EV2658-Q-00A

36V, Switching Charger for Battery Pack with Battery Regulation Voltage from 2V to 31V Evaluation Board

DESCRIPTION

The EV2658-Q-00A is an evaluation board designed to demonstrate the capabilities of the MP2658, a highly integrated switching charger designed for portable devices with different battery chemistries. The MP2658 supports up to 7-cell series Li-ion, Li-polymer, and $LiFePO_4$ battery packs. It also supports lead-acid, super capacitor, NiMH, and NiCd battery packs from 2V to 31V. The device achieves up to 3A of charge current with any battery regulation voltage (V_{BATT_REG}).

The device operates under a maximum 36V DC input voltage and hold-off voltage up to 45V. When an input power supply is present, the MP2658 generally charges the battery with four phases: trickle charge, pre-charge, constant-current charge, and constant-voltage charge.

The MP2658 can be configured to different pre-charge to fast charge thresholds and different charge termination modes via the external pins. This allows the device to support super capacitor charging, as well as different types of battery charging.

Power management is based on the input current (I_{IN}) and input voltage (V_{IN}). If I_{IN} exceeds the preset I_{IN} limit, or V_{IN} drops to the preset V_{IN} limit, the MP2658 automatically decreases the charge current to protect the input power supply from overload conditions.

To guarantee safe operation, the MP2658 offers robust protection features such as battery over-voltage protection (OVP), battery temperature sensing and protection, thermal shutdown, and a charging safety timer.

The MP2658 is available in a QFN-19 (3mmx3mm) package.

PERFORMANCE SUMMARY

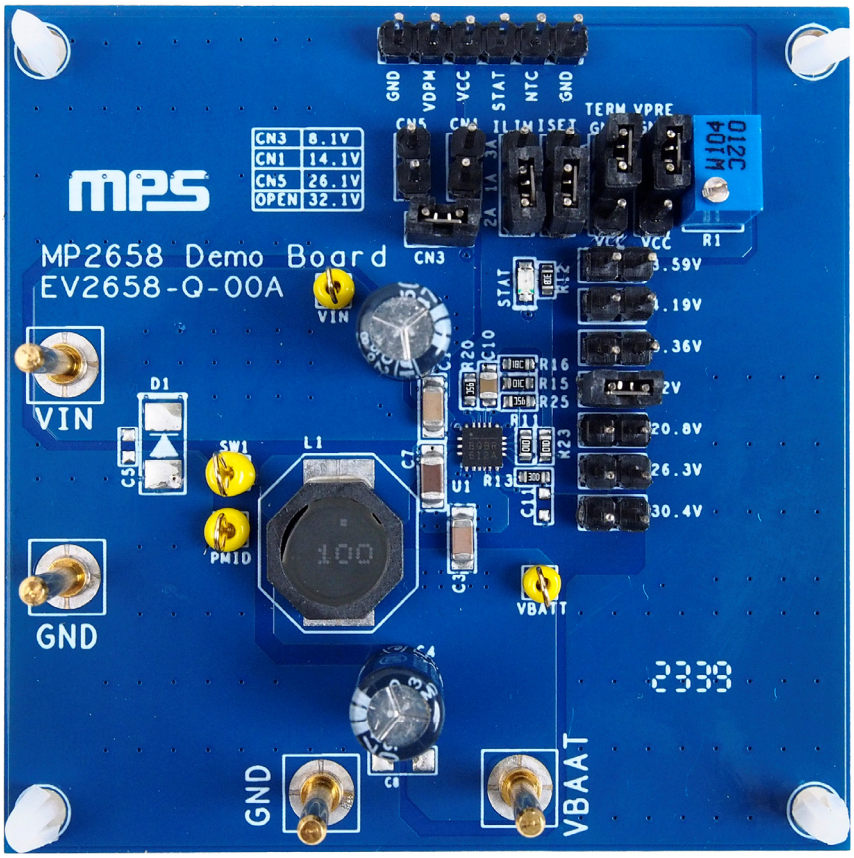
Specifications are at T_A = 25°C, unless otherwise noted.

