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## PS501 Two-Cell Battery Manager Module with LED SOC Display for Lithium Chemistries

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### Features

- PS501 tested, fully populated modules for evaluation
- Designed to work with 2 series cell Lithium chemistry configurations
- Performs all major Lithium battery management functions, including:
  - Accurate capacity monitoring
  - Lithium cell protection
- SOC display with four LEDs and a switch
- Fully compliant with industry standard Smart Battery Data Specification v1.1a
- SMBus v1.1 with PEC/CRC-8 communication with system host
- High accuracy measurement of charge/discharge current, voltage and temperature with on-chip 16-bit integrating A/D
- Precise capacity reporting using Microchip patented algorithms and 3D battery cell models
- 3D models and “learned” parameters stored in integrated memory
- Complete hardware and software development tools available:
  - ICD (In-Circuit Debugger) port to support development of custom code
- Extremely low-power operation:
  - Run mode: 140  $\mu$ A typical
  - Low-Voltage Sleep mode: 30  $\mu$ A typical
  - Shelf-Sleep mode: 5  $\mu$ A typical
- Overall mechanical dimensions:
  - 0.339 W x 2.165 L (inches)
  - 8.6 W x 55.0 L (millimeters)

### Ordering Information

Part Number	Description
PS5162	Li Ion/Poly – 2 series cells

# PS5162

## 1.0 GENERAL DESCRIPTION

The PS5162 module is a complete smart battery controller subsystem based on the Microchip PS501 field reprogrammable battery manager with patented Accuron® technology. The module is designed to operate in a battery pack consisting of two (2) series connected Li-based cells. The module consists of the Microchip PS501 battery manager IC with a four-LED SOC display and an optional connection for an external thermistor.

## 1.1 Quick Start – Pack Assembly

Follow these directions to assemble a pack with the PS5162 module.

- Use standard precautions when handling static sensitive devices.
- Modules should be connected to battery cells in the order indicated below to insure proper start-up and operation. Wires should be attached to the modules first and then connected to the battery cells as instructed.
- The connection sequence is critical to successful use of the PS501 family of CMOS ASICs. The pack positive should be securely connected to the module first, followed by the intermediate cell connection and then pack negative.

**Step 1)** Configure the module for optional external thermistor use. PS5162 modules are shipped configured to use the internal temperature sensor only. To add an external thermistor to the board, remove resistor R16 (side 2) and connect the thermistor across via TN and TR.

**Step 2)** Connect wires to module. Use large diameter wire (18 AWG-20 AWG) for current carrying lines from VR, V1, BP and BN. All others are signal only lines (24 to 22 AWG).

