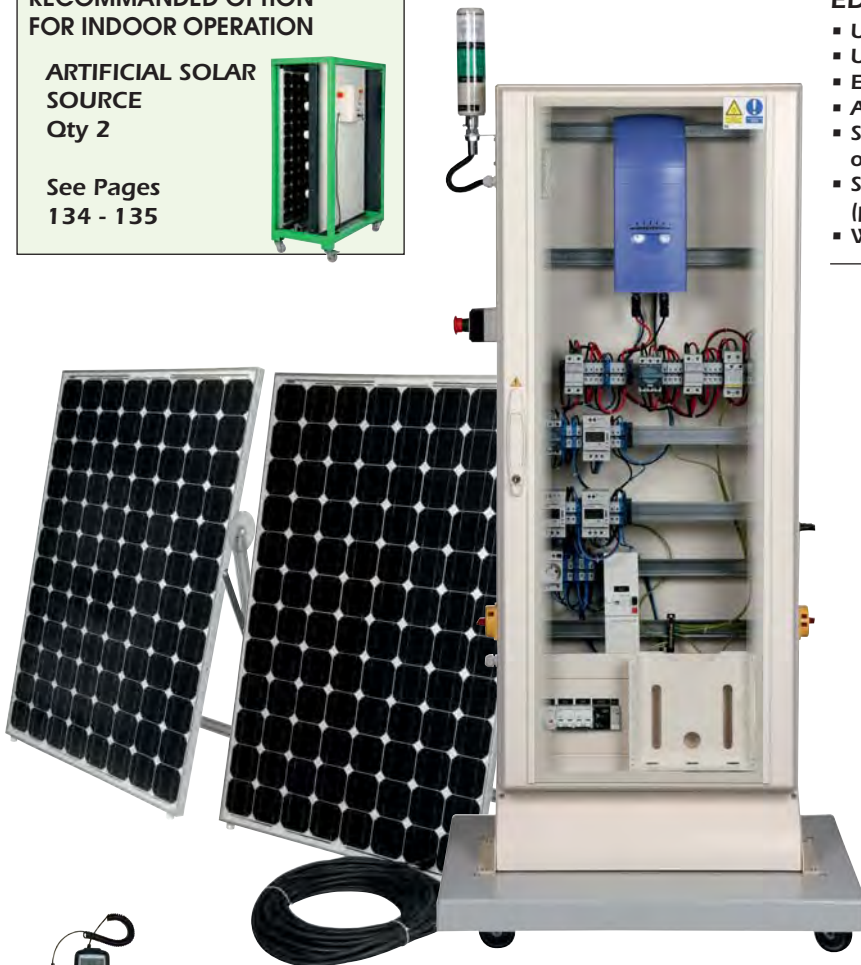
VOLTAGE CONVERTER	Voltage	Max Current	Power
INPUT	20~32 VDC	11A	210W
OUTPUT	230VAC 50Hz	1,5A	300VA

## Solar central unit with network injection

### RECOMMENDED OPTION FOR INDOOR OPERATION

**ARTIFICIAL SOLAR SOURCE**  
Qty 2

See Pages  
134 - 135



Supplied with  
1 pyranometer

ref. SOL-2 electrical cabinet + 2 photovoltaic solar panels + 1 link cable

ref. SOL-2-N electrical cabinet

Sold without panel. Use your own panels with characteristics comprise between 35 and 150VDC.

### PARTIAL OR TOTAL RESALE OPERATION

In the cabinet a DC/AC inverter converts the DC from the photovoltaic panels to AC 220VAC 50Hz, and injects its power in synchronism into the network through an isolation transformer. This inverter is protected against any polarity reversal and any overload on the DC or AC side. When the panels are not lit, the inverter consumes no current.

#### Technical characteristic for the inverter coupled to the public network.

INVERTER	Voltage	Max current	Power
INPUT	65~125VDC	8A	
OUTPUT	230VAC-50Hz	2,25A	500W

### EDUCATIONAL OBJECTIVES

- Understanding the different elements of a photovoltaic system.
- Understanding the safety components involved in the system.
- Electrical measurements of different parameters.
- Analyzing and interpreting results.
- Studying the efficiency and impacts related to the positioning of the solar panels.
- Studying of the chain of solar energy (production, storage, consumption, resale, energetic behavior).
- Wiring of a photovoltaic system.

### TEACHING RESOURCES STUDENT & TEACHER

#### 1. ELECTRICAL CABINET

Technical cabinet of standardized solar central unit on wheeled frame.

Dimensions: 810 x 600 x 1890mm

##### Comprises

- 2 disconnectors
- 1 500mA -30A differential
- 1 30mA differential
- 1 lightning arrester + fuses
- 1 Mushroom head emergency stop
- 3 100 Wh resolution meters
- 1 set of photovoltaic connectors
- 1 500W inverter for network synchronisation

#### 2. LINK CABLE

30-m cable for connecting the solar panels to any type of solar system.

#### 3. PHOTOVOLTAIC SOLAR PANEL 200WC ON TILTING FRAME (FOR EACH PANEL)

- Open circuit voltage: 57V DC
- Short-circuit current: 4.6A
- Optimum operating voltage: 47V DC
- Optimum operating current: 4.3A
- Maximum power: 200Wc (variation of  $\pm 10\%$  depending on the series)
- Sealed connections IP65 – 1000V on the rear of the panel.
- Type of cells: Monocrystalline silicon
- Robust aluminium frame.
- Useful surface area of the cells 1.5m<sup>2</sup>.
- Output 47VDC – 4.2A – 200Wc per panel on 2 photovoltaic terminals.
- Device for measuring the tilt angle
- Tilt adjustable from 5° to 70°
- Two ball joints with clamping levers for positioning the panel to the required tilt angle.
- Light and easy to move.  
Folded position: 1620 x 1060 x 100mm  
Unfolded to 70° position: 2100 x 1060 x 700mm

## Solar central unit for isolated site

### RECOMMENDED OPTION FOR INDOOR OPERATION

**ARTIFICIAL SOLAR SOURCE**  
Qty 2

See Pages  
134 - 135



### EDUCATIONAL OBJECTIVES

- Understanding the different elements of a photovoltaic system.
- Understanding the safety components involved in the system.
- Electrical measurements of different parameters.
- Analyzing and interpreting results.
- Studying the efficiency and impacts related to the positioning of the solar panels.
- Studying of the chain of solar energy (production, storage, resale, energetic behavior).
- Wiring of a photovoltaic system.

TEACHING RESOURCES STUDENT & TEACHER

### 1. ELECTRICAL CABINET

Technical cabinet of standardized solar central unit on wheeled frame.

Dimensions: 810 x 600 x 1890mm

#### Comprises

- 2 disconnectors
- 1 lightning arrester + fuses
- 1 Mushroom head emergency stop
- 1 charging controller 12/24VDC-20A
- 2 batteries 12V-12Ah
- 1 set of photovoltaic connectors
- 1 Voltage converter 24VDC/230VAC-200W

### 2. LINK CABLE

30-m cable for connecting the solar panels to any type of solar system.

### 3. PHOTOVOLTAIC SOLAR PANEL 200WC ON TILTING FRAME (FOR EACH PANEL)

- Open circuit voltage: 57V DC
- Short-circuit current: 4.6A
- Optimum operating voltage: 47V DC
- Optimum operating current: 4.3A
- Maximum power: 200Wc (variation of  $\pm 10\%$  depending on the series)
- Sealed connections IP65 – 1000V on the rear of the panel.
- Type of cells: Monocrystalline silicon
- Robust aluminium frame.
- Useful surface area of the cells 1.5m<sup>2</sup>.
- Output 47VDC – 4.2A – 200Wc per panel on 2 photovoltaic terminals.
- Device for measuring the tilt angle
- Tilt adjustable from 5° to 70°
- Two ball joints with clamping levers for positioning the panel to the required tilt angle.
- Light and easy to move.  
Folded position: 1620 x 1060 x 100mm  
Unfolded to 70° position: 2100 x 1060 x 700mm



Supplied with  
1 pyranometer

ref. SOL-3 electrical cabinet + 2 photovoltaic solar panels + 1 link cable

ref. SOL-3-N electrical cabinet

Sold without panel. Use your own panels with characteristics comprise between 18 and 50VDC.

### OPERATION IN ISOLATED SITE WITH NO RESALE

The photovoltaic current charges two 12V sealed batteries cabled in series through a charging controller. This DC voltage is used directly by low energy consumption lamps 24VDC, and/or converted to 250VAC 50Hz by a 200W voltage converter.

#### Technical characteristics for the isolated site converter

VOLTAGE CONVERTER	Voltage	Max current	Power
INPUT	20~32 VDC	11A	210W
OUTPUT	230VAC 50Hz	1,5A	300VA

## Loading panels for solar central units

Wheeled frame which reproduces domestic electrical installations on a vertical panel and enables the use of the voltage sources (AC + DC) produced by our solar central units SOL-1 to SOL-3. At the back another blank panel protects the electrical cables.

Dimensions: 1000 x 500 x h 1600mm

The frame is supplied assembled, fully cabled, ready to operate, with safety leads for the measuring units, and a CD including the technical data and cabling diagram.



Profile view of the frame

Measurement with a clamp



### NETWORK INJECTION AND ISOLATED SITE



ref. HABITAT-1

#### LOADING ZONE FOR ISOLATED SITE USE

This part includes a standard unit with standardized protection described below, and the different loads.

- 1 differential circuit-breaker 16A/30mA
- 1 two-pole fuse holder with fuse cartridges gPV 10x38 1000V
- 2 24V DC low energy consumption light fittings with switches
- 2 light fittings 230VAC with switches
- 1 230VAC 50Hz 2P+E socket
- 1 mimic unit with safety terminals for I and U measurements in different circuits.

#### LOADING ZONE FOR USE ON SITE WITH ELECTRICITY NETWORK

This part includes a standard unit with standardized protection described below, and the different loads.

- 1 connection circuit-breaker 500mA
- 1 differential circuit-breaker 16A/30mA
- 3 magnetothermal circuit breakers
- 2 light fittings 100W-230VAC with switches
- 1 500W convector
- 1 230VAC 50Hz 2P+E socket
- 1 mimic unit with safety terminals for I and U measurements in different circuits.

### NETWORK INJECTION



ref. HABITAT-2

#### LOADING ZONE FOR USE ON SITE WITH ELECTRICITY NETWORK

This part includes a standard unit with standardized protection described below, and the different loads.

- 1 connection circuit-breaker 500mA
- 1 differential circuit-breaker 16A/30mA
- 3 magnetothermal circuit breakers
- 2 light fittings 100W-230VAC with switches
- 1 500W convector
- 1 230VAC 50Hz 2P+E socket
- 1 mimic unit with safety terminals for I and U measurements in different circuits.

### ISOLATED SITE

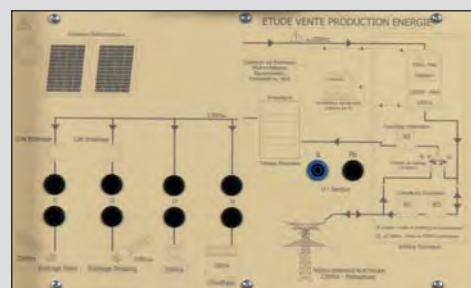


ref. HABITAT-3

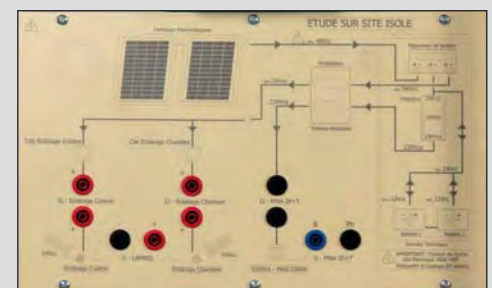
#### LOADING ZONE FOR ISOLATED SITE USE

This part includes a standard unit with standardized protection described below, and the different loads.

- 1 differential circuit-breaker 16A/30mA
- 1 two-pole fuse holder with fuse cartridges gPV 10x38 1000V
- 2 24V DC low energy consumption light fittings with switches
- 2 light fittings 230VAC with switches
- 1 230VAC 50Hz 2P+E socket
- 1 mimic unit with safety terminals for I and U measurements in different circuits.



