PK565

CHROMALOX

Advanced Thermal Technologies

MiniMax Digital

User's Manual

www.chromalox.com
800-443-2640

P/N 0037-75589

Thank you for choosing the Chromalox® MiniMax™ - a complete power control solution with industry-best price and performance.

For more than 80 years, customers have relied on Chromalox for the utmost in quality and innovative solutions for industrial heating applications. Chromalox manufactures the world's largest and broadest line of electric heat and control products.

The MiniMax Series SCR Controllers provide the best control for applications where consistent heater/process temperature is critical or where fine resolution of power is required.

Common MiniMax features include:

- 120 - 575 Vac @ 30 - 75 Amps
- Isolated Control Circuit
- Easy Customer Interface
- Remote Stop
- Compact Size and Construction
- dv/dt Transient Voltage Protection
- MOV Protection
- Automatic 50/60 Hz line sensing

Features for the MiniMax 1, 2, and 3 include:

- Zero Crossover Firing
- Isolated Control Circuit
  - On/Off Control Inputs:
    - 120 thru 240 Vac
    - 5 - 32 Vdc
    - Dry Contact Closure
  - Proportional (DOT Firing) Inputs:
    - 4 - 20 mA, 0-5 Vdc, 1 - 5 Vdc, 0 - 10 Vdc
    - Remote Manual Adjust (Optional)
    - Remote Auto/Manual Switch (Optional)
- Electronically Protected with Temperature Warning and Stop System
- Cycle Resolution 3,5,7,11,13,17,19
- Shorted SCR Detection (Optional)
- Soft Start
- Time Proportional Switching Mode
- Staged Heating
- Rotary Switch Selection of Input, Leg Configuration, Modbus

Features for the MiniMax 1P include:

- Phase Angle Firing
- Isolated Control Circuit Inputs
  - 0 - 5 mA, 0 - 20 mA
  - 0 - 50 mA, 1 - 5 mA
  - 4 - 20 mA, 10 - 50 mA
  - 0 - 5 Vdc, 0 - 10 Vdc
- Optional Current Limit
- Soft Start
- Line Voltage Compensation
- Zero & Gain Adjustments
- Built-In Manual Adjustment
- Current Limit Adjustment (Optional)

If you have application questions, refer to the Engineering Resource section of our website at www.chromalox.com to find the answer you're looking for, or call one of our application engineers at 1-888-996-9258 for personal assistance.

Table of Contents

IMPORTANT SAFEGUARDS

The MiniMax User Manual uses this symbol to alert personnel to potential hazards that may damage the equipment.

The MiniMax User Manual uses this symbol to alert personnel to potential hazards that may cause injury or death.

Please read all instructions before installing and operating your MiniMax.
Before working inside the equipment, confirm that all power has been turned off, locked off, and preferably earthed [grounded] at all points of low and high potential, on both the supply line and load side circuits, as required / permitted by all codes and standards.
Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Contact an area supervisor or safety personnel for more information.
Throughout the MiniMax User Manual, the safety alert and the international electric shock/electrocution symbols will alert you to potential hazards. Safety precautions should always be followed to reduce the risk of personal injury to persons from fire and electrical shock hazards.
Each safety message is preceded by a safety alert symbol and one of three words: DANGER. WARNING, or CAUTION. These mean:

DANGER You WILL be killed or seriously hurt if you do not follow instructions.

WARNING You CAN be killed or seriously hurt if you do not follow instructions

CAUTION You CAN be hurt if you do not follow instructions.

Damage Prevention Messages:

You will see other **IMPORTANT** messages that are proceeded by the word **CAUTION** that are intended to help prevent damage to the MiniMax or other equipment. Note that Damage Prevention Messages are NOT accompanied by the Safety Alert Symbol.

Key Safety Practices
All personnel working on high voltage electrical equipment must adhere to all national and local regulations, codes, and standards.
Only suitably qualified and experienced persons, who are familiar with this equipment, and the work they are to do, should carry out installation, commissioning, operation, or maintenance of this panel and the associated heater.
Such persons shall adhere to proper high voltage safety procedures, including the use of appropriate personal protective equipment (ppe).
Failure to adhere to any of the above may result in equipment damage, operating losses, injury, or death. Chromalox will not be liable for failure to adhere to all governing regulations, codes, standards, site procedures and information given in this manual.

2 Description

MiniMax 1, 2, and 3

The Chromalox MiniMax 1, 2, and 3 controllers are highly versatile SCR Power Paks with optional plug-in proportional firing and shorted SCR detection boards. Firing modes include On/Off and DOT proportional zero voltage switching. Chromalox exclusive DOT (Demand Oriented Transfer) firing technique switches the fewest number of cycles to provide the most precise zero crossover control. At 50% output, the unit's output alternates between one cycle "On" and one cycle "Off." At 51%, the output continues with one cycle "On," one cycle "Off," and gradually integrates one extra "On" cycle for the additional 1%. This DOT fired technique also minimizes temperature overshoot, temperature fluctuations and helps extend the load's element life due to reduced thermal shock.

The power SCR assemblies consist of one, two, or three pairs of SCRs connected back to back (with an optional semiconductor fuse), RC Snubber, and MOV protection. The firing circuit is based on a common On/Off control board with plug and play Shorted SCR and DOT fired plug-in boards. Diagnostic indicators are included. Plug-in terminal blocks for easy customer interface are also provided.

MiniMax 1P

The Chromalox MiniMax 1P utilizes Single Phase, Phase Angle firing to modulate power to an inductive or resistive load. Phase Angle control has the advantage of proportioning every cycle thereby providing very fine resolution of power. Fast responding loads in which the resistance changes as a function of temperature require Phase Angle control. The MiniMax 1P offers a Soft Start feature that assures that the load power is gradually increased from zero to the value set by the command signal in the event of a power interruption. In addition, optional Current Limit is used to protect the load, SCR controller and the total system from large surge currents that could occur at start-up.

† This can be set to three cycles 'On' / three cycles 'Off' (see section on installation options).

3 Before You Install

READ AND UNDERSTAND BEFORE CARRYING OUT THE WORK DETAILED BELOW

Immediately after receiving your MaxPac I, II, III or IP Series Controller, visually inspect the shipment packaging and record any damage on the shipping documents. Unpack the controller and carefully inspect for obvious damage due to shipment. If any damage has occurred, YOU must file a claim with the carrier company, since the carrier company will not accept a claim from the shipper (Chromalox).

Be sure to check the model number and verify that you have received the correct Model of controller.

If the controller is not installed and placed into operation immediately, it should be stored in a cool, dry environment. Temperature extremes and excessive moisture can damage the controller.

Before choosing a location in which to mount your MaxPac, please consider the following:

Temperature

When mounting the SCR unit in a control panel, attention should be paid to the enclosure temperature. The SCR is rated to perform at its nameplate current rating in temperatures up to 50˚C (122˚F). Ensure that adequate ventilation is provided or some other method of maintaining the correct cabinet temperature is used.

Cleanliness

Careful attention must be paid in areas subjected to airborne particles. The efficiency of the heat sinks relies on their conducting surfaces being maintained in a clean manner. (See the Maintenance Section.)

Dampness

High humidity or hosing down a unit should be avoided.

Clearance

Choose a location that will provide adequate spacing around the unit when mounted. This will ensure proper air flow necessary to cool the device.

WARNING

HAZARDOUS VOLTAGE: Disconnect and lockout power before installing or servicing. Failure to comply could result in personal injury or equipment damage.

4 Installation

READ AND UNDERSTAND BEFORE CARRYING OUT THE WORK DETAILED BELOW

Please read all information in this section before beginning the installation of your MiniMax.

Installation of the MiniMax requires three steps:

1. Mounting
2. Power wiring
3. 120 **or** 230 Vac 50/60hz for instrument power. See 4.2.4, pg. 11.

4.1 - Step 1: Mounting

Before mounting your MiniMax, please read the section titled “Before You Install’ on page 5 for a description of an ideal environment for the unit’s operation.

