Evaluation Board for Compact, 1.5 A Linear Charger Single-Cell Li+ Battery

ADP2291-EVAL

DESCRIPTION

The ADP2291 is a linear, constant current/constant voltage charger controller for a single-cell lithium ion battery. See the ADP2291 data sheet for detailed information on the part.

The ADP2291-EVAL evaluation board is designed to provide a maximum of 750 mA charge current from an input voltage of 5 V. However, the evaluation board is flexible enough to accommodate different charge currents and input voltages. Jumpers are provided to disable the timer function, shutdown the charger, and disconnect the LED charge status indicator.

For more information regarding the operation of the ADP2291, please refer to the product data sheet included with the evaluation board. The most current version of Analog Devices data sheets can also be downloaded at www.analog.com.

SPECIFICATIONS

Input voltage range: 5 V ± 10%
EOC output voltage: 4.2 V ± 1%
Maximum charge current: 750 mA

SCHEMATIC DIAGRAM

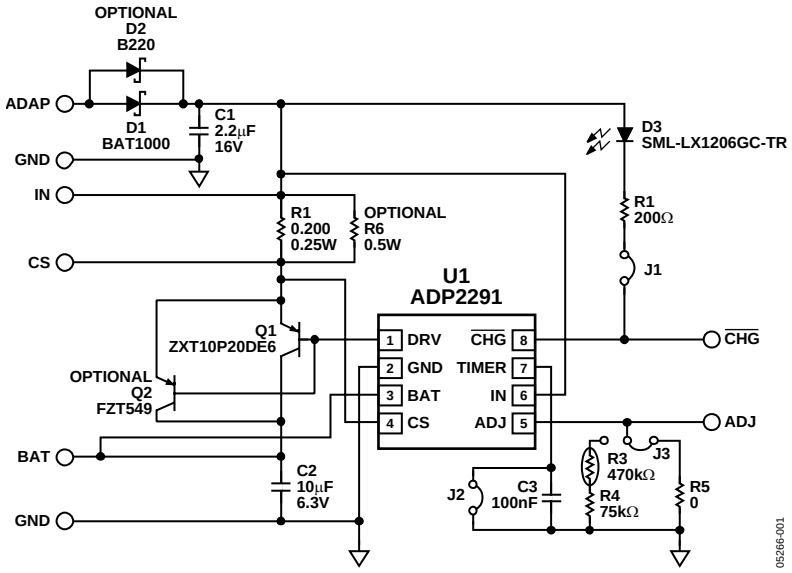

Figure 1. ADP2291 Evaluation Board Schematic

Rev. 0

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REVISION HISTORY

1/05—Revision 0: Initial Version

HARDWARE

TEST EQUIPMENT

The following is a suggested equipment list for testing the ADP2291-EVAL evaluation board:

- One 0 V to 12 V, 1 A power supply
- Two digital multimeters
- One 100 MHz oscilloscope
- One electronic load
- One single-cell lithium battery

TEST INSTRUCTIONS

Use the following guidelines to verify that the ADP2291 evaluation board is functional. Make sure all the connections are made before applying power to the evaluation board.

Preparation

1. Make sure that jumper shunts J1 and J3 are installed. This connects the LED charge status indicator to $\overline{CHG}$ and connects the thermistor to the ADJ pin to provide thermal protection for Q1. J3 should be placed in the left-hand position, otherwise the charger is disabled.
2. Verify that a jumper shunt is not installed at the J2 location (timer enabled).
3. Preset the adapter power supply for 5 V and turn off. Connect the power supply to the evaluation board, connecting the positive terminal to the ADAP pin and the negative terminal to the GND pin.

Initial Tests

1. Turn on the adapter power supply.
2. Place a voltmeter across the IN and CS pins to monitor the current sense voltage. Place the other voltmeter to monitor the BAT voltage.
3. Verify that the no load BAT voltage is 4.2 V $\pm$ 50 mV and check that D3 is off.
4. Monitor the TIMER pin with an oscilloscope. A triangular wave shape from 1.2 V to 2.0 V should be observed.
5. If the initial tests have failed do NOT proceed to the charger tests until the problem is resolved.

