

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

Features

- PS501 tested, fully populated modules for evaluation
- Designed to work with 4 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:
 - PS050 PC software
 - ICD (In-Circuit Debugger) port to support development of custom code
- Extremely low-power operation:
 - Run mode: 170 μ A typical
 - Low-Voltage Sleep mode: 45 μ A typical
 - Shelf-Sleep mode: 25 μ A typical
- Overall mechanical dimensions:
 - 0.525 W x 2.500 L (inches)
 - 13.3 W x 63.5 L (millimeters)

Ordering Information

Part Number	Description
PS5164	Li Ion/Poly – 4 series cells

PS5164

1.0 GENERAL DESCRIPTION

The PS5164 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 four (4) 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 PS5164 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 cells from most positive to least positive and finally, pack negative.

Step 1) Configure the module for optional external thermistor use. PS5164 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, B+ and BN. All others are signal only lines (24 to 22 AWG).

Step 3) Connect external connector to BN, T, C, D and B+.

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

Step 5) Connect the negative end of the top-most cell to V2, the negative end of the next cell to V3 and the negative end of the third cell to V4.

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)

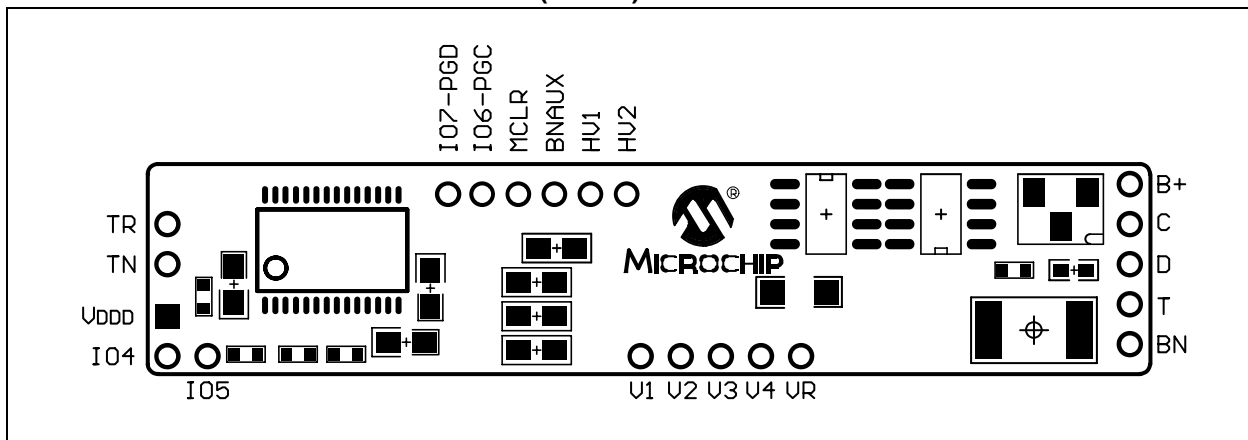


FIGURE 1-2: BOARD ASSEMBLY (SIDE 1)

