MINIVERTER MANUAL

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SOLID STATE CONVERTER

PEC Miniverter DC Power Supply

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It must be understood that these instructions cannot cover all details or variations on equipment, nor provide for every possible contingency in connection with installation operation or maintenance. When the rectifier is installed, it will require little attention.

Should further information be desired or particular problems arise which are not covered herein, please contact:

Process Electronics Corporation.

100 Brickyard Road
Mount Holly, North Carolina 28120
704-827-9019

1. UNPACKING AND STORING

As all units are shipped F.O.B. our plant, it is suggested that the shipping container be removed and inspected for possible damage during shipment. If any damages are found, the claims must be handled by the purchaser, and the carrier should be contacted immediately.

The P.E.C. Service Department should be notified if the nature of the damage is such that operation of the equipment has been impaired.

If it is necessary to store the converter for a period of time before it is installed, be sure to place unit in a clean dry area. To prevent excessive dust from accumulating on the unit, it is advisable to protect the converter by placing it in the original shipping container.

The power supply must be handled at all times with the same care you would give any piece of precision electrical equipment.

2. INSTALLATION

2.1 General

The P.E.C. Miniverter power supply (converter) has been completely inspected and operated under full load prior to shipment.

These units should be installed in a clean, dry ventilated location with the front and back of the units at least 6" from the wall or other objects that would obstruct air flow. Do not install near furnaces, radiators or any other sources of heat.

If the converter is installed in the operating area, it should be protected from splashing fumes, vapor from the tank or drip from overhead piping. Do not install converter units in a location where they are subject to moving lint, as this may clog up the air intake screen, thereby reducing air flow.

In many cases, the converter can be located in an adjacent room, thus isolating the unit from poor atmospheric conditions existing in most manufacturing plants. When installed in a separate room, particularly if the room is small, ample ventilation should be provided to keep room temperature from rising excessively. It is absolutely essential to keep the ambient temperature below 105° F.

2.2 Access to the Inside of the Converter

Access to components of the Miniverter model power supply can be gained by removing the front and rear panels.

2.2.1 Control Component Access

1. Remove the four screws from the front panel.
2. Lower front panel for access to control components.

2.2.2 Power Component Access:

1. Remove the four screws from the rear panel.
2. Remove rear panel for access to all power components.

CAUTION

Never operate the converter without panels in position.