Charger Tests

1. Turn off the adapter supply and connect a single-cell lithium battery (or electronic load) to the BAT and GND pins. Double check that the polarity of the load is correct.
2. Turn on the adapter supply and verify charger operation.
3. Adjust the load for a BAT voltage less than 2.7 V. The current sense voltage should measure less than 18 mV and the charge status LED should be on.
4. Momentarily disconnect J3 and monitor the current sense voltage. It should be less than 20 mV. Reinstall J3.
5. Adjust the load for a BAT voltage of about 3.6 V. The current sense voltage should measure less than 120 mV and the charge status LED should be on.
6. Switch the location of Jumper J3 to shutdown the charger. The current sense voltage should be 0 V and the charge status LED should be off.
7. Momentarily disconnect J3 and monitor the current sense voltage. It should be less than 160 mV.
8. Restore Jumper J3 in the thermal protection position. Charging should resume and the charge status LED should be on.
9. Adjust the battery load for a no load condition on the charger. The BAT voltage should be 4.2 V and the charge status LED should go off.

COMMENTS

The evaluation board is configured for a charge current of 750 mA. For charge currents exceeding 1 A, the reverse voltage protection diode, D1, needs to be removed and a diode with a 2 A rating needs to be installed at D2 (SMB package).

The charge current can be adjusted by changing the value of the current sense resistor R1 or R6. The pad for R1 can accommodate 1206 packages, and the optional pad for R6 can accommodate 2010 packages, depending on the power dissipation required.

The thermal protection provided by R3 and R4 allows the small SOT-23-6 package to be used when operated under conditions that would normally exceed the 1 W power rating. See the typical performance curves shown in Figure 2 and Figure 3.

For operation without the thermal protection circuit or under conditions where power dissipation on the pass transistor is high, Q1 can be removed and a SOT-223 package installed at Q2.

Jumper J1 is provided to allow the charge status LED to be disconnected. With Jumper J1 removed, the open collector $\overline{CHG}$ output can be monitored by an external processor directly.

Jumper J2 can be installed to disable the timer.

Jumper J3 can be used to select thermal protection, charger shutdown, or to adjust the charge current. By connecting the ADJ pin to R3 and R4, thermal protection is provided. By connecting the ADJ pin through R5 to GND, the charger is shutdown. The charge current can be adjusted by changing the value of R5. See the ADP2291 data sheet for more details.

