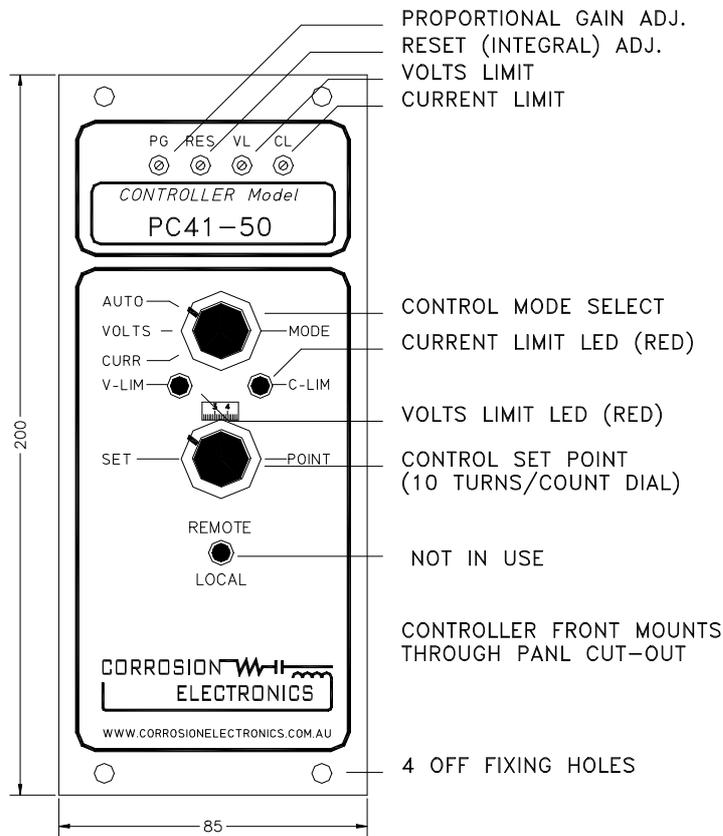


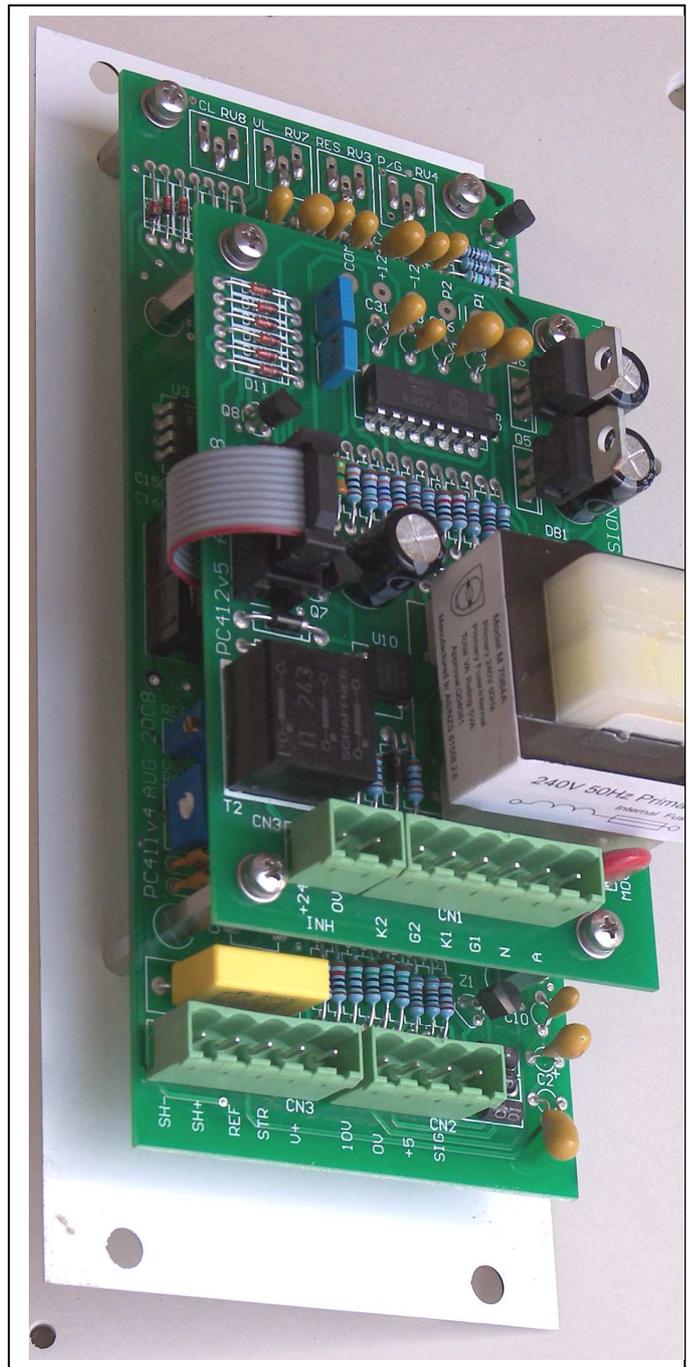
**PRODUCT SHEET**

**Model PC41  
PHASE ANGLE  
CONTROLLER**

- **COMPACT**
- **VERY MODULAR**
- **ULTRA RELIABLE**



**Model PC41  
Controller front panel**



**This module locates through a cutout in a front panel and is retained by 4 screws. All wiring at the rear of this module is plug/socket connected.**

