POWER CONTROL SERIES

SCR POWER CONTROL
SERIES 1Z

Manual No. 19000326

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WARNING

The use of an appropriate single-phase or single-phase fused disconnect or circuit breaker with this Power Controller is required to ensure the safety of operating personnel.

HAZARDOUS VOLTAGES exist at the Power Controller Heat Sinks and at the Load, **AT ALL TIMES**, when input voltage is connected. This condition exists even when the Power Controller is set to deliver zero output.

The fused disconnect or circuit breaker must be open or **OFF** to perform maintenance of any kind, including at the Load.

ORIGINAL EQUIPMENT MANUFACTURERS
—PLEASE NOTE—

If this Handbook is not supplied to the End User, a WARNING statement identical to the above should be prominently displayed in the Installation and Operation Instructions provided to the End User.

ASIRobicon
Industrial Power Control

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CHAPTER 1. Description

1.1. Models Covered

This manual cover Series 1Z models rated from 60 through 1200 amperes, as specified in Table 1-2.

1.2. Application

Series 1Z power controllers provide control of single-phase power to resistive loads. The 1Z utilizes zero-crossover firing of the SCRs, which virtually eliminates the generation of line spikes and EM1.

1.3. General Description

The 1Z is a single-phase, zero-fired power controller, and can operate with a wide variety of input signals and line voltages. The 1Z's output voltage is proportional to its input signal, with the output voltage regulated to ± 1% with a ± 10% line voltage change. The 1Z features a variable-time-base output, which provides for more constant power delivered to the load, less temperature fluctuation, and extended load life due to minimized thermal shock. The 1Z also features pulse-train firing which provides high immunity to possible SCR firing disturbances, and terminals to permit connection of a variety of external control methods. A more detailed description of the features mentioned above is provided in Chapter 4 of this manual.

1.4. Operation

The 1Z accomplishes power control by the switching action of a pair of inverse-parallel power SCRs. The switching, or gating, of the SCRs is controlled by a digital firing control circuit synchronized to line frequency (50 Hz or 60 Hz). The digital firing control circuit may be manually controlled by the BIAS control, or automatically or manually controlled by one of several external methods. Screwdriver-adjusted BIAS and GAIN controls are used to set up the 1Z for operation by external control. Section III describes how to implement the various control methods.

1.5. Specification

Specifications for the 1Z SCR power controller are given in Tables 1-1 and 1-2.

Table 1-1. 1Z Model Number Breakdown

1Z-24 60
240 Vac (24)
60 Aac (60)

1Z – 48 120
480 Vac (48)
120 Aac (120)

NOTE: Voltage and current ratings are implicit in the model number as shown in the above examples.

Table 1-2. General Specifications of 1Z Models

Input line voltage: *	120, 208◆, 240, 400,480, or 575 Vac, +10%, -20% , single-phase
Line frequency:	50 or 60 Hz
Current rating: *	As indicated by model number (refer to Table 1-1)
Thermostat contact rating:	120 Vac, 5 A; resistive
Control methods:	1. Potentiometer, 5 kΩ, ½ watt (Customer-supplied). 2. Dry contact closure (customer-supplied). 3. Temperature on process controller** **Output Range, current loop:** 0 to 3 mAdc minimum 0 to 30 mAdc maximum **Voltage input:** 0 to 1.5 Vdc minimum 0 to 15 Vdc maximum
Control signal input impedance:*	500 ohm, ½ watt standard (easily changed by customer to 1500 ohm).
Control signal isolation:	
From SCRs	2,500 Vac
From ac power input lines	2,500 Vac
From chassis	500 Vac
Power output:	
Voltage regulation	±1% per ±10% line voltage change.
Power output linearity versus control signals input	±1%
Power SCRs protection:	
Sustained current surge	Subcycle I^2T semiconductor fuse.
Transient voltage spikes (dv/dt)	Metal Oxide Varistor (MOV) and R-C snubber across each SCR pair; all SCRs have PIV rating of 1,400 V.
Miscellaneous:	
Output voltage change versus ambient temperature change	0.07% per ºF (0.04% per ºC)
Zero-firing timebase	Variable, see paragraph 4-5
Power SCRs gating control:	17 kHz (approximate) pulse train at approximately 15 ms duration
User controls:	BIAS and GAIN potentiometers; 1-turn, screwdriver-adjustable, lockable.
Fan-cooling power (as applicable):	
For 180 A through 500 A units	0.21 amperes, 25 VA (50 Hz) 0.19 amperes, 23 VA (60 Hz)
For 650 A through 1200 A units	1.4 ampere, 168 VA (50 Hz) 1.2 amperes, 144 VA (60 Hz)
Ambient Temperature range:	
Operating	32ºF to 122ºF (0ºC to 50ºC)
Storage	14ºF to 158ºF (-10ºC to 70ºC)

Table 1-2.
General Specifications of 1Z Models (Cont.)

Weight per unit:	**Current Rating**	**Lbs**	**Kg**
	60 through 120 A	15	6.8
	180, 225 A	22	10.0
	350, 500 A	24	10.9
	650A	47	21.4
	800, 1000, 1200 A	71	32.3
Outline and mounting:	See appropriate drawing in rear of manual		

* Specify with order

** If you will be using temperature/process controller, specify its output; e.g., 4-20 mA, 0-10 Vdc, 2-10 Vdc, etc. with your order.

◆ 208 Vac input tolerance is +20%, -10%

NOTE: The 1Z should be tested or operated with an adequate load since an open output will have line voltage at the load connections.

