
User Manual for the

Dome Solarimeter

and Albedometer type GS1 & GS2



GS1&2-UM-2

AT

DELTA-T DEVICES

TYPE GS1 & GS2

USER MANUAL

GS1&2-UM-2

ABOUT THIS MANUAL

This manual provides specifications and installation information on the Dome Solarimeter type GS1 in mast mounted and free-standing versions and describes its connection to the Delta-T Logger type DL2.

Details of the type GS2 albedometer are included at the end of this manual. The GS2 utilises two solarimeters, and is supplied fully assembled.

In this manual, all references to loggers and weather stations relate to the Delta-T Logger DL2, its software LS2, and the WS01 Weather Station, and the sensor codes used with them. The references also apply to the DL2e and its derivatives.

For the DL3000 logger, you must refer to the DL3000 documentation which contains specific connection details and sensor type codes used by the DL3000. General information in this manual concerning the performance and installation of the sensor remains relevant.

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INTRODUCTION

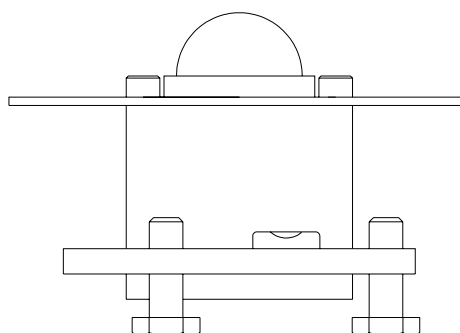
The GS1 Dome Solarimeter (pyranometer) is designed for the measurement of solar radiation. Its specifications are in accordance with ISO 9060 and WMO: second class pyranometer.

The sensor is a high quality, blackened thermopile with a glass covering dome which acts as a filter letting through solar radiation. The sensor has a flat spectral response in the range 0.3 to 3.0 micro metres, being the full solar spectrum.

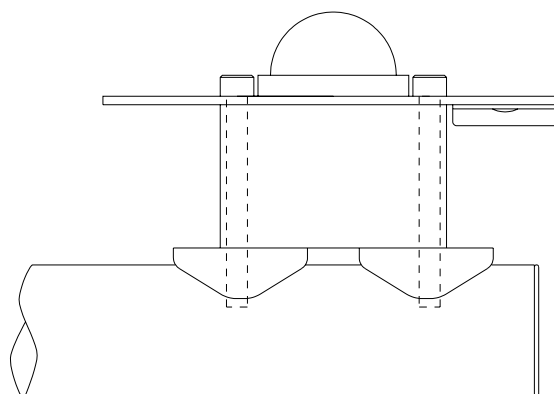
Heating of the sensor by incoming solar radiation produces a signal in the microvolt range. Each sensor is supplied with its own calibration factor to convert the output voltage into units of watts per square metre.

The standard sensor is supplied with a one metre long pole and fittings to facilitate mounting onto the mast of the Delta-T Weather Station or similar vertical pole. Alternatively, the sensor can be supplied with a levelling fixture for standing on a horizontal surface.

**Version with
levelling fixture**



Mast mounted version



UNPACKING THE SOLARIMETER

When unpacking the solarimeter, check that your consignment includes:

1. A GS1 fitted with a cable of length as stated in your order.
2. A calibration certificate bearing the serial number of your GS1.
3. Either mast mounting fittings or free standing fittings as appropriate to your order.

SITING THE SOLARIMETER FOR MEASUREMENT OF GLOBAL RADIATION

Ideally the site for the solarimeter should be free from any obstructions above the plane of the sensing element, but should enable cleaning and inspection of the dome.

If this is not possible, the site should be chosen such that any obstruction over the azimuth range between earliest sunrise and latest sunset should have an elevation not exceeding 5° (the apparent sun diameter is 0.5°). This is important for an accurate measurement of the direct solar radiation. The diffuse (solar) radiation is less influenced by obstructions near the horizon. For example, an obstruction with an elevation of 5° over the whole azimuth range of 360° decreases the downward diffuse solar radiation by only 0.8%.

