Enclosure Heating and Heater Selection

Why Heat an Enclosure?

Today's miniaturization of enclosure components results in high packing densities, which in turn results in higher temperatures within the enclosure. These high temperatures are harmful to electronic components. In response, cooling systems have become standard in many applications. However, just as critical and widely underestimated, are failures caused by the formation of moisture.

Under certain climatic conditions, moisture can build up not only in outdoor or poorly insulated enclosures, but also in highly protected and well-sealed enclosures.

Moisture and Failure

Moisture, especially when combined with aggressive gases and dust, causes atmospheric corrosion and can result in the failure of components such as circuit breakers, busbars, relays, integrated circuit boards and transformers. The greatest danger lies in conditions where electronic equipment is exposed to relatively high air humidity or extreme variations in temperature, such as day-and-night operation or outdoor installation. Failure of components in such cases is usually caused by changing contact resistances, flashovers, creepage currents or reduced insulation properties.

Eliminate Moisture

Moisture and corrosion will remain low if relative air humidity stays below 60%. However, relative humidity above 65% will significantly increase moisture and corrosion problems. This can be prevented by keeping the environment inside an enclosure at a temperature as little as 9°F (5°C) higher than that of the ambient air. Constant temperatures are a necessity to guarantee optimal operating conditions. Continuous temperature changes not only create condensation but they reduce the life expectancy of electronic components significantly. Electronic components can be protected by cooling during the day and heating at night.

Thermal Management

Modern enclosure heaters are designed to protect against condensation. They heat the air inside enclosures, preventing water vapor from condensing on components while providing the greatest possible air circulation and low energy consumption.

Other heating element technology improvements include:

- Longer operating life
- Greater energy efficiencies
- Quick wiring options
- Easier mounting
- Fan heaters should be considered for larger enclosures to ensure that the entire enclosure is heated uniformly

Heater Location

Ideally, most heaters will perform optimally when mounted near the bottom of an enclosure and used in conjunction with a control device, thermostat, and/or hygrostat. The control device may be a separate device, or it may be integral to the heater. With the controller located in an area of the cabinet that is representative of the average temperature or humidity requirement, the heater should then be placed in a position near the bottom of the enclosure. If a separate control device is used, the heater should not be located directly beneath the controller to ensure that the controller is not influenced by direct heat from the heater.

Heater Calculation

Follow Steps 1-5 to determine the heating requirement of an enclosure (US units - left column, metric - right)

STEP 1: Determine the Surface Area (A) of your enclosure which is exposed to open air.

Enclosure Dimensions:

height =_____feet _____meters

width =_____feet _____meters

depth =_____feet _____meters

Choose Mounting Option from next page, and calculate the surface area as indicated

A = _____ ft2 or _____ m2

STEP 2: Choose the Heat Transmission Coefficient (k) for your enclosure's material of construction.

painted steel = 0.511 W/(ft2K) 5.5 W/(m2K)

stainless steel = 0.344 W/(ft2K) 3.7 W/(m2K)

aluminum = 1.115 W/(ft2K) 12 W/(m2K)

plastic or insulatedstainless = 0.325 W/(ft2K) 3.5 W/(m2K)

k = _____W/(ft2K) or _____ W/(m2K)

STEP 3: Determine the Temperature Differential (ΔT).

A. Desired enclosure interior temp. = ___oF ___oC

B. Lowest ambient (outside) temp. = ___oF ___oC

Subtract B from A = Temp. diff. (ΔT) = ___oF ___oC

For these calculations, ΔT must be in° Kelvin (K). Therefore, divide ΔT (oF) by 1.8. ΔT = _____ K

STEP 4: Determine Heating Power (PV), if any (generated from existing components, i.e. transformer).

PV = _____ W or _____ W

STEP 5: Calculate the Required Heating Power (PH) for your enclosure based on the above values.

