Heaterstat™ Sensorless DC Controller

No separate sensor or thermostat required

PCB mount

Leadwire version

ACTUAL SIZE

Overview

The Heaterstat takes temperature readings from heater models with a high temperature coefficient. You get accurate, efficient electronic control at prices comparable to thermostats.

• Use with Minco Thermal-Clear™ and select Thermofoil™ heaters

• Complete heating control system provides repeatable process control for worry-free and stable operation

• Solid state on-off control with adjustable set point offers greater durability than electro-mechanical devices

• Low power consumption — ideal for battery operated and vehicular devices

• The small PCB mount package and less wiring saves space to reduce the footprint of your device

• Mounting the Heaterstat separately allows the heater to be placed in tight spaces

• Available factory matched calibration option allows for easy plug-and-play operation

Operation

The diagram below shows how the Heaterstat works. It periodically powers the heater just long enough to check resistance. If heater temperature is above setpoint (left side of graph), power shuts off within 0.010 seconds.

If heater temperature is below setpoint, the Heaterstat leaves power on and continually reads resistance until element temperature reaches setpoint. It then shuts off and waits until time for the next pulse.

Scan rate, the off-time between pulses, is factory set from 0.1 to 10 seconds (1 second is standard). Faster scans provide tighter control while slower scans conserve power during idle times (a 0.010 second pulse every 10 seconds takes only 0.1% of full-on power).
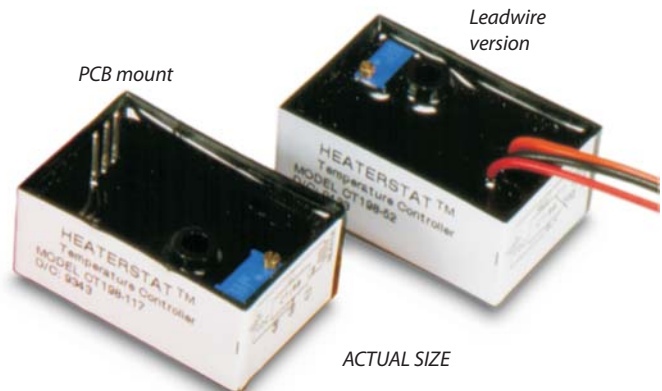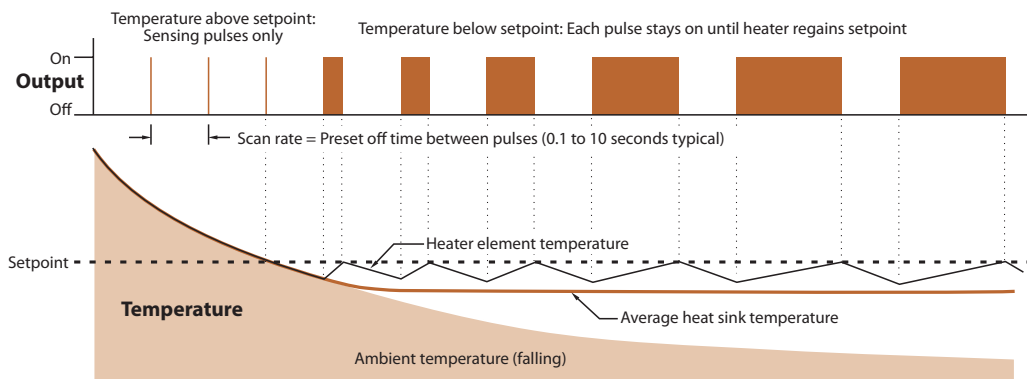
Applications

The Heaterstat's unique design makes it the ideal companion with Minco heaters to achieve precise thermal control. Here are some application ideas and examples:

• Improve performance of LCDs or other electronics in cold storage areas.

• Replace bulky, slow-responding thermostats.

• Regulate temperature of miniature or low-mass heaters in situations where a temperature sensor is impractical or will impede response.

• Protect portable medical devices from effects of cold.

• Maintain temperature of critical circuit board components, such as crystals.

• Independently control individual sections of large area heaters, using one Heaterstat per zone.

Temperature above setpoint: Sensing pulses only

Temperature below setpoint: Each pulse stays on until heater regains setpoint

On — **Output** — Off

Scan rate = Preset off time between pulses (0.1 to 10 seconds typical)

Setpoint

Temperature

Heater element temperature

Average heat sink temperature

Ambient temperature (falling)

Specifications subject to change

Specifications

Setpoint range: Nominal resistance ±20% min. Specify heater resistance to produce the necessary heat output in watts, given available voltage.

Connections: Three pins on 0.1" centers or AWG 22 wires.

