Environmental monitoring solutions

Secondary Standard Pyranometer DPA252

User's manual

Revisions list

Issue	***Date***	***Description of changes***
Origin	14/10/2019	
1	31/05/2023	Added information on safety, handling, storage, packaging, preservation and delivery

About this manual

The information contained in this manual may be changed without prior notification. No part of this manual may be reproduced, neither electronically nor mechanically, under any circumstance, without the prior written permission of LSI LASTEM.

LSI LASTEM reserves the right to carry out changes to this product without timely updating of this document.

Summary

1 Introduction

The LSI LASTEM pyranometer is an instrument to measure the solar irradiance (direct and diffuse) which reaches the terrestrial surface.

With this instrument it is possible to measure not only the global radiation (see WMO n°8 7th ed.), but also the reflected sun radiation (*albedometer*) and the diffuse radiation by means of the occultation band.

The pyranometer measures radiation values within 300 and 3000 nm, with a visibility of 2π steradians. The element used to for the measurement is a thermopile whose external surface has been darkened with matt black paint bearing a reflecting power < than 2% (e>0.98) in the spectral area of the sensor.

The following table compares the specifications required for the pyranometers in “first class” or “second class” (ISO 9060) or in “good quality” (WMO n°8, 7th ed.) and the Lsi Lastem pyranometers.

ISO 9060	**Secondary standard**	**First class**	**Lsi Lastem 1st class**	**Second class**	**Lsi Lastem 2nd class**
Response time (95 % response)	< 15 s	< 30 s	26 s	< 60 s	28 s
Zero offset: (a) Response to 200 Wm^{-2} net thermal radiation (ventilated) (b) Response to 5 Kh-1 change in ambient temperature	 7 Wm^{-2} 2 Wm^{-2}	 15 Wm^{-2} 4 Wm^{-2}	 12 Wm^{-2} 2 Wm^{-2}	 30 Wm^{-2} 8 Wm^{-2}	 14 Wm^{-2} 3 Wm^{-2}
Stability (change per year, percentage of full scale)	0,8 %	1,5 %	< 1 %	3 %	<1,5 %
Non-linearity (percentage deviation from the responsivity at 500 Wm^{-2} due to any change of irradiance within the range 100 to 1000 Wm^{-2})	0,5 %	1 %	0,75 %	3 %	1,5 %
Directional response for beam radiation (the range of errors caused by assuming that the normal incidence responsivity is valid for all directions when measuring, from any direction, a beam radiation whose normal incidence irradiance is 1000 Wm^{-2})	10 Wm^{-2}	20 Wm^{-2}	20 Wm^{-2}	30 Wm^{-2}	30 Wm^{-2}
Spectral sensitivity (percentage deviation of the product of spectral absorptance and spectral transmittance from the corresponding mean within the range 200 to 3000 nm)	2 %	5 %	< 2 %	10 %	< 2 %
Temperature response (percentage maximum error due to any change of ambient temperature within an interval of 50 K)	2 %	4 %	< 4 %	8 %	< 7 %
Tilt response (percentage deviation from the responsivity at 0° tilt (horizontal) due to change in tilt from 0° to 90° at 1000 Wm^{-2})	0,5 %	2 %	-	5 %	-
WMO n°8 7th ed. Pyranometer table 7.5					
Achievable uncertainty (95 % confidence level): - Hourly totals - Daily totals	 3 % 2 %	 8 % 5 %	 < 8 % < 5 %	 20 % 10 %	 < 20 % < 10 %

