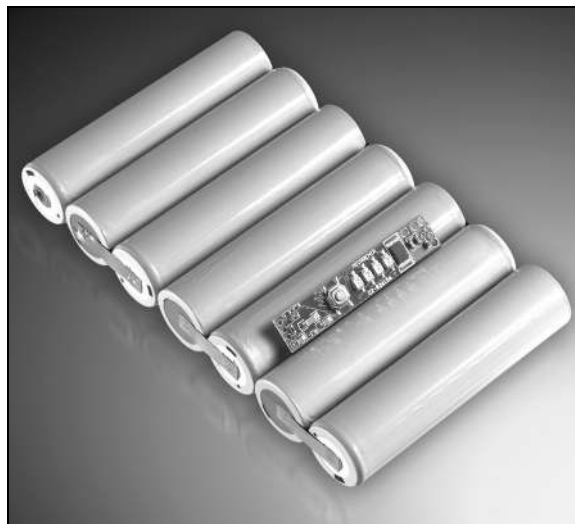# PS4200

PS402 Battery Manager Module with LED SOC Display

Features

- PS402 tested, fully populated modules for evaluation and production
- Designed to work with 6 to 10 series cell NiMH configurations
- Performs all major NiMH battery management functions including
  - Accurate capacity monitoring
  - Optional external thermistor configuration for accurate temperature monitoring
  - Supports three full charge detection methods - dT/dt, -dV, programmable overcharge
- 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 15-bit integrating A/D
- Precise capacity reporting using Microchip patented algorithms and 3D battery cell models
- 3D models and "learned" parameters stored in integrated EPROM and EEPROM
- Extremely low power operation:
  - Sleep Mode: < 13 A typical
  - Run Mode: < 500 A typical
  - Sample Mode: < 250 A typical
- Complete hardware and software development tools available
- Overall mechanical dimensions:
  - 0.339 W x 1.772 L (inches)
  - 8.6 W x 45.0 L (millimeters)

Board Photo

Ordering Information

Part Number	Description
PS4200	NiMH - 6 to 10 series cells

PS4200

1.0   GENERAL DESCRIPTION

The PS4200 module is a complete smart battery controller subsystem based on the Microchip PS402 battery manager with patented Accuron™ technology. The module is designed to operate in a battery pack consisting of six (6) to ten (10) series connected Ni-based cells. The module consists of the Microchip PS402 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 PS4200 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 PS402 family of CMOS ASICs. The pack positive should be securely connected to the module first, followed by pack negative.

Step 1: Configure the module for optional external thermistor use. PS4200 modules are shipped configured to use the internal temperature sensor only.

To add an external thermistor to the board, remove resistor R16 and connect the thermistor across vias TN and TR.

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

Step 3: Connect V1 to the most positive point on the battery cell stack.

Step 4: Connect VR to the most negative point on the battery cell stack.

Step 5: Connect external connector to BN, T, C, D and BP.

Step 6: Program the assembled pack using Microchip's PowerTool™ software and PowerCal™ board or PowerInfo™ board hardware.

The EEPROM parameters can be changed at will using the utilities on the P4 EE page in the PowerTool software. The OTP EPROM parameters can be changed a limited number of times using utilities on the P4 OTP page. To write to the OTP EPROM, an additional voltage (V_{PP}) must be applied to the PS402. This programming voltage can be obtained from the PowerInfo board and applied to the PS4200 at connection VP (small thru-hole) located on the small edge of the board opposite the connector edge.

Step 7: Calibrate the pack using the PowerTool software and PowerCal board hardware. The pack is now ready for use.

