

EV2665A-QB-00A 21V, 1A, Linear Charger for Single-Cell Li-Ion Batteries with

Power Management Evaluation Board

It provides system short-circuit protection (SCP)

to prevent the Li-ion battery from being

The MP2665A also provides an on-chip battery

under-voltage lockout (UVLO) threshold that

cuts off the path between the battery and the

system if the battery voltage drops below the

configurable UVLO threshold. This prevents the

The integrated I²C interface can configure the

following charging parameters: input current

limit, input voltage regulation limit, charging

current, battery regulation voltage, safety timer,

and battery UVLO threshold. The MP2665A is

available in a QFN-12 (2.5mmx3mm) package.

Li-ion battery from being overly discharged.

damaged due to excessively high currents.

DESCRIPTION

The EV2665A-QB-00A is an evaluation board designed to demonstrate the capabilities of the MP2665A, a highly integrated, single-cell Liion/Li-polymer battery charger with system power path management. The MP2665A is ideal for space-constrained portable applications. It takes input power from either an AC adapter or a USB port to supply the system load and charge the battery simultaneously. It also features pre-charge, constant current (CC) fast charge, constant voltage (CV) regulation, charge termination, and auto-recharge.

The MP2665A ensures that the system is continuously powered by automatically selecting the input, the battery, or both to power the system.

PERFORMANCE SUMMARY

Specifications are at $T_A = 25^{\circ}C$, unless otherwise noted.

Parameters	Conditions	Value
Input voltage (V _{IN}) range		4.35V to 5.5V
Battery voltage (V _{BATT})		3.6V to 4.545V
Fast charge current (Icc)		16mA to 896mA
Input current limit		50mA to 1000mA
Minimum V _{IN} regulation		3.88V to 5.08V

EVALUATION BOARD



LxWxH (6.3cmx6.3cmx0.16cm) 2 Layers, 1oz/1oz

Board Number	MPS IC Number
EV2665A-QB-00A	MP2665AGQB-xxxx



QUICK START GUIDE

The EV2665A-QB-00A evaluation board is designed to demonstrate the capabilities of the MP2665A, a highly integrated, single-cell Li-ion/Li-polymer battery charger with system power path management. The EV2665A-QB-00A's layout accommodates most commonly used capacitors. The default function of this board is preset for charger mode, and the full-charge voltage is preset to 4.2V for single-cell Li-ion batteries.

Evaluation Platform Preparation:

1. To use the evaluation platform, the following is required: a computer with at least one USB port, a USB cable, and a USB-to-I²C communication kit (EVKT-USBI2C-02) (see Figure 1).



Figure 1: USB-to-I²C Communication Kit

2. The MP2665A programming tool software must also be properly installed. This software can be downloaded from the MPS website.

MPS				Welcome Guest ~	Log in	MP2665			٩
C Ebench	Request								
By Category	Search Result	'MP2665'							
Conversion(718)				GUI					
AC-DC Power	Name	\$	Description				ŧ	Download	\$
LED Lighting & Illumination(22)	Programming tool	MP2665A	Programming tool,	V1.0. Parts supported: I	MP2665A.			٤	
Power Modules(20)									
Battery Management(42)									
Display Backlighting Power(14)									
E-Fuse & Load Switches(30)									

Figure 2: MP2665A Programming Tool on eBench

- 3. Figure 3 on page 3 shows the original test set-up for the MP2665A.
 - a. Connect the input voltage (V_{IN} = 5V) and the input ground to the VIN and GND pins, respectively.
 - b. Connect the load terminals to:
 - Positive (+): SYS
 - Negative (-): GND



- c. Connect the battery (V_{BATT} = 3V to 4.2V) terminals to:
 - Positive (+): BATT
 - Negative (-): GND



Figure 3: Test Set-Up for the MP2665A

4. Turn on the computer and launch the MP2665A evaluation software. Figure 4 shows the main window of the software.

ONFIG REGIS	TER MAP			Status
Ceneral Setting REG_RST Vin,Min lin_lim ICC Vrech VBATT_UVLO Vbatt_REG ITERM VBATT_PRE Vsys_REG IDSCHG tRST_DUR tRST_DUR tRST_DGL EN_SHIPPING_DGL	REG_RST 4.36V * 940mA * 220mV * 200mV * 2.76V * 4.200V * 3V * 3200mA * 4s * 1s *	Image: Control EN, HIZ FET_DIS GEB Image: Control EOC NTC PG BATT_OVP CHG_Status Image: Control TERM_TIMR EN_TERM VIN_LOOP	Timer Control EN_TIMER TMR2X_EN CHG_TMR 20hrs O Thremal Control Disable PCB_OTP EN_NTC TJ_REG 1200C Watchdog Control EN_WD_DISCH6 WAtchDOG Watchdog Timer RST Watchdog Timer RST	Rev MP2665A CHG_STAT Not Charging PM_STAT Power Fail PG_STAT Power Fail Imput fault Imput fault Battery OVP Imput fault Safety Timer Expiration Imput fault NTC Hot Imput fault NTC Hot Imput fault Imput fault Imput fault Safety Timer Expiration Imput fault NTC Hot Imput fault Imput fault Imput fault NTC Hot Imput fault Imput fault Imput fault Imput fault Imput fault NTC Hot Imput fault Imput fault Imput fault Imput fault Imput fault NTC Hot Imput fault Imput fault Imput fault </th

Figure 4: MP2665A Evaluation Interface



PROCEDURE

Ensure that all the connections (e.g. between the USB-to-I²C communication kit and the EV2665A-QB-00A) are successful.

