User Manual for

EV2 Evaporation Pan and Gauge

EV2-UM-3.0

Delta-T Devices Ltd

Copyright

Contents

About this document

This manual describes how to install the Evaporation Pan type EV2/P and Evaporation Gauge type EV2/G and use it with a Delta-T data logger. Refer also to your data logger documents and logging software Help.

Warnings

The sensor contains an exposed pressure diaphragm which is extremely sensitive and is vulnerable to damage if overloaded.

When unpacking the gauge it is important to handle the transmitter with care.

The aperture at the end of the sensor is the sensing area and on no account must this surface be touched by sharp objects, or any pressure applied to the face other than the water pressure which is to be measured.

Introduction and Description

The evaporation sensor comprises a United States Class A pan and a high accuracy water level sensor.
Evaporation, recorded as changes in the water level, is measured by a high accuracy pressure transducer designed to measure water depths of around 250 mm for use in the standard Evaporation Pan.
The electrical output signal is linearly related to the depth of water. The sensor requires a DC voltage power supply.

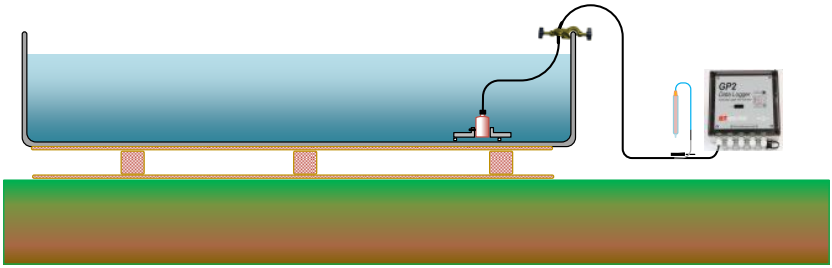
Regular readings can be made with the use of a Delta-T data logger. This is typically used to record hourly and/or daily evaporation rates.

About Evaporation

Evaporation is influenced by temperature, wind speed and relative humidity. In general, evaporation rates increase with temperature and wind speed, and decrease at higher humidity. For the agronomist, evaporation measurement is particularly important where irrigation demand is being calculated. This is because plants use more water in conditions favouring high evaporation, while at the same time less water may be available for plant growth.

Siting and installing the Evaporation Pan

The choice of a suitable location depends on the use you have in mind. But be aware that the World Meteorological Organisation (WMO) recommend that evaporation stations should be located at sites which are fairly level and free from obstructions such as trees, buildings, shrubs or instrument shelters. Such single obstructions, when small, should not be closer than five times their height above the pan. For clustered obstructions this becomes ten times. Plots should be sufficiently large to ensure that readings are not influenced by spray drift or by upwind edge effects from a cropped or otherwise different area. Such effects may extend more than 100 m. The plot should be fenced to protect the instruments and to prevent animals from interfering with the water level, but the fence should be constructed in such a way that it does not affect the wind structure over the pan.
The WMO also recommends that the ground cover at the evaporation station should be maintained as near as possible to the natural cover common in the area. Grass, weed, etc. should be cut frequently to keep them below 7.5 cm for a Class A pan. Under no circumstances should the instrument be placed on a concrete slab or asphalt, or on a layer of crushed rock, and the pan should not be shaded from the sun.



The Class A pan should be supported 3 to 5 cm above ground level on an open-frame wooden platform which permits air circulation under the pan, keeps the bottom of the pan above the level of water on the ground during rainy weather, and enables the base of the pan to be inspected without difficulty.
The pan is filled to 5cm below the rim (called the reference level).

Installing the Evaporation Sensor

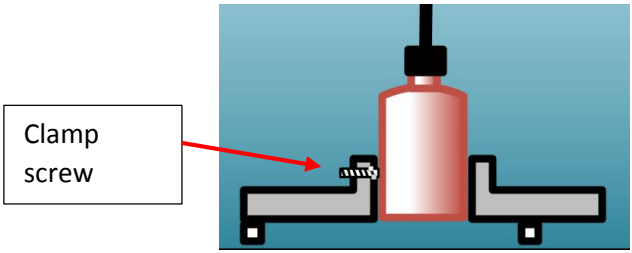
Handle with care

The evaporation sensor is a very sensitive pressure transmitter which, when used correctly, will measure water pressure to a depth of 250mm to better than ± 1 mm. When unpacking it is important to handle the transmitter with care. The aperture at the end of the sensor is the sensing area and on no account must this surface be touched by sharp objects or any pressure applied to the face other than the water pressure which is to be measured.

Install the evaporation sensor

During the installation of the evaporation sensor it is important to follow these procedures:

Assembly



Without touching the sensitive circular diaphragm in the base of the sensor, carefully place the sensor into the hole in the base plate. Ensure that the sensor body does not protrude through the hole but is flush with the base plate (see figure).
Use the hexagonal Allen key supplied to carefully adjust the clamping grub screw used to hold the sensor in the required position.
DO not over tighten the clamp screw as this could damage the sensor. Only tighten it enough to secure the sensor.

