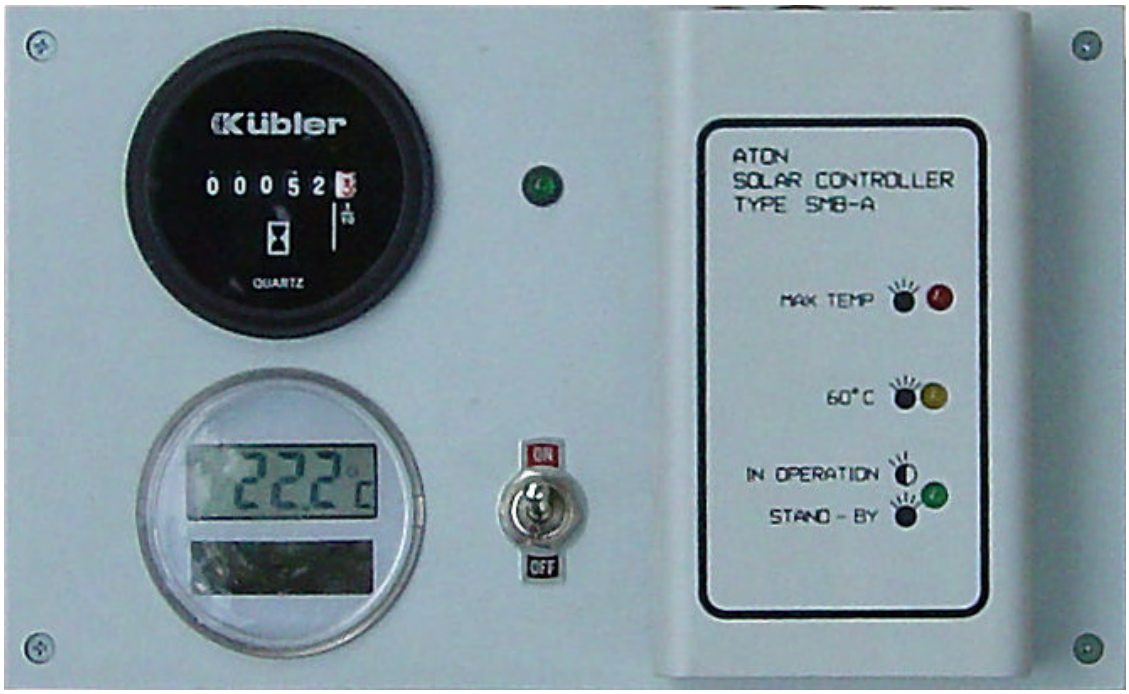
IMAGINATION SOLAR LTD

Installation Guide B5

ATON Light Level Controller
- for PV Powered Systems



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B 5 Aton Light Level Controller

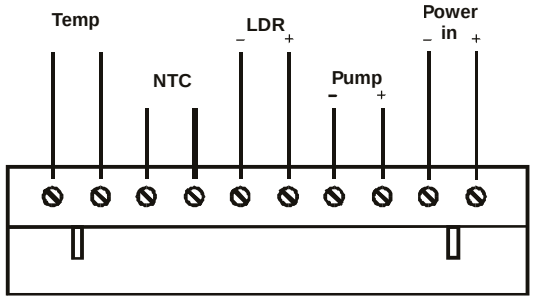
The Aton light level controller is used on PV powered installations rather than delta T (temperature difference) controllers.

B 5.1 Wiring

The pump and control system are powered from a 20W panel. If installing in overcast conditions a 21V power supply is essential for testing and commissioning purposes. Another essential tool is a multimeter showing at least voltage and resistance.

N.B. the following with regard to Part P of the current Building Regulations. A new socket or fused spur on an existing ring main would be regarded as *'an alteration or addition which does not extend to the introduction of new circuits'* and that this would therefore require inspection and testing to BS7671 and then a Minor Electrical Installation Works Certificate to be issued to the owner by a *'competent person'.*

A PV powered system however is outside the scope of Part P and therefore exempt from any of the requirements as it does not constitute an "Electrical Installation". As the PV power supply for the ISL system is not *'on the consumers side of the electrical supply meter'* Part P is therefore not relevant or applicable.