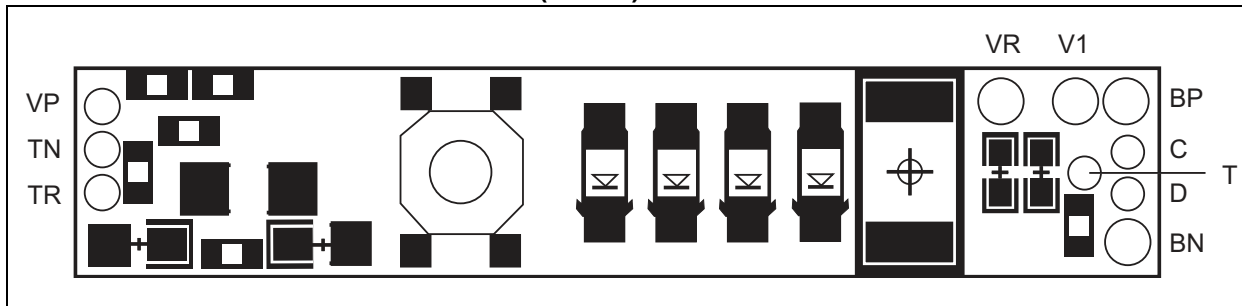**FIGURE 1-1:   CONNECTION POINTS (SIDE 1)**
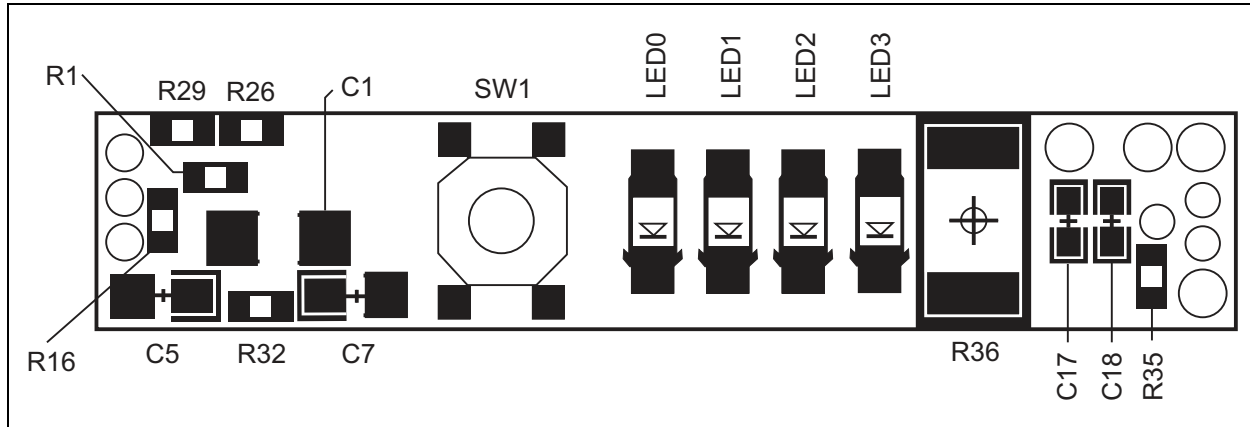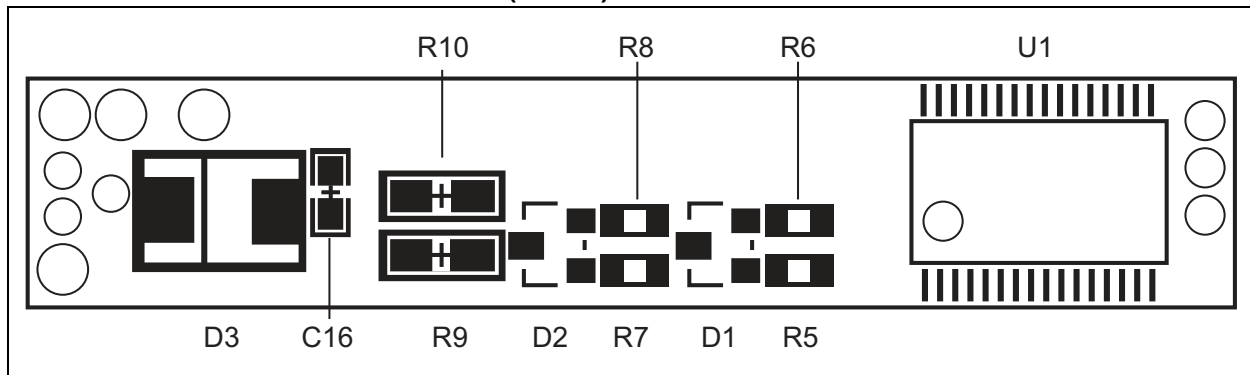
FIGURE 1-2: **BOARD ASSEMBLY (SIDE 1)**

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

2.0 FUNCTIONAL DESCRIPTION

2.1 PS402 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 PS402 monitors the pack voltage, battery temperature and current to determine SOC and battery status. The State-of-Charge calculations are compensated for cell self discharge and charge acceptance. 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 data sheet "PS402 Single Chip Battery Manager - Nickel Chemistries" for details on configuring the PS402.

