



TC64X/TC64XB Fan Control Demo Board User's Guide

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Microchip's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, Accuron, dsPIC, KEELOQ, MPLAB, PIC, PICmicro, PICSTART, PRO MATE and PowerSmart are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.


AmpLab, FilterLab, microID, MXDEV, MXLAB, PICMASTER, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

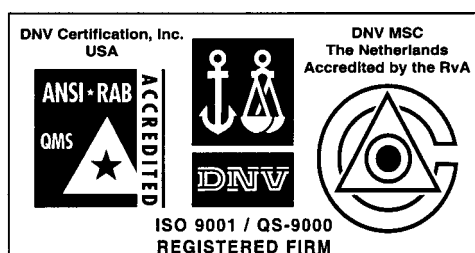
Application Maestro, dsPICDEM, dsPICDEM.net, ECAN, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, microPort, Migratable Memory, MPASM, MPLIB, MPLINK, MPSIM, PICkit, PICDEM, PICDEM.net, PowerCal, PowerInfo, PowerMate, PowerTool, rLAB, rfPIC, Select Mode, SmartSensor, SmartShunt, SmartTel and Total Endurance are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

Serialized Quick Turn Programming (SQTP) is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2003, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.



Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999 and Mountain View, California in March 2002. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, non-volatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.



TC64X/TC64XB FAN CONTROL DEMO BOARD USER'S GUIDE

Table of Contents

Chapter 1. General Information

1.1 Introduction	1
1.2 TC64X/TC64XB Fan Control Demo Board	2
1.3 Reference Documents	4

Chapter 2. Getting Started

2.1 TC64X/TC64XB Fan Control Demo Board Typical Module Configurations	5
2.2 System Connection For +5V Operation	6

Appendix A. Board Layout and Schematic

A.1 Introduction	7
A.2 Board Layout and Schematic	7

Appendix B. Bill-of-Materials (BOM)

B.1 Demo Board Components	9
---------------------------------	---

Worldwide Sales and Service	10
-----------------------------------	----

TC64X/TC64XB Fan Control Demo Board User's Guide

NOTES:



TC64X/TC64XB FAN CONTROL DEMO BOARD USER'S GUIDE

Chapter 1. General Information

1.1 INTRODUCTION

Thank you for purchasing the TC64X/TC64XB Fan Control Demo Board from Microchip Technology Inc. The TC64X/TC64XB Fan Control Demo Board allows the user to quickly prototype fan control circuits based on Microchip's pulse width modulation (PWM) Fan Control integrated circuits.

These devices will be referred to as TC64X in this document:

- TC642
- TC646
- TC647
- TC648
- TC649

These devices will be referred to as TC64XB in this document:

- TC642B
- TC646B
- TC647B
- TC648B
- TC649B

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 overtemperature condition.

The TC64X/TC64XB Fan Control Demo Board has the following features:

1. Complete implementation of TC64X or TC64XB fan control circuitry on a 1.5" x 2.0" board
2. Works with standard thermistors
3. Temperature-proportional fan speed control
4. Overtemperature fault detection
5. Fan fault detection
6. Installs directly into user's end equipment
7. Speeds up prototyping, system development and system thermal characterization

TC64X/TC64XB Fan Control Demo Board User's Guide

1.2 THE TC64X/TC64XB FAN CONTROL DEMO BOARD

The TC64X/TC64XB 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 kit is shipped with the following items:

1. TC64X/TC64XB Fan Control Demo Board
2. Demo and Evaluation Kit Software and Documentation CD, DS51306

The CDROM contains:

- Device Data Sheets
- TC64X/TC64XB Fan Control Demo Board User's Guide, DS21401

3. Sample Devices:

Device	Part Number	
	PDIP	SOIC
TC642B	TC642BEPA	TC642BEOA
TC646B	TC646BEPA	TC646BEOA
TC647	TC647VPA	TC647VOA
TC647B	TC647BEPA	TC647BEOA
TC648	TC648VPA	TC648VOA
TC648B	TC648BEPA	TC648BEOA
TC649	TC649VPA	TC649VOA
TC649B	TC649BEPA	TC649BEOA

The components that are populated on the TC64X/TC64XB Fan Control Demo Board are listed in Table B-1 of the Appendix B section. If any component is damaged or missing, please contact your nearest Microchip sales office, listed on the back of this publication.

