ENERPRO

# 3-Phase Regulator Packages

## For Phase-Controlled Converters and Controllers

Simplify controller and converter applications

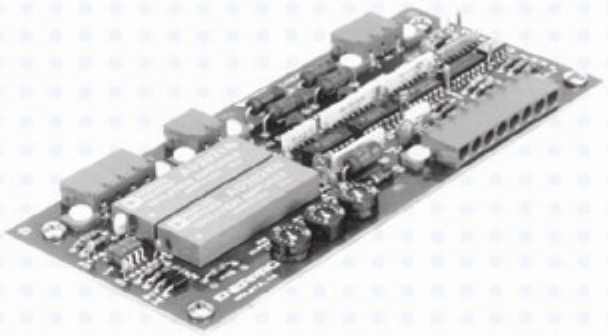
Used as current-limited AC motor starters

Regulate current in AC controllers

Control voltage/current with two voltage/current limits for battery chargers

Offered as firing/regulator board packages

Isolate voltage and current feedback signals



Since 1983, Enerpro has been a leading manufacturer of thyristor firing packages. This experience, coupled with our continuing drive to meet the design needs of OEMs, has lead to the development of several regulators designed to simplify your controller and converter applications.

The Enerpro family of regulators is designed to operate with and obtain power from Enerpro firing boards. Therefore, the regulators are sized to provide easy mounting above their associated firing board. This board arrangement eases maintenance and minimizes the package footprint.

Our regulators are designed to provide the range of functions typically required in controller and converter applications. These functions are outlined in the following text and are also summarized in a quick reference chart.

### Features and Applications

- The CR400 board is used as a current-limited AC motor starter.
- The CTRCT-1 and CTRCT-2 boards regulate current in AC controllers.
- The CVCI-1 allows for battery charger profile control.
- The EA6-1, normally mounted on a firing board, provides proportional and integral voltage or current regulation.
- The ISOVLCL-1 and ISOVLCL-2 boards isolate voltage and current feedback signals.
- The MVC-1 regulator holds the converter output constant in weak electrical grid areas.
- The PRVLCL-1 adds proportional and integral power regulation to the comparable ISOVLCL-1 board.
- The VRCL3P-1 regulator provides an outer proportional plus integral voltage loop with an inner current loop.

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# 3-Phase Regulator Packages

## Product Descriptions

### CR400

The CR400 is normally used as a current-limited AC motor starter by sensing the motor current with customer-provided current transformers. The CTs are configured in a wye and then connected to the CR400. The 3ø feedback signal on the CR400 is then rectified into a floating DC current feedback signal. This feedback signal is connected in polarity opposition to a current command from an on-board potentiometer to form the SCR gate delay angle command input to the firing board.

The CT rectifier burden resistor value is selected to give a feedback signal level of about 10 Vdc with a typical current command of 13 Vdc. This 3 Vdc difference establishes the proper gate delay angle for current-limited operation during the start mode.

When the motor reaches its normal operating speed, the current drops to about 40% of starting current which in turn drops the feedback signal from 10 to 4 Vdc, causing the delay command to increase from 3 to 9 Vdc. A zener diode on the CR400 board limits the actual level of the delay command to 6.2 Vdc, which is sufficient to provide maximum output from the controller.

### CTRCT-1

The CTRCT-1 board is designed to regulate the current in an AC controller and provide an overcurrent trip feature which will latch off the output. This latch can be configured for automatic or manual reset.

The CTRCT-1 board accepts CT output signals, and rectifies them in a 3ø bridge. This feedback signal is then dropped across a burden resistor to generate a dc voltage signal proportional to the current. A 15 V zener diode protects the circuitry against extra-ordinary high current, as in a short circuit.

The CTRCT-1 board allows the customer to customize the setup to coincide with a particular application. By adjusting the bias and span potentiometers located on board in conjunction with a voltage or current command signal, the customer can determine the minimum and maximum output of the controller as required by custom applications.

As an option, the CTRCT-1 board will operate as a current limiter with an overcurrent trip. This mode is useful in applications such as motor starters where direct control is not normally required.

### CTRCT-2

An expanded version of the CTRCT-1, the CTRCT-2 enables the customer to provide two command inputs which allows for automatic switching from the current-limiting operation to the current-regulated operation. In addition, the CTRCT-2 adds the ability to control the ramp time of the soft-start feature. Drivers for remote board status indicators are also provided.

In an alternate configuration, voltage limit and voltage regulation can be provided, while maintaining the current trip feature. This configuration is normally used for transformer primary control since it allows you to maintain the desired voltage while providing a short circuit shut-down feature.

### CVCI-1

Generally used in battery charger applications, the CVCI-1 provides two voltage limits, two current limits, a voltage trip, and a current trip. The ability to control current and voltage with two limits enables the customer to control the battery charge profile from a microcomputer in the form of TTL signals.

### EA6-1

Designed to mount "piggy-back" style above the firing board, the EA6-1 provides proportional and integral regulation, an inhibit inverter, and an on-board bias adjustment to assist in scaling the command signal voltage.

The EA6-1 board compares the command and feedback signals and generates an error command. This error command is then output to the firing board as E', and used to control the gate delay angle.

### ISOVLCL-1

Our most popular regulator, the ISOVLCL-1 provides the following functions:

- **Isolation of the voltage and current feedback signals.**
- **Load current limiting, or**
- **Load voltage limiting.**
- **Automatic crossover between current and voltage limiting.**
- **Overcurrent trip with automatic reset.**
- **Soft-start.**
- **Absolute value functions for the current and voltage feedback signals.**
- **Load voltage readout signal.**
- **Load current readout signal.**

Current and voltage feedback are from customer-provided 0-50 mVdc current shunt and 0-4 Vdc attenuator respectively. Other feedback levels can also be accommodated. The current and voltage feedback signals are galvanically isolated from the regulator board circuitry by Analog Devices Model AD202KN Isolation Amplifiers. The rated isolation voltage is 2000 V-peak.