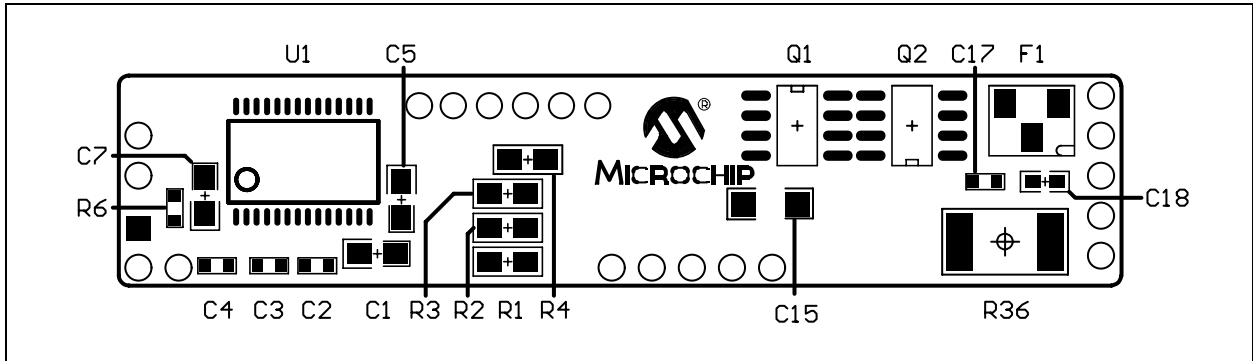
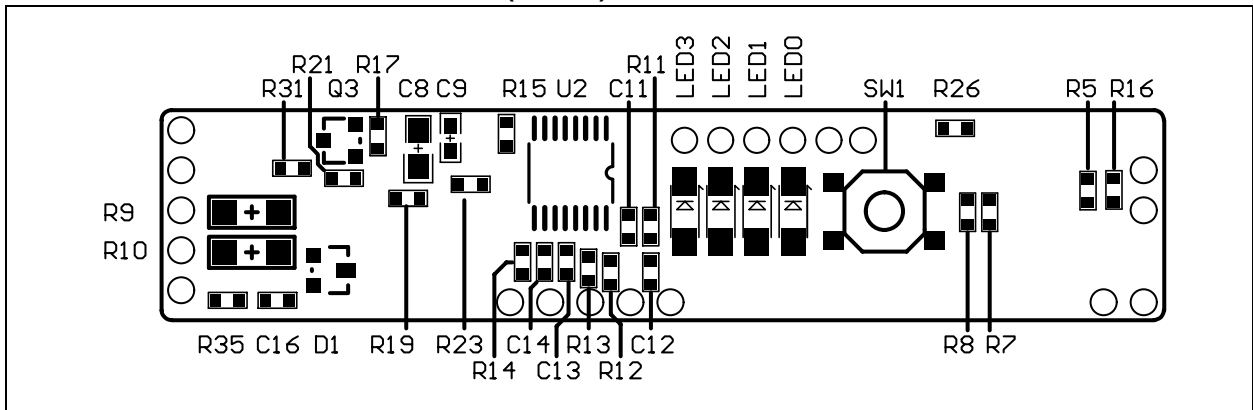


FIGURE 1-3: BOARD ASSEMBLY (SIDE 2)



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.

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

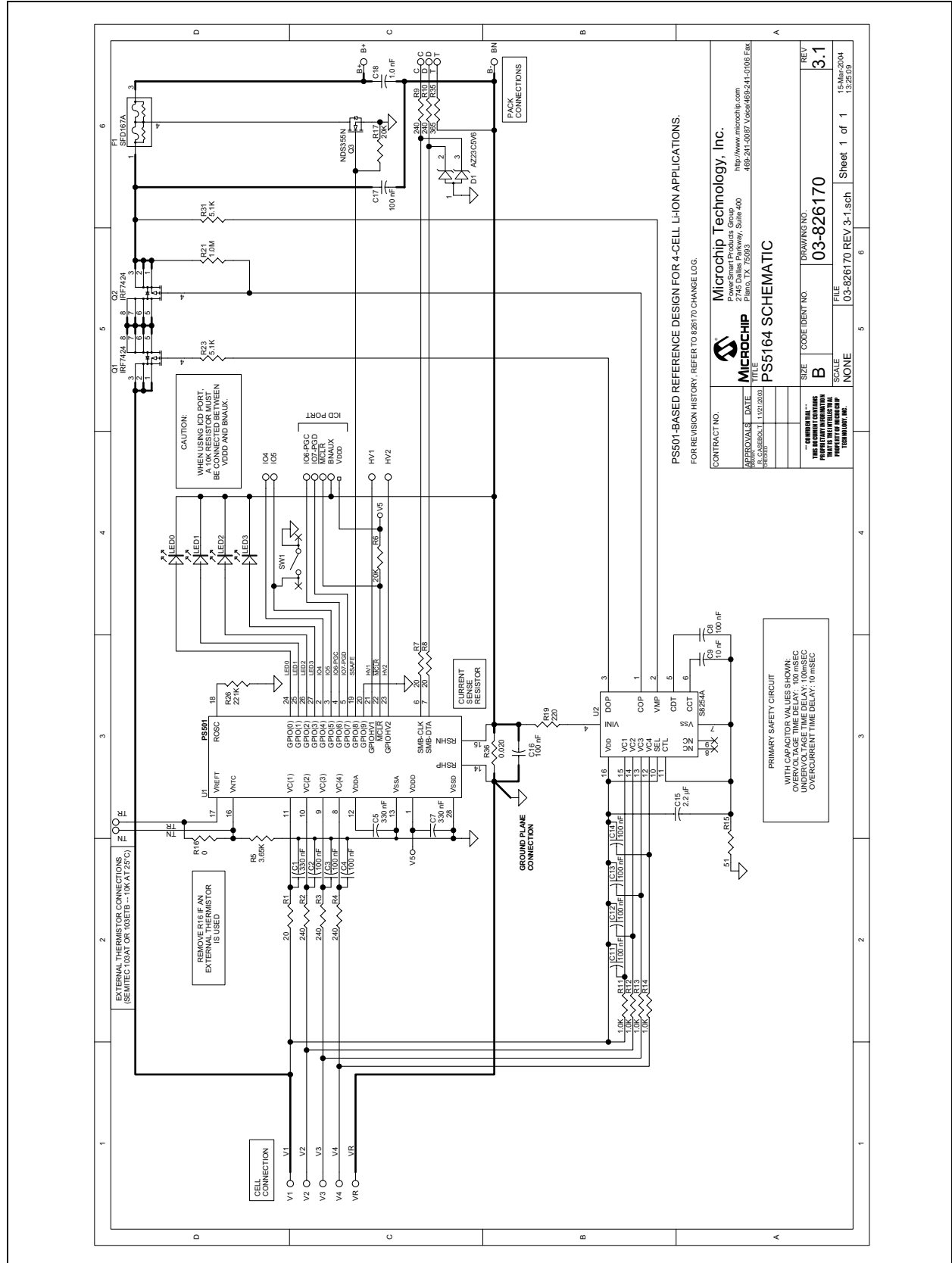
PCB schematics and bill of materials are included here for completeness. To download the full size schematic and BOM, please visit the Microchip web site.

