



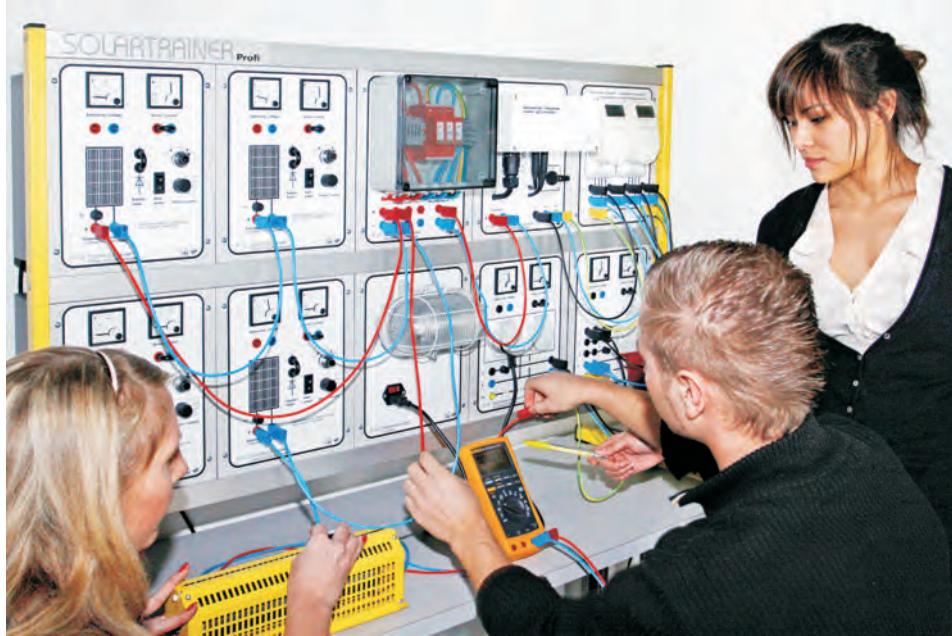
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Photovoltaic – Trainingsystem for vocational and advanced training

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

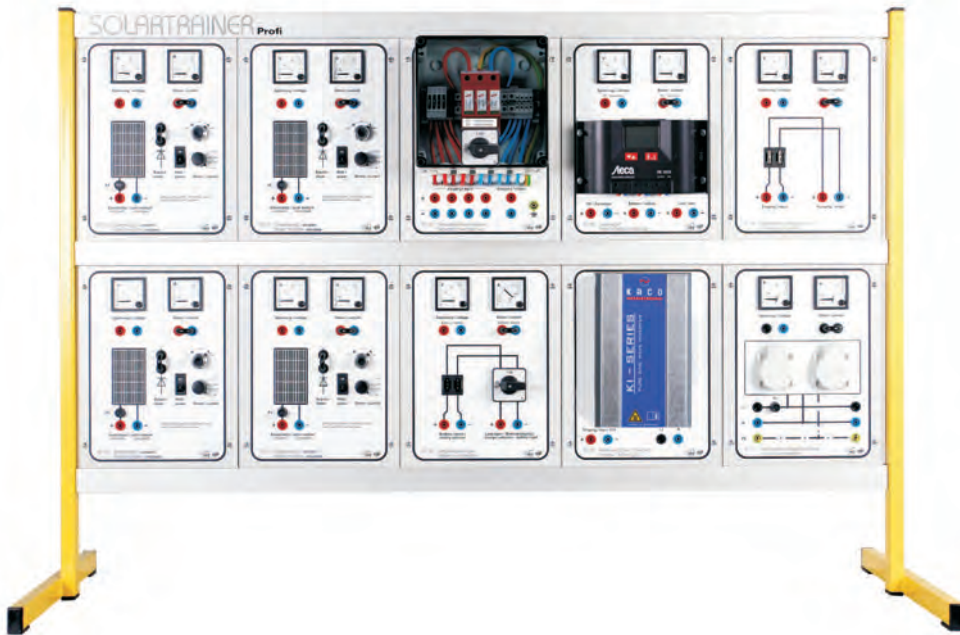
plus module stand. Using a dimmable spotlight which is vertically as well as horizontally movable fixed to an outrigger, seasonal daily curves can easily be simulated.

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 lab-scale experiments, is transferable to real systems without problems.



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.

German
English
Spanish
French

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
- Grid parallel operation mode
Different operation modes and directions of electric energy power flow. Calculation of the efficiency (inverter)
- Stand alone systems DC and AC. Different operation modes
- Integration of outdoor solar module



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. Technical changes reserved 2014-06



ST 01
Solar Module
Connection Indoor

For connecting the solar module of "ST 14 module stand" to the socket on the front. The two front sockets of the schematically shown solar module can be connected to a variable load (e.g. ST 20 B). Measuring of voltage and current.



ST 05 O / ST 05 D
Inverter Grid Connection

Transforms direct current into sinusoidal alternating current, single-phase feed-in, line-commutated. Input 28 - 50 V DC, MPP-tracking AC power approx. 110 W
Available versions:
230 V / 50 Hz (ST 05 O / ST 05 D)
230 V / 60 Hz (ST 05 D)
115 V / 60 Hz (ST 05 D)



ST 02
Solar Module Simulated

Solar module simulator for the exact simulation of a solar module.
Short circuit current can be adjusted in steps or variably. Parallel and series connection possible
Switchable bypass diode.
Mains connection 230 V / 50-60 Hz.
Open circuit voltage 23.1 V, short circuit current 0 -1.5 A, rated power 24 Wp



ST 06 R
Inverter Island Grid

Transforms direct current into rectangular alternating current for operation of an island grid system. Input 12 V DC/8 A, output 230 V / 50 Hz.
AC power approx. 100 W



ST 03
Generator Terminal Box

For the parallel connection of 4 solar modules/ simulators each via one diode onto one output. Overvoltage protection Without function. Max. current per input 24 V/3 A DC-disconnector.



ST 06 S
Inverter Island Grid

Transforms direct current into sinusoidal alternating current for operation of an island grid system. Input 12 V DC/8 A AC power approx. 100 W
Available versions:
230 V / 50 Hz
230 V / 60 Hz
115 V / 60 Hz



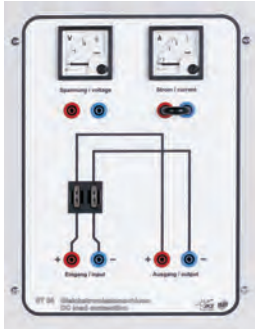
ST 04
Solar Charge Controller

For monitoring of the state of charge state of the battery. Controls the loading process and the connection and disconnection of loads (low voltage disconnection). Operation status on LCD display.
Rated voltage 12 V/max 8 A



ST 07
AC Load Connection

For connection to the mains (via "ST 13 Mains connection) or to an inverter island grid ("ST 06 / ST 06 A") and operation of alternating current loads of max. 450 W
Available versions:
230 V / 50-60 Hz
115 V / 60 Hz



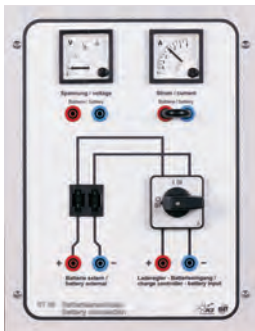
ST 08 DC Load Connection

For connection to "ST 04 solar charge controller" and operation of direct current loads 12 V / max. 8 A



ST 12 Automatic Insulation Unit

For monitoring single-phase power feeding systems. It prevents uncontrolled island effects following failure or shutdown of the public electricity supply. Operating voltage 230 V / 50 Hz



ST 09 Battery Connection

For the connection of "ST 21 solar-battery" to "ST 04 charge controller"



ST 13 Mains Connection

Three-phase AC connection for connection of the public grid via a 5-pole CEE coupling 16 A to the training system. Adapter cable for single-phase available.