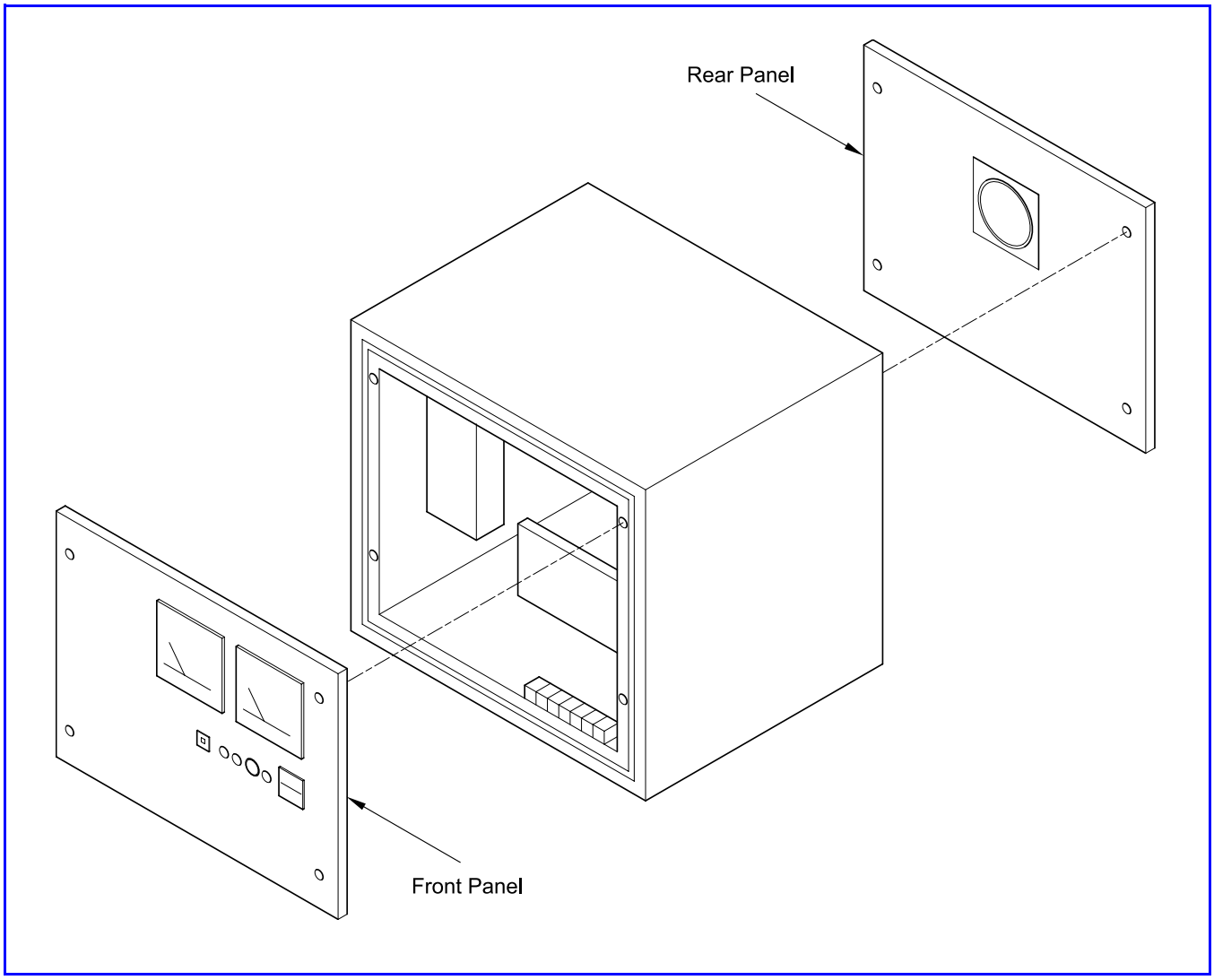

Figure 1 *Access to Converter's Control and Power Components*

3. INSPECTION

All connections between the components should be checked because excessive vibration during shipment may have caused some of them to become loose.

3.1 A.C. Input Wiring

PLEASE NOTE: All work described within this section is to be done in accordance with national electrical code and any prevailing local electrical code.

Check the panel nameplate to be sure that the voltage and frequency match the input power available. If the supply voltage differs from the rated voltage of the unit by an amount greater than ten percent, the factory will advise necessary changes before the converter can be operated. Under no conditions should the unit be connected to any source which does not conform to the nameplate rating without the expressed approval of **Process Electronics Corporation**.

A fused safety switch, as required by the national electrical code, should be provided by the user as a disconnect and for short circuit protection.

Run main power feeders from fused safety switch to converter control panel and connect to input terminals of main starter. These leads should be of sufficient size as determined by the national electrical code. See **Section 3.2** entitled *Control Wiring*. Line current may be determined from the nameplate rating.

3.2 Control Wiring

The customer, on all integral controlled units, is not required to do any additional control wiring.

On remote controlled units, the converter and the remote control cabinet are to be connected with No. 14 wire, except leads a plus and a minus (ammeter leads). To correctly size the ammeter leads and maintain reasonably accurate readings, see **Table 1**.

Wire Size	Length of Lead Run	
	Feet	Meters
No. 14	0 - 15	0 - 4.5
No. 12	16 - 25	4.8 - 7.5
No. 10	26 - 40	7.2 - 12
No. 8	41 - 60	12.3 - 18.2
No. 6	61 - 100	18.5 - 30.5
No. 4	101 - 140	30.8 - 42.6

Table 1 *Wire Size Comparison with Length of Ammeter Leads*

The indicating and controlling elements for the remote controlled units are mounted in a Nema 12 enclosure. The enclosure should be mounted close to the operator's normal position.

Connections from the converter are made to a terminal strip mounted on a subpanel inside the enclosure. The wiring diagram included with each converter shows the number of wires required to connect the converter and control unit together. It is a good practice to include a spare wire or two for future requirements.

3.3 D.C. Hook-Up

The D.C. terminals are 1/2-inch diameter copper studs protruding 1-1/2-inches from the rear of the cabinet. Cable or bus of sufficient capacity to carry rated D.C. amperes should be used to make the connections between the rectifier and work.