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Chapter 2. Installation

2.1. Mounting the 1Z

Determine the voltage and current ratings from the nameplate of the unit (refer to Table 1-1). Then determine space and mounting hold requirements by referring to the outline drawing (at the rear of this manual) that applies to your model's current rating. Mount the unit so the line and load connections are at the top. Ensure that upward airflow over the heat sink fins is unrestricted. On high current models, allow adequate clearance for routing the relatively large diameter input and output lines.

CAUTION

Printed circuit boards contain sensitive components that can be damaged by electrostatic discharge (ESD).

Your Power Controller has been shipped from the factory wrapped in static-free packing materials. Avoid handling the printed circuit board unless ESD protection has been observed.

Details concerning ESD protection can be found in the Maintenance and Troubleshooting section (Chapter 5) of this manual.

2.2. Fan Wiring (applicable to models rated 180 A and higher)

1Z models with cooling fans require 120 Vac power, which must be supplied by the customer. Power requirements are shown in Table 1-2.

The 1Z terminals available for the 120 Vac fan connections are shown in the drawings at the rear of this manual. Locate the correct drawing for your model's current rating.

CAUTION

The application of fan power should precede, or coincide with, the turn-on of the line voltage source that is to be controlled by the 1Z. How this is accomplished and ensured is up to the customer.

2.3. Wiring Overtemperature Contacts

Normally-open (N.O.) heat sink thermostats are standard on all fan-cooled models (rated 180 A and higher). These thermostats, which close on high heat sink temperature (200ºF), may be used to initiate an alarm, shunt trip, or other device for SCR protection.

If desired, normally-closed (N.C.) contacts may be purchased rather than normally-open (standard). Heat sink thermostats are optional on units with current ratings lower than 180 amperes and can be ordered with either N.O. or N.C. contacts.

2.4. Input/Output Wiring

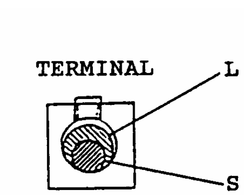
Using appropriately sized and insulated conductors for the voltage and current ratings of your model, make connections as shown in Figure 2-1. (Refer to Table 2-1.for wire size information). Torque specifications of bolted connections can be found in Table 5-3.

WARNING

Branch circuit overcurrent protection required is to be provided in accordance with the national and local codes of the inspecting authority.

Connect a lugged conductor from line-source “2” to screw terminal L2 on the power control. This conductor will carry low return current at line voltage, from control transformer T1 on the power controller.

Table 2-1. Wire Size Information



Current Rating	Size Range S	Each Conductor L
60, 90, 120A	8 AWG	0 AWG
180, 225 A	6 AWG	250 MCM
350 A through 1200 A	Not Applicable	Not Applicable

MCM = 1000 CM (circular mils) 1 CM = Area od circle of 0.001 in. dia.
L = Largest allowable conductor size S = Smallest allowable conductor size

Inside the 1Z, the wire from the L2 should connect to the appropriate tap of transformer T1, depending on the line voltage to be used. Check the T1 connection by opening the 1Z cover; T1 terminal voltages are clearly marked.

2.5. Voltage Changeover

The 1Z may be changed to accept a wide range of line voltages (120, 208◆, 240, 400, 480, 575 Vac), as long as the load current does not exceed the 1Z’s current rating. This is accomplished by moving the black wire on transformer T1 to the appropriate voltage tap, depending on the line voltage to be used.

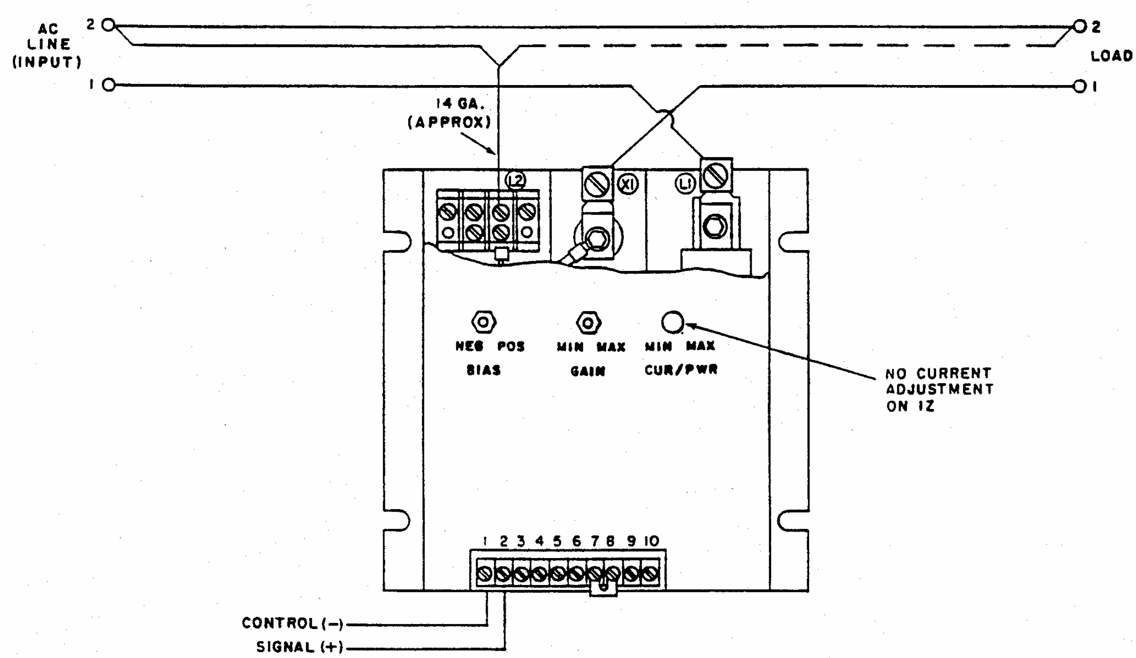


Figure 2-1. Typical 1Z Line and Load Connections

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CHAPTER 3. Operation

3.1. General

This chapter provides information necessary for proper setup and operation of various methods used to control the 1Z. These methods are:

a. Internal manual control of power output
b. Temperature controller
c. Remote manual control (only) with a potentiometer
d. Auto/manual control with a controller and potentiometer
e. On/off control
f. Controlling several 1Zs connected in parallel
g. Controlling several 1Zs connected in series
h. Temperature-controlled slidewire

3.2. Internal Manual Control of Power Output

NOTE

For the following procedures, measurements of the output voltage should be made with an analog voltmeter.

