

SmartFan[®] Design & Installation Considerations

SmartFan controllers function to proportionally control fan/blower speed to maintain a nearly constant temperature. Under difficult thermal conditions, fan speed is automatically increased. Under more normal conditions, fan speed is reduced to idle (about one-half speed), substantially reducing acoustical noise.

Additional information on operating principles, choosing Control Temperature and cooling system noise control can be found in the Technical Data section on pages 52 through 55.

Fan/Blower Size

Size the air mover for worst-case thermal conditions. Don't compromise available air flow. The controller will power the air mover only as necessary to maintain the selected Control Temperature. Consider allowing maximum flow somewhat greater than for a fixed speed design.

AC or DC Power

Once the cooling power requirements are set, the choice of AC or DC power is made. In HVAC applications and in some electronic cooling applications at power levels above 100 watts, AC power is usually preferred. At lower power levels in electronic applications, DC power is usually preferred because it is readily available, avoids high voltage AC wiring and provides air flow that is independent of power line voltage and frequency.

Any quantity of air movers can be powered by a single controller as long as the total power or current rating of the controller is not exceeded.

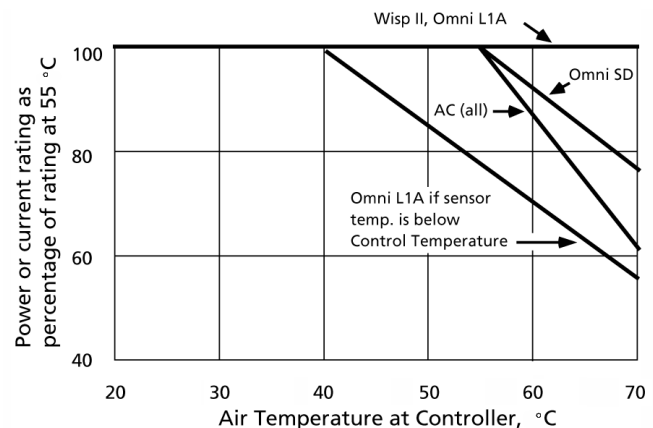
Configuration and Operating Principle

The Selection Guide (page 3) is an aid in selecting the most suitable controller. DC controllers use either a switching or linear operating principle. Switching offers the advantages, (at higher power levels), of smaller size, lower cost, and high power efficiency. Linear controllers are least expensive at low power levels. Both switching and linear controllers apply a smooth DC voltage to the air mover, permitting a wide speed range with minimum acoustical and electrical noise.

AC controllers use a triac phase control principle to vary the AC voltage applied to the fan.

Derating Data

Maximum power and current for SmartFan controllers depends on ambient air temperature and velocity. Data pages give ratings at 55°C both in a low velocity air stream (200 ft/min) and in still air. For controller operation at air temperatures exceeding 55°C, use the derating curves below.



Derating Curves

Control Temperature

Control Temperature is simply the temperature to be held constant by the SmartFan controller. SmartFan's controlled sensitivity results in a sensor temperature change of 3° to 4°C in the control region. This "slope" partly compensates for the change in air-to-junction temperature due to changing air velocity, resulting in nearly constant junction temperature for typical ICs. It also ensures control system stability.

EXAMPLE

The table below serves as a guide in selecting Control Temperature. The shaded area represents typical applications. The inlet air temperature below which fans idle (at about half speed) is red. The inlet air temperature above which fans run at full speed is black. Between these temperatures the fan speed is controlled for a nearly constant temperature at the sensor location.

A system is designed such that with fans running at full speed, the temperature rise from inlet to the sensor location is 7°C. Choosing a 40°C Control Temperature will result in fan idle speed for inlet air (room) temperatures below 23°C. Fans will reach full speed at an inlet air temperature of 33°C.

Positioning the Temperature Sensor

For controllers requiring a temperature sensor, it is the controller circuit and not the sensor that determines Control Temperature. Air sensors are most commonly used; however, surface sensors and immersion sensors are also available.