The space required for mounting the MiniMax Power Pak depends upon the model. The table below refers to the figures on the following pages. These figures illustrate the dimensions and mounting holes for the various MiniMax Power Pak models. Please refer to these figures before mounting your unit.

Figure	Model
1	MiniMax 1 – 30 & 50 Amp Mounting Base
1	MiniMax 1P – 30 & 50 Amp Mounting Base
2	MiniMax 1 – 75 Amp Mounting Base
2	MiniMax 1P – 75 Amp Mounting Base
3	MiniMax 2 – 30 & 50 Amp Mounting Base
4	MiniMax 2 – 75 Amp Mounting Base
5	MiniMax 3 – 30, 50 & 75 Amp Mounting Base

IMPORTANT: Please note that the figures on the following pages are **not drawn to the same scale.**

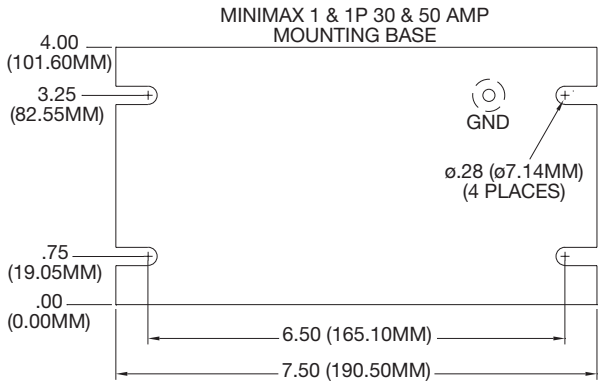


Figure 1

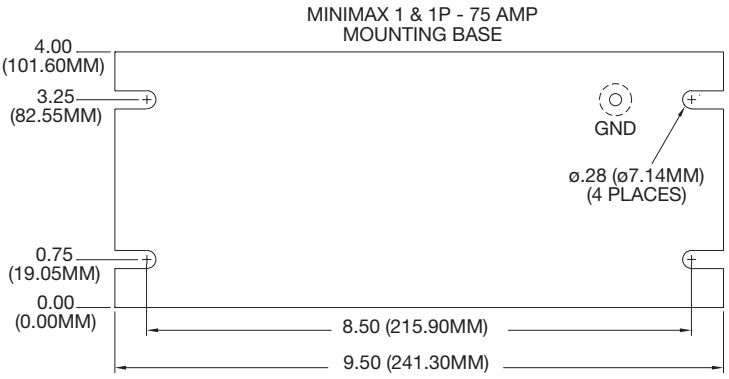


Figure 2

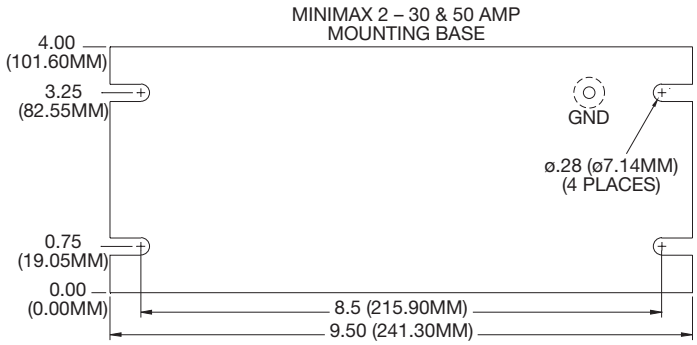


Figure 3

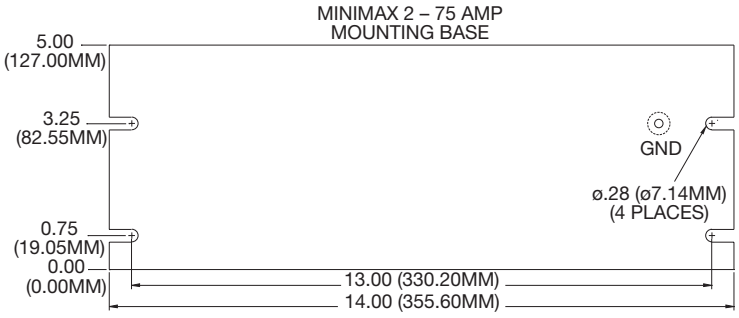


Figure 4

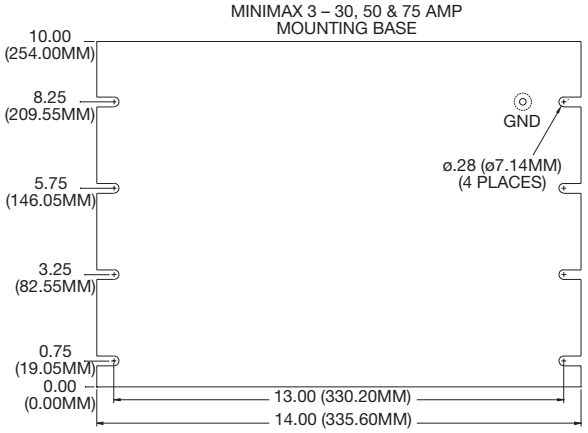


Figure 5

4.2 - Step 2: Wiring

Careful attention must be paid when attaching the wiring to the MiniMax to ensure proper and safe operation. This section contains detailed information on how to connect the power, resistive load, ground, and command signal wiring.

WARNING

HAZARDOUS VOLTAGE: Only qualified personnel should perform electrical wiring for the MiniMax Power Paks. LETHALLY HIGH VOLTAGES are associated with this equipment and are dangerous if improperly installed.

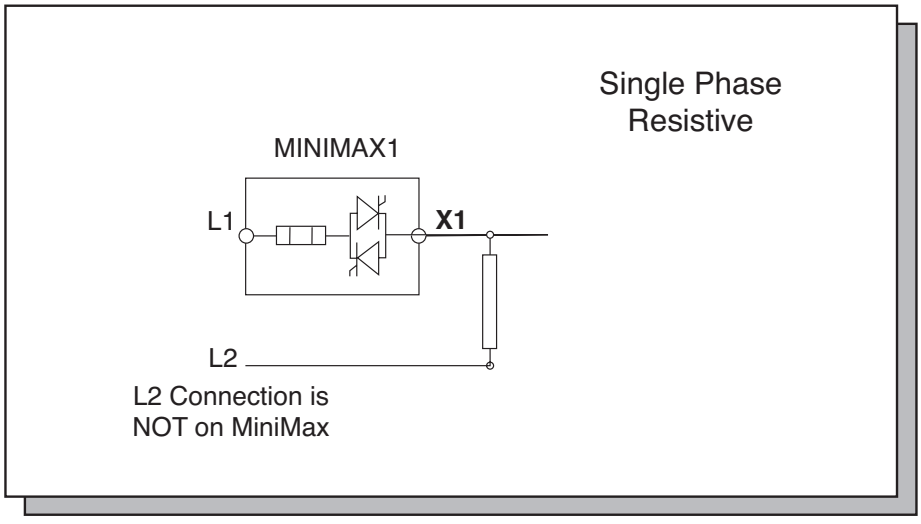
IMPORTANT: Select installation wiring that is in accordance with the National Electrical Code and any local standards that may be applicable.

