DIDACTIC GMBH
ELABO Training Systems

PHOTOVOLTAICS

in Training

HARDWARE

From the Cell to the Module

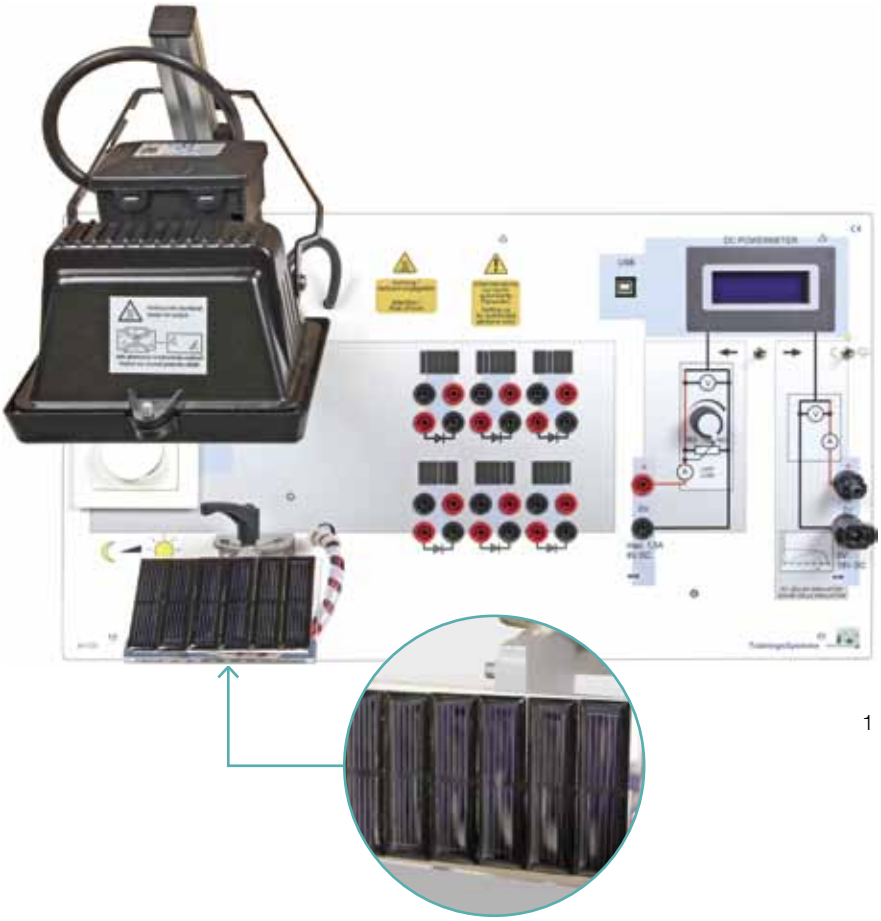
1

Learning Objectives

- ⟩ Key solar cell data
- ⟩ Linking solar cells and modules
- ⟩ Bypass diodes
- ⟩ String diodes
- ⟩ Partial switch-off of cells and modules
- ⟩ Partial failure of modules
- ⟩ Solar cell output under different radiation conditions

No.	Description / Title	Order no.
1	PV Board	44100

Manual or computer-supported Recording of characteristic Curves



1

Technical Data PV Board (1)

- 6 solar cells, wired separately, mounted able to rotate and swivel
- 6 diodes, can be used as string or bypass diodes
- 1 dimmable light source, can be swivelled to simulate the sun's path
- Simulation PV-generator U_0 18 V, I_{SC} 2.5 A for connection to real charge controllers
- Voltage, current and power meters with USB interface
- Electronic load, to be set manually and using software

HARDWARE

Off-Grid Charge Controller Board and Series Charge Controller Board

1 2

Learning Objectives

- Types of charge controllers
- Discharge protection
- Deep discharge protection
- Energy storage
- Operation of consumers at a rechargeable lead gel battery
- Power adaptation

Technical Data Off-Grid Charge Controller Board (1)

