CN5001 and CN5002

Digital Temperature Controllers

OMEGA®

An OMEGA Technologies Company

Operator's Manual

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE/STRAIN FORCE

- Transducers & Strain Gages
- Load Cells & Pressure Gauges
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition and Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

M0441/0594

TABLE OF CONTENTS (cont'd.)

TABLE OF CONTENTS
SERIES CN5000 DIGITAL TEMPERATURE CONTROLLERS

TABLE OF CONTENTS (cont'd.)

SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The OMEGA® CN5000 Series Digital Controllers are designed for maximum versatility at an economical price. These units have standard features including a 10 amp mechanical relay with either a proportional or ON/OFF control, an easy-to-ready LED display, push-to-engage setpoint knob, and LED indication of output status. J, K, T or E thermocouple types may be used as input, with either °C or °F display.

TABLE 1-1
MODEL NUMBERS AND RANGES

Input Type	Range	No. of Outputs	Model Number
J Iron Constantion	0 to 650°C	Single	CN5001J1
		Dual	CN5002J1
	0 to 1000°F	Single	CN5001J2
		Dual	CN5002J2
K Chromel Alumel	0 to 2000°F	Single	CN5001K1
	0 to 1000°C	Single	CN5001K2
		Dual	CN5002K2
	0 to 1000°F	Single	CN5001K3
		Dual	CN5002K3
T Copper Constantan	0 to 350°C	Single	CN5001T1
		Dual	CN5002T1
	0 to 650°F	Single	CN5001T2
		Dual	CN5002T2
	-85 to 350°C	Single	CN5001T3
		Dual	CN5002T3
E Chromel Constantan	0 to 650°C	Single	CN5001E1
		Dual	CN5002E1
	0 to 1000°F	Single	CN5001E2
		Dual	CN5002E2

TABLE 1-2
OUTPUTS, MODES, OPTIONS

OUTPUT OPTIONS–
PRIMARY OUTPUT

ORDERING SUFFIX	DESCRIPTION
A	PID, 10 A Relay (CN5001 only)
B1	0-24 Vdc switched, time proportioning
B2	0-24 Vdc switched, PID (CN5001 only)
D1	1.5 A SSR, time prop. (Obsolete)
D2	1.5 A SSR, PID (obsolete)
F1A	20 Amp SSR
G1	4-20 mA, time proportioning (CN5001 only)
G2	4-20 mA, PID (CN5001 only)

MISCELLANEOUS OPTIONS

ORDERING SUFFIX	DESCRIPTION
E1	Downscale break protection
E2	Surface mount bracket (n/a with options, F1 F2)
E3	Aux. 0-5 Vdc recorder output (CN5002 only)
E4	Output inversion, primary output
E5	Adjustable on/off differential (CN5001 only, N/A F2, D2, B2, G1, G2)
E6	Burst proportioning (CN5001 only, N/A F2, D2, B2, G1, G2)
E7	Tracking Second Setpoint
E8	High Limit-Latching Relay (CN5001 only)

Table 1-1 shows Model Numbers for both the single and the dual output models along with availables ranges, Tables 1-2 describes the various options. For example, a Model CN5001J1-F is a single 20 amp solid state relay output, time proportional/on-off, 0-650°C controller for use with a "J" type thermcouple.

The modular design of these controller enables them to be used in various applications. These optional control modes and outputs are also available as field installable kits. Various output options include solid state relay and 4-20 mA proportional current. PID (proportional-integral-derivative) control is also available, with either relay or current output.

1.1.1 CN5001 Single Setpoint

The CN5001 can be operated as either proportional or ON/OFF controller. Set the adjustable bandwidth at up to 10% of full scale and it's a proportional controller; or, with the bandwidth set to 0, ON/OFF control with a 0.25% of span differential is possible. To read and adjust the setpoint, simply depress the push-to-set knob, and turn it to the desired setpoint.

The standard CN5001 is available with either J, K, T, or E thermocouple types, and has a 10A mechanical relay. Available options include solid state relays or proportional current outputs and PID control.

1.1.2 CN5002 Dual Setpoint

The first setpoint of the CN5002 incorporates the features of the CN5001 with addition of an independent second setpoint and output. The second setpoint temperature may be set to any value within the full span of the controller, independent of the first setpoint. The output on the second setpoint is ON/OFF. The second setpoint is blind and is set by a screwdriver adjustment.

1.1.3 BS5001 Bench Top Controller

This model number is a single setpoint CN5000 Series controller in a Bench Top Case, shipped with manual addendum M441A which describe the Bench Stand operation.

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 MOUNTING

The Series CN5000 Controllers are compact and versatile units, requiring only 3 7/8 " of panel depth for mounting. They may also be surface mounted, using an optional bracket.

WARNING

To maintain stated calibration accuracy, the internal chassis should not be separated from its enclosure. Always mount controllers in a place isolated from shock, vibration, moisture and dust. Make sure of adequate space for access to wiring terminals. Locate unit where ambient temperature remains between 32° to 130°F (0° to 55°C).

2.2.1 Panel Mounting

The cutout dimensions are 3 5/8 " (92 mm) square, as shown in Figure 2-1. Referring to the Figure, install gasket, then place enclosure into a panel opening making sure controller faceplate is oriented vertically. Place the mounting struts along the top and bottom grooves (as shown in Figure 2-1), then thread in mounting screws and tighten until struts are firm against back of panel. If wiring space is restricted, first wire the unit through the cutout, then mount.

2.2.2 Surface Mounting

All CN5000 Controllers may be surface mounted facing either to the side or front. Refer to Figure 2-2 for mounting holes. The surface mounting bracket is available with the unit. The bracket may also be used for mounting the controller inside an electrical box or enclosure.

2.3 CN5001/5002 POWER CONNECTIONS

WARNINGS

Be sure power cord is not plugged in when attaching the line voltage wire to unit. Do not plug in until installation is complete.

Wire the controllers for compliance with local and national electric codes. Use wire no larger than 14 gage. Observe the markings for the terminals; incorrectly applied wiring may damage the unit.

Remove the protective cover from the back of the enclosure (2 screws). Note the wiring diagram on the protective cover. (See Figure 2-3.) Retain the cover and replace when wiring is completed.

