



TC642 Fan Control Demo Board User's Guide

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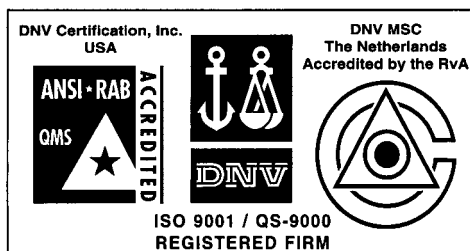
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Chapter 1. General Information

1.1 INTRODUCTION

Thank you for purchasing the TC642 Fan Control Demo Board from Microchip Technology Inc. The TC642 Fan Control Demo Board is an evaluation tool that allows the user to quickly prototype fan control circuits based on Microchip's TC642/TC646/TC647/TC648/TC649 pulse width modulation (PWM) Fan Control integrated circuits.

A versatile sensor input and output driver circuitry allows the Fan Control Module to be used with virtually any brushless DC fan and standard thermistor. An optional LED status indicator gives a visual indication of a fan fault (stalled, open or unconnected fan) or an over-temperature condition.

The TC642 Demo Board has the following features:

1. Complete implementation of TC642 fan control circuitry on a 1.5" x 2.0" board.
2. Works with standard thermistors.
3. Temperature proportional fan speed control.
4. Over-temperature fault detection.
5. Fan fault detection.
6. Installs directly into user's end equipment.
7. Speeds up prototyping, system development and system thermal characterization.

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1.2 THE TC642 FAN CONTROL DEMO BOARD

The TC642 Fan Control Demo Board (Figure 1-1) measures only 1.5" x 2.0", allowing direct installation to the user's end equipment for system evaluation. It uses through-hole components for easy assembly and evaluation.

The TC642 Demo Board Kit is shipped with the following items:

1. TC642 Fan Control Demo Board.
2. The TC642 Fan Control Demo Board User's Guide (DS21401).
3. *Analog Design Pack* CD-ROM (DS51205).
4. TC642, TC646, TC647, TC648 and TC649 Fan Control IC.

The components which are populated on the Fan Control Demo Board are listed in Table A-1 in the Appendix A section. If any component is damaged or missing, please contact your nearest Microchip sales office, listed on the back of this publication.

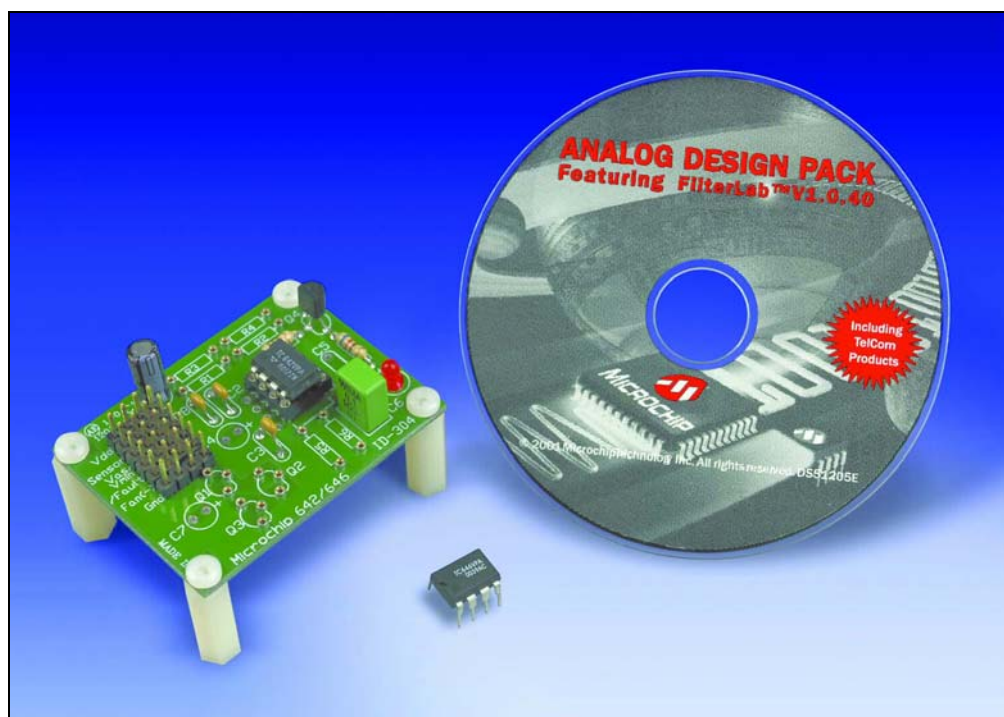


FIGURE 1-1: The TC642 Fan Control Demo Board Kit

1.3 REFERENCE DOCUMENTS

Other Reference Documents may be obtained by contacting your nearest Microchip sales office (listed on the back of this document) or by visiting the Microchip website (www.microchip.com).

