EV2635A-R-00A
Fully Power Management Charger For Single-Cell Battery System

The Future of Analog IC Technology

DESCRIPTION

The EV2635A-R-00A, the evaluation Board is designed to demonstrate the capabilities of MPS' MP2635A, a high-integrated, flexible switching charger for a single-cell battery used in portable application.

EV2635A covers two operation modes, charge mode and boost mode, manages the power according to the different input conditions.

When input is present, the board charges a single cell battery with programmable charge currents up to 2A.

When input is absent, the board switches to the boost mode via MODE pin to power the SYS from the battery up to 1A.

The evaluation board provides full operating status indication to distinguish charge mode from boost mode.

For guaranteed safe operation, the EV2635A has input over voltage protection, battery over voltage protection, thermal shutdown, battery temperature monitoring, and programmable timer to prevent prolonged charging of a dead battery.

FEATURES

- 4.5V to 16V Input Voltage Range
- Input Current Based Power Management
- Up to 2A Programmable Charge Current
- Selectable 3.6V/ 4.2V Charge Voltage with 0.5% Accuracy
- Battery Temperature Monitoring
- Full Operation Indicators
- Programmable Timer Back-up Protection
- Battery Reverse Leakage Blocking
- Reverse Boost Operation for Powering System
- Up to 90% Efficiency for Boost Mode
- Up to 1A Programmable Output Current Limit for Boost Mode

APPLICATIONS

- Sub-battery Application
- Power-bank Application
- Mobile Internet Device
- Portable Media Player

All MPS parts are lead-free and adhere to the RoHS directive. For MPS green status, please visit MPS website under Products, Quality Assurance page.

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ELECTRICAL SPECIFICATION

Parameter	Symbol	Value	Units
Input Voltage Range	V_{IN}	4.24 – 6	V
Charge Full Voltage	V_{BATT_Full}	4.2/ 3.6	V
Charge Current	I_{CHG}	2	A
Input Current Limit	I_{IN_LIM}	2.7	A
Battery Voltage	V_{BATT}	2.5 – 4.35	V
SYS Voltage Regulation	V_{SYS}	5	V
SYS Output Current Limit	I_{SYS}	1	A

