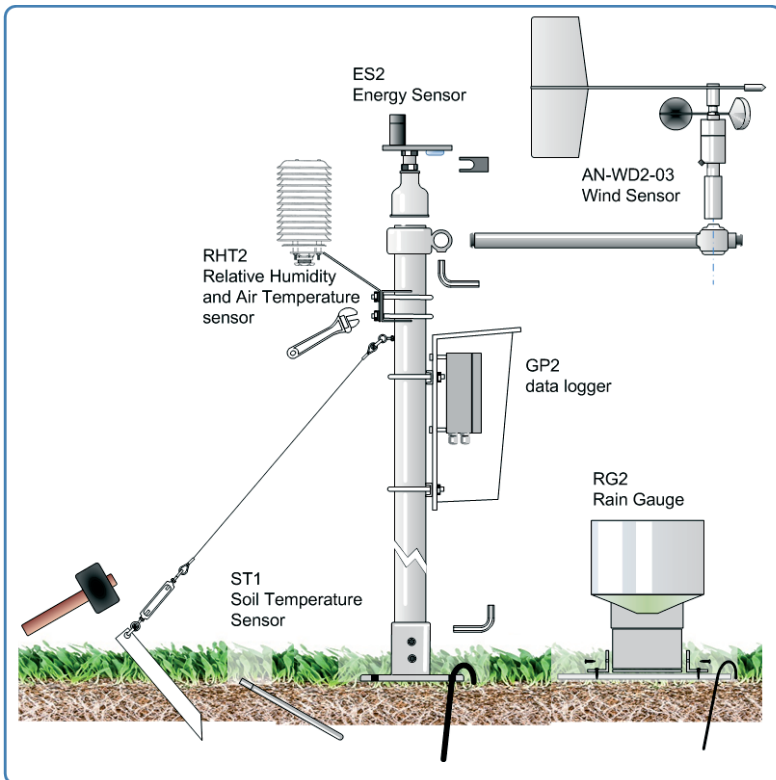


WS-GP2 Weather Station

WS-GP2 Weather Station for wind speed and direction, relative humidity, air and soil temperature, rain and solar radiation

Quick Start Guide

Version 1.0



Delta-T Devices Ltd

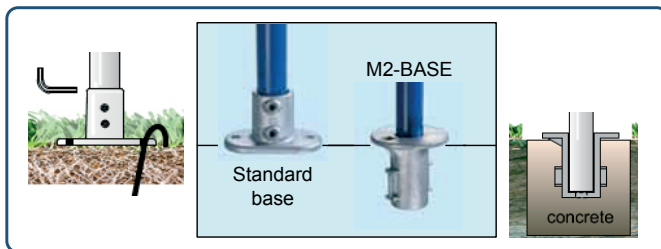
Introduction

The WS-GP2 Weather Station measures wind speed and direction, air temperature, relative humidity, solar radiation, rainfall and soil temperature.

This guide explains how to choose a site, install the mast, mount and align the sensors. Then, using a PC we show how to change the weather station program, check the sensor readings, then acquire and display readings.

Description

The weather station has a 2m high by 48 mm diameter anodised aluminium mast. Cross arm, connectors and fittings are provided for sensors and a GP2 data logger. The mast attaches to the ground via the standard base. This may be pinned to the ground by the stakes provided or bolted down on to concrete or rock.



The M2-BASE is an optional extra suitable for fixing into concrete. A levelling mechanism fits on the top of the mast for mounting a type ES2 solar radiation sensor.

The cross arm is installed near the top of the mast and has adapter to take a combined wind direction and speed sensor.

Below this can fit a bracket holding the combined air temperature and humidity sensor in a radiation shield.

The RG2-BP rain gauge has a base-plate to be staked level on the ground.



1 Unpacking

Check your contents against your order - you should have:-

- **M2** mast with cross arm, steel guy ropes, baseplate, stakes, logger canopy, U-bolts, and GP2 Logger and a logger canopy
See Figure 1 and the **Parts Index** on page **Error! Bookmark not defined.**
- Wind speed and direction sensor **AN-WD2-03**
- RH and air temperature sensor **RHT2ni-03**
- Solar energy flux sensor **ES2-05**
- Rain gauge **RG2+BP-06**
- Soil Temperature sensor **ST1-05**
- **GP2** Logger, with **GP2-USB** cable and **GP2 User Manual**
- **Delta-T Software and Manuals CD** including DeltaLINK3

You may need a pickaxe and shovel to prepare the site.

You will need a PC running DeltaLINK3 (supplied with the GP2 logger).