Off-Grid charge controller with display

- With additional integrated meter for current, voltage, power
- PWM-controlled
- System voltage: 12 V DC
- Maximum load current: 10 A

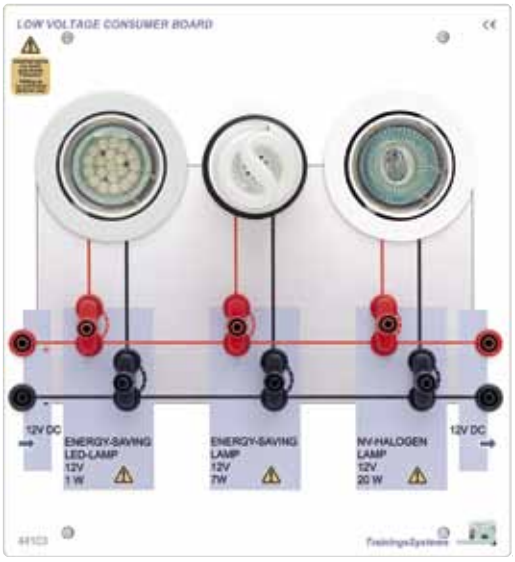
Technical Data Series Charge Controller Board (2)

Off-Grid charge controller

- With additional integrated meter for current, voltage, power
- Serial control
- System voltage: 12 V DC
- Maximum load current: 6 A

No.	Description / Title	Order no.
1	Off-Grid Charge Controller Board	44101
2	Series Charge Controller Board	44106

Low-Voltage Consumer Board and Battery



3

Built-in meters for current, voltage and power

4

Technical Data Low-Voltage Consumer Board (3)

- Low-voltage consumers
- LED lamp 1 W
- Fluorescent lamp 7 W
- Halogen lamp 20 W

Technical Data Battery (4)

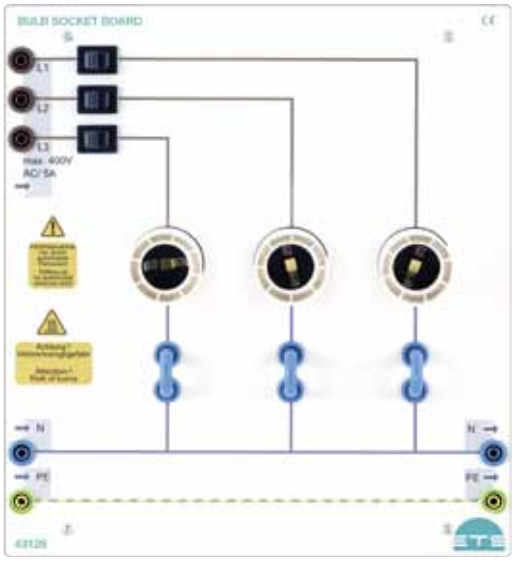
- Battery 12 V DC
- Lead gel battery with 7.8 Ah
- Built-in fuses
- Integrated, switchable meter for current, voltage, power

No.	Description / Title	Order no.
3	Low-Voltage Consumer Board	44103
4	Battery	44102

HARDWARE

Off-Grid Inverter Board and Bulb Socket Board

1



2

Learning Objectives

- Stand-by losses
- Efficiency of inverters
- Start-up behaviour of inverters
- Voltage shape and harmonics
- Load behaviour

Technical Data Off-Grid Inverter Board (1)

- Off-Grid inverter
- Input voltage: 12 V DC
- Output voltage: 230 V AC / 50 Hz, 275 VA, sinus-shape
- Integrated metering device for current, voltage, effective, apparent and blind power, power factor, energy

Technical Data Bulb Socket Board (2)

- Lighting technology board with sockets for 3 bulbs (E27)

Set of Bulbs (3)

- Comprising 6 lamps 230 V

3

No.	Description / Title	Order no.
1	Off-Grid Inverter Board	44104
2	Bulb Socket Board	43126
3	Set of Bulbs	43122