Most ATON controllers are supplied as a complete pre-wired kit in a plastic enclosure, in which case wiring is very simple as per the diagram opposite. The rest of this guide, however, provides complete details.

B 5.2 Providing Power for a One Collector System

The control unit is powered using a 20W photovoltaic (PV) panel mounted next to the thermal collector on the roof. The cable must be run into the loft and under an overlap in the roof felt to maintain waterproofing integrity.

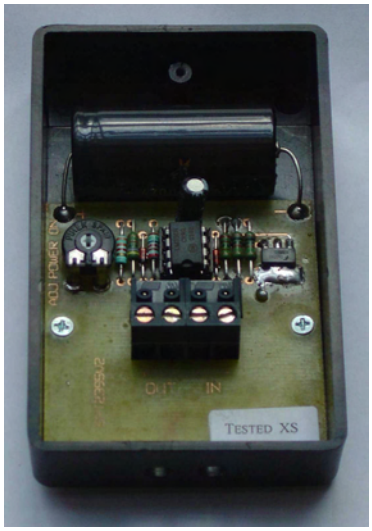
Electronic circuits are usually designed to operate on a fixed DC voltage whenever they are switched on, but this is not possible when the power supply is a PV panel, unless a charge controller and battery are also added to the system.

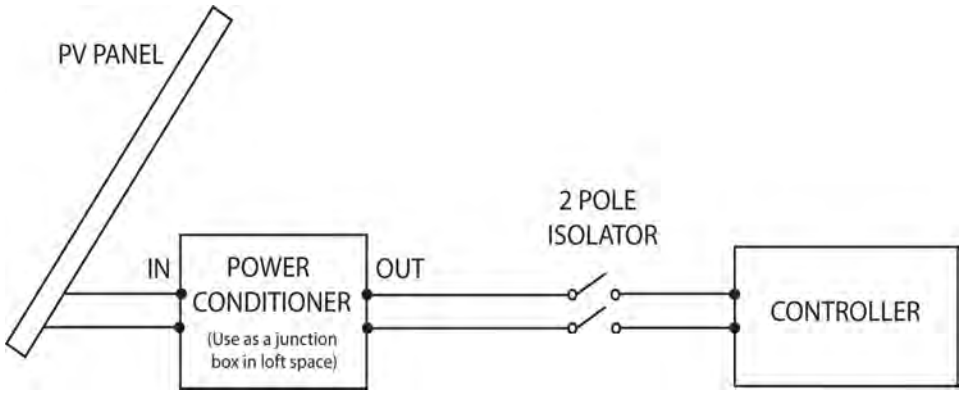
Instead the voltage and power available to the controller depends on the light level and time of day, falling to zero at night. Therefore a particularly difficult time for a PV powered electronic circuit is first thing in the morning when the controller is trying to power up at first light. Under these circumstances the controller can potentially malfunction, although turning it off and on again in brighter conditions will clear any such problem.

In order to minimise any such potential malfunction, Imagination Solar supply as standard a 'Power Conditioner', which ensures that the controller only receives power in 'good condition', suitable for reliably running the electronics. It does this by holding off power to the controller in the morning until slightly brighter sky conditions exist (around 10 W/m2, rather than 2 W/m2).

Installing the power conditioner does not require any additional work.

Simply use it to replace the terminal block in the loft when extending the PV cable, as shown in figure 1. The circuit has two pairs of terminals simply marked IN (from PV panel) and OUT (to the 2 pole isolation switch).

