

SERIES 30 AIR / WATER COOLED



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



CAUTION

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.



SHOCK HAZARD

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.

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. Clicking any blue text will take you to that section of our website.

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INTRODUCTION

Trystar 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 30 is a primary SCR, single transformer, DC power supply for low voltage plating/anodizing applications. It is available in air- or water-cooled configurations; plus NEMA 1, NEMA 2, NEMA 3R, or NEMA 4X enclosure ratings.

Input voltages ranging from 208V – 600VAC, three phase 60Hz or 50Hz

Input AC Voltage: 208V – 600V

Output DC Voltage Range: 6V – 100V

Output DC Current Range: 500A – 10,000A

FEATURES & BENEFITS

- Highly efficient all-copper transformer construction
- Standard remote control panel
- Air- or water-cooled flexibility
- Domestic and international voltage capability
- Low ripple
- Tight voltage and current regulation
- Diagnostic options for ease of maintenance

APPLICATIONS

- Plating
- Anodizing
- Electro-machining
- Testing
- Electro-winning
- Electro-galvanizing

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 Line Variation: $\pm 5\%$ from nominal ($\pm 10\%$ optional)
- Output Voltage Regulation: $\pm 0.5\%$
- Output Current Regulation: $\pm 0.5\%$
- AC RMS Output Ripple at Full Voltage and Current: 5% RMS
- Optional AC RMS Output Ripple at Full Current: 1% or 5% @ 25% to 100% output voltage
- Efficiency 85% – 90%

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.

MAIN TRANSFORMER - The design of the power transformer section of this power supply is of the highest quality and reliability. The power transformer is a ventilated, dry type. The primary circuit is (3) three phase, ungrounded, delta connected. The secondary is a (6) six pulse star. ANSI circuit # 9 standard 34.2.

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.

The primary is separated from the core and secondary by a double layer arc resistant barrier (nomex) 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 stand-off or support insulators for both transformer leads and other rectifier bus are glass materials. Organic materials are not used for bus or cable support due to possible deterioration.

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.

RECTIFIER CIRCUIT - A six (6) phase star, USAS circuit No. 9 is used.

Output rectification is by means of silicon diodes.

DIODES - Diodes have a minimum Peak Reverse Voltage rating of 2 ½ times the Peak A. 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 are rated for continuous full load operation. The power supply incorporates a sensing circuit to detect a phase imbalance in the unlikely event of a device failure. This 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 - Forced Air Cooled Transformer and direct water cooled semiconductor devices. The heat is removed from the enclosure by an air over water cooling system. 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
- Pressure Gauge

CONTROLS - A remote operator's control panel is provided as a standard item which includes the volt meter, ammeter, control potentiometer, volt/amp switch, start/stop/power off push buttons and some option components may also be included. The enclosure is constructed to NEMA 12 standards.

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 limited value.

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 CONTROLS CONTINUED

DC OVERLOAD - Digitally enhanced overload circuit allows selection of one of four settings from zero (0) to three (3) restat 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

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.

Signal conditioners fully isolate interface signals to control and monitor the DC output. One of the following signals can be specified 4-20 milli-amp, 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.

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

DC OUTPUT - The DC output of the unit is floating. Either terminal may be grounded.

PROTECTION

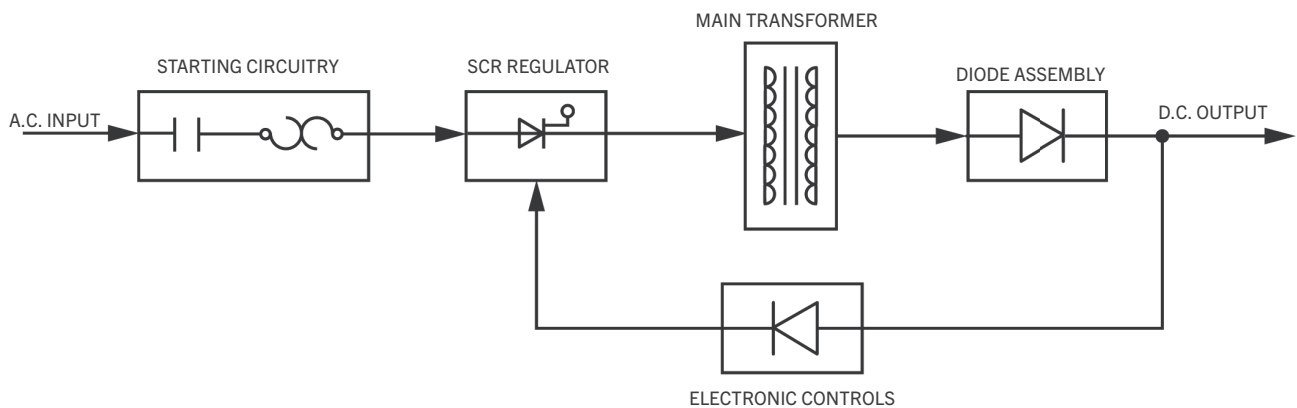
PRIMARY PROTECTION - Primary protection is achieved by fast acting electronic circuitry which shuts the rectifier down under fault conditions. Back-up protection is provided by means of an AC Magnetic Starter (Contactor with thermal-magnetic overloads). This starter is IEC rated and sized to interrupt the fault current of normal installations.

THEORY OF OPERATION

The overall function of any Controlled Power Series 30 D.C. Power Supply is to convert AC power to DC power. There are six major building blocks to each supply. The function of each block is:

1. **Starting Circuitry** - An electrically operated contactor with a current overload device in each incoming phase to provide the “on” and “off” function, AC over current protection and isolation from the incoming AC power line.
2. **SCR Regulator** - Three inverse parallel pairs of SCR’s provide full range (0 to 100% of rated) control of the output voltage.
3. **Electronic Controls** - The Controlled Power Omni gate card and control amplifier card combine to “tell” the SCR’s what to do.
4. **Main Transformer** - This block serves to isolate the input and output voltages from one another as well as stepdown the incoming AC voltage to lower voltages required by the application.
5. **Diode Assembly** - The solid state silicon devices that convert the AC voltage to DC.

BASIC BLOCK DIAGRAM



RECEIVING THE POWER SUPPLY

WARNING

Inspection, placement, installation, setup and Start-up should be performed by qualified Personnel only

INSPECTION

As all units are normally shipped F.O.B. Trystar, 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.

SAFETY PRECAUTIONS

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.

PRELIMINARY INSTALLATION

SELECTING A LOCATION

Your DC 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.

All units which are air-cooled should be installed in a clean, dry, ventilated location with enough clearance (approx. 24 in.) at the top of the unit. Allow clearance for door swings. Allow a minimum of 36" service clearance on all sides of the unit (including the back). Some internal components are only accessible through the rear of the unit.

Do not install near furnaces, radiators, or other heat generating sources. It is desirable to locate the unit in a separate room adjacent to the operating area, thus isolating it from the poor environmental conditions which may exist.

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

INSTALLATION SUGGESTIONS

If the unit is located in an operating area, precaution should be taken to protect it from splashing, fumes, vapor from the tanks, and dripping from overhead pipes. Do not install units in a location where they are subject to airborne dirt.

WATER COOLED UNITS

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.

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.

SERIES 30 DC POWER SUPPLY

 TRYSTAR

SYSTEM NO.: P-12-10746-90

A.C. INPUT		D.C. OUTPUT	
VOLTS:	480	VOLTS:	480
PHASE:	3	AMPS:	500
HERTZ:	60	RIPPLE:	5%
KVA:	240	FULL OUTPUT	

CONTROL CIRCUIT VOLTAGE: 120VAC
AMBIANT RANGE: 0-40C
ELECTRICAL DIAGRAM: #400654

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.