1.3 REFERENCE DOCUMENTS

The following is recommended reading:

- *Technical Library CD-ROM*, DS00161
- *Analog & Interface Families Data Book 2002*, DS00207
- *2002 Technical Documentation Analog & Interface Product Families CD-ROM*, DS51205
- AN768, “*Redundant Fan Systems Using the TC642 Fan Manager*”, DS00768, Microchip Technology Inc., 2002
- AN770, “*Linear Voltage Fan Speed Control Using Microchip’s TC64X Family*”, DS00770, Microchip Technology Inc., 2003
- AN771, “*Suppressing Acoustic Noise in Pulse Width Modulation (PWM) Fan Speed Control Systems*”, DS00771, Microchip Technology Inc., 2003
- AN772, “*Speed Error in Pulse Width Modulation (PWM) Fan Control Systems*”, DS00772, Microchip Technology Inc., 2003

TC642 Fan Speed Control Module for TC64X Family Sell Sheet, DS51251

Other Reference Documents may be obtained by contacting your nearest Microchip sales office (listed on the back of this document).

The Microchip web site (www.microchip.com) also contains a wealth of documentation. Individual data sheets, application notes, tutorials and user’s guides are all available for easy download.

TC64X/TC64XB Fan Control Demo Board User's Guide

NOTES:

Chapter 2. Getting Started

This chapter describes the TC64X/TC64XB Fan Control Demo Board's configuration, how it functions and lists typical fan demo board operating configurations for fan applications.

2.1 TC64X/TC64XB FAN CONTROL 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 and TC64XB 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	2.4 k	9.1
100 mA	—	X	1.1 k	4.7
150 mA	—	X	750	3.0
200 mA	—	X	620	2.4
200 mA	X	—	5.6 k	2.4
250 mA	X	—	4.7 k	2.0
300 mA	X	—	3.9 k	1.8
350 mA	X	—	3.3 k	1.5
400 mA	X	—	3.0 k	1.3
450 mA	X	—	2.4 k	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 and TC64XB devices is sufficient to saturate the transistor when it is conducting the full fan current.

TC64X/TC64XB Fan Control Demo Board User's Guide

2.1.2 Using Logic Level MOSFETS

Substituting a logic level MOSFET for Q_3 (such as a BS170) results in lower system voltage losses and significantly reduces output loading on the TC64X and TC64XB devices. 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. Refer to the Applications section of the TC64X and TC64XB data sheets for details.

