Installation and Operating Guidance for Mk2 PV Routers

This document is primarily intended for use with pre-built systems that I have supplied for customers in the UK. All such systems will have been fully tested before despatch. For use overseas, local rules may apply.

With home-built systems, this material can only be offered as general guidance. The constructor is ultimately responsible for all aspects of their build.

The installation of a pre-built unit that I have supplied should be a very straightforward affair. As most Mk2 Routers are used to control a conventional 3kW immersion heater, these guide notes have been written on that basis. Please read through the whole of this document before starting the installation process.

If you are not sufficiently competent to do this work yourself, please seek assistance from a qualified electrician.

NB. The Mk2 Router relies on a working immersion heater and thermostat being available. After a long period of infrequent use, these components may not be in a reliable condition. In the absence of a working thermostat, a hot water tank can easily become over-heated. I would always recommended that the state of these components should be tested before a Mk2 Router is brought into service.

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To avoid risk of damage to the delicate wiring, it may be helpful to disconnect at least one end of the red/green control cable which runs between the two printed-circuit boards. When re-fitting this cable, the red core needs to be aligned with the '+' symbol at each end. Please do not disturb any of the other connections.

To gain access to the mounting holes for the enclosure, the four corner clips may need to be removed. This can be done using a pair of screwdrivers: one to gently lever the curved section away from the tube in which the clip is situated, the other to carefully ease it out. Please take care not to break these clips or allow them to 'ping' away into the distance.

After fixing the enclosure to the wall, two high-power electrical connections need to be made. A diagram showing these cables can be found on the Home page of my website at www.mk2pvrouter.co.uk

1. A permanently live 240V AC feed is required at the L, N and E elements of the 4-way connector block. To comply with IET regulations, this cable should be supplied directly from a Consumer Unit or fusebox rather than from a ring-main. This wiring should be protected by a suitably rated Circuit Breaker, and a 30mA RCD is normally provided as additional protection in the event of a fault.

2. An output cable to the load is required, its three cores being connected to the S/L, N and E elements of the 4-way connector block. This cable is normally a T&E solid-core type; flexible 3-core flex is only suitable for the final link to the immersion. To comply with IET regulations, a double-pole isolation switch should be installed close to the immersion. This is the point where the solid-core and flexible cables are normally joined. Once a Mk2 router has been installed, this isolation switch should be permanently 'on'.

When these electrical connections are in place, standard installation tests such as Continuity and Insulation Resistance can be performed. During these tests, it is important that the two mains switches on the unit are in the correct state:

- the round "mains" switch must be in the "off" position.
- the rectangular "constant" switch must be in the "on" position.

The round mains switch interrupts both the Line and the Neutral feeds. Only by having this switch in the "off" state will it be safe to apply the high DC voltage which forms part of the Insulation Resistance test.

The final electrical connection is for the current sensor. This is a Current Transformer, or CT, which needs to clip around one of the 'live' cores at the supply point adjacent to the meter. Either live core will do, the correct orientation will be determined later. The CT's lead can be lengthened if necessary by means of a M-F coaxial extension cable, or a section of 2-core cable can be inserted to provide the same effect. Only the 'tip' and 'screen' contacts are used, the 'ring' on the stereo plug of the CT is not connected. The plug end of the CT needs to be pushed firmly into the jack socket marked "current sensor".

Commissioning.

Before power is first applied to the unit, the "mains" and "constant" switches should both be in the "off" state.

If there is any doubt as to whether the premises is importing or exporting power from the mains, it may be helpful to bias the premises temporarily towards import by turning on a high-powered appliance such as a kettle. Then, when the Router is first powered up, its load should remain firmly off because no surplus power is available. If the load comes on instead, that means the CT has been fitted the wrong way around. This situation can be corrected by either reversing the direction of the CT or by clipping it to the other 'live' cable.

Assuming that no surplus power is available, the unit will start up in its idle mode. Once surplus power does become available, the unit will automatically start to divert power to the load. At this stage, the neon will illuminate whenever the load is 'on', and the display (if fitted) will change to '0000' and start counting up.

Output mode settings

The rate at which the load is cycled on/off can be adjusted by the "output mode" switch. When set to "normal", the on/off cycling rate will be as fast as is possible. When set to 'anti-flicker' or "AF", the rate of cycling will be as slow as a standard meter will allow. Although both modes will heat water just as effectively, the AF setting may be helpful to minimise any perceptible flicker of local mains lights.

If using the AF mode, it is important that the settings are configured appropriately for your supply meter. While the Router is actively diverting power, the LED in the supply meter should never go 'off' after being 'on', nor should it pulse. If the state of the meter's LED ever changes in this way (other than going 'on' after several minutes of being 'off'), then you are being charged. In this case, the Anti-flicker settings would need to be adjusted in the software. If this operation can't be done on-site, then the Router should only be used with the output mode switch in its "normal" setting.

Re-programming the software

If re-programming is to be undertaken, the appropriate Mk2 PV Router sketch will need to be obtained from the Downloads page of my website at www.mk2pvrouter.co.uk To maintain correct calibration, the default value of **powerCal_grid** (and **powerCal_diverted** if relevant) will need to be replaced by the correct value(s) for your individual hardware. Any relevant calibrations values will be shown on a label inside the enclosure.

Depending on the sketch that is in use, the AF parameter will be in one these forms:

float offsetOfEnergyThresholdsInAFmode = 0.1; // <-- must not exceed 0.5
const int postMidPointCrossingDelayForAF_cycles = 25; // in 20 ms counts

In both cases, the AF setting can be 'tightened' by reducing the value until there is no doubt that the system is working within the allowed range of the meter. Reducing the value by more than this amount will simply result in the system cycling more rapidly than is necessary

The display

If a display is fitted, it will show the surplus energy that has been diverted each day in kWh. In the absence of a real-time clock, the day is deemed to have ended when no surplus power has been detected for a period of ten hours. The display then returns to its idle state in readiness for the next day, and the previous value is discarded. On particularly poor days, the level of generation may never exceed consumption in which case the display will never leave its idle state which is a "walking dots" pattern.

The "constant" switch

This switch provides a manual over-ride facility so that water can be heated quickly at times when free power is not available. Other than during installation, this switch should normally be in the 'off' state.

Operating tips

To maximise the benefit of your router, it is best not to heat water in the morning by any other means. The DHW tank will then be able to accept the maximum amount of surplus energy that your PV inverter can provide. Once the temperature has reached its maximum setting and the thermostat has opened, the "Load On" neon will remain permanently illuminated because the load is no longer able to consume any power.

By using some hot water at appropriate times, the thermostat can often be encouraged to allow more power to be routed into the tank. To maximise the take-up of free energy, the thermostat is normally adjusted to its highest setting. If this is found to result in uncomfortably hot water at the taps, the thermostat's setting may need to be reduced.

During periods of minimal surplus power, it may be wise to heat the water periodically by some other means. This can be achieved by using the "constant" facility, or an external boiler if one is available.

The Mk2 PV Router is intended to be left on continuously. If the house is to be empty for extended periods, it may be best to turn the mains switch to "off".

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