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# SERIES 50
## Model 5012 DC Power Supply
## Air & Water Cooled Specifications

**SINGLE TRANSFORMER, 12 PULSE RECTIFIER**

**Standard DC output ratings: 100 – 1000 Volts @ 100 to 5000 Amperes**

**TECHNICAL SPECIFICATIONS**

## General

The following specification describes Controlled Power Company's Model 5012, single transformer, secondary thyristor (SCR) DC power supply. All systems are designed and built to assure maximum reliability, flexibility, serviceability and performance. Controlled Power Company meets the individual needs of their customers through product options and system customization.

## Standards

The DC Power Supply is designed and manufactured in accordance with applicable portions of the following standards:

National Electric Code (NEC) current edition
American National Standards Institute (ANSI)
National Fire Protection Association (NFPA-70)
National Electrical Manufacturers Association (NEMA)

## Performance Specifications

| | | |
|---|---|---|
| Input Voltage | Standard Voltages: | 240 or 480 volts, 3 phase |
| | Optional Voltages: | 208, 380, 400, 440 or 600 volts, 3 phase |
| Input Line Variation | Standard: ±5% from nominal | |
| | Optional wider ranges available | |
| Frequency | Standard: | 60 hertz |
| | Optional: | 50 hertz |
| Efficiency | 95% typical (size dependent) | |
| Power Factor | 0.90 typically at full output | |
| Reliability | 65,000 + hours (MTBF) | |
| Voltage Regulation | ± 0.5% | |
| Current Regulation | ± 0.5% | |
| Dynamic Response | 1 cycle | |
| Correction Time | 6 cycles maximum with output filtering (10% to 90% step load) | |
| Ambient Temp | 0 º C (32 º F ) to 40 º C (104º F) maximum | |
| Humidity | 95% non-condensing | |
| Elevation | Maximum elevation 5000 feet (1524 meters) without de-rating | |
| Storage Temp | -20° C (-4° F) to 50° C (122° F) | |

## Regulation

Solid-state regulation of the output voltage or current is accomplished by means of thyristors (silicon controlled rectifiers, SCRs), a highly efficient solid-state device with an extremely long life cycle. Thyristor regulation provides full range voltage control, with or without a load, affording maximum operating flexibility and minimum maintenance.

## Main Transformer

The rectifier's main power transformer is a ventilated, dry type design, engineered for maximum reliability and performance. The primary circuit is (3) three phase, ungrounded, delta connected. A dual secondary is provided, one wye connected and the other delta connected, per ANSI/IEEE C57.18.10 circuit No. 31. The transformer has separate primary and secondary windings. Auto-transformer types are not used.

All electrical conductor material is highly conductive electrolytic copper of not less than 101% of the international annealed standard for conductivity. Insulation is Class N (200° C rating), designed to operate within safety margins.

The primary is separated from the core and secondary by a double layer arc resistant barrier (Nomex) to minimize the possibility of short circuits.

All transformer leads are supported so that the weight is removed from the coils and they are securely braced to prevent damage in transit and during installation.

All cores are manufactured from high-grade silicon steel with high magnetic permeability, low hysteresis and low eddy current losses. Magnetic flux densities are kept well below saturation to allow for a minimum of 5% over-voltage excitation. All laminations are free from burrs and stacked without gaps.

All stand-off or support insulators, used to support transformer leads and copper bus, are made of glastic material. Organic material is not used for bus or cable support due to possible deterioration.

All transformer coils and connections are thoroughly braced for the magnetic stresses resulting from short circuits of 18.0 times the rated base RMS symmetrical current, phase to phase, or phase to neutral for a period of 3.35 seconds. The transformer is constructed to be capable of withstanding, without damage, the mechanical stresses of an external short circuit or ground fault of this magnitude while rated primary voltage is maintained.

## Rectifier Circuit

A dual secondary is provided, one wye connected and the other delta connected, per ANSI/IEEE C57.18.10 circuit No. 31. Each secondary is connected to six thyristors (SCRs), used for rectification and regulation.

## Ripple

3% RMS AC ripple at full rated current and 100% output voltage.

Optional
1% RMS AC ripple at full rated current, when operating at 25%-100% output voltage.

## Cabinet

The rectifier cabinet is all-steel constructed and built to NEMA 1 or NEMA 2 standards. The metal is pre-treated with a phosphate coating and finished with a powder-coat paint to resist corrosion, marring or scratching. An optional NEMA 4X stainless steel rectifier enclosure is available for highly corrosive environments.

## Thyristors

The thyristors (SCRs) are rated for continuous full load operation. In the unlikely event of a device failure, an optional auxiliary sensing circuit will detect a phase current imbalance and shut down the DC power to prevent the overload of remaining devices.

The thyristor assembly is designed for a maximum junction temperature not to exceed 80% of the maximum rated junction temperature of the device, to prolong the life of the device.

The peak inverse and forward voltage ratings of the devices are at least 2.5 times the peak voltage of the AC supply.

The devices are mechanically clamped and mounted to an extruded heat sink in a manner which insures less than a 10° C difference between the device and the heat sink.

The heat sink is designed to provide proper cooling and to limit the maximum temperature rise to 40° C. This design is in conjunction with the appropriate air CFM maintained on the heat sink. The heat sink is machined to exceed thyristor manufacture specifications.

