

Lucas Nülle is proudly and exclusively
represented in Australia and New Zealand by



Training Systems Australia

First in Vocational Training Equipment
A Division of Pullman Learning Group

300 Centre Road, Bentleigh, Victoria, 3204

p: +613 9557 7993 e: info@trainingsystemsaustralia.com.au

LN
LUCAS-NÜLLE

RENEWABLE ENERGIES HYBRID SYSTEM



RENEWABLE ENERGIES HYBRID SYSTEM

In a hybrid system, the continuous supply of electrical energy is safeguarded by using different energy sources. Hybrid photovoltaic systems are generally used. An energy storage system ensures that consumers are supplied on demand and compensates for fluctuations. It is primarily the time-dependent and weather-related fluctuations of solar energy, and hence of generation, that need to be balanced out.



A hybrid photovoltaic system can be supplemented with other energy sources such as wind turbines, hydroelectric power plants and/or diesel generators. This can be useful in regions with less intense solar radiation since it allows the use of a moderately (over) dimensioned photovoltaic system to compensate for the fluctuations arising over the course of the day and year. In sunny regions, a hybrid system can increase security and independence of supply.



A hybrid system can be implemented in different ways:

- **Grid-connected**
 - Self-consumption optimised to increase autonomy
 - Uninterruptible power supply (UPS) to ensure security of supply in the event of power failure
- **Off-grid (stand-alone)**
 - Photovoltaic system with energy storage for load supply
 - Microgrid consisting of battery, PV and wind turbine

THE EXPANDABLE HYBRID PHOTOVOLTAIC SYSTEM



The training system uses industrial components to permit a hybrid photovoltaic system to be set-up in a realistic fashion. The use of fault-protected connections and safety leads makes it possible to convey the operating principles of the system in a secure environment. Complex energy flows within the hybrid system are graphically visualized and evaluated with the help of SCADA. The off-grid, grid-connected and uninterruptible power supply (UPS) modes of operation are replicated with the compact training system. The experiments in the laboratory are performed with the aid of a solar panel emulator. This guarantees reproducible results even when there is no sun.

This training system can be combined with the training systems for wind turbines and solar pump systems to create a microgrid. There is also the option of expanding the system to include real PV systems and wind turbines, thus allowing the training system to be used outside the laboratory.

Training contents

- Configuration of the charging characteristic for the accumulator
- Efficiencies of the system components
- Operating principles of an inverter
- Dimensioning the system components
- Set-up and configuration of the components
- Consideration of different operating modes: off-grid, grid-connected and UPS operation
- Analysis of complex energy flows with SCADA
- Expandable with the small wind turbine to create a microgrid
- Expandable with the solar pump system

THE HYBRID INVERTER



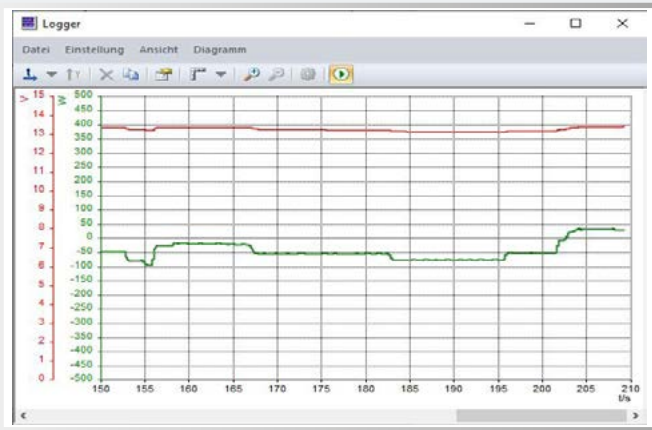
The hybrid inverter supplies the connected load from the accumulator, the PV system or the power grid. The accumulator can be charged with the IUoU charging characteristic by means of an integrated AC charge controller and/or an MPPT solar charge controller. The hybrid inverter protects the accumulator from overload, overcharging and deep discharge. A display and LEDs provide information about the operating status and state of charge.

