CONTROL CONCEPTS INC.

INSTRUCTION MANUAL
MODEL 1021B

CONTROL CONCEPTS

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DESCRIPTION:

The model 1021B controller is a single-phase distributive zero-cross SCR controller. Distributive zero-cross control implies that the load voltage is switched on only when the instantaneous value of the sinusoidal supply voltage is zero and that the load power is controlled by varying the number of electrical cycles that power is applied and removed from the load.

The controller is capable of accepting mA command signals, DC voltage signals, or it may be controlled by a potentiometer. Electrical isolation is provided to isolate the command signal from the line and load voltages.

The model 1021B includes a feature called Sync-Guard which reduces the possibility of several controllers being on and off simultaneously.

THEORY OF OPERATION:

THE SCR

The heart of the SCR power controller is the SCR (silicon controlled rectifier, also sometimes referred to as a thyristor).

The SCR has two states, ON and OFF, and allows current to flow in only one direction. SCR's can remain in the off state even though the applied potential may be several thousand volts; in the on state, they can pass several thousand amperes. When a small signal is applied between the gate and cathode terminals (Figure 1), the SCR will turn on in 10-100 microseconds. Once turned on, it will remain on until the current through it is reduced below a very low value, called the holding current.

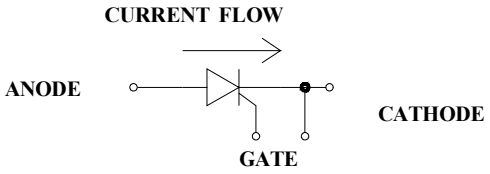


Figure 1. SCR Symbol.

Because the SCR allows current to flow in only one direction, two SCR's are connected in a "back to back" configuration to control AC current (Figure 2).

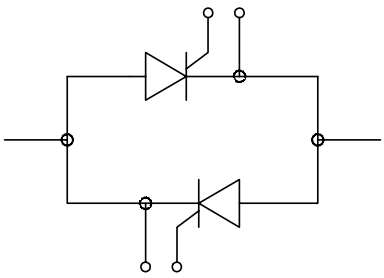


Figure 2. SCR AC Switch.

ZERO-CROSS OPERATION

In zero-cross control, the load power is turned on or off only when the instantaneous value of the sinusoidal waveform is zero. Load power is controlled by switching the SCRs "on" for a number of complete electrical cycles, and then "off" for a number of complete electrical cycles. The circuit determines the ON versus the OFF time of the silicon controlled rectifiers (SCRs) such that the load power is linear with the command signal. The circuit at 50% power will cause the SCRs to be "on" for 3 cycles and "off" for 3 cycles. At higher power levels, the SCRs are ON for more cycles and OFF for 3 cycles. At lower power levels, the SCRs are ON for 3 cycles and OFF for more cycles. The SCRs are turned ON and OFF only at the beginning and end of each electrical cycle.

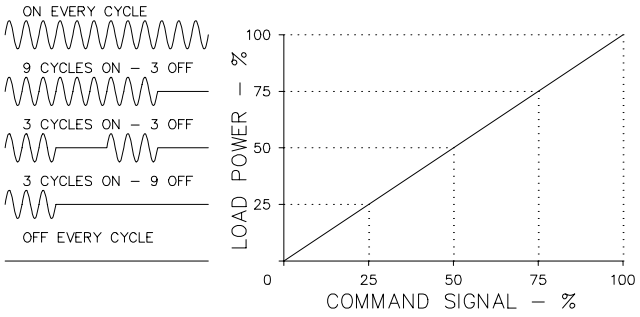


Figure 3. Distributive Control.

SYNC-GUARD™:

"**Sync-Guard**" reduces the possibility of two or more controllers operating sychronously, thereby reducing the possibility of all controllers being on and off simultaneously. The "**Sync-Guard**" feature provides a more uniform or continuous power demand and therefore reduces the variations in the supply voltage that can occur when multiple controllers operate synchronously.

See page 2 for "**Sync-Guard**" connections.