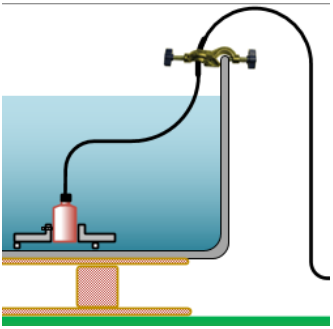
Fill pan with water

Fill the evaporation pan to approximately 50 mm from the top edge.
Note: it is recommended to keep the pan topped up to 50 mm from the top edge for optimum performance. In countries with high ambient radiation from the sun the sensor should be kept submerged as excessive heat could damage the sensor.

Place the base plate with the sensor into the water

Note: it is important to remove any air bubbles from the underside of the sensor by carefully turning the sensor upside down under water until all the air has escaped from the cavity in the sensor.

Attach cable to pan rim

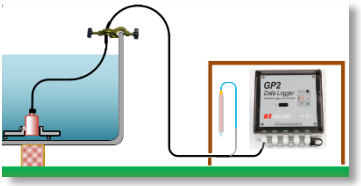


Locate the short thick section of the cable about 50cm from the sensor. With the sensor sitting inside the pan, attach this to the edge of the pan using the clamp – to hold the cable secure but **do not crush** it.

Connect sensor cable to the logger

Please see the following sections about connecting Delta-T loggers
DL2e Logger: page 14
GP1 logger: page 21
GP2 logger: page 25

Connect breather hose to desiccant tube



The back of the pressure sensor needs to be open to the atmosphere but it can be damaged by moisture, so it is protected by a vapour barrier in the form of a tube of desiccant.

Figure 1 showing the desiccant tube as shipped, with flexible hose and steel connector. Remove the yellow cap at right before taking readings.

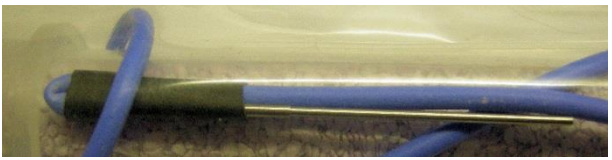


Figure 2 This shows the black tape used to crimp the rubber tube closed to help preserve the desiccant during shipment. Remove it when installing.

Installation

Attach the small rubber tube of the vapour barrier capsule on to the small plastic tube that protrudes from the sensor wire near to the connection plug.
Important: remove the yellow plug on the vapour barrier capsule opposite to the small pipe connected to the sensor pipe.
The capsule is now active and will only allow dry air to access the sensor.

Mounting the desiccant tube

If possible mount this inside a ventilated weather- proof housing to protect it from rain or immersion. If installed outside mount it vertically with the open end pointing downwards.
See also Maintenance on page 29.

Sensor connections

Wire tails at the free end of the cable are provided for connection to data loggers or other electronic measuring equipment.

Function	Colour	
Signal HI	white	
Signal LO	black	
Power V+	red	
Power 0V	blue	
Screen	green (if present)	

Notes:

1. The Signal LO and Power 0V are connected within the cable.
2. The cable screen is connected to the metal body of the gauge, but is not connected to any other wire. It may or may not be provided with a tail.
3. A precision 10 ohm resistor is embedded in the free end of the cable.

EV2 Calibration

Standard calibration

This is derived from the basic 4-20 mA output of the pressure transducer passing through the precision 10 ohm resistor to produce a linear millivolt signal output.

mV	*mm water*
0	-62.5
40	0
80	62.5
120	125.0
160	187.5
200	250.0

For the DL2e, the following values are required:

- Conversion factor: 0.64 (mV per mm)
- Offset: – 62.5 (mm)

Accuracy and resolution

The standard calibration values can be used for any EV2/G Gauge. Using these values, the changes in water level will be accurately recorded to within a few tenths of a millimetre.
The resolution of readings obtained with a Delta-T data loggers is 0.1 mm.
The absolute depth of water may not correspond exactly to the depth of water as measured by a ruler, owing to the uncertainty in the exact position of the pressure sensor diaphragm near the bottom of the pan. This is not important, since only changes in level are relevant. However, if you wish to eliminate any discrepancy, the Offset value shown above can be adjusted.

Use with a DL2e data logger

Requirements

Programming the logger requires a PC running Ls2Win, connected via a serial cable to a DL2e fitted with a LAC1 input card.

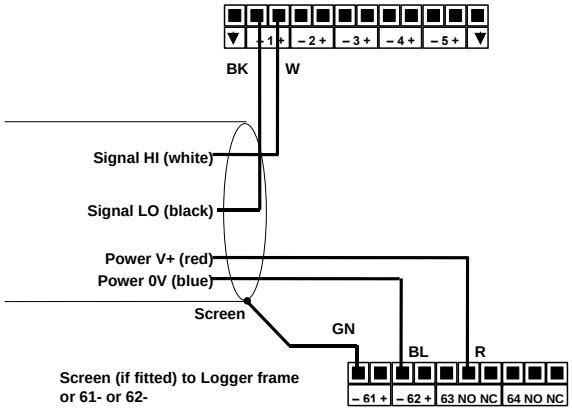
DL2e Reference Documents

See also Ls2Win PC software on-line Help and the DL2e Quick Start, Hardware Reference and Getting Started documents. These documents are all installed on the PC with Ls2Win and available from the Start menu, typically under All Program/ Delta-T Devices/Ls2Win/Documents.