If enclosure is located inside:

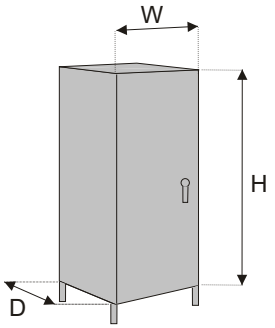
PH = (A x k x ΔT) - PV = _____ W

If enclosure is located outside:

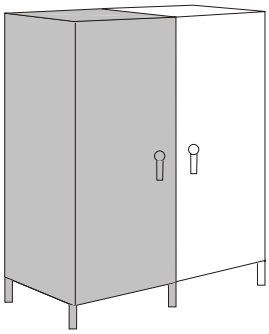
PH = 2 x (A x k x ΔT) - PV = _____ W

Enclosure Mounting Types and Surface Area Calculations

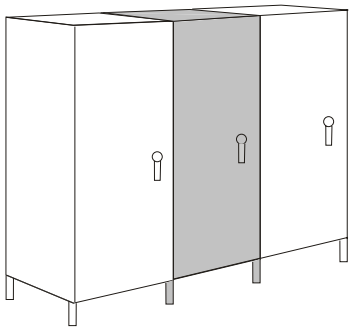
1. Free-Standing



Area (A) =1.8ft³ [0.05m³] (H x W) + 1.8 (H x D) +1.8ft³ [0.05m³] (W x D)

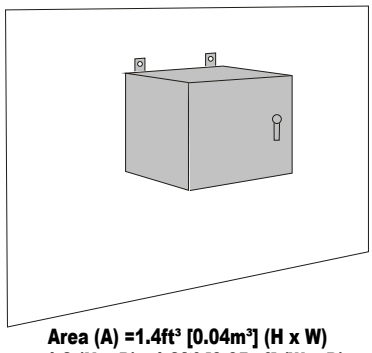


Area (A) =1.8ft³ [0.05m³] (H x W) + 1.4 (H x D) +1.8ft³ [0.05m³] (W x D)

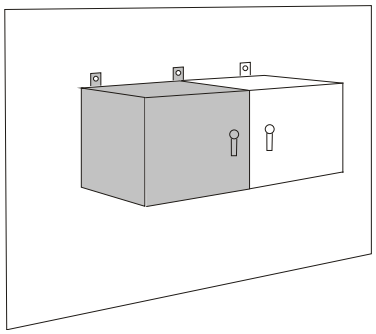


Area (A) =1.8ft³ [0.05m³] (H x W) + (H x D) +1.8ft³ [0.05m³] (W x D)

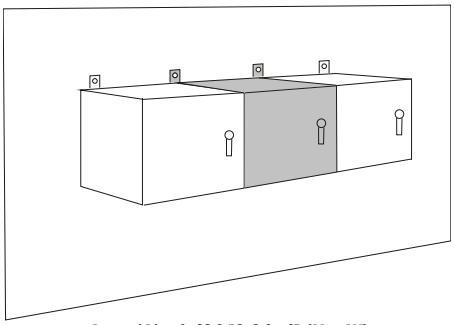
2. Wall-Mounted



Area (A) =1.4ft³ [0.04m³] (H x W) + 1.8 (H x D) +1.8ft³ [0.05m³] (W x D)

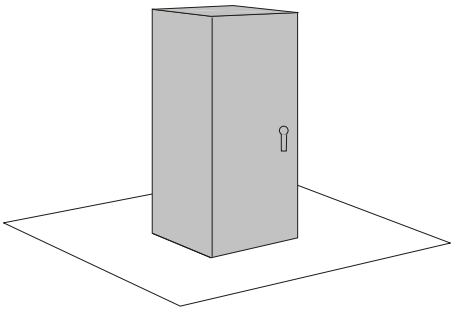


Area (A) =1.4ft³ [0.04m³] (H x W) + 1.4 (H x D) +1.8ft³ [0.05m³] (W x D)

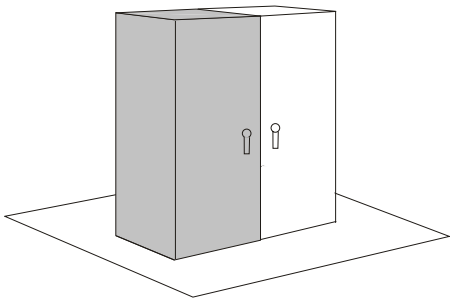


Area (A) =1.4ft³ [0.04m³] (H x W) + (H x D) +1.8ft³ [0.05m³] (W x D)