3.1 Mechanical Dimensions

Overall Dimensions: 2500 mils x 525 mils

3.2 Schematic

FIGURE 3-1: PS5164 BOARD SCHEMATIC



PS5164

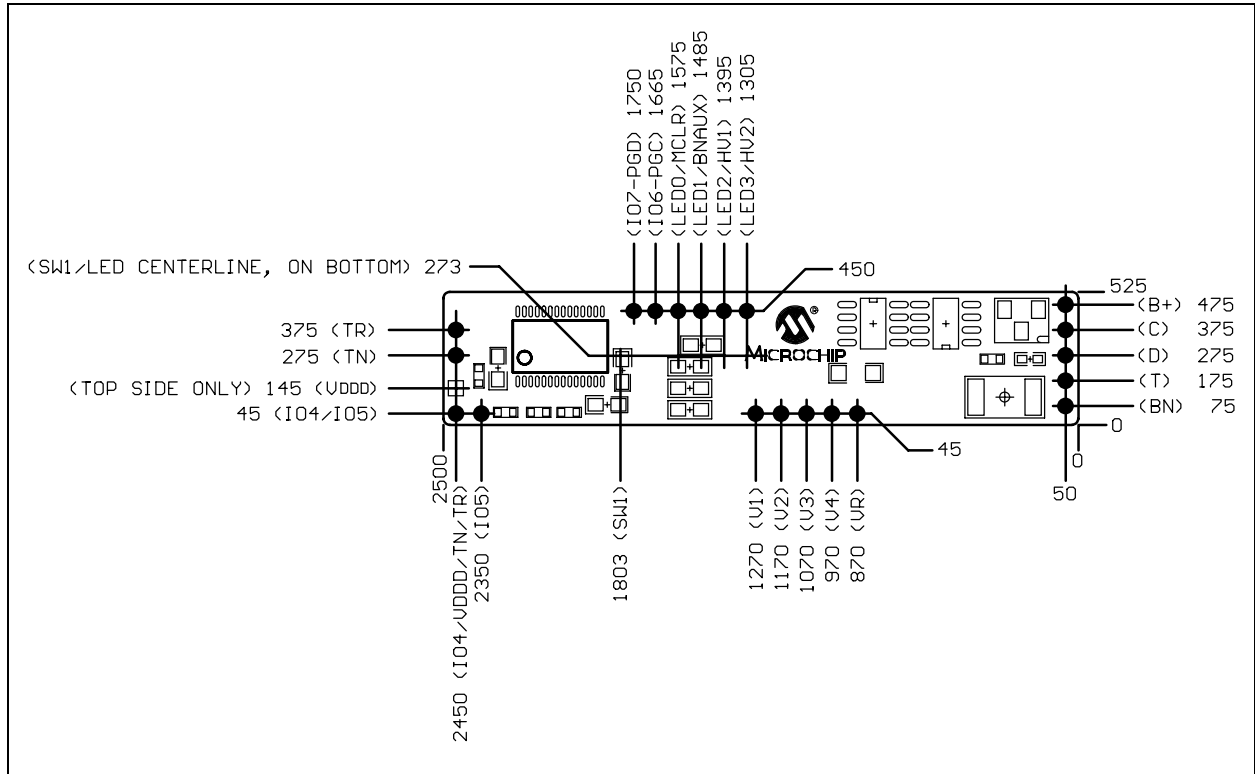
3.3 Bill of Materials

TABLE 3-1: PS5164 BILL OF MATERIALS

Symbols	Description	Manufacturer	Manufacturer PN	Qty.
	Raw PCB, PS5164	Microchip	04-826170 REV. 3.1	1
C9	Capacitor, Ceramic, 10 nF, 25V, +/-10%, X7R dielectric, 0603	Panasonic	ECJ-1VB1E103K	1
C18	Capacitor, Ceramic, 1.0 nF, 50V, +/-10%, X7R dielectric, 0603	Panasonic	ECJ-1VB1H102K	1
C2-C4, C11-C14, C16-C17	Capacitor, Ceramic, 100 nF, 25V, +80%/-20%, Y5V dielectric, 0603	Panasonic	ECJ-1VF1E104Z	9
C8	Capacitor, Ceramic, 100 nF, 25V, +/-10%, X7R dielectric, 0805	Panasonic	ECJ-2VB1E104K	1
C1, C5, C7	Capacitor, Ceramic, 330 nF, 25V, +80%/-20%, Y5V dielectric, 0805	Panasonic	ECJ-2YF1E334Z	3
C15	Capacitor, Ceramic, 2.2 µF, 25V, +80%/-20%, Y5V dielectric, 1206	Panasonic	ECJ-3YF1E225Z	1
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	<u>Diodes Inc.</u> General Semi.	<u>AZ23C5V6-7</u> AZ23-C5V6	1
F1	Fuse, battery pack protector, 7A, 36 Vdc, 50A breaking capacity, 5 +/- 1.5 mOhm resistance, 31.6 +/- 3.2 ohms heater resistance, 11.1-25.0V heater operating voltage range, UL248-14, 3-terminal surface mount package	Sony Chemicals	SFD-167A	1
Q1-Q2	MOSFET, P-channel Enhancement mode, -30V, 11A, 13.5 mOhms, 1.9W, SO-8	<u>Int. Rectifier</u> Toshiba	<u>IRF7424</u> TPC8108	2
Q3	MOSFET, N-channel Enhancement mode, 30V, 1.6A, 0.125 ohms, 500 mW, SOT-23	<u>Fairchild Semi.</u> Fairchild Semi.	<u>NDS355N</u> NDS355AN	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
R16	Resistor, zero ohm, 0603	Panasonic	ERJ-3GEY0R00V	1