Synoptic sale of energy production



Synoptic for isolated site use



## Solar central units - 800Wc - with acquisition

NETWORK INJECTION + ISOLATED SITE		NETWORK INJECTION	
SOL-4	ELECTRICAL CABINET	SOL-5	
1	1500W inverter for network synchronisation	1	
1	Interface + 4-20mA sensors	1	
1	Voltage converter 24VDC/230VAC. 200W	-	
1	Charging controller 12/24VDC-20A	-	
2	batteries 12V-12AH	-	
3	100Wh resolution meter	3	
1	lightning arrester	1	
1	2P-45A circuit breaker with residual current protection 500mA	1	
1	Residual current circuit breaker 30mA/16A	1	
2	Thermal magnetic circuit breaker 2A (controls)	2	
5	2-pole fuse holder and fuses	1	
2	Interrupteur de puissance	2	
2	Disconnecter	2	
1	Mushroom head emergency stop	1	
1	Power socket 2P+E 230VAC	1	

ref. SOL-4-EXP

Electrical cabinet + 4 solar panels + link cable

ref. SOL-5-EXP

Electrical cabinet + 4 solar panels + link cable

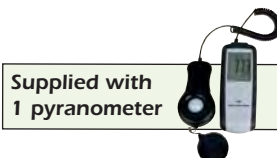


### EDUCATIONAL OBJECTIVES

- Understanding the different elements of a photovoltaic system.
- Understanding the safety components in the system.
- Electrical measurements of different parameters.
- Analyzing and interpreting results.
- Studying the efficiency and impacts related to the positioning of the solar panels.
- Studying of the chain of solar energy (production, storage, consumption, resale, energetic behavior).
- Wiring of a photovoltaic system (coupling of panels).

### TEACHING RESOURCES STUDENT & TEACHER

SOL-4-EXP and SOL-5-EXP are solar centrals with an electric power of 800Wp (+/- 10%) necessary to inject a significant current on the electrical network by the inverter and the other components of the housing part, to load the batteries and to allow equivalent measures as in a real housing installation. The system of data acquisition (temperature, radiation, wind speed and all the electrical parameters) allows making some practical works even in the absence of sun.



Supplied with  
1 pyranometer

### 1. ELECTRICAL CABINET

See the table

### 2. LINK CABLE

30-m cable for connecting the solar panels to any type of solar system.

### 3. PHOTOVOLTAIC SOLAR PANEL 200WC ON TILTING FRAME (FOR EACH PANEL)

- Open circuit voltage: 57V DC
  - Short-circuit current: 4.6A
  - Optimum operating voltage: 47V DC
  - Optimum operating current: 4.3A
  - Maximum power: 200Wc (variation of ± 10% depending on the series)
  - Sealed connections IP65 – 1000V on the rear of the panel.
  - Type of cells: Monocrystalline silicon
  - Robust aluminium frame.
  - Useful surface area of the cells 1.5m<sup>2</sup>.
  - Output 47VDC – 4.2A – 200Wc per panel on 2 photovoltaic terminals.
  - Device for measuring the tilt angle
  - Tilt adjustable from 5° to 70°
  - Two ball joints with clamping levers for positioning the panel to the required tilt angle.
  - Light and easy to move.
- Folded position: 1620 x 1060 x 100mm  
Unfolded to 70° position: 2100 x 1060 x 700mm

**PARTIAL OR TOTAL RESALE OPERATION  
(SOL-4-EXP AND SOL-5-EXP)**

In the cabinet a DC/AC inverter converts the DC from the photovoltaic panels to AC 220VAC 50Hz, and injects its power in synchronism into the network through an isolation transformer.  
This inverter is protected against any polarity reversal and any overload on the DC or AC side.  
When the panels are not lit, the inverter consumes no current.

**TECHNICAL CHARACTERISTIC FOR THE INVERTER COUPLED TO THE PUBLIC NETWORK.**

INVERTER	Voltage	Max current	Power	Cos	Distorsion	Rendement
INPUT	150~450VDC	10,8A				
OUTPUT	230VAC-50Hz	6,5A	1,5kW	1	≤3,5%	91%

**OPERATION IN ISOLATED SITE WITH NO RESALE  
(SOL-4-EXP ONLY)**

The photovoltaic current charges two 12V sealed batteries cabled in series through a charging controller.  
This DC voltage is used directly by low energy consumption lamps 24VDC, and/or converted to 250VAC 50Hz by a 200W voltage converter.

**TECHNICAL CHARACTERISTICS FOR THE ISOLATED SITE CONVERTER**

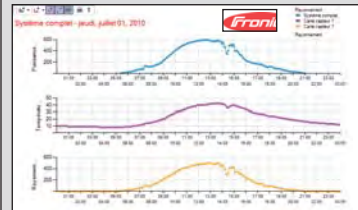
VOLTAGE CONVERTER	Voltage	Max current	Power
INPUT	20~32 VDC	11A	210W
OUTPUT	230VAC 50Hz	1A	200VA

**INTERFACE AND SENSORS  
DELIVERED WITH SOL-4-EXP  
AND SOL-5-EXP**

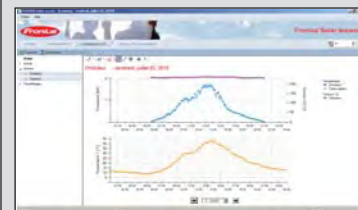
*Measure of the solar radiation  
Temperature of the solar panels  
Wind speed*

These physical parameters and also the electrical parameters (voltage and current AC/DC), the power and the energy are recorded (1 year of data maximum) by an interface placed in the electrical cabinet and monitored by a PC.

The software provided with SOL-5 and SOL-4 allows to display one or several curves on the screen, diagrams, ...  
All data can be exported to Excel®.

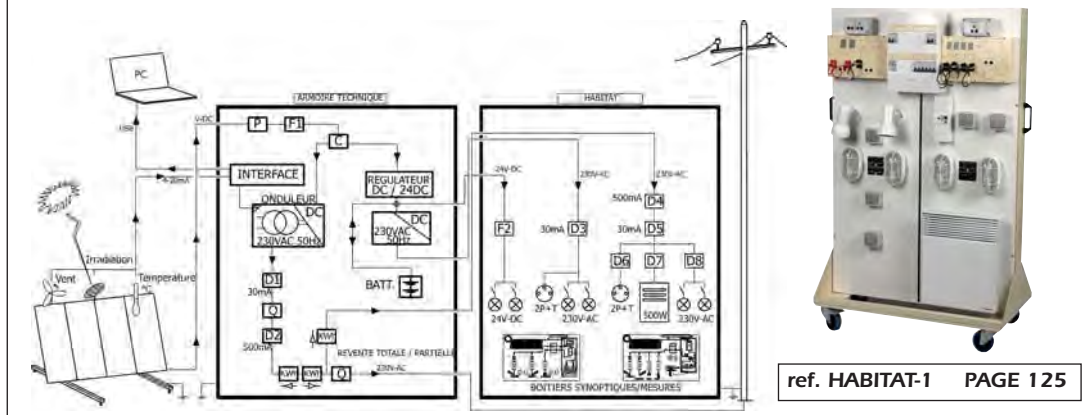


Screenshot of 3 recordings made during the day : Instant alternative power, temperature of panels, intensity of solar radiation.



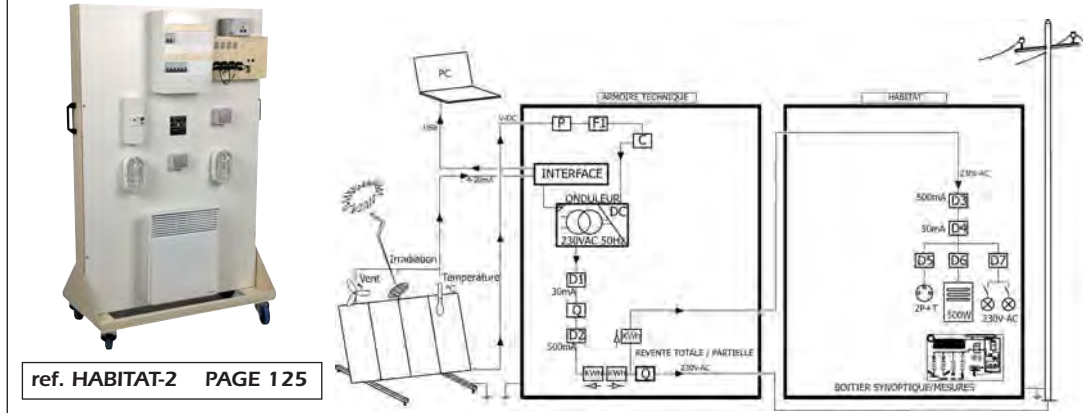
Screenshot showing the voltage and the power at the output of the inverter, the temperature of panels. Scales are specified with units.

**FUNCTIONING DIAGRAM OF SOL-4-EXP + HABITAT-1**



ref. HABITAT-1 PAGE 125

**FUNCTIONING DIAGRAM OF SOL-5-EXP + HABITAT-2**



ref. HABITAT-2 PAGE 125

**SUPPLIED ACCESSORIES**

- A connection cable of 30 meters – 3x 6mm<sup>2</sup> panels/electrical cabinet
- A connection cable of 30 meter for the link sensors/interface for signal 4-20mA
- A CD-rom with all the practical works
- A software for the exploitation of data
- A pyranometer for measuring the solar radiation (200 and 2000 W/m<sup>2</sup> range)

**WARRANTY**

Factory guarantee of the inverter: 5 years  
The website of Fronius offers the free update of the software, and answers the Frequently Asked Questions.

## Portable solar central unit for isolated site with artificial light source



ref. SOL-PRO

The SOL-PRO solar unit includes:  
1 technical case + 2 photovoltaic panels + 1 artificial light source (3 spotlights) + 2 cords for connecting the panels to the case.

### EDUCATIONAL OBJECTIVES

- Understanding of a photovoltaic system in an isolated site.
- Understanding the safety components involved in the system.
- Understanding of the wiring of a photovoltaic system.
- Make electrical measurements of different parameters.
- Analyzing and interpreting results.
- Studying the performance and impacts related to the positioning of the solar panels.
- Studying of the the chain of solar energy (production, storage, use of the solar charge regulator for battery).

### TEACHING RESOURCES STUDENT & TEACHER

A synoptic shows the different components and the interconnections.  
Connection in jump wires by safety leads 4mm.  
Connection of the panels to the technical case by 2 photovoltaic leads (delivered).  
Measures are possible indoor by using the artificial solar source.



### Electrical characteristics of the solar unit

- photovoltaic panel (panel features):
  - nominal power  $P_{mpp}$ : 30 Wc
  - max power voltage  $V_{mpp}$ : 18V DC
  - max power current  $I_{mpp}$ : 1.67 A
  - open circuit voltage  $V_{oc}$ : 22.5V DC
  - short-circuit current  $I_{sc}$ : 2A
- Power injected, with artificial source: 17 Wc (24V/0.7A)
- Output voltage 230 V - 50 Hz pure sinusoidal. 120 VA max.
- Output voltage 24V DC. 180W max

### Composition of the technical case

- Case made of impact-resistant polypropylene. It can be closed without disconnecting the safety cords from the front. Light and easy to carry by its handle.
- 2 photovoltaic sockets for connecting solar panels.
- 1 surge arrester.
- 1 Start/Stop switch to isolate the solar panel circuit from the technical case.
- 4 two-pole fuse holders with gPV cartridge protecting the solar panel circuit, batteries and use.
- 1 24V/20A solar charge controller with display showing:
  - battery charge
  - current supplied by the solar panels
  - battery charge current
  - current consumed by the use circuit
  - battery voltage.
- 1 voltage converter pure sinusoidal 50 Hz - 24/230V AC, 120 VA. Auto-protection by resettable thermal fuse.
- 1 set of 4 mm safety cords.
- 1 output 230V AC - 120 VA on 4 mm safety terminals
- 1 use output 24V DC - 180 VA on 4 mm safety terminals
- Dimensions: 540 x 430 x 215mm

### Composition of the photovoltaic panels frame

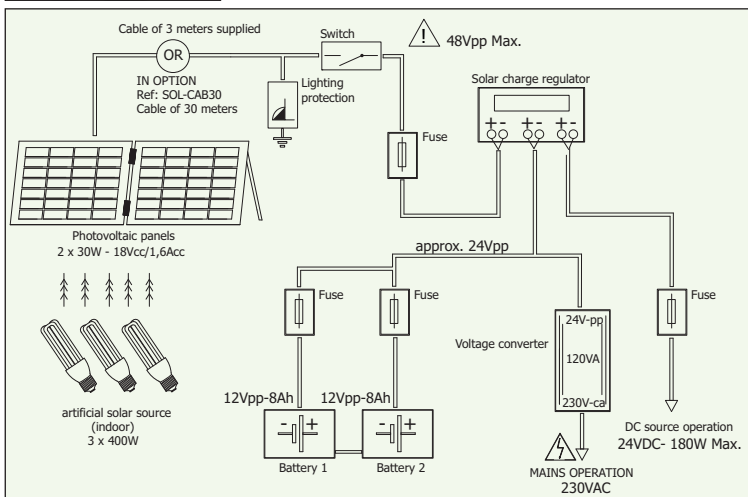
- Aluminium frame
- 2 mono-crystalline photovoltaic panels, each 30 Wc.
- 2 hinges for folding them together.
- Separate cabling for series or parallel connection.
- Useful surface area of the cells on each panel 0.2 m<sup>2</sup>
- 2 ball joints for putting the panels at the tilt angle required.
- 1 device for measuring the tilt angle.
- 2 3-metre photovoltaic cords.
- Light and easy to move (Carrying handle).
- Dimensions in unfolded position: 1140 x 470 x 200 mm
- Dimensions in folded position: 570 x 470 x 100 mm

### Composition of the artificial light source

- 3 400W spotlights with variable tilt.
- Power supply 230V AC 50/60 Hz by 2-metre mains cord.
- Spotlight dimensions: 300 x 220 x h360 mm

### Supplied with CD containing

- Theoretical summary of the different types of photovoltaic cells and energy.
- The detailed wiring diagram of the solar unit
- 5 theoretical assignments and 3 complete practical assignments as student/instructor book.
- Full instructions for each component



## Solar kit



ref. VALSOL



## EDUCATIONAL OBJECTIVES

- Studying the principles of solar energy, storage and conversion.
- Electrical measurements of different parameters.
- Analyzing and interpreting results.
- Studying the efficiency and impacts related to the positioning.