INSTALLATION

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 than 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 mA 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

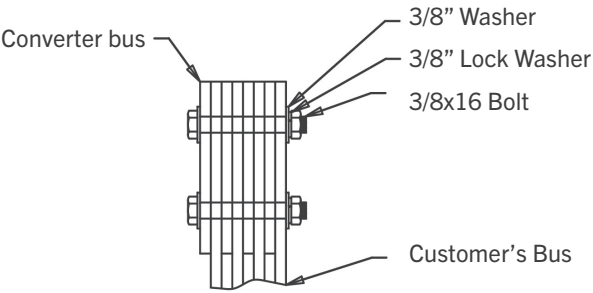
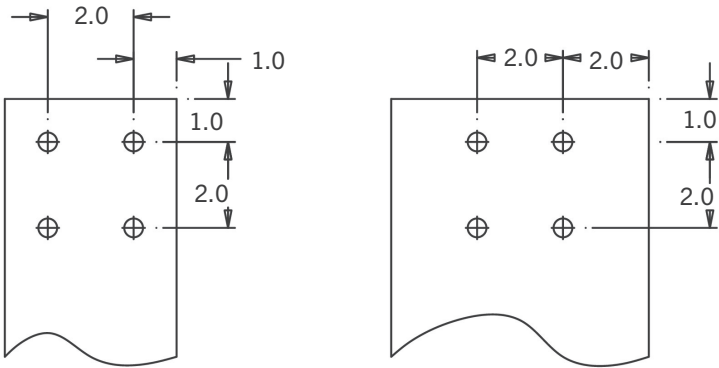
The D.C. output connection will vary in size depending on the rated D.C. output. Refer to your unit’s circuit diagram and the unit’s data plate to obtain the D.C. output rating. Follow guidelines as specified in the National Electric Code. Make sure to inspect the units D.C. output connections in order 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.

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.

ALL HOLE 7/16" DIAMETER



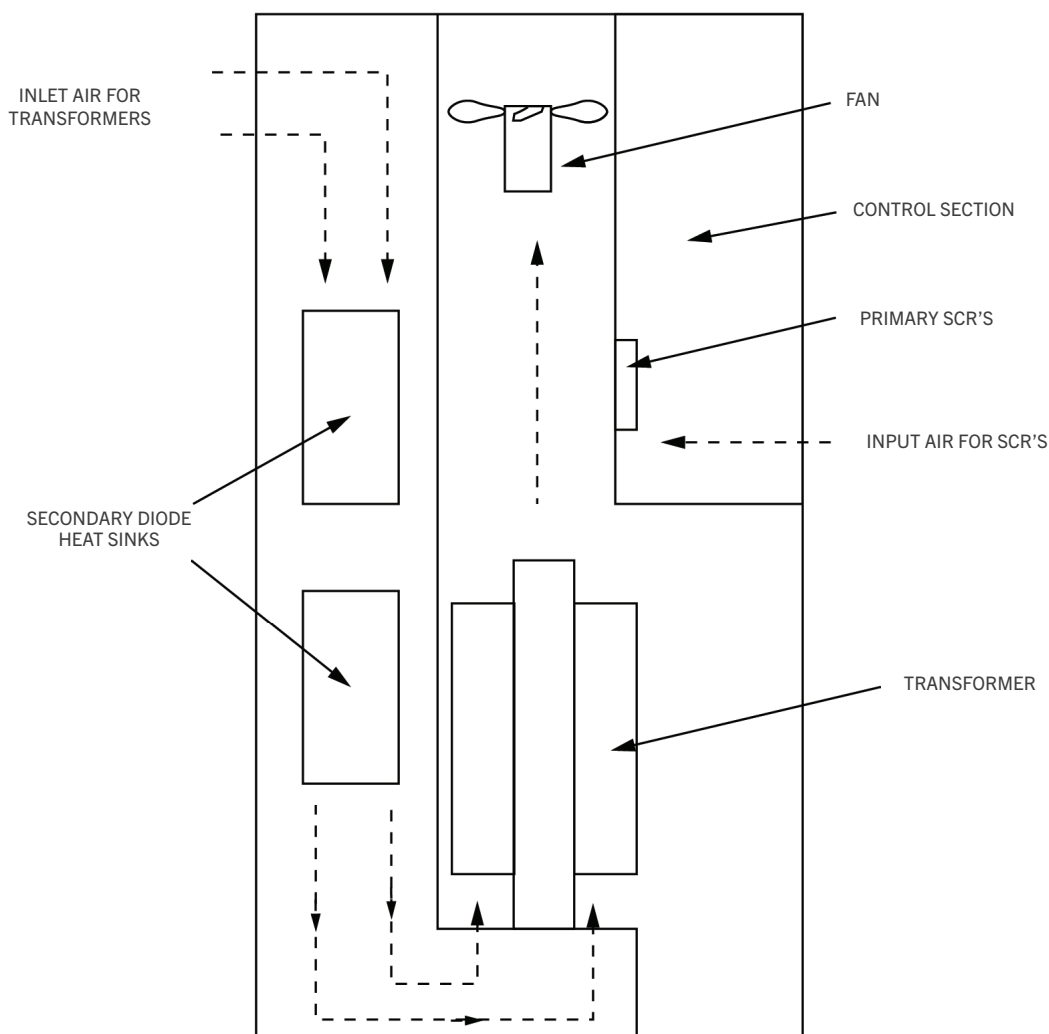
COOLING SYSTEM

The sixth major building block is the cooling system. Conversion of energy causes heat to be generated, and this heat must be removed from the power supply components and enclosure in order for the unit to operate properly.

Three types of cooling are available. Air Cooling, Water Cooling and Convertible Air or Water Cooling.

AIR COOLING

This system uses a fan to draw air into the power supply enclosure, force it over and through the components to be cooled, and exhaust it from the enclosure.