4.2.1 - Power/Load Wiring

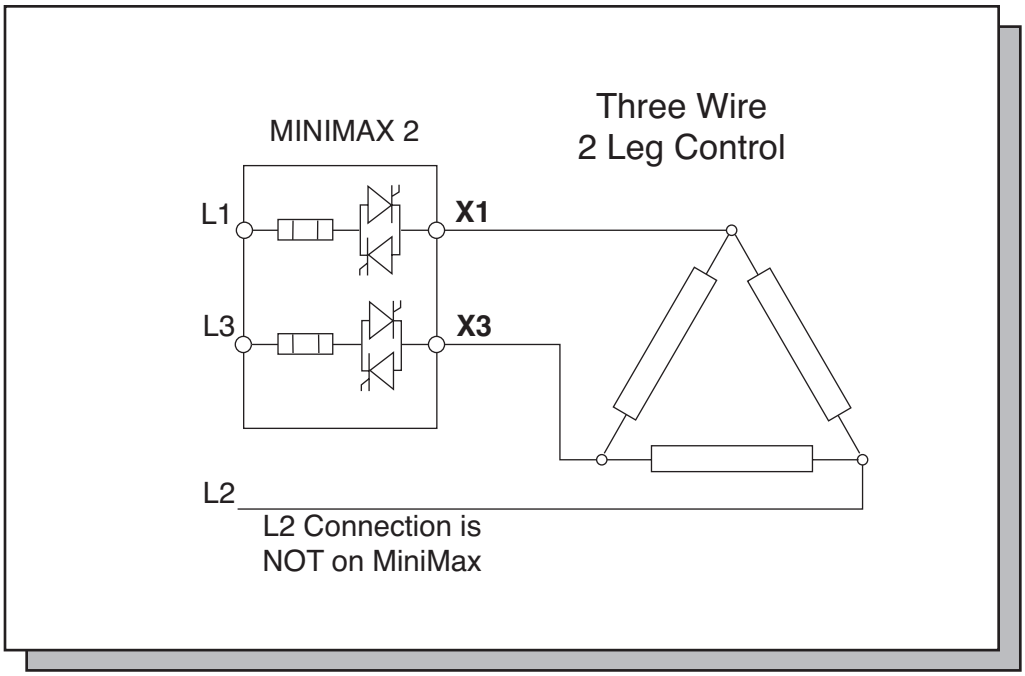
The following illustrations depict how to connect the MiniMax to a resistive or inductive load. Make sure you refer to the correct illustration for the MiniMax series you have purchased.

WARNING

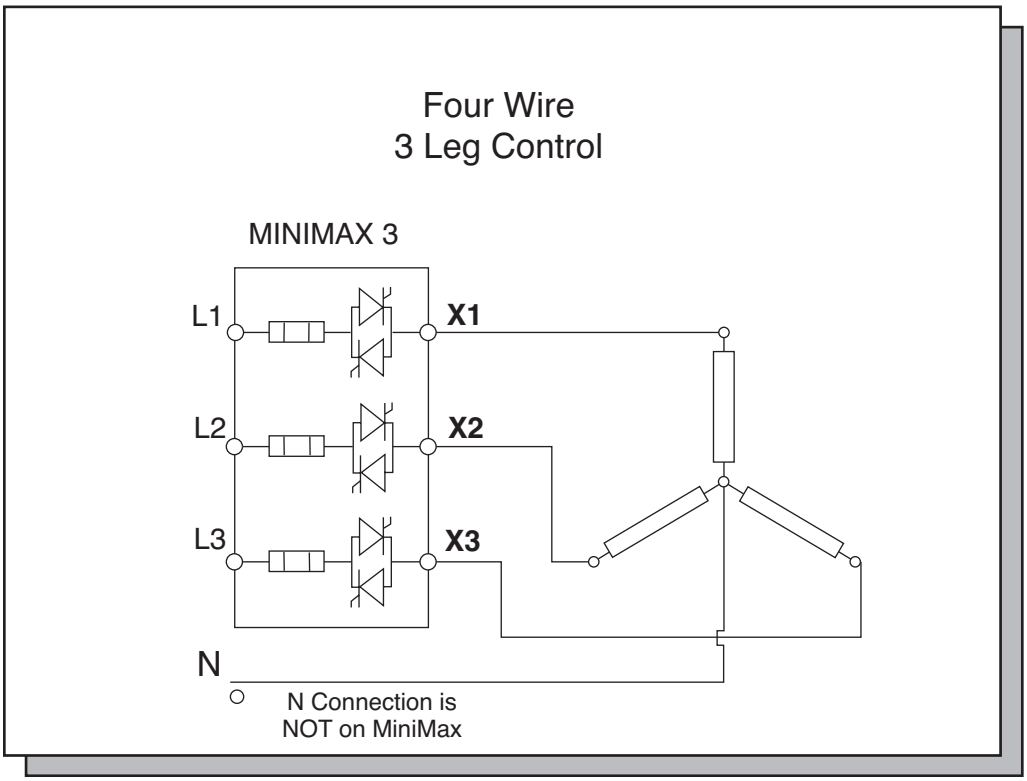
The following wiring instructions are for the Digital Minimax only. If using Analog Minimax, contact factory for appropriate wiring schematics. Analog Minimax is designated as MMAXI, II, or III followed by the number 1, 2, 3, or 4 under the firing mode.



MiniMax 2

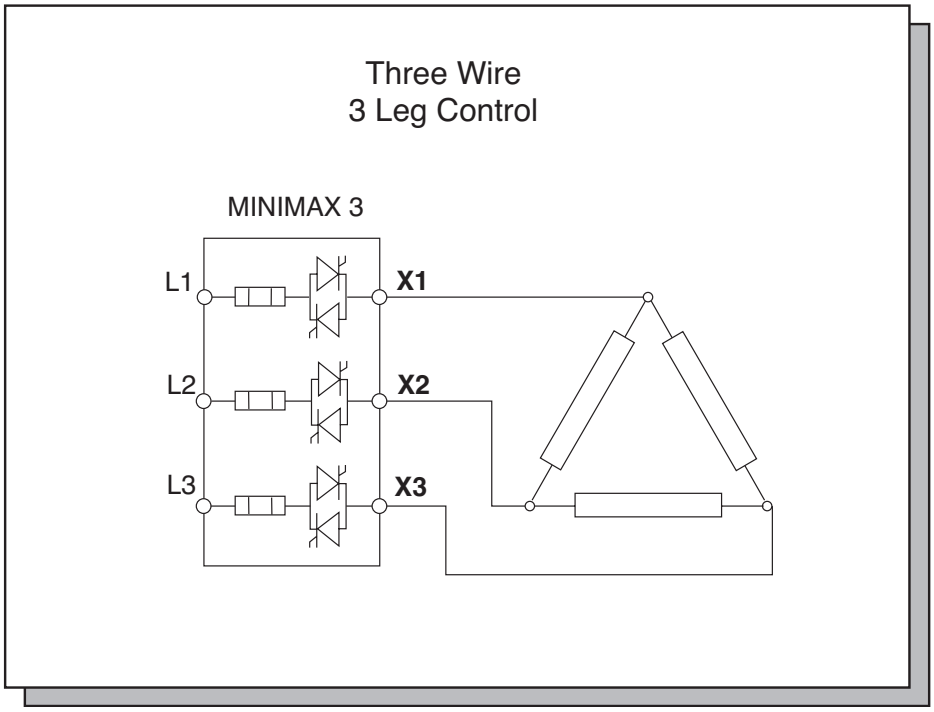


MiniMax 3

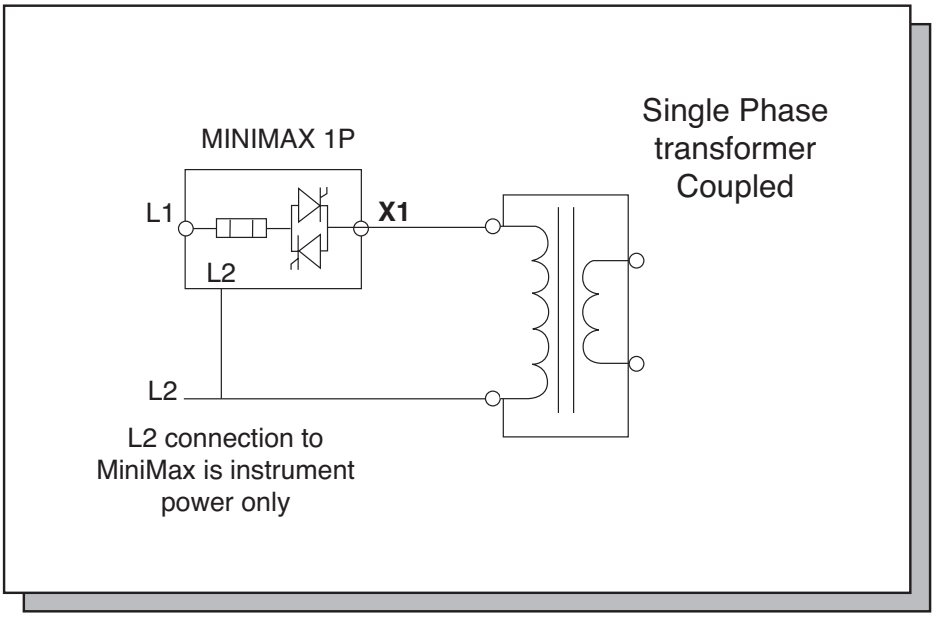


CAUTION
IMPORTANT: The I^2t fuses installed on the SCR are designed to protect the SCR from faults on the load connection side. They are **NOT** intended to provide wire protection.