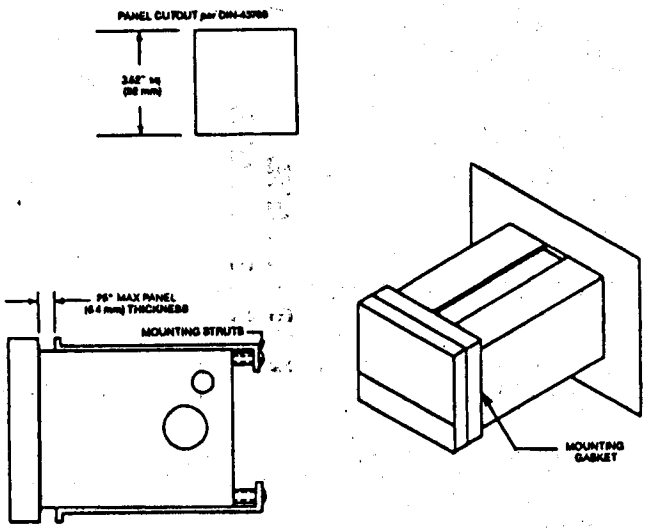


Figure 2-1. Panel Mounting

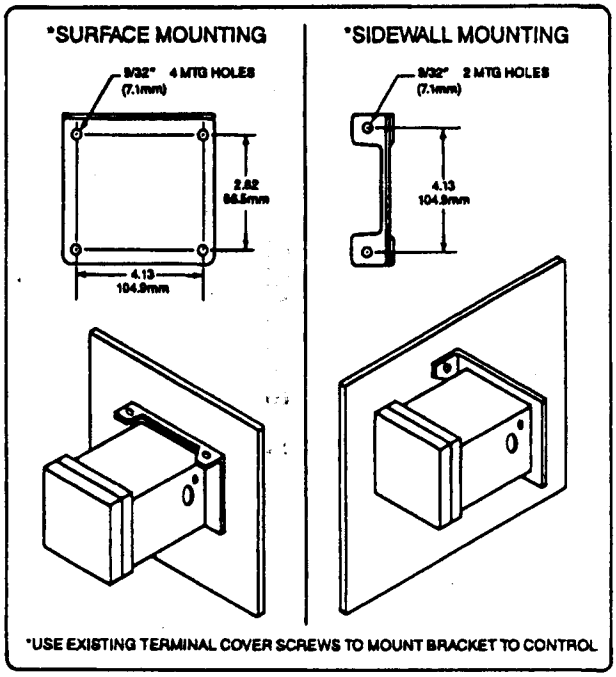


Figure 2-2. Surface Mounting

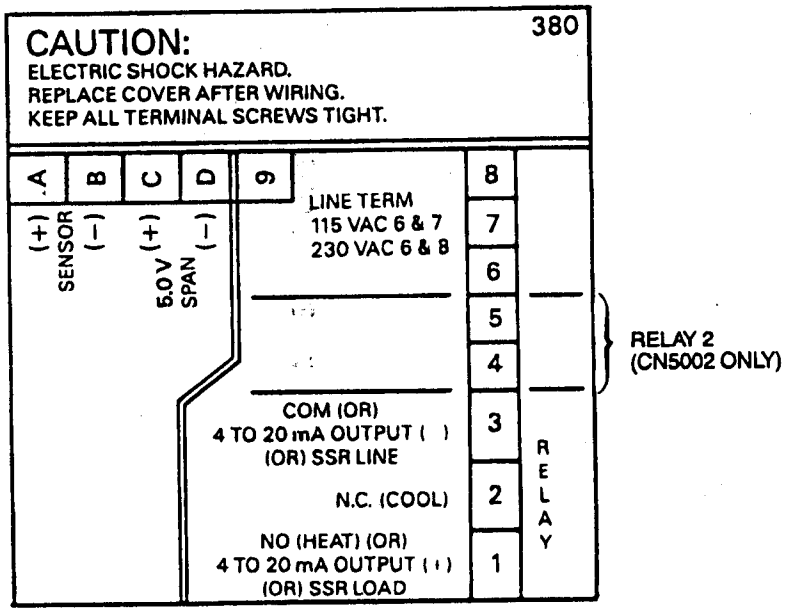


Figure 2-3. Wiring Diagram for CN5001/5002

Feed power lead wires through larger conduit hole. Attach the stripped, bare ends of the wire to terminals 6 and 7 for 115 Vac or terminals 6 and 8 for 230 Vac (see Figure 2-4). Standard power consumption is 8.5 watts.

WARNING
Connecting 230 Vac to a controller wired for 115 Vac will permanently damage controller.

2.4 THERMOCOUPLE INPUT CONNECTIONS

Use thermocouple or extension wire and connectors matching the unit's thermocouple calibration to make all connections between the thermocouple sensor and the controller. Feed thermocouple or extension wire of appropriate type through the small conduit hole and attach the leads to sensor terminals A and B.

Thermocouple lead wires and extension wires are color-coded. The negative lead (-) is red, and connected to terminal B. The positive (+) lead is color-coded (see Table 2-1) and is attached to terminal A. If a shielded cable is used, ground at one end.

The compensation resistor assembly (see Figure 2-4) should remain connected, or be reconnected, between terminals B and D after thermocouple installation.

CAUTION
Do not run thermocouple leads in the same conduit with power or load leads.

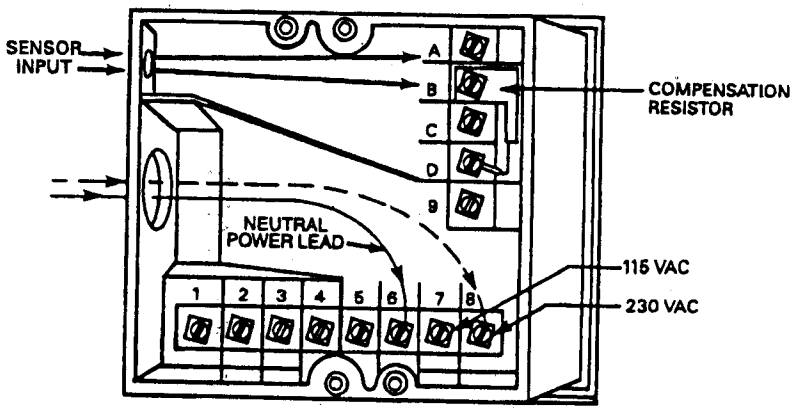


Figure 2-4 CN5001/5002 Connections

The CN5000 Controllers also provide thermocouple break protection. If the thermocouple sensor opens, upscale break protection circuit provides simulated high temperature input. In normal heating applications, heat will be turned off. Downscale break protection circuit provides simulated low temperature input, with cooling element being turned off in normal cooling applications. To change from upscale break protection to downscale break protection, simply move the jumper (see Figure 2-5).

TABLE 2-1
THERMOCOUPLE WIRE COLOR-CODING

CALIBRATION TYPE	MATERIAL (+)	MATERIAL (-)	POSITIVE LEAD	NEGATIVE LEAD
T	copper	constantan	blue	red
K	chromel	alumel	yellow	red
J	iron	constantan	white	red
E	chromel	constantan	purple	red

Small deviations from true readings will be caused by the resistance (in ohms) of the thermocouple wire used to connect the controller. The CN5000 Controllers are designed to minimize this effect and perform accurately with hundreds of feet of lead wire.

To calculate the deviation due to lead wire resistance, select the constant from Table 2-2 for the thermocouple type and wire gage used. Multiply this contstant by the total length of lead wire use in feet. The result is the deviation in °F.

TABLE 2-2
THERMOCOUPLE RESISTANCE

WIRE GAGE	THERMOCOUPLE TYPE J	K	E	T
12	0.00054	0.00091	0.00109	0.00046
14	0.00087	0.00146	0.00175	0.00117
16	0.00137	0.00230	0.00276	0.00117
18	0.00222	0.00374	0.00448	0.00190
20	0.00357	0.00586	0.00707	0.00298
24	0.00878	0.01490	0.01780	0.00752

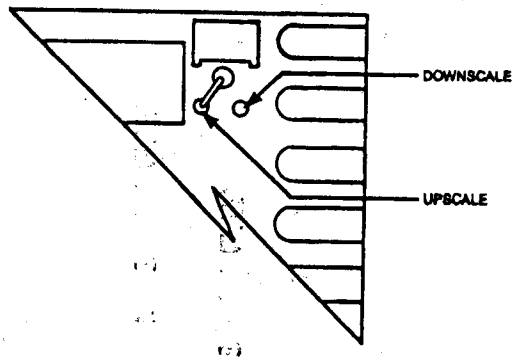


Figure 2-5. Changing Break Protection

2.5 OUTPUT CONNECTIONS

WARNING

Power must not be applied directly between COM and N.O. (for heating) or COM and N.C. (for cooling) on the relay. Such connections place the power directly across the relay contacts and will permanently damage the unit. The heat and cool terminals must be connected to the appropriate loads before being connected to the load power line (see Figure 2-6).