ST 10 Electric Meter

Single-phase electronic AC meter for measuring of the generated solar energy. Display of current power, kWh, measurement duration, inputting of tariff possible. Available versions:
230 V / 50 Hz
230 V / 60 Hz
115 V / 60 Hz



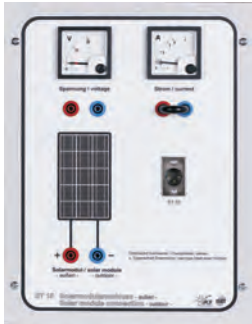
ST 11 Input /Supply Meter

Single-phase electronic AC meters for measuring of the solar energy fed into the grid and for measuring of the energy drawn from the grid. Display same as ST 10 Available versions:
230 V / 50 Hz
230 V / 60 Hz
115 V / 60 Hz



ST 14 Module Stand

For the illumination of a 10 W solar module by means of a 400 W dimmable halogen spotlight. The inclination of the solar module and the height and distance of the spotlight to the solar module are Adjustable. The inclination of the spotlight can also be altered by fine adjustment. The solar module can be swung to simulate the sun's path during the day. Power supply 230 V / 50-60 Hz.



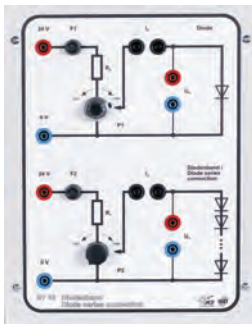
ST 15
Solar Module
Connection Outdoor

For connection of the module "ST 22 Solar Module Outdoor " or similar to the socket on the front. The solar module is connects to the two front sockets of the schematically shown solar module.



ST 19
Set of Safety Test Leads
with movable laboratory stand

Highly flexible safety-test leads with 4 mm plugs. Contacts gold-plated brass/hard copper, inclusive movable laboratory stand with 2 brackets supplied with total 42 holding fingers. Lockable wheels, height 1.45 m



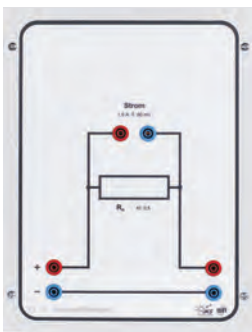
ST 16
Diode Series Connection

To perform the basic experiments "Characteristic curve of a diode" and "Characteristic curve of a diode series connection". Power supply external 24 V DC by "ST 27 Power Supply".



ST 20 AC
AC Load

Panel 1
60 W bulb
Standard plug socket with switch.
Available versions:
230 V / 50-60 Hz
115 V / 60 Hz



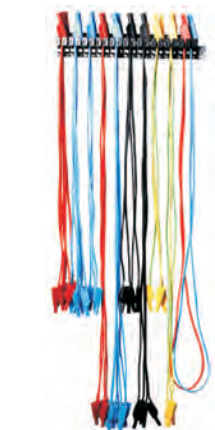
ST 17
Shunt

For measuring current up to 1.5 A as voltage drop at the shunt resistance. E.g. for measurements in grid parallel operation circuits using an oscilloscope.



ST 20 AC
AC Load

Panel 2
60 W bulb.
Standard plug socket with switch.
Available versions:
230 V / 50-60 Hz
115 V / 60 Hz



ST 18
Set of Safety Test Leads

Highly flexible safety-test leads with 4 mm plugs. Contacts gold-plated brass/hard copper, inclusive wall bracket with 21 holding fingers.

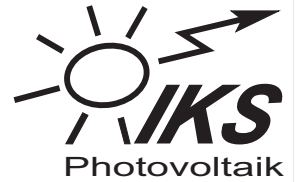


ST 20 AC
AC Load

Panel 3
9 W Energy-saving lamp.
Standard plug socket with switch.
Available versions:
230 V / 50-60 Hz
115 V / 60 Hz (15 W)

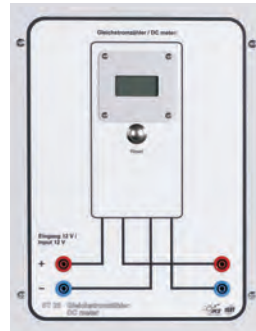
SOLARTRAINER

Profi



**ST 20 DC
DC Load**

Panel 4
50 W halogen lamp,
with switch, 12 V.



**ST 23
DC Meter**

Electronic DC meter for
measuring direct current loads.
Using in load circuits.
Display of current power and
Wh, reset button.



**ST 20 RW
Set of electrical loads**

Four variable resistors:
15 Ohm / 5,5 A
170 Ohm / 1,7 A
325 Ohm / 1,2 A
15,8 K.Ohm / 0,17 A



**ST 24
Set Multimeter**

Particularly robust.
Automatic range selection,
large display.
DC / AC max. 1000 V,
max. 10 A



**ST 21
Solar Battery**

Closed lead-gel battery
especially for storing solar
energy. Connected via
"ST 09 battery connection"
to "ST 04 solar charge
controller" for operation of
an island grid with storage.
12 V / 27 Ah C100.



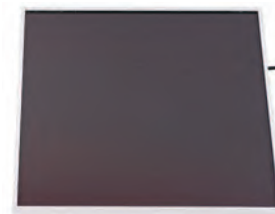
**ST 27
Power Supply**

For the power supply of
"ST 16 diode series connection"
Control range 0 - 30 V DC / 0-2 A
Power supply:
115-230 V / 50-60 Hz.



**ST 22
Solar Module Outdoor**

Solar module for outdoor
experiments. Angle of
inclination adjustable,
can be read off on a large
degree scale
Power 55 Wp
Operation with "ST 15
Solar module connection
outdoor".



**ST 28 Solar Module polycrystalline
ST 28 Solar Module amorphous**

Alternatively additional
solar module for
"ST 14 module
Frame". Quick
change holder.
Power:
Polycrystalline ca. 10 W
Amorphous ca. 5 W

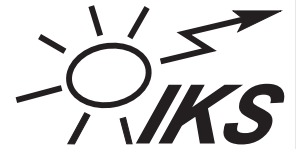


**ST 30
Fuse Box**

Fuse box with 4-pole FI-
circuit breaker, CEE plug
and 1.5 m feed cable with
CEE plug.
400 V / 50 Hz.

SOLARTRAINER

Profi



ST 95 Transformer

For the adaption of ST 02 and ST 14 in 115 V-gridss. Inclusive outlet strip 230 V
Transformer 115 V AC to 230 VAC / 500 W



ST 96 Laboratory Table

Laboratory table , lockable wheels.
Serves as a support for "ST 99 take-up frame", incl. fastening screws.
Tabletop 1.25 x 0.62 m, height 0.74 m



ST 99 15 panels Holding Frame

Take-up frame for 15 instruction panels.



ST 99 10 panels Holding Frame

Take-up frame for 10 instruction panels.



ST 97 Basic Photovoltaic Laboratory

Detailed experimental instructions on 12 themes, with solutions. Available in German English Spanish French



ST 98 Instruction Manual

Instructions for all components.
Available in German English Spanish French

Technical changes reserved 2014-06

Reseller

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Training systems
Measurement engineering
Special developments

Some user report on practical experiences:

Technikerschule Butzbach

„Solartrainer Profi has been in use for 15 years completely error-free and without repairs”



Handwerkskammer Münster

Already the prototype won over -
Solartrainer Profi in successful operation since 1997”



Landesstelle Hessen für gewerbliche Berufsförderung in Entwicklungsländern

„Solartrainer Prof for multiplier training”



Bildungsinstitut Pscherer

“Fit for the job: basic and continuing vocational
training with the Solartrainer Profi”



BZ Bildungszentrum Kassel

„Since 1997 more than 500 participants were trained with the Solartrainer Profi”



University of Nairobi

Institute of Nuclear Science and Technology



SOLAR I-V

MULTIFUNCTION INSTRUMENT FOR TESTING AND VERIFYING SINGLE-PHASE PHOTOVOLTAIC INSTALLATIONS

SOLAR I-V has been designed to meet any requirement of photovoltaic installation specialists. Further to providing the possibility of measuring and recording the efficiency of single-string and single-phase photovoltaic systems, SOLAR I-V also measures the I-V characteristic both of a single module and of module strings. Thanks to SOLAR I-V, the operator can test the photovoltaic system and, should it give a negative result, immediately identify the problems of the system in order to promptly solve them. SOLAR I-V is provided with the remote unit SOLAR-02 which permits the remote measuring of irradiation and temperature with preliminary automatic synchronization between main unit and remote unit. SOLAR-02 is positioned next to the photovoltaic modules and it is connected to the probes for measuring environmental parameters. The synchronization between the two units guarantees the necessary contemporaneity of measurements. In the case of PV efficiency recordings, this grants the right efficiency calculation. For I-V curve measurements, the synchronization permits to extrapolate the I-V curve at STC without using long extension cords cable. SOLAR I-V allows carrying out efficiency recordings over time with programmable integration period from 5 seconds to 60 minutes. Each value is automatically saved in the internal memory and can be downloaded onto the PC for subsequent analyses. The measured I-V characteristic is not affected by the resistance of the measurement cables, as the measurement is carried out with the 4-terminal measuring method. SOLAR I-V also manages a database of photovoltaic modules, which can be updated at any time. The measured values, correctly reported at standard test conditions, are immediately compared with the values declared by the manufacturer to give the OK / NO result of the test. The operator must not do any calculation, the instrument carries out the comparison rapidly and automatically.