MiniMax 3



MiniMax 1P



CAUTION
IMPORTANT: The I^2t fuses installed on the SCR are designed to protect the SCR from faults on the load connection side. They are **NOT** intended to provide wire protection.

4.2.2 - Instrument Power

IMPORTANT
MiniMax requires 120 or 230 Vac 50/60Hz for instrument power. This voltage supplies power for the control circuits, fans, high temperature warning indicator, and shorted SCR Indicators (see Fig. 1 on page 15). **This supply is fused on the main circuit board.**

4.2.3 - Grounding

Chasis is provided with a stud for ground connections.

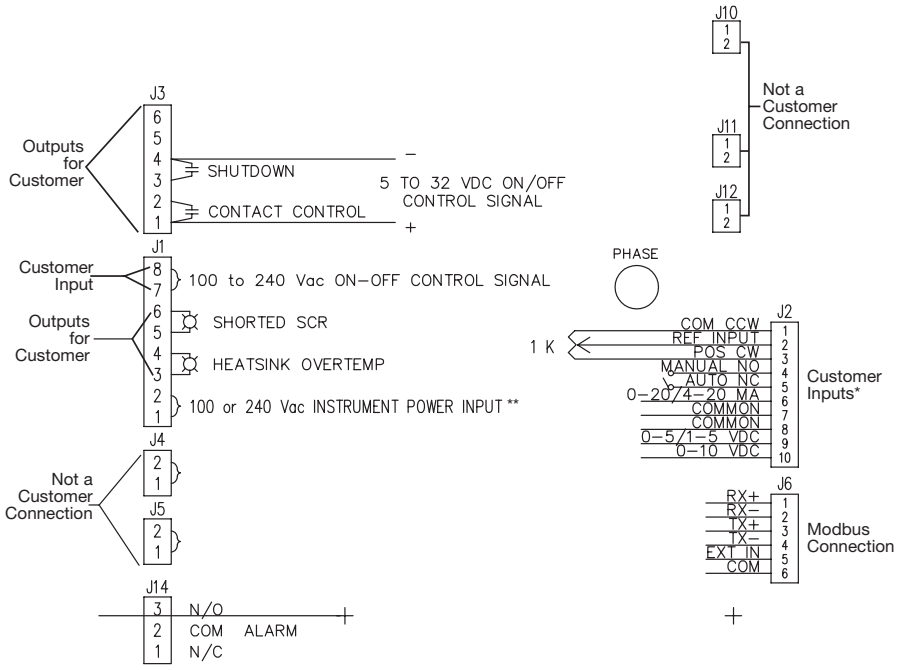
WARNING

HAZARDOUS VOLTAGE: This Electrical Equipment must be installed by a qualified person and effectively grounded in accordance to the National Electric Code and local codes.

4.2.4 - Command Signal Wiring

WARNING

The following wiring instructions are for the digital minimax only. If using analog minimax, contact factory for appropriate wiring schematics. Analog minimax are designated as MMAXI, II, or III followed by the number 1, 2, 3, or 4 under the firing mode.



Please refer to the figures on page 12 for illustrations of the 6-, 8-, and 10-pin input terminals.

MiniMax 1, 2, and 3

On/Off Control Signals

AC Input – The 120 thru 230 Vac signal lines are connected to terminal J1 - 7 & 8 (see Fig. 9 on page 21). An input voltage of 120 to 230 Vac turns the power On. The turn OFF voltage is 0 Vac.

DC Input – The 5 - 32 Vdc signal lines are connected to terminal J3 - 1 & 4 (see Fig. 10 on page 21). An input voltage of 5 to 32 Vdc turns the power On. The turn OFF voltage is 0 Vdc.

Contact Closure Input – The dry contact signal lines are connected to terminal J3 - 1 & 2 (see Fig. 11 on page 21). A closed contact turns the power On. The turn OFF voltage is an open contact.

Process Analog Control Signals

MiniMax 1, 2, and 3 have been factory calibrated. These units accept 0 - 5, 1 - 5, 0 - 10 Vdc, and 4 - 20 mA input signals that are connected to Terminal Block J2. The following signals are connected to:

0 - 5 Vdc: Terminal J2 - 9(+) & 7(-) (see Fig. 7)
1 - 5 Vdc: Terminal J2 - 5(+) & 7(-) (see Fig. 5)
0 - 10 Vdc: Terminal J2 - 10(+) & 7(-) (see Fig. 8)
4 - 20 mA: Terminal J2 - 6(+) & 7(-) (see Fig. 6)

Auto/Manual Input

The MiniMax 1, 2, and 3 can be wired to make it possible to select an input from either a temperature process controller or a manual input potentiometer. A switch is used to select between the input from a 1K potentiometer and a linear control input (see Fig. 4 on page 15). The unit is shipped with a jumper from terminals 2 and 3 of terminal block J2 (see illustration 3). Remove jumper to install auto/manual input.

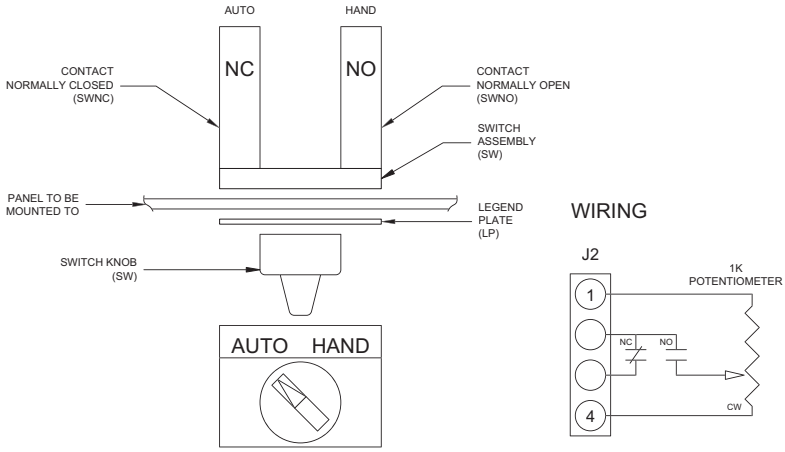


Illustration 3

CAUTION
IMPORTANT: When enabling the Auto/Manual Input, the jumper from terminals 2 and 3 of terminal block J2 must be removed.

Demand Indicator

The LED demand indicator is located on the main PC board and is viewable through the cover. With the On/Off control option, the indicator will display steady “on” and steady “off”. With the DOT Firing option, the indicator will display the rapid firing sequence.

SCR Control Board

The Basic control board provides the following functions:

The low voltage DC to operate the circuitry:

A switching regulator circuit converts the instrument power voltage to +8Vdc.

The power distribution for the cooling fans:

The incoming instrument power is routed to the fan power terminals. Add fusing as required for power fan requirements

The signal condition for the on/off input and analog inputs:

The 120 to 240 on/off input is isolated by an opto-coupler. The dc and contact closure inputs are buffered by the circuitry.

