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Interfacing Microchip's Fan Speed Controllers to a SPI™ Port

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INTRODUCTION

Microchip's TC642, TC643, and TC646 are the world's first integrated circuits dedicated for controlling and monitoring fan speed. The new family of fan speed controllers modulate fan speed to compensate for changes in system temperature. This means the fan runs at full speed only when necessary, significantly extending fan life. In addition to increased fan life, fan speed is controlled by PWM control circuitry that is more efficient than conventional linear techniques. The ICs provide other features such as fan current limiting, minimum speed control, auto shutdown, and speed, fault, and over-temperature indication.

These ICs can be used in a stand-alone configuration if interfaced with other support/control ICs. This application note discusses ways in which these devices can be controlled over a SPI™ port.

STANDARD IMPLEMENTATION

The TC642, TC643, and TC646 use two different methodologies to control fan speed. The TC642/646 provide a standalone solution whereas the TC643 requires an external drive signal and RPM sense circuitry. The TC642/646 are designed to provide speed control for a power supply cooling fan. The ICs are driven by an analog voltage, usually provided by a local thermistor, that is proportional to system temperature.The fan speed increases with increasing input voltage. In such a configuration, these ICs provide a self-contained, hardware-based solution whose only interface to the digital world is via fan fault and overtemp logic flags (see Figure 1).

Using a different approach, the TC643 was designed to interface with an ASIC or microcontroller that receives temperature data from one or several remote sensors. The ASIC or microcontroller generates the PWM drive signal for the TC643 based upon the system's thermal algorithm. The TC643 monitors fan speed and provides an RPM output that can be monitored by the ASIC or microcontroller (see Figure 2). By monitoring the RPM output, early signs of fan degradation (bearing wear) can be detected, allowing corrective action to be taken prior to a catastrophic failure. The TC643 also has built-in current limit circuitry in case a catastrophic event should take place.

