CONTROLLED POWER COMPANY

TROY, MICHIGAN

RXPO MODULAR DC POWER SUPPLY

OWNERS MANUAL

Model 2400 Water Cooled

IMPORTANT - SAVE THESE INSTRUCTIONS - PLEASE READ THIS MANUAL
BEFORE USING EQUIPMENT

107534-Rev 3
09/07/2021

The following symbol indicates that caution should be taken when performing the process required in this manual. Damage to the unit or personal harm could happen if proper precautions are not taken.

Caution

The following symbol indicates that there is a risk of electrical shock if proper precautions are not followed. Only qualified personnel should perform the actions required in this manual.

Shock Hazard

ABOUT THIS MANUAL

When viewing electronically, click on the subject to jump to that page.
Clicking the header on the front page will launch the Controlled Power web site.
Clicking anywhere else on the front page will also jump to the Table of Contents.
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INTRODUCTION

Controlled Power Company engineers and manufactures the industry's highest quality D.C. Power Supplies, capitalizing on 40 years of expertise. We have an enviable reputation for quality, which is reflected in the design, workmanship, and performance of our products.

The Series 2400 is a modular, water cooled, primary SCR, medium voltage DC power supply. The Series 2400's modular configuration provides expandability for increasing future capacity of the unit as well as redundancy for "fail safe" reliability.

The modular design offers unique benefits in expandability, reliability and serviceability. Each system is made up of 1 or more "Power Modules." When you require more D.C. Power, you simply slide in another power module (expandable units only). If a power module fails, you can leave the module off and still run your operation with the other modules. A failed module can then be sent in for repair without ever interrupting your operations. There are many other special applications that utilize the RXPO Modular D.C. Power Supply.

Each power supply manufactured has a special, made to order, circuit diagram that must be referred to for a better understanding of your particular D.C. Power Supply.

Output Voltage Range: 6V-600V 50 or 60Hz

Output Current Range: 37A-36,000A

FEATURES & BENEFITS

- Modular Expandability
- Simplified Installation
- Small Footprint
- "Fail Safe" Reliability
- Simplified Maintenance
- Water Cooled
- Completely Automatic

APPLICATIONS

- Electro-coating
- Electro-refining
- Anodizing
- Plating
- Electro-machining

STANDARDS

The D. C. Power Supply is designed and manufactured in accordance with the following where applicable:

- 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 or 600 Volts, 3 Phase.
- Input Line Variation Standard: +5% from nominal.
- Optional wider ranges available.
- Frequency Standard: 60 hertz.
- Optional: 50 hertz.
- Efficiency Typically 85% to 93%
- Power Factor Typically 90% at full output
- Reliability 16,598 hours (MTBF)
- Voltage Regulation + 0.5%
- Current Regulation + 0.5%
- Ambient 0 º C (32 º F) to 40 º C (104º F) Maximum
- Humidity 95% non-condensing.
- Elevation Maximum elevation 5000 feet (1524 meters).
- Storage 2° C (34° F) to 50° C (122° F)

SYSTEM OVERVIEW

REGULATION - Solid state regulation of the output power is accomplished by means of Thyristors (silicon controlled rectifier, SCR), a solid state device with extremely long life, high efficiency and superior power factor. Thyristor regulation provides full range control, with or without a load, affording maximum operating flexibility and minimum maintenance.

TRANSFORMERS - The design of the power transformer section of this power supply is of the highest quality and reliability. The power transformer is a fan cooled dry type. The primary circuit is (3) three phase, ungrounded, delta connected. The secondary is either wye or double wye with or without interface as needed.

The transformer has separate primary and secondary windings, auto-transformer types are not used.

All electrical conductor material is high conductive electrolytic copper of not less than 98% of the international annealed standard for conductivity. Insulation is Class 200 (200° C rating), designed to operate within safety margins.

There is a double layer arc resistant barrier (nomex) between the primary, core and secondary windings to minimize the possibility of shorts.

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 a high-grade, grain oriented silicon steel with high-magnetic permeability, low hysteresis and 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 transformer coils and connections are thoroughly braced for the magnetic stresses for 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.

SYSTEM OVERVIEW CONTINUED

RECTIFIER CIRCUIT - A wye secondary, ANSI circuit No. 23 standard 34.2 or a double wye with interphase transformer ANSI circuit No.35A standard 34.2 is used. Output rectification is by means of Diodes.

DIODES - Diodes have a minimum Peak Reverse Voltage rating of 2 ½ times the Maximum D. C. voltage. The design for maximum junction temperature is 80% of the manufacture's allowable rating.

RIPPLE - 5% Rms. AC ripple at unit full output rating. Filtering can be added as an option to reduce the percentage of ripple if required.

CABINET - The cabinets are all steel construction built to NEMA 12 standards. The metal is pre-treated with a phosphate coating and finished with a baked-on enamel paint to resist corrosion, marring or scratching.

THYRISTORS - The thyristors (SCR) are rated for continuous full load operation. An optional auxiliary sensing circuit is available to detect a phase imbalance in the unlikely event of a device failure. This circuit insures no fault load will be placed on the 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 ½ 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 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 protection 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.

COOLING - The cooling system is air over water type for the transformers and primary SCR assembly. The diode assembly is either direct water cooled or air over water cooled depending on the output voltage level. The unit is completely sealed and gasketed from local ambient conditions. The cabinet and device temperatures are controlled by means of two solenoid valves on the water inlet line which are operated by temperature sensors inside the rectifier.

WATER QUALITY

- pH of 6.0 to 9.0
- Chloride content of not more than 20 parts per million (PPM)
- Nitrate content of not more than 10 PPM
- Sulfate content of not more than 100 PPM
- Solids content of not more than 250 PPM
- Total hardness of not more than 150 PPM
- Maximum insoluble iron content of not more than 50 PPM
- Maximum conductivity 1500 Micro-ohms

Preferred Equipment:

- 140 to 150 micron filter on the system
- Valves (Ball Cock) on the inlet and outlet
- Flow Meter and Pressure Gauge

SYSTEM OVERVIEW CONTINUED

CONTROLS - The operator's control panel is on the door of the control enclosure and includes the volt meter, ammeter, control potentiometer, volt/amp switch, start/stop/power off push buttons and some option components may also be included.

AUTOMATIC CONTROLS

- MICROPROCESSOR BASED CONTROL SYSTEM - This system provides accurate repeatability and programmable features.

- CONSTANT VOLTAGE CONTROL - This control maintains the preset output voltage constant to within +0.5%. The control limits the output of the DC power supply to a safe level if an excessive load is placed on the power supply.

- CONSTANT CURRENT CONTROL - This control maintains the selected output current constant to within +0.5% over a 10-100% voltage range with varying input voltages and loads. If the load is removed, the voltage will rise to a preset limit value.

- DC OVERLOAD - Digitally enhanced overload circuit allows selection of one of four settings from zero (0) to 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 it's 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 if the excessive load has not been cleared the unit will shut down. The overload level is factory adjusted for 5% over the units rated current output.

OPTIONAL CONTROLS

- AC CURRENT UNBALANCE - Fast acting AC current unbalance circuitry detects AC current unbalance and shuts down the DC power before serious damage may occur.

- AUTOMATIC SLOPE - Automatic slope is digitally stepped to ramp the DC power at an adjustable rate. One (1) of two (2) standard time frames may be selected. Zero (0) to two (2) minutes or zero (0) to twenty (20) minutes. Optional longer times frames are available.

- COMPUTER INTERFACE - Signal conditioners fully isolate interface signals to control and monitor the DC output. One of the following signals can be specified 4-20 miliamp, 0-10 volt or 0-5 volt.

- AMP HOUR COUNTER - Allows the accumulated ampere-time product to be continually monitored for chemical replenishment or maintenance scheduling.

- PARALLEL CONTROL CIRCUIT - For balanced operation allows two (2) or more units to be operated in parallel for increased current output levels to a load.

- CYCLE TIMER with optional alarm for time controlled operation.

PRIMARY PROTECTION - Primary protection is provided by means of an AC Thermal Magnetic Circuit Breaker. This breaker is sized to interrupt the fault current of normal installations. An optional fast acting AC current unbalance circuit which shuts the rectifier down under fault conditions is available.

SYSTEM PROTECTION - Circuit breakers in lieu of fuses are utilized throughout to protect the power circuits. Thermal sensors are used to protect against damage by excessive heat in the power section of the system. A leak sensor grid operates a main breaker shunt trip circuit in the event of a water leak inside the unit.

SYSTEM OVERVIEW CONTINUED

MODULE PROTECTION - In the event of a transformer or diode short circuit failure, a magnetic circuit breaker automatically disconnects the faulty power module from the incoming line. The power supply is automatically de-rated by the faulty increment so that the remaining power sections do not assume a larger than rated load.

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 damaging current surges at start-up.

- SYNCHRONIZATION - A Phase Lock Loop circuit digitally produces synchronized gating signals for proper gating and insures that all phases are present before gating commences.

- INHIBIT CIRCUITS (optional) - A potential free contact controlled circuit can disable the gate card to remove gate signals from the thyristors. (Contact closure enables the gate signals).

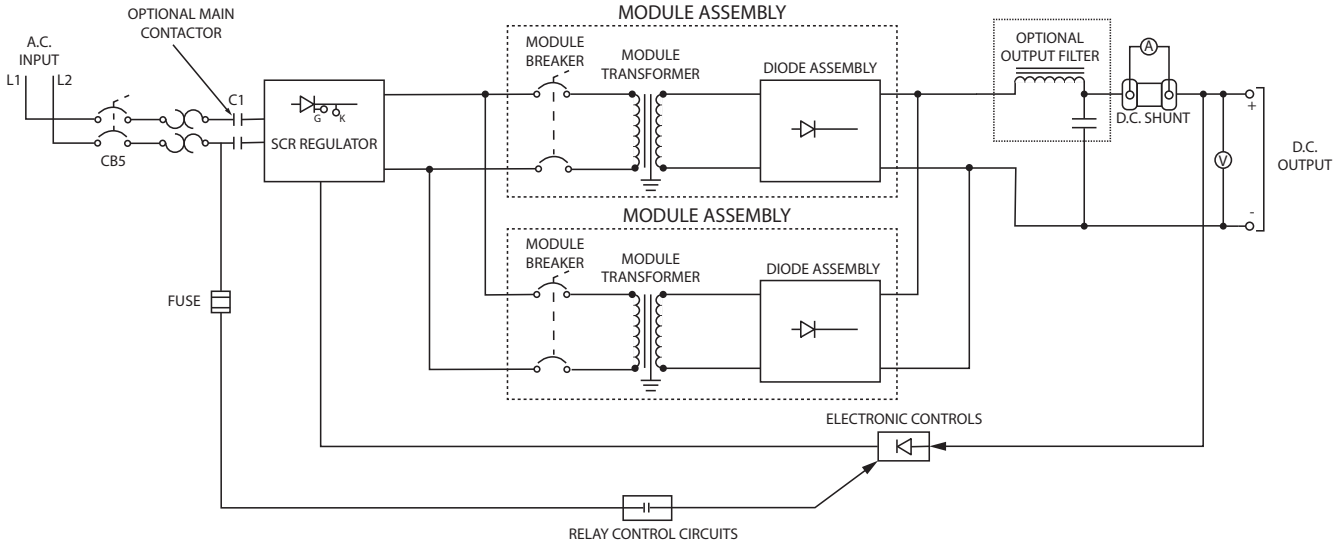
  An automatic absolute zero gate inhibit circuit board will disable gate signals and suppress leakage whenever the output is set for zero (0) in voltage or current mode of control.

DC OUTPUT - The DC output of the unit is floating. Either terminal may be grounded. The output terminals are located inside the unit when the output voltage.

THEORY OF OPERATION

The basic function of a D.C. Power is to take A.C. power and convert it to D.C. power.