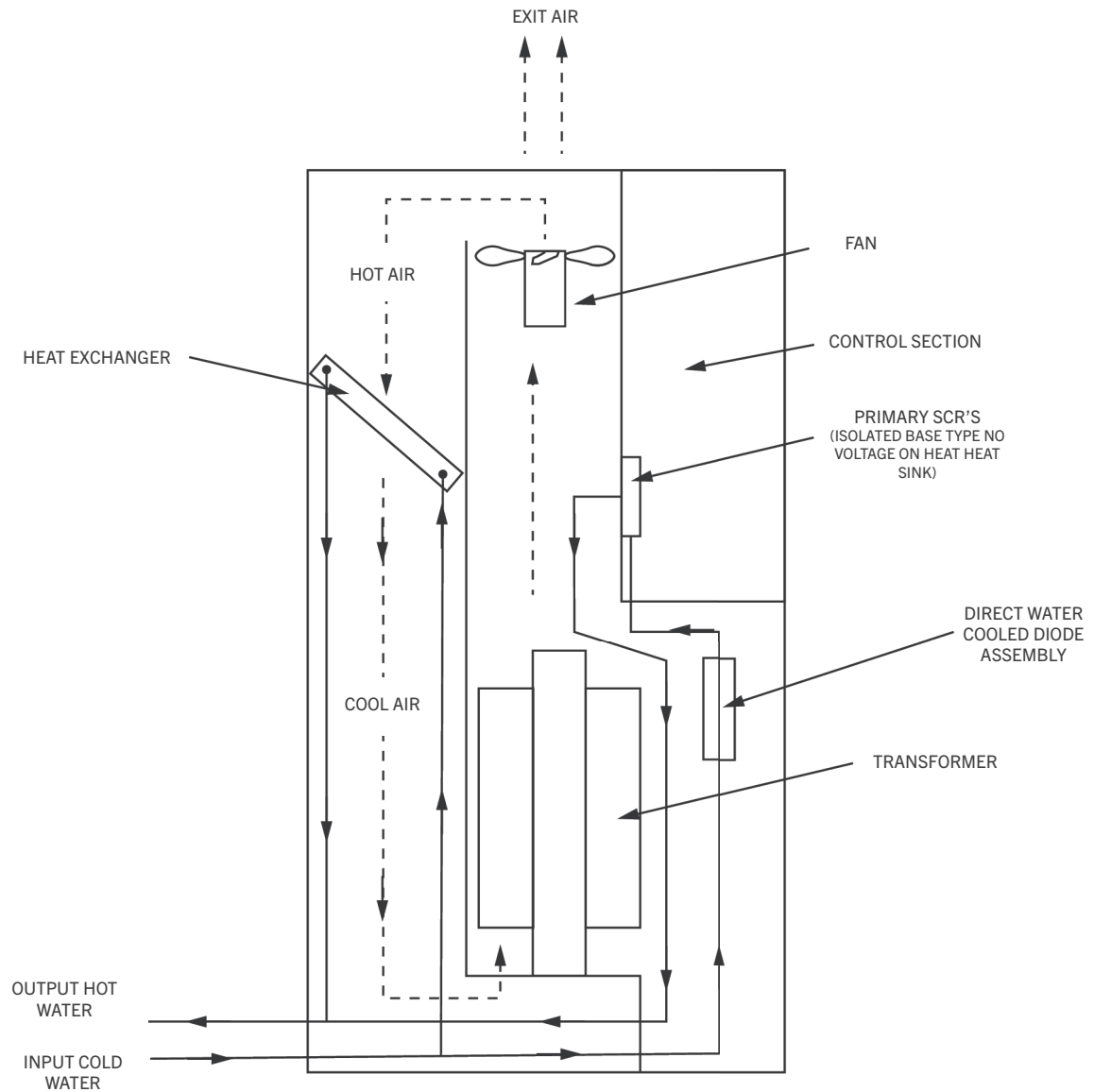


COOLING SYSTEM CONTINUED**WATER COOLING**

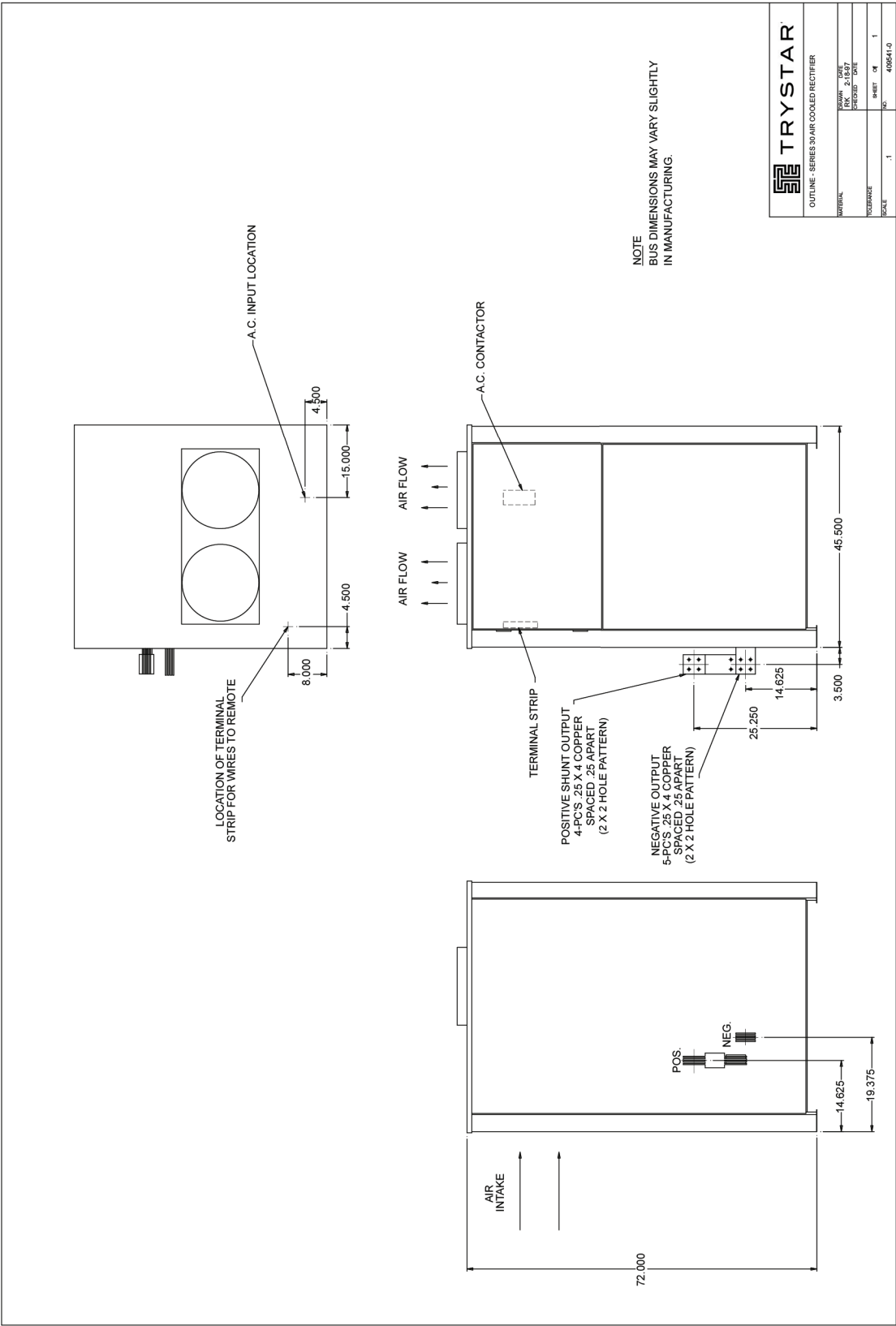
This system uses the plant water supply to remove the heat. The diodes and SCR's are cooled by water which flows through cooling passages built into the heat sinks on which they are mounted.

The transformer is cooled by air which is circulated inside the enclosure and cooled by means of an air to water heat exchanger. This eliminates the need to flow water directly through the transformer windings.

