



# Fault-Tolerant Fan (FTF) Systems; Now Easily Accomplished

## Introduction

The need for reliability in electronic equipment does not stop at using the highest quality fans, such as Comair Rotron fans. There is an ever-increasing need to use additional fans as added insurance in the event of a fan failure. For example, a system that would normally use 4 Muffin fans would be equipped with 2 additional Muffin fans for redundancy; bringing the total to 6 Muffin fans. The additional 2 fans gives peace of mind to customers who rely heavily on their equipment operating; but it also produces additional noise that nobody wants.

As a way to provide redundant cooling and reduce noise emission, Comair Rotron has developed the Fault Tolerant Fan (FTF) system. Under normal operation, the fans are ran at a reduced speed that provides the necessary airflow for cooling. In the event of a fan failure, the remaining fans increase their speed to compensate for the failed fan. The end result is quiet operation with the reliability that our customers have come to expect.

Comair Rotron's FTF systems have several advantages:

1. Ease of installation
2. Uninterrupted cooling
3. Lower noise; same airflow
4. Higher reliability per fan
5. Eliminates fan redundancy

## Description

Many engineers design redundant fan systems, which over compensate for potential failures by putting extra fans into their system. By taking advantage of modern day electronics located in the fans themselves, a simple redundant system can be created. This system would use Comair Rotron's ThermaPro-V technology with a Fan Performance Sensor. The ThermaPro-V option includes a programmable capability that is tied to the alarm output.

Unfortunately, AC fans do not have the programmable ability and will still require over compensation or an external control circuit.

Fan noise increases and decreases proportionally with RPM. When comparing the noise in dBA of one Patriot fan at full speed vs. two Patriot fans 1/2 speed, we see a noise reduction from 54.9 dBA to 49.9 dBA. This 5 dBA reduction in noise is clearly noticeable. In terms of airflow, the two-1/2 speed Patriots will deliver 235 CFM at free delivery the same as one fan at full speed.

Higher reliability per fan is obtained by running the fans at a lower RPM. The two main factors which come into play are bearing wear and internal temperature rise.

1. Each fan, at low speed, will be using less power and dissipating less heat internally. As a result, the bearings will run cooler.
2. The propeller/shaft/bearing assembly will be turning at fewer revolutions per minute, creating less wear on the bearings.

A fault tolerant system can be applied with the fans in series, parallel, both, or multiple fans and at various speeds. Multiple fans (3 or more) require different circuitry than a system with 2 fans. Both methods are described later. Fault Tolerant Fan systems can be supplied as part of a tray assembly or can be integrated into the system logic by the customer.

Presently, we have customers taking advantage of these systems in the telecommunications and mainframe industries. To externally supply the circuitry required to monitor and control the fan speed would cost significantly more than simply adding our Therma Pro-V and FPS to the fan.

## Two Fan FTF Systems

All the necessary circuitry for a two fan FTF system can be provided internally to most of our DC fans. We simply use our Therma Pro-V Programmable feature and a Fan Performance Sensor, then cross-wire them together. The cross wiring allows the Fan Performance Sensor (FPS) signal of fan #1 to program the speed of fan #2 (see Figure 1). The program lead uses the output transistor of the alarm as its path to the common ground. In normal operation, both fans are running at reduced speed (the program lead is shorted to the common ground). If fan #1 fails, then its FPS output transistor will allow the programming lead of fan #2 to open and increase to full speed. The end result is an uninterrupted supply of airflow. To further simplify installation of this type of system, we offer sheet metal fabrication and assembly in-house. All we need is the specific dimensional and performance requirements. We have expanded these capabilities for better control of our product and potential cost savings to our customers.

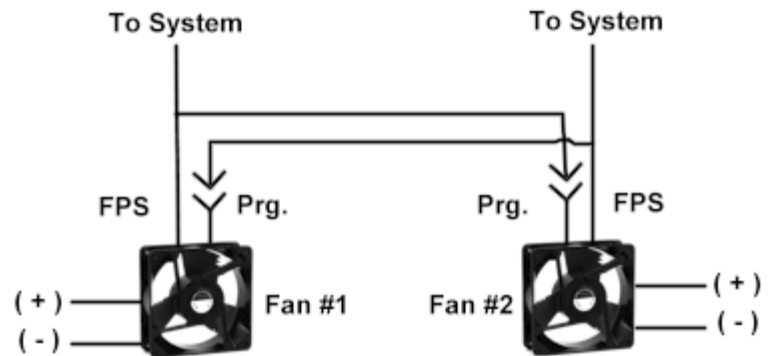


Figure 1: Two Fan Wiring for Fault Tolerance

## Three or More Fan FTF Systems

Three fan FTF systems use circuitry similar to the 2 fan FTF systems, but have special circuitry internal to the fan motor to account for the additional alarm transistors. This system wires all of the alarm outputs together as well as the program leads together. The base fan speed is predetermined by a resistor network internal to the fan. If a failure occurs in one or more of the fans, the remaining fans will program up to a high-speed condition.

## Conclusion

Uninterrupted cooling is a significant concern for companies who offer products for On-Line Transaction Processing or other high reliability systems. The effectiveness of high-reliability systems is that they are always on-line. Since a system shutdown would lead to a loss of transactions, not being able to accept an order is very costly for immediate maintenance, etc. An FTF system, as described above, will provide continuous cooling and help avoid nuisance shutdowns due to loss of airflow. Expensive and elaborate external controller cards can be used, but the idea behind the FTF system is to keep it simple and take advantage of the fans existing abilities. To further integrate the fans, the additional FPS alarm can alert the system of a failure and to call for field service.

In order to design these systems most effectively; please contact the Comair Rotron Application Engineer Department. The Application Engineer will be able to assist in finding the optimum program speeds, airflow/pressure losses to be expected, estimated fan performance at reduced speed in terms of airflow and noise etc.