

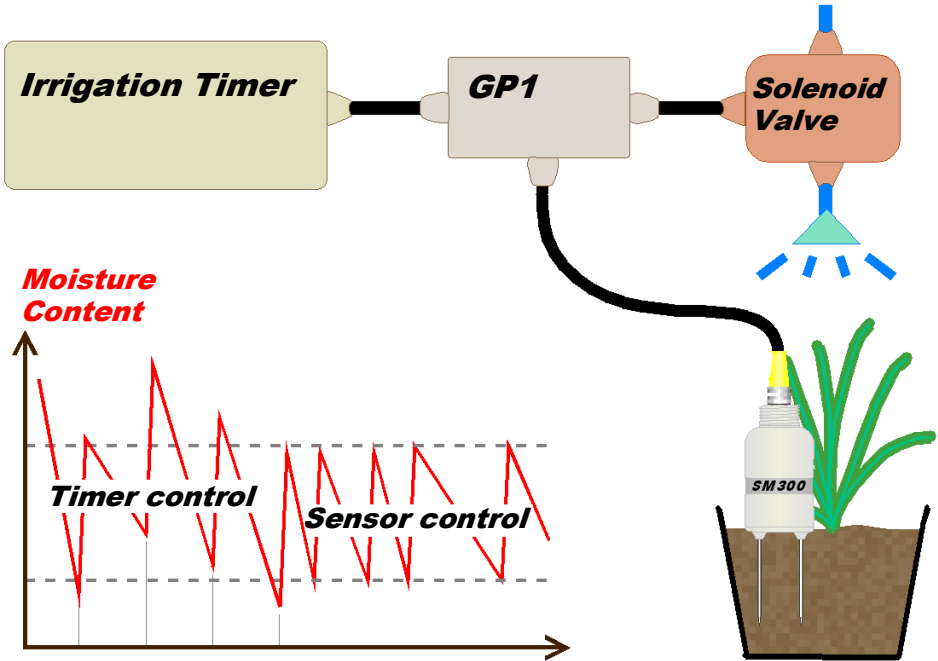
Irrigation Control

Using Soil Moisture Sensors

Quick Start Guide *Version 2c*



Overview



Potential benefits of sensor control

- Reduced water use
- Compact plants
- Fewer weeds
- Reduced labour for watering, pruning and weeding
- Plants are less soft so establish more reliably
- More fruit and flowers, less vegetative growth

This guide explains how to adapt timer-based irrigation control systems to include soil moisture sensing using the **GP1** irrigation monitor and **SM300** soil moisture sensor. The instructions are particularly directed at container-grown plants, but can be applied to other shallow-rooting crops in free-draining compost or soil.

System Requirements




Check through this list carefully to make sure your system is compatible:

- ✓ **Overhead** or **drip** irrigation
 - Capillary, sand bed or flood and drain systems switch off too slowly for accurate moisture control
- ✓ Reasonably **uniform** irrigation system
 - The Coefficient of Uniformity (CU) should be > 80% for you to get the most benefit from the system (otherwise you will have to routinely over-water to prevent the less irrigated plants from drying out).
- ✓ Plant pots, grow bags, mineral wool slabs etc. > **0.8 litre** volume
 - The SM300 can be set to control irrigation in smaller pots but it may be difficult to insert with sufficient distance (~2cm) from the edge of the pot.
- ✓ The timer-based irrigation system controls irrigation by **solenoid valves**
 - The relay cannot be used for direct pump control
- ✓ If you plan to control irrigation for a mixed bed, the plants must have **similar water requirements**.




Preparation

You need to assemble the following equipment:

| Item | Accessories / notes |
|--|--|
| GP1  | Mounting kit (GP1-MP1) Serial cable, small screwdriver and PC software on CD (included with GP1) |
| SM300  | Logger cable (SMSC/sw-05) Extension cables may be required (see section 1.1) <i>Note that the SM300 includes a built-in temperature sensor but this can only provide soil / substrate temperature readings when the SM300 is fully buried.</i> |
| Cable to solenoid | Round cross-section 2-core wire |
| 3-way connector block  | You will need to put the connector block into a sealed box if connecting to the solenoid valve in a wet area. |
| Tape and/or cable ties | For keeping wires tidy and preventing accidents. |

