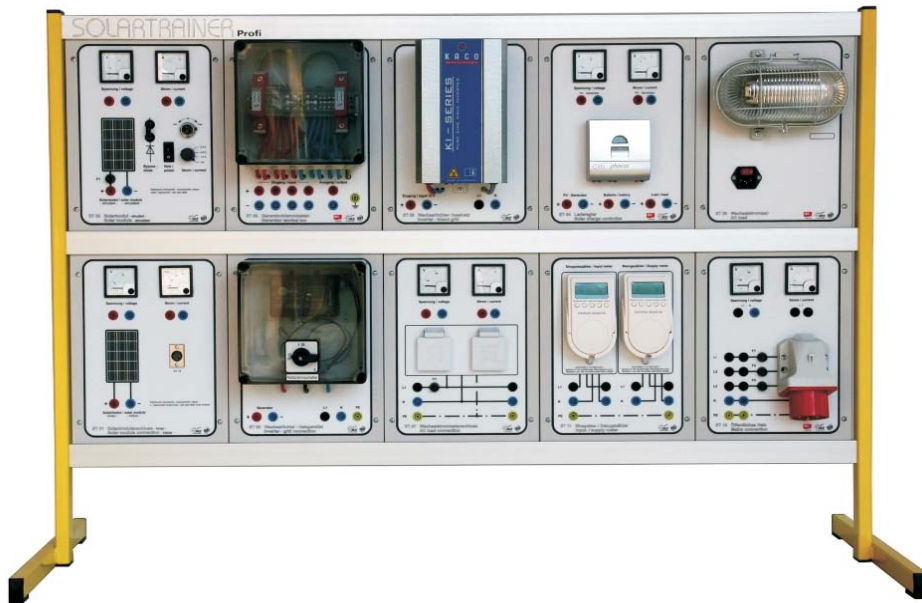


Photovoltaic – Trainingsystem for vocational and advanced training

The Solar branch is one of the important growth market of the future. The number of jobs grows, the demand of specialists and executive staffs increases continuously. For this reason worldwide the vocational and advanced training in the field of photovoltaic will become more and more important.



Development

In cooperation with the ISET - Institut für Solare Energieversorgungstechnik e. V. (now: Fraunhofer Institut für Windenergie und Energiesystemtechnik IWES) in Kassel the company IKS Photovoltaik developed the Photovoltaic-Trainingsystem Solartrainer profi.

Application

The PV-Trainingsystem is suited for the instruction at schools, vocational training Schools, training centres, evening classes and universities. Supported learning objectives can be electrical and system engineering, construction, mode of operation, connecting and installation of PV-plants. It can be used both to the supplementary demonstration of lessons and courses as well as for the use in practical training.

Construction

The system consists of individual plugin units each with components for different experimental arrangements. The plugin units are put in the rackside and connected according to the demand. The conception of the system allows indoor and outdoor experiments. Indoor experiments are easily possible among others because of the system included PV-module

plus module stand. Using a dimmable spotlight which is vertically as well as horizontally movable fixed to an outrigger, seasonal daily curves can easily be simulated.

Additional options are the change of slope angle and the simulation of the influence of irradiation and temperature on the characteristic curve of a PV-module.

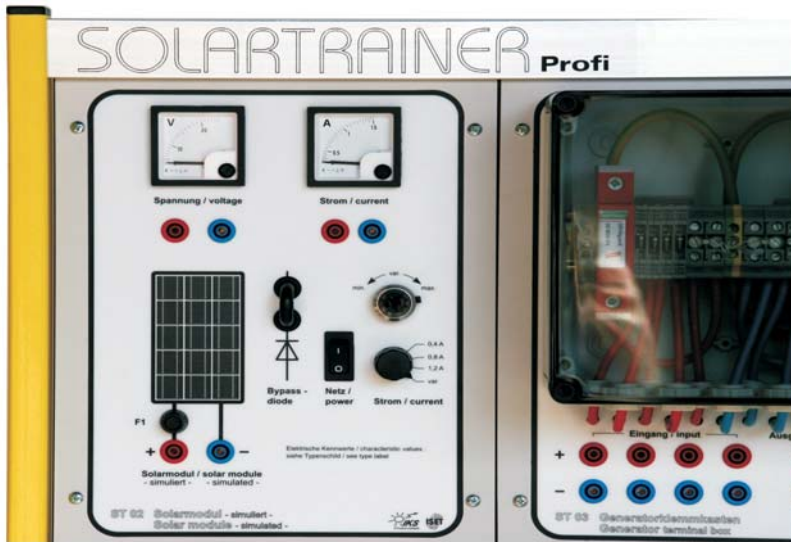
To ensure a reproducibility of measurements and not to depend on the weather, a PV-module simulator was developed, which exactly simulates the behaviour of a PV-module. The short circuit current can be adjusted.