Input Card and Power

This example shows the DL2e terminal connections appropriate for a LAC1 input card, and assumes the DL2e and sensor are powered by the DL2e's internal alkaline cells.

Wiring Schematic for DL2e connections



The example shows the wiring of one EV2 Evaporation Gauge to analogue channel number 1 (for convenience) and assumes:

- The DL2e is powered by its internal alkaline cells.
- An LAC1 input card is used, in its 15-channel mode
- The DL2e internal battery is used to power the EV2 via warm-up relay channel 63. The power is returned to channel 62-, the digital earth (frame) for the DL2e.

The following jumpers/sliders inside the DL2e must be set:

- Power supply selection: jumper set to INTL
- Power to Relay 63: jumper in place
- LAC1 card: 15-30 slider set to "15"

Notes:

- If connected to logger channel 1 ensure the DL2e thermistor is switched off. Alternatively, connect to another channel.
- The cable screen wire (when fitted) is connected to either channel 61- or 62-, the logger's digital earth (frame) for electrical screening purposes.

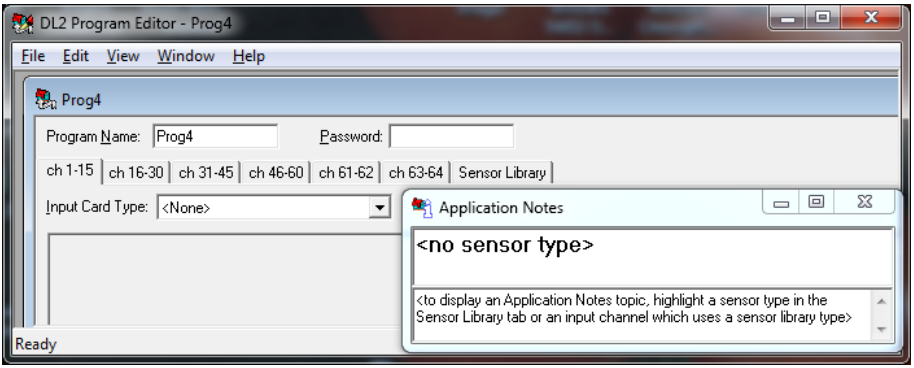
DL2e logger configuration

When you have decided which channel to connect your Evaporation Gauge to, and which relay channel you will use, you are ready to start.
You will need to refer to the DL2e User Manual to do this.

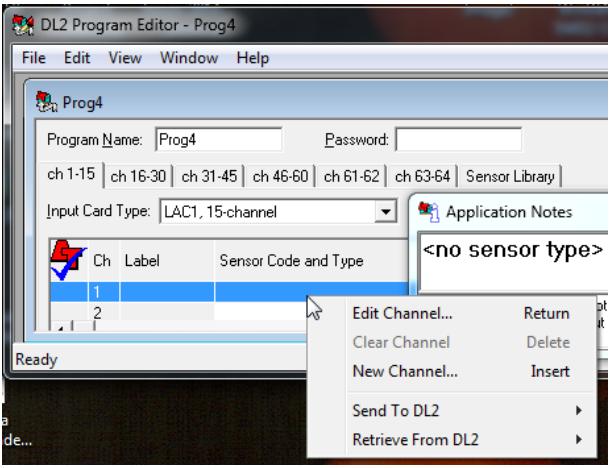
You can select any analogue channel, but for the LAC1 input card you must use the 15-channel mode with differential input (not the 30-channel mode). Either relay channel (63 or 64) can be used for the warm-up function.

Create DL2e program for EV2/G sensor type

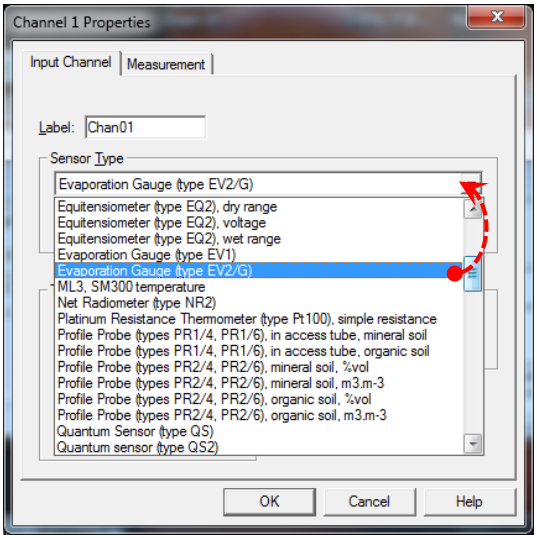
On a PC running DL2 Program Editor **s**elect **File, New** :