Identify Parts

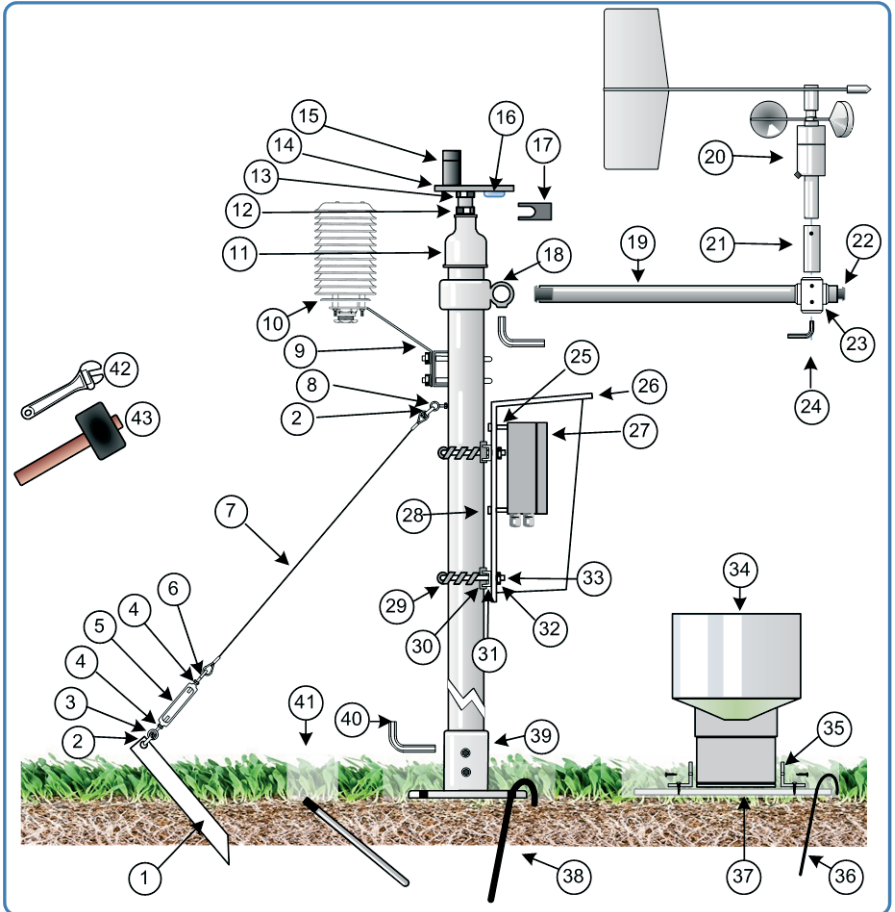
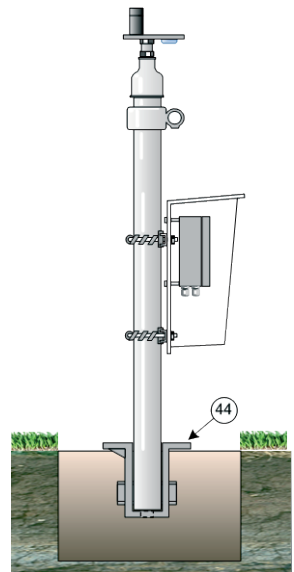


Figure 1: WS-GP2 Weather Station Mast and Sensor Parts (*not to scale*)

- 1) Ground stake (x3)
- 2) D-shackle (x6) size: 3/16 inch
- 3) Ring bolt (x3) size: M6
- 4) Lock nut. (x3 size: M6
plus x3 with a reverse screw thread)
- 5) Guy- line tensioning shackle /straining screws (x3).
- 6) Hook bolt (x3)
- 7) Stainless steel guy rope (3x 1.5m)
- 8) Ring bolt & lock nut (size:M8)
- 9) Mounting bracket for RHT2 sensor.
- 10) RHT2 radiation shield.
- 11) Mast to ball & socket connector
- 12) Ball & socket levelling device.
- 13) M8 nut.
- 14) Levelling plate
- 15) ES2 solar radiation sensor
- 16) Bubble level.
- 17) Spanner for ball and socket device 22mm locknuts
- 18) Mast to cross arm connector
- 19) Cross arm (1m x 32mm) with 6.5 mm dia. holes at 4 positions
- 20) Combined wind speed and direction sensor.
- 21) Alignment hub
- 22) Cross arm end plug x2.
- 23) Cross arm adapter
- 24) Allen key for cross arm adapter.
- 25) Stand offs for mounting GP2 to Logger Canopy (4x M4 x 15mm)
- 26) Logger canopy
- 27) GP2 data logger
- 28) Logger- canopy connectors
- 29) Protective spiral wrap for canopy U bolts (x2).
- 30) Protective strip (x4).
- 31) U bolt clamp plate (51mm x2)
- 32) Nuts & washers (x4 size: M6).
- 33) U Bolts (51mm x2)
- 34) RG2 rain gauge.
- 35) Right angle brackets (x2) with self- tapping screws
for mounting RG2 to base-plate.
- 36) Stakes for RG2 base plate (x4)
- 37) Base plate for RG2
- 38) Stake for M2 Mast base-plate x2
- 39) M2 mast base
- 40) Allen key (8mm)
- 41) ST1 soil temperature probe.
- 42) Adjustable spanner
- 43) Mallet
- 44) Optional extra type M2-BASE for fixing mast in
concrete (7¼ x 5½ inch, internal depth 5 inch)



2 Choose the Location

Results depend not just on sensor accuracy and reliability but also on how representative the site is – so choose the site carefully.

Where data is to be compared to a “standard” meteorological site, the sensors should be exposed in a similar way to sensors at the standard sites, i.e. over a level surface of short grass and away from trees or buildings.

These are rough guidelines. Refer to meteorological publications for further advice.

e.g. <http://www.wmo.int/web/www/IMOP/WebPortal-AWS/Index02.html>

Rules of thumb

Near a building, mount the sensors outside the zone of influence. Horizontally this extends roughly twice the height of the building upstream and ten times downstream. Vertically it extends to about twice the height of the structure.

If the requirement is to measure the true local conditions, e.g. a field of newly planted corn, select a relatively uniform area of the terrain. Be aware that, as a crop grows up towards the sensors, the measured wind speed decreases as the canopy approaches.

Sensors are also influenced by the changing local thermal and humidity microclimate above the crop. There are no simple rules to follow – but be aware of the following:

Clothes line effect: vegetation upwind may affect vapour gradients and heat transfer.

Oasis effect: If an isolated source of water, e.g. a lake or glacier, is surrounded by a relatively arid area, then the relative humidity may be affected if the wind direction draws air from the water source.