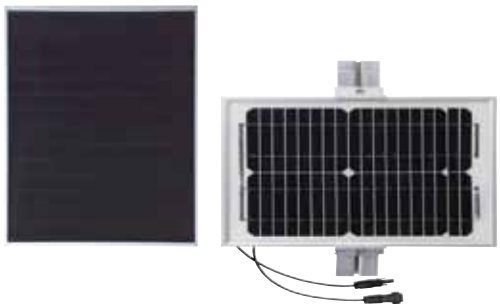
Extensions

4

PV sun position simulation (4)

Mobile frame for carrying out technical measurements on solar modules

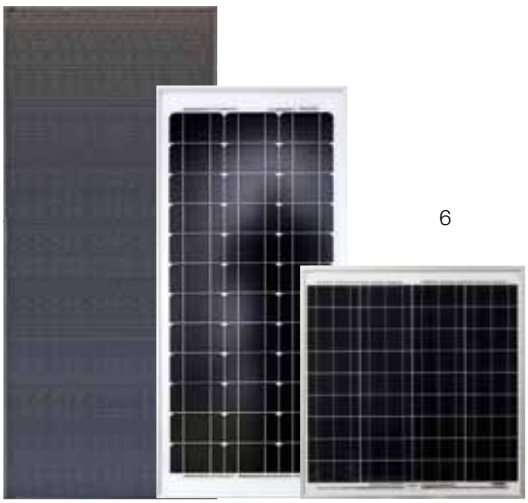
- Light source with dimmer, can be rotated and swivelled, for simulating the position of the sun during the day and during the year
- Operating voltage 230 V
- Module holder for the 10 W and 50 W solar modules from module sets 44121 and 44122, adjustable, for simulating different roof angles, adjustment using a degree scale
- The frame is also suitable for the use of 50 W modules outdoors
- The modules are attached using genuine roof attachment material, making the frame suitable for installation practice



5

10 W Solar Modules Set (5)

- The set contains one polycrystalline (10 W) and one amorphous (6 W) solar module
- The modules are equipped with an installation frame and Sunclix connectors ready for connection



6

50 W Solar Modules Set (6)

- The set contains one monocrystalline (50 W) and one polycrystalline (45 W) solar module
- The modules are equipped with an installation frame and Sunclix connectors ready for connection

No.	Description / Title	Order no.
4	PV Sun Position Simulation	44120
5	10 W Solar Modules Set	44121
6	50 W Solar Modules Set	44122