2.2 OTP EPROM Programming

To write to the OTP EPROM, an additional voltage (VPP) must be applied to the PS402. This programming voltage can be obtained from the PowerInfo board and applied to the PS4200 at connection VP (small thru-hole) located on the small edge of the board opposite the connector edge. Then use the utilities located on the P4 OTP page of the PowerTool software to write new values to the PS402 OTP EPROM.

PS4200

3.0   BOARD DESCRIPTION

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

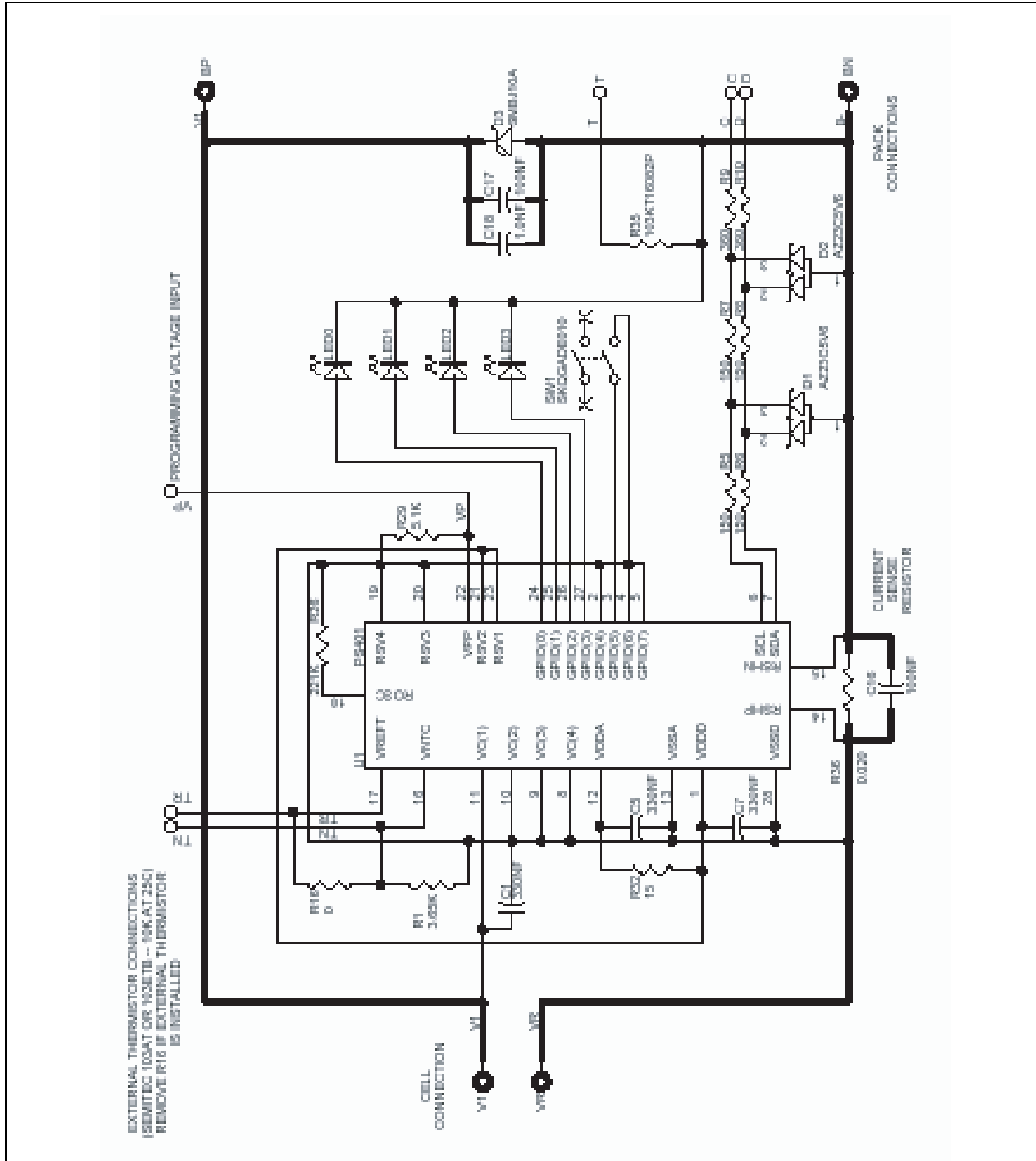**FIGURE 3-1:   BOARD SCHEMATIC**
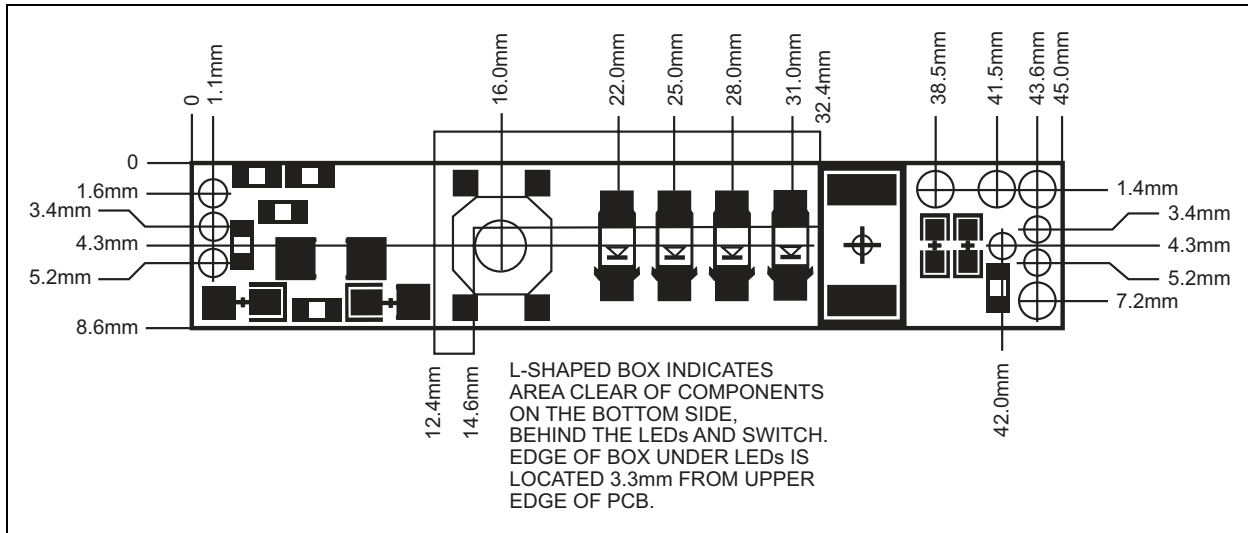
TABLE 3-1: BILL OF MATERIALS