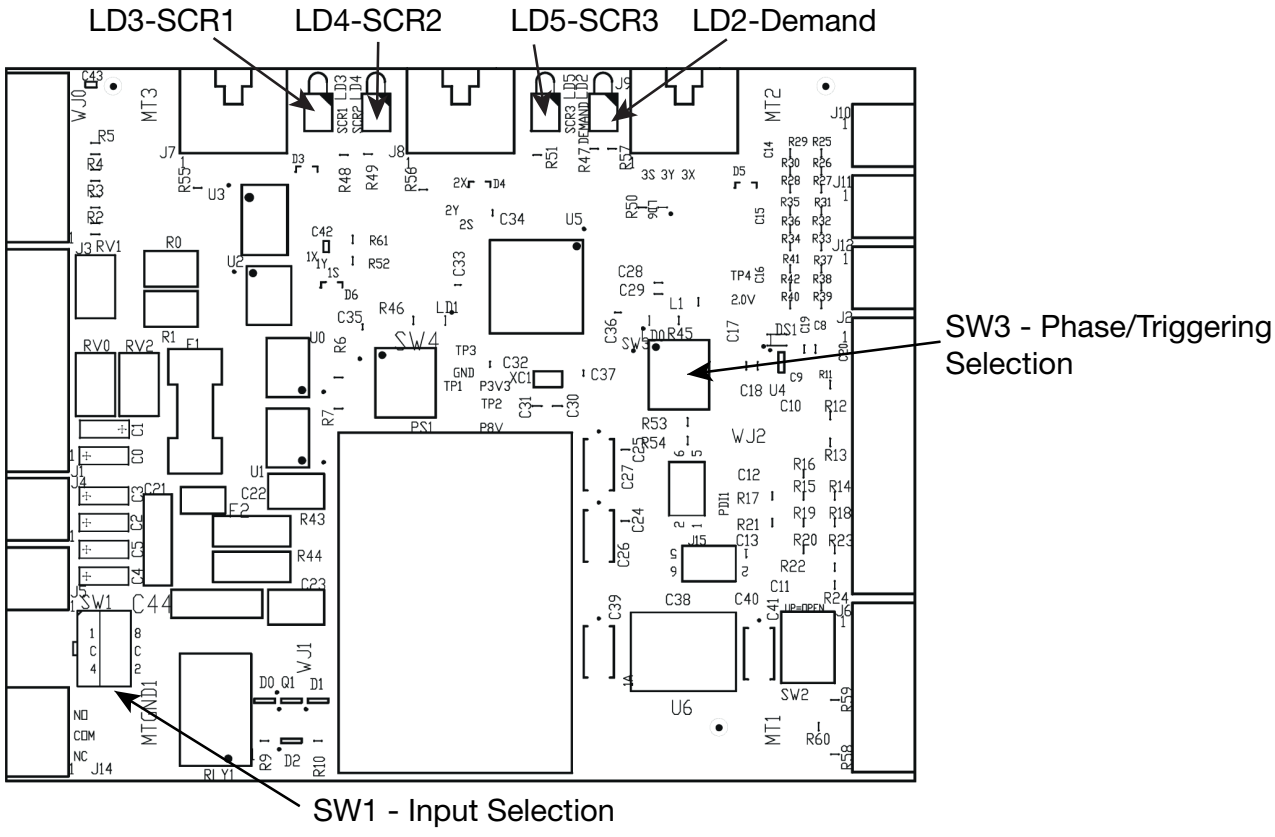
The drive signal to the SCR trigger boards:

The temperature alarm:

The heat sink temperature is derived from a resistive temperature detection (RTD) mounted on the heat sink. This is then compared to two set points. The first alarm is a warning and activates the externally connected device. This allows time to correct the problem before the second alarm inhibits the firing circuit.

The Shorted SCR Alarm:

When a short is detected the externally connected device output is activated.



The method of setting the MaxPac for desired mode of operation is as follows:
Input Command Selection
The unit can be set to drive its output in response to the following command inputs:

- Analog potentiometer
- Analog inputs: 4-20mA (or 0-20mA), 0-5Vdc (or 1-5Vdc), 0-10V
- Digital ON/OFF inputs: AC ON/OFF, DC ON/OFF

To select between any of these inputs, set the MiniMax as indicated in the table below:

Input Command Select	Method of Selection
Potentiometer	Select MANUAL mode by leaving no connection between J2.4 & J2.5. The rotary switch selection at SW1 is ignored when in MANUAL mode OR Select AUTO mode by jumpering J2.4 & J2.5, and then set rotary switch at SW1 to position 1
ON / OFF (will turn output in if either AC or DC ON/ OFF inputs are energized)	Select AUTO mode by jumpering J2.4 & J2.5, and then set rotary switch at SW1 to position 0
0-10Vdc	Select AUTO mode by jumpering J2.4 & J2.5, and then set rotary switch at SW1 to position 2
0-5Vdc	Select AUTO mode by jumpering J2.4 & J2.5, and then set rotary switch at SW1 to position 3
1-5Vdc	Select AUTO mode by jumpering J2.4 & J2.5, and then set rotary switch at SW1 to position 4
0-20mA	Select AUTO mode by jumpering J2.4 & J2.5, and then set rotary switch at SW1 to position 5
4-20mA	Select AUTO mode by jumpering J2.4 & J2.5, and then set rotary switch at SW1 to position 6
Note: SW1 position 7 is reserved for factory use, and should not be used	

Phase Selection and Firing Mode

SW3 selects the phase selection and firing method of the MaxPac.

Normally, this switch should be left in its factory-installed position. If it should become necessary to change it, set only accordance to the table below. Choosing a setting that does not match your unit's number of phases and legs will result in the unit entering alarm mode and turning the output off after an initial attempt to turn outputs on.

SW3 Position	Selection	Note
0	Reserved for factory use	Do Not Use this Selection
1	DOT for MMAXI	Caution: Do not choose this setting if your unit is a MMAXII or MMAXIII type
2	DOT for MMAXII	Caution: Do not choose this setting if your unit is a MMAXI or MMAXIII type
3	DOT for MMAXIII	Caution: Do not choose this setting if your unit is a MMAXI or MMAXII type
4	Time Proportional for MMAXI	Caution: Do not choose this setting if your unit is a MMAXII or MMAXIII type
5	Time Proportional for MMAXII	Caution: Do not choose this setting if your unit is a MMAXI or MMAXIII type
6	Time Proportional for MMAXIII	Caution: Do not choose this setting if your unit is a MMAXI or MMAXII type
7	Reserved for factory use	Do Not Use this Selection

LED Indicators

LEDs and their function are as follows:

Designator	Name	Description
LD2	Output Demand Indication	This LED blinks on according to the switching of output
LD3	Switch SCR1	OFF in normal operation. Turns ON if shorted SCR is detected in one direction. Blinks rapidly if phase voltage is not present or if SCR is shorted in both directions.
LD4	Switch SCR2	OFF in normal operation. Turns ON if shorted SCR is detected in one direction. Blinks rapidly if phase voltage is not present or if SCR is shorted in both directions.
LD5	Switch SCR3	OFF in normal operation. Turns ON if shorted SCR is detected in one direction. Blinks rapidly if phase voltage is not present or if SCR is shorted in both directions.

Alarm Output

The form C contact at J14 will be in the alarmed state in any of the following conditions:

- If any shorted SCR is detected. One or more of the shorted SCR LEDs LD3-LD5 will be lit in this case
- If missing Zero Cross transitions are detected at the SCRs. Typically, this is caused by missing power on one or more phases, or from incorrect detection of phase sequence. One or more of the shorted SCR LEDs LD3-LD5 will be blinking in this case
- If sensed temperature of the heat sink at an SCR junction exceeds 200 degrees Fahrenheit or 93 degrees Celsius. The Overtemp output will also be engaged in this case.
- If sensed phase sequence does not match the setting of selector SW3. (Normally, SW3 should be left in its factory-set state. See caution in section titled, “Phase Selection and Firing Mode“).