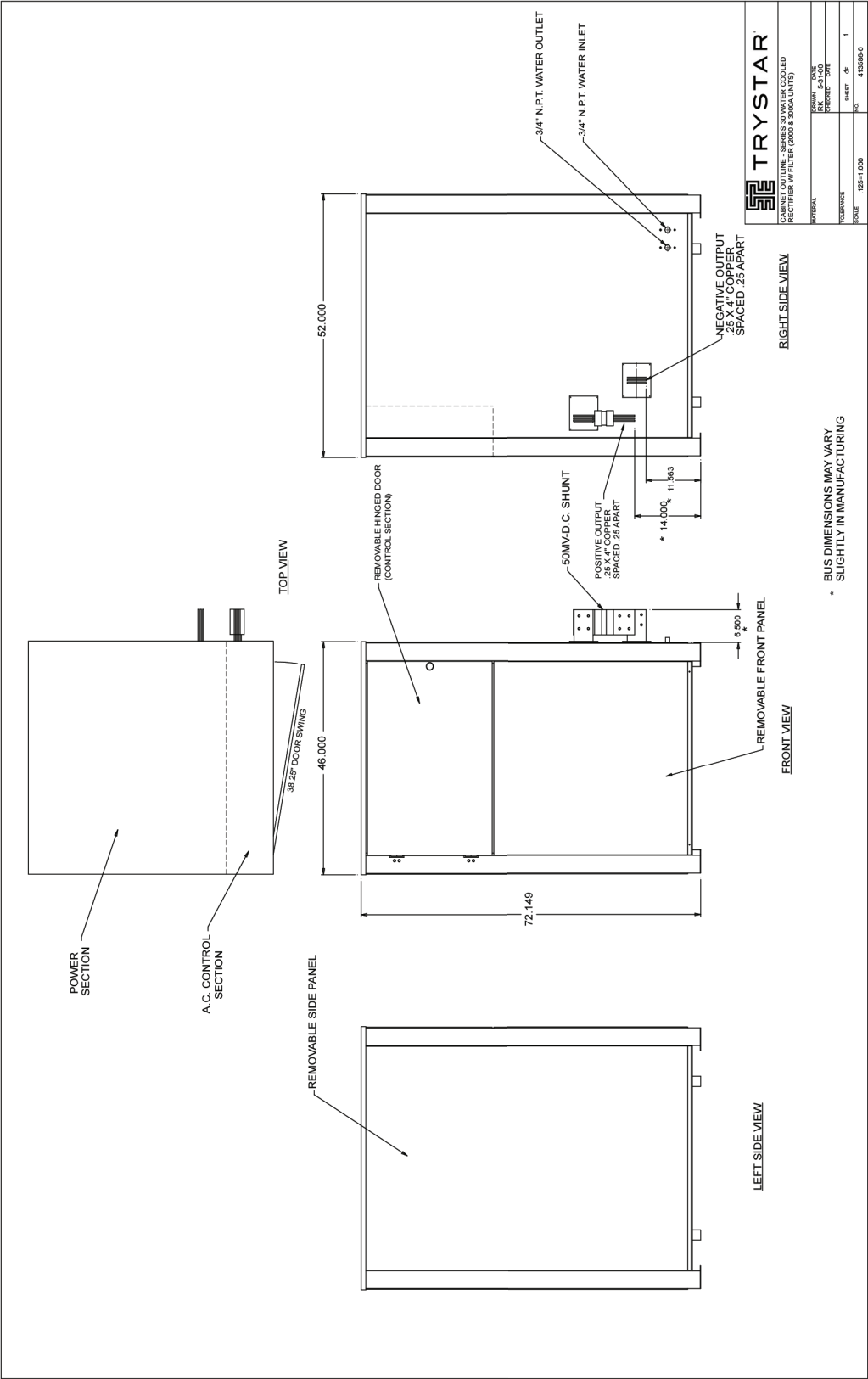
All high-voltages, (above 100 volts) are isolated from the cooling water.



TYPICAL CABINET OUTLINE - AIR COOLED



TYPICAL CABINET OUTLINE - WATER COOLED



COMPONENT DESCRIPTION

STARTER

The starter provides for remote “on-off” of the power supply during normal operation as well as back-up protection for the rectifier.

The starter will be de-energized and the power supply shut down in case of excessive line current, excessive DC current or component over temperature.

The sizing of the contactor deserves special mention. This depends primarily on the AC line current, and the type of “duty” the starter will see. The most conservative rating is the UL rating listed on the contactor. The maximum rating is the IEC AC rating which is also listed on the contactor. A safe rating for rectifier duty is somewhere between the UL and IEC ratings.

CURRENT TRANSFORMERS

Controlled Power DC power supplies have an electronic current overload protection (E-Cop) circuit built into the electronic controls. The current transformers are part of this circuit.

SILICON CONTROLLED RECTIFIER (SCR)

SCR's are used to regulate the output voltage of the DC Power Supply. This device allows current flow in one direction only (from anode to cathode) so they must be used in pairs (“back to back” or inverse parallel) to achieve full range control of the AC voltage. A three phase system requires one pair of SCR's in each of the three incoming power lines- a total of six devices.

SCR's (sometimes called thyristors) come in both stud type and “Hockey-Puck” type. (Figure #7) and Power Module Type (Figure #8) which is pre-package set of 2 SCR's back to back on an isolated base. Both types are mounted to heat sinks and proper mounting is very important. Overheated SCR's are a major cause of power supply failure..

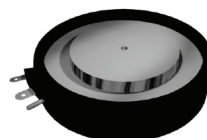


FIGURE #7



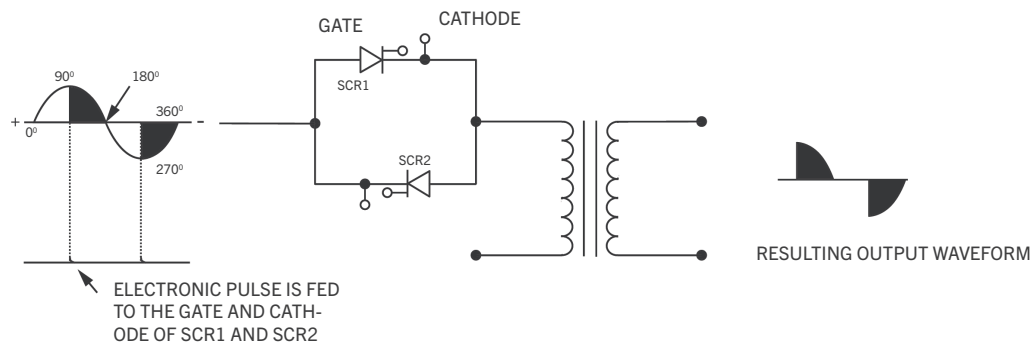
FIGURE #8

PHASE CONTROL

On the positive half-cycle of the input waveform, the anode of SCR1 is positive with respect to the cathode. At any time during the positive half-cycle, a positive pulse between the gate and cathode of SCR1 will cause conduction to the end of the positive half-cycle. This occurs at 90° in the illustration above. The voltage on SCR1 will reach zero at 180°, and SCR1 will stop conduction.

A second pulse is fed between the gate and cathode of SCR2 when the anode of SCR2 is positive, which is during the negative half-cycle of the input waveform. As illustrated in Figure 9, this pulse occurs at 270°. SCR2 will conduct from 270° to 360° of the input waveform. The waveform across the transformer will consist of the conducting portion of the input waveform as indicated in Figure 9. By time shifting the gate pulse with respect to input waveform, the output voltage of the power supply can be controlled. A three phase system operates in a similar manner.

PHASE CONTROL CONTINUED



DV/DT PROTECTION

An electronic RC network (snubber) is used to provide dv/dt (voltage spike) and di/dt (current surge) protection for the SCR's.

MAIN TRANSFORMER

The main transformer isolates the incoming power line from the DC output, and steps-down the incoming AC voltage to a level needed for a specific DC voltage output.

The transformer is built using all copper conductors, grain orientated steel and class H (220° C) insulation. It is forced air cooled in both air and water cooled rectifiers.

DIODE ASSEMBLY.

Diodes are silicon devices which conduct in only one direction. As with SCR's, diodes are commonly available in stud type and hockey-puck type. They are mounted on heat sinks to provide cooling and proper mounting is essential.

The Controlled Power Series 30 rectifier utilizes a USA's circuit No. 9 (six phase star).

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 in conjunction with an ammeter to monitor the output current as well as by the electronic controls for current control, D.C. overload and current limit.

ELECTRONIC CONTROL TRANSFORMER

Provides power for the trigger and amplifier boards.

CONTROL TRANSFORMER

Steps down the primary line voltage to 115 volts, single phase, for use in the control circuit.

PROTECTIVE DEVICES

Protection for the rectifier is provided by the following means:

1. **AC Overload Relays** - These will trip with excessive AC line current and will shut off the power supply.
2. **Fan Motor Overload Relays** - These will trip with excessive motor current and will shut off the rectifier.
3. **Thermal Overloads** - Thermal overloads are used to sense the operating temperature of the SCR's, diodes and main transformer. If these items exceed safe temperature limits, the power supply is shut down.
4. **DC Overload** - If the DC output current exceeds the rating of the rectifier, the fast acting DC overload circuit will shut off the rectifier.
5. **Electronic-Current Overload Protection (E-Cop)** - Excessive instantaneous AC line currents and current unbalance are sensed via current transformers the E-Cop circuitry will turn off the gating to the SCR's and shut the power supply down.

