



Solarimeter

SL 200



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I – Introduction

In addition to environmental applications, and face to development of renewable energy, SL 200 instrument allows to control on test or on site, equipment with thermal or photovoltaic sensors. Thanks to its big capacity of measurement and storage, SL 200 becomes an instrument of control and investigation particularly suited.

SL 200 instrument is a portable instrument which can measure and display :

Instantaneous:

- Irradiance or irradiation for spot check measures in W/m^2 .

On a timed duration of measurement:

- Max./min. values
- Average value of irradiance
- Accumulated energy or radiant exposure in Wh/m^2

Data are saved when the instrument is stopped or in case of battery failure.

Its sensor is composed of a strained silicon cell, not very sensitive to the thermal changes. It absorbs the solar radiation through a diffusor and a correction filter. The output voltage of the sensor is related to the received radiation.

SL 200 instrument is mainly an efficient and easy-to-use instrument : with small size, it has a large display with a resolution of 64×128 pixels involving a very high electronic technology.

II – General information

Measured units

SL 200 instrument can process the energy intensity emitted by the solar radiation in a precise place of the earth .

Expression of the solar energy and associated units :

Irradiance is the solar radiant **flow** received by unit area, expressed in W/m^2 .

The radiant exposure or global irradiation is the **quantity** of solar energy by unit area: it's the product of irradiance by the duration of irradiation, expressed in Wh/m^2

Use

Solar radiation :

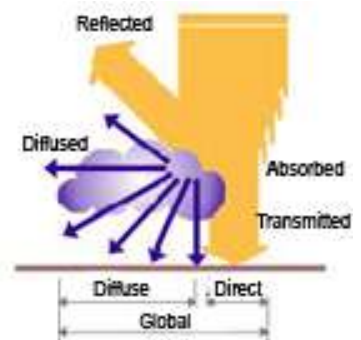
Among all solar radiations, (opposite draw),

SL 200 was designed to measure the sum of direct solar radiation and diffuse solar radiation, which constitutes global solar radiation.

For any application, before, during and after the installation of solar thermal photovoltaic sensors, it is required to control means of measurement to obtain valid and coherent results. Means of use of the instrument has at least so much importance on the result than the quality of the instrument.



It is definitely necessary to take into account the influence of environment, in particular :

1. Position or direct correctly solar cell of SL 200 instrument, according to location of solar sensors or supports (roof, terrace...)
2. Avoid dark areas (present or to come)
3. Go away as much as possible from reflecting zones







III - Operating principle

Keyboard presentation

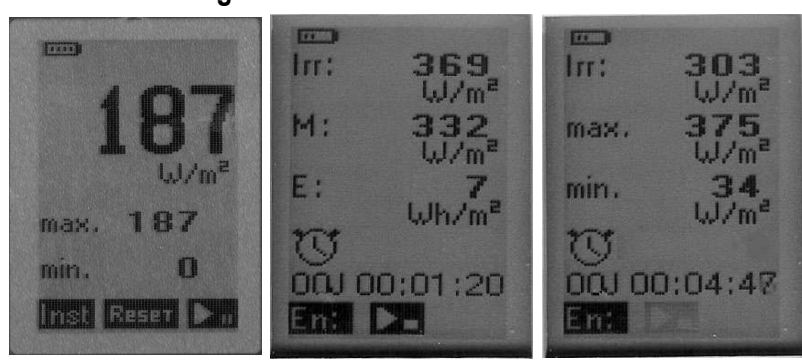
When being switched on, "measurement screen" is displayed. From this screen, the operator has access to three others screens by pressing  on keyboard; return to measurement screen is obtained by activating .