CAUTIONS

Do not exceed output ratings and provide external fusing for load lines.

After wiring, replace the insulating cover on the back of the controller enclosure, and secure the two (2) cover screws.

For all the CN5000 Controllers (except those with output code F1 or F2) terminals 1, 2 and 3 are the controller output terminals. For dual output Model CN5002, the secondary output utilizes terminals 4 and 5 (see Figure 2-6).

Outputs:

a. 10 Amp Mechanical Relay–(Standard)

   See Figure 2-6 for wiring connections.

b. 0-24 Vdc Logic–Output Code B1 or B2

   The 0-24 Vdc is availabe at terminals 1 and 3. Make wiring connection per Figure 2-7.

c. 1.5 Amp Solid State Relay–Output Code D1 or D2

   1.5 Amp SSR is rated 1.5 amps (resistive or inductive) at 24–230 Vac, at 75°F. Wiring per Figure 2-8.

d. 20 Amp Solid State Relay–Output Code F1 or F2.

e. 4-20 mA–Output Code G1 or G2

   Provides 4-20 mA output signal on terminals 1 and 3. Maximum load impedance is 750 ohms. Wire as per Figure 2-10.

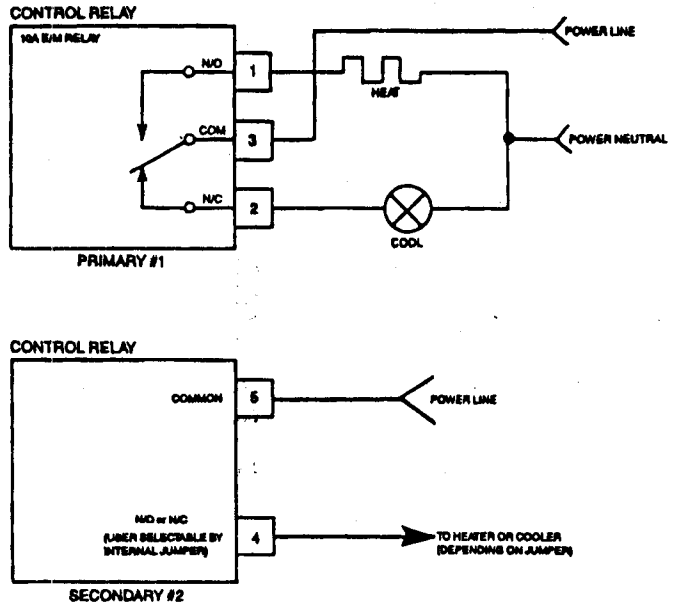


Figure 2-6. 10 Amp Mechanical Relay Connections

WARNINGS

After wiring the controller, leave the power off when installing the 20 amp SSR, until the SSR is fully installed and wired.

Shorting the load or placing voltage directly across the SSR output terminals will permanently damage the relay.

The load wires are connected to the "HOCKEY PUCK", which is on the heat sink mounted on the rear of controller (see Figure 2-9). Fast blow I2T fuses are recommended to protect against damage due to an overload".

The 20 amp solid state relay is normally closed below setpoint for heating applications. For cooling applications, specify the optional unit E4 so the SSR is normally closed when above setpoint.

NOTE

The 20 amp SSR is rated at 20 amps resistive or inductive with voltage ratings of 24 to 240 Vac. Derate the load if the controller is located in tight dead air space.

A SPST relay is provided for the second setpoint. Change jumper on output board to convert from Normally Open to Normally Closed (see Figure 2-6a).