INSTALLATION:

The controller must be mounted on a vertical surface with the fins oriented vertically such that air will flow over the heat dissipating fins. The plug-in connector may be removed by pulling it straight away from the circuit board.

The 24Vac transformer may be connected to any source of the correct voltage.

For the line voltage compensation feature to work properly, the 24Vac transformer must be connected to the same supply used to power the load.

ZERO AND SPAN ADJUSTMENTS:

The zero and span adjustments have been factory adjusted to provide zero load voltage when the minimum command signal is applied and to provide rated output voltage to the load when the maximum command signal is applied. Further adjustment of these settings should not be required.

If it is desired to readjust the zero and span settings the following procedures should be followed.

1. Apply minimum command signal and adjust the zero potentiometer until the LED is just off. (Clockwise rotation of both the span and zero potentiometer increase the load voltage)

2. Apply maximum command signal and adjust the span potentiometer until the LED is just full on.

3. It may be necessary to repeat these steps due to interaction that can occur.

The 1021B controller has line voltage compensation. Therefore if the supply voltage is above the nominal rating the controller will supply the nominal rated voltage to the load. For example, if a controller rated for 240 volt operation is supplied from a 260 volt supply and the maximum command signal is applied the controller will supply only 240 volts to the load thereby eliminating the effects of line voltage changes.

SYNC-GUARD CONNECTIONS:

The two control lines that couple the Sync-Guard connections together must be terminated with a 1000 ohm load. This termination resistor is found on the 1021B circuit board and is enabled with a jumper P2.

Only one of the circuit boards must have this jumper moved to the "**IN**" position.

When using Sync-Guard, pin # 5 from each circuit board must be tied to pin # 5 on the other circuit boards and pin # 6 from each circuit board must be tied to pin # 6 on the other circuit boards.

A maximum of 10 boards may be connected together in this manner.

CAUTION! WHEN USING THE SYNC-GUARD FEATURE, THE mA CONTROL SIGNALS MUST BE ISOLATED FROM EACH OTHER.

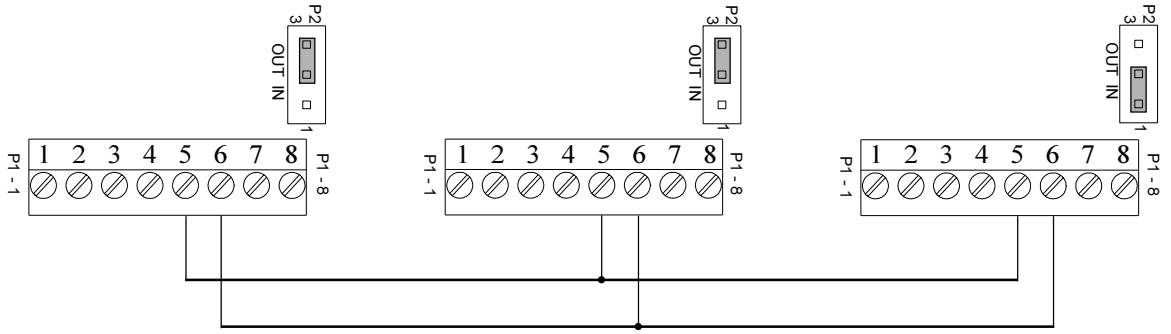


Figure 4. Sync-Guard connections for multiple controllers.