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

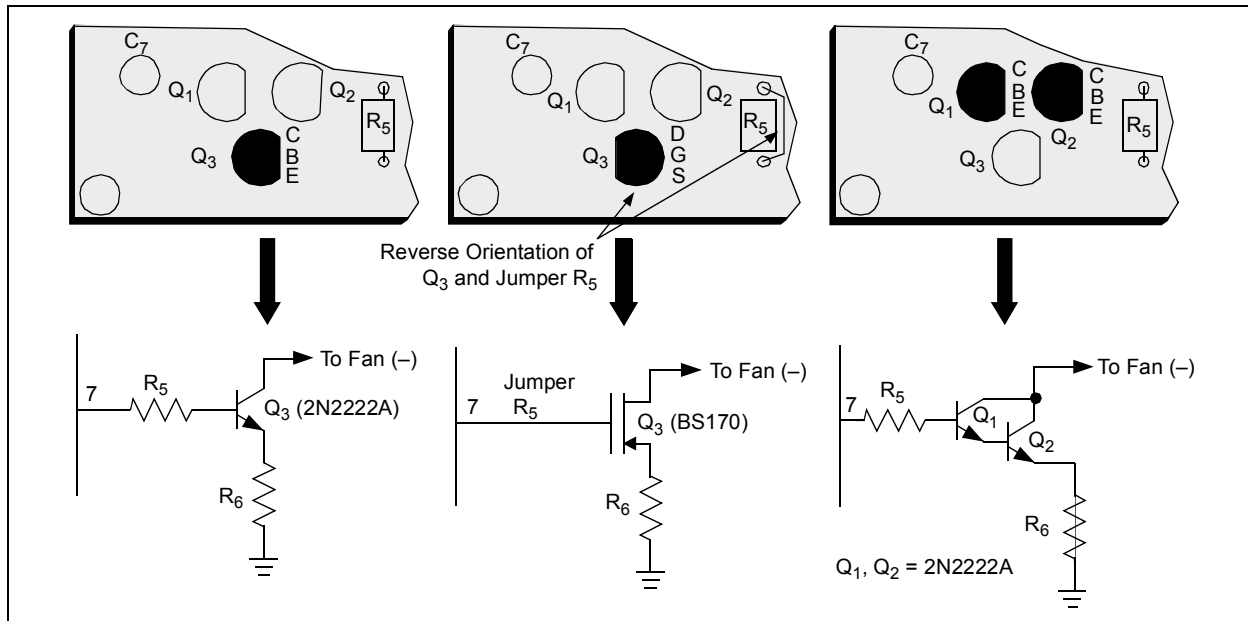


FIGURE 2-1: Output Driver Configuration Options

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. A NTC thermistor connects from the SENSOR input of the fan control module to V_{DD} . Fan control module resistors R_1 and R_2 (See Figure A-2), in conjunction with characteristics of the NTC thermistor, determine the fan speed versus the temperature profile of the system.

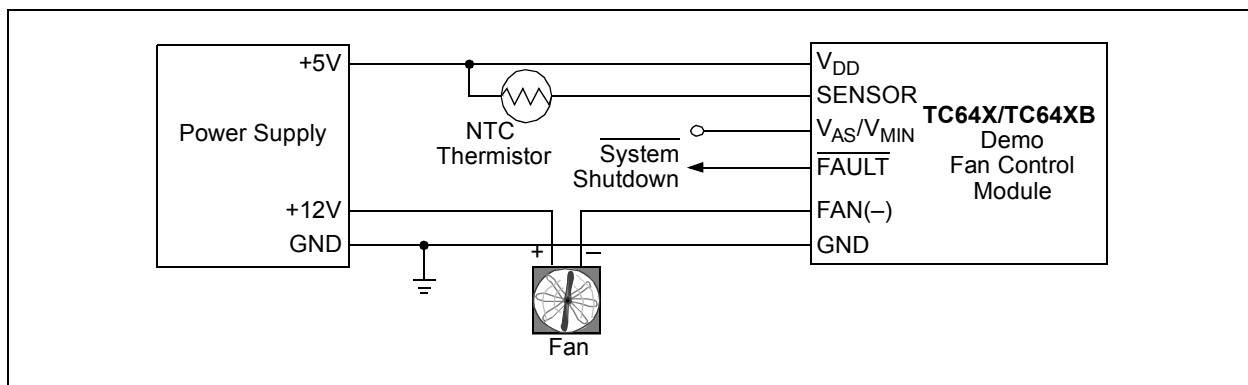


FIGURE 2-2: Typical Wiring Connections to Fan Module for +12V Fan and +5V Module Supply

Appendix A. Board Layout and Schematic

A.1 INTRODUCTION

This appendix contains general information concerning the layout, schematic and components for the TC64X/TC64XB Fan Control Demo Board.

A.2 BOARD LAYOUT AND SCHEMATIC

Figure A-1 depicts the layout for the TC64X/TC64XB Fan Control Demo Board. Figure A-2 shows the schematic for the TC64X/TC64XB Fan Control Module.

