EV2723A-QC-00A

5V, 3A, I²C, SW Charger with NVDC PPM, USB OTG, and Enhanced ADC Evaluation Board

DESCRIPTION

The EV2723A-QC-00A is an evaluation board for the MP2723A, a 3A, highly integrated switch-mode battery charger IC for single-cell Li-ion or Li-polymer batteries. This device supports narrow-voltage DC (NVDC) architecture with power path management, and is suitable for portable applications, such as tablets, mobile internet devices, and smartphones. The device's low-impedance power path optimizes efficiency, reduces battery charging time, and extends battery life. The I²C serial interface can control the charging and system settings.

The EV2723A-QC-00A supports 5V input sources, including standard USB host ports and wall adapters with fast charging capabilities.

The EV2723A-QC-00A supports USB on-the-go (OTG) operation by supplying 5V with 1.5A. The MP2723A is available in a QFN-26 (3.5mmx3.5mm) package.

PERFORMANCE SUMMARY

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

Parameters	Conditions	Value
Input voltage (V_{IN}) range		3.7V to 5.5V
Typical charge full voltage (V_{BATT_REG})	V_{IN} = 5V, I²C-configurable;	V_{BATT_REG} = 4.2V
Typical charge current (I_{CC})	V_{IN} = 5V, I²C-configurable;	1.916A
Typical efficiency	V_{IN} = 5V, V_{BATT} = 3.8V, I_{CC} = 2A	94%
Peak efficiency	V_{IN} = 5V, V_{BATT} = 3.8V, I_{CC} = 0.8A	95.4%
Switching frequency		1.35MHz

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EVALUATION BOARD

LxWxH (6.3cmx6.3cmx1.3cm)

Board Number	MPS IC Number
EV2723A-QC-00A	MP2723AGQC-0000

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QUICK START GUIDE

The EV2723A-QC-00A is designed for the MP2723A when the MP2723A is used as a standalone switching charger with integrated USB detection and USB on-the-go (OTG) functionality. Its 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 single-cell Li-ion batteries. The EV2723A-QC-00A can be used with multiple jumper connections for different functions (see Table 1).

Table 1: Jumper Connections

Jack	Description	Default
JP3	Pull the OTG pin high to enable on-the-go (OTG) mode	Pull low
JP2	Pull the CE pin low to enable charging	Pull low
JP1	Pull the NTC pin low to set NTC at a fixed 50% ratio	Pull low
P1	I²C connector	N/A

Evaluation Platform Preparation

The EV2723A-QC-00A requires at least one USB port and a USB cable. The MP2723A evaluation software must be properly installed, and an evaluation kit (EVKT-USBI2C-02) must be used to connect the USB and I²C (see Figure 1).

Figure 1: USB to I²C Communication Kit

The MP2723A evaluation kit .exe file can be downloaded from MPS website. Double-click on the "MP2723A Evaluation Kit" .exe file to run the MP2723A evaluation software. The software supports Windows XP, Windows 7, and later operating systems. Figure 2 shows a recommended test set-up.

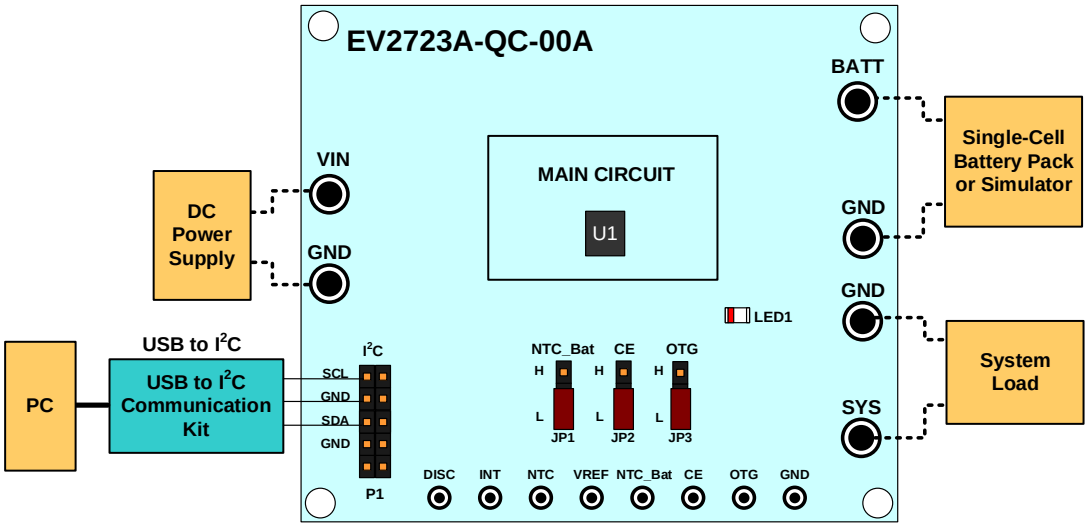

Figure 2: Test Set-Up for the MP2723A

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To use the software, follow the steps below:

1. Turn on the computer, and launch the MP2723A evaluation software. The software's main window should appear (see Figure 3).
   - The status "USB: Connected" indicates a successful USB connection.
   - That status "MP2723A Demo board: Connected" indicates a successful EVB2723A-QC-00A connection.