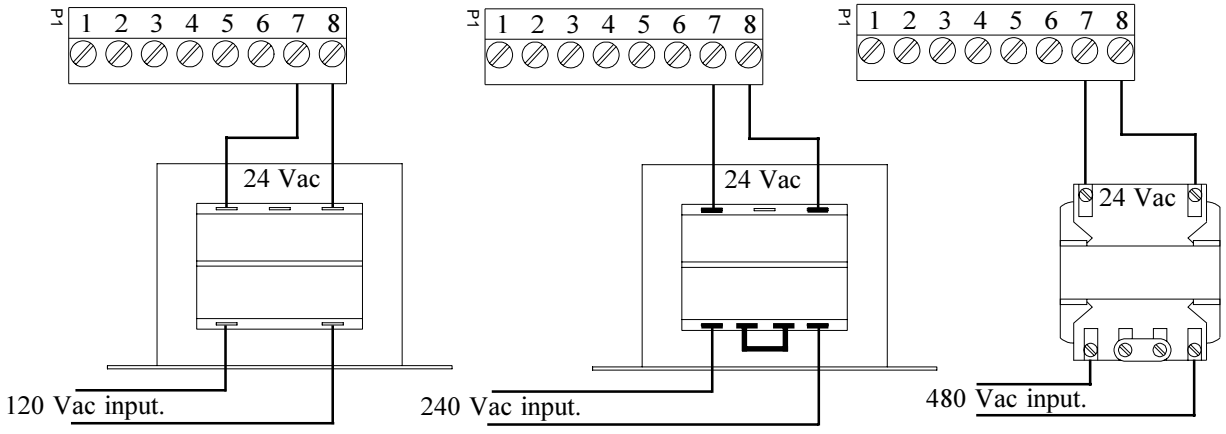


Figure 5. Various 24V power connections. Two fuses are recommended to protect the transformer circuit. See note about primary connection on page 1.

SPECIFICATIONS:

VOLTAGE RATINGS

The (LINE VOLTAGE) term within the model number specifies the voltage at which the controller is calibrated. This voltage has a tolerance of -15% to +10%.

CURRENT RATING

The (LOAD CURRENT) term within the model number specifies the maximum continuous RMS current rating at a 55ºC maximum ambient temperature.

COMMAND SIGNAL

Signal	Input Resistance
0 to 5Vdc	100K
0 to 10Vdc	200K
4/20 mA	300 ohms
Potentiometer	200K

(1K, 1/2 watt recommended, 20K maximum permissible.)

ISOLATION

2500V rms input signal to load and line voltages.

CONTROL MODE

Zero-cross, distributive.

LINE VOLTAGE COMPENSATION

The average load voltage remains constant within 2% over line voltage changes of +10% to -15%.

FUSES

It is recommended that the controller and the load be protected with fast acting fuses such as the JJN and JJS, class "T", series of fuses manufactured by the Bussman company.

Control Concepts, Inc. stocks a complete line of Bussman class "T" fuses for controllers. Contact the factory for price and delivery information.

ELECTRICAL CONNECTIONS:

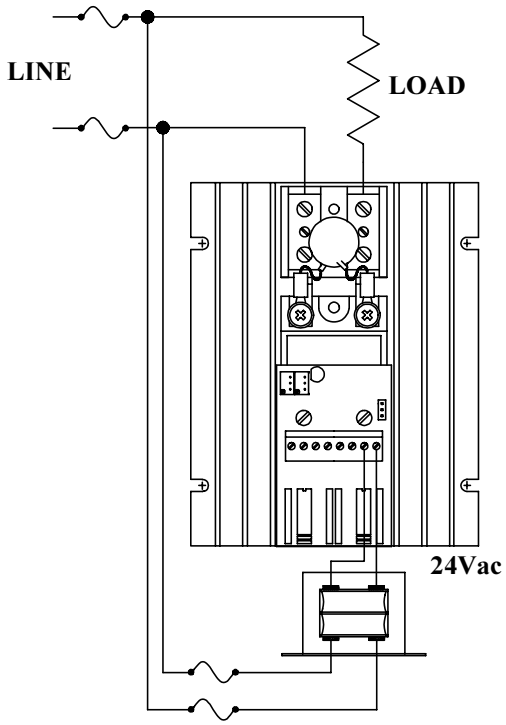


Figure 6. Electrical connections.

The primary of the transformer may be connected to any source.

For line voltage compensation to work properly, the transformer must be connected to same supply as the controller.