ID	PartSmart Part Number	Symbols	Description	Manufacturer	Manufacturer PN	Supplier	Supplier PN	Qty:
1	04-826156 Rev. 1.1		Raw PCB, PS4200	Microchip	04-826156 Rev. 1.1	Microchip	04-826156 Rev. 1.1	1
2	CC-0603-10X7R50-1.0NF-01	C18	Capacitor, Ceramic, 1.0nF, 50V, +/-10%, X7R dielectric, 0603	Panasonic	ECJ-1VB1H102K	Digikey	PCC1772CT-ND	1
3	CC-0603-8020Y5V25-100NF-01	C16-C17	Capacitor, Ceramic, 100nF, 25V, +80%/-20%, Y5V dielectric, 0603	Panasonic	ECJ-1VF1E104Z	Digikey	PCC1794CT-ND	2
4	CC-0805-8020Y5V25-330NF-01	C5, C7	Capacitor, Ceramic, 330nF, 25V, +80%/-20%, Y5V dielectric, 0805	Panasonic	ECJ-2YF1E334Z	Digikey	PCC1856CT-ND	2
5	CC-1206-10X7R25-330NF-01	C1	Capacitor, Ceramic, 330nF, 25V, +/-10%, X7R dielectric, 1206	Panasonic	ECJ-3VB1E334K	Digikey	PCC1889CT-ND	1
6	DL-1206LED-GC-SMLLX1206GC-01	LED0-LED3	LED, clear green, 1206 package	Lumex	SML-LX1206GC-TR	Digikey	67-1357-1-ND	4
7	DT-SMB-X-SMBJ20A-01	D3	TVS, 20V, 600W, unipolar, SMB package	Diodes, Inc. Crydom Central Semi.	SMBJ20A-13 SMBJ20A 1SMB20A-PST	Digikey Digikey Central Semi.	SMBJ20ADICT-ND SMBJ20ACCCT-ND 1SMB20A-PST	1
8	DZ-SOT23-5D-AZ23C5V6-01	D1, D2	Dual Zener Diode, 5.6V +/-5%, 300mW, common-anode, SOT-23	Diodes Inc. General Semi.	AZ23C5V6-7 AZ23-C5V6	Digikey General Semi.	AZ23C5V6DICT-ND AZ23-C5V6	2
9	RF-0603-1-221K-01	R26	Resistor, film, 0603, 1%, 221K ohms	Panasonic	ERJ-3EKF2213V	Digikey	P221KHCT-ND	1
10	RF-0603-1-3.65K-01	R1	Resistor, film, 0603, 1%, 3.65K ohms	Panasonic	ERJ-3EKF3651V	Digikey	P3.65KHCT-ND	1
11	RF-0603-5-0-01	R16	Resistor, zero-ohm, 0603	Panasonic	ERJ-3GEY0R00V	Digikey	P0.0GCT-ND	1
12	RF-0603-5-150-01	R5-R8	Resistor, film, 0603, 5%, 150 ohms	Panasonic	ERJ-3GEYJ151V	Digikey	P150GCT-ND	4
13	RF-0603-5-15-01	R32	Resistor, film, 0603, 5%, 15 ohms	Panasonic	ERJ-3GEYJ150V	Digikey	P15GCT-ND	1
14	RF-0603-5-5.1K-01	R29	Resistor, film, 0603, 5%, 5.1K ohms	Panasonic	ERJ-3GEYJ512V	Digikey	P5.1KGCT-ND	1
15	RF-0805-5-360-01	R9-R10	Resistor, film, 0805, 5%, 360 ohms	Panasonic	ERJ-6GEYJ361V	Digikey	P360ACT-ND	2
16	RF-2512-1-0.020-01	R36	Resistor, metal strip, 2512, 1%, 0.020 ohms	Vishay	WSL2512-0.020-1%-R86	Vishay	WSL2512-0.020-1%-R86	1
17	RT-0603-2-103KT16082P-01	R35	Thermistor, 10K ohms at 25C, B value 3435, -40C to 125C operating temperature range, 0603 SMT package	Semitec	103KT1608-2P	Semitec	103KT1608-2P	1
18	SW-SWSMD65X52-SPSTM-SKQGADE010-01	SW1	Switch, SPST-momentary, pushbutton, surface-mount	ALPS	SKQGADE010	ALPS	SKQGADE010	1
19	UM-SSOP28-2585-PS402-01	U1	IC, Single-chip NiMH Battery Manager, programmable, -25C to 85C, SSOP-28	Microchip	PS402	Microchip	PS402	1

PS4200

3.1 Mechanical Dimensions

Overall Dimensions: 1772 mils x 339 mils

FIGURE 3-2: **PS4200 DIMENSION DETAILS**

L-SHAPED BOX INDICATES AREA CLEAR OF COMPONENTS ON THE BOTTOM SIDE, BEHIND THE LEDs AND SWITCH. EDGE OF BOX UNDER LEDs IS LOCATED 3.3mm FROM UPPER EDGE OF PCB.

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 PS4200. 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 PS4200 Battery Manager Module. For further information on the PS402 and development tool operations, please refer to the documents listed in Table 4-2 available for download at www.microchip.com.

TABLE 4-1: MICROCHIP DEVELOPMENT TOOL SUMMARY

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

TABLE 4-2: MICROCHIP REFERENCE DOCUMENTS

Document Number	Documents Available
DS21766A	PS402 Single Chip Battery Manager - Nickel Chemistries Data Sheet (IC Products)
DS40234A	PS041 PowerInfo Configuration Interface Product Brief
DS40237A	PS042 PowerCal Calibration Platform Data Sheet (Development Tool Documentation)

Preliminary

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