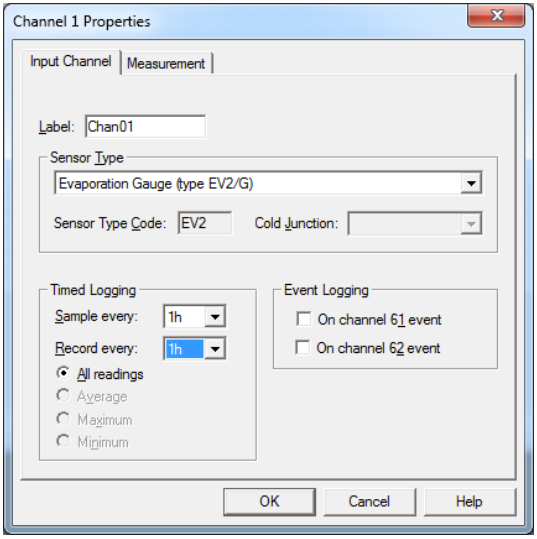
Set the Input Card Type to LAC1, 15 channel.
Right click on Channel 1



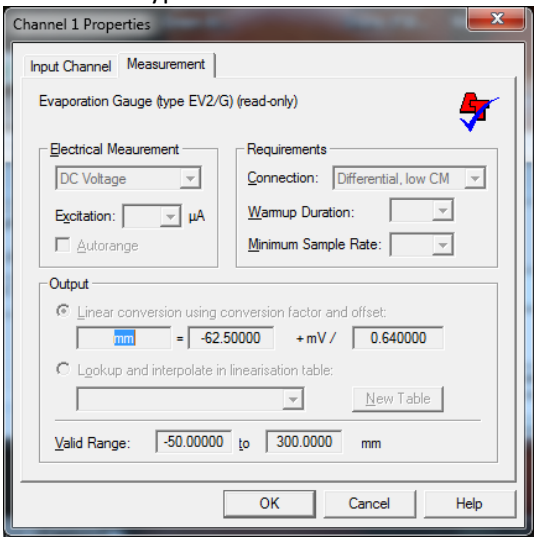
Select **Edit Channe**l to open the **Channel Properties** dialog and on the **Input Channel** tab, for **Sensor Type** select "**Evaporation Gauge type EV2/G**" from the drop down list:



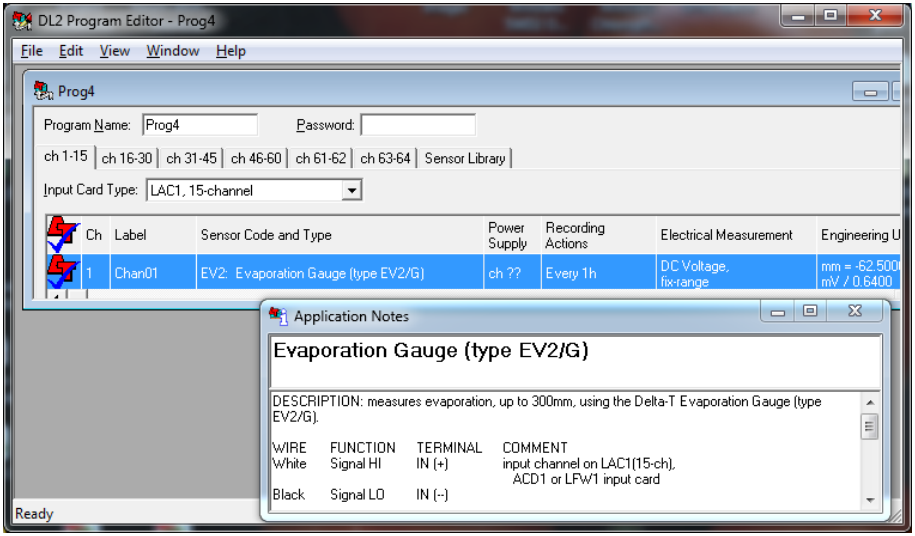
Under **Timed Logging** set **Sample every** and **Record every** to an appropriate period, say 1h.



Click on the **Measurement** tab to inspect the default settings for this sensor type:

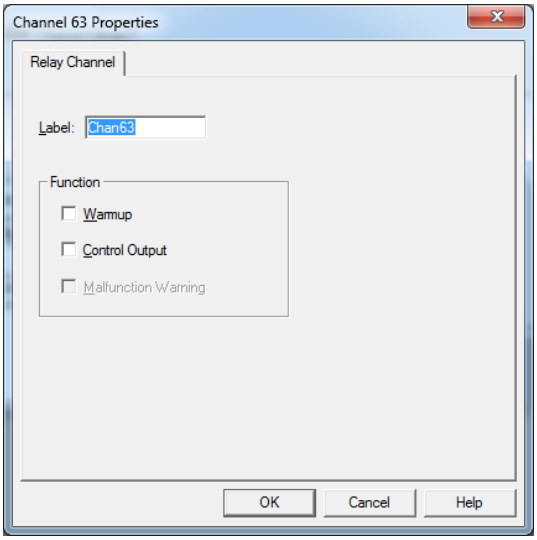


Click on OK and observe that the row corresponding to channel one is now populated with the correct settings.