EV2635A-R-00A EVALUATION BOARD

(L × W × H) 6.1cm × 5.1cm × 1.3cm

Board Number	MPS IC Number
EV2635A-R-00A	MP2635A

EVALUATION BOARD SCHEMATIC
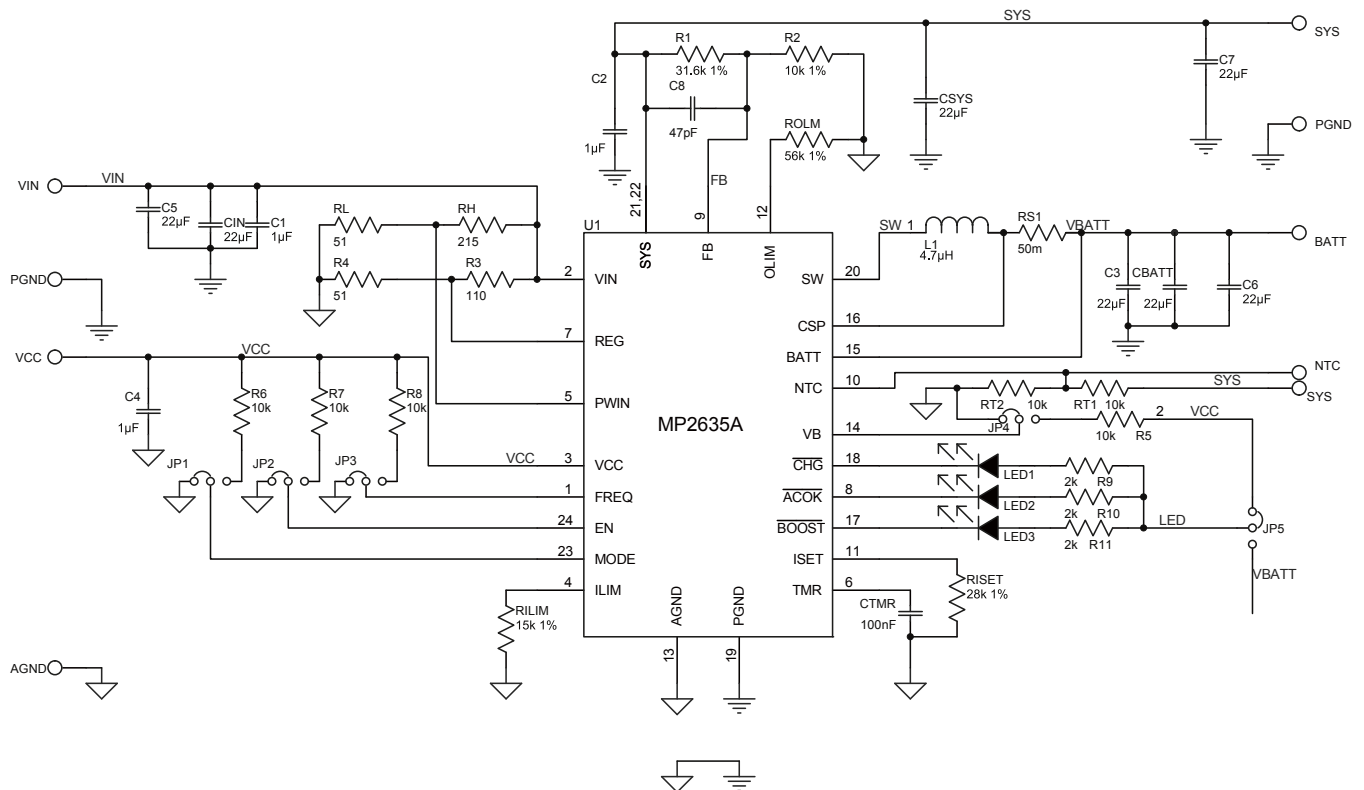
EV2635A-R-00A BILL OF MATERIALS

Qty.	Ref	Value	Description	Package	Manufacture	Manufacture_PN
1	C1,	1μF	Ceramic Capacitor; 25V; X5R	CAP/0603	TDK	C1608X5R1E105K
1	C2	1μF	Ceramic Capacitor; 16V; X7R;	CAP/0603	muRata,	GRM188R71C105KA12D
4	C3, C7, CSYS, CBATT	22μF	Ceramic Capacitor; 10V; X7R;	CAP/1206	muRata	GRM31CR71A226KE15L
2	C4, CTMR	100nF	Ceramic Capacitor; 50V; X7R;	CAP/0603	muRata	GRM188R71H104KA93D
2	C5, C6	NC				
1	C8	47pF	Ceramic Capacitor; 50V; C0G;	CAP/0603	TDK	C1608C0G1H470J
1	CIN	22μF	Ceramic Capacitor; 25V; X5R;	CAP/1206	muRata	GRM31CR61E226KE15
1	L1	4.7μH	Inductor; 4.7uH;	SMD	Wurth	744311470
					Cooper	DR73-4R7-R
2	LED1, LED3	BL-HUF35A-TRB	LED;Red	LED/SMD/0805	BRIGHT LED	BL-HUF35A-TRB
1	LED2	HL-PSC-2012H203BC	LED;Blue	LED/SMD/0805	BRIGHT LED	HL-PSC-2012H203BC
1	R1	31.6k 1%	Film Resistor; 1%;	RES/0603	Yageo	RC0603FR-0731K6L
4	R2, R5, , RT1, RT2	10k 1%	Film Resistor; 1%;	RES/0603	Yageo	RC0603FR-0710KL
1	R3	110	Film Resistor; 1%	RES/0603	Yageo	RC0603FR-07110RL
2	R4, RL	51	Film Resistor; 1%	RES/0603	Yageo	RC0603FR-0751RL
3	R6, R7, R8	10k	Film Resistor; 5%;	RES/0603	Yageo	RC0603JR-0710K
3	R9, R10, R11	2k	Film Resistor; 5%; 1/10W	RES/0603	LIZ	CR0603JA0202G
1	RH	215	Film Resistor; 1%	RES/0603	Yageo	RC0603FR-07215RL
1	RILIM	15k 1%	Film Resistor; 1%;	RES/0603	Yageo	RC0603FR-0715KL
1	RISET	28k 1%	Film Resistor; 1%;	RES/0603	Yageo	RC0603FR-0728KL