The instrument can be interfaced with accessory MPP300, which extends the characteristics of SOLAR I-V by enabling recordings on single-phase and three-phase, single-string and multi-string (up to three strings), single-inverter and multi-inverter photovoltaic systems (therefore also in three-phase systems provided with three single-phase inverters).

(multi-string with MPP 300 - see pag. 10)

FUNCTIONS

Photovoltaic installation testing

- Measurement of DC/AC TRMS voltage and current
 - Measurement of DC/AC powers on single-phase systems
 - Measurement of solar irradiation [W/m²] with reference cell
 - Measurement of environmental and module temperature by means of external probe
 - Synchronization with remote unit SOLAR-02
 - Display of real-time irradiation and temperature
 - Use of PDC compensation ratios according to environmental and module temperature
 - Three-phase up to three strings PV systems (with MPP300)
 - Recording of parameters with programmable IP (5s – 60min)
- ### I-V characteristic measurement
- Meas. of output voltage from module/string up to 1000V DC
 - Meas. of output current from module/string up to 10A DC
 - Measurement of solar irradiation [W/m²] with reference cell
 - Measurement of module temperature, automatic or by means of external probe
 - Meas. of output DC and nominal power from module/string
 - Synchronization with remote unit SOLAR-02
 - Numerical and graphical display of I-V characteristic
 - Measurement of the resistance of photovoltaic module series
 - Mechanical inclinometer for the detection of the incidence angle of solar irradiation
 - 4-terminal measuring method
 - Extrapolation to standard test conditions (STC)
 - Evaluation of testing result: OK / NO
 - Management of up to 30 types of photovoltaic modules in the internal database

Common characteristics

- Internal memory for data saving
- Recalling results on the display
- Optical/USB port for PC connection
- Help on line on the display

Some standard accessories



HT4004N HT4005K SOLAR-02 HT304 M304

GENERAL CHARACTERISTICS

Display:	LCD custom, 128x128pxl, backlit
Power supply:	6x1.5V alkaline bat. type AA LR06
Auto power off:	after 5 minutes in stand-by
PV testing duration:	1.5 hours (@IP=5s); 8 days (@IP=10min)
Curves which can be saved:	> 200 curves
PC interface:	optoisolated optical/USB port
Safety:	IEC/EN61010-1
Measuring accessory safety:	IEC/EN61010-031, IEC/EN61010-032
Measures on PV modules:	IEC/EN60891
Insulation	double insulation
Pollution degree:	2
Measurement category:	CAT II 1000V DC, CAT III 300V (to earth) Max 1000V between inputs
Dimensions:	235x165x75mm
Weight (batteries included):	1.3kg

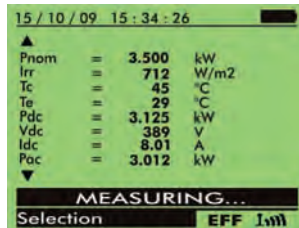


SOLAR I-V
HV00001V

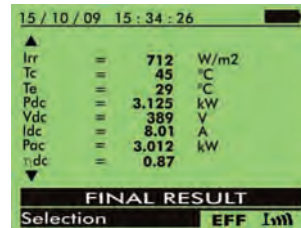
ACCESSORIES SUPPLIED	Code
Series accessories	
Remote unit to record irradiation and temperature	SOLAR-02
Kit of 4 cables with 4mm banana plugs + 4 alligator clips	KITGSC4
Kit of 2 adapters with MC3 compatible connectors	KITPVMC3
Kit of 2 adapters with MC4 compatible connectors	KITPVMC4
Transducer for AC 0÷200A, diameter 40mm	HT4005K
Transducer for AC/DC currents 0÷10 - 0÷100A, diameter 32mm	HT4004N
Reference cell for irradiation measurement	HT304
Probe PT1000 for environmental and module temperature	PT300N
Mechanical inclinometer	M304
Windows software + optical/USB cable C2006	TOPVIEW2006
Transport bag	BORSA2051
User manual on CD-ROM	
Calibration certificate ISO9000	
Rapid user guide	
Opzional accessories	
Multi-string three-phase adaptor	MPP300
Unbatteried transducer for AC/DC currents 0÷10A, 0÷100A, max. diameter 32mm*	HT4004P
Transducer for AC currents 0÷5 - 0÷100 A, diameter 20mm	HT4005N
Rigid clamp AC 1-100-1000A/1V, diameter 54mm	HT96U
Rigid clamp AC 10-100-1000A/1V, diameter 54mm	HT97U
Rigid clamp DC 1000A/1V, diameter 50mm	HT98U
Kit of belts for slinging the instrument over one's shoulder	SP-0400
Kit of 2 cables banana 4mm, green/black, 25m	KITPVEXT25M
Rigid transport suitcase	VA400
Connector with magnetic tip	606-IECN

(*) to be used with MPP 300 only
Your sales partner:

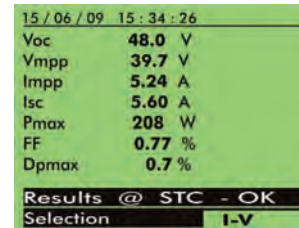
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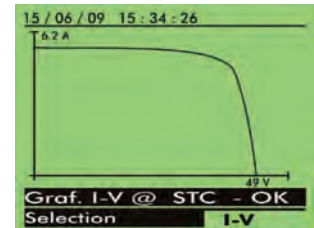
Testing / Recording in progress