The solarimeter should also be located so that no shadows will be cast on it at any time, and far away from light-coloured walls or other objects likely to reflect sunlight on to it.

In principle no special orientation of the sensor is required, but the WMO recommend that the emerging leads are pointed to the nearest Pole to minimise heating of the electrical connections. Accurate measurement of the global radiation requires the proper levelling of the thermopile surface. The bubble level fitted may be used to achieve this in conjunction with the adjustments on the mounting fixture. Note that on the mast mounted version, the mast (not supplied with GS1) must be vertical to achieve this easily.

Reference:

W.M.O No. 8 'Guide to Meteorological Instruments and Methods of Observation', Fifth edition, 1983, of the World Meteorological Organization (WMO) , Geneva, Switzerland.

WIRING CONNECTIONS

The GS1 is supplied with a screened, multi-core cable.

- Red core is Signal HI (+ve).
- Blue core is Signal LO (-ve).

On units supplied from 1996, the cable screen is connected internally to the metal body of the GS1.

At the logger, the screen may be:

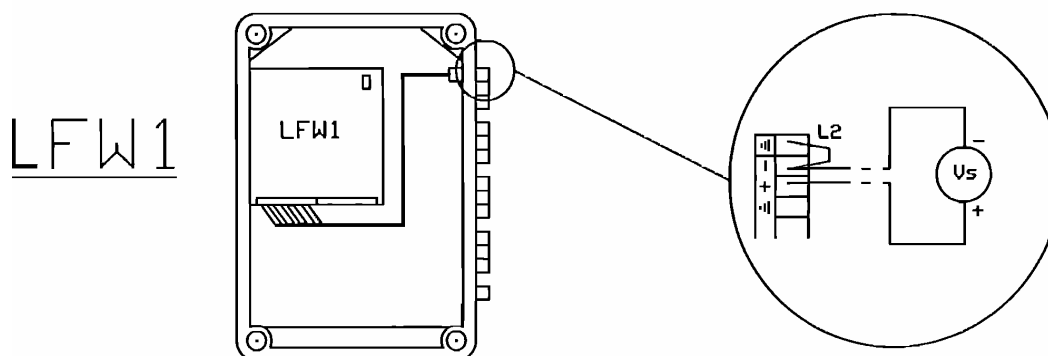
- not connected at all, or
- connected to analogue earth, or
- connected to digital earth.

Units with CE certificates may have Good Practice Installation Notes which you should follow for optimum EMC (electromagnetic compliance) performance.

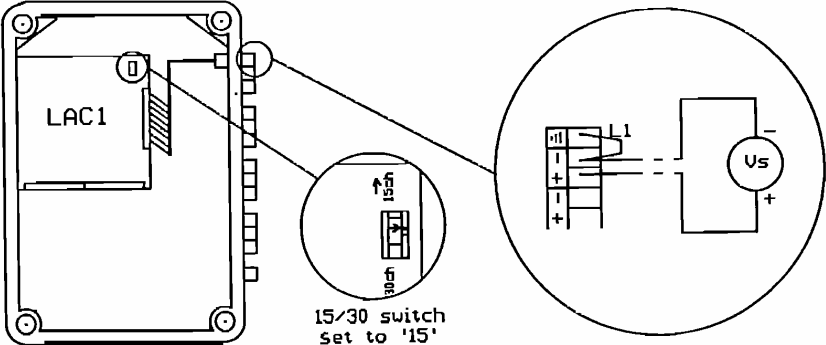
If the cable has been extended, the joint is weatherproof but not recommended for long periods of immersion and should be protected from such conditions. Additional screened cable of similar cross-section may be added if required without significantly affecting the Delta-T logger accuracy.

The GS1 gives a low level voltage signal. When used with the Delta-T Logger, one of the following input cards should be used. For LAC1, 15 channel mode should be selected because of the low signal level from the sensor. Single ended connection is the simplest installation and is recommended.

