

# Thermal-Clear™ Transparent Heaters

## Overview

Featuring a micro-thin wire heating element laid in a pattern between optical grade polyester sheets, Thermal-Clear™ heaters provide reliable heat without blocking light.

- Custom heater element routing and profiling optimizes the visual clarity of the LCD and prevents “shadowing”
- Tight resistance tolerance provides constant and repeatable wattage output for longer battery life
- Low mass and high watt density offers faster warm up time needed for immediate LCD response in cold weather operation
- Rugged materials prevent costly damage during installation and handling
- Integral temperature sensors optional
- Rectangular, round, or irregular shapes
- Uniform or profiled heat patterns

## Typical applications

- Cockpit displays
- Ruggedized computers
- Portable military radios
- Handheld terminals
- Outdoor card readers
- Portable and vehicular computers
- Camera lens deicing
- Defogging windows in environmental chambers
- Heating microscope stages

## Custom options

- Integral RTD or thermistor sensors
- Flex circuit terminations
- Rigid materials
- Custom shapes and sizes to 11" × 22" (280 x 560 mm)
- RoHS compliance
- Contact Access: Minco Sales and Support for design assistance

Configure Minco heaters and order online at:

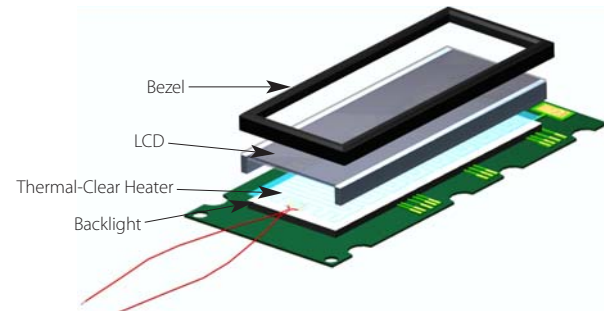
[www.minco.com/heater\\_config/](http://www.minco.com/heater_config/)



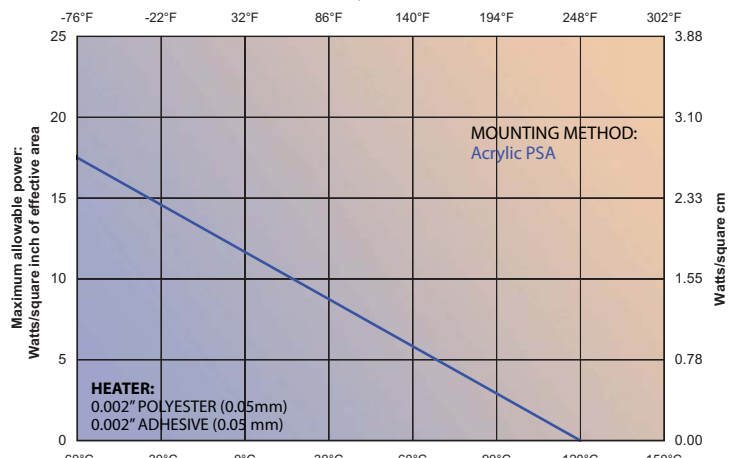
## Thermal-Clear heaters and LCDs

Most dot matrix LCDs lose sharpness and response speed below 0°C. Achieve acceptable performance at much colder temperatures with a Minco Thermal-Clear heater. 1-2 W/in<sup>2</sup> (0.16 - 0.31 W/cm<sup>2</sup>) will keep a typical LCD operating properly in ambients as low as -55°C.

Shown below is a typical installation on a backlit LCD. The heater is sandwiched between the backlight and the LCD. We recommend a light diffuser between the heater and LCD if there is no diffusion coating on the back of the LCD. Diffusion will soften and conceal shadows cast by the heating element.



## Thermal-Clear Heaters Maximum Watt Density



Example: At -20°C, the maximum power for a Thermal-Clear mounted with acrylic PSA is 14 W/in<sup>2</sup> (2.17 W/cm<sup>2</sup>).

