Member of GHM GROUP

Solar Energy

Delta OHM – Inspired by the Environment

Delta OHM

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO
ACCREDIA LAT N° 124 laboratory
Temperature – Humidity – Pressure – Air speed
Photometry / Radiometry – Acoustics

At Delta OHM we offer our customers the technology for measuring, understanding and influencing the world we live and work in and the environment around us.

Delta OHM is an Italian company specialized in the design, manufacturing and calibration of portable, bench top and industrial scientific instruments for the measurement of physical quantities. Our products are completely developed within the company, where more than 25 % of the work force is involved in research and development departments.

The range includes instruments for the measurement of Acoustics and Vibration, Environmental and Weather Stations, Indoor Air Quality, Wireless Data Logger Systems, Relative Humidity, Air Speed, Photo Radiometry, Light, Temperature and Pressure.

Delta OHM Calibration Center, based on six modern laboratories equipped with a state-of-the-art equipment, is part of the international circuit ILAC-MRA and ISO 17025 accredited. The main production at Delta OHM is based on specific national and international standards, in order to help and ease the work of experts who are designated to ensure workers" and citizens" safety as well as a cleaner and healthier environment.

In Delta OHM we do not only produce measuring instruments; in Delta OHM we like to be able to contribute to the development and sustainability of the society throughout technologically advanced measurement solutions.

The Accredia Lat N°. 124 calibration laboratories of Delta Ohm are accredited for measurements of the following physical variables:

- Temperature
- Humidity
- Pressure
- Air speed
- Photometry / Radiometry
- Acoustics

Foreword

Dear readers,

the sustainable energy generation is one of the most important tasks for the future and it poses major challenges to research, development and industry. One of the most promising renewable energy is solar energy: it is the most abundant one and it is available in direct as well as indirect form. The enormous market growth in photovoltaics during the 21st century has revived the research and expansion in the solar industry, including the maintenance of existing plants.

The utmost precision is required to get maximum yield from sun energy. Monitoring and maintenance are a key for ensuring the productivity of the photovoltaic system. Researches have shown that an effectively monitored plant has a yield of more than 5% compared to a system without control.

For several decades GHM GROUP has accompanied the development of renewables monitoring plants and ensured their safe operation providing technologies that allow to evaluate and measure the efficiency of a photovoltaic plants. Our measurement technology is able to acquire almost every value, which leads to an efficient overview.
Due to our long-term know-how in renewables technologies, we have received a long-standing confidence by our customers and we offer a first-class standard of innovation, high quality, excellent service as well as continuous maintenance and evolution of measurement technology.
Sustainability is the most precious gift that we can give to our future generations.

With the present brochure, it is our concern to provide you a comprehensive overview of all our components such as monitoring devices, analog and digital sensors, data loggers and integrated solutions.

Specialists by Competence.

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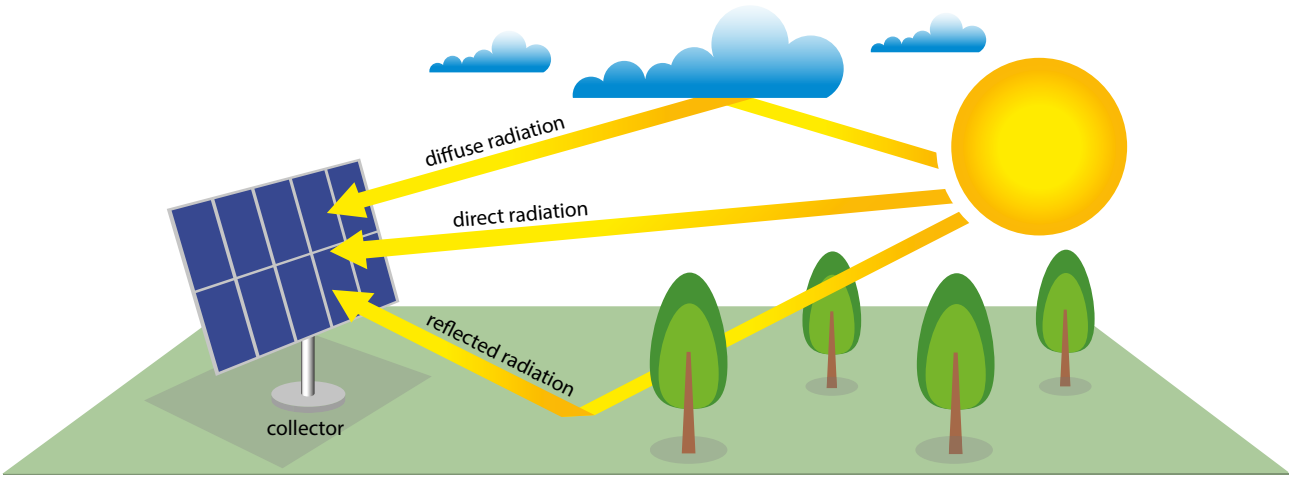
Solar Radiation – direct, diffuse and reflected radiation