AIR COOLING SYSTEM

COOLING FAN ASSEMBLY

A three phase TEBB motor directly drives an axial fan which forces ambient air through the components to be cooled. The rectifier is designed to operate at full rating with an ambient air temperature of 40°C (104° F) maximum. At higher ambient temperatures, the rectifier output must be de-rated.

WATER COOLING SYSTEM

Series 30 water cooled DC power supplies have a hybrid cooling system, direct water cooled diode, SCR heat sinks, air-over-water cooled transformer and cabinet.

SOLENOID VALVE

The cooling water flow is controlled (on and off) by an electrically operated valve to prevent condensation and conserve water. It is also interlocked with a leak detector circuit. Should water be detected in the cabinet, the unit shuts down and the valve is closed stopping all water flow.

DIODE HEAT SINK

All copper heat sinks with water paths are utilized to cool the diodes. Since these devices are on the low voltage side of the main transformer, there is no isolation between the cooling water, the heat sink and the diode. Overtemperature thermal sensors are used to protect the devices should water flow become insufficient.

SCR HEAT SINK

A copper heat sink with internal cooling water paths is used to cool the SCR's. Since these devices are on the line or high voltage side of the main transformer, they are electrically isolated from the heat sink and the cooling water. They also have over-temperature thermal sensors to protect the devices should water flow become insufficient.

HEAT EXCHANGER

The air to water heat exchanger is used to cool the main transformer and the inside of the power section enclosure. It is constructed of copper water tubes and aluminum fins.

COOLING FAN

A TEBB three phase motor drives a direct connected high pressure axial fan. This fan circulates internal air through the main transformer and the cooling coil.

CONTROLS**SCR FIRING PACKAGE**

The OMNI three phase unipolar SCR firing board is used in all Controlled Power Series 30 DC power supplies.

This control has a built-in phase loss inhibit circuit which removes gate drive if a power line phase voltage is missing. It incorporates phase-locked loop circuitry which is not affected by frequency or phase rotation.

ELECTRONIC CONTROLLER

This control continuously monitors AC line current and balance, DC load current and DC terminal voltage. Under fault conditions, it signals the firing package to "turn off" the SCR's and opens the AC contactor with overload.

Also, this control responds to voltage and current potentiometer settings (inputs) to adjust the SCR firing angle and maintain a constant DC voltage or current.

OPERATION

CONTROL FUNCTIONS

1. **Automatic Voltage Control with Current Limit** - This control maintains the DC output voltage constant at a level set by the “voltage” pot. For example, the operator may adjust the DC voltage of a 12 volt (max) rectifier to 10 volts. The control will adjust the firing of the SCR’s as needed to keep the voltage at 10 volts $\pm 1\%$ or $\pm .12 \pm$ volts. (1% of the rated 12 volts).

If the DC output current should try to exceed the current limit setting, the voltage control will be over-ridden and the voltage will drop until the current is at the limit point. The current limit is set by adjusting the “current” pot and usually is set at full rated output 100%.

2. **Automatic Current Control with Voltage Limit** - This control maintains the DC output current constant at a level set by the “current” pot. 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 at 800 amperes $\pm 1\%$ or ± 10 amps (1% of the rated 1000 amperes).

The DC output voltage will not be allowed to exceed the setting of the “voltage” pot.

3. **Current Density Control (optional)** - This control is a variation of automatic voltage control and has limited application. It cannot control amps per square foot, but can help to achieve an “average current density” per rack in a large multi-station tank. It does this by sensing the increase in the DC output current of the power supply and proportionally raising the DC output voltage. This compensates for voltage drops in the system (bus drop, contact resistance, etc.) and keeps the voltage at the tank more constant. Thus we get closer to the desired current required as racks of parts are added. This system works best if all racks have the same number of identical parts (same area).

Picture a large nickel tank with 8 stations. Manually put in the first rack of parts, and adjust the “voltage” knob until the desired DC current is achieved, say 1000 amps. (At this point, the “current density” knob is at zero). Then put in the rest of the 7 identical racks (loads).

The total DC current will now be something less than 8000 amps (1000 amps x 8 racks). Now turn the current density adjustment up until the ammeter reads 8000 amps. This completes the set-up procedure.

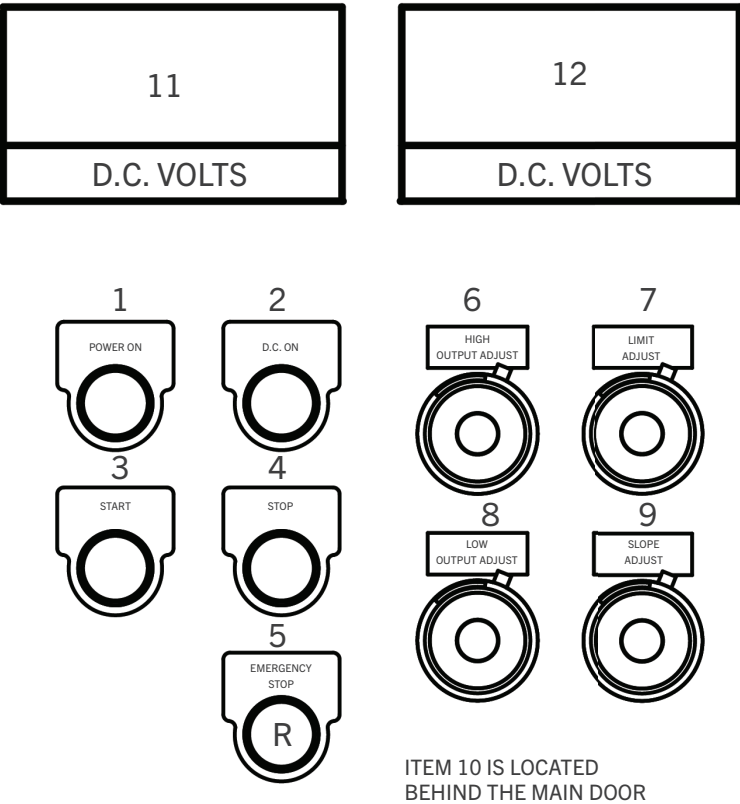
4. **Ramp Control (optional)** - The purpose of this control is to linearly increase the output of the rectifier to a preset voltage (or current) in a preset time. The standard time range is 0 to 20 minutes. The target voltage (or current) is set by the appropriate output adjust pot on the

remote control panel. The ramp time is set by means of a 10-turn pot mounted inside the remote panel.

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 of the unit or the remote enclosure. The volts/amp switch (when provided), is located inside the front door of the unit or remote enclosure.



