TC64X/TC64XB Fan Control Demo Board User's Guide

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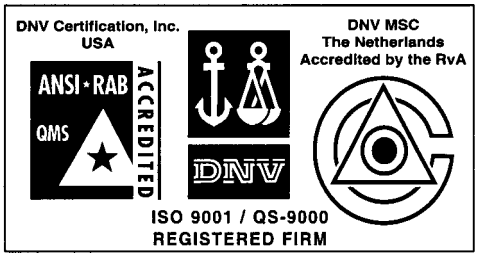

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TC64X/TC64XB FAN CONTROL DEMO BOARD USER'S GUIDE

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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

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	TC642B**EPA**	TC642B**EOA**
TC646B	TC646B**EPA**	TC646B**EOA**
TC647	TC647**VPA**	TC647**VOA**
TC647B	TC647B**EPA**	TC647B**EOA**
TC648	TC648**VPA**	TC648**VOA**
TC648B	TC648B**EPA**	TC648B**EOA**
TC649	TC649**VPA**	TC649**VOA**
TC649B	TC649B**EPA**	TC649B**EOA**

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.

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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.

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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., Q_3 installed; Q_1 and Q_2 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.

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_{DSON} 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.

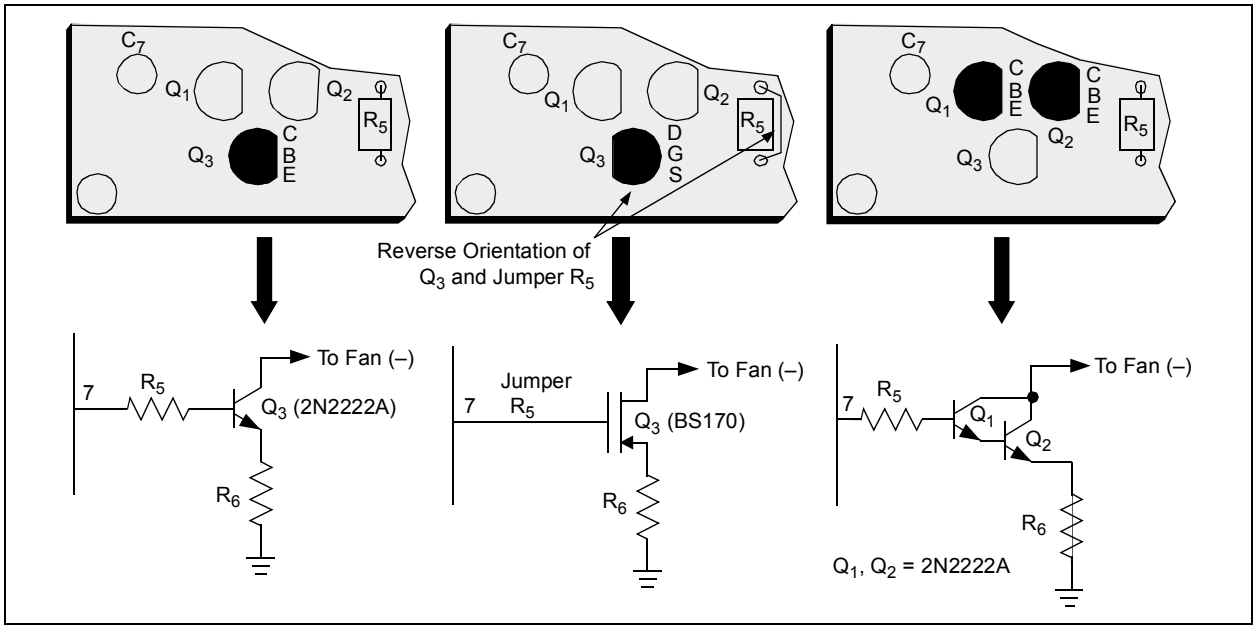

FIGURE 2-1: *Output Driver Configuration Options*

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.