1. Figure 5 shows the default values of the charger function.

General Setting		
REG_RST	REG_RS	г
Vin_Min	4.36V	•
lin_lim	940mA	-
ICC	224mA	-
Vrech	200mV	-
VBATT_UVLO	2.76V	-
Vbatt_REG	4.200V	-
ITERM	7.5mA	-
VBATT_PRE	3V	-
Vsys_REG	4.65V	-
IDSCHG	3200mA	-
tRST_DUR	4s	-
tRST_DGL	16s	-
EN_SHIPPING_DGL	1 s	-

Figure 5: Charger Function

2. Figure 6 shows the minimum V_{IN} setting. Set the minimum V_{IN} to 4.36V (the range is 3.88V to 5.08V).

Vin_Min	4.36V	•
lin_lim	4.12V	
ICC	4.20V	
The second second	4.28V	
Vrech	4.36V	
VBATT UVLO	4.44V	
	4.52V	
Vbatt_REG	4.60V	
ITERM	4.68V	
VRATT DRE	4.76V	
VDAIL_FRE	4.84V	
Vsys_REG	4.92V	
IDSCHG	5.00V	
22222/11/17/08/06	5.08V	
tRST_DUR		*

Figure 6: Minimum V_{IN} Setting



3. Figure 7 shows the input current limit setting. Set the input current limit to 940mA (the range is 50mA to 1000mA).



Figure 7: Input Current Limit Setting

4. Figure 8 shows the fast charge current setting. Set the fast charge current to 224mA (the range is 16mA to 896mA).

ICC	224mA	-
Vrech	224mA	
VBATT UVIO	238mA	
	252mA	
Vbatt_REG	266mA	Ţ
ITERM	280mA	
	294mA	
VBATT_PRE	308mA	Ī
Vsys_REG	322mA	
IDSCHG	336mA	
boend	350mA	
tRST_DUR	364mA	
tRST_DGL	378mA	
UN 7.17.17.17.17.17.7888	392mA	1
EN_SHIPPING_DGL	406mA	•

Figure 8: Fast Current Charge Setting

5. Figure 9 shows the BATT_UVLO threshold setting. Set the BATT_UVLO threshold to 2.76V (the range is 2.4V to 3.03V).

VBATT_UVLO	2.76V 💌
Vbatt_REG	2.4V
ITERM	2.49V
	2.58V
VBATT_PRE	2.67V
Vsvs REG	2.76V
IDECILIC	2.85V
IDSCHG	2.94V
tRST_DUR	3.03V

Figure 9: BATT_UVLO Threshold Setting



6. Figure 10 shows the charge termination current setting. Set the charge termination current to 7.5mA (the range is 2.5mA to 62mA).

ITERM	7.5mA	-
VBATT_PRE	7.5mA	•
Vsys_REG	12.5mA 17.5mA	
IDSCHG	18mA	
tRST_DUR	22mA	
tRST_DGL	26mA 30mA	
EN_SHIPPING_DGL	34mA	
	38mA	
	42mA	
	46mA	
	50mA	Ĩ
	54mA	1
	58mA	•

Figure 10: Charge Termination Current Setting

7. Figure 11 shows the battery regulation voltage setting. Set the battery regulation voltage to 4.2V (the range is 3.6V to 4.545V).

Vbatt_REG	4.200V	-
ITERM	4.200V	
VBATT PRE	4.215V	
	4.230V	
Vsys_REG	4.245V	
IDSCHG	4.260V	
	4.275V	
tRST_DUR	4.290V	
tRST_DGL	4.305V	
	4.320V	
	4.335V	
	4.350V	, I
	4.365V	
	4.380V	1
	4.395V	•

Figure 11: Battery Regulation Voltage Setting

8. Figure 12 shows the pre-charge to fast charge threshold setting. Set the pre-charge to fast charge threshold voltage to 3V (the range is 2.8V to 3V).

VBATT_PRE	3V	•
Vsys_REG	2.8V	
IDSCHG	3V	

Figure 12: Pre-Charge to Fast Charge Threshold Setting



9. Figure 13 shows the battery auto-recharge voltage setting. Set the battery auto-recharge voltage to VBAT_REG to 200mV (the range is 100mV to 200mV).

