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OMEGA ENGINEERING, INC.
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One Omega Drive, Box 4047
Stamford, CT 06907-0047
(203)359-1660 Telex: 996404 Cable: OMEGA
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OMEGA ENGINEERING, INC.

An OMEGA Technologies Company

Series 6100 (6102, 6103, 6132H) Temperature Controllers

Operator's Manual

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 our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our 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 current, heat, moisture, vibration, or misuse. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

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To avoid processing delays, also please be sure to include:

1. **Returnee's name, address, and phone number.**
2. **Model and Serial numbers.**
3. **Repair instructions.**

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OMEGA ENGINEERING, INC.
An OMEGA Technologies Company
One Omega Drive, Box 4047
Stamford, Connecticut 06907-0047
(203)359-1660 Telex: 996404 Cable: OMEGA
FAX: (203) 359-7700

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SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The Series 6100 Controllers are half the size of other units, with performance equal or better than controllers costing almost twice as much. High quality and high performance at an economical price. Designed to be reliable in industrial applications, these units provide extremely accurate control and can switch loads up to 10 A at 120 VAC.

The time proportional control circuit gives accurate, reliable control with minimum overshoot. Built-in power feedback automatically compensates for variations in heater power which could be caused by voltage fluctations.

1.2 CONFIGURATIONS

The Model 6102 single set point time proportional controller is the "socket mount unit" (plug-in) and is supplied with a mating socket for easy mounting. Available for type J, K, and S thermocouple inputs and platinum RTD inputs.

The Model 6103 single set point time proportional controller is the "quick disconnect unit" (panel mount) and is supplied with terminal connectors for easy wiring. Available for type J, K, and S thermocouples.

6132H is the same as 6102 with Single Pole Double Throw (SPDT) 5A relay for on/off operation (not time proportional).

1.3 FEATURES

1. Type J, K, and S thermocouple and platinum RTD
2. Time proportional convertible to on/off
3. 10 Amp load capacity (5A 6132H)
4. Compact, less than 2" (48 mm) square
5. Plug-in or panel mount

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the Packing List to check off actual equipment received. If there are any questions about the shipment, please call OMEGA's Customer Service Department at (203) 359-1660.

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 CONTROLLER LOCATION

Select a location for the controller that is reasonably free from excessive shock, vibration, dirt, moisture and oil. The ambient temperature of the area should be between 32° and 122°F (0° and 50°C).

2.3 MOUNTING – INSTALLATION INSTRUCTIONS (refer to Figure 2-1)

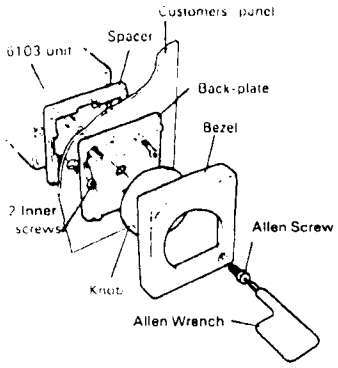


Figure 2-1. Exploded View of Front of 6103

NOTE

Steps 1-4 only are for 6102 & 6132H. All 6 steps pertain to 6103.

1. Remove the allen screw, then pull off the bezel and knob.
2. Undo the two inner screws and remove the backplate.
3. Use either of the following 2 steps: (refer to Figure 2-2):
   a. **45 mm x 45 mm cutout.** Insert unit from the rear of panel keeping spacer on inside of panel to locate in cutout. [Max. panel thickness 3/16" (5 mm)].
   b. **3 mm x 8 mm cutout.** Panels up to 5/32" (4 mm) – leave spacer on top of unit. Panels 5/32" to 9/32" (4-7 mm) discard spacer. Panels over 9/32" (7 mm), consult OMEGA Engineering. Three holes can be drilled in panel as shown in Figure 2-2.
4. From front of panel, screw backplate to unit; then push on knob, bezel, and secure with allen screw.
5. Slide colored boots on wires before crimping to receptacles.
6. The accessories bag contains (including some spare items):
   Receptacles – 8 single, 4 dual.
   Boots – 1 red, 1 black, 1 brown, grey, 2 green, 2 blue, & 2 violet).
   One molded Allen Wrench (2.5 mm).

