

## DESCRIPTION

The EV2681-S-00A is an evaluation board for MP2681 which is a voltage and current control IC integrated a precision voltage reference and charge status indications. It is suitable for AC adapter input in the plug-in, cradle charger applications.

The device automatically detects the battery cell through the battery ID resistor and regulates the battery voltage according to the cell information: 3S1P, 3S2P, 4S1P, 4S2P, 5S1P and 5S2P. Then the AC adapter output is automatically set according to the battery specification. Additionally, for the battery spec which is inside the six kinds but without the ID resistor, user can artificially connect a resistor from ID pin to GND to make a right ID voltage input for cell detection and MP2681 could set the output voltage accordingly. The DC voltage and the current level at the output of the forward-switching power supply are compared to the voltage reference and current limitation, respectively. MP2681 feeds the control signal back to the controller IC at the primary side through an opto-coupler. Furthermore, MP2681 provides fixed pre-charge mode for the deep-discharged battery.

The safety feature includes battery temperature monitoring-NTC control, charge time-out and fault control, it also provides charge status indication.

## ELECTRICAL SPECIFICATION

Parameter	Symbol	Value	Units
Input Voltage	$V_{ACIN}$	85V-220V	V
Battery Voltage	$V_{BATT}$	0 to 21	V
VDD Voltage	$V_{SYS}$	5 to 30	V
Charge Current	$I_{CHG}$	0-3	A

## FEATURES

- Constant Voltage and Constant Current Control
- Pre-Charge Mode for Deep-discharged Battery
- Automatic Battery Cell Detection
- Two 1MHz Bandwidth Operational Amplifier Output Connected with OR Logic
- Wide Input Voltage Range: 4.5V to 30V
- Auto-Recharge
- Charge On/Off Control
- Programmable Internal Timer
- Battery Temperature Monitoring
- Charge Status Indication
- Power Line Fault Detection
- Over Temperature Protection

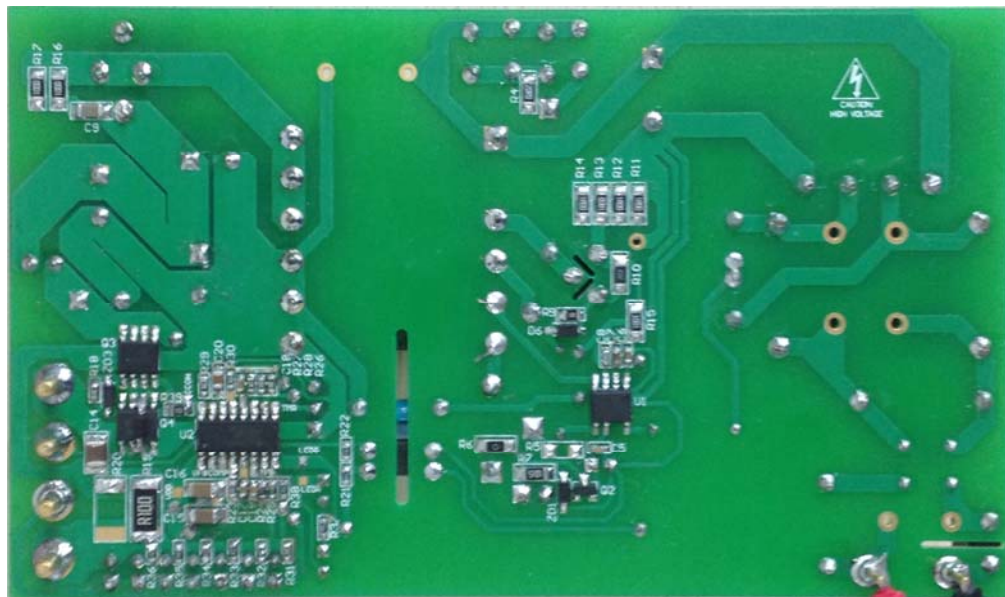
## APPLICATIONS

- Battery Charger for Portable Tools
- Standalone Fast Charger

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.

"MPS" and "The Future of Analog IC Technology" are registered trademarks of Monolithic Power Systems, Inc.

