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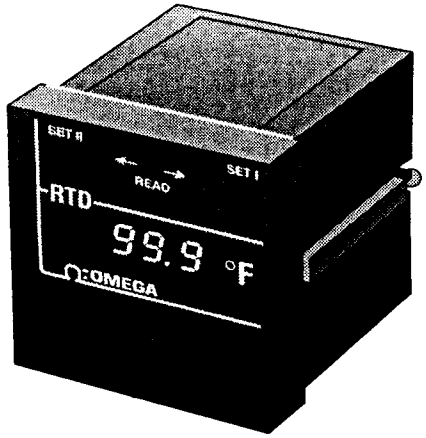
4200A Series, RTD
Temperature Controllers



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Operator's Manual
M0051/0793

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TABLE OF CONTENTS
4200A SERIES RTD
TEMPERATURE CONTROLLERS

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SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The OMEGA® 4200A Series RTD Temperature Controllers are quality built, linearized instruments which are available in both 1.0° and 0.1° resolutions in either °C or °F ranges. Higher accuracies, accuracies 5 to 10 times greater than the typical 1% meter indicating controller, are achieved through a unique linearizing technique. Accuracy is enhanced through three wire lead compensation—a feature allowing the sensor to be up to 1000 feet from the controller.

The standard unit includes adjustable proportional band, manual reset, plus a metal case with full plug-in construction allowing front removal of the control unit without disturbing the case and its rear wiring.

The 4200A Series RTD Controllers are available in single (Model 4201A) and dual (Model 4202A) set point models with relay output as standard. Triac or 4-20 mA optional outputs are available on the first set point.

The Model 4201A is a versatile digital controller which can be operated both as a proportional or on-off controller. Internal DIP switches allow selection of proportional cycle time or on-off control mode. The standard 4201A has an internal SPDT mechanical relay (7 amp resistive at 120 VAC). In addition plug in output modules allow optional Triac or 4-20 mA outputs in place of the relay (See paragraph 1-3).

The first set point of the Model 4202A incorporates the same features as the Model 4201A (including optional Triac or 4-20 mA output). The second set point may be set at any value within the full span of the controller. It energizes an SPDT internal relay (3 amp resistive 120 V ac) which can be used as either an on-off control, a high limit alarm, or a low limit alarm. For an alarm with latching features, an external latching relay and push button to reset are suggested.

The controllers are designed for use with 100 ohm platinum elements and probe assemblies (α = .00385). OMEGA offers a wide variety of RTD probes in the ***OMEGA Temperature Measurement Handbook.***

1.2 FEATURES

- Modular primary output
- High accuracy—to 0.1% of span
- Single and dual set points
- 1.0° and 0.1° resolution models
- Adjustable proportion band or on-off
- Bright LED display

1.3 AVAILABLE OPTIONS FOR MODELS 4201A AND 4202A

The basic unit without any suffixes includes time proportioning relay output, output lamp, proportioning band and manual reset adjustments, and digital temperature indication.

1.3.1 Option T—Triac Output

Option T replaces the relay output on the first set point only with a solid state plug-in Triac which yields time proportional, switching, for contactors or small heaters. The Triac is rated at 1 amp continuous and 10 amps in-rush for both (120/240 V ac service). For higher amperage loads the Triac may be used to drive higher rating solid state relays or mechanical contactors. Identified as Option T after the model number.

1.3.2 Option F — 4-20 mA Output

Option F includes 4-20 mAdc output signal, output lamp, proportional band and manual reset adjustments, and digital temperature indication.

This option is applicable to the first set point only and is used to drive proportioning devices such as SCR power controller, motor positioners or electropneumatic actuators. The 4-20 mA dc output signal can be connected to a maximum of 1000 ohm resistance load. This signal is 20 mA at the low temperature end of the proportional band and is decreased linearly through the band to 4 mA at the high temperature end. If the driven device is not isolated (ungrounded) an ungrounded thermocouple must be used with the 4200A Series which is designed for only one ground in the system. Identified as Option F after the model number.

1.3.3 Model 4202A

This unit includes on/off relay output, energized on temperature rise over second set point.

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 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 free from excessive shock, vibration, dirt, moisture, and oil. The ambient temperature should be between 30° and 130°F (−1° and 54°C).

