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## PS200 Switch Mode Charger Evaluation Board

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### Features

- Complete PS200 Battery Charger application circuit
- Direct connection to Microchip's PowerInfo™ 2 (PS051) interface board and PowerCal™ 2 (PS052) calibration board
- Configure PS200 with PS020 PowerTool™ 200 PC software
- Change or upgrade firmware with In-Circuit Serial Programming™ (ICSP™)
- Evaluate charger circuits with:
  - Voltage max: 16.8V
  - Current max: 2.0A
- Overall mechanical dimensions:
  - 2.5 W x 4.0 L (inches)
  - 63.5 W x 101.6 L (millimeters)

### Ordering Information

Part Number	Description
PS2070	PS200 Charger Evaluation Board and PS020 PowerTool™ 200 Software
PS2070EV	PS2XX Charger Evaluation Board, PS051 Configuration Interface and PS020 PowerTool™ 200 Software

# PS2070

## 1.0 PRODUCT OVERVIEW

The PS2070 evaluation board is a complete charger evaluation circuit subsystem based on the Microchip PS200 charge controller. The board is designed to operate with a rechargeable battery pack consisting of lithium based, nickel based or lead acid cells. The board includes the Microchip PS200 battery monitor IC in a socket, a 100 mOhm sense resistor and power components to enable charging currents to a maximum of 2.0A.

## 2.0 GENERAL SETUP

The Microchip PS2070 evaluation board plugs directly into a PowerInfo 2 interface board or PowerCal 2 calibration board. These development tools, connected to a PC running PowerTool™ 200 (PS020) development software, form a complete PS200 battery charger evaluation environment. The information that follows will guide you through the setup of the various features available. Please refer to the PowerInfo 2 or PowerCal 2 data sheet for information on setting up those products.

### 2.1 Connectors

- JBat – Battery input connector. The battery pack to be charged is connected here. Looking into the connector on the board, the pins from left to right are:
  - BAT+: Battery pack positive
  - CLK: SMBus clock
  - DTA: SMBus data
  - TMP: Temperature
  - GND: Battery pack negative
- PHost – Charger host interface. The PowerInfo 2 or PowerCal 2 is connected here. Looking into the connector on the board, the pins from left to right are:
  - GND: Battery pack negative
  - TMP: Temperature
  - DTA: SMBus data
  - CLK: SMBus clock
  - BAT+: Battery pack positive
- J1 – In-Circuit Serial Programming (ICSP) interface. The PS200 Flash memory can be reprogrammed via this interface. This is only necessary to upgrade to a newer firmware revision or install firmware for a different rechargeable chemistry.
- J3 – Charger DC power supply input. Input voltage range is 18 to 22 Vdc. The supply must be current limited or fused to a maximum of 2.5A.

### 2.2 Jumpers

- JP2 – Jumper to configure board for standard operation with PS200 pin 2 (LED 2) connected to the red LED or connected to PHost CLK for communication with PowerTool 200 PC software.

	Jumper Position	
	1-2	2-3
PS200 pin 2 to Red LED	X	O
PS200 pin 2 to PHost CLK	O	X

**Legend:** O = open, X = connect

- JP18 – Jumper to disconnect the overvoltage protection divider from PS200 pin 18 (VOVP). This allows pin 18 to be used for ICSP.

	Jumper Position
	1-2
Disable VOVP (Enable ICSP™)	O
Enable VOVP input	X

**Legend:** O = open, X = connect

- JP19 – Jumper to disconnect the temperature divider from PS200 pin 19 (TEMP). This allows pin 19 to be used for ICSP.

	Jumper Position
	1-2
Disable TEMP (Enable ICSP™)	O
Enable TEMP input	X

**Legend:** O = open, X = connect

- OPV – Jumper to configure overvoltage protection (OVP) limit.

	Jumper Position			
	1-8 (1 Cell)	2-7 (2 Cells)	3-6 (3 Cells)	4-5 (4 Cells)
OVP 4404 mV	X	O	O	O
OVP 8808 mV	O	X	O	O
OVP 13200 mV	O	O	X	O
OVP 17640 mV	O	O	O	X
No OVP limit	O	O	O	O

**Legend:** O = open, X = connect

- VIN – Jumper to configure voltage sense scaling factors. The values indicate the maximum battery voltage.

	Jumper Position			
	1-8 (1 Cell)	2-7 (2 Cells)	3-6 (3 Cells)	4-5 (4 Cells)
5V	X	O	O	O
10V	O	X	O	O
15V	O	O	X	O
16.8V	O	O	O	X

**Legend:** O = open, X = connect

## 2.3 Configuration for Lithium Pack Chemistries

Before attaching the lithium battery pack, please insure that jumpers OVP and VIN are properly configured for the maximum pack voltage. Attach the battery pack to the JBat connector by attaching the top of the pack (positive) to the left most pin (looking into the connector) and the bottom of the pack (negative) to the right most pin.