- ① ② ③ **Function keys**  Directly associated to text displayed shown above on display, they allow measurement setting.
- ④ **Key "leaves current screen"** 
- ⑤ **Screen key**  From measurement screens, give access to other screens
- ⑥ **On/Off key** 

Instrument offers 3 groups of screens

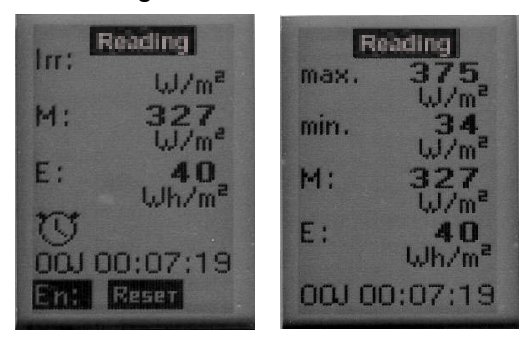
1- Screens during measurement



*Irradiance
Min./Max value*

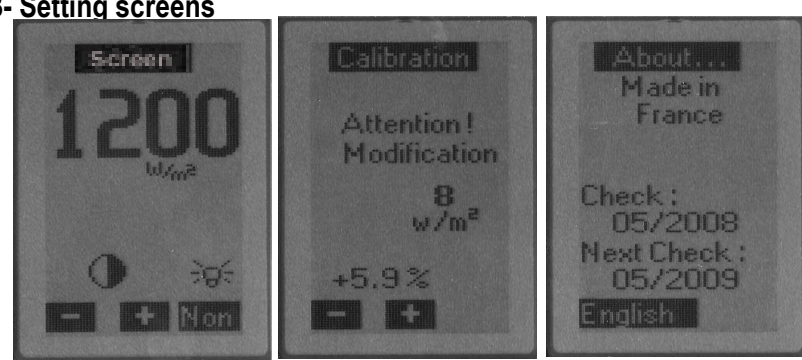
*Irradiation, average, accumulated energy,
Min./Max instantaneous irradiation*

2- Reading screens after measurement



*Irradiation, average, accumulated energy,
Min./Max instantaneous irradiation, reading of
memory and graphic display*

3- Setting screens




Brightness

Calibration



About

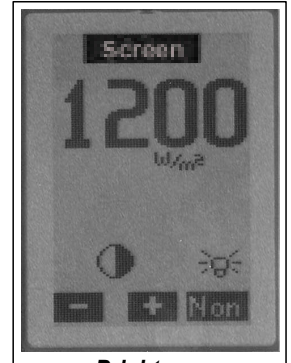
IV – Setting

Accessible from the principal measuring screen by successive pushes on the key , those different screens allow setting of the instrument. They also inform users.

Brightness

To optimize display reading, the operator can :



1. Adjust brightness by pressing  and  function keys.
2. Backlight LCD display for a better reading in a dark place.
 “No” means backlight is switch off and “Yes” it is switch on.
 In this last case, battery life is reduced by about 15%.



Brightness

Calibration

To recall calibration conditions including calibration coefficient of the sensor. It is strongly recommended not to change the instrument calibration, this screen is reserved to the manufacturer or laboratory partner.

In case of unwanted push on a key, an alert occurs: **Caution modification!**. Leave via the keys  or .


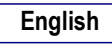
In case of sensor replacement, please refer to METROLOGY Chapter.



Calibration coefficient

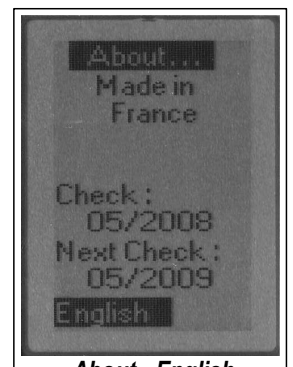
About

Information on origin of manufacture and dates of last and next audits.

By pressing  and  keys, you can Choose language : French or English.



