

# FCRO4100



## Features:

Industry Standard  
ASIC-Based Design

Fully Connectorized

Independently  
Configurable  
Soft-Start and  
Soft-Stop

Isolated Gate Drive  
Circuitry

Power-On Reset  
Protection

Low Signal Inhibit

## Applications:

Four-SCR  
Bridge Rectifiers

SCR/Diode Bridge  
Rectifiers

Anti-Parallel SCR  
Controllers

Reversing Single  
Phase Rectifiers

Generator Field  
Rectifier

Process Heating  
Control

## FCRO4100 Standard Single-Phase FourSCR Firing Board

### Description

The FCRO4100 provides phase-angle control of single-phase SCR AC controllers, center tapped rectifiers, and two- or four-quadrant bridge rectifiers for a wide variety of power control applications. The board features four isolated gate drives, independently configurable soft start/soft stop control inputs, and an analog delay angle command input configurable for a variety of common voltage or current ranges. Optional plug-in regulator boards provide regulation functionality ( VRCL1P -1 board) or timed polarity transition inhibit for four-quadrant rectifier applications ( PTIR-1 board).



### Operational Features

**Analog Delay Angle Command Signal (SIG HI):** Users may choose a variety of DC control signal ranges including 0-5 V, 4-20 mA, or custom ranges.

**Soft-Start and Soft-Stop:** Upon soft-start, SCR firing is enabled and the delay angle command ramps from the maximum value to the setpoint value determined by the SIG HI command signal. Upon soft-stop, the delay angle ramps from the setpoint value to the maximum value after which SCR firing is inhibited.

**Instant Enable and Inhibit:** A contact closure (relay, switch, transistor) instantly enables or inhibits SCR firing at the delay angle commensurate with the SIG HI command signal.

**50/60 Hz Frequency Selection:** Operation from 50 or 60 Hz mains may be selected via an onboard jumper.

**High Current Picket Fence Gate Drive:** The transformer-isolated gate drive circuits provide a hard firing initial 15 V open circuit/1.5 A short circuit firing pulse followed by sustaining "back porch" pulses at 7 V open circuit/0.5 A short circuit. The gate pulse burst frequency is 256 times the mains voltage frequency.

**Power-On Reset:** A special circuit prevents unintentional SCR gating upon board power-up.

### Analog Delay Determinator Circuit:

Enerpro's gate delay determinator circuit is based on an analog PLL circuit and implemented with a proprietary ASIC. This circuit adjusts the gate delay firing angle in negative proportion to the SIG HI delay angle command signal.

**Plug-In Regulator Boards :** Two plug-in regulator boards are available for the FCRO4100 . The VRCL1P -1 board provides voltage regulation and current limit functionality. The PTIR-1 board provides voltage regulation and allows the user to program a specific dead time between switching polarity of an 8- SCR bridge rectifier.

**Simple Control Power Connection:** The FCRO4100 derives its control power from the same ac source controlled by the SCRs. An onboard transformer steps down 120, 240, or 480 Vac mains and also provides the phase reference signal for the firing circuit.

**Board Construction:** All circuit boards are assembled at the Enerpro plant in Goleta, California and are manufactured by a UL-approved fabricator from 2.4 mm thick FR4 fire resistant fiberglass epoxy laminate. All boards are conformal coated (MIL-1-46058, Type UR).

**Enerpro applications engineers are available by e-mail or fax for applications assistance.**

Product Datasheet	
Maximum Ratings	
AC mains voltage	480 Vac
Pulse transformer hipot	3500 Vac (60 seconds)
Operating temperature range	-5 C to 85 C
Board ac supply voltage	28 Vac (24 Vac nominal)
12 V regulator output current	20 mA (Note 1)
5 V reference output current	5 mA (Note 1)
Auxiliary control power available from 24 Vac and 30 V outputs	2 W
Delay angle range	$10^\circ \leq \alpha \leq 170^\circ$
Characteristics	
Delay angle command signal (SIG HI)	0-5 V, 4-20 or 0-20 mA Adjustable with SPAN/BIAS pots
Control signal isolation from ground	Galvanic isolation provided by pulse transformers and control power transformer
Gate delay steady-state transfer function	Delay angle inversely proportional to delay angle command SIG HI
Gate delay dynamic transfer function bandwidth	-3 dB at 67 Hz, phase shift -45° at 57 Hz
Gate drive phase balance	±1° (max)
Delay angle variance	$\Delta(\alpha)/\Delta(f) = 1.5^\circ/\text{Hz}$ 50/60 Hz compensation via J3
Lock acquisition time	30 ms (typ)
Soft-start/stop time	0.05 - 20.0 s, independently configurable
Low SIG HI inhibit	Firing inhibited when SIG HI less than 0.49 V; remove D6 to defeat.
Power-on inhibit	Automatic
Instant/soft inhibit/enable inputs	Dry contact
Gate pulse burst frequency	256 times line frequency
Initial gate pulse open circuit voltage	15 V (Note 1)
Sustaining gate pulse open circuit voltage	7.0 V (Note 1)
Peak gate drive short circuit current	1.5 A (Notes 1, 2)
Sustaining gate drive short circuit current	0.5 A (Notes 1, 2)
Short-circuit gate drive current rise time	1.0 A/μs (Notes 1, 2)
Board dimensions	191 x 152 x 35 mm (L x W x D)
Minimum creepage distance to ac mains	13 mm
Conformal Coating	per MIL-1-46058, Type UR
<b>NOTES</b>	
1 Assumes nominal 30 V control power is applied to board	
2 Assumes a purely resistive gate load of 1.0 Ω	

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Ordering Guide		
Parameter	Description	Code
SCR Circuit Arrangement	<i>AC Controller</i>	
	1	2-SCR AC Controller
	<i>Two-Quadrant Converters</i>	
	2	2-SCR Center Tapped Rectifier
	3	4-SCR Bridge Rectifier
	<i>Four-Quadrant Converters</i>	
	4	4-SCR Center Tapped Rectifier
Mains Frequency	50	50 Hz
	60	60 Hz
	50/60	50 or 60 Hz
	XX	Specify (Note 3)
SCR Mains Voltage	XX	Specify as mains voltage/10 (e.g.: 480 V/10 = 48)
On-Board Transformer Primary Voltage	0	Omit (Note 4)
	1	120 Vac
	2	240 Vac
	3	480 Vac
	9	Other
Regulator Circuit	0	None
	1	Current
	2	Voltage
	3	Voltage and Current (Note 5)
9	Other	
<b>NOTES</b>		
1 Auxiliary firing board required for 8- SCR circuits.		
2 PTIR-1 Polarity Transition Inhibit Board required.		
3 Specify code as mains frequency divided by 10. Example: 400Hz / 10 = 40		
4 Customer must supply 24 Vac or 30VDC for board control power		
5 Additional regulator board required.		