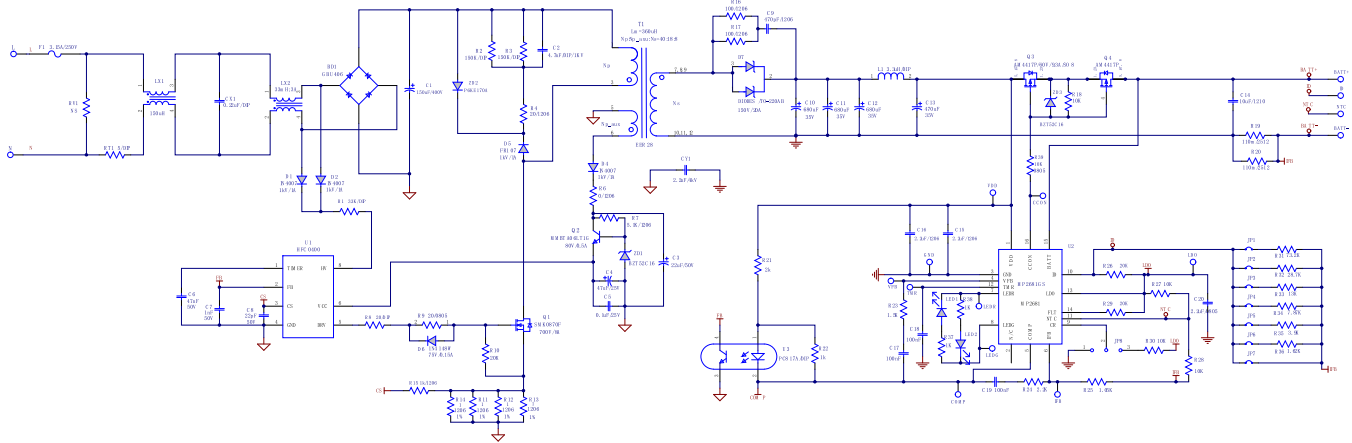
EV2681-S-00A EVALUATION BOARD



(L x W x H)  
(12.2cm x 7.1cm x 0.16cm)

Board Number	MPS IC Number
EV2681-S-00A	MP2681

# EVALUATION BOARD SCHEMATIC



**EV2681-S-00A BILL OF MATERIALS**

Qty	Ref	Value	Description	Package	Manufacture	Manufacture_PN
1	BD1	GBU406	Diode;600V;4A	DIP	Diodes	GBU406
1	C1	150uF	Electrolytic Capacitor;400V;Electrolytic;	DIP	Jianghai	CD267-400V150
1	C2	4.7nF	High Voltage Capacitor;1000V	DIP	any	any
1	C3	22uF	Capacitor;50V	DIP	Rubycon	50YXM22MEFC5*11
1	C4	47uF	Electrolytic Capacitor;25V;Electrolytic;	DIP	Jianghai	CD28L-25V47
1	C5	0.1uF	Ceramic Capacitor;25V;X7R;	0603	Yageo	CC0603KRX7R8BB104
1	C6	47nF	Ceramic Capacitor;50V;X7R;	0603	muRata	GRM188R71H473KA61D
1	C7	1nF	Ceramic Capacitor;50V;X7R;	0603	muRata	GRM188R71H102KA01D
1	C8	22pF	Ceramic Capacitor;50V;C0G;	0603	muRata	GRM1885C1H220JA01D
1	C9	470pF	Ceramic Capacitor;1000V;U2J;	1206	muRata	GRM31B7U3A471JW31L
3	C10, C11, C12	680uF	Electrolytic Capacitor;35V;Electrolytic;	DIP	Jianghai	CD287-35V680
1	C13	470uF	Electrolytic Capacitor;35V;Electrolytic	DIP	Jianghai	CD263-35V470
1	C14	10uF	Ceramic Capacitor;50V;X7R	1210	Murata	GRM32ER71H106KA12L
2	C15, C16	2.2uF	Ceramic Capacitor;50V;X7R;	1206	muRata	GRM31CR71H225KA88L
3	C17, C18, C19	100nF	Ceramic Capacitor;50V;X7R;	0603	muRata	GRM188R71H104KA93D
1	C20	2.2uF	Ceramic Capacitor;16V;X7R;	0805	TDK	C2012X7R1C225K
1	CX1	0.22uF	Film Capacitor;275V;10%	DIP	Kaili	PX224K3ID49L270D9R
1	CY1	2.2nF	Capacitor;4000V;20%	DIP	Hongke	JN12E222MY02N
3	D1, D2, D4	1N4007	Diode;1000V;1A	DO-41	Diodes	1N4007
1	D5	FR107	Diode;1000V;1A	DO-41	Diodes	FR107
1	D6	1N4148W	Diode;75V;0.15A;	SOD-123	Diodes	1N4148W
1	D7	MBR20150FCT	Diode;150V;20A	TO-220AB	Xutong	MBR20150FCT
1	F1	SS-5-3.15A	Fuse;250V;3.15A	DIP	COOPER BUSSMANN	SS-5-3.15A
1	L1	3.3uH	Inductor;3.3uH;25m;4A	DIP	Würth	7447462033
1	LED1	LED	Green LED;	DIP		F3D02HG-1A
1	LED2	LED	Red LED;	DIP		F3D02R-4A
1	LX1	150uH	Inductor;150uH;45m;3A	DIP	Emei	TP4U150-00
1	LX2	33mH	Inductor;33mH;210m;3A	DIP	Würth	744825433
1	Q1	SMK0870F	Mosfet;700V;900;32;8	TO-220F-3L	AUK	SMK0870F
1	Q2	MMBTA06LT1G	Transistor;80V;0.5A;	SOT-23	Diodes	MMBTA06LT1G
2	Q3, Q4	AM4417P	P-Channel Mosfet;-60V;23;46;9.3	SO-8	Analog Power	AM4417P
1	R1	33kΩ	Resistor;5%;1/4W	DIP	any	any
2	R2, R3	150kΩ	Resistor;5%;1W	DIP	any	any