BASIC BLOCK DIAGRAM



A.C. input power is supplied to the main disconnect. The control circuits consist of relay logic and monitoring devices that provide means for starting/stopping, temperature monitoring, emergency stop, cooling fans, and options such as automatic cycle timers, fault warnings, etc.... A.C. power then feeds into the SCR regulator which functions as a variable A.C. voltage controller in series with the module transformer(s). SCRs variably control the cycle conduction time of the incoming A.C. and if the SCRs conduct the entire cycle, the output voltage of the D.C. Power Supply will be at rated maximum. If the SCRs conduct only a part of the cycle the D.C. output voltage is proportionally less than the rated maximum. The SCR conduction time is controlled by the electronics' closed loop feedback that interface with the operators output adjust knob.

The variable A.C. is fed into individual module breakers. The transformer in the module steps the variable A.C. voltage up or down to achieve the required A.C. voltage to be rectified. The diodes in the module assembly convert A.C. voltage from the module transformer to D.C. The module assemblies are then connected in parallel to obtain the desired D.C. output current capacity.

D.C. output is continuously monitored by the electronic controls, which send signals to the SCR regulator. An operator's adjustment knob sets the output level. The electronic controls use the adjustment knob setting as a reference to "tell" the SCRs how much to conduct. As the SCRs conduct, the output voltage will rise to the selected output level. This "closed loop" method allows for a precision regulated D.C. output.

The diode assembly converts A.C. to D.C. leaving an A.C. component known as "A.C. Ripple" riding with the D.C. output. The "A.C. Ripple" may be filtered with an optional inductive/capacitive circuit to provide a more pure D.C. before the final output is transferred to your loads. A typical, optional "A.C. Ripple" specification is no more than 5% A.C. ripple on 25-100% D.C. output range. To verify A.C. ripple on your system a true RMS multimeter can be used with the following formula to measure the amount of A.C. ripple on your D.C. output.

(A.C. / D.C.) * 100 = _____% A.C. Ripple

RECEIVING THE POWER SUPPLY

INSPECTION, PLACEMENT, INSTALLATION, SETUP AND START-UP SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY

INSPECTION

As all units are normally shipped F.O.B. Controlled Power Company, it is suggested that the shipping container be removed and the power supply inspected on the interior and exterior for possible damage during shipment. If any damage is found, the claims must be handled by the purchaser, and the carrier should be immediately notified.

HANDLING THE D.C. POWER SUPPLY

Extreme care must be exercised when handling the unit. The weight distribution and center of gravity varies with the type and size of the unit. Please take special care when removing the unit from the pallet and/or container. Proper equipment must be used when lifting and moving. When removing the unit from the pallet and/or container, be sure to take proper safety precautions. Serious injury and/or unit damage can result from not taking proper precautions.

IMPORTANT NOTICE

This shipment has been carefully inspected, checked and properly packaged at our company.

When it was delivered to the carrier it was in good condition and technically it became your property at that time. Thus, any damage, whether obvious or hidden, must be reported to the transportation company within FIVE days of receipt of the shipment at your premises to avoid forfeiting claims for damages.

FOR ALL SHIPMENTS DAMAGED IN TRANSIT

Leave the items, packing material and carton “AS IS”. Notify your carrier’s local office and ask for immediate inspection of the carton and contents.

After inspection has been made by the carrier, and you have received acknowledgment in writing as to the damage, notify our Customer Service Department to make any required repair arrangements.

It is your responsibility to follow the above instructions or the carrier will not honor any claims for damage. Also, if there are any shortages or questions regarding this shipment, please notify us within FIVE days.

Please note that we cannot be responsible for any service work or back-charges unless authorized by us in writing, before the work is performed.

STORAGE

If necessary to store the unit for a period of time before it is installed, be sure to place the unit in a clean, dry area. To prevent an excessive accumulation of dust, it is advisable to protect it by replacing it in the original container or packaging. The unit must be handled at all times with the same care you would give any piece of precision industrial equipment. If the unit is water cooled and was previously in use; verify all water is removed from the system to prevent internal water passages from possible freezing.

IMPORTANT SAFEGUARDS, READ AND FOLLOW ALL SAFETY INSTRUCTIONS.
SAVE THESE INSTRUCTIONS.

*** WARNING ***

THERE ARE DANGEROUSLY HIGH VOLTAGES WITHIN THE DC POWER SUPPLY ENCLOSURES. UNDER NO CIRCUMSTANCES SHOULD ANYONE OPEN ACCESS DOORS TO THE DC POWER SUPPLY OR THE TANK WHILE THE SYSTEM IS ENERGIZED. ONLY QUALIFIED, TRAINED, ELECTRICAL PERSONNEL SHOULD SERVICE AND MAINTAIN THIS EQUIPMENT. LOCKOUT PROCEDURES MUST BE ENFORCED WHILE SERVICING OR MAINTAINING THE POWER SUPPLY.

- **FOLLOW ALL STANDARD AND LOCAL ELECTRICAL CODES.**
- **BE SURE INPUT POWER TO THE POWER SUPPLY IS PROPERLY GROUNDED.**
- **DO NOT ALLOW WATER OR FOREIGN OBJECTS TO GET INSIDE THE POWER SUPPLY.**
- **DO NOT PLACE OBJECTS OR LIQUIDS ON TOP OF THE POWER SUPPLY.**
- **DO NOT MOUNT NEAR GAS OR ELECTRIC HEATERS.**
- **EQUIPMENT SHOULD BE MOUNTED IN LOCATIONS AND AT HEIGHTS WHERE IT WILL NOT READILY BE SUBJECTED TO TAMPERING BY UNAUTHORIZED PERSONNEL.**
- **THE USE OF ACCESSORY EQUIPMENT NOT RECOMMENDED BY THE MANUFACTURER MAY CAUSE AN UNSAFE CONDITION.**
- **DO NOT USE THIS EQUIPMENT FOR OTHER THAN INTENDED USE.**
- **KEEP UNAUTHORIZED PERSONNEL AWAY FROM THE POWER SUPPLY.**
- **READ AND FOLLOW ALL SAFETY INSTRUCTIONS. SAVE THESE INSTRUCTIONS.**

SELECTING A LOCATION

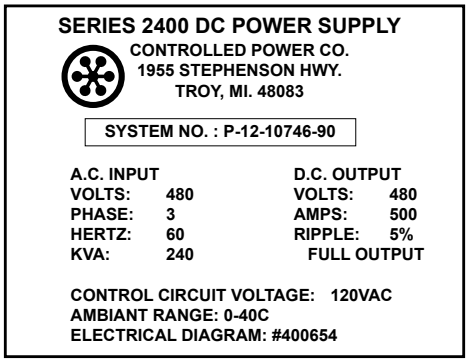
Your D.C. power supply has been completely inspected and extensively operated under various load conditions prior to shipment. Care in locating the unit will assure long, trouble-free operation.

Water cooled units are sealed so that internal parts are protected from the plant atmosphere. However, when locating these units, keep in mind that people will have to maintain them and will need tolerable working conditions. It is critical that the water supply is clean, filtered, and always available within the water specifications typically located on a tag near the water connections. The door seals must be checked annually and replaced if harsh outside environmental conditions are leaking into the power supply.

- Ventilation
- Weight Load
- Audible Noise Requirements
- Clean Environment
- Accessibility
- Proper Ground Techniques
- Input Source Voltage
- Distribution of Power
- Room Temperature
- Clearances

ELECTRICAL INSTALLATION AND TYPICAL DATA PLATE

Check the data plate to be sure that the rated input voltage, frequency, and AC line current match the available power. The D.C. Power Supply should not be connected under any circumstances to a power source which does not match the data plate rating.



SYSTEM NO. : Used as a Serial Number to identify the unit. It should be referenced when service or spare parts are required.

AC INPUT

Volts: Input Voltage to System.
Phase: Number of Phases Required.
Hertz: Frequency Design of System.
KVA: Input KVA Required.
Ambient Range: Outside Operating Temperature

DC OUTPUT

Volts: Units Rated D.C. Voltage.
Amps: Units Rated D.C. Amps.
Ripple: Percentage of Ripple Defined as RMS Value of Peak-to Peak Voltage at Full Output.
Control Circuit Voltage: Voltage for Control Circuitry.

AC INPUT CONNECTION

The primary input connections can be made through the top of the cabinet in the area of the starter panel or as specified in circuit drawings that accompany the unit. When cutting or drilling the conduit entry holes, care must be exercised to keep all debris, especially metallic, out of the cabinet. The input wiring must conform to National Electrical Code standards and/or local codes as required. Make sure to inspect the input circuit breaker terminals and match your wire size to the terminals supplied. Torque input wires as specified for the breaker terminals.

The input is not phase sensitive and therefore three phase input lines may be connected without concern for phase rotation. However following proper phase rotation is the best practice.

Customers primary disconnect (fuses) or circuit breaker should be rated at least 25% greater then full KVA stamped on the data plate and calculated as follows:

$$\text{Circuit Breaker or Fuse Size} = 1.25 \times \frac{\text{KVA} \times 1000}{1.73 \times \text{Input Voltage}}$$

REMOTE CONTROL WIRING (OPTIONAL)

D.C. Power Supplies have optional remote control panels that interface with the main unit. The remote control typically includes output meters, potentiometer controls, start/stop push buttons and other special controls as required per order.

It is important to use the proper interface wire, size, color and type as described:

Note: Use #14 gauge wire for distances up to 100 ft.
Use #12 gauge wire for distances up to 200 ft.
Consult the National Electrical Code for longer lengths.

Three (3) types of interface signals must be run in separate conduits as listed. Refer to your unit's circuit diagram for interconnecting wire diagram information.

1. 0-7.5 VDC signals interface the voltmeter, ammeter, and output control potentiometers. Use blue #14 or #12 gauge wire as noted above.

2. 120 VAC signals interface the start/stop pushbuttons and other controls as specified on the circuit diagram. Use red #14 or #12 gauge wire as noted above.

3. (Optional) PLC interface use 0-10 VDC or 4-20 made signals. Use 2 wire with ground shielded cable in accordance with NEC guidelines.

Note: some units remote ammeter wire directly from the 0-50 mvdc shunt signal-check your circuit diagram supplied with your unit and use the chart below for wire size. Run this wire in separate conduit.

Wire Size	Maximum Length of Wire
# 14	15 Ft.
# 12	25 Ft.
# 10	40 Ft.
# 8	60 Ft.
# 6	100 Ft.