EV2635A-R-00A BILL OF MATERIALS *(continued)*

Qty.	Ref	Value	Description	Package	Manufacture	Manufacture_PN
1	ROLM	56k 1%	Film Resistor; 1%	RES/0603	Yageo	RC0603FR-0756KL
1	RS1	50m	Sense Resistor; 1%; 1/2W;	RES/1206	Yageo	RL1206FR-070R050L
5	JP1, JP2, JP3, JP4, JP5		JUMPER/3P/DIP/2.54MM			
1	U1			QFN24/4X4MM/EP	MPS	MP2635AGR

PRINTED CIRCUIT BOARD LAYOUT
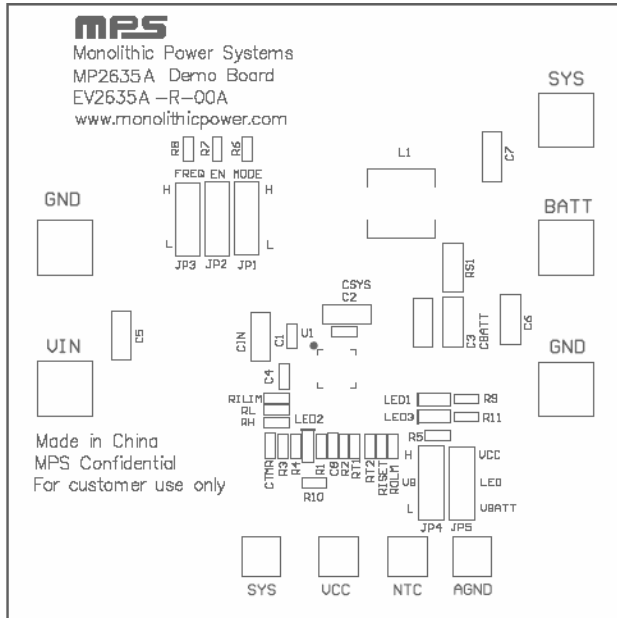
Figure 1: Top Silkscreen Layer
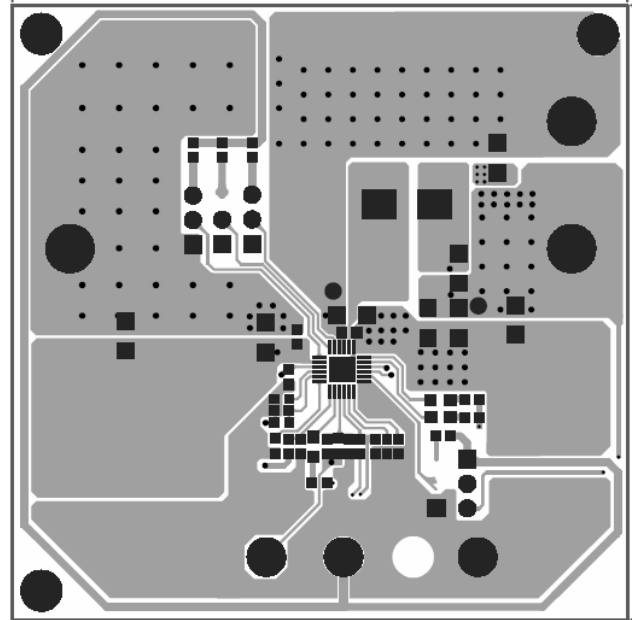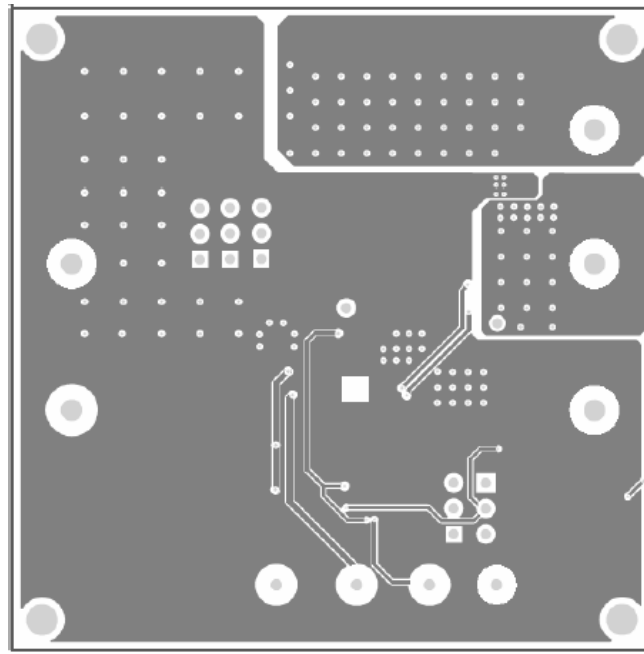