DC OFF-GRID SYSTEMS

Set-up Variant – DC Off-Grid Systems without Storage

❶

DC

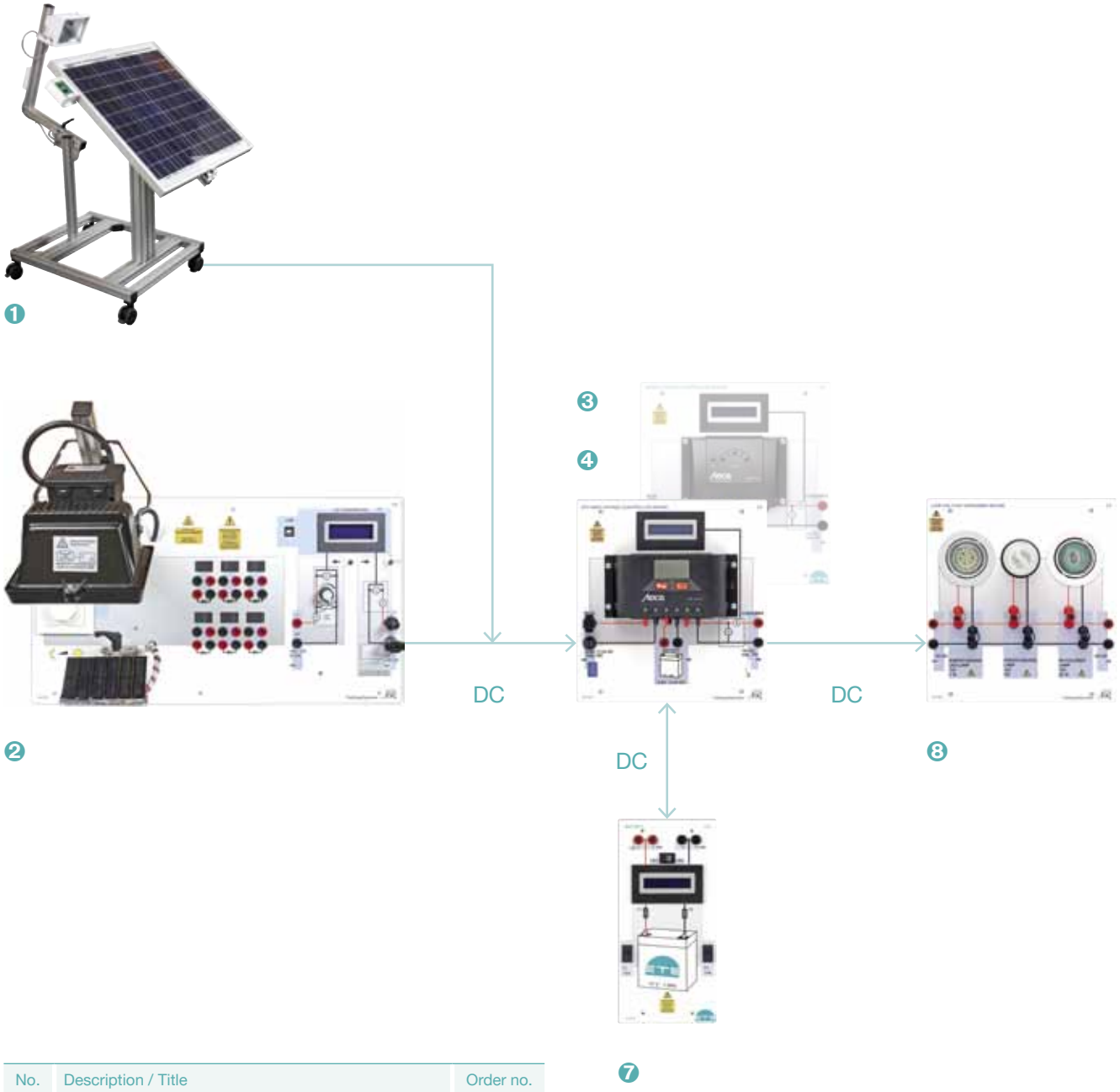
❷ ❽

No.	Description / Title	Order no.
1	PV Cells simulation of the sun's position	44120
2	PV Board solar cells	44100
8	Low-Voltage Consumer Board – Low-voltage consumers	44103