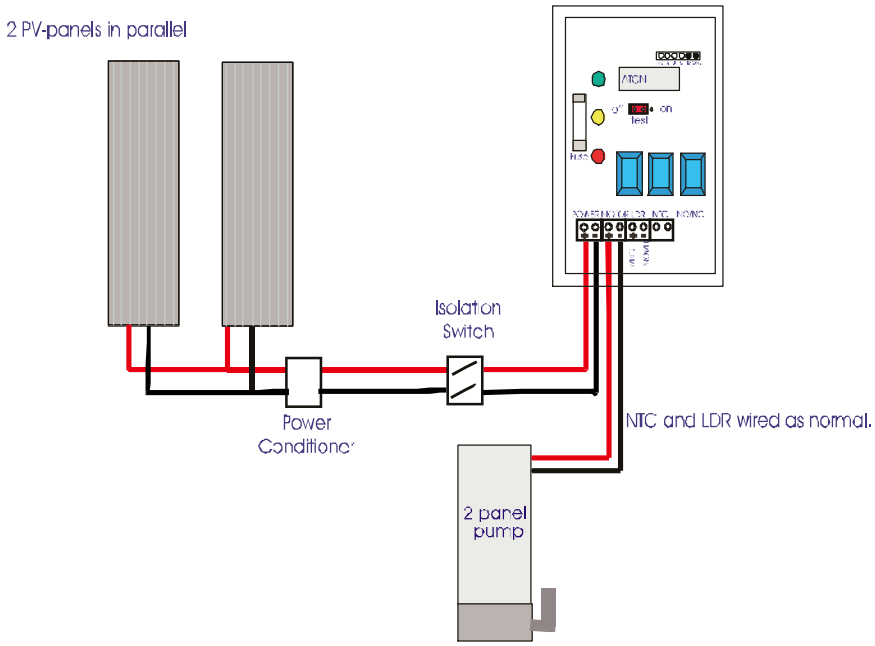




B5 Figure 1: wiring diagram for connecting P.V. panel to controller.

B 5.3 Providing Power for a Two Panel System

In the case of a two-panel system, twice the power is needed to pump the water through the system. However, no more than 24V should be supplied to the controller, hence power is supplied to the pump via two PV modules in parallel (see figure 2 below). No relay is required.



B5 Figure 2: Schematic details of the PV wiring for a two panel system.

N.B. A two-pole on/off switch suitable for DC (without neon light) should be fitted between the panel and the control unit.

B 5.4 Providing Power for a Multi Collector System

In the case of a three or four collector system, three or four times the power is needed to pump the water through the system. However, no more than 24V should be supplied to the controller, hence power is supplied to the pump via three or four PV modules in parallel. No relay is required when switching less than 1 Amp.

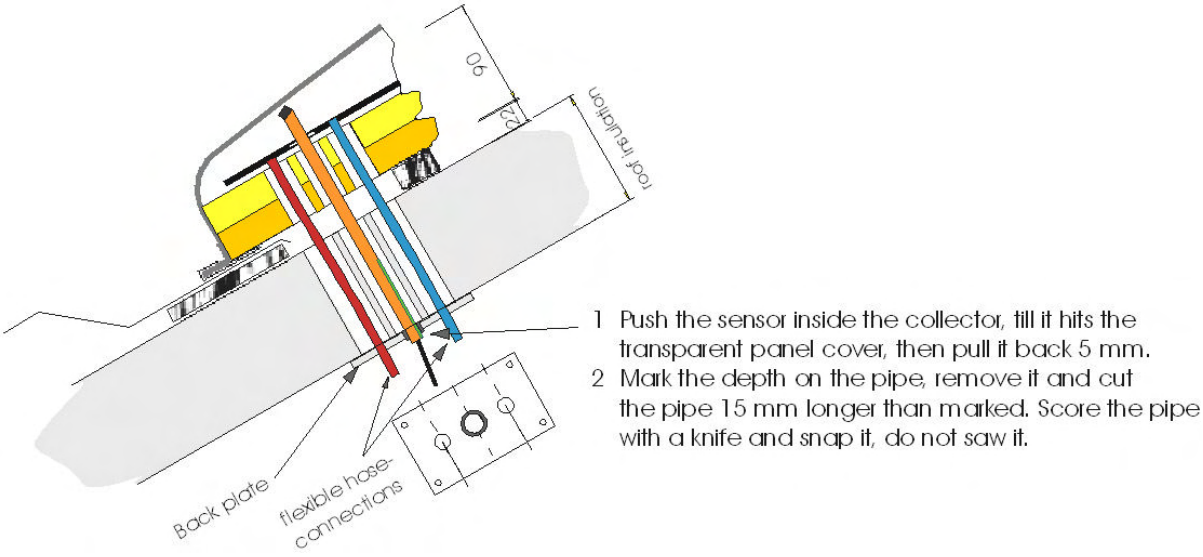
B 5.5 Installing the NTC Cylinder Temperature Sensor

