19-2096; Rev 0; 7/01

MAXIM

MAX1873 Evaluation Kit

Evaluates: MAX1873

General Description

The MAX1873 evaluation kit (EV kit) is a complete, fully assembled and tested PC board that is capable of supplying power to a system load while charging a lithium-ion (Li+) or nickel (Ni)-based battery pack. The EV kit is preset to limit the total source current and the maximum battery-charging current to 3A, and to charge 4-series Li+ cells up to 4.2V each. An analog output voltage proportional to the charging current also permits an ADC or microcontroller to monitor the charging current. The EV kit requires a power source with a minimum output of 18.5V.

The EV kit can be reconfigured to limit the total input current drawn from the power source, the maximum battery-charging current, and the charging cell voltage. The Li+ cell voltage can be set between 4.009V and 4.387V using standard 1% resistors. To charge Li+ battery packs with two or three cells, replace the IC on the EV kit board with one of the ICs listed on the *Parts Selection Table*.

Part Selection Table

PART	LITHIUM-ION CELLS TO CHARGE	Ni CELLS TO CHARGE	INPUT VOLTAGE RANGE
MAX1873REEE	2	5, 6	9.5V to 28V
MAX1873SEEE	3	7, 8, 9	14.0V to 28V
MAX1873TEEE	4	10	18.5V to 28V

Features

- **Input-Current Source Limiting**
- **Charges 4 Lithium-Ion Batteries**
- **Also Charges Ni-Based Batteries**
- **Up to 28V Input**
- **300kHz PWM Operation**
- **16-Pin QSOP Package**
- **Surface-Mount Construction**
- **Fully Assembled and Tested**

Ordering Information

PART	TEMP. RANGE	IC PACKAGE
MAX1873EVKIT	0°C to +70°C	16 QSOP

Component Suppliers

SUPPLIER	PHONE	FAX
AVX	843-448-9411	843-448-1943
Fairchild	888-522-5372	972-910-8036
IRC	361-992-7900	361-992-3377
Murata	770-436-1300	770-436-3030
Sumida	847-545-6700	847-545-6720
Taiyo Yuden	800-348-2496	847-925-0899
TDK	847-803-6100	847-390-6296

Note: *Please indicate you are using the MAX1873 when contacting these manufacturers.*

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	2.2µF ±20%, 10V X5R ceramic capacitor (0805) Taiyo Yuden LMK212BJ225MG or TDK C2012X5R1A225KT
C2, C3	2	0.22µF ±10%, 35V X7R ceramic capacitors (0805) Taiyo Yuden GMK212BJ224KG or TDK C2012X7R1H224KT
C4, C5	2	0.047µF ±10%, 50V X7R ceramic capacitors (0805) Taiyo Yuden UMK212BJ473KG
C6, C7, C8, C14, C15	5	0.1µF, 50V, X7R ceramic capacitors (0805) Taiyo Yuden UMK212BJ104KG or TDK C2012X7R1H104KT
C9, C10	2	22µF ±10%, 35V low-ESR tantalum capacitors (E) AVX TPSE226K035R0200
C11	1	68µF ±20%, 25V low-ESR tantalum capacitor (E) AVX TPSE686M025R0125
C12	0	Not installed, capacitors (E)

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C13	1	1000pF ±10%, 50V ceramic capacitor (0603) TDK C1608X7R1H102KT or Murata GRM188R71H102KA01
C16	1	1µF ±10%, 10V, X7R ceramic capacitor (0805) Taiyo Yuden LMK212BJ105KG or TDK C2012X7R1A105KT
D1, D2	2	3A Schottky diodes (SMC) Fairchild MBRS340
L1	1	10µH, 3A inductor Sumida CDH115-100
P1	1	30V, 7.9A, P-channel MOSFET (SO-8) Fairchild NDS8435A