Advantages and technical data

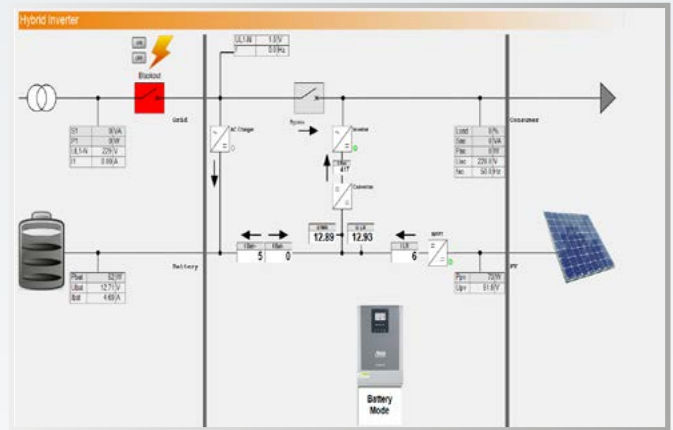
- Fault-protected industrial hybrid inverter
 - Reverse polarity and overvoltage protection of the battery connection: 30 A ATO
 - Overvoltage protection of the line power connection: 255 V
 - Circuit breaker: 6A
- Compact system consisting of:
 - Inverter
 - MPP tracker
 - Charge controller
 - Bypass for direct power supply of loads from the power grid
- System voltage: 12 V
- System power: 1200 VA, 240 VA for 5 sec.
- MPPT charge controller, 15 V to 80 V, max. 100 V
- Connectors: 4-mm safety sockets

Art. no. CO3208-1U

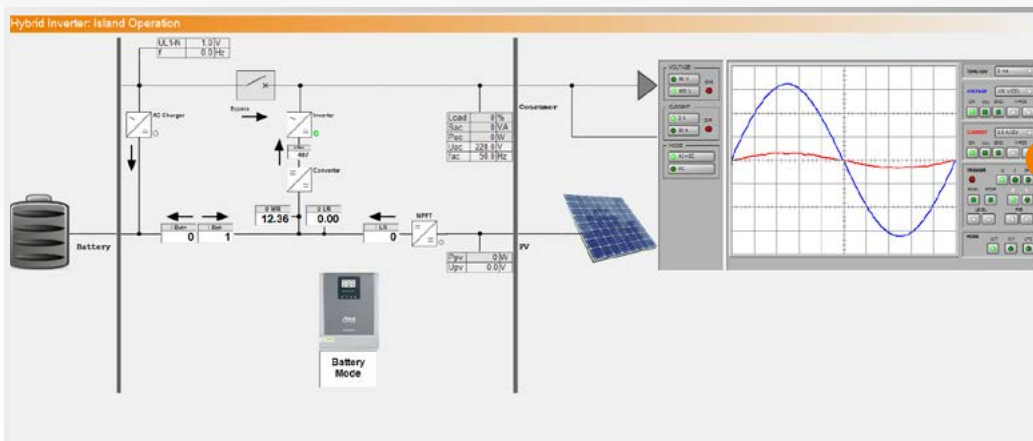
SCADA LINK



Logger



SCADA



Integrated virtual instrument: oscilloscope

Supervisory control and data acquisition (SCADA) is used to visualize the complex energy flows within the compact hybrid inverter and to represent the system's operating states. The integrated oscilloscope makes it possible to analyze the operation of the inverter and the quality of the modulated voltage. The variation of measured values over time can be recorded with the logger.

When the hybrid photovoltaic system is combined with the small wind turbine, the energy flows in the resulting micro-grid can be visualised with SCADA.

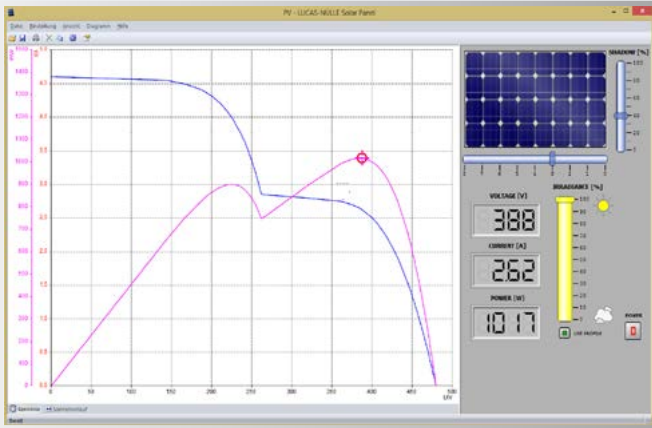
Functions of the software

- Didactic SCADA for operation
- Display of measured values and operating states in real time
- Recording of graphs of the measured values over time
- Processing, analysis and export of graphs
- Can be expanded by any number of individual projects created with SCADA Designer