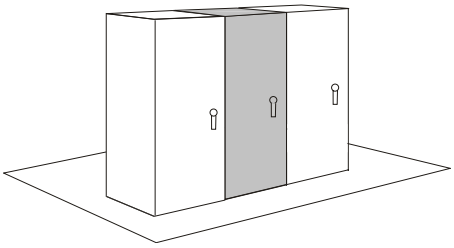
3. Ground



Area (A) =1.8ft³ [0.05m³] (H x W) + 1.8 (H x D) +1.4ft³ [0.04m³] (W x D)

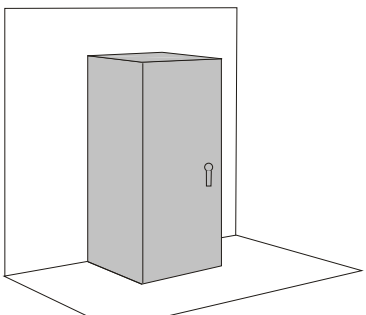


Area (A) =1.8ft³ [0.05m³] (H x W) + 1.4 (H x D) +1.4ft³ [0.04m³] (W x D)

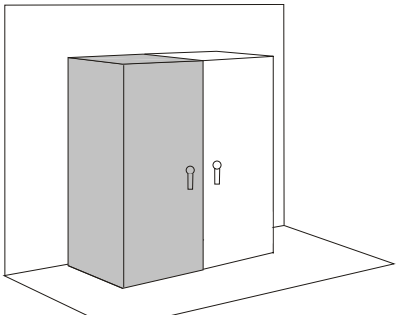


Area (A) =1.8ft³ [0.05m³] (H x W) + (H x D) +1.4ft³ [0.04m³] (W x D)

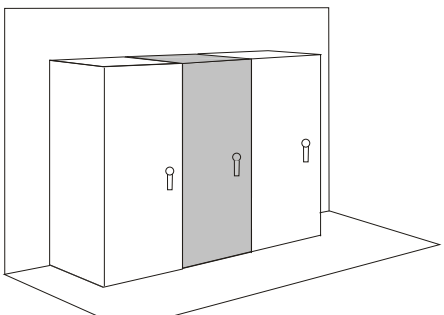
4. Ground and Wall



Area (A) =1.4ft³ [0.04m³] (H x W) + 1.8 (H x D) +1.4ft³ [0.04m³] (W x D)



Area (A) =1.4ft³ [0.04m³] (H x W) + 1.4 (H x D) +1.4ft³ [0.04m³] (W x D)



Area (A) =1.4ft³ [0.04m³] (H x W) + (H x D) +1.4ft³ [0.04m³] (W x D)

550W to 650W PTC Fan Heaters

Applications

These semiconductor positive temperature coefficient fan heaters prevent the formation of condensation and ensure an even temperature in enclosures. The integrated thermostat is used to set the desired temperature while the high performance axial fan provides forced air circulation.

Features

- Compact fan heater
- Heating power adjusts to ambient temperature
- Integrated adjustable thermostat
- Built-in overheat protection
- DIN rail mountable

550W to 650W PTC Fan Heaters Specifications	
Heating Element	PTC Resistor - Temperature limiting
Overheat Protection	Built-in temperature limiter
Axial Fan, Ball Bearing	Service life 50,000h at 77°F [25°C]
Connection	2-pole terminal 14 AWG [2.5 mm²], max. solid wire or stranded wire with wire end ferrules, 0.8 N·m max.clamping torque
Housing	Plastic, UL 94V-0, light gray
Function Control Light	LED
Mounting	Clip for 35mm DIN rail, EN 60715
Mounting Position	Vertical (exhaust up)
Recommended Mounting Distance	Sides: 0.79in [20 mm] Bottom/above: 3.94in [100 mm]
Operating / Storage Temperature	-49 to 158°F [-45 to 70°C]
Protection Class	II (double insulated)
Protection Type	IP20
Approvals	CE, UL Recognized File No. E204590, RoHS 2 compliant