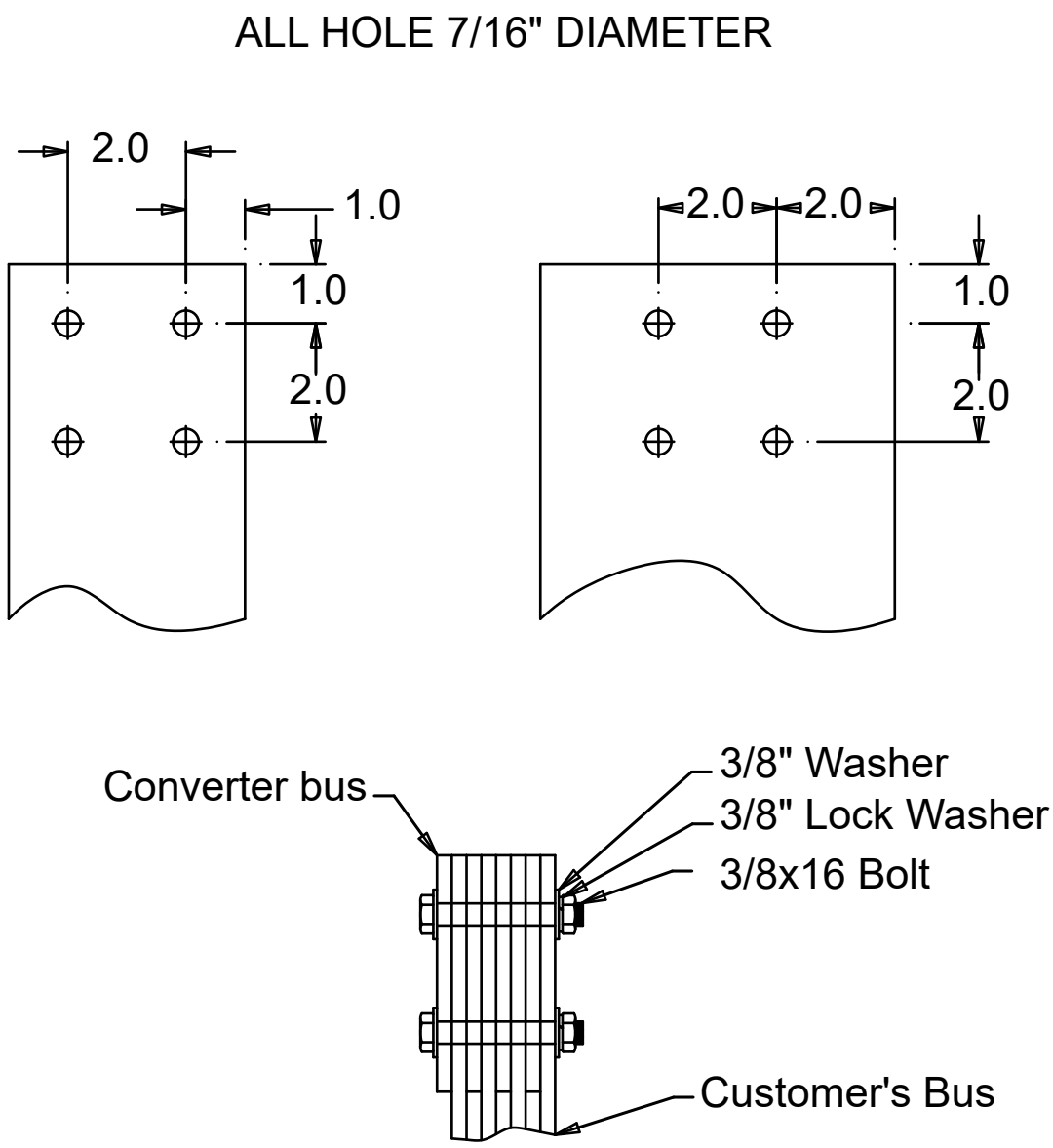
DC OUTPUT CONNECTION

The D.C. output connection will vary in size depending on the rated D.C. output. Refer to your unit's circuit diagram and the unit's data plate to obtain the D.C. output rating. Follow guidelines as specified in the National Electric Code. Make sure to inspect the units D.C. output connections in order to choose the proper terminals and wire size. Make sure to connect your output to the load side of the shunt typically located on the positive D.C. output leg.

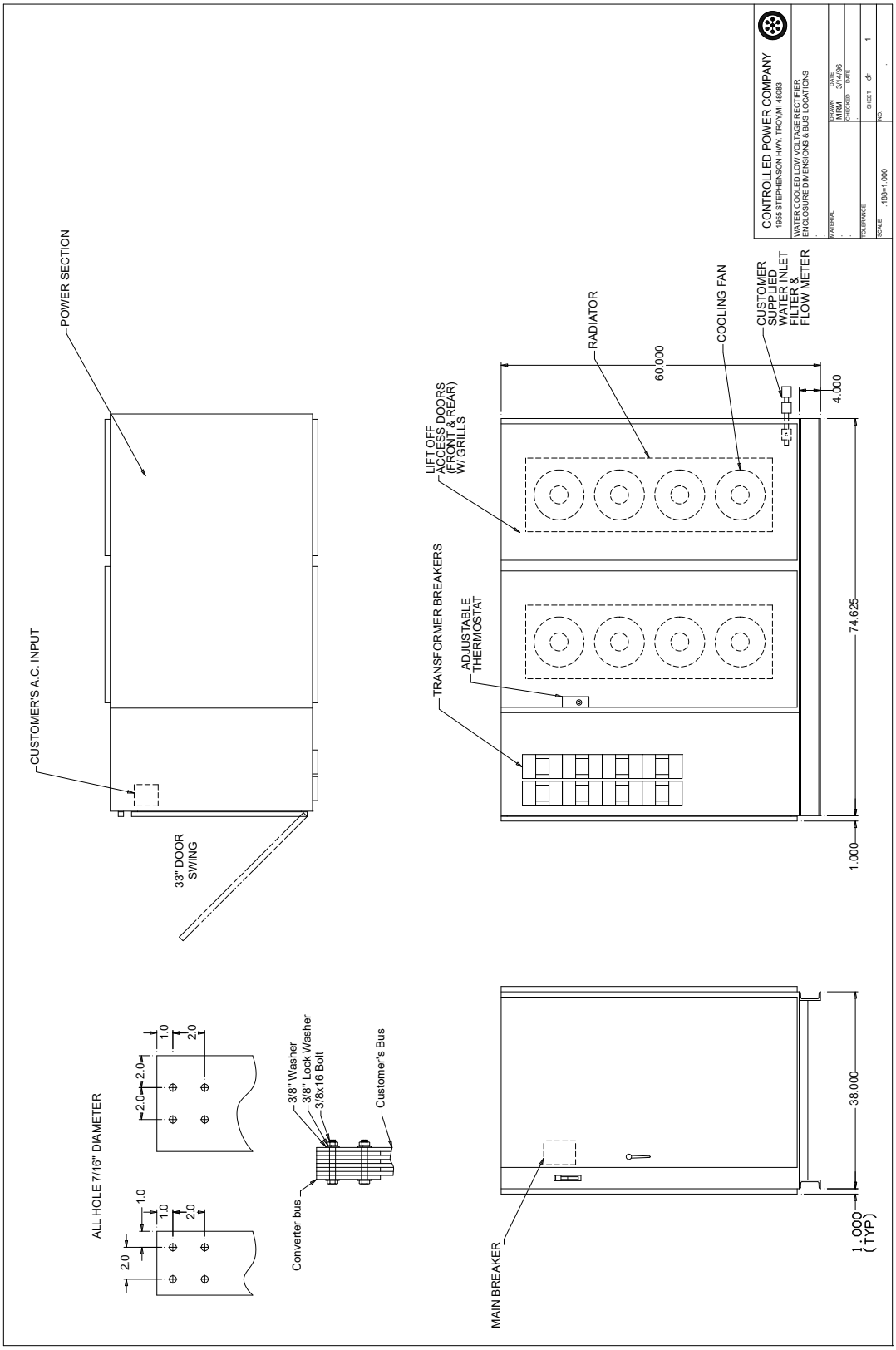
Refer to your unit's circuit diagram for D.C. output wiring information.

Low voltage units require copper or aluminum bus on the output. Use the following guidelines.

1/4" x 4" copper bus with 1/4" spacing between bars = 1000 amps per piece. 1/4" x 6" aluminum bus with 1/4" spacing between bars = 1000 amps per piece. Bus joint compound should be used on all connections. Bus clamps are available and eliminate the need for drilling holes in the bus.



TYPICAL CABINET OUTLINE



COMPONENT DESCRIPTION

MAIN INPUT BREAKER - The main input breaker serves as a total disconnect from primary power and also protection from overloads.

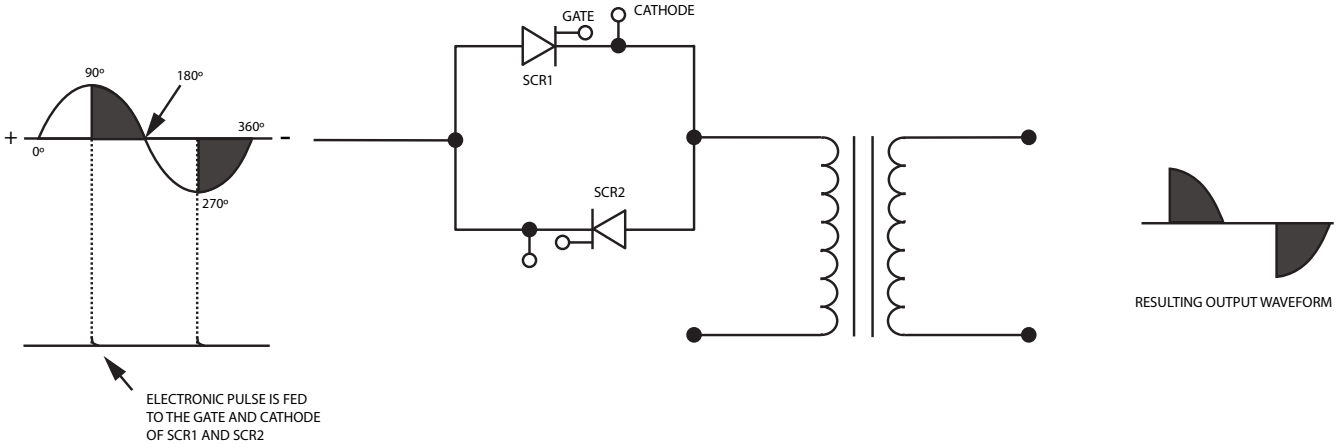
MODULE BREAKER - The modular breaker serves as a means of AC module disconnect and provides overload protection for each individual “Power Module Assembly”.

AC CONTACTOR (OPTIONAL) - Primary power passes through a main contactor and then into the SCR assembly. The contactor is utilized to turn D.C. power on and off automatically, also to automatically shut off D.C. power in the event of detecting various emergency shutdown devices.

SILICON CONTROLLED RECTIFIER (SCR) ASSEMBLY - SCRs are used to regulate the A.C. input voltage to the power module(s). This device allows current flow in one direction only (from anode to cathode).

SCRs (sometimes called thyristors) come in “Pig Tail”, “Hockey-puck” and “Power Module” type (which is a prepackage set of 2 SCRs back to back on an isolated base). All types are mounted to heat sinks and proper mounting is very important. Overheated SCRs are a major cause of power supply failure.

An example of how a SCR works is explained below.



FAN AND MOTOR - Used to pull air through the SCR assembly, power module, filter choke, radiator (water cooled) and circulate air inside the cabinet.

RADIATOR (WATER COOLED) - Cool water runs through the radiator in order to exchange heat generated inside the cabinet.

POWER MODULE - The power module consists of an individual isolation transformer, cooling fans, and diode assembly. The isolation transformer changes the input voltage to the desired A.C. output voltage that is fed into the diode assembly for A.C. to D.C. conversion. Additional power modules are easily added to expand the D.C. output rating of expandable units.

DC SHUNT - The D.C. shunt is mounted on either the positive or negative output bus and provides a 0 to 50 millivolt signal proportional to the D.C. output current. This signal is used to monitor the output current as well as by the electronic controls for current control, D.C. overload and current limit.

CONTROL TRANSFORMER - The Control Transformer provides power for the control circuit boards, PLC relays, and indicator lights.

ELECTRONIC PACKAGE - All electronic package adjustments are pre-set at Controlled Power Company. Any questions when attempting to re-calibrate should be referred back to Controlled Power Company. A certified electronic technician is available if re-calibration is desired. Technical training seminars are also available to train your personnel. The function of the electronic package is to supply trigger pulses to the SCR regulator module, which in turn gives the proper voltage and current versus load relationships. The electronic package is made up of electronic circuit cards to control and monitor the D.C. output.

PROTECTIVE DEVICES - Protection for the D.C. Power Supply is provided by the following means:

1. **Main Circuit Breaker** - The main input AC power is protected with a circuit breaker. If any excessive current is drawn through the main breaker it will trip and remove all power to the rectifier. The breaker must be reset to turn DC power back on.