**EV2681-S-00A BILL OF MATERIALS (continued)**

Qty	Ref	Value	Description	Package	Manufacture	Manufacture_PN
1	R4	20Ω	Film Resistor;5%;1/4	1206		1206J0200T5E
1	R6	0Ω	Film Resistor;5%;	1206	Yageo	RC1206JR-070RL
1	R7	5.1kΩ	Film Resistor;5%;1/4W	1206	LIZ	CR06T05NJ5K1
1	R8	20Ω	Resistor;1%;1/4W	DIP	any	any
1	R9	20Ω	Resistor;5%;1/8W;	0805	Yageo	RC0805JR-0720RL
1	R10	20kΩ	Film Resistor;5%;1/4W	1206	LIZ	CR1206J40203G
4	R11, R12, R13, R14	1Ω	Film Resistor;1%	1206	Yageo	RC1206FR-071RL
1	R15	1kΩ	Resistor;1%	1206	Yageo	RC1206FR-071KL
2	R16, R17	100Ω	Film Resistor;5%;1/4W	1206	Yageo	RC1206JR-07100RL
1	R18	10kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-0710KL
2	R19, R20	110mΩ	Film Resistor;1%;	2512	Vishay	WSL2512R1100FEA
1	R21	2kΩ	Resistor;1%	0603	Yageo	RC0603FR-072KL
1	R22	1kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-071KL
1	R23	1.5kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-071K5L
1	R24	2.2kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-072K2L
1	R25	1.05kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-071K05L
2	R26, R29	20kΩ	Resistor;1%;1/10W;	0603	Royalohm	0603F2002T5E
3	R27, R28, R30	10kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-0710KL
1	R31	73.2kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0773K2L
1	R32	28.7kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0728K7L
1	R33	13kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-0713KL
1	R34	7.87kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-077K87L
1	R35	3.9kΩ	Film Resistor;5%;1/10W	0603	LIZ	CR0603JA0392G
1	R36	1.62kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-071K62L
2	R37, R38	1kΩ	Resistor;1%;	0603	Royalohm	0603F1001T5E
1	R39	10kΩ	Film Resistor;5%;	0805	Yageo	RC0805JR-0710KL
1	RT1	5Ω	Resistor	DIP	Xinshun	5D2-10LC
1	T1	360uH	EER28,Np:Np_aux:Ns=40:18:8	DIP	Emei	FX0349
1	U1	HFC0400	Offline Regulator	SOIC8-7	MPS	HFC0400HS
1	U2	MP2681	CC/CV Controller	SOIC16	MPS	MP2681GS
1	U3	PC817A	Photocoupler;1-Channel	DIP	Sharp	PC817A
2	ZD1, ZD3	BZT52C16	Zener Diode;16V;5mA/500mW;	SOD-123	Diodes	BZT52C16
1	ZD2	P6KE170CA	Diode;145V;1mA	DO-15	Brightking	P6KE170CA

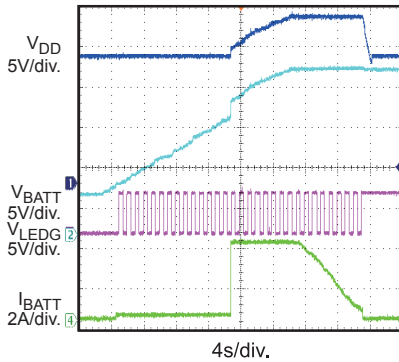
## EVB TEST RESULTS

Performance waveforms are tested on the evaluation board.