## TEACHING RESOURCES STUDENT &amp; TEACHER

## Suggested tutorials

One of the jumpers isolates the photo-voltaic panels from the rest of the electronics.

In this way, students can measure

- The voltage in the no-load circuit (approximately 21V)
- The short-circuit current (approximately 1.9A)
- The current and the voltage according to the lighting, by covering one of the two panels or by varying the tilt of the kit's lid in relation to the sun by an angle  $\alpha$ ; and check that the power output is a function of the power factor
- Using a rheostat (e.g. ECO1/2-330), students can look for the charge which corresponds to a maximum power supplied by the panel

The control panel's second jumper measures the DC level at the converter's input.

Students can:

- Measure the no-load voltage and current at the converter's input, and calculate the no-load power input
- Measure currents and voltages upstream and downstream of the converter and calculate the converter's efficiency and losses by loading the 220V AC output.
- Check that the converter can supply up to 150W. Compare this power with the power supplied instantly by the panels. Draw conclusions about the role of the battery.

## Mesure de l'angle d'incidence des rayons solaires

The solar kit VALSOL is supplied with a protractor and a simplified targeting system **3** allowing the measuring (within a few degrees of precision) the angle of incidence of sun rays on the solar panels. This targeting system which is placed on side can be removed and stored in the side compartment **2** dedicated to accessories storage. A stand **1** (also removable) allows the stepless adjustment of the inclination of the solar panels.

When closed, the panels are protected against impact and scratches. The following can be found underneath the solar panel:

- a standard 15V DC 15 Ah Li-ion battery
- a 12V DC/220V AC, 50Hz, 150W converter
- a safety and monitoring electronics device

## Control panel

- On/Off button
- a circuit breaker to protect against over-currents
- 4mm safety terminals for voltage and electric current inputs, with jumpers
- the converter's On/Off button
- a 230V AC 50Hz socket with on and defect lamps
- a two-line LCD display delivering messages about the battery: temperature, % charge, charging current and voltage, usage current and voltage, undercharged battery, overcharged battery and overheating, etc., as well as the power output. NB: these are indications, rather than highly accurate measurements.

## PROTECTION OF COMPONENT IN THE CASE OF

- battery overcharge: when its voltage reaches 16.5V the charging current is automatically cut, in order to preserve the battery's service life.
- excessive battery discharge: When its voltage reaches 11.5V, an audible alarm will be triggered.

When it falls below 10.5 V the output will be disconnected automatically.

- overload or short-circuit on the converter's output

## SPECIFICATIONS OF THE SOLAR PANEL

- Total surface area: 420 x 680mm
- Typical voltage: 17.5V
- Short-circuit current: 1.9A
- Total power: 30W
- Typical current: 1.7A
- No-load circuit: 21.5V

## OTHER CHARACTERISTICS

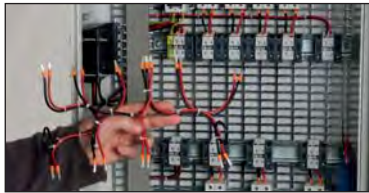
- Fitted side compartment for the storage of leads, jumpers, the targeting system and the inclination stand **2**. Dims: 570 x 380 x 160mm. Weight 17kg.

## Solar pumping station

### EDUCATIONAL OBJECTIVES

- Understanding a photovoltaic system dedicated to the power supply of a water pump.
- Measurements of electrical parameters.
- Analyzing and interpreting results.
- Understanding live wiring tests with putting into service and functioning.
- Studying the efficiency and impacts related to the positioning of the solar panels.
- Studying the solar charge regulator.

TEACHING RESOURCES STUDENT & TEACHER



Simply remove the strand before asking students to do the cabling.

### Comprises

- 1 photovoltaic solar panel 200Wc mounted on a robust frame that tilts from 5° to 70°. Open circuit voltage: 57V DC. Optimum operating voltage: 47V DC. Short-circuit current: 4.6A. Optimum operating current: 4.3A.
  - 1 30m. link cable.
  - 1 100-l tank simulates the underground water source.
  - 1 60-l transparent container acts as water reserve. A tap simulates user consumption and returns water to the tank.
  - 1 sealed motor pump 140W- 24VDC-6A. 13l/min capable of pumping dry. It takes water from the tank and fills the reserve water container.
  - 2 12V/6Ah batteries supply the pumping station when sunlight is absent.
  - 1 24VDC-20A regulator controls battery charging. One 2-button display accessible outside the cabinet enables configuration and viewing of the currents of the solar panel, the battery charge and the lamp and the battery voltage.
  - 1 electrical cabinet includes the cabling of all the solar components on connection terminals. A lightning arrester protects the installation and each component is protected by fused circuit-breaker type gPV. The cabling is fully marked and students can easily remove the original strand to do their cabling.
- Students can also take voltage and current readings. A main switch isolates the solar panel from the electrical cabinet.
- A switched 24VDC lamp lights the area.
- A wheeled frame for passing under doors. SOLPUITS requires no direct water connection. Once the 80-l tank is filled with water, the system is totally self-contained. Supplied cabled with detailed instructions and complete practical works.
- Dimensions: 750 x 670 x 1980mm. Weight 141kg.

Didactical solar pumping station simulating the water supply of a population in a desert area.



ref. SOLPUITS

ref. SOLPUITS-N Sold without panel.

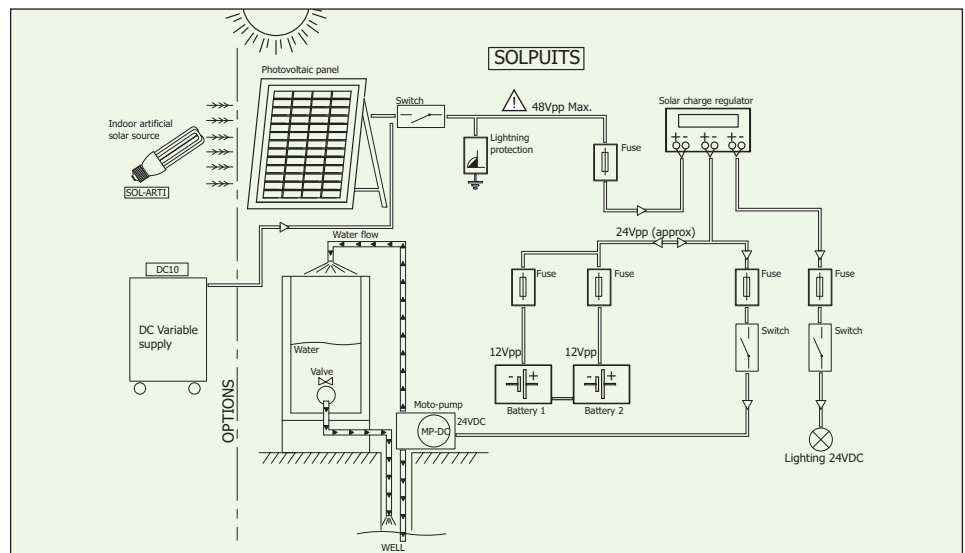
Use your own panels with characteristics comprises between 18 and 50VDC.

RECOMMENDED OPTION FOR INTERNAL OPERATION



ARTIFICIAL SOLAR SOURCE Qty 1

See Pages 134 - 135



## Self-contained public lighting with LEDs

MAQ-LED demonstrates public lighting with LEDs which is increasingly found in new housing schemes. Completely self-contained, the assembly operates using solar energy (Polycrystalline panel combined with a large capacity battery).

Two artificial solar sources, for connection to the mains 230VAC, enable the battery to be recharged for better organization of the explanations and practical assignments.

### EDUCATIONAL OBJECTIVES

- Studying street lighting with LED lamp and solar energy.
- Putting a solar system into service.
- Demonstrating the ecological operation of LED technology.
- Discovering the different technologies of solar panels.
- Wiring the components of a lighting installation with presence sensor & light sensor.
- Reading the different electrical values of a production system of solar energy.
- Calculating the installation's efficiency.

### TEACHING RESOURCES STUDENT & TEACHER

### Practical works

- Lessons on the different solar panel technologies (Monocrystalline, Polycrystalline, Amorphous)
- Study on the positioning of solar panels for maximum output.
- Study of solar radiation.
- Reminder on Direct, Diffused and Reflected solar radiation.
- Interpretations of the theoretical curves produced from the 3 solar sensors.
- Study and creation of the wiring for a solar energy system in an isolated site.
- Reading the currents and voltages at different points of the wiring.
- Interpreting the measurements then calculation of the efficiency.
- Calculation of the discharge time of the battery according to the load.

### Comprises

- Easy-to-move wheeled frame with large heavy-duty wheels.
- 1 Battery 12VDC – 90Ah.
- 1 Solar load regulator 12VDC-20A.
- 1 Plastic unit that is easy to remove to directly access the wiring of the battery, solar panel and load regulator.
- 1 Solar panel 12V/80W pivoting and swivelling on an easy-to-remove pole.
- 1 Lamp with LEDs 12VDC-50W equipped with a presence and light sensor.
- 2 artificial solar sources 230VAC on removable pole.



ref. MAQ-LED



Battery + load regulator unit.



Dimensions : 600 x 800 x 1700mm. Weight : 92kg.

## Worksite traffic lights - LED technology – Self-contained

Simulator of worksite traffic lights powered with solar energy.  
Two artificial and variable light sources simulate sunlight and enable the batteries to be recharged.  
Fully self-contained, operation of the FEU-LED is managed with a Schneider® controller.  
One solution for manually recharging the batteries is included in the electrical unit for better organization of the explanations and practical work.

ref. FEU-LED

### EDUCATIONAL OBJECTIVES

- Study and putting into service of solar energy worksite traffic lights.
- Reminder on the different solar panel technologies.
- Wiring of the components of a photovoltaic installation at an isolated site.
- Reading the different electrical values of the production system of solar energy.
- Calculation of the efficiency of the installation.
- Programming a controller (PLC).

TEACHING RESOURCES STUDENT & TEACHER

### Practical works

- Lessons on the different technologies of solar panels (Monocrystalline, Polycrystalline, Amorphous)
- Study on the positioning of solar panels for maximum output.
- Study of solar radiation.
- Reminder on Direct, Diffused and Reflected solar radiation.
- Interpretations of the theoretical curves produced from the 3 solar sensors.
- Study and creation of the wiring of a solar energy system at an isolated site.
- Reading the currents and voltages at different points of the wiring.
- Interpreting the measurements then calculation of the efficiency.
- Calculation of the discharge time of the battery according to the load.
- Creation of a controller program in contact language.

### Comprises

#### Electrical cabinet

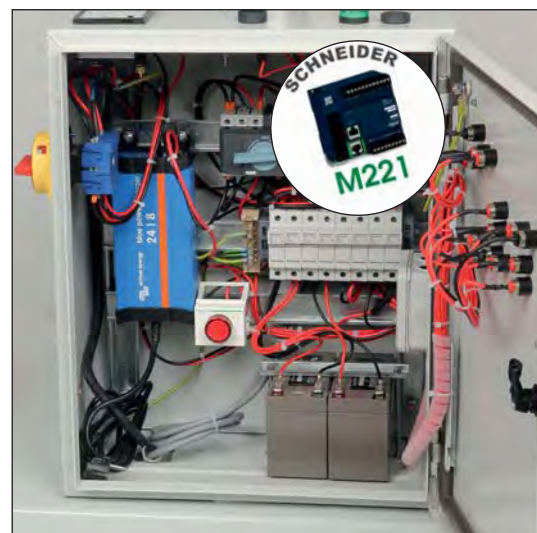
- 1 Voltmeter measures the voltage of the photovoltaic panels.
- 1 Voltmeter measures the voltage of the 2 batteries.
- 1 Set of pushbuttons, switches and indicator lights.
- 1 front synoptic gives the overall diagram of the system.
- 4mm connection terminals enable reading of U/I panels, U/I batteries, U/I charge and I charger.
- 1 SCHNEIDER® programmable logic controller (PLC).
- 1 solar load regulator 12VDC/20A.
- 1 battery charger 12V.
- 2 batteries 12V-8Ah.
- 1 set of electrical protection with gPV cartridge fuses.

#### Pole

- 2 traffic lights with Red / Orange / Green LEDs.
- 2 photovoltaic panels 30W/12V Monocrystalline.
- 2 artificial sources with light controller.