These may also be helpful:

| | |
|---|--|
| SM300 + HH2  | Useful for checking range of moisture contents during set up and adjustment. <i>Note that the HH2 does not display readings from the SM300 temperature sensor.</i> |
|---|--|

You will also need access to the following:

| | |
|--|--|
| Tools | Wire cutters & wire strippers... An electrical multi-meter with audible short circuit warning is also very useful. |
| Ladder | If some of the wiring will run overhead. |
| Portable computer with Windows 98, XP, Vista or 7 | For configuring the GP1. It is even more convenient to do this with an iPAQ (see section 7), but check for compatibility. |

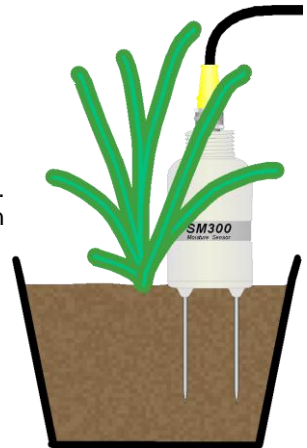
Installation

1 Install the SM300

1.1 Plan cable runs

Locate the solenoid valve that controls the bed irrigation. Plan where to splice into the cable to the valve, and then consider where it makes sense to mount the GP1.

Depending on available extension cables, this will then determine the general location for the SM300.



1.2 Choose a location for the SM300

If there's more than one type of plant within the bed, choose a variety that uses more water.

Choose a representative plant i.e.

- Not in the outside row
- Moderate growth
- Foliage won't shed water unduly
- No voids in the growing media

Check the water content of potential control plants using an SM300 and HH2 if available, otherwise by lifting the pots or feeling the compost. Avoid plants that appear to be unusually dry or wet.

1.3 Insert SM300 into pot / soil

Screw the cable onto the sensor (attach the extension cable first if you are using one, otherwise directly attach the logger cable which terminates in bare wires). Make sure the connectors halves are clean and aligned before pushing together, then push them fully home and tighten to maintain the seal.

Insert the SM300 into the pot as close to the centre as reasonably possible – see illustration above. Once inserted, don't joggle the sensor as this will create air gaps around the measurement rods. You may find it useful to tape the cable to the side of the pot.

Refer to the **SM300 Quick Start** Guide for more detail:

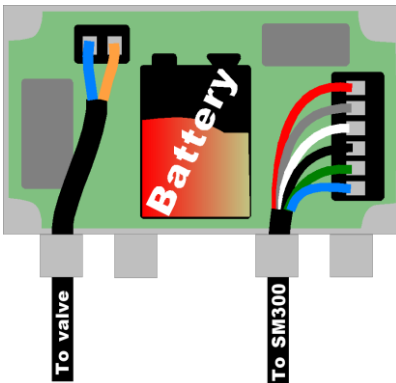


2 Connect the GP1

2.1. Mount GP1 on post

Open the GP1 cover and attach to the mounting plate using the 4 screws provided. Then fix the mounting plate to a suitable post either using cable ties, tape or U-bolts (provided).

2.2. Connect cables to GP1

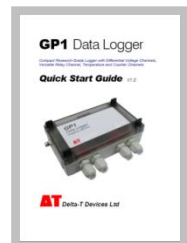


Pass the cable from the SM300 through the cable gland and connect to Channel 1 as shown (order for channel 1 is red, grey, white, black, green and blue):

Connect the cable for controlling the solenoid valve to the relay as shown (note the colours of your cable will likely be different but the orientation of the connection is unimportant). Don't connect the other end to the solenoid valve at this stage.

Tighten the cable glands, replace the GP1 cover, secure all cables to the post and tape carefully over any cable runs in walkways.

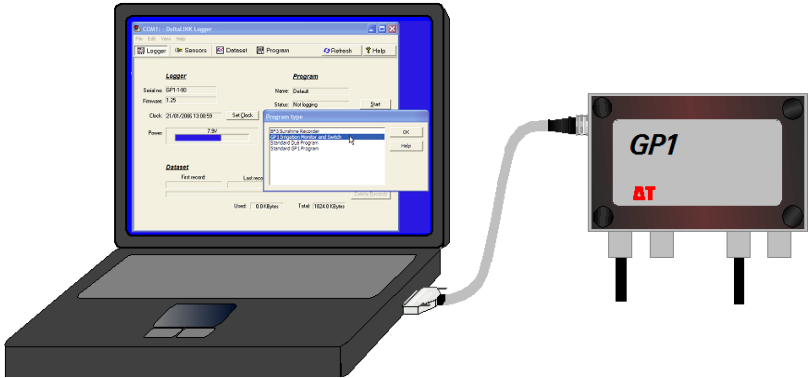
Refer to the **GP1 Quick Start Guide** if you want to connect the SM300 temperature sensor or need more detailed instructions.