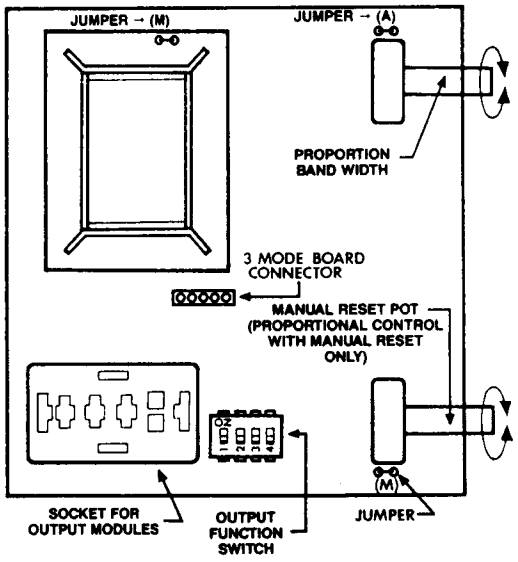
2.3 SETTING OUTPUT FUNCTION SWITCHES

There is a switch assembly on the bottom board (see Figure 2-1). This four-position switch regulates cycle time and output selection. It is factory-configured for the plug-in output ordered. Check the output function chart to make sure the configuration is correct for your application.

OUTPUT TYPE	CYCLE TIME (SECONDS)	SETTING
Relay, Triac and Pulsed DC	15	
	10	
	5	
Triac and Pulsed DC	1.5	
	1	
	.5	
4-20 mA ONLY	mAdc "F"	

OUTPUT MODE	
PROPORTIONAL	
ON/OFF	

(BOTTOM BOARD ILLUSTRATION)



NOTE:
- SWITCH NO. 4 IN "ON" POSITION IS FOR: "B" OR "T" OUTPUTS WHEN DRIVING MECHANICAL DEVICES, E.G., CONTACTORS
- SWITCH NO. 4 IN "OFF" POSITION IS FOR: "T", "F", OR "S" OUTPUTS WHEN DRIVING DEVICES THAT CAN WITHSTAND RAPID CYCLING, E.G. SOLID STATE DEVICES, SOLINOIDS, ETC.

Figure 2-1. Output Function Switch Chart

Reconfigured or field modified units should always be checked to insure that output switch positions are correct.

Switches 1 & 2:
These switches act together to select either proportional current output or one of the time proportioning cycle times. (See output function switch chart). Use longest times to get best relay life expectancy. If meter shows temperature swings following each "on" cycle, select a faster time to reduce "ripple".

Switch 3:
Selects either on/off or proportional action. On provides proportional action. Off provides on/off action.

Switch 4:
Selects output for either mechanical or solid state relays.
On: Provides slow proportional lines for mechanical relays.
Off: Provides 20 mAdc when used with the "F" module or fast time proportioning times when used with "T" modules.
NOTE: Switch 4 changes the cycle times in conjunction with switches 1 and 2. Check output function switch chart.

2.4 MOUNTING

Mount the controller into a 3⅝" (92 mm) square cutout. See Figure 2-2 for the cutout and case dimensions. The plug-in controller does not have to be removed from its housing for mounting.

Remove the two screws that hold the mounting slides; then remove the slides. Insert the case into the cutout from the front side of the panel and reinstall the two slides and two screws. The length of the slides must be reduced if the controller is to be mounted in an extra thick panel. If the controller has been unplugged from its housing, the top of the housing can be determined by the serial tag.

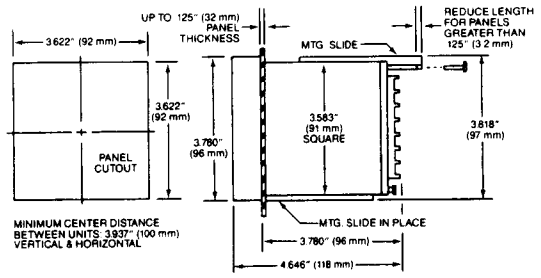


Figure 2-2. Outline Dimensions

2.5 WIRING POWER CIRCUIT

Consult the serial tag on the unit and select the proper wiring diagram for the model specified. Use the proper size wire rated for the load connected to the controller. A choice of screw terminals or 0.187" push-on type terminals is provided for user convenience.

The controller operates on either 120 or 240 V ac (+10%, −15%), 50 to 60 Hz line voltage when connected to the proper terminals. Incoming power lines should be properly fused.

NOTE

Fuse incoming high side of line with fast blow fuse of appropriate rating. Shorted heater or wiring will destroy the relay or output Triac. See Table 2-1.