Figure 2: Top Layer

Figure 3: Bottom Layer

QUICK START GUIDE

This board is designed for MP2635A used as a standalone switching charger with integrated reverse directional boost from BATT to SYS, and layout accommodates most commonly used capacitors. The default function of this board is preset for charger mode and the charge full voltage is preset to 4.2V for 1 cell Li-Ion battery.

Charge Mode Setting

1. Input Over Voltage Limit Setting

The MP2635A has a PWIN pin to monitor the input voltage. Once the voltage input voltage at PWIN pin exceeds 1.15V, the input to system path is cut off to protect the device connected at the system from being damaged. To the maximum input be designed as 6V, the following equation must be followed.

$$\frac{V_{PWIN}}{V_{IN}} = \frac{1.15}{6} = \frac{RL}{RH + RL} \tag{1}$$

Assume RL=51Ω, RH is 215Ω. [1]

2. REG Voltage Setting

REG pin is the feedback input of the input voltage. Connect this pin to external resistor divider from VIN to GND. The voltage on this pin should be always higher than 1.2V when normal operation.

$$V_{REG} = \frac{R4}{R3 + R4} \times V_{IN\_MIN} > 1.2V \tag{2}$$

If V_{IN_MIN}=4.25V, given R4=51Ω, R3=127Ω. [1]

3. Input Current Limit Setting

An input current limit can also be set to be a little bit lower than the max current rating of the input source. When input current hits this limit, the charge current will be decreased to keep the input current constant at the limit value, in order to power the system firstly. This limit can be programmed via RILIM, the resistor connected toILIM pin. To set the input current limit at 2.7A, the 15kΩ RILIM can be used.

$$I_{ILIM}(A) = \frac{40.5(kV)}{R_{ILIM}(k\Omega)} \tag{3}$$

4. Charge Full Voltage Setting

There are two options of the charge full voltage. That is to leave VB pin floating or connect to high logic for 4.2V and to connect to GND for 3.6V.

5. Charge Current Setting

The charge current can be programmed via both RS1 and RISET. With given RS1=50mΩ, the charge current can be set by the following formula:

$$I_{CHG}(A) = \frac{70(k\Omega)}{R_{ISET}(k\Omega)} \times \frac{40(mV)}{RS1(m\Omega)} \tag{4}$$

E.g. if the charge current is expected to be 2A, a 28kΩ RISET can be selected.