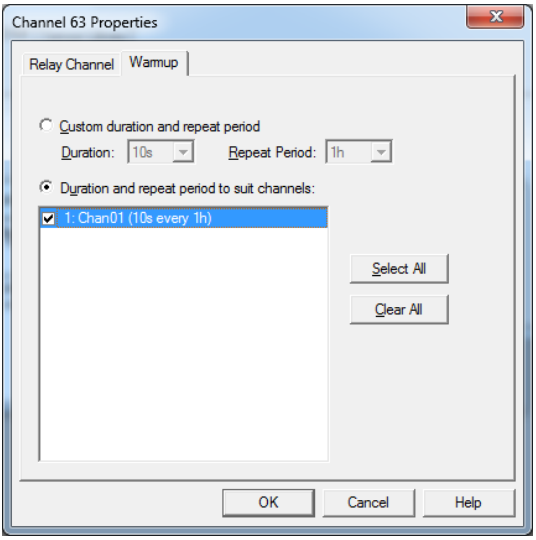


Note also the Applications Note window describing the sensor wiring configuration and with simple instruction about how to set up and use the sensor.

Select the **Ch63-64** tab and double click on the row for Ch63 to bring up the **Channel 63 Properties** dialogue and select **Warmup**



On the Warmup tab select **Duration and repeat period to suit channels** and check the channel tick box and click **OK.**



Select **File, Save** to save a copy of the program to your PC and **File, Send** to DL2 to download the program onto your DL2e logger.

Summary: In this example your DL2e logger, with a LAC1 input card in 15 channel (differential voltage) mode, is now wired up to the evaporation pan sensor via channel 1 and configured to read it every hour, providing “warm-up” power to the sensor for 1s via channel 63 from the logger’s internal batteries.
(For optimum accuracy use a 10s warm-up time.)

At this point it might be worth temporarily changing the program to read once every 10s in order to check the device is working OK.

For further guidance see the DL2 logger documentation and Help as described on page 14.

Use with a GP1 Logger

Requirements

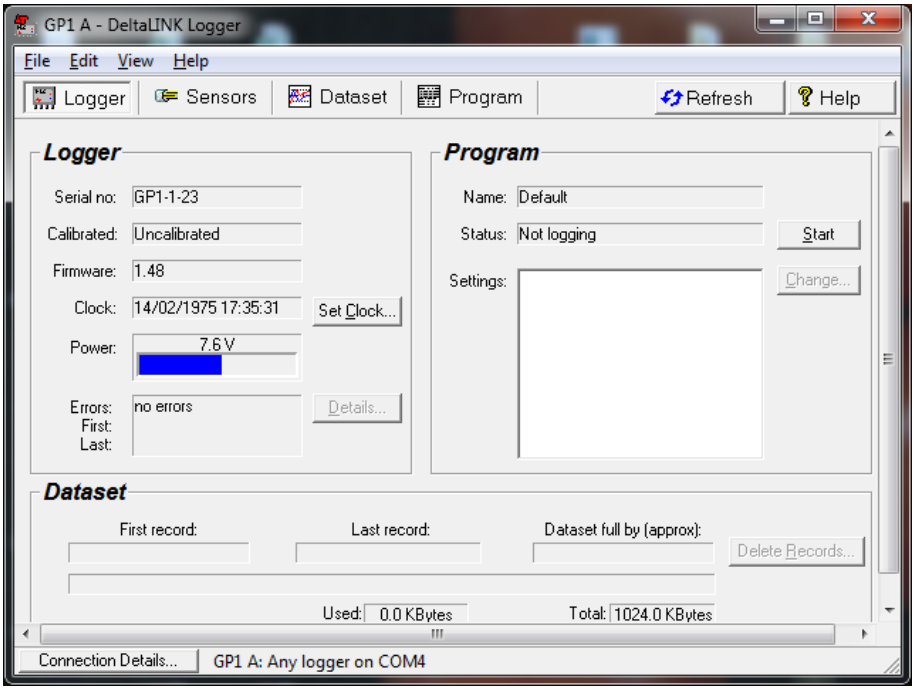
You need a PC running DeltaLINK, connected via a serial cable to the logger.