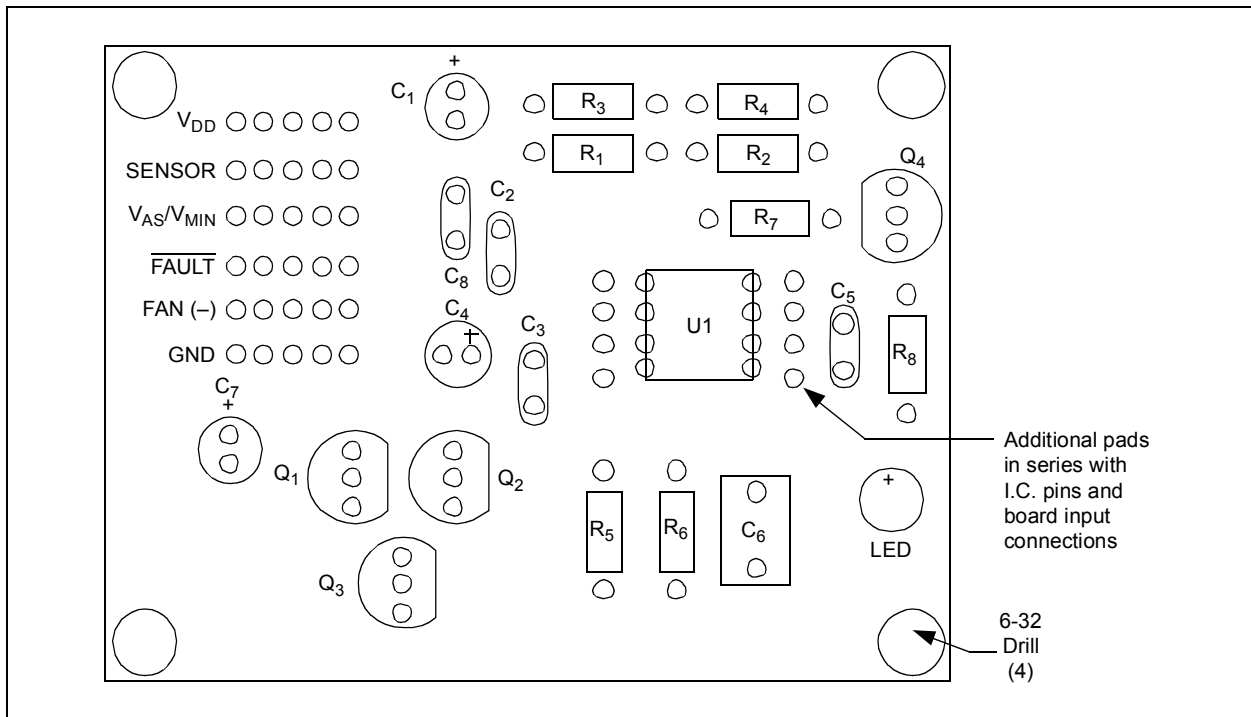


FIGURE A-1: TC64X/TC64XB Fan Control Demo Board Layout

TC64X/TC64XB Fan Control Demo Board User's Guide

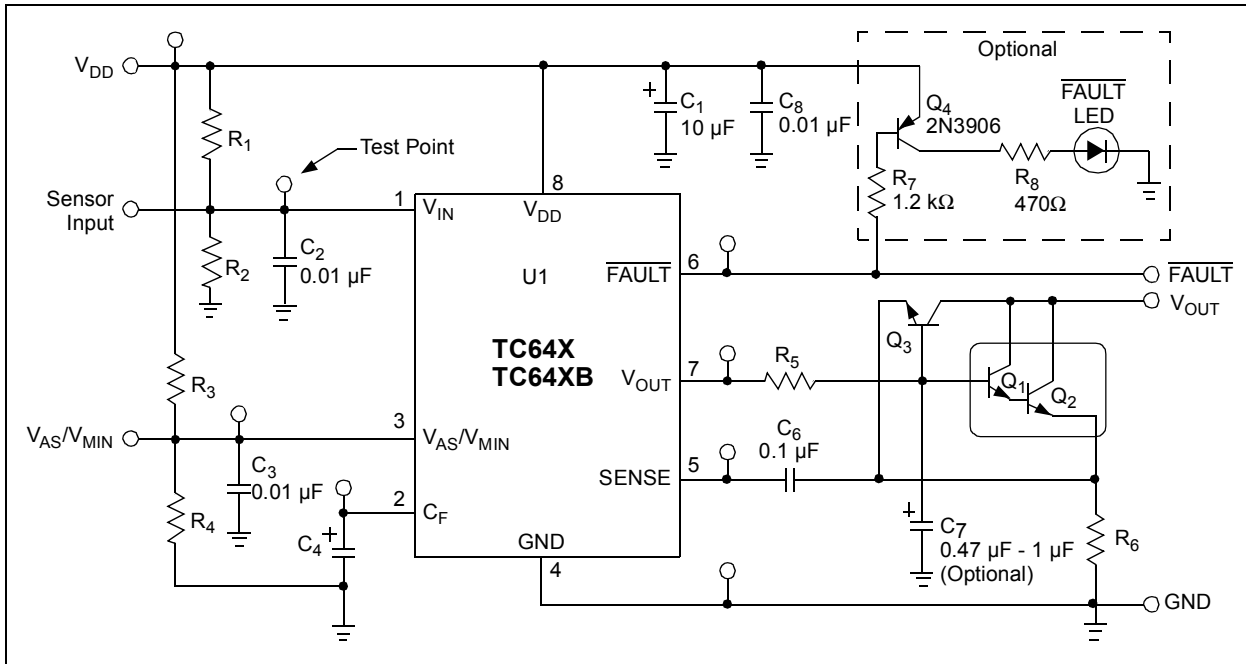


FIGURE A-2: TC64X/TC64XB Fan Control Demo Board Schematic



TC64X/TC64XB FAN CONTROL DEMO BOARD USER'S GUIDE

Appendix B. Bill-of-Materials (BOM)

B.1 DEMO BOARD COMPONENTS

Table B-1 lists typical components and the associated values that comprise the TC64X/TC64XB Fan Control Demo Board.