3 Configure the GP1

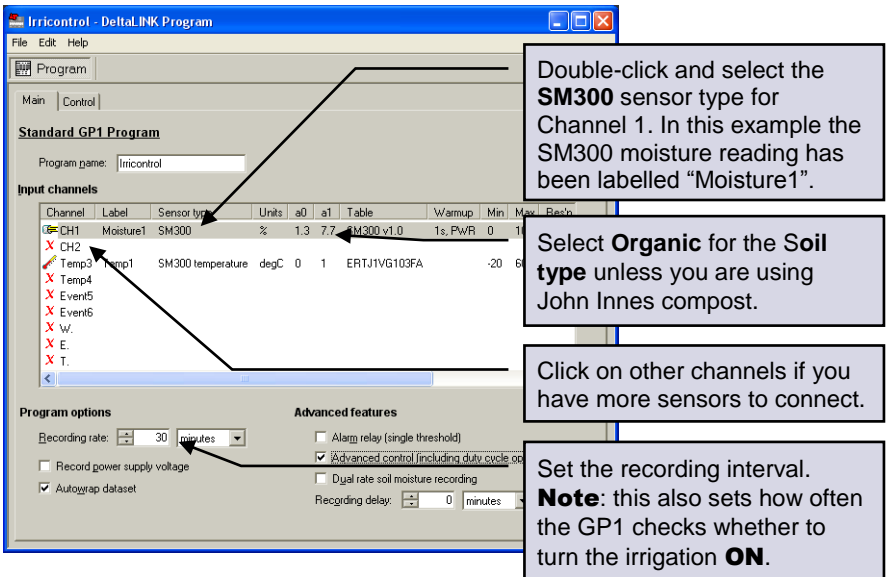
3.1. Connect laptop to GP1

These instructions assume you've already fully installed the DeltaLINK software - if not, you should refer to the **GP1 Quick Start Guide**.



Connect your laptop to the GP1. Start DeltaLINK and select **File, New, Program....** From the list choose **Standard GP1 Program**.

3.2. Set up the GP1 recording program



Double-click and select the **SM300** sensor type for Channel 1. In this example the SM300 moisture reading has been labelled "Moisture1".

Select **Organic** for the **Soil type** unless you are using John Innes compost.

Click on other channels if you have more sensors to connect.

Set the recording interval. **Note:** this also sets how often the GP1 checks whether to turn the irrigation **ON**.

| Channel | Label | Sensor type | Units | a0 | a1 | Table | Warmup | Min | Max | Resol |
|---------|-----------|-------------------|-------|-----|-----|--------------|---------|-----|-----|-------|
| CH1 | Moisture1 | SM300 | % | 1.3 | 7.7 | SM300.v1.0 | 1s, PwR | 0 | | |
| CH2 | | | | | | | | | | |
| Temp3 | Temp1 | SM300 temperature | degC | 0 | 1 | ERTJ1VG103FA | | -20 | 60 | |
| Temp4 | | | | | | | | | | |
| Event5 | | | | | | | | | | |
| Event6 | | | | | | | | | | |
| X | W | | | | | | | | | |
| X | E | | | | | | | | | |
| X | T | | | | | | | | | |