WARNING

HAZARDOUS VOLTAGES exist at the 1Z output terminals and at the load when the input voltage is connected. This condition exists even when the 1Z is set to deliver zero output, by any of the control methods described in this Chapter. The line input fused disconnect or circuit breaker must be open or OFF to perform maintenance of any kind, including at the load.

To ensure proper operation of the 1Z for internal manual control of power output, perform the following steps:

a. With line power off, set **BIAS** fully CCW and set **GAIN** to full CW.

b. Turn on line power to the 1Z. The output (as seen at voltmeter) should be at or near zero volts. Adjust **BIAS** slowly to full CW, for full output.

c. Slowly turn the **GAIN** control counterclockwise (CCW) until the voltmeter needle begins to decrease, then slowly turn the **GAIN** control clockwise just until the 1Z is fully on again. Lock the control.

d. The **BIAS** potentiometer can now control the output of the 1Z. Zero power output occurs at about the midpoint of the control's rotation, and 100% power output occurs at the extreme clockwise position. Do not use the center setting (0%) to turn off the 1Z for maintenance, as hazardous voltages will still be present.

3.3. Temperature Controller

A wide range of controller outputs can be used to drive the 1Z. The range of acceptable full-scale output voltages is 1.5 to 15 Vdc. Since most controllers have a current output, the input impedance of the 1Z may need changed to accommodate your controller. Table 3-1 depicts some typical alterations to the impedance of the 1Z to match it to various controllers.

Table 3-1. Matching SCR Power Control to your External Controller Signal

Temperature or Process Controller		SCR Power Control Input Impedance (See Diagrams)
Output type	Full Scale Range	
Voltage*	Lowest: 0 to 1.5 Vdc F.S. Highest: 0 to 15 Vdc F.S.	1500 ohms (Fig. B)
Current Loop*	Lowest: 0 to 3 mA dc F.S. Medium: 0 to 10 mA dc F.S. Highest: 0 to 30 mA dc F.S.	500 ohms (Fig. A) (standard)
* External controller can have any practical low-end value (e.g. 2 V or 3 V, or 2 mA or 4 mA) that corresponds to zero power output. The SCR power control's BIAS potentiometer is used to offset that value to obtain a corresponding zero voltage output.		

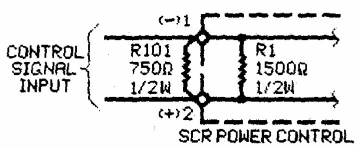

Fig A. Impedance = 500 ohms
(Standard; R101 in place)

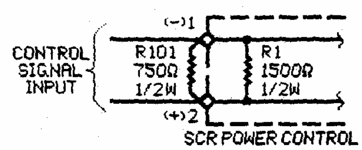

Fig B. Impedance = 1500 ohms
(R101 Removed)

As an example of the use of Table 3-1, consider a typical controller that will supply 10 V maximum for a 0-20 mA current loop. According to Table 3-1, a controller impedance of 500Ohm would be correct for proper operation, and the external 750Ohm resistor would not need to be removed.

3.4. Calibration

Calibration of the 1Z for use with a temperature controller is performed as follows:

a. Set the **GAIN** and **BIAS** controls fully CCW (counterclockwise).

b. Connect an analog voltmeter across terminals X1 and L2 the 1Z. Set the voltmeter range to measure full input voltage.

c. Close the fused disconnect or circuit breaker to apply power to the 1Z. Turn the temperature controller on and set to demand zero power output.

d. Set the **BIAS** and **GAIN** controls fully CW. The output should be full-on.

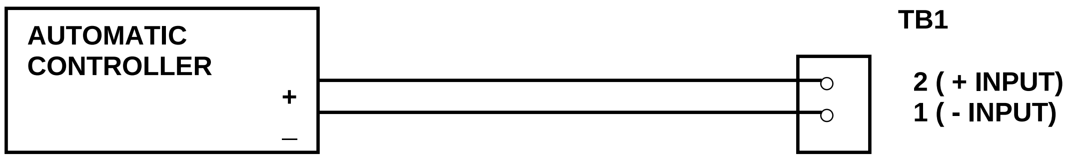

Figure 3-1. Automatic Controller Input Connections

e. Observe the voltmeter and adjust the **BIAS** control CCW just to the point where the output voltage reading is zero.

f. Set the temperature controller to demand 100% output. Observing the voltmeter, adjust **GAIN** CCW just to the point where the reading is below the maximum output voltage. Then adjust **GAIN** CW just to the point where the meter reading is maximum.

g. Repeat steps 3-4e and 3-4f as necessary, to ensure proper control adjustments have been made.

h. Lock the **GAIN** and **BIAS** controls to retain their settings. Turn off the line power to the 1Z and disconnect the test equipment. The 1Z is now ready for automatic operation.