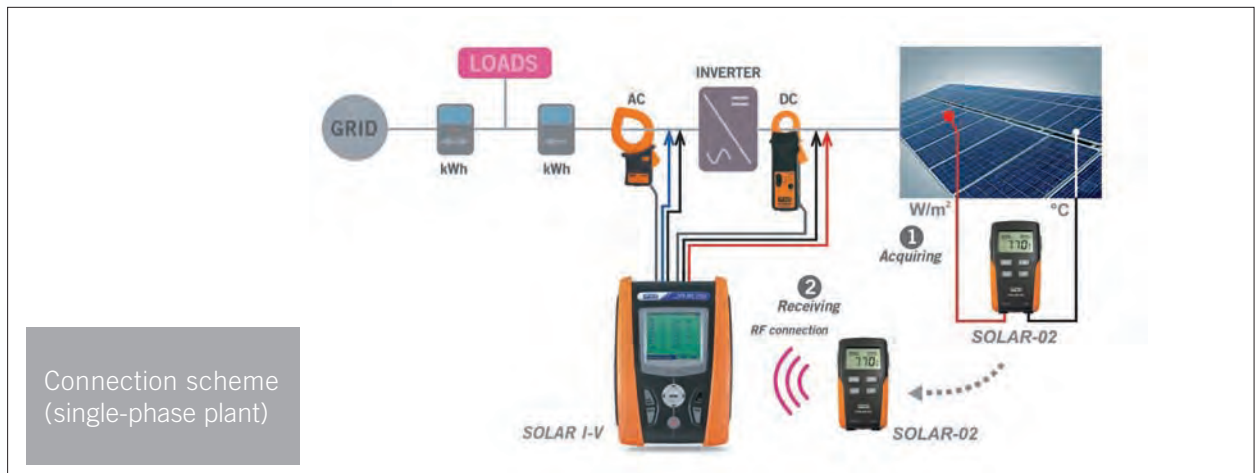
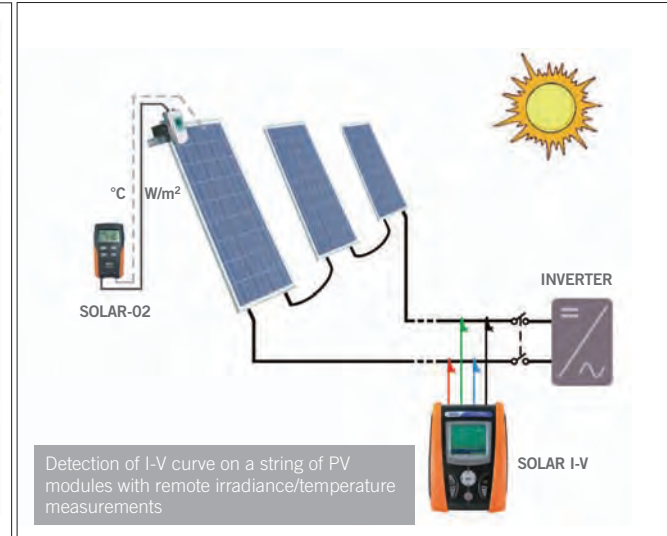
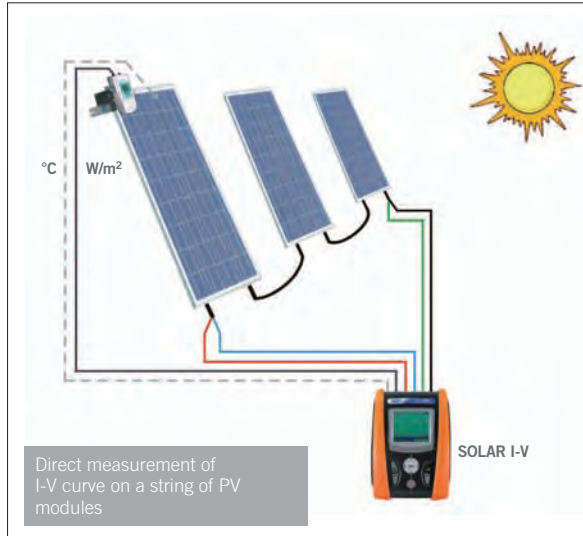
Testing result of photovoltaic system



Numerical display of results with OK result



Graphical display of an I-V curve with OK result



Photovoltaic-experimental kit for teaching at schools

The available experimental materials allow the carrying out of all basic experiments in the field of photovoltaics.

Because the experiments are built up modularly the adaption to the actual teaching is possible according to the requirement.

The materials are arranged clearly and optically attractive in a specific yellow suitcase. Everything is always completely at hand, extra material is not necessary.

The experiments can be built up and removed fast. The pupils are able to carry out the experiments by themselves with the help of the easily understandable experimentation instruction. The teacher gets further information to do the exercises and to understand the physics.



Development supported financially by the German Federal Ministry for education, science, research and technology. Identification-number 0329841C

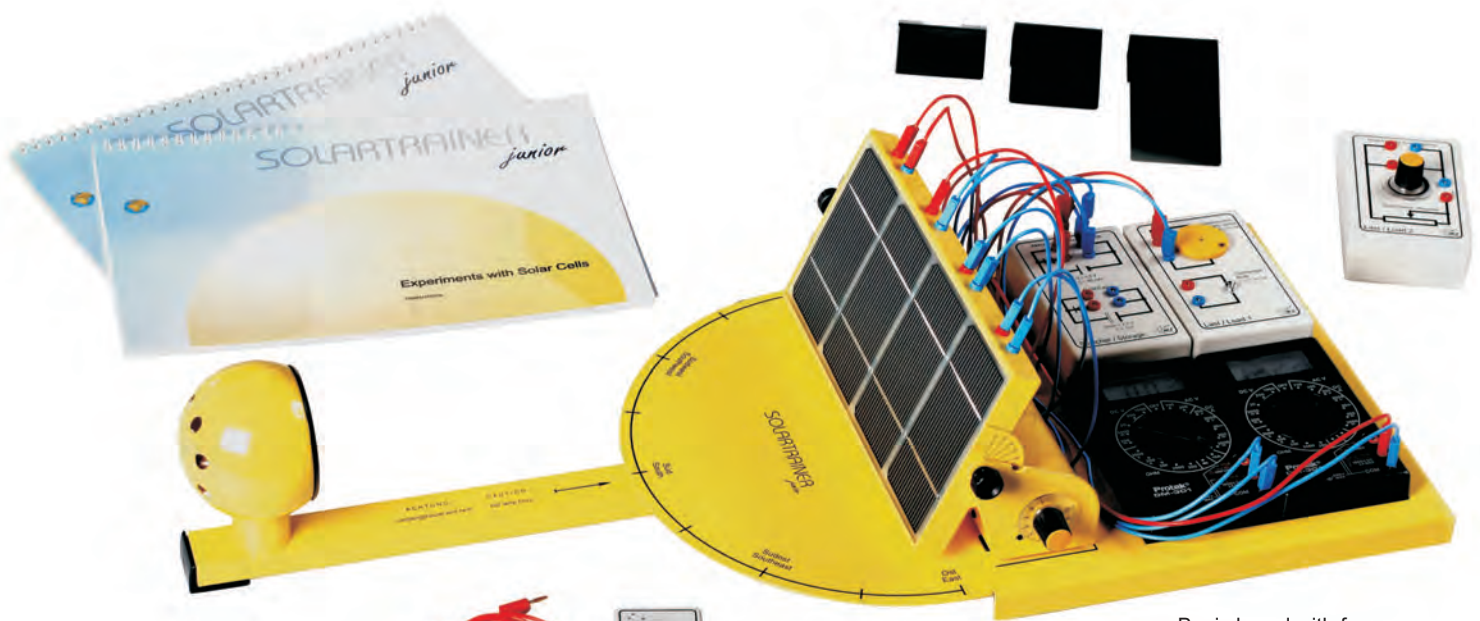
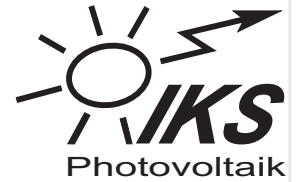
Picture is showing optional extra



With the set of equipment supplied, the following experiments are possible:

- Measuring of the irradiance of different light sources
 - Solar cell as an energy converter
 - Solar cell as an energy converter and diode function
 - Open circuit voltage of a solar cell at different shadowing conditions
 - Short circuit current of a solar cell at different shadowing conditions
 - Open circuit voltage and short circuit current of a solar cell at different irradiance
 - Short circuit current of a solar cell depending on angle of incidence of the light
 - Series connection of solar cells / different shadowing conditions / bypass diode
 - Parallel connection of solar cells / different shadowing conditions
 - Characteristic curve of a solar cell (I/U) / different irradiance
 - Characteristic curve of a solar cell (U/P), MPP, figure out of the efficiency
 - Simulation: Short circuit current of a solar cell depending on position of the sun (sunrise to sunset)
 - Charging a GoldCap / accumulator with solar cells
 - Discharging a GoldCap / accumulator with electric motor and light bulb
 - Building up of a stand alone operation net
- With extension kit - measurement with PC:**
- Characteristic curve of a solar cell (I/U) / different irradiance
 - Demonstration of an inverter (sinwave / rectangular)
 - Charging a GoldCap / accumulator with solar cells, discharging a GoldCap / accumulator with electric motor and light bulb

SOLARTRAINER junior



Dimmable halogen light (low voltage 12 V) which can be moved around the solar module in a semicircle, disconnectable for experiments with sun light

Solar module with 4 single solar cells and angle adjustment. Integrated power supply in the basic housing

Basic board with frame to put the experimental boxes and multimeters

Set of equipment supplied:

- Specific yellow suitcase with shaped part made of foam plastic
- Basic board with frame to put the experimental boxes and multimeters
- Low voltage (12 V) halogen lamp
- Power supply with dimmer switch, power cable (mains fed, input 230 V AC 50 Hz, output 12 V AC)
- Solar module with 4 single cells and angle adjustment
- 2 multimeters with 2 mm connectors
- Sensor box for measuring irradiance
- Load box with electric motor and light bulb
- Storage box with NC accumulator and GoldCap and blocking diode
- Measuring box with variable resistor
- Connecting cords, high flexible, contacts brass / hard copper gold plated
- Experimental instruction / Experimental solutions / Professional informations

Optional extension kit:

- PC measuring box
- Inverter box
- Interface cable
- RS 232/ USB converter
- Software (running under WINDOWS)



Subjekt to alteration. Pictures additionally are showing partially optional extra. State: 2014-06

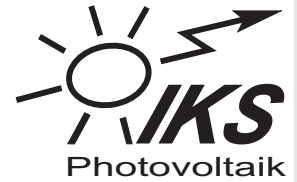
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Training systems
Measurement engineering
Special developments

Reseller

WINDTRAINER *junior*



Windenergy-experimental kit for teaching at schools

The available experimental materials allow the carrying out of all basic experiments in the field of windenergy.