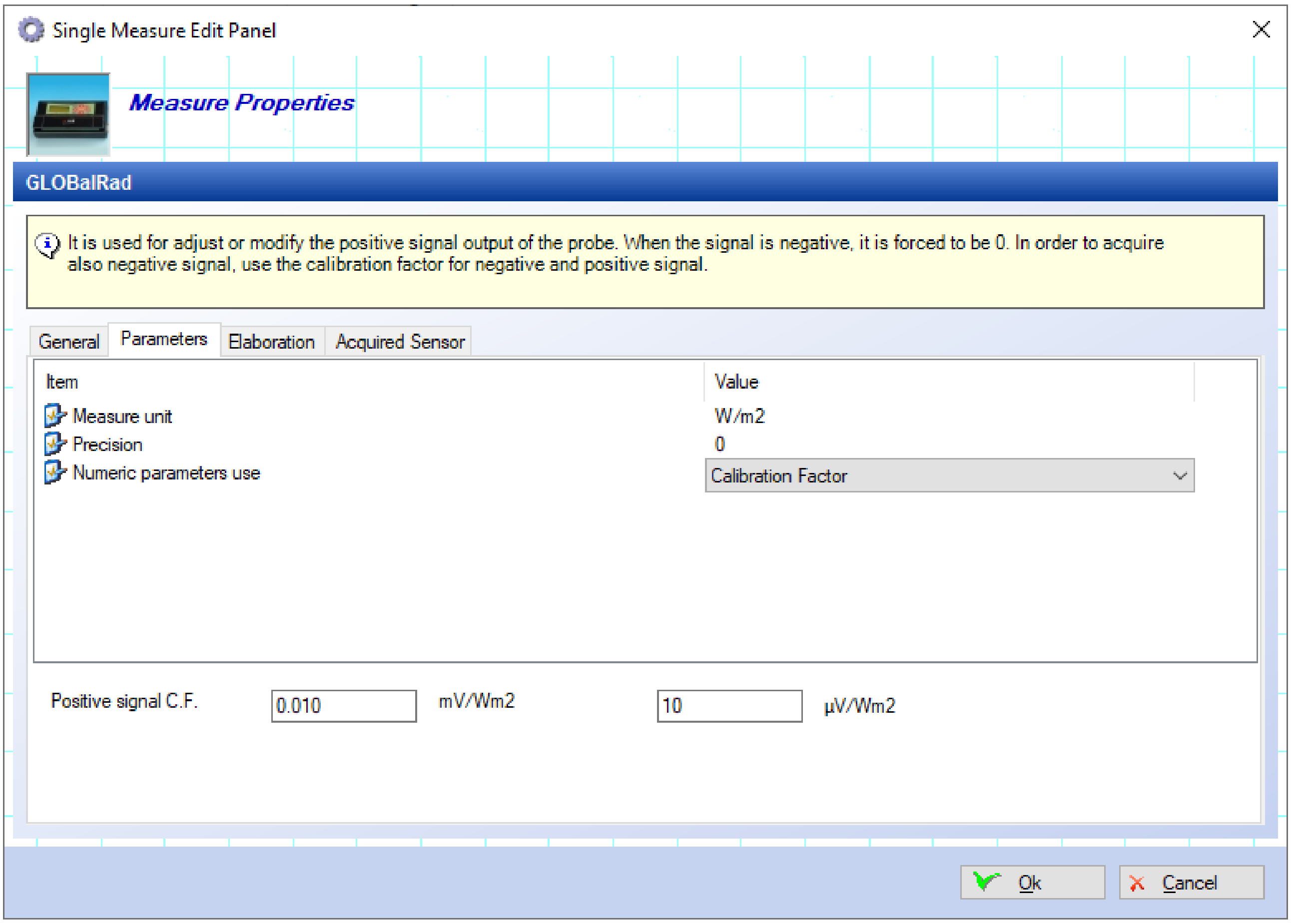
2 Technical features

Output	μV
Sensitivity	7÷25 μV/W/m^2
Irradiance range	0÷4000 W/m^2
Response time	4,5 s.
Output values	Instant value

ISO 9060 2018 classification	Spectrally flat Class A (Secondary Standard)
IEC 61724-1: 2017 classification	Class A
WMO performance level	High quality pyranometer
WMO estimate on achievable accuracy for daily sums	±2%
Spectral range	285÷3000 nm
Non-stability	<± 0,5% change per year
Directional response	<±10 W/m^2
Tilt response	<± 0,2% (0÷90° at 1000 W/m^2)
Temperature response	<± 0,4% (-30÷50°C)
Zero offset a (response to 200 W/m^2 net thermal radiation)	<5W/m^2 (unventilated)
Zero offset b (response to 5K/h change in ambient temperature)	<±2 W/m^2
Non linearity	<± 0.2 % (100 to 1000 W/m^2)
Stability (% change/year)	<± 0.5 %
Standard built-in temperature sensor	YES
Standard built-in heater	YES (12 Vdc, 1,5W)
Data provided with each sensor	• Calibration certificate • Temperature dependence data • Directional response data