Power supply voltage: 4.75 to 10 VDC or 7.5 to 60 VDC, depending on model. Ripple up to 10% has negligible effect; simple unregulated DC supplies are adequate for most applications.

Nominal heater current: 0.05 to 4 amps. See ranges below. Higher current possible with special models.

Nominal heater current	Minimum current for proper sensing	Maximum current (1 minute)	Output ON resistance in series with heater (pin 3 to 2)	Minimum output OFF resistance
CT198				
0.05 to 0.2 A	0.012 A	0.5 A	2.3 Ω	50K Ω
0.21 to 0.5	0.050	1.0	0.8	50K
0.51 to 1.5	0.125	2.0	0.5	50K
1.51 to 3.0	0.350	4.0	0.3	50K
2.50 to 4.0	1.0	5.0	0.25	50K

Scan rate (temperature above setpoint): 1 second standard. 0.1 seconds to 10 seconds optional.

Scan pulse width: 10 milliseconds.

LED indicator: Indicates heater power on. Optional on leadwire versions.

Calibration accuracy: ±0.2% std*. Note that standard resistance tolerance on heaters is ±10%.

Hysteresis: 0.05%*.

Setpoint drift due to:
Self-heating: ±0.2%* (±0.4% for 1.5 to 4 A range).
Ambient temperature: ±0.02%/°C* (±0.06%/°C for 1.5 to 4 A range).
Supply voltage change: ±0.03%/volt*.

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

Controller supply current:
Output ON: 3 mA max.
Output OFF: 2 mA max; 1 mA typical at 10 VDC.

Ambient temperature:
Operating: -40 to 70°C (-40 to 158°F).
Storage: -55 to 85°C (-67 to 185°F).

Relative humidity: 90% max.

Physical: Epoxy sealed for moisture resistance. Will withstand wave soldering and water/detergent wash; contact Minco before cleaning with other chemicals.

Weight: 1 ounce (28 g).

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

Heater: Wire-wound or etched-foil heater with high temperature coefficient of resistance (TCR).

Heater element	TCR (Ω/Ω/°C)
Copper foil or wire (Cu)	0.00427
Nickel foil (Ni)	0.00536
Nickel wire (Ni)	0.00672
Nickel-iron foil or wire (NiFe)	0.00519

* To convert resistance deviations to temperature:

$$\Delta T = \% \; deviation \left(T + \frac{1}{TCR} \right)$$

Where:
   TCR = Temperature coefficient of resistance (Ω/Ω/°C)
     T = Setpoint temperature (°C)
    ΔT = Temperature deviation (°C)

For example, assume a Heaterstat setpoint of 50°C, and heater TCR of 0.00536 Ω/Ω/°C (nickel foil). Calibration accuracy is ±0.2% of nominal resistance which translates to temperature as:

$$\Delta T = \pm\, 0.2\% \left(50°C + \frac{1}{0.00536} \right) = \pm\, 0.47°C$$

Specifications subject to change

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Standard models
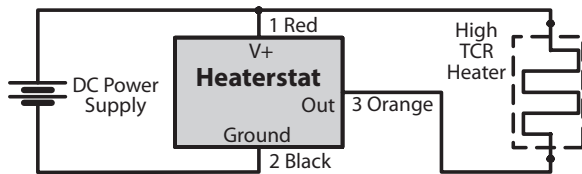
One second scan rate.

6" (150 mm) leadwires.

LED power indicator.

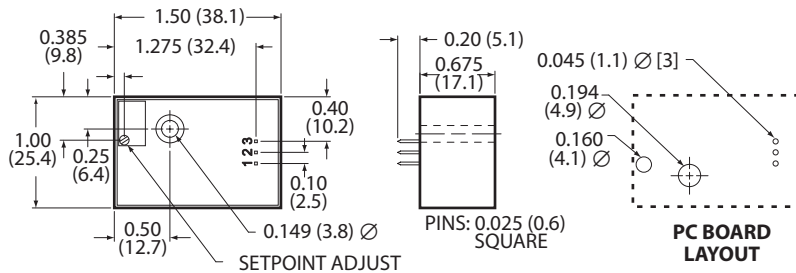Calibration: Setpoint factory-calibrated to specified resistance.