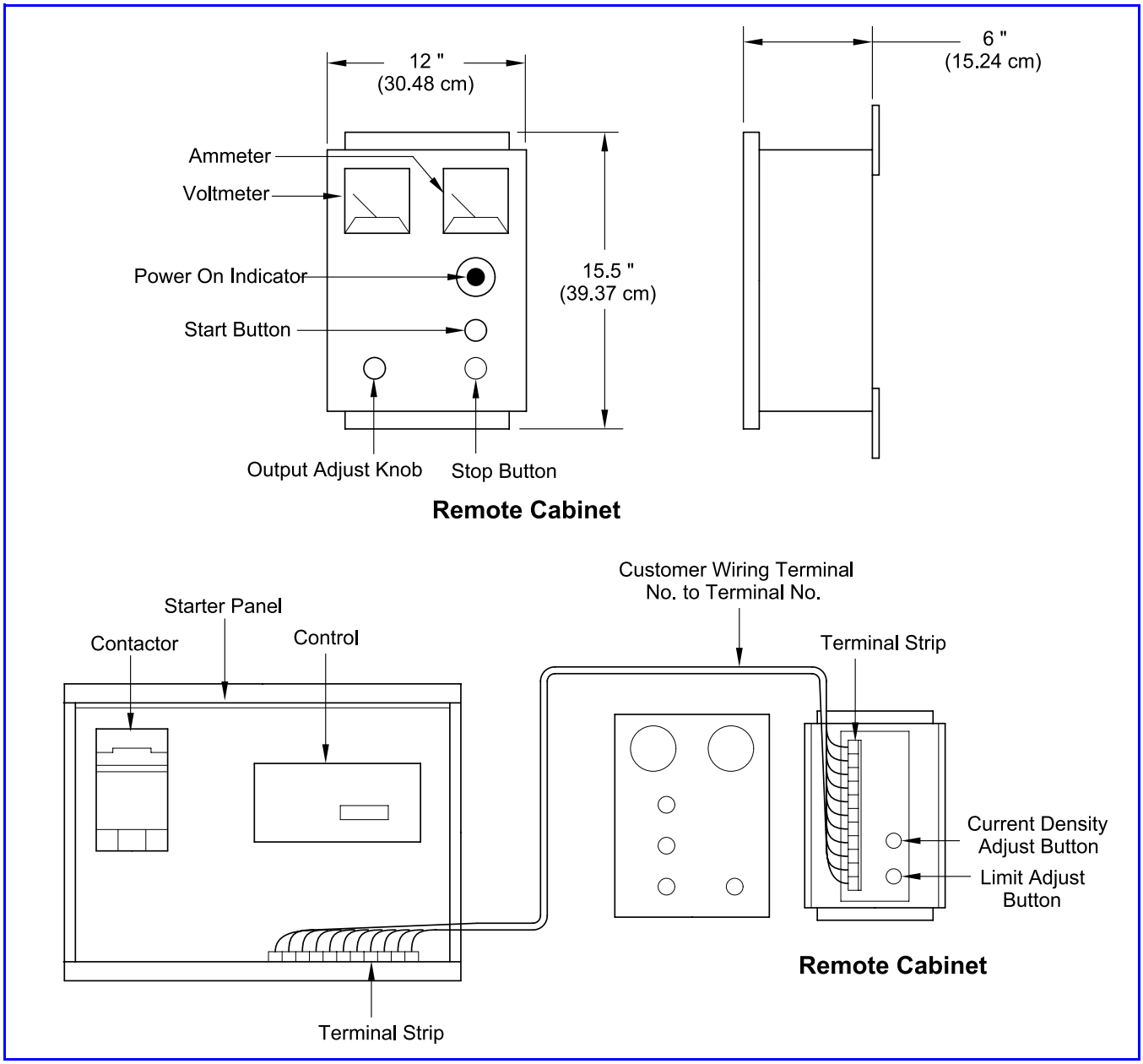

Figure 2 *Remote Control Cabinet Interconnection Diagram*

4. OPERATION

4.1 Starting Operation

NOTE: All removed panels must be placed back onto the converter before the unit is started.

1. Make certain that the output adjust control knob is set at zero or minimum position (fully counterclockwise).
2. Close the main safety switch.

   NOTE: All units have magnetic starters.

3. Start the converter by pressing the start button.
4. Check the air flow on systems with forced air cooling. This is important because the unit will not function without the cooling obtained from the ventilation system.
5. Adjust the converter for proper output (see the adjustment procedure for various control functions).
6. Stop the rectifier by pressing the stop button.

4.2 Control Operation

4.2.1 Trigger/Amplifier Board

By controlling the firing of the Silicon Controlled Rectifiers (SCR's), the trigger/amplifier board varies the converter output voltage and current. Using the feedback signals from the D.C. output, the converter output can be controlled and held constant at: voltage with current limiting, average current density with current limiting or current with voltage limiting. The board provides the reference controlling voltage and accepts the control input from the potentiometers.

4.2.2 Control Function

A. Automatic Voltage Control with Current Limiting

The function of this control is to maintain the converter output voltage at a value preset by the operator's control knob. The preset value of output voltage will be held constant within -+ 1% of the converter's full rated output voltage over range of 10% to 100% of output current under varying load conditions.

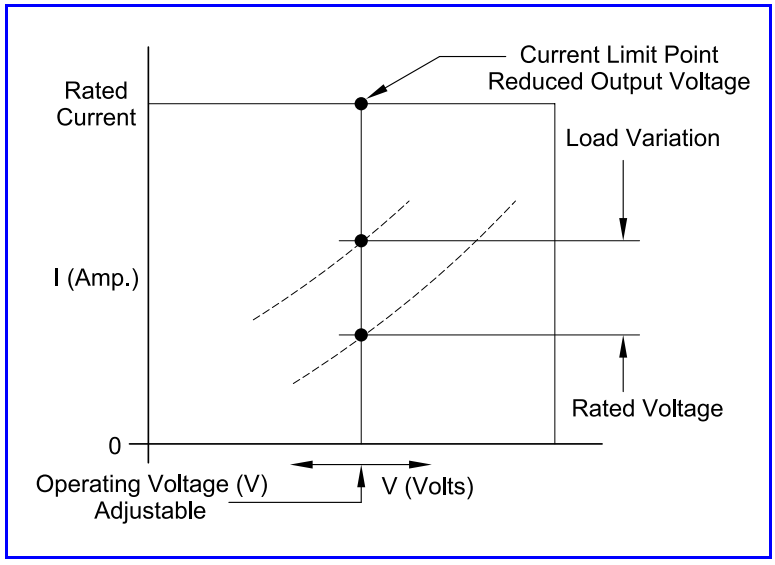

Figure 3 *Voltage Compliance*

For example, with a 100 amp @ 12 volt unit, the output voltage will be held constant -+ 0.12 volts over a range of operation from 10 amp to 100 amp. The voltage will remain constant throughout the operational cycle and will eliminate the costly burning or overplating which can result from widely varying load voltages.