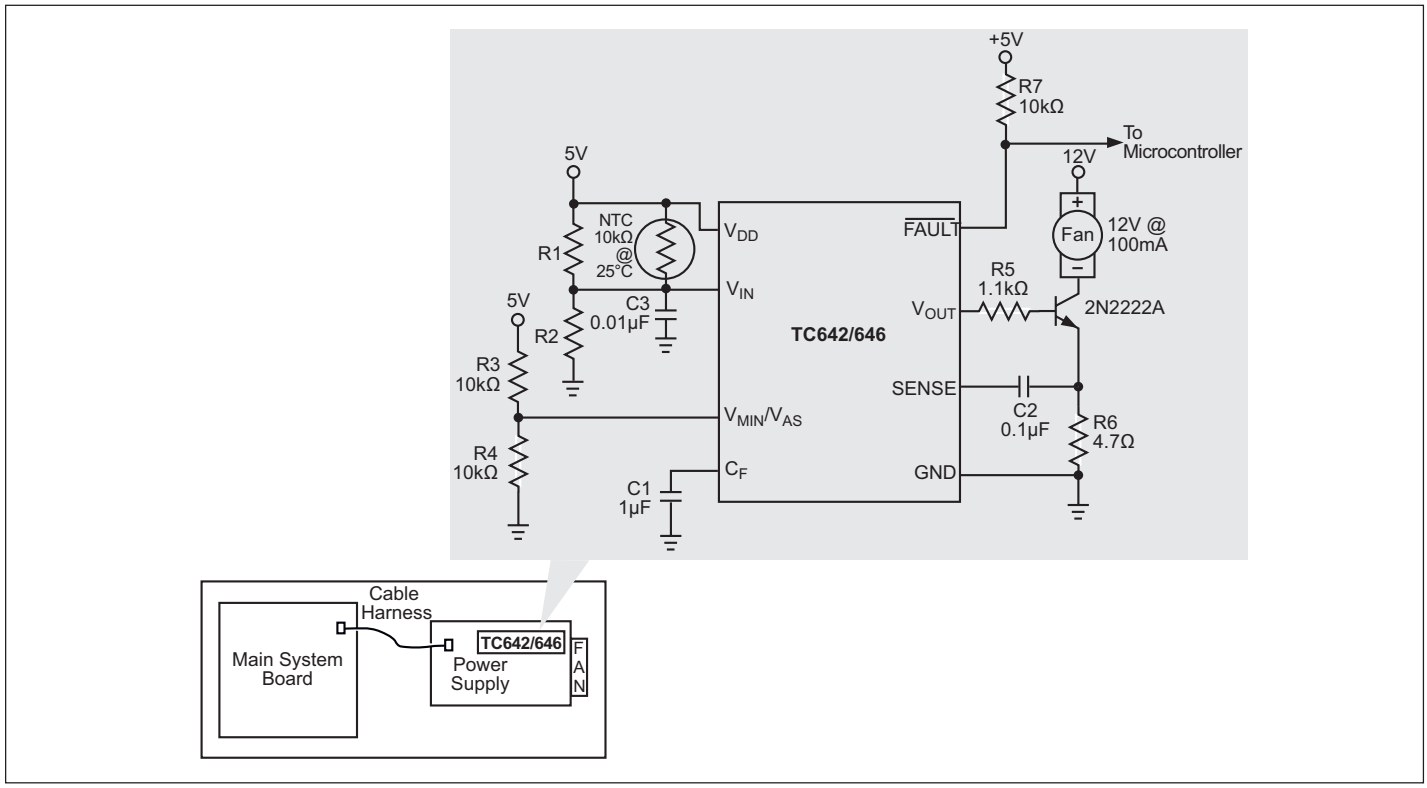


FIGURE 1: TC642/646 in standalone configuration.

SPI is a trademark of Motorola, Inc.