- *Technical Library CD-ROM*, (DS00161) or the individual data sheets:
 - *TC642 Data Sheet*, (DS21444)
 - *TC646 Data Sheet*, (DS21446)
 - *TC647 Data Sheet*, (DS21447)
 - *TC648 Data Sheet*, (DS21448)
 - *TC649 Data Sheet*, (DS21449)
- *Analog & Interface Families Data Book 2002*, (DS00207)
- *2002 Technical Documentation Analog & Interface Product Families CD-ROM*, (DS51205)
- *Suppressing Acoustic Noise in Pulse Width Modulation (PWM) Fan Speed Control Systems* Application Note, (AN771)
- *Speed Error in Pulse Width Modulation (PWM) Fan Control Systems* Application Note, (AN772)
- *TC642 Fan Speed Control Module for TC64X Family* Sell Sheet, (DS51251)

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Chapter 2. Getting Started

This chapter describes the TC642 Demo Board's configuration, how it functions, and lists typical fan demo board operating configurations for fan applications.

2.1 TC642 DEMO BOARD TYPICAL MODULE CONFIGURATIONS

2.1.1 Using Bipolar Driver Transistors

All component selections should be made based on the information provided in the Applications section of the TC64X data sheets. Table 2-1 lists typical Fan Module operating configurations for 12V fan applications. These are provided as a guide only. The values in the table assume the use of low cost, bipolar transistors, such as 2N2222A, unless stated otherwise.

TABLE 2-1: SUGGESTED OUTPUT DRIVER/CURRENT SENSE VALUES VS. FAN CURRENT

Full Speed Fan Current	Darlington Pair (Q ₁ , Q ₂)	Single Transistor (Q ₃)	R ₅ (Ω)	R ₆ (Ω)
50 mA	—	X	2.4k	9.1
100 mA	—	X	1.1k	4.7
150 mA	—	X	750	3.0
200 mA	—	X	620	2.4
200 mA	X	—	5.6k	2.4
250 mA	X	—	4.7k	2.0
300 mA	X	—	3.9k	1.8
350 mA	X	—	3.3k	1.5
400 mA	X	—	3.0k	1.3
450 mA	X	—	2.4k	1.2

Fan motors of 50 mA to 150 mA can be driven using the single transistor driver configuration (i.e., Q₃ installed; Q₁ and Q₂ not installed). Fans having a motor current of 200 mA may be driven using either the single transistor or Darlington configurations. If a single transistor is used, care must be taken to select a transistor having a minimum h_{FE} of at least 50 to ensure the minimum output current specification (5 mA) of the TC64X IC is sufficient to saturate the transistor when it is conducting the full fan current.

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2.1.2 Using Logic Level MOSFETS

Substituting a logic level MOSFET for Q₃, such as a BS170, results in lower system voltage losses and significantly reduces output loading on the TC64X ICs. The low R_{DS(ON)} of the MOSFET (1Ω in the case of the BS170), enables it to be used instead of the Darlington configuration, in high current fan applications. See the Applications section of the TC64X data sheets for details.

Population options for single transistor output drivers (using either MOSFET or bipolar transistor) and the two transistor (Darlington) stage is shown in Figure 2-1.