Leading Edge effect: When air moves over the boundary between two surfaces that differ in temperature, moisture content, roughness or some other characteristic, it takes time for the air to adjust. The line of discontinuity is known as the leading edge. The boundary layer will vary in vertical extent with distance from the leading edge as it adjusts to the new conditions.

Thermal plume effect: Avoid placing objects directly under the air humidity and temperature sensor, such as a solar panel, which can create a rising thermal plume when warmed by the sun.

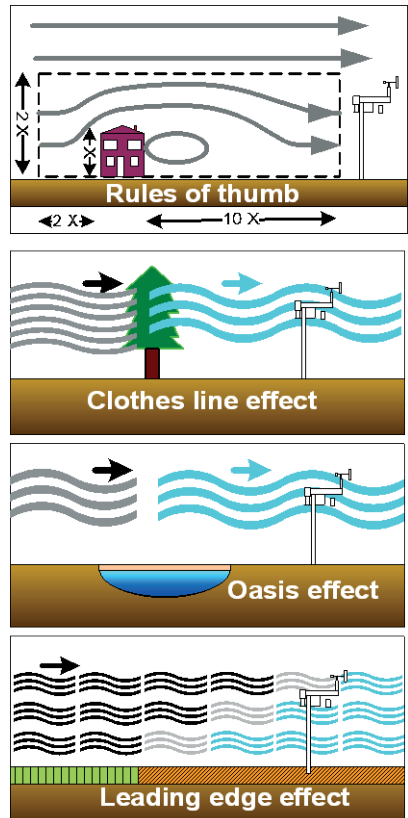


Figure 2: Location

3 Assembly

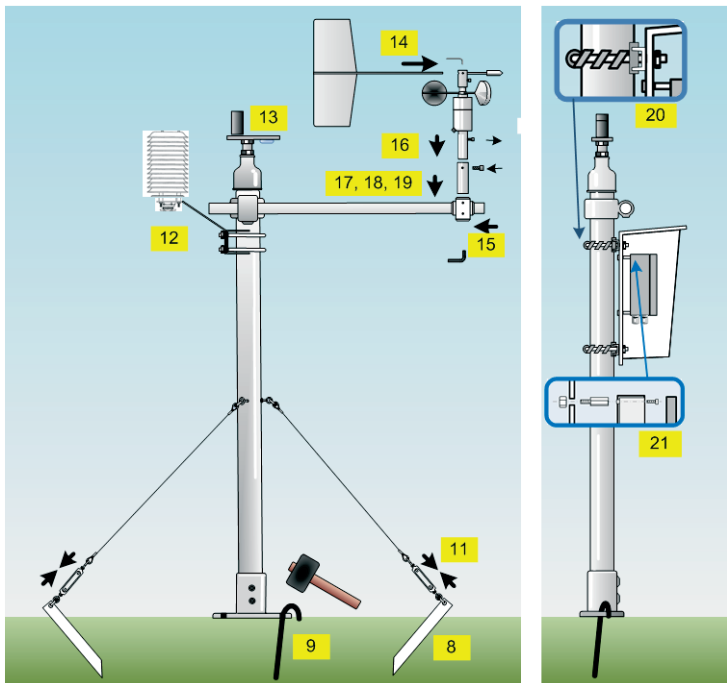
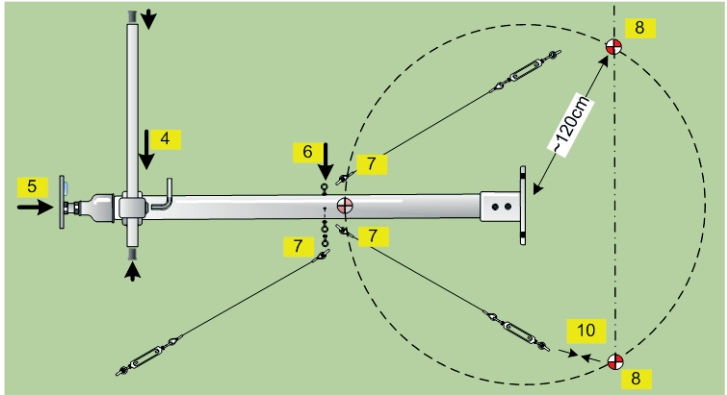


Figure 4
Steps to
assembly

Mast Assembly

It helps to have two people available.

Step 0. Before assembly lay out all the parts and identify them.
See **Identify Parts** on page **Error! Bookmark not defined..**

Step 1. Insert the 2m **mast into the base** (part 4) and tighten up the locking grub-screw using the 8mm (M8) Allen key.

Step 2. Slide the **mast cross-arm connector** (part 18) over the mast and position it near the top of the mast (To minimise interference with the wind sensors). Secure the join by tightening the socket grub-screw with the hexagonal 8 mm Allen key (44).

Step 3. Screw the **mast ball and socket connector** (11) on to the top of the mast.

Step 4. **Insert cross arm** (19) through connector (18), and secure it by tightening the locking grub-screw using the M8 Allen key.

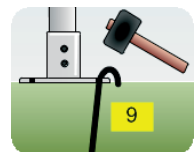
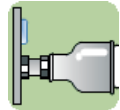
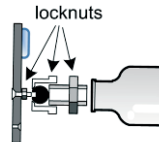
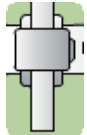
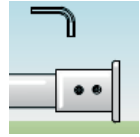
Step 5. Screw the **solar sensor levelling device** 12,13,14,16 onto the mast ball and socket connector (11).