TABLE 2-1
FUSE GUIDE

Type	Main Set Point 120 V ac	Main Set Point 240 V ac	Second Set Point Relay 120 V ac only
Standard (relay)	10 A	6 A	3A
Option T (Triac)	1 A Sub-cycle Current limiting type fuse (I^2T)		3A
Option F (4-20 mA output)	—	—	3A

2.5.1 Model 4201A (No Options) 120 V ac

Use Figure 2-3 for proper wiring. Shown for 840 W maximum 120 V ac heater (non-inductive load rating). For larger loads replace the heater with power contactor rated as required. The N.C. contacts can be used for cooling.

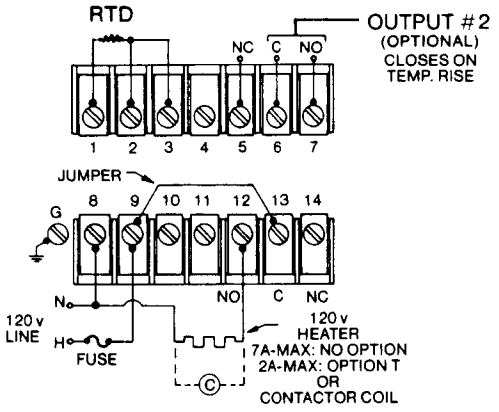


Figure 2-3. Wiring Diagram

2.5.2 Model 4201A (Option T) 120 V ac

Use Figure 2-3 for proper wiring. Wiring is the same as the 4201A (No Options, 120 V ac). Solid State N.O. contacts are provided, with 2 amp continuous current rating and 10 amp in-rush.

2.5.3 Model 4201A (No Options) 240 V ac

Use Figure 2-4 for proper wiring. Shown for 1200 W maximum 240 V ac heater (non-inductive load rating). For larger loads replace heater with power contactor rated as required.

2.5.4 Model 4201 (Option T) 240 V ac

Use Figure 2-4 for proper wiring. Wiring is the same as Model 4201A (No Options, 240 V ac). Solid State N.O. contacts are provided with 2 amp continuous current rating and 10 amp in-rush.

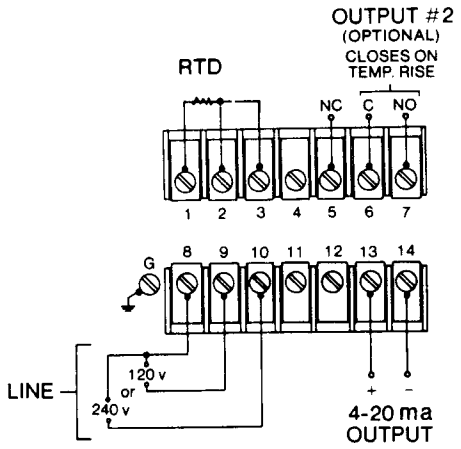


Figure 2-4. Wiring Diagram

2.5.5 Model 4202A (No Options and Option T)

The main set point operates the same as equivalent Model 4201A. The second set point is on-off. Wiring diagram is as follows:

a. Use Figure 2-3 for 120 V ac. Note that Output 2 is rated at 3 amps (non-inductive load rating).

b. Use Figure 2-4 for 240 V ac on the main set point. Note that Output 2 is rated for use with 120 V ac only at maximum 3 amps (non-inductive load rating).

2.5.6 Model 4201A (Option F) 120 and 240 V ac

SHOULD BE 2-4 TYPO

Use Figure 2-5 for proper wiring. 4-20 mA dc output can be connected to maximum 1000 ohms resistance load on device being proportioned, such as SCR power controller, motor positioner or electropneumatic actuator. If the controller is used with a device that does not have an isolated input, care must be taken to insure that there is not more than one ground in the system. An ungrounded RTD must be used if there is a ground in the circuit of the device connected to the 4200A (with Option F). Standard OMEGA RTD probes are ungrounded.

2.5.7 Model 4202A (Option F) 120 and 240 V ac

Use Figure 2-5 for proper wiring. The main set point operates the same as 4201A (Option F). Observe carefully the prescribed limitation covered in paragraph 2.5.6. The second set point is rated for 120 V ac use, only at maximum 3 amps (non-inductive load rating).