2.4 FRONT PANEL LAYOUT

The layout of the front panel is shown in Figure 2-2.

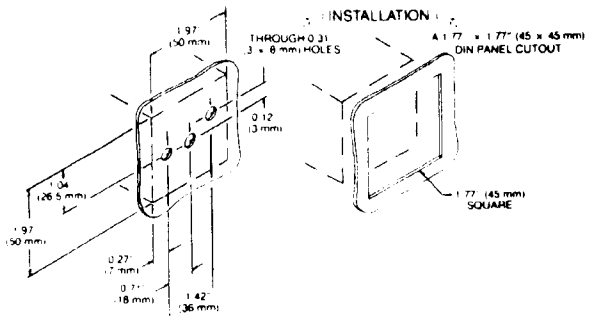


Figure 2-2. Series 6100 Mounting Dimensions

2.5 WIRING POWER CIRCUIT (See Figures 2-4 and 2-5)

WARNING

Remove line voltage from the instrument before making any connections.

Make sure there is no voltage present on the thermocouple wires before making connections.

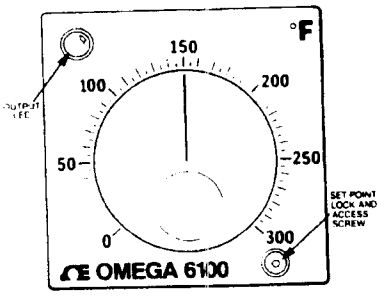


Figure 2-3. Front Panel Layout

CAUTION

Fuse incoming high side of line with fast blow 10 A fuse. Shorted heater or wiring will destroy the relay.

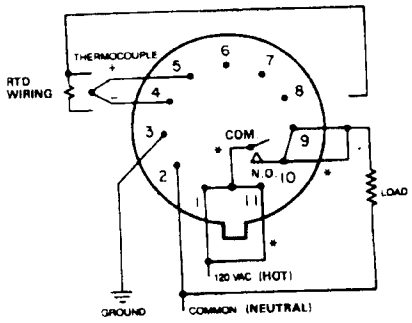


Figure 2-4. Model 6102 Wiring Diagram (Time Proportional)

* NOTE: Power is internally wired from input power to relay. However, it is recommended that external jumpers be added between terminals 1 & 11 and 9 & 10.

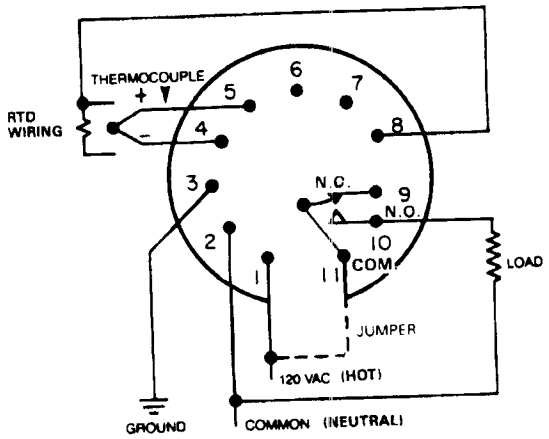


Figure 2-5. Model 6132H Only Wiring Diagram (Heating On/Off Control)