Because the experiments are built up modularly the adaption to the actual teaching is possible according to the requirement.

The materials are arranged clearly and optically attractive in a specific with suitcase. Everything is always completely at hand, extra material is not necessary.

The experiments can be built up and removed fast. The pupils are able to carry out the experiments by themselves with the help of the easily understandable experimentation instruction. The teacher gets further information to do the exercises and to understand the physics.



Picture is showing optional extra



With the set of equipment supplied, the following experiments are possible:

- Measuring of the wind force in the vicinity of the school
- Measuring of the wind force of the wind machine depending on the adjustment of the control knob
- Power output of the generator depending on the shape of the wing (even / curved)
- Power output of the generator depending on the number of wings (2, 3, 4)
- Power output of the generator depending on the position (angle) of the wing
- Characteristic curve of a generator (U/I) at constant speed
- Characteristic curve of a generator (U/I). Measuring the resistance- and buoyancy rotor at constant wind force

- Power output of the generator depending on the wind force
- Charge of an akku/Gold Cap with the generator
- Discharge an akku/Gold Cap with different loads
- Build up of a stand alone operation net

With extension kit savonius rotor:

- Characteristic curve of a savonius rotor(U/I) at constant speed
- Power output of the savonius rotor operating with and without aperture

Wind power plant with protection cover and degree scale

Controllable wind machine (low voltage)

Anemometer



Basic board with frame to put the experimental boxes und multimeters

Accessories and tool

Set of equipment supplied:

- Specific white suitcase with shaped part made of foam plastic
- Basic board with frame to put the experimental boxes und multimeters
- Wind machine with controllable power supply
- Wind power plant with axial rotor, generator without gear, with tacho generator, hub for mounting 2, 3, and 4 wings, angle of the wings adjustable
- 4 wings even, 4 wings curved
- Protection cover, wind shield, tool
- 2 multimeters with 2 mm connectors
- Anemometer
- Load box with electric motor and light bulb
- Storage box with NC accumulator and GoldCap and blocking diode
- Measuring box with variable resistor
- Experimental instruction / experimental solutions / professional informations/CD

Optional extension kit:

- Savonius-Rotor

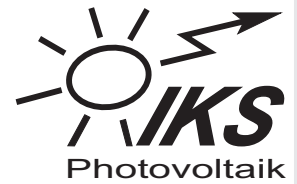


Subjekt to alteration. Pictures partially with optional extra.
State: 2014-06

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Reseller

H₂-TRAINER junior



Hydrogen-/ Fuel Cell-experimental kit for teaching at schools

The available experimental materials allow the carrying out of all basic experiments in the field of hydrogen-/ fuel cell technology.

Because the experiments are built up modularly the adaption to the actual teaching is possible according to the requirement.

The materials are arranged clearly and optically attractive in a specific red suitcase. Everything is always completely at hand, extra material is not necessary.

The experiments can be built up and removed fast. The pupils are able to carry out the experiments by themselves with the help of the easily understandable experimentation instruction.

The teacher gets further information to do the exercises and to understand the physics.



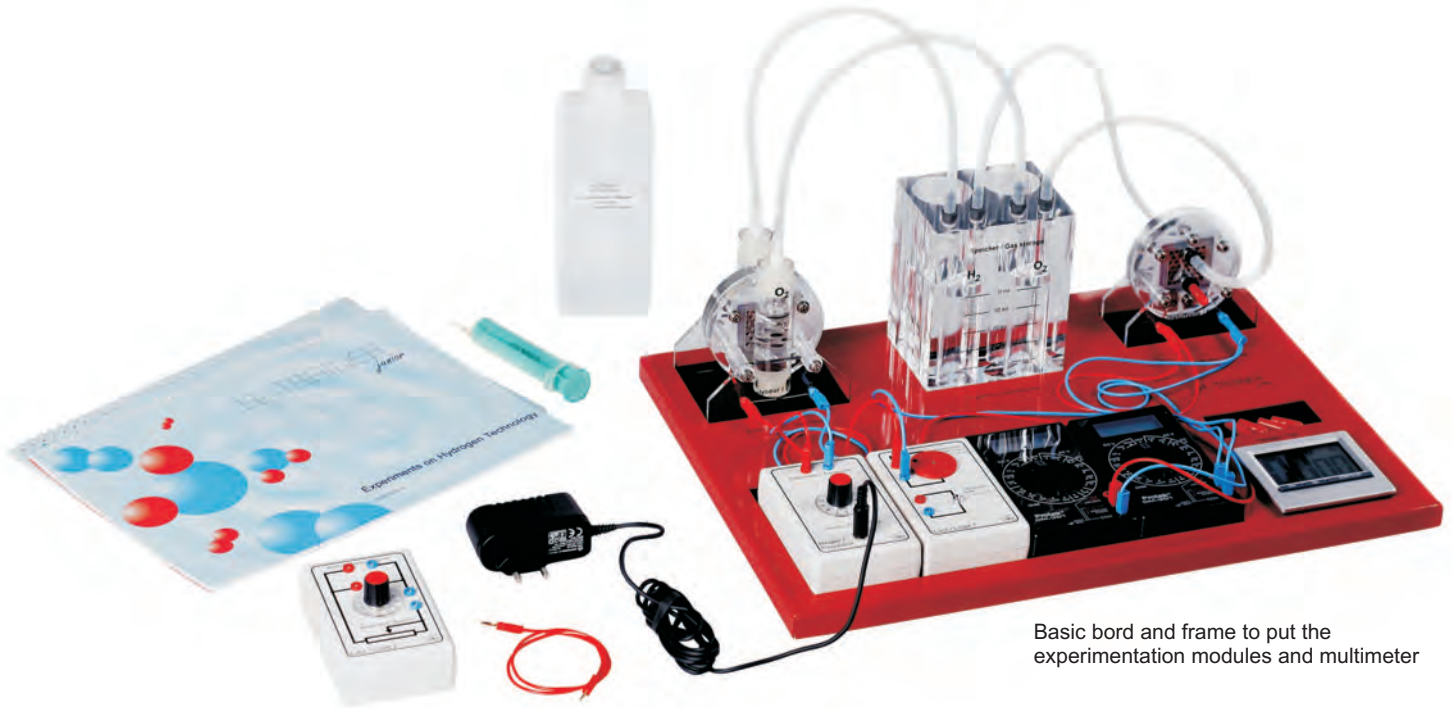
With the set of equipment supplied, the following experiments are possible:

- Measuring of the volume ratio of the generated gases
- Measuring of the generated volumes of the gases per unit of time depending on the current
- Determination of the power efficiency and the Faraday efficiency of the electrolyser
- Determination of the U/I- characteristic of the electrolyser
- Determination of the power efficiency and the Faraday efficiency of the fuel cell
- Determination of the U/I- characteristic of the fuel cell
- Building up of a stand alone operation net
- In combination with the Solartrainer junior: Operation of the electrolyser with solar cells
- In combination with the Windtrainer junior: Operation of the electrolyser with windenergy
- In combination with the Solartrainer junior and the Windtrainer junior: Operation of the electrolyser with solar cells and windenergy as a hybrid system

H₂-TRAINER junior



Elektrolyser, gas storage and fuel cell



Basic board and frame to put the experimentation modules and multimeter

Power supply and accessory

Set of equipment supplied:

- Specific red suitcase with shaped part made of foam plastic
- Basic board with frame to put the experimental boxes und multimeters
- Elektrolyser
- Power supply
- Current control box
- Gas storage
- Fuel cell
- 2 multimeters with 2 mm connectors
- Load box with electric motor and light bulb
- Measuring box with variable resistor
- Connecting cords, highly flexible, contacts brass/hard copper gold plated
- Connecting hoses/caps
- Distilled water
- Syringe
- Experimental instructions / Experimental solutions

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Training systems
Measurement engineering
Special developments

Reseller

Measurement equipment

For energy consultants, caretakers, consulting engineers and environment issues managers the ideal tool for building diagnostics and room air analyses.