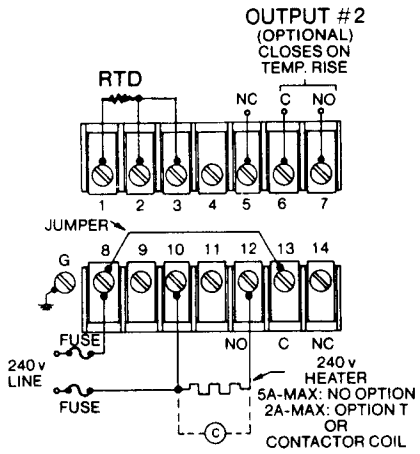


Figure 2-5. Wiring Diagram

2.6 WIRING RTD SENSOR CIRCUIT

For high accuracy, particularly where long lead wire runs are involved, a three wire RTD is recommended. The three lead wires should be copper and all legs essentially the same length. If any of the leads have an appreciably greater resistance than the others, it should be wired to Terminal 1. The size of the wire should be sufficiently large so that the resistance per leg does not exceed 10 ohms, (see Table 2-2).

TABLE 2-2
COPPER WIRE GAGE SELECTION

Wire Gage	Ohms/1000 ft
20	10.2
22	16.1
24	25.7
26	40.8

Two wire RTD's are connected to Terminals 1 and 2 with a jumper connected between Terminals 2 and 3. Keep leads short and use heavy gage copper lead wire, if necessary, to minimize lead resistance.

2.7 SENSOR PLACEMENT

Proper sensor placement is essential. It can eliminate many problems in the total system. The probe 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 probe should be placed close to the heater. In processes where the heat demand is variable, the probe should be close to the work area. Experimenting with probe location can often provide optimum results.

In a bath process, the addition of a stirrer will help to eliminate lags. Some RTD's are shock sensitive and require care in handling and installation.

SECTION 3 OPERATION

3.1 CONTROLS AND INDICATORS

Figure 3-1 and Table 3-1 illustrate and describe the controls and indicators on the 4200A Series Controllers.

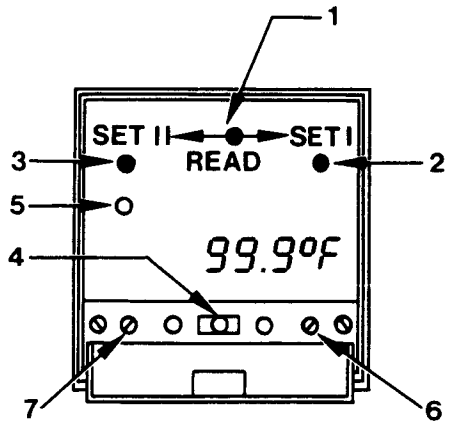


Figure 3-1. Controls and Indicators

TABLE 3-1
CONTROLS AND INDICATORS

ITEM	CONTROL OR INDICATOR	FUNCTION
1	Set point selector switch	When pushed to the right, the set point temperature on the Model 4201A and the first set point on the Model 4202A is shown on controller display. When pushed to the left, the second set point of the 4202A is displayed.
2	SET I knob	With the set point selector switch pushed to the right, the SET I is used to adjust the first set point temperature.
3	SET II knob	With the set point selector switch pushed to the left, the SET II is used to adjust the second set point temperature.
4 and 5	Output Lights (Set point 1 and 2	Lights are lit when the output circuitry has been actuated to apply power to the process.

6	Proportional band adjustment	Widens or narrows the band over which proportional action occurs. With this adjustment the controllers can be used as either proportional or on-off. (See Section 3.3.1.)
7	Manual reset adjustment	After the proportional band is set, the process temperature will stabilize at a point with a slight deviation from set temperature. This deviation can be corrected using the manual reset adjustment. (See Section 3.3.2.)

3.2 OPERATION

The typical control system contains the sensor, controller (4200A) and the process (load). The RTD sensor produces a small resistance change proportional to the measured temperature of the process. This is converted and linearized in a unique active bridge circuit, whose output voltage is amplified by the controller, where it is compared with 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 light. The digital meter displays the sensor's (process) temperature, and when switched to right or left, the primary or secondary control set points.

3.2.1 Model 4201A—Relay Output

The output relay has SPDT contacts rated 7 amps @ 120 V and 5 amps @ 240 V ac. These contacts can be wired to provide power to a heater within the above ratings. A contactor can be added to handle larger loads. Solenoids can be operated to control oil or gas heaters. Cooling processes can also be controlled by connecting the valve or solenoid to the N.C. (#14) terminal.