DESIGNATION	QTY	DESCRIPTION
R1	1	0.033Ω ±1%, 1W resistor (2010) IRC LRC-LR2010-01-R033-F
R2	1	0.068Ω ±1%, 1W resistor (2010) IRC LRC-LR2010-01-R068-F
R3, R4	2	100kΩ ±1% resistors (0805)
R5, R8	2	10kΩ ±5% resistors (0805)
R6, R7	2	4.7Ω ±1% resistors (0603)
R9, R10, R11	0	Not installed, resistors (0805)
U1	**1**	**MAX1873TEEE (16-PIN QSOP)**
JU1	1	2-pin header
None	1	Shunt
None	1	MAX1873 PC board
None	1	MAX1873 data sheet
None	1	MAX1873 EV kit data sheet

Quick Start

The MAX1873 EV kit is a fully assembled and tested surface-mount board. Follow the steps below to verify board operation. **Do not turn on the power supply until all connections are completed and confirm that the battery is a 4-cell in-series Li+ battery**.

1) Verify that a shunt is not across jumper JU1 (EN). Shunting JU1 to ground disables the charger.
2) Place a voltmeter across the BATT+ and GND terminals of the EV kit.
3) Place a voltmeter across the IOUT and AGND terminals of the EV kit.
4) Connect a 19V to 28V, 4A power supply across VIN and GND.
5) Turn on the power supply.
6) Verify that the no-load voltage across BATT+ and GND is approximately 16.8V.
7) **Observe correct Li+ cell polarity**. Connect the four Li+ battery cells (in series) across the BATT+ and GND terminals of the EV Kit.
8) Monitor the BATT+ voltage until it reaches 16.8V ±0.75%.

Detailed Description

The MAX1873 EV kit can supply power to a system load while charging a lithium-ion (Li+) or nickel (Ni)-based battery pack without exceeding the AC adapter current limits. Charging is achieved with an external P-channel MOSFET operated in a step-down DC-DC configuration. An analog output voltage proportional to the charging current is available at the IOUT pad so that an ADC or microcontroller can also monitor the charging current. As configured for 4-cell Li+ charging, the EV kit requires a power source that can supply a voltage of 18.5V to 28V and a current of 3A.

The EV kit is preset to limit the total source current and the maximum charging current to 3A, and to charge 4-series Li+ cells to 4.2V per cell. The user can reset these current limits by replacing the current-sense resistors R1 and R2 on the EV kit board or by adjusting the input voltage at the ICHG/EN pin with an external voltage supply at the ICHG/EN pad. The cell-charging voltage can be set between 4.009V and 4.387V using standard 1% resistors. The user can easily reconfigure the EV kit board to provide a regulated current to charge 10-cell Ni-based battery packs. To charge Li+ or Ni-based battery packs with a different number of cells, replace the IC on the EV kit board with one of the ICs listed on the *Parts Selection Table*.

Input Source

The MAX1873 EV kit requires a power supply that can source 3A, or the peak system current load if greater than 3A, with a voltage range of 18.5V to 28V. This voltage range is required for the MAX1873EEET, which comes installed on the EV kit board. The minimum input

voltage can be decreased if the MAX1873TEEE is replaced with the MAX1873REEE or the MAX1873SEEE. Refer to the *Parts Selection Table* at the beginning of this document for their respective input voltage ranges.

Note: If the system load is greater than 3A, verify that the input source is rated accordingly and replace D1 with a higher-current-rated diode.

Current Limits

The MAX1873 EV kit features input-source current limiting and maximum-charge current limiting. When the sum of the charge current and the load current exceed the input current limit, the charging current is reduced. The EV kit's source-current limit and charging-current limit is preset to 3A with current-sense resistors R1 and R2. As the system-load current increases, the remaining current is made available for charging. If the system-load current is greater than 3A, the EV kit will stop charging the battery pack. The user can modify the current limits by replacing R1 and R2 with resistors that will meet the respective voltage drop specification for proper current regulation. Refer to the *Input Current Regulator* and *Setting the Charging Current Limit* sections in the MAX1873 data sheet to modify R1 and R2 components and the current limits.

Note: If the EV kit is modified for current limits higher than 3A, verify that D1, D2, and P1 are rated accordingly.

Charging Lithium-Ion Cells

The MAX1873 EV kit is preset to charge 4-series Li+ cells to 4.2V each. The cell voltage can be set between 4.009V and 4.387V by replacing resistors R3 and R4 with other standard 1% resistors. To charge two or three Li+ cell packs, replace the MAX1873TEEE (U1) with the MAX1873REEE or the MAX1873SEEE, respectively. Refer to the *Voltage Regulator* section in the MAX1873 data sheet for instructions on how to select new resistors for a different charging voltage.