**Step 3)** Connect external connector to BN, T, C, D and BP.

**Step 4)** Connect V1 to the most positive point on the battery cell stack.

**Step 5)** Connect V2 to the middle of the cell stack.

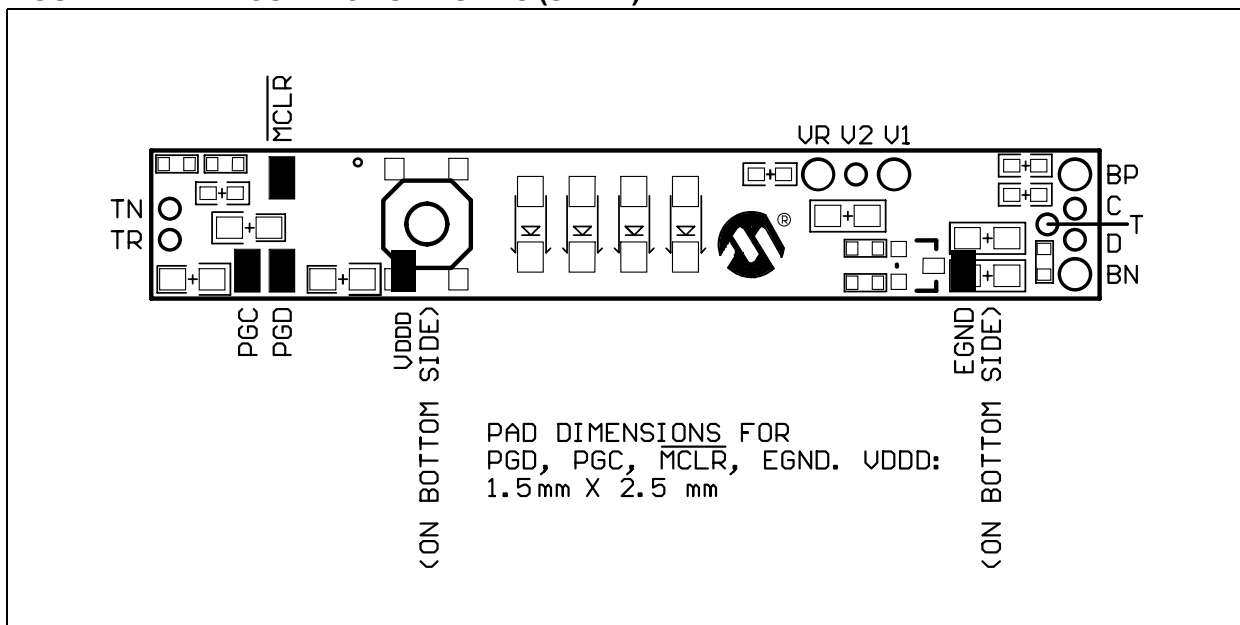
**Step 6)** Connect VR to the most negative point on the battery cell stack.

**Step 7)** Program the assembled pack using Microchip's software and PowerCal™ board or PowerInfo™ board hardware.

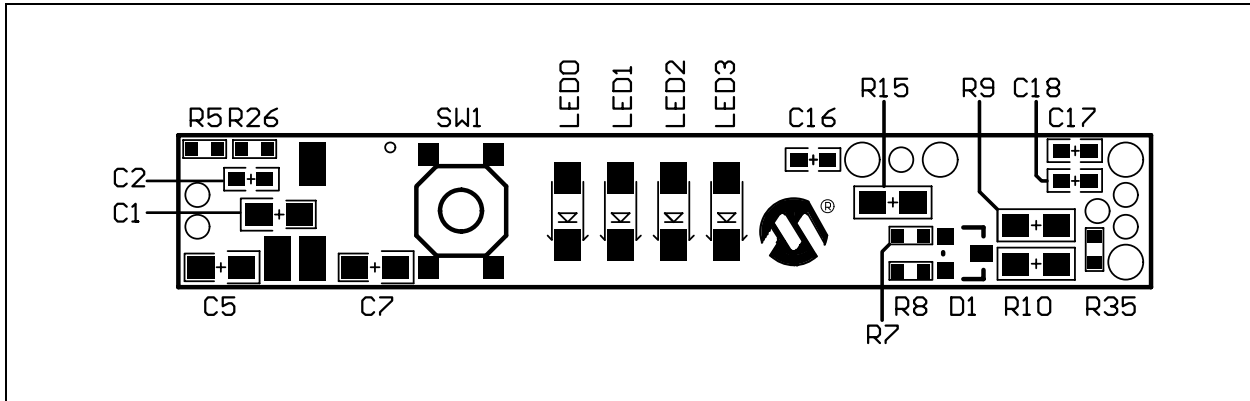
The memory parameters can be changed at will using the utilities on the memory page in the software.