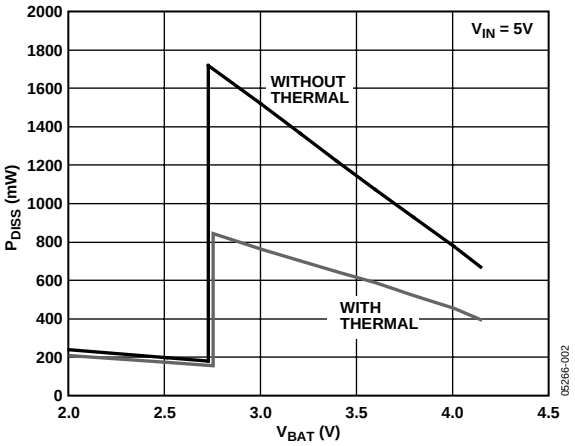

Figure 2. Power Dissipation

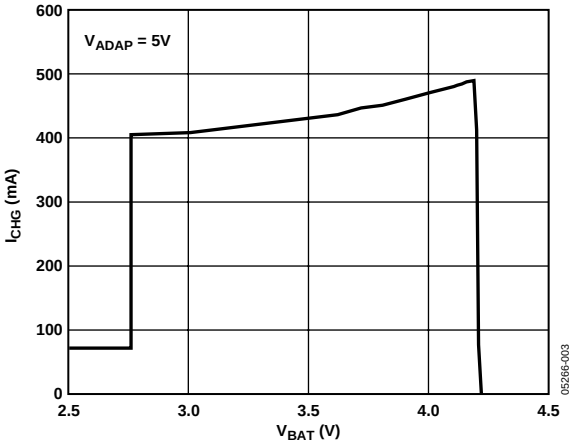

Figure 3. Charge Current vs. Battery Voltage

PC BOARD LAYOUT

The layout for the evaluation board is shown in Figure 4 through Figure 7. Gerber files for the ADP2291 evaluation board are available on request.

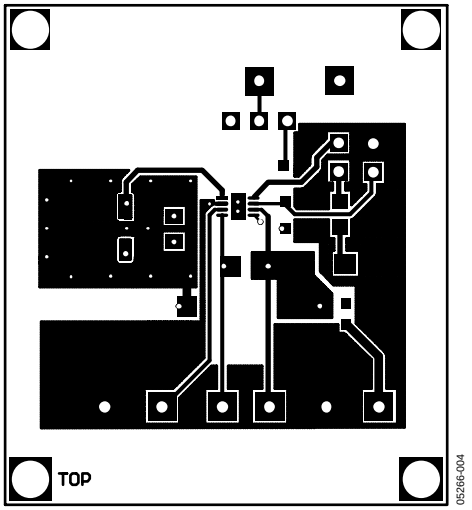

Figure 4. Top Layer (Top View)

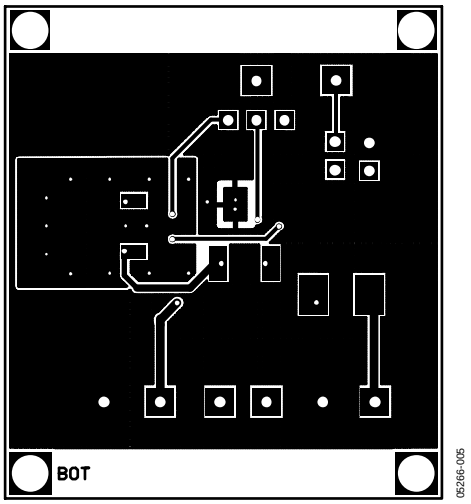

Figure 5. Bottom Layer (Top View)

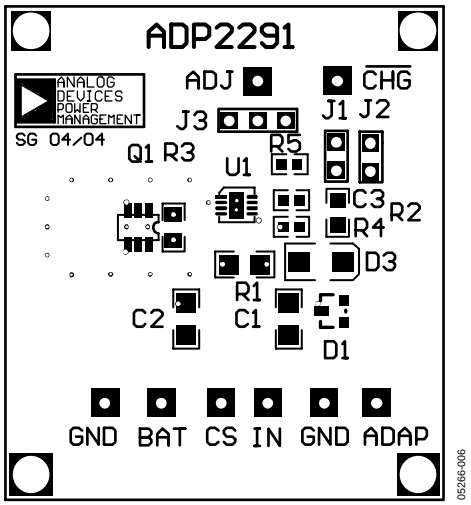

Figure 6. Top Silkscreen

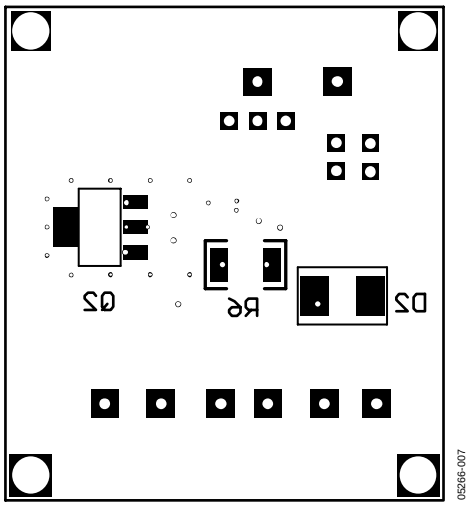

Figure 7. Bottom Silkscreen (Top View)

PARTS LIST

Table 1.