2. **Power Module Circuit Breaker** - Each individual power module is protected with a circuit breaker. If excessive current is drawn through the power module transformer it will trip off and only remove power to that particular power module. The breaker must be reset (while the main breaker is off) to turn the power module back on.

3. **Thermal Overloads** - Thermal overloads are used to sense the operating temperature of the SCRs, transformer and choke (for some units). If these items exceed safe temperature limits, the power supply is shut down. Note: Optional thermal overloads may also be supplied on the main transformer, filter, choke, cabinet, etc...

4. **DC Overload** - If the DC output current exceeds the rating of the unit, the fast acting DC overload circuit will shut off the rectifier output. This will occur up to 3 times before final shutdown at which time the main A.C. contactor (optional) or DC will turn off and the “Reset” button (optional) must manually be depressed to restart the unit.Note: D.C. overload is dip switch selectable for 1, 2 or 3 tries.

5. **DV/DT Protection** - An electronic RC network (snubber) is used to provide DV/DT (voltage spike) and DV/DT (current surge) protection for the SCRs and diodes.

6. **Leak Detection (Water Cooled)** - A water leak detection circuit is located on the bottom of the cabinet. In the event of a water leak the input breaker will trip and the D.C. Power Supply will shut down.

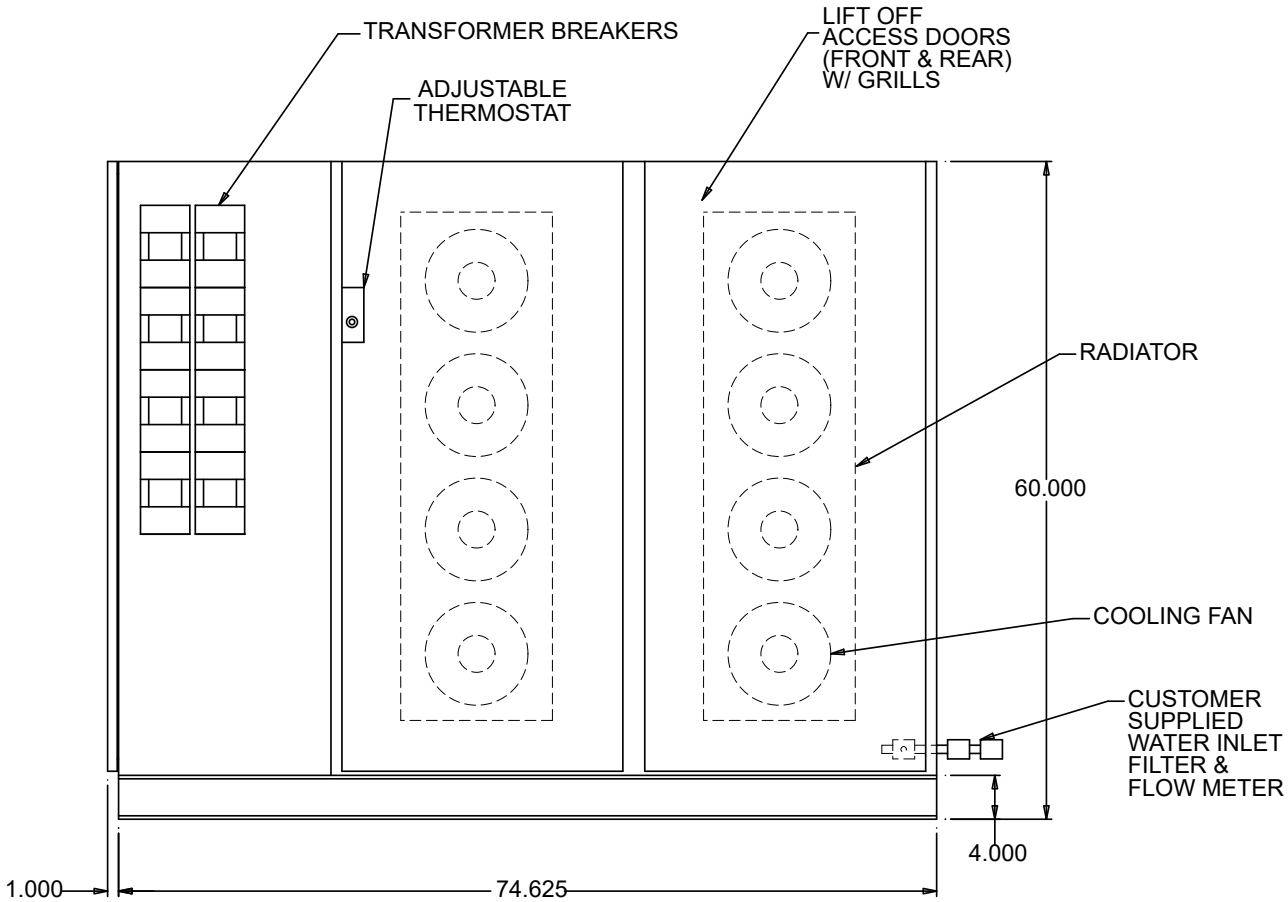
7. **Electronic A.C. Over Current (Optional)** - Monitors A.C. input current and if a phase is lost on the primary or an SCR malfunctions the D.C. output will shutdown instantly.

WATER COOLING SYSTEM - The D.C. Power Supply is a totally sealed cabinet that circulates air in the power section of the cabinet via a fan motor. The fan draws air through a radiator. The radiator receives water from a customer supplied source. The water flow is controlled by a solenoid and air temperature thermostat located in the power section. As the temperature rises the thermostat opens the solenoid allowing cool water to circulate in the radiator which then has air flow passed through the radiator in order to circulate cool air inside the cabinet. Normal thermostat setting is 85°F and should not be any cooler as condensation may build up inside the cabinet. Some units use water jackets to cool the diodes and output bus. A thermal sensor mounted near the diode opens a separate water solenoid at a pre-set temperature allowing water to flow and cool the diodes. The SCR regulator is thermally protected and will shut down the rectifier in the event of a cooling fan failure or water failure. Some units have an optional water flow switch to monitor proper water flow.

It is critical that the water supply is clean, filtered and always available within the water specifications typically located on a tag near the water connections. The door seals must be checked annually and replaced if harsh outside environmental conditions are leaking into the power supply.

COMPONENT DESCRIPTION CONTINUED

WATER COOLING SYSTEM CONTINUED



MINIMUM WATER REQUIREMENTS

- pH of 7.0 to 9.0
- Chloride content of not more than 20 parts per million (PPM)
- Nitrate content of not more than 10 PPM
- Sulfate content of not more than 100 PPM
- Solids content of not more than 250 PPM
- Total hardness of not more than 150 PPM
- Maximum conductivity 1500 Micro Ohms.

PREFERRED EQUIPMENT

- A 140-155 micron filter on the system.
- Valves (Ball Cock) on inlet and outlet.
- Flow Meter
- Pressure Gauge

Note: The water solenoid valve is located on the inlet line so water is turned off in the event of a leak.

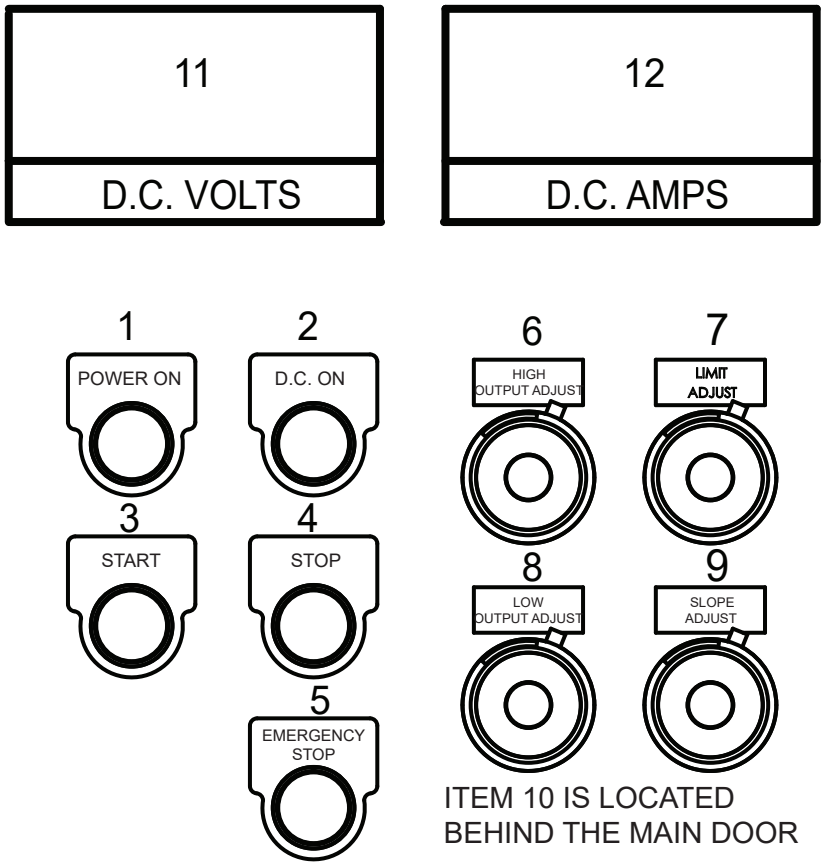
Note: In order to prevent water from draining out of the unit:

- Connect the water outlet to a closed loop system (pressurized).
- “Loop” the water outlet line to the height of the D.C. Power Supply cabinet.

CONTROLS

Each D.C. Power Supply is equipped with output adjust knobs, and various control circuits. Please reference your circuit diagrams to verify all the controls equipped with your system. The output adjust knobs are described in this section.

Note: Output adjust knobs are typically located on the front door and inside the front door directly behind any exterior adjust knobs. The volts/amp switch (when provided), is located inside the front door also.



1. **Power On** - Light to indicate that the main circuit breaker is energized.

2. **DC On** - Light to indicate that the AC contactor (where applicable) is energized and power is supplied to the rectifier electronics.

3. **Start -** Energizes the AC contactor (where applicable) and turns the DC output on.

4. **Stop** - De-energizes the AC Contactor (where applicable) shutting off the DC output.

5. **Emergency Stop** - opens the main AC input circuit breaker cutting power to the rectifier.

6. **Voltage High Output Adjust (Output Adjust) -** This control maintains the DC output voltage constant when the volt/amp switch is in “Volts” position at a level set by the output adjust knob. For example, the operator may adjust the DC voltage of a 400 volt (max) rectifier to 300 volts. The control will adjust the firing of the SCR’s as needed to keep the voltage at constant 300 volts.

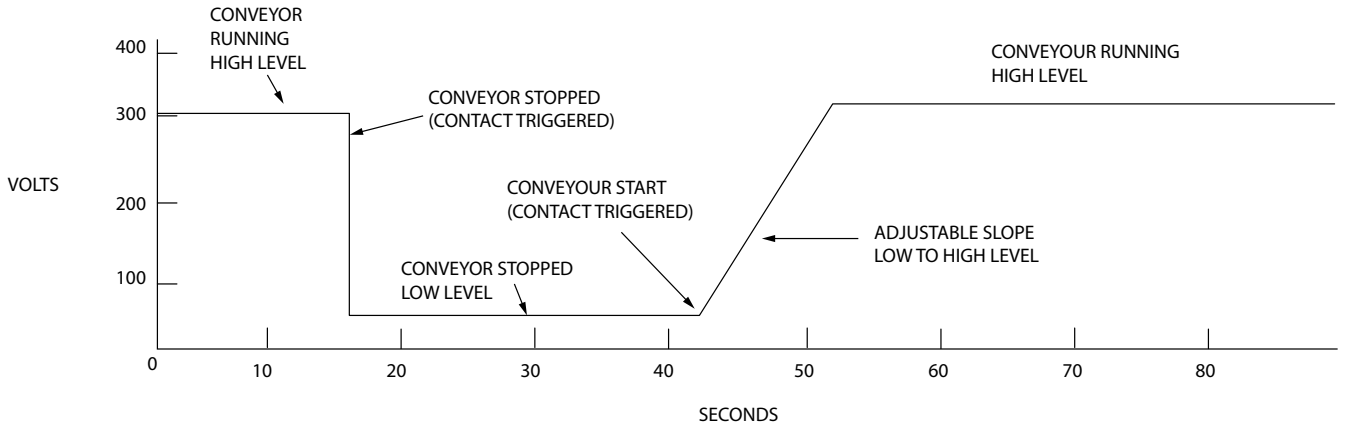
   If your load exceeds the current limit setting, the voltage control will be over-ridden and the voltage will drop to a level determined by the load while the current will maintain its maximum or limit setting.