About - French



About - English

V – During measurement




Irradiance

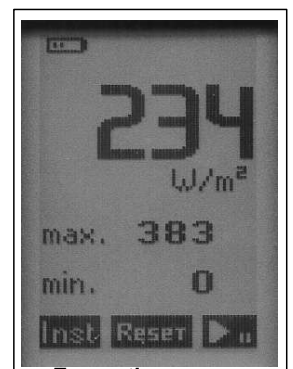
Once switched on, the instrument measures and displays twice a second the instantaneous value of solar power (or irradiance) in W/m². This value gives information to users about sunshine local conditions.

Display :

- Solar power W/m²
- Maximum value
- Minimum Value

Functions :

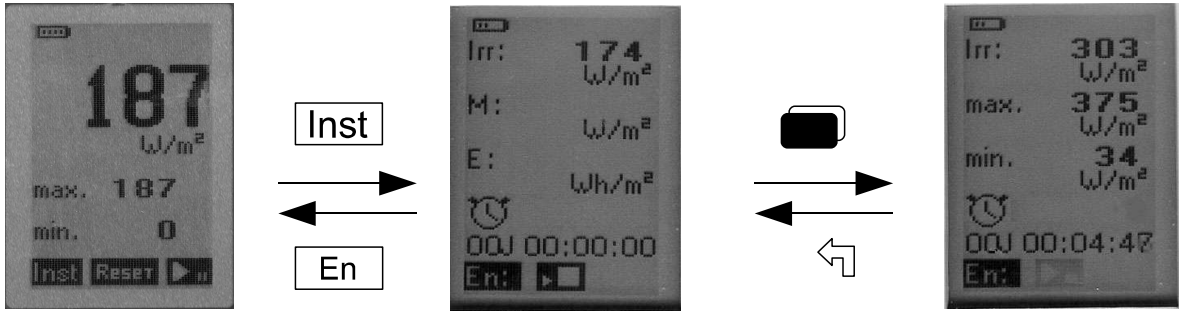
-  Reset minimum and maximum values
-  Activate pause function
-  Continue measurement



Energetic exposure

Radiation exposure or global irradiation

The instrument measures twice a second the irradiance and displays it, while memorizing minimum and maximum values. From these data, it calculates and displays the measurement duration: average value, Radiation exposure or global irradiation.



From start screen, the operator have access to energy measurement over a period controlled by timer and clock, he proceeds as follows:

- 1 x Access to exposure measurement and in sunshine control Irr. **Measurement is not launched yet.**
- 1 x Launch of the energy accumulation in **Wh/m²** visualized by the "On" pictogram which flashes. The chronometer starts, it indicates secondes-minutes- hours-day (max : 03D00H00M00S). First average values and accumulated energy values appear.
- 1 x Switching to second screen to recall max and min.
- 1 x Stop of measurement, "**Reset**" is displayed.

VI – After measurement

After a requested shut-down of measurement, results are saved automatically and systematically presented to the operator before a launch of a new measurement.

Data reading

Three successive screens are displaying by pressing

Screen 1 : Average of Irradiance **M**
Radiant exposure **E** on period of measurement

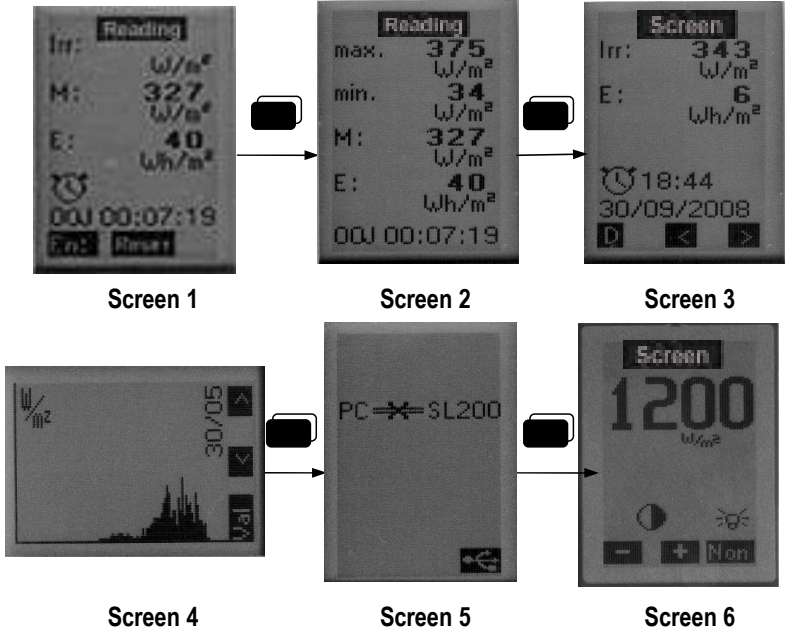
Screen 2 :Screen 1 + minimum and maximum value of instantaneous irradiation