Step 6. **Attach ring bolts** to the mast

Step 7. **Attach steel guy wire** to the ring bolts using the D-shackles

Step 8. If you have an assistant, now is the time to ask them to hold the mast vertical. Then, using the steel guy ropes as an indicator, **hammer in the guy rope stakes** at 3 locations around the mast, about 120 cm away from the centre. If you don't have an assistant, put two stakes in, haul up the mast with the third, and position your third stake that way.

Step 9. Hammer the 2 stakes in to **attach the mast base securely to the ground.**



Step 10. **Attach the steel guys** to the 3 stakes using the D shackles.



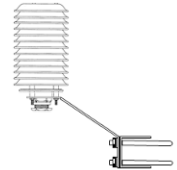
Step 11. **Tighten the guy line** tensioning shackle/straining screws.
Try to ensure the mast is vertical.



Sensor Assembly

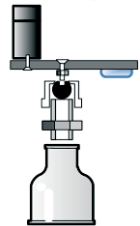
Step 12. **Attach the RHT2** mounting bracket using the U-bolts provided.

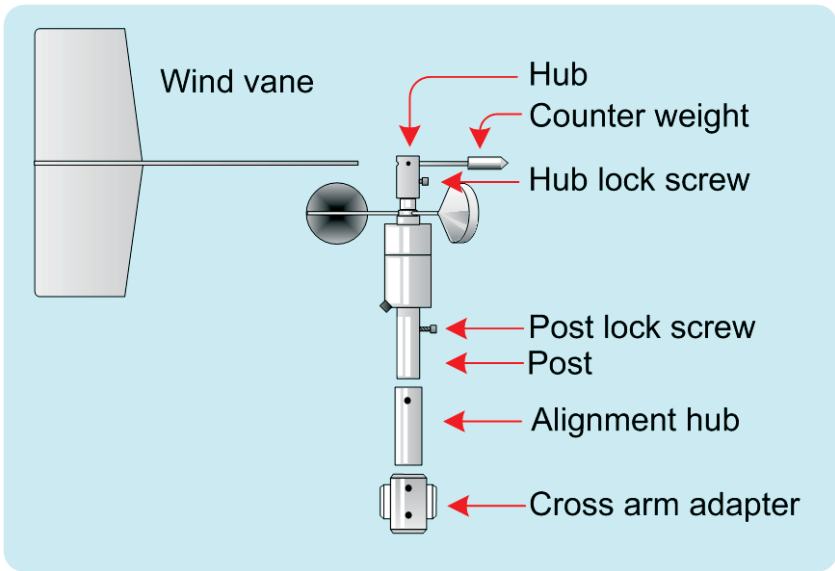
Mount the RHT2 sensor in the radiation shield using the housing sleeve and plastic compression nut provided.



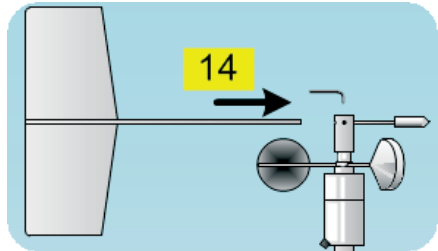
Step 13. **Attach the ES2** solar radiation sensor to the levelling plate via a screw into its base.

Level it using the bubble level indicator and lock it in place using the 22mm ball and socket device spanner

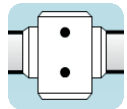




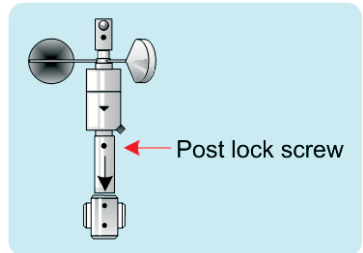
- Step 14. Fully **insert wind vane arm** into the hub at the top of the wind sensor. Align the vane with the centre axis of the sensor. Using the 5/64 inch Allen key, tighten the set/grub screw at the top of the hub to lock the windvane in place.



- Step 15. Slide the **cross arm adapter** onto the cross arm. This requires the 5/32 inch (~4mm) Allen key.



- Step 16. Remove the socket head post lock screw using a 5/32" (or 4mm) Allen key. Insert the post into the alignment hub replace the screw, so joining the two together.



- Step 17. Sit the wind sensor + alignment hub into the cross arm adapter, ensuring the sensor axis is vertical.

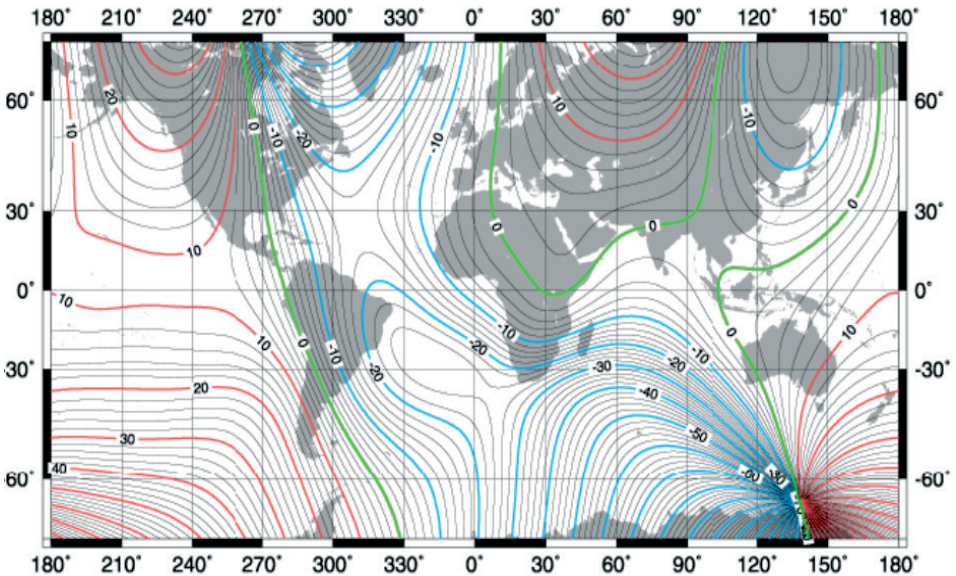
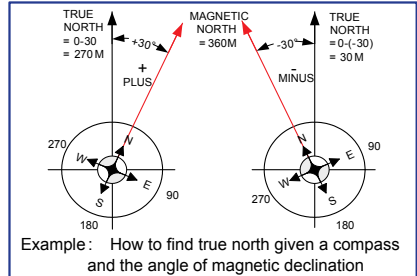
Step 18. Find true north