Parameters	Conditions	Value
Input voltage (V_{IN}) range		4.5V to 36V
Battery voltage (V_{BATT_REG})		2V to 31V
Fast charge current (I_{CC})		Up to 3A (1)
Input current (I_{IN})		Up to 3A
Peak efficiency	V_{IN} = 24V, V_{BATT} = 17.3V, I_{BATT} = 2A	97%

Note:

1) This value depends on V_{IN} and the PCB layers.

EVALUATION BOARD



LxWxH (6.1cmx5.1cmx1.3cm)

Board Number	MPS IC Number
EV2658-Q-00A	MP2658GQ-0000

QUICK START GUIDE

This board is designed for the MP2658, a highly integrated switching charger for up to 7-cell Li-ion, Li-polymer, and $LiFePO_4$ battery packs It also supports lead-acid, super capacitor, NiMH, and NiCd battery packs from 2V to 31V. This board's layout accommodates most commonly used capacitors.

1. Connect the battery pack terminals to:
   a. Positive (+): VBATT
   b. Negative (-): GND

   Ensure that the battery's positive and negative terminals are not reverse-connected.
2. If using a battery emulator, preset the battery emulator to the correct voltage. Turn the emulator off, connect its positive (+) terminal to VBATT and its negative (-) terminal to GND, then turn the emulator's output on.
3. Preset the input power source to its correct voltage, then turn the power source off.
4. Connect the power source to VIN and GND, then turn the power source on. The evaluation board should start charging the battery.
5. The MP2658 utilizes a dead battery pack recovery function if the battery voltage drops below 2V. In this mode, the input current (I_{IN}) is regulated to I_{TC} (typically 60mA) for 20ms, then stops for 1.4s. The cycle is repeated to regulate I_{IN}.

   Table 1 shows the possible configurations on the evaluation board.

Table 1: Adjustable Parameters

Parameter	Value	Units
Charge current	1, 2, or 3	A
Input current limit	1, 2, or 3	A
Battery regulation voltage	3.59, 4.19, 8.36, 12, 20.8, 26.3, or 30.4	V
Minimum input voltage limit	8.1, 14.1, 26.1 or 32.1	V

Table 2 shows a description of the connectors. See Figure 1 on page 4 for more details.

Table 2: Connectors

Connectors	Description
VIN	Connect VIN to the input source's positive terminal.
GND	Connect GND to the input source's negative terminal.
VBATT	Connect VBATT to the battery pack's positive terminal.
GND	Connect GND to the battery pack's negative terminal.
SW	SW is the test point for the switching node.
PMID	PMID is the test point for the PMID.
VDPM, VCC, NTC, STAT, GND	Test connection for related signals.

6. To modify the charging parameters, configure the EVB using the jumpers (see Table 3 on page 4).

Table 3: Jumpers and Shunts

Jumpers	Description	Default	All Open
3.59V, 4.19V, 8.36V, 12V, 20.8V, 26.3V, 30.4V	Selects the battery regulation voltage.	12V	N/A
VPRE	Selects the pre-charge to fast charge threshold. • AGND: 70% of V_{BATT_REG} • FLOAT: 75% of V_{BATT_REG} • Pull up to VCC: disable pre-charge • 100kΩ resistor to AGND: 50% of V_{BATT_REG}	70% of V_{BATT_REG}	50% of V_{BATT_REG}
TERM	Selects the termination current enables termination. • AGND: Enable termination • Pull up to VCC: Disable termination • 100kΩ resistor to AGND: Disable termination, 94% of V_{BATT_REG}	Enable termination	Disable termination, 94% of V_{BATT_REG}
ILIM	Selects the input current limit.	2A	1A
ISET	Selects the constant-current charge current.	2A	1A
CN1, CN3, CN5	Selects the minimum input voltage limit.	8.1V	32.1V

Figure 1 shows the test set-up for the MP2658.