3.5. Remote Manual Control (only) with a Potentiometer

This potentiometer may be located on a remote panel near other controls related to the process being powered by the 1Z. It may be calibrated to correspond to a percentage of rated power output, process temperature, or some other parameter. The potentiometer may by 500Ohm to 5kOhm, and should be rated at ½ watt, minimum.

a. With the power to the 1Z turned off, connect the potentiometer as shown in Figure 3-2. The CW position is the full power output position. Terminal TB1-5 is internally connected to a positive dc voltage source.

b. Remove the jumper from terminals TB1-7 and TB1-8. This disables the **BIAS** control, and permits operation with the remote potentiometer.

c. Connect an analog voltmeter across terminals X1 and L2 the 1Z. Set the voltmeter range to measure the full output voltage.

d. Set the **GAIN** control and remote potentiometer fully CCW.

e. Close the fused disconnect or circuit breaker to apply power to the 1Z. The unit should be energized, with no output.

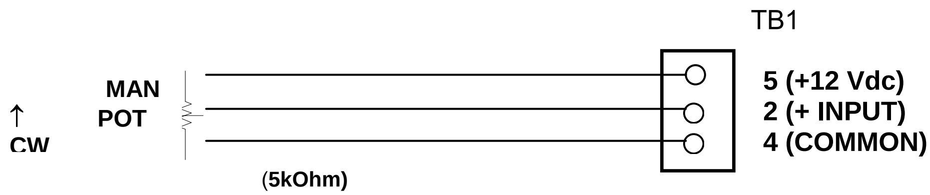

Figure 3-2. Remote Control with a Potentiometer

f. Set the **GAIN** control and remote potentiometer fully CW. The output should be full-on.

g. Observe the voltmeter and slowly adjust the **GAIN** control CCW, just to the point where the output voltage reading is full up.

WARNING

Hazardous voltages exist at the exposed 1Z heat sinks and at the load unless the line-source fused disconnect or circuit breaker is open or off. This is true even when the SCRs are turned off. Always remove power to the unit before attempting service.

h. Lock the **GAIN** control to retain the setting. Turn off the line power to the 1Z and disconnect the test equipment.

3.6. Auto/Manual Control with a Controller and Remote Potentiometer

Following the instructions detailed in Chapter 3-5, select and install the remote potentiometer. Install the **AUTO/MAN** switch in the same general location as the remote manual potentiometer.

With the power to the 1Z turned off, connect the switch, potentiometer, and controller as shown in Figure 3-3. Note that the full CW position of the potentiometer is the full-power-output position.

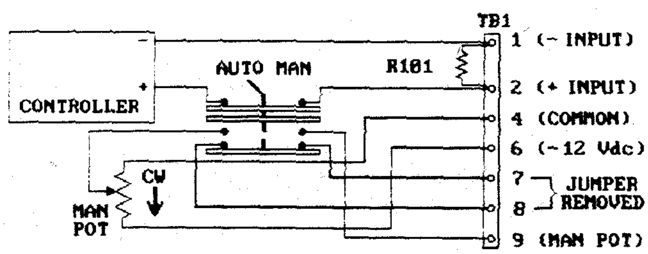

Figure 3-3. Auto/Man Control with Controller and Remote Potentiometer

Place the **AUTO/MAN** switch to **AUTO** and calibrate the system as described in steps 3-4a through 3-4h.

3.7. On/Off Control

Two methods of on/off control are provided:

a. Output enabled by contact closure.

b. Output disabled by contact closure.

3.8. Output Enabled

With the power to the 1Z turned off, connect the system as shown in Figure 3-4.

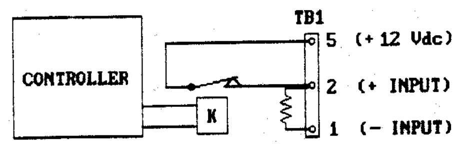

Figure 3-4. On/Off control (Output Enabled by Contact Closure)

Calibrate the system by performing the steps in 3-2. Note that zero power demand is accomplished by opening the contacts with the controller, and maximum power demand is present when the contacts are closed.

3.9. Output Disabled

With the power to the 1Z turned off, connect the system as shown in Figure 3-5.

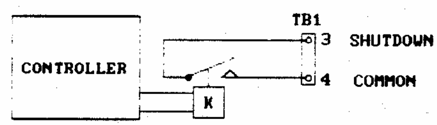

Figure 3-5. On/Off control (Output Disabled By Contact Closure)

Calibrate the system by performing the steps in 3-2. Note that zero power demand is accomplished by closing the contacts with the controller, and maximum power demand is present when the contacts are open.

3.10. Controlling Several 1Zs in Parallel with One Controller

Multiple control of parallel connected 1Zs with a single controller can be accomplished as follows:

a. Connect each unit as shown in Figure 3-6.

b. Remove the external shunt resistor, R101 (if installed) from TB1 terminals 1 and 2, from all units.

c. Remove internal resistor R1 from all units.

d. Connect the appropriate impedance matching resistor for your controller across terminals TB1-1 and 2 of the 1Z nearest the controller.

e. Calibrate each unit as described in 3-4.