It is best to set the wind direction sensor to true north, not magnetic north.

Compass Method: Get a compass and the local angle of magnetic declination – either from a map, local airport - or use an online calculator e.g. <http://www.ngdc.noaa.gov/geomag-web/#declination> ...and enter your latitude and longitude.

Magnetic declination (or variation) is the angle between magnetic north and true north.

It is positive when the angle measured is east of true north and negative when west. So, if the declination is positive, true north is left of magnetic north.



Typical map of magnetic declination for year 2000
(reproduced courtesy of NOAA)

From this map you can see the magnetic variation around the world can be quite large. Magnetic north also drifts over time, so it is best to refer wind direction to true north.

Star Method: Find the North Star or the Southern Cross.

Whichever method you use, establish where true north intersects the horizon.

Step 19. **Orient the body of the wind vane**

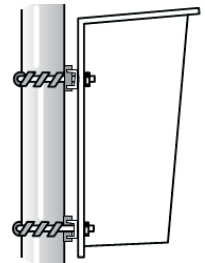
19.1. Ensure that the hub lock screw is in place on the hub.
In this state the wind vane cannot rotate and, if read, the sensor should indicate 180 degrees, i.e. south.

19.2. Rotate the body of the sensor until the counterweight and the black arrow on the housing actually point to true south (and the wind vane tail points to true north).

19.3. Tighten the two vertically paired grub screws on the cross arm adapter and then remove the hub lock screw - to release the wind vane and allow it to rotate freely.

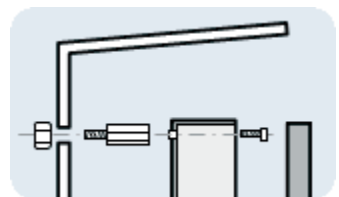
19.4. Attach the sensor cable to the socket on the housing.

Step 20. **Mount the canopy**, or optional M2 enclosure, at a convenient height on the mast using the two U bolts (29). These are supplied with a protective spiral plastic strip (28) and two strips of plastic channel (27).

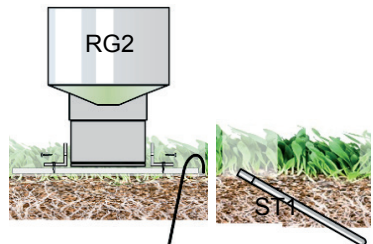


The canopy is designed to protect the logger from the heat of the sun, so mount it facing away from the equator (north in the northern hemisphere, on the south side in the southern hemisphere).

Step 21. **Mount the logger.** Remove the logger lid and insert the four M4 bolts to protrude out of the hole at the back of the logger. Hold these in with a screwdriver and bolt on the 4xM4x15mm stand offs. These allow air currents flow between the canopy and the back of the logger and so help it stay cool in hot weather.























Step 22. **Install raingauge RG2.** Locate it away from air flow obstructions and fix it horizontally on the ground the mounting plate and stakes provided



Step 23. **Install soil temperature sensor ST1**
Bury it along with about 1 m of cable to isolate it from the direct heat of the sun.

4 Wire-up the Sensors

	Colour	Function	GP2 connection
Air Temperature & RH			
RHT2nl Temperature and RH	Blue	 Air temp HI	CH2 (+) and CH2(-)*
	Yellow	 Air Temp LO	CH2 (SGND)
	White	 RH Signal HI	CH1 (+)
	Green	 RH Signal LO	CH1 (-)
	Red	 Power V+	CH1 (PWR)
	Black	 Power 0V	CH1 (PGND)
	Screen	 Shield	CH1 (PGND)
Soil Temperature			
ST1	Brown	 Thermistor HI	CH3 (+) and CH3 (-)*
	Braid	 Thermistor LO	CH3 (SGND)
Solar Radiation			
ES2 Energy Sensor	Red	 Signal HI	CH4 (+)
	Blue	 Signal LO	CH4 (-) and SGND
	Braid	 Screen	CH4 (PGND)
Wind Speed & Direction:			
Pin 1	Red	 Wind Speed Signal	Ev1
Pin 2	Black	 Wind Speed GND	Ev GND
Pin 3	Yellow	 Wind Dir HI	CH7 (+)
Pin 4	Green	 Wind Dir LO	CH7 (-) and SGND
Pin 5	White	 Wind Dir V+ REF	CH7 (PWR)
	White/brown	 Shield	CH7 (PGND)
Rainfall			
RG2	Red	 Switch NO	Ev3
Rain	Blue	 Switch common	GND

* link inputs together

Individual sensor wiring instructions are also displayed in the Info Panel of each program. See the example on the next page.

