



Isolated site Photovoltaic and wind power Kit

for studies and projects around solar and wind energy production in isolated sites

Highlights & Key Activities

- ✓ Support for a student project on photovoltaic solar energy (e.g. design of an autonomous energy system) provided with an example of a teaching scenario
- ✓ Solar panels can be mounted on the ground, on a wall or on wheels
- ✓ Monitoring of the operating data of the installation
- ✓ Study of solar panel technologies, storage technologies (Regulator and solar batteries) and low voltage and 230V distribution (Inverter)
- ✓ Energy efficiency study
- ✓ Measuring activities, implementation (wiring and connection), energy balances, dimensioning and justification of components, communication, technical and economic analyses...
- ✓ 160W wind turbine to complement renewable energy activities
- ✓ Weather station (optional).

Références

- ✓ CH30: Photovoltaic kit
- ✓ CH31: Weather sensors
- ✓ CH32: Wind turbine 160W 24V

Features

- ✓ Power supply : 230VAC- 50Hz- 10A
- ✓ Control panel dimensions : L 94 x l 79 x H 180 cm
- ✓ Dimensions of the photovoltaic module : L 170 x H 100 x P 80 cm

Documentation

- ✓ The CH30 kit is delivered with a complete technical file (electrical diagram, technical data sheets of the main components, installation and maintenance manual) and educational file (possible educational activities)

Functional description

- ✓ This product has been designed to allow the study of electricity production by solar photovoltaic and wind energy and its storage.
- ✓ It implements a complete chain of production, storage and distribution of electrical energy.
- ✓ Its modular nature makes it ideal for student projects.

CAP MELEC, Bac Pro MELEC / CIEL
BTS Electrotechnique - IUT
Universités - Ecoles d'ingénieurs



Non-contractual photos

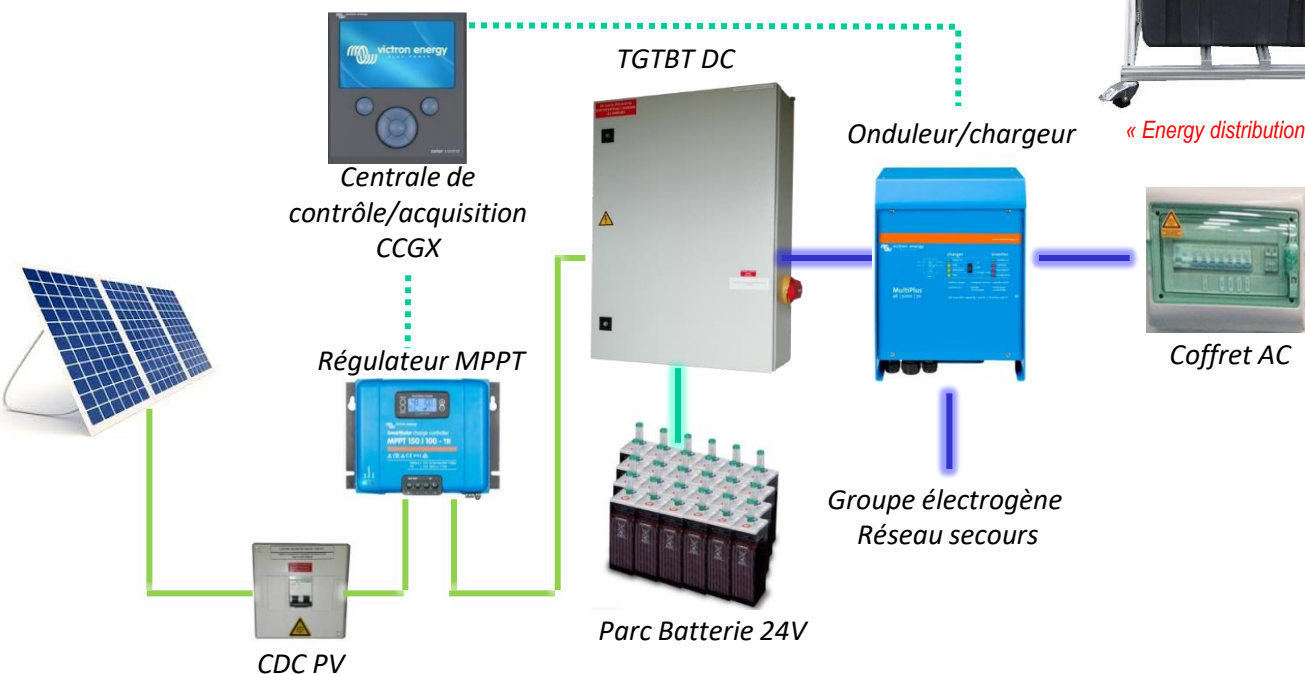


« Control Panel » side



« Energy distribution » side

Architecture du système





Main components

Photovoltaic sub-assembly 330Wc

- ✓ 1x Monocrystalline photovoltaic module 330Wp to 360Wp (or equivalent).
- ✓ 1x Triangulated aluminium structure to be fixed to the ground, on a 60° roof terrace or mobile on wheels
- ✓ 1x Set of cables