Model Number	Setpoint range (Ω)		Supply voltage (VDC)	
	Minimum	Maximum	Minimum	Maximum
CT198-1000	4.50	6.75	4.75	10
CT198-1001	5.63	8.44	7.5	16
CT198-1002	7.03	10.55	7.5	21
CT198-1003	8.79	13.18	7.5	26
CT198-1004	10.99	16.48	7.5	33
CT198-1005	13.73	20.60	7.5	41
CT198-1006	17.17	25.75	7.5	60
CT198-1007	21.46	32.19	7.5	60
CT198-1008	26.82	40.23	7.5	60
CT198-1009	33.53	50.29	7.5	60
CT198-1010	41.91	62.86	7.5	60
CT198-1011	52.39	78.58	7.5	60
CT198-1012	65.48	98.23	7.5	60
CT198-1013	81.85	122.78	7.5	60
CT198-1014	102.32	153.48	7.5	60
CT198-1015	127.90	191.85	7.5	60
CT198-1016	159.87	239.81	7.5	60
CT198-1017	199.84	299.76	7.5	60
CT198-1018	249.80	374.70	7.5	60
CT198-1019	312.25	468.38	7.5	60
CT198-1020	390.31	585.47	7.5	60
CT198-1021	487.89	731.84	9	60
CT198-1022	609.86	914.80	11	60

Specification options

CT198-1019	Model number CT198 = Heaterstat (nominal setpoint) CT698 = Heaterstat matched to heater
R	Setpoint calibration code R = Nominal heater resistance (CT198) T = Heaterstat/heater matched set (CT698)

365	Initial calibration setpoint
	Setpoint calibration code = R:
	    Nominal heater resistance at set point temperature (in ohms).* Must be within allowable range for specified model.
	Setpoint calibration code = T:
	    Temperature setpoint. Specify temperature and scale (°C or °F)
	    Ex: 120F represents 120°F

L	Leads L = Leadwires (standard) P = Pins (LED not available)
1	Scan rate 0.1 to 10 seconds (1 second standard)
CT198-1019R365L1 = Sample part number	

Wiring diagram

Dimensions in inches (mm)

Sensors, Controllers & Accessories

Heaterstat™ Sensorless DC Controller

Design considerations

Minco will be pleased to provide assistance with any of the design steps below.

Heater: A heater intended for use with a Heaterstat must have a temperature-sensitive element. All Thermal-Clear heaters meet this requirement, as do heaters with NiFe or NI foil.

Installation: The Heaterstat is small enough to mount directly to printed circuit boards and will withstand both wave soldering and water wash. Secure it to the board through the mounting hole. If you intend to adjust the setpoint after installation you will need a hole in the board opposite the setpoint trimmer. The leadwire version does not require a circuit board.

System accuracy: The Heaterstat, by its design, controls the temperature of the heater instead of the heat sink. The heater's element always runs hotter than the surface to which it is mounted. For best accuracy under changing ambient conditions, your design should attempt to either reduce this gradient or stabilize it to a predictable level. Some suggestions are:

• Use the proper amount of heat. Try to size the heater to run at least 50% of the time in normal operation and at no more than 5 W/in² (0.78 W/cm²).

• Maximize contact between the heater and heat sink.

• Stabilize the system. Maintain a fairly constant supply voltage and insulate the assembly from changes in ambient temperature.

• Specify standard 1-second scan rate or faster.

• Consider the CT325 miniature DC controller

Setpoint calibration: A Heaterstat is factory calibrated to the nominal resistance of the heater at the setpoint temperature. Standard heaters, however, have a resistance tolerance of ±10%, or >25°C. For best results we recommend you recalibrate your Heaterstat after installation. Simply adjust the setpoint until temperature settles at the desired value as verified by a digital thermometer such as the Minco TI142.

Where recalibration is impractical you can improve accuracy by ordering Heaterstats and heaters in matched sets. Minco can compensate for heater tolerance by calibrating the controller to the actual measured resistance of its mating heater rather than to the nominal resistance. The heater and controller will be marked with matching serial numbers. When ordering a Heaterstat for a matched set, specify model CT698 instead of CT198.

Evaluation kits

Test the concept and performance of Heaterstats before investing in a custom design. Each includes a controller and matching heater. You just supply electric power.

Evaluation kit #4

Contains H15227 Thermal-Clear transparent heater and CT198-4. **Order CT198-K4**.

Setpoint: Adjustable from -40 to 95°C.

Voltage: 4.75 to 10 VDC. 5 VDC nominal.

Watts: 1.7 W at 5 VDC and 50°C.

Heater dimensions: 0.75" × 4" (19 × 102 mm).

Scan rate: 10 seconds; LED indicator.

Evaluation kit #2

Contains HK15228 polyimide Thermofoil heater and CT198-2. **Order CT198-K2**.

Setpoint: Adjustable from 0 to 120°C.

Voltage: 7.5 to 38 VDC. 24 VDC nominal.

Watts: 40 W at 24 VDC and 80°C.

Heater dimensions: 2" × 4" (51 × 102 mm).

Scan rate: 1 second; LED indicator.

Miniature Heaterstat controllers

Minco can furnish SIP or DIP packages using remote digital setpoint adjustment.

CT281

CT288