What a pupil or trainee can work out on his own in practice oriented labscale experiments, is transferable to real systems without problems.

SOLARTRAINER

Profi



Flexible

The modular conception of the system allows the selection of the plug-in units and components for the different training objectives.

The at any time possible enlargement and integration of new technology assure a system that is always state-of-the-art.

Instructional materials

An experimental instruction as well as two developed training sessions are available. (at the moment only in German language)

Contents of the experiments

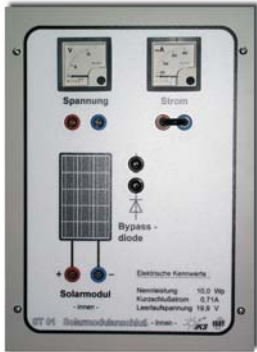
The basic principles of photovoltaics considering the influence of different parameters can also be imparted as the application of direct connected small systems, the mains behaviour of stand alone systems and the especially for craftsmen very important line powered operation mode:

- Characteristic curve of a diode, respectively a diode series
- Characteristic curve of a solar module (I/U) and (U/P), MPP
- Characteristic curve of a solar module (I/U) depending on irradiation
- Characteristic curve of a solar module (I/U) depending on temperature
- Power output of a solar module depending on the angle of incidence of the light
- Simulation: Power output of a solar module depending on the position of the sun (morning to evening / winter- and summertime)
- Series connection of solar modules
- Parallel connection of solar modules
- Series connection of solar modules and shadowing without bypass-diode
- Series connection of solar modules and shadowing with bypass-diode
- Line powered operation mode: solar energy is fed via inverter (changes solar DC into sinusoidal AC, singlephase) to the mains. Different constellations of power flowing in the system. Calculation of efficiency (inverter)
- Stand alone systems DC and AC. Solar charging controller, battery, stand-alone inverter, DC and AC loads. Different constellations of power flowing in the system

- Integration of outdoor solar module
- Measurement with PC, data storage

The listing does not contain all experiments which are possible to carry out. The possibility of carrying out the experiments is depending on the equipment.





ST 01
PV-module connection indoor

For connecting the solar module from "ST 14". Analogous voltmeter, ammeter



ST 05
DC / AC inverter / mains parallel operation

Changes DC into sinusoidal AC, singlephase feeding, linecommutated.
input = 24- 35 VDC / 3A
output = 230 V AC
Pmax = 110 W



ST 02
PV-module simulator

For exact imitation of a PV-module, mains-fed 230 V AC.
Output DC:
Voc = 23,1 V
Isc = 0 - 1,5 A
Pmax = 24 W.
Short circuit current can be adjusted in three steps or continuously. Switchable bypass-diode.
Analogous voltmeter, ammeter



ST 06
DC / AC inverter / stand-alone operation

Changes DC into rectangular AC to create a stand alone mains.
input = 12V DC / 3A
output 230V AC
Pmax = 100 W.
Analogous voltmeter, ammeter



ST 03
PV-module terminal box

For parallel connection of 4 solar modules / simulators over diodes to one output. Excess voltage protection not operable.

Power rating 24 V/ 3 A each input



ST 06A
DC / AC inverter / stand-alone operation

Changes DC into sinusoidal AC to create a stand alone mains.
input 12V DC / 3 A
output 230V AC
Pmax = 100 W.
Analogous voltmeter, ammeter



ST 04
Solar charging controller
Controls the charging of the battery "ST 21" and loads, deep discharge control, visualisation of operating status and key values.
Nominal voltage 12 V DC, max. current 8 A DC.
Analogous voltmeter, ammeter



ST 07
AC load connection

For connecting with the mains via "ST 13", two 230 V AC sockets for AC loads, max. 450 W.
Analogous voltmeter, ammeter

SOLARTRAINER

Profi



ST 08
DC load connection

For connecting DC loads in stand alone systems, two 12 V DC sockets for DC loads, max. 100 W



ST 13
Mains connection

Threephase AC -grid connection to connect the trainingsystem with the mains.
Five-pin plug CEE 16 A
Fuse 2 A. Analogous voltmeter, ammeter



ST 09
Battery connection

For connecting a solar batter "ST 21" with "St04".
The battery can be switched
Analogous voltmeter, ammetk bidirectional



ST 10
Electronic AC electricity mete
1x input, 1x output

For measuring the via inverter generated solar energy.
Measuring kWh, W, time,
different tariffs can be selected