**Step 8)** Calibrate the pack using the software and PowerCal™ board hardware. The pack is now ready for use.

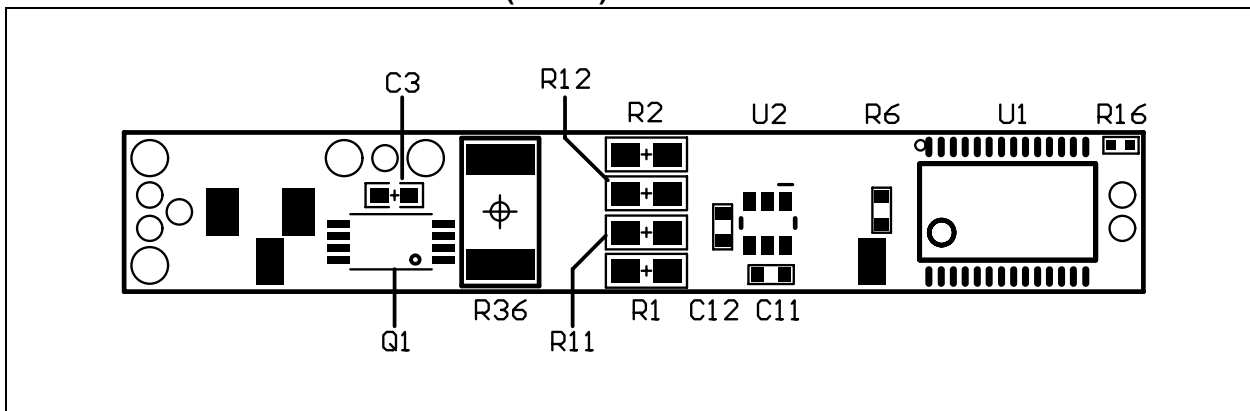
FIGURE 1-1: CONNECTION POINTS (SIDE 1)



**FIGURE 1-2: BOARD ASSEMBLY (SIDE 1)**



**FIGURE 1-3: BOARD ASSEMBLY (SIDE 2)**



## 2.0 FUNCTIONAL DESCRIPTION

### 2.1 PS501 Fuel Gauge

The module fuel gauge provides State-Of-Charge (SOC) and battery status data in accordance with the SMBus standards version 1.1. The PS501 monitors the cell voltages, battery temperature and current to determine SOC and battery status. The State-Of-Charge calculations are compensated for cell self-discharge. The remaining time calculation is compensated for temperature and discharge rate. The parameters for determining battery status flags and alarm thresholds are all programmable, as is the battery design capacity and the battery performance model data. Please refer to the *"PS501 Data Sheet"* (DS21818) for details on configuring the PS501 device.

### 2.2 Primary Safety

The primary safety circuit provides cell protection from conditions of overcharge, overdischarge and over-current. The analog safety IC measures individual cell voltages, current and voltage across the safety FETs. These values are compared against internal reference values and the gates of two N-channel power MOSFETs are controlled based on the comparison results.