In electrically noisy environments the differential input connection (remove the link L1 or L2) may give better accuracy. Full details of this operation are given in the Delta-T Logger user manual.



LAC1
15-channel
mode



CONFIGURING THE DELTA-T LOGGER

Configuring the Delta-T Logger is the process of specifying which type of sensor will be connected to which channel.

The following is an illustration of how this might be done for the GS1.

LOGGING PARAMETERS							
SENSOR		TIMED INTERVALS		TRIG/	Auto	Cold	CONTROL OUTPUT
Code	Label	Sample	Compress	61 62	range	jnctn	Ch Threshold
1	GS1	Dome Sol	10s	1m	A		
2							
3							
4							
5							
6							
7							
8							
9							
10							

SENSOR CHARACTERISTICS									
SENSOR		UNITS		CONVERSION			VALID RANGE		Thrm
Code	sig	µA	Base	Eng'ng	Factor	Offset	Minimum	Maximum	-cpl
1	GS1	V	mV	kW/sqm	35	(*see note)	-59.90	59.90	
2									
3									
4									
5									
6									
7									
8									
9									
10									

* Note: you must change this value!

Each GS1 has an individual sensitivity calibration value, shown on a calibration certificate which is supplied with the sensor. This value must be entered into the CONVERSION Factor column of the SENSOR CHARACTERISTICS screen above.

Logger PC Software LS2 v.1.04 has been used in this example. Earlier software versions may require that small changes be made to this configuration. Please refer to your logger user manual for definitive instructions.

CALIBRATION

The following is an example of the calibration certificate supplied with the GS1. *When using your GS1, use the values on your certificate **not** those shown below.*

TYPICAL CALIBRATION CERTIFICATE

CALIBRATION DATE :	19 Aug 1995
CALIBRATED BY:	W K
PYRANOMETER TYPE:	CM3
SERIAL NUMBER:	*****
SENSITIVITY ($\pm 0.5\%$) at 20°C and 500 W/m ²	19.88×10^{-6} V per W/m ² (with no load) (Example value only - do not use this)
RADIATION SCALE:	World Radiometric Reference (WRR)
CALIBRATION PROCEDURE:	By comparison with an outdoors calibrated reference pyranometer type CM6B ser no. 910012. Pyranometers were mounted horizontally, side by side. Source: 1000 W tungsten-halogen lamp. Colour temp 3300 K. Angle of incidence: normal incidence.

MAINTENANCE

Once installed, the GS1 needs little maintenance. The outer dome should be inspected and cleaned at regular intervals, preferably on a daily basis.

The pyranometer case is sealed during manufacture and no servicing or replacement of internal parts by the user is possible.

You are recommended to make annual checks of the calibration of your GS1. To check the calibration to within about 3%, compare the daily integral (total) output of the GS1 with that of another known or standard solarimeter for a number of sunny days, on the same site. If the GS1 differs by more than 3% from the standard, you should correct for it by varying its sensitivity value accordingly.

Alternatively, the GS1 can be returned to Delta-T Devices for a similar test to be done - see the Service and Spares section.

SPECIFICATION

Response time for 95% response	18 s
Zero offset	
a. in response to 200 W/m ² net thermal radiation	<15 W/m ²
b. response to 5 K/h change in ambient temperature	<4 W/m ²
Long term stability	< 1% per year
Non-linearity	± 2.5% below 1000 W/m ²
Percentage deviation from the responsivity at 500 W/m ² due to the change in irradiance within 100 W/m ² to 1000W/m ²	
Directional error	<± 25 W/m ² at 1000 W/m ²
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 irradiation is 1000W/m ²	
Spectral selectivity (350-1500 nm)	± 5%
Percentage deviation of the product of spectral absorbance and spectral transmittance from the corresponding mean within the range 350 and 1500 nm	
Sensitivity temperature deviation (-10 to +40°C)	6% relative to 20°C
Tilt response	<± 2%
Sensitivity	10 - 35 μV/W.m ⁻²
Impedance	79 - 200 Ω
Operating temperature	-40 to +80°C
Spectral range (50% points)	305 - 2800 nm
Standard cable length	5 m
Overall ISO classification:	Second class

ALBEDOMETER TYPE GS2

Introduction

Albedo measurements give the fraction of solar radiation reflected by the ground surface.