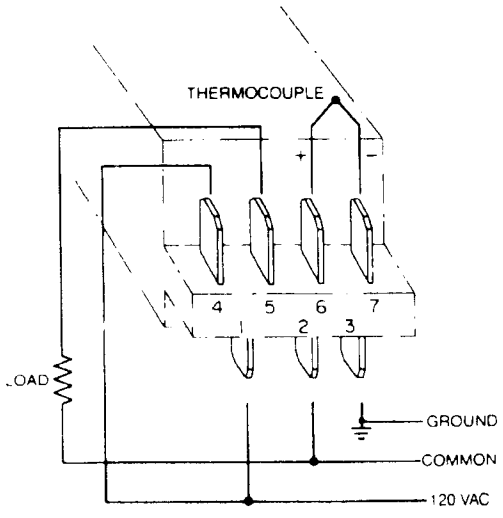


Figure 2-6. Model 6103 Wiring Diagram Time Proportional

2.6 WIRING THERMOCOUPLE OR RTD CIRCUIT

Connect Thermocouple or RTD sensor of appropriate type (as specified on unit's label) to input terminals.

The Thermocouple negative (-) lead is colored red. See Figures 2-4 and 2-5.

The RTD sensor common lead is colored red. See Figures 2-4 and 2-5.

For long runs between the controller and thermocouple, the thermocouple wire gage must be of sufficient size so that thermocouple resistance does not exceed 100 ohms. You will find a resistance table for various gage thermocouple wire in the technical section of the OMEGA Temperature Measurement Handbook. Do not run thermocouple or RTD sensor leads in the same conduit as the power lines. If shielded wire is used, terminate the shield only at the controller end.

Proper sensor placement is essential. It can eliminate many problems in the total system. The sensor should be placed so that it can detect any temperature change with little thermal lag. In a process that requires fairly constant heat output, the sensor should be placed close to the heater. In processes where the heat demand is variable, the sensor should be close to the work area. Experimenting with sensor location can often provide optimum results.

SECTION 3 OPERATION

The typical control system contains the sensor, the 6100 Controller and the process (load). The sensor produces a small signal proportional to the measured temperature of the process. This signal is amplified by the controller, where it is compared with the set point temperature. If the temperature of the sensor is below set point, the output circuitry will be actuated to apply power to the process. This is indicated by means of an LED on the face of the controller.

3.1 MODEL 6102 "SOCKET MOUNT" – RELAY OUTPUT

The output relay has a SPST contact rated 10 Amps at 120 VAC. An OMEGA solid state relay or mechanical relay can be added to handle larger loads. See Figure 3-1.

3.2 MODEL 6100 "QUICK DISCONNECT" – RELAY OUTPUT

The output relay has a SPST contact rated 10 Amps at 120 VAC. An OMEGA solid state relay or mechanical relay can be added to handle larger loads. See Figure 3-1.

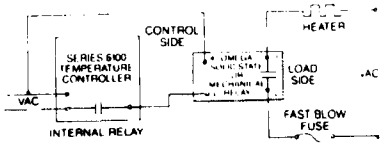


Figure 3-1. Wiring Diagram for Larger Loads

SECTION 4 ADJUSTMENTS AND CALIBRATION

4.1 MANUAL RESET ADJUSTMENT OFFSET

The controller is factory set with the proportioning band an equal distance either side of set point temperature.

At the set-point: $\frac{\text{Power On Time}}{\text{Power Off Time}} = 1 = 50\%$ power

If more or less than 50% power is required, the controller will not stabilize at the set point, but at some other temperature within the proportioning band. The difference between this temperature and the desired set point temperature is called OFFSET.

In most applications the OFFSET is not important and no adjustment is necessary.

4.1.1 Instructions To Adjust Offset

1. Remove black cap in plastic module cover above potentiometer P1.
2. Adjust P1 until offset is removed. See Figure 4-1. Turn clockwise if process temperature is below set point temperature. Turn counterclockwise if process temperature is above set point temperature. Allow the system to stabilize before re-adjusting.
3. If the set point is changed to a different temperature or if the load conditions change, a new offset adjustment might be required.

4.1.2 Proportional Band Adjustment

The proportional band is factory set to about 3.5% of span. This can be varied by changing the value of resistor R11. See Figures 4-1a and 4-1b, and Tables 4-1 and 4-2.

