CT198-__ HEATERSTAT™ INSTRUCTIONS

GENERAL:

The CT198 Heaterstat is a sensorless DC temperature controller. It uses a high TCR (Temperature Coefficient of Resistance) heater to sense and control heat output - no separate sensor or thermostat required. The CT198 is more durable than a mechanical thermostat due to the solid state electronics, and has an adjustable setpoint which allows you to fine tune the control temperature for your application. All that is required for temperature control is a DC power source, a CT198 Heaterstat, and a matching heater.

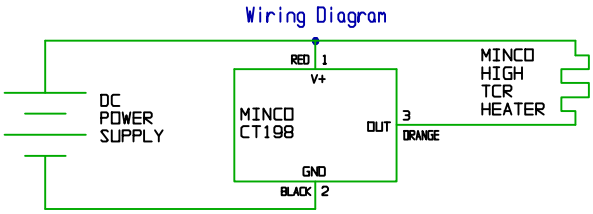


FIGURE 1

OPERATION:

Figure 2 shows the operation of the Heaterstat. Every 2 or 10 seconds, depending upon the model chosen, the heater is powered momentarily to check the element temperature. If temperature is above setpoint the Heaterstat turns off the power within 10 milliseconds. If the element temperature reads below setpoint, heater power stays on until the setpoint is reached. The Heaterstat then returns to the periodic scanning mode.

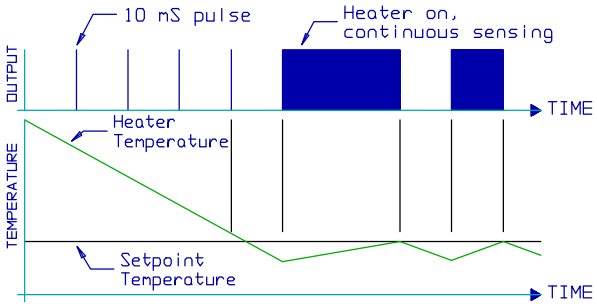


FIGURE 2

INSTALLATION:

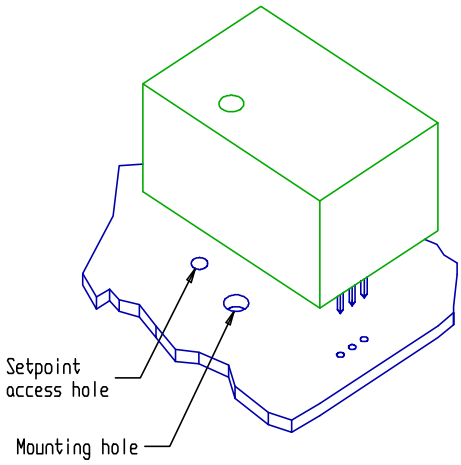
The CT198 is small enough to mount directly to printed circuit boards, and will withstand ordinary wave soldering and water washing. Test before washing with other chemicals.

If you intend to adjust the setpoint after installation you will need a hole in the board opposite the setpoint trimmer. Refer to the data sheet for recommended PCB layout. Secure the CT198 to the board through the mounting hole.

Several manufacturers (e.g. AMP and MOLEX) make a variety of .100" spaced connectors which mate with the controller's pins. Contact these or one of many other manufacturers for details.

The leadwire version of the CT198 does not require a circuit board. Install it using a #8 thread forming screw or a #6 screw through.

FIGURE 3



PCB Installation

HEATER MOUNTING:

Evaluation kits #1 and #2 are supplied with #10 pressure sensitive adhesive for easy installation. #10 PSA is suitable for flat or slightly curved surfaces and has a temperature limit of 100°C. To use PSA:

1. Remove the white (unmarked) backing paper. Be careful not to touch the adhesive.
2. Press the flat side of the heater onto the adhesive and rub it down.
3. Trim the excess adhesive.
4. Remove any dirt or oil from the mounting surface.
5. Carefully lift the marked backing paper and peel it away, leaving the adhesive on the heater.
6. Press the heater onto the mounting surface and rub it to remove any entrapped air.

Bulletin HS-201 and Application Aid #22 describe the complete range of options for heater mounting. Refer to them for custom designed heaters. For the best performance, always design for maximum contact between the heater and heat sink.

