EV2639B-R-00A

Single Cell Charger EV board
with 5A charging current and wide Input & OTG

The Future of Analog IC Technology®

DESCRIPTION

The EV2639B-R-00A is the reference design board for MP2639B, a highly-integrated, flexible switch-mode battery charge management for a single-cell Li-ion and Li-Polymer battery used in a wide range of applications.

The demo board shows two operating modes—charge mode and boost mode.

When input power is present, the board charges a single-cell battery with a programmable charge current up to 5A.

In the absence of an input source, the board switches to boost mode through the PB pin control to power the VH pin from the battery with a current up to 3A.

The evaluation board provides 4-LED to indicate the voltage based fuel gauge and distinguish charge mode from boost mode.

To guarantee the safe operation, the EV2639B-R-00A has input-over-voltage protection, battery over-voltage protection, thermal shutdown, battery-temperature monitoring, and a programmable timer to prevent prolonged charging of a dead battery.

FEATURES

- 4.5V-to-16V Input Voltage Range
- Programmable Charge Current
  - Up to 5A for 1-Cell Application
- 4.35V Charge Voltage with 0.5% Accuracy
- Programmable Discharge Output Current
  - Up to 3.0A for 5V Output
- Programmable OTG Output Voltage
  - Up to 15V
- Negative Temperature Coefficient Pin for Temperature Monitoring
- Push Button Turn On Boost
- Programmable Timer Back-up Protection
- Thermal Regulation and Thermal Shutdown
- 4 LEDs Battery Level and Status Indication

APPLICATIONS

- Power Station Applications
- USB PD Power Banks
- Mobile Internet Devices

ELECTRICAL SPECIFICATION

Parameters	Value	Unit
Charge mode		
Input Voltage	4.5 – 16	V
Battery Charge Voltage Regulation	4.35	V
Fast Charge Current	Up to 5.0	A
Input Minimum Voltage Regulation	4.5	V
Input Current Limit	3.0	A
Discharge mode		
Min Battery Voltage	2.7	V
Boost Output Voltage	Up to 15.0	V
Boost Output Current Limit	3.0	A

EV2639B-R-00A EVALUATION BOARD

(L x W x H)

(4.3cm x 4.5cm x 0.16cm)