All standard models, as well as units with Option T, allow configuration for on-off or proportional control and selection of proportional cycle time by means of internal switches (see Sec. 2.3). In the proportional mode a bandwidth adjustment is provided which will reduce temperature overshoot and swings. The percentage of time that the relay is energized is varied by the controller to meet the thermal load requirements of the process.

3.2.2 Model 4201A — Option T Controller

The 4201A (Option T) is designed as a solid state output variation of the standard relay output controller. The time proportioning circuit, along with the proportional band and manual reset adjustments, work as before. The T model produces no arcing or contact bounce, and switches "off" at zero current. It is designed for millions of operations when operated within its current ratings, but will be instantly destroyed by a short in the load circuit, if I^2T fusing is not used.

3.2.3 Model 4202A — Second Set Point On-Off Relay Output

The Model 4202A provides a second full-scale individually adjusted control point and output.

With the set switch in the Set II position, any value of temperature within the span of the controller can be set and read on the digital display. The output relay will energize when the process temperature equals or exceeds the present value. The relay will de-energize within a small differential below the pre-set value. The relay is capable of controlling up to 3 amps @ 120 V ac resistive loads.

3.2.4 Model 4201A — Option F Current Output

The output of the 4200A F is a proportional 4 to 20 mA dc signal. Controller output is 20 mA at the low temperature end of the proportional band. Maximum load resistance is 1000 ohms.

3.3 ADJUSTMENTS

3.3.1 Proportional Band Adjustment

The proportional band adjustment widens or narrows the band over which proportional action occurs. Too narrow a band can cause the temperature to swing about the set point. This can be seen on the digital indicator. Too wide a band can cause error between the set point and the actual temperature (droop error) as measured at the sensor.

The proper setting of this adjustment is the point where temperature swings just stop. When adjusting the proportional band control, do so in small increments, allowing time between each adjustment for the process to stabilize.

Turning the adjustment in a clockwise direction widens the proportional band and should reduce swings to straight line control with most processes.

3.3.2 Manual Reset Adjustment

After the proportional band is set, the process temperature will stabilize at a point with a slight deviation from the set temperature. This offset is normal with single mode proportional controllers and can be corrected by adjusting the manual reset potentiometer. If the digital display indicates a stable temperature lower than the set temperature turn the reset potentiometer clockwise (+ direction) and wait until the process stabilizes. If the display indicates temperature higher than the set temperature, turn the reset potentiometer counterclockwise (– direction) and wait until the process stabilizes. These adjustments should be made in small increments. On processes with a large thermal mass, the time between a manual reset adjustment and stabilization at the new temperature may be minutes.

For applications requiring multiple setpoints over wide temperature spans, some automatic droop compensation can be achieved by cutting jumper "A". Refer to Figure 2-1.

NOTE

If close control cannot be obtained after carefully repeating the above procedures, check to see if the probe is in good contact with the heated process, and if the heaters are correctly sized for the application. Applications involving large changes in set point operating temperatures, or large load changes, will require readjustment of the proportional band and manual reset pots.

3.3.3 DEADBAND

An adjustable 0 to 5° deadband can be accessed by setting switch #3 to off and cutting the jumper next to the manual reset pot. The band can be adjusted using the proportional band adjustment. Refer to Figure 2-1.

SECTION 4 SERVICE INFORMATION

4.1 MAINTENANCE

Some simple preventative maintenance will keep the controller operating properly:

A. Keep the controller clean and protected from dirt, oil and corrosion. An optional dust cover is available for use in hostile environments.

B. Periodically recheck all electrical connections.

CAUTION

Since the front panel and the meter face are plastic, do not use solvents to clean them.

4.2 CALIBRATION PROCEDURE

Equipment required for calibration:

1. Equivalent resistance (Decade Box) for specified temperatures with resolution of 0.01 ohms
2. Digital Multimeter (optional)

The calibration procedure is as follows:

1. Remove the controller by opening flip-down door on the instrument and removing the two, pan-head screws behind it. (Controller should now slide out of case).
2. Detach the back panel by removing the six Phillips head screws and reconnect it to the controller (without the case); wire the panel as described in paragraph 2.4.
3. Energize the controller by applying the specified input voltage (110 V ac or 220 V ac) and allowing the instrument to warm up for 2 to 3 minutes.
4. With the setup illustrated in Figure 4-1 and set point selector switch in the center position, apply the resistances shown in Table 4-1 and 4-2 and make the necessary adjustments.
5. After making the adjustments, go back and recheck the zero and span, and readjust as necessary until there is no discrepancy.