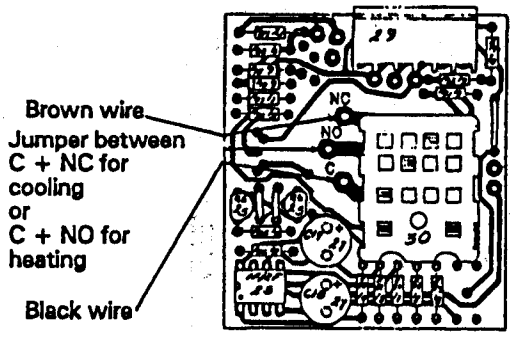


Figure 2-6a. CN5002 Second Output

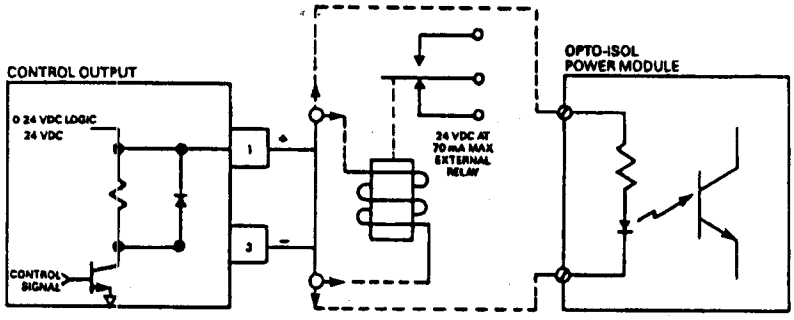


Figure 2-7. 0-24 Vdc Logic Output Wiring

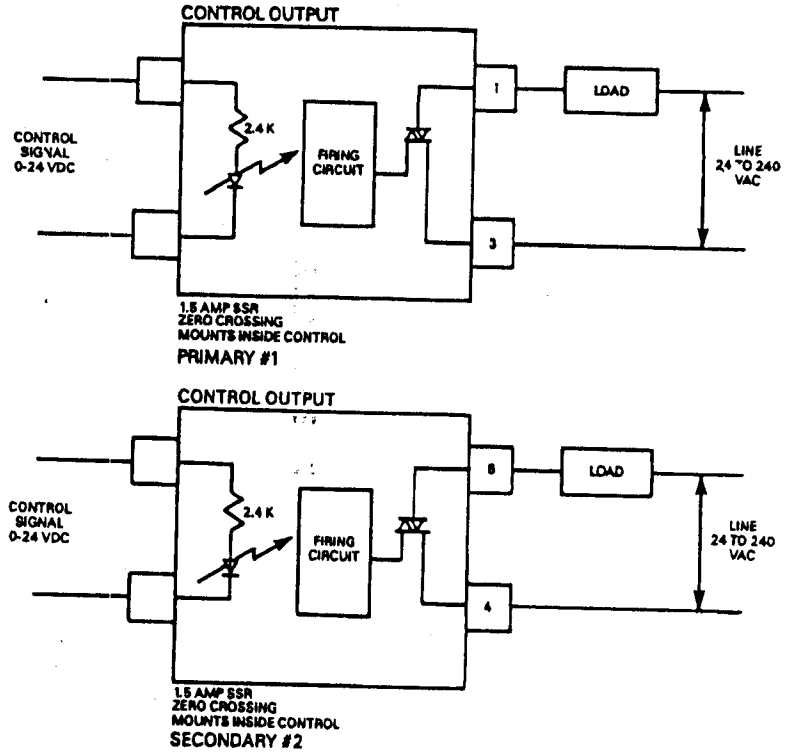


Figure 2-8. 1.5 Amp Solid State Relay Wiring

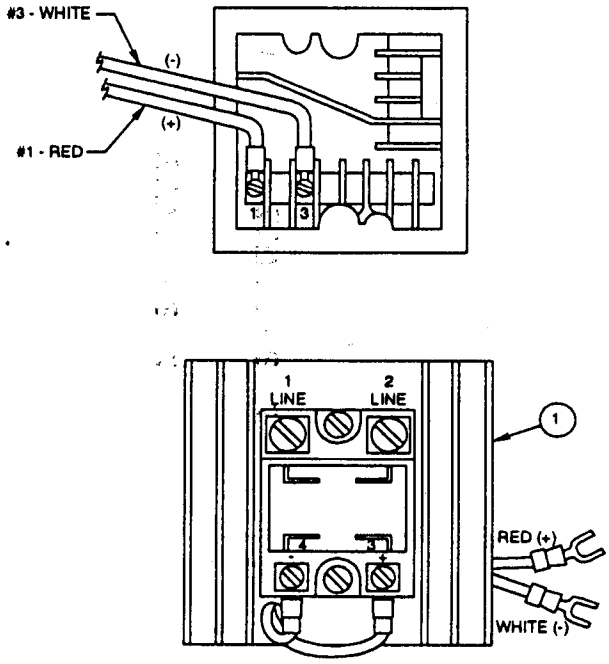


Figure 2-9. 20 Amp Solid State Relay Wiring

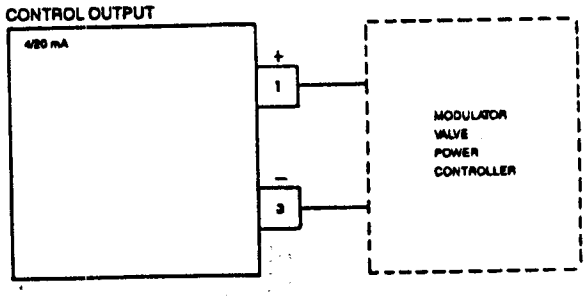


Figure 2-10. 4-20 mA Output Wiring

Notes

SECTION 3 OPERATION

3.1 SETPOINT ADJUSTMENT

3.1.1 Single Setpoint Model (CN5001)

Push and turn the potentiometer knob while simultaneously depressing the push-to-read setpoint button. The setpoint temperature will appear on the display. When the button is released, the display will revert to indicating the process temperature.

3.1.2 Dual Setpoint Model (CN5002)

The primary output is set the same as for the corresponding single setpoint models.

Secondary Output is ON/OFF

Second setpoint is accessible through flip-up door, and is marked "Set 2", located at position 1 (far left). Secondary output adjustment can be independently set anywhere within the range span via the 20 turn (minimum) set pot at position 1. Turn adjustment clockwise to increase setpoint, and counterclockwise to decrease setpoint. One turn of the set pot adjustment is approximately equal to 5% of range span.

For accurate setting of second channel, replace sensor with a mV signal equivalent to desired setpoint and adjust secondary output set pot until light changes state. Differential from relay "on" to relay "off" is approximately 0.25% of span.

NOTE

For reference, both channels are set at midpoint when shipped.

3.2 TIME PROPORTIONING TO ON/OFF ADJUSTMENT

3.2.1 ON/OFF Control

The adjustments on controllers are factory set for ON/OFF operation, with the differential from relay ON to relay OFF of approximately 0.25% of range span.

Bandwidth adjustment should already be fully counterclockwise (CCW) and the cycle time fully clockwise (CW). An adjustment is necessary only when the process temperature has stabilized, and the setting temperture is not in the center of the "sawtooth" cycle. Should this occur, the manual reset adjustment may be turned slightly to center the temperature setting at that specific setpoint.

NOTE

Turning the reset adjustment may affect the calibration accuracy at other setpoints. See paragraph 3.2.3.

3.2.2 Time Proportioning Control

Controller may be converted to time proportioning control by turning the bandwidth and cycle time adjustments.

a. Bandwidth-the symmetrical region around the setpoint within which the proportioning action occurs. The bandwidth may be adjusted from 0.25% to 10% of the range span. To increase the bandwidth, turn the adjustment labeled BANDWIDTH clockwise.

b. Cycle Time-sets the time, in seconds, for the controller to complete an ON/OFF cycle. This may be adjusted from approximately 2 to 36 seconds. To increase the cycle time (reduce the cycling rate), turn the adjustment marked CYCLE TIME or TIME counterclockwise. The cycle time value is dependent on the bandwidth value. Adjust the cycle time after the bandwidth adjustment is made. The cycle time also varies with the process temperature and is at maximum when the temperature is at setpoint (center of bandwidth).

3.2.3. Manual Reset Adjustment

The manual reset adjustment allows operator to eliminate thermal offset or droop, which is the difference between the stabilized temperature and the setpoint. This is a normal condition when using the proportioning control mode and is a function of the thermal design of the process.

3.3 TUNING A TIME PROPORTIONING CONTROLLER TO A SYSTEM

1. Set controller for ON/OFF operation by adjusting bandwidth fully counterclockwise and cycle time fully clockwise. The maual reset needs no adjustment at this time; it has been factory calibrated to make the relay de-energize at setpoint.
2. Let the temperature stabilize at setpoint. Note the amount of temperature overshoot and the width of the "sawtooth" temperature swings (the closeness of control). If these values are acceptable, no further adjustments are neceassary.
3. If closer control or less initial overshoot is desired, the time proportioning mode is needed. Increase the bandwidth adjustment 1/4 of a turn clockwise. This should result in closer control (without sawtooth swings).

4. Start up the system again, and if the amount of overshoot is still unacceptable, turn the bandwidth adjustment fully clockwise.

5. If even closer control or less overshoot is desired, convert the controller to burst proportioning with a solid-state relay (option E6).

6. If longer relay life is desired when using the 10 amp mechanical relay, increase the cycle time by turning its adjustment pot counter-clockwise 1/8 turn.

7. If the stabilized temperature is below the setpoint because of droop, turn the manual reset pot clockwise 1/8 turn. The temperature should then stabilize at or closer to setpoint. Should the stabilized temperature be above setpoint, turn the manual reset adjustment counter-clockwise in 1/8 turn increments until the temperature stabilizes at the setpoint.

3.4 4-20 mA PROPORTIONING ADJUSTMENT (OPTIONS G1 AND G2)

The controller circuit is isolated from the 4-20 mA otuput by a transformer and opto-isolator. This control mode is recommended for applications where the 4-20 mA is driving a device that does not provide line voltage isolation. The standard output is 20 mA at the beginning of the bandwidth (below setpoint) and is 4 mA at the upper end of the band (above setpoint). The output at setpoint is approximately 12 mA.

Adjust the cycle time pot fully clockwise and leave in this position. The bandwidth pot can then be adjusted to obtain the desired bandwidth (see Figure 2-3 and Figure 2-10 for wiring).

3.5 ADJUSTMENTS FOR PID CONTROL (Options A, B2, D2, F2, G2, Model CN5001 only)

The integral (or automatic reset) portion of the PID mode automatically returns the process temperature to setpoint temperature when offset or droop occurs inside the bandwidth. Integral action is inhibited when the process temperature is outside the bandwidth. The amount of integral action, expressed in repeats per minute (RPM), is determined by adjusting a 15 turn trim pot. The integral pot, labeled RPM, is adjustable from 0 to 0.45 repeats per minute. Turning adjustment CCW will increase amount of integral; a large amount may cause system to become unstable.