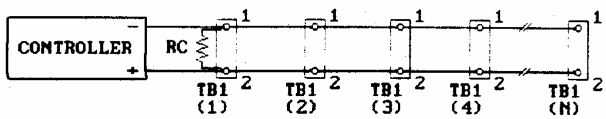

Figure 3-6. Controlling Several 1Zs Connected in Parallel

3.11. Controlling Several 1Zs in Seried with One Controller

Multiple control of series connected 1Zs with a single controller can be accomplished as follows:

a. Connect each unit as shown in Figure 3-7.

b. Multiply the 1Z's impedance value by the number of units connected in series. If the total is greater than the impedance rating of the controller (usually 1kΩ), it will be necessary to decrease the total impedance by replacing R101 on each controller with a resistor of less resistance, as shown by the following formula:

$$R101 = \frac{1}{\frac{1}{(1000 \div n)} - \frac{1}{1500}}$$

Example:

Four 1Zs connected in series have an impedance of 500Ω each. Total impedance would be 500 X 4, or 2kΩ. Since the total impedance exceeds the rated impedance of the controller, (usually 1kΩ maximum), you must reduce the value of R101.

$$R101 = \frac{1}{\frac{1}{(1000 \div n)} - \frac{1}{1500}}$$

Using the formula, R101 is equal to the inverse of the reciprocal of 1kΩ (maximum impedance of the controller) divided by the number of 1Zs connected in series, minus the reciprocal of the impedance of a single 1Z (with R101 removed).

$$R101 = \frac{1}{\frac{1}{(1000 \div 4)} - \frac{1}{1500}} = 300 \text{ ohms}$$

To match the load impedance to the controller, each 1Z should have R101 replaced with a 300Ω resistor, instead of the 750Ω resistor usually installed.

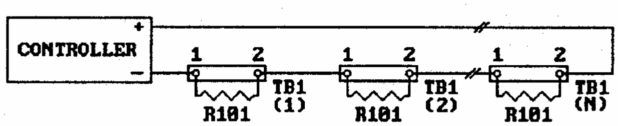

Figure 3-7. Controlling Several 1Zs Connected in Series

3.12. Temperature-controlled Slidewire

This type of temperature controller typically uses a 135Ω slidewire. However, the actual resistance for use with the 1Z must be approximately 815Ω.

When connecting a 1Z for control by a temperature-controlled slidewire potentiometer, install a 681Ω resistor in series with the slidewire, as shown in Figure 3-8 (815Ω – 135Ω = 680Ω).

a. Turn off all power to the SCR Power Controller.

b. Connect the 681Ω (681 – 945Ω) resistor in series with the slidewire.

c. Using an ohmmeter, ensure that the total resistance of the slidewire and resistor is approximately 815Ω.

d. Connect the controller as shown in Figure 3-8.

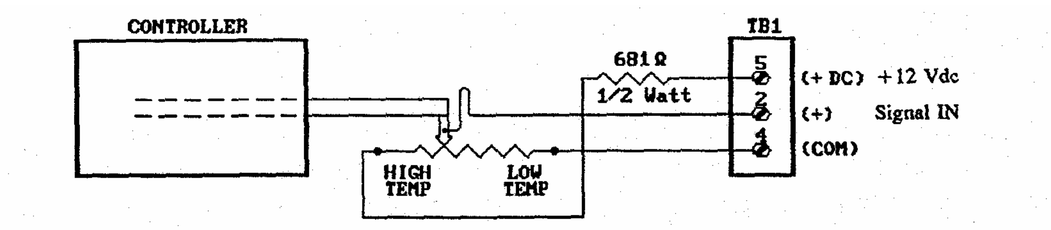

Figure 3-8. Slidewire Control

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CHAPTER 4. Theory

4.1. Functional Description

The following paragraphs provide a functional description of the digital firing control circuit, variable-time-base, pulse-train firing, zero-phase firing, and the GAIN and BIAS controls.

4.2. Digital Firing Control Circuit

Firing (gating) of the SCRs is controlled by a digital firing control circuit synchronized to the line frequency (50 or 60 Hz). The firing control circuit may be manually controlled by the built-in BIAS control, or a remote potentiometer. Automatic control may be from a temperature or process controller that provides a demand-proportional low-level voltage or milliampere output signal. The firing control circuit may also be turned on and off by an external switch or relay contacts. (Chapter 3 discusses some external control methods.)

4.3. Variable-Time Base

The firing control circuit of the 1Z operates on a variable rather than fixed time base. Operating on a fixed-time –base of 1/3 second (20 cycles), for example, at 50% power the SCRs would be on for 10 cycles, off for 10 cycles, on for 10 cycles, and so on. Operating on a variable-time-base, at 50% power, the SCRs are on for one cycle and off for the next. At 75% power, the controller, with a fixed-time-base of one-third second (20 cycles), would be on for 15 cycles and off for 5. The variable-time-base, however, would be on for three cycles, off for one, and so on. The time required to describe the operation of the 1Z would be the period of four cycles in this case – three cycles on and one cycle off.

For 50% power, the time required to describe the operation of the variable-time-base would be the period of two cycles – one cycle on and one cycle off. Hence the time-base of the 1Z would be the period of two cycles for 50% power and four cycles for 75% power. The time-base varies for other power levels as well, so its period is always that of a whole number of cycles. This theoretical relationship is shown in Table 4-1. It may not appear precisely as indicated when the output is viewed with an oscilloscope, as other factors such as voltage feedback may be occurring.

An important consideration is that, for discrete cycles of output, the "off" time is the minimum possible for any specific power demand (see above). This reduces thermal shock to the load and thus extends load element life. Of equal importance, variable-time-base firing provides excellent control resolution and fast response, and the circuit design facilitates accurate voltage regulation. The lowest shock factor the load is achieved at 50% output (one cycle on, one cycle off).

4.4. Pulse-Train Firing

The 1Z's output to the SCRs consists of a pulse-train of approximately 13 to 17 kHz. This means that for every cycle of controlled output, the SCRs would receive many trigger pulses, which will ensure constant gating during the "on" period of the 1Z's output. This also ensures that the SCR is gated on in case of a mid-cycle turnoff.

Table 4-1. Variable-Time-Base Relationship (Example)

Control signal, % Power Demand	SCR Pair, Complete On Cycles	SCR Pair, Complete Off Cycles
1%	1	99
25%	1	3
50%	1	1
60%	3	2
70%	7	3
75%	3	1
80%	4	1
90%	9	1
95%	19	1
99%	99	1
100%	N	0

4.5. Zero-Firing

Zero-firing simply means that each time the ac line passes through the 0% point of the ac sinewave, the SCRs will be gated on or off in one cycle increments. Gating depends on the amount of control selected by the BIAS control, or any other control method described in Chapter 3.