DESIGN NOTES:

The heaterstat has been designed to replace mechanical thermostats in some applications. Reliable low cost solid state efficient heating are the primary benefits of the CT198. Usually, precision control is not required, however it can be achieved in a well designed system. If your system requires precision control, then you must consider several other factors besides the simple calibration tolerances of the heater and the Heaterstat. Achieving tight control will require some experimentation and careful design.

First, it is important to remember that the CT198 controls the temperature of the heater element, not the heat sink. In most cases, you will control the heater at a temperature higher than your desired heat sink temperature. To understand why, consider a thermal system during warm-up. It's obvious that the temperature of the object being heated will lag behind the temperature of the heating element. This temperature difference is called a thermal gradient. Even after the system has stabilized, the heater element will be warmer than the heat sink. While this gradient can be minimized with Minco Thermofoil heaters, it can never be eliminated. Since the controller is controlling the temperature of the element, the heat sink will settle at a somewhat lower temperature.

In a stable system (i.e. constant thermal load and constant input power), this thermal gradient can be calibrated out by turning up the setpoint. In an unstable system, this gradient will vary with operating conditions, causing the heat sink temperature to go up and down even though the element is controlling at the right temperature.

How can you optimize control accuracy?

- Use the proper amount of heat. Excess wattage causes element temperature to reach setpoint very rapidly, which means that the heating takes place in short bursts and the heat sink never catches up to the heater. As a rule of thumb, try to size the heater so it runs 50% of the time in normal operation.
- Use a foil heater instead of wire unless you need transparency. The thermal gradient is inversely proportional to element coverage. Minco Thermofoil heaters have 50% element coverage.
- Maximize contact area of the heater. For example, wrap heaters around cylinders instead of mounting on one end.
- Make sure the heater element is in close contact with the object being heated, using thin, void-free adhesive layers.
- Stabilize the system by insulating the assembly from changes in ambient temperature.
- Stabilize the system by minimizing changes in input power. Use a regulated power supply.
- Stabilize the system by reducing changes in the thermal load.

CALIBRATION:

The CT198 has a single trimmer for temperature setpoint, factory calibrated to the resistance of your heater at the desired control temperature. Depending upon your application, you may not have to change the setpoint.

The accuracy of the setpoint, as received from the factory, depends to a large degree on the resistance tolerance of the heater. A typical allowance is ±10% for an etched-foil heater, ±2% for wire. Tighter tolerances will improve accuracy and interchangeability but at increased cost. When close calibration is essential, Minco can calibrate heaters and controllers in matched sets. In this case, it is important to connect the heater leads directly to the CT198 leads or pins or as close as practical. This will minimize errors due to extension leadwire or circuit traces.

The best calibration method is with the heater installed in the system as it will actually be used. Then, using a separate temperature meter and sensor in contact with the heat sink or heater, adjust the setpoint until the proper control temperature is achieved. This will compensate for typical thermal gradients, heater tolerances, and any circuit traces or extension leadwire to the heater. Since the setpoint is adjustable, ±20%, most errors can be calibrated out.

Alternatively, the heater may be placed in a temperature controlled bath (note that most standard heaters are not suitable for direct immersion in water). Use an ammeter as shown in Figure 4, and adjust the setpoint to the point where the heat just begins to cycle on and off.

A third method for calibration, is to simulate the heater's resistance at setpoint with a decade box or fixed resistor. This method may be difficult because of the precision resistance required while also dissipating power. Care must be taken to prevent the heat from shifting the resistance value.

Be sure to thoroughly test your prototype system under all operating conditions

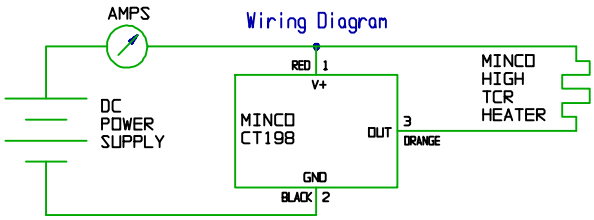


FIGURE 4

RELATED LITERATURE:

Bulletin CT198 provides ordering information and lists the general physical and electrical specifications for the Heaterstat.

