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SOLARTRAINER Profi

Photovoltaic – Trainingsystem for vocational and advanced training

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

Development

In cooperation with the ISET - Institut für Solare Energieversorgungstechnik e. V. (now: Frauenhofer 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.

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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 sinusodial 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 controler, 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.

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ISET

IKS Photovoltaik

ST 01
PV-module connection indoor

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

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 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 04
Solar charging controler
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 05
DC / AC inverter / mains parallel operation

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

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 06A
DC / AC inverter / stand-alone operation

Changes DC into sinusodial AC to create a stand alone mains.
input 12V DC / 3 A
output 230V AC
Pmax = 100 W.
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

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ISET

IKS Photovoltaik

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, ammet
bidirectional

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

For measuring the via inverter fed solor 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

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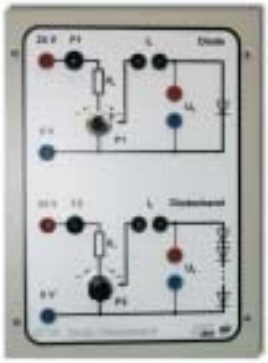
ISET

IKS Photovoltaik



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 17
Shunt

Max. current 1,5 A

For measuring with “ST 05” mains parallel operation / connecting with an oscilloscope

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

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 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

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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

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SOLARTRAINER junior

IKS Photovoltaik

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.

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

Picture shown with extension kit

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

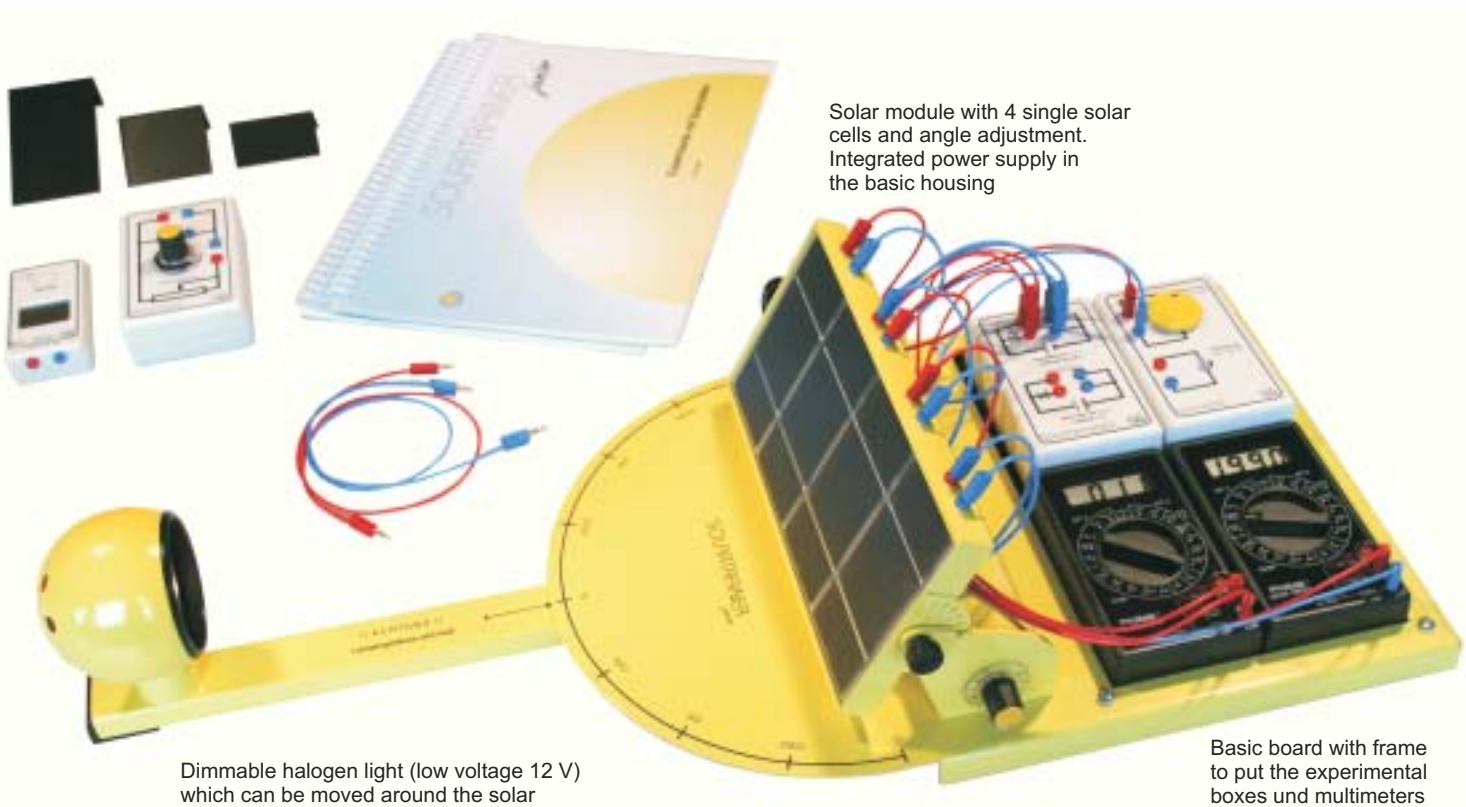
- Measuring of the irradiance of different light sources
- Solar cell as an energy converter
- Solar cell as an energy converter and diode function
- Open circuit voltage of a solar cell at different shadowing conditions
- Short circuit current of a solar cell at different shadowing conditions
- Open 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
- 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*