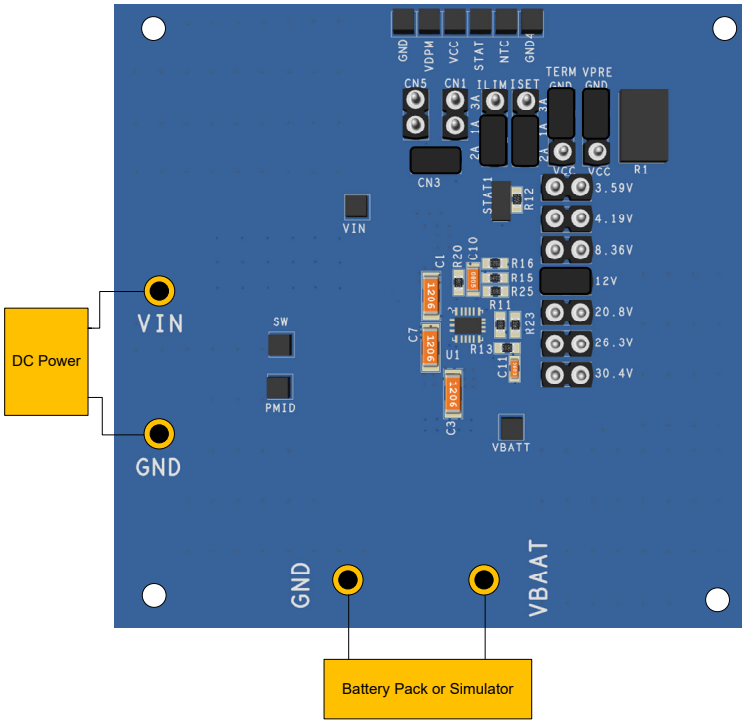


Figure 1: Measurement Equipment Set-Up

EVALUATION BOARD SCHEMATIC

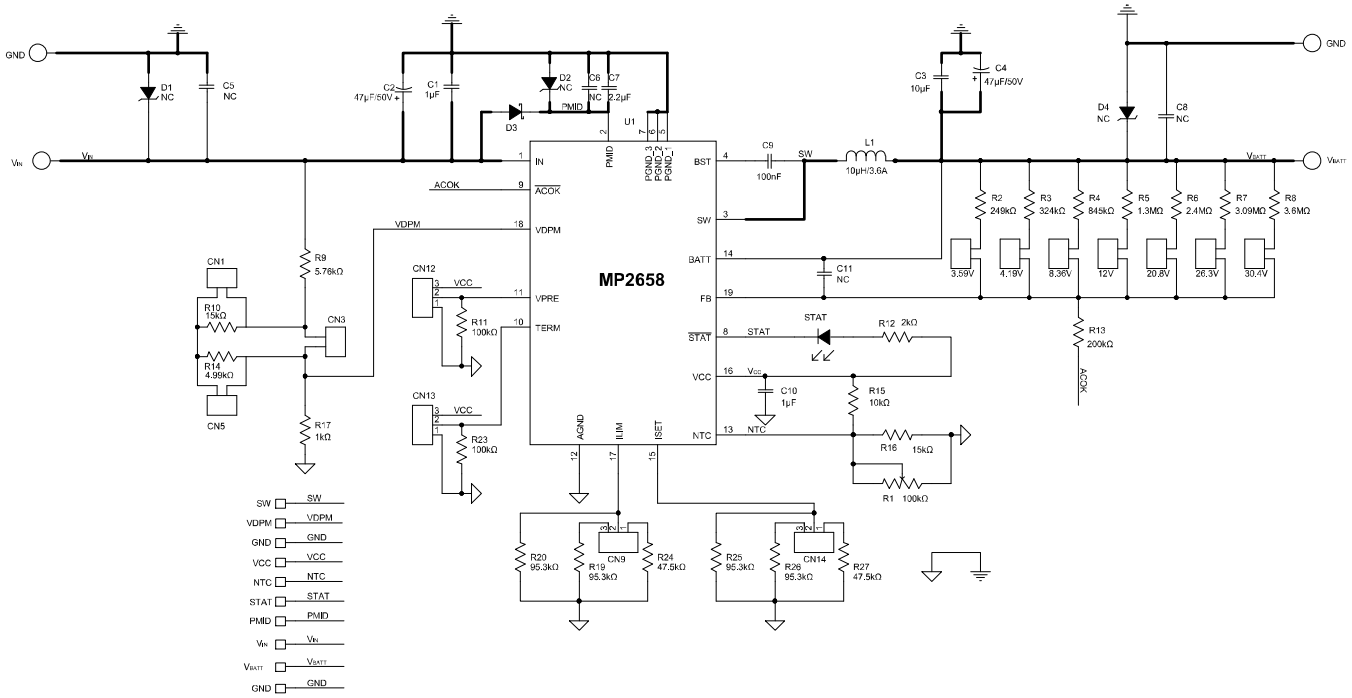


Figure 2: Evaluation Board Schematic

EV2658-Q-00A BILL OF MATERIALS

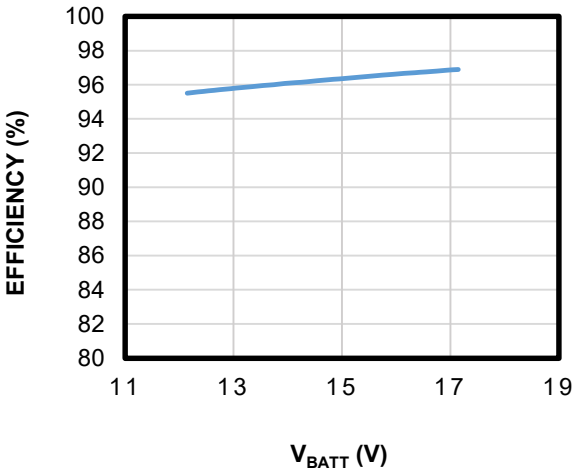
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	C1	1μF	Ceramic capacitor, 50V, X5R	1206	Lion	1206X105K500T
2	C2, C4	47μF	Electrolytic capacitor, 50V	DIP	Jianghai	CD263-50V47
1	C3	10μF	Ceramic capacitor, 50V, X5R	1206	Murata	GRM31CR61H106KA12L
1	C5	NS				
1	C6	NS				
1	C7	2.2μF	Ceramic capacitor, 50V, X7R	1206	Murata	GCM31CR71H225KA55L
1	C8	NS				
1	C9	100nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
1	C10	1μF	Ceramic capacitor, 25V, X5R	0805	Murata	GRM216R61E105KA12D
3	D1, D2, D4	NS				
1	D3	40V	Diode, 40V, 1A	SMA	Diodes	B140-13-F
1	L1	10μH	Inductor, 35mΩ, 3.6A	SMD	Wurth	744066100
1	R15	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	R2	249kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07249KL
1	R3	324kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07324KL
1	R4	845kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07845KL
1	R5	1.3MΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071M3L
1	R6	2.4MΩ	Film resistor, 1%	0603	Yageo	RC0603FR-072M4L
1	R7	3.09MΩ	Film resistor, 1%	0603	Yageo	RC0603FR-073M09L
1	R8	3.6MΩ	Film resistor, 1%	0603	Yageo	RC0603FR-073M6L
1	R9	5.76kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-075K76L
2	R10, R16	15kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0715KL
2	R11, R23	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R12	2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-072KL
1	R13	200kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07200KL
1	R14	4.99kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-074K99L
1	R17	1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
4	R19, R20, R25, R26	95.3kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0795K3L
2	R24, R27	47.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0747K5L
1	R1	100kΩ	Film resistor	DIP	Bourns	3266W-1-104LF
1	STAT	Green	LED green	0805	Any	
1	U1	MP2658	Switching charger	QFN-19 (3mmx 3mm)	MPS	MP2658GQ-0000

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 24V, L = 10µH/35mΩ, V_{BATT_REG} = 17.6V, I_{CC} = 2A, T_A = 25°C, unless otherwise noted.

