**FCOG1200**

**Features:**
- Industry Standard
- ASIC-Based Design
- Fully Connectorized
- Virtually eliminates 5th and 7th harmonics
- Balance circuit minimizes DC ripple voltage and supply current imbalance
- Independently Configurable
- Soft-Start and Soft-Stop
- Phase Loss and Power-On Reset Protection

**Applications:**
- 12-Pulse Converters or Controllers
- UPS Systems

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**FCOG1200 Standard Twelve-Pulse SCR Firing Board**

**Description**
The FCOG1200 board provides a six-phase firing circuit with achieve equidistant 30-degree gating and excellent bandwidth. Twelve isolated gate outputs provide hard-firing pulses for parallel or series connected 12-pulse converters or ac controllers. The twelve gate outputs are spaced at 30-degree intervals as required to eliminate the 5th and 7th harmonics of the ac input current.

**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 Balance Circuit:** The FCOG1200 provides three methods of trimming the nominal 30-degree group delay angle to optimize the rectifier performance: on-board (manual), on-board (auto), and external (auto). The 30-degree delay angle trim balances parallel bridge currents, ensuring full utilization of phase shift transformer secondary windings. Mains current harmonics and DC ripple voltage are also minimized.

**High Current Picket Fence Gate Drive:** The twelve transformer-isolated and 30-degree spaced 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 a six phase phase-locked loop consisting of a summing junction, low-pass filter, voltage controlled oscillator implemented with two proprietary ASIC devices. The VCO frequency is locked to the power line frequency. The DC delay angle command signal (SIG HI) varies the delay angle.

**Control Power Options:** The FCOG1200 is powered from an external 30 VDC or 24 Vac source.

**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.**

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*Power Electronics Control Specialists – www.enerpro-inc.com*
### Fabrication and Design Data

#### Maximum Ratings
- **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**: 5 mA
- **5 V reference output current**: 5 mA
- **Auxiliary control power available from 24 Vac and 30 V outputs**: 10 W
- **Delay angle range**: $10^\circ \leq \alpha \leq 170^\circ$

#### Characteristics
- **Delay angle command signal (SIG HI)**: 0-5, 0.85-5.85, 0-10, 1-2 V, 4-20 mA, or as specified
- **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 167 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 to 20.0 s, independently configurable
- **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. Select via JU1 & JU2.
- **Gate pulse burst frequency**: 384 times line frequency
- **Gate pulse width, 50 Hz**: 20-22 $\mu$s
- **Gate pulse width, 60 Hz**: 24-26 $\mu$s
- **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 $\mu$s (Notes 1, 2)
- **Board dimensions**: 194 x 191 x 34 mm (L x W x D)
- **Minimum creepage distance to ac mains**: 13 mm
- **Conformal Coating**: per MIL-1-46058, Type UR

### Ordering Guide

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<th>Description</th>
<th>Code</th>
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<tr>
<td></td>
<td>DC Converter</td>
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<tr>
<td><strong>Mains Frequency</strong></td>
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<tr>
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<tr>
<td><strong>Command Signal</strong></td>
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<tr>
<td></td>
<td>0.85 - 5.85 V</td>
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<tr>
<td></td>
<td>0 - 10 V</td>
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<tr>
<td></td>
<td>1 - 2 V</td>
<td>4</td>
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<tr>
<td></td>
<td>4 - 20 mA</td>
<td>5</td>
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<td>On-Board Auto-Balance</td>
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<tr>
<td></td>
<td>External Auto-Balance</td>
<td>03</td>
</tr>
</tbody>
</table>

### Notes
1. Specify code as frequency divided by 10
   - Example: 400 Hz / 10 = 40
2. Specify as mains voltage divided by 10
   - Example: 480 V / 10 = 48

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