Note: The cell-battery termination voltage is a function of the battery chemistry and construction. Consult the battery manufacturer to determine this voltage.

Charging Nickel Cells

The MAX1873 EV kit is preset to charge Li+ cells but can be reconfigured to supply current to charge 10-cell, Ni-based battery packs. Refer to the *Charging NiMH* and *NiCd Cells* section in the MAX1873 data sheet for more information.

Control Input/Output

The MAX1873 EV kit features output (IOUT) and input (ICHG/EN) PC board pads that allow the user to monitor and set the battery-charging current, as well as to enable and disable the charger. The IOUT PC board pad is an analog output voltage supply that is proportional to the charging current. The voltage at IOUT is 4.0V (±0.4V) during maximum charge current. Use a microcontroller or an ADC to detect this voltage. Refer to the *Electric Characteristics* table in the MAX1873 data sheet for more information about the IOUT pin.

The ICHG/EN pin can also be used to set the charge current or to disable the charger. To disable the charger, place a shunt across jumper JU1 or set the voltage at the ICHG/EN PC board pad below 500mV. The charger is automatically enabled when the shunt is removed from jumper JU1, because it is pulled up to VREF through resistor R8 (10kΩ). Refer to Table 1 for JU1 configurations. To set the charge current at the ICHG/EN pin, replace the voltage-divider resistors R8 and R9 so that the input voltage is set between 700mV and VREF. An external op amp or DAC with the required output can also be connected at the ICHG/EN PC board pad to set the charging current or disable the charger.

Output Capacitor Selection

The output capacitor can be reduced in size and value, depending upon the charger being used. For the MAX1873R use a 68µF capacitor, for the MAX1873S use a 47µF capacitor, and for the MAX1873T use a 33µF capacitor. Use a capacitor with ESR < 1Ω. Refer to the MAX1873 data sheet for more information.

Table 1. Jumper JU1 Functions

SHUNT POSITION	ICHG/EN PIN	EV KIT FUNCTION
Installed	Connected to GND	Charger in shutdown
None	Pulled to VREF	Normal operation