Wiring

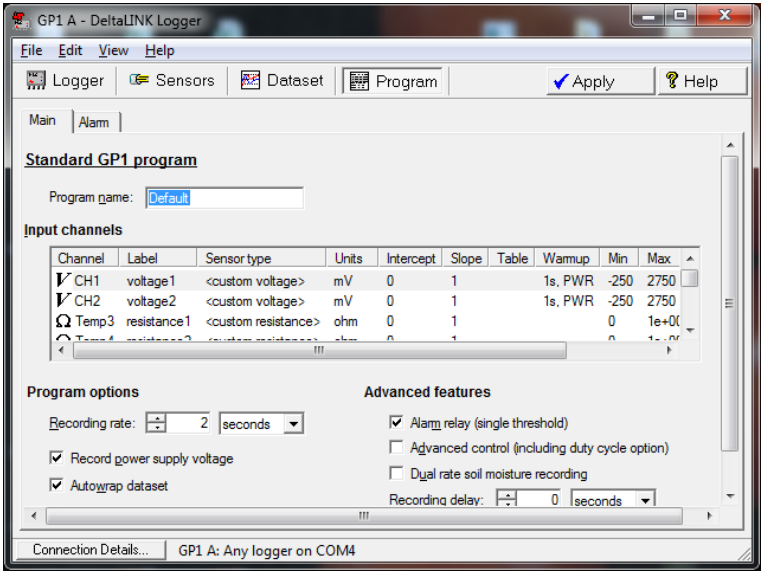
See Sensor connections on page 12

Program GP1 logger

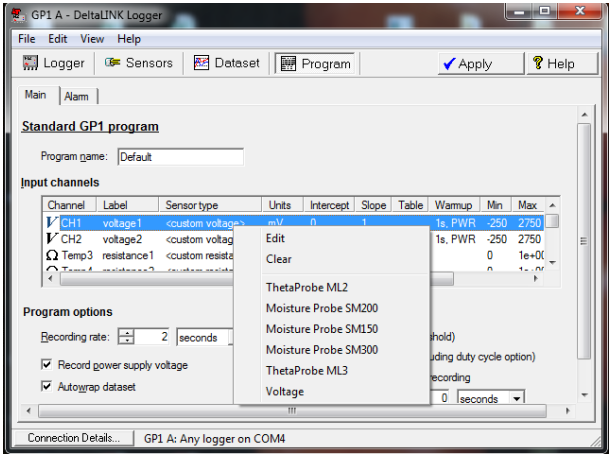
With DeltaLINK running, select **File, New Program,** and chose the **Standard GP1 Program** and press **OK**.



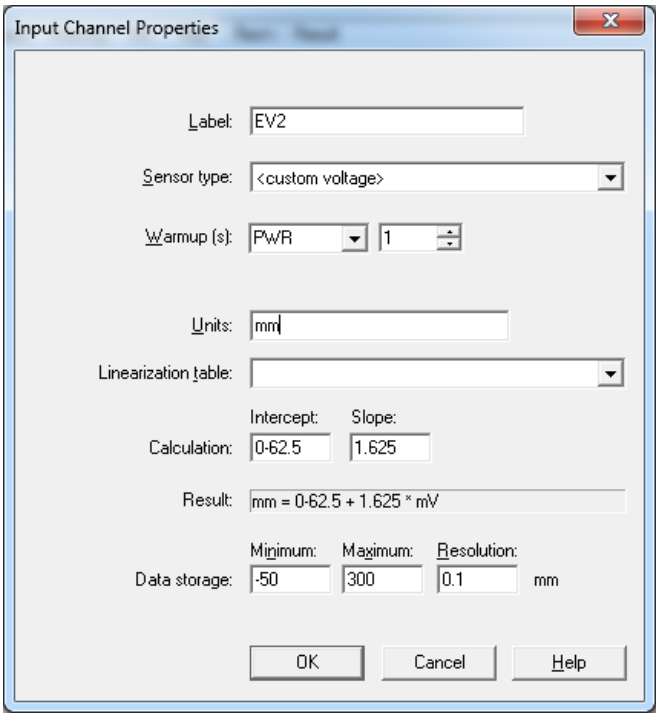
…to display the following:-



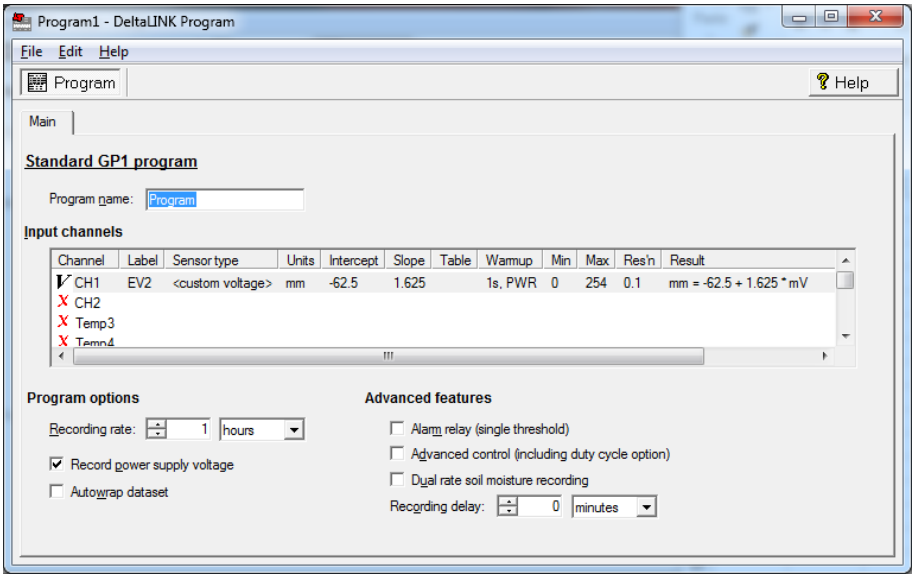
Right click on **Ch1** and select **Edit**:



This should open the Channel Properties dialog.
Populate the fields as shown below and click **OK**



Under **Program Options** specify a Recording rate: e.g. 1 hour or 1 day.



Select each of the other channels in turn and use right click, **Clear** or simply press **Delete** on the keyboard to clear them.

Click on **File, Send to Logger** to send the program to a connected GP1.

To check it runs OK click **Change** on the **Program** tab and temporarily change to a quicker recording rate e.g. 2s (or 10 s if you are using the 10s warmup). Click **Apply** and then select the **Sensors** tab and select **Read Now.**

This should display a graph of the water depth vs time, and so allow you to quickly determine if everything is working OK.