Solar Radiation

The solar radiation, often called "global radiation" is the sum of direct, indirect and reflected radiation.

"Direct radiation"

also called sometimes „beam radiation" or „direct beam radiation", is used to describe solar radiation travelling on a straight line from the sun down to the surface of the earth. Because of this fixed direction, shadows of the objects which come in the way of sun rays are formed. This way shadows are only produced when direct radiation is blocked.

"Diffuse radiation"

on the other hand, does not have a fixed direction but just goes any which way. The term describes the sunlight that has been scattered by molecules and particles in the atmosphere but that has still made it down to the surface of the earth.

"Reflected radiation"

is the component of radiation which is reflected from surfaces other than air particles.

"Normal radiation"

describes the radiation that strikes a surface that is at a 90° angle to the sun's rays. By constantly keeping our solar collectors at a 90° angle with the sun, we maximize the direct radiation received on that day.

"Ratio of direct to diffuse radiation"

varies according to the sun position. When the sky is clear and the sun is very high in the sky, direct radiation is around 85 % of the total insolation striking the ground and diffuse radiation is about 15 %. As the sun goes lower in the sky, the percentage of diffuse radiation keeps going up until it reaches 40 % when the sun is 10° above the horizon.

Pyranometer – monitoring solar plant efficiency

Pyranometer

A pyranometer is a type of actinometer used to measure broad-band solar irradiance on a planar surface and it is a sensor that is designed to measure the solar radiation flux density (in W/m^2) from a field of view of 180 degrees. Pyranometers are frequently used in meteorology, climatology, solar energy studies and building physics. They can be seen in many meteorological stations – typically installed horizontally and next to solar panels – typically mounted with the sensor surface in the plane of the panel.

Pyranometers are standardised according to the ISO 9060 standard, that is also adopted by the World Meteorological Organization (WMO). This standard discriminates three classes. The best is called "Secondary Standard", the second best "First Class" and the last one "Second Class"

Pyranometer
Secondary Standard
LP Pyra 10

Pyranometer
First Class
LP Pyra 02

Pyranometer
Second Class
LP Pyra 03

Reasons for measuring Solar Radiation

- to select the most appropriate PV system, cell technology and fixed or tracking type
- to find optimal locations (solar prospecting, field mapping)
- to help investment decisions
- to monitor system performance
- to schedule maintenance and maximize operating efficiency
- for performance calculations

