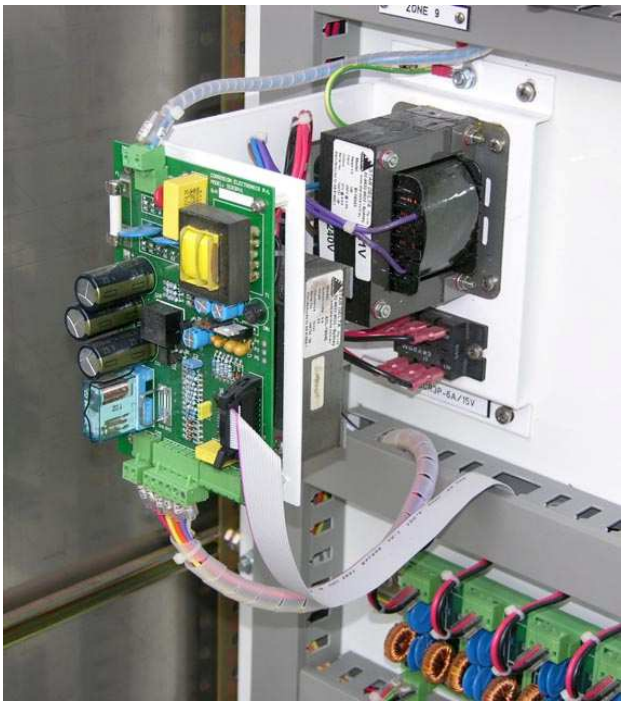
DATA SHEET

Model PC42 PHASE ANGLE CONTROLLER

CORROSION ELECTRONICS PTY.LTD.
A.B.N. 47 105 844 728

NEW IMPROVED DESIGN for CONCRETE CP

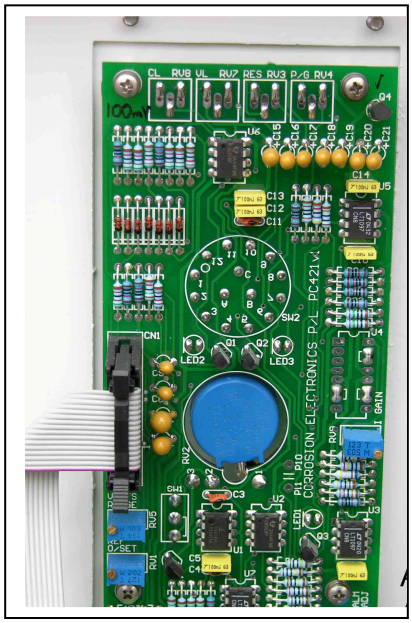
- ***COMPACT***
- ***VERY MODULAR***
- ***ULTRA RELIABLE***



- ***UP TO 6 AMPS, 20V***

User controls at front panel

DCR3P sub-assembly---Rear pan
Ribbon cable connects to front panel controls
Module bolts to rear pan with 4 screws and all wiring is plug and socket connected



Rear view behind panel

MAIN FEATURES and OPTIONS

PC42 Front Panel Controls.

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
- Green “low current alarm” LED which is user settable at any current from zero to full output. This LED is normally energised
- Proportional gain and Integral 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.