4.1.3 Cycle Time Adjustment

The cycle time is normally set to about 25 seconds. This can be varied up to 50 seconds by changing the value of C4. See Figures 4-1a and 4-1b, and Table 4-3.

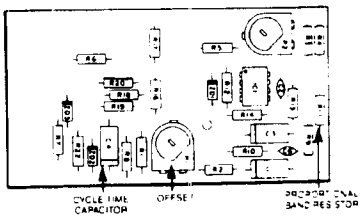


Figure 4-1a. Series 6100 Amplifier Board – Thermocouple Model

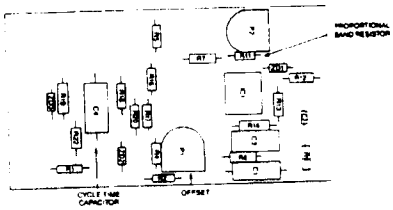


Figure 4-1b. Series 6100 Amplifier Board – RTD Model

TABLE 4-1
THERMOCOUPLE MODELS

R11	Bandwidth (Approx.)
10 MΩ	1.75% of Span
4.7 MΩ	3.5% of Span
2.2 MΩ	7% of Span

TABLE 4-2
RTD MODELS

R11	Bandwidth (Approx.)
3.3 MΩ	1% of Span
1.0 MΩ	3% of Span (standard)
680 kΩ	5% of Span

TABLE 4-3
CYCLE TIME ADJUSTMENT

C4μf/V	Cycle Time (second)
47/10	25 (standard)
22/10	12
100/10	50

4.2 CALIBRATION PROCEDURE FOR 6102 AND 6103 TEMPERATURE CONTROLLERS

4.2.1 Equipment Required:

1. Stable millivolt source for thermocouple input models.
2. Decade resistance box for PT100 RTD input models.
3. OMEGA temperature reference chamber (TRC) or ice bath consisting of equal parts of crushed ice and water stirred regularly in suitable flask.
4. OMEGA temperature reference probe (TRP).
5. Digital voltmeter having at least 10 microvolt resolution

WARNING
Use extreme care in calibrating the controller with 120 VAC power applied.

4.2.2 Calibration Procedure

1. Remove the Allen screw at the lower right corner of the bezel and pull the bezel off.
2. Remove dial by pulling from opposite sides.
3. Remove the two Phillips screws and take the base plate and spacer off.

Calibration Procedure (Cont'd)

4. Remove the rear cover using the two tabs on each side of the case and remove the chassis assembly.
5. Connect 120 VAC power to controller (see paragraph 2.5 wiring power circuit). See Figures 2-4 through 2-6.
6. Connect calibration equipment for thermocouple or RTD models as shown in Figures 4-2 and 4-3.
7. Connect digital voltmeter across set point pot P3.
   Positive lead (+) to grey wire
   Negative lead (−) to green wire
8. Set the required mV input for thermocouple models or ohm's for RTD models from Table 4-4.
9. Adjust set point dial to mid-scale position (e.g., 150°F for 300°F range)
10. Check the mV reading on digital voltmeter. Refer to Table 4-4.
11. If necessary adjust P2 for value shown in Table 4-4.