4.6. GAIN and BIAS Controls

The BIAS and GAIN potentiometers are screwdriver-adjustable. The zero position of the BIAS control corresponds to zero bias and zero power output. The approximate zero setting can be found by rotating the control over its range, stopping near the midpoint of rotation.

The precise zero setting can be found by observing the output level while rotating the control near the midpoint of rotation. From the midpoint to extreme CCW (counterclockwise) is the bias or negative region. Operating the control in this region, one can zero the output from the 1Z at any output level of a temperature controller or other external control device. From midpoint to extreme CW is the positive control region, whose extremes correspond to 0% and 100% power output, respectively, as manually adjusted.

The GAIN control is used as a final adjustment to set the 1Z output to precisely 100%, when the principal control device (external controller, external manual control, or BIAS potentiometer) is set to demand 100% output.

4.7. Voltage-Squared Feedback

Voltage-squared feedback simulates power feedback. It is used to help maintain constant power delivered to the load when the line voltage changes and the load resistance remains constant.

4.8. Shutdown

The shutdown circuit provides a quick SCR shutdown signal. This is accomplished via a customer provided contact across terminal 3 and terminal 4 (common). This removes the input signal to the comparator that tells the circuit when to gate the SCRs on. It also instantaneously turns off the SCR gating pulses.

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CHAPTER 5. Troubleshooting

5.1. Customer-Service Program

Although service is seldom necessary, because of the inherent long-term reliability of solid-state components and conservative design, ASIRobicon emphasizes customer satisfaction by maintaining a rapid-response, cooperative customer-service. If operational difficulties occur, ASIRobicon will provide replacement parts or units quickly, courteously and efficiently. If servicing problems arise that are not within the scope of the following troubleshooting guide, service is readily available, as detailed in Chapter 6.

5.2. Troubleshooting Typical Symptoms

The 1Z is considered to be operating properly when its output voltage can be satisfactorily varied from 0% to 97% of the available input voltage by a control signal. Improper operation of the unit is usually indicated by one of the following symptoms:

a. No output.

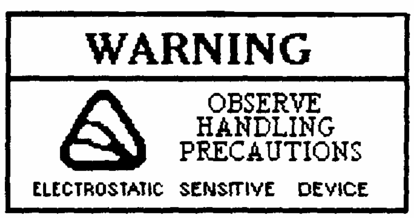
b. Full output at all times, with no change resulting from a control signal change.

c. Output variable from some intermediate value to maximum, but cannot be brought to zero.

d. Output variable from zero to some intermediate value, but cannot be brought to maximum.

The symptoms listed may be caused by one or more of the following: an environmental problem, faulty input-power or load connections, and the 1Z itself. These possible causes should be investigated as described in Chapters 5-4 through 5-8.

5.3. Static Precautions when Servicing



Servicing should be performed by qualified personnel only, following procedures described herein.

WARNING

HAZARDOUS VOLTAGES exist at the exposed 1Z heat sinks and at the load unless the line-source fused disconnect or circuit breaker is open or off. This is true even when the SCRs are turned off. Always remove power to the unit before attempting service.

If troubleshooting indicates a need to replace a component on a printed circuit board or possibly the entire board, measures to prevent electrostatic discharge (ESD) damage must be taken.

a. ALWAYS wear a wrist strap connect to ground through a 1-megohm resistor when working on printed circuit boards.

b. Use soldering iron with a grounded tip.

c. Use a non-static solder sucker (metallic) or solder removal braid.

d. Transport static sensitive components in static shielding bags or rails. A new printed circuit board should be treated as a static sensitive device. A part completely installed on a board does not make the part static-safe.

e. If possible, perform printed circuit board maintenance at a work station that has a conductive covering which is grounded through a 1-megohm resistor. If a conductive table top is unavailable, a clean steel or aluminum table top is an excellent substitute.

f. Keep plastic, vinyl, styrofoam or other non-conductive materials away from printer circuit boards. They are good static generators that do not give up their charge easily.

g. Return good to ASIRobicon in static-safe packaging. This will limit further component damage from ESD.

h. CAUTION. Do not touch any printed circuit board unless you are wearing a ground wrist strap, as circuit damage may occur.

NOTE:

A Field Service Grounding Kit is available from ASIRobicon. Grounding kits are also available commercially and can be purchased through most electronic wholesalers.

5.4. Environmental Problems

Check to see that none of the following environmental problems exist.

Inadequate Cooling. For models with separate power and trigger modules, allow at least an inch of air space (in any direction) between the heat sinks and any item or structure near the 1Z power modules. Heat sink fins should be free of dust or dirt for proper heat transfer, and free of obstructions which could prevent proper airflow.

Contamination. The unit should be periodically cleaned of all dust and dirt. However, certain kinds of dust or particles are particularly conductive. A small accumulation of conductive material can cause component failures from arc-over or complete shorts.

High Ambient Temperature. Lack of a proper ambient-temperature check before installation, or an increase in ambient temperature, can result in numerous problems. Check the ambient temperature under existing conditions. If it is 122ºF (50ºC) or lower, ambient temperature should not be a problem. If it is above 122ºF (50ºC), steps should be taken to provide more cooling, or the 1Z should be moved to a cooler location, or call the ASIRobicon Service Department.

Excessive Vibration. A significant degree of pitched or unpitched vibration can cause numerous problems. If vibration is isolated as a probable cause of improper operation, standard vibration-isolation mounting techniques should be employed.

