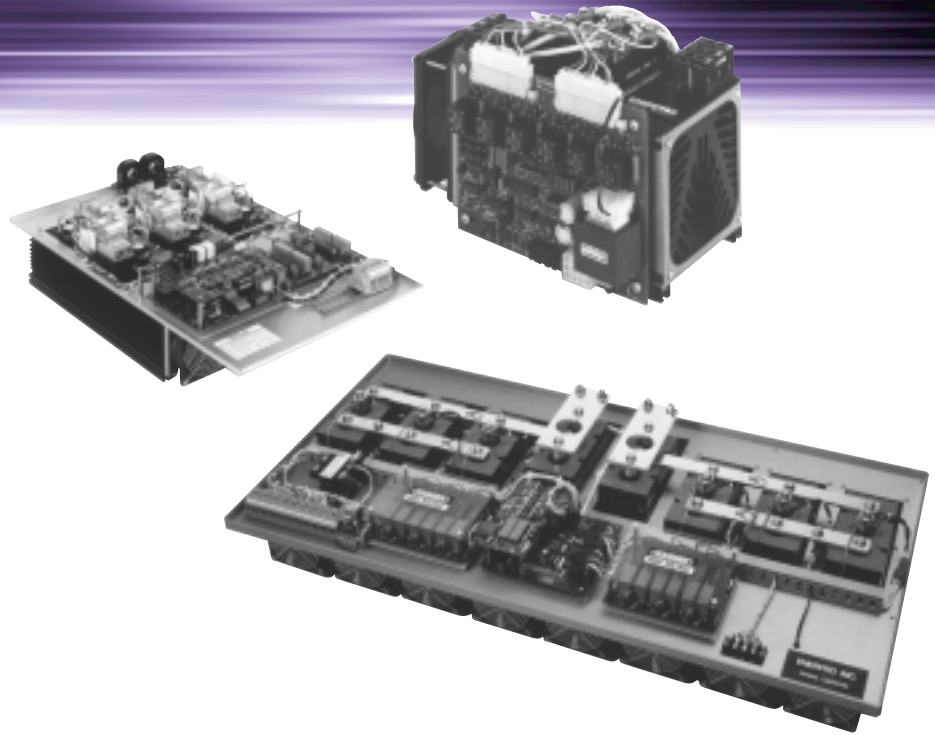


- Sealed or Ventilated Enclosure Options
- AC Controller and AC/DC Converter Applications
- 25A to 1000A+ Current Ratings
- Open or Closed Loop Control
- Industry Standard Firing Circuits
- 1Ø, 3Ø, and 6Ø SCR Assemblies Available



The Enerpro series of phase control SCR (Silicon Controlled Rectifier) assemblies are designed to meet the demanding custom requirements of today's OEM market.

The Enerpro SCR assemblies are primarily used in the AC controller and the AC/DC converter applications. The assemblies provide a complete, convenient, cost-effective solution to OEM power supply, variable-speed drive and solid-state motor starter design using a variety of 2-, 3-, 4-, 6-, 8-, and 12-SCR configurations.

Current ratings in the range of 25A to 1000A+ are achieved by SCR module selection, heat sink profile and length, and by utilizing natural or forced convection cooling.

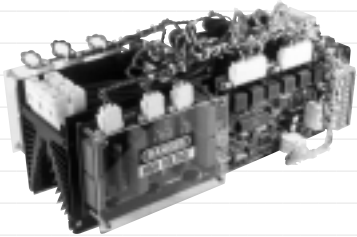
Voltage and current control can be open or closed loop. With open loop control, the SCR gate delay angle varies in proportion to the customer's 0/5V (or 4/20 mA) control signal.

Numerous modes of closed loop current, voltage, speed, and other types of regulation are achieved by using a wide range of standard regulator boards.

# Assembly Design Concept

Enerpro uses four different SCR assembly designs (PCM, PCA, PPA, and PCP) to meet the wide range of OEM customer specifications. The basic assembly in each category consists of Enerpro-standard firing circuit boards, isolated-base dual SCR modules, and heat sink extrusions. The four assembly types are described as:

## PCM Assembly



Power Control Module (PCM) assemblies provide a complete, convenient, cost-effective solution to OEM power supply, variable-speed drive and solid-state motor starter design requirements. The compact design combines Enerpro-standard isolated-base dual SCR modules, high-efficiency heat sinks and forced-air cooling, RC-MOV transient snubber and SCR firing circuit.

Cooling extrusions are offered in 100mm, 200mm, 300mm and 457mm lengths and may be configured with up to two cooling fans. Input current ratings range from 25A to 200A for this type of assembly.

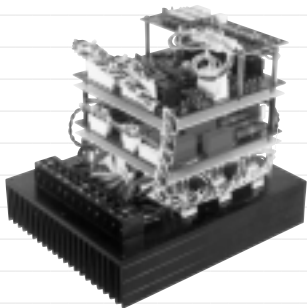
## PCA Assembly



PCA assemblies are ideal for applications where the assembly is mounted with the heat sink protruding through an opening in an electrical cabinet. Depending on the amount of dissipated power, this type of assembly allows the cooling fins of the heat sink be cooled by natural convection or forced air flow. Typically the maximum

amount of current recommended for this assembly is 150A without forced air cooling.