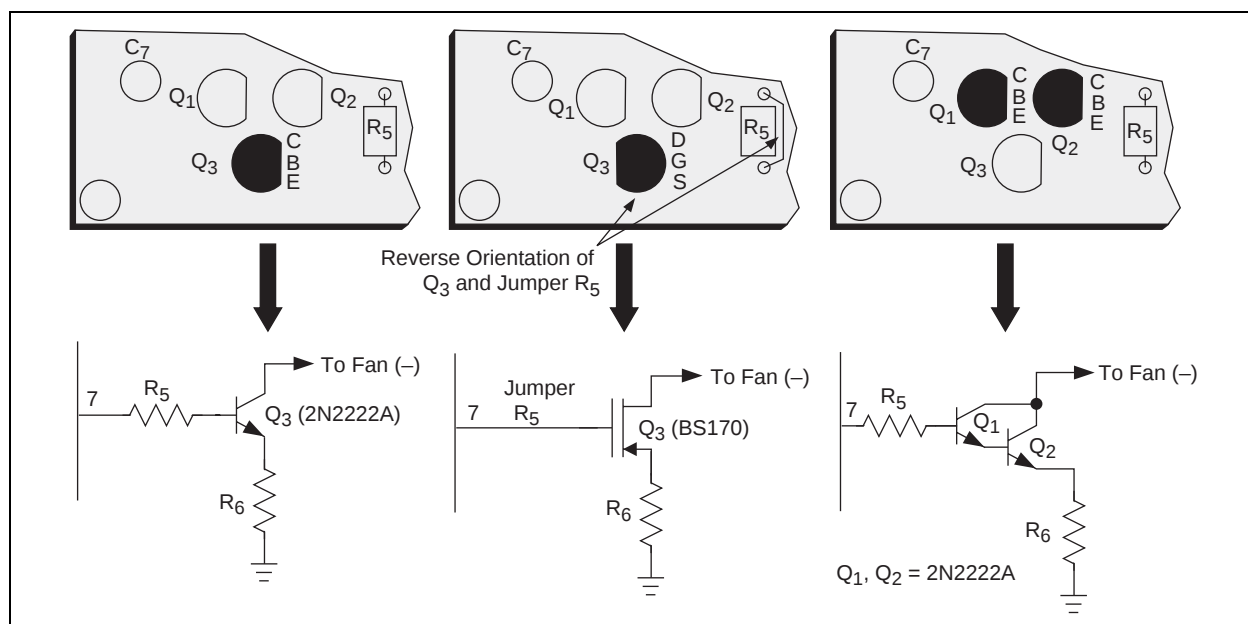


FIGURE 2-1: Output Driver Configuration Options

2.2 SYSTEM CONNECTION FOR +5V OPERATION

Figure 2-2 shows typical wiring connections to the Fan Control Module. The fan operating voltage is +12V, while the Fan Control Module operates from a supply voltage of +5V. An NTC thermistor connects from the SENSOR input of the Fan Control Module to V_{DD}. Fan Control Module resistors R₁ and R₂ (See Figure A-2), and the characteristics of the NTC thermistor, together determine the fan speed versus the temperature profile of the system.

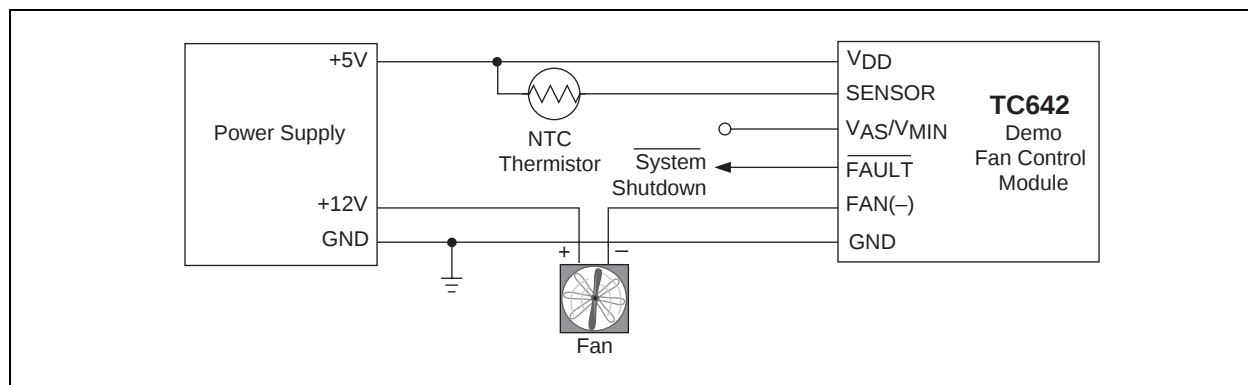


FIGURE 2-2: Typical Wiring Connections to Fan Module for +12V Fan and +5V Module Supply

Appendix A. Board Layout

A.1 INTRODUCTION

This appendix contains general information concerning the layout, schematics and components for the TC642 Demo Board.