Vrech	200mV 🔻
VBATT_UVLO	100mV
Vbatt REG	200mV

Figure 13: Battery Auto-Recharge Voltage Setting

10. Figure 14 shows the battery discharge current limit. Set the battery discharge current limit to 3200mA (the range is 400mA to 3200mA).



Figure 14: Battery Discharge Current Limit

11. Figure 15 shows the INT control setting.



Figure 15: INT Control Setting

- 12. Figure 16 on page 8 shows the FET control setting.
 - a. EN_HIZ controls the low-dropout (LDO) FET's on/off function.
 - b. CEB controls the Battery FET's on/off function in charge mode.
 - c. Select FET_DIS to turn off the Battery FET in both the charge and discharge modes.
 - d. De-selecting FET_DIS cannot turn on the battery FET. Use the push button or plug in the input adapter for 2 seconds to pull INT low, which turns on the battery FET when it is turned off by FET_DIS.





Figure 16: FET Control Setting

13. Figure 17 shows the VIN_LOOP control setting.

Figure 17: VIN_LOOP Control Setting

14. Figure 18 shows the battery FET time setting.

tRST_DUR	4s	•
tRST_DGL	16s	•

Figure 18: Battery FET Time Setting

15. Figure 19 shows the thermal control setting to enable PCB over-temperature protection (OCP).

Thremal Control	
Disable PCB_OTP	
EN_NTC	
TJ_REG	120oC 🔻

Figure 19: Thermal Control Setting

Table 1: NTC Function Selection

For other applications, see Table 1 for the NTC function selection.

I ² C Control		Function
EN_NTC	EN_PCB OTP	Function
0	X ⁽¹⁾	Disabled
1	1	NTC
1	0	PCB OTP

Notes: 1) "x" means not applicable.

16. Figure 20 shows the safety timer setting.



Figure 20: Safety Timer Setting



17. Figure 21 shows the I²C watchdog timer setting.



Figure 21: I²C Watchdog Timer Setting

18. Figure 22 shows the content of the registers.

CONFIG RE	EGISTER MAP			
Command code	Command name	Register Vaule(0x)	Register Vaule(0b)	
00H	00H	6E	0110 1110	
01H	01H	AC	1010 1100	
02H	02H	OF	0000 1111	
03H	03H	F1	1111 0001	
04H	04H	A3	1010 0011	
05H	05H	38	0011 1000	
06H	06H	C0	1100 0000	
07H	07H	B9	1011 1001	
08H	08H	40	0100 0000	
09H	09H	00	0000 0000	
0AH	0AH	00	0000 0000	
OBH	OBH	20	0010 0000	

Figure 22: Content of the Registers

19. Figure 23 shows the MP2665A's operation status and fault report.

			 Fault 	
			WATCHDOG_FAULT	\bigcirc
			Input fault	\bigcirc
1			Battery OVP	\bigcirc
	🔿 Status		Safety Timer Expiration	\bigcirc
	Rev	MP2665A	NTC Hot	\bigcirc
	CHG_STAT	Not Charging	NTC Cold	\bigcirc
	PPM_STAT	No PPM	In Thermal Regulation	\bigcirc
	PG_STAT	Power Fail	Thermal Shutdown	\bigcirc

Figure 23: MP2665A Operation Status and Fault Report



EVALUATION BOARD SCHEMATIC



Figure 24: Evaluation Board Schematic



EV2665A-QB-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	C1	4.7µF	Ceramic capacitor, 25V, X5R	0603	Murata	GRM188R61E475KE11D
2	C2, C9	NC				
1	C3	100nF	Ceramic capacitor, 25V, X7R	0603	Murata	GRM188R71E104KA01D
1	C4	10µF	Ceramic capacitor, 16V, X7R	0805	Murata	GRM21BR61C106KE15
1	C5	NC	Ceramic capacitor, 25V, X7R	0805	Murata	GRM21BR71E225KA73L
2	C6, C8	NC	Ceramic capacitor, 16V, X7R	0805	Murata	GRM21BR61C106KE15
1	C7	22µF	Ceramic capacitor, 16V, X5R	0805	Murata	GRM21BR61C226ME44L
1	P1	2.54mm	5-pin, dual-row header	DIP	Any	
1	R1	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
2	RT1, RT2	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	SW1	6.35mmx 8.89mm	Push switch	7914J	Any	
1	U2	6.8mmx 8.23mm	Micro-B USB connector	DIP	Any	
1	U1	MP2665A	1A, single-cell battery charger	QFN-12 (2.5mmx 3mm)	MPS	MP2665AGQB-0000



EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. $V_{IN} = 5V$, $V_{BATT_{REG}} = 4.2V$, $I_{IN_LIM} = 1000$ mA, $I_{CC} = 896$ mA, $I_{SYS} = 0.4$ A, $T_A = 25$ °C, unless otherwise noted.





PCB LAYOUT



Figure 25: Top Silk



Figure 27: Bottom Layer



Figure 26: Top Layer



REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	1/3/2022	Initial Release	-

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