MAX8601 Evaluation Kit

Recommended Equipment

- 20V, 2A variable power supply
- 5V power supply
- 1-cell Li+ battery
- Digital voltmeter (DVM)

Quick Start

The MAX8601 EV kit is fully assembled and tested. Follow these steps to verify board operation.

1) Verify on the MAX8601 EV kit that there is **no** shunt on JU2.

2) Verify on the MAX8601 EV kit that there is a shunt between positions 1 and 2 on JU3 to select a 750mA DC charge current.

3) Verify on the MAX8601 EV kit that there is a shunt on JU4 to disable the THM input.

4) Preset the variable 2A power supply to +5V. Turn off the power supply. **Do not turn on the power supply until all connections are made.**

5) Ensure that the 5V power supply is off. **Do not turn on the power supply until all connections are made.**

6) Connect the positive lead of the 2A power supply to the DCIN pad on the EV kit and the negative lead of the power supply to the GND pad on the EV kit.

7) Connect the positive lead of the 5V power supply to the VLOGIC pad on the EV kit and the negative lead of the power supply to the GND pad on the EV kit.

8) Connect the DVM from BAT+ to BAT-.

9) Turn on the power supplies. Verify that the BAT+ voltage is 4.2V.

10) **Determine the correct Li+ cell polarity.** Connect the positive side of the single-cell Li+ battery to BAT+. Connect the negative side of the single-cell Li+ battery to BAT-. Monitor charging cycles.

11) Repeat steps using the USB input.

Detailed Description

Input Source

The MAX8601 is designed to charge a single-cell Li+ battery from a 4.15V to 7V DC source voltage or a 100mA/500mA 5V USB port. The MAX8601 accepts input voltages up to 14V, but disables charging when the input voltage exceeds 7.5V. A male, B-type USB jack is available to connect the MAX8601 EV kit to a standard 100mA/500mA USB port to power the EV kit. Note that the +5V logic input supply is required when charging from USB.

Charge Profile

The MAX8601 charger uses voltage, current, and thermal control loops to facilitate charging of a single Li+ cell and to protect the battery. When a Li+ battery with a cell voltage below 3V is inserted, the charger enters the prequalification stage, precharging the cell with 10% of the user-programmed fast-charge current. Once the cell voltage rises above 3V, the charger soft-starts into the fast-charge stage. The fast-charge current level is programmed with a resistor from SETI to GND (JU3). A red LED indicates the charge status. As the battery voltage approaches 4.2V, the charging current is reduced. If the battery current drops below 7.5% of the fast-charging current, the red LED turns off signaling the battery is charged; however, charging continues for an additional 30 minutes to top off the battery. After charging is complete, the charger restarts if the battery voltage falls below 4.05V. See Table 1 for a description of the charge states.

Setting the Charge Current (SETI, USEL)

The MAX8601 EV kit features an easily adjustable charge-current limit using JU3. JU3 allows the user to select one of three charge-current levels. Remove the shunt to select a 500mA charge current, place the shunt between positions 1 and 2 to select 750mA charge current or between 2 and 3 to select a 1A charge current.

Component Suppliers

SUPPLIER	COMPONENT	PHONE	WEBSITE
Assmann	USB jack	877-ASSMANN	www.assmann.com
Panasonic	Resistors	714-373-7366	www.panasonic.com
Taiyo Yuden	Capacitors	408-573-4150	www.t-yuden.com
TDK	Capacitors	888-835-6646	www.component.tdk.com
Vishay	Resistors	402-563-6866	www.vishay.com

Note: Indicate you are using the MAX8600/MAX8601 when contacting these component suppliers.

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Table 1. Charge States with THM = GND or 3.94kΩ < R$_{THM}$ < 28.3kΩ

CONDITIONS			RESULTS			
$\overline{EN}$	$\overline{POK}$*	V$_{BAT}$	I$_{BAT}$	LED	$\overline{FLT}$	STATE
Low	High	X	0	Off	High	Off
Low	Low	V$_{BAT}$ < 3V	10% of I$_{FAST}$	Off	High	Prequal
Low	Low	3V < V$_{BAT}$ < 4.2V	I$_{FAST}$	On	High	Fast-Charging in Controlled Current Mode
Low	Low	4.2V	> 7.5% I$_{FAST}$	On	High	Fast-Charging in Controlled Voltage Mode
Low	Low	4.2V	< 7.5% I$_{FAST}$	Off	High	Top-Off
Low	Low	4.05 < V$_{BAT}$ < 4.2V	0	Off	High	Charging Done
High	High	X	0	Off	High	Off
Low	Low	< 3V	0	Off	Low	Timeout in Prequalification Mode
Low	Low	3V < V$_{BAT}$ < 4.2V	0	Off	Low	Timeout in Charge Mode

