

# Thermal-Clear™ Transparent Heaters

Perfect for de-icing and de-fogging transparent materials

## 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

## Applications

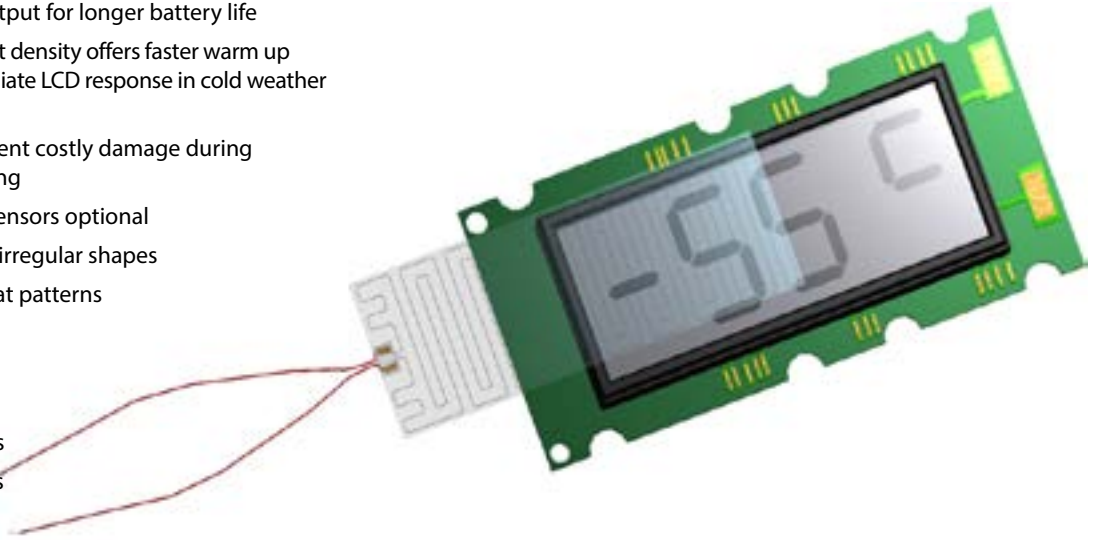
- Cockpit displays
- Ruggedized computers
- Portable military radios
- Handheld terminals
- Outdoor card readers
- Portable and vehicular computers
- Camera lens deicing
- Defogging windows in environmental chambers
- Heating microscope stages

## Custom options

- Integral RTD or thermistor sensors
- Flex circuit terminations
- Rigid materials
- Custom shapes and sizes to 11" x 22" (280 x 560 mm)
- RoHS compliance
- Contact Customer Service for design assistance

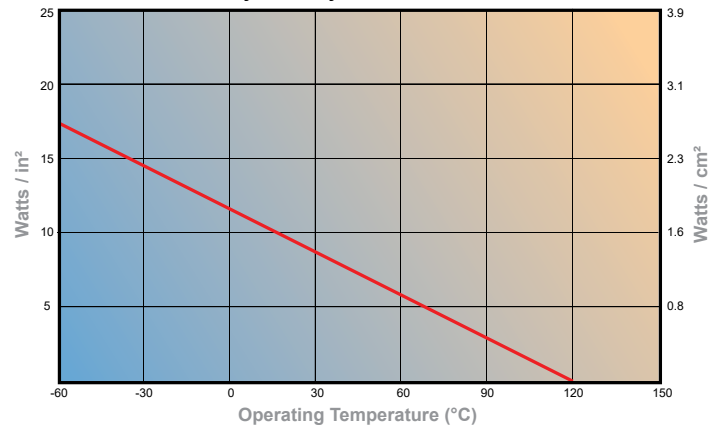
## Thermal-Clear heaters and LCDs

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 Ω/in<sup>2</sup> (0.16 - 0.31 Ω/cm<sup>2</sup>) will keep a typical LCD operating properly in ambients as low as -55°C.



**Thermal-Clear™ Heaters**  
Maximum Watt Density with Acrylic PSA

2mil/50µm Polyester  
2mil/50µm Adhesive



# Thermal-Clear Transparent Heaters

## Technical specifications

### Specifications

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

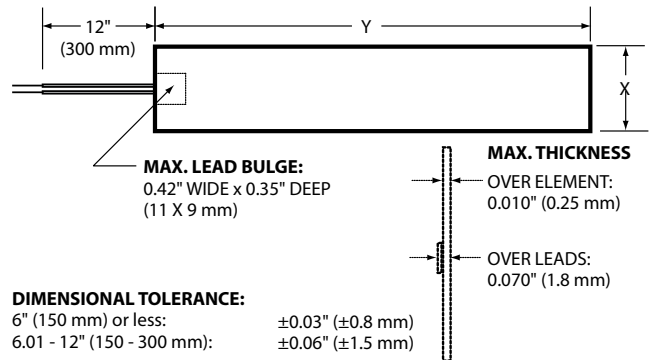
**Insulation:** Optical grade polyester is standard. Glass and polycarbonate materials are available on custom models.