Picture: AE Photonics GmbH

Solar pump system in Morocco

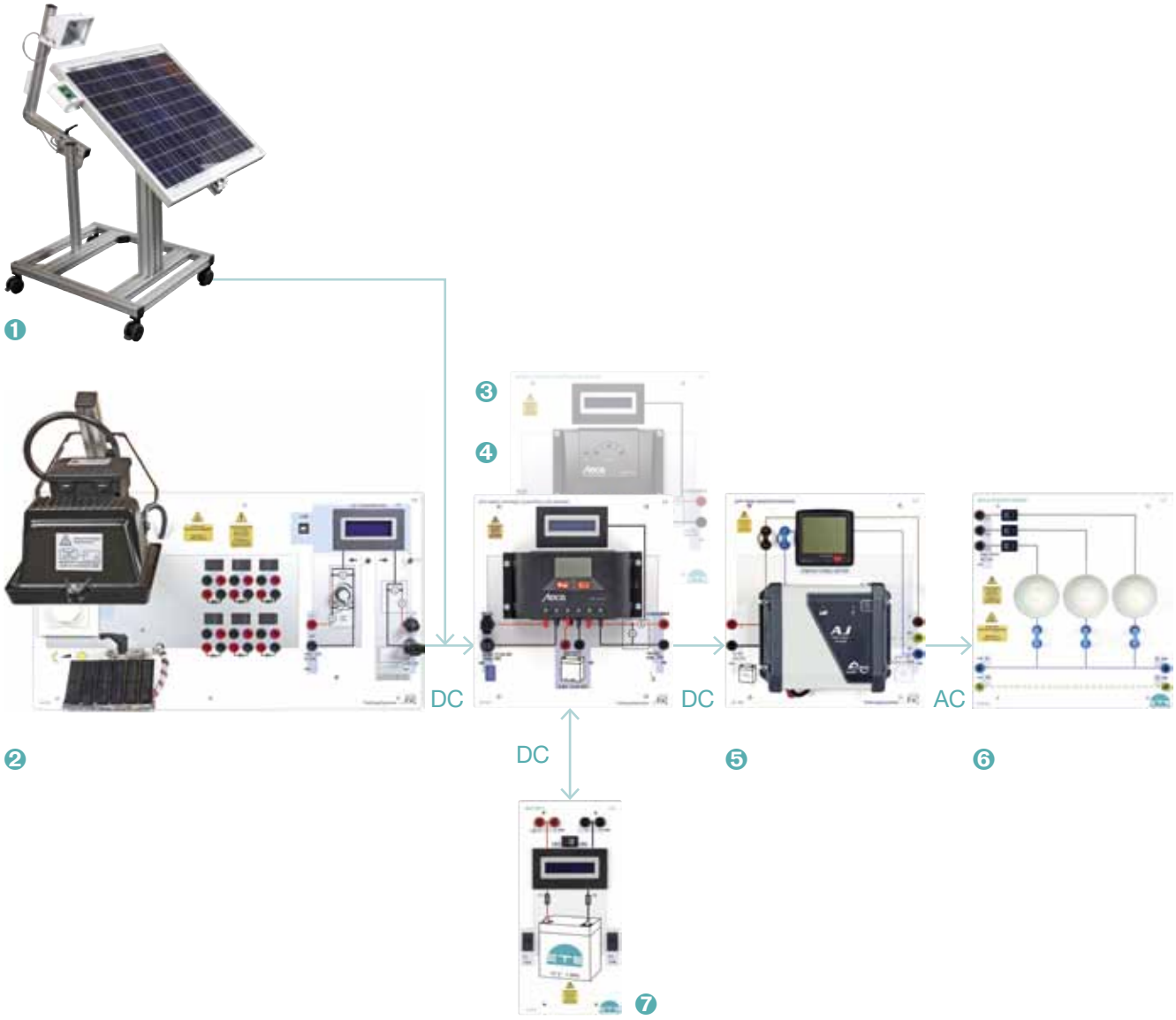
Set-up Variant – DC Off-Grid Systems with Storage



No.	Description / Title	Order no.
1	PV Cells simulation of the sun's position	44120
2	PV Board solar cells	44100
3	Series Charge Controller Board	44106
4	Off-Grid Charge Controller Board	44101
7	Battery 12 V DC	44102
8	Low-Voltage Consumer Board – Low-voltage consumers	44103

DC OFF-GRID SYSTEMS

Set-up Variant – DC Off-Grid Systems with Off-Grid Inverter and AC Load

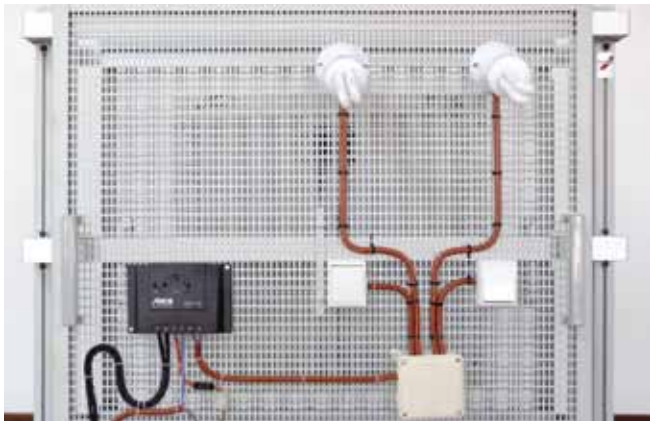


No.	Description / Title	Order no.
1	PV Cells simulation of the sun's position	44120
2	PV Board solar cells	44100
3	Series Charge Controller Board	44106
4	Off-Grid Charge Controller Board	44101
5	Off-Grid Inverter Board	44104
6	Bulb Socket Board	43126
7	Battery – 12 V DC	44102