5 Install DeltaLINK3

Install and start the GP2 software DeltaLINK3 on your PC as instructed in the GP2 Quick Start Guide and connect to the GP2 logger using the GP2-USB cable provided.



6 Examine the Weather Station Program

The screenshot shows the DeltaLINK Logger software interface. The main window is titled "New connection - DeltaLINK Logger". It has a menu bar (File, Edit, View, Help) and a toolbar with icons for Logger, Sensors, Dataset, and Program. The Program icon is circled with a '1'. Below the toolbar is a table of measurements:

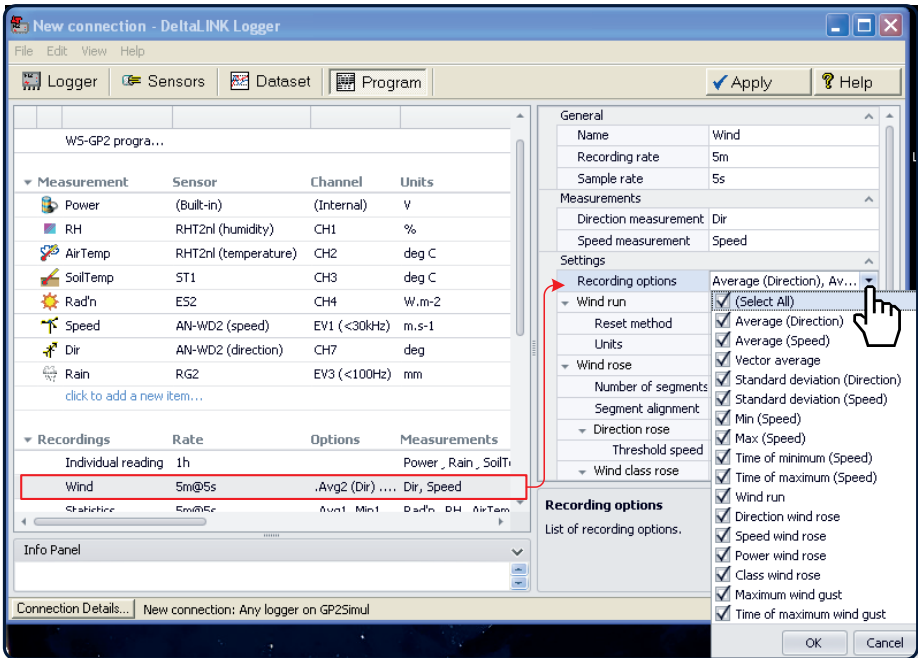
Measurement	Sensor	Channel	Units
Power	(Built-in)	(Internal)	V
RH	RHT2nl (humidity)	CH1	%
Air Temp	RHT2nl (temperature)	CH2	deg C
SoilTemp	ST1	CH3	deg C
RadIn	ES2	CH4	W.m-2
Speed	AN-WD2 (speed)	EV1 (<30kHz)	m.s-1
Dir	AN-WD2 (direction)	CH7	deg

The "Air Temp" row is circled with a '2'. Below the table is an "Info Panel" titled "RHT2nl RH and Air Temperature Sensor". It contains a "DESCRIPTION" section, a "WIRING" section with a table, and a "Print (Preview)" button. The wiring table is:

Colour	RHT2nl wiring	GP2 terminal	Notes
Green	RH Signal LO	CH1 (-)	
White	RH Signal HI	CH1 (+)	

The "Print (Preview)" button is circled with a '3'. To the right of the Info Panel is a "General" panel with fields for Sensor type, Description, Measurement, Categories, Input type, Channel, Cable resistance, Ground current, Input range, and Power channel. Below this is a "Calculation" section with a "Result" field. A red arrow points from the "Print (Preview)" button to a "Print Preview" window. The Print Preview window shows a preview of the sensor information page, including the wiring table and installation notes. The Print Preview window is circled with a '4'.

1. Select the **Program** window. Factory installed weather stations will have the **WS-GP2 Weather Station Program** pre-installed as shown. If missing, to reinstall this program Click **Change** on the **Program** window and select **Edit, Import Program**, select, **WS-GP2 Weather Station Program** from the folder location C:\Program Files\Delta-T\DeltaLINK3.0\WS-GP2 and click **OK**. Resize your window and the panels as convenient in order to read them. This weather station program is just an example to get you started, so please feel free to alter it.
2. Click on each sensor in the Measurement section of the Properties panel and observe that information about that sensor appears in the Info Panel.
3. To view the entire Sensor instructions in a separate panel right click over the Info panel to display "Print Preview" and select it with a right click.
4. To print this use **ALT P** or click the print icon.



Note: different recording rates and calculated results can be chosen, and they can be different for each sensor.

Note also you can run the weather station program connected to the GP2 simulator without a GP2 logger or weather station present. This is useful for tweaking the program and seeing the effect of different options on the simulated results graphs. See also: **GP2 User Manual**.

7 Can I add more Sensors?

Yes! The WS-GP2 uses 5 analogue and 2 counter channels.

