

# MEDIUM POWER RECTIFIER SYSTEMS

*For*

*Steel Plants*

*Electrochemical Processes*

*Electrowinning Processes*

*Cranes and Elevators*

*Special Applications*



*Rapid Power and its parent company Dynapower are global providers of power conversion systems*

# Power Supplies For Industrial Applications

Rapid Power's power supplies are serving in hundreds of industrial, military, commercial and research applications. These applications have several things in common: the requirement for large blocks of direct current for power ratings in excess of 10 kW, and very unique specifications that demand customization.

Our large power supplies are precision engineered heavy duty units, and generally are self-contained within a steel enclosure. They are available as regulated or non-regulated versions and are used whenever direct current is required.

Rapid Power is one of the few companies that custom manufactures large DC power supplies to meet unique requirements in construction materials, size, weight with a competitive price. All power supplies are custom designed to your specifications by our engineering staff and completely fabricated in our 175,000 square foot manufacturing facility.

Our units are designed, built and tested in accordance with ANSI C34.2 specifications, and are available with ratings up to 2,000 volts and 100,000 amperes with input voltages up to 15 kilo volts. The power supplies may be forced air-cooled, water-to-air heat exchangers, direct water-cooled or closed-loop liquid-cooled.

All units may be interfaced with a PLC, either digitally, via RS 422/485, using industry standard protocols, or through an isolated analog interface.



2,000 kW DC Substation

## Applications

Rapid Power's power supplies are custom units designed and manufactured for applications such as:

### Steel Plants

- Continuous Strip
- Cranes
- Electromagnets
- DC shop power

### Electrochemical Processes

- Chlorine
- Hydrogen
- Oxygen

### Electrowinning Processes

- Gold, zinc, lithium, copper, cobalt, silver, etc.

### Dockside Power

### Resistive Heating

### Elevators

## Enclosure

The enclosure is a rigid, welded, free-standing, self-supporting steel structure that is constructed of cold rolled and coated sheet steel. The base is fabricated from structural-steel members to carry the load of the electrical components.

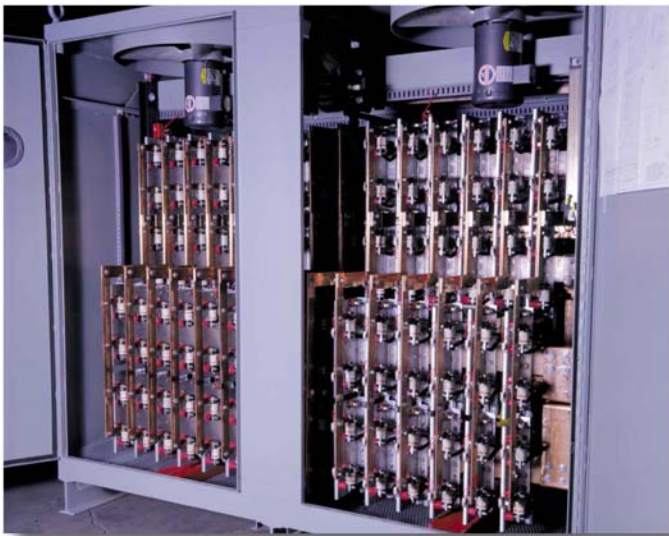
The front and rear of the enclosure is serviceable through lockable, latch-type full length doors or panels.

The coated steel is covered with two coats of a suitable primer and two coats of ANSI 61 gray or a medium blue finish.

## Basic Power Supply

The basic power supply contains the main transformer, power on light, fuses and power semiconductors. On regulated units, solid state modules provide voltage regulation with current limit and are located in a sealed compartment. This is to protect modules against adverse atmospheric conditions.

Current limiting fuses are used for additional protection of the semiconductors. Thermal detectors are built in to protect the SCRs and transformer from excess temperatures.