TABLE B-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 <u>FAULT</u> 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 and TC64XB 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 and TC64XB 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 and TC64XB data sheets.	Value depends on the desired minimum fan speed setting (TC642/2B, TC647/7B) or auto-shutdown temperature (TC646/6B, TC648/8B, TC649/9B).
R ₅	See the Applications section of the TC64X and TC64XB data sheets.	Base current limiting resistor. Value depends on the type of fan and driver used. Typical values appear in Table B-1.
R ₆	See Applications section of the TC64X and TC64XB data sheets.	Fan Current sensing resistor. Value depends on full-speed fan current. Typical values are shown in Table B-1.
R ₇	1.2 k 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/B, TC646/B, TC647/B, TC648/B or TC649/B Fan Control devices	



WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support: 480-792-7627
Web Address: <http://www.microchip.com>

Atlanta

3780 Mansell Road, Suite 130
Alpharetta, GA 30022
Tel: 770-640-0034
Fax: 770-640-0307

Boston

2 Lan Drive, Suite 120
Westford, MA 01886
Tel: 978-692-3848
Fax: 978-692-3821

Chicago

333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 630-285-0071
Fax: 630-285-0075

Dallas

4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7423
Fax: 972-818-2924

Detroit

Tri-Atria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI 48334
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo

2767 S. Albright Road
Kokomo, IN 46902
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles

18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888
Fax: 949-263-1338

Phoenix

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7966
Fax: 480-792-4338

San Jose

2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950
Fax: 408-436-7955

Toronto

6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Australia

Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing

Unit 915
Bei Hai Wan Tai Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100
Fax: 86-10-85282104

China - Chengdu

Rm. 2401-2402, 24th Floor,
Ming Xing Financial Tower
No. 88 TIDU Street
Chengdu 610016, China
Tel: 86-28-86766200
Fax: 86-28-86766599

China - Fuzhou

Unit 28F, World Trade Plaza
No. 71 Wusi Road
Fuzhou 350001, China
Tel: 86-591-7503506
Fax: 86-591-7503521

China - Hong Kong SAR

Unit 901-6, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Shanghai

Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700
Fax: 86-21-6275-5060

China - Shenzhen

Rm. 1812, 18/F, Building A, United Plaza
No. 5022 Binhe Road, Futian District
Shenzhen 518033, China
Tel: 86-755-82901380
Fax: 86-755-8295-1393

China - Shunde

Room 401, Hongjian Building
No. 2 Fengxiangnan Road, Ronggui Town
Shunde City, Guangdong 528303, China
Tel: 86-765-8395507 Fax: 86-765-8395571

China - Qingdao

Rm. B505A, Fullhope Plaza,
No. 12 Hong Kong Central Rd.
Qingdao 266071, China
Tel: 86-532-5027355 Fax: 86-532-5027205

India

Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaughnessy Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan

Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471-6166 Fax: 81-45-471-6122

Korea

168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-882
Tel: 82-2-554-7200 Fax: 82-2-558-5932 or
82-2-558-5934

Singapore

200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-6334-8870 Fax: 65-6334-8850

Taiwan

Kaohsiung Branch
30F - 1 No. 8
Min Chuan 2nd Road
Kaohsiung 806, Taiwan
Tel: 886-7-536-4818
Fax: 886-7-536-4803

Taiwan

Taiwan Branch
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Austria

Durisolstrasse 2
A-4600 Wels
Austria
Tel: 43-7242-2244-399
Fax: 43-7242-2244-393

Denmark

Regus Business Centre
Lautrup høj 1-3
Ballerup DK-2750 Denmark
Tel: 45-4420-9895 Fax: 45-4420-9910

France

Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - ler Etage
91300 Massy, France
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany

Steinheilstrasse 10
D-85737 Ismaning, Germany
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy

Via Quasimodo, 12
20025 Legnano (MI)
Milan, Italy
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands

P. A. De Biesbosch 14
NL-5152 SC Drunen, Netherlands
Tel: 31-416-690399
Fax: 31-416-690340

United Kingdom

505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44-118-921-5869
Fax: 44-118-921-5820

07/28/03