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

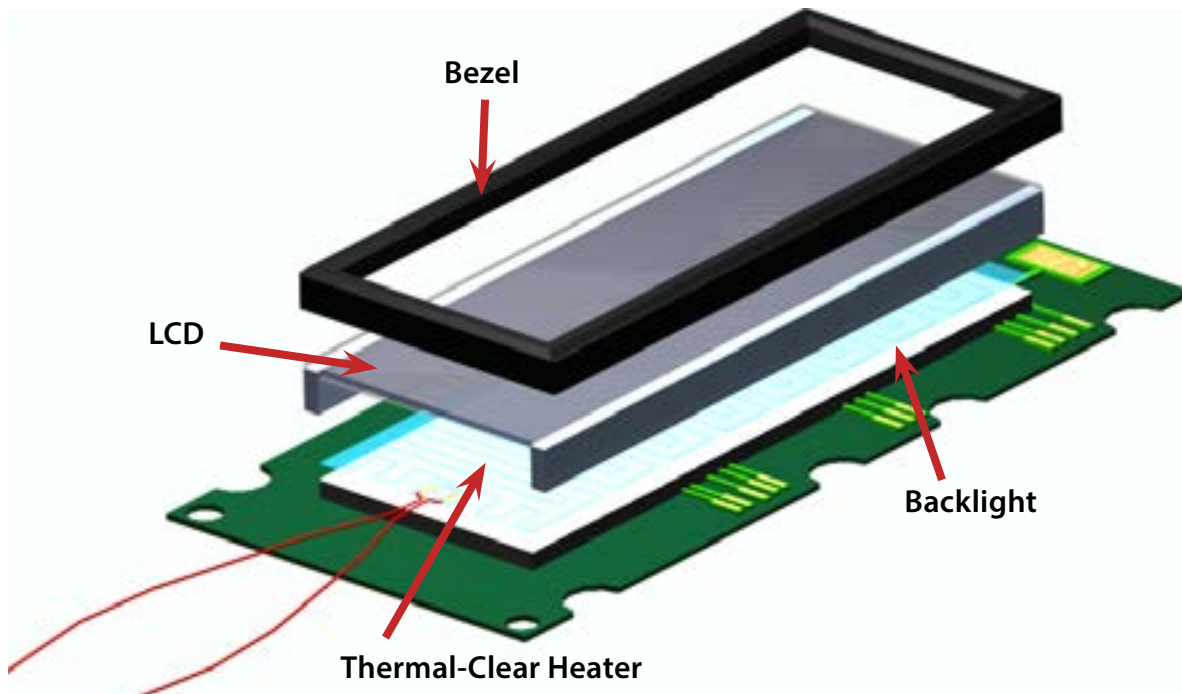
**Heating element:** Resistive wire, diameter 0.0008" to 0.002" (0.02 to 0.05 mm).

**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.



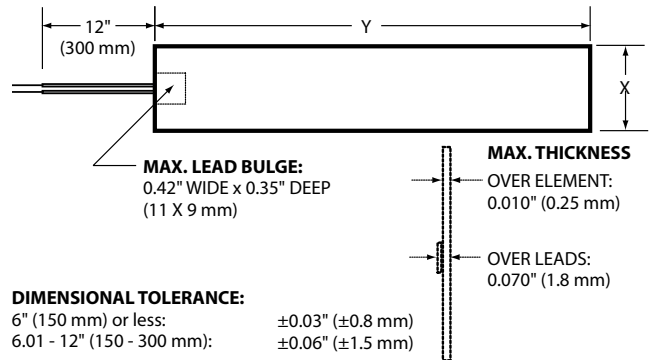
*Shown below is a typical installation on a backlit LCD. The heater is sandwiched between the backlight and the LCD. We recommend a light diffuser between the heater and LCD if there is no diffusion coating on the back of the LCD. Diffusion will soften and conceal shadows cast by the heating element.*



# Stock Thermal-Clear Transparent Heaters

## Notes for Stock Heaters

- Heated area is within the X and Y dimensions
- Resistance tolerance is +/- 10% or +/- 0.5Ω, whichever is greater
- Standard leadwire length is 12" (305mm) minimum
- Mounting: acrylic PSA applied on entire substrate area



Sized (inches)		Size (mm)		Type	Resistance (Ω)	Typical power		Effective area		Lead AWG	Model number
X	Y	X	Y			Watts	Volts	in <sup>2</sup>	cm <sup>2</sup>		
0.58	2.20	14.60	55.90	1	89.4	1.6	12	0.80	5.13	30	H6985
0.75	4.00	19.10	101.60	1	22.0	6.5	12	2.35	15.16	30	H6986
0.90	5.75	22.90	146.00	1	14.1	10.2	12	4.29	27.68	30	H6987
1.10	4.40	27.90	111.80	1	30.0	19.2	24	4.09	26.39	30	H6988
1.20	3.65	30.50	92.70	1	101.0	7.8	28	3.71	23.94	30	H6989
2.90	5.75	73.70	146.00	1	9.6	60.0	24	15.55	100.32	30	H6990
4.00	5.00	101.60	127.00	1	31.2	41.5	36	18.83	121.48	30	H6991
0.60	2.35	15.24	59.69	1	240.0	2.4	24	0.95	6.13	30	H6992
0.60	2.85	15.24	72.39	1	192.0	3.0	24	1.19	7.68	30	H6993
1.00	3.35	25.40	85.09	1	96.0	6.0	24	2.62	16.90	30	H6994