### Features

- 3-metre mains lead included, for the charger and artificial source.
- Dimensions: 1000 x 1000 x 2035mm. Weight: 68kg.
- The pole and the panels are easy to remove for going through doorways.



## Photovoltaic installation analyzer



ref. VA1011



Professional device for testing, maintaining, troubleshooting and checking the efficiency of solar panels.

### The VA1011 analyzer measures and displays:

- the search for maximum solar energy (Pmax) with the AUTO SCAN function (1000V, 12A)
  - the maximum voltage (Vmaxp) at Pmax
  - the maximum current (Imaxp) at Pmax
  - the open circuit voltage (Vopen)
  - the short-circuit current (Ishort)
  - the I / V curve of a panel or set of solar panels.
  - The efficiency calculation (%) of your installation
  - Solar radiation as W/m<sup>2</sup>
  - The temperature of your solar panel
  - The series resistance (Rs) of solar panels
- All these functions are accessible through the software.

### Using the amps and watts clamps

- P min/max as DC/AC upstream and downstream of the inverter. Digital display and as curves.
  - U and I min/max as DC / AC upstream and downstream of the inverter.
  - The power factor as AC.
- All the readings taken can be saved as easy to recover dated files. 3980 measurements by file.

### Scope of supply

- 1 portable solar analyzer, power supply by lithium battery with its mains charger 230V AC 50/60 Hz. Dim: 257x155x57 mm. Weight: 1.55 kg
- 1 program + cord for USB link to PC.
- 1 amps clamp (direct link to analyzer using specific cord).
- 1 watts clamp (direct link to analyzer using specific cord).
- 1 solar radiation sensor with its support for attaching to solar panel
- 1 temperature sensor for attaching to solar panel.
- set of safety and photovoltaic cords.
- 1 carrying case.
- Detailed instructions with connection diagrams.

## Solar analyser



- Current/voltage graph drawing (characteristic of the solar panel)
- Autoscan search of the solar panel maximum power – Pmax (60V – 6A)
- Maximal voltage Vmaxp at Pmax power
- Maximal current Imaxp at Pmax power
- Opened circuit voltage Vopen
- Short-circuit current Ishort
- I = f(V) graph with a cursor
- Efficiency calculation in %
- Power by area unit (in W/m<sup>2</sup>)
- Manual test for a particular point
- Range 10V / accuracy 0.001V
- Range 60V / accuracy 0.01V
- Range 1A / accuracy 0.1mA
- Range 6A / accuracy 1mA
- Accuracy 1% + 18dgt

Battery info: 8 x LR6

ref. VA200



Package includes:

- bag
- AC power
- accumulators
- cables connecting panels
- USB cable & software.

## Pyranometer



The PYR1307 pyranometer measures the power of solar radiation in watts per m<sup>2</sup>: W/m<sup>2</sup>

- Ratings: 199.9 W/m<sup>2</sup> and 1,999 W/m<sup>2</sup>
- Measuring error: < 10W/m<sup>2</sup> or 5% of the reading
- Display: 2,000 pixel LCD
- Captures min. and max. values
- "Hold" key allows one to freeze the display
- Backlighting
- Supplied with a carry case
- Dimensions: 162 x 63 x 28mm
- Weight: 250g

Battery info: 2 x LR03

ref. PYR1307



## Artificial solar source

This source for getting around the loss of sunlight by illuminating the solar panel with artificial light whose spectrum is close to sunlight. While not having as much luminosity as unclouded sunlight, it illuminates with sufficient intensity for the panel to generate 1/3 of its peak power  $W_c$  (corresponding to sunlight at  $1\text{ kW/m}^2$ )

Comprise a solar panel (depends on the version) placed facing a set of evenly distributed spotlights. The solar panel can be removed easily in order to replace a spotlight quickly if necessary.

The unit located on the back of the spotlights panel includes

- a key-operated emergency stop button for cutting the electricity supply to the spotlights
- a digital thermometer shows the temperature at the surface of the solar panel. Accuracy  $1^\circ\text{C}$ .
- a potentiometer for lighting adjustment, by dimmer built into the unit
- a flow control for the forced ventilation
- automatic power supply cut-off to the spotlights in the event of abnormal temperature rise of the solar panel

### ELECTRICAL FEATURES OF THE SOLAR PANEL AT $25^\circ\text{C}$

LIGHTING	SOLAR	ARTIFICIAL
Maximum power	220W <sub>c</sub>	70W <sub>c</sub>
Open circuit voltage	43V	43V
Short-circuit current	6.2A	2.3A

- Sealed connections IP65 – 1000V
- Power supply: 230VAC.
- Dimensions/Weight: 1228 x 665mm height 1926mm.
- 4 casters including 2 with brake

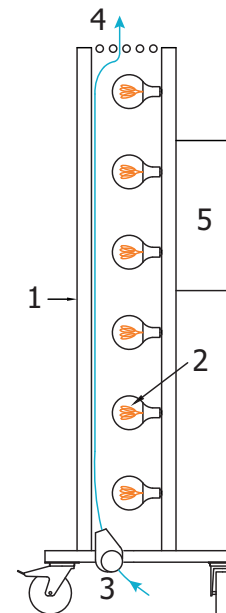
### PRACTICAL WORK

Adjustment of the light intensity demonstrates the correlation between the light flow and the current delivered by the photovoltaic panel, at constant voltage.

A temperature probe linked to the unit thermometer is located on the solar panel. This shows its instantaneous temperature. Any reduction of the ventilation flow causes the panel temperature to rise, and lowers the photovoltaic current in constant lighting.



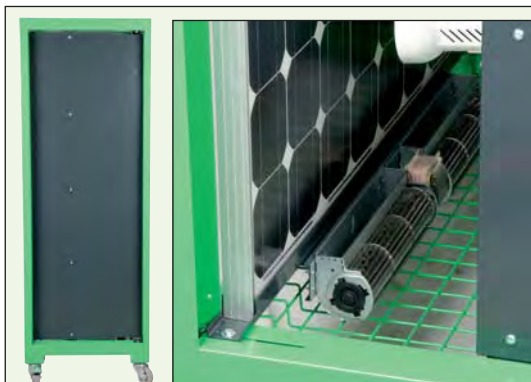
**SOL-ARTI**  
Side protection panel removed for the photograph.



1. solar panel
2. spotlights
3. fan and air inlet
4. grid and air outlet
5. electrical cabinet.

REF	Photovoltaic panel delivered installed	Side protection against the direct access to the lamps	Forced ventilation to simulate the wind	Poles and chains for zone boundary
<b>SOL-ARTI</b>	Yes	Yes	Yes	No
<b>SOL-ARTI-N</b>	No	Yes	Yes	No
<b>SOL-ECO</b>	Yes	No	No	Yes
<b>SOL-ECO-N</b>	No	No	No	Yes

The versions without "installed photovoltaic panels" are compatible with the reference SOL-200 of page 152 and the solar panels of all our systems.



**SOL-ARTI:** Side panel of protection and ventilation system with protection grid.

### Special characteristics only for SOL-ARTI and SOL-ARTI-N

Two opaque side panels prevent the accidental blinding of a student. With the solar panel and spotlight support they also make a closed duct for evacuating heat by an air current going from bottom to top. Centrifugal fans, located in the bottom part, inject fresh air that runs up the panel.

Grids in the bottom and top parts let the air flow pass evacuating the heat, and prevent accidental contact by hand with a burning spotlight or with the fan blades.

The versions SOL-ECO and SOL-ECO-N have no lateral protection, no forced ventilation. Versions delivered with 4 poles and 2 chains for the delimitation of a safety zone around the system



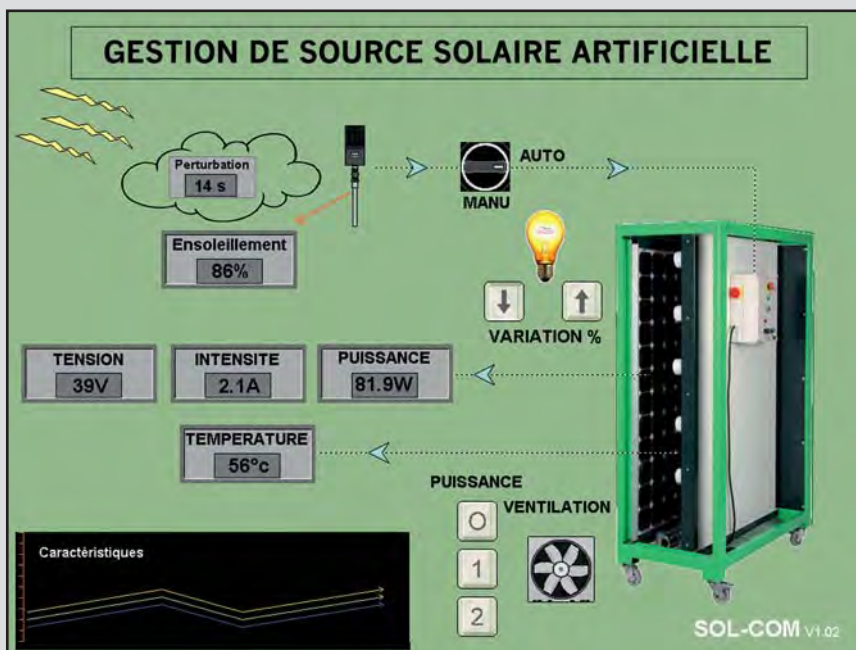
**SOL-ECO:** protection by bounded safety zone

# Artificial solar source : communicating version



Version identical to SOL-ARTI but with these additional features:

- 1 Schneider programmable PLC with its Ethernet interface
- 2 analog card I/O for PLC
- 1 electronic interface to retrieve the voltage/current parameters of the photovoltaic panel.
- 1 RJ45 connector for the connection to a PC.



## SUPERVISION SOFTWARE SUPPLIED

Vijeo designer of Schneider®.

### Allows:

- the acquisition and the display of PLC variables
- the supervision and the process control
- the programming of your own supervision
- the creation of your own Ethernet computer network

### Displays:

- The values of U(V) / I(A) / P(W) supplied by the solar panel
- The temperature (°C) of the solar panel
- The level of sunshine (solar radiation)
- The level of ventilation

### Controls:

- The level of the artificial light intensity
- The disturbance which simulate the passing of a cloud (you can select the duration if the effect).
- The level of ventilation

## PRACTICAL WORKS

- Theoretical study on the solar panel functioning
- Theoretical study on the solar panel positioning
- The Ethernet networking of the system
- The influence of the panel temperature on the intensity supplied
- The programming of the PLC
- The setting of the analog cards
- The creation of a supervision programming

## Photovoltaic solar panels and frame

### FEATURES OF EACH PANEL

- Open circuit voltage: 57VDC
- Short-circuit current: 4.6A
- Optimum operating voltage: 47VDC
- Optimum operating current: 4.3A
- Maximum power: 200Wc (variation of  $\pm 10\%$  depending on the series)
- Sealed connections IP65 – 1000V on the rear of the panel.
- Type of cells: Monocrystalline silicon

### PHOTOVOLTAIC SOLAR PANELS 200Wc ON TILTING FRAME (1 PANEL)

- Robust aluminum frame.
  - Useful surface area of the cells 1.5m<sup>2</sup>.
  - Device for measuring the tilt angle
  - Tilt adjustable from 5° to 70°
  - Two ball joints with clamping levers for positioning the panel to the required tilt angle.
  - Several SOL-200 can be coupled electrically to increase power.
  - Light and easy to move.
- Dimensions Folded position: 1620 x 1060 x 100mm  
 Dimensions Unfolded to 70° position: 2100 x 1060 x 700mm  
 Weight 27kg

ref. SOL-200



### LINK CABLE

30-m cable for connecting the solar panels to any type of solar system.

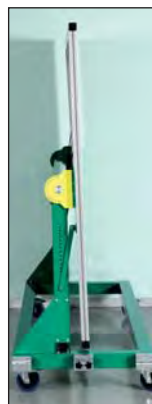


ref. SOL-CAB30

### PHOTOVOLTAIC SOLAR PANELS 400WC ON TILTING WHEELED FRAME (2 PANELS)

- Compact wheeled frame.
- Sufficiently compact to be rolled through a door-way.
- An instantly removable stand is fixed to the wheeled frame
- Four actuators raise the SOL-400 to a stable and horizontal position
- Unfolded stand wheelbase: 225 x 260cm
- Overall folded stand dimensions: 227 x 75cm high 195cm
- Effective surface area of cells: 3.1m<sup>2</sup>
- Total power of the panels 400Wc (may vary by 10%)
- Tiltable from the vertical to the horizontal position in 5° increments.
- A protractor measures the panel tilt.

ref. SOL-400



### PHOTOVOLTAIC SOLAR PANELS 800WC ON TILTING WHEELED FRAME (4 PANELS)

- Compact wheeled frame.
- Sufficiently compact to be rolled through a door-way.
- An instantly removable stand is fixed to the wheeled frame
- Four actuators raise the SOL-800 to a stable and horizontal position
- Unfolded stand wheelbase: 225 x 260cm
- Overall folded stand dimensions: 227 x 75cm high 195cm
- Effective surface area of cells: 6.3m<sup>2</sup>
- Total power of the panels 800Wc (may vary by 10%)
- Tiltable from the vertical to the horizontal position in 5° increments.
- A protractor measures the panel tilt.

ref. SOL-800



## Solar tracker with battery



ref. TRACSOL

The solar tracker is a technical innovation for tracking the sunlight, in order to increase the efficiency of photovoltaic panels. The productivity gain can reach 40% with a 2-axis tracking installation. TRACSOL is a teaching solution for learning this technique. Equipped with 2 axes and 4 cells for automatic sunlight tracking, it is completely self-contained. No connection to the mains 230V is required. Only the artificial solar source enabling TRACSOL to be used indoors is powered with 230VAC. The transparent sides of the mechanical box enclosing the two axes provide a full view of the chain drive linkages.