## 3.0 BOARD DESCRIPTION

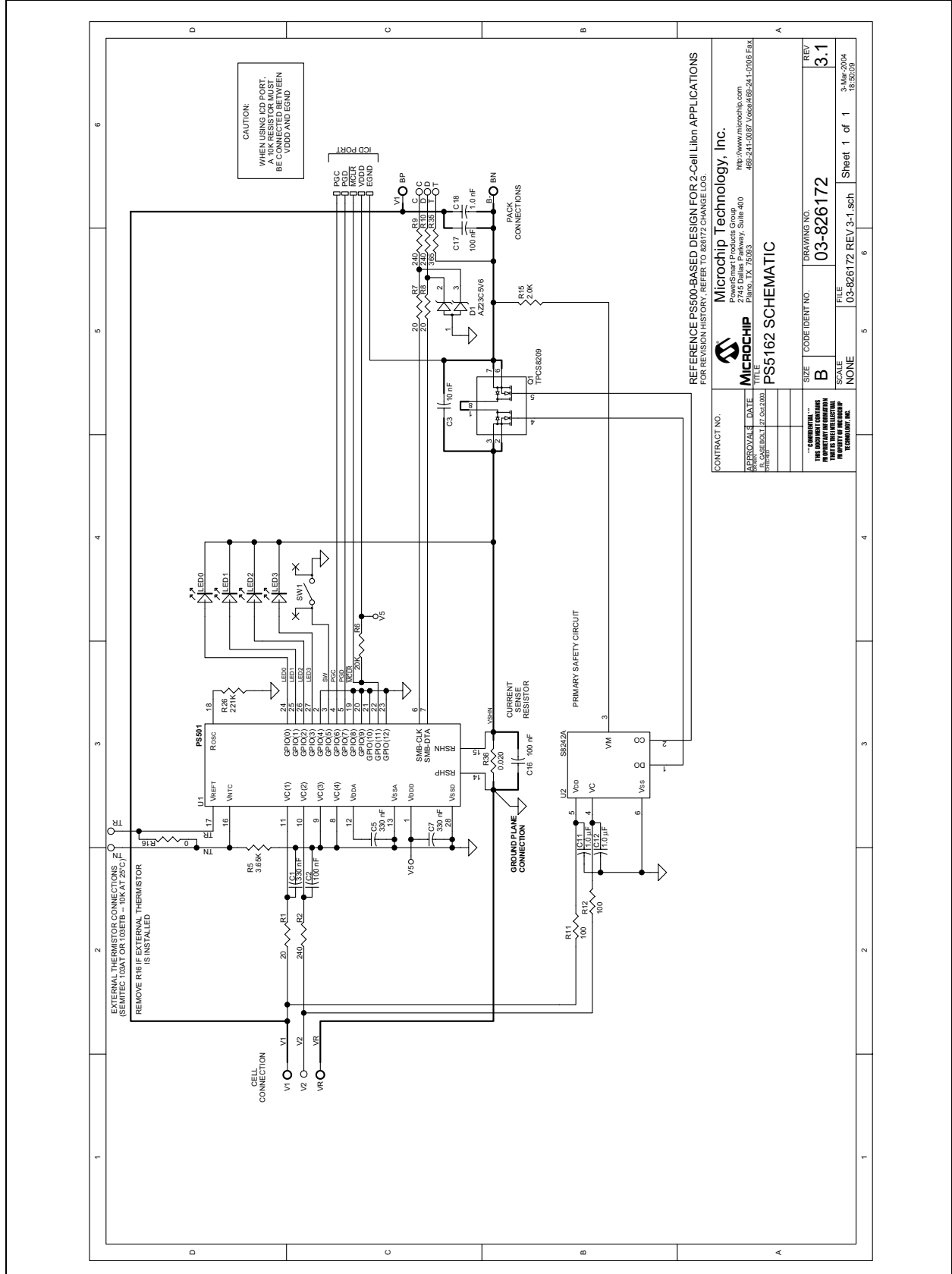
PCB schematics and bill of materials are included here for completeness. To download the full size schematic and BOM, please visit the Microchip web site.