TABLE 4-1
ZERO OR NEGATIVE CALIBRATION

Range	Resistance	Adjust	Desired Reading
0 to 999°F	93.01 ohm	Zero Pot.	000
−199.9 to 199.9°F	50.67 ohm	Zero Pot.	−190.0
0 to 600°C	100.00 ohm	Zero Pot.	000
−199.9 to 199.9°C	22.71 ohm	Zero Pot.	−190.0

TABLE 4-2
SPAN CALIBRATION

Range	Resistance	Adjust	Desired Reading
0 to 999°F	293.24 ohm	Span Pot.	999
−199.9 to 199.9°F	133.86 ohm	Span Pot.	+190.0
0 to 600°C	313.65 ohm	Span Pot.	600
−199.9 to 199.9°C	172.16 ohm	Span Pot.	+190.0

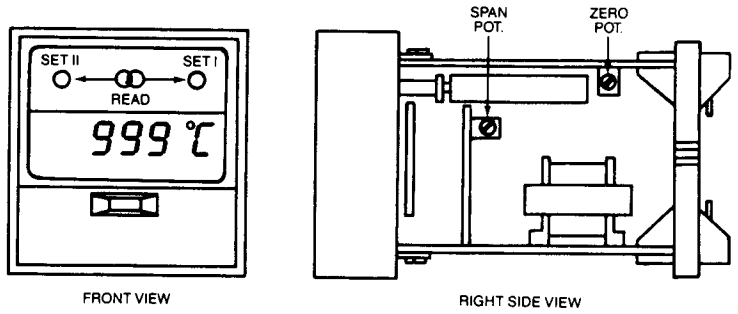


Figure 4-1. Calibration Setup and Adjustment Location

4.3 TROUBLESHOOTING GUIDE

The troubleshooting information in Table 4-3 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 4-3

TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
1. Controller is inactive. No output light, no digital display	No line voltage input	Check line voltage
	Blown heater	Replace heater
	Blown fuse	Replace fuse
	Open PC board backplate connector	Replace defective connector
	Open power transformer primary	Replace power transformer

TABLE 4-3 (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
2. No output, display reads ambient	Blown Triac	Replace Triac
	External backplate jumper missing (except with option F)	Install jumper
	Defective relay	Replace relay if contacts are worn or dirty
	Open heater, or circuit wiring	Replace open heater, correct defective wiring
3. No output	Open RTD	Replace RTD, correct defective wiring
4. Full output, no control	Three wire RTD connections reversed	Connect correctly
	Shorted Triac	Replace Triac
	Relay contacts welded closed	Replace relay

TABLE 4-3 (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
5. Process control temperature always above set point	RTD lead wires shorted between RTD and controller (in room ambient temperature)	Repair or replace
6. Controlled temperature differs from set point	Wrong type of RTD used for controller's range.	Install correct type of RTD
	High resistance wire being used as extension wire	Run proper wire between RTD and controller
7. Apparent control temperature differs from set point temperature when using a second measuring device (e.g., pyrometer)	Gradient error	Always measure temperature at same location as controller is sensing

TABLE 4-3 (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
8. Temperature overshoots or oscillates	Process overpowered	Reduce total heater power
	Band width too narrow	Widen band
9. Temperature stabilizes above or below set point	Manual reset adjusted incorrectly	Adjust (+) to increase controlled temperature, (−) to decrease controlled temperature (see paragraph 3.3.2).

Display Indications for Various RTD Problems

1. 1° Resolution Models
   a. Open RTD: One decimal point illuminated, no digits
   b. Reversed RTD: Digits displayed and one decimal point
   c. Overrange: Digits increment to 999 then recount with one decimal point displayed
2. 0.1° Resolution Models
   a. Open RTD: Digit "one" displayed only
   b. Reversed RTD: Minus (−) sign and digits displayed
   c. Overrange: Digit "one" displayed only

SECTION 5 SPECIFICATIONS

5.1 SPECIFICATIONS FOR 4200A SERIES CONTROLLERS

TYPE:	100 ohm platinum α = .00385 (DIN curve)
CONFIGURATION:	Three wire
EXTERNAL LEAD WIRE RESISTANCE EFFECT:	0.1% span up to 10 ohms per lead wire lag
SENSOR BREAK PROTECTION:	Built-in, upscale on open sensor
CALIBRATION ACCURACY:	1.0° resolution model, ±0.1% span ± 1 digit 0.1° resolution model, ±0.2% span ± 1 digit