3 Calibration Factor

Each pyranometer is supplied with a *Calibration Report* produced by comparison, under the sun or under a lamp (ISO 9847), with a pyranometer calibrated at the WRC-PMOD in Davos (WRC: World Radiation Center; PMOD: Phisikalisch Meteorologisches Observatorium Davos).
The *Calibration Report* contains the Calibration Factor with its expanded uncertainty. This Factor must be entered in the data logger. For LSI LASTEM's data logger the Calibration factor is set using 3DOM software, in Measure Properties:



4 Product installation

The pyranometers must be exposed towards the equator in a place that, in every season, is free of shadows during the day and installed at a height of 2 m on grassy places.

4.1 General safety rules

Please read the following general safety rules in order to avoid injuries to people and prevent damages to the product or to possible other products connected with it. In order to avoid any damages, use this product exclusively according to the instructions herein contained.

The installation and maintenance procedures must be carried-out only by authorized and skilled service personnel.

Carry-out all connections in a suitable manner. Pay strict attention to the connection diagrams supplied with the instrument.

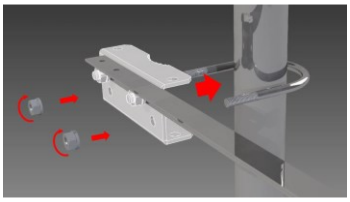
4.2 Mechanical installation

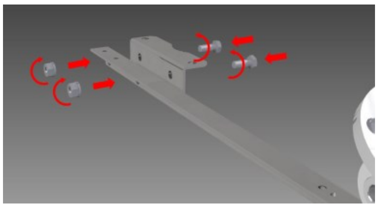
A pyranometer is sensitive to thermal shocks. Do not mount the instrument with the body in direct thermal contact to the mounting plate (so always use the levelling feet also if the mounting is not horizontal), do not mount the instrument on objects that become very hot (black coated metal plates).
in case of horizontal mounting only use the bubble level and levelling feet. For inspection of the bubble level the sun screen must be removed. By convention with the cable exit pointing to the nearest pole (so the cable exit should point north in the northern hemisphere, south in the southern hemisphere).

Do the Installation on pole using a DYA049 collar and DYA034-035 support. Follow these steps:

1. Remove the radiant protective screen from the pyranometer body.

2. Fix the DYA032-034-035 support the DYA049 collar and mount them on pole.
3. Turn the support until the sensor points to the terrestrial equator.





5. N.2 x M5 bolt at 65 x 10-3 m centre to centre distance on north-south axis, connection from below under the bottom plate of the instrument. Or 1 x M6 bolt at the centre of the instrument, connection from below under the bottom plate of the instrument

6.Reassemble the protective screen on the pyranometer body.

4.3 Electrical connection

Connections must be performed following the drawing of the pyranometer:

Wire color	Nome	Significato
White	+ output	Thermopile output +
Green	- output	Thermopile output -
Black	Gnd	Ground

5 Operation check

To check the sensor output it is necessary to have the accompanying drawing (DISACC) of the sensor, in the last page of this document, and a multimeter.

Check the electrical resistance of the sensor between the green (-) and white (+) wire. Use a multimeter at the 1000 Ω range. Measure the sensor resistance first with one polarity, than reverse the polarity. Take the average value. The typical resistance of the wiring is 0.1 Ω/m. Typical resistance should be the typical sensor resistance of 100 to 200 Ω plus 1.5 Ω for the total resistance of two wires (back and forth) of each 5 m. Infinite resistance indicates a broken circuit; zero or a low resistance indicates a short circuit. Check if the sensor reacts to light: put the multimeter at its most sensitive range of DC voltage measurement, typically the 100 x 10-3 VDC range or lower. Expose the sensor to strong light source, for instance a 100 W light bulb at 1 x 10-1 m distance. The signal should read > 2 x 10-3 V now. Darken the sensor either by putting something over it or switching off the light. The instrument voltage output should go down and within one minute approach 0 V. Check the data acquisition by applying a 1 x 10-6 V source to it in the 1 x 10-6 V range. Check the condition of the connectors (on chassis as well as the cable).