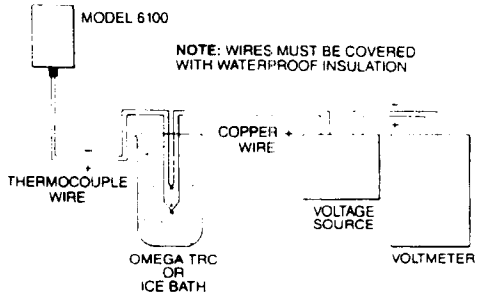


Figure 4-2. Calibration Set-up for Thermocouple Model

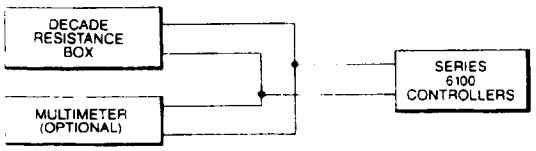


Figure 4-3. Calibration Set-up for RTD Model

TABLE 4-4
CALIBRATION TABLE

Range	Sensor type	mV input	Adjust	mV Across P3
0 to 300°F	J	3.411	P2	9.0
0 to 500°F	J	6.420	P2	15.7
0 to 1000°F	J	14.108	P2	30.6
0 to 300°C	J	8.008	P2	17.0
0 to 500°F	K	4.964	P2	11.4
0 to 1000°F	K	10.560	P2	23.5
0 to 1500°F	K	16.349	P2	26.6
0 to 1200°C	K	24.902	P2	50.6
0 to 1600°C	S	7.345	P2	18.5
0 to 600°C	Pt-100	Resistance input 212.03Ω	P2	31.1

SECTION 5 SERVICE INFORMATION

5.1 PARTS LIST—MODELS 6102, 6103 (THERMOCOUPLE)

R1	100kΩ	P1	250	K1	MZP 16
R2	150Ω	P2	100		
R3	6.8kΩ	P3	220	T1	TX1700
R4	*				
R5	*	Q1	BC 337	Rectifier	W004
R6	5.6Ω	Q2	BC 337		
R7	12Ω			LED	2000
R8	27kΩ	C1	100µf 4V		
R9	4.7kΩ	C2	10nF 50V		
R10	4.7kΩ	C3	4.7µf 50V		
R11	4.7MΩ	C4	47µf 10V		
R12	4.7kΩ	C5	100µf 40V		
R13	33kΩ	C6	10nF		
R14	22kΩ				
R15	680Ω	D1	IN4005		
R16	470kΩ				
R17	68kΩ	ZD1	12V		
R18	470kΩ	ZD2	6.2V		
R19	470kΩ	ZD3	12V		
R20	3.3MΩ	ZD4	3.3V		
R21	820½W				
R22	18kΩ	IC1	LM358N		
R23	10kΩ				
R24	2.2kΩ	RT	VA1100		

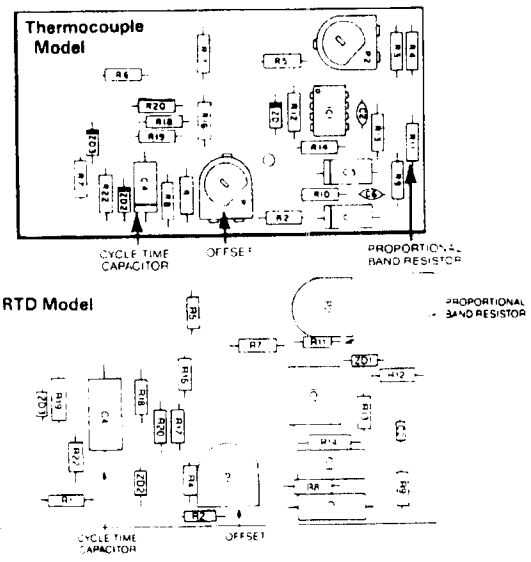
* Selected at Manufacture

5.2 PARTS LIST–MODEL 6102 (PLATINUM RTD)

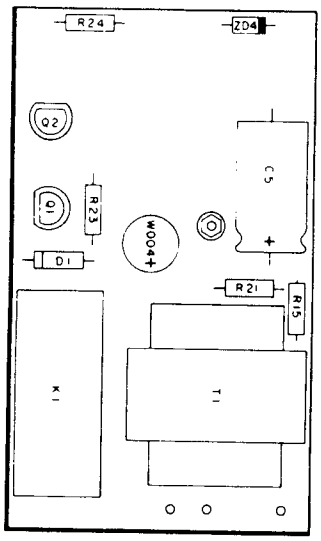
R1	33kΩ	P1	250	K1	MZP 16
R2	150Ω	P2	100		
R4	100Ω	P3	220	T1	TX1700
R5	12kΩ				
R7	10kΩ	Q1	BC337	Rectifier	W004
R8	10kΩ	Q2	BC337		
R9	10kΩ			LED	2000
R11	1MΩ	C1	100µf 4V		
R12	4.7kΩ	C2	4.7µf 50V		
R13	27kΩ	C3	4.7µf 63V		
R14	27kΩ	C4	47µf 10V		
R15	680Ω	C5	100µf 40V		
R16	470kΩ				
R17	68kΩ	D1	IN4005		
R18	470kΩ				
R19	470kΩ	ZD1	12V		
R20	3.3MΩ	ZD2	6.2V		
R21	820½W	ZD3	12V		
R22	18kΩ	ZD4	3.3V		
R23	10kΩ				
R24	2.2kΩ	IC1	LM358N		
		RT	VA1100		