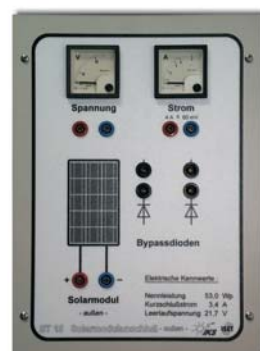
ST 14
PV-module stand

The halogen lamp 500 W (mains connection 230 V AC) with dimmer switch is vertical as well as horizontal movable fixed to an outrigger and irradiates the PV-module.
Adjustable angle of inclination of the PV-module.
PV-module
Pmax = 10 W, monocrystalline.
Stand with 4 rolls with stop-function



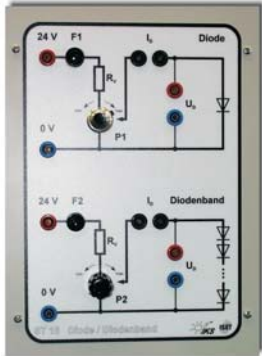
ST 11
Electronic AC electricity meter,
2x input, 2x output

For measuring the via inverter fed solar energy to the mains and the supplied energy from the mains.
Measuring kWh, W, time,
different tariffs can be selected



ST 15
PV-module connection
outdoor

For connecting the solar module from "ST 22".
Analogous voltmeter, ammeter

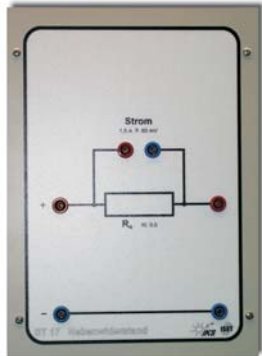


ST 16
Diode / diode series

For recording the characteristic curve of a diode, respectively a diode series.
Input 24 V DC, max. 1 A (power supply ST 27)

ST 19
Movable laboratory stand and set of safety connecting / measuring cords

Highly flexible safety cords, 4 mm. Contacts brass / hard copper gold plated.
Bracket with 42 consoles mounted, 4 rolls with stop-function



ST 17
Shunt

Max. current 1,5 A
For measuring with "ST 05" mains parallel operation / connecting with an oscilloscope

ST 20 A
plug-in units
2 x AC load 230 V, 60 W lamp
1 x AC load 230 V, 11 W energy saving lamp
1 x DC load 12 V, 50 W halogenlamp

ST 20 B
Set of electrical loads, consisting of:

- 1 x variable resistor 378 Ohm / 1,3 A
- 1 x variable resistor 148 Ohm / 1,6 A
- 1 x variable resistor 12,8 K.Ohm / 0,16 A
- 1 x variable resistor 13,1 Ohm / 6 A



ST 18
Set of safety connecting / measuring cords

Highly flexible safety cords, 4 mm. Contacts brass / hard copper gold plated.
Bracket with 21 consoles for wall mounting



SOLARTRAINER

Profi

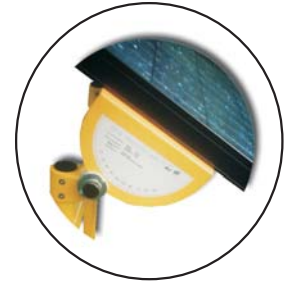


ST 21
Solar battery

Closed lead-gel battery specific for storage of solar energy. Connecting with "ST 09" and "ST 04" to build a stand-alone system

ST 22
PV-module outdoor

For outdoor experiments. Adjustable angle of inclination of the PV-module, mounted on a frame with two wheels. Output DC:
Voc = 20,8 V
Isc = 3,6 A
Pmax = 56 W
Type polycrystalline



ST 23
Electronic DC electricity meter, 1x input, 1x output

For measuring energy in DC mains (one direction)
Measuring W



ST 27
Power supply

Mains connection 230 V AC, output 0 - 30 V / 0 - 2 A DC, for use with "ST 16 "

ST 29
PV- module amorphous

5 W, with alternate mounting system (for Pos. 14), incl. connection cord and plug



ST 30
Safety box

with false current cut - out (4 - pole), CEE five-pin plug and 1,5 m connecting cord. With CEE five-pin socket. For connecting with mains and "St13"

SOLARTRAINER

Profi



ST 99
Take up frame

For 10 instruction - panels



ST 97
Experimental introduction

Languages deliverable

German
English
Spanish
French



ST 98
Instruction manual

Languages deliverable

German
English
Spanish
French



ST 96
Laboraty roller desk

For use with ST 99

Subject to alteration. State: 10/2009

IKS Photovoltaik GmbH
An der Kurhessenhalle 16 b
D-34134 Kassel / Germany
Phone +49 (0) 561 / 9538050
Fax +49 (0) 561 / 9538051
www.iks-photovoltaik.de
info@iks-photovoltaik.de



Training systems
Measurement engineering
Special developments

Reseller