COMMON MODE REJECTION:	Max. error +1°C with 240 V, 60 Hz applied as common mode signal between sensor and input chassis ground
SERIES MODE REJECTION:	Max. error ±1° with series mode signal of 100 mV peak-to-peak at 60 Hz

CONTROL OUTPUT FIRST SET POINT
(Adjustable time proportional or on-off)

RELAY (Standard Model):	SPDT relay 7 amps resistive at 120 V ac, 5 amps resistive at 240 V ac
OPTION T (Triac):	Solid state plug-in Triac rated 1 amp holding and 10 amps in-rush
OPTION F (Current Proportional):	4-20 mA (dc) into 1000 ohm max
SECOND SET POINT Relay (on-off only):	SPDT, rated 3 amps at 120 V ac

ADJUSTMENTS

PROPORTIONAL BAND (gain):	0-3% of span
MANUAL RESET (off-set):	Adjustable
CYCLE TIME:	Internally switch selectable for .5, 1, 1.5, 5, 10, or 15 seconds
ON/OFF DEADBAND:	0.25% of FS

DISPLAY AND INDICATIONS

TEMPERATURE:	Filtered LED, 3 or 3½ digits, 2 readings per second update. Readability is either 0.1° or 1.0° C or F, according to model
SET POINT:	By spring loaded switch, 1st or 2nd set point is displayed in place of temperature. Set point adjusted by 25 turn pot.; 0.1° or 1.0° C or F setability according to model.
OUTPUTS:	LED indication for both 1st and 2nd set points. LED's are "on" when output drive signal present. "On-off" indication on relay and Triac model. Proportional intensity for Option "F"
TEMPERATURE OVERRANGE:	Red LED indication
SET POINT RESOLUTION:	0.1° or 1.0°C or F according to model
REPEATABILITY:	±0.1% to ±0.2% of span
POWER:	120, 240 V ac (+10% −15%), 50 to 60 Hz. Power consumption less than 5 watts

ENVIRONMENTAL AND PHYSICAL

OPERATING TEMPERATURE:	30° to 130°F (−1° to 54°C)
WEIGHT:	2 lbs. (0.91 Kg)
1/4 DIN CASE:	Metal, full plug-in with screw terminal on rear. Adjustable brackets for mounting. Panel cutout is 3.622" vertical and horizontal dimensions
DIMENSIONS:	H: 3.7" (96 mm) × W: 3.7" (96 mm) × D: 4.6" (118 mm)

5.2 PARTS LIST

5.2.1 Amplifier Board

Description	Part Number
I.C.	UA714LHC
I.C	MC1741CP
I.C.	MC1741CP
Transistor	MPS A06
Relay	RC1V-3-DC24
Set point Pot	120-0071
Switch	MTMS-104G
Switch	7105-S-D9-AQ

5.2.2 DVM/Display Board

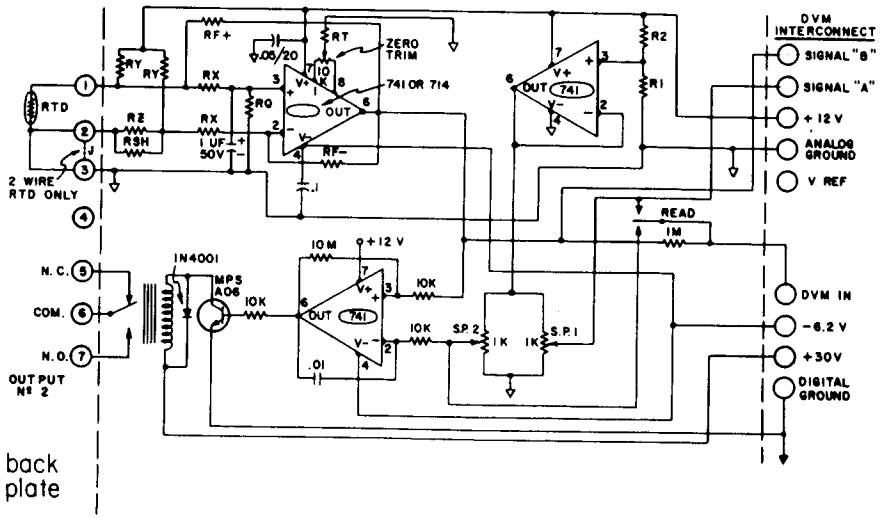
Description	Part Number
D.V.M Chip	ICL-7107CPL-7721
Transistor	MPS-A06
Transistor	MPS-4356
Regulator Transistor	UA78L05
Voltage Reference	MC1403AP1
Zener Diode	IN4735
Display	TIL312
LED-RED	FLV117