Protection of the converter from D.C. overloads is provided for by the automatic current limiting. Any decrease in load resistance above the converter current rating will result in a decrease of output voltage and the converter output current will be limited at its maximum rated current.

In some plating processes where a current interruption by a D.C. overload device can result in costly stripping and replating, the current limiting feature automatically prevents the overload from damaging the converter while maintaining continuous operation at reduced output voltage.

B. Automatic Average Current Density Control with Current Limiting

The need for average current density control is due to the fact that the current in a plating system does not increase in direct proportion as the plating area is increased, even though the plating voltage is held constant. It is necessary to increase the voltage as work area is added in order to maintain the proper average current density.

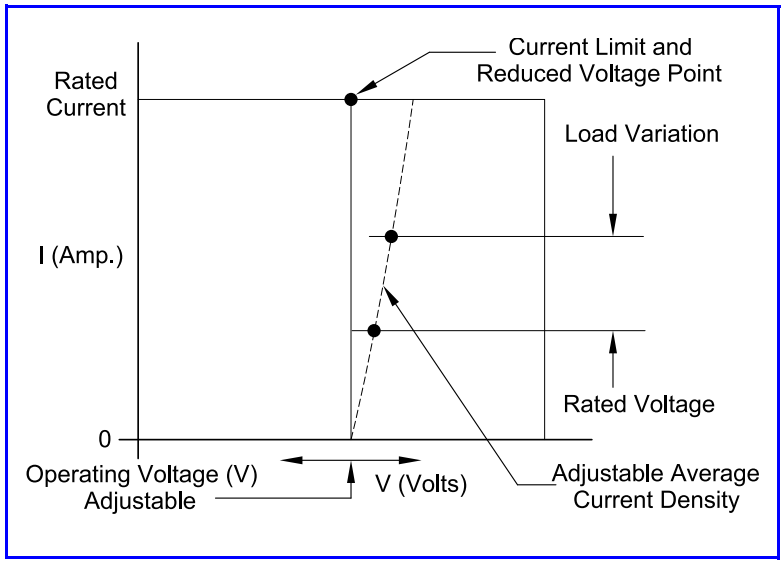

Figure 4 *Current Density Control*

The automatic average current density control increases the converter's output voltage as a greater amount of bus current is sensed. This is done by converting a current signal to a proportional voltage and adding it to the basic operating voltage. A current limiting feature automatically prevents an overload from damaging the converter while maintaining continuous operation at reduced voltage.

C. Automatic Current Control with Voltage Limiting

This control will maintain the converter output current at a value preset by the operator's control knob. A preset value of output current will be held constant within -+ 1% of the converter's full rated current value over a range of 10% to 100% of output voltage under varying load conditions during operation. For example, the output of a 100 amp @ 12 volt converter will be held constant -+ 1 amp from 1.2 volts to 12 volts.

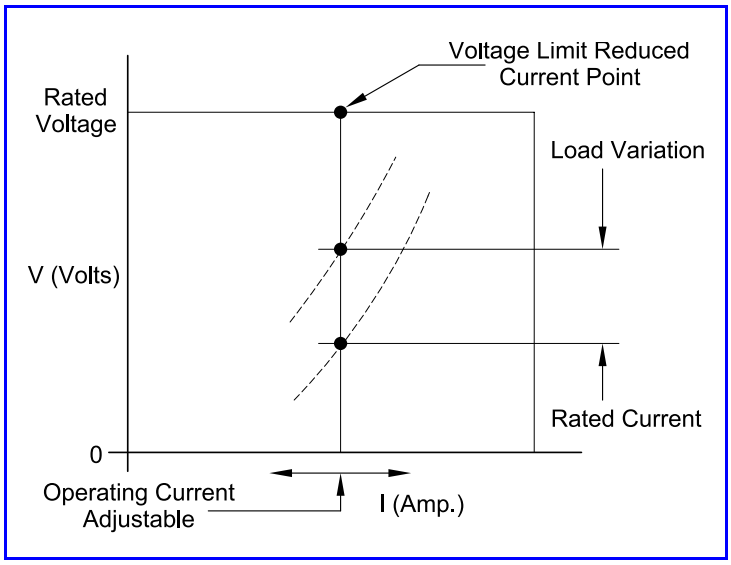

Figure 5 *??*

The voltage limit control is designed to reduce load burning due to overvoltage and prevent power interruption to the load. Any increase in load resistance will result in a decrease of output current and the converter will be limited at its rated voltage output.

This automatic current control can be used in operations where thickness must be accurately controlled. It can eliminate costly overplating, grinding and stripping operations. An automatic current control can be used in any type of operation where variations in solution, temperature, thickness and contact area will adversely affect the work being done.