300 kW Rectifier

## Semiconductors

Rapid Power manufactures and tests all of the semiconductor sub-assemblies for our power supplies. Unregulated systems use diodes and our regulated systems use primary or secondary thyristors for the regulating elements.

Semiconductors are selected to withstand transient voltages and surges without breakdown, offering better reliability for all applications.

High grade, hermetically-sealed semiconductors are mounted on heat sinks and are protected with quick-acting silver sand fuses. The PRV rating of all semiconductors used is a minimum of three times the rated output voltage. These PRV ratings are used for additional transient-voltage protection.

In combining semiconductors to obtain required output current, adequate provisions are made to ensure that no device will carry current in excess of the safe operating current under any steady state or transient condition. Semiconductors are conservatively rated to provide ample capacity for overload.

## Transformer

The transformer is of the separate primary and secondary type that withstands continuous operation 10% above rated input voltage at the maximum rated DC output. The coils are wound with continuous conductors (without splices or joints).

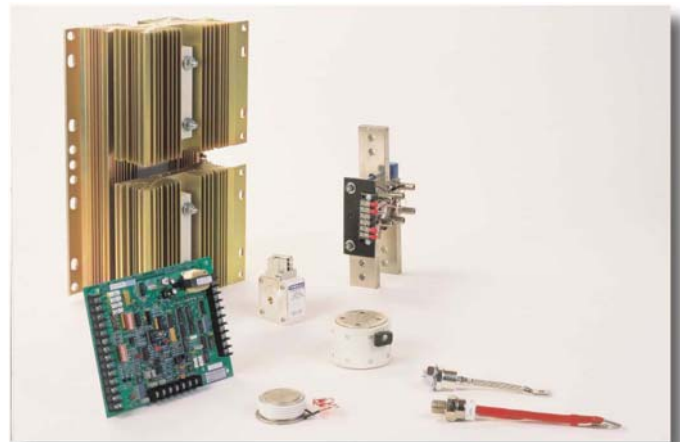
The coils are preheated, vacuum-varnish impregnated and oven baked for protection against dust, moisture and fumes.

The transformer core is constructed of high grade, grain-oriented silicon electrical steel of interleaved sheets operating at a flux density achieving efficiency levels of 98%.

Thermal-overload sensing devices are included in each leg of the transformer to detect winding overtemperature due to single phasing, overloading or loss of cooling air. They are to be used with the customer-supplied or optional undervoltage trip device of the incoming line circuit breaker or with a magnetic starter. Activation de-energizes power to the unit. All standard ANSI configurations are available.