5.2.3 Output Board

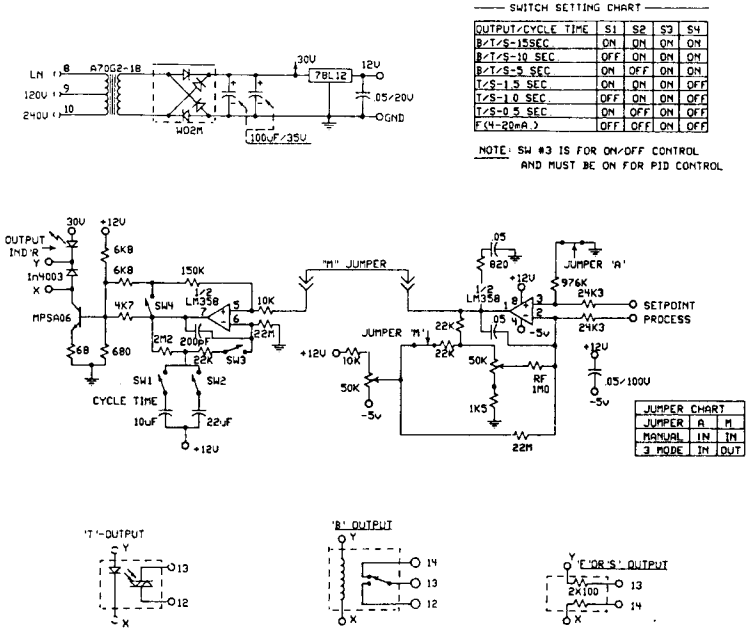
Description	Part Number
Transformer	A-70G2-18B
Bridge Rectifier	WO2M
Bridge Rectifier	VM48
Photo-SCR	H11C6
I.C.	MC1741CP
Regulator Transistor	78L12AWC
Transistor	MPSA06
Transistor	2N3053
LED-RED	FLV117
Relay	R
Triac	T
4-20 mA Module	4001-F

5.2.4 Miscellaneous Assemblies & Hardware

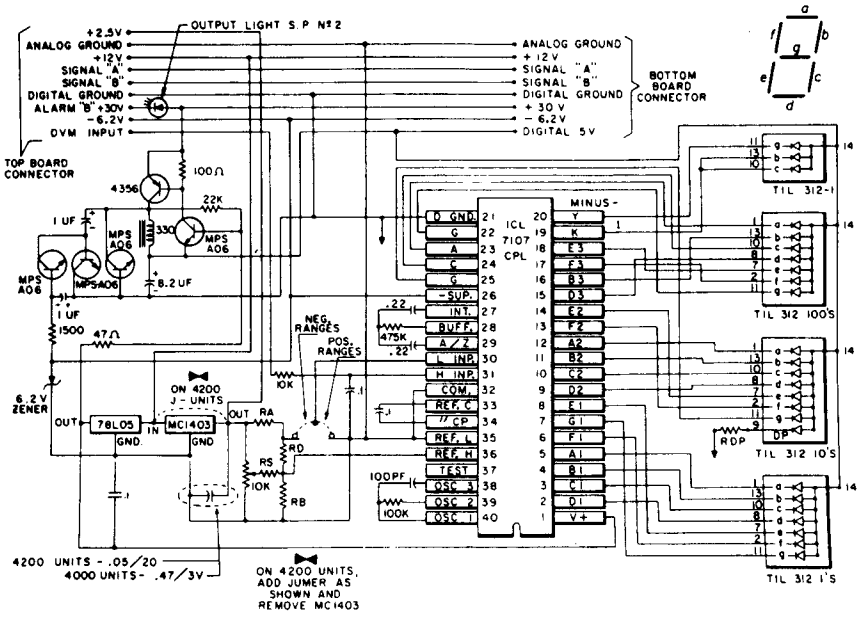
Description	Part Number
Red Filter Omega °F	N-158-A
Red Filter Omega °C	N-158-B
Backplate Assy. (Specify: Controller Output)	CA-03
Extrusion-Case; Length-3.093"	10812
Extrusion-Anchor; Length-2.718"	10800-B
Splash Cover	Option 15



Series 4200A Amplifier Board



4000A SERIES OUTPUT BOARD



Series 4200A Display Board