* Selected at Manufacture

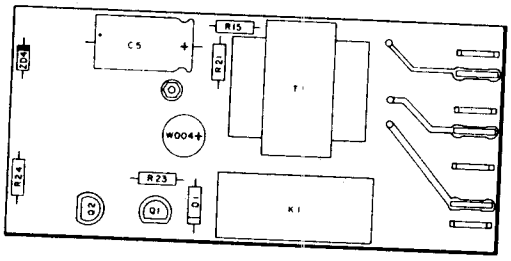
5.3 AMPLIFIER BOARD DIAGRAM–MODEL 6102, 6103



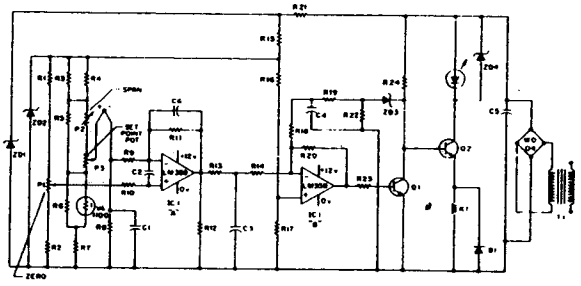
5.4 POWER SUPPLY BOARD DIAGRAM–MODEL 6102



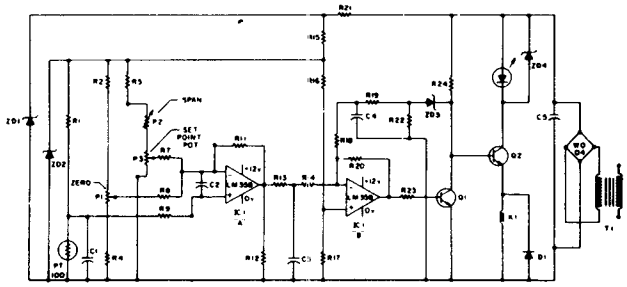
5.5 POWER SUPPLY BOARD DIAGRAM–MODEL 6103



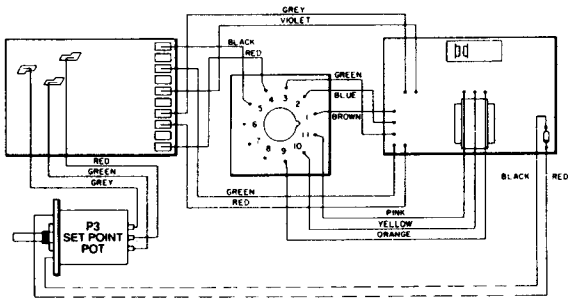
5.6 SCHEMATIC–MODELS 6102, 6103 (THERMOCOUPLE INPUT)



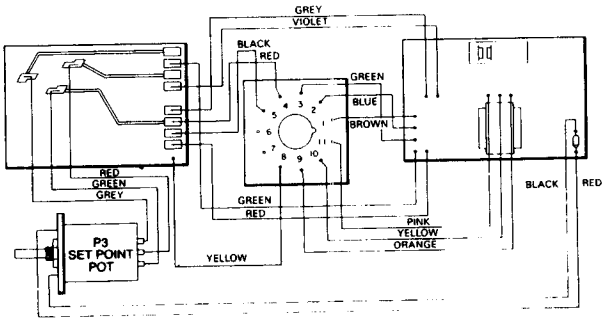
5.7 SCHEMATIC–MODEL 6102 (PLATINUM RTD)