Transformer Manufacturing

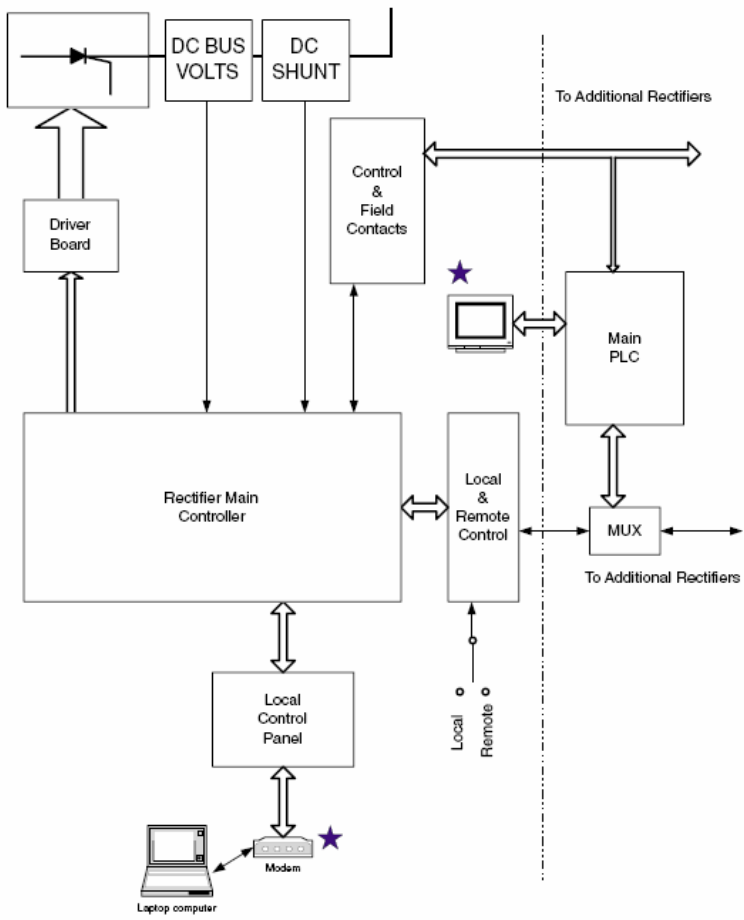


Rectifier Component

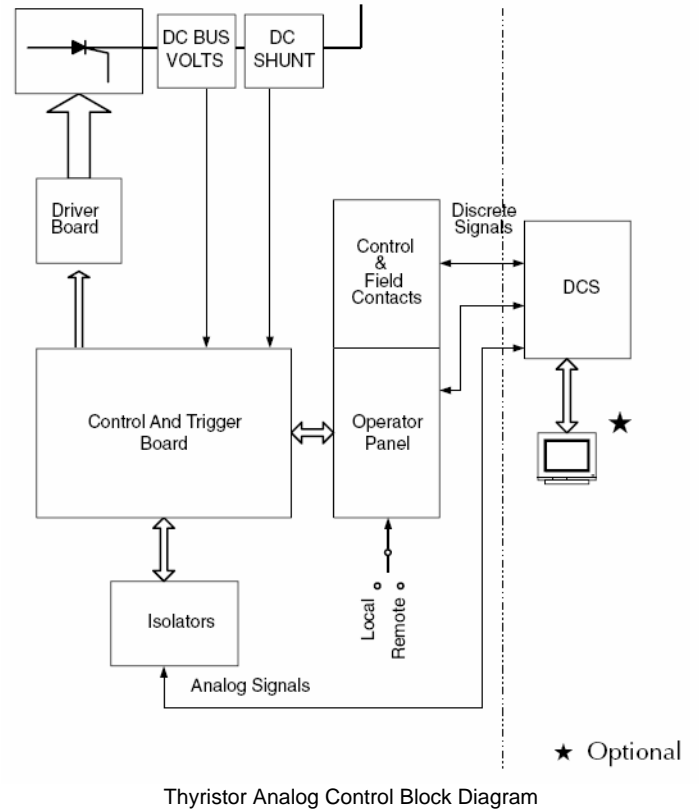
# Controls for Regulated Power Supplies

Rapid Power engineers design all of the rectifier control systems and our in-house manufacturing produce these proprietary printed circuits for our medium power rectifier systems. The integration of this control with commercially available Relaying, Programmable Logic Controllers (PLC) and Personal Computers (PC) is used to produce simple to complex power rectifier system designs.

Rapid Power's medium power rectifiers are available in both analog and digital-based designs. Such designs are compatible to interface with industrial PLC networks. Computer interface equipment and PLC networks are optional.



Thyristor Digital Control Block Diagram



Thyristor Analog Control Block Diagram

# Specifications for Power Supplies

## Basic Specifications

**Input Voltages:** Up to 15 kV  $\pm$  5%, 3 phase

**Input Frequencies:** 50 or 60 Hertz,  $\pm$  2%

**DC Output Voltages:** Up to 750 VDC

**DC Output Currents:** Up to 25,000 Amps

**DC Output Power:** Up to 3,000 kW

*Note: See High Power Rectifier brochure for higher power system solutions*

**Output Regulation:**  $\leq$  6% for unregulated applications  
 $\leq$  0.5% for regulated applications

**Cooling:** Convection, forced air, direct water, closed loop liquid-liquid, closed loop liquid-air

**Enclosures:** NEMA 1, 3R, 4, 4X, 12

## Technical Specifications

ANSI C34.2 Industrial Service Class is the most common requirement; other classes available.