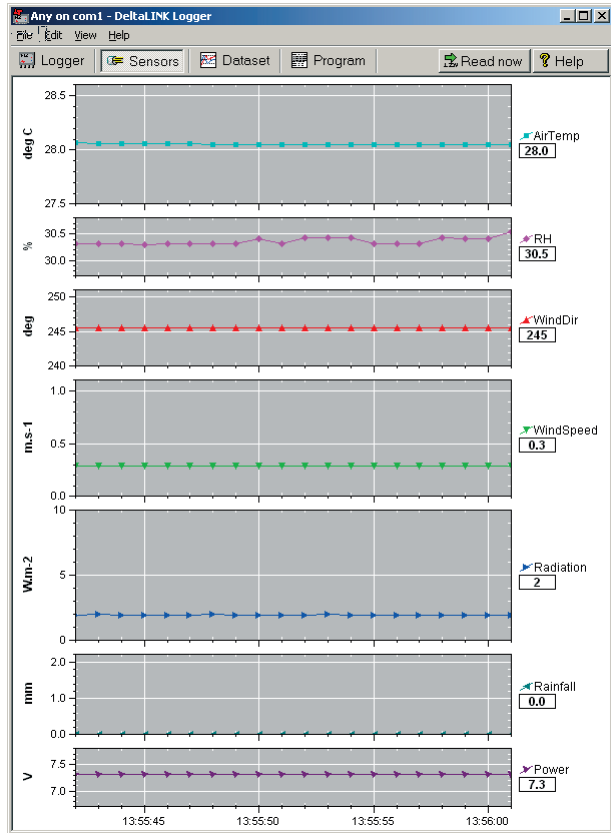
The rest can be used for other sensors.

For further information see the GP2 User Manual

Note that the WS-GP2 weather station program has assigned Power Bank B to supply the precision reference 3V needed for the wind direction sensor on channel 7. So all the Power Bank B terminals, (adjacent to channels 7-12) will also be supplied 3V.

8 Check Sensors & Start Logging

1. Select the **Sensors** window and click the **Read now** button. The sensor readings will continually refresh on a scrolling time graph.
2. Observe the sensor reading display in the scrolling charts and value panels.
3. Check the wind vane reads 360 degrees at north and 180 at south.
4. Spin the anemometer and blow on the radiation shield and check the readings look plausible.
5. Illuminate the light sensor then cover it, and check the readings seem plausible.
6. Pour water into the rain gauge funnel to simulate rainfall.
7. Click the **Cancel** button when finished.
8. Select the **Logger** window and click **Start** to commence logging.



Weather Records

9 Collect and Save Logged Data

1. Select the **Dataset** window. All stored data in the logger will be retrieved and displayed on the screen (it may take a few seconds to download the data). Click **Refresh** if required.
2. Select **File, Save** to save the data to a dataset file.
3. Select **File, Open** to open and view a previously saved dataset file.
4. To save a dataset file as a ASCII file for importing into other programs, open the file in DeltaLINK, and select **File, Save As...** selecting the appropriate file type to save.

10 View Weather

Display Options in Dataset View

Right-click on the timescales axis to select from the preset timescale options.

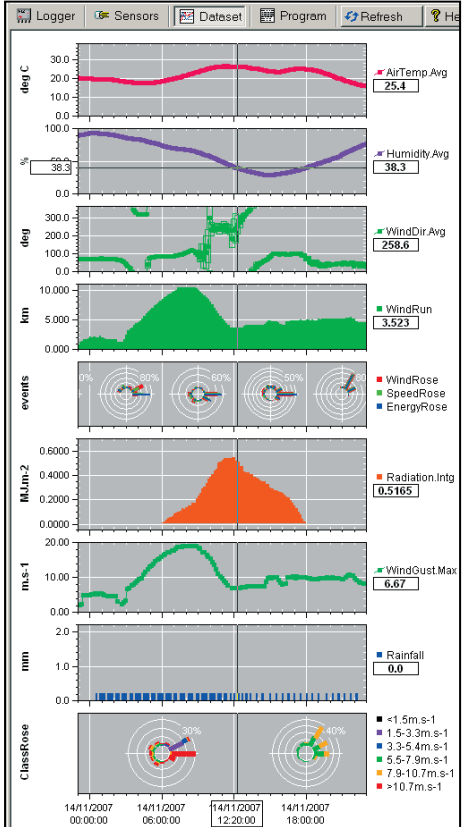
Left click and drag on a chart to mark out a zoom region. Then right-click to zoom.

Right click on the value axis to restore the default zoom.

Left click and drag top and bottom chart borders then click to resize the chart

Right click on the chart region to pop up a menu of display options including **Hide**, **Show all Charts** and **Details** options

See also the online **Help**



Key to graphing symbols

Note – Statistical symbols are only available if selected in the program

Key to statistical symbols

■ WindRose % of time wind was from each direction:
■ SpeedRose % of windrun from each direction
■ EnergyRose % of wind energy from each direction

Class Rose: % of time speed was in each Beaufort scale range

■ <1.5m.s-1	1
■ 1.5-3.3m.s-1	2
■ 3.3-5.4m.s-1	3
■ 5.5-7.9m.s-1	4
■ 7.9-10.7m.s-1	5
■ >10.7m.s-1	6 and greater

Further processing your weather data

Dataset Import Wizard helps you seamlessly import data into MS Excel spread sheets. Multiple dataset files may be imported and the data interleaved.

See **GP2 User Manual** for instructions on using the Dataset Import Wizard.

Once your data is in Excel, many third-party Excel add-ins are available to help you process your database.

Battery Life

Replace the battery before the battery voltage indicator drops below 5.5V.

At 1 reading/ minute on all sensors the internal 6 long life alkaline AA (LR6) batteries should last one year.

Note the simulator does not accurately predict battery life and should not be relied on.

To increase battery life this, reduce the reading frequency, and/or use an external lead acid battery or an approved mains-powered 12V DC supply.

You might expect an external 10 AHr lead acid battery to last longer but this is not the case - the GP2's input overvoltage regulator for external power sources uses quite a lot of current (~0.8mA) but also internal self- discharge in the lead acid battery can limit this - to 10 months at 25°C, and only 3 months at 40°C, unless periodically recharged – for example by a solar panel.