CONTROLS CONTINUED

7. **Current Output Adjust (Limit Adjust)** - This control maintains the DC output current constant when the volt/amp switch is in the “Amps” position at a level set by the “output adjust” knob. For example, the operator may adjust the DC current of a 1000 ampere (max) rectifier to 800 amperes. The control will adjust the firing of the SCR’s in order to maintain the current constant at 800 amperes.

   The DC output voltage will not be allowed to exceed its rating or it will go into automatic voltage limit.

8. **Low Output Adjust or Holding Voltage (Optional)** - This control typically interfaces with a relay contact controlled by a conveyor running or conveyor stopped signal. When the conveyor stops, the “Low Adjust” or “Holding Voltage” knob takes control of the D.C. output and is typically set at a lower level then the “High Adjust” knob. When the conveyor starts, the D.C. output will slope up from the low adjust level to the high adjust level.



9. **Slope Adjust (Optional) -** This control slope time of the D.C. output from its low adjust level to its high adjust level. The slope circuit is triggered by a relay contact. The contact open enables the low adjust level, and the contact held closed slopes the D.C. output from low adjust to high adjust. The slope adjust is variable from 0-2minutes or an optional 0-20 minute setting. The slope adjust knob turned fully counter clockwise is the fastest output slope time. Clockwise is the slowest.

10. **Volt/Amps Switch** - (Not Shown) This switch is located behind the output adjust knob and allows the rectifier to operate in either constant volts or a constant amps mode. In the volts position, the output adjust knob controls and regulates the rectifiers voltage. In the amps position, the output adjust knob controls and regulates the rectifiers current.

    Note: In the amps position, a load is required otherwise the output may run out of control.

11. **D.C. Voltmeter -** D.C. Output Voltage reading.

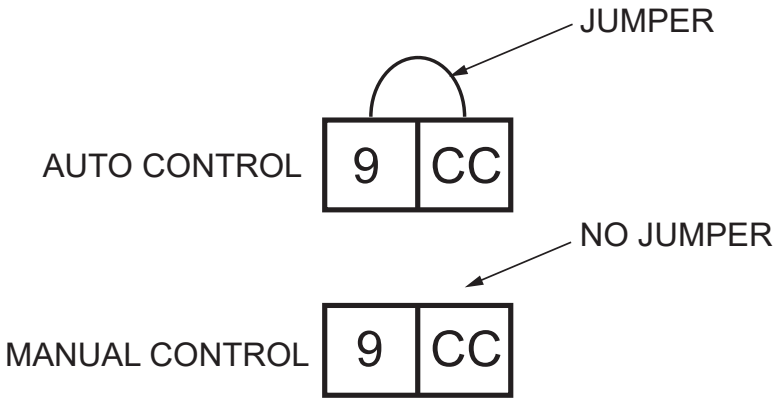
12. **D.C. Amperes** - D.C. Output Amps reading.

Control Panel Indicator Lights (Not Shown) - Refer to the unit’s circuit diagram for a description of the control panel indicator lights.

AUTOMATIC CONTROL AND MONITOR OPERATION (Optional)

A unit with automatic control typically has an auto/manual selector switch. To operate the unit automatically, simply place the selector switch in the “Auto” position. If your unit does not have an auto/manual switch, then 2 terminal’s are supplied on the electronic package that require a wire jumper to select auto or manual mode (refer to the unit’s circuit diagram). In auto mode the unit is automatically controlled via a PLC. The PLC is interfaced to the D.C. Power Supply through our “Omni Isolated Interface Board”, which provides isolated signals to control either or both voltage and current output of your rectifier. Either a 0-10 volt D.C. or 4-20 milliamp D.C. signal is available. Output monitoring that is proportional to the rectifier’s output current and or voltage is also available. Either a 0-10 volt D.C. or 4-20 milliamp D.C. signal is available.

The Single Channel Computer Interface Board is an excellent interface circuit board for applications utilizing PLC or other automated devices with a Controlled Power Company rectifier.



TURN ON PROCEDURE

1. All doors and panels on the D.C. Power Supply must be closed. All tank doors and other emergency interlocks must be secure.

2. Set all control knobs to zero (fully counter-clockwise).

3. Energize the AC voltage to the system by turning the main AC circuit breaker. The “Power On” light should illuminate (if provided).

4. Press the “Start” push button and the “D.C. On” light should illuminate.

5. Check your circuit diagram and make sure any optional interlocks are correctly interfacing with D.C. Power Supply control circuits. For example if you have a conveyor interlock signal it must provide a relay contact to enable the “High Output” adjust knob.

6. With a load in the tank adjust the output knob so that the desired value of voltage or current is obtained.

TURN OFF PROCEDURE

1. Press the “Stop” push-button and the “D.C. On” light will turn off and disable D.C. output.

2. Most systems have an “Emergency Power Off” push-button that when depressed will shunt trip the main AC circuit breaker. The breaker must be reset in order to restart the unit.

FAULT DEVICES

Various faults will either disable the D.C. output or give an optional visual/audio alarm. Refer to your circuit diagrams to verify how your system is equipped.

The following are typical faults which may be provided:

- SCR fuse failure.
- SCR overtemp.
- Transformer overtemp
- Water leak detected.
- D.C. overload.
- Under voltage detect.
- Filter choke overtemp.
- D.C. output fuse failure.
- Cabinet door open.
- Tank door open.

OPTIONS

11860 Remote Control Panel : The remote operators control panel allows operation of the power supply from a location away from the main power supply cubicle. The enclosure is constructed to NEMA 12 standards and is custom built for your operation with any variety of start/stop, cycle times, multi level output control, emergency stop etc.....

11870 Timed Automatic Cycle Control : The timed automatic cycle control consists of a heavy-duty timer that is initiated when the "start" button is depressed. The timer is configured as a count-up timer. Upon completion of the preset elapsed time the unit will shut down (or drop to holding voltage with slope option). The timer range may be set in seconds, minutes or hours. The values of three digits with a moveable decimal point may be set.

Note: See option #11871 "Audible Alarm with Pilot Light and Silence Switch" for cycle end annunciation.

11871 Audible Alarm with Pilot Light and Silence Switch : This option is used with Option #11870 (Cycle Timer) to provide an audible and visual indication of the end of cycle. When the timer times out a "cycle end" light will illuminate, and an audible alarm will sound. An alarm silence button is provided to silence the alarm and extinguish the light. At the end of the cycle, it is optional to allow the unit to operate or turn-off. A jumper wire determines which function is operational.

Note: The audible alarm may be a bell, horn or buzzer, to distinguish the rectifier from other equipment. Please specify when ordering.

11890 Command Two-Level Control : The command two-level control allows the adjustment of one level before a command signal and a second level after the command signal is applied. The command signal from the customer, is a potential free contact. This control consists of two, ten turn, adjustment potentiometers with locking dials. When the command signal is open, the low output potentiometer controls the output of the unit. When the command signal is closed, the high output potentiometer controls the output of the unit. When the command signal opens again, the unit will immediately switch to the low output level.

Note: If this option is used in conjunction with the Slope Control (option 11970) the unit output will slope (ramp) up from the low output level to the high output level when the command signal is closed. The unit will immediately return to the low output level when the command signal is opened.

11900 Command On/Off Control : The command on/off control allows the rectifier to be started from an external command contact closure and stopped when the external contact is opened. This circuit includes start and stop push buttons and a ready light.

Operation: Once the rectifier's main breaker is energized and the "start" button is depressed the "ready" light will illuminate, indicating the rectifier is ready for the command start signal. A contact closure on the command signal will start the DC output. Upon a command signal opening the rectifier will return to the ready state and await the next command start signal. Depressing the "stop" button will remove the rectifier from the ready state.

11960 Cumulative Ampere-Hour Meter : The totalizing ampere-hour meter is microprocessor based and has a 12 digit, non-resettable display of the accumulated ampere-hour (or ampere-minute) product and a 12 digit, resettable, cumulative ampere-hour (or ampere-minute) display. See the additionally provided manual for more information on this option.

11961 Cumulative Ampere-Hour Meter with Preset, Time Based Control for Two Pumps : The totalizing ampere-hour meter with preset, time based control for two pumps is microprocessor based. See the additionally provided manual for more information on this option.

OPTIONS CONTINUED

11962 Automatic 2 Pump Feeder for Paint / Chemical Adder with Pre-Set Pump Stroke Counters (Two Pump Operation) : The automatic solids or brightener adder and pre-set pump stroke counters is microprocessor based. See the additionally provided manual for more information on this option.

11970 Automatic Slope Control : The automatic slope control provides a step less increase in the voltage or current from zero (0) to a preset level. The slope is completely adjustable with a ten-turn potentiometer to give a linear rate of rise. The slope is initiated with the “start” button. The time ranges when going from zero (0) to full output are adjustable over two (2) ranges:

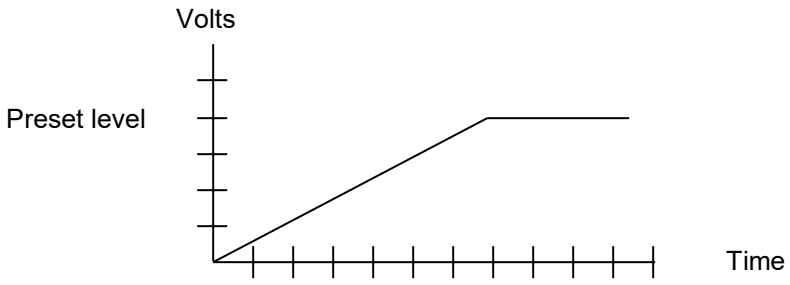
Short Duration: 3 seconds to 2 minutes maximum.

Long Duration: 3 seconds to 20 minutes maximum.

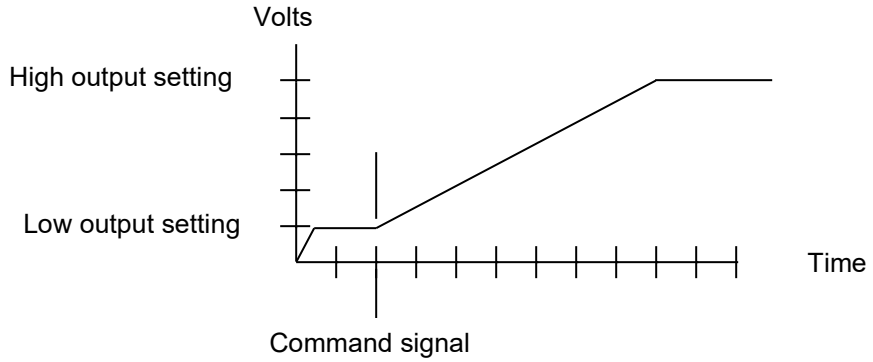
For extended times beyond 20 minutes consult factory.

11970A Used in conjunction with the “Command Two-Level Control” (option 11890) the unit will slope up from the low output setting to the high output setting after a command signal (potential free contact) is given.