The derivative (or rate) portion of the PID mode recognizes the speed at which process temperature changes are occurring and makes the controller anticipate those changes. The result is reduced setpoint overshoot or undershoot. The amount of derivative action, expressed in seconds, is determined by adjusting a 15 turn trim pot. The derivative pot, labeled RATE, is adjustable from 0 to 500 seconds. Turning adjustment CW will increase the derivative; a large amount will cause system to become unstable.

3.6 TUNING A PID CONTROLLER TO A SYSTEM

1. Turn both the cycle time and bandwidth adjustments fully clockwise (CW). This applies whether the controller has the time proportioning or 4-20 mA signal form. The manual reset adjustment should not have to be touched.
2. Turn RATE (derivative) adjustment fully counterclockwise and RPM (integral) adjustment fully clockwise. Integral and derivative are now zero.

3. Turn RPM trim pot screw counterclockwise five full turns, and RATE trim pot clockwise five full turns.
4. Start up the system and observe what happens as the temperature approaches the setpoint. If the amount of overshoot is too great, increase amount of derivative by turning rate adjustment clockwise. If no overshoot is desired, use a lower than normal setpoint for the initial start-up.
5. Note that as more derivative (RATE) is selected, the temperature will approach setpoint more slowly. Also, if too much derivative (RATE) is used, the system may not stabilize at setpoint.
6. When using the time proportioning signal form, there may be situations, such as when the system is unbalanced and responds very fast, when it will be necessary to use burst proportioning with solid state relay (Option E6) in order for the controller to keep up with the system and prevent overshoot.
7. When system has stabilized, observe amount of offset error between setpoint and process temperature. If there is too much offset, remove power, unplug chassis, and increase integral by turning RPM set pot counterclock wise several turns. Allow process to restabilize and evaluate the new setting, repeating this step if necessary.
8. There is a direct relationship between bandwidth and system response time. When fully clockwise, the system will have long settling times. By turning the bandwidth pot counterclockwise, the system will settle out faster. Do not adjust bandwidth pot less than 1/4 turn from fully counterclockwise or the system will convert to ON/OFF and the PID will have no effect on the system.

3.7 BURST PROPORTIONING ADJUSTMENT (OPTION E6)

The cycle time is typically 0.2 to 3.6 seconds, reduced from 2 to 36 seconds on standard time proportioning controllers. To adjust, perform the same procedures as in paragraph 3.2.2. This option is available only with solid state relay (output codes D1/D2 and F1/F2) and logic output 0-24 Vdc (output code B1/B2).

3.8 OPTIONAL CONFIGURATIONS

3.8.1 Auxiliary 0-5 Vdc Process Signal (Option E3)

This option provides a 0 to 5 Vdc proportional signal over the range span, which can be used for remote indication or as an input to recorder or computer. The terminal wiring is shown in Figure 2-3. The minimum load resistance is 500 ohms.

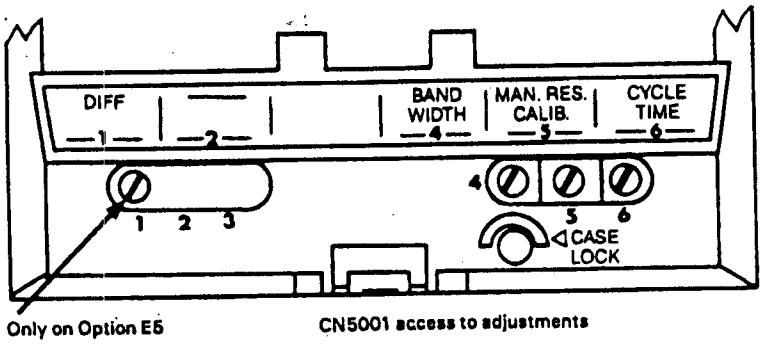


Figure 3-1. Differential Adjustment Pot Location (Front Cover Adjustment)

3.8.2 Adjustable Differential (Option E5) No Longer Available

This optional adjustment pot controls the span between the pull-in and the drop-out of the relay. The span is adjustable from 0.125% to 3.5% of range span typically. To widen the differential, turn the pot labeled DIFF clockwise (see Figure 3-1). The differential is symmetrical around the setpoint.

3.8.3 Tracking Second Setpoint (Option E7)

The second setpoint tracks the primary output. Separation, up to ±7% of span, is determined by adjusting set pot in position 1. To set a specific separation (e.g. secondary setting 25° higher than primary), first stabilize process temperature at a known value. Next, quickly lower primary setting by 25° and turn separation adjustment until second pilot changes state. Second pilot light will be on below second setpoint.

3.8.4 High Limit Latching Relay (Option E8)

Relay latches open and red LED comes on above setpoint. Relay will not reset (close) until the manual reset pushbutton on front of the unit is pushed and temperature is below setpoint.

Notes

SECTION 4 SERVICE INFORMATION

4.1 INTERNAL ACCESS

If access to the inside of the controller enclosure is necessary, gently press down the center tab located at the bottom of the controlller front and lift the two tabs on the door outward. Swing the door upward. Then, by exerting very slight pressure downward on the middle of the door, it will catch and remain open. Proceed to loosen the cover lock screw on the lower right side under the front panel door. Grasp the front faceplate frame on both sides near the bottom and pull straight out. The tight fit of the spring contacts and the circuit board may require a strong initial pull.

WARNING

Do not put hand or foreign inside controller enclosure without first shutting off alll power to prevent shock. Before sliding unit into enclosure, make sure the contact/terminal screws on the back of the case are tight. This prevents bending and assures contacts will slide into place.

To reassemble unit, be sure board is in the guide track, then slide board in making sure unit is straight. After the circuit board engages, push it firmly into place and tighten the case lock screw.

CAUTION

Although firm pressure is required to snap board into place, do not force if it appears to require an unusual amount of pressure.

On the CN5000 Controllers, close the front door by lifting slightly and exerting very light downward pressure on the middle of the door. After the door has swung down, press the two bottom tabs firmly and the door will lock in place. Do not force, too much pressure can permanently bend the door.

4.2 CHANGING OUTPUTS AND MODES (PRIMARY)

The modular design of Series CN5000 Controllers makes it possible for the user to convert any model from the basic time proportioning model with a 10 amp mechanical relay to a wide variety of other models by purchasing additional plug-in modules. These modules can be easily mounted in the field.

After making any field change, the side information label must be changed to reflect a new output rating. Also, please note that the U.L. listing is voided when field changes are made. In order to maintain the U.L. listing, the controller must be returned to OMEGA ENGINEERING for any conversion.

4.2.1 4-20 mA Output, Output Code G1, G2 (Kit 62150-167), Model CN5001

1. Remove the relay from its socket and detach the spring clip retainer.
2. Remove jumpers J8 and J10 completely from the circuit board. To do this, cut both ends of each jumper flush with the circuit board. For jumper locations, see Component Layouts.
3. The small, plug-in circuit board has three leads which have to be connected to the control circuit board. For the location of the connecting pins, see Figure 4-1. The two black leads connect to points A and D (non-polarized) and the red lead should be attached to point G.