### 3.1 Mechanical Dimensions

Overall Dimensions: 2165 mils x 339 mils

## 3.2 Schematic

FIGURE 3-1: PS5162 BOARD SCHEMATIC



# PS5162

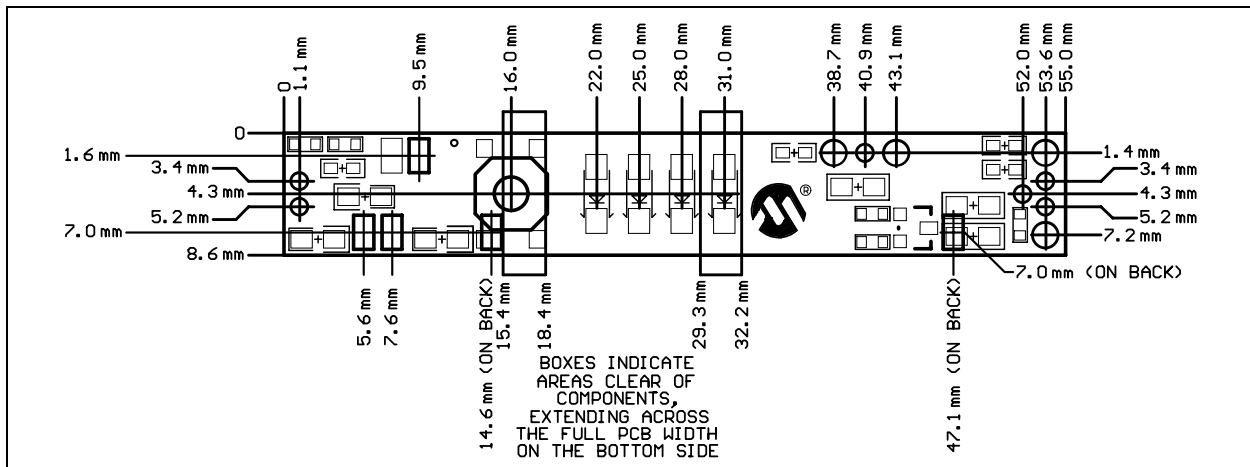
## 3.3 Bill of Materials

TABLE 3-1: PS5162 BILL OF MATERIALS

Symbols	Description	Manufacturer	Manufacturer PN	Qty.
	Raw PCB, PS5162	Microchip	04-826172 Rev. 3.1	1
C11, C12	Capacitor, Ceramic, 1.0 $\mu$ F, 16V, +/-10%, X5R dielectric, 0603	Panasonic Murata	ECJ-1VB1C105K GRM188R61C105KA93D	2
C18	Capacitor, Ceramic, 1.0 nF, 50V, +/-10%, X7R dielectric, 0603	Panasonic	ECJ-1VB1H102K	1
C3	Capacitor, Ceramic, 10 nF, 50V, +/-10%, X7R dielectric, 0603	Panasonic	ECJ-1VB1H103K	1
C2, C16-C17	Capacitor, Ceramic, 100 nF, 25V, +80%/-20%, Y5V dielectric, 0603	Panasonic	ECJ-1VF1E104Z	3
C1, C5, C7	Capacitor, Ceramic, 330 nF, 25V, +80%/-20%, Y5V dielectric, 0805	Panasonic	ECJ-2YF1E334Z	3
LED0-LED3	LED, clear green, 1206 package	Lumex	SML-LX1206GC-TR	4
D1	Dual Zener Diode, 5.6V, +/-5%, 300 mW, common anode, SOT-23	Diodes Inc. General Semiconductor	AZ23C5V6-7 AZ23-C5V6	1
Q1	MOSFET, dual N-channel Enhancement mode, -20V, -5A, TSSOP (8/4.4 mm body width) package	Toshiba	TPCS8209(TE12L)	1
R16	Resistor, zero ohm, 0402	Panasonic	ERJ-2GE0R00X	1
R5	Resistor, film, 0603, 1%, 3.65 KOhms	Panasonic	ERJ-3EKF3651V	1
R35	Resistor, film, 0603, 1%, 365 ohms	Panasonic	ERJ-3EKF3650V	1
R26	Resistor, film, 0603, 1%, 221 KOhms, 25 ppm TC	Susumu Co. Ltd.	RR0816P-2213-D-34D	1
R7-R8	Resistor, film, 0603, 5%, 20 ohms	Panasonic	ERJ-3GEYJ200V	2
R6	Resistor, film, 0603, 5%, 20 KOhms	Panasonic	ERJ-3GEYJ203V	1
R11-R12	Resistor, film, 0805, 5%, 100 ohms	Panasonic	ERJ-6GEYJ101V	2
R15	Resistor, film, 0805, 5%, 2.0 KOhms	Panasonic	ERJ-6GEYJ202V	1
R1	Resistor, film, 0805, 5%, 20 ohms	Panasonic	ERJ-6GEYJ200V	1
R2, R9-R10	Resistor, film, 0805, 5%, 240 ohms	Panasonic	ERJ-6GEYJ241V	3
R36	Resistor, metal strip, 2512, 1%, 0.020 ohms	Vishay	WSL2512-0.020-1%-R86	1
SW1	Switch, SPST-momentary, push button, surface mount	ALPS Fuk Hing Ind.	SKQGADE010 11871501	1
U2	IC, Battery Protection Circuit, Li Ion, 2-cell, -40°C to +85°C, SOT-23-6 package	Seiko Instruments	S-8242AAG-M6T2G (Note 1)	1
U1	IC, Single Chip Battery Manager, programmable, -20°C to +85°C, SSOP-28	Microchip	PS501-I/ST	1