IKS Photovoltaik



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

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

Basic board with frame to put the experimental boxes und multimeters

Set of equipment supplied:

- Specific yellow suitcase with shaped part made of foam plastic
- Basic board with frame to put the experimental boxes und 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 / documentation for teacher

Optional extension kit:

- PC measuring box
  Inverter box
  Interface cable
  Software (running under WINDOWS)

Subjekt to alteration. Pictures partially with optional extra.
State: 01/2009

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WINDTRAINER *junior*

IKS Photovoltaik

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 und to understand the physics.

- Measuring of the wind force in the vicinity of the school
- Measuring of the wind force of the wind machine dending 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/) at constant speed
- Characteristic curve of a generator (U/). 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/) at constant speed
- Power output of the savonius rotor operating with and without aperture

WINDTRAINER *junior*

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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 / documentation for Teacher

Optional extension kit:

- Savonius-Rotor

Subjekt to alteration. Pictures partially with optional extra.
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H_2-TRAINER *junior*

IKS Photovoltaik

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 effiency and the Farady efficiency of the elektrolyser
- Determination of the U/I- characteristic of the elektrolyser
- Determination of the power effiency and the Farady 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 elektrolyser with solar cells
- In combination with the Windtrainer junior: Operation of the elektrolyser with windenergy
- In combination with the Solartrainer junior and the Windtrainer junior: Operation of the elektrolyser with solar cells and windenergy as a hybrid system

H_2-TRAINER *junior*

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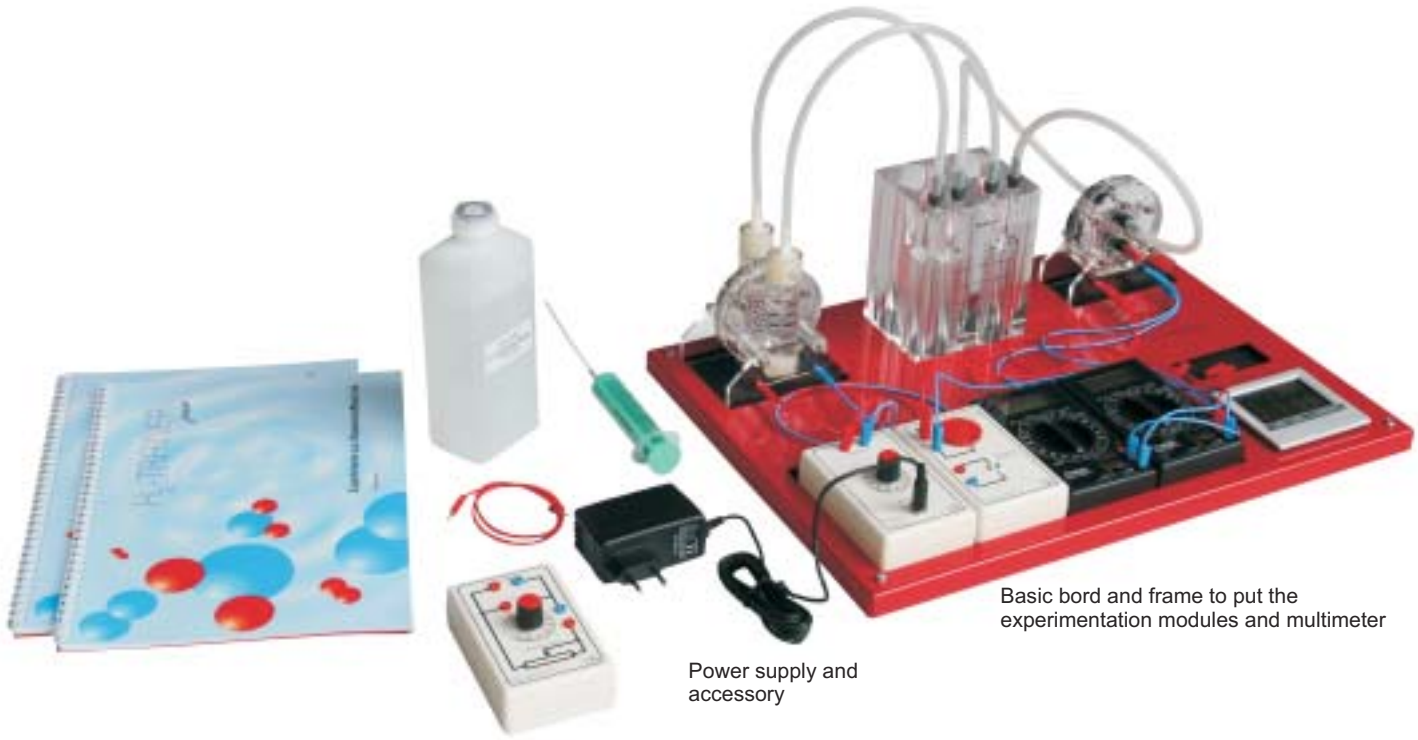