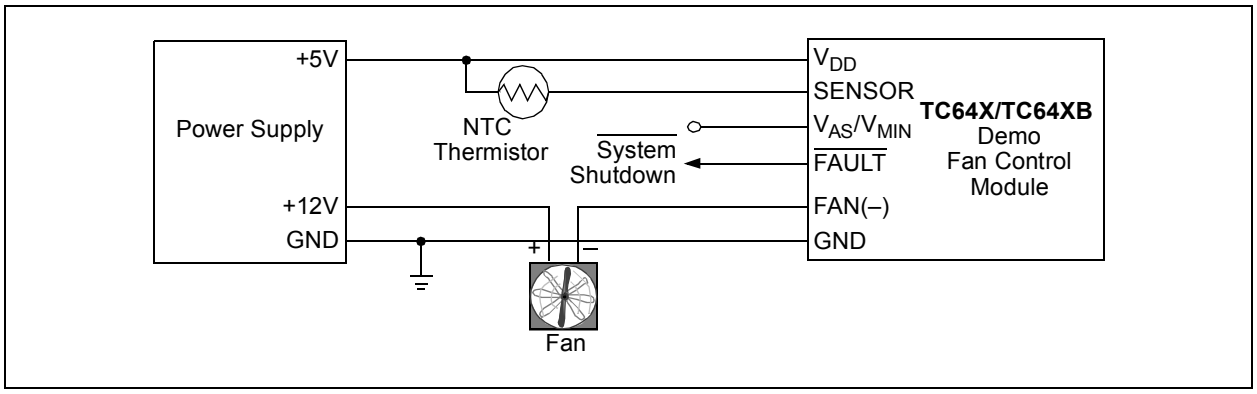

FIGURE 2-2: *Typical Wiring Connections to Fan Module for +12V Fan and +5V Module Supply*

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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.