5.5. Input Power and Load Connections

Turn off the power to the 1Z and check all power connections, input and output, to make sure they are mechanically secure and free of corrosion. Make the same checks at the power source and load. Visually check insulation on input and load wiring for evidence of damage or overheating.

5.6. Correcting Troubles in the 1Z Itself

Table 5-1 provides a comprehensive guide for troubleshooting the 1Z. Refer to Table 5-1 for possible causes and solutions.

5.7. Replacement Fuses for the 1Z

Table 5-2 lists the replacement fuses from the various 1Z models. The 1Z may come supplied with fuses having identifying numbers different from the numbers shown in the table. In such a case, the fuse may be replaced either with an identical fuse or the one shown in the table.

NOTE:

If the 1Z has been changed (L2 wiring to T1 tap) to operate at a higher voltage than as originally shipped, it is quite possible to obtain output current higher than the original rating. This undesired condition could result in frequently blown fuses.

Table 5-1. Troubleshooting Chart (1Z Symptoms and Solutions)

Cause	Solution
No output even with manual control (Bias) turned full CW.	
(1a) Open SCR fuse	Remove and check the fuse. If it has opened, replace it after completing (b)
(1b) SCRs not firing	Install a good fuse in the circuit, and apply power to the 1Z. If the output is fully controllable using the manual control, then resume normal operation. If the power output is still zero, contact ASIRobicon service.
Maximum power at all times regardless of control setting.	
(2a) All SCR networks shorted	On units rated above 225 A; Remove the fuse and check the front-to-back SCR pairs by measuring resistance between the cathode of the SCR being checked and an unanodized portion of the heat sink. On the Rx1 scale, the resistance should be infinite in both directions. If a shorted component is indicated in any of these checks, replace it. On units rated at 225 A and below: Remove the fuse and check the front-to-back SCR pairs by measuring resistance between terminals L1 (of the SCR) and X1. On the Rx1 scale, the resistance should be infinite in both directions. If a shorted component is indicated in any of these cases, replace it.
(2b) Firing control section defective	Replace the fuse and return the power the unit. If the problem persists, contact ASIRobicon service.
Output is variable but can't be brought to zero with BIAS control	
(3a) SCR network shorted	Check SCR network per solution 2a.
(3b) Firing control section defective	Contact ASIRobicon service for assistance
Output is variable but can't be brought to maximum with GAIN control	
(4a) Firing control section defective	Contact ASIRobicon service for assistance

Table 5-2. 1Z Fuse Specification
(See model-number explanation in Table 1-1)

	Vendor Part Numbers		
Amperes	**Brush**	**Gould-Shawmut**	**Carbone-Ferraz**
60	-	-	-
90	XL70F125	A70P125	A070F125
120	XL70F150	A70P150	A070F150
180	XL70F225	A70P225	A070F225
225	XL70F300	A70P300	A070F300
350	XL70F450	-	A070F450
500	XL70F600	A70P600	A070F600
650	XL70F800	A70P800	A070F800
800	XL70F1000	A70P1000	A070F1000
1000	XL70F1200	A70P1200	A070F1200
1200	-	A70P1600	A070F1600

NOTE: Arbitrary substitution of improper fuses may void the warranty. The 1Z may be supplied originally with fuses with identifying numbers different from the ones shown in the table. Either fuses with the original number or with the number given in the table may be used for replacement.

Table 5-3. Torque Specifications
(With Slotted-Head and Hex-Head Screws)

	TORQUE, INCH POUNDS		
INPUT/OUTPUT CONDUCTOR SIZE, AWG OR CIR. MILS	**SLOT WIDTH***		**HEX HEAD (ALL)**
	¼ " OR LESS	**OVER ¼"**	
6-4 AWG	35	45	110
2 AWG	40	50	150
1 AWG	--	50	150
1/0 – 2/0 AWG	--	50	180
3/0 – 4/0 AWG	--	--	250
250 – 350 CM	--	--	325

*** = Screwdriver Blade Width to Match**

(With Socket-Head Screws, all Conductor Sizes)

SOCKET SIZE, ACROSS FLATS	TORQUE INCH POUNDS
3/16"	120
1/4"	200
5/16"	275
3/8"	375
1/2"	500

NOTE: All input/output conductors have a minimum temperature rating of 75ºC.

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6.3. Spare Parts List

The following table lists the minimum recommended quantities for spare parts for the 1Z. As spares are used, replacements should be ordered.

The listed SCR current ratings are the half-wave average values. The calculation for half-wave AVG value is nameplate current times 0.45.