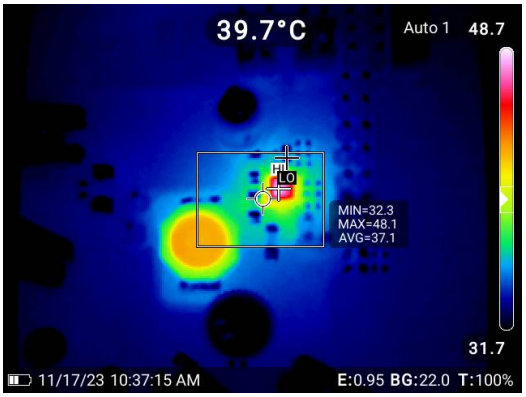
Efficiency

V_{IN} = 24V, V_{BATT_REG} = 17.6V, I_{CC} = 2A



Thermal Performance

V_{IN} = 24V, V_{BATT} = 15V, I_{CC} = 2A.

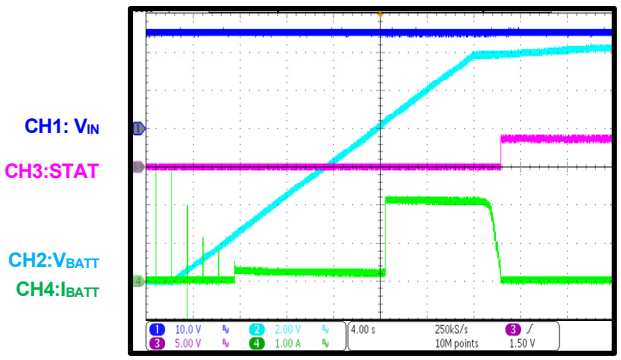


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. L = 10µH/35mΩ, C_{BATT} = 10µF, T_A = 25°C, unless otherwise noted.