$V_{DD} = 18V$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

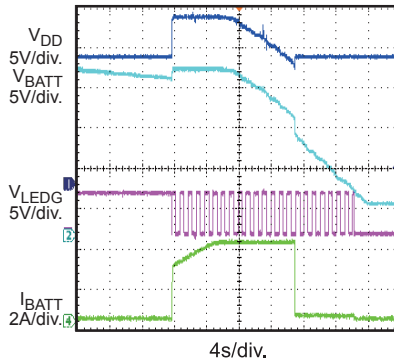
### Battery Charge Curve

5 Cell,  $I_{CHG} = 4A$



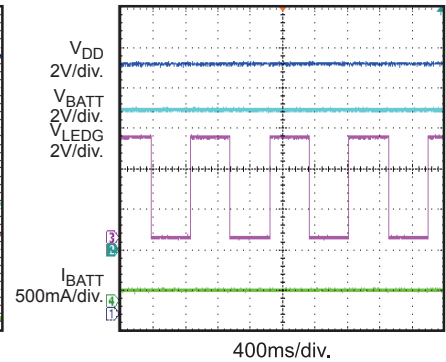
### Auto-Recharge

5 Cell,  $I_{CHG} = 4A$



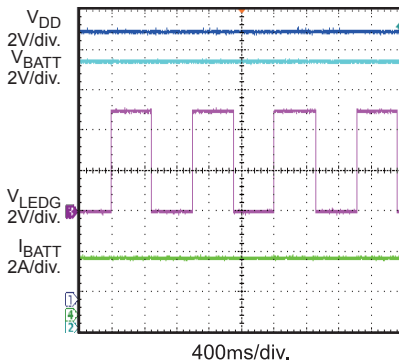
### Pre-Charge Steady State

$V_{BATT} = 7V$



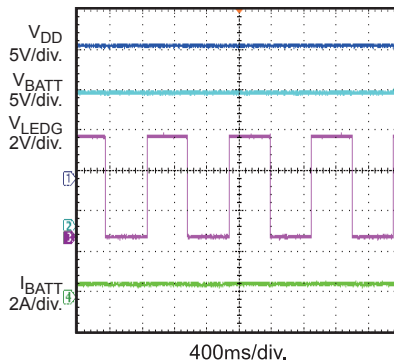
### CC-Charge Steady State

$V_{BATT} = 15V$



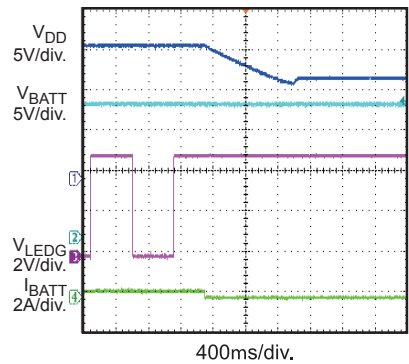
### CV-Charge Steady State

$V_{BATT} = 16.6V$



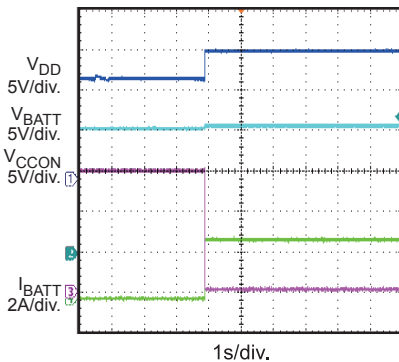
### Charge Full

$V_{BATT} = 16.6V$



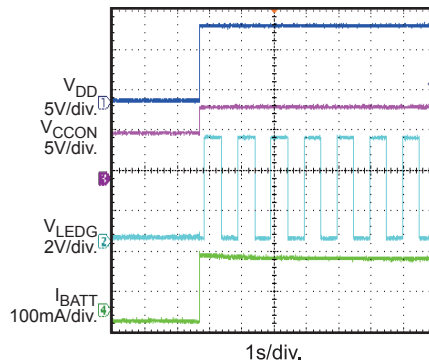
### Auto-Recharge

$V_{BATT} = 15.5V$



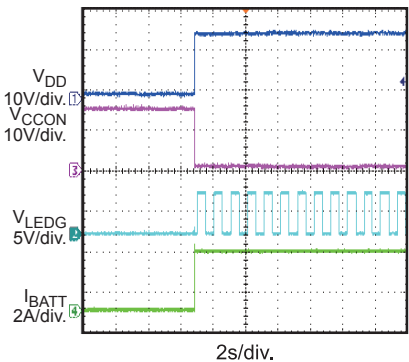
### AC-IN Power ON

3 Cell,  $V_{BATT} = 6V$



### AC-IN Power ON

$V_{BATT} = 15V$



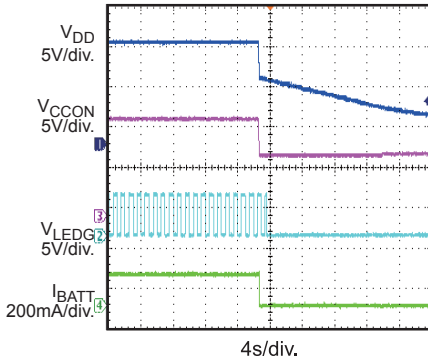
## EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