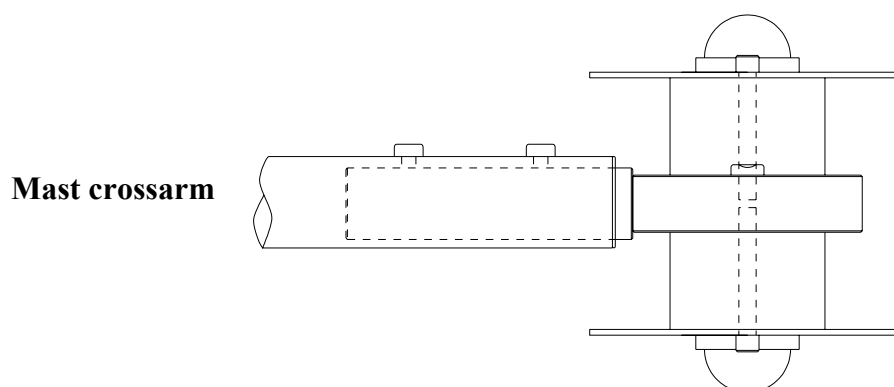
A pair of solarimeters can be used as an albedometer by inverting one of them to receive reflected solar radiation.

The GS2 is constructed in this manner, using two GS1s, and much of the detailed information previously for GS1 given is equally relevant to the GS2.

Mounting

A special mounting bracket is provided for this application and is assembled as shown.

Levelling the unit is as important as it is for GS1.



Siting

The W.M.O recommends mounting the albedometer 1-2m above the ground surface, which should preferably be grass covered.

Special considerations are needed for snow cover and reference should be made to W.M.O No. 8.

Wiring connections and logger configuration.

The GS2 requires two Delta-T logger channels, one connected to each solarimeter. Each solarimeter should be treated exactly as if it were a GS1 and will have its own calibration factor.

Albedo calculations (that is, the ratio of the reflected solar radiation to the incident radiation), should be performed after they have been logged in terms of W/m^2 .

GUARANTEE, REPAIRS AND SPARES

Our Conditions of Sale ref: COND/91/11 set out Delta-T's legal obligations on these matters. For your information the following paragraphs summarise Delta-T's position but reference should always be made to our Conditions of Sale which prevail over the following explanation.

Instruments supplied by Delta-T are guaranteed for one year against defects in manufacture or materials used. The guarantee does not cover damage through misuse or inexpert servicing, or other circumstances beyond our control.

For the UK this means that no charges are made for labour, materials or return carriage for guarantee repairs.

For other countries, the guarantee covers free exchange of faulty parts during the guarantee period.

Alternatively, if the equipment is returned to us for guarantee repair, we make no charge for labour or materials but we do charge for carriage and UK. customs clearance.

We strongly prefer to have such repairs discussed with us first, and if we agree that the equipment does need to be returned, we may at our discretion waive these charges.

SERVICE AND SPARES

We recognise that some users of our instruments may not have easy access to technically specialised backup.

Spare parts for our own repairable instruments can be supplied from our works. These can normally be despatched within 1 working day of receiving an order.

Spare parts and accessories for sensors not manufactured by Delta T, but supplied by us individually or as part of the weather station or other system, may be obtained from the original manufacturer. We will endeavour to obtain parts if requested, but a certain amount of additional delay is inevitable.

Should it prove necessary, instruments may be returned to our works for servicing. We normally expect to complete repairs of our own instruments within 2 days of receiving the equipment. Other manufacturers' sensors supplied by us and returned for servicing will take longer. They will have to be returned to the original manufacture for servicing, and may be subject to additional delays of two to four weeks.

Users in countries that have a Delta-T Agent or Technical Representative should contact them in the first instance.