Fully insert the NTC sensor into the temperature sensor pocket. This pocket is brazed into the cylinder already. Fix it in place by injecting silicon mastic into the pocket. Run the cable to the pump control unit and connect to terminals either way round (resistance device – no polarity).

NB. As a safety feature the system will not operate without the NTC connected, indicated by the green and yellow lights flashing.

B 5.6 Installing the Light Sensor

You should see two stainless steel flexi pipes coming through into the roof space, with red and blue stickers. Fit the backplate on the inside of the roof so that the pipes go through the two outer holes. You may need a batten of wood to support the plate if it is between two rafters. It is not sufficient to screw it only into the panel insulation.



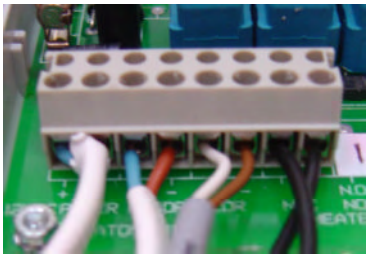
B5 Figure 3: Securing the light sensor inside the roof.

If roof access is available, ensure that the sensor can be seen from outside. Ensure it has not got stuck behind the collector surface or been obscured by debris such as insulation or roof felt.

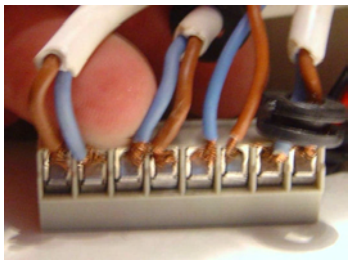
The cable from the light sensor to the control unit is usually run at the same time as the pipework and PV cable. The sensor wire can be clipped behind the insulation in the pipe clips or secured with cable clips. Use thin multistrand twin-core flex (e.g. 0.75mm^2) to extend the length using a junction box or power conditioner. It is essential to check polarity with a multimeter before connecting to the terminal block as reversed connections will cause the pump to run continuously. Ensure the cable is well secured at all points on its route. Do not use bell wire or other similar single strand cable as there is potential for this cable to break.

B 5.7 Wiring The Controller

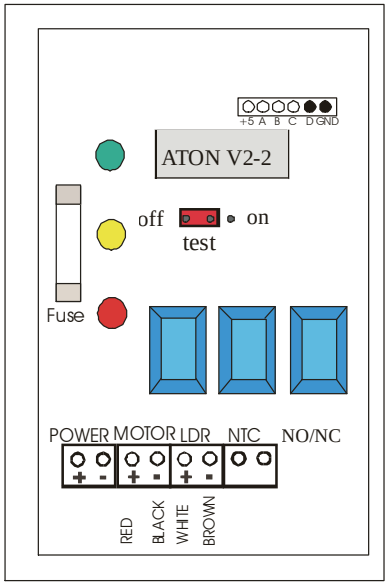
All wiring should be neat and tidy. Do not strip off too much insulation and avoid bare wire and stray fronds, which can cause short circuits.



Right!



Wrong!