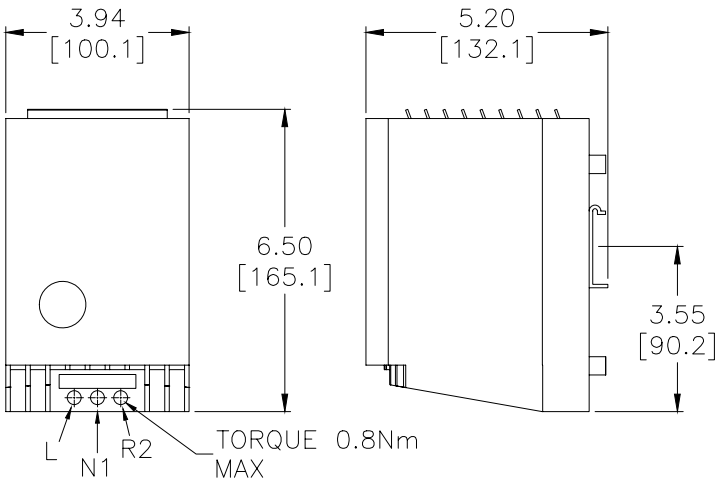
Note: To obtain the most current agency approval information, see the Agency Approval Checklist section on the specific part number's web page at www.automationdirect.com

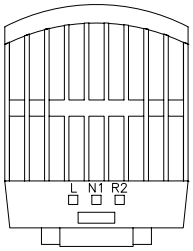
550W to 650W PTC Fan Heaters							
Part Number	***Price***	***Heating capacity[1] (@ 60 Hz)***	***Operating Voltage (Min/Max)***	***Max. current (inrush)***	***Air flow,free blowing***	***ThermostatRange[2]***	***Weight (approx.)***
027009-00	$198.00	550W	100-120V AC, 50/60 Hz	14.0 A	20 cfm [35 m3/h]	32 to 140°F	2.0 lb [907g]
027009-01	$198.00					0 to 60°C	
027000-00	$198.00		220-240V AC, 50/60 Hz	11.0 A		0 to 60°C	
027019-01	$221.00	650W	100-120V AC, 50/60 Hz	15.0 A	26 cfm [45 m3/h]	0 to 60°C	2.4 lb [1089g]
027010-00	$221.00		220-240V AC, 50/60 Hz	13.0 A		0 to 60°C	
027019-00	$221.00		100-120V AC, 50/60 Hz	15.0 A		32 to 140°F	

Notes: [1] At 68°F [20°C] ambient temperature
[2] Switch difference 12.6 °F ±7°F [7K ±4K]

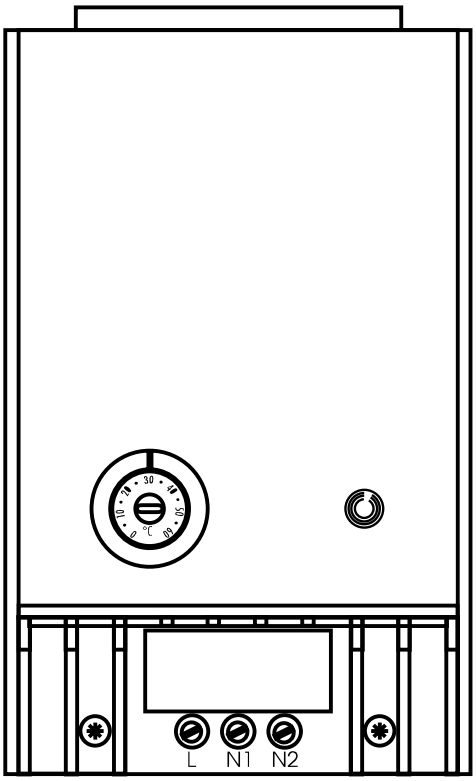
550W to 650W PTC Fan Heaters

Dimensions





Wiring Diagram



Notes: Only connect the L and N1 terminals – N2 is not used and Grounding is not required.
When wiring 230 volt units for North American installations “L” (line) and “N” (neutral) will be used as”L1” (line1) “L2” (line2) respectively with no neutral connection.