Note: When retrieving data, keep an eye on your logger battery. Its status is reported by the logger software, and you can also log it along with the sensor readings. The voltage reported is that presented to the sensors, and is slightly less than that at the battery terminals.

Note: If a powered sensor is connected to power bank A or B, then every time any of those sensors are read, power is supplied to all the sensors on that power bank.

Specifications

	Specification	Range/Notes
Logger GP2		
Accuracy analog	$\pm (87\mu\text{V} + 0.007\%)$	at 25°C
	$\pm (122\mu\text{V} + 0.043\%)$	-20°C to + 60°C
Accuracy other	See detailed specifications in the GP2 Quick Start Guide	
Readings	2.5 million approximately	depends on program settings
Logging frequency	1s to > 1000 days	
Data collection	To PC	
Logging status	Flashing LED	
Environmental	-20°C to +60°C, IP67	
Air Temperature RHT2nl (combined with RH sensor)		
Accuracy	$\pm 0.1^\circ\text{C}$	over 0-70°C
Environmental rating	IP65	
Radiation Shield error	0.5 °C	at 3 m.s ⁻¹
	1.0 °C	at 2 m.s ⁻¹
	2.0 °C	at 1 m.s ⁻¹
Relative Humidity RHT2nl (combined with air temperature sensor)		
Accuracy at 25°C	$\pm 2\%$ RH	5 to 95% RH
	$\pm 2.5\%$ RH	< 5% and > 95% RH
Environmental	-20 to 80°C, 0-100%RH	
Response time	< 10s	90% of scale for a step change from 11% to 75% RH
Soil Temperature ST1		
Accuracy	$\pm 0.2^\circ\text{C}$	over -10 to 65°C
Environmental	IP65	
Solar Radiation ES2		
Absolute accuracy	$\pm 5\%$	at 20°C, subject to limitations below
Linearity	$\pm 1\%$	over 0-2 kW.m-2
Asimuth error	$\pm 1\%$	over 360°
Cosine response	$\pm 5\%$	up to 70° zenith angle
Stability	Typically better than $\pm 2\%$ per year	
Temperature sensitivity	<0.2% / °C	
Environmental Limits	-10 to 60°C, IP65	Operating range
	-10 to 60°C	Storage range
Wind Speed AN-WD2 (combined wind sensor)		
Accuracy	$\pm 0.1\text{m.s}^{-1}$	up to 10m.s ⁻¹ (22.7 mph)
	$\pm 1.1\%$ of reading	over 10m.s ⁻¹ (22.7 mph)
Range	0 to 75m.s ⁻¹ (0 to 167 mph)	
Starting threshold	0.4 m.s ⁻¹ (0.9 mph)	
Wind Direction AN-WD2 (combined wind sensor)		
Accuracy	$\pm 4^\circ$	
Range	0 to 356°	electrical
	0 to 360°	mechanical
Starting threshold	0.4 m.s ⁻¹ (0.9 mph)	
Damping ratio	0.25	
Resolution	< 0.5°	
Rainfall RG2		
Sensitivity	0.2mm per tip	up to 360 mm.hr ⁻¹
Mast M2-FSG		
Hardware	2m mast, 1m cross arm, stakes, steel guy wires, mast foot, logger canopy	

Service & Recalibration

Before returning parts please contact Delta-T or your local agent for instructions.

Wind speed and direction AN-WD2

Recalibrate: every year. **Service:** 6-12 months: look & listen to see if the vane and cups are running freely, are undamaged, and are not loose. 12-24 months: replace anemometer bearings. 24-36 months: complete factory overhaul of sensor. Most parts are replaceable in the field.

See also **AN-WD2 User Manual** and document folder on the on the Delta-T Software and Manuals CD.

Rain gauge RG2

Can be recalibrated in the field.

See also the **RG2 User Manual** on the Delta-T Software and Manuals CD.

Light sensor ES2

Typical drift <2% per year. Recalibrate every 2 years. Keep it clean and level.

See also the **ES2 User Manual** on the Delta-T Software and Manuals CD.

RH & air temp sensor RHT2nl

Typical drift -1.5 to -2% in the first year, -1% in the second year and -0.5% in the third. No adjustment of the RH or temperature element is possible. Inaccurate sensors must be replaced with new module which can be plugged in the field. Replace every two years in clean atmospheric conditions or every year if the atmosphere is polluted.

See also the **RHT2nl User Manual** on the Delta-T Software and Manuals CD.

ST1 Soil temperature sensor

This cannot be recalibrated. The only check you can do is to check the resistance across the terminals, which should be 2000 Ohms at 25°C.

See also the **ST1 user Manual** on the Delta-T Software and Manuals CD.

Notices

This product uses software code. It should not be used in safety-critical applications or where consequential loss may occur. It is the responsibility of the user to ensure appropriate safeguards are in place for regularly monitoring and checking the equipment.

In no event shall Delta-T's liability exceed the selling price of the product. Delta-T is not liable for indirect, incidental or consequential damages in connection with the use of equipment, including but not limited to: data loss, vegetation loss, loss of energy or water, cost of substitute equipment or services, property damage, or personal injury that results from installer's negligence. The customer agrees to the limitations and exclusions of liability by purchase or use of this product.

See also the **GP2 Product Usage.pdf** in the online **Document Library** folder.

The WS-GP2 Weather Station is CE compliant, See **WS-GP2 EC Certificate.pdf** in the online **Document Library** folder and on the Delta-T Software and Manuals CD.



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