6. .Charge Timer Setting

The MP2635A also integrates a charge timer to provide a back-up protection to prevent a damaged battery from being charged after a certain time. The total charge time can be set via the following formula.

$$t_{TOTAL\_TMR} = 6Hours \times \frac{C_{TMR}(\mu F)}{0.1\mu F} \times \frac{1(A)}{I_{CHG}(A)} \qquad (5)$$

So if the charge current is set to 2A, a 0.1µF generates 3hours timer.

Boost Mode Setting

1. System Output Voltage Setting

When the EV2635A works in the boost mode, it can be enabled or disabled via MODE pin. And the output voltage can also be adjustable via resistive divider composing of R1 and R2, the setting formula is shown as follows,

$$V_{SYS\_REG}(V) = 1.2V \times \frac{R1+R2}{R2} \qquad (6)$$

Select R1 and R2 as 31.6kΩ and 10kΩ can make the system voltage 5V.

2. System Output Current Limit Setting

The system output current limit in boost mode to make the EV2635A like a standard adapter. The output current limit can be set via the following equation.

$$I_{OLIM}(A) = \frac{70(k\Omega)}{R_{OLIM}(k\Omega)} \times \frac{40(mV)}{RS1(m\Omega)} \qquad (7)$$

Others

1. Operating Frequency Setting

For both charger and boost mode, the operation frequency can be programmable to optimize the design. The frequency is set to 1.2MHz by connecting the FREQ pin to "H" or leaving the FREQ pin floating, while set to 600kHz by connecting the FREQ pin to "L".

For the other detailed description on the operation of the MP2635A, please refer to the datasheet.

Note: 1. Considering these resistors (R3, R4, RH, RL) as the dummy load at input port, recommend resistors with hundreds of ohms to increase the power off speed.

EQUIPMENT REQUIREMENT

Before the evaluation, the following equipments should be prepared:

1. A DC power source. The output voltage range should be greater than 6V, and output current greater than 2A.

2. A battery simulator or a single-cell battery pack. The output rating of battery simulator should be greater than 4.5V/2.5A. While use the real battery pack, please observe all precautions on the battery manufacturer's data sheet first and then make sure the charger's setting doesn't exceed the absolute maximum specification of the battery.

3. An oscilloscope. A single voltage probe and a single current probe are required at least.

4. A multi-meter.

Charge Function

(1) Connect the jumper "EN" to "H" and the "MODE" to "L" with shunts respectively!

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

(3) Preset the DC power source to 5V. Then attach the DC output port and ground to the "VIN" and "GND" terminals, respectively.

(4) Turn on the DC power source. The charger will start to work. Verify the 2A charge current is being delivered to the battery with the oscilloscope.

(5) Remove the shunt between the "EN" and "L" to disable charging.

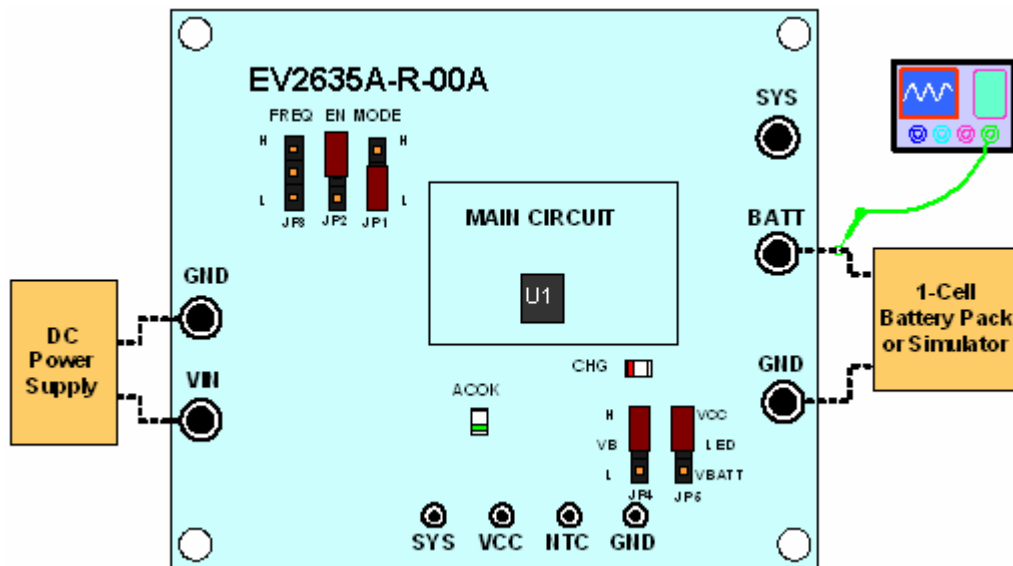(6) Re-insert the shunt between the "EN" and "H" to enable charging.