A.2 BOARD LAYOUT AND SCHEMATICS

Figure A-1 depicts the layout for the TC642 Demo Board. Figure A-2 shows the schematic for the TC642 Fan Control Module.

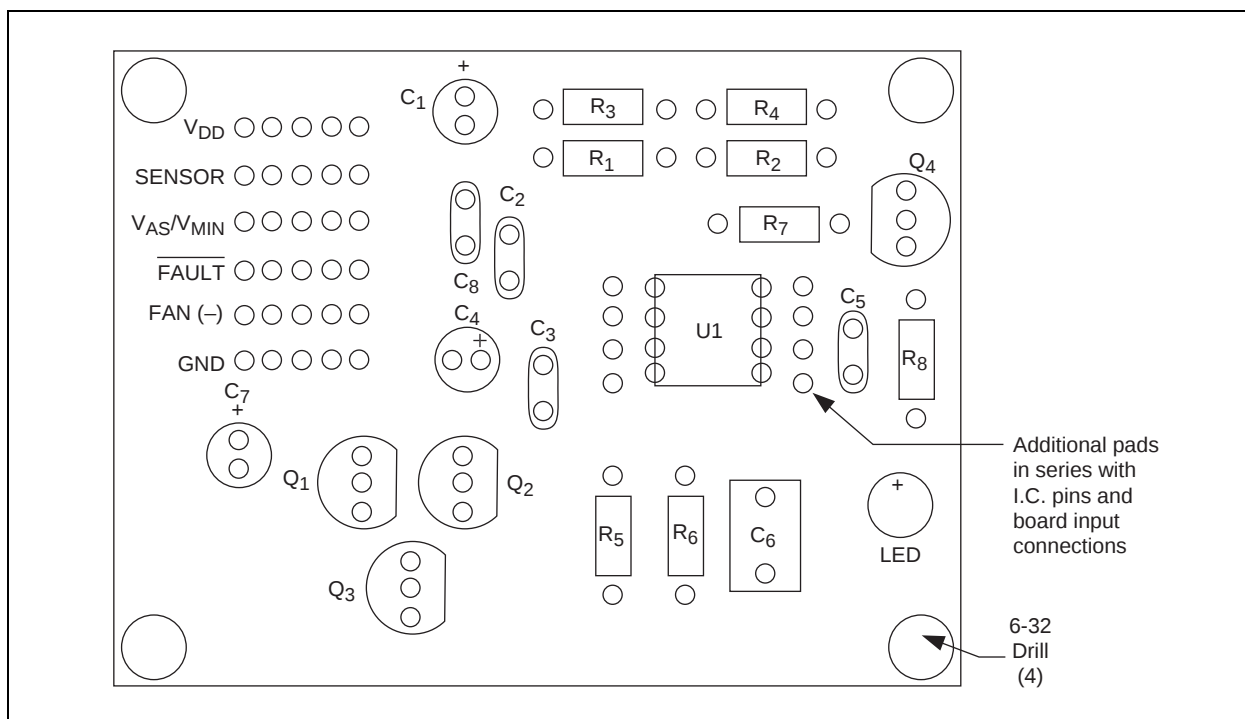


FIGURE A-1: TC642 Fan Control Board Layout

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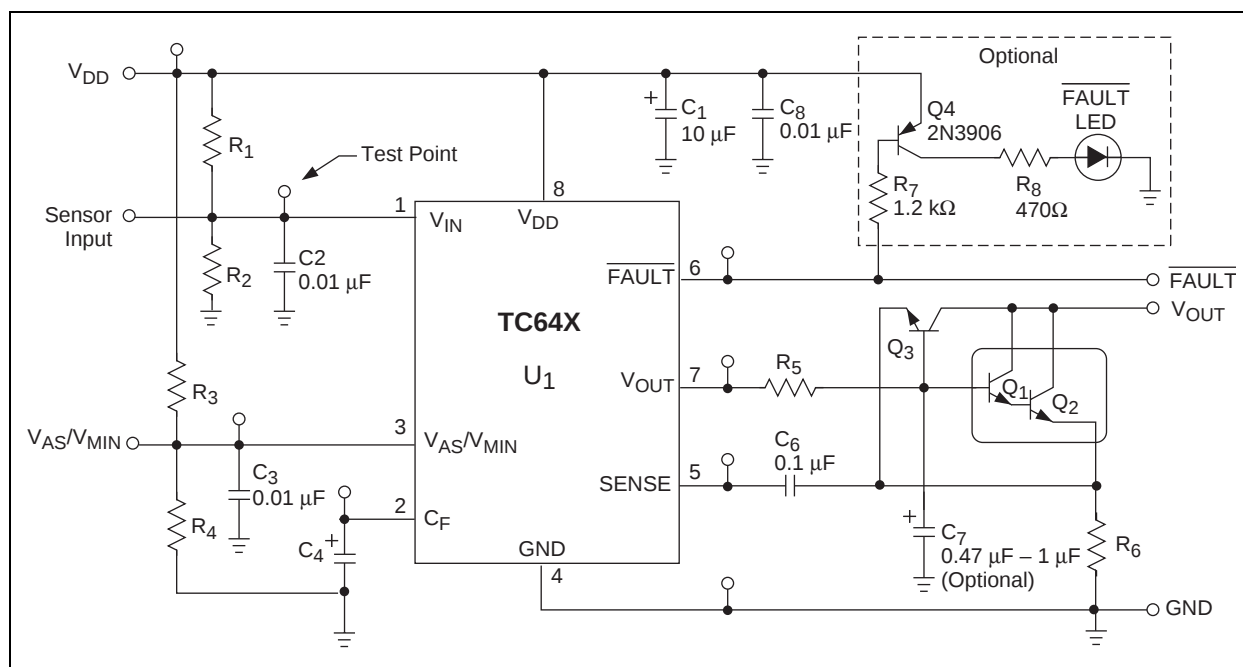


FIGURE A-2: TC642 Fan Control Module Schematic

A.3 DEMO BOARD COMPONENTS

Table A-1 lists typical components and the associated values that comprise the TC642 Fan Control Demo Board.

TABLE A-1: FAN CONTROL MODULE COMPONENTS LIST

Component	Typical Value	Comments
C ₁	10 μ F Radial Electrolytic Capacitor	Power supply filter.
C ₂	0.01 μ F Ceramic Disk Capacitor	Bypass capacitor.
C ₃	0.01 μ F Ceramic Disk Capacitor	Bypass capacitor.
C ₄	1.0 μ F Ceramic Capacitor	PWM capacitor. Typical value is 1.0 μ F (PWM frequency of 30 Hz).
C ₅	Not used	—
C ₆	0.1 μ F Ceramic Disk Capacitor	SENSE input coupling capacitor.
C ₇	0.47 μ F to 1 μ F Radial Electrolytic Capacitor	Fan acoustic noise suppression capacitor. (Optional)
C ₈	0.01 μ F Ceramic Disk Capacitor	Bypass capacitor.
LED	10 mA Miniature LED	LED lights when FAULT output is LOW (active). (Optional)
Q ₁ , Q ₂	2N2222A NPN Transistor	Darlington pair output option. If used, Q ₃ location MUST be left open.