Board Number	MPS IC Number
EV2639B-R-00A	MP2639BGR

DEMO BOARD SCHEMATIC

Main chip is MP2639BGR

RILIM = 73.2K for 3A ILIM, RILIM=640K/3/ILIM

ROLIM = 71.5K for 3A OLIM, ROLIM=640K/3/IOLIM

RISET = 42.6K for 5A ICHG, RISET=640K/3/ICHG
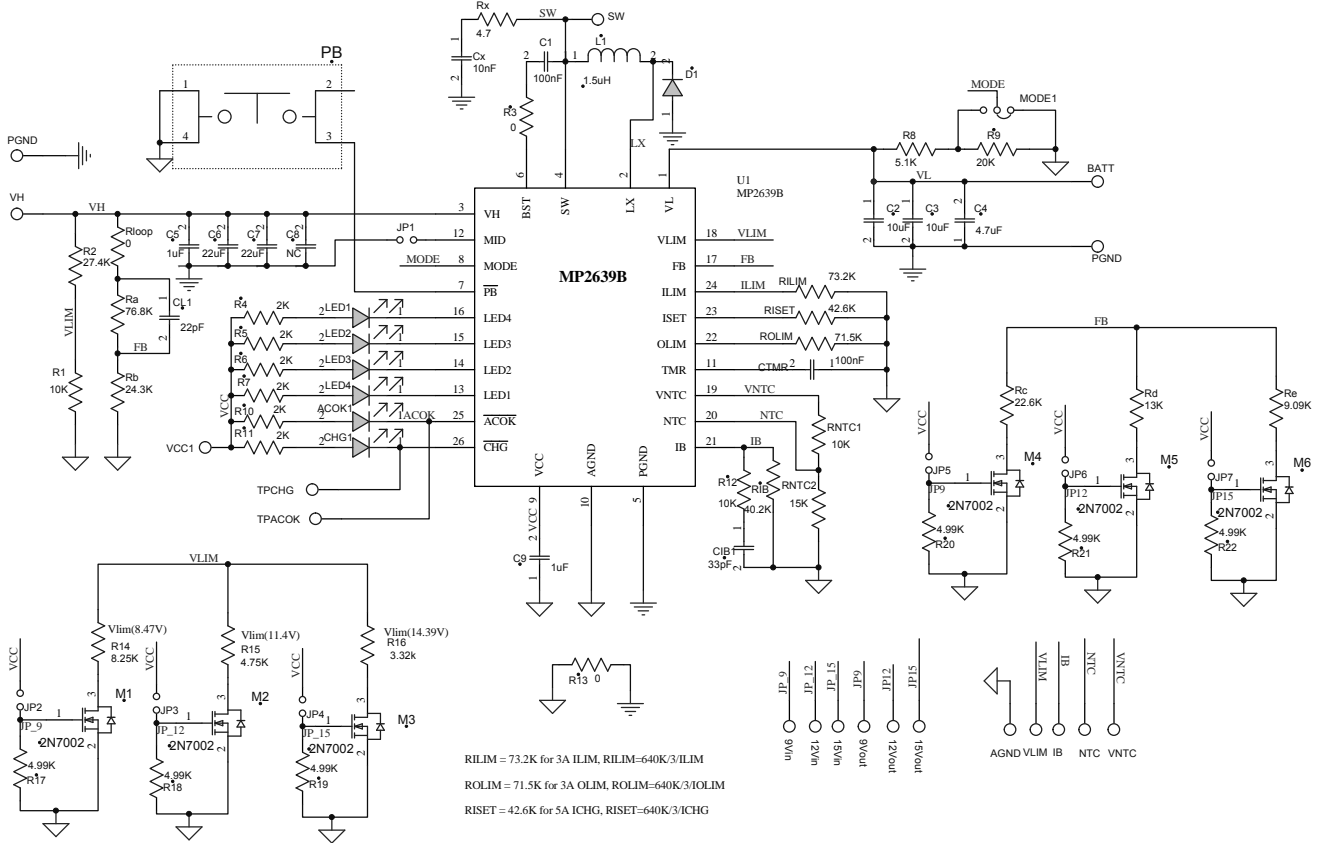
BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacture	Manufacture_PN
5	CHG1, LED1, LED2, LED3, LED4	BL-HGE35A -AV-TRB	LED; Blue light	0805	Bright Red	BL-HGE35A-AV-TRB
1	ACOK1	BL-HUE35A -AV-TRB	LED; Red light	0805	Bright Red	BL-HUE35A-AV-TRB
2	C1, CTMR	100nF	Capacitor; 25V; X7R; 0603	0603	muRata	GRM188R71H104KA93D
2	C2, C3	10µF	Capacitor;25V;X7R	1206	muRata	GRM31CR71E106KA12
1	C4	4.7µF	Ceramic Capacitor; 16V; X5R; 0805	0805	muRata	GRM21BR61C475KA88L
2	C5, C9	1µF	Capacitor; 16V; X7R; 0603	0603	muRata	GRM188R71C105KA12D
2	C6, C7	22µF	Capacitor;25V;X5R	1206	Murata	GRM31CR61E226KE15
1	C8	NC				
1	RX	NC				
1	CIB1	33pF	Ceramic Capacitor; 50V; C0G; 0603	0603	TDK	C1608C0G1H330J
1	CL1	22pF	Ceramic Capacitor; 50V; C0G; 0603	0603	muRata	GRM1885C1H220JA01D
1	Cx	10nF	Ceramic Capacitor; 50V; X7R; 0603	0603	muRata	GRM188R71H103KA01D
1	D1	B330B	Schottky Diode; 30V; 3A	SMB	Diodes	B330B-13-F
1	L1	1.5µH	Inductor; 1.5uH; 10m; 14A	SMD	Wurth	744311150
6	M1, M2, M3, M4, M5, M6	2N7002MTF	N-Channel 60V; 1.2Ω; 115mA	SOT-23		2N7002MTF
1	PB	Push button	Button; SM 4x10mm; 1.5mm Height			
3	R1, R12, RNTC1	10kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0710KL

BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacture	Manufacture_PN
1	R2	27.4kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0727K4L
3	R3, R13, Rloop	0Ω	Film Resistor;5%	0603	Yageo	RC0603JR-070RL
6	R4, R5, R6, R7, R10, R11	2kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-072KL
1	R8	5.1kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-075K1L
1	R9	20kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0720KL
1	R14	8.25kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-078K25L
1	R15	4.75kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-074K75L
1	R16	3.32kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-073K32L
6	R17, R18, R19, R20, R21, R22	4.99kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-074K99L
1	Ra	76.8kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0776K8L
1	Rb	24.3kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0724K3L
1	Rc	22.6kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0722K6L
1	Rd	13kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0713KL
1	Re	9.09kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-079K09L
1	RIB	80.6kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0740K2L
1	RILIM	73.2kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0773K2L
1	RISET	42.2kΩ	Film Resistor;1%	0603	Yageo	RC0402FR-0742K2L
1	RNTC2	15kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0715KL
1	ROLIM	71.5kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0771K5L
1	U1	MP2639BGR		QFN4x4	MPS	MP2639BGR

RINTED CIRCUIT BOARD LAYOUT

Top Layer

Mid Layer1

Mid Layer2

Bottom Layer

Table 1: Jumper Connections

Jack	Description	Factory Setting
Mode	Short to low, enable charge mode Short to high, enable boost mode	Short to low
JP2	8.25kΩ parallel with R1 to set 8.47V V_{IN_MIN}	Float
JP3	4.75kΩ parallel with R1 to set 11.4V V_{IN_MIN}	Float
JP4	3.32kΩ parallel with R1 to set 14.4V V_{IN_MIN}	Float
JP5	22.6kΩ parallel with Rb to set 9V V_{OUT}	Float
JP6	13kΩ parallel with Rb to set 12V V_{OUT}	Float
JP7	9.09kΩ parallel with Rb to set 15V V_{OUT}	Float

Table 2: Operation Setting

Charge mode				
Mode	JP2	JP3	JP4	Operation mode
Low	float	float	float	4.5V VIN minimum voltage regulation
	short	float	float	8.5V VIN minimum voltage regulation
	float	short	float	11.4V VIN minimum voltage regulation
	float	float	short	14.4V VIN minimum voltage regulation
Discharge mode				
Mode	JP5	JP6	JP7	Operation mode
High	float	float	float	5V output in boost mode
	short	float	float	9V output in boost mode
	float	short	float	12V output in boost mode
	float	float	short	15V output in boost mode

QUICK START GUIDE

This board is designed for MP2639B used as a standalone switching charger with wide range input and integrated reverse programmable OTG. And the layout accommodates most commonly used capacitors. The default function of this board is preset in charger mode with the battery regulation voltage preset to 4.35V for 1 cell Li-Ion battery.

Charge Mode Setting

1. Input Current Limit

An input current limit can be set slightly below the input source's maximum current rating. When the input current hits this limit, the charge current decreases to keep the input current constant at the limit value. RILIM—the resistor connected to the ILIM pin—programs this limit. The default input current limit at 3A, use an RILIM of 71.5kΩ.

$$I_{IN\_LMT} \ (A) = \frac{640(k\Omega)}{3 \times R_{ILIM} \ (k\Omega)} \qquad (1)$$

2. Charge Current

The charge current can be programmed via RISET. Determine the charge current using the following formula:

$$I_{CC} \ (A) = \frac{640(k\Omega)}{3 \times R_{ISET} \ (k\Omega)} \qquad (2)$$

For default 5A charge current, the given RISET is 42.2kΩ.

Boost Mode Setting

1. Output Current Limit

Set the output current limit in boost mode for the demo board to operate like a standard adapter. Set the output current limit as per the following equation:

$$I_{OLIM} \ (A) = \frac{640(k\Omega)}{3 \times R_{OLIM} \ (k\Omega)} \qquad (3)$$

For default output current limit is 3A for 5V, the given ROLIMIT is 71.5kΩ.