Note: if using a 10s warmup time the first readings when using **Read Now** will show #NAN (Not A Number). This will persist until first set of 10s is complete.

When you are ready, change it back to the longer- e.g. hourly or daily recording rate and start the logger running from the Logger tab in the normal way.

For c help see the DeltaLINK online Help and the GP1 User Manual

Use with a GP2 logger

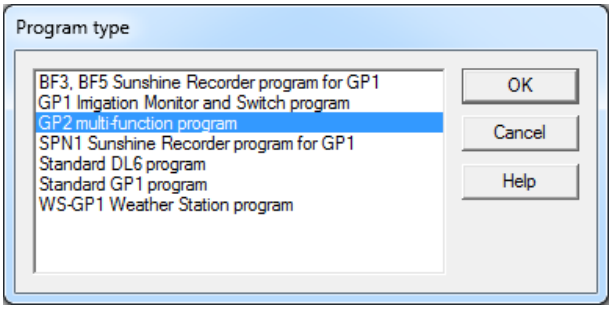
Requirements

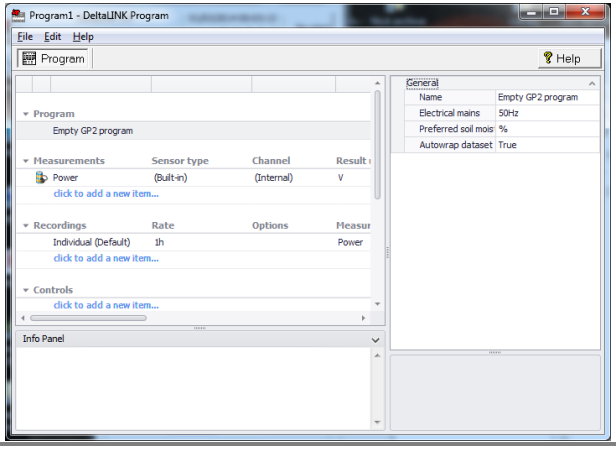
You need a PC running DeltaLINK software connected via a serial cable to the GP2.

Help and documentation

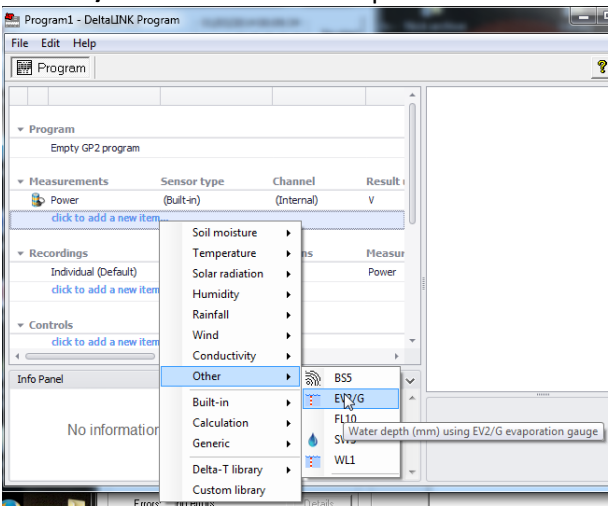
The online help for the GP2 when running DeltaLINK is exceptionally useful, as is the GP2 User Manual and the GP2 programming tutorials at www.delta-t.co.uk

With DeltaLINK connected to your GP2 logger (or the GP2 Simulator) select **File, New, Program** and select the **GP2 multifunction program.**

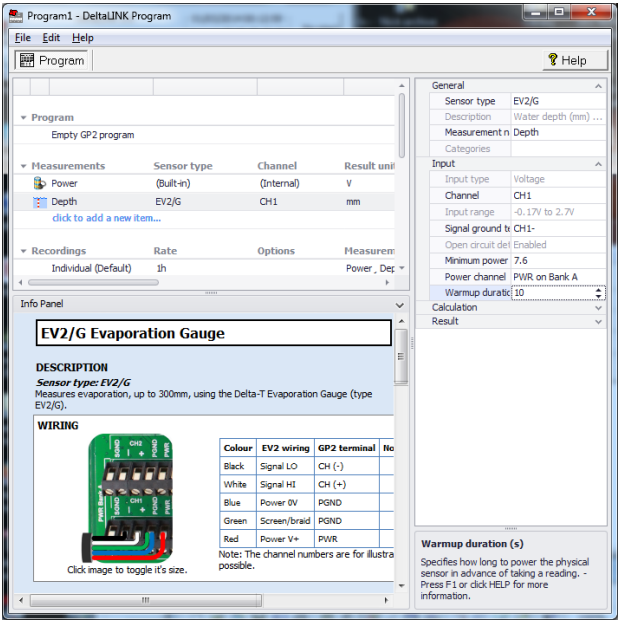




In Measurements click on "**Click on to add new item**" and select the **EV2/G** sensor from the drop down list under **Other**:



This loads the following default program:



Note in the **Info Panel** at lower left there is a comprehensive description of the EV2/G sensor along with a wiring diagram and instructions on how to configure it.