Screen 3 : Reading of saved data

Screen 4 : Viewing of graphic display of stored data each day of 24 hours.

Screen 5 : Data transfer toward a computer trough USB cable

Screen 6 : Screen of brightness and backlight setting (if necessary during reading of data)



Data stored reading

•Screen 3 :

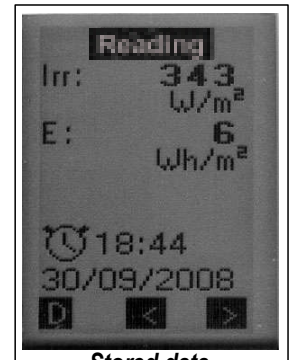
Irr : represents the averaged value over a minute with date and time indicated of irradiance.

E : represents the energetic exposure in Wh/m² accumulated from the beginning of measurement until date and time displayed.

To facilitate evaluation data, user can choose the scanning pitch through the D, H, M key :

- D for date
 H for hour
 M for minute

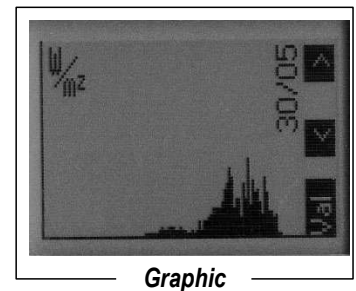
then through arrow keys < (decremented) and > (incremented) user displays the searched date and time.



• Screen 4 :

This screen visualizes a daily graphic display of irradiance values from **0:00 am to 0:00 pm** on a scale of **1300 W/m² maximum**

Choice of the day is made through arrow keys < (decrements) and > (increments).
The Val pictogram appears. Press Val key to change the graph and to visualize it.

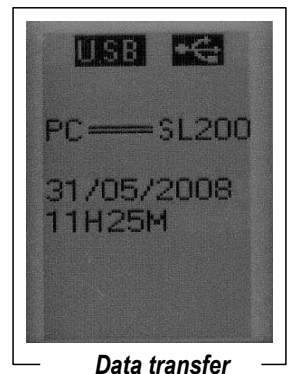
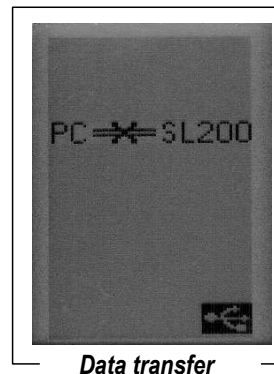


Data transfer

Screen 5 "Data transfer " allows data transfer toward a computer trough USB cable. **DL 200 software** have been previously loaded into the computer (see notice of DL 200 Software).

To access screen 5 from reading screen, press to obtaining the screen data transfer. Then press USB symbol.

Once the connection, computer detects SL200 instrument on the appropriate port. The software allows only the transfer, the instrument is still pending. It only indicates date and time (which can be updated through software DL200).