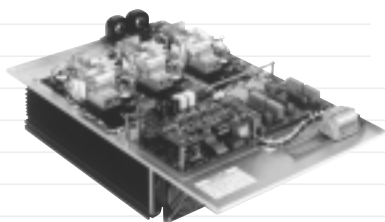
## PPA Assembly



The PPA assembly is a compact 12-pulse rectifier rated at 80A, with natural convection cooling. This assembly uses the industry standard FCOG1200 firing board, ISOVLCL current/voltage regulator board, and the TSB-12 snubber board. These Enerpro circuit boards are combined with high quality 90A rated SCR modules

mounted on a standard heat sink for a low cost solution in applications where harmonics must be minimized.

## PCP Assembly



PCP style assemblies are used where maximum heat dissipation is required. The dual thyristor modules are mounted on individual extrusions which are in turn attached to a formed aluminum panel. The circuit boards are also mounted on the panel. The assembly fits over a cut-out in the control cabinet with the extrusion fins extending through the cutout. The PCP

style extrusions may be cooled by natural convection or forced air and are used for applications up to and in excess of 1000A.

# Assembly Applications

## AC Controllers

### 3- and 6-SCR

- Transformer primary control  
high current power supply  
high voltage power supply
- AC motor starter
- Induction generator synchronizer

### 10-SCR

- Reversing motor starter
- Two-speed motor control

## AC/DC Converters

### 2-, 3-, 4-, and 6-SCR

- One and two-quadrant converter  
DC and AC motor drive  
DC power supply

### 8- and 12-SCR

- Four-quadrant converter  
regenerative DC power supply  
regenerative DC and AC motor drive  
one phase/three phase  
cycloconverter  
sequence controlled converter
- 12-pulse converter

# Components

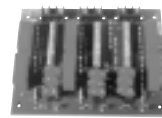
## Circuit Boards

Enerpro's single and three phase SCR firing boards are basic to the assembly design. Based on Enerpro's proprietary digital LSI devices, these versatile firing circuits became industry standards (50,000+ currently in use) because of ease of application, excellent performance and reliability, compact size and reasonable cost.

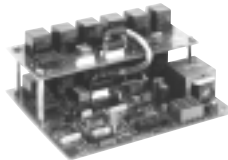
Some of the boards used in the Enerpro SCR assemblies are:



ISOVLCL-1  
regulator board



TSB-3 snubber board



FCOG6100 three phase firing board &  
FCOAUX60 auxiliary firing board

## Isolated Base Dual SCR Modules

The SCR module base is bolted to the extrusion with an intervening shim Thermstrate™ joint material for excellent heat transfer.

Six module sizes are offered. Modules are ranked from low to high current by the size of the silicon wafer. Some examples are shown below:



15 mm diameter silicon wafer; rated to 95 A average SCR current, to 1800 V blocking voltage



23 mm diameter silicon wafer; rated to 150 A average SCR current, to 1600 V blocking voltage



52 mm diameter silicon wafer; rated to 500 A average SCR current, to 2200 V blocking voltage



67 mm diameter silicon wafer; rated to 840 A average SCR current, to 2200 V blocking voltage

## Heat Sink Extrusions

Three standard extrusions are shown. Extrusions are finished in gold irridite with black anodize as an option.

The finned-on-one side extrusions (PCA and PCP assemblies) make sealed enclosure designs possible. SCR modules and circuit boards mount on the flat surface. The assembly is bolted to the enclosure wall with fins extending through a gasketed cut-out so that SCR dissipation is conducted through the wall to the outside air.



9.9 in. (250 mm) wide with  
2.5 in. (63.5 mm) fin height



Power Module Cooler with tee slots for attaching SCR modules and circuit boards



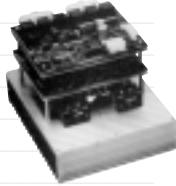
9.9 in. (250mm) wide with  
1.31 in. (33.3 mm) fin height

## Case Histories

The following examples illustrate the wide application range of Enerpro power control assemblies:

### *Medical Electronics Power Supply*

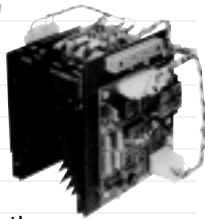
#### AC/DC Converter



The off-line 20 kVA converter regulates the DC link voltage and current into the customer's 20 kHz switch-mode X-ray machine power supply. The converter provides DC link modulation while the IGBT inverter creates the high frequency carrier reducing the weight and volume of the high voltage transformer.

### *Synchronous Motor Field*

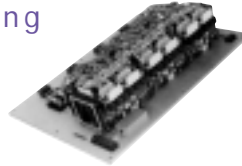
#### AC/DC Converter



This single phase assembly illustrates the compact integration of the Power Module Cooler style extrusion, 90 A average SCR and Enerpro circuit boards. The availability of this assembly facilitated the modernization of a large synchronous drive system.

### *Linear Induction Motor*

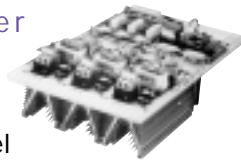
#### Triple Reversing AC Controller



Large linear induction motors replace hydraulic cylinders for positioning chassis assemblies in auto manufacturing plants. To control these motors, 30 SCRs are arranged as 15 anti-parallel pairs to form a three-section sequence reversing AC switch. To improve efficiency, the three switch sections energize only the part of the stator adjacent to the moving part, or shuttle, of the motor. The customer-provided position controller selects the motor segment to be energized and regulates the motor thrust magnitude and direction.

### *Wind Powered Induction Generator*

#### AC Mains Synchronizer



This 250 kVA assembly of three anti-parallel SCR pairs connects the induction generator to the utility grid when the wind turbine accelerates the generator to synchronous speed. Synchronization takes place with minimal inrush current, and generator efficiency is improved by operating the generator at a voltage level increasing with shaft input power.

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