4. Plug the 4-20 mA module into the relay socket and secure it with the enclosed #8 self-tapping screw. For adjustments, see paragraph 3.4.

4.2.2 1.5 Amp N.O. Solid State Relay-Output Code D1/D2 (Kit 62150-4)

The 1.5 amp SSR plugs directly into the mechanical relay socket; however, its enclosure is higher and requires a different retaining spring (supplied). For wiring, see Figure 2-8.

WARNING

Observe load wiring polarity Figure 2-8. Shorting the load or placing voltage directly across the SSR output terminal without a load will permanently damage the relay.

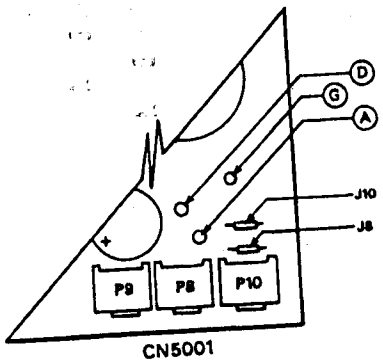


Figure 4-1. Connection Locations

4.2.3 20 Amp Solid State Relay Kit (P/N 62150-196) Mounting Instructions

CAUTION

DISCONNECT ALL POWER FROM UNIT BEFORE PERFORMING THIS OPERATION.

1. Remove head assembly from enclosure.
2. Remove plug-in relay and hold-down clip.
3. Insert PCB assembly into relay socket.
4. Re-install head assembly into enclosure.
5. Screw stand-offs into rear of enclosure as shown in Figure 4-2.

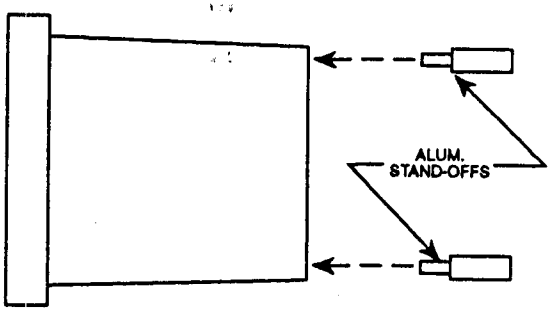


Figure 4-2. Mounting 20 Amp SSR Kit

6. Attach leadwires from relay to terminals #1 and #3, per Figure 2-9.
7. Route lead wires so they won't get crimped between the relay assembly and the terminal barriers.
8. Attach relay assembly to enclosure, using captured screws in Heat Sink.

WARNING

Observe load wiring polarity Figure 2-9. Shorting the load or placing voltage directly across the SSR output terminals without a load will permanently damage the relay.

4.2.4 Burst Proportioning (Option E6) (Kit 62150-6)

Burst proportioning is a speeded-up cycling rate with an adjustable range of 0.2 to 3.6 seconds, in lieu of the normal cycle time 2 to 36 seconds. This option can be used with the SSR, or 0-24 Vdc logic outputs.

1. Remove jumpers J8 and J10 completely from the circuit board. To do this, cut both ends of each jumper flush with the circuit board. For exact locations see Component Layouts.
2. Connect the 10 microfarad (μf) capacitor (C10) provided, to points A and D on the control circuit board (see Figures 4-1 and 4-2).

NOTE
Point "A" is positive (+), and point "D" is negative (-).

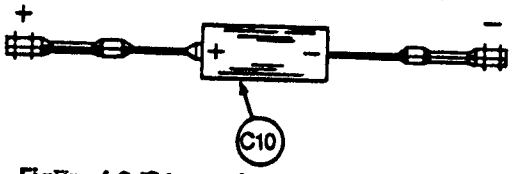


Figure 4-3. Connecting the 10µF Capacitor

WARNING
Be sure to observe the polarity of the capacitor and cut only the correct jumpers for proper operation, or the controller will be inoperative.

NOTE
Position the capacitor (C10) so that it will not short or interfere with any moving parts.

4. 2.5 Automatic Reset/Integral and Derivative (PID) for Options A, B2, D2, F2 & G2

The CN5000 Controllers can be converted to a full three mode integral, derivative controller with anti-windup by simply plugging in a small PC board. (Adjustment instructions in paragraph 3.5.)

4. 2.6 0-24 Vdc Logic-Output B1/B2 (Kit 62150-8)

This output is used for applications where it is desirable to have a 0-24 Vdc output instead of relay contacts.

1. Remove the relay from its socket and detach the spring clip connector.
2. Observing polarity, install the 0-24 Vdc option card, into the relay socket.
3. A 0-24 Vdc control signal is now supplied to terminals 1 and 3 (positive and negative, respectively) instead of the relay contact closures.

NOTE

Observe output polarity. Refer to Figure 2-7. Be sure to change both the model and type identification lable and mark the outputs on the wiring label.

4.3 TROUBLESHOOTING

The troubleshooting information in Table 4-1 is included to serve as a guide to enable equipment repair. It is a guide only, and cannot cover all possible contingencies that may occur.

TABLE 4-1
TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
1. Heat on-LED is not lit and temperature won't come up to setpoint.	No line voltage applied to controller	Check wiring.
	Relay or PC board not properly installed in socket	Check and correct if necessary.

TABLE 4-1 (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	Wiring is incorrect	Check wiring
	Relay has failed; meter reads ambient	Replace relay.
	Voltage applied directly to relay output terminals without a connection through the thermal load	Board tracks possible burned and components damaged. Contact OMEGA Customer Service.
2. Same as syptom 1, except meter reads temperature above upper limit or pointer is pegged upscale	Open thermocouple, or thermocouple leads cut	Repair or replace.
3. Heat on-LED is lit but temperature won't come up to setpoint	Blown fuse	Replace fuse.
	Open heater or defective wiring	Replace heater; check wiring.
4. Heat on-LED is lit and temperature is far above setpoint (runaway condition)	Thermocouple shorted at some point outside of the process medium	Check for short along lead wires; repair or replace.
	Control relay failed (contacts welded closed)	Check relay contacts.

TABLE 4-1 (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
5. Heat on-LED not lit and temperature far above setpoint	Relay contacts welded	Check relay contacts.
	Defective external wiring. Heater getting power but control relay contacts open	Check wiring.
6. Thermocouple control operates in reverse (e.g., indication of decreased temperature when heat is applied to sensor)	Thermocouple is wired backwards	Wire to proper terminals.
7. Controller setting is way out of calibration (e.g., set at 500°, but product being controlled at 525°); meter agrees with setting.	Thermocouple type not correct for controller range	Use proper thermocouple type.
	Lead wires reversed	Check thermocouple lead wire polarity (Red wire should be on negative (-) terminal).

TABLE 4-1 (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	Control sensor is located away from spot where process temperature is being measured by reference thermometer	Adjust setpoint until reference thermometer reads desired temperature or place sensor next to reference thermometer sensor.
	Controller out of calibration	Check calibration using mV source in place of sensor. (See Section 5 Calibration)
8. After system stabilization, controller reading is offset from set point value	If using proportional control (time prop. or 4-20 mA) system droop is experienced	Eliminate droop by turning manual reset pot or adding the PID option.
	Controller out of calibration	Check calibration with mV source.
	Line voltage more than ±15% from 115 or 230 Vac	Check line voltage.
9. Not getting close control, but cycles are consistent	If ON/OFF mode a. Differential too wide	Improve circulation of medium. Use a heat transfer

TABLE 4-1 (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	b. Heater wattage too large compared to heat demand (overshoot) c. Sensor located far from heater (lag) d. Sensor has slow response time	compound with the sensor.
	If proportioning mode bandwidth too narrow	Widen band.
	If control has auto reset, too much integral and/or derivative action	Adjust accordingly.
	Cycle time needs adjustment	Adjust cycle time.
10. Not getting close control. Cycles are inconsistent	a. Excessive amperage load on relay contacts: contacts sticking b. If control has auto reset, too much integral or derivative action.	Make sure load current does not exceed contact rating.
11. Too much overshoot during start up	a. Heater wattage too large compared to heat demand	Go to proportioning mode with wide bandwidth.