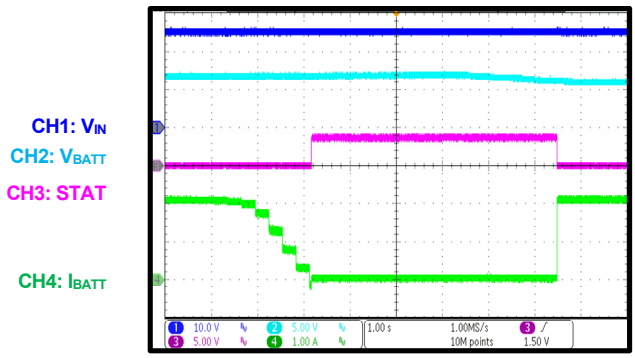
Charge

V_{IN} = 24V, V_{BATT_REG} = 12V, I_{CC} = 2A, I_{LIM} = 2A



Auto-Recharge

V_{IN} = 24V, V_{BATT_REG} = 12V, I_{CC} = 2A, I_{LIM} = 2A



PCB LAYOUT

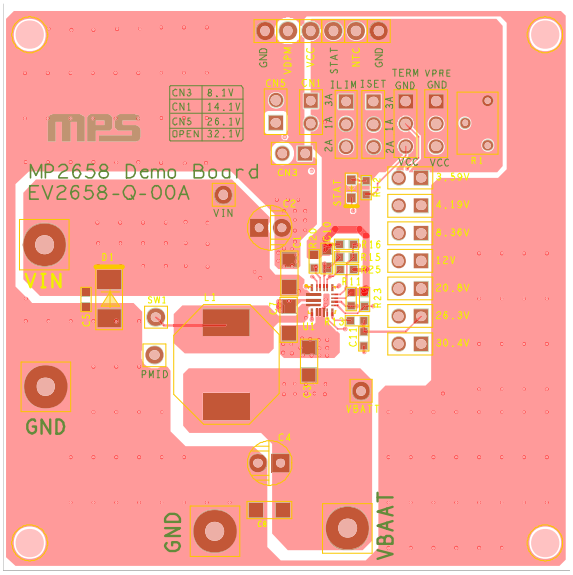


Figure 3: Top Layer

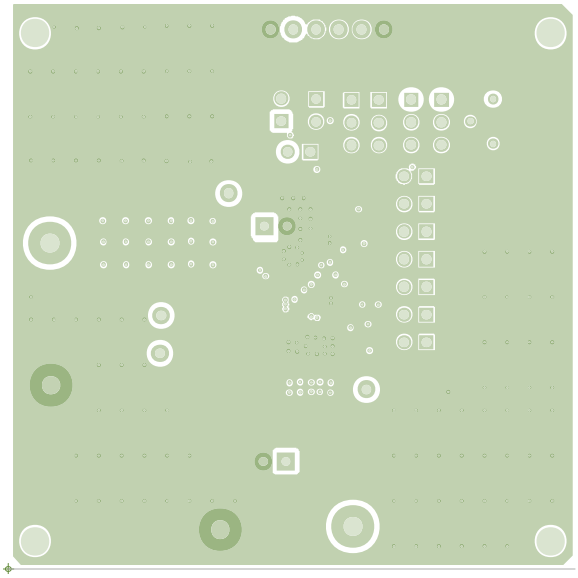


Figure 4: Mid-Layer 1

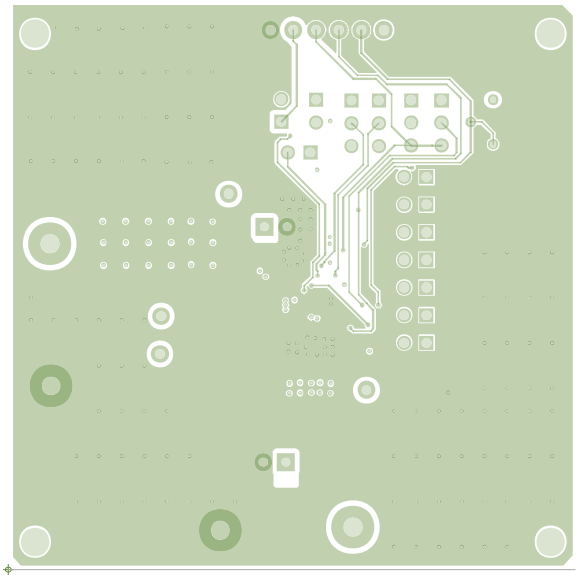


Figure 5: Mid-Layer 2

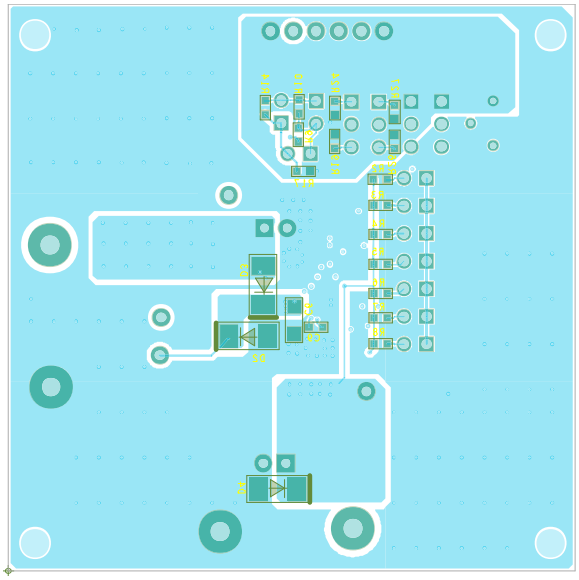


Figure 6: Bottom Layer

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	3/1/2024	Initial Release	-