4.3 Automatic Voltage with Current Limit Operation Adjustment Procedure

All converters are shipped in the voltage mode of control unless otherwise specified at time of order.

1. The "current density adjust" pot must be turned completely counterclockwise for automatic voltage operation. This pot is located on the front panel of the integral control units or inside the remote cabinet for remote control units. To adjust, remove the locknut and turn the pot with a screwdriver completely counterclockwise, then replace and tighten the locknut.
2. The "limit adjust" pot should be turned completely clockwise. At this setting, the converter current output will be limited at its full rated value. If a lower current limit point is desired, then turn the pot counterclockwise to the desired setting. For example, setting the pot at midpoint will limit the current to approximately half the rated output current. This pot is located on the front panel of integral control units or inside the remote cabinet for remote control units. To adjust, remove the locknut, turn the pot to the desired setting with a screwdriver, then replace and tighten the locknut.
3. Turn the "output adjust" knob completely counterclockwise.
4. Energize the converter by pushing the start button.
5. Adjust the "output adjust" knob to the desired voltage level. The converter will hold the desired voltage level constant for varying load conditions.

   NOTE: Desired voltage level setting must be between 10% and 100% of the full rated output voltage of the converter.

4.4 Automatic Average Current Density Control with Current Limit Adjustment Procedure

All converters are shipped in the voltage mode of control unless otherwise specified at the time of order. The automatic average current density control must be used with the voltage mode of control for proper operation.

1. Turn the "current density adjust" pot completely counterclockwise. This pot is located on the front panel of integral control units or inside the remote cabinet for remote control units. To adjust, remove the locknut and turn the pot with a screwdriver completely counter clockwise. Do not replace the locknut until the remainder of the adjustment is complete.
2. The "limit adjust" pot should be turned completely clockwise. This pot is located on the front panel of the integral control units or inside the remote cabinet of the remote control units. To adjust, remove the locknut, turn the pot with a screwdriver, replace and tighten the locknut.
3. Turn the "output adjust" knob completely counterclockwise.
4. Energize the converter by pushing the start button.
5. With the smallest anticipated work load in the tank, turn the "output adjust" knob clockwise to produce the desired current output for that work load.
6. Increase the work load in the tank to the maximum expected load Although the current has increased, the total current will be less than desired for that load.
7. Turn the "current density adjust" knob clockwise until the proper current is reached.
8. Repeat steps 5, 6, and 7 to minimize the current difference from small to large loads.
9. Replace and tighten locknut on "current density adjust" pot.

NOTE: This control works well for repeated loads of the same type. A change in size and shape of the workload may require readjustment of the pot settings.

4.5 Automatic Current Control with Voltage Limit Adjustment Procedure

All converters are shipped in the voltage mode of control unless otherwise specified at the time of order. Refer to **Section 4.6** entitled *Conversion to Current Mode of Control* for instructions to change from voltage mode to current mode.

1. The "current density adjust" pot must be turned completely counterclockwise for automatic current operation. This pot is located on the front panel of integral control units or inside the remote cabinet for remote control units. To adjust, remove the locknut and turn the pot with a screwdriver completely counterclockwise, then replace and tighten the locknut.
2. The "limit adjust" pot should be turned completely clockwise. At this setting, the converter voltage output will be limited at its full rated value. If a lower voltage limit point is desired, turn the pot counterclockwise to the desired setting. For example, setting the pot at midpoint will limit the voltage to approximately half the rated output voltage. This pot is located on the front panel of integral control units or inside the remote cabinet for remote control units. To adjust, remove the locknut, turn the pot to the desired setting with a screwdriver, then replace and tighten the locknut.
3. Turn the "output adjust" knob completely counterclockwise.

4. Energize the converter. See **Section 4.4** entitled *Automatic Average Current Density Control with Current Limit Adjustment Procedure* for details.

5. Adjust the "output adjust" knob to the desired current level. The converter will hold the desired current level constant for varying load conditions.

NOTE: The converter will hold the desired current level for an operating range from 10% to 100% of the converter's full rated output voltage.

4.6 Conversion to Current Mode of Control

The conversion from voltage mode to current mode of control is easily accomplished.