Furthermore there can be made analyses in the field of water consumption, lighting and energy consumption of electrical appliances.



The measurement devices are arranged clearly and optically attractive in a specific green suitcase. Everything is always completely at hand, extra material is not necessary.

With the set of equipment supplied, the following measurements are possible:

Room air quality

With the high-class multi measuring device and a multiple sensor the CO₂-concentration, relative air humidity, indoor temperature and the absolute air pressure can be measured contemporaneously.

The values are displayed on a big LCD-display and can be logged optionally.

With the relative air humidity and the indoor temperature it is possible to determine the dew point temperature tabularly.

Surface temperature

With the infrared thermometer it is possible to measure surface temperatures contactless.

The wall temperature can be inspected of critical dew point temperatures (mildew potential).

Illuminance level

With the lux meter living areas and workplaces can be inspected of adequate and evenly distributed illuminance level - which is prerequisite for a non fatigue seeing.



This way it is possible to detect deficiencies and wasteful illumination can be avoided.

Water consumption

With the flow rate meter the water consumption at every spigot can be determined.

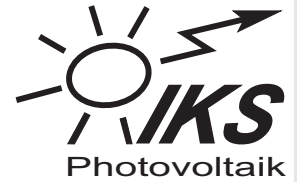
Energy consumption of electrical appliances

With the energy meter the energy consumption of electrical appliances can be determined as well as the energy costs.

Room dimensions

Longitudes, areas and volumes can be measured comfortably and contactlessly with the electronic distance meter.

Energie Check Profi



Content



- 1 Luxmeter digital**
Effective range 0 - 50.000 Lux, value-hold-function, sensor external with spiral cable. Metering precision +/- 5% + 2 digits



- 1 Electronic distance meter digital**
Effective range 0,6 ... 20 m, with laser pointer, measuring of longitudes, aereas and volumes, memory, adding up function. Metering precision +/- 0,5%



- 1 Energy cost meters digital**
Measuring of energy, power (Effective, apparent and idle power), voltage, current, power factor, frequency, measuring time 24 h, 1-7 or 1-30 days, costs, min. / max. values, cost prognosis and more features. Max. 3.680 W.



- 1 Multi measuring device**
With multiple sensor (IAQ sensor) for measuring of CO₂- concentration 0 .. + 10,000 ppm, temperature 0 .. + 50° C, relative air humidity 0 .. + 100 %, absolute air pressure + 600 .. 1.150 hPa. Big digital LCD display. With data logger. Set up of up to 99 measuring localities

1 Power supply

1 USB interface cable

1 Software



- 1 Flow rate meter**
Effective range 1 to 25 l/min, actual value can be read directly on the scale



- 1 Infrared digital thermometer**
Contactless measuring with two point laser targeting, display of measuring spot size, effective range -30 ...+400 C°, emission factor adjustable 0,2 ... 1,00, lighted display, value hold function

- 1 Set of short instructions**

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Training systems
Measurement engineering
Special developments

Reseller

Measurement equipment

For projects at schools the ideal measurement equipment to deal with energy-saving, room-air condition, water consumption, room lighting and energy consumption of electrical appliances.



Indoor and outdoor temperatures

With the two digital temperature meters the indoor and outdoor temperatures can be measured just as the min. And max. Values.



The measurement devices are arranged clearly and optically attractive in a specific green suitcase. Everything is always completely at hand, extra material is not necessary.

With the set of equipment supplied, the following measurements are possible:

Room air quality

With the two digital temperature-humidity-meters the relative air humidity and the air temperature can be measured.

The measured values are displayed on a LCD-display, it is also possible to log the datas.

With the relative air humidity and the air temperature it is possible to determine the dew point temperature.

The data can be read out by the RS-232 -interface with the enclosed software.

Surface temperature

With the digital precision temperature meter it is possible to measure surface temperatures, water and air temperatures.

The wall temperature can be inspected of critical dew point temperatures (mildew potential).

With the two analog temperature meters the air temperature and the min. and max. values can be measured.

Illuminance level

With the lux meter class-rooms and laboratory areas can be inspected of adequate and evenly distributed illuminance level - which is prerequisite for a non fatigue seeing.

This way it is possible to detect deficiencies and wasteful illumination can be avoided.

Water consumption

With the flow rate meter the water consumption at every spigot can be determined.

Energy consumption of electrical appliances

With the energy meter the energy consumption of electrical appliances can be determined as well as the energy costs.

Content



- 1 Lux meter digital**
Effective range 0 - 50,000 Lux,
value-hold-function, sensor
external with spiral cable.
Metering precision +/- 5% + 2
digits



- 2 Temperature humidity
meters digital**
Effective range temperatur:
0 .. + 59.9° C,
Metering precision +/- 0.5 °C
Effective range relative air
humidity: 1 .. 99 %
Metering precision +/- 3%
Time (DCF-77 signal)
Min.-/ Max.- values
Preset of alarm values possible
Average values
Dew point temperature
Big digital-LCD-display,
Data logger, up to 3,000 values,
memory, time interval selectable
RS 232-interface
Foot to put up
2 Interface cables
Software to read out, data export
and processing with other soft-
ware possible



- 1 Precision digital
thermometer**
External sensor for measuring of
surface, water and air temperat-
res.
Effective range -199.9 ..+199.9 C°,
Resolution 0.1° C
Precision 0...100° C: 0.1°C +/- 1
digit



- 2 Enery cost meters digital**
Measuring of energy, power
(Effective power), voltage,
measuring duration, duty cycle,
costs, min. / max. values, cost
prognosis and more features



- 2 Indoor-/ outdoor tempe-
rature meters digital**
External sensor for measuring the
outdoor temperature,
Cable length 3 m
Effective range indoor temp.
-10 ...+60° C
Effective range outdoor temp.
-50 ...+70° C
Min- / Max. - values
Big digital-LCD-display



- 1 Flow rate meter**
Effective range 1 to 25 l/min,
actual value can be read off
directly on the scale



- 2 Indoor temperature
meters analog**
Effective range -35 ...+50° C
Min- / Max. - values, reset

- 1 Instructions**
1 Solutions
1 Professional informations

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Training systems
Measurement engineering
Special developments

Reseller

Solar radiation sensor ISET Sensor high-quality measurement technology for the mass market

The new ISET Sensor

Photovoltaic plant system operators want to have simple, quick and reliable information about the function of their PV-plant.

Thermoelectric radiation sensors cannot be compared easily with a real PV-generator with respect to the "energy yield" because of their different spectral sensitiveness as well as their different reflection- and temperature characteristics.

In addition you have the relatively high acquisition cost.

In contrast to this, the radiation sensors of the lower price category do not fulfill the long-term accuracy requirements and may find no acceptance because of their "low-cost equipment", in particular in the field of buildings.

The solar cell sensor **ISET Sensor** eliminates these deficits. It fits well the physical characteristics of the solar generator. The simple and compact but nevertheless precise construction predestine it for use in the field of building measurement technology.

With the new housing design it gains the necessary acceptance in the technical services for facilities as well as in the general field of architecture.