Silicon Pyranometer – affordable control

Silicon Pyranometer for low cost monitoring solar plant efficiency

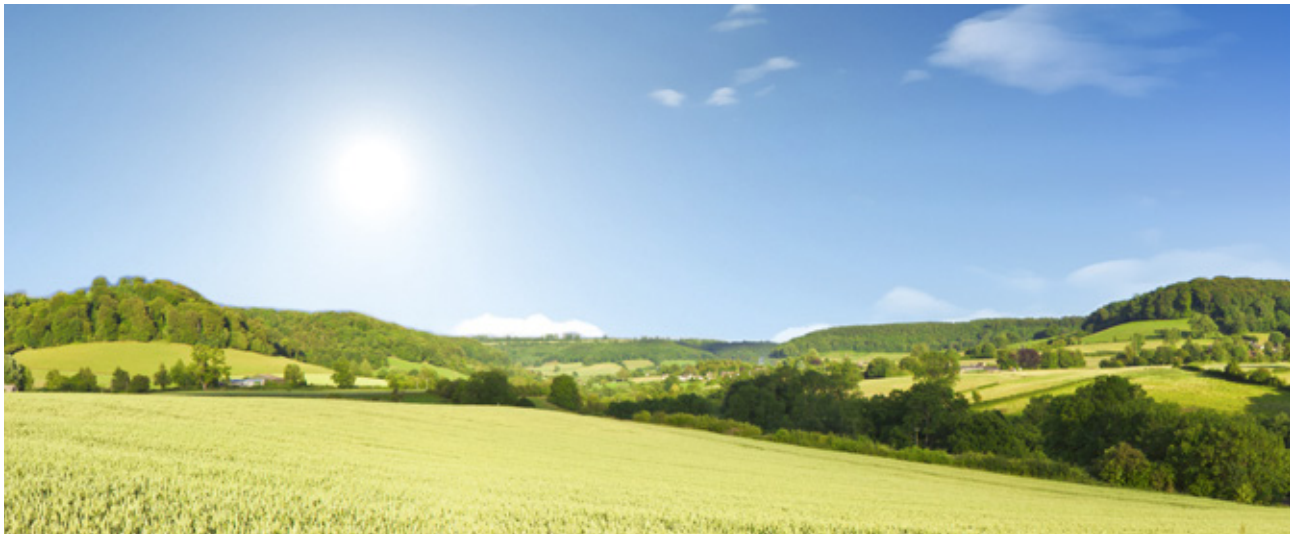
The LP Silicon-PYRA 04. pyranometer measures the global solar radiation (W/m^2) by using a silicon photodiode (350 nm –1100 nm). The special geometry and the diffuser allow to have a pyranometer field of view of 180 degrees according to cosine law. The pyranometer is suitable for the measurement of natural sunlight.

Silicon Pyranometer
LP Silicon-PYRA 04

Advantages of a Pyranometer over a Reference Cell

- The pyranometer gives an indipendent, accurate reading of the total available solar radiation.
- Pyranometers are classified and calibrated to ISO standards and WMO standards.
- The response time of a pyranometer is longer than a PV cell.
- The pyranometer is PV cell type independent.
- A pyranometer can have a very small temperature coefficient.
- A pyranometer could not need power supply limiting energy consumption.
- A pyranometer does not suffer for sun incidence.
- References of the PV cells are specified only at STC (Standard Test Conditions).
- Reference cells (and PV panels) suffer more from pollution than pyranometers.
- Performance ratio or performance index calculations are more accurate using a pyranometer.

Sunshine Duration and Pyrheliometer



WMO - World Meteorological Organization

The WMO defines the sunshine duration as the time during which the direct solar radiation exceeds the level of 120 W/m^2. The choice of instruments for sunshine duration is more difficult. This type of instrument is not standardized and the measurment can be done in various ways.

Sunshine duration is often monitored in order not to interrupt historical records.

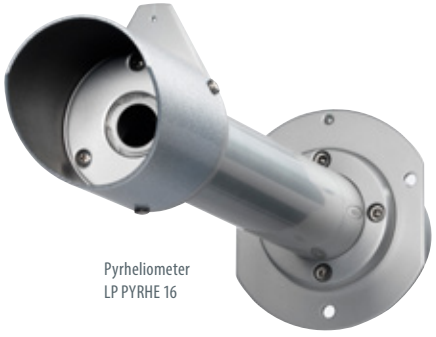
The Sunshine Duration Sensor
LP SD18

The Sunshine Duration Sensor

- performes the measure of radiation with an array of photodiodes arranged in a particular geometry which allows to obtain an accurate measurement in any weather conditions.
- measures also direct radiation (SRD).
- is available in three versions, which differs in the type of output.