File Format :

File values adopt a text termination : **txt**, which is easily exploitable by a Excel spreadsheet for example.

```
-----
                               SL N°9999
Raw data from the collector
-----
Contents the 08/07/2008 at 18:31:52
-----
08/06/2008,11:10:00,beginning
13/06/2008,13:09:00,end
08/06/2008,11:10:00,0007
08/06/2008,11:11:00,0019
08/06/2008,11:12:00,0021
08/06/2008,11:13:00,0023
08/06/2008,11:14:00,0025
08/06/2008,11:15:00,0025
-----
Data file text format
-----
```

Data evaluation

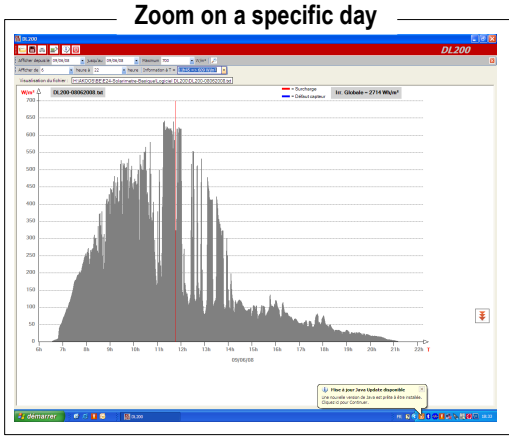
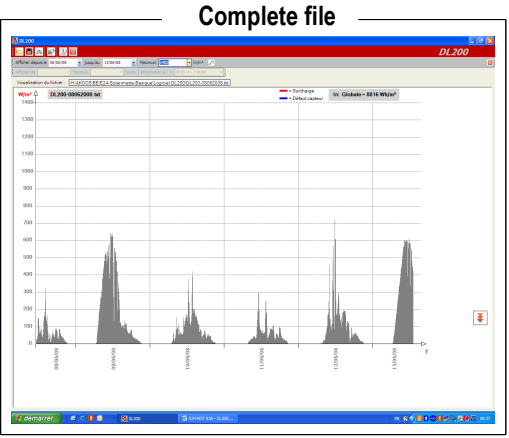
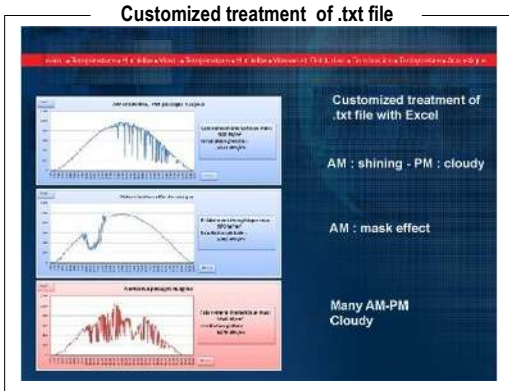
The operator can organize his control or investigation folder by importing .txt file in an appropriate spreadsheet.

For example

Evaluation of the .txt file through DL 200 software allows rapid obtaining of tracing time of irradiance and an easy graphic process.

For example :

These images can be saved or printed for an integration into the corresponding folder. Images are saved in .jpg format.

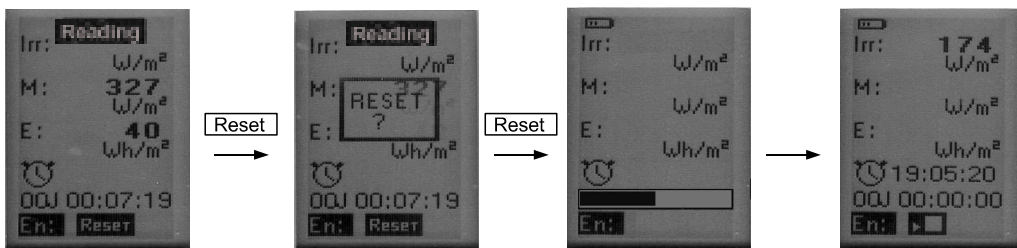


New measurement – Resetting memory

After recording of results in its folder or transfer toward a computer, the operator can launch a new measurement. Before, he imperatively has to erase stored data of the previous measurement.