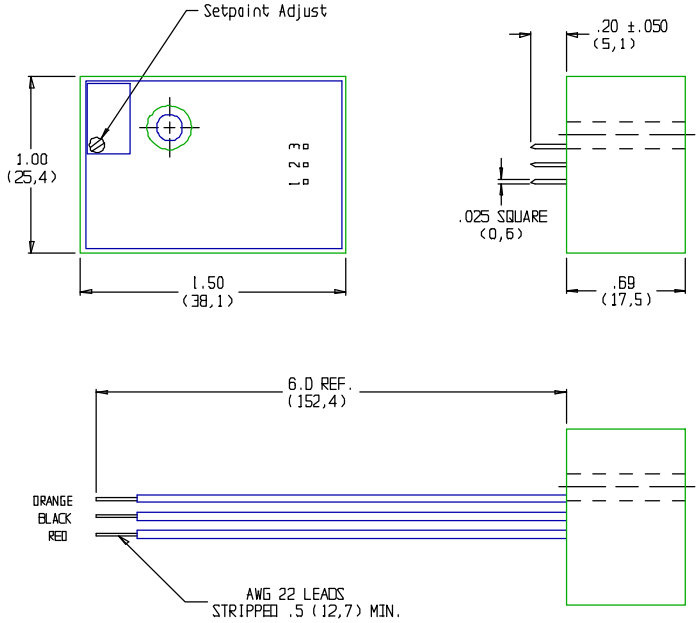
Bulletin HS-201 describes Thermofoil etched-foil heaters. Included are insulation comparisons, mounting methods, wattage ratings, standard models, and a custom design guide.

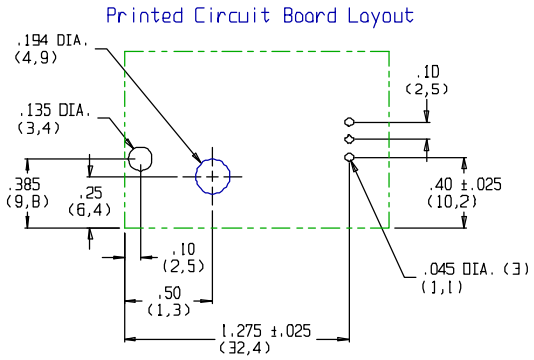
Bulletin HS-1 discusses Thermal-Clear transparent heaters.

Application Aid #21 presents simplified methods for estimating heater power requirements.

Application Aid #22 recommends adhesives for heater installation.

Bulletin TI-400 summarizes Minco's temperature instrument product line.





MODEL CT198-____ SPECIFICATIONS

Note: For your convenience, certain specifications have been converted to temperature using nominal values and placed in ( ).

CT198 HEATERSTAT™

Heater Data:
- Minco Model Number: _____
- Resistance: _____Ω ±_____% at _____°C
- Element: Copper / Nickel / Nickel-iron
- Nominal TCR: 0.00427 / 0.00570 / 0.00519 Ω/Ω/°C

Standard calibration:
- Setpoint: _____Ω (_____°C)
- CT198 accuracy: ±0.2% (±_____°C)
- Combined w/heater: ±_____% (±_____°C)

Calibrated matched sets (heater & controller):
- Setpoint: _____°C or _____°F
- System accuracy: ±_____°C or ±_____°F

Setpoint range: _____to_____Ω (_____to_____°C)

Hysteresis: 0.05% max. (_____°C)

Maximum Setpoint drift due to:
- Self-heating: ±_____% (±_____°C)
- Ambient temp.: ±_____%/°C (±_____°C/°C)
- Supply voltage: ±0.03%/volt (±_____°C/volt)

Ambient:
- Operating temperature: -40 to 70°C (-40 to 158°F)
- Storage temperature: -55 to 85°C (-67 to 185°F)
- Relative humidity: 90% max. continuous

Power supply: _____ VDC
- Supply voltage range: _____ to _____ VDC

Output:
- Nominal heater current: _____ Amps
- Minimum current for proper sensing: _____ Amps
- Maximum continuous current: _____ Amps
- Output ON resistance: _____ Ω
- Output OFF resistance: 50 KΩ

Scan rate, temp. above setpoint:
. . . . . Approximately_____ seconds

Scan pulse width: 10 milliseconds max.

Supply voltage ripple effects: Negligible, assuming 50/60 Hz, 10% max. ripple.

Controller supply current:
- Output ON: 3 mA max.
- Output OFF: 2 mA max. (<1 mA typ. @ 10 VDC)

Physical: ABS case, epoxy sealed for moisture resistance

Dimensions: 1.0 x 1.5 x 0.69"

Connections: Three .100" spaced pins or _____ inch leadwire

Weight: 1 ounce (30 g)

Mounting: Mounting hole for #6 screw through, or #8 thread forming screw.

When quality and performance are as important as price, call...

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