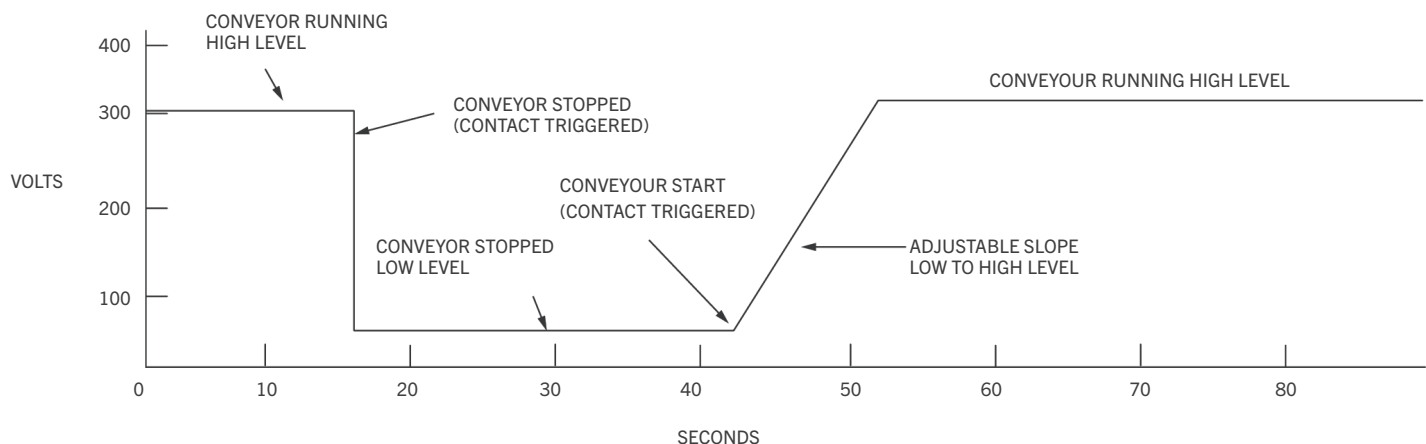
1. **Power On** - Light to indicate that the main circuit breaker is energized.
2. **DC On** - Light to indicate that the AC contactor is energized and power is supplied to the rectifier electronics.
3. **Start** - Energizes the AC contactor and turns the DC output on.
4. **Stop** - De-energizes the AC Contactor 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.

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.

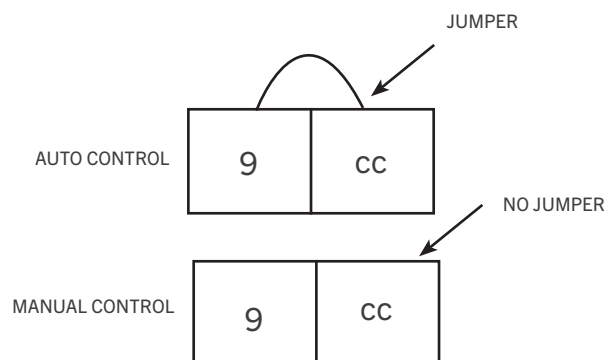
12. D.C. Amperes - D.C. Output Amps reading.

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

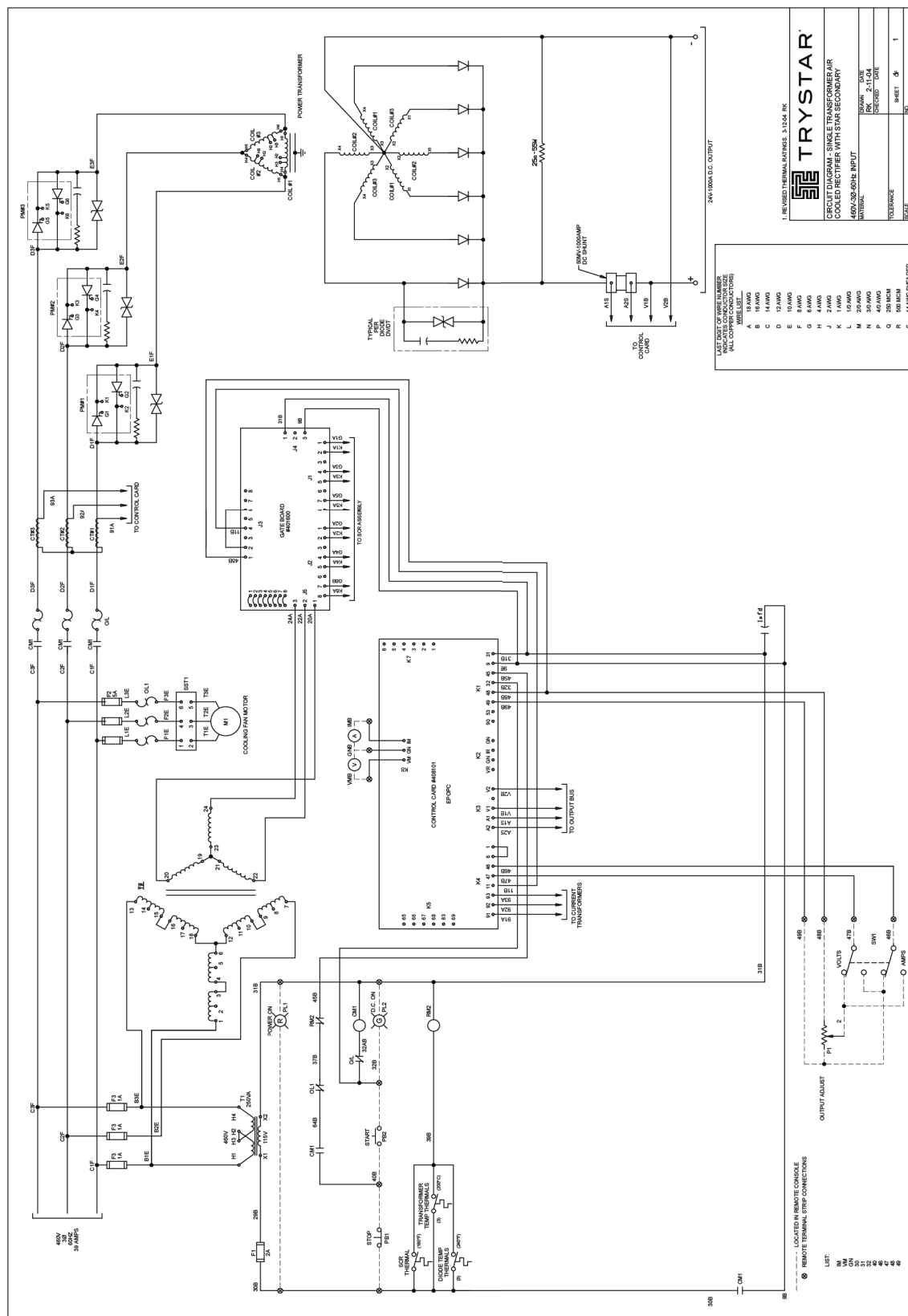
AUTOMATIC CONTROL AND MONITOR OPERATION (Optional)

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 Trystar rectifier.



TYPICAL CIRCUIT DIAGRAM



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

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

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

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.

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.

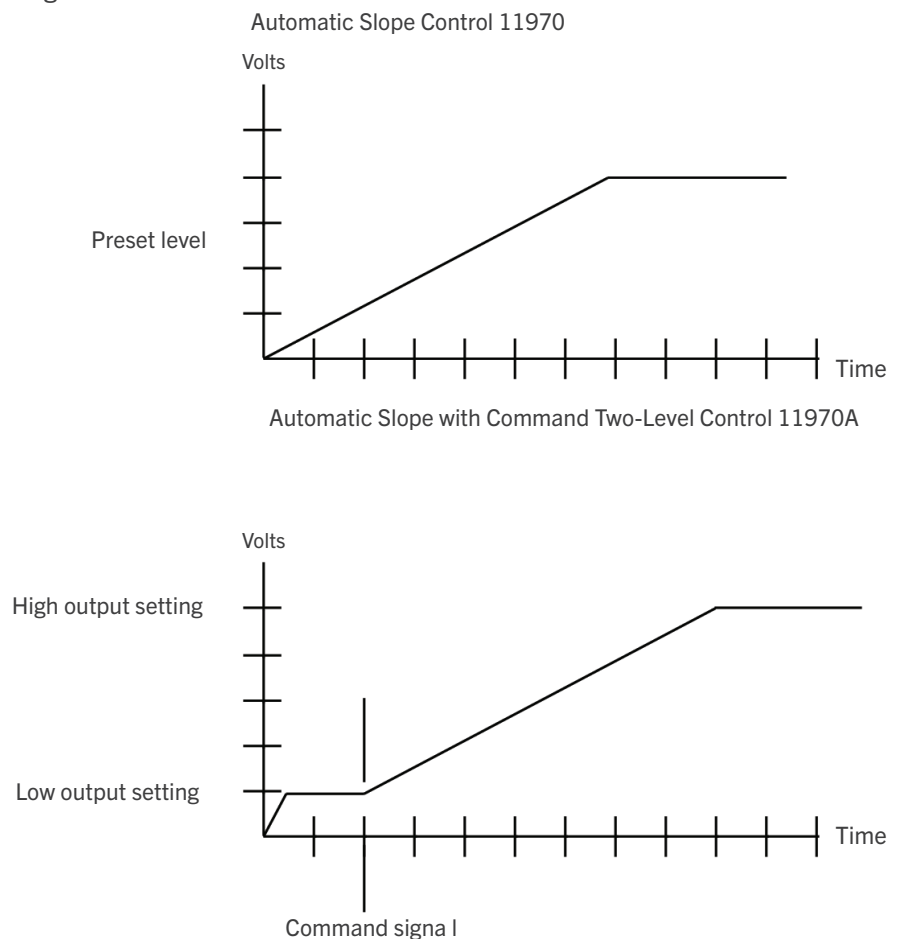
11970 Automatic Slope Control : The automatic slope control provides a step less increase in the voltage or current from zero (0) to a preset level. The slope is completely adjustable with a ten-turn potentiometer to give a linear rate of rise. The slope is initiated with the “start” button. The time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