OUR RESPONSIBILITY

1.3 Billion People around the World have no Electricity. In Africa, south of the Sahara, only one Third of the Population can use Electricity (source: GIZ).

It is a well-known fact that theory alone is not enough; that's why we give hands-on training to our customers all over the world.



Installation and maintenance of Pico and Solar Home systems.

SHARING KNOW-HOW

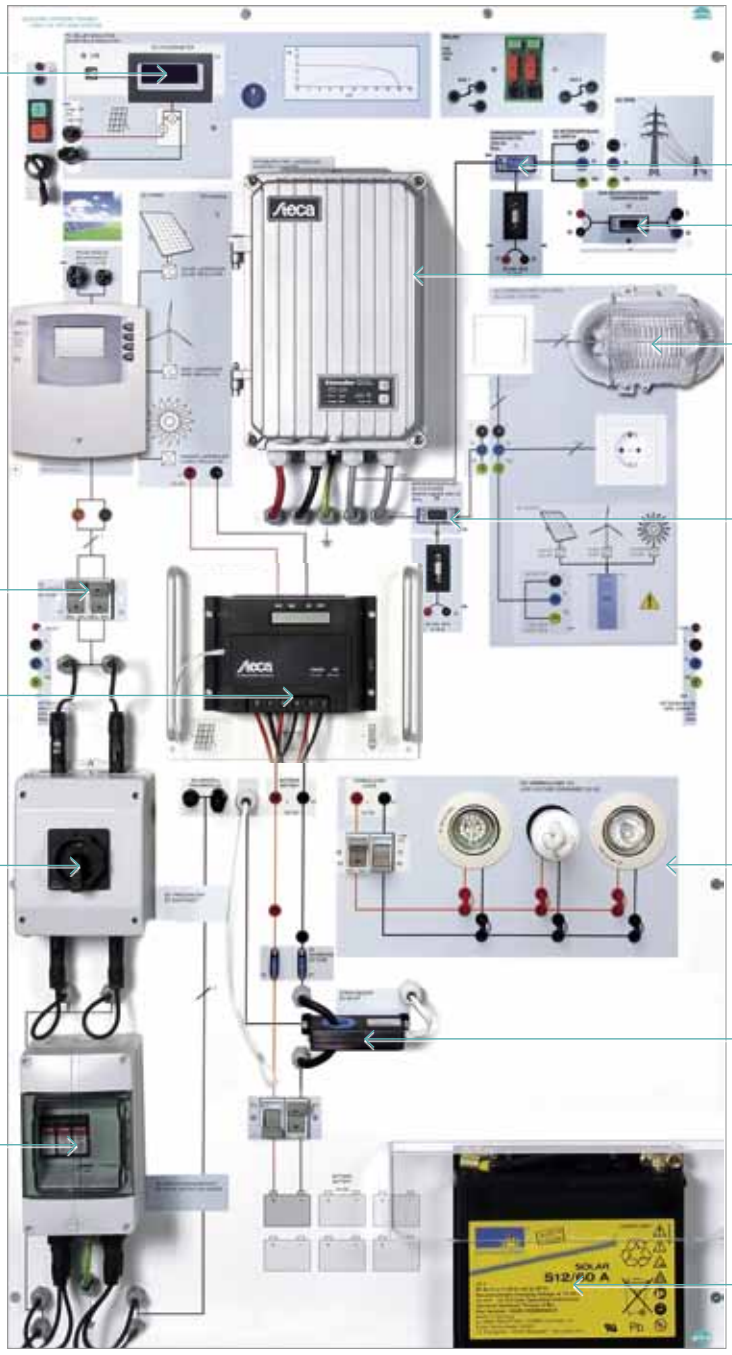
Planning, Installation and Commissioning of PV and Hybrid Systems

We share all our know-how with our customers in practical hands-on seminars.