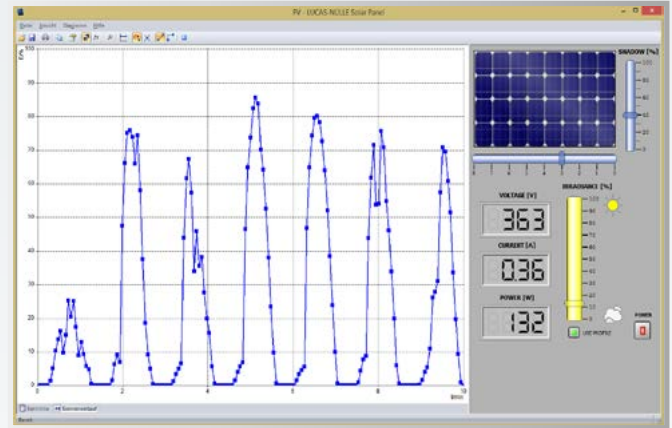
Art. no. SO4001-3F (SCADA Designer)

Art. no. SO4001-3H (SCADA Viewer)

SOLAR PANEL EMULATOR, 80 V



PV emulator with shading



Irradiance curve over a week



The solar panel emulator replicates the behaviour of a solar panel in a realistic manner, and the connected industrial hybrid inverter responds as it would to a real solar panel. This makes it possible to obtain reproducible results in the laboratory at any time by setting specific operating points. All aspects of a solar panel can be taken into account using the supplied software. In addition to setting the irradiance to values between 0% ... 100%, partial shading of the solar panel can be realised, and time curves representing, for example, the course of a day, can be stored. The current operating point of the MPPT charge controller is displayed graphically on the PV characteristic in the software of the solar panel emulator.

Benefits

- Reproducible results
- Indicates the operating point on the PV characteristic
- Partial shading of the solar panel
- Variation of irradiance over time

Art. no. CO3208-1V

SOLAR MODULE WITH ADJUSTABLE ANGLE OF INCLINATION



The solar modules are well-suited for presentation in the lab and also for use outdoors. The adjustable inclination angle is used to adapt the module to the sun's radiation angle. The module can be connected in series or in parallel and the solar energy can be stored in an accumulator.

Benefits

- Outdoor operation
- Laboratory presentation
- Explore optimum alignment of solar modules

Art. no. CO3208-1X

MICROGRID WITH SMALL WIND TURBINE



The Hybrid Photovoltaic System training system can be expanded to include a small wind turbine in order to take into account the aspects of increasing security and independence of supply on the basis of renewable energies in a microgrid. The structure of the overall system and the operation of the parallel charge controllers are considered.

Also taken into account are the dynamic variations of the wind and sun. The energy flows are analyzed with the help of SCADA using real wind and irradiance profiles.

Training contents

- Microgrid consisting of hybrid photovoltaic system and small wind turbine
- Increase in security and independence of supply
- Parallel wind and PV charge controllers
- Evaluation of energy flows with SCADA

SOLAR PUMP SYSTEM EXPANSION



The combination of the solar pump system with the hybrid photovoltaic system makes it possible to pump well water even without solar irradiance since the hybrid system also provides a battery storage unit.

In addition to water pumps, other AC consumers can also be supplied by the hybrid system. The aim here is to match the components to the requirements and achieve prioritisation by setting the parameters accordingly.



Training contents

- Set-up of the solar pump system with energy storage
- Supply with water and electricity in one system
- Prioritising consumers



RENEWABLE ENERGIES HYBRID SYSTEM



Training Systems Australia
First in Vocational Training Equipment
A Division of Pullman Learning Group

p +61 3 9557 7993
e info@trainingsystemsaustralia.com.au
w www.trainingsystemsaustralia.com.au
a 300 Centre Road, Bentleigh, VIC, 3204