X = Don't care.
*$\overline{POK}$ is an open-drain output controlled by V$_{IN}$ (V$_{DC}$ or V$_{USB}$) and $\overline{EN}$. If $\overline{EN}$ is high, $\overline{POK}$ is high regardless of V$_{IN}$.

If another charge-current level is desired, remove the shunt and replace R7 with a resistor calculated as follows:

$$R7 = 1500 / I_{CHARGE(MAX)}$$

where I$_{CHARGE(MAX)}$ is in amps and R7 is in ohms. Refer to the MAX8600/MAX8601 IC data sheet for more details.

When using the USB input, charge current is selected using the USEL input (JU1). Drive USEL low by connecting a shunt across JU1 to select 95mA charge current. Drive USEL high by removing the shunt from JU1 to select a 475mA charge current.

$\overline{EN}$ Input
$\overline{EN}$ is a logic input (active low) that enables the charger. Drive $\overline{EN}$ high by connecting a shunt across JU2 to disable the charger control circuitry. Drive $\overline{EN}$ low by removing the shunt from JU2 to enable the MAX8601.

Timer Capacitor Selection
The MAX8601 contains internal timers for prequalified fast-charge and top-off states. These time periods are determined by the capacitance from CT to GND (C3). To set the charge times, calculate C3 as follows:

$$C3 = (0.068\mu F / 334min) \times t_{FASTCHARGE}$$

Note that t$_{PREQUAL}$ = t$_{TOPOFF}$ = 1/10 x t$_{FASTCHARGE}$

Thermal Control
The MAX8601 features a thermal limit that reduces the charge current when the die temperature exceeds +100°C. As the temperature increases, the IC lowers the charge current by 50mA/°C above +100°C when I$_{FAST}$ is set to 1A.

$\overline{CHG}$ Output
$\overline{CHG}$ is an open-drain output that indicates charger status. $\overline{CHG}$ goes low during charge cycles where V$_{BAT}$ is greater than 3V and I$_{BAT}$ is greater than 7.5% of the maximum charge current set by R$_{SETI}$. The MAX8601 EV kit uses a red LED to signal charging cycles.

$\overline{FLT}$ Output
The MAX8601 contains an open-drain $\overline{FLT}$ output to signal the user when a fault occurs. $\overline{FLT}$ goes low when the prequalified timer expires and the battery voltage has not exceeded 3V (typ), or when the fast-charge timer expires and the battery current has not dropped below 7.5% (typ) of the maximum fast-charge current set by R$_{SETI}$. Toggle $\overline{EN}$ or the input power to clear the $\overline{FLT}$ indicator.

$\overline{POK}$ Output
The MAX8601 contains an open-drain $\overline{POK}$ output that goes low when a valid input source is detected at DC or USB. A valid input source is one whose voltage exceeds the rising UVLO threshold of 4V, exceeds the battery voltage by 255mV, and does not exceed 7.5V. After a valid input has been established, charging is sustained with inputs as low as 3.5V as long as the input remains above the battery by at least 55mV. $\overline{POK}$ is high impedance when the charger is disabled.

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THM Input

The MAX8601 monitors battery temperature through a negative TC thermistor in close thermal contact with the battery. Select a thermistor resistance that is 10kΩ at +25°C and has a beta of 3500. The IC compares the resistance from THM to GND and suspends charging when it is greater than 28.3kΩ or less than 3.94kΩ, translating to battery temperatures of 0°C and +50°C, respectively. Remove the shunt from JU4 and connect the thermistor from the THM pad to GND to use the THM function. Connect a shunt across JU4 to disable the THM function.