Air Sensors (P1,P4,P5,P6,P9,P10) SmartFan controls the temperature of air passing its sensor. This temperature should relate to that of the air passing over components and to the temperature of the components themselves. For this to happen, the air must be in motion. The sensor is usually placed in the exhaust air stream. When choosing a location, consider that the effects down stream from the sensor are outside the control loop and cannot be sensed. Avoid placing the sensor near a hot device as this could result in heating by radiation.

Open loop controllers (P suffix such as 018L135PA) function by compensating for changes in inlet air temperature. The sensor is therefore placed near the inlet. Fan speed is proportional to room temperature in the range from 23° to 35°C. Fans idle below 23°C while above 35°C, they run at full speed.

Surface and Immersion Sensors (P3,P7,P8) These sensors are placed in direct contact with the surface or liquid whose temperature is to be regulated. SmartFan then controls fan speed to maintain near constant temperature.

Alarms

A temperature alarm is included on many SmartFan speed controllers. If the sensor temperature reaches 10°C above Control Temperature the alarm is triggered. The alarm is also triggered if fan power is lost.

Stand alone alarms that sense temperature, fan speed or fan current are also available. See page 35 for design information on alarms.

Lower/Upper limits of Control Region for Inlet Air Temperature

Air Temperature Rise from Inlet to Sensor, °C (air mover at full speed)

Control Temperature in°C	3	4	5	6	7	8	9	10	11	12
35	26/32	24/31	22/30	20/29	18/28	16/27	14/26	12/25	10/24	8/23
40	31/37	29/36	27/35	25/34	23/33	21/32	19/31	17/30	15/29	13/28
45	36/42	34/41	32/40	30/39	28/38	26/37	24/36	22/35	20/34	18/33

Mounting the Circuit Board

Circuit boards are usually mounted using four snap-in plastic spacers such as Richco CBS-4-19, or equivalent. Omni SD should be mounted using metal spacers at hole locations surrounded by conductive pads to minimize EMI. Hardware packs, which include typical mounting and connecting hardware, are available (see product pages). Note that power ratings are greater when the circuit board is mounted in an air stream (see product pages).

Vibration

Most fan noise is caused by the blades, with an additional component due to motor vibration transmitted to the mounting plate. At idle speed, depending on the design of the mount, the motor component may become a significant contributor. Should this situation be encountered, vibration isolation may help. Rubber grommets or Wellnuts may be used.

Testing Tips

SmartFan must be tested in a complete cooling system (except for open loop controllers with a P suffix in their part number); that is, the sensor must be in the controlled fan's air stream. Using a heat gun or hair dryer directly on the sensor forces its temperature from below Control Temperature to above so quickly that the fan may seem to "switch speed." The hot air is not being forced by the fan but by the hair dryer, and the fan, therefore, cannot control it.

To operate air movers at full speed for test purposes, short-circuit the sensor terminals. The sensor may be left connected or removed.

EXAMPLE

SmartFan® vs. a Fixed Speed Design

Fixed Speed Design A cooling system is configured to use a fan rated at 3000 RPM (full speed) to provide a flow of 200 CFM. Because the noise at 3000 RPM is excessive, the fan is run at a reduced speed of 2200 RPM, where noise is marginally acceptable. Air flow is less than desired so that under worst-case conditions, temperatures are excessive. The design is definitely a compromise.

SmartFan Design The same 3000 RPM, 200 CFM fan is used. A Control Temperature of 40°C is chosen and the controller adjusts speed automatically, depending on environmental conditions, to hold exhaust air temperature at 40°C. Under typical installation conditions of 23°C (73°F) at sea level, the fan slows to 1500 RPM where its noise level is 15 dB(A) lower than at 3000 RPM, and 8 dB(A) lower than that of the fixed speed design. Increases in thermal load due to higher room temperature, greater system power, or factors such as higher altitude or higher system flow resistance cause the fan to increase speed to hold temperature at 40°C. Under worst-case conditions the fan reaches 3000 RPM where it provides nearly 40% more air flow than the fixed speed design.