PHOTOVOLTAIK OFF-GRID

BST®–BuildingSystemsTrainer

PV simulator
Simulation of a
PV module
U_0 = 17.5 V
I_{SC} = 2.5 A



MID-conform meter
with RS485 interface

Load resistance
for bus system

Inverter and
charge controller

AC consumer

MID-conform meter
with RS485 interface

DC string
fuse

Charge Controller
interchangeable

DC cut-off switch

DC consumer

Measuring shunt

DC excess voltage
protection

Solar battery

1

1

2

Target Group

- Electrical engineers specialising in energy and building technology
- Electrical engineers for building and infrastructure systems
- Institutes of higher education
- Technical colleges
- Schools for master trade qualifications

Technical Data

- Different modes of operation possible (hybrid operation), Off-Grid system, DC-hybrid, AC-hybrid
- Simulation of a PV module
- Switchover grid/solar operation
- Integration of existing PV modules
- Integration in a SMARThome
- Smart Grid thanks to network-capable meters

Learning Objectives

- Project planning for PV system components
- Setting up and integrating decentralised energy supply and energy conversion systems
- Setting up and connecting all the necessary energy supply and communication units
- Establishment of the necessary lighting and excess voltage protection
- Maintenance and service of PV systems

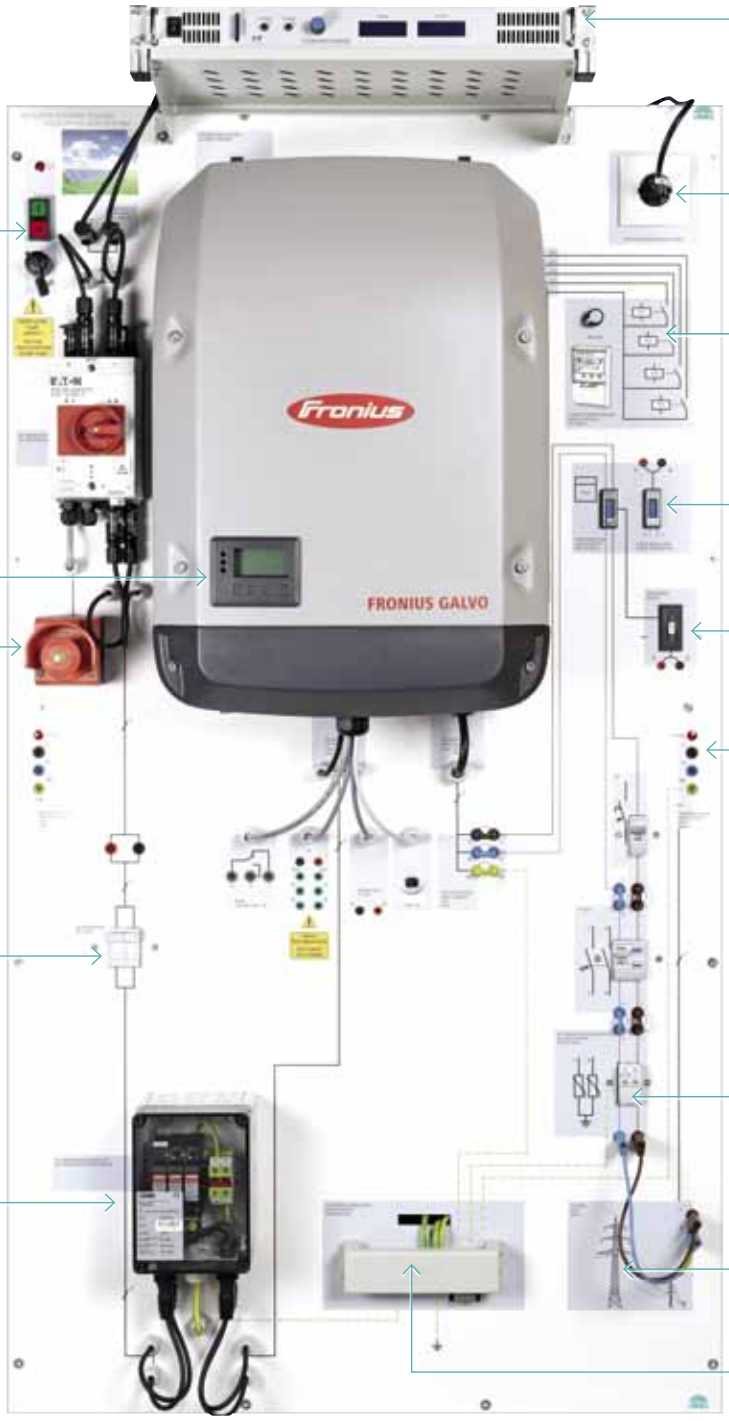
Advantages

- Learning targets integrated in an overall concept
- Better understanding of the contexts
- Use of components standard on the market

No.	Description / Title	Order no.
1	BST® PV Off-Grid System	43521
2	BST® PV On-Grid System	43520

PHOTOVOLTAIK ON-GRID

BST®–BuildingSystemsTrainer



Power supply for illustration the PV characteristic PV module simulation

Power outlet for power supply unit

Key switch and pushbutton for release of the energy supply

Simulation switch ripple control receivers

Energy meter systembus S-Bus

PV inverter according

Output systembus S-Bus

PV-OFF-Button with protective collar

Network supply

DC switch disconnector

Surge protection on the AC side

DC surge protection

Input supply grid

Main potential equalisation via the main earthing bars

1

2

Target Group

- Industrial engineers
- Electrical engineers specialising in energy and building technology
- Technical grammar schools, environmental technology
- Schools for master trade qualifications, higher education institutions, technical colleges

Technical Data