24V 160W Wind Turbine Sub-Assembly (Option CH32)

- ✓ 1x Wind turbine AIR 40 (or equivalent), 160W, with integrated 24V regulator, rotor diameter 1.14m
- ✓ 1x 3m metal mast for wind turbine, with wall mounting brackets
- ✓ 1x Set of cables

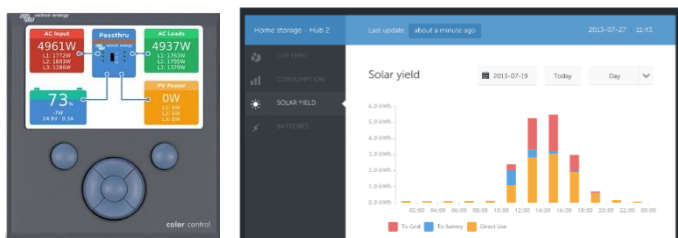
Control panel sub-assembly

Control panel including :

- ✓ 1x CCGX Victron Energy data acquisition system with web interface for data processing and analysis for education.
 - Colour graphic interface with data visualisation and communication via application, SD card or server.
 - The CCGX allows for the monitoring and display of product data in real time.
 - **The information can also be transmitted to the remote monitoring website**
 - Ability to export data (CSV or XLS format) for further processing
- ✓ 1x MPPT charge controller, Victron SmartSolar 75/15, 15A module / 15A conso 12/24V V_{co} MAX 75 V IP43
 - Bluetooth connectivity for viewing solar production data on a smartphone (iOS or Android)
- ✓ 1x Charging inverter Victron MultiPlus MP24/800/16-16, 24Vdc, 230Vac, 800W, Sinusoidal, 16A Charger
- ✓ 1x BMV712 Battery Charge Controller/Display 9 to 90 VDC, Shunt 500A/50mV (RJ12 10m supplied, max distance 65m)
- ✓ 1x 1x Switch cabinet with 24V and 230V feeder, battery isolator, shunt...



Control panel with switch cabinet



Data acquisition system with display example



Data display on PC, tablet or smartphone



MPPT charge controller



Charging inverter

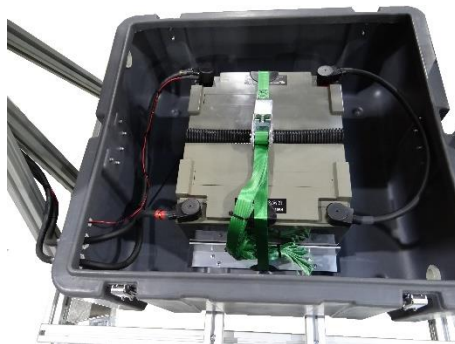


Battery charge display

Main components (continued)

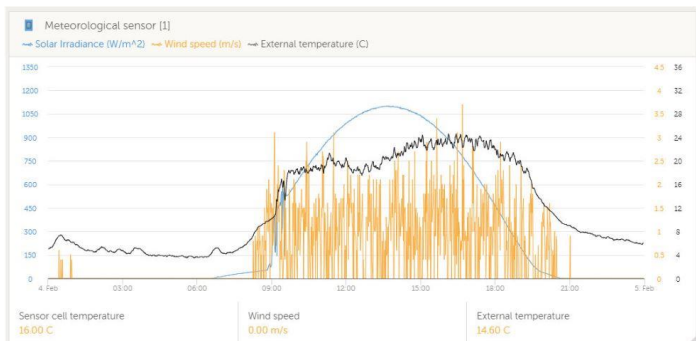
Battery sub-assembly

- ✓ 2x AGM flat plate sealed lead-acid solar batteries, model DeepCycle Victron 110, 110Ah C20, 12V
- ✓ 1x Polyethylene box 180 litres equipped (ventilation, handles, PE, etc).
- ✓ 1x Temperature sensor in the battery box



Sous-ensemble Sondes météorologiques (Option CH31)

- ✓ 1x Sunlight sensor
- ✓ 1x Ambient or module temperature
- ✓ These two probes are connected to the Victron CCGX data acquisition system, which allows these values to be integrated into the production monitoring curves (see below)