B5 Figure 4: Schematic of Controller Unit. LDR = light sensor. NTC = cylinder sensor

1. Carefully lever off the snap-in terminal block, for ease of wiring.
2. Connect the PV power supply to the terminal block marked 'POWER', ensuring correct polarity with a multimeter. Unless it is a bright day a mains power supply should be used initially for testing and commissioning purposes before connecting the PV panel. If the green LED does not light up, check the polarity of the wiring.
   Disconnect the power supply and make the rest of the wiring connections.
3. Before fitting the light sensor, check the polarity of the sensor with a multimeter. The sensor will give around 0.55 volts on a sunny day and 0.4 volts at low light levels. If you are getting no voltage, take the sensor out of the panel and direct it at a light bulb to check it is not broken. Connect the light sensor to the terminal block, marked as LDR. If you connect the wires the wrong way around the pump will start but will not stop at low light levels.
4. Connect the temperature sensor to the terminal block marked with NTC. It does not matter about the polarity of this resistance-based sensor.
5. The pump is wired, red to positive, black to negative.
6. The terminal block is a snap-in, snap-out, for easy wiring and to check open circuit voltages. Always ensure it is firmly snapped in when tests are completed.
7. Wire in an hours run meter in parallel to the motor/pump terminals. This is usually done with a terminal block inside the DBU casing.

B 5.8 Testing and Commissioning the ATON Controller

1. Switch on the PV power supply. The green LED should come on in daylight.
2. If there is enough sunlight, the pump will start after about 4 minutes and the green LED will begin to flash, showing that the pump is on. The water level in the drain back bottle will go down, until the solar circuit has filled up.
3. If there is not sufficient sunlight to start the system, it can be tested by moving the test jumper to the "test on" position (see figure 4). Ignore any other jumpers on the circuit board. The pump will then start to run after about 4 minutes in good daylight.
4. For an instantaneous test (rather than waiting 4 minutes) put another jumper between the pins marked 'D' and 'GND' towards the top right hand side of the control box. This will override the time delay device and should start the pump running immediately.

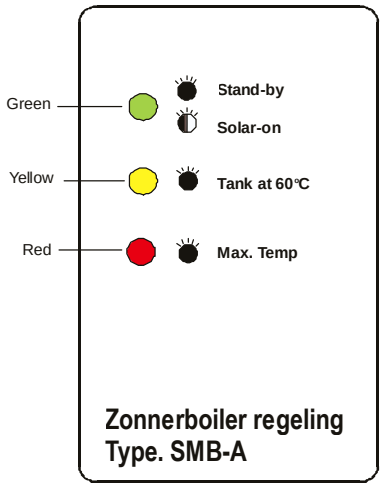
   Remember to put any jumper back to its original position when you finish commissioning the system.

5. Fill system as per section B2.8.
6. Assuming all is well, **move jumper out of test mode** ('test off' position).
7. If a bright day the system should now be working.

The following tests should be performed during the first few days of operation:

- On a sunny day check that the pump is running and hot water is circulating through the solar circuit.
- When it is dark check that the pump has switched off. See that the drain-back bottle is up to the originally marked level e.g. 60mm from the top.
- Record hours run which should correlate with bright/sunny hours.

N.B. Installers should always carry a mains adaptor for testing purposes. It is not possible to commission a PV-powered system under a low light level situation without a mains power supply.



B5 Figure 5: Controller Display

- If PV powered, the green power light will be on but the pump not running if there is less than 150W/m2 but there is daylight available.
- If there is enough sunlight the pump will start after 4 minutes and the green light will start flashing.
- When the hot water cylinder reaches 60°C the middle, yellow light will come on.
- If the cylinder reaches 80°C the red light will come on and the pump switch off.
- Alternatively there is the option of 65º max temperature microprocessor chip.

If the system does not appear to be working consult the fault-finding section (B5.12 - B5.18).