## 2.4 Configuration for Nickel Pack Chemistries

Rechargeable nickel based battery packs can be attached to the PS2070. Before attaching battery cells, please insure that jumpers OVP and VIN are properly configured for the maximum pack voltage. Attach the battery pack to the JBat connector by attaching the top of the pack (positive) to the left most pin (looking into the connector) and the bottom of the pack (negative) to the right most pin.

## 2.5 Configuration for Lead Acid Chemistries

Lead acid configuration will be updated when firmware is available.

## 3.0 FUNCTIONAL DESCRIPTION

### 3.1 PS2070 Switch Mode Charger Evaluation

The Switch Mode Charger Evaluation Board includes a simple buck topology charger using the PS200 IC. The PS200 monitors the battery to determine its status. The control is a dual loop design with hardware based current feedback control and firmware based voltage feedback control. The hardware is configured as a constant current loop, controlling the Pulse-Width Modulator (PWM). The firmware sets the current level by adjusting the PWM signal at PS200 pin 5 (CTRLOUT). The firmware also measures the voltage and dynamically adjusts the current to maintain the fully charged constant voltage value. Please refer to the "PS200 Data Sheet" for details on configuring the PS200.

Overvoltage protection – the PS200 provides overcharge protection. This circuit can be disabled by leaving all OVP jumper positions open. JP18 should still be connected.



## 4.2 Bill of Materials

**TABLE 4-1: PS2070 BILL OF MATERIALS**

Symbols	Description	Manufacturer	Manufacturer PN	Qty.
	Raw PCB, PS2070	Microchip	04-826196 Rev. 2.1	1
C7	Capacitor, Ceramic, 120 nF, 25V, +/-10%, X7R dielectric, 1206	Panasonic	ECJ-3VB1E124K	1
C9	Capacitor, Ceramic, 470 nF, 25V, +/-10%, X7R dielectric, 1206	Murata	GRM319R71E474KA01D	1
C16	Capacitor, Ceramic, 1.0 nF, 50V, +/-10%, X7R dielectric, 1206	Panasonic	ECU-V1H102KBM	1
C1, C3, C6	Capacitor, Ceramic, 100 nF, 50V, +/-10%, X7R dielectric, 1206	BC Components	1206B104K500BT	3
C8	Capacitor, Ceramic, 10 nF, 50V, +/-10%, X7R dielectric, 1206	Panasonic	ECU-V1H103KBM	1
C18, C21-C23	Capacitor, Ceramic, 4.7 $\mu$ F, 25V, +/-20%, X5R dielectric, 1206	Panasonic	ECJ-3YB1E475M	4
GRNLED, POWER	LED, clear green, 1206 package	Lumex	SML-LX1206GC-TR	2
REDLED	LED, clear red, 1206 package	Lumex	SML-LX1206SIC-TR	1
D1, D2	Schottky Diode, 40V, 3A, SMC package	<u>On Semiconductor</u> <u>International Rct.</u> <u>Central Semi.</u> Central Semi.	<u>MBRS340T3</u> <u>MBRS340TR</u> <u>CMSH3-40-PST</u> CMSH3-40L-PST	2
D6	Diode, Schottky, 200 mA/30V, SOT-23	Zetex	BAT54TA	1
JP2, JP18, JP19, OVP, VIN	Connector, shorting jumper, female, 2-position, 100 mil spacing, mates with 25 mil square pins, 15-microinch gold over nickel.	AMP	382811-6	5
J3	Header, pluggable terminal block, 5.08 mm pitch x 2 positions, 12A/250V, right-angle, closed end	Phoenix	1757242	1
JBat	Header, pluggable terminal block, 5.08 mm pitch x 5 positions, 12A/250V, right-angle, closed end	Phoenix	1757271	1
DUT	Socket, 20-pin DIP, 0.300" spacing, machine pin	Mill-Max	110-93-320-41-001000	1
J1	Connector, modular, 6-position/6-contact, right-angle mount	AMP	520470-3	1
BAT-, GND, PGND, PGND2	Test point, 0.125" OD, for 0.062" hole, black	Keystone	5011	4
BAT+	Test point, 0.125" OD, for 0.062" hole, red	Keystone	5010	1
BATID, CHGFBK, CHGOUT, CTRL, FDBK, IFBOUT, TEMP, VI	Test point, 0.125" OD, for 0.062" hole, white	Keystone	5012	8
L1	Inductor, 68 $\mu$ H, 1.8A, 130 mOhms DCR, 730 x 600 mil SMT package, -40°C to +85°C	Coilcraft	DO5022P-683	1
	Bumper, hemispherical, 0.44" D x 0.20" H, transparent plastic	3M	SJ-5303 (CLEAR)	4
OVP, VIN	Connector, break apart PCB header, straight, 2-row x 36-pin, 100 x 100 mil spacing, 235 mil/100 mil/145 mil length, 25 mil square pins, 10-microinch gold	3M	929665-09-36-I	1
JP2, JP18, JP19	Connector, break apart PCB header, straight, 36-pin, 100 mil spacing, 235 mil/100 mil/145 mil length, 25 mil square pins, 10-microinch gold	3M	929647-09-36-I	1
J3	Pluggable terminal block, 5.08 mm pitch x 2 positions, 12A/250V	Phoenix	1757019	1
JBat	Pluggable terminal block, 5.08 mm pitch x 5 positions, 12A/250V	Phoenix	1757048	1