Sub-assembly Power Distribution

- ✓ 1x LED strip
- ✓ 1x porthole + led lamp
- ✓ 2x LED spotlights
- ✓ 1x 230V power socket





Pedagogical approach

Planned educational activities

Sizing & Energy Balances

- ✓ Functional analysis
- ✓ Sizing of an installation and evaluation of energy production
 - Estimation of electrical
 - Determination of the photovoltaic field, batteries, inverter
 - Use of an installation sizing software
- ✓ Verification of the sizing data of the installation (photovoltaic power, cable sections, inverter power, battery capacity, size of protections, etc.)

Economic and environmental analyses

- ✓ Technical and economic analyses (case of an individual, a company, a community...)
 - Return on investment time depending on subsidies
 - Comparison of a photovoltaic investment with a connection to the EDF grid
- Power generation in developing countries
- ✓ Environmental analysis
 - CO2 emissions avoided
 - The problem of decentralised production compared to centralised production (line losses, etc.)

Controller & Communication

- ✓ Programming, parameterisation and operation of the CCGX controller (e.g. retrieval and parameterisation of production data)
 - ✓ Study of communication protocols

Commissioning & Implementation

- ✓ Wiring of the electrical cabinet, connection of panels, batteries, etc.
- ✓ Commissioning of the installation
- ✓ Implementation of sunshine and temperature data acquisition
- ✓ Setting up a generator (Real or simulated by a battery charger)

Measurement

- ✓ Measurement and interpretation of data
- Determining the optimal
- Overall system efficiency, Inverter efficiency

Maintenance

- ✓ Diagnosis (Troubleshooting: Cable disconnected...)
- ✓ Planning and organisation of maintenance work (checking connections, cleaning panels, monitoring batteries, etc.)
- ✓ Changing a defective panel
- ✓ Planning and organisation of maintenance interventions (Checking connections, Checking the wind turbine, Monitoring the batteries...)

Exemples de Travaux Pratiques

Practical work 1 : Discovering photovoltaic production

- ✓ Objective: Discover energy and the different photovoltaic technologies and their insertion in the world and the needs.
- ✓ Chronology:
 - Principle of photovoltaic production and its use
 - Generation connected and not connected to the distribution network
 - The different photovoltaic
 - Solar radiation rate survey
 - Variability factor of solar production
 - Installed capacity in different countries and need for global production

Practical work 2 : Photovoltaic identification

- ✓ Objective: To discover the elements of the photovoltaic system
- ✓ Chronology:
 - Presentation of the 4 types of photovoltaic installations
 - Determining our type of photovoltaic system
 - Identification of energy sources
 - Identification of the components of the photovoltaic system
 - The solar chain :
 - MPPT solar controller features
 - Photovoltaic panel features
 - Influence of temperature
 - Study of the efficiency of the photovoltaic module
 - Study of the line voltage drop in cables
 - Study of batteries: characteristics, couplings, variation of capacity with temperature, factors influencing their lifetimes, safety standards for storage.
 - Installation methods for solar panels.

Practical work 3: Wind discovery

- ✓ Objective: Discovering wind power installations and the installation kit
- ✓ Chronology:
 - Presentation of the two types of use of wind turbines
 - Presentation of the two axis technologies
 - Presentation of the 3 different wind turbine families

- Exploitation of power curves
- Presentation of the two types of generators used (advantages and disadvantages)
- Study of the coupling of the wind turbine to the Photovoltaic and Wind Turbine isolated site system
- Study of the protection elements of the wind turbine
- Observation of wind turbine output and calculation of average power
- Calculation of the operating time of the wind turbine for a defined use
- Justification of the dimensioning of the distribution cable

Practical work 4: Dimensioning of the equipment of the isolated site Photovoltaic and wind power installation

- ✓ Objective: Carry out case studies of the sizing of the installation for a given use according to several parameters.
- ✓ Chronology:
 - Determining the energy requirements to be stored in the battery
 - Determination of the required battery capacity and peak power of the photovoltaic panel using CALSOL software according to the needs of the receivers, the geographical position of the production site, the orientation of the photovoltaic panel

Practical work 5: Maintenance of off-grid systems Photovoltaic and wind power

- ✓ Objective: Maintain the production system safely
- ✓ Chronology:
 - Identification of risks
 - Electrical identification of the installation
 - Maintenance and testing of the battery circuit
 - Maintenance and testing of the solar panel
 - Maintenance and testing of the wind turbine



Exemples d'installations

