# PS5162

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

## 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 μA typical
  - Low-Voltage Sleep mode: 30 μA typical
  - Shelf-Sleep mode: 5 μA 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 |

## 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)**

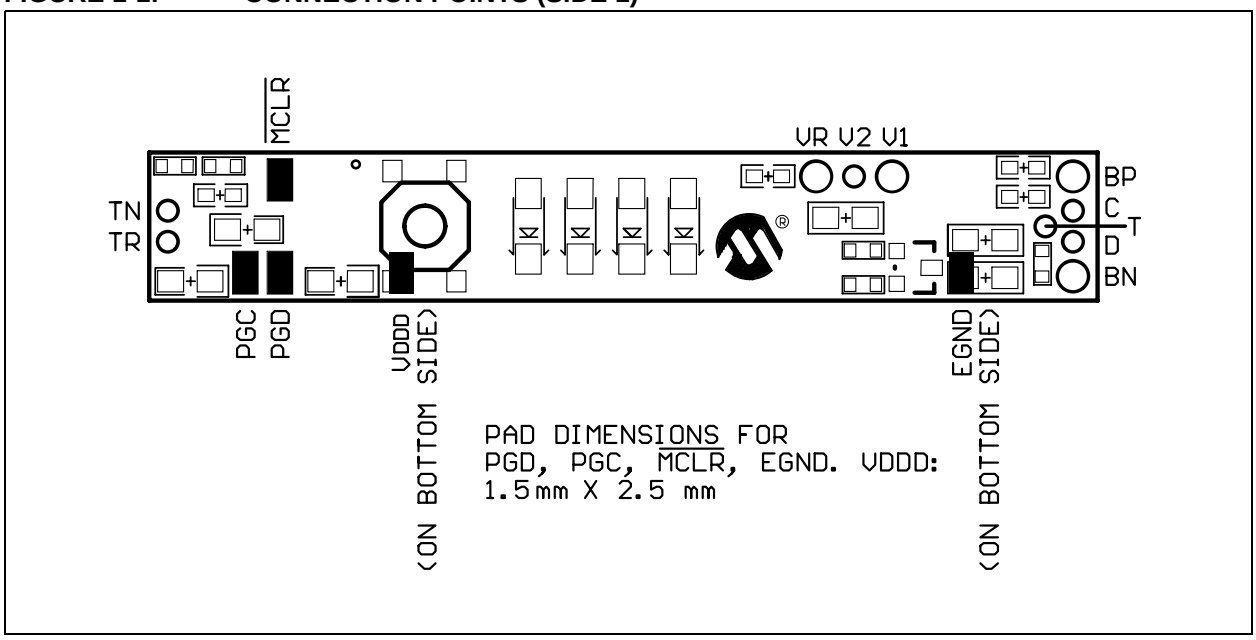


**FIGURE 1-2: BOARD ASSEMBLY (SIDE 1)**

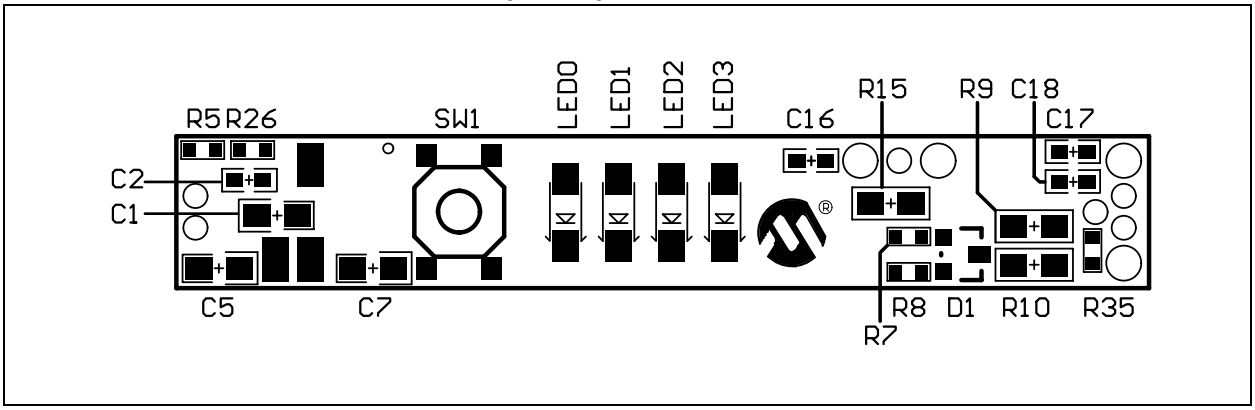
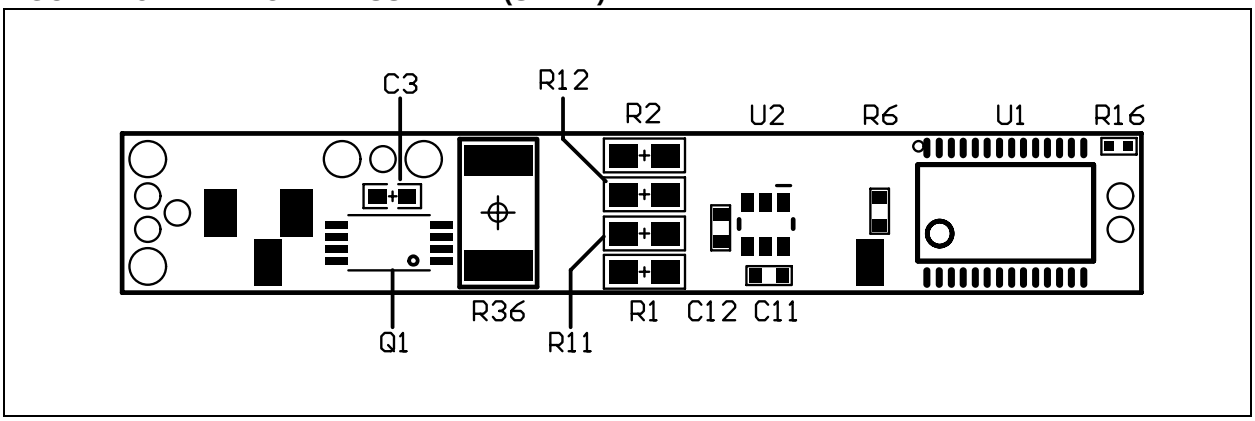