- Note that night-time signals may be negative (down to -5 W/m2 on clear windless nights), due to zero offset a.
- Check if the pyranometer has clean domes.
- Check the location of the pyranometer; are there any obstructions that could explain the measurement result.
- Check the orientation / levelling of the pyranometer.
- Check if the right calibration factor is entered into the algorithm. Please note that each sensor has its own individual calibration factor, as documented in its calibration certificate. Check if the voltage reading is divided by the calibration factor in review of the algorithm.
- Check the condition of the wiring at the logger.
- Check the cable condition looking for cable breaks.
- Check the condition of the connectors (on chassis as well as the cable).
- Check the range of the data logger; signal can be negative (this could be out of range) or the amplitude could be out of range. Check the data acquisition by applying a 1 x 10-6 V source to it in the 1 x 10-6 V range. Look at the output. Check if the output is as expected.
- Check the data acquisition by short circuiting the data acquisition input with a 100 Ω resistor. Look at the output. Check if the output is close to 0 W/m2

6 Maintenance

#	Interval	Subject	Action
1	1 week	Data analysis	Compare measured data to maximum possible / maximum expected irradiance and to other measurements nearby (redundant instruments). Also historical seasonal records can be used as a source for expected values. Analyse night time signals. These signals may be negative (down to - 5 W/m2 on clear windless nights), due to zero offset a. In case of use with PV systems, compare daytime measurements to PV system output. Look for any patterns and events that deviate from what is normal or expected
2	2 weeks	Cleaning	Cleaning use a soft cloth to clean the dome of the instrument, persistent stains can be treated with soapy water or alcohol
3	6 months	Inspection	Inspection inspect cable quality, inspect connectors, inspect mounting position, inspect cable, clean instrument, clean cable, inspect levelling, change instrument tilt in case this is out of specification, inspect mounting connection, inspect interior of dome for condensation
4	2 years	Desiccant replacement	Desiccant replacement (if applicable). Change in case the blue colour of the 40 % humidity indicator turns pink (indicating humidity), then replace desiccant. Coat the rubber of the cartridge with silicone grease or vaseline. Desiccant regeneration: heating in an oven at 70 °C for 1 to 2 hours. Humidity indicator regeneration: heating until blue at 70 °C
5	2 years	Recalibration	Recalibration by side-by-side comparison to a higher standard instrument indoors according to ISO 9847 or outdoors according to ISO9846
6	2 years	Lifetime assessment	Judge if the instrument should be reliable for another 2 years, or if it should be replaced
7	6 years	Parts replacement	If applicable / necessary replace the parts that are most exposed to weathering; cable, connector, desiccant holder, sun screen
8	6 years	Internal inspection	If applicable: open instrument and inspect / replace O-rings; dry internal cavity around the circuit board

7 Handling

Avoid the introduction of electrostatic discharge (ESD). The product, or part of it, is fragile, avoid mechanical shocks, abrasions or scratches on the surface and dome.

8 Storage, packaging, preservation, delivery, disposal

For storage, respect the humidity (10÷100% non-condensing) and temperature (-40÷80 °C) limits. Avoid direct sun exposure.

For delivery and storage, use the packaging supplied with the product.

For preservation, it is recommended to respect the environmental limits of humidity (10÷100% non-condensing) and temperature (-30÷60 °C).

Upon receipt of the material, visually check the package for signs of crushing or perforation; in the presence of these signs, check the integrity of the product inside.

This item is a highly electronic scientific device. In accordance with the standards of environmental protection and collection, LSI LASTEM advises to handle the product as waste of electrical and electronic equipment (WEEE). It is therefore not to be collected with any other kind of waste.