From the reading screen, please proceed this way :

1. 1 x **Reset** A message alerts the operator of a reset of memory backup.
2. 1 x **Reset** Memory is erasing , visualized by the progress bar. Memory is erased, the operator can launch a new measurement.

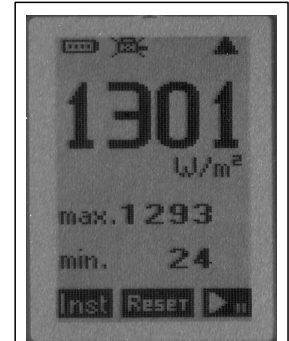


VII – Operating information

Over-range

Although it is quite impossible, in very special conditions of reflections concentrated to the sensor, a pictogram of exceeded range appears.

It comes for an irradiance higher to **1300 W/m²**. The maximum value will indicate **1301 W/m²**.



Overrange

Sensor default

In case of a defective sensor (sensor unplugged) during the measurement, symbols * * * appear and disappear after its proper connection.

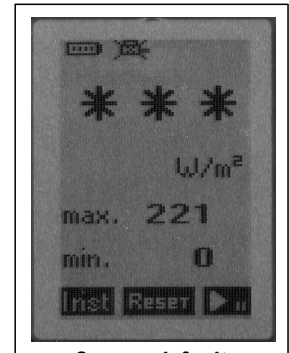
During the dysfunction sequence :

The chronometer still running correctly, it indicates to the operator the real duration of measurement containing the time of sensor default.

Max. min., M. irradiation values are false. Only the energetic exposure is exploitable on the duration of running without sensor default detected by the instrument.

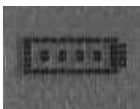


To remind the operator this default and to keep it into consideration in exploitation of results, a pictogram is at the top of the screen for the measure. It is also displayed after the measurement.



Sensor default

Power source



When the instrument is equipped with alkaline batteries, it can operate for **72 hours minimum**. A symbol informs the user about electric power remaining. If battery is low, less than 1 bar on the pictogram, the instrument stops measuring, save current measurement and switches off.

VIII – Maintenance

Servicing

The SL 200 instrument conception allows a reduce maintenance which consists in changing batteries and cleaning the sensor with a cloth slightly dampened.

Clock

SL200 instrument has a permanent clock powered by an internal battery that is recharged when the device is switched on. In case of non-use of the device, the battery will allow the running of the clock for 6 months.

After 6 months or at the start of the device, if it is displayed a wrong time (eg: 00:00), it means that it is necessary to recharge battery. Switching **SL200** instrument for about two hours allows its recharge.

Important : The correct resetting of the clock is made through a computer and the **DL 200** software (cf. instructions for use of **DL 200** software).

Regular checking

Like most measuring instruments, it is strongly recommended to regularly control and calibrate SL200. Return to the manufacturer each year will provide necessary metrological traceability.

Batteries replacement – adaptors

Batteries :

To replace batteries, open the back hatch and insert the 3 new batteries of type 1.5 V / AAA-LR3 inside.

Warning: respect meaning of batteries. If storage is very long, remove batteries.

Adaptors :

Depending on the conditions of measurement, there are several possibilities of power supply of SL200 :

- Connecting to the USB plug of a computer

- USB adapter type

- Medium capacity battery pack

- High-capacity battery pack

(Cf : accessories)

Note: when using with an external power, it is recommended to remove batteries from SL100. An internal protection, however, allows to secure all if you forget it.