MiniMax 1P

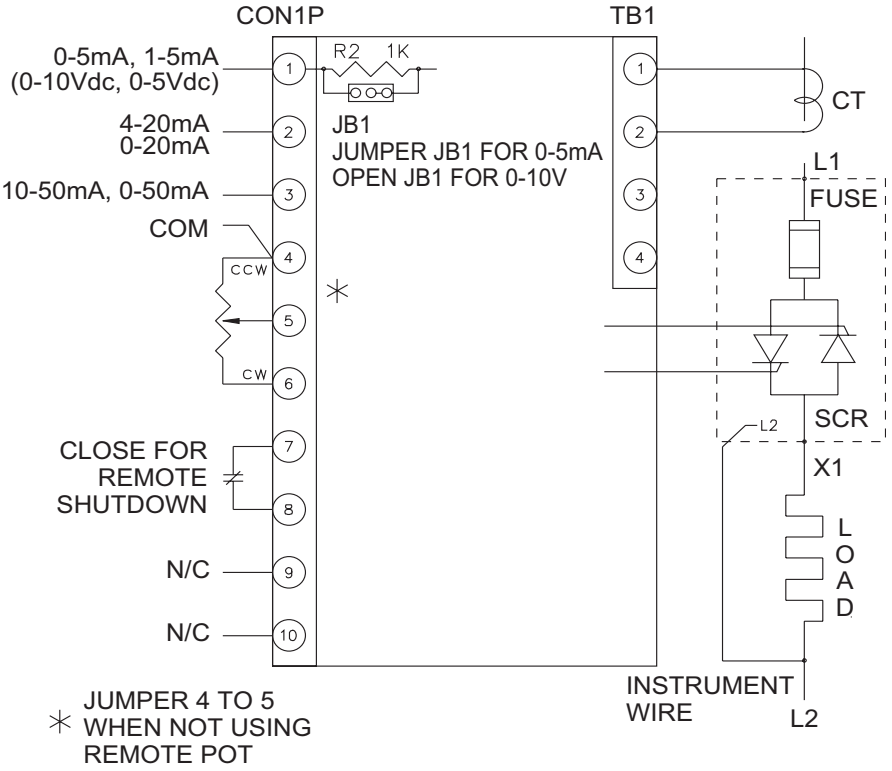
The Chromalox MiniMax 1P is a solid-state proportional power controller that utilizes a Phase Angle firing technique to modulate power to an inductive or resistive load. Separate adjustable Zero, Gain, Manual Bias, and Current Limit potentiometers are provided along with screw type plug-in connectors for input signals, Emergency Shutdown, and optional Remote Manual Bias with 0 - 100% dial. All units have thermostat protection with N.C. contacts.

Start-up

The MiniMax 1P has been factory calibrated for 4 - 20 mA input. Be sure the operating voltage and signal input are correctly applied. Also, make sure the Emergency Shutdown, if used, has N.O. contacts and jumper pins 4 & 5 on the 10-pin connector if remote manual bias are not used. Please read the information on calibration at the end of this section for current limit settings for loads with extreme hot to cold ratios or those that are overrated. Other ranges may be field calibrated by use of zero and gain potentiometers.

CAUTION

IMPORTANT: With the Current Limit option, the current transformer must be terminated properly to prevent it from being damaged.



Customer Connection

4.2.5 - Calibration (MiniMax 1P):

Many high-temperature heating elements exhibit extreme hot to cold resistance ratios. Heating elements composed of Platinum, Molybdenum, Tungsten, and Tantalum, to name a few, draw excessive current on start-up. Depending on the mass of the elements, these “high starting currents” may exist for extended periods of time. Generally, once the elements have achieved their normal operating temperatures, the current drawn through the MiniMax Power Pak will fall within the rating of the unit. For these types of loads, we recommend adjusting the I LIM (Current Limit) to 50% or less. This will decrease voltage as well as current.

1. Set Current Limit (I LIM) pot to 0% for full current output (CCW).
   Current Limit is for limiting current for loads that have extreme hot to cold resistance ratios or are overrated. We recommend for these types of loads to adjust I LIM (Current Limit) to 50% or less. This will also decrease voltage as well as current. 0% Current Limit gives 100% current output (CCW). 100% Current Limit gives 10% current output (CW).

2. Set Manual (MAN) pot to zero so unit will not be biased above input (CCW).
   Manual control adjustment provides a means of setting the output level of the MiniMax Power Pak in the absence of controlling instrumentation. The manual control signal value “adds” to the controlling instrument to set minimum output. The desired output power level may be set by adjusting the manual control. This value of output will then be present even in the absence of a control signal.

3. Set Remote Manual pot to zero output so unit will not be biased above input (CCW). (Jumper pins 4 & 5 if not used.)
   Remote Manual control adjustment provides a means of setting the output level of the MiniMax Power Pak in the absence of controlling instrumentation. The Remote Manual control is also effective when a control signal is connected. The Remote Manual control signal value “adds” to the controlling instrument to set minimum output. The desired output power level may be set by adjusting the Remote Manual control. This value of output will then be present even in the absence of a control signal. Connect Remote Manual pot wire to Pin 4 (CCW), Pin 5 (W), and Pin 6 (CW) of plug-in connector.

4. Check for open contact for Emergency Shutdown.
   Emergency Shutdown inhibits all SCR trigger pulses regardless of the level of the input signal or manual potentiometer. For Emergency Shutdown, close contact Pin 7 to Pin 8 of plug-in connector. Leave contacts open for operation.

5. Check for polarity of input signal.

6. Adjust input signal to low end of scale.
   Zero Adjust control sets the power output starting point or reference. Thus, it effectively cancels positive inputs to the MiniMax Power Pak.
   EXAMPLE: 0 - 5 mA input à set to 0 mA input
   4 - 20 mA input à set to 4 mA input

7. With power off, connect line voltage and load as shown.

8. Connect meter to input and output.
   WARNING: Set meter to correct scale to read proper input or output.

9. Apply power to unit.

10. Adjust input signal to low end of scale.

11. Using the Zero pot, adjust the output voltage just to zero volts.

12. Adjust input signal to top end of scale.
    Gain Adjust Control sets the maximum power output for maximum input signal.
    EXAMPLE: 0 - 5 mA input: set to 5 mA input
    4 - 20 mA input: set to 20 mA input

13. Using the Gain pot, adjust output voltage just to maximum volts.

14. Repeat steps 11, 12, 13, and 14 until no adjustment is necessary of Zero and Gain pots for proper output voltage indication. Voltage output should increase proportionally to the signal input applied.

15. Adjust input signal to low end of scale (zero voltage output).

16. With Manual pot at zero for zero voltage output, adjust (CW) to 100% for full voltage output. Voltage output should increase proportionally. Return to CCW position and output will decrease to zero output.

17. With Remote Manual at zero for zero voltage output, adjust (CW) to 100% for full voltage output. Voltage output should increase proportionally. Return to CCW position and output will decrease to zero output.

18. With Manual pot (CW) at 100% and I LIM (Current Limit) at 0%, adjust I LIM towards 100% noting that voltage output decreases with the adjustment of the Current Limit pot. Adjust Current Limit pot for your application, if needed.

19. Turn POWER OFF and remove meters. TEST COMPLETE.

5 Specifications

MiniMax 1, 2, and 3

Control Inputs
Accepts all of the following as standards:

On/Off Control
Signal Input
120 thru 230 Vac ± 10%
5-32 Vdc
Contact Closures

Proportional Control

Signal Input	Input Impedance
4 - 20 mA	50 Ohms
1 - 5 Vdc	10k Ohms or greater
0 - 5 Vdc	10k Ohms or greater
0 - 10 Vdc	10k Ohms or greater

Optional Remote Manual Adjust
Auto/Manual Switch

Instrument Power ..... 120 or 230 Vac 50/60 Hz

Output Voltage ..... 0 - 99% RMS line voltage (Eo=Vsupply - 1.5V SCR forward drop)

Resolution (proportional) Better than 0.1%

Line Voltage .....120 - 575 Vac, 60 Hz

Load Current Rating 30, 50, 75

Ambient Temperature ....0 - 50°C (32 - 122°F)

SCR Capability
Dielectric .....Withstand capability
Surge Rating 1500V RMS min. Typically fifteen (15) times nominal RMS rating for 8.3 milliseconds
Isolation .....SCRs isolation 2500V Input-output isolation 1500V

Heat Sink .....Ground potential up to 650 Amps

High Temperature Indicator Output .....Voltage Output 100 mA @ Instrument Power

Shorted SCR Indicator Output .....Voltage Output 100 mA @ Instrument Power

---

MiniMax 1P

Control Inputs
Accepts all of the following as standards:

Phase Angle Control

Signal Input	Input Impedance
1 - 5, 0 - 5 mA	1K Ohms
4 - 20, 0 - 20 mA	250 Ohms
10 - 50, 0 - 50 mA	100 Ohms

Optional Remote Manual Adjust

Fan Power ..... 120 or 230 VAC 50/60 Hz

Output Voltage..... 0 - 99% RMS line voltage

Resolution (proportional) Better than 0.1%

Line Voltage ..... 120, 208, 240, 277, 380, 480 and 575 Vac ± 10% 50/60 Hz

Load Current Rating... 30, 50, 75

Ambient Temperature.....0 - 50°C (32 - 122°F)

SCR Capability.....Withstand capability 1500V RMS min. Typically fifteen (15) times nominal RMS rating for 8.3 milliseconds

Surge Rating .....Typically fifteen (15) times nominal RMS rating for 8.3 milliseconds

Isolation.....SCRs isolation 2500V Input-output isolation 1500V

Heat Sink.....Ground potential up to 650 Amps

Thermostat.....4 Amps @ 120V resistive 2 Amps @ 240V resistive N.C. Contact Standard

Current Limit.....10 - 100% of rated output current

Soft Start .....25% demand per second typical reset speed 8.3 milliseconds

6 Maintenance

READ AND UNDERSTAND BEFORE CARRYING OUT THE WORK DETAILED BELOW

WARNING

HAZARDOUS VOLTAGE: Disconnect all power before performing any maintenance or examining the power module. Exposed terminals may carry LETHALLY HIGH VOLTAGES when power is applied.

Connections – Loose connections in the power wiring will generate hot spots. These will cause degradation of electronic equipment. Periodic inspections should be made to ensure that connections are secure and that there are no signs of excessive heating such as discoloration, and so on.

Corrosion – If the power module is installed in an environment with high humidity or dampness, electrical connections may suffer corrosion. Periodically check the power module for corrosion.

Damage – Periodically check for rodent damage to wiring and other components.

Filters – Many high-powered control enclosures rely on blowers or fans to maintain a safe operating temperature. The filters used with these devices should be changed on a periodic basis to insure adequate enclosure cooling is maintained.

Dust – Periodically check for dust or other particulate buildup on heatsinks and bus bars.

7 Troubleshooting

READ AND UNDERSTAND BEFORE CARRYING OUT THE WORK DETAILED BELOW

The following guidelines cover most of the common problems that could occur with the MiniMax. They are not intended to be, nor can they be, absolutes to cover every possible failure.

Problem

Note: Heater load must be connected to Test.
No Power or unbalanced power to the load.
If Demand Light is "**Off**"

1. Check incoming line power. Verify that fans are running
2. Check the instrument power.
3. Check the fuse on the main board.
4. Verify the input signal.
5. Check that remote stop J3 - 3 to 4 is open.
6. Check that the J2 - 4 to 5 is Jumpered.
7. Verify that heat sink is not in over temperature mode.

If Demand Light is "**On**"

1. Check the connections to SCR trigger board.
2. Check the power fuses (I^2t).
3. Look for damage on the trigger board.

Observation	Possible Root Cause
LD3 – SCR1 light is ON and Alarm relay engaged	Shorted SCR1
LD4 – SCR2 light is ON and Alarm relay engaged	Shorted SCR2
LD5 – SCR3 light is ON and Alarm relay engaged	Shorted SCR3
LD3 – SCR1 light is blinking and Alarm relay engaged	Missing phase or phase error, SCR1
LD4 – SCR2 light is blinking and Alarm relay engaged	Missing phase or phase error, SCR2
LD5 – SCR3 light is blinking and Alarm relay engaged	Missing phase or phase error, SCR3
Over temp output conducts, Alarm relay engaged, and heater output still functions	Heat Sink Temperature greater than 200˚F (93˚C) detected but all outputs less than 212˚F (100˚C)
Over temp output conducts, Excessive temperature of heat sink and Alarm relay engaged, heater output still functions	Heat Sink Temperature greater than 200˚F (93˚C) detected but all outputs less than 212˚F (100˚C)

Diagnostics with Safety Cover Removed

Observation	Possible Root Cause
Heartbeat LED not blinking	Loss of electronics AC power. Check fuse.

8 Parts and Accessories

WARNING

The following parts lists are for the Digital Minimax only. If using Analog Minimax, contact factory for appropriate parts list. Analog Minimax is designated as MMAXI, II, or III followed by the number 1, 2, 3, or 4 under the firing mode.

Instrument Power Fuse

Chromalox Part Number	Description
0024-01097	Littlefuse # 225 002 2 AG 2AMP

I^2T Fuses for 500 Vac Applications

0024-03015	40 Amp I^2t Fuse
0024-03085	70 Amp I^2t Fuse
0024-03072	100 Amp I^2t Fuse

I^2T Fuses for 575 Vac Applications

0024-03033	40 Amp I^2t Fuse
0024-03137	70 Amp I^2t Fuse
0024-47561	100 Amp I^2t Fuse

SCR Replacement (120 - 480 Vac)

Be sure to replace thermstrate interface material and torque as follows:

MFG Part #	SCR Part #	Thermstrate Part #	Torque inch/lb to Heat Sink	Torque inch/lb to Terminals
SKKT42	0002 - 42508	0029 - 00700	44 inch/lb (5 Nm)	26 inch/lb (3Nm)
SKKT92	0002 - 47560	0029 - 00700	44 inch/lb (5 Nm)	26 inch/lb (3Nm)

SCR Replacement (575 Vac)

Be sure to replace thermstrate interface material and torque as follows:

MFG Part #	SCR Part #	Thermstrate Part #	Torque inch/lb to Heat Sink	Torque inch/lb to Terminals
SKKT42/14E	0002 - 42519	0029 - 00700	44 inch/lb (5 Nm)	26 inch/lb (3Nm)
SKKT92/14E	0002 - 47561	0029 - 00700	44 inch/lb (5 Nm)	26 inch/lb (3Nm)

MiniMax 1, 2, and 3 Accessories:

Part Number	Description
0135 - 20117	Potentiometer & Remote/Manual Switch
G0135 - 28193	SCR Trigger Board <480V
G0135 - 28194	On/Off Main Firing Board

MiniMax 1P Accessories:

Part Number	Description
0135 - 28002	Firing Circuit 120, 240 Vac
0135 - 28006	Firing Circuit 208, 277, 480 Vac
0135 - 28037	Firing Circuit 380 Vac

9 Warranty and Return Information

Warranty Notice
The Warranty below complies with the federal law applicable to products manufactured after December 31, 1976. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

Chromalox Warranty
Chromalox Instruments and Controls are warranted against defects in workmanship and materials. No other express warranty, written or oral, applies with the exception of a written statement from an officer of Chromalox®, Inc.

Warranty Period
This warranty extends for three years from date of shipment from the factory or authorized distributor.

Limitations
Products must be installed and maintained in accordance with Chromalox instructions. Users are responsible for the suitability of the products to their application. There is no warranty against damage resulting from corrosion, misapplication, improper specification or other operating conditions beyond our control. Claims against the carrier company for damage in transit must be filed by the buyer.

Returns
Items returned to Chromalox Instruments and Controls must be accompanied by a Return Authorization Number. This number may be obtained from Chromalox Instruments and Controls' Customer Service Department at the phone number listed below.

The Return Authorization Number must appear on the exterior of the shipping carton and on the shipping documents.

Defective items will be repaired or replaced at our option and at no charge.