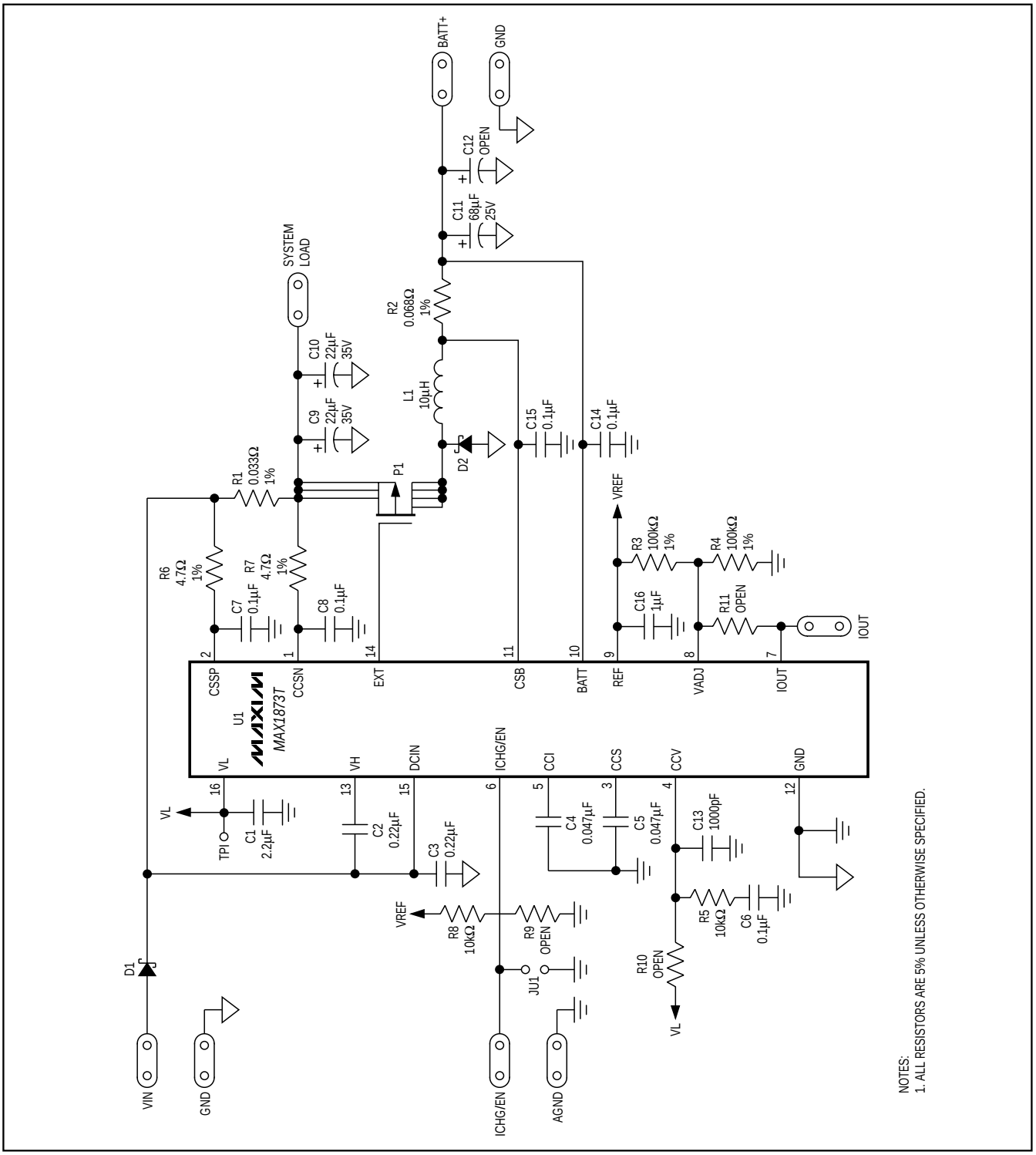

Figure 1. MAX1873 EV Kit Schematic 3

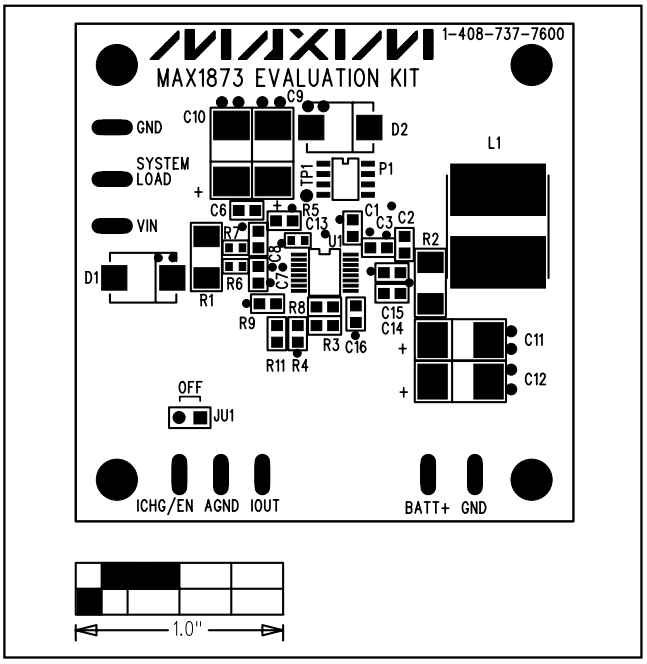

Figure 2. MAX1873 EV Kit Component Placement Guide—Component Side

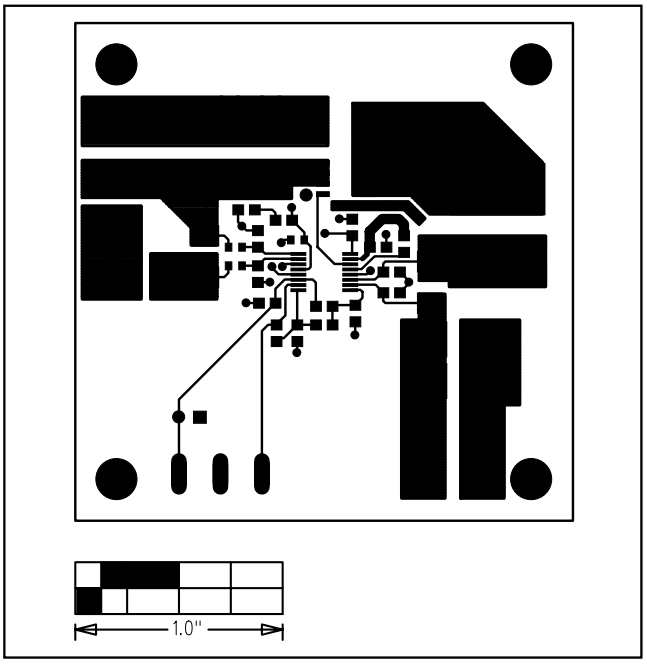