Elektrolyser, gas storage and fuel cell

Basic bord 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
- Destilled water
- Syringe
- Experimental instruction / documentation for Teacher

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Energie Check Profi

IKS Photovoltaik

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 multible sensor the CO_2-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 Lux meter digital
Effective range 0 - 50.000 Lux, value-hold-function, sensor external with spiral cable.
Metering precision +/- 5% + 2 digits

2 Energy cost meters digital
Measuring of energy, power (Effective, apparent and idle power), voltage, current, power factor, frequency, measuring duration, duty cycle, costs, min. / max. values, cost prognosis and more features

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

1 Infrared digital themometer
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 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 Multi measuring device
With multible sensor (IAQ sensor) for measuring of
CO_2- 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 Set of short instructions

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Energie Check junior

IKS Photovoltaik

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.

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).

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.

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.

Energie Check *junior*

Content:

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

1 Precision digital thermometer
External sensor for measuring of surface, water and air temperatures
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

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

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

1 Software to read out, data export and processing with other software possible

2 Indoor-/ outdoor temperature 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

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

1 Set of short form instructions

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ISET *Sensor*

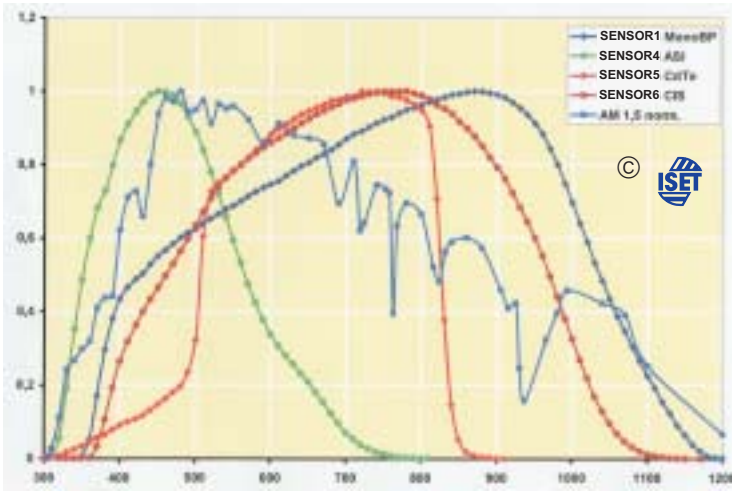
Solar radiation sensor ISET *Sensor* - high-quality measurement technology for the mass market

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 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 thermicall 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 archieved with a reference element constructed in an identical fashion by an accredited test laboratory in W/m² and is documented on a quality assurance calibrating certificate.