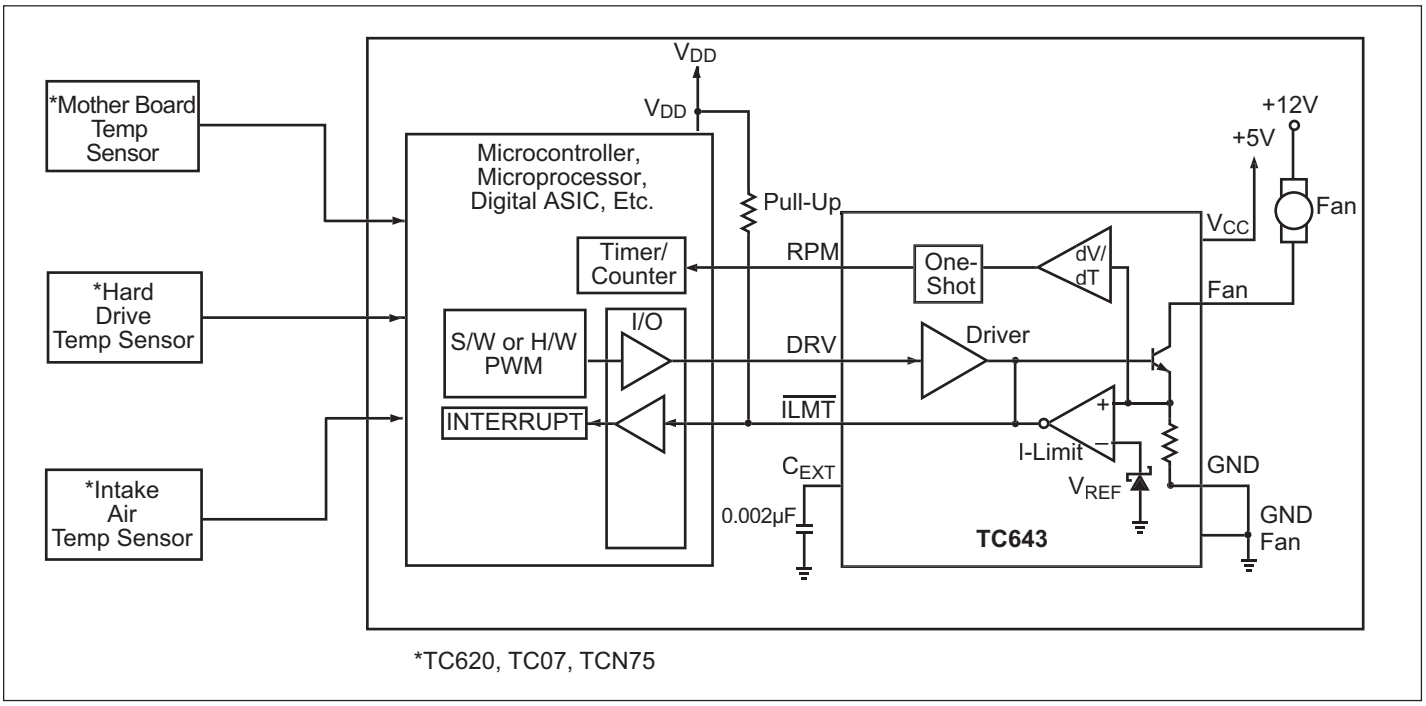


FIGURE 2: TC643 interfacing with a microcontroller.

SPI™ PORT IMPLEMENTATION OF THE TC642/646

Although the TC642/646 provide an excellent standalone fan controller, some system architects would prefer to have a fan speed controller that can be used as a peripheral. Many PCs and workstations have a multi-zone temperature sensor scheme that communicates to a microcontroller over some type of bus. The microcontroller then needs to communicate to the TC642/646 over a SPI™ port to control fan speed.

The TC642/646 needs to be driven by an analog voltage. Consequently, a SPI™ port bit stream needs to be converted into an analog voltage. This can be accomplished with a SPI™ port digital pot (see Figure 3). As the analog voltage varies on the TC642/646's V_{IN} pin, so will fan speed.

Dual digital pots are offered by Microchip Technology, allowing one digital pot IC to be used as an interface for multiple fans.

The TC642/646 also provide fan fault output. This output can be connected to the interrupt input of the bus master, if so desired. This type of configuration converts the TC642/646 to a software-based solution.

In some cases, a hardware override is still required. If so, a local thermistor can be used and diode-ORed with the output of the digital pot (see Figure 4). This will insure that the fan will turn on even if there is a software-related lock-up.