LSI LASTEM is liable for the compliance of the production, sales and disposal lines of the product, safeguarding the rights of the consumer. Unauthorized disposal will be punished by the law. Dispose of the dead batteries according to the regulations in force.

Recycle or dispose of the packaging material according to local regulations.

9 Safety

For safety regulations please refer to manual INSTUM_05290.

10 Calibration

It is not necessary to re-calibrate the instrument frequently. It is advisable to re-calibrate the instrument every 2 to 3 years in order to keep calibration uncertainty variations in the range of 2%.

Recalibration of field pyranometers is typically done by comparison in the field to a reference pyranometer. The applicable standard is ISO 9847 "International Standard- Solar Energy- calibration of field pyranometers by comparison to a reference pyranometer". At LSI LASTEM an indoor calibration according to the same standard is used.

LSI LASTEM recommendation for re-calibration: if possible, perform calibration indoor by comparison to an identical reference instrument, under normal incidence conditions.

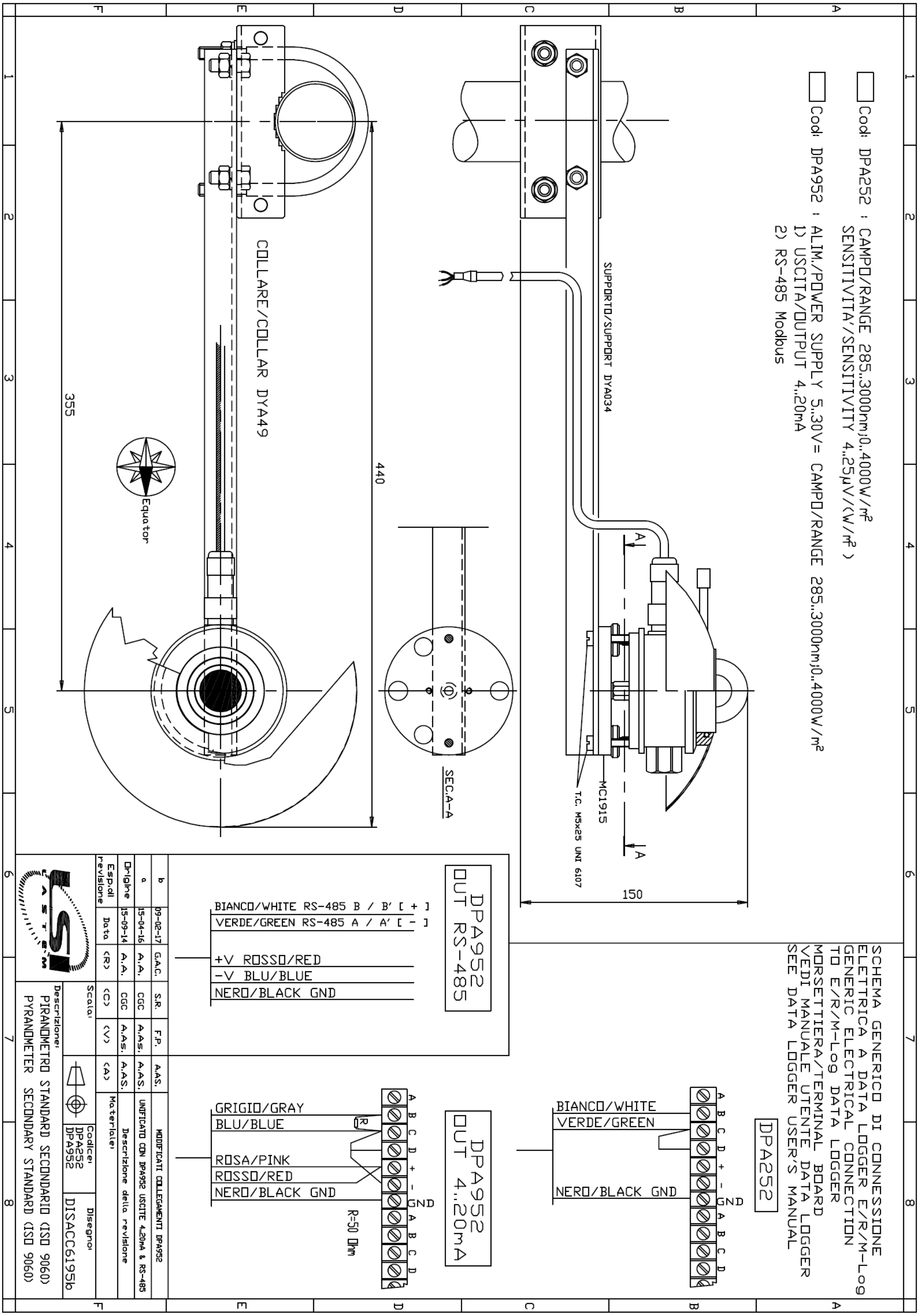
In case of field comparison; ISO recommends field calibration to a higher class pyranometer. LSI LASTEM suggests also allowing use of sensors of the same model and class, because intercomparisons of similar instruments have the advantage that they suffer from the same offsets. It is therefore just as good to compare to pyranometers of the same brand and type as to compare to an instrument of a higher class. ISO recommends to perform field calibration during several days; 2 to 3 days under cloudless conditions, 10 days under cloudy conditions. In general this is not achievable. In order to shorten the calibration process LSI LASTEM suggests to allow calibration at normal incidence, using hourly totals near solar noon.