Specifications

EV2/G Evaporation Gauge

Submersible pressure transducer

Range	0 to 250 mm WG (water gauge)
Over-range	5 x range
Accuracy	± 1 mm of water depth (typically ± 0.5 mm)
Output	40 to 200 mV (linear)
Excitation Voltage	7.5 to 28 V dc unregulated (30 V dc absolute maximum)
Maximum supply current	22 mA
Recommended warm-up	At least 1 second (10 s for complete stabilisation)
Operating temperature range	0 to 50 °C
Storage temperature range	-20 to 80 °C

Dimensions

Gauge body	50 x 38 mm (height x diameter)
Weight	0.9 kg (including cable)
Cable length	5 m

A cable clamp is provided to anchor the cable to the rim of the pan.

Warning! Do not attempt to shorten the cable. A high precision 10 ohm resistor is embedded in the free end of the cable. Protect this end of the cable from physical damage.

Pressure Reference

The reference pressure is provided using an air pipe embedded in the cable.

Desiccant Capsule

Connected by the air pipe to the back of the sensor, this provides a vapour barrier to protect the sensor from moisture

Holder for Evaporation Gauge

Dimensions: 30 x 125 mm (height x diameter)
Weight: 1.2 kg

EV2/P Class A Evaporation Pan

Stainless steel USA Class A Evaporation Pan
Dimensions: 254 x 1220 mm (height x diameter)
Weight: 64 kg

Maintenance

Pan and sensor

To avoid any debris blocking access to the sensor and to help avoid inducing higher temperatures to the water, it is recommended that the pan is cleaned out every 3 to 4 months and the water changed. A clean pan should reflect a high percentage of radiation from the sun.

Do NOT clean the aperture of the sensor as this could damage the sensitive pressure transducer.

Desiccant

Inspect the capsule from time to time to see if the silica gel has turned pink. If this does happen then disconnect the capsule from the sensor and remove both yellow caps and place in a warm dry environment at 90°C until the silica gel has changed to blue.

Warranty and Service

Terms and Conditions of Sale

Our Conditions of Sale (ref: COND: 1/07) set out Delta-T's legal obligations on these matters. The following paragraphs summarise Delta-T's position but reference should always be made to the exact terms of our Conditions of Sale, which will prevail over the following explanation.

Delta-T warrants that the goods will be free from defects arising out of the materials used or poor workmanship for a period of **twelve months** from the date of delivery.

Delta-T shall be under no liability in respect of any defect arising from fair wear and tear, and the warranty does not cover damage through misuse or inexpert servicing, or other circumstances beyond their control.

If the buyer experiences problems with the goods they shall notify Delta-T (or Delta-T's local distributor) as soon as they become aware of such problem.

Delta-T may rectify the problem by replacing faulty parts free of charge, or by repairing the goods free of charge at Delta-T's premises in the UK during the warranty period.

If Delta-T requires that goods under warranty be returned to them from overseas for repair, Delta-T shall not be liable for the cost of carriage or for customs clearance in respect of such goods. However, Delta-T requires that such returns are discussed with them in advance and may at their discretion waive these charges.

Delta-T shall not be liable to supply products free of charge or repair any goods where the products or goods in question have been discontinued or have become obsolete, although Delta-T will endeavour to remedy the buyer's problem.

Delta-T shall not be liable to the buyer for any consequential loss, damage or compensation whatsoever (whether caused by the negligence of the Delta-T, their employees or distributors or otherwise) which arise from the supply of the goods and/or services, or their use or resale by the buyer.

Delta-T shall not be liable to the buyer by reason of any delay or failure to perform their obligations in relation to the goods and/or services if the delay or failure was due to any cause beyond the Delta-T's reasonable control.

Service, Repairs and Spares

Users in countries that have a Delta-T distributor or technical representative should contact them in the first instance.

Spare parts for our own instruments can be supplied and can normally be despatched within a few working days of receiving an order.

Spare parts and accessories for products not manufactured by Delta-T may have to be obtained from our supplier, and a certain amount of additional delay is inevitable.

No goods or equipment should be returned to Delta-T without first obtaining the return authorisation from Delta-T or our distributor.

On receipt of the goods at Delta-T you will be given a reference number. Always refer to this reference number in any subsequent correspondence. The goods will be inspected and you will be informed of the likely cost and delay.

We normally expect to complete repairs within one or two weeks of receiving the equipment. However, if the equipment has to be forwarded to our original supplier for specialist repairs or recalibration, additional delays of a few weeks may be expected. For contact details see below.

Technical Support

Users in countries that have a Delta-T distributor or technical representative should contact them in the first instance.

Technical Support is available on Delta-T products and systems. Your initial enquiry will be acknowledged immediately with a reference number. Make sure to quote the reference number subsequently so that we can easily trace any earlier correspondence.

In your enquiry, always quote instrument serial numbers, software version numbers, and the approximate date and source of purchase where these are relevant.

Contact Details:

Tech Support Team
Delta-T Devices Ltd
130 Low Road, Burwell, Cambridge CB25 0EJ, UK
email: tech.support@delta-t.co.uk
email: repairs@delta-t.co.uk
web: www.delta-t.co.uk
Tel: +44 (0)1638 742922
Fax: +44 (0)1638 743155