Q ₃	See Applications section of TC64X data sheets	Single transistor output option. Can be bipolar transistor or logic level MOSFET (depending on cost constraints and fan current). If used, Q ₁ and Q ₂ locations MUST be left open.
Q ₄	2N3906 (or Equivalent) PNP Transistor	LED Driver transistor. (Optional)
R ₁ , R ₂	See the Applications section of the TC64X data sheets	Value depends on the type of sensor used and the desired fan speed vs. temperature profile.
R ₃ , R ₄	See the Applications section of the TC64X data sheets	Value depends on the desired minimum fan speed setting (TC642, TC647) or auto-shutdown temperature (TC646, TC648, TC649).

TABLE A-1: FAN CONTROL MODULE COMPONENTS LIST (CONTINUED)

Component	Typical Value	Comments
R ₅	See the Applications section of the TC64X data sheets	Base current limiting resistor. Value depends on the type of fan and driver used. Typical values appear in Table A-1.
R ₆	See Applications section of the TC64X data sheets.	Fan Current sensing resistor. Value depends on full speed fan current. Typical values are shown in Table A-1.
R ₇	1.2k Ω , 1/4 Watt, 5% Resistor	LED Drive transistor base resistor. (Optional)
R ₈	470 Ω 1/4 Watt, 5% Resistor	LED Drive transistor series limiting resistor. (Optional)
U ₁	TC642, TC646, TC647, TC648 or TC649 Fan Control ICs	



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