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.

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.

MAINTENANCE AND 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.

ACCESS TO COMPONENTS

Transformer - The transformer is accessible by removing the front and side panels. The diodes are clearly accessible on the bottom front side of the cabinet on water- cooled units, and the rear panel on air- cooled units.

SCR Regulator and Electronic Control - The SCR regulator assembly and electronic control PC cards are located within the control center. The SCR's can be removed by disconnecting related terminal connectors and retainer hardware. The plug-in cards are accessible on the control panel by removing the retaining bolts and connector assemblies.

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.

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.
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

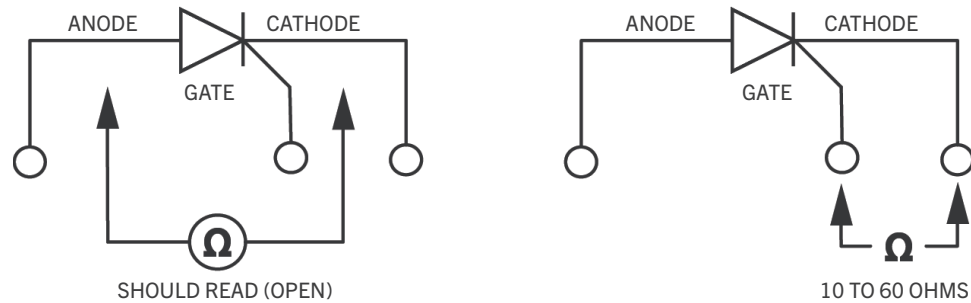
Follow the “Rectifier Performance Checklist” and the circuit diagram for the unit under test. Note: All items on the checklist may not apply to your unit. Verify that each item functions as it should in accordance with this manual and the circuit diagram for your rectifier. Make sure all cooling fans 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

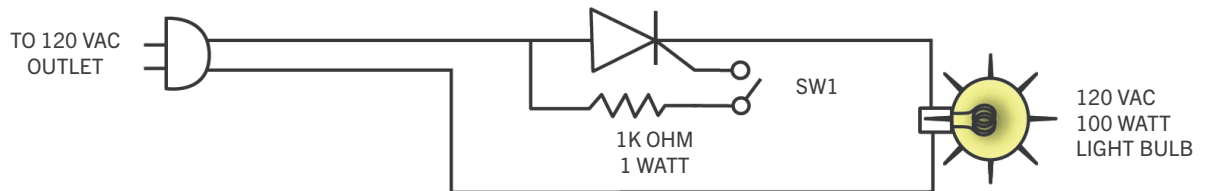
Place a test load on the system and verify that the rectifier functions normally before placing it into production.

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:



1. Note: Occasionally an ohm check may not detect a faulty SCR. A working test circuit can be easily constructed
2. 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 $\frac{3}{4}$ 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 $1 \frac{1}{2}$ turns. Typical isolated base SCR's require approximately 44 in/lbs.

DIODE TEST PROCEDURE

A silicon diode may lose its unidirectional characteristics because of an open or short circuit.

With an open circuit, current will not pass in either direction. With a short circuit, current will pass in either direction. A faulty diode cannot always be identified by visual inspection. To test for a defective diode, proceed as follows:

Disconnect the pigtail lead to the diode from the transformer and check for continuity between the pigtail and the base of each individual diode with an ohmmeter.

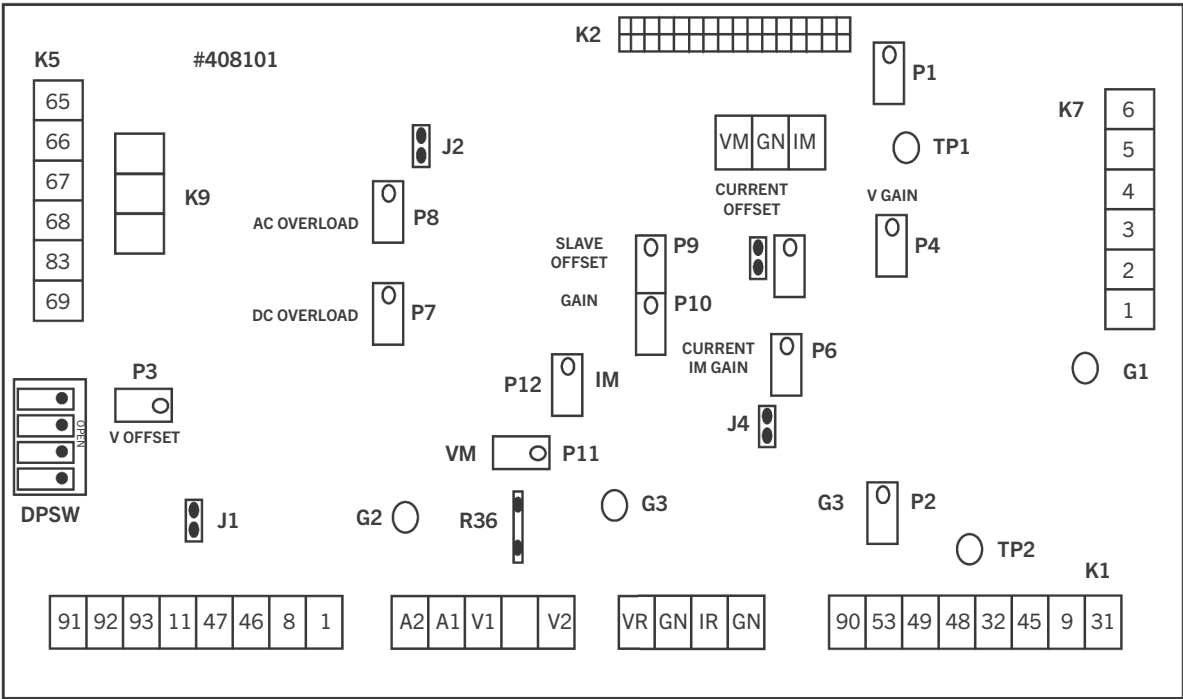
A good diode- will show high resistance when the ohmmeter is connected across the individual rectifier in one direction, and a low resistance when the ohmmeter leads are reversed.

A defective diode with a short circuit- will show a low resistance when the ohmmeter is connected in either direction, and must be replaced.

A defective diode with an open circuit- will show a high resistance in either direction, and must be replaced. The resistance value of a good diode may vary from one diode to another. This variance is no indication as to the quality of the diode. These readings are only taken to indicate if a diode is short or open circuited. If it is necessary to remove a silicon diode for any purpose, replace it with a factory approved unit. A small amount of Dow Silicon Grease #200, or equivalent, should be placed on the contact side of the base to insure a good thermal transfer between the two mating surfaces. Note: The direction of the symbol on the device, if it is replaced backwards, it will place a direct short on the output of the power supply.