Jumper Settings

Table 2. Jumper JU1 (USEL Control)

JU1 SHUNT LOCATION	USEL	MODE
On	Connect to GND	95mA USB charge current
Off	Connected to VIN	475mA USB charge current

Table 3. Jumper JU2 Function (EN Control)

JU2 SHUNT LOCATION	$\overline{EN}$	MODE
On	Connected to VIN	Disabled
Off	Connect to GND	Enabled

Table 4. Jumper JU3 Function (SETI Resistor Selection)

JU3 SHUNT LOCATION	SETI RESISTOR (kΩ)	CHARGE CURRENT
Off	3.01	500mA
Pins 1 and 2	2.00	750mA
Pins 2 and 3	1.50	1A

Table 5. Jumper JU4 Function (THM Control)

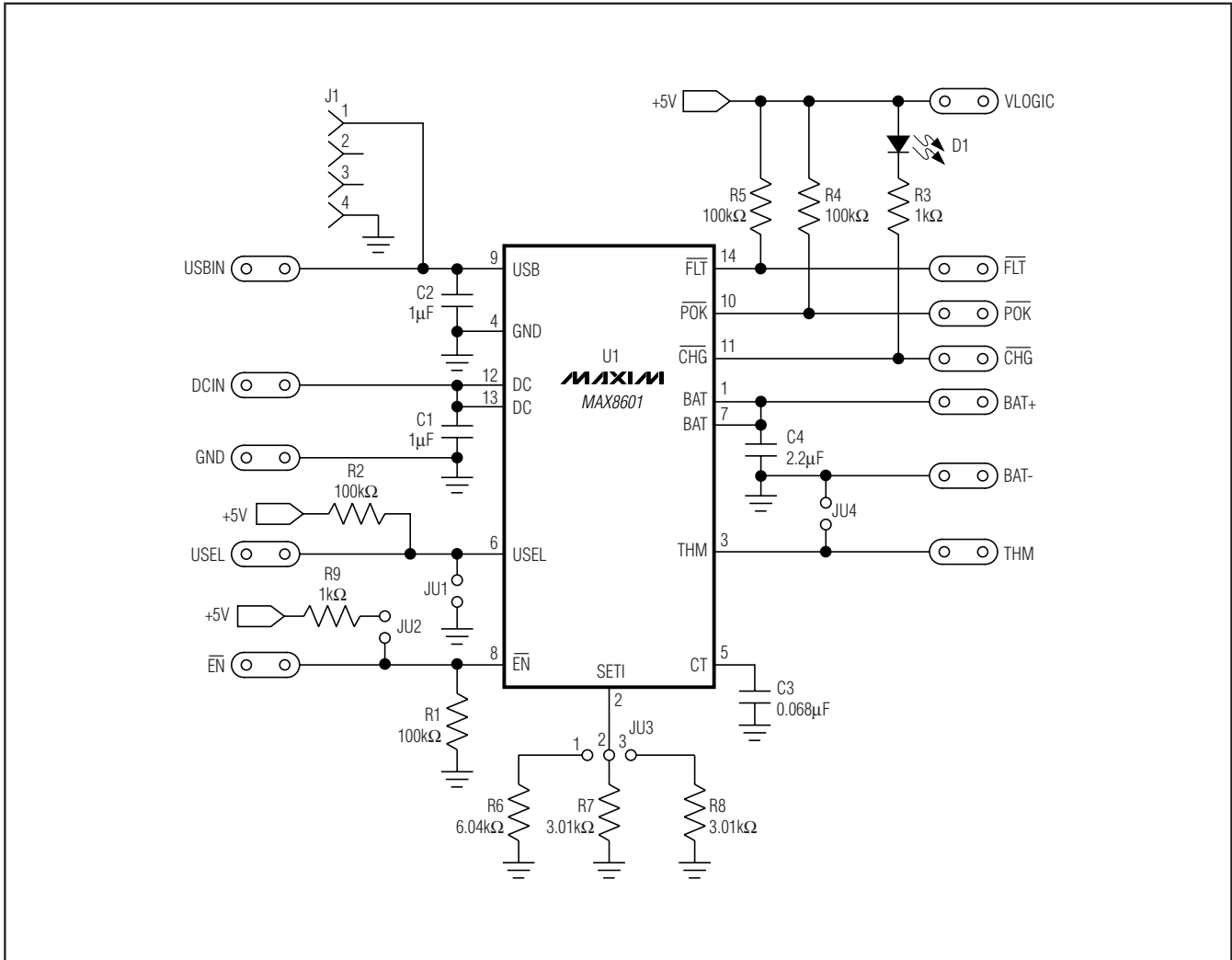| JU4 SHUNT LOCATION	THM	THM CONDITION
On	Connected to GND	Disabled
Off	Connect to an external thermistor	Enabled