$V_{DD} = 18V$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

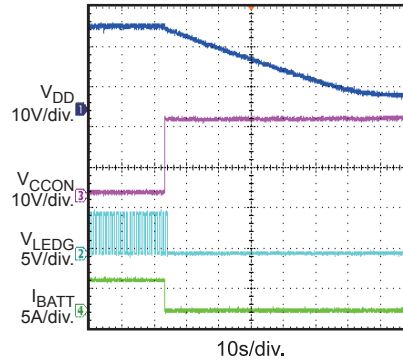
### AC-IN Power OFF

$V_{BATT} = 8V$



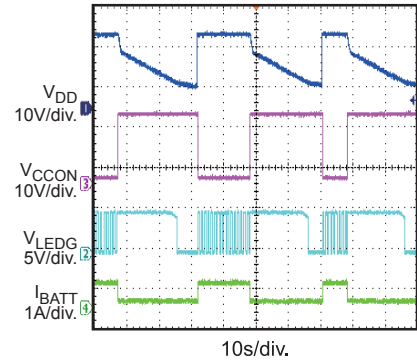
### AC-IN Power OFF

5 Cell,  $V_{BATT} = 19V$ ,  $I_{CHG} = 4A$



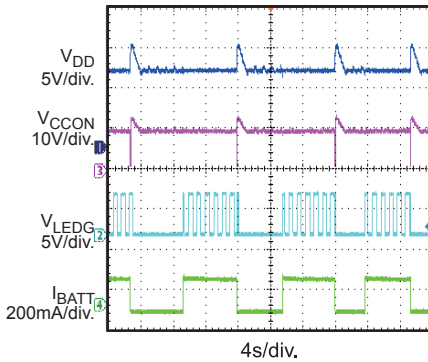
### AC-IN Power ON/ OFF

$V_{BATT} = 16.6V$



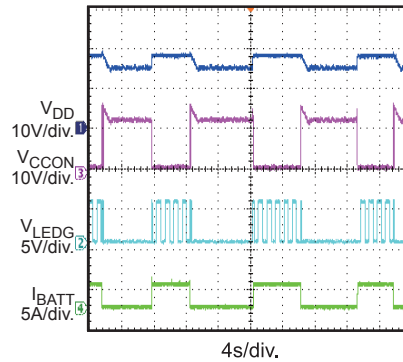
### Battery Insertion/ Removal

3 Cell,  $V_{BATT} = 6V$



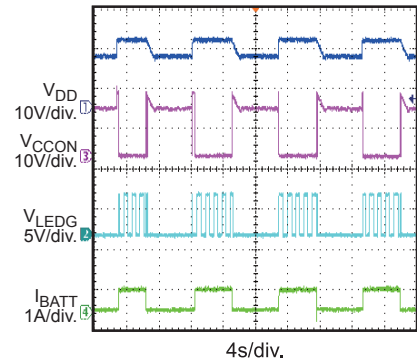
### Battery Insertion/ Removal

$V_{BATT} = 15V$



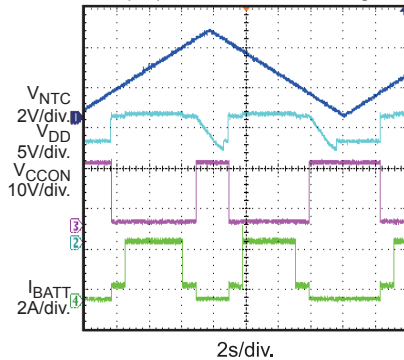
### Battery Insertion/ Removal

$V_{BATT} = 16.6V$



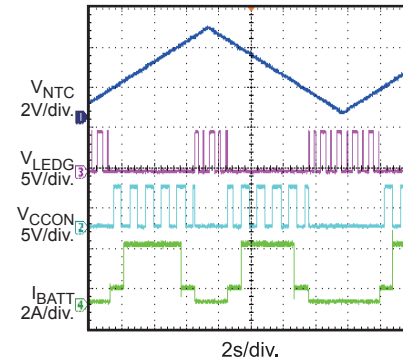
### NTC Fault Control

$V_{BATT} = 15.5V$ ,  
Ramp up and down NTC voltage



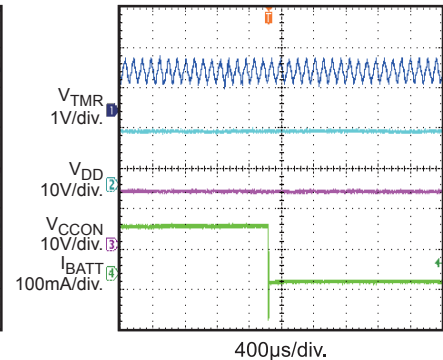
### NTC Fault Indication

$V_{BATT} = 15.5V$



### Timer Out Protection

$C_{TMR} = 150pF$ ,  $V_{BATT} = 10V$



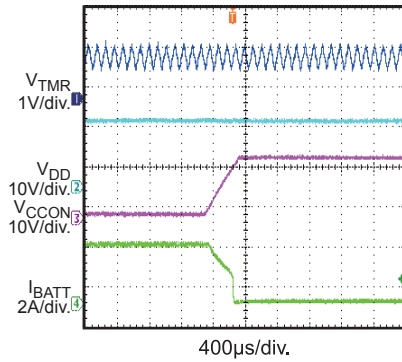
## EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