Specifications subject to change



# Thermal-Clear™ Transparent Heaters

## Specifications

**Temperature range:** -55 to 120°C (-67 to 248°F).

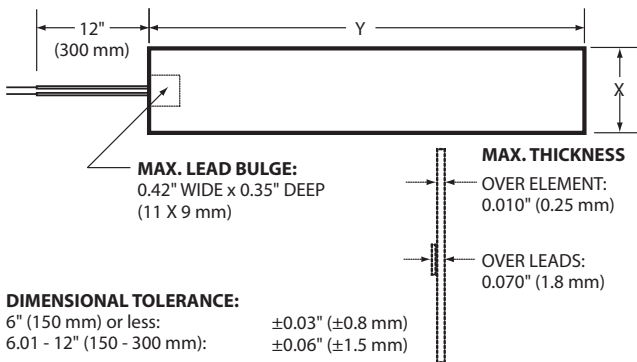
**Insulation:** Optical grade polyester is standard. Glass and polycarbonate materials are available on custom models.

**Transparency:** 82% minimum light transmission over the visible spectrum.

**Heating element:** Resistive wire, diameter 0.0008" to 0.002" (0.02 to 0.05 mm).

**Resistance tolerance:** ±10% or ±0.5 Ω, whichever is greater.

**Leadwires:** PTFE insulated wire is standard. Lead connections are welded and anchored between heater layers for strength. Special terminations are available on custom models.



## Heaterstat™ Sensorless Temperature Controller

Any Thermal-Clear heater will work with the CT198 Heaterstat™ Sensorless Temperature Controller, which directly regulates element temperature without requiring a separate sensor. See the "Sensors and Controllers" section for full specifications and compatibility.



## Specification options

H6700	Model number
R9.0	Heater resistance in ohms
L12	Lead length in inches 12" (305 mm) is standard
A	Heater backing option: A = No backing -55 to 120°C B = Acrylic PSA backing -55* to 120°C
H6700R9.0L12A = Sample part number	

\*Bonding strength deteriorates rapidly below -32°C. If the heater is not mechanically clamped, avoid excessive vibration and lead pull. Bonding strength recovers at temperatures above -32°C.

## Standard Thermal-Clear Heaters

Size (inches)		Size (mm)		Resistance options (at 0°C) in ohms*					Effective area in <sup>2</sup> (cm <sup>2</sup> )	Lead AWG	Model number
X	Y	X	Y								
0.58	2.20	14.6	55.9	3.6	9.0	32.5	89.4	1.26 (8.13)	30	H6700	
0.75	4.00	19.1	101.6	8.8	22.0	79.4	218	3.00 (19.35)	30	H6701	
0.90	2.00	22.9	50.8	4.8	12.0	43.3	119	1.80 (11.61)	30	H6702	
0.90	2.75	22.9	69.9	6.4	16.0	57.8	159	2.48 (16.00)	30	H6703	
0.90	5.75	22.9	146.0	14.1	35.0	126	348	5.18 (33.42)	30	H6704	
1.10	4.40	27.9	111.8	12.0	30.0	108	298	4.84 (31.23)	30	H6705	
1.20	2.75	30.5	69.9	8.0	20.0	72.2	199	3.30 (21.29)	30	H6706	
1.20	3.65	30.5	92.7	11.2	28.0	101	278	4.38 (28.26)	30	H6707	
2.90	5.75	73.7	146.0	9.6	24.0	86.6	238	16.70 (107.74)	30	H6708	
3.00	3.00	76.2	76.2	6.1	16.0	62.4	168	9.00 (58.06)	30	H6710	
4.00	5.00	101.6	127.0	11.8	31.2	122	327	20.00 (129.03)	30	H6711	
6.00	8.00	152.4	203.2	14.8	28.1	70.0	253	48.00 (309.68)	30	H6709	
1.25 diameter	31.8 diameter			4.3	11.2	43.5	117	1.23 (7.94)	30	H6712	
3.00 diameter	76.2 diameter			8.0	20.9	81.5	219	7.07 (45.61)	30	H6713	
Element wire type and diameter:				Copper	Copper	Copper	Nickel	Nickel-iron			
				0.0016"	0.0016"	0.001"	0.001"	0.001"			
Element TCR (Ω/Ω/°C):				0.04 mm	0.04 mm	0.03 mm	0.03 mm	0.03 mm			
				0.00427	0.00427	0.00427	0.00672	0.00519			

\*Resistance tolerance is ±10% or ±0.5 Ω, whichever is greater

Specifications subject to change