150W to 450W Touch-Safe PTC Fan Heaters

Panel Mount Fan Heaters

Applications

These fan heaters are designed to prevent the formation of condensation and ensure an evenly distributed interior air temperature in enclosures. The heater is connected using the internal terminal connectors. The desired temperature can be set and maintained by an external thermostat (available separately) and the high-performance axial fan provides forced air circulation. The heater design minimizes side surface temperatures of the housing. The small size of these heaters makes them ideal for use in enclosures where space is at a premium.

Features

- Compact fan heater
- Quiet operation
- Heating power adjusts to ambient temperature
- Models available that are both DIN rail mountable as well as panel mounted

DIN Mount Fan Heaters

150W to 450W Touch-Safe PTC Fan Heaters Specifications		
Heating Element	***DIN Mount***	***Panel Mount***
	PTC Resistor - Temperature limiting	
Axial Fan,Ball Bearing	Service life 40,000h at 104°F [40°C]	
Connection	2-pole terminal 14 AWG [2.5mm], max. solid wire or stranded wire with wire end ferrule, 0.8 N·m max. clamping torque	
Housing	Plastic, UL 94V-0, black	
Mounting	Clip for 35mm DIN rail, EN 60715	Screw mount
Mounting Position	Vertical (exhaust up)	
Recommended Mounting Distance	Sides: 0.79in [20 mm] Bottom/above: 3.94in [100 mm]	
Operating / Storage Temperature	-49 to 158°F [-45 to 70°C]	
Operating / Storage Humidity	Max. 90% RH (non-condensing)	
Protection Class	II (double insulated)	
Protection Type	IP20	
Approvals	CE, UL Recognized File No. E234324, RoHS 2 compliant	

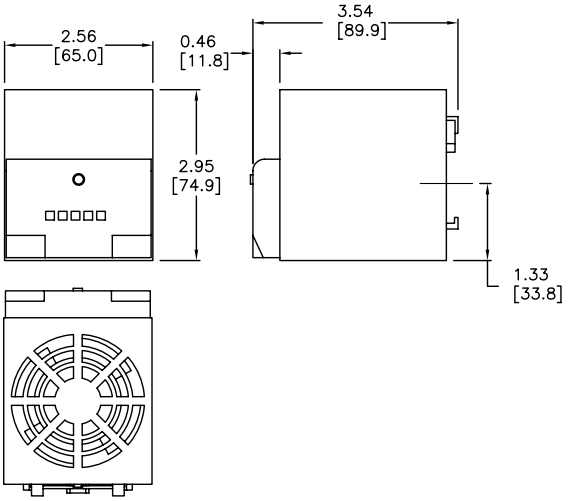
Note: To obtain the most current agency approval information, see the Agency Approval Checklist section on the specific part number's web page at www.automationdirect.com

150W to 450W Touch-Safe PTC Fan Heaters								
Part Number DIN Mount	***Price***	***Part Number Panel Mount***	***Price***	***Heating Capacity[1]***	***Operating Voltage***	***Max. current (inrush)***	***Air flow,free blowing***	***Weight (approx.)***
028009-00	$119.00	***028009-01***	$119.00	150W	120V AC, 50/60 Hz	6.0 A	8 cfm [13.8 m³/h]	10.6 oz [301g]
028000-00	$119.00	***028000-01***	$119.00		230V AC, 50/60 Hz	12.0 A		
028119-00	$137.00	***028119-01***	$137.00	250W	120V AC, 50/60 Hz	6.0 A	32 cfm [54 m³/h]	17.6 oz [499g]
028110-00	$137.00	***028110-01***	$137.00		230V AC, 50/60 Hz	9.0 A	26 cfm [45 m³/h]	
028109-00	$151.00	***028109-01***	$151.00	400W	120V AC, 50/60 Hz	9.0 A	32 cfm [54 m³/h]	
028100-00	$151.00	***028100-01***	$151.00		230V AC, 50/60 Hz	15.0 A	26 cfm [45 m³/h]	
Note: [1]At 68°F [20°C] ambient temperature @ 60Hz								