Wavelength [nm]

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

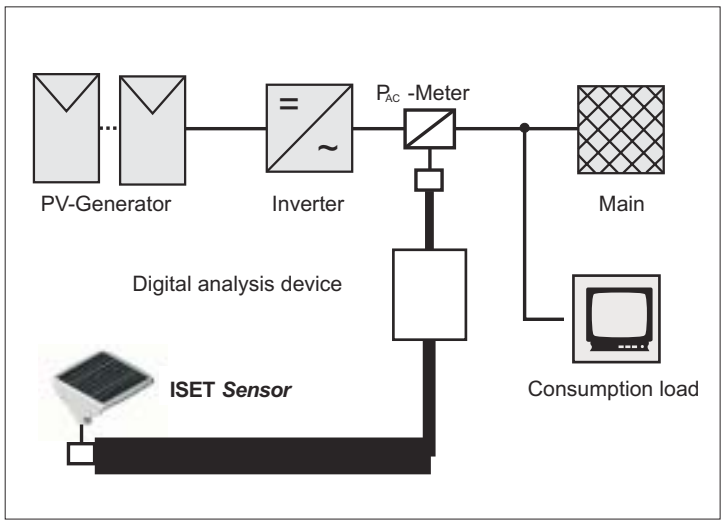
It is clearly visible and derivable that for the energetical rating and monitoring of a PV-plant should only be used the same technology of the sensor and the PV-plant because of the different spectral sensitivity of the different technologies.
Further there are the same physical characteristics regarding 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 new 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 3m *
Plug connected

Available solar cell sensors
- monocrystalline
- polycrystalline
- EFG
- amorphous

Embedded under clear glass hardened thermiclly or embedded like solar module

Measuring voltage
- about 100 mV (cal.val.) /1000 W/m², 25°C
- Specific shunt resistance coupled thermiclly 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 according to EN 45001 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 celll

Operating temperature range
-25° to + 80° C

* other versions according to customer preference (minimum quantity)
Subject to alteration. State: 10/2009

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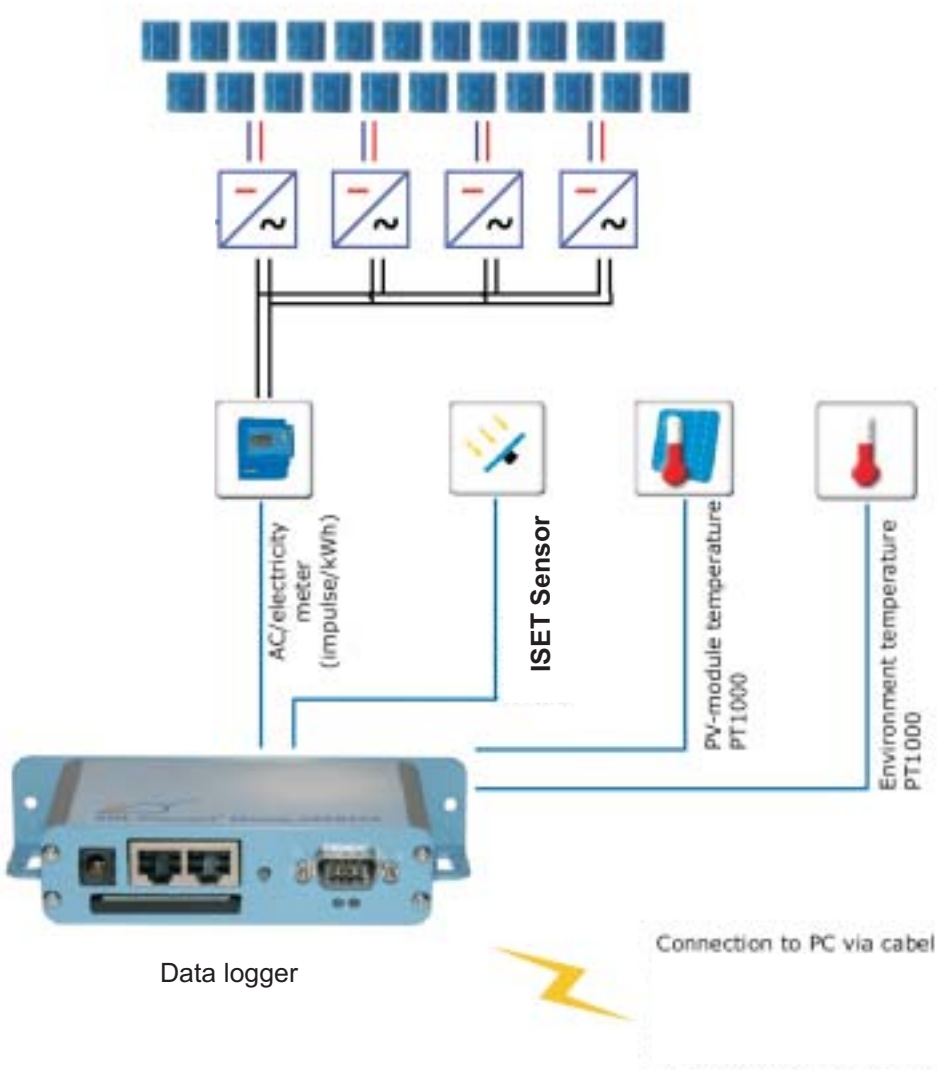
Training systems
Measurement engineering
Special developments