$V_{DD} = 18V$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

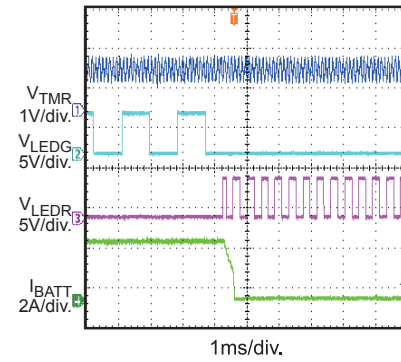
### Timer Out Protection

$C_{TMR} = 150pF$ ,  $V_{BATT} = 15V$



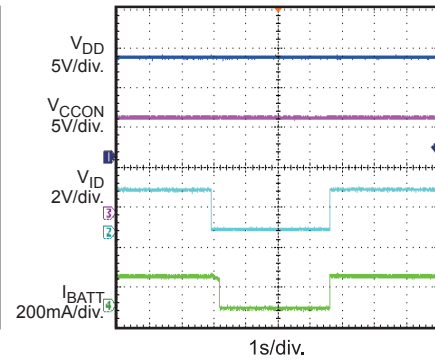
### Timer Out Indication

$C_{TMR} = 150pF$ ,  $V_{BATT} = 15.5V$



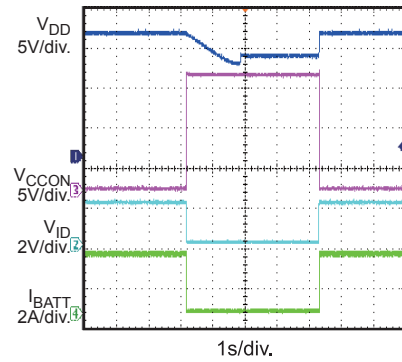
### ID Short Protection

$V_{BATT} = 10V$



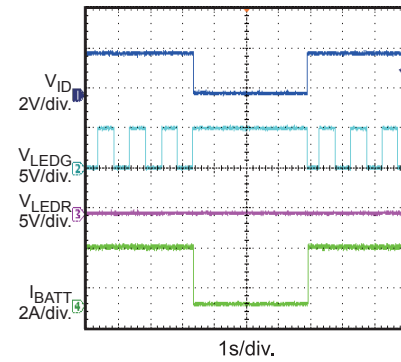
### ID Short Protection

$V_{BATT} = 15V$



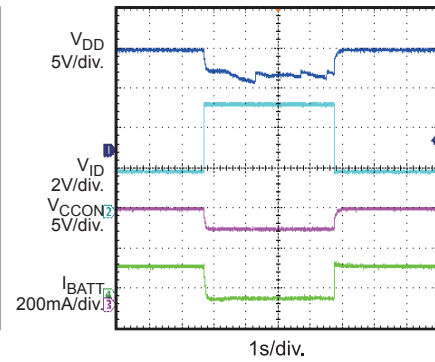
### ID Short Indication

$V_{BATT} = 15V$



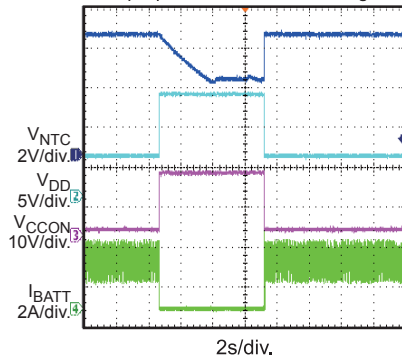
### ID Open Protection

$V_{BATT} = 10V$



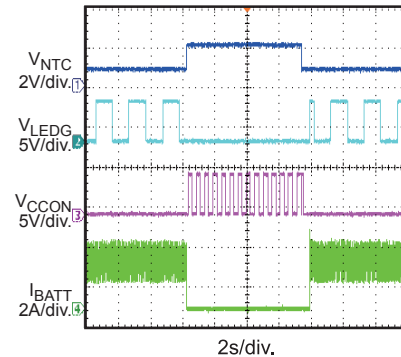
### NTC Fault Control

$V_{BATT} = 15.5V$ ,  
Ramp up and down NTC voltage



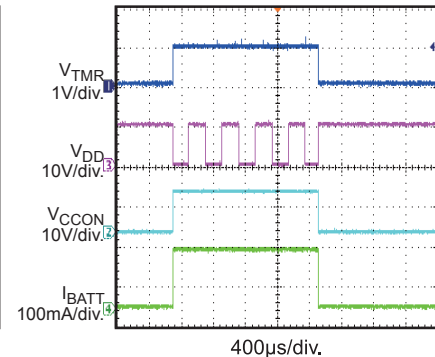
### NTC Fault Indication

$V_{BATT} = 15.5V$



### Timer Out Protection

$C_{TMR} = 150pF$ ,  $V_{BATT} = 10V$





### PRINTED CIRCUIT BOARD LAYOUT

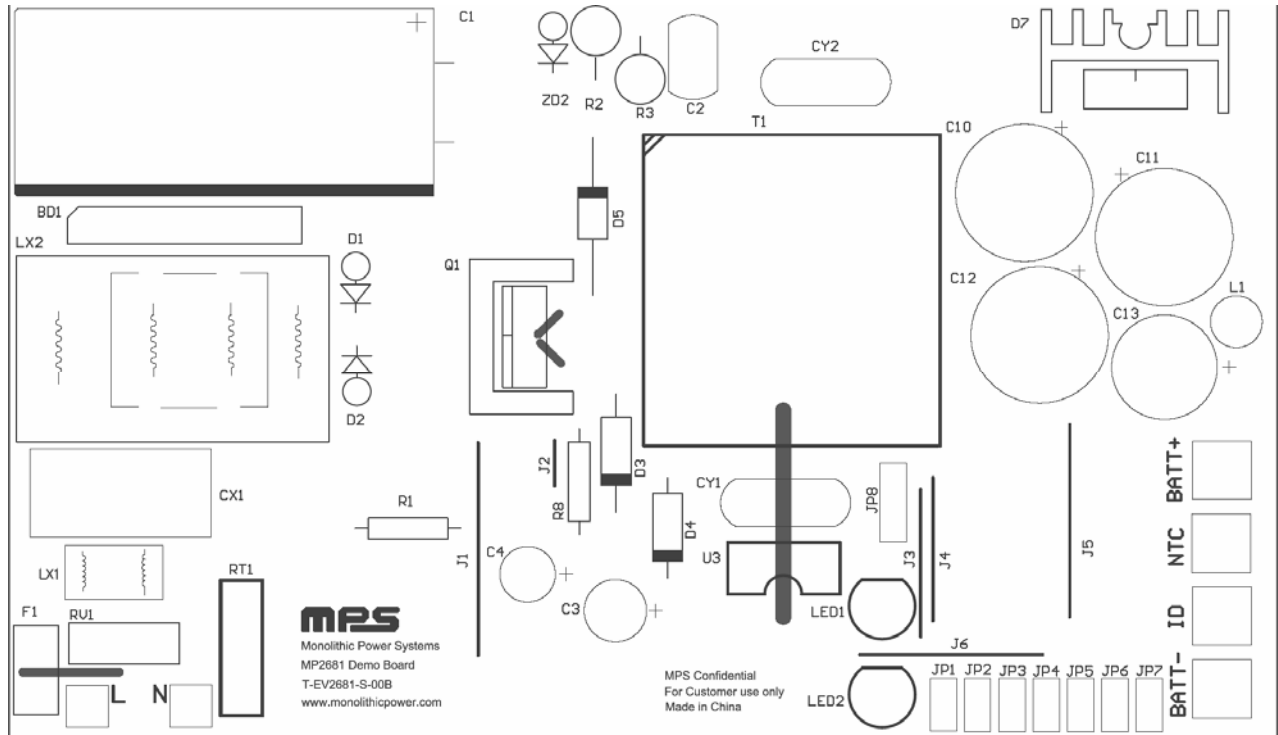


Figure 1—Top Silk Layer

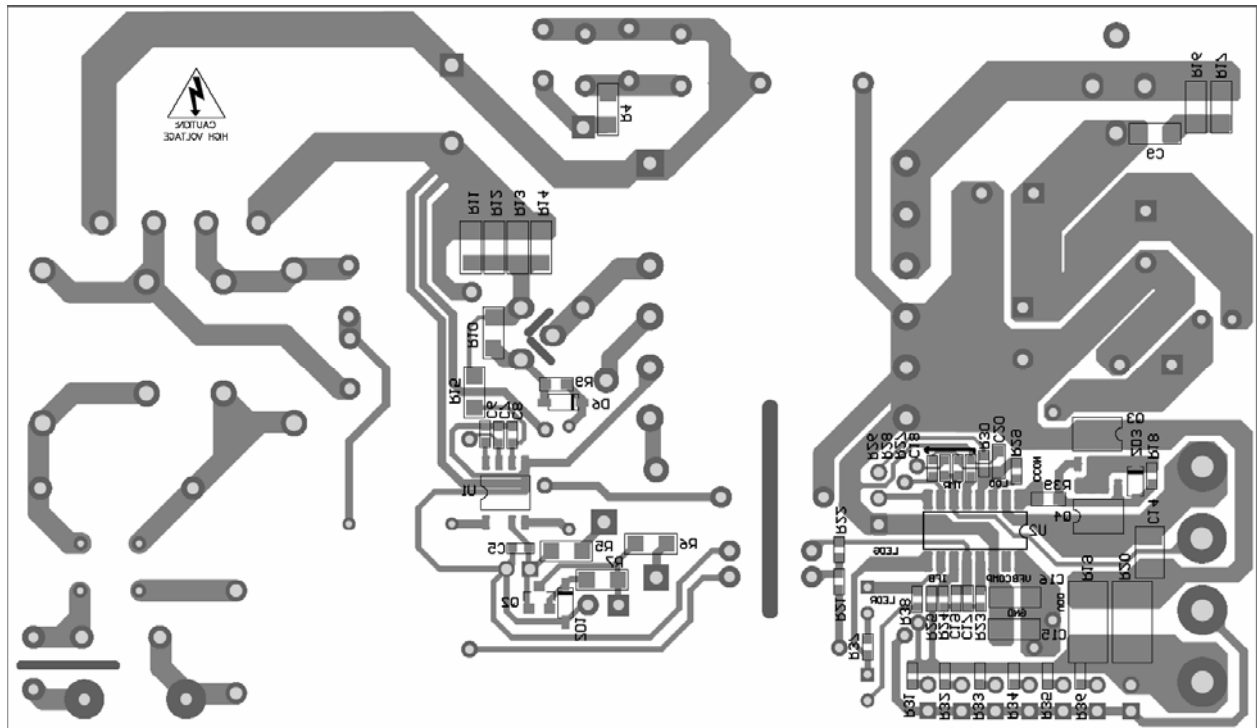