**FIGURE 1-3: BOARD ASSEMBLY (SIDE 2)**



## 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 overcurrent. 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

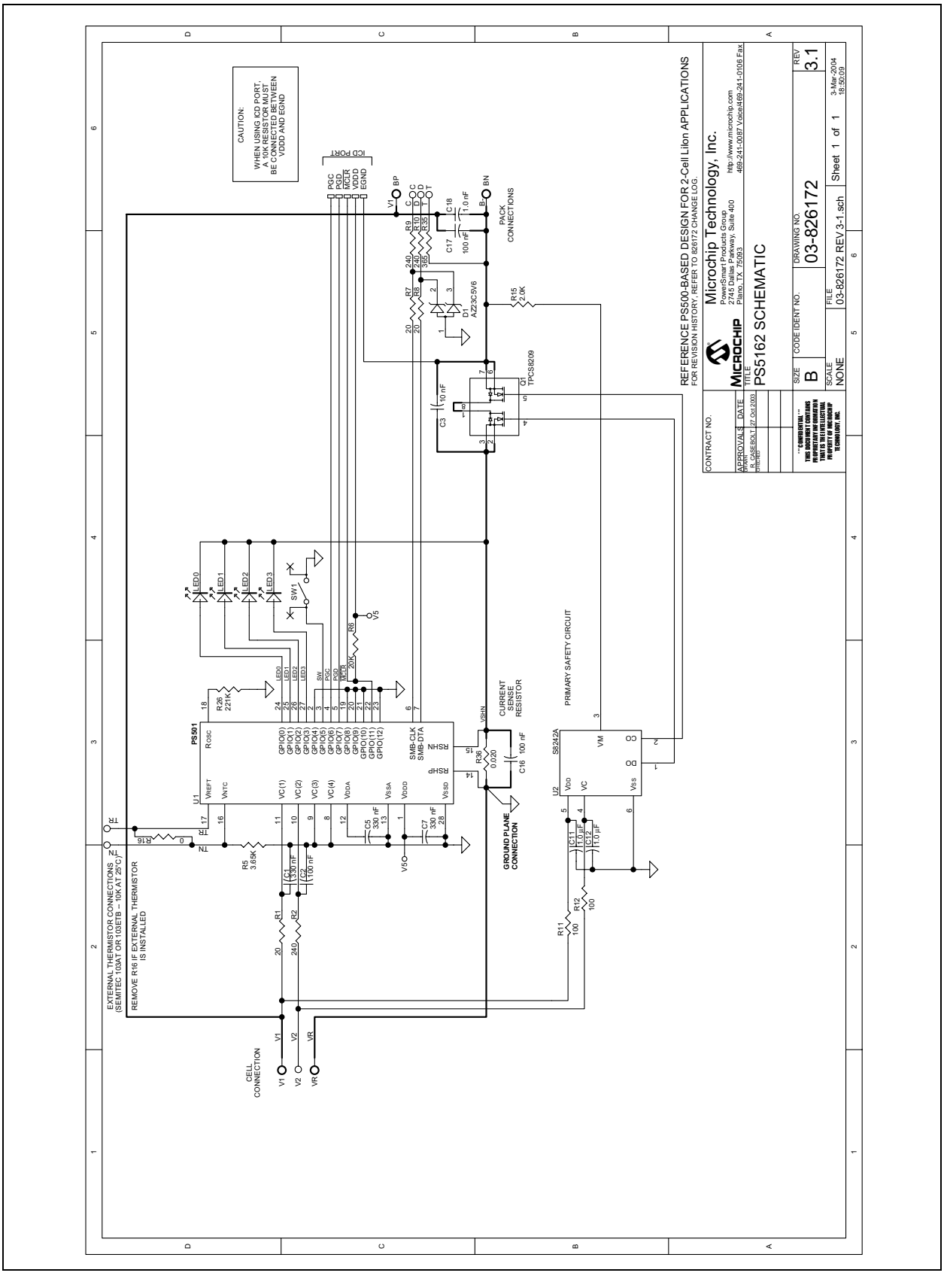
PCB schematics and bill of materials are included here for completeness. To download the full size schematic and BOM, please visit the Microchip web site.