1. Open the front panel of the converter and locate the terminal strip mounted on the control panel.

2. Locate the control wires, No. 7 and No. 8 on the terminal strip. See **Figure 2**.

3. Remove wire No. 7 (blue) from the terminal and wire No. 8 (blue) from its terminal.

4. Plug wire No. 7 (blue) on wire No. 8 terminal and plug wire No. 8 (blue) on wire No. 7 terminal. See **Figure 6**.

5. For conversion back to voltage mode of control, reverse steps 3 and 4. See **Figure 7**.

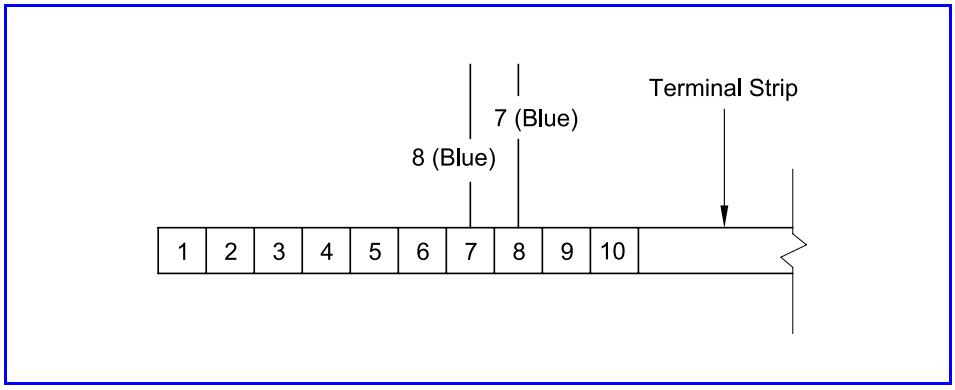

Figure 6 *Wiring Connection for Current Mode of Operation*

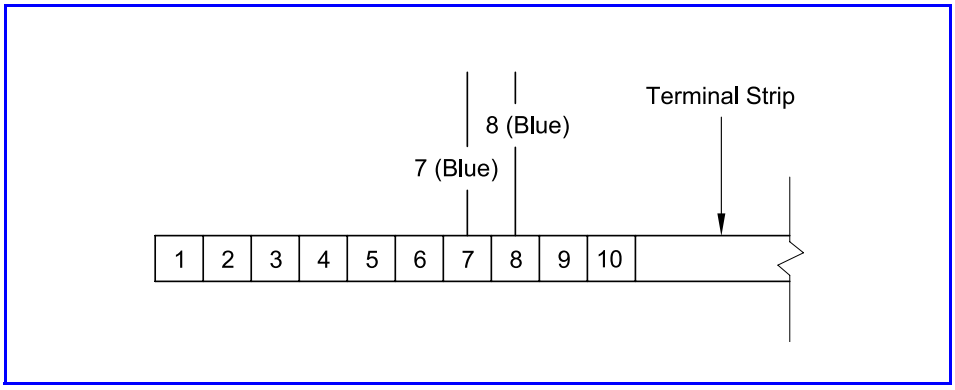

Figure 7 *Wiring Connection for Voltage Mode of Operation*

5. MAINTENANCE

This unit is designed for a minimum of maintenance. The amount of maintenance required is largely determined by the cleanliness of the plant in which the unit is located.

Minor preventative maintenance procedures, performed at regular intervals, will reduce the possibility of component failures to an absolute minimum. Proper care, based on good judgement, will insure many years of reliable, uninterrupted service. Inspection intervals should be based on severity of operating conditions and number of hours of operation.

The maintenance performed during each service inspection should consist of blowing the unit out with compressed air. All accumulated dust, dirt and particles of foreign matter should be removed at each service inspection. A soft bristle brush should be used to clean off the heat sinks and diodes.

Precision aligned fan motors have long life bearings requiring no lubrication.

On the first inspection, the wire leads should be checked at each terminal for loose connections. The SCR's are connected to the heat sinks with cadmium plated steel nuts. They are installed at the factory using a torque wrench for proper tension. If necessary to remove a SCR for any purpose, replace with factory approved unit.

A small amount of Dow Silicone Grease No. 200 should be placed on the contact side of the SCR stud to complete a thermally conductive film between the two mating surfaces.

6. TROUBLESHOOTING

All units are completely tested prior to shipment. If a unit arrives inoperable or damaged, contact **Process Electronics Corporation**.

Any difficulties appearing after the unit has been in service should be of a minor nature. A chart follows for troubleshooting these units.

Under no conditions should a SCR be checked with hi-potential test sets.

Over voltage from this source could cause cell failure.

As extremely high voltages are encountered in the circuit of the rectifier transformer primary, only authorized personnel should attempt to check for trouble or repair the unit. A neon type voltage indicator should not be used because the low striking voltage would give false reading. A voltmeter and a tong or clamp on a type A.C. ammeter are essential tools to properly check a rectifier unit.

Refer to description of operation before attempting to service units.

WARNING

Do not enter the converter without throwing A.C. disconnect switches. There are dangerous voltages present at all times, unless the A.C. disconnect switch is in "OFF" position.

6.1 Method of Checking Diodes Using an Ohmmeter

In this method you use an ohmmeter comparable to a Triplett Model 310 meter and proceed as follows:

1. Disconnect the power input to the converter.
2. Set the ohmmeter at x times 10.
3. Read the forward and reverse resistance of the diode by placing one test prong on the heat sink or diode stud and the other on the pigtail, then reverse the prongs to read reverse resistance.
4. From readings obtained, the following conclusions can be drawn.
    a. A good diode will have a resistance reading, but it will be other than those listed below under items (b) and (c).
    a. If the resistance reading is infinite in both directions, the diode is open and, therefore, no good.
    b. If the resistance reading is zero in both directions, the diode is short circuited and also no good.

The resistance reading value of a good diode may vary from one diode to another. This variance gives no indication as to the quality of the diode. These reading are only taken to indicate if a diode is short circuited or open.