- Easy to use
- Easy to replace in the field
- Three selectable modes of control, Voltage, current, reference potential.
- 10 turn control set point with turns counting dial

- Independent current and voltage limit set points with LED indicators
- Proportional gain and Reset potentiometers for optimising loop stability under any likely load condition.
- OPTIONAL (Specify if required) Remote control input. Requires 0-10V isolated signal. Switch on front panel selects REMOTE or LOCAL control.
- Control resolution 1 in 1000, ie, 5mA in 5 amps

## OPERATION

### 1. Initial start-up

- 1.1 Before energising the controller for the first time, a physical check of connected wiring should be made. It is possible that some wires may have become displaced during shipment. All plugs and sockets are matched in such a way that only the correct plug will fit into a particular socket.
- 1.2 It is wise to commence with zero output (set point fully anti-c/w) in current mode and local control selected.
- 1.3 Slowly wind the set point clockwise (C/W) while observing the output volts, output amps and structure to reference potential. Two scenarios are likely.
- (a) The desired structure to reference potential will establish instantly. This is typical of pipelines and well coated structures.
- (b) The reference potential may not shift enough initially and may require some hours, days or weeks to polarise.
- NOTE:** Different applications require particular polarising strategies, for example, concrete rebar protection which requires that the rebar must be progressively polarised over a 28 day period.
- 1.4 In the case of (a), discontinue increasing the output current when the desired reference potential is attained. At this point, it would be reasonable to set up AUTO reference control with current and voltage limits as detailed in step 2 & 3

In the case of (b), follow the **prescribed commissioning procedures** if the application is **concrete rebar protection**.

For **other bare steel** applications, the polarisation needs to be conservatively achieved without over-protection. This can be done in two ways,

(i) Select an appropriate current and voltage suitable for the anode material and **frequently** monitor the reference potential. Note that in constant current mode, the voltage will rise as the structure polarises. Conversely, if the control is set to voltage mode, the output voltage will remain constant and the current will reduce as the structure polarises.

(ii) Switch to AUTO control and adjust the set point to the desired potential. Set the current and voltage limits to an appropriate level. As the structure approaches the set potential, the current and voltage will automatically reduce to maintain the set potential. See step 2 & 3

## 2. Set Current & Voltage Limits

- 2.1 These limits are user set using a small screwdriver. The trimpots are labeled CL and VL and are located at the top of the controller front panel. If the current or voltage output exceeds these set points, the control is over-ridden to prevent the output exceeding the pre-set levels. These are important adjustments for the following reasons based on the following control modes.

### Voltage Control.

In constant voltage control, the current will change due to changes in the external loop resistance to maintain the output voltage at the set level. Some field conditions may cause the current to increase markedly which may cause over-protection. By setting the current limit to an appropriate value, the protection levels will be safe guarded.

### Current Control.

In constant current control, the voltage will change due to changes in the external loop resistance to maintain the output current at the set level. Some field conditions may cause the voltage to increase markedly which may exceed the maximum voltage rating of particular anodes. By setting the voltage limit to an appropriate value, the integrity of the anodes will be safe guarded.

### Auto Control.

In auto reference control, setting both limits is important for the same reasons. If the reference electrode fails or is damaged, the only protection against over-protection is to set both limits to a safe level, particularly the current limit.

- 2.2 The setting for the current limit can be adjusted as follows:

(i) Take note of the main set point position for whichever control mode is in play. Increase the output current by winding up the main set point to a current that produces the most negative structure / reference potential that you are prepared to tolerate.

(ii) This current value is the "limit point" at which the current limit should operate. Using a small screwdriver, turn the CL trimpot slowly anti-c/w until the current limit LED just energises at the established "limit point".

(iii) Restore the main set point to the originally noted position. The current limit has now been set to activate at the current which will hold the reference potential at the most negative structure / reference potential that you are prepared to tolerate.