### Industrial Service Rating - Standard

100% rated load current continuously at 40°C ambient temperature.

### Industrial Service Rating Class (Optional)

- 15% continuous overload when operated at 40°C ambient temperature \*
- 100% rated load current continuously at 50°C ambient temperature \*
- 125% for two hours following continuous operation at 100% at 40°C ambient temperature
- 200% for 10 seconds following 100% operation at 40°C ambient temperature. (Altitude 3300 feet or lower)

## Voltage Surge Protection

Two sets of surge suppressors are provided to protect against voltage surges from both the AC and DC sides as well as providing dv/dt protection.

## Cooling

Air cooled units are convection or forced up-draft by means of centrifugal fans/motors protected by thermal-overload relays. Low DC voltage system cooling options available are direct-water cooled, water-to-water or water-to-air heat exchangers. Higher DC voltage systems do not use direct water cooling. Low and medium sizes of choppers may be direct water cooled as the chopper power module heat sinks are at ground potential. Special liquid immersed cooling using insulating liquids are available.

## Standard Features:

- Copper bus
- High efficiency
- Precision shunt for control and metering \*\*
- Copper transformer with Class H insulation 40°C ambient

## Standard Protection Features:

- Semiconductor thermal sensors
  - Transformer thermal sensors
  - Electronic peak overload detector \*\*
- Electronic current limit \*\*

## Optional Features:

- AC magnetic starter system
- AC circuit breaker
- AC circuit breaker with undervoltage or shunt trip
- DC circuit breaker
- Fuse monitoring system
- Fuse failure system
- Redundancy
- Individually fused semiconductors
- Regeneration
- Anti-single phase protection
- Reusable filters
- Space heaters
- Remote control
- Analog meters
- Switchgear
- Computer interface \*\*
- Ramp control \*\*
- Special programming \*\*

\* Exceeds ANSI C34.2 requirements

\*\* Regulated units only



Continuous Tin Line Rectifiers

# Options Regulated and Unregulated Power Supplies

## AC Magnetic Starter System

The magnetic starter will include three thermal-overload relays, start/stop pushbutton (mounted on the enclosure door), a 110-volt control transformer (if required) for starter coil and a power-on indicating light.

## AC Circuit Breaker

A thermal-magnetic breaker will shut the power supply down in the event of an excessive overload or short-circuit condition. An indicating power-on light will be supplied.

## AC Circuit Breaker with Undervoltage or Shunt Trip

A thermal-magnetic circuit breaker will shut the power supply down in the event of an excessive overload or short-circuit condition.

## DC Circuit Breaker

The two-pole, DC thermal-magnetic circuit breaker will disconnect the load when an excessive DC overload or short circuit condition exists. Three-wire systems are normally supplied with one two-pole breaker.

## Fuse Monitoring System

The fuse monitoring system consists of an indicator light connected across each semiconductor fuse. In the event of a fuse failure, the corresponding indicator light will light. The lights are easily viewed through a window located on the front of the enclosure.

## Fuse Failure System

This system consists of semiconductor fuses with integral failure indicators and auxiliary contact blocks that are used to indicate that the fuse has failed or shut the power supply down. Units incorporating the Redundancy option, the Fuse Failure System will include a "first failure alarm" and "second failure trip" circuit.

## Redundancy

With this option, the power supply is designed with an additional semiconductor per leg, which will allow operation at full output with one device per leg not functioning.

## Regeneration

When DC motors are reversed quickly, or when they rotate because of an overhauling load (as occurs when a crane or elevator lowers), excessive back voltages are developed that are impressed across the DC source. This excessive voltage is dissipated through the regeneration resistor. The circuit consists of a DC contactor, a resistor bank, and a solid-state automatic control system. The usual rating of the regeneration circuit is 10% of the kW rating of the unit. Rapid Power's

regeneration circuit is designed fail safe.