4 BNC attached to the front of the cabinet enable the reading on oscilloscope of the signals generated by the 4 solar cells.

The voltage of the solar panels is available on the two safety terminals.

The assembly is mobile thanks to 4 heavy-duty wheels attached under the frame.

### EDUCATIONAL OBJECTIVES

- Study and putting into service of a solar tracker.
- Understanding the operation of solar cells.
- Mastering the wiring of the components of a photovoltaic installation at an isolated site.
- Taking measurements using an oscilloscope and clampammeter.

TEACHING RESOURCES STUDENT & TEACHER

### Practical works

- Lessons on the different solar panel technologies (Monocrystalline, Polycrystalline, Amorphous)
- Study on the positioning of solar panels for maximum output.
- Study of solar radiation.
- Reminder on Direct, Diffused and Reflected solar radiation.
- Comparison of the read powers with fixed panels and tracking panels.
- Study and creation of the wiring of a solar energy system at an isolated site.
- Reading the currents and voltage at different points of the wiring.
- Interpreting the measurements then calculate the efficiency.
- Calculation of the discharge time of the battery according to the load.

### Comprises

- 2 solar panels 30W-12V Monocrystalline.
- 1 azimuth rotation motor of 160° maximum, that is more than 8 hours of tracking in position perpendicular to the sun.
- 1 zenith rotation motor 43° for full tracking of the sun's elevation.
- 1 set of solar cells.
- 1 cabinet with door.
- 1 Solar load regulator 12V/20A.
- 1 battery 12V-14Ah.
- 1 output 12VDC-60W available on 4mm terminal.
- Protection with gPV cartridge fuse.
- Emergency stop and switch + 'on' indicator light.
- 1 printed side with 4 BNC plugs.
- 1 artificial solar source mounted on telescopic stand.

### Features

- 3-metre mains lead for the artificial source.
- Dim.: 800 x 600 x h 1700mm. Weight: 80kg.
- The pole and the panels are easy to remove for going through doorways.

## Simulation of a solar panel

Given that photovoltaic panels do not produce significant power in cloudy conditions, it is not possible to complete the related tutorials. DC10 is a source which, by replacing the solar panels, overcomes unpredictable sunshine.

- |                                |  |
|--------------------------------|--|
| • Mains input                  | 230V single-phase  |
| • Stop/start switching         | Push-button + LED indicator lights                       |
| • Emergency stop               | Key operated   |
| • DC output                    | Adjustable from 0 to 230V DC                             |
| • Maximum current              | 10A  |
| • Filtering                    | 5% of residual ripple at 10A.                            |
| • Adjustment method            | Button on the top  |
| • Display of outputs           | 1 voltmeter and 1 ammeter                                |
| • Output terminals in parallel | 2 photovoltaic type connectors<br>2 4mm safety terminals |
| • Upstream protection          | By fuse  |
| • Output protection            | By circuit breaker                                       |
| • Protection of individuals    | By safety isolation transformer                          |
| • Dimensions/Weight            | 330 x 280mm height 510mm/49kg                            |
| • Castors                      | 4 including 2 with brakes                                |

Suitable for indoor operation with our products.

SOL-1  
SOL-2  
SOL-3  
SOL-4  
SOL-5  
SOLPUITS  
SOLHAB

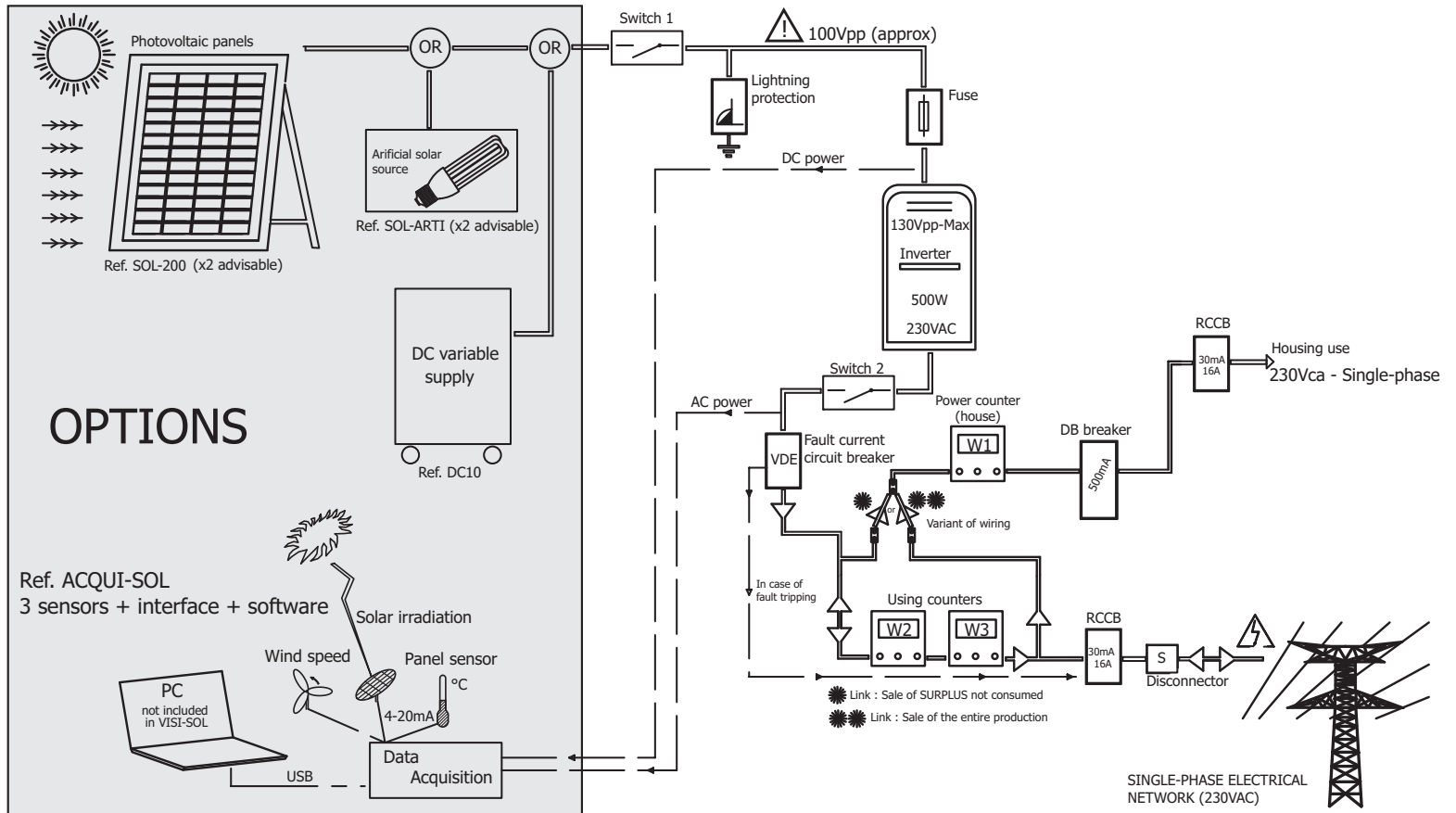


ref. DC10

Supplied with cable (1m) for connection to the management system of photovoltaic panels.



## Photovoltaic kit for energy injection



Kit of photovoltaic components for studying a solar installation with total or partial energy injection to the electricity network 230VAC-50Hz.

### The kit comprises

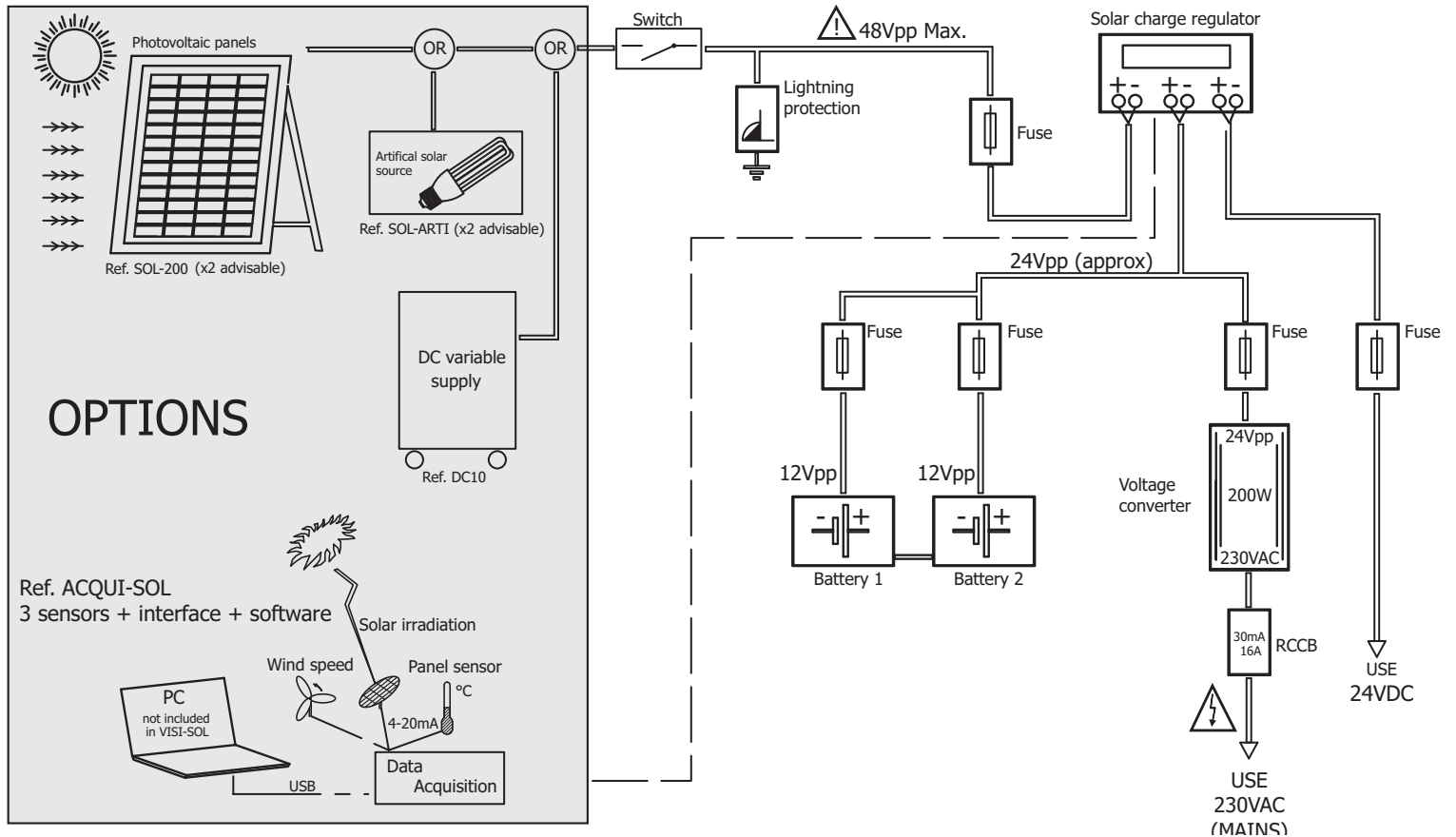
- 2 photovoltaic switches 0/1 – 32A/500VDC – 3-pole.
- 1 lightning arrester 500VDC
- 1 photovoltaic fuse holder 1000VMax. 2-pole. 10x38mm
- 4 photovoltaic fuse cartridges gPV 1000V. 10x38mm
- 1 network inverter 500W. Automatic synchronization on the network 230VAC-50Hz. Input voltage from 65 to 130VDC. Thermal protection integral to the box. 1 residual current circuit-breaker 30mA-10A two-pole.
- 3 single-phase modular energy meters 63A. Gauges key kWh/kW/Partial. Reset key. Resolution 0.1kW
- 1 two-pole Photovoltaic circuit-breaker with EMS default current in compliance with Standard VDE0126. Gauge 16A-30mA. Use voltage from 196 to 250VAC
- 1 Main switch 25A – 5.5kW/400V.
- 2 residual current circuit-breakers 30mA/16A two-pole.
- 1 two-pole connection circuit-breaker 500mA, 230 V CA, 15/30/45 A
- 1 plug 2P+E male.
- 1 set of 10mm<sup>2</sup> connection terminals
- 1 set of photovoltaic connectors 4-6mm<sup>2</sup>
- 1 sheet of 10 photovoltaic labels showing different safety operations
- 1 file on CD: detailed instructions for each component, cabling diagram and practical assignments.
- Works with photovoltaic panels with voltage between 35 and 150VDC



### OPTIONS

- Ref. SOL-200** (2 panels recommended) Photovoltaic panel 200W on tilting foot with device for measuring the tilt angle (description P.136)
- Ref. SOL-CAB30** Connection cable for photovoltaic panels 30m 3G6mm<sup>2</sup> (description P.136)
- Ref. EOLYS-500** 400W Wind turbine (description P.144).
- Ref. ACQUI-SOL** Interface with 3 sensors and acquisition software to read the installation's electrical characteristics. (description P.127).
- Ref. DC10** Power supply DC 0 - 220 volts - 10A protected. Simulates the panels. (description P.137).
- Ref. SOL-ARTI** Source of artificial sunlight. (description P.134).
- Ref. HABITAT-2** Load panel for use on site with electricity network. (description P.125)

## Photovoltaic kit for isolated site



ref. KX-TEST

Kit of photovoltaic components for studying a solar installation on isolated site.