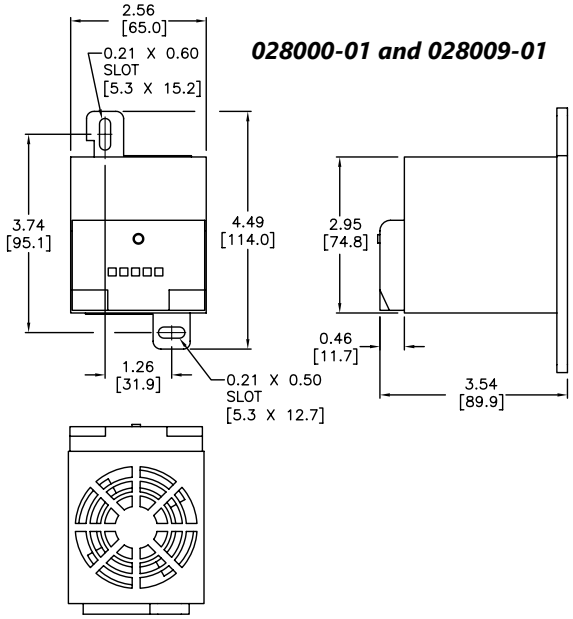
150W to 450W Touch-Safe PTC Fan Heaters

Dimensions

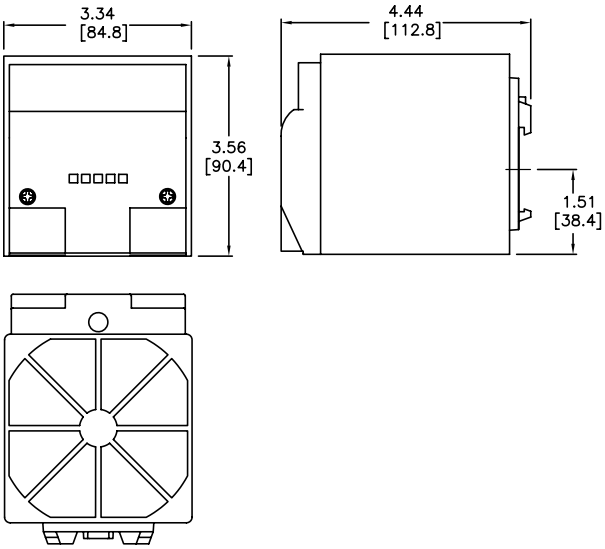
028000-00 and 028009-00



028000-01 and 028009-01



028100-00, 028109-00, 028110-00, 028119-00



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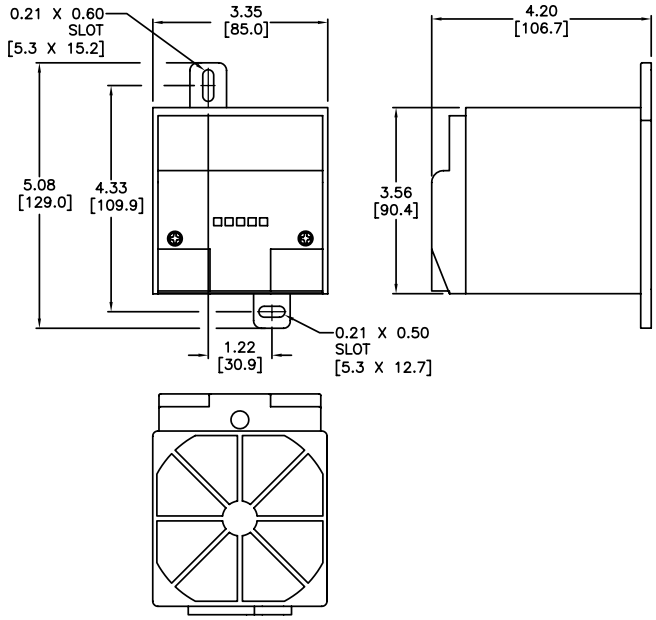
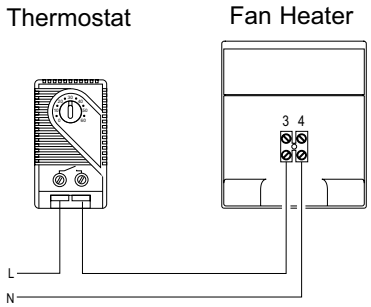


Wiring Diagram



Note: When wiring 230 volt units for North American installations “L” (line) and “N” (neutral) will be used as”L1” (line1) “L2” (line2) respectively with no neutral connection.