### 3.1 Mechanical Dimensions

Overall Dimensions: 2165 mils x 339 mils

## 3.2 Schematic

**FIGURE 3-1: PS5162 BOARD SCHEMATIC**



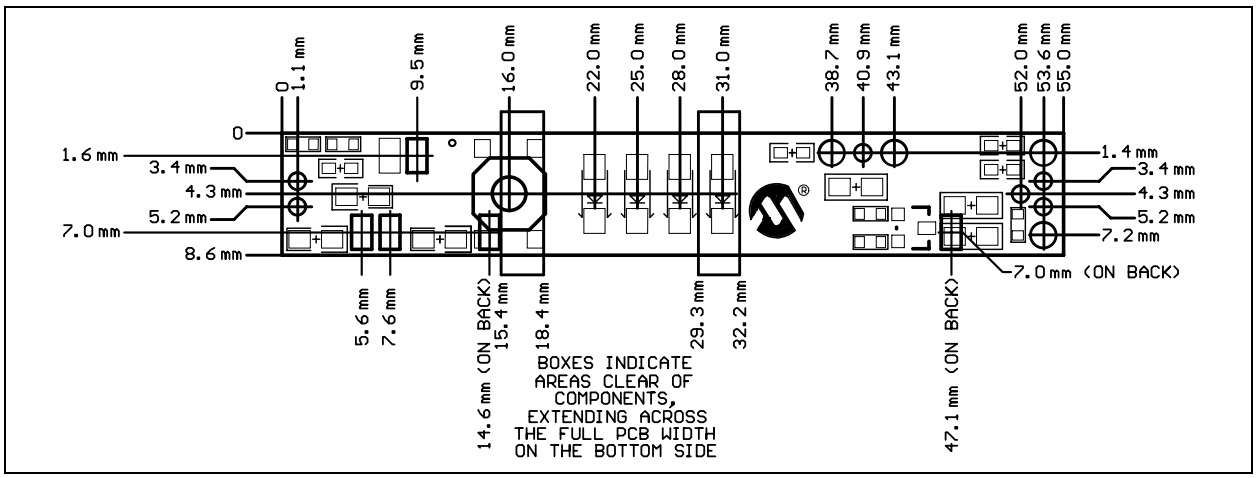
## 3.3 Bill of Materials

**TABLE 3-1: PS5162 BILL OF MATERIALS**

| Symbols | Description | Manufacturer | Manuafacturer PN | Qty. |
|---|---|---|---|---|
| | Raw PCB, PS5162 | Microchip | 04-826172 Rev. 3.1 | 1 |
| C11, C12 | Capacitor, Ceramic, 1.0 µF, 16V, +/-10%, X5R dielectric, 0603 | Panasonic<br>Murata | ECJ-1VB1C105K<br>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.<br>General Semiconductor | AZ23C5V6-7<br>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<br>Fuk Hing Ind. | SKQGADE010<br>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.

### 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.

**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 |

**NOTES:**

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 and PowerSmart are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SmartShunt is a registered trademark of Microchip Technology Incorporated in the U.S.A.

PowerCal, PowerInfo, PowerMate, PowerTool, SmartSensor and SmartTel are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

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



Printed on recycled paper.

# 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

**San Jose**
1300 Terra Bella Avenue
Mountain View, CA 94043
Tel: 650-215-1444
Fax: 650-961-0286

**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 706B
Wan Tai Bei Hai Bldg.
No. 6 Chaoyangmen Bei Str.
Beijing, 100027, 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
District, Foshan City, Guangdong 528303, China
Tel: 86-757-28395507 Fax: 86-757-28395571

**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'Shaugnessey Road
Bangalore, 560 025, India
Tel: 91-80-22290061 Fax: 91-80-22290062

**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 hoj 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

02/17/04