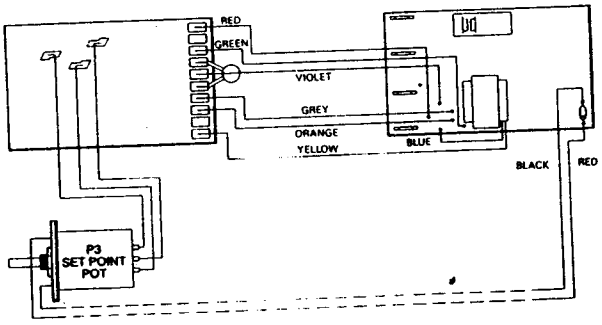
THERMOCOUPLE WIRING DIAGRAM
FOR BOARD ASSEMBLY
MODEL 6102



PT 100 WIRING DIAGRAM
FOR BOARD ASSEMBLY
MODEL 6102



THERMOCOUPLE WIRING DIAGRAM
FOR BOARD ASSEMBLY
MODEL 6103



5.9 MAINTENANCE

Some simple preventive maintenance steps for controllers are:

1. Keep the controller fairly clean and protected from dirt, oil, and corrosion.
2. Periodically recheck all electrical connections.

5.10 TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE	CHECK	CORRECTIVE ACTION
1. Controller dead. No output light.	No line voltage input.	(1) 120 V ac 50/60 Hz input voltage (2) Heater for shorts. (3) For open circuit breaker (4) For open external fuse.	Replace heater, if shorted. Restore power. Reset breaker, replace fuse.
2. No output, Step 1 OK.	Defective relay	Visually inspect relay contacts.	Replace if contacts are worn or dirty.
	Open heater or heater circuit wiring error.	Heater continuity and wiring.	Replace open heater, correct defective wiring.

SYMPTOM	PROBABLE CAUSE	CHECK	CORRECTIVE ACTION
3. No output	Open thermocouple or thermocouple wiring.	Thermocouple continuity. Disconnect thermocouple connections from instruments. Measure thermocouple circuit resistance. Ohmmeter should read 100 ohms or less.	Replace thermocouple. Correct defective thermocouple wiring.
4. Full output, no control.	Thermocouple connections reversed.	Connection polarity. Thermocouple wires are color-coded. Red is negative (−) lead.	Connect thermocouple correctly.
5. Controlled temperature differs from set point	Wrong type of thermocouple being used for controller's range.	Serial tag on controller housing indicates type of thermocouple for controller's range.	Install correct type of thermocouple.
	Standard electrical wire being used as thermocouple extension wire (cold junction not at controller).	Correct the type of thermocouple wire.	Run thermocouple wire between thermocouple and controller.

SYMPTOM	PROBABLE CAUSE	CHECK	CORRECTIVE ACTION
6. Apparent control temperature differs from set point temperature when using a second measurement device (e.g., pyrometer).	Gradient error.	If possible use an electronic temperature indicator or another temperature controller in parallel with suspect instrument's thermocouple input.	Always measure temperature at same location as controller is sensing.
7. Temperature overshoots or oscillates.	Process overpowered.	Compare "on time" to "off time." Short on time to off time indicates too much heater capacity for the process.	Reduce total heater power.
8. Process control temperature always above set point.	Thermocouple lead wires shorted between thermocouple and controller (in room ambient temperature).	Thermocouple lead wiring.	Repair or replace.