Figure 4: Setup for Charge Mode

Boost Function

(1) Connect the jumper "MODE" to "H" and the "EN" to "L" with shunts respectively!

(2) Attach the load to the "SYS" and "GND" terminals respectively.

(3) Attach the positive and negative ends of the battery to the "BATT" and "GND" terminals respectively.

If it's a battery simulator, please preset the voltage to 3.8V (typical value) firstly. The boost will start to work. Verify the system output current is limited at 1A.

(4) Remove the shunt between the "MODE" and "L" to disable boost.

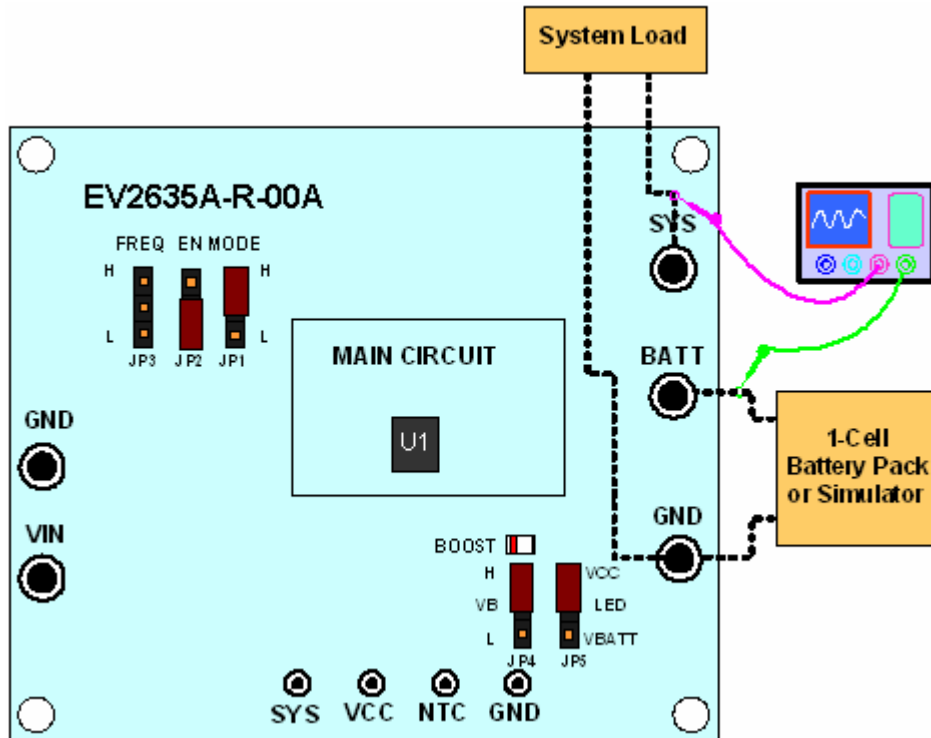(8) Install the shunt between the "MODE" and "H" to enable boost.

Figure 5: Setup for Boost Mode