Table 6-1. 1Z Spare Parts List

Item	Item No.	Quan
60 Ampere Units		
Fuse, 125A, 700V	261277.30	1
PCB Assy, 1Z trigger	H019961	1
PCB Assy, SCR module #1, *DVDT VAR*	H023870	1
SCR/dual pkg, 92 A, 1400 V	H011024	1
90 Ampere Units		
Fuse, 125 A, 700 V	261277.30	1
PCB Assy, 1Z trigger	H019961	1
PCB Assy, SCR module #1, *DVDT VAR*	H023870	1
SCR/dual pkg, 92 A, 1400 V	H011024	1
120 Ampere Units		
Fuse, 150 A, 700 V	261227.31	1
PCB Assy, 1Z trigger	H019961	1
PCB Assy, SCR module #2, *DVDT VAR*	H023871	1
SCR/dual pkg, 142 A, 1400 V	H017371	1
180 Ampere Units		
Fan, axial, 115 Vac, 110 CFM	H018659	1
Fuse, 225 A, 700 V	H018813	1
PCB Assy, 1Z trigger	H019961	1
PCB Assy, SCR module #2, *DVDT VAR*	H023871	1
SCR/dual pkg, 142 A, 1400 V	H017371	1
225 Ampere Units		
Fan, axial, 115 Vac, 110 CFM	H018659	1
Fuse, 300 A, 700 V	261277.34	1
PCB Assy, 1Z trigger	H019961	1
PCB Assy, SCR module #2, *DVDT VAR*	H023871	1
SCR/dual pkg, 162 A, 1400 V	H019070	1
350 Ampere Units		
Fan, axial, 115 Vac, 110 CFM	H018659	1
Fuse, 450 A, 700 V	H019253	1
Lug Kit, single-phase 350 A, CSA Certified	H020477	1
PCB Assy, 1Z trigger	H018246	1
SCR, 298 A, 1400 V	068237	2
Varistor, 660 V	H026669	1
500 Ampere Units		
Fan, axial, 115 Vac, 100 CFM	H018659	1
Fuse, 508 A, 700 V	261277.38	1
Lug Kit, single-phase 500 A, CSA Certified	H020478	1
PCB Assy, 1Z trigger	H018246	1
SCR, 508 A, 1400 V	H020035	2
Varistor, 660 V	H026669	1

Item	Item No.	Quan
650 Ampere Units		
Fan, axial, 115 Vac, 350 CFM	074892	1
Fuse, 800 A, 700 V	261277.40	1
Lug Kit, single-phase 650 A, CSA Certified	H020479	1
PCB Assy, 1Z trigger	H018246	1
SCR, 589 A, 1400 V	261095.34	2
Varistor, 660 V	H026669	1
800 Ampere Units		
Fan, axial, 115 Vac, 350 CFM	074892	1
Fuse, 1000 A, 700 V	261277.42	1
Lug Kit, single-phase .8-1.2kA, CSA Certified	H020760	1
PCB Assy, 1Z trigger	H018246	1
SCR, 719 A, 1400 V	261300.34	2
Varistor, 660 V	H026669	1
1000 Ampere Units		
Fan, axial, 115 Vac, 350 CFM	074892	1
Fuse, 1200 A, 700 V	261074.43	1
Lug Kit, single-phase .8-1.2kA, CSA Certified	H020760	1
PCB Assy, 1Z trigger	H018246	1
SCR, 1329 A, 1400 V	H020038	2
Varistor, 660 V	H026669	1
1200 Ampere Units		
Fan, axial, 115 Vac, 350 CFM	074892	1
Fuse, 1600 A, 700 V	H013430	1
Lug Kit, single-phase .8-1.2kA, CSA Certified	H020760	1
PCB Assy, 1Z trigger	H018246	1
SCR, 1329 A, 1400 V	H020038	2
Varistor, 660 V	H026669	1

6.4. Drawing List

This section contains drawings that show outline dimensions, installation wiring, and printed circuit board component locations, as well as an overall schematic of the 1Z. These drawings are useful in installing and troubleshooting all 1Z models. Table 6-2 lists the drawings in the order of their appearance.

Table 6-2. 1Z Drawing List

Drawing Title	Drawing No.
Outline & Mounting, 1Z – 60, 90, 120 A	02D104479
Outline & Mounting, 1Z – 180 A, 225 A	02D104488
Outline & Mounting, 1Z – 350 A, 500 A	02D104593
Outline & Mounting, 1Z – 650 A	02D104594
Outline & Mounting, 1Z – 800, 1000, 1200 A	02D104778
Schematic, 1Z – 60, 90, 120 A	05C104401
Schematic, 1Z – 180, 225 A	05C104484
Schematic, 1Z – 350 A through 1200 A	05C104419

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CHAPTER 7. Warranty Policy and Product Reliability

This chapter details the warranty policy of ASIRobicon products as well as product liability information. ASIRobicon's standard warranty policy is listed below. Note that the warranty policy for a particular job agreement may be different from the standard policy. When in doubt about warranty information, consult the factory.

7.1. Guarantee and Product Liability

ASIRobicon's "standard" warranty policy is listed as follows. When in doubt about warranty and/or product liability issues, consult the factory. All products are warranted for a period of two years from date of shipment against defects in materials or workmanship. Guarantee repairs are to be performed FOB (free on board) ASIRobicon factory to qualify for no charges. ASIRobicon's liability and customer's exclusive remedy under this warranty are expressly limited to repair, replacement, or repayment of the purchase price. Whether there shall be repair, replacement, or repayment is to be exclusively ASIRobicon's decision. ASIRobicon is not liable for incidental and consequential damages.

This warranty shall not apply to major devices or equipment such as transformers not manufactured by the seller or to equipment or parts which shall have been repaired or altered by others than the seller so as, in its judgment, to affect adversely the same, or which shall be subject to negligence, accident, or damage by circumstances beyond the seller's control. For equipment and parts not manufactured by the seller, the warranty obligations of the seller shall in all respects conform and be limited to the warranty extended to the seller by the supplier.

7.2. In-house Repair Services

For all repair service at ISE, you will need a Repair Service Order (RA) number. Call **(440) 237-3200** and request a Repair Service Order (RA) number. Please reference this number when making inquiries. Use the shipping address below for returns:

ISE, Inc.
10100 Royalton Rd.
Cleveland, OH 44133
Attention: Repair Department/RA #( )

Prepay the shipment and include the following information if you are not using a ASIRobicon Return Repair Tag: the Repair Service Order (RA) number, part number, a description of the problem, contact phone number, a technical contact phone number (if different) and any additional comments. Put the Repair Service Order (RA) number on the label.

> Before sending a printed circuit board to ASIRobicon for repair, make a list of parameter values first, then be sure to follow proper ESD precautions when handling boards.

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