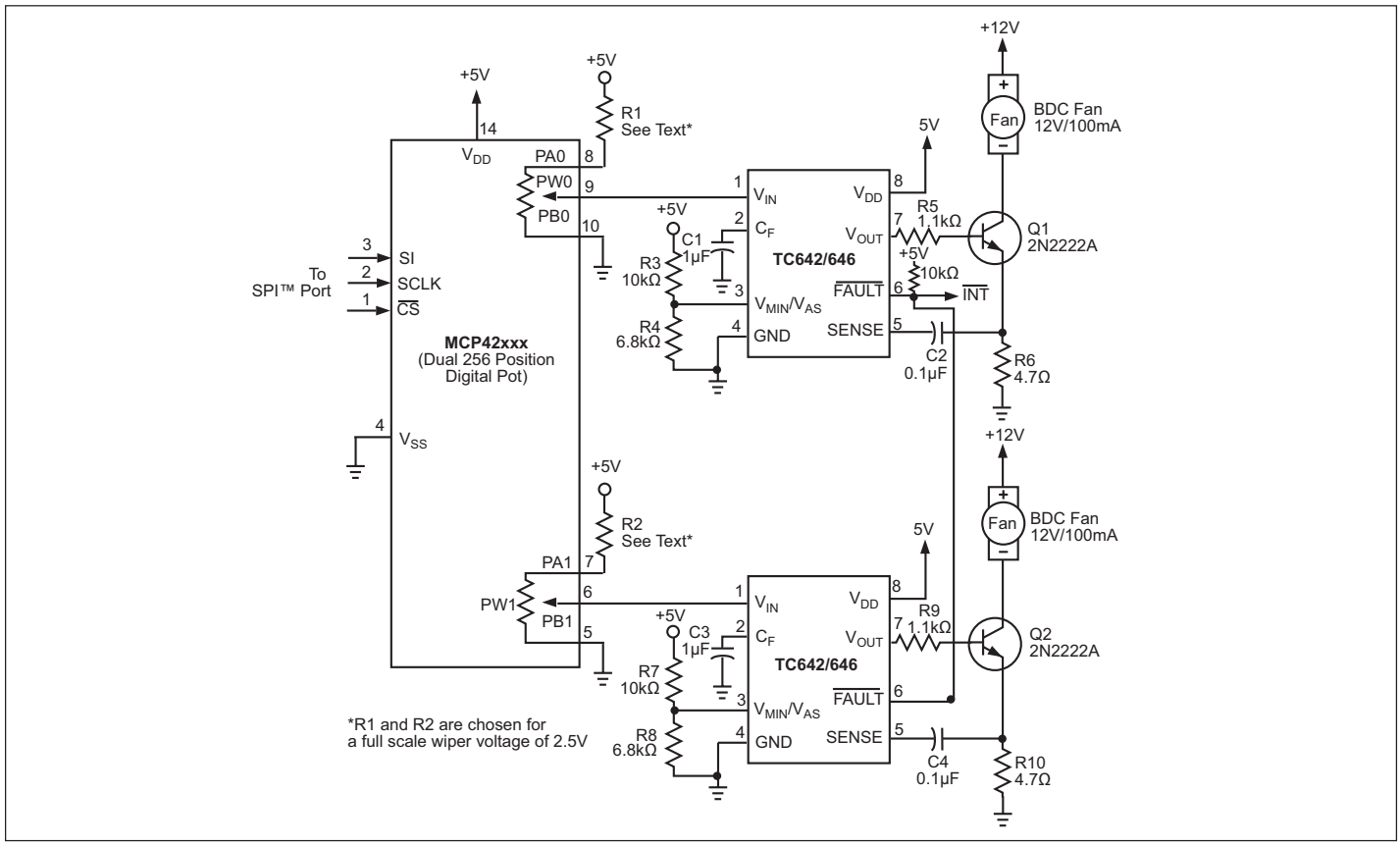


FIGURE 3: Dual fan manager with SPI™ port interface.

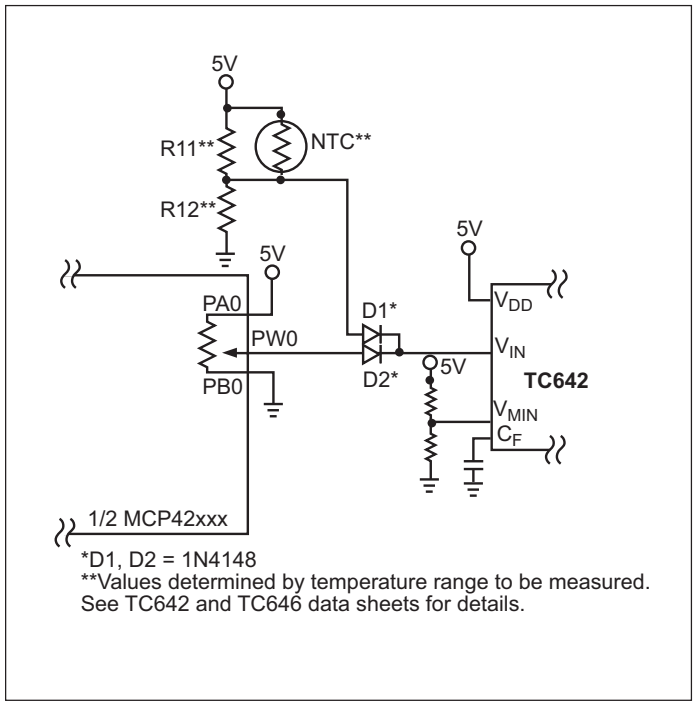
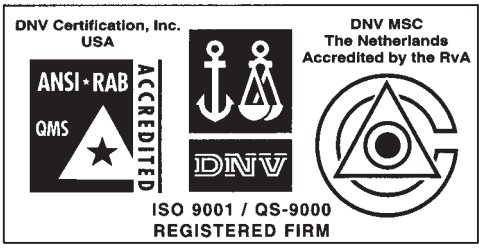


FIGURE 4: Diode OR-ing hardware and software inputs.

SUMMARY

Microchip's fan speed controllers provide many features that simplify fan speed control. They provide a variety of options to the system designer as either a standalone solution or one that interfaces to a microcontroller or ASIC. In addition, with the use of some simple low cost ICs, the fan controllers can be integrated into a system as SPI™ port peripherals.

NOTES:



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03/01/02