**The kit comprises**

- 2 sealed solar batteries 12VDC -12Ah.
- 1 photovoltaic switch 0/1 – 32A/500VDC – 3-pole.
- 1 pure sine-wave voltage converter with power 300W. input voltage from 20 to 32VDC and output voltage 230VAC-50Hz.
- 1 lightning arrester 500VDC
- 5 photovoltaic fuse holder 1000VMax. 2-pole. 10x38mm
- 12 photovoltaic fuse cartridges gPV 1000V. 10x38mm
- 1 Solar charge regulator with LCD. Max current 20A. Operating voltage 12V or 24V with automatic recognition. Input voltage area from 6.9 to 17.2VDC and from 17.3 to 43VDC. Front pushbuttons for displaying the voltage and current of the charge in the battery and in the use circuit. Solar panels input 48VDC Max. Minimum battery voltage 6.9V.
- 1 residual current circuit-breaker 30mA-16A two-pole.
- 1 set of 10mm<sup>2</sup> connection terminals
- 1 set of photovoltaic connectors 4-6mm<sup>2</sup>
- 1 sheet of 10 photovoltaic labels showing different safety operations
- 1 file on CD: detailed instructions for each component, cabling diagram and practical assignments.
- Works with photovoltaic panels with voltage between 18 and 50VDC

**OPTIONS**

- Ref. SOL-200** (2 panels recommended) Photovoltaic panel 200W on tilting foot with device for measuring the tilt angle (description P.136)
- Ref. SOL-CAB30** Connection cable for photovoltaic panels 30m 3G6mm<sup>2</sup> (description P.136)
- Ref. ACQUI-SOL** Interface with 3 sensors and acquisition software to read the installation's electrical characteristics. (description P.127).
- Ref. DC10** Power supply DC 0 - 220 volts - 10A protected. Simulates the panels. (description P.137).
- Ref. SOL-ARTI** Source of artificial sunlight. (description P.134).
- Ref. HABITAT-3** Load panel for use on isolated site. (description P.125)

## Boxed components for studying solar energy

These components are made safe in plastic boxes with transparent covers.

They are perfectly visible and the cabling is facilitated by the different safety terminals Ø4mm.

Each box is supplied with detailed instructions

### OPTIONS

**Ref. SOL-200** Photovoltaic panel 200W on tilting foot with device for measuring the tilt angle (description P.136)

**Ref. SOL-CAB30** Connection cable for photovoltaic panels 30m 3G6mm<sup>2</sup> (description P.136)

**Ref. ACQUI-SOL** Interface with 3 sensors and acquisition software to read the installation's electrical characteristics. (description P.127).

**Ref. DC10** Power supply DC 0 - 220V - 10A protected. Simulates the panels. (description P.137).

**Ref. SOL-ARTI** Source of artificial sunlight. (description P.134)

### SEALED SOLAR BATTERIES



ref. CIA-BAT24

- Lot of 2 sealed solar batteries 12V-12Ah.
- Separate cabling of the two sources for putting the 2 batteries in series or parallel.
- L x l x h: 280x190x130mm

### LIGHTNING ARRESTER PROTECTION



ref. CIA-PRF

- Lightning arrester protection for 2-pole DC circuit - 500VDC.
- L x l x h: 180x80x90mm

### SOLAR CHARGE REGULATOR



ref. CIA-REG

- Solar charge regulator with LCD.
- Max current 20A.
- Operating voltage 12V or 24V with automatic recognition.
- Input voltage area from 6.9 to 17.2VDC for 12VDC and from 17.3 to 43VDC for 24VDC.
- Front pushbuttons for displaying the voltage and current of the charge in the battery and in the use circuit.
- Solar panel input 48VDC Max
- Minimum battery voltage 6.9V.
- L x l x h: 200x200x130mm

### NETWORK INVERTER



ref. CIA-OND05

- Network inverter 500W.
- Automatic synchronization on the network 230VAC-50Hz.
- Input voltage from 65 to 130VDC.
- Input on safety terminals and output on 2 1-m cables fitted with safety plugs Ø 4mm male.
- Thermal protection integral to the box.
- L x l x h: 350x150x60mm

### VOLTAGE CONVERTER



ref. CIA-CONV

- Pure sine-wave voltage converter 300W.
- Input voltage, on safety terminal, from 20 to 32VDC and output 230VAC-50Hz on 2P socket.
- Thermal protection integral to the box.
- L x l x h: 210x210x70mm

**For instance : set of components for the study of the wiring of a solar energy system with energy release on the electrical network 230 Vac (mains).**

2 x CIA-COM  
1 x CIA-PRF  
1 x CIA-FUS  
4 x SBT-FUS10  
1 x CIA-OND05  
3 x CIA-CPT  
1 x CIA-BORN  
1 x CIA-VDE  
1 x CHT-V6 (See Page 55)  
1 x CIA-SE0 (See Page 62)  
2 x CIA-MT37 (See Page 61)  
2 x SOL-200 (See Page 136)  
1 x SOL-CAB30 (See Page 136)

6 leads 302S-R (See Page 254)  
15 leads 302S-N (See Page 254)  
10 leads 302S-B (See Page 254)  
2 leads 304S-R (See Page 254)  
6 leads 304S-N (See Page 254)  
2 leads 304S-B (See Page 254)  
4 leads T200 (See Page 254)

*Tips and wiring diagrams provided*

**INTERFACE FOR SAFETY TERMINALS**



ref. CIA-BORN

- Interface unit for converting 2 photovoltaic type terminals into safety terminals 4mm.
- 32A Max.
- L x l x h: 105x80x90mm

**MODULAR ENERGY METER**



ref. CIA-CPT

- Single-phase modular energy meter 63A.
- Gauges key kW.h/kW/Partial.
- Reset key.
- Resolution 0.1kW
- L x l x h: 170x140x100mm

**PHOTOVOLTAIC SWITCH**



ref. CIA-COM

- Photovoltaic switch 500VDC.
- 3-pole – 32A.
- Front operation control 90°
- Position: O/I
- L x l x h: 120x120x100mm

**PHOTOVOLTAIC 2-POLE FUSE HOLDER**



ref. CIA-FUS

- Photovoltaic two-pole fuse holder 10x38mm,
- 2-pole for DC.
- Fuse replacement without opening box
- Max: 1000VDC.
- L x l x h: 130x80x90mm
- Supplied without fuse cartridges gPV.
- Option Fuse gPV 10x38 1000V:  
Ref. SBT-FUS10

**2-POLE CIRCUIT-BREAKER**



ref. CIA-VDE

- 0126 two-pole Photovoltaic circuit-breaker with EMS default current in compliance with Standard VDE0126.
- Adjustable without opening box
- Gauge 16A-30mA.
- Use voltage from 196 to 250VAC
- L x l x h: 170x140x100mm

**PHOTOVOLTAIC INVERTER**



ref. CIA-INV

- Photovoltaic inverter switch 500VDC.
- 6-pole – 32A.
- Front operation control 190°
- Position I/O/I
- L x l x h: 170x140x100

**OPTION FOR HANGING ON RAILS**



Option for fast attachment onto an universal rail. In this way, you can attach your various industrial components onto a grid in order to make wiring and testing easier. To order this option, simply add -FIX to the end of the reference  
Ex : CIA-VDE-FIX

- |                |                                |
|----------------|--------------------------------|
| 1 x CIA-COM    | 1 x CIA-MT37 (See Page 61)     |
| 1 x CIA-BAT12  | 2 x SOL-200 (See Page 136)     |
| 1 x CIA-PRF    | 1 x SOL-CAB30 (See Page 136)   |
| 5 x CIA-FUS    | 15 leads 302S-R (See Page 254) |
| 12 x SBT-FUS10 | 15 leads 302S-N (See Page 254) |
| 1 x CIA-REG    | 2 leads 304S-R (See Page 254)  |
| 1 x CIA-CONV   | 2 leads 304S-N (See Page 254)  |
| 1 x CIA-BORN   | 2 leads T200 (See Page 254)    |

**For instance : set of components for the study of the wiring of a solar energy system for isolated site using batteries.**

**SOLAR PUMP 24VDC - 3.5A**



ref. CIA-POMP

- Self-priming
- Power supply on safety terminals

Tips & wiring diagrams provided



# WIND TURBINE ENERGY

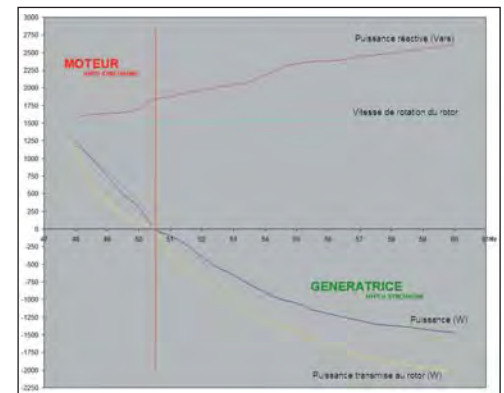
## Wind turbine simulator - Network injection

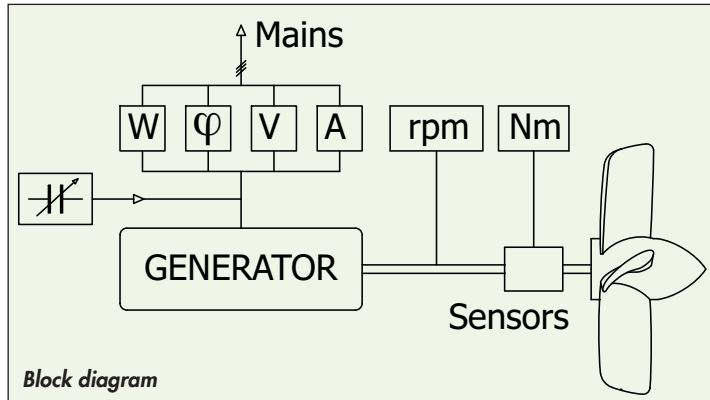
EOLYP is a test bench dealing with the study of the hyper synchronous activity of a wind turbine for its electricity production aspects, excluding the mechanical aspects. Due to noise pollution and draughts, which are incompatible with a classroom environment, the propeller has been replaced by a variable speed drive motor.

The functional diagram presents the operating principle. The safety components placed in the electrical cabinet are not represented to simplify reading. The propeller, for which the operator adjusts the speed, drives the generator from 0 to 1800 rpm. Two sensors placed on the shaft, returns rotation speed and torque information to the console which displays this information. The generator is coupled to the public three-phase network, through an electrical measurement bench indicating the:

- active power injected into the network.
- voltage between phases
- current
- power factor.

The central-zero wattmeter shows that depending on the drive speed, the generator consumes or produces energy highlighting the hypersynchronous and hyposynchronous operations. The voltage/current distortion also changes with the rotation speed as indicated by the central-zero power factor meter. The adjustable capacitors battery is used to adjust the power factor to around 1 depending on the speed and power produced.





### EDUCATIONAL OBJECTIVES

- Understanding the mechanical & electrical principles of a wind turbine.
- Studying the hypo-synchronous and hyper-synchronous operating modes of an asynchronous motor.
- Studying the synchronization of the electrical network.
- Calculating the efficiency of the energy production system.
- Using a clamp-on Ammeter.

### TEACHING RESOURCES STUDENT & TEACHER

### Proposed Practical Works

- Reminders on the wind turbine functioning.
- Synchronization procedure on the electrical network.
- Raising the power factor by a capacitors bank and study the results.
- Plotting the electrical characteristics of the energy production system.
- Calculating the overall efficiency.
- Studying of the functioning in an isolated site.