Transient voltage surge suppression limits the maximum transient voltage to less than 2.5 times the peak inverse voltage of the device. This protects each device from surges caused by switching and other alternating current variables.

## Primary Protection

Primary protection is provided by means of an AC thermal magnetic circuit breaker with industry standard AIC ratings. An optional fast-acting AC current imbalance circuit is available, which shuts the rectifier down under a fault condition.

## Cooling

**Air Cooled Units:** Cooling is accomplished by circulating ambient air across the heat generating components with axial fans. Optional NEMA 4X rectifier enclosure features an air conditioning system.

**Water Cooled Units:** Heated air from power semiconductors and main transformer is drawn into an air-to-water heat exchanger. Thermal transfer effectively reduces the air temperature, and then circulates the cooled air back into the semiconductor and transformer areas. An internal thermostat is adjustable to maintain the water cycle for proper cooling, while minimizing internal condensation. Direct water-cooled semiconductor designs are also available and can help lower the component ratings. This method of cooling insures long rectifier life for extreme operating environments. For either water-cooled design, the recommended water temperature range is 75º F to 85º F. Optional rectifier designs are available to accommodate higher and lower water temperatures.

## DC Output

The DC output of the unit is isolated. Either the positive or negative terminal may be grounded.

## Control Panel

A local control panel is located on the front door of the rectifier and includes output voltage and current analog meters, AC on and DC on indicator lights, start/stop/power off push buttons, output voltage and current control potentiometers, a voltage or current regulation mode switch, and a voltage or current limit control potentiometer. As an option, a NEMA 12 remote control panel can be provided.

## Controls And Monitoring

MICROPROCESSOR BASED CONTROL SYSTEM

A microprocessor based control system is used to provide accuracy, repeatability and programmable features.

CONSTANT VOLTAGE CONTROL

Constant voltage control maintains the preset output voltage constant to within ±0.5%. An adjustable maximum current setting limits the output of the DC power supply to a safe level and protects the system from an overload condition.

CONSTANT CURRENT CONTROL

Constant current control maintains the selected output current constant to within ±0.5% over a voltage range of 10% to 100%, with varying input voltages and loads. If the load is removed, the output voltage will rise to a preset limit value.

DC OVERLOAD

A digitally enhanced overload circuit allows the selection of zero (0), one (1), two (2), or three (3) restart attempts once excessive output current is detected. Upon overload detection, the circuitry will disable the DC output, ramp the output back to its set level within five (5) seconds and continue operation without interruption as long as the excessive load has cleared. Upon exceeding the selected number of restart attempts and if the excessive load has not been cleared, the unit will shut down. The overload level is factory adjusted for 5% over the unit's rated current output.

## Optional Controls And Monitoring

PHASE IMBALANCE PROTECTION

Fast-acting AC current imbalance circuitry is available. If imbalance limits are exceeded, the DC power will be shut off to prevent potential overload conditions.

OUTPUT RAMPING

Automatic ramping (slope) is digitally controlled to ramp the DC output to a preset voltage or current setting, at an adjustable rate. One (1) of two (2) standard timeframes may be selected. The first timeframe is zero (0) to two (2) minutes, and the second is zero (0) to twenty (20) minutes. Optional longer timeframes are available. Ramping can be controlled via potentiometer settings, or an internal or external PLC.

PLC INTERFACE

PLC interface cards fully isolate interface signals used to control or monitor the rectifier's DC output voltage and current. The following interface signals may be specified: 4 to 20 milliamp, 0 to 10 volt or 0 to 5 volt.

PLC CONTROL

Advanced PLC control and monitoring options are available to work with building and process management systems.

AMP HOUR COUNTER

An amp hour counter allows the accumulated ampere-time product to be continually monitored for chemical replenishment or maintenance scheduling.

CYCLE TIMER

A cycle timer is available with optional alarm for time controlled operation.

COMMAND TWO LEVEL CONTROL

Command two level control automatically switches the output of the rectifier from one DC voltage level to a second preset level, after a remote command signal is received.

PARALLEL OPERATION

A parallel control circuit allows the balanced operation of two (2) or more rectifiers in parallel for increased output current capacity.

AUTOMATIC AVERAGE CURRENT DENSITY CONTROL

The AACD (Automatic Average Current Density) option is used to automatically control the rectifier's DC output voltage and optimize paint usage in e-coat applications. The AACD insures that the proper voltage levels are applied to the paint tank based upon the size of the part being painted, eliminating the need for manual voltage adjustments.

*More optional equipment is available contact factory for details.*

## Gating Circuitry

SOFT START

The output voltage is ramped from zero (0) to the set value in a minimum of 300 milliseconds by electronic circuitry, limiting excessive current surges at start-up.

SYNCHRONIZATION

A phase lock loop circuit digitally produces synchronized gating signals for proper gating of the thyristors (SCRs), and insures that all phases are present before gating commences.

INHIBIT CIRCUITS (Optional)

A potential free contact controlled circuit will disable the gate card and remove gate signals from the thyristors.

An automatic absolute zero gate-inhibit circuit board disables gate signals to suppress leakage voltage and insure a zero power output whenever the output is set for zero (0) in the constant voltage or constant current mode of control.

## Warranty

The system is guaranteed against defects in material and workmanship for one (1) year from the date of shipment.