

FRS300



Features:

Industry Standard
ASIC-Based Design

Half-Controlled
Rectifier

Voltage/Current
Regulator
(Optional)

RC Snubber Circuit
(Optional)

Independently
Configurable
Soft-Start and
Soft-Stop

Isolated Gate Drive
Circuitry

Phase Loss and
Power-On Reset
Protection

Applications:

DC Bus Capacitor
Chargers

Battery Chargers

Corrosion-Protecting
Semi-converters

FRS300 Three-Phase Half-Controlled Rectifier, Regulator, and Snubber Board

Description

The FRS300 provides an economical combination firing, regulator, and snubber board solution for three-phase half-controlled rectifiers. The compact circuit board replaces the individual boards that usually provide these functions. The FRS300 board may be supplied with or without current or voltage regulation, or with or without snubber RC components as long as the maximum SCR dV/dt rating is not exceeded.



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.

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 delay angle command signal (SIG HI).

Regulator Circuit: The board typically operates in voltage or current regulation mode, depending upon which error signal is larger. This allows a seamless transition from voltage to current regulation or vice-versa.

Snubber Circuit: The snubber section consists of three RC circuits connected to the SCR anodes and cathodes.

High Current Picket Fence Gate Drive: The transformer-isolated gate drive circuits provide a hard firing initial 13 V open circuit/1.3 A short circuit firing pulse followed by sustaining "back porch" pulses at 6 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 $\pm 1^\circ$.

Control Power Options: The FRS300 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.

Product Datasheet		Ordering Guide			
Maximum Ratings		Parameter	Description	Code	
AC mains voltage	630 Vac	Snubber Circuit	1 Omit 2 Install		
Pulse transformer hipot	3500 Vac (60 seconds)	Regulation	1 Open Loop 2 Voltage Regulation with Current Limit 3 Voltage Regulation Only 4 Current Limit Only		
Operating temperature range	-5 C to 85 C		J1 & J2 Header Type	0 Horizontal 1 Vertical	
Board ac supply voltage	28 Vac (24 Vac nominal)		CT Ratio	XX (Note 1)	
12 V regulator output current	20 mA (Note 1)		Command Signal	1 0 - 5 V 2 0 - 10 V 3 4 - 20 mA 4 Other (Specify)	
5 V reference output current	5 mA (Note 1)	SCR Mains Voltage		XX Specify (Note 2)	
Auxiliary control power available from 24 Vac and 30 V outputs	10 W	Mains Frequency		50 50 Hz 60 60 Hz 5/6 50 or 60 Hz XX Specify (Note 3)	
Delay angle range	$13^\circ \leq \alpha \leq 168^\circ$			Rectifier Filter	1 None 2 Capacitor 3 Inductor
Characteristics			Notes		
Delay angle command signal (SIG HI)	0-5, 0.85-5.85, 0-10, 1-2 V 4-20 mA Or as specified	1 1.0 A maximum CT current			
Delay angle reference phase shift	-30° (application-specific)	2 Specify as mains voltage divided by 10 Example: 480 V / 10 = 48			
Control signal isolation from ground	653 k Ω	3 Specify as mains frequency divided by 10 Example: 400 Hz / 10 = 40			
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	$\Delta(\alpha)/\Delta(f) = 1.5^\circ/\text{Hz}$				
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				
Gate pulse width, 50 Hz	24-29 μs				
Gate pulse width, 60 Hz	20-24 μs				
Initial gate pulse open circuit voltage	13 V (Note 1)				
Sustaining gate pulse open circuit voltage	6.0 V (Note 1)				
Initial gate drive short circuit current	1.3 A (Note 1 and 2)				
Sustaining gate drive short circuit current	0.6 A (Note 1 and 2)				
Short-circuit gate drive current rise time	0.9 A/ μs (Note 1 and 2)				
Board dimensions	165 x 152 x 34 mm (L x W x D)				
Minimum creepage distance to ac mains	8 mm				
Conformal Coating	per MIL-1-46058, Type UR				
NOTES					
1 Assumes nominal 30 V control power is applied to board					
2 Assumes a purely resistive gate load of 1.0 Ω					

Enerpro, Inc.
 99 Aero Camino
 Goleta, CA 93117 (USA)
 Tel: (805) 683-2114
 (877) 648-2114
 Fax: (805) 964-0798
info@enerpro-inc.com
www.enerpro-inc.com