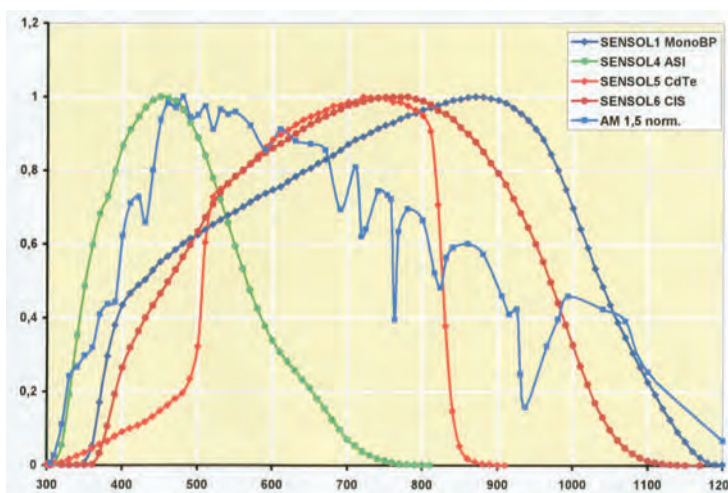
Technical features of the ISET Sensor

The solar radiation is converted into a proportional current by an exact defined solar cell. Via a specific shunt resistance which is coupled thermically to the compact aluminum housing, the measured voltage is determined.

The almost identical geometrical construction of the test cell, comparable with PV modules, as well as the specifically formed housing with possibilities of outside temperature link-up and high weather resistance assure reproducible results of measurement.

A Pt 1000 - temperature sensor registers the cell temperature over a two-wire data line with high measuring accuracy.

The calibration of every **ISET Sensor** is achieved with a reference element constructed in an identical fashion by an accredited test laboratory in W/m^2 and is documented on a quality assurance calibrating certificate.



Spectral sensitivity of different **ISET Sensor** sensors under AM 1,5 (normalized).

It is clearly visible and derivable that for the energetical rating and monitoring of a PV-plant should only be used the same technology of the sensor and the PV-plant because of the different spectral sensitivity of the different technologies. Further there are the same physical characteristics regarding temperature, reflection and degradation.

With the **ISET Sensor** for each photovoltaic technology the suitable radiation sensor can be delivered.

ISET Sensor

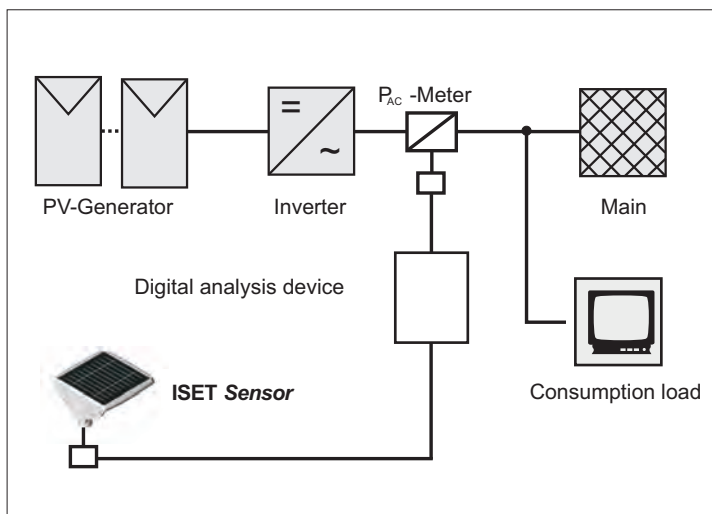


Monitoring concept

Using the **ISET Sensor** in a monitoring concept the received radiation power measured on the PV generator level is compared with the output (AC) generated by the PV system.

The comparison quotient represents a functional and quality parameter for the PV-plant in the simplest way.

By the implemented evaluation logic, solar module manufacturers, traders and even electricians receive via the cumulated energy output an insight into a simplified "course of life documentation" of their products. In this way, questions about a "guaranteed" energy output are discussed more reasonably, the energy output can be provable.



Monitoringsystem

Technical data ISET Sensor

Housing

- Aluminum, powder coating in facade quality, color is silvery grey *
- Mounting with two nuts M 5 backside
- Housing pressure balance by means of a special membrane.

Connecting cable

AWG 26, shielded, black, length 3 m, Plug connected

Available solar cell sensors

- monocrystalline
- polycrystalline
- amorphous

Embedded under clear glass hardened thermicly or embedded like solar module

Measuring voltage

- about 100 mV (cal.val.) / 1000 W/m², 25°C
- Specific shunt resistance coupled thermicly to the case.

Calibration

The calibration of every **ISET Sensor** is achieved by a reference element (quality grade A, constructed in an identical fashion) from an accredited test laboratory in W/m² by IWES/Kassel.

A calibrating printout similar to EN DIN 17025 documents the product specific parameters.

The relative measurement uncertainty is < ±4% (cryst.mat.) / < ±5% (am. mat.) The measurement uncertainty refers to a confidence level of 1-alpha =95%

Temperature sensor

Pt 1000, laminated or bonded centrally under the cell

Operating temperature range

-25° to + 80° C

Subject to alteration. State: 2014-06

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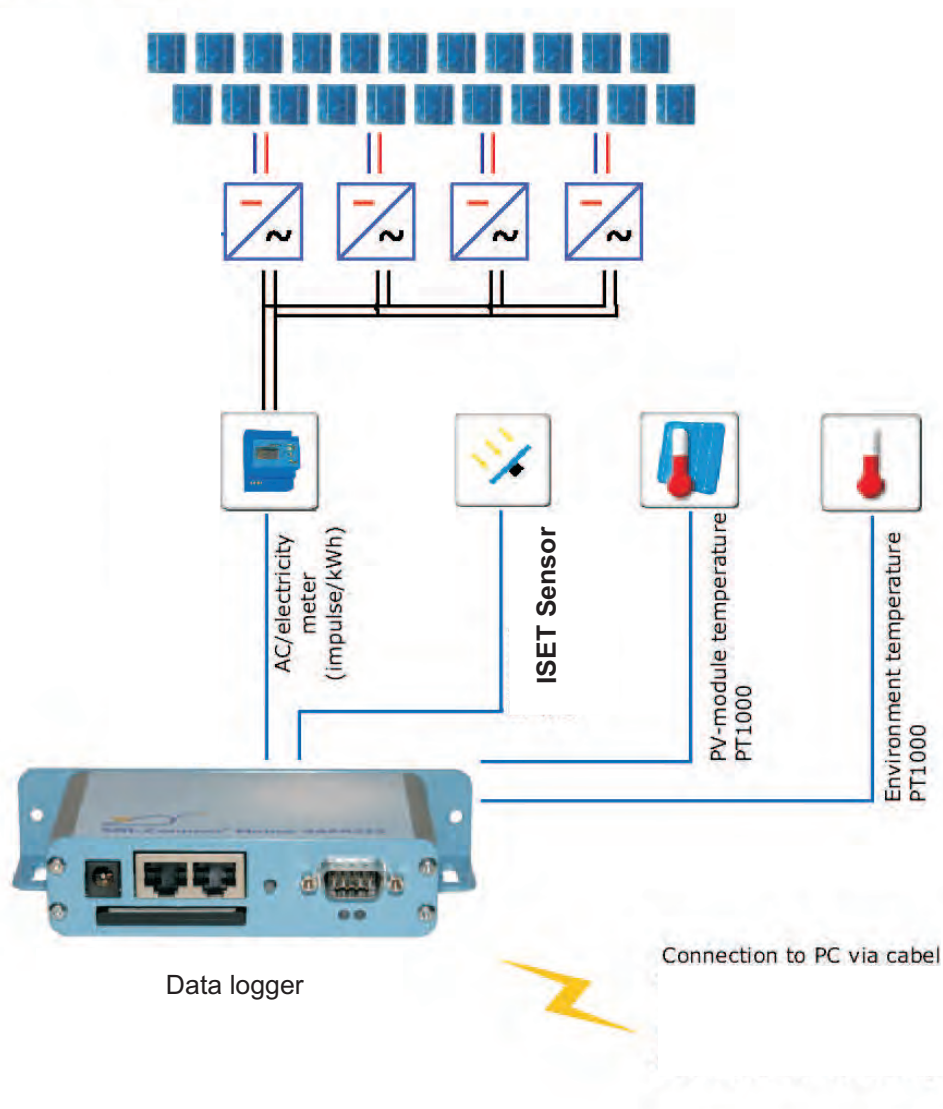


Training systems
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Reseller

Data logger

Typical setup



Datalogger - SOL.Connect® Mouse

Photovoltaic plants are working very reliable today. Nevertheless it is advised to check them on a regular basis. Inverter or solar controls should be monitored preferably in realtime, yields should be checked at least once a month. Only like that can malfunctions be immediately recognised and investments be secured.