Automatic Slope Control 11970



Automatic Slope with Command Two-Level Control 11970A



OPTIONS CONTINUED

12020 Parallel Control: The paralleling control allows the operation of (2) two or more units in direct parallel. One unit will be selected as master and will be operated as a voltage source and be responsible for the voltage control. The master unit will send a signal to all other units connected in parallel, which will operate as current sources to balance the load current between all units.

12030 Module Off Alarm: The function of the module off alarm is to give an audible and visual alarm when a module circuit breaker is in the “off” position. This does not indicate which module is off, only that a module circuit breaker is off. The visual indicator is a light. The audible indicator is supplied with a silence switch. Note: The audible alarm may be a bell, horn or buzzer, to distinguish the rectifier from other equipment. Please specify when ordering.

12231 Single Channel Computer Interface Board (29950): The single channel computer interface board (29950) is used in conjunction with the Omni Control board (408101). The single channel computer interface board can be configured to provide or accept isolated interface signals of 0 to 10 volts or 4 to 20 milliamps. The isolation devices have a “dielectric withstand voltage” of 750 volts maximum. The card may be used for an isolated output signal for voltage or current monitoring, or an isolated input signal for voltage or current control. One card is required for each signal to be used. When using input signals for control, only 1 signal is needed to control either voltage or current. *The other signal can be internally wired to achieve maximum rated output level.

12235 Ripple Filtering: The Ripple Filter consists of a Choke (L) and a capacitor (C). A bleed resistor (BR) is utilized to discharge the capacitor in approximately five (5) seconds when the power is turned off. The LC filter will provide 5% or less RMS ripple over the range of 25% to 100% output.

12236 Fuse Blown Indication: The fuse blown indication may be used for any fuse in the rectifier. The blown fuse indication may be relay contact, pilot light, horn, buzzer or any combination.

12238 Ripple Meter with Under/Over Voltage Alarm: The Ripple meter is a microprocessor based voltage meter. The DC and AC rms voltage is monitored and displayed on the LCD. The processor automatically calculates and displays the percentage of ripple.

The meter can also be programmed to monitor the DC voltage, and provide an alarm indication if it is over or under the alarm setpoints. The alarm circuit will activate for out-of specified voltage or ripple levels.

The alarm parameters for ripple and voltage are fully programmable using a simple 2-key "membrane" type keypad. A time delay adjustment is also included to prevent false alarms during initial power-on of the DC power supply.

An indicator light and a "potential-free" contact are provided as alarm signals. A jumper wire provision is included in the rectifier to automatically shut the DC off in the event of an alarm (remove jumper). An audible horn, bell, or buzzer may be provided as an option. See the additionally provided manual for more information on this option.

Anode Distribution System: The anode distribution system may be provided for single or multiple zones. The distribution system provides rectifier and multiple anode connection points. Each point is fused for wire protection. Fuse blown indicating lights, blocking diodes, analog metering or isolated monitoring signals may also be provided.

GENERAL TROUBLESHOOTING

*** WARNING ***

THERE ARE DANGEROUSLY HIGH VOLTAGES WITHIN THE DC POWER SUPPLY ENCLOSURES. UNDER NO CIRCUMSTANCES SHOULD ANYONE OPEN ACCESS DOORS TO THE DC POWER SUPPLY OR THE TANK WHILE THE SYSTEM IS ENERGIZED. ONLY QUALIFIED, TRAINED, ELECTRICAL PERSONNEL SHOULD SERVICE AND MAINTAIN THIS EQUIPMENT. LOCKOUT PROCEDURES MUST BE ENFORCED WHILE SERVICING OR MAINTAINING THE POWER SUPPLY.

Equipment required: Digital multimeter, common hand tools, safety glasses and an AC current clamp.

PROBLEM	PROBABLE CAUSE
Unit will not start.	1. Check fault circuits. Refer to circuit diagram.
	2. Check DC on -holding circuits. Refer to circuit diagram.
Main circuit breaker tripping.	1. Check for transformer ground fault. Check for shorted output.
	2. Refer to SCR assembly test procedure.
	3. Replace circuit boards.
	4. Bad shunt trip or breaker.- Replace.
DC turns on then shuts off.	1. Check fault alarms.- Refer to circuit diagram.
	2. Check SCR's. Refer to SCR test procedure.
	3. Replace circuit boards.
High temp warning.	1. Possible fan failure.
	2. Air intakes blocked.
	3. Outside air temp. excessive.
	4. No water flow. - Check solenoids, radiator, thermostat and water temperature.
Power on with no output voltage.	1. Check output adjust setting.
	2. Check DC on holding circuit. Refer to circuit diagram.
	3. Check PLC interface board.
	4. SCR fuse failure or SCR failure. Refer to SCR test procedure
	5. Replace circuit boards.
No lights on control console.	1. Check primary incoming AC power.
	2. Check console fuses.
Output voltage with no current.	1. No load in tank.
Output current with no voltage.	1. Check for shorts on output.
Output current with not enough voltage.	1. Check current limit. Adjust.
	2. Check for load increase.
	3. Circuit boards out of adjustment.
Excessive output ripple.	1. Check SCR's. Refer to SCR test procedure.
	2. Replace gate board.
	3. Check filter capacitors and fuse.
Main input A.C. current unbalanced.	1. Check SCR's and SCR gate/cathode connections.
	2. Check SCR fuses.
	3. Replace gate board.

*** WARNING ***

THERE ARE DANGEROUSLY HIGH VOLTAGES WITHIN THE DC POWER SUPPLY ENCLOSURES. UNDER NO CIRCUMSTANCES SHOULD ANYONE OPEN ACCESS DOORS TO THE DC POWER SUPPLY OR THE TANK WHILE THE SYSTEM IS ENERGIZED. ONLY QUALIFIED, TRAINED, ELECTRICAL PERSONNEL SHOULD SERVICE AND MAINTAIN THIS EQUIPMENT. LOCKOUT PROCEDURES MUST BE ENFORCED WHILE SERVICING OR MAINTAINING THE POWER SUPPLY.

Frequency - Preventive maintenance should be performed annually and in harsh environments, perhaps 2-3 times annually. Training seminars are available for entire rectifier trouble shooting, operation, adjustments and preventive maintenance. Please contact the factory for more information.

Preparation - A shutdown period must be scheduled to complete maintenance of your rectifier. After the maintenance is complete, test loads should be applied and normal operation of the rectifier verified before using in a production situation.

Check off each item on the “Rectifier Performance Checklist” located at the end of this section as you go through this procedure.

EQUIPMENT

Digital multimeter, wire brush or emery cloth, safety glasses, common screwdrivers and wrenches, vacuum cleaner and A.C. current clamp.

INSPECT & TIGHTEN CONNECTIONS

1. Turn off all power to the rectifier including the utility feed breaker that supplies AC input power.

2. Remove any load from the output.

3. Open all doors and panels and visually check for loose connections, burnt, frayed or broken wires. Use the applicable screwdriver or wrenches to tighten all connections. Refer to the “Rectifier Performance Checklist” and check off each item in Section 1. Vacuum any debris accumulated inside the unit.

4. Correct and note any loose connections on the checklist, replace any physically burned or broken components. Use extreme care when replacing components to assure correct installation. Take apart and clean any corroded connections with a wire brush or emery cloth. Use electrical grease when re-assembling high current connections.

CIRCUIT BOARD CHECKS

Circuit boards are very sensitive and should only be handled using electrostatic safe procedures. Special adjustment procedures and training is required to complete circuit board check out in accordance with the “Rectifier Performance Checklist”. Contact the factory for more information.

1. Inspect each circuit board closely for any loose connections or burned components. Correct or replace any bad circuit boards.

CIRCUIT BOARD CHECKS CONTINUED

2. Clean off any accumulation of dust or debris on the circuit boards. Use pre-packaged compressed air especially formulated for electronic circuit boards, available at any electronic distributor. If a circuit board is extremely dirty or corroded, send back to the factory for evaluation and cleaning.

OPERATION CHECKS

Follow the "Rectifier Performance Checklist" and the circuit diagram for the unit under test. Note: All items on the checklist may not apply to your unit. Verify that each item functions as it should in accordance with this manual and the circuit diagram for your rectifier. Make sure all cooling fans are working, verify all overtemp circuits, safety interlocks, emergency stops, output control knobs, etc….Make note of any item that is not working properly on the checklist and correct as required.

FINAL CHECKS

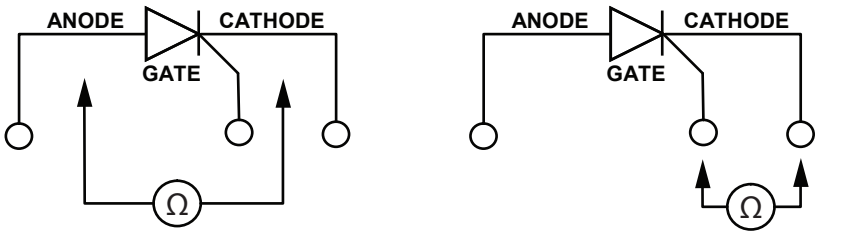
Place a test load on the system and verify that the rectifier functions normally before placing it into production.

SCR TESTING - Refer to your units circuit diagram to confirm how the SCR's are configured in your unit.

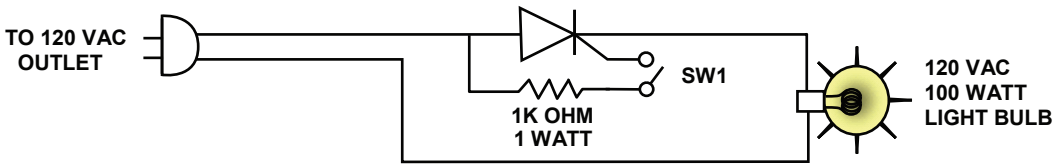
1. SCR under test must be isolated from the rectifier.

2. Hockey puck style SCR's must be clamped across the anode and cathode or left in its heat sink assembly when checking the SCR. Make sure the clamp does not damage the SCR surface and that the anode and cathode are not shorted by the clamping device.

3. With an ohm meter, measure as shown below:



Note: Occasionally an ohm check may not detect a faulty SCR. A working test circuit can be easily constructed to insure a properly functioning SCR as follows:



There should be no light with SW1 open and with SW1 closed, the lamp will glow with approximately ¾ brilliance.

SCR INSTALLATION

Proper alignment and torque of a hockey puck style SCR is required to obtain correct thermal impedance between the SCR junction and the heat sink.

1. Apply a thin coating of semi-conductor thermal compound to each side of the SCR.
2. Align the hockey puck with the centering pins on the heat sinks.
3. Tighten each bolt evenly on the clamp assembly.
4. With each bolt finger tight, additionally tighten each bolt in half turn increments for a total of 1 ½ turns.

DIODE TEST PROCEDURE

DANGER- HIGH VOLTAGE, TURN OFF ALL POWER BEFORE SERVICING

1. Isolate the diode by removing it from the circuit.

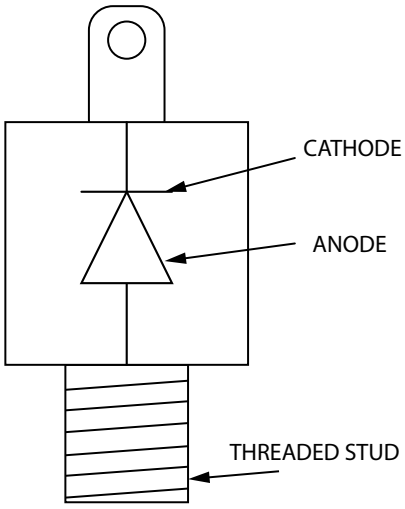
2. Place a digital multimeter on ohms position and use the diode scale.

3. Place negative meter lead on the cathode and positive on anode. You should read .400 -.500 on the meter. If you read a short or an open replace the diode.