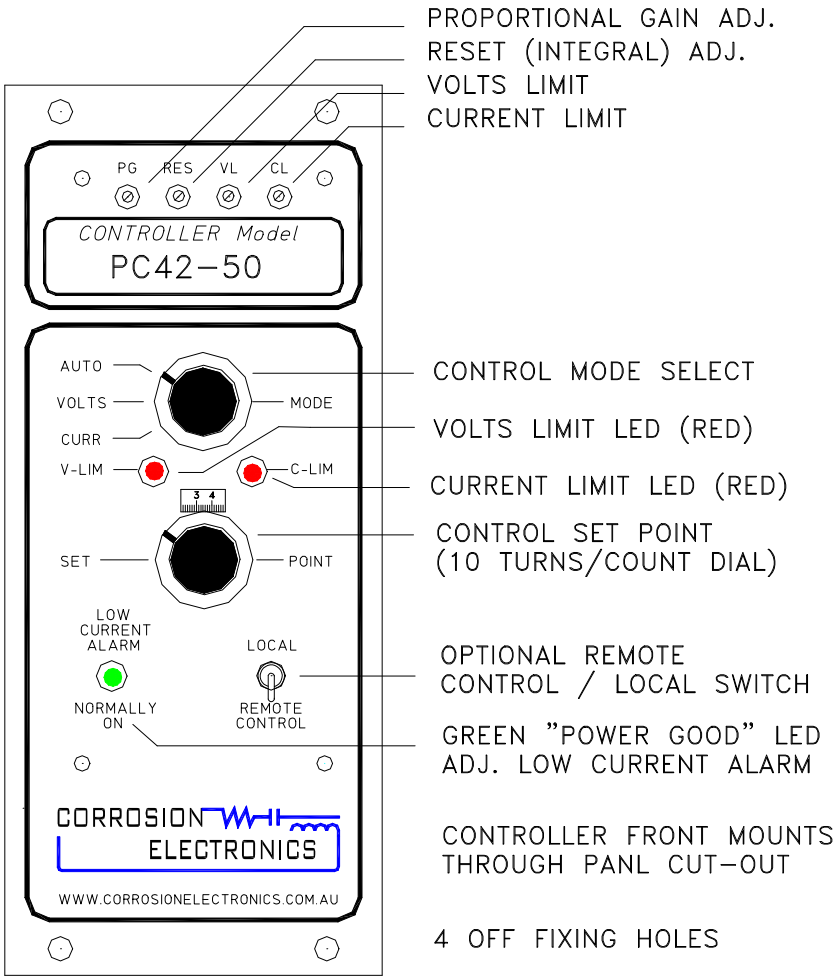
DCR3P Sub Assembly

This module surface mounts on a rear pan with 4 screws. All wiring is plug/socket connected.

- Transformer and filter choke
- SCR / diode controlled bridge rated 28A / 600PIV
- Printed circuit board. All inputs / outputs plug/socket connected to facilitate maintenance should it be necessary.
- Interrupt relay. This relay open circuits the output if mains power is lost.
- MOV surge suppression for rectifier devices
- On board Transformer secondary FUSE and DC OUTPUT fuse
- Output ripple is typically < 2%
- Slow start on Power-up
- Telemetry terminals for Remote control input, current, voltage and reference potential output

- Structure / reference control input impedance >100 megohm to prevent loading the reference cell under dry conditions.
- Control resolution 1 in 5000, ie, 1mA in 5 amps

Model PC42
Controller front panel



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 stuctures.

(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
+1.0 V Str/Ref	**0.00**
+0.5V Str/Ref	**1.00**
0.0V Str/Ref	**2.00**
-0.5V Str/Ref	**3.00**
-1.0V Str/Ref	**4.00**
-1.1V	**4.20**
-1.2V	**4.40**
-1.25V	**4.50**
-1.3V	**4.60**
-1.4V	**4.80**
-1.5V Str/Ref	**5.00**
-2.0V Str/Ref	**6.00**
-2.5V Str/Ref	**7.00**
-3.0V Str/Ref	**8.00**
-3.5V Str/Ref	**9.00**
-4.0V Str/Ref	**10.00**

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. Low Current Alarm Indicator

The low current alarm green LED should normally be energised while ever the output current is higher than the alarm set point. This LED is essentially a “DC Power Good” indicator. The set point is nominally set at the factory at 15% of rated output. This setting may suit most applications.

4.1 If necessary, set the low current alarm level as follows: This will involve adjusting a small trimpot at the rear of the front panel controls. **Refer picture on front page.**

(i) Decide at what level the low current alarm should be
(ii) Turn the output down to that level
(iii) Adjust the trimpot at the rear with a very small blade screwdriver. Turn the screw c/w until the green LED on the front energises. Slowly turn the screw anti-c/w until the green LED just de-energises. This represents the low current alarm point.

5. Fuses

The DCR3P sub-assembly on the rear pan has two (2) 3AG ceramic fuses. They are labeled:
F1 RECTIFIER FUSE 3AG These are quick blow fuses

F2 DC FUSE 3AG These are anti-surge fuses
They can both be checked with an ohm meter in situ. They should read <0.5ohm

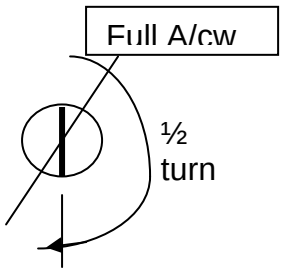
6. Proportional Gain and Integral

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:

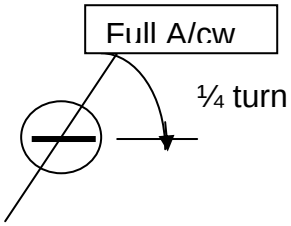
- DC output hunting due to interaction with other units in the same environment.
- DC output unstable due to very low field resistance, ie, low volts / high current.
- Output overshoots on resumption after interruption

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

PG (Prop. Gain)



RES (Reset)