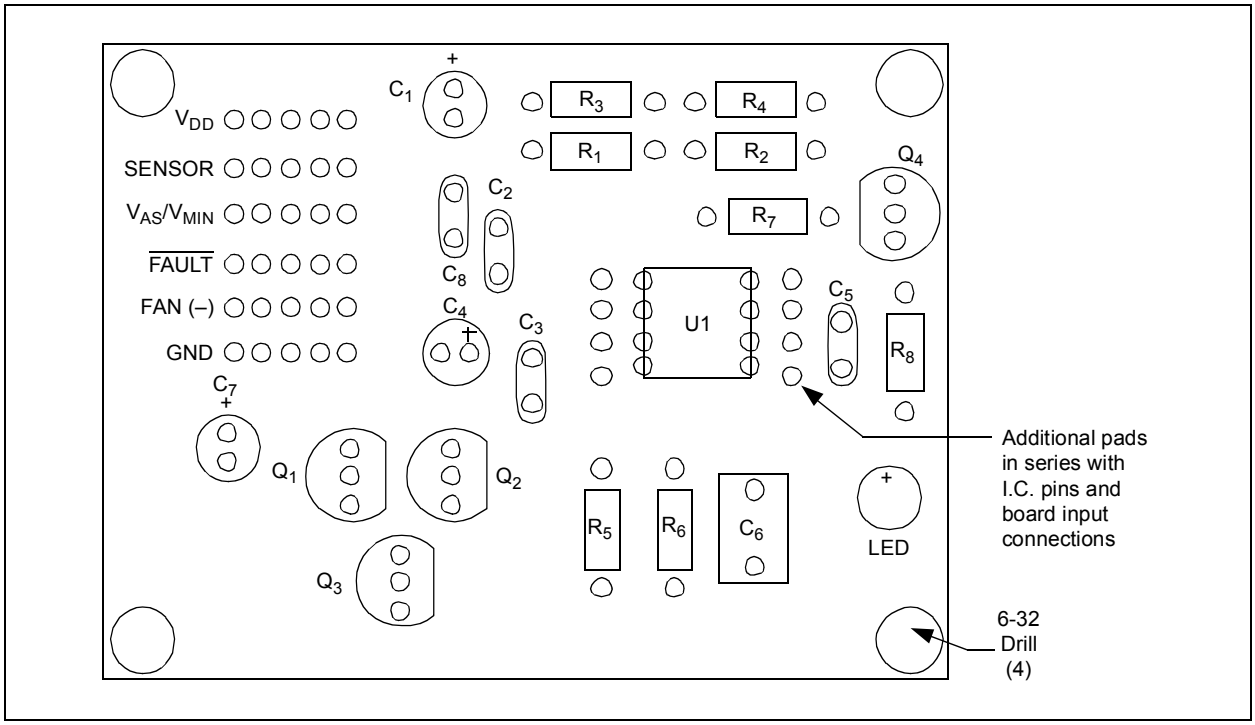

FIGURE A-1: *TC64X/TC64XB Fan Control Demo Board Layout*

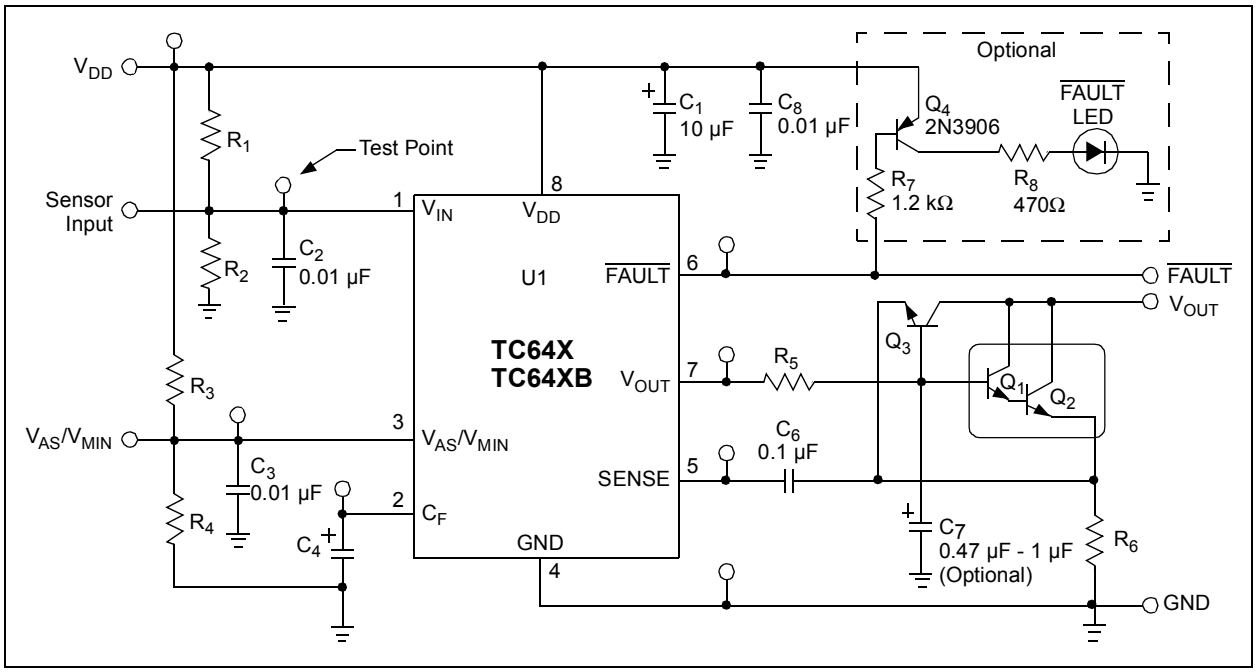

FIGURE A-2: *TC64X/TC64XB Fan Control Demo Board Schematic*

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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 µF Radial Electrolytic Capacitor	Power supply filter.
C_2	0.01 µF Ceramic Disk Capacitor	Bypass capacitor.
C_3	0.01 µF Ceramic Disk Capacitor	Bypass capacitor.
C_4	1.0 µF Ceramic Capacitor	PWM capacitor. Typical value is 1.0 µF (PWM frequency of 30 Hz).
C_5	Not used	—
C_6	0.1 µF Ceramic Disk Capacitor	SENSE input coupling capacitor.
C_7	0.47 µF to 1 µF Radial Electrolytic Capacitor	Fan acoustic noise suppression capacitor. (Optional)
C_8	0.01 µF Ceramic Disk Capacitor	Bypass capacitor.
LED	10 mA Miniature LED	LED lights when $\overline{\text{FAULT}}$ output is LOW (active). (Optional)
Q_1, Q_2	2N2222A NPN Transistor	Darlington pair output option. If used, Q3 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 kΩ, 1/4 Watt, 5% Resistor	LED Drive transistor base resistor (Optional).
R_8	470Ω, 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	

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Corporate Office
2355 West Chandler Blvd.
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Web Address: http://www.microchip.com

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Fax: 765-864-8387

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Fax: 480-792-4338

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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

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No. 71 Wusi Road
Fuzhou 350001, China
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Kwai Fong, N.T., Hong Kong
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Far East International Plaza
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Fax: 86-21-6275-5060

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No. 5022 Binhe Road, Futian District
Shenzhen 518033, China
Tel: 86-755-82901380
Fax: 86-755-8295-1393

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Shunde City, Guangdong 528303, China
Tel: 86-765-8395507 Fax: 86-765-8395571

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

India
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1 Floor, Wing A (A3/A4)
No. 11, O'Shaugnessey 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
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Kaohsiung 806, Taiwan
Tel: 886-7-536-4818
Fax: 886-7-536-4803

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Taiwan Branch
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Austria
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Ballerup DK-2750 Denmark
Tel: 45-4420-9895 Fax: 45-4420-9910

France
Parc d'Activite du Moulin de Massy
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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
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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

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