## Anti-Single Phase Protection

The anti-single phase protection system shuts the power supply down in the event of a single phase condition.

## Reusable Filters

Reusable aluminum mesh, air-inlet filters will be used. The filters are easily installed and removed without entering the enclosure.

## Space Heaters

A heater is provided and is energized when the power supply is not operating. Space heaters are used to prevent moisture condensation.

## Remote Control

Remote consoles with meters are available.

## Analog Meters

A voltmeter and ammeter will be supplied. Both the ammeter and voltmeter are 2.0% accurate. Switchboard type meters with 1% accuracy, or digital meters with better than 1% accuracy are also available.

## Switchgear

Rapid Power can supply AC and DC switchgear configured for the application. The switchgear can be housed in a separate dead front arrangement or can be integral with the power supply.

**AC Switchgear** – Rapid Power provides fused and non-fused disconnects as well as high voltage vacuum contactors or circuit breakers.

**DC Switchgear** – Rapid Power can supply a simple fixed DC circuit breaker or switch in the power supply, or complete dead front switchgear with drawout breakers and lift device.

## Computer Interface \*\*

Analog and digital interface is available for most computer systems and includes isolated signals and auto/manual select.

## Ramp Control \*\*

Variable ramp: range or ramp time adjustment from 1 to 100% of maximum setting. 15 maximum settings available from 12 seconds to 100 minutes.

## Special Programming \*\*

Ramp programming, slow rise, computer control, and other types of controls are available.

\*\* Regulated units only

# Applications

Rapid Power's power supplies are custom units designed and manufactured for applications such as:

## Steel Plants

Steel Mills have a number of areas where DC power supplies are used. The major application is general Shop Supply to power motors, shears and general equipment. Most of the overhead cranes (bridge, trolley, hoist or ladle) use DC power to operate them. Large electromagnets use DC power. In a continuous strip line operation for tin, chrome or electrogalvanizing, low voltage, high current is required.

## DC Elevators

Many older high rise buildings contain elevators that operate on DC power. It has become very costly for the utilities to supply DC to these customers, so they are being replaced, on an individual site basis, with solid state DC power supplies.

## Electrochemical Processes

Many on-site chlorine and sodium hypochlorate generators for water purification, waste treatment and other uses require DC power supplies. Hydrogen generators for use in semiconductor production use DC power supplies. Oxygen and Fluorine generators are some of the many uses that require DC power supplies. Large processes use Rapid Power's High Power Rectifier systems.

## Electrowinning Processes

Small pilot plant processes require medium power rectifiers for electrowinning of gold, zinc, lithium, copper, cobalt, silver and other metals. Rapid High Power Rectifiers are used for full scale metallurgical processes.

## Dockside Power

Much equipment on board ocean liners and military ships generate their own DC power when at sea. When at dockside, and the engines are not running, they still require DC power for many critical functions. Dockside units are designed to operate in harsh marine duty environment.

## Resistive Heating

Although resistive heating can be accomplished with DC or AC, it becomes very cumbersome using high power AC, since it would greatly unbalance the input lines, while a DC system will allow the input AC lines to remain balanced.



Elevator Power Supply



Submersible Power Supplies



Resistance Heating Power Supplies



Sodium Hypochlorate Power supply



## RAPID POWER CORPORATION

Our corporate headquarters contain over 175,000 square feet of modern, fully-integrated manufacturing and engineering facilities.

As a vertically integrated company, Rapid Power manufactures the complete power system specializing in the power transformers and high power rectifiers for an international clientele. Rapid Power incorporates the latest controls, conversion technologies and highest quality materials to meet the customer's exact specifications. Our understanding and experience make us the number one choice worldwide for high power rectifier systems.

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