INTRODUCTION
The NLX Power Supply Specification released by Intel® Corporation defines the requirements for next-generation PC system power supplies. There are several enhancements outlined in this specification as compared to the “old” PS/2 power supply form factor. One of these features is control and monitoring of the cooling fan(s) inside the NLX power supply. The NLX specification designates two interface fan control signals:

1. **FanM** signal is an output from the NLX-compliant power supply. This signal allows the host (typically a system management ASIC) to monitor fan RPM. FanM is an open-collector signal consisting of two pulses per fan rotation.

2. **FanC** is an input to the NLX-compliant power supply used by the motherboard to regulate fan speed and to shut the fan down. FanC is a 0V to 12V analog signal.

BRUSHLESS DC FAN BASICS
Brushless DC (BDC) fans are popular for cooling electronics and come in many voltage, current and CFM ratings. The most common versions in PCs are +5V and +12V. The nominal voltage rating is typically the input voltage at which the fan runs at approximately 100% RPM. Some fans have a third terminal that outputs pulses as a tachometer signal.

APPLICATION CIRCUIT
The application circuit using the Microchip TC646 is shown in Figure 2. Please refer to the TC646 datasheet (DS21446) for details on pin descriptions. The overall circuit can be broken down into five basic functional blocks, plus the TC646 itself:

1. **FanC “Y-Network” Input From Motherboard**: This section accepts the 0V–12 VDC signal from an NLX-compliant motherboard. The Y-network formed by R12, R1 and R2 performs level shifting and range compression to match the 1.25V–2.65V analog input range of the TC646. The FanC signal indicates a shutdown request at or below +1 VDC. Above that, the signal is used for proportional fan speed control. If FanC becomes disconnected or is not present, the fan will be driven at full speed via the R13 pull-up resistor.

2. **Thermistor-Controlled Fan Override**: T1 (thermistor 10 kΩ at 25°C), R6 and Q1 form the “thermal override function”. This circuit provides a local override in the event of high ambient temperature. Under normal operation, Q1 is off.

3. **Output Stage**: This section consists of the fan and its drive components: R5, Q2. The signal output from the VOUT pin is a 30 Hz nominal 5 Vpp PWM waveform. Q2 is a 2N2222A small-signal BJT. The fan is driven to a full +12V (minus Q2 saturation voltage).
4. **FanM Signal**: To fully comply with NLX specification, the power supply must provide a signal back to the motherboard (FanM). The NLX specification requires this signal to be an open-collector output from the tachometer of a 3-wire fan.

5. **Minimum Speed and Auto-Shutdown**: R₃ and R₄ form a divider network that defines the shutdown threshold of the circuit. This corresponds to the +1V NLX-specification for fan shutdown.

System operation is straightforward: fan speed ranges from approximately 30% to 100% for a FanC voltage range of 1V to 10.5V. The fan will be held in shutdown when FanC is less than 1V. FanM is returned to the motherboard as prescribed in the NLX specification. FanM also is monitored by the TC646. FAULT is asserted if the fan fails to operate (see TC646 datasheet for details). Additionally, C₄ sets the 30 Hz PWM frequency and R₇ is the pull-up resistor for the FAULT output.

**SUMMARY**

The Microchip TC646 Fan Speed Controller allows a computer designer to implement a robust system-cooling design and be fully NLX-compliant. Additionally, the PWM control mode is superior to traditional linear control methods. The low cost of the TC646, and its supporting components, make it the ideal choice for high-volume applications.

**FIGURE 2**: BDC fan control for NLX power supply (3-wire fan).
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