Figure 2—Bottom Layer

## QUICK START GUIDE

The MP2681 is a voltage and current control IC integrated a precision voltage reference and charge status indications, which is suitable for AC adapter input in the plug-in, cradle charger applications.

The device automatically detects the battery cell numbers through the battery ID resistor and regulates the battery voltage according to the cell information: 3S1P, 3S2P, 4S1P, 4S2P, 5S1P and 5S2P.

ID Resistor	Detection Voltage	Operation Mode	Battery Spec	Output Voltage
Float	VID>4.145V	Sleep Mode	Unknown	3.2V/cell
73.2K	3.534V<VID<4.145V	Automatic mode	3S1P	12.45V
28.7K	2.54V<VID<3.25V		3S2P	12.45V
13K	1.685V<VID<2.195V		4S1P	16.6V
7.87K	1.185V<VID<1.605V		4S2P	16.6V
3.9K	0.64V<VID<0.965V		5S1P	20.75V
1.62K	0.265V<VID<0.475V		5S2P	20.75V
Short	VID<0.265V	Sleep Mode	Unknown	3.2V/cell

- The charge current is set to 3A as the below formula in this board,

$$I_{\text{CHG}} = 0.16/\text{RS} = 3\text{A}$$

Note: the reference voltage 0.16V has a +/-15% variation.

- In this board, there are two LEDs controlled by the MP2681 to work as smart charger status indicators.
  - During the charging, LEDG flashes. At the same time, LEDR keeps off.
  - When the charging is finished, LEDG keeps on and LEDR is off.
  - When fault protection happens, LEDR flashes and LEDG keeps off.
- Attached the AC Line (85~220V) terminals to L and N pins, respectively.
- Connect the positive terminal of the battery to BATT+ pin, and connect the negative terminal of the battery to BATT- pin, respectively.
- Turn the power supply on. The board automatically startup.
- The output voltage on this board is determined by voltage at the ID pin.

*For more details, please apply the latest datasheet of the MP2681 for reference.*

**NOTICE:** The information in this document is subject to change without notice. Users should warrant and guarantee that third party Intellectual Property rights are not infringed upon when integrating MPS products into any application. MPS will not assume any legal responsibility for any said applications.