2. Output Voltage regulate

In discharge mode, the demo board can provide different output voltage through the voltage divider of FB pin according to:

$$V_{OUT} = V_{FB} \times \frac{Ra+Rb}{Rb} \qquad (4)$$

V_{FB} is 1.2V, and the default output voltage is 5V.

EQUIPMENT REQUIREMENT

Evaluation requires the following equipments:

1. For charge, input port needs a power source with 15V/3A capability.

2. Battery simulator or a single-cell battery pack. The battery simulator's output rating should exceed 4.5V/8.0A. When using a real battery pack, please observe all precautions on the battery manufacturer's data sheet first and ensure the charger's setting doesn't exceed the battery's absolute maximum specifications.

3. E-load or real resistance load. The E-load capability should exceed 15V/3A.

4. An oscilloscope. A single voltage probe and a single current probe.

5. Multi-meter.

Charge function (Mode=Low):

1. Attach the positive and negative ends of the battery to the "BATT" and "PGND" terminals, respectively. If it's a battery simulator, please preset the voltage to 3.8V (typical value) first.

2. Attach the positive and negative ends of the DC source to the "VH" and "PGND" terminals, the input voltage can be varied in range of 4.5V to 16V.

3. Connect the input source and battery, the charge starts. Use the oscilloscope to verify that the charge current is being delivered to the battery, the charge current could be a different value under following conditions:

   a. The charge current could be limited by input current limit.

   b. The charge current could be limited by the input voltage regulation.

   Once the input voltage approaches the input minimum voltage regulation threshold preset such as 4.5V internally, charge current begins to reduce and maintain proper regulation of the input voltage. It happens when the input power source does not have enough capability or the voltage loss on test line is too big.

4. Connect input source and battery, also can verify other functions:

   a. Input Current Limit.

   When the DC power supply has bigger current capability than the input current limit, increase battery voltage, when the input current hits this limit, the charge current decreases to keep the input current constant at the limit value.

   b. Input minimum Voltage Regulation

   When the DC power supply has smaller current capability than the input current limit, the input power source is insufficient to support the large charge current and the input voltage drops. Once the voltage drops to the $V_{IN-MIN-REG}$, the charge current reduces to maintain the input voltage avoid dropping further.
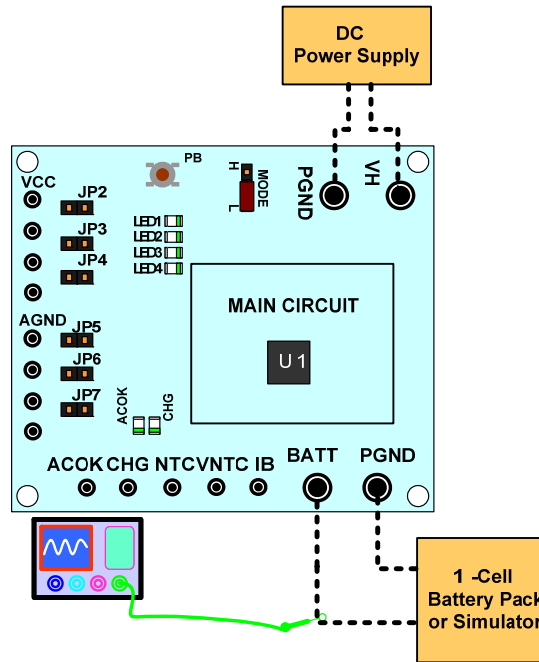
Figure1: Step for charge mode

Boost function (Mode=High):

1. Connect E-load or resistor to VH on the demo board.

2. Attach the positive and negative ends of the battery to the "BATT" and "PGND" terminals respectively. If it's a battery simulator, please preset the voltage to 3.8V (typical value) firstly.

3. Short push the PB, the boost starts to work. Verify the output current is limited at 3A for 5V output (default), 9V、12V and 15V are also selectable but the max output power should be limited within 15W .

4. Long push the PB for longer than 2.5 s, the boost operation shuts down.