Item	Description	Manufacturer/Part Number	Designator	Qty
1	Capacitor, Ceramic, 2.2 µF, 16 V, X5R, 1206 SMD	Taiyo Yuden EMK316BJ225MD Murata GRM316R61C225KA88	C1	1
2	Capacitor, Ceramic, 10 µF, 6.3 V, X5R, 1206 SMD	Taiyo Yuden JMK316BJ106MD Murata GRM319R61A106KA19	C2	1
3	Capacitor, Ceramic, 100 nF, 16 V, X7R, 0603 SMD	Taiyo Yuden EMK107BJ104MA Murata GRM188R71C104KA01 or equivalent	C3	1
4	Resistor, 0.200 Ω, ¼ W, 1%, 1206 SMD	Dale WSL1206 0R20 1% IRC LRC-LR1206-01-0R20-F	R1	1
5	Resistor, 200 Ω, 1/10 W, 5%, 0805 SMD	Dale CRCW 0805 201 J IRC WCR0805 201 J or equivalent	R2	1
6	Thermistor, 470 kΩ, 1/5 W, 5%, 0805 SMD	Vishay 2322 615 1.474 BetaTHERM SMD@500KJ425J	R3	1
7	Resistor, 75.0 kΩ, 1/16 W, 1%, 0603 SMD	Dale CRCW 0603 7502 F IRC WCR0603 7502 F	R4	1
8	Resistor, 0 Ω Jumper, 0603 SMD	Dale CRCW 0603 000 Z IRC WCR0603 0R0 J	R5	1
9	Diode, Schottky, 1 A, 40 V, SOT-23	Diodes Inc BAT1000 Zetex ZHCS1000	D1	1
10	LED, Green, 10 mcd, 2.2 V_F at 20 mA, 1206 SMD	Lumex SML-LX1206GC-TR CML CMD15-21VGC/TR8	D3	1
11	Transistor, PNP, 2 A, 20 V, 1 W, SOT-23-6	Zetex ZXT10P20DE6 ON Semiconductor MBT35200MT1	Q1	1
12	IC, Single-Cell Lithium Battery Charge Controller, 3 mm × 3 mm LFCSP	ADI ADP2291ACPZ	U1	1
13	Header, Single Row, Straight 0.100" Ctrs, 15 Circuits	3M 929834-01-15 or equivalent	J1, J2, J3, ADAP, GND, IN, CS, $\overline{\text{CHG}}$, ADJ, BAT	1
14	Shunt, 2 A	3M 929952-10 or equivalent	J1, J2, J3	3

Optional Parts List (Not Installed)

Table 2.

Item	Description	Manufacturer/Part Number	Designator	Qty
1	Resistor, ½ W, 1%, 2010 SMD	Dale WSL2010 0RXXX, 1% IRC LRC-LR2010-01-0RXX-F	R6	0
2	Diode, Schottky, 2 A, 20 V, SMB	Diodes Inc B220	D2	0
3	Transistor, PNP, SOT-223	Zetex FZT549	Q2	0

VENDOR LIST

BetaTHERM
508-842-0516
www.betatherm.com

CML Innovative Technologies
201-489-8989
www.chml.com

Diodes Inc.
805-446-4800
www.diodes.com

IRC
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Lumex
847-359-2790
www.lumex.com

Murata Manufacturing Co., Ltd.
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www.onsemi.com

Taiyo Yuden
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www.t-yuden.com

Vishay
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Vishay Dale
402-563-6866
www.vishay.com/company/brands/dale

Zetex Semiconductors
631-360-2222—U.S. Sales
www.zetex.com

3M
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www.3m.com

ORDERING INFORMATION

ORDERING GUIDE

Model	Description
ADP2291-EVAL	Evaluation Board

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

NOTES

EB05266-0-1/05(0)