Figure 3. MAX1873 EV Kit PC Board Layout—Component Side

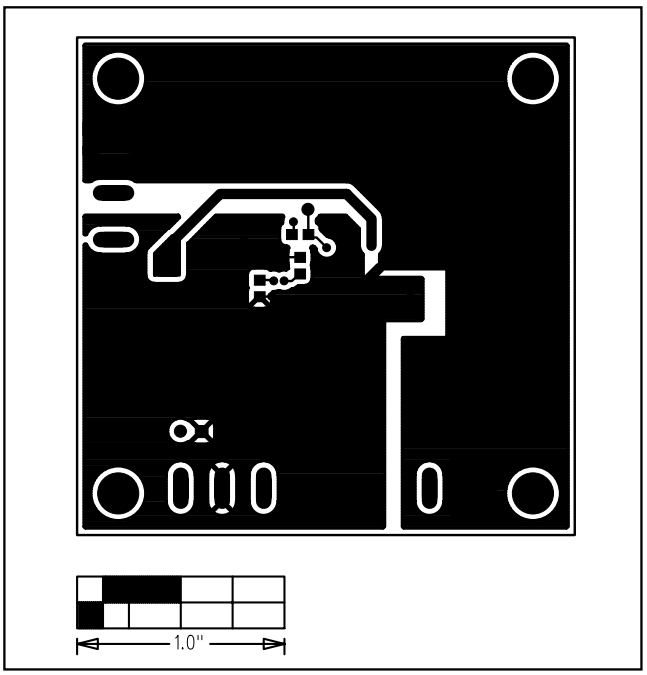

Figure 4. MAX1873 EV Kit PC Board Layout—Solder Side

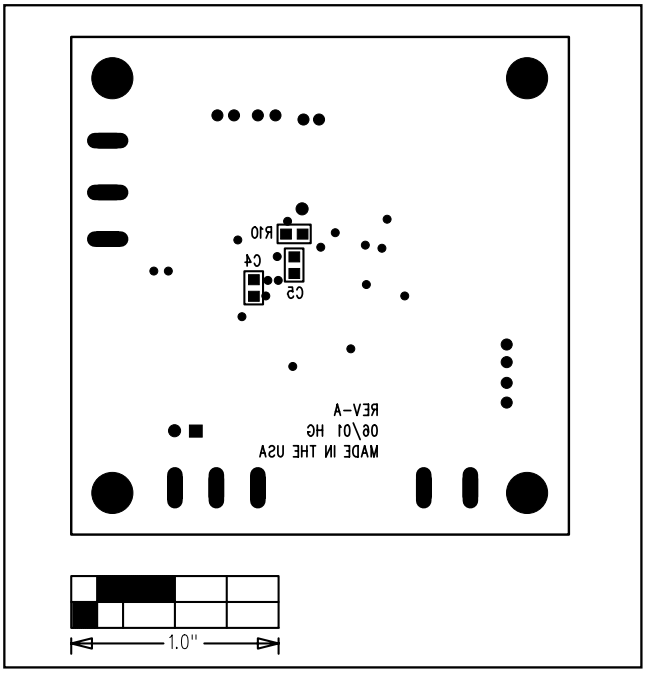

Figure 5. MAX1873 EV Kit Component Placement Guide—Solder Side