Current and voltage feedback signals are processed by precision rectifier circuits to avoid positive feedback and to permit operation with polarity reversing loads.

Current and voltage command signals can be derived from board-mounted potentiometers, or can be obtained from external sources.

The soft-start circuit ramps the gate delay command voltage input to the firing board up to the preset level in approximately 2 secs. Other soft-start times can be specified.

A board-mounted potentiometer sets the current trip level. The current trip resets the soft-start circuit and its response time to an overcurrent event is approximately 3 msecs. If the overcurrent condition persists, the current trip cycles on and off.

### ISOVLCL-2

In addition to the features available on the ISOVLCL-1, the ISOVLCL-2 increases flexibility by providing the following:

- **Over-voltage trip.**
- **Proportional plus integral* voltage regulation.**
- **Adjustable soft-start time.**
- **Trip latches* for voltage and current trips.**
- **Remote status drivers.**

* This feature can be disabled

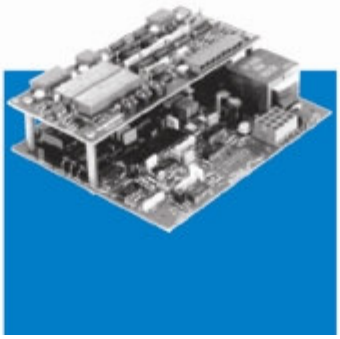

**Figure 2**
*The CVR600 Firing/Regulator assembly shown here comprises the FCOG6100 SCR Firing Board and the ISOVLCL-1 Regulator Board.*

### MVC-1

The MVC-1 circuit board operates in a feed-forward circuit to hold the converter output approximately constant in response to mains voltage dips. This is particularly useful in areas with a weak electrical grid.

### PRVLCL-1

Comparable to the ISOVLCL-1, this highly specialized regulator adds proportional plus integral power regulation. This enables the OEM to charge a battery based upon an actual power command while maintaining both current and voltage limits.

### VRCL3P-1

The VRCL3P-1 provides an outer proportional plus integral voltage loop with an inner current loop. In addition, the regulator provides adjustable start and stop times and a 0 to 5 Vdc current output.

This board is designed to operate with a 0 to 2 Vdc voltage feedback and a 50 mVdc current feedback. The current loop can also be configured for operation with a 0.5 Vdc feedback signal.

The regulator is in the voltage regulation mode when the load current is less than the commanded current. And when the load current is greater than the commanded current, the regulator is in the current-limit mode.

The current-command signal is provided by the customer and is a 0 to 12 Vdc signal. The voltage command can be obtained from a customer-supplied 0 to 5 Vdc signal or from the on-board span potentiometer. The bias and span potentiometers are used to adjust the operation range of the controller package to the individual application.

### Additional Information

Applications assistance and additional technical information are available. Please contact our Applications Department, Monday through Friday, 7 a.m. to 4 p.m., PST.

## Quick Reference Table

| | | CR400 | CTRCT-1 | CTRCT-2 | CVCH-1 | EAS-1 | ISOVLCL-1 | ISOVLCL-2 | MVC-1 | PRVLCL-1 | VRCLSP-1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Envelope (inches) | Height | 2.75 | 3.30 | 3.30 | 3.30 | 1.44 | 3.30 | 6.00 | 3.30 | 3.30 | 6.00 |
| | Width | 2.50 | 7.50 | 7.50 | 7.50 | 1.91 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 |
| | Depth | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Mounting Pattern (inches) | Height | 2.375 | 2.50 | 2.50 | 2.50 | N/A | 2.50 | 5.00 | 2.50 | 2.50 | 5.00 |
| | Width | 2.125 | 6.75 | 6.75 | 6.75 | N/A | 6.75 | 6.75 | 6.75 | 6.75 | 6.75 |
| | Diameter | 0.19 | 0.19 | 0.19 | 0.19 | 0.144 | 0.19 | 0.19 | 0.19 | 0.19 | 0.19 |
| Stackable | | | √ | √ | √ | P | √ | √ | √ | √ | √ |
| Current | Limit | √ | O | √ | √ | | √ | √ | | √ | √ |
| | Regulation | | √ | √ | | O | | | | | |
| | Trip | | √ | √ | √ | | √ | √ | | √ | |
| Voltage | Limit | | | O | √ | | √ | √ | | √ | |
| | Regulation | | | O | | √ | | | | | √ |
| | Trip | | | | √ | | | √ | | | |
| Power Regulation | | | | | | | | | | √ | |
| On-Board Indication | Limit | | √ | √ | √ | | | √ | | | |
| | Trip | | √ | √ | √ | | √ | √ | | √ | |
| External Indication | Limit | | | √ | | | | √ | | | |
| | Trip | | | √ | | | | √ | | | |
| Feedback Isolation | | CT | CT | CT | | | √ | √ | | √ | |
| Trip Latch | | | √ | √ | | | | √ | | | |
| FCOG6100 | | √ | √ | √ | √ | √ | √ | √ | √ | | √ |
| FCOG6101 | | √ | √ | √ | √ | √ | √ | √ | √ | | √ |
| FCOV6100 | | √ | √ | √ | √ | | √ | √ | | √ | |

√ Yes
O Optional configuration
CT Isolation provided by current transformers (customer-provided)
P Plug-in

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