# PS2070

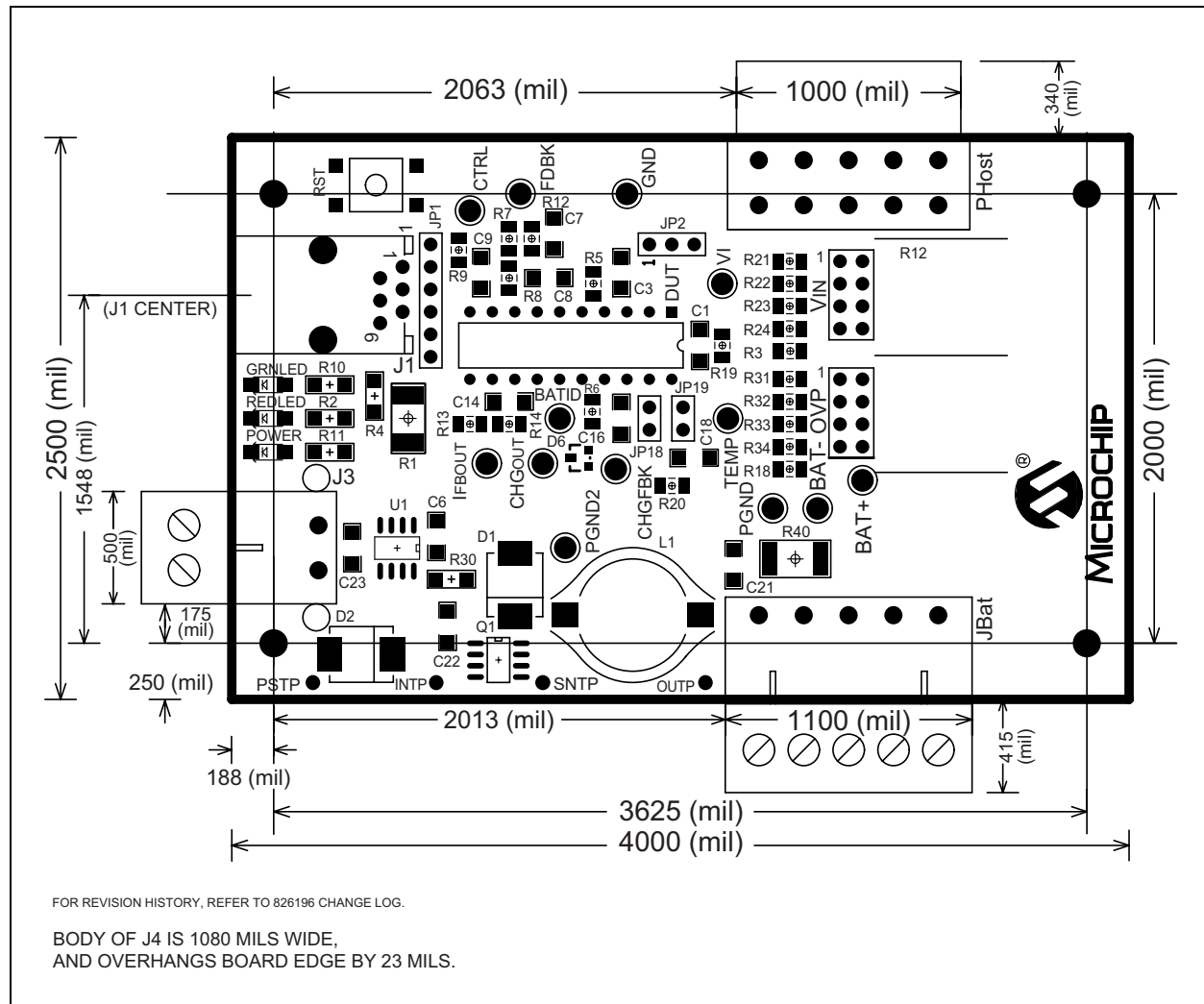
**TABLE 4-1: PS2070 BILL OF MATERIALS (CONTINUED)**