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 immeadiately 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 envirnment 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
- Controler 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: 10/2009

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Training systems
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Reseller

Solar radiation meter Standard

Technical Specification

Measuring range / Resolution

	P_{tot}	T
Unit	W/m²	°C
values	0 ... 1.000	-40 ... +85
Resolution	1	0.1

Max. Variation P_{tot}:	< 3 % ± 1 digit in range 50 … 1.000 W/m² (AM 1,5 / normal axis radiation (*2), T = 0 … +50 °C)
Max. Variation T:	< 3 °C ± 1 digit in range -25 … +75 °C, optional < 1 °C ± 1 digit
Power requirement (active Mode):	4 mW
Integrated solar module nominal power	180 mW *1
Ambient temperature measurement range:	-20 … +50 °C (Ambient tempratur)
Max. ambient humidity:	90 %
Dimensions (without mounting):	130 x 90 x 30 mm or
Weight (without mounting):	170 g
Certification	CE / EN50081, EN50082
Calibration according to:	IEC904/3, Calibration certificate on request
Warrenty	2 years

(*1) At standard conditions Ptot = 1.000 W/m², solar spectrum AM 1,5 at T = 25 °C
(*2) Certified by PI Photovoltaik-Institut Berlin AG

Subject to alteration, state 06/2008

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Photovoltaic - simulators

Model line PV - ES 150 to PV - ES 18.000

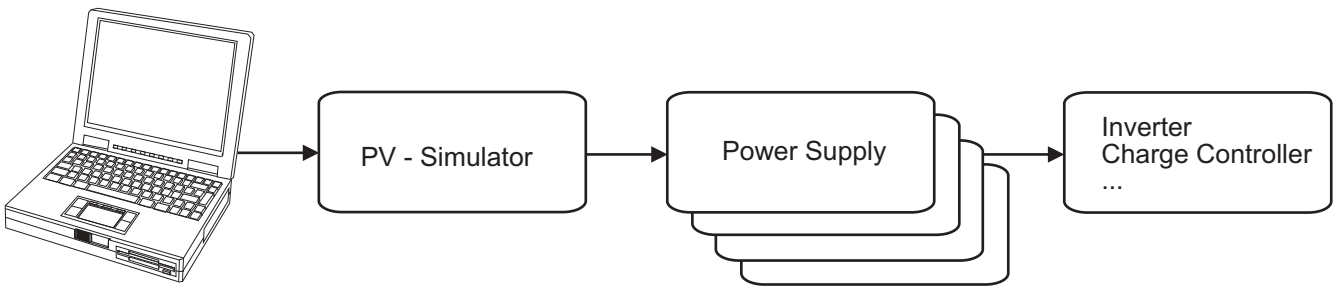
For the development and research of photovoltaic system components experiments on photovoltaics generators are absolutely essential.
Since real PV generators depend on temporal and meteorological influence factors they are unsuitable for a continuous laboratory operation with reproducible conditions needed.
That's why for tests and certifeing of different devices PV-simulators are used. They have the one advantage of beeing cheap and easy in construction, even for high demanding relating to the dynamics.

Technical Concept

The PV-Simulator is controlling one or several DC power supplies in a way, that their characteristics simulate those of a PV-generator.
By using the operating panel it is possible to effect „on-the-fly" changes concerning environmental influences such as solar irradiation [w/m²] and temperature [°C].
For this procedure, two potentiometers are used and the LC-display is monitoring the set values in real-time.