Note 1: Other variants of the S-8242A series, with different trip points, are also available. Consult the S-8242A series data sheet.

FIGURE 3-2: PS5162 DIMENSION DETAILS



## 4.0 DEVELOPMENT TOOL SUMMARY

Microchip provides all the necessary hardware and software to enable easy tailoring of battery control algorithm parameters and cell performance models to meet specific application requirements and attain the highest accuracy available anywhere. Table 4-1 summarizes the development tool offering from Microchip to support the PS5162. Please refer to the Microchip web site for ordering information and design documentation (including schematics) at [www.microchip.com](http://www.microchip.com).

## 4.1 Reference Documents

This data sheet provides an overview of the PS5162 Battery Manager module. For further information on the PS501 and development tool operations, please refer to the following documents available for download at [www.microchip.com](http://www.microchip.com).

**TABLE 4-1: MICROCHIP DEVELOPMENT TOOL SUMMARY**

Development Tool	Use
PowerInfo™ hardware with PC software (PS041)	Read and write Smart Battery data values, memory programming
PowerCal™ hardware with PC software (PS042)	Read and write Smart Battery data values, memory programming, pack calibration, pack test

**TABLE 4-2: MICROCHIP REFERENCE DOCUMENTS**

Document Number	Documents Available
DS21818	PS501 Single Chip Field Reprogrammable Battery Manager Data Sheet (IC Products)
DS40234	PS041 PowerInfo™ Configuration Interface Product Brief
DS40237	PS042 PowerCal™ Calibration Platform Data Sheet

# PS5162

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NOTES:



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#### Corporate Office

2355 West Chandler Blvd.  
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Tel: 480-792-7200  
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Tel: 248-538-2250  
Fax: 248-538-2260

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Kokomo, IN 46902  
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Fax: 765-864-8387

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Fax: 949-263-1338

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Mississauga, Ontario L4V 1X5, Canada  
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### ASIA/PACIFIC

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Epping 2121, NSW  
Australia  
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#### China - Beijing

Unit 706B  
Wan Tai Bei Hai Bldg.  
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Fax: 86-10-85282104

#### China - Chengdu

Rm. 2401-2402, 24th Floor,  
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Unit 28F, World Trade Plaza  
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Fuzhou 350001, China  
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Room 401, Hongjian Building, No. 2  
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District, Foshan City, Guangdong 528303, China  
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Qingdao 266071, China  
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Divyasree Chambers  
1 Floor, Wing A (A3/A4)  
No. 11, O'Shaughnessy Road  
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Benex S-1 6F  
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Tel: 82-2-554-7200 Fax: 82-2-558-5932 or  
82-2-558-5934

#### Singapore

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

#### Taiwan

Kaohsiung Branch  
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Tel: 886-7-536-4818  
Fax: 886-7-536-4803

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Tung Hua North Road  
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### 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

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

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D-85737 Ismaning, Germany  
Tel: 49-89-627-144-0  
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Fax: 39-0331-466781

#### Netherlands

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Fax: 31-416-690340

#### United Kingdom

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Wokingham  
Berkshire, England RG41 5TU  
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Fax: 44-118-921-5820

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