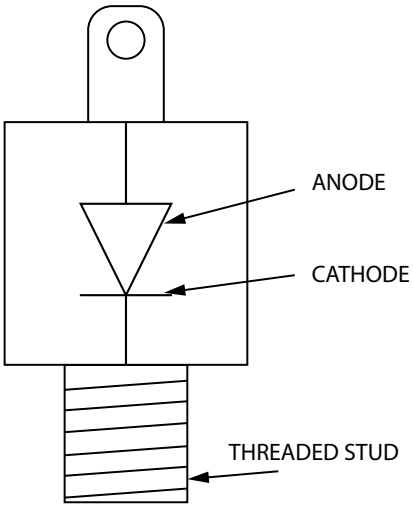
4. Reverse meter leads and place positive on the cathode and negative on the anode. You should read open. If you read a short, replace the diode.

5. There are 2 configurations on the stud type diode and you must note how the symbol on the side of the device is pointing. MAKE SURE the symbols direction is the same as the diode being replaced or the diode will fail instantly.

6. Apply a film of silicon conductive grease on the base of the diode to assure a good contact.



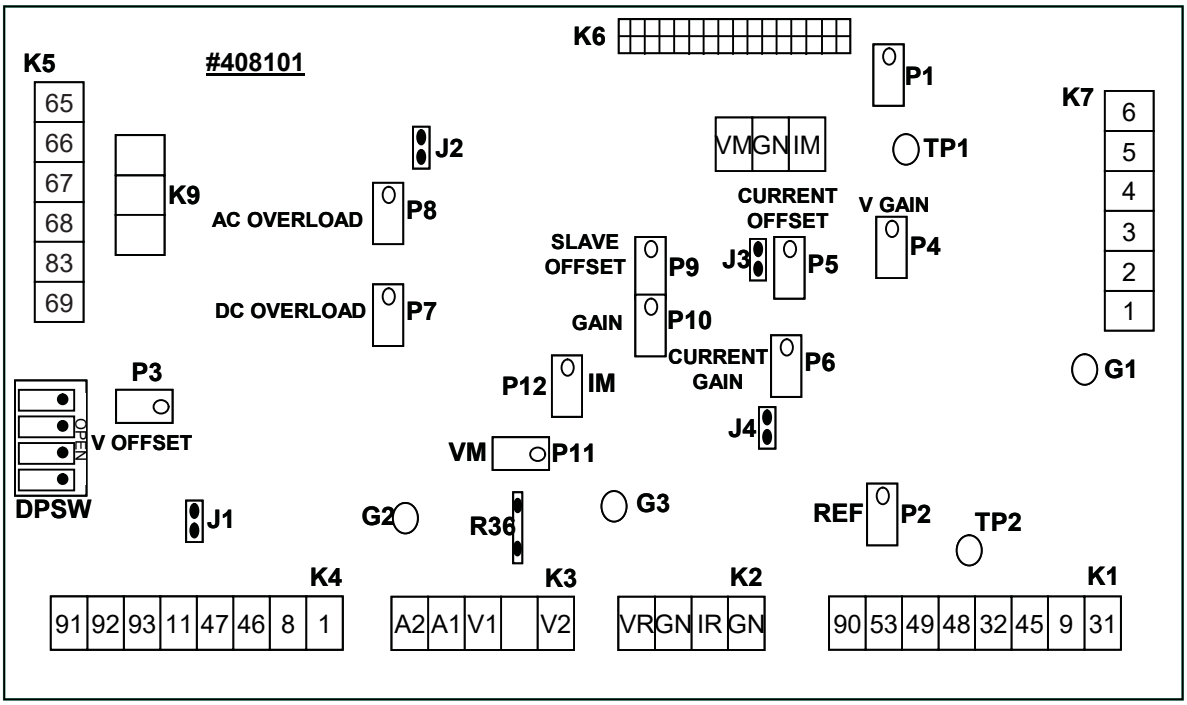
ANODE STUD



CATHODE STUD

ELECTRONIC PACKAGE CHECKS AND ADJUSTMENTS

OMNI CONTROL #408101



CONNECTORS

K1-9 & 31-120 VAC Supply.
K1-48 circuit common.
K1-53- D.C. disable (contact triggered).
K2-GN-circuit common.
K2-VR-output voltage PLC interface monitor signal.
K3-A2 & A1-0-50 MVDC D.C. output current feedback.
K4-46-0-7.5 VDC current control.
K4-11-0-5 VDC gate drive.
K5-65 & 66- slope enable (contact activated).
K5-68-slope input 0-7.5 VDC.
K5-83- slope adjust 0-7.5 VDC.
K7-1-output voltage interface.
K7-3-power supply + 14 VDC.
K7-5-circuit common.
K8-IM-0-7.5 VDC current output meter signal.
K8-GN-circuit common/K9-1-digital auxiliary input.

K1-32 & 45-Relay contact for D.C. on holding circuit.
K1-49 reference 7.5 VDC regulated.
K1-90 slave output signal 0-7.5 VDC.
K2-IR-output current PLC interface monitor signal.
K3-V2 & V1-D.C.output voltage feedback.
K4-1 & 8 module derating interface.
K4-47-0-7.5 VDC voltage control.
K4-91, 92, 93 A.C. current transformer signals.
K5-67 low output adjust 0-7.5 VDC.
K5-69- slope output 0-7.5 VDC.
K6- optional signal monitoring.
K7-2-amp hour output current interface.
K7-4- power supply-14 VDC.
K7-6 – power supply +5 VDC.
K8-VM-0-7.5 VDC voltage output meter signal.
K9-2-analog auxiliary input.

ADJUSTMENTS

P1-+5-CW increases.
P3-V offset-CCW raises DC output.
P5-I offset-CW-makes signal more neg. @ 1.
P7-DCOL CCW de-senses.
P9-slave offset CCW more positive @ 90.
P11-VM CW increases.

P2-Ref-CW increases.
P4-V gain-CW decreases DC output.
P6-I-gain CW lowers DC output I.
P8-ACOL CW de-senses.
P10-slave gain- CCW raises gain.
P12-AM CCW increases.

OMNI CONTROL #408101

TEST POINTS, JUMPERS, DIP SWITCH (DPSW), R36 (SCALE RESISTOR).

TP1 & G1-Regulated 5 VDC power supply for microprocessor.
TP2 & G1-Regulated 7.5 VDC reference.

G2-Isolated common for current feedback circuit.
G3-Isolated common for voltage feedback circuit.

N.O. Jumper-jump for normally open contact in D.C. on holding circuit @ connector K1-32 & 45.
N.C. Jumper-jump for normally closed contact in D.C. on holding circuit @ connector K1-32 & 45.

J1-Install jumper when using derating circuit on modular design units (2 or more modules), otherwise remove jumper.
J2-Install jumper to de-sensitize D.C. overload circuit.
J3-Remove jumper to increase current feedback gain.
J4-Remove jumper to increase slave signal gain.

Connector K7 terminal 5 (common) to 4=-14 VDC regulated.
Connector K7 terminal 5 (common) to 3=+14 VDC regulated.
Connector K1 terminal 9 & 31=120 VAC supply voltage.

DPSW-4 position dipswitch controls D.C. overload retry circuit and slope circuit. Position 1 & 2 controls the number of tries the D.C. overload will disable D.C. output power before final shutdown which requires a manual restart. Position 3 determines either a 0-2 min. slope cycle or 0-20 minute slope cycle. Either slope cycle is controlled by a users slope adjust knob. Position 4 is not used.

HOW TO PROGRAM "DPSW"

OVERLOAD TRIES	DIP SWITCH	
	POSITION 1	POSITION 2
3	0	0
2	0	1
1	1	0
0	1	1

SLOPE TIME	DIP SWITCH
	POSITION 3
0-2 MINUTES	1
0-20 MINUTES	0

R36 Scale Resistor – Used to scale voltage feedback signal at connector K3-V1 & V2.
Formula: (Rated D.C. Output Voltage –2.5) x 1000 = R36.

ADJUSTMENTS OMNI CONTROL #408101

1. Place DCVM on TP1 and G1, adjust P1 so the meter reads 5 VDC, clockwise increases voltage.

2. Place DCVM on TP2 and G1, adjust P2 so the meter reads 7.5 VDC, clockwise increases voltage.

3. Disconnect J3 connector from gate card part # 401600.

4. Turn output adjust knob to “0”.

5. Turn P3 completely clockwise (note this is a 10 turn pot). Place DCVM on terminals 48 and 11 and you should read-.5 VDC. While watching DCVM, slowly turn P3 counter clockwise until you see the signal on your DCVM start to go positive, STOP turning P3 now! While watching your DCVM, turn P3 SLOWLY until the DCVM starts to go negative. STOP turning P3 now! The DCVM should keep going negative until it is at about -.5 VDC again. This is an offset adjustment to set up your gate drive to “0”.

6. Reconnect J3 connector on the gate card #401600.

7. Place DCVM on connector K3 terminals V2 & V1. With no load on output, dial output adjust knob to maximum and adjust P4 (V Gain) to the units rated D.C. output. Clockwise decreases D.C. output.

8. With unit running at rated voltage output, place DCVM on connector K8 terminals GN & VM. Adjust P11 (Volt Meter Gain) so DCVM reads 7.5 VDC. Clockwise increases signal.

9. Place a load on the output that will draw full output current continuously. Turn output adjust to “0”. Place DCVM on terminals 48 and 1 and adjust P5 (Current Offset) until DCVM reads -.05 volts. Clockwise makes signal go negative.

10. Turn P7 (D.C. Overload) completely counter clockwise. Calculate your maximum D.C. shunt signal by using this formula:

.050 (Rated Shunt Signal)	/	Shunt Size (In D.C. Amperes)	X	Units Rated Output Current	=	Maximum Shunt Signal @ A1, A2 in Millivolts.

Example: .050 / 1000 X 800 = .04 or 40 Millivolts.

Place D.C. millivolt meter on connector K3 terminals A1 and A2. Turn output adjust to maximum and adjust P6 (Current Gain) to the calculated millivolt signal.

11. With unit running at rated current, place DCVM on connector K8 terminals GN and IM. Adjust P12 (Current Meter Gain) so DCVM reads 7.5 VDC. Counter clockwise increases signal.

12. With unit running at full current, turn P7 (D.C. Overload) clockwise until the D.C. output goes to “0”. STOP TURNING P7 NOW! Turn P7 counter clockwise 4 turns to desensitize D.C. overload about 5% of rated current and 6 turns for about 10%.

13. Place DCVM on 48 and Pin 3 of component A13. Adjust P8 (A.C. Overload) so DCVM reads 9-10 VDC. Clockwise raises signal.