Return the defective part or product, freight prepaid, to the following address:
Chromalox Instruments and Controls
1347 Heil Quaker Blvd.
LaVergne, TN 37086-3536

Phone: (615) 793-3900
Fax: (615) 793-3563

MiniMax 1 Ordering Information

Model **SCR Power Pack**

Mmax 1 **Single Phase SCR Power Controller Complete with Lugs and I^2T Fusing[1, 2]**

Code	Control Configuration
5	Proportional Control, DOT Zero-Crossover Firing, Command Input Signals: 4-20mA, 0-5 VDC, 1-5 VDC (via Modbus RTU/485 only), 0-10 VDC, Remote 0-1000 OHM Potentiometer w/Manual Override, Modbus RTU/RS485 Communications. RTD Heat Sink Temperature Sensor with Two Set-Points, Automatic Line Sensing 50/60HZ, Remote Permissive Stop Input, Form "C" Dry Contact Alarm Output, Staged Heating w/Digital Calibration Zero / Span Adjustments(4-8 mA, 8-12 mA,12-16 mA,16-20 mA (via Modbus RTU/RS485 only), LED Diagnostics: Command Input, Main/Trigger Boards Running, SCR Status per Phase, Diagnostic Kit via Modbus RTU/RS485: Highest Heat Sink Temperature, Last Heat Sink Temperature, Highest and Lowest Ambient Temperature, Line Frequency Monitoring, Third Party Certifications: UL, cUL, CE, DEMKO (650 A and below).

Code	Current at 50°C (104°F) Ambient
01	30 Amp
02	50 Amp
03	75 Amp

Code	Line Voltage
1	120 - 480Vac
2	575Vac

Code	Instrument Power
1	120 to 240Vac 50/60Hz

Code	Remote Manual Adjust/Auto Manual Switch[3]
0	None
1	Pot with 0 - 100% dial and local/Remote Switch, Single Turn 1K ohm Potentiometer (Requires Proportional Board)

Mmax I -	**5**	**01**	**1**	**1**	**0**	**Typical Model Number**

1) SCR Fusing is for semiconductor protection only, not wire protection.
2) Supplied loose for customer mounting. 575V Fusing only
3) Supplied loose for customer mounting

Note:
Storage Temperature 14ºF to 158ºF (-10ºC to 70ºC).
CE application requires filters.

Chromalox Part Numbers
0005-60055 — Line filter, single phase, 230VAC
0005-60057 — Line filter, 120-230VAC
CE application requires filter.

MiniMax 1P Ordering Information

Model **1P Power Pack**

Mmax 1P	**Single Phase SCR Power Controller Complete with Lugs and I²T Fusing[1, 2]**				
	Code	**Control Configuration**			
	1	Phase Angle Control (Accepts: 1 - 5/0 - 5mA, 4 - 20/0 - 20mA, 10 - 50/0 -50mA)			
	2	Phase Angle Control with Current Limit			
		Code	**Current at 50°C (104°F) Ambient**		
		01	30 Amp		
		02	50 Amp		
		03	75 Amp		
			Code	**Voltage**	
			1	120 Vac	
			2	208 Vac	
			3	240 Vac	
			4	277 Vac	
			5	480 Vac	
			6	575 Vac	
				Code	**Remote Manual Adjust/Auto Manual Switch[3]**
				0	None
				1	Pot with 0-100% dial and local/Remote Switch, Single Turn 1K ohm Potentiometer(Requires Proportional Board)
Mmax 1P -	**2**	**01**	**1**	**1**	**Typical Model Number**

1) SCR fusing is for semiconductor protection only, not wire protection.
2) Supplied loose for customer mounting. 575V fusing only
3) Supplied loose for customer mounting.

Note:

Storage temperature 14ºF to 158ºF (-10ºC to 70ºC).
SCR units calibrated for 4-20mA input.

MiniMax 2 Ordering Information

Model **SCR Power Pack**

Mmax2 **3 Phase SCR Power Controller complete with Lugs and I2T Fusing[1, 2]**

Code	Control Configuration
5	Proportional Control, DOT Zero-Crossover Firing, Command Input Signals: 4-20mA, 0-5 VDC, 1-5 VDC (via Modbus RTU/485 only), 0-10 VDC, Remote 0-1000 OHM Potentiometer w/Manual Override, Modbus RTU/RS485 Communications. RTD Heat Sink Temperature Sensor with Two Set-Points, Automatic Line Sensing 50/60HZ, Remote Permissive Stop Input, Form "C" Dry Contact Alarm Output, Staged Heating w/Digital Calibration Zero / Span Adjustments(4-8 mA, 8-12 mA,12-16 mA,16-20 mA (via Modbus RTU/RS485 only), LED Diagnostics: Command Input, Main/Trigger Boards Running, SCR Status per Phase, Diagnostic Kit via Modbus RTU/RS485: Highest Heat Sink Temperature, Last Heat Sink Temperature, Highest and Lowest Ambient Temperature, Line Frequency Monitoring, Third Party Certifications: UL, cUL, CE, DEMKO (650 A and below).

Code	Current at 50˚C (104˚F) Ambient
01	30 Amp
02	50 Amp
03	75 Amp

Code	Line Voltage
1	120 - 480 Vac
2	575 Vac

Code	Instrument Power
1	120 to 240Vac 50/60Hz

Code	Remote Manual Adjust/Auto Manual Switch[3]
0	None
1	Pot with 0-100% dial and local/Remote Switch, Single Turn 1K ohm Potentiometer (Requires Proportional Board)

Mmax2	**-**	**5**	**01**	**1**	**1**	**0**	**Typical Model Number**

1) SCR fusing is for semiconductor protection only, not wire protection.
2) Supplied loose for customer mounting. 575V fusing only
3) Supplied loose for customer mounting.

Note:

Storage Temperature 14ºF to 158ºF (-10ºC to 70ºC).
CE Application requires filters.

Chromalox Part Numbers

0005-60056 — Line filter, three phase, 440VAC
0005-60057 — Line filter, 120-230VAC

CE application requires filter.

MiniMax 3 Ordering Information

Model **SCR Power Pack**

Mmax3 **3 Phase Six SCR Power Controller Complete with Lugs and I^2T Fusing**

Code	Control Configuration
5	Proportional Control, DOT Zero-Crossover Firing, Command Input Signals: 4-20mA, 0-5 VDC, 1-5 VDC (via Modbus RTU/485 only), 0-10 VDC, Remote 0-1000 OHM Potentiometer w/Manual Override, Modbus RTU/RS485 Communications. RTD Heat Sink Temperature Sensor with Two Set-Points, Automatic Line Sensing 50/60HZ, Remote Permissive Stop Input, Form "C" Dry Contact Alarm Output, Staged Heating w/Digital Calibration Zero / Span Adjustments(4-8 mA, 8-12 mA,12-16 mA,16-20 mA (via Modbus RTU/RS485 only), LED Diagnostics: Command Input, Main/Trigger Boards Running, SCR Status per Phase, Diagnostic Kit via Modbus RTU/RS485: Highest Heat Sink Temperature, Last Heat Sink Temperature, Highest and Lowest Ambient Temperature, Line Frequency Monitoring, Third Party Certifications: UL, cUL, CE, DEMKO (650 A and below).

Code	Current at 50˚C (104˚F) Ambient
01	30 Amp
02	50 Amp
03	75 Amp

Code	Line Voltage
1	120 - 480 Vac
2	575 Vac

Code	Instrument Power
1	120 to 240 Vac 50/60Hz

Code	Remote Manual Adjust/Auto Manual Switch
0	None
1	Pot with 0-100% dial and local/Remote Switch, Single Turn 1K ohm Potentiometers (Requires Proportional Board)

Mmax3-	**5**	**01**	**1**	**1**	**0**	**Typical Model Number**

1) SCR fusing is for semiconductor protection only, not wire protection.
2) Supplied loose for customer mounting. 575V fusing only
3) Supplied loose for customer mounting.

Note:
Storage Temperature 14ºF to 158ºF (-10ºC to 70ºC).
CE Application requires filters.

Chromalox Part Numbers
0005-60056 — Line filter, three phase, 440VAC
0005-60057 — Line filter, 120-230VAC
CE application requires filter.

Limited Warranty:
Please refer to the Chromalox limited warranty applicable to this product at http://www.chromalox.com/customer-service/policies/termsofsale.aspx.

Chromalox, Inc.
1347 Heil Quaker Boulevard
Lavergne, TN 37086
(615) 793-3900
www.chromalox.com