

More on Choosing Control Temperature

The table on page 14 is a guide to selecting Control Temperature. Further specific recommendations are given below.

Recommended Control Temperatures based on equipment temperature rise are given in the following table. Temperature rise is measured from equipment air inlet to the point where the sensor is located, often near the exhaust, with air movers running at full speed. These Control Temperatures will result in minimum noise under normal conditions of room temperature, altitude, and system resistance while maintaining lowest operating temperatures under all conditions.

For this design temperature rise from air inlet to air sensor with air movers running at full speed	3-6°C	6-8°C	8-12°C
Choose this Control Temperature	35°C	40°C	45°C

Recommended Control Temperatures

Recommended Control Temperatures based on equipment application are given in the following table.

35°C Control Temperature

- Larger equipment
- Machine room equipment
- Equipment designed for use in both normal and high temperature environments, e.g., office or storage room

40°C Control Temperature

- Good choice for many purposes
- Equipment of moderate size intended for installation in open offices, hospitals

45°C Control Temperature

- Smaller equipment
- Equipment to be installed in private offices and homes
- Equipment that will be used in proximity to an operator (e.g., desk-mounted)

How SmartFan® Regulates Component Temperatures in Electronic Equipment

A 3° to 4°C temperature change causes a closed-loop SmartFan controller to change speed from idle to maximum. A unit with a 40°C Control

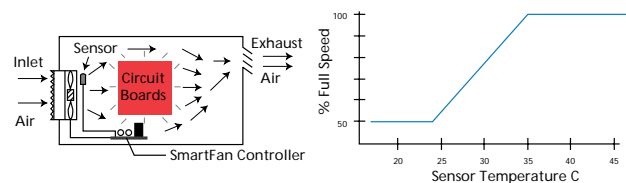
Temperature regulates temperature within a range from about 36° to 40°C. In principle, a controller could be made to regulate air temperature more precisely. It would have very high sensitivity such that at a fraction of one degree below 40°C, fans would idle and at 40°C they would reach full speed. There are two reasons why SmartFan sensitivity is controlled at a moderate level.

First, very high sensitivity could result in instability (sometimes called hunting) with fans having difficulty finding a stable speed.

Secondly, the temperature that we really want to control is that of semiconductor junctions, not air. As the air velocity over a typical semiconductor device (e.g., DIP or similar) changes by two-to-one, as it does when fan speed changes from full speed to idle, the difference between the air temperature and junction temperature changes by a few degrees. Changing the air temperature by an equal number of degrees cancels this effect to hold absolute junction temperature more nearly constant.

Temperature Compensation - The Open-Loop Alternative

An alternative to regulating temperature inside equipment is to sense and compensate for changes in inlet air (room) temperature as shown in the figure below. A disadvantage of such an open-loop system is that it is responsive only to inlet air temperature and cannot respond to changes in power dissipation, altitude, or system resistance. As the curve shows, a change in inlet air temperature from 23°C (73°F) to 35°C (95°F) causes fan speed to change from 50 to 100%. Open-loop versions of SmartFan controllers are available and, like closed-loop units, can reduce noise levels by 15 dB(A) or more.



AC Controller Operating Principles

SmartFan AC fan speed controllers use a triac phase control principle to vary the AC voltage applied to the fan. As the chart below illustrates, the voltage applied to the fan is switched off for a period of time, called T_{OFF} and switched on for a period of time, called T_{ON} during each half of one line cycle. As a result, the fan RMS voltage changes proportionately to increases and decreases in T_{ON} . Since fan speed is proportional to the RMS voltage applied, it will also vary in proportion to changes in T_{ON} .

Many permanently split capacitor (PSC), shaded pole, and universal single phase motors are compatible with SmartFan AC controllers. Use of SmartFan controllers with capacitor start motors, where a capacitor is switched in and out of the motor windings, should be avoided.

Some PSC and shaded pole fans are not voltage controllable. When used with a SmartFan controller at idle speed, and with a nominal pressure load, such fans will idle at a speed far above or far below the intended 50% of full speed.

Except in the smallest sizes, a PSC-type fan is preferred over a shaded pole-type fan for the following reasons:

- Speeds are less sensitive to power line voltage changes
- When used with SmartFan, idle speed is more closely regulated
- PSC fans draw lower electrical current than equivalent shaded pole units
- PSC fans have higher starting torque

DC Controller Operating Principles

The speed of a DC fan is nearly proportional to the DC voltage applied. Low power Wisp II and Omni L1A controllers use a linear dissipative principle to vary applied voltage. At higher power levels, the Omni SD uses a high frequency switching principle to achieve power efficiency of more than 90%.

Both linear and switching controllers are connected between the negative fan terminal and the negative terminal of the fan's power supply. The positive fan terminal is connected directly to the positive terminal of the power supply.

Triac Phase Control Principle: Line & Fan Voltage vs. Time