Pyrheliometer

When the sky is clear and the sun is very high in the sky, direct radiation is around 85 % of the total insolation striking the ground and diffuse radiation is about 15 %. As the sun goes lower in the sky, the percent of diffuse radiation keeps going up until it reaches 40 % when the sun is 10° above the horizon.



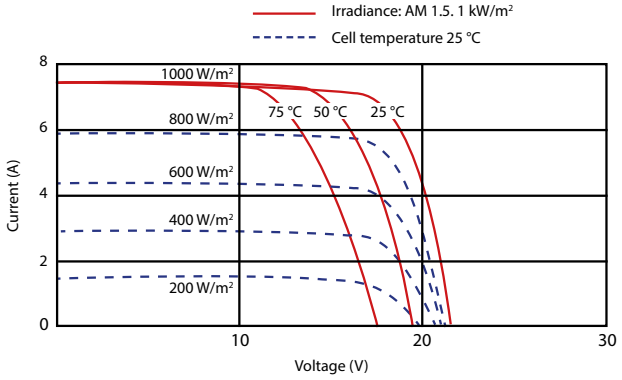
Pyrheliometer
LP PYRHE 16

Panel Temperature

Temperature Coefficients

The temperature coefficients of a module describe the temperature dependencies of the current, and in particular of the voltage.
As a result, the temperature also has a major impact on the measurement result, and in the end, on the measurement of power. Depending on the device, there are a variety of ways to measure the temperature.

Temperature dependent resistances (e.g. Pt100) are the most common method. The temperature sensors must be attached to the rear of the module and set in the centre behind a cell.
The temperature and irradiation recorded must also be sent to the measurement device and attributed to the measurement to the nearest second.



Example of I-V curves of a PV module

Temperature Transmitters

Active temperature transmitters complete with contact temperature probe for solar panels with 5 or 10 m cable, 1/3 DIN thin-fi lm Pt100 sensor

HD48T

HD4807TFP

Environmental Sensors – maximizing of the profitability

Schedule maintenance and increase of performance

Anemometer

Wind speed and direction parameters do not directly affect the performance of PV plants but are used to evaluate air mass transfer phenomena on the modules' surface. In fact, it is well known that air mass movement improves temperature dissipation of the PV cells. Moreover, these data are used on PV plants equipped with solar trackers in order to warn about possible dangerous situations.

Two axis ultrasonic anemometer
HD 52.3D
HD 52.3DP147R

Temperature and Humidty Transmitter

The ambient temperature is measured by PT100 sensors. The measurement of the temperature allows the evaluation of the performance with respect to standard conditions of the test.

Temperature and humidity transmitter
HD 9007A-1
HD 9008TRR
HD 9007R

Rain Gauge

Rain may damage the photovoltaic system by infiltrating the fixing holes, if not perfectly sealed, or penetrating between the edges that separate the panels between them. Of course the cleaning of the solar panels frequently exposed to rain is a must. Acidity, dirt and aloes are consequences that worsen the absorption of sunlight.

Rain Gauge
HD 2013
HD 2015

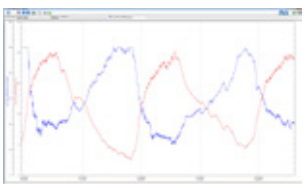
Environmental Data Acquisition Systems

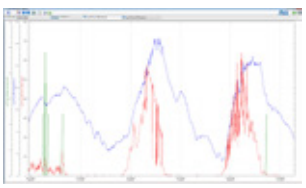
Improving technical availability and efficiency of the PV plant

A solar monitoring station consists in a data logger capable to store the measured values and to acquire the parameter measured by specific sensors.