The typical diode clamp uses two ¼-20 grade B bolts. The diode should be seated on the pins in the heat sink and tightened by hand. The bolts should be alternately tightened a ¼ turn at a time for 1½ total turns to insure proper clamping pressure.

ELECTRONIC PACKAGE CHECKS AND ADJUSTMENTS
OMNI CONTROL #408101



CONNECTORS

K1-9 & 31-120 VAC Supply.
K1-32 & 45-Relay contact for D.C. on holding circuit.
K1-48 circuit common.
K1-49 reference 7.5 VDC regulated.
K1-53- D.C. disable (contact triggered).
K1-90 slave output signal 0-7.5 VDC.
K2-GN-circuit common.
K2-IR-output current PLC interface monitor signal.
K2-VR-output voltage PLC interface monitor signal.
K3-V2 & V1-D.C.output voltage feedback.
K3-A2 & A1-0-50 MVDC D.C. output current feedback.
K4-1 & 8 module derating interface.
K4-46-0-7.5 VDC current control.
K4-47-0-7.5 VDC voltage control.
K4-11-0-5 VDC gate drive.
K4-91, 92, 93 A.C. current transformer signals.
K5-65 & 66- slope enable (contact activated).
K5-67 low output adjust 0-7.5 VDC.
K5-68-slope input 0-7.5 VDC.
K5-69- slope output 0-7.5 VDC.
K5-83- slope adjust 0-7.5 VDC.
K6- optional signal monitoring.
K7-1-output voltage interface.
K7-2-amp hour output current interface.
K7-3-power supply + 14 VDC.
K7-4- power supply-14 VDC.
K7-5-circuit common.
K7-6 – power supply +5 VDC.
K8-IM-0-7.5 VDC current output meter signal.
K8-VM-0-7.5 VDC voltage output meter signal.
K8-GN-circuit common/K9-1-digital auxiliary input.
K9-2-analog auxiliary input.

ADJUSTMENTS

P1-+5-CW increases.
P2-Ref-CW increases.

P3-V offset-CCW raises DC output.

P4-V gain-CW decreases DC output.

P5-I offset-CW-makes signal more neg. @ 1.

P6-I-gain CW lowers DC output I.

P7-DCOL CCW de-senses.

P8-ACOL CW de-senses.

P9-slave offset CCW more positive @ 90.

P10-slave gain- CCW raises gain.

P11-VM CW increases.

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	0

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.

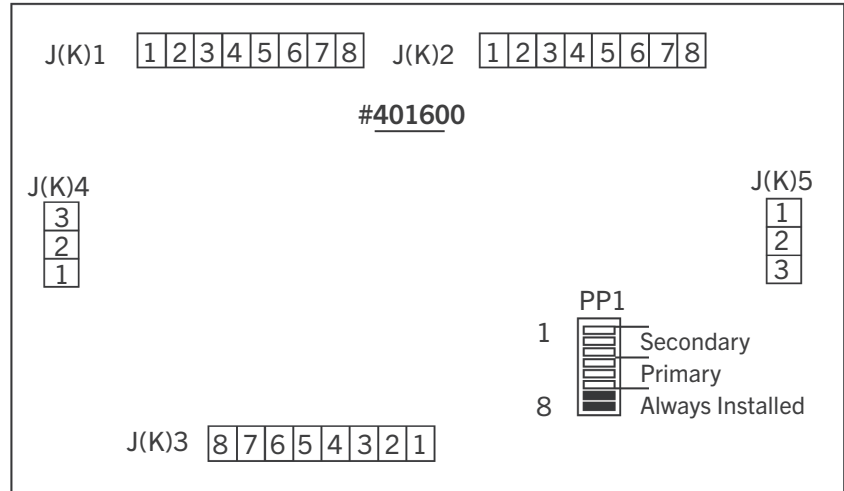
Place D.C. millivolt meter on connector K3 terminals A1 and A2. Turn output adjust to maximum and adjust P6 (Current Gain) to the calculated millivolt signal.

- 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)1-4 SCR #3 Gate
 J(K)1-7 SCR #5 Gate
 J(K)1-2 SCR #1 Cathode
 J(K)1-5 SCR #3 Cathode
 J(K)1-8 SCR #5 Cathode
 J(K)2-1 SCR #2 Gate
 J(K)2-4 SCR #4 Gate
 J(K)2-7 SCR #6 Gate
 J(K)2-2 SCR #2 Cathode
 J(K)2-5 SCR #4 Cathode
 J(K)2-8 SCR #6 Cathode
 J(K)3-1 Current Common
 J(K)3-4-0-5 VDC Gate drive
 J(K)3-6-12 VDC
 J(K)3-2 Jumper to J3-6
 J(K)4-1 & 3 –120 VAC J(K)5-1, 2 & 3 –16-18 VAC
 J(K)6-7 Circuit Common
 J(K)6-7 & TP2 -5 VDC
 J(K)6-7 & 6 –5 VDC regulated
 J(K)6-7 & 9 –12 VDC regulated
 J(K)6-7 & 10 –30 VDC unregulated
 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

 TRYSTAR® SERIES 30 RECTIFIER PERFORMANCE CHECKLIST					
SRO #:				DATE:	
COMPANY:					
SYSTEM NUMBER:					
RATED DC VOLTS:		RATED DC AMPS:			
COOLING: AIR COOLED					
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)	✓				
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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)	✓			
SCR (1) G-K (1)		A-K (1)		
SCR (2) G-K (2)		A-K (2)		
SCR (3) G-K (3)		A-K (3)		
SCR (4) G-K (4)		A-K (4)		
SCR (5) G-K (5)		A-K (5)		
SCR (6) G-K (6)		A-K (6)		
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	✓			
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CONTROL CIRCUITS		✓			COMMENTS	
DC ON		✓				
DC OFF		✓				
HOLDING VOLTAGE		✓				
SLOPE CONTROL		✓				
UNDER VOLTAGE		✓				
RIPPLE METER		✓				
AC CONTACTOR		✓				
MISC					COMMENTS	
VOLTMETER		✓			CALIBRATED?	NO
AMMETER		✓			CALIBRATED?	No
SLAVE CONTROL		✓				
MASTER CONTROL		✓				
CABINET FANS		✓				
SCR FANS		✓				
FUSES					COMMENTS	
CONTROL FUSES		✓				
SCR FUSES		✓				
DC FUSES		✓				
FILTER FUSES		✓				
OUTPUT RIPPLE					COMMENTS	
VAC		VAC				
VDC		VDC				
RIPPLE		% RIPPLE				
AMPS DC		AMPS DC				
CAPS		VAC				
INPUT MEASUREMENTS					COMMENTS	
PHASE ROTATION		✓				
ØA - ØB	VOLTS	✓				
ØB - ØC	VOLTS	✓				
ØC - ØA	VOLTS	✓				
ØA	AMPS	✓				
ØB	AMPS	✓				
ØC	AMPS	✓				
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WATER COOLED				COMMENTS
LEAK SENSOR	✓			
RADIATOR	✓			
THERMOSTAT	✓			
WATER SOLENOIDS	✓			
WATER LEAKS	✓			
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CUSTOMER SUPPORT

Contact Trystar

PRODUCT SUPPORT SERVICES

Trystar 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 Trystar'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

Trystar 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/>

Trystar 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 Trystar'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 Trystar, 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. Trystar 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 Trystar service person, without the written permission of Trystar.
4. This Warranty is in lieu of all other warranties, expressed or implied. Trystar 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, Trystar 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.

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