11 How to contact LSI LASTEM

In case of problem contact the technical support of LSI LASTEM sending an e-mail to support@lsi-lastem.com, or compiling the technical support request module at www.lsi-lastem.com.

For further information refer to addresses and numbers below:

- Phone number		+39 02 95.414.1 (switchboard)
- Address:		Via ex S.P. 161 – Dosso n. 9 - 20049 Settala Premenugo, Milano
- Web site:		www.lsi-lastem.com
- Commercial service:	info@lsi-lastem.com
- After-sales service:	support@lsi-lastem.com, Repairs: riparazioni@lsi-lastem.com


Cod: DPA252 : CAMPO/RANGE 285..3000nm;0..4000W/m²
SENSITIVITA'/SENSITIVITY 4..25µV/(W/m²)
Cod: DPA952 : ALIM./POWER SUPPLY 5..30V= CAMPO/RANGE 285..3000nm;0..4000W/m²
1) USCITA/OUTPUT 4..20mA
2) RS-485 Modbus
SUPPORTO/SUPPORT DYA034
COLLARE/COLLAR DYA49
355
440
150
Equator
SEC.A-A
MC1915
T.C. M5x25 UNI 6107
SCHEMA GENERICO DI CONNESSIONE ELETTRICA A DATA LOGGER E/R/M-Log
GENERIC ELECTRICAL CONNECTION TO E/R/M-Log DATA LOGGER
MORSETTIERA/TERMINAL BOARD
VEDI MANUALE UTENTE DATA LOGGER
SEE DATA LOGGER USER'S MANUAL
DPA252
BIANCO/WHITE
VERDE/GREEN
NERO/BLACK GND
DPA952 OUT 4..20mA
GRIGIO/GRAY
BLU/BLUE
ROSA/PINK
ROSSO/RED
NERO/BLACK GND
R=50 Ohm
DPA952 OUT RS-485
BIANCO/WHITE RS-485 B / B' [+]
VERDE/GREEN RS-485 A / A' [-]
+V ROSSO/RED
-V BLU/BLUE
NERO/BLACK GND
A B C D + - GND A B C D
b 09-02-17 G.A.C. S.R. F.P. A.AS. MODIFICATI COLLEGAMENTI DPA952
a 15-04-16 A.A. CGC A.As. A.AS. UNIFICATO CON DPA952 USCITE 4..20mA & RS-485
Origine 15-09-14 A.A. CGC A.As. A.AS.
Esp.ol revisione Data (R) (C) (V) (A) Descrizione della revisione
Scala: Materiale:
Descrizione: PIRANOMETRO STANDARD SECONDARIO (ISO 9060)
PYRANOMETER SECONDARY STANDARD (ISO 9060)
Codice: DPA252 DPA952
Disegno: DISACC6195b