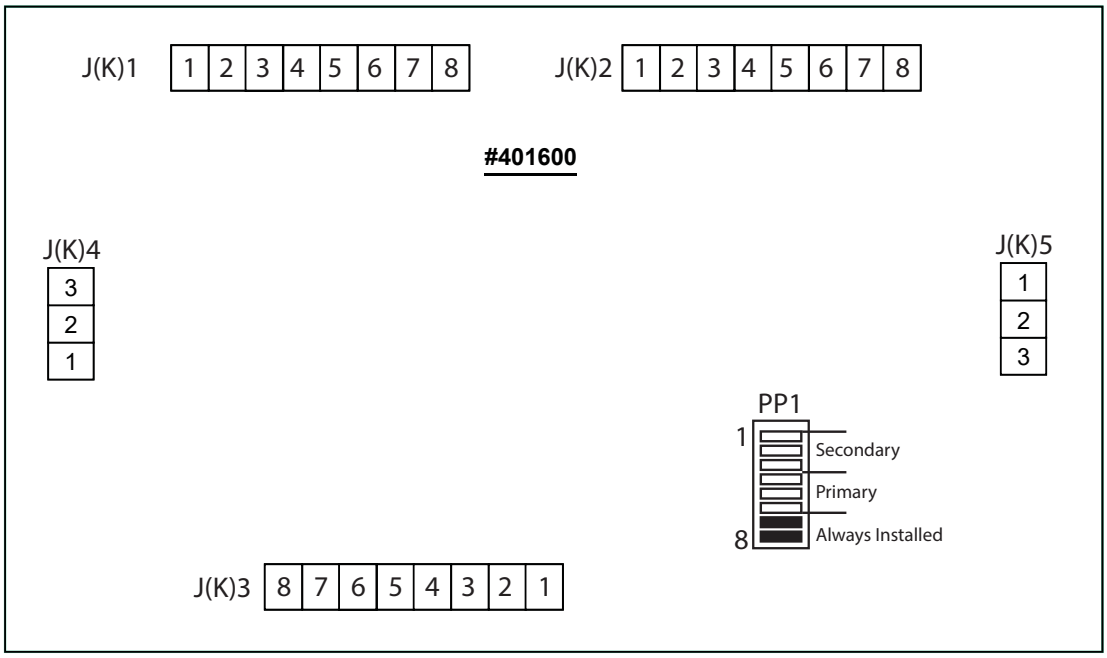
ADJUSTMENTS OMNI CONTROL #408101 CONTINUED

14. For units with slave option only:

    A. Turn output adjust to “0”. Place DCVM on terminal 48 and 90, adjust P9 (Slave Offset) so DCVM reads “0”. Clockwise makes signal go negative.

    B. Turn output adjust to maximum and with unit running at full current continuously adjust P10 (Slave Gain) so DCVM @ 48 and 90 reads 7.5 VDC. Counter clockwise raises signal.

OMNI GATE BOARD #406100



CONNECTORS, TEST POINTS:

J(K)1-1 SCR #1 Gate
J(K)1-2 SCR #1 Cathode
J(K)2-1 SCR #2 Gate
J(K)2-2 SCR #2 Cathode
J(K)3-1 Current Common
J(K)3-6-12 VDC
J(K)4-1 & 3 –120 VAC
J(K)6-7 Circuit Common
J(K)6-7 & 9 –12 VDC regulated

J(K)1-4 SCR #3 Gate
J(K)1-5 SCR #3 Cathode
J(K)2-4 SCR #4 Gate
J(K)2-5 SCR #4 Cathode
J(K)3-4-0-5 VDC Gate drive
J(K)3-2 Jumper to J3-6
J(K)5-1, 2 & 3 –16-18 VAC
J(K)6-7 & TP2 -5 VDC
J(K)6-7 & 10 –30 VDC unregulated

J(K)1-7SCR #5 Gate
J(K)1-8 SCR #5 Cathode
J(K)2-7 SCR #6 Gate
J(K)2-8 SCR #6 Cathode

J(K)6-7 & 6 –5 VDC regulated

PD1-LED when on, indicates phase loss at connector J(K)5 and disables the gate board. This is a 3 phase A.C. signal to synchronize gate pulses to the incoming A.C. line voltage and should be about 16-18 VAC across J(K)5 terminals 1, 2 & 3.

PD2-LED when on, indicates gate card is disabled. Connector J(K)3 terminal 2 & 6 must be jumped. Verify 12 VDC signal from J3-1 & 6, J3-1 & 2.

PERFORMANCE CHECKLIST

CONTROLLED POWER COMPANY

S-1800 AND S-2400 RECTIFIER PERFORMANCE CHECKLIST

SRO # : | DATE :

COMPANY :

SYSTEM NUMBER :

RATED DC VOLTS : | RATED DC AMPS :

COOLING : DRAW OUT AIR

PROCESS : BATCH

	OK	NOT OK	N/A	EXPLANATION OF ITEMS CHECKED "NOT OK"
ENVIRONMENTAL CHECKS				***COMMENTS***
CLEANLINESS (inside unit)	✓			
VENTILATION	✓			
AIR FILTERS	✓			
ROOM TEMP (Record Actual)				
CONNECTIONS TIGHTEN & INSPECT:				***COMMENTS***
A.C. BREAKER - LINE SIDE	✓			
A.C. BREAKER - LOAD SIDE	✓			
FAN MOTORS AND BRACKETS	✓			
MAIN A.C. CONTACTOR	✓			
MODULE TRANSFORMERS	✓			
CONTROL TRANSFORMERS	✓			
TERMINAL STRIPS	✓			
ELECTRONIC PACKAGE	✓			
SCR ASSEMBLY	✓			
SCR SNUBBER	✓			
DC CAPACITORS	✓			
CHOKE	✓			
RELAYS	✓			
DC BUSS	✓			
SCR FUSES	✓			
FUSE BLOCKS	✓			
D.C. SWITCH	✓			
CIRCUIT BOARD CHECKS				
CONTROL BOARD				***ACTUAL VALUE***
POWER SUPPLY (+5VDC)	✓			
POWER SUPPLY (+14VDC)	✓			
POWER SUPPLY (-14VDC)	✓			
REFERENCE	✓			
DC OVERLOAD	✓			
R SCALE	✓			
GATE BOARD				***ACTUAL VALUE***
POWER SUPPLY (+5VDC)	✓			
PULSE TRANSFORMER (1)	✓			
PULSE TRANSFORMER (2)	✓			
PULSE TRANSFORMER (3)	✓			
PULSE TRANSFORMER (4)	✓			
PULSE TRANSFORMER (5)	✓			
PULSE TRANSFORMER (6)	✓			

SCR1	G-K (1)		A-K (1)	
SCR2	G-K (2)		A-K (2)	
SCR3	G-K (3)		A-K (3)	
SCR4	G-K (4)		A-K (4)	
SCR5	G-K (5)		A-K (5)	
SCR6	G-K (6)		A-K (6)	

PERFORMANCE CHECKLIST CONTINUED

CIC BOARDS				ACTUAL VALUE
VOLTAGE CONTROL	✓			
VOLTAGE MONITOR	✓			
CURRENT CONTROL	✓			
CURRENT MONITOR	✓			
EP VOLTAGE CHECKS				**ACTUAL VALUE**
SLOPE (48-83)	✓			
SLOPE IN (48-68)	✓			
SLOPE OUT (48-69)	✓			
GATE DRIVE (48-11)	✓			
SLAVE (48-90)	✓			
VOLTAGE (48-47)	✓			
CURRENT LIMIT (48-46)	✓			
OPERATIONAL CHECKS				
SAFETY CIRCUITS				**COMMENTS**
TRANSFORMER OVERTEMP	✓			
FILTER CHOKE OVERTEMP	✓			
SCR OVERTEMP THERMAL	✓			
SCR HIGH TEMP WARNING THERMAL	✓			
DOOR INTERLOCK	✓			
MAIN SHUNT TRIP	✓			
EMERGENCY STOP	✓			
DE-RATING CIRCUIT	✓			
CONTROL CIRCUITS				**COMMENTS**
DC ON	✓			
DC OFF	✓			
HOLDING VOLTAGE	✓			
SLOPE CONTROL	✓			
UNDER VOLTAGE	✓			
RIPPLE METER	✓			
AC CONTACTOR	✓			
	✓			
MISC				**COMMENTS**
VOLTMETER	✓			CALIBRATED? YES
AMMETER	✓			CALIBRATED? YES
SLAVE CONTROL	✓			
MASTER CONTROL	✓			
CABINET FANS	✓			
SCR FANS	✓			
	✓			
MODULES				**COMMENTS**
NUMBER OF MODULES		AIR		
FWD DIODES	✓			
REV DIODES	✓			
DIODE THERMALS	✓			
SNUBBER BOARDS	✓			
RESISTOR	✓			
FAN MOTORS	✓			
FAN BLADES	✓			
MODULE BREAKERS	✓			
INTERPHASE COIL	✓			
FUSES				**COMMENTS**
CONTROL FUSES	✓			
SCR FUSES	✓			
DC FUSES	✓			
FILTER FUSES	✓			

PERFORMANCE CHECKLIST CONTINUED

OUTPUT RIPPLE					COMMENTS
VAC				VAC	
VDC				VDC	
% RIPPLE				@ AMPS DC	
CAPS				VAC	

INPUT MEASURMENTS						COMMENTS
PHASE ROTATION			✓			
ØA - ØB		VOLTS	✓			
ØB - ØC		VOLTS	✓			
ØC - ØA		VOLTS	✓			
ØA		AMPS	✓			
ØB		AMPS	✓			
ØC		AMPS	✓			

WATER COOLED				COMMENTS
LEAK SENSOR	✓			
RADIATOR	✓			
THERMOSTAT	✓			
WATER SOLENOIDS	✓			
WATER LEAKS	✓			
HOSE CLAMPS	✓			

QAF #: 19.29	SUBJECT: S-1800 AND S-2400 RECTIFIER PERFORMANCE CHECKLIST	**Revision #: 3**
Effective Date: 10/19/20	APPROVED BY: Service Department	**Page #:3 of 3**

Contact Controlled Power Company.

PRODUCT SUPPORT SERVICES

Controlled Power Company offers total Customer Support that assures your critical equipment is maintained properly for trouble free operation.

SPARE PARTS

DC power supplies are made to order and do not always share the same parts. To obtain a complete parts list please contact Controlled Power Company's Customer Support Department at 1-800-521-4792 or 1-248-528-3700. We highly recommend that spare parts are purchased for your stock since your rectifier controls a critical part of your operation. Any down time will surely exceed the cost of a simple part if it is not available when needed. When ordering parts please obtain the units system number located on the specification tag typically located on the inside door near the main AC input breaker.

EMERGENCY SERVICE:

Call our 24 hour hotline at 1-800-521-4792 or 1-248-528-3700 for emergency service or to dispatch our field technicians.

TRAINING SEMINARS

Controlled Power Company offers hands on training at our factory in Troy, Michigan or at your site on your equipment.

PREVENTIVE MAINTENANCE

Scheduled preventive maintenance assures that your equipment is running 100% keeps your maintenance personnel familiar with the equipment, and makes sure your spare parts are working or in need of replenishing.

Call 1-800-521-4792 or 1-248-528-3700 for more information on any of our services.

WARRANTY

This Warranty applies only to the original purchaser who must properly register the product within thirty (30) days of receipt.

https://controlledpwr.com/customer-support/warranty-registration/

Controlled Power Company warrants that our products and their components will remain free from defects in material and workmanship for the period of one (1) year from the date of shipment and agrees to replace, F.O.B. its factory, any parts which fail through defect in material or workmanship during such period.

1. This Warranty shall be effective only if and so long as the system is installed and operated in the manner specified in the manual which accompanied the product, and is operated within the ratings on the nameplate of the system.

2. This Warranty shall be effective provided the purchaser pays the cost of transporting the faulty component(s) to and from Controlled Power Company's factory at the purchaser's own expense. There is no cost for installation of the replacement component(s) when done at the factory. Otherwise installation of the replacement component(s) are the responsibility of the purchaser. If after inspection the faulty component has been caused by misuse or abnormal conditions in the judgment of Controlled Power Company, the purchaser will be charged for repairs based on parts and labor required. This Warranty does not cover fuses, light bulbs, and other normally expendable items. Controlled Power Company service personnel are not included in this warranty.

3. This Warranty shall be void if any alteration is made to the system, or any of its components are altered by anyone other than an authorized Controlled Power Company service person, without the written permission of Controlled Power Company.

4. This Warranty is in lieu of all other warranties, expressed or implied. Controlled Power Company neither assumes, nor authorizes any person to assume for it, any liability other than that specifically set forth in this Warranty. Except for its obligations, Controlled Power Company assumes no liability or responsibility for personal injury, loss of life, consequential or other damages resulting from defects in, or failure of, the system or any of its components.

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