CURRENT CAPACITY				KW				
Continuous RMS rating	RMS 1 Second	Peak 1 cycle (Non-Repetive)	I^2t rating	120Vac	240Vac	277Vac	480Vac	575Vac
10	22	140	81	1.20	2.40	2.77	4.80	5.75
20	40	250	260	2.40	4.80	5.54	9.60	11.55
30	80	625	1620	3.60	7.20	8.31	14.40	17.31
40	150	1000	4150	4.80	9.60	11.08	19.20	23.08
70	150	1000	4150	8.40	16.80	19.39	33.60	40.39

CONTROL SIGNAL CONNECTIONS:

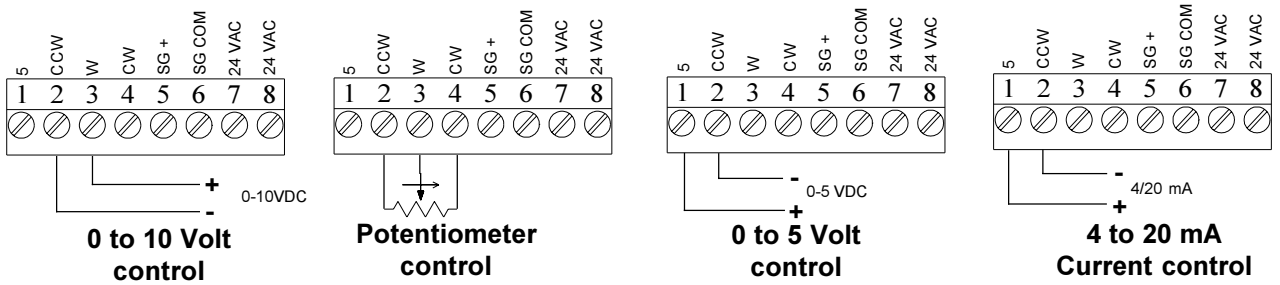
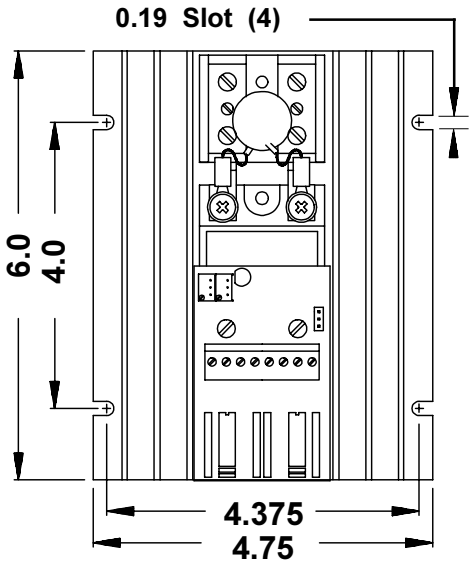


Figure 7. Various control signal connections.

INSTALLATION DRAWINGS:



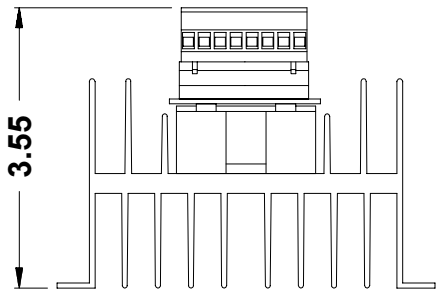
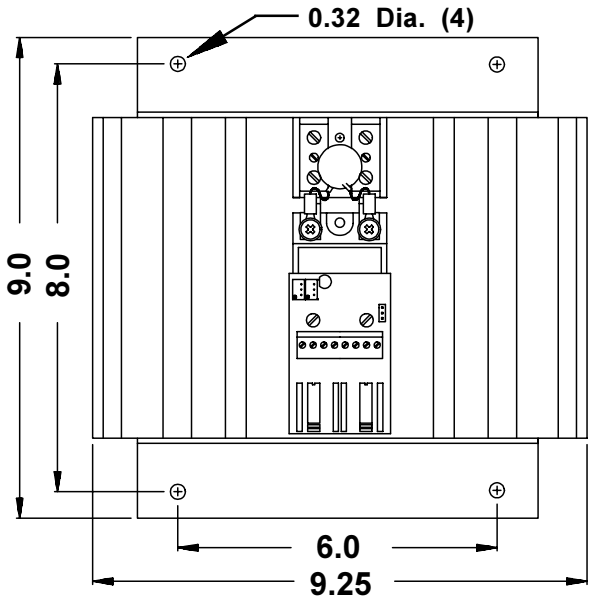