TABLE 4-1 (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	b. System responds too slowly, or system has thermal lag	
	If proportional mode bandwidth is too narrow	Adjust bandwidth and cycle time
12. Relay chatters	Very high inductive load being switched	Put resistor and capacitor in series with load.

SECTION 5 CALIBRATION

5.1 FIELD CALIBRATION

CN5000 Series Controllers require special calibration apparatus to perform field calibration. Contact OMEGA Engineering at 1-800-872-9436 for further details.

SECTION 6 SPECIFICATIONS

THERMOCOUPLE INPUTS:	Types J, K, T and E cold junction compensated
UPSCALE BREAK PROTECTION:	Standard, convertible to down scale
LEAD RESISTANCE:	F° shift per 100Ω
MODES/SIGNAL FORMS	
TIME PROPORTIONING TO ON/OFF	
CYCLE TIME:	Adjustable approximately 2-36 sec
BANDWIDTH:	Adjustable 0-10% of span, with setpoint in the center
MANUAL RESET:	Adjustable ±12% of span
ON/OFF:	Field convertible to ON/OFF with differential approximately 0.25% of span symmetrical around setpoint.
BURST PROPORTIONING:	Same as time proportioning except cycle time adjustable approximately 0.2 to 3.6 sec (Not for use with 10 amp relay)
PID (PROPORTIONAL— INTEGRAL-DERIVATIVE)	
INTEGRAL SELECTION:	15-turn trim pot, labeled RPM, is adjustable from 0 to .45 repeats per minute

SPECIFICATIONS (Cont'd)

DERIVATIVE SELECTION:	15-turn trim pot, labeled RATE, is adjustable from 0 to 500 seconds
4-20 mA (ISOLATED) MODE:	20 mA at lower end of proportional bandwidth approximately 12 mA at setpoint, 4 mA at upper end of bandwidth. Bandwidth adjustable 0 to 6% of range span with setpoint in the center. Isolated optically and by transfomer
SWITCHING DEVICES	
10 AMP MECHANICAL RELAY:	• Plug-in for easy replacement • Rated 10 amps @ 115 Vac resistive, 5 amp @ 240 Vac resistive, SPDT
1.5 AMP SOLID STATE RELAY (SPDT):	• Rated 1.5 amps @ 130°F ambient temperature, resistive or inductive, 24 to 230 Vac • Surge current 30 amps for one cycle. Typical off-state leakage current 6 mA @ 230 Vac • Zero crossing, optically isolated
OUTPUT INVERSION:	• For cooling applications • Available with solid state or mechanical relay

SPECIFICATIONS (Cont'd)

	• Failsafe control during power failure
NON-TRACKING SECOND OUTPUT:	• Independent of primary setpoint
	• Adjustable over 100% of span
ADJUSTABLE ON/OFF DIFFERENTIAL:	• Adjustable from .13% to 3.5% of span, symmetrical around setpoint
	• Available only on primary setpoint
OPERATING AMBIENT TEMPERATURE STANDARD:	32° to 130°F (0° to 55°C)
STORAGE TEMPERATURE:	-40° to 165°F
PANEL CUTOUT:	3 5/8" (92 mm) sq. per DIN-43700

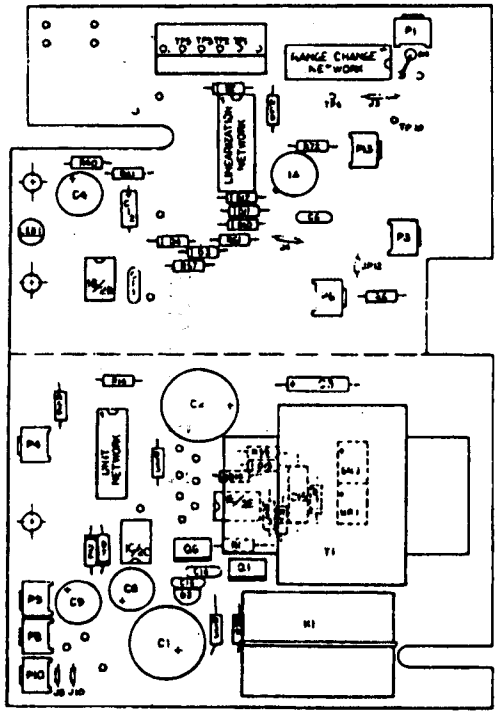
6.1 COMPONENT LIST

PART NUMBER	DESCRIPTION
62132-24	5.1 V Zener
62132-11	5.6 V Zener
62132-21	16 V Zener
62132-13	4003 Diode
62135-25	-25 Transistor-digital
62135-18	-18 Transistor
62133-29	PASS Transistor 5294
6219-553	Regulator 7815
62133-63	T/C Op Amp CA741
6251-45	LED (922) Relay Status
6295-27	Relay Clip
6295-28	1.5 A S.S.R. Clip
6212-271	O ring for LED
62132-29	Dual Bridge
6289-139	Unit Clip
6219-535	1458 Op Amp
62131-35	Cap 470 µf
62131-39	Cap 100 µf
62131-36	Cap .47 µf
62131-15	Cap 10 µf
62131-32	Cap .01 µf
62134-90	Pot 2 kΩ
62134-86	Pot 10 kΩ
62134-85	Pot 5 kΩ
62134-88	Pot 50 kΩ
62132-23	LED
62133-60	3240 Op Amp
62133-17	Transistor 2N3704
62131-47	Cap 1000 µf
	Pot 1 kΩ