The SOL.Connect® Mouse is a reasonably priced, powerful Compact Flash® data logger for small and medium individual plants.

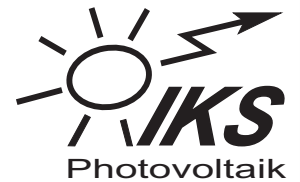
The device is able to log the directed solar radiation, temperature of the sensor solar cell, module or

environment temperature and energy production and include them into assessment.

By continuously logging all relevant data malfunctions are automatically dedected and communicated (LED / speaker / relay contact).

Storage media are standard Compact Flash® memory cards. The reasonable priced media allow consistent and continuous logging of all data and error protocols over long periods of time with high granularity (typically 500 days).

Data logger



Technical data

- Fanless aluminium profile case for indoor use
- Dimensions without frame connector (DxHxW) 110 x 100 x 30 mm
- 9-pole Sub-D plug for PC / modem
- LED t display system status
- Controller Atmel ATMEGA 128
- Compact Flash Adapter Type 1
- Internal speaker
- External power supply 12 - 30 V DC 0,5 W
- Operating temperature 0°C to + 50°C
- Electromagnetic compatibility (EMC) - 89/336/EEC
- Electrical safety - 73/23/EEC
- Software for configuration and data evaluation

Subjekt to alteration. State: 06/2014

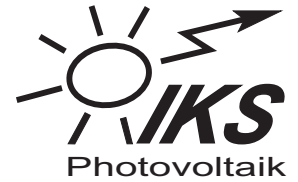
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Training systems
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Solar radiation meter Standard



Technical Specification

Measuring range / Resolution

	P _{tot}	T
Unit	W/m ²	°C
values	0 ... 1500	-40 ... +85
Resolution	1	0.1

- Overall accuracy P_{tot} < 3% ± 1 digit (50...1.000 W/m² / AM1,5 / normal incidence(*2) / T_{modul} = 0...+50 °C)
- Overall accuracy T < 3K ± 1 digit (-25...+75 °C) / < 1K ± 1 digit on request
- Power consumption (active Mode) 4 mW
- Rated power of integr. Solar panel 180 mW *1
- Working temperature range -20 ... +50 °C (Ambient tempratur)
- Max. ambient humidity 90 %
- Dimensions (without fastening bow) 130 x 90 x 30 mm or
- Weight (without fastening bow) 170 g
- Certification CE / EN50081, EN50082
- Calibration according to IEC904/3
Calibration certificate on request
- Warrenty 2 years

*1 at standard test conditions: P_{tot} = 1.000 W/m², spectrum AM1,5 , T = 25 °C

*2 as certified by FhG ISE Freiburg in Germany
04/2006, subject to change without notice

The standard version combines:

- a sensor for measuring global radiation,
- a sensor for measuring temperature,
- a display and operation unit and
- a solar power supply

in a weather-proof housing. The version permits measuring of current light intensity and temperature (direct measuring mode). In addition to this, a mode for registering maximum values is available.

Values mentioned above are necessary for calculating solar plants. Moreover, they are also useful within the field of building physics and for solar training facilities. The meter is delivered without mounting fixture as long-term measurements are not possible.

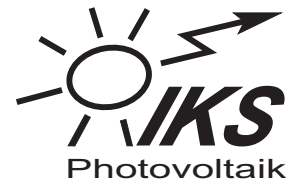


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Lehrsysteme
Laborausstattungen
Messtechnik
Sonderentwicklungen
Demonstrationsmodelle

Solar radiation meter With Datalogger / software



Technical Specification

Measuring range / Resolution

	P_{tot}	T	P_n	U_{II}	I_{II}	hour
Unit	W/m ²	°C	%	%	%	h
values	0 ... 1500	-40 ... +85	0 ... 150	0 ... 150	0 ... 150	0 ... 9999
Resolution	1	0.1	0.1	0.1	0.1	0.1 / 1

- Overall accuracy P_{tot} < 3% ± 1 digit (50...1.000 W/m² / AM1,5 / normal incidence(*2) / $T_{modul} = 0...+50$ °C)
- Overall accuracy T < 3K ± 1 digit (-25...+75 °C)
< 1K ± 1 digit on request
- Power consumption (sleep mode) 0,6 mW
- Power consumption (active Mode) 4 mW
- Rated power of integr. Solar panel 180 mW *1
- Power supply externa 9 – 12 V / 20 mA
- Data storage capacity 256 kbit
- Data transmission seriell (RS232), USB on request
- Ambient temperature range -20 ... +50 °C
- Max. ambient humidity 95 %
- Dimensions (without fastening bow) 130 x 90 x 30 mm
- Weight (without fastening bow) 170 g
- Certification CE / EN50081, EN50082, EN60068
- Calibration according to IEC904/3
Calibration certificate on request
- Warrenty 2 years

*1 at standard test conditions: $P_{tot} = 1.000$ W/m², spectrum AM1,5 , T = 25 °C

*2 as certified by FhG ISE Freiburg in Germany

04/2006, subject to change without notice

The extended version combines:

- a sensor for measuring global radiation,
- a sensor for measuring temperature,
- a display and operation unit,
- a solar power supply and
- a computer-assisted simulator for photo-voltaic modules

in a weather-proof housing, together with mounting fixture for wall or roof. By measuring current light intensity and temperature, typical characteristics of solar plants are simulated by the integrated computer. Thus, plumbers, architects or owners are quickly able to carry out an exact yield check of an installed solar plant.

Yield checks can be performed over any period of time by registering mean average values. Using the data-logger-method, data are periodically stored in the internal memory. Via interface cord they can be transmitted to a PC.

With the delivered software the meter is an ideal complement to simulation programs and a meaningful extension for checking the yield of solar plants.

The interface package consists of:

- D-Sub 9 cable (optional with USB-cord)
 - software SLMread (data transmission in ASCII file)
 - software SLMview (data evaluation into graphic or table)
- Software is provided on CD-ROM.



Child oriented readout system for visualization of energy yields from photovoltaic plants

Photovoltaic plants as shining examples on the roofs of kindergartens and schools

The possibility to convert sunlight with solar cells directly into electric power, makes the photovoltaic to one of the popular renewable energies. It is for this reason that photovoltaic plants are installed enhanced on kindergartens and schools. Apart from the aspirated example function the kids should be most familiarized with renewable energies.

Visualization not child oriented so far

For the visualization of the energy yields of photovoltaic plants typically the "standard solution" is used: A large sized digital display to show the actual power and the total electric power fed to the mains. It has turned out however that most of the kids quickly loose interest in the display also because it is not really plain.

New concept of a visualization

That is why the University of Applied sciences Münster has created a new concept of visualization within the scope of a disatation. The preproduction model was developed by the company IKS Photovoltaik as a licence partner.



The actual electric power is displayed analoguely by means of 24 symbolic incandescent lamps (inside LED), because kids know electricity above all from incandescent lamps in everyday life. The higher the actual output of the photovoltaic plant is the more lamps are in operation.

The monthly fed in energy is displayed analoguely by red balls, which were transported by the sun wheel into the catch tank. The number of balls transported depends on the energy fed into the mains. At the end of the month the balls are filled back into the above storage tank and the digital display for the monthly energy yield is set to zero.

Digital displays for the actual power, the monthly and the total energy yield are there additionally.

The system is preferably for wallmounting in public areas of entryways.



Technical specifications:

- Dimensions: 1036 x 836 x 146 mm
- Weight: 12 kg
- Power supply 230 V / 50 Hz / 12 V DC
- Digitale LCD display
 - Actual power
 - Monthly energy yield (with reset function)
 - Total energy yield
- Analogue display of the actual power by 24 symbolic "incandescent lamps" (LED inside)
- Analogue display of the monthly energy yield by red balls (360 pieces), which are transported by the sun wheel from the storage tank into the catch tank depending on the energy fed into the mains
- Removable catch tank, secured by lock
- Low power requirement (max. 6.5 W)
- Inputs:
 - 1x impulse for meter
 - For So-interface according to DIN EN 62053-31
 - Not suited for meters with impulse packets output
- According to the photovoltaic plant size freely programmable
- Advertising space for label ca. B 280 x H 170 mm
- Only for indoor use

Subjekt to alteration. State: 2014-06

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