Symbols	Description	Manufacturer	Manufacturer PN	Qty.
PHost	Plug, inverted Combicon, 5.08 mm pitch x 5 positions, 12A/250V	Phoenix	1786433	1
Q1	MOSFET, P-channel Enhancement mode, -30V, -5.3A, 50 mOhms, 2.5W, SO-8, -55°C to +125°C	Fairchild Semi.	NDS9435A	1
R13	Resistor, film, 1206, 1%, 1.00 kOhms	Panasonic	ERJ-8ENF1001V	1
R7	Resistor, film, 1206, 1%, 1.27 kOhms	Panasonic	ERJ-8ENF1271V	1
R3, R18-R20	Resistor, film, 1206, 1%, 10.0 kOhms	Panasonic	ERJ-8ENF1002V	4
R22	Resistor, film, 1206, 1%, 10.5 kOhms	Panasonic	ERJ-8ENF1052V	1
R33	Resistor, film, 1206, 1%, 100 kOhms	Panasonic	ERJ-8ENF1003V	1
R34	Resistor, film, 1206, 1%, 137 kOhms	Panasonic	ERJ-8ENF1373V	1
R14	Resistor, film, 1206, 1%, 19.6 kOhms	Panasonic	ERJ-8ENF1962V	1
R5, R8-R9, R12	Resistor, film, 1206, 1%, 20.0 kOhms	Panasonic	ERJ-8ENF2002V	4
R23	Resistor, film, 1206, 1%, 20.5 kOhms	Panasonic	ERJ-8ENF2052V	1
R21	Resistor, film, 1206, 1%, 232 ohms	Panasonic	ERJ-8ENF2320V	1
R31	Resistor, film, 1206, 1%, 26.7 kOhms	Panasonic	ERJ-8ENF2672V	1
R6	Resistor, film, 1206, 1%, 3.01 kOhms	Panasonic	ERJ-8ENF3011V	1
R24	Resistor, film, 1206, 1%, 30.9 kOhms	Panasonic	ERJ-8ENF3092V	1
R32	Resistor, film, 1206, 1%, 63.4 kOhms	Panasonic	ERJ-8ENF6342V	1
R2, R4, R10, R11	Resistor, film, 1206, 5%, 1.5 kOhms	Panasonic	ERJ-8GEYJ152V	4
R30	Resistor, film, 1206, 5%, 47 ohms	Panasonic	ERJ-8GEYJ470V	1
R40	Resistor, metal strip, 2512, 1%, 0.100 ohms	Vishay	WSL2512-0.100-1%-R86	1
R1	Resistor, film, 2512, 5%, 620 ohms	Panasonic	ERJ-1TYJ621U	1
RST	Switch, SPST momentary tact, surface mount, 6 mm square, 4.3 mm high, 260 G-force	E-Switch	TL3301NF260QG	1
DUT	IC, Battery Charger Microcontroller, 20-pin DIP, -40°C to +85°C	Microchip	PS200	1
U1	IC, Power MOSFET Driver circuit, 30V, 1.5A, inverting, with UV lockout, SO-8, 0°C to +70°C	Microchip	TC4431COA	1

## 4.3 Mechanical Dimensions

Overall Dimensions: 2.5" W x 4.0" L

FIGURE 4-2: PS2070 DIMENSION DETAILS



## 5.0 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 5-1 summarizes the development tool offering from Microchip to support the PS2070. Please refer to the Microchip web site for ordering information and design documentation (including schematics) at [www.microchip.com](http://www.microchip.com).

## 5.1 Reference Documents

This data sheet provides an overview of the PS2070 Switch Mode Charger Evaluation Board. For further information on the PS200 and development tool operations, please refer to the following documents available for download at [www.microchip.com](http://www.microchip.com).

**TABLE 5-1: MICROCHIP DEVELOPMENT TOOL SUMMARY**

Development Tool	Use
PowerInfo™ 2 hardware with PowerTool™ 200 software (PS051)	Read and write register values, EEPROM programming and test
PowerCal™ 2 hardware with PowerTool™ 200 software (PS052)	Read and write register values, EEPROM programming, test and calibration

**TABLE 5-2: MICROCHIP REFERENCE DOCUMENTS**

Document Number	Documents Available
DS21891	PS200 PowerSmart® Configurable Lithium Ion/Lithium Polymer Battery Charger Data Sheet
DS21815	PS051 PowerInfo™ 2 Configuration Interface Data Sheet
DS21817	PS052 PowerCal™ 2 Calibration Platform Data Sheet
DS21925	PS020 PowerTool™ 200 Development Software User's Guide



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