- To be operated on existing PV modules from a voltage of 150 V
- To be operated as "stand alone" unit thanks to PV characteristic curve simulator
- DC and AC protective devices
- Data logger for data recording and power control
- PV inverter according to the current standards (ENS, 50.2 Hz problem etc.)

Learning Objectives

- Planning, implementing and commissioning photovoltaic (PV) systems
- Repairing and modifying PV systems
- Measuring the energy produced in a PV system
- Planning data recording and remote systems for implementing mandatory requirements and putting systems into operation
- Controlling the power of a PV system in accordance with the power to grid directive
- Control of own consumption

Advantages

- Integration of the PV system in Smart Grid/Smart Home systems
- Practical use of abstract terms (Smart Grid, Smart Metering, Smart Home)
- Practical set-up, with use of components standard on the market

No.	Description / Title	Order no.
1	BST® PV On-Grid System	43520
2	BST® PV Off-Grid System	43521

ACCESSORIES

Measuring Devices

1

Power and I-U characteristic curve analyser (1)

- The instrument allows the on field measurement of I-V curve as well as of the main parameters of a single module and of a whole photovoltaic system up to a maximum of 1000 V and 10 A.
- The instrument allows to perform quick tests (IVCK) to measure the open voltage Voc, the short circuit current I_{sc} and the maximum power point on PV modules/strings. The acquired data are then worked out and transferred to the reference conditions (STC) in order to compare them with the rated data declared by the manufacturer of those modules.
- The comparison between the detected and the rated data permits to immediately determine whether the string or the module respect the parameters declared by the manufacturer.
- The I/V curve tester is delivered in a rigid carrying case

2

Solar power meter (2)

- Portable digital meter for power solar radiation measurements up to 2000 W/m^2, extremely compact and easy to use with photo sensor connected to the meter to perform accuracy readings.
- With carrying bag and battery.

No.	Description / Title	Order no.
1	Power and I-U characteristic curve analyser	90240
2	Solar power meter	90241

EXCELLENCE IN TRAINING

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Subject to technical modifications and further developments

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