6.2 Method of Checking Diodes Using a Continuity Tester

IMPORTANT: Before testing any diodes, check the continuity tester by touching the probe and clip together. If it is functioning properly, the light will go on.

1. Disconnect one end of the diode.
2. Apply clip end of the continuity tester to the diode pigtail and the probe end to the diode stud. See **Figure 8**.
3. Apply probe end of the continuity tester to the diode pigtail and the clip end to the diode stud. See **Figure 8**.

If the light in the continuity tester goes on in both steps 2 and 3, this indicates a shorted diode condition.

If the light in the continuity tester does not go on in steps 2 and 3, this indicates an open diode condition.

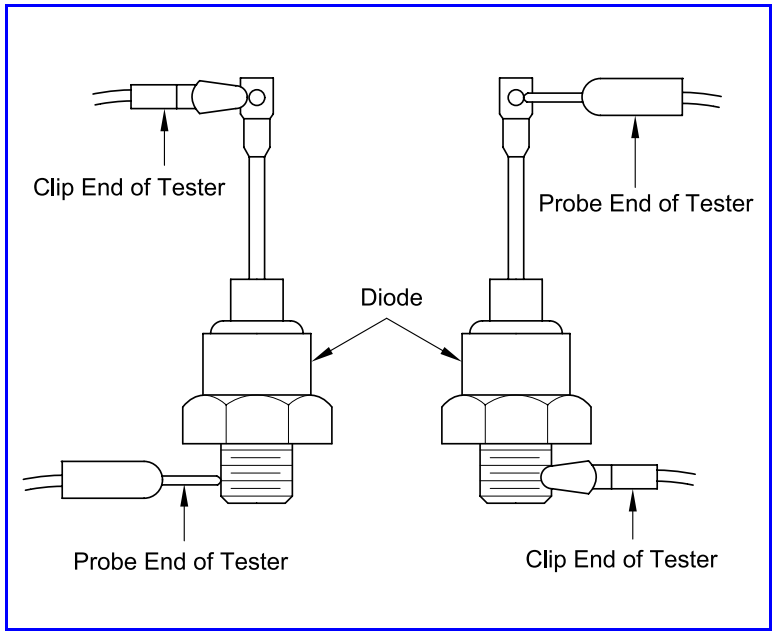

Figure 8 *Continuity Tester Attached to Diode*

A good diode will cause the light in the continuity tester to go on in one direction only.

6.3 Method of Checking Silicon Controlled Rectifier (SCR)

1. Disconnect power to the converter.
2. Remove the SCR from the circuit.
3. Identify the SCR terminals. See **Figure 9**.
4. Build a test fixture. See **Figure 10**.
5. Place the red lead and black lead across the SCR. See **Figure 10**.

No light should register. If the light comes on, the SCR is shorted.

6. If the light does not come on, momentarily, short the gate lead of the SCR to the anode stud and remove. The light should come on and in many cases stay on. If the light comes on, the SCR is good.