Features of the Controller

B5.9 Instantaneous Response

For testing and demonstration purposes it is often useful to bypass the built in four minute on/off time delay. This is achieved by adding a jumper across pins D and GND in the top right hand corner of the controller.

B5.10 Limit Maximum Collection Temperature

We can supply controllers that limit the temperature to 65°C or provide a replacement microprocessor 'chip'.

B5.11 Changing the Light Level Switch Point of the Controller

To trigger at lower or higher light levels (e.g. at a higher level with a long pipe run) change the 20,000 ohm resistor in the controller. Making this resistance smaller or larger will change the set point of the light levels. Contact ISL for details of how.

Fault Finding

B5.12 Green LED is off on a bright day

- Check the fuse of the controller. If blown please replace with a glass 800mA anti-surge (slow blow) fuse commonly available from an electrical spares retailer such as Maplins or RS.
- Check the connections to the controller
- Check voltage into and out of power conditioner

B5.13 Green LED does not flash when sunny

- Check light sensor is properly mounted in the solar collector.
- Measure the voltage over the sensor on the controller when it is connected:
  To switch on the pump it should be a minimum of approximately –1.0V in bright cloudy weather up to a maximum of approximately 0.45V measured when the weather is sunny.
- Disconnect light sensor cable from controller and check for open circuit voltage of 0.3-0.5V in daylight. If no voltage check for broken wiring and check sensor for damage. Replace sensor if no voltage from wires connected to sensor.

B5.14 Green light flickers, but the pump does not run

- Check for power to the pump:
  No power to pump - check wiring. If wiring is correct and continuity is proved replace controller.
  Power to pump - Replace pump.

B5.15 Green light flickers pump runs, but no water is circulating.

- Is there at least 12V to the pump?
  Yes - Clean filter. Check for blockages or constrictions in the solar pipe runs or solar coil.
  No - Check PV panel connections.

B5.16 Green, orange and red LED on continuously, but cylinder temperature is lower than 80°C (or 65ºc with lower temperature chip).

- Check terminal block is fully snapped in.
- Power down and re-power to see if it clears the fault.
- Disconnect the NTC from the controller. Are green, orange and red LED's still on continuously?
  Yes - Replace controller
  No - Check for water in NTC cylinder pocket. If none present replace NTC.

B5.17 Pump does not stop at very low light levels.

- Check test jumper is not in 'on' position
- Check polarity of light sensor (LDR) wiring.

Disconnect the wiring to the light sensor at the controller and measure the voltage produced in daylight, which should be between 0.3 and 0.55 Volts. If incorrect voltage – replace light sensor.

B5.18 Cylinder temperature too high? (over 90°C)

- Is the NTC cylinder temperature sensor mounted well in the cylinder pocket?
  No – Ensure NTC is secured in the pocket.
  Yes – Inspect NTC and replace.
- NTC is correct - replace controller.

Accessories

B5.19 Hours Run Meter

The hours run meter will record the total number of hours that the pump runs. This gives a measure of the time that a solar system has been generating hot water.
Not only does this provide a useful guide to performance but it also confirms the system is working properly.

The hours run meter should be fixed neatly to a wall or board near the drainback unit where it is visible. Simply wire in parallel to the pump.

B5.20 Digital Temperature Display

This is a very versatile panel mounted digital thermometer module for a conveniently visible indication of hot water cylinder temperature.

Specification:

- The digital temperature module has a 0.1C resolution LCD display reading
- The module is powered by a solar cell that charges a long-lasting rechargeable battery
- The unit can be directly wall mounted using the holes in the back of the casing

The module has an external probe fitted, which is 50mm long and 8mm diameter (6mm at the tip). The probe is supplied connected to 3m of cable. The external probe should be fixed in the same pocket as the NTC sensor. If it is necessary to extend the cable this should be done using the minimum possible length of cable as long runs causes a decrease in accuracy.

(Note that the accuracy of the meter may be unstable with long wires or cable different from that supplied with probe. Extending the cable would also void the warranty.)