

FCOG6100

Features:

Industry Standard
ASIC-Based Design

Fully Connectorized

Independently
Configurable
Soft-Start and
Soft-Stop

Isolated Gate Drive
Circuitry

Phase Loss and
Power-On Reset
Protection

Applications:

Plating Rectifiers

Battery Chargers

Wind Turbine
Controllers

DC Drives

Semiconverters

UPS Systems

Transformer
Primary
Controllers

ENERPRO®

FCOG6100 Standard Three-Phase SixSCR Firing Board

Description

The FCOG6100 provides economical and reliable phase-angle control of SCR AC controllers and DC converters operated from three-phase mains. The board features six 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. A variety of current and voltage regulator boards are available in addition to auxiliary firing boards for remote or parallel SCR arrangements.

Operational Features

Analog Delay Angle Command Signal (SIG HI): Users may choose a variety of DC control signal ranges including 0-5 V, 0-10 V, 4-20 mA, or custom ranges.

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

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.

Phase Loss Inhibit: A phase loss circuit instantly inhibits SCR firing if a loss of one or more phases or gross phase imbalance is sensed on the AC line. Firing will soft-start when such a fault is cleared.

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

Phase Sequence Insensitivity: SCR gating is unaffected by mains voltage phase sequence.

Enhanced Frequency Insensitivity: A new compensation circuit reduces delay angle variance with respect to frequency. The gate drive angle decreases approximately



5° for a frequency change from 60 to 50 Hz, whereas the delay angle of previous configurations decreased 12.5° over the same frequency range.

High Current Picket Fence Gate Drive: The transformer-isolated gate drive circuits provide a hard firing initial 15 V open circuit/1.8 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 384 times the mains voltage frequency.

Analog Delay Determinator Circuit: Enerpro's gate delay determinator circuit is based on the Ainsworth three-phase PLL circuit and implemented with a proprietary ASIC. This circuit adjusts the gate delay firing angle in negative proportion to the SIG HI command. Gate drive phase balance is typically less than $\pm 1^\circ$.

Flexible Control Power Options: The FCOG6100 may be powered from an external 30 VDC or 24 VAC source. With the addition of an onboard transformer, the board may be powered from a 120 V, 240 V, 380 V, or 480 V external source. Board power may also be obtained directly from the connections to the SCR cathodes.

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	
<i>Maximum Ratings</i>	
AC mains voltage	600 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 30 V output	10 W
Delay angle range	$10^\circ \leq \alpha \leq 170^\circ$
<i>Characteristics</i>	
Delay angle command signal (SIG HI)	0-5, 0.85-5.85, 0-10, 1-2 V 4-20 mA Or as specified
Delay angle reference phase shift	0 or -30° (application-specific)
Control signal isolation from ground	653 k Ω
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 119 Hz, phase shift -45° at 68 Hz
Gate drive phase balance	$\pm 1^\circ$ (max)
Delay angle variance	$\Delta(\alpha)/\Delta(f) = 0.2^\circ/\text{Hz}$
Lock acquisition time	30 ms (typ)
Soft-start/stop time	0.05 - 20.0 s, independently configurable
Phase rotation effect	None
Phase loss inhibit	Automatic
Power-on inhibit	Automatic
Instant/soft inhibit/enable inputs	Dry contact
SCR gate pulse waveform	120° burst or 2-30° bursts, 30° spaced
Gate pulse burst frequency	384 times line frequency
Initial gate pulse open circuit voltage	15 V (Note 1)
Sustaining gate pulse open circuit voltage	7.0 V (Note 1)
Initial gate drive short circuit current	2.0 A (Note 1 and 2)
Sustaining gate drive short circuit current	0.5 A (Note 1 and 2)
Short-circuit gate drive current rise time	1.0 A/ μs (Note 1 and 2)
Board dimensions	191 x 152 x 35 mm (L x W x D)
Minimum creepage distance to ac mains	
With onboard phase references	13 mm
With phase references entering on J5	5.0 mm
Conformal Coating	per MIL-1-46058, Type UR
NOTES	
1 Assumes nominal 30 V control power	
2 Assumes a purely resistive gate load of 1.0 Ω	

Ordering Guide		
Parameter	Description	Code
SCR Circuit Type	AC Controllers	
	01 Six-SCR	
	02 Parallel SCR	
	DC Converters	
Parallel SCRs	03 Two-quadrant, Parallel SCR	
	04 Two-quadrant, Six- SCR	
Mains Frequency	0 No	
	1 Yes (Note 1)	
Command Signal	5/6 50/60 Hz	
	XX Specify (Note 2)	
Used with Regulator Board	1 0 - 5 V	
	2 0.85 - 5.85 V	
	3 0 - 10 V	
	4 1 - 2 V	
	5 4 - 20 mA	
	6 Other - Specify	
SCR Mains Voltage	0 No	
	1 Horizontal Header	
On-Board Transformer Primary Voltage	2 Vertical Header	
	XX Specify (Note 3)	
	0 Omit Transformer (Note 4)	
	1 120-240 Vac	
On-Board Transformer Power	2 240-480 Vac	
	3 350 Vac	
	4 380 Vac	
Phase References	0 Not Installed	
	1 External Source	
Phase References	2 SCR Cathodes	
	1 On-board	
Phase References	2 External via J5, R6, R7 and R8 (Note 5)	

Notes

- 1 Auxiliary firing board required for parallel SCRs
- 2 Specify code as mains frequency divided by 10. Example: 400 Hz / 10 = 40
- 3 Specify code as mains voltage divided by 10. Example: 480 V / 10 = 48
- 4 Customer must supply 24 Vac or 30VDC for board control power
- 5 Connect ac mains via J5 (to be attenuated by R6, R7, and R8) to provide phase out references

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