6.2 HARDWARE

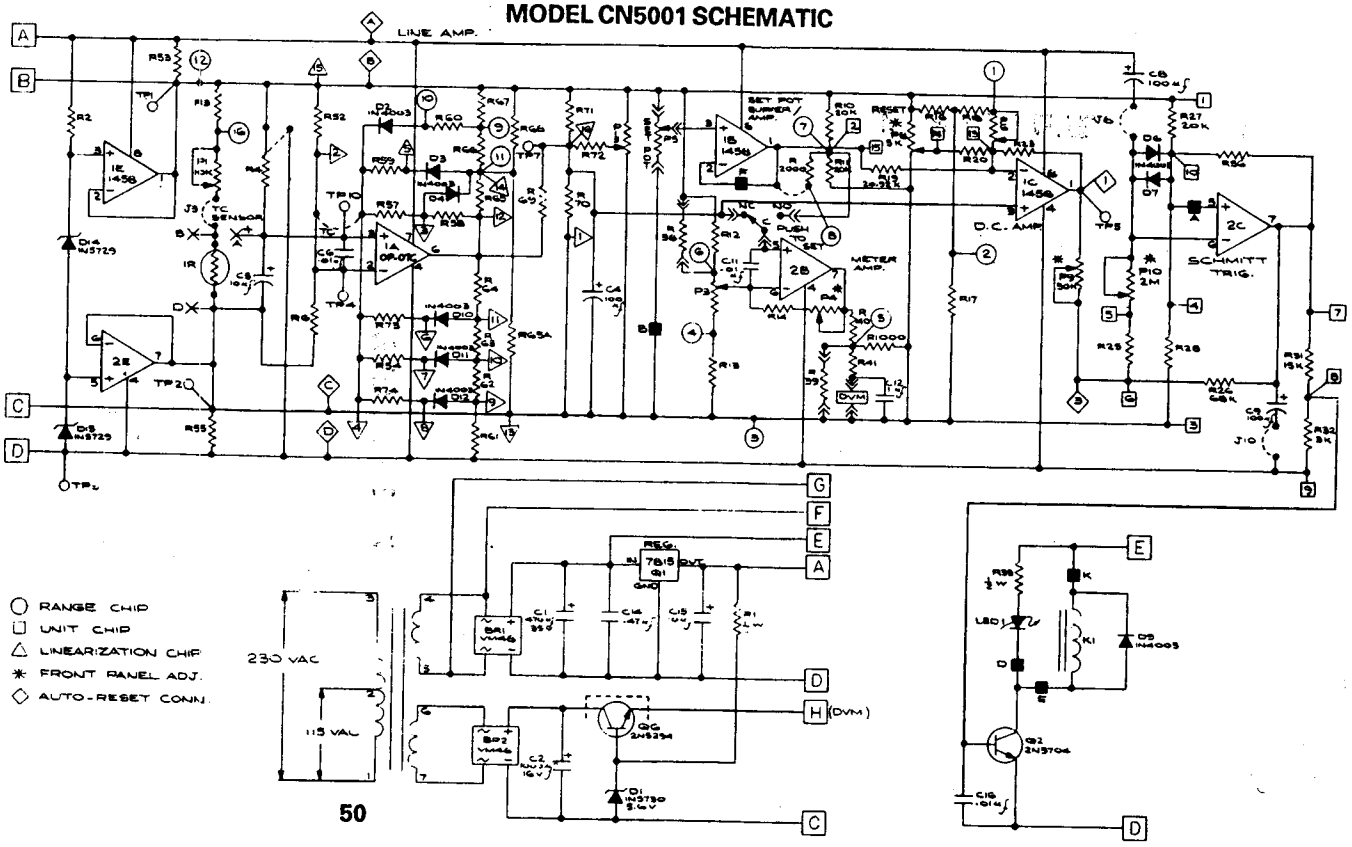
PART NUMBER	DESCRIPTION
0-113-08038	Back plate screw
6277-9	Front cover screw
6277-121	PC Board screw
0101-04100 & 0101-04088 6269-128	Transistor Mounting Screw and Nut

PART NUMBER	DESCRIPTION
0101-Q4028	Trans. bracket mounting screw
0118-08125	S.S.R. (15 A) Nylon screw
0113-08113	Steel screw
6244-137	Encl. back wiring screw
6244-136	Enclosure fingers
0101-04038	Trans. mounting screw (CN5001)
6254-346	Trans. mounting spacer (CN5001)



MODELS CN5001 and CN5002 COMPONENT LAYOUT

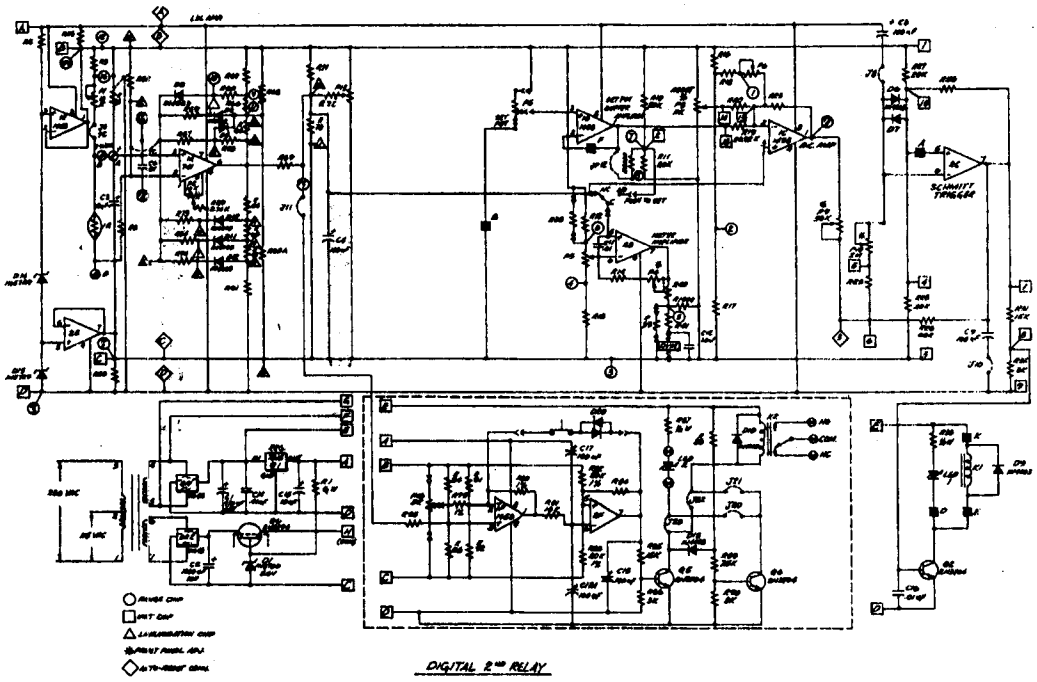
MODEL CN5001 SCHEMATIC



○ RANGE CHIP
□ UNIT CHIP
△ LINEARIZATION CHIP
✳ FRONT PANEL ADJ.
◇ AUTO-RESET CONN.

NOTES:

MODEL CN5002 SCHEMATIC



MADE IN THE USA

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

OMEGA is glad to offer suggestions on the use of its various products. Nevertheless, OMEGA only warrants that the parts manufactured by it will be as specified and free of defects.

OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

Every precaution for accuracy has been taken in the preparation of this manual; however, OMEGA ENGINEERING, INC. neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages that result from the use of the products in accordance with the information contained in the manual.

SPECIAL CONDITION: Should this equipment be used in or with any nuclear installation or activity, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the equipment in such a manner.

OMEGA

Servicing USA and Canada: Call OMEGA Toll Free

USA

One Omega Drive, Box 4047
Stamford, CT 06907-0047
Telephone: (203) 359-1660
FAX: (203) 359-7700

Canada

976 Bergar
Laval (Quebec) H7L 5A1
Telephone: (514) 856-6928
FAX: (514) 856-6886

Sales Service: 1-800-826-6342 / 1-800-TC-OMEGA℠
Customer Service: 1-800-622-2378 / 1-800-622-BEST℠
Engineering Service: 1-806-872-9436 / 1-800-USA-WHEN℠
TELEX: 996404 EASYLINK: 62968934 CABLE: OMEGA

Servicing Europe: United Kingdom Sales and Distribution Center

25 Swannington Road, Broughton Astley, Leicestershire
LE9 6TU, England
Telephone: 44 (1455) 285520 FAX: 44 (1455) 283912

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS OR **CALIBRATION**, consult OMEGA for current repair/calibration charges. Have the following information available BEFORE contacting OMEGA:

1. P.O. number to cover the COST of the repair/calibration,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

DFM0495RFM1C8B