Program options

Recording rate: 30 minutes

Record power supply voltage

Autowrap dataset

Advanced features

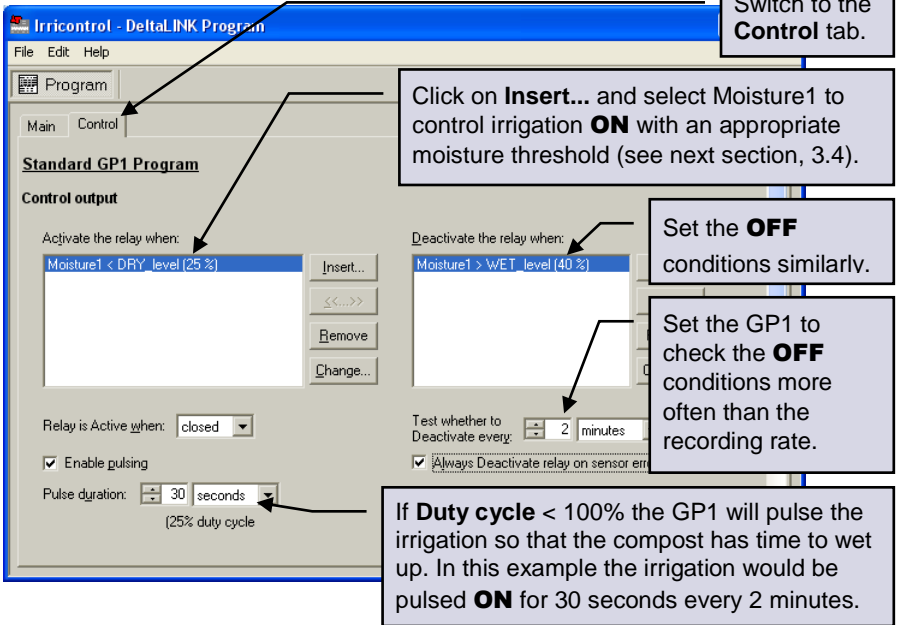
Alarm relay (single threshold)

Advanced control (including duty cycle 0s)

Dual rate soil moisture recording

Recording delay: 0 minutes

3.3. Set moisture control levels and pulse irrigation



Switch to the **Control** tab.

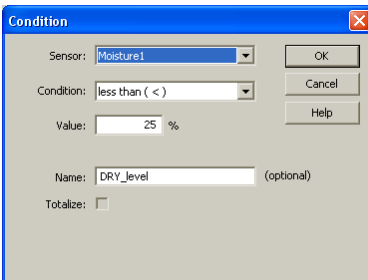
Click on **Insert...** and select Moisture1 to control irrigation **ON** with an appropriate moisture threshold (see next section, 3.4).

Set the **OFF** conditions similarly.

Set the GP1 to check the **OFF** conditions more often than the recording rate.

If **Duty cycle** < 100% the GP1 will pulse the irrigation so that the compost has time to wet up. In this example the irrigation would be pulsed **ON** for 30 seconds every 2 minutes.

3.4. Adjustable thresholds



Condition dialog box showing:

- Sensor: Moisture1
- Condition: less than (<)
- Value: 25 %
- Name: DRY_level (optional)
- Totalize:

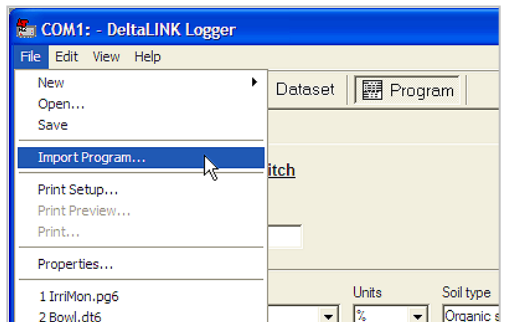
When setting the control conditions, it is useful to give a name to the threshold (“DRY_level” in this example). You will then be able to adjust the thresholds later without starting and stopping the program (this feature requires DeltaLINK version 2.4 or later).

3.5. Configure the GP1

Save the program and close the program editor.

In the main **DeltaLINK** window, select the **Program** view and click on the **Change** button.

Select **File, Import Program...**, and select the program file (.pg6) that you have just saved.