The PV-Simulator is built in a metal housing. The supply voltage of the PV-Simulator is 90 - 250 V AC, 50 - 60 Hz.
In the simulation mode, the simulated solar irradiation and temperature are monitored.
The PV-Simulator is capable of handling a maximal Output voltage from the Power Supply up to 1000 V, the PV-Simulator is programmed with the following parameters (condition of delivery):
off-load voltage (U0) 240 V, short circuit current (IK) 8A, UMPP 200 V, IMPP 7,0 A, Temp. coefficien -1000 mV/°C
By means of a terminal program or with the supplied demo software these values can be adjusted for other panels.
For the input of the voltage and current values an entry of 0.1 V and 0.01 A stepps is possible.

Equivalent circuit diagram



VisiKid

Fachhochschule Münster University of Applied Sciences

IKS Photovoltaik

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 greated 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.

Awarded with the „Special prize for the most interesting exhibit“ by the conference jury of the 20th symposium of photovoltaic solarenergy 2005 in Staffelstein / Germany.

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.

Currently only available within Germany

VisiKid

Fachhochschule Münster University of Applied Sciences

IKS Photovoltaik

Kinder sehen, wie der Strom vom Himmel fließt

FH-Professor erhält Preis Visualisierung der „Stromernte" / Vermarktung

Burgsteinfurt. Wenn die Sonne kräftig scheint, leuchten alle 24 Lämpchen auf der Schautafel und eine Sonnenuhr schaufelt für jede gewonnene Kilowattstunde der Solaranlage zwei Holzperlen in eine „Batterie". So soll die „Stromernte" der Solaranlage auf dem Dach auch schon für Kindergartenkinder begreifbar werden.

Entwickelt worden ist die so genannte VisiKid-Anlage unter Leitung von Prof. Dr.-Ing. Konrad Mertens am Fachbereich Elektrotechnik und Informatik der Fachhochschule in Burgsteinfurt. Der Hochschullehrer hat die Anlage jetzt auf einer Photovoltaik-Konferenz in Bamberg vorgestellt und ist mit einem Sonderpreis für das interessanteste Exponat durch die Konferenz-Jury ausgezeichnet worden. Zudem konnte sich der Wissenschaftler vor Nachfragen und Bestellwünschen kaum retten.

„Nun stellte sich uns die Frage, wie wir mit dem offensichtlich hohen Vermarktungspotenzial umgehen sollten", betont Mertens. Da sich der Wissenschaftler eher in der Rolle des Ideengebers als in der des Produzenten sieht, lag es nahe, die Anlage durch einen Lizenznehmer produzieren und vermarkten zu lassen. Mertens hat nun mit dem Unternehmen IKS-Photovoltaik in Kassel einen Lizenzvertrag für die Produktion von VisiKid abgeschlossen.

Angefangen hatte die Entwicklung mit der Bitte eines Emsdettener Kindergartens. Dort sollte die Stromerzeugung der Solarstromanlage auf dem Dach für die Kinder erlebbar werden. Der Hochschullehrer und Leiter des Labors für Optoelektronik und Sensorik nahm sich der Sache an und entwickelte das Konzept „VisiKid – Kindgerechte Visualisierung von Solarstromerträgen".

Ein erster Prototyp, der seit dem den Emsdettenern Kindern die Solarenergie erklärt, ist während einer Diplomarbeit entstanden. Die jeweilige elektrische Leistung der Anlage signalisieren bis zu 24 Energie sparenden Leuchtdioden. Gleichzeitig zeigen Holzkugeln, die durch ein mittels Mikrocomputer gesteuertes Zahnrad in einem Behälter befördert werden, die erzeugten Kilowattstunden an. IKS-Geschäftsführer Holger Kunsch gibt sich optimistisch: „Das Konzept ist bereits eine gute Grundlage für unsere Weiterentwicklung. Wir gehen davon aus, dass wir schon in Kürze mit der Serienproduktion beginnen können." Auch Prof. Mertens freut sich, „dass dieses Interesse stieß." Darüber hinaus könne über die Lizenznehmen über Ausstattung im Labor verhandelt werden.

Die Geschäftsführer von IKS Photovoltaik Holger Kunsch und Michael Schröder sowie Prof. Dr.-Ing. Konrad Mertens von der FH (v.l.) besiegelten per Händedruck den Lizenzvertrag.

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
- Factor according to the photovoltaic plant size freely programmable:
  -One LED (of 24) = x W
  -One ball = x kWh
- Individual labeling possible

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