**NOTE: For structures that are subject to severe telluric effects, it is common practice to allow the current to increase to a higher level to control the positive structure to soil shifts.**

### **NOTE:**

**The current limit should be fine tuned after the structure is fully polarised.**

- 2.3 Similarly, the voltage limit can be set the same way. The voltage limit setting will be based on the maximum allowable voltage for the anodes being used and the need

to cater for very changeable soil or water resistivities. It may not be possible to wind up the voltage to the set point level because of a very low DC loop resistance. In this event, switch the control mode to voltage control, turn the main set point to zero, then disconnect the +ve anode cable. **Very slowly** wind up the output volts to the desired trip level then adjust the VL trimpot anti-clockwise until the VL LED just energises. Restore the control mode as required.

### 3. Set Auto Reference Control

3.1 The main set point calibrated dial is 10 turns for a 5 volt set point range which represent 0.5V per turn.

Fully anti-c/w represents +1V structure to reference and fully clockwise represents -4V structure to reference. The following table shows the reference set point Vs number of turns. NOTE: These voltages are nominal but they should be within +/- 0.1 volt

| Reference Set Point   | Calibrated Dial Setting |
|-----------------------|-------------------------|
| <b>+1.0 V Str/Ref</b> | <b>0.00</b>             |
| <b>+0.5V Str/Ref</b>  | <b>1.00</b>             |
| <b>0.0V Str/Ref</b>   | <b>2.00</b>             |
| <b>-0.5V Str/Ref</b>  | <b>3.00</b>             |
| <b>-1.0V Str/Ref</b>  | <b>4.00</b>             |
| <b>-1.1V</b>          | <b>4.20</b>             |
| <b>-1.2V</b>          | <b>4.40</b>             |
| <b>-1.25V</b>         | <b>4.50</b>             |
| <b>-1.3V</b>          | <b>4.60</b>             |
| <b>-1.4V</b>          | <b>4.80</b>             |
| <b>-1.5V Str/Ref</b>  | <b>5.00</b>             |
| <b>-2.0V Str/Ref</b>  | <b>6.00</b>             |
| <b>-2.5V Str/Ref</b>  | <b>7.00</b>             |
| <b>-3.0V Str/Ref</b>  | <b>8.00</b>             |
| <b>-3.5V Str/Ref</b>  | <b>9.00</b>             |
| <b>-4.0V Str/Ref</b>  | <b>10.00</b>            |

3.2 Set up AUTO Reference control as follows:

- (i) Wind the set point down to zero amps and volts
- (ii) Switch to AUTO mode
- (iii) Slowly increase the set point while observing the current and reference potential. In circumstances described as in 1.3 (a), the desired reference potential will instantly establish.

In circumstances described as in 1.3 (b), the potential set point can be adjusted using the chart above. It is normal in this case for the current to turn fully on and invoke the current limit. Adjust the voltage and current limits down to an acceptable value.

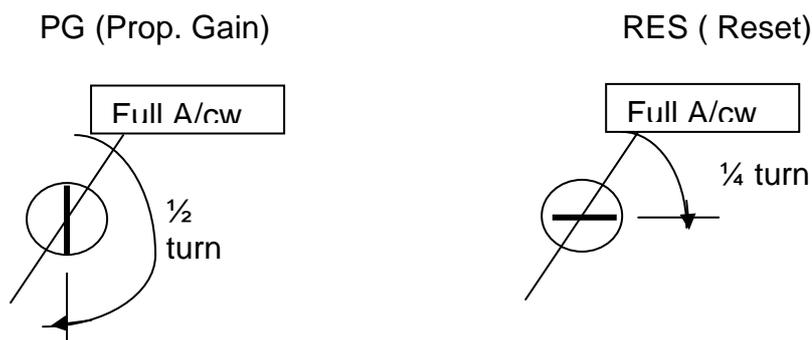
- (iv) As the structure potential approaches the set point, the current and voltage will automatically reduce and come out of the limited state.
- (v) Finally, re-adjust the set point based on "instant off" potentials and when the structure is finally polarised, fine tune the voltage and current limits

#### 4. Proportional Gain and Integral

These two settings are designed to promote control loop stability which may be necessary depending on field conditions. Typical examples of the need to adjust these two trimpots are:

- DC output hunting due to interaction with other units in the same environment.
- DC output unstable due to very low field resistance, ie, low volts / high current.
- Output overshoots on resumption after interruption

The settings for the PG and RES which suits most applications is as follows:



The RES adjustment controls the speed of response to a step change of output. Fully anti-c/w is the fastest and most likely to be unstable

The PG adjustment controls the amount the output has to change before the control loop responds. Fully anti-c/w is the lowest gain and the most stable. Fully clockwise produces a very sensitive control response but it is likely to be very unstable.

Generally, we recommend the RES adjustment to be 1/4 turn back from fully anti-c/w and the PG to the fastest position that will produce a stable output. It may be necessary to finely trim the PG to produce a clean restart without overshoot after interruption.

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