COM1 - DeltaLINK Logger File menu showing:

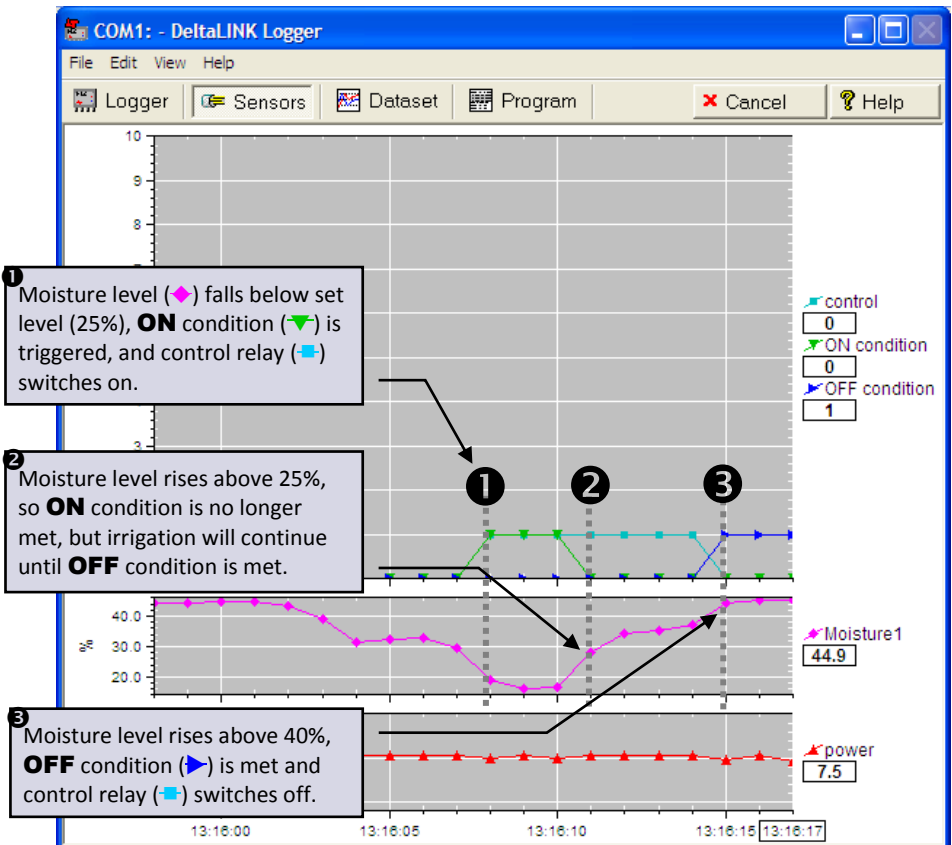
- File Edit View Help
- New
- Open...
- Save
- Import Program... (highlighted)
- Print Setup...
- Print Preview...
- Print...
- Properties...

4 Check the system

4.1. Check the SM300 readings and relay operation

In the main **DeltaLINK** window, select the **Sensor** view. Click on **Read now** and check that the SM300 is giving sensible readings.

By withdrawing and re-inserting the SM300 partially from the soil/compost you can simulate drying/wetting and check the relay operation as in this (rather artificial) example.



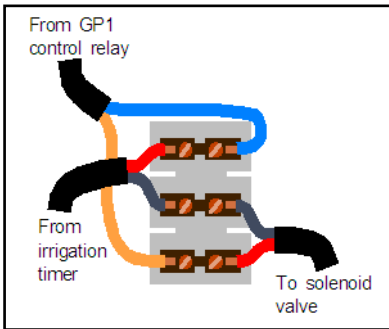
Note: you should be able to hear the GP1 relay switching, but it may be convenient to attach a multi-meter to the end of the control cable, so that you can check the switching remotely.

When finished, click on **Cancel** to stop the readings, and if you have been checking the readings by withdrawing the SM300, **re-insert it in a new hole**.

5 Connect the solenoid valve and start irrigation

5.1. Connect the solenoid valve

Turn off irrigation to the bed. Cut the cable from the irrigation timer to the solenoid valve and splice in the cable from the GP1 control relay using the connector block as shown below. You will need to mount the block in a small waterproof enclosure if the connection is likely to get wet.



Note: cable colours are likely to be different from this illustration.

5.2. Adjust the irrigation timer

Adjust your irrigation timer to water for longer periods.

The SM300 and GP1 will prevent your irrigation system from over-watering, so you can safely increase the irrigation times. The sensor control will attempt to switch the irrigation **ON** soon after the moisture level falls below the lower threshold (depending on the time set in the recording rate) so it is important that the timer allows irrigation to start within a reasonable time.

If you are watering by drip irrigation you may want to adjust the timer to irrigate continuously throughout the day, leaving all the control to the SM300 and GP1.

5.3. Start irrigation control

Connect your laptop to the GP1, start **DeltaLINK**, and in the main **Logger** view click on **Start**.