### COMPRISES

- 1 frame on casters, dim. 1200x750mm height : 1820mm. Weight: 143kg.
- 1 asynchronous motor 1.5 kVA
- 1 generator
- 1 DC tachogenerator / 1 torque sensor
- 1 command console
- 1 electrical cabinet
- 1 network coupling unit

### GENERATOR FEATURES

- Generator: 3 x 400VAC Asynchronous motor.
- Active power injected into the network: 0 to 1.2kVA
- Generator efficiency: 78%
- Speed variation: 0 to 1800 rpm

### ELECTRICAL CABINET FEATURES

#### Interior

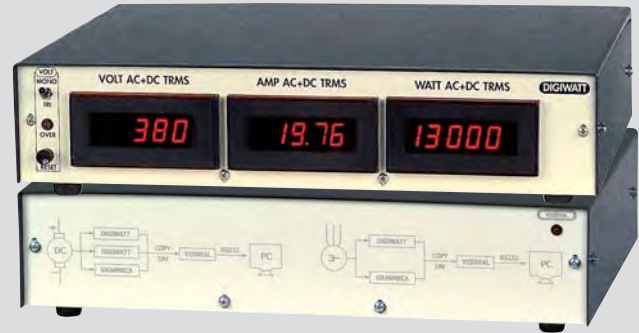
- 30 mA circuit breakers & magnetothermal and thermal circuit breakers.
- 2.2kVA speed controller with control unit on the console.
- stepped capacitors battery

#### On the front

- 1 emergency stop circuit breaker
- 1 switch disconnector
- 1 stop/Start button with push button
- 4 switches triggering the capacitors to rectify the  $\cos\phi$
- 2 indicator lights show a thermal fault on the motor and generator

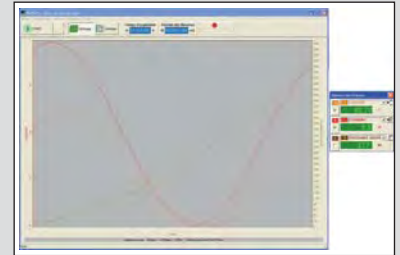


## Pack Acquisition



### ref. EOL-COM

EOL-COM is an option for EOLYP and EOLYP-ECO. This option allows recording and plotting on PC the electrical values as voltage, current and power provided to the Electrical network. The software supplied displays these electrical values in real time and collects them in Excel format.



During the acquisition, the values of U/I/P are displayed at the same time as curves and numerical values. Connection on PC by a USB cable of 2m (supplied). Mains supply: 230Vac – 50/60Hz

### DISPLAY

By two 3 1/2 and one 4 1/2 digits displays, height of digits 15mm.

### INPUTS

**Voltage inputs:** Three floating potential voltage terminals, situated at the rear of the apparatus allowing either the application of an alternating, continuous or composite voltage, or a balanced three phase voltage. These inputs are electronically protected against over voltages. Max. voltage: 400Vrms single phase, 700Vrms three phase

**Current inputs:** Two floating potential current terminals, situated at the rear of the apparatus allowing the application of an alternating, continuous or composite current.  $I_{max} = 20A$ . The current input is protected by a delay fuse, allowing measurements on starting up a motor

### RECOPY OUTPUTS

Voltage output: 0 to 10V DC signal for 0 to 1000Vrms entering.

Current output: 0 to 10V DC signal for 0 to 20Arms entering.

Power output: 0 to 10V DC for 0 to 0.2kW - 0 to 2kW - 0 to 20kW; these three ratings are switched automatically.

Important: these three outputs are insulated from the voltage and currents applied to the input terminals of the apparatus.

### OTHER CHARACTERISTICS

Dimensions of each case : 375 x 80 x 275mm. Weight : 5kg.

Function	U	I	W
Ranges	400Vrms single-phase 700Vrms 3-phase	20Arms	0.2 - 2 - 20kW
Accuracy		2% 0 ~ 20kHz	2% 0 ~ 20kHz
in %	1% from 0 to 70kHz	3% 20 ~ 70kHz	3% 20 ~ 30kHz
of reading		5% 30 ~ 70kHz	5% 30 ~ 70kHz
Protection	Electronic breaker	20A delayed fuse	
Impedance	1.5MΩ	<5mΩ	
Recopy outputs	10VDC/1000Vrms	10VDC/20Arms	10VDC/ 0,2kW - 2kW - 20kW

## Three-phase wind turbine 400W



EOLYS-500 is a three-phase wind turbine 400W belt-linked to a driven motor that simulates the wind strength. This system is suited to class room conditions. It perfectly simulates wind turbine operation without noise or draughts since there is no fan. Protected by a transparent cover, the wind turbine can be seen with no risk of direct contact. EOLYS-500 is more than a simulator because it rotates a true three-phase generator and short blades.

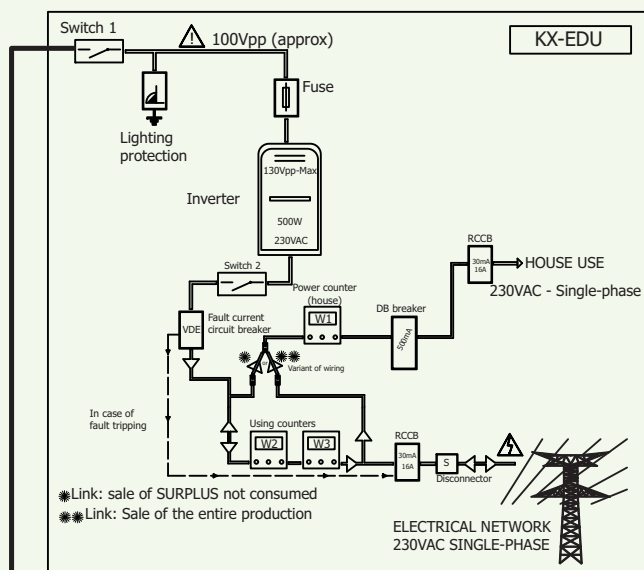


### EDUCATIONAL OBJECTIVES

- Understanding the different elements of a wind turbine.
- Make the measurements of electrical parameters (3-phase and continuous).
- Analyzing and interpreting results.
- Studying the efficiency and impacts related to the wind force.
- Studying the chain of wind energy (production, storage, consumption, energetic behavior).
- Control and set a speed variator from a PC.

DELIVERED WITH TESTS & PRACTICAL WORKS

### EXAMPLES OF COMPATIBLE LOADS



● Link: sale of SURPLUS not consumed  
 ●● Link: Sale of the entire production

ref. EOLYS-500

### Wind turbine features

- Three-phase output 3 x 53V AC - 400W at 370 rpm on safety terminals.
- Direct current output 90V DC - 400W at 370 rpm on safety terminals.
- Selection of these outputs by using an included rectifier or by direct connection.

### Features of the wind simulation

- Squirrel-cage three-phase asynchronous motor.
- Speed controller simulating wind turbine speed 0-400 rpm.
- Using the supplied SOMOVE software, the PC operations are:
  - Acceleration of the wind speed.
  - Deceleration of the wind speed.

### General features

- Wheeled frame with brakes
- Overall dimensions: 750 x 670 x (h) 1500 mm
- Top cover made with aluminium frame and Lexan sides (translucent and unbreakable).
- Power supply 2P+N+E 230V AC - 50/60 Hz (5m lead with mains plug)
- Supplied with: Practical assignments in the form of measurements/tests; RJ45-USB cable for linking between the speed controller and the PC. **Schneider® SoMove software.**



Supplied with SoMove

## Three-phase wind turbine units, 400W

### EDUCATIONAL OBJECTIVES

- Understanding the different parts of a wind turbine.
- Make the measurements of electrical parameters.
- Analyzing and interpreting results.
- Studying the efficiency and impacts related to the wind force.
- Study the chain of wind energy (production, storage, consumption, energetic behavior).
- Wiring of a wind turbine installation.

TEACHING RESOURCES STUDENT & TEACHER

### Proposed practical works

- Studying and reading of the electrical features of the wind turbine.
- Calculate the system's efficiency.
- Realization of the diagram and wiring for the energy injection on the electrical network.
- Realization of a diagram & wiring for the energy use in an isolated site.



Reference EOL-1

### 1. WIND TURBINE 400W

- SEE opposite EOLYS-500

### 2. ELECTRICAL CABINET

Standard technical cabinet on wheeled frame.  
Dimensions: 810 x 600 x 1890mm base included.

#### Comprises

- 2 disconnectors
- 1 500mA -30A RC device
- 1 30mA RC device
- 1 lightning arrester + fuses
- 3 100Wh resolution meters
- 1 Mushroom head emergency stop
- 1 source inverter
- 1 charging controller 12/24VDC-20A
- 2 batteries 12V-12Ah
- 1 set of photovoltaic connectors
- 1 500W inverter for network synchronisation
- 1 Voltage converter 24VDC/230VAC-200W

### 3. LINK CABLE

30-metre long cable for connection from the turbine to the electrical cabinet.



Réf	Features
EOL1	Operation with partial and total resale + at isolated site
EOL2	Partial or total resale operation only
EOL3	Operation at isolated site only

Each reference includes:

1 turbine (Ref. EOLYS-500) + 1 specific electrical cabinet + 1 link cable

### PARTIAL OR TOTAL RESALE OPERATION

In the cabinet, a DC/AC inverter converts the DC current from the turbine into alternating current 220VAC 50Hz and feeds it into the grid in synchronism. This inverter is protected against any polarity reversal and any overload on the DC or AC side.

#### When the turbine is stopped, the inverter consumes no current

INVERTER	VOLTAGE	Max current	Power
INPUT	65~125VDC	8A	
OUTPUT	230VAC-50Hz	2,25A	525VA

### OPERATION AT ISOLATED SITE

The turbine current charges two 12V sealed batteries cabled in series through a charging controller. This DC voltage is either available on safety terminals at the rear of the cabinet, or transformed into 250VAC 50Hz voltage by a 200W voltage converter.

#### Technical characteristics for the isolated site converter

VOLTAGE CONVERTER	Voltage	Max Current	Power
INPUT	20~32 VDC	11A	210W
OUTPUT	230VAC 50Hz	1.5A	300VA

## Studying the conversion of renewable energy



ref. CONVERTYS  
 ref. CHARGEOL

### EDUCATIONAL OBJECTIVES

- Study of the conversion of the electrical energy from 3-phase to single-phase.
- Make some measurements with a clamp-on ammeter.

TEACHING RESOURCES STUDENT & TEACHER

### Proposed Practical Works

- Understanding of the wiring diagram.
- Sizing of the electrical components related to the voltage and the power.
- Reading of currents and voltage in different points of the circuit.
- Calculation of powers.
- Calculation of electrical efficiencies.

These converters operate on the same principle as an industrial model. They treat the electrical power supplied by a wind turbine. The output cannot be synchronized with the network but can be used in isolated site.

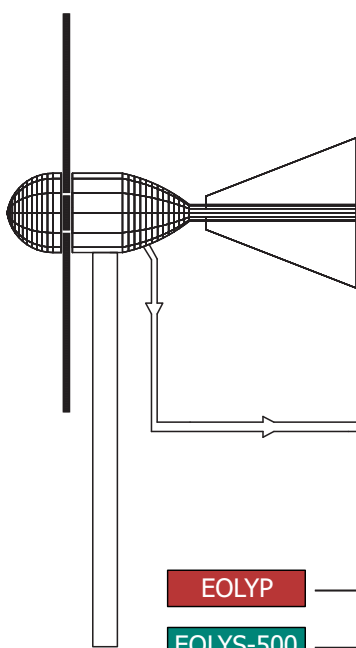
### TECHNICAL CHARACTERISTICS

- The converter's synoptic, printed on the front, facilitates location of the components and measurement points.
- The three-phase voltage from the wind turbine is applied to CONVERTYS or CHARGEOL through 4 safety terminals 4mm dia. The wind turbine-to-converter interconnection is made using laboratory leads.
  - CONVERTYS : Inputs between 375 and 460V three-phase.
  - CHARGEOL : Inputs between 80 and 120V three-phase.
- A main switch located on the top of the box, starts and stops the converter's power supply.
- Safety terminals 4mm diam. located between each component enable the voltages and currents to be measured at each conversion step.
- A magneto-thermal circuit-breaker protects the transformer primary against any overload.
- Output converter 500W/230V.
- A differential circuit-breaker 30mA protects the output to the use network cabled according to neutral system TT.
- Unit on casters dimensions: 600 x 450mm. Height 530mm

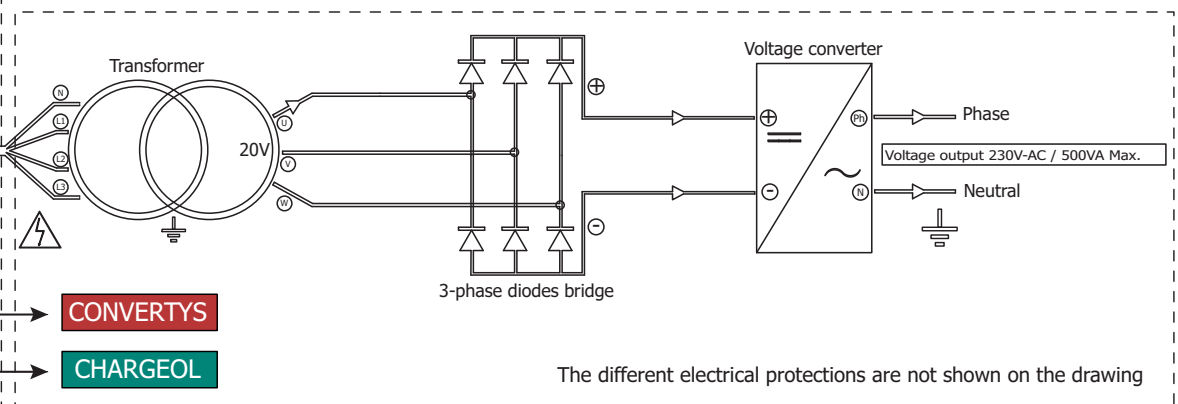
### CONVERTYS IS SPECIALLY MADE TO WORK WITH EOLYP CHARGEOL IS SPECIALLY MADE TO WORK WITH EOLYS-500

#### List of Practical Works achievable with each set:

- Principle of functioning
- The 3-phase voltage delivered by the wind turbine is galvanically separated by an isolation transformer, and then rectified by a Graetz bridge.
- This DC voltage is transformed by a DC/AC converter in an alternative voltage 230V (50Hz) / 500VA
- In case of exceeding of this power, the converter automatically offloads the output, switch on an overload indicator light, and resets 15 seconds after load reduction.