IX – Main specifications

SL200

Solar irrigation measuring range.....from 1 W/m² to 1300 W/m²

Energetic exposure measuring range...from 1 Wh/m² to 500 kWh/m²

Frequency of the measure.....2 / s

Accuracy.....5% of measurement

Calculation frequency (W/m²).....1 / min (average on 60 seconds)

Storage capacity.....31 days, 44640 saved recording points

Fast datas download.....1000 values/second

Detection.....out of range and sensor default

Operating temperature.....from -10°C to +50°C

Storage temperature.....from -10°C to +55°C

Package dimensions.....58 x 120 x 33 mm

Autonomy.....more than 72 hours in continuous mode

Unlimited with power supply adapter

Power supply.....3 LR3-AAA batteries

Electronic.....Digital

Electronic card.....Varnish

Conformity.....in accordance with RoHS directives

Solar cell

Spectral response	from 400 to 1100 nm
Nominal calibration coefficient	100mv for 1000W/m ²
Response in cosine	corrected until 80°
Coefficient in temperature	+0.1%/°C
Operating temperature	from -30°C to +60°C
Humidity dependence	100% HR
UV performance	excellent (PMMA filter)
Mode	photovoltaic
Surface active	1 cm ²
Material	Polycrystallin silicon
Front face	Translucent PMMA
Tightness	Polyurethane resin and housing PMMA and polyacetol
Cell weight	60 g
Cell dimensions	30 x 32 mm

Standard reference

This instrument is based on recommendations and requirements of the standard ISO9060 -1990: Solar energy - Specification and classification of instruments for measuring solar radiation hemispheric and direct.

X – Metrology

Traceability

Calibration of this instrument was performed to determine calibration coefficient of the sensor with a method by comparison with a working standard radiometer attached to the World Reference radiometric (DPR).
A calibration certificate is provided with the instrument..



Sensor replacement

In case of accidental damage of the sensor and impossibility of return the instrument for troubleshooting, user can ask for a new sensor to our after sales service .
This one is provided with a calibration certificate showing its coefficient expressed in $\mu V/W/m^2$.

To change this coefficient and adapt this new sensor to the SL 200, you have to enter its value by pressing **+** or **-** . A last imperative press on the key **Val** finalize the recording of the new sensor calibration certificate.



Calibration certificate

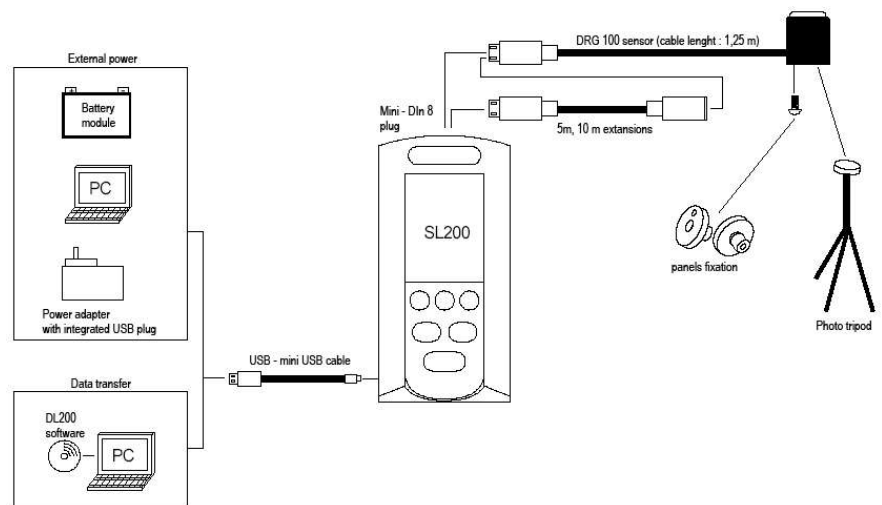
Remember : to avoid unwanted manipulation and from the first press on a function key, an alert appears: **Caution!Modification**. Exit the calibration function if necessary trough the key  or .

XI – Delivery and packaging

- SL 200 housing
- Silicium sensor and 1.25 metre of cable with mini -DIN connector
- Transport case with foam protection
- 3 LR3-AAA batteries
- Instructions for use
- Calibration certificate
- CD with Instruction for use of SL 200 instrument and DL 200 software

XII – Accessories

- Tripod
- Fixing kit for solar panels
- Extensions : 5m, 10m and on demand
- Power supply adaptor



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