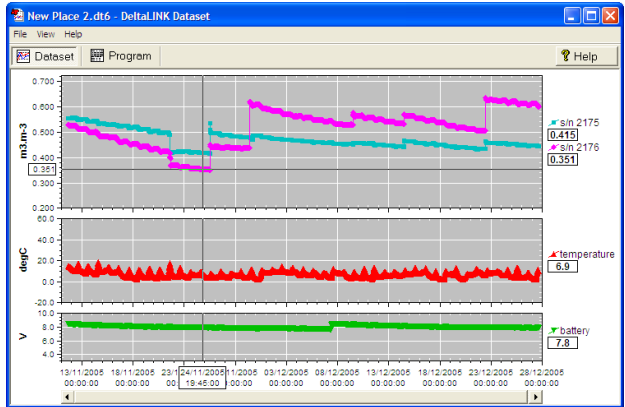
Turn on your irrigation system.

Your irrigation system is now under sensor control

6 Adjust the settings

6.1. Check recorded data

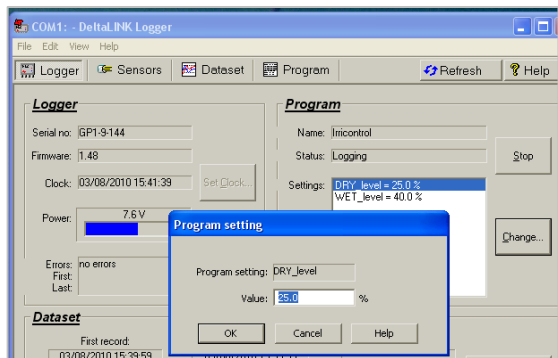
Connect your laptop to the GP1, start **DeltaLINK** and select **Dataset**. The GP1 will automatically download the stored data and display the soil moisture readings as a graph (this example shows a GP1 with 2 SM300s and a temperature sensor):



To save the data, select **File, Save** and enter a name for your data.

6.2. Adjust irrigation levels

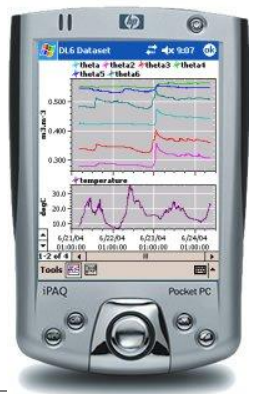
If you want to adjust an irrigation control level, in the main **Logger** view click on **Change...** and adjust the threshold value in the **Program setting** window that opens up. Click **OK** to apply the change.



7 Pocket DeltaLINK

The GP1 can also be configured using the Pocket PC version of **DeltaLINK**. This provides exactly the same facilities for programming the logger and examining the stored readings, but is even more convenient for field use.

Pocket DeltaLINK requires a pda running Pocket PC version 4.2 or later and an RS232 serial port for connection to the GP1.



Notes

Battery use: the GP1 battery can be changed quickly without losing program settings or data, but no readings will be taken and no control of irrigation will occur while the battery is removed.

A standard PP3 alkaline battery will power the GP1 and SM300 for more than 4 months when recording at 30 minute intervals. Check the battery voltage from time to time in **DeltaLINK** and replace when below 6 Volts. See the **GP1 Quick Start Guide** for further detail.

Sealing: the SM300, GP1 and all connectors are sealed to an appropriate standard, but to maintain this sealing you should:

- Take care when attaching cables to ensure that the connectors are clean, undamaged and properly aligned before pushing the parts together. Screw together firmly to ensure the connection is water-tight.
- Ensure that all cable glands and cover screws are fully tightened.
- Where possible avoid placing the GP1 directly underneath irrigation nozzles.
- Replace the GP1 desiccant bags annually.

Status LED: the GP1 LED flashes twice every 10 seconds when it is logging normally. It will flash four times instead if it detects a problem.

Care and Safety

- The rods of the SM300 are sharp in order to ease insertion. Take care and follow handling precautions.
- Avoid touching the rods or exposing them to other sources of static damage. Keep the SM300 in its protective tube when not in use.
- Do not pull the sensor out of the soil by its cable.
- If you feel strong resistance when inserting the SM300 into soil, it is likely you have encountered a stone or a root. Stop pushing and re-insert at a new location.



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