EOLYP →  CONVERTYS  
 EOLYS-500 →  CHARGEOL



The different electrical protections are not shown on the drawing

## Speed controller used for energy saving



### EDUCATIONAL OBJECTIVES

- Energy savings by speed controller demonstrated.
- Creation of the configuration of a speed controller with software.
- Using an energy measuring unit.
- Using a clamp ammeter.

### TEACHING RESOURCES STUDENT & TEACHER

#### Practical works

- Configuration of the speed controller with software.
- Configuration of the energy measuring unit.
- Comparison of energy consumption.
- Calculation of the cost of depreciation of the speed controller.
- Reading and plot of the electrical characteristics.

#### ref. MAQ-WATT

In a pumping or ventilation installation, the motor, supplied direct from the mains, rotates at its nominal speed. The flow rate can be regulated with manual valve or speed controller. The speed controller enables significant electricity savings to be made, which is not the case of the manual valve.

MAQ-WATT demonstrates this phenomenon by comparing the consumption in the two situations.

2 types of operation are offered:

- Direct supply of the pump with a contactor and regulation of the water flow with manual valve.
- Supply of the pump with controller and regulation of the flow rate by variation of the speed of rotation.

A measuring unit compares, among other things, the 2 powers absorbed.

A float provides a visual indication of the flow rate.

#### Comprises

- Wheeled frame.
- One surface pump 750W – three-phase 400VAC. Self-priming and protected against dry running.
- A 30-litre water tank makes the model self-contained.
- A manual valve for regulating the water flow.
- A float flow rate indicator.
- A cabinet with top engraved showing the diagram of operation of the system.
- A set of magneto-thermal and RC protection devices.
- A set of switches and indicator lights to select the type of operation required.
- An energy measuring unit with display of P/Q/S/I/U/V/Cosphi.
- Speed controller with software. 1500W – three-phase 400VAC. Offset control box for controlling the controller from the top of the cabinet.
- 3 safety sockets are available at the output of the speed controller for the connection of your own pump or any other load as a fan (3x 400V / 1.5kW max.)

#### Features

- Three-phase mains lead 400V 3 metres long for power supply.
- Dimensions: 600 x 800 x h 1400mm. Weight: 85kg.



## "Intelligent Home" energy control system



### EDUCATIONAL OBJECTIVES

- Study a measurement system for energy consumption according to standard RT2012.
- Study the principle of a home control installation equipped with DELTA DORE® radio components
- Parameter the DELTA DORE® radio components (RF technology)
- Produce wiring for home components.
- Learn how to use a clamp ammeter.

### TEACHING RESOURCES STUDENT & TEACHER

### Possible practical works

- Production of the complete wiring diagram.
- Study of the production of the wiring and programming of the components from the DELTA DORE touch screen module
- Study and production of radio commands for lighting, roller blinds and heating.
- Reading of power according to the heating operating cycles.
- Comparison of the power displayed on screen with that calculated from the different readings.
- Creation of scenarios according to the outside temperature and sunshine.

ref. MAQ-NRJ

More and more standards and directives require individual homes to be equipped with a system enabling energy consumption to be measured or estimated. MAQ-NRJ groups all the DELTA DORE® components needed to learn about electrical energy consumption.

A colour touch screen module displays all the energy use information as graphs. The different components are prepared in plastic housings engraved and equipped with 4 mm terminals to facilitate and make safe the wiring using safety leads. The modules are very easy to install on the aluminium wheeled frame.



### Characteristics

- Power supply 230V AC by 5-metre mains cord
- Dimensions of the frame: 950 x 50 x 1620 mm
- Dimensions of each module: 250 x 165 mm
- Total weight: 50 kg

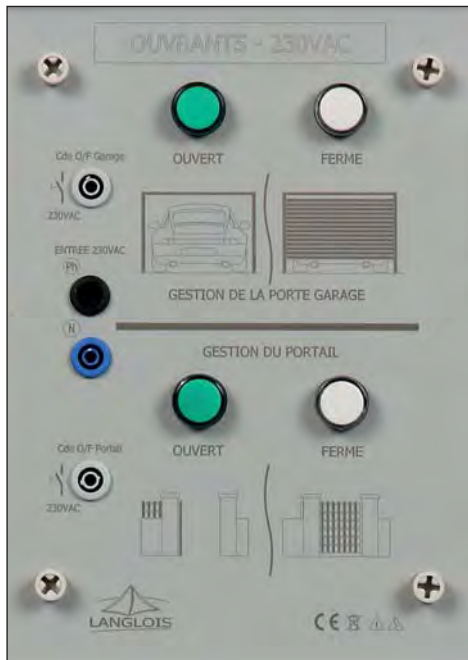
### Composition

- One wheeled aluminium frame taking 4 rows of 5 modules
- One power supply console 230 V AC on Ø 4 mm terminals
  - protection by 30mA RC circuit breaker
  - emergency stop button
  - 2 2P+E sockets with lamp
- 1 rack for leads - 20 fingers.
- 1 Module - data transmitter with off-peak hours control
- 1 Module - colour touch screen displaying all the detail of consumption, for controlling heating (pilot wire and load shedding), lighting and roller blinds.
- 1 Module - 3 current transformers (max 60A) for measuring 3 different circuits.
- 1 Module - power interface technical unit for touch screen.
- 1 Radio module - sunlight sensor.
- 1 Radio module - outside temperature sensor
- 2 Radio modules - roller blind control
- 1 Simulation module - 2 blinds.
- 1 Radio module - lighting variation.
- 1 Radio module - lighting variation, off/on, timing
- 2 Modules - bulkhead lights 230V AC - 60 W
- 3 Modules - load 320 W + indicator lights
- 1 Simulation module - 3 pilot wire convector heaters, 1 hot water tank and 1 pellet burner.

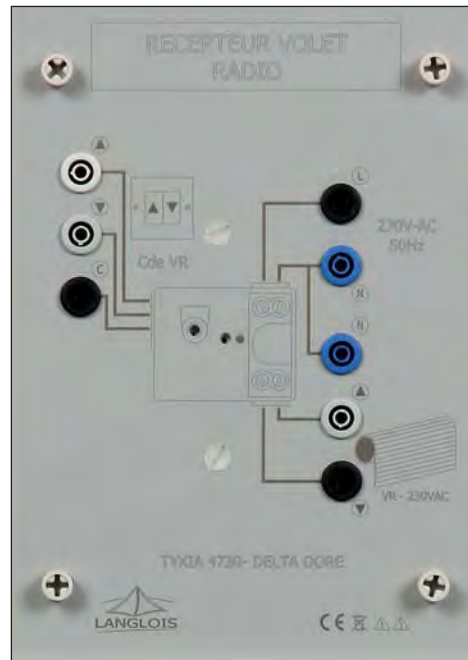




Rapid installation of modules on the frame



Openings control module



Roller blind interface module

The colour touch screen module displays all the detail of consumption, for controlling heating (pilot wire and load shedding), lighting and roller blinds.



### KIT OF COMPONENTS FOR HOME ENERGY CONTROL

We propose, with this kit of modular panel devices, an alternative enabling your study of intelligent home energy control. Supplied without cables or electrical protective devices.

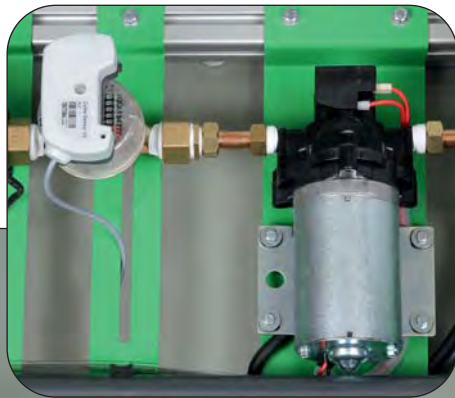
- 1 data transmitter with off-peak hours control.
- 1 colour touch screen module displays all the detail of consumption, for controlling heating (pilot wire and load shedding), lighting and roller blinds.
- 3 current transformers (max 60A) for measuring 3 different circuits.
- 1 Module - power interface technical unit for touch screen.
- 1 sunlight radio sensor.
- 1 outside temperature radio sensor.
- 2 radio controls for roller blinds.
- 1 lighting variation radio control.
- 1 lighting variation, off/on, timing control.
- 2 bulkhead lights 230V AC – 60 W.

ref. KI-NRJ





## Automatic leak alert system



Model ref. MAQ-FUIT-A.

Length: 1005mm.

### EDUCATIONAL OBJECTIVES

- Learning about water leak detection by sensor.
- Using a GSM phone transmitter
- Using and programming a ZELIO logic module

TEACHING RESOURCES STUDENT & TEACHER

### practical works

- Configuration and installation of the water leak sensor
- Configuration of the GSM phone transmitter and test with mobile phone
- Creation of the ZELIO logic module programmes with or without presence in the home, with or without solenoid valve control.

Fully self-contained version thanks to its tank and pump 24V. Requires no water inlet.

ref. MAQ-FUITE-A

Version with no pump or tank.

Requires a pressurized water inlet in the room.

ref. MAQ-FUITE

A leak of water can be very costly and statistics show that this fault is common at all distribution points. This model represents the drinking water supply circuit of a house equipped with a leak detection system and GSM alert device. When the house is declared unoccupied, a sensor, connected to the water meter, detects the slightest abnormal consumption. A GSM phone transmitter then sends an SMS to warn you of the problem. The assembly is managed by a ZELIO logic module.

### PULSE WATER METER

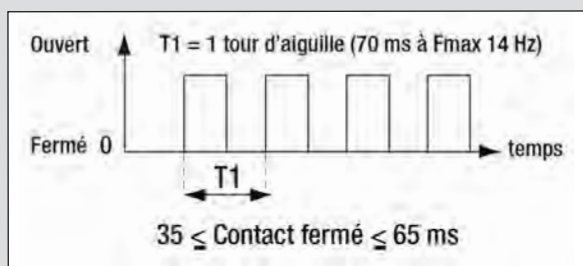
ref. CHT-EAU



Water meter equipped with 2-wire pulse transmitter for remotely sending information relating to the water meter.

Ratio K = 1 - 1 meter unit equal to 1 pulse.

Connection to the water circuit using 2 quick connectors (not supplied).



### Composition OF THE sytem

- 1 tank, 5 litres (for the MAQ-FUITE-A version)
- 1 pump 24VDC - 3.5A (for the MAQ-FUITE-A version)
- 1 quick connector for water inlet (for the MAQ-FUITE version)
- 1 water meter
- 1 pulse sensor attached to the meter
- 1 solenoid valve 24V
- 1 valve for creating a water leak
- 1 valve for cutting off the water inlet
- 1 unit with connector for linking to the technical cabinet

### Composition of the technical cabinet

- 1 set of magneto-thermal and RC protection devices.
- 1 modular power supply 24VDC.
- 1 ZELIO logic module
- 1 GSM transmitter
- 1 set of switches, emergency stop and indicator lights

### Features

- Dimensions of the frame
  - MAQ-FUITE-A version: 370 x 230 x 1005mm.
  - MAQ-FUITE version: 370 x 230 x 700mm.
- Technical cabinet dimensions: 330 x 200 x 440mm
- Total weight, frame + cabinet
  - MAQ-FUITE-A version: 25kg.
  - MAQ-FUITE version: 19 kg
- Mains power supply 230V + E with 3-metre lead
- Requires phone SIM card with subscription or prepaid.