FIGURE 8. 10, 20, 30 AND 40 AMPS



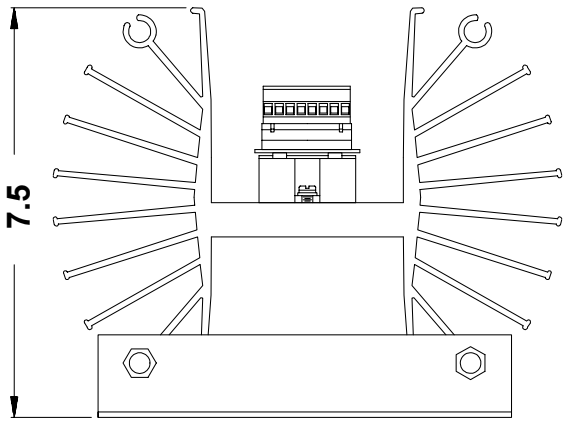


FIGURE 9. 70 AMPS

TROUBLE SHOOTING:

Control Concepts has field service engineers who can aid in determining the cause of controller problems. Please call with any problems or questions you may have.

CAUTION:

High voltage exists on the supply and load terminals of this controller and may exist on other equipment located near the controller. Use extreme caution to avoid electrical shock.

The LED located on the controller circuit can be used to aid in determining problems. This LED varies in intensity proportional to the command signal and therefore should be proportional to the load voltage.

THE FOLLOWING ARE SYMPTOMS AND POSSIBLE CAUSES:

NO LOAD POWER AND LED IS NOT ON:

Determine that the command signal is applied to the controller. Determine that 24 volts AC is applied to the circuit.

LED RATE CAN BE VARIED:

Determine that all fuses are "OK". If the voltage across the SCR module is equal to the line voltage the SCR module has probably failed. NOTE: If a replacement SCR module is ordered specify the voltage and current rating of the controller and the serial number of the failed unit.

LOAD POWER IS MAXIMUM AND CANNOT BE REDUCED: LED IS OFF:

Remove the 24Vac circuit power. If the load still has power, the SCR module has probably failed as a short allowing full power to be applied to the load. To determine if the SCR module has shorted, remove power and then the line and load connections and measure the resistance across the line and load terminals on the SCR module. If the resistance is less than 10,000 ohms the module has failed. NOTE: If a replacement SCR module is ordered specify the voltage and current rating of the controller and the serial number of the failed unit.

LOAD POWER IS MAXIMUM AND CANNOT BE REDUCED: LED IS ON:

Determine that the command signal is adjusted to zero. Try removing the command signal wiring from the circuit board. If the LED is not off; the circuit card has probably failed.

MAXIMUM LOAD VOLTAGE CANNOT BE OBTAINED:

1. Determine that the primary of the circuit transformer is connected to the same supply as the controller and load.
2. The Span calibration may be misadjusted.
3. Line voltage compensation may be restricting the load voltage.
4. High load current may cause the same symptom.

Typically this problem is caused by the primary being connected across the load and line connection at the controller. Measure the 24Vac supply at the circuit board.

MODEL No. IDENTIFICATION:

1021B-(VOLTAGE)-(LOAD CURRENT)-(XX)

(VOLTAGE) = Rated operating voltage
- **12** = 120 Vac
- **24** = 240 Vac
- **48** = 480 Vac
- **57** = 570 Vac

(LOAD CURRENT) = Current applied to load at 100% command signal.
- **10** Amps
- **20** Amps
- **30** Amps
- **40** Amps
- **70** Amps

(XX) = Command signal:
- 0 to 5Vdc,
- 0 to 10Vdc,
- 4 to 20mA
- Potentiometer.

REFERENCE DRAWINGS:

B1000897	Schematic
AS1401	Transformer Inst. Dwg.

MANUFACTURED BY:

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