R11-R14	Resistor, film, 0603, 5%, 1.0 KOhms	Panasonic	ERJ-3GEYJ102V	4
R21	Resistor, film, 0603, 5%, 1.0 Megohms	Panasonic	ERJ-3GEYJ105V	1
R7-R8	Resistor, film, 0603, 5%, 20 ohms	Panasonic	ERJ-3GEYJ200V	2
R6, R17	Resistor, film, 0603, 5%, 20 KOhms	Panasonic	ERJ-3GEYJ203V	2
R19	Resistor, film, 0603, 5%, 220 ohms	Panasonic	ERJ-3GEYJ221V	1
R23, R31	Resistor, film, 0603, 5%, 5.1 KOhms	Panasonic	ERJ-3GEYJ512V	2
R15	Resistor, film, 0603, 5%, 51 ohms	Panasonic	ERJ-3GEYJ510V	1
R1	Resistor, film, 0805, 5%, 20 ohms	Panasonic	ERJ-6GEYJ200V	1
R2-R4	Resistor, film, 0805, 5%, 240 ohms	Panasonic	ERJ-6GEYJ241V	3
R9-R10	Resistor, film, 1206, 5%, 240 ohms	Panasonic	ERJ-8GEYJ241V	2
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	SKQGAE010	1
U1	IC, Single chip Battery Manager, programmable, 25°C to 85°C, SSOP-28	Microchip	PS501-I/ST	1
U2	IC, Battery Protection Circuit, Li Ion, 3 or 4-cell, 40°C to 85°C, 4.4 mm body width TSSOP-16 package	Seiko Instruments	S-8254AAJFT-TB (Note 1)	1

Note 1: Other variants of the S-8254A series, with different trip points, are also available. Consult the S-8254A series data sheet.

FIGURE 3-2: PS5164 DIMENSION DETAILS



PS5164

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 PS5164. 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 PS5164 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

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.

© 2004, Microchip Technology Incorporated. Printed in the U.S.A., All Rights Reserved.



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'Shaughnessy 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 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 - Ier 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