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Figure 1. MAX8601 EV Kit Schematic
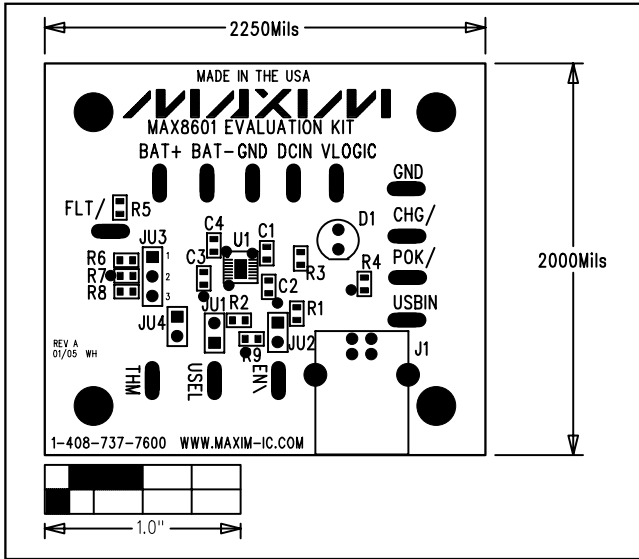
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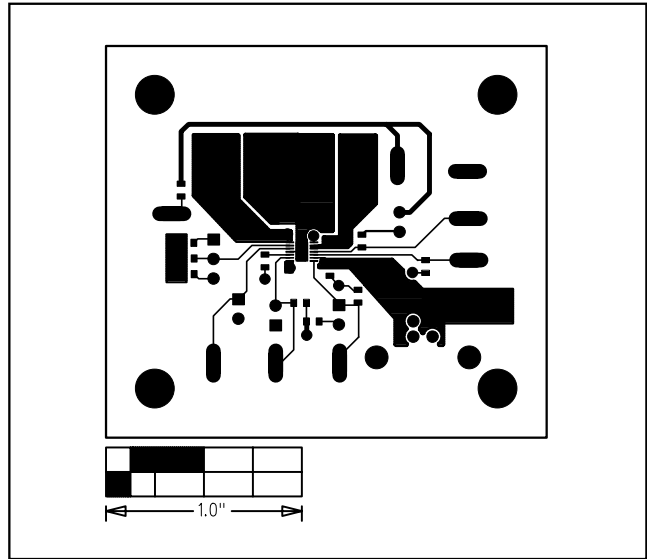Figure 2. MAX8601 EV Kit Component Placement Guide—Top Silkscreen

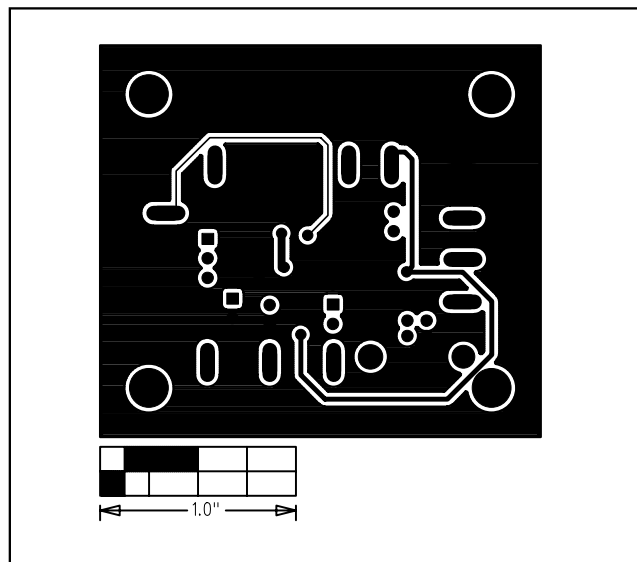Figure 3. MAX8601 EV Kit PC Board Layout—Component Side

Figure 4. MAX8601 EV Kit PC Board Layout—Solder Side

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