The innovative HD35 wireless data acquisition system is a battery-operated, cabling system which collects the measurements from the sensors and transmits them to an access point which in turn allows remote management and delivery of the data. Depending on the size of the plant, multiple data acquisition systems can be part of a single network which centralize all collected measures.

The possibility to access the by the monitoring system directly measured data, upstream of software processing, is a preferential feature for monitoring systems used in medium and large PV plants which need targeted performance analysis. Weather data as well as panel temperature, solar radiation or sunshine duration are displayed in real time allowing an adequately and more effective intervention on failures and a reduction of operation time, thus improving technical availability and efficiency of the PV plant.





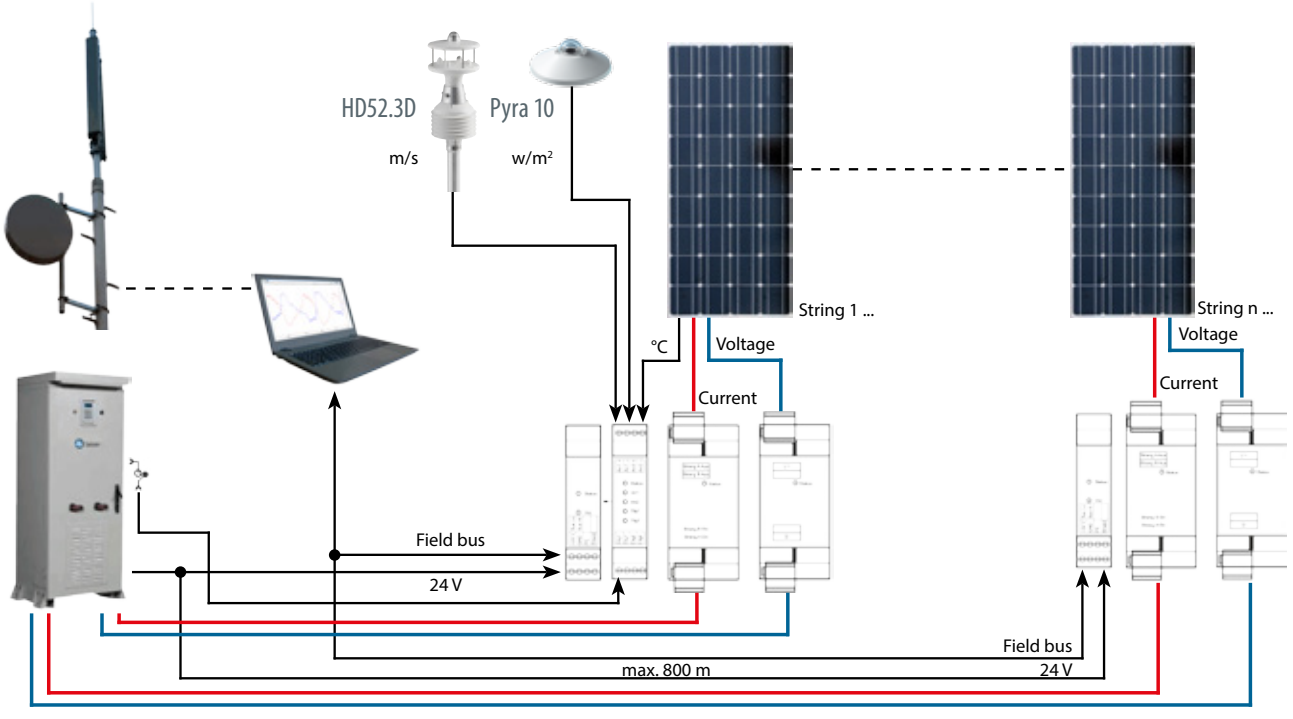
HD 35xx - Wireless data logger

String Data Acquistion Solutions – part I

String monitoring: an essential tool for reliable PV operation and maintenance

Permanent control provides early detection of defects and malfunction of a PV system or its solar panels.
Data and state acquisition of the PV system is designed with modular components.
There are modules measuring DC current and voltage of the individual strings, modules for panel temperature, and signals of wind speed, irradiation sensors and air temperature.