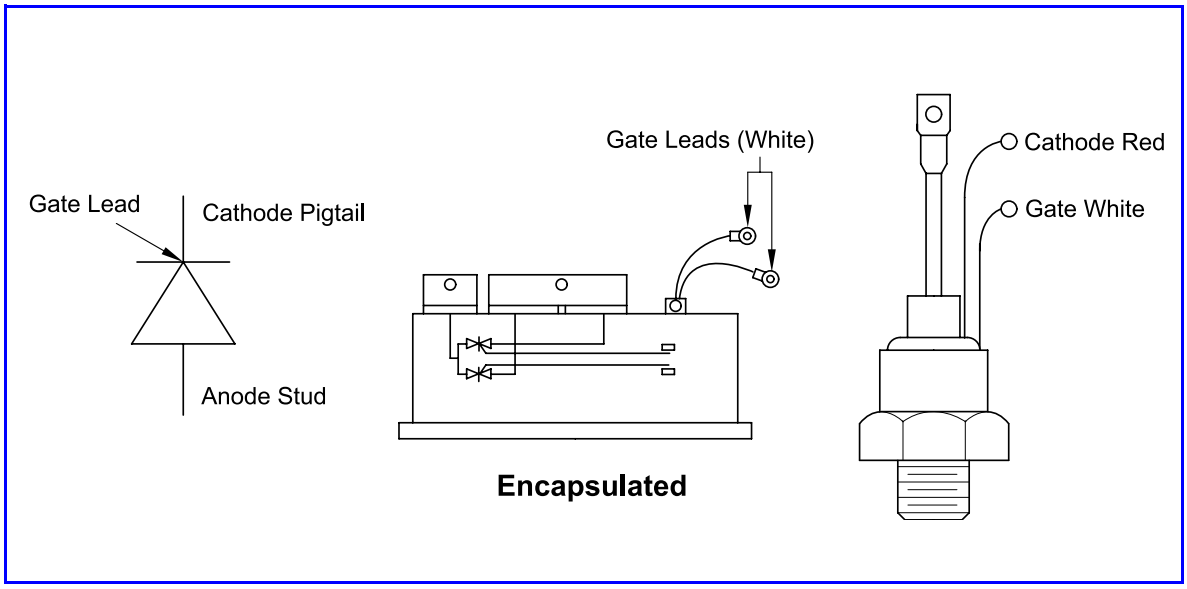

Figure 9 *SCR Terminal Identification*

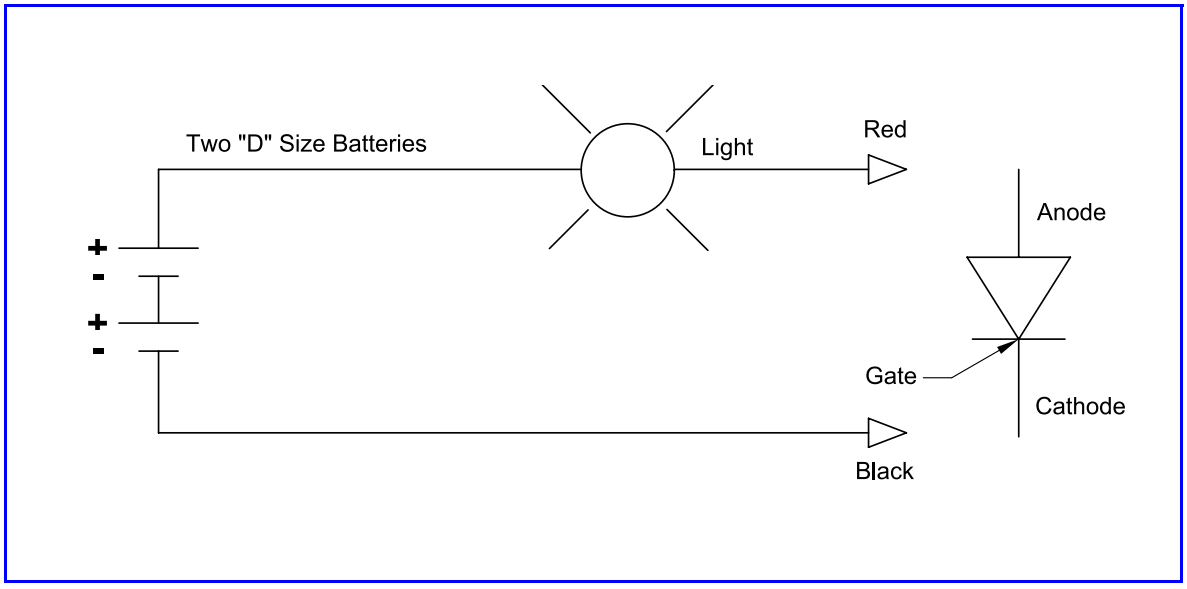

Figure 10 *Checking SCR on Test Fixture*

Troubleshooting Chart

Trouble	Probable Causes	Remedy
Unit will not energize when push-button is pressed	1. Main fuses blown 2. Control Circuit fuse blown 3. Loose power or control wiring 4. Faulty push-button 5. Main safety switch open 6. Starter thermo in tripped position	1. Replace fuse 2. Replace fuse 3. Tighten all loose connections 4. Replace push-button 5. Close safety switch 6. Reset starter
Converter starts then shuts off almost immediately	1. Loose connection start-hold circuit 2. Defective SCR or diode 3. Excessive D.C. load	1. Tighten loose connections 2. Replace defective part 3. Lower D.C. output
Converter starts, runs for a period, then drops out and cannot be re-started immediately	1. Defective fan motor 2. High ambient conditions 3. Blocked air intake screen 4. Starter thermo in tripped position	1. Replace fan motor 2. If ambient is in excess of 105 °F reduce D.C. output 3. Change maintenance schedule so unit is cleaned out more frequently 4. Check for fan binding or loose thermo's reset starter
Unit runs for a long period and then drops out, however, it can be re-started immediately	1. Intermittent loose connections 2. Excessive D.C. output 3. Faulty push-buttons	1. Check and tighten wiring 2. Lower D.C. output 3. Replace push-buttons
Unit runs for a period and then drops out, however, it can be re-started after three to five minute periods	Faulty diode or SCR high limit thermo	Replace thermo
Converter energizes properly, but has no output	1. Meter connections loose or broken 2. Defective meter(s) 3. Open output control potentiometer 4. Defective trigger/amplifier board	1. Check and tighten wiring 2. Replace defective meter(s) 3. Check and replace if necessary 4. Replace board
Output with little or no control	1. One or two shorted SCR's 2. Feedback connections loose or broken 3. Defective trigger/amplifier board	1. Replace SCR's 2. Check and tighten wiring 3. Replace board
Over sensitivity of output adjust potentiometer	1. Feedback connections loose or broken 2. Defective control potentiometer 3. Insufficient load in current mode-of-operation 4. Defective trigger/amplifier board	1. Check and tighten wiring 2. Replace potentiometer 3. Add load 4. Replace board
Oscillation of the ammeter or voltmeter sometimes accompanied by violent vibration of bussing	1. Defective SCR's 2. Defective diodes 3.Defective trigger/amplifier board	1. Replace SCR's 2. Replace diodes 3. Replace board


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