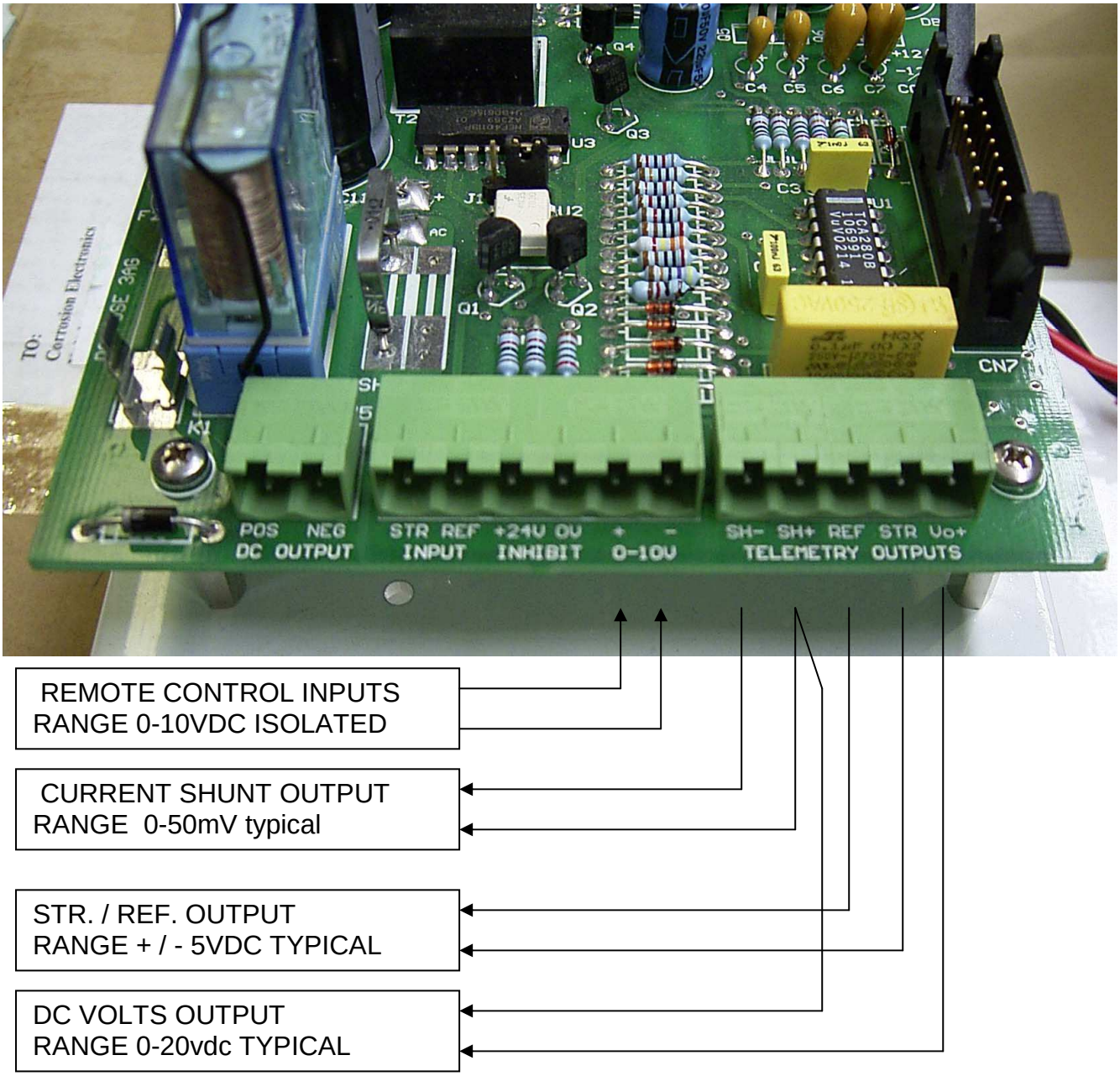
The RES adjustment controls the speed of response to a step change of output. Fully anti-c/w is the fastest and most likely to be unstable

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 ¼ 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.

7. Remote monitoring and control

The Telemetry inputs / outputs are located at the bottom of the DCR3P circuit board. The connections are via plug and socket. Refer following photograph.



Remote Control

The Remote control input must be galvanically isolated from the circuit it feeds into and from other 0-10V inputs.

The switch on the PC42 control panel selects Local or Remote control

The 0-10V control simply switches in to replace the PC42 set point potentiometer for whichever control mode is selected.

Remote Monitoring

The Remote monitoring channel inputs should be isolated from each other, preferably with a dielectric rating greater than +/- 300V

Input impedance for the Current and Volts channels is not a problem but the structure / reference input impedance should be >100 megohms, preferably 1000 megohms.

20 megohms should be considered as a minimum for concrete and even then, some references may be loaded adversely with significant reading errors.

The Telemetry outputs as shown above are not factored in any way. They are directly representing the output current, volts and structure to reference potential.

Remote Interrupt

The Telemetry system should have a clean changeover relay contact to allow interfacing to the Transformer Rectifier Interrupt circuit. It is normal for the Relay contacts to be rated at least 2A / 30VDC

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