The current-to-voltage characteristic of a solar panel built of several solar cells connected in series, reflects the specific properties of this power generator.
The curve of a solar panel is very similar to a single cell, despite the different scale factor. Solar panels are again connected in series or in parallel to generate more current or voltage as appropriate.



String Data Acquistion Solutions – part II

What kind of information we can obtain?

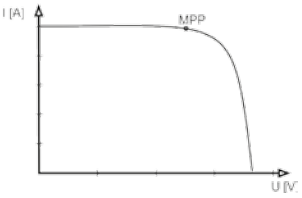
The electrical quantities to acquire for a proper PV plant's supervision are as follows:

Electrical quantities (V, I, P):
- o String
- o Inverter input
- o Inverter output

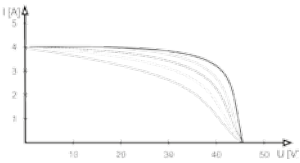
Energy power (Wh)
- o Output inverter
- o Line input
- o Self-consumption

Faulty signals from:
- o String
- o Inverter
- o Electrical switchboards

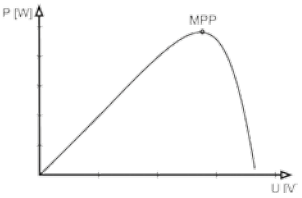
The monitoring of the production plants' management aims to keep under constant control the technical and environmental parameters of production facilities in order to analyze the trend of the technical and economic performances so to maintain alignment with (or even improve) the expected operational results.



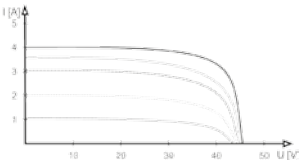
Schematic view of IV characteristic Voltage value at MMP



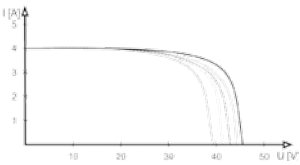
Schematic view of shadowing impact



Schematic view of maximum power characteristic



Schematic view of irradiation impact



Schematic view of temperature impact

PV Module Devices

Module	Input						Output		
Sensor	**Voltage**	**Current**	**Signal Voltage**	**Signal Current**	**Pt100**	**Digital Out**	**Interanl (SPI)**	**Modbus RS 485**	**CAN**
IPV Voltage	●						●		
IPV Current		●					●		
IPV Signals AD			⊙	⊙	⊙	●	●		
IPV Signals D						●	●		
IPV Communication								●	○

● = Standard / ○ = Optional / ⊙ = per type of sensor

(Mistakes reserverd, technical specifications subject to change without notice)

IPV communication

This IPV module serves to transmit data acquired by the current, voltage, and signal modules of solar systems for string efficency monitoring in medium sized and large facilities.

IPV voltage

This IPV module serves to acquire DC voltage values in solar systems for string efficency monitoring in medium sized or large facilities.

IPV current

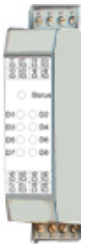
This IPV module serves to acquire DC current values in solar systems for string efficency monitoring in medium sized or large facilities.

IPV signals AD

This IPV module serves to acquireanalog and digital signals in solar systems.

IPV signals D

This IPV module serves to acquire digital signals in solar systems.



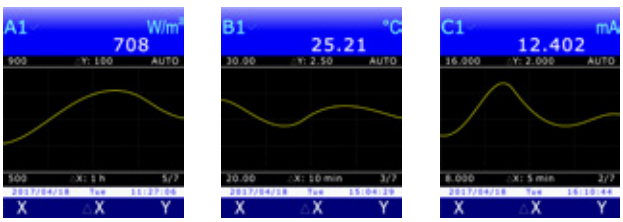
Portable Photovoltaic Testing

Multifunctional Portable Devices for testing and maintenance

Portable instruments are used by professionals to perform regular problem-solving.
While operating, it may happen that some of the modules can compromise the performance of the entire system. When the efficiency of the system is lower than expected, it is important to solve the problem in order to remove the inefficiency. The portable instrumentation allows this analysis to be done directly on the field. In case of malfunctions, it is important to act promptly, without losing the kwh produced, which are the main responsible for the success of the investment. In fact, the payback period will be respected if the plant produces within the expected time.