SECTION 6 SPECIFICATIONS

SUPPLY VOLTAGE:	115 VAC − 15% + 20%, 50/60 Hz
POWER CONSUMPTION:	2 VA
OUTPUT RELAY:	Model 6102: 7 A (see Figure 2-4 for 10 A wiring) Model 6103: 10 A Model 6132: 5A SPDT
CONTROL CALIBRATION ACCURACY:	±2% of scale span or 39°F (4°C), whichever is greater (from 10-90% of scale span).
LINEARITY-RESOLUTION:	Linearity 6%, resolution 1% max., of scale span (dependent on sensor/range).
CONTROL ACCURACY:	±0.4% of full scale span at an ambient of 72°F ±2°F (22°C ±2°C), at rated line voltage, after 30 minutes warm up.
CONTROL MODES	
TIME PROPORTIONAL:	Proportional with accelerated response to temperature variations.
THERMOCOUPLE:	J, K, and S
EXTERNAL RESISTANCE:	Max. 100 ohms
COLD JUNCTION COMPENSATION:	Automatic

SPECIFICATIONS (Cont'd)

COMMON MODE:	Negligible effect up to 270 VAC 50-60 Hz
SERIES MODE:	Negligible effect up to scale spread mV equivalent at 50-60 Hz.
SENSOR BURNOUT PROTECTION:	Automatic upscale
RTD SENSOR:	100 OHM Platinum, α = 0.00385
GENERAL INDICATION:	A high brightness LED—shows Heat ON.
AMBIENT TEMPERATURE:	32°-122°F (0°-50°C)
SUPPRESSION:	Filtering is provided for main power and sensor input interference.
DIMENSIONS:	H: 1.89" (48 mm) × W: 1.89" (48 mm) × D: 3.86" (98 mm), depending on model.
NET WEIGHT:	7 oz (200 g)
CONNECTIONS:	¼" (6.35 mm) standard terminal lugs or 11 pin connector.
CONSTRUCTION:	Flame-retardant polycarbonate and ABS. Bezel and knob coated with Nextel.

6.1 ACCESSORIES

Mounting track–3 foot section (Catalog No. 6000-TRK)

Replacement socket (Catalog No. 6102-SKT)

Refer to Figure 6-1.

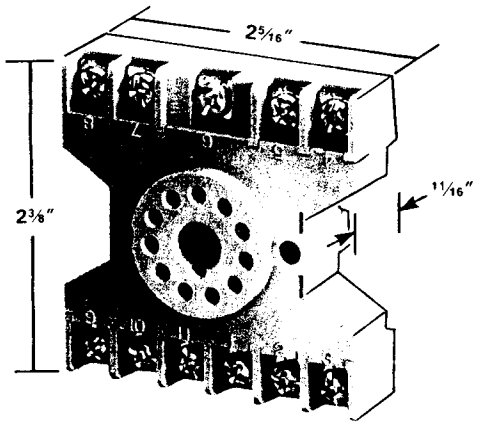


Figure 6-1. Socket for Controller

OMEGA ... Your Source for Process Measurement and Control

TEMPERATURE
- ☐ Thermocouple, RTD & Thermistor Probes & Assemblies
- ☐ Connector Systems and Panels
- ☐ Wire: Thermocouple, RTD and Thermistor
- ☐ Calibrators and Ice Point References
- ☐ Recorders, Controllers and Process Monitors
- ☐ Data Acquisition Modules and Data Loggers
- ☐ Computer Sensor Interface

FLOW
- ☐ Rotameters
- ☐ Flowmeter Systems
- ☐ Air Velocity Indicators
- ☐ Turbine/Paddlewheel Systems
- ☐ Vortex Meters and Flow Computers

PRESSURE/STRAIN
- ☐ Transducers
- ☐ Strain Gauges
- ☐ Load Cells
- ☐ Pressure Gauges
- ☐ Instrumentation

pH
- ☐ Electrodes
- ☐ Benchtop/Laboratory Meters
- ☐ Controllers
- ☐ Calibrators/Simulators
- ☐ Transmitters

OMEGA ENGINEERING, INC.
An OMEGA Technologies Company
One Omega Drive, Box 4047
Stamford, CT 06907-0047
(203)359-1660 Telex: 996404 Cable: OMEGA
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