Tests and Security Checks

The testing tests at plant start-up are carried out to certify their safety (IEC 62446). In some countries there is a benchmark for testing where, in the interest of financing, it is necessary to provide specific performance requirements. The comparison between detected and nominal data allows to determine immediately whether the string or module meets the efficiency parameters declared by the manufacturer.

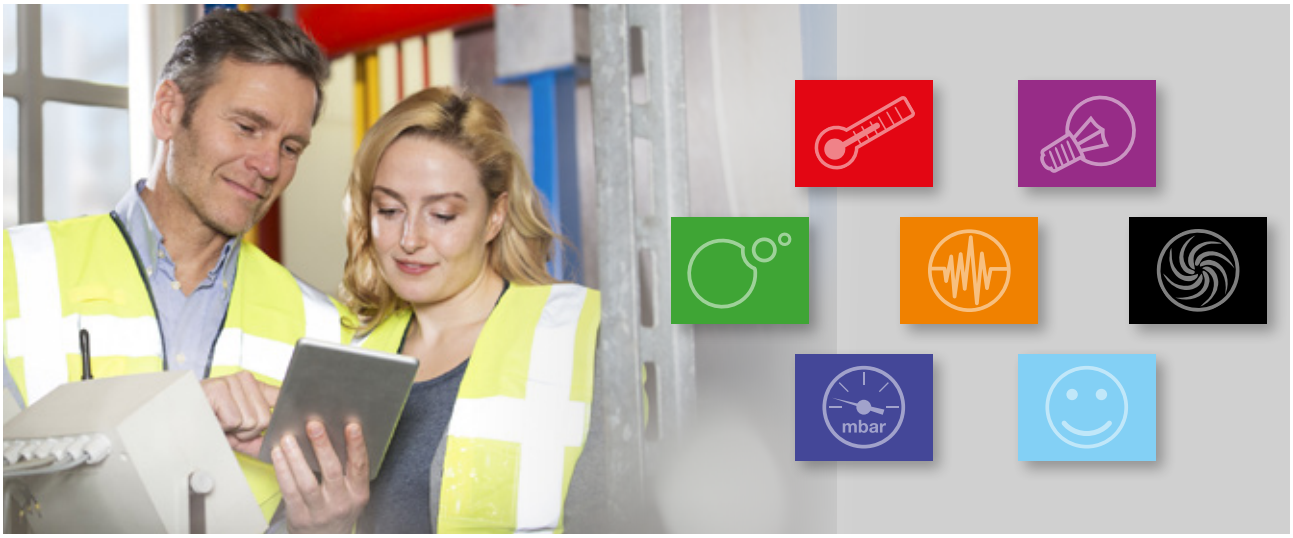


HD31 Multifunktional Datalogger

HD31 is a 3 channel multifunctional datalogger. Each of the input allow connecting probes for measurement of a variaty of physical quantities including temperature, humidity, solar radiation, panel temperature, current and voltage by using separate high accurancy sensors.
This measurement allow the immediat evaluation.

HD31 with photovoltaic probes

Accurately Measuring is our Standard



Delta OHM Calibration Center

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OUR LABORATORIES

- **Temperature**
- **Humidity**
- **Pressure**
- **Air speed**
- **Acoustics**
- **Photoradiometry - SOLAR RADIATION**

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

LAT N° 124

Temperature - Humidity - Pressure - Air speed
Photometry/Radiometry - Acoustics

ACCREDIA is the italian national accreditation body appointed by the Italian State to perform accreditation activity.


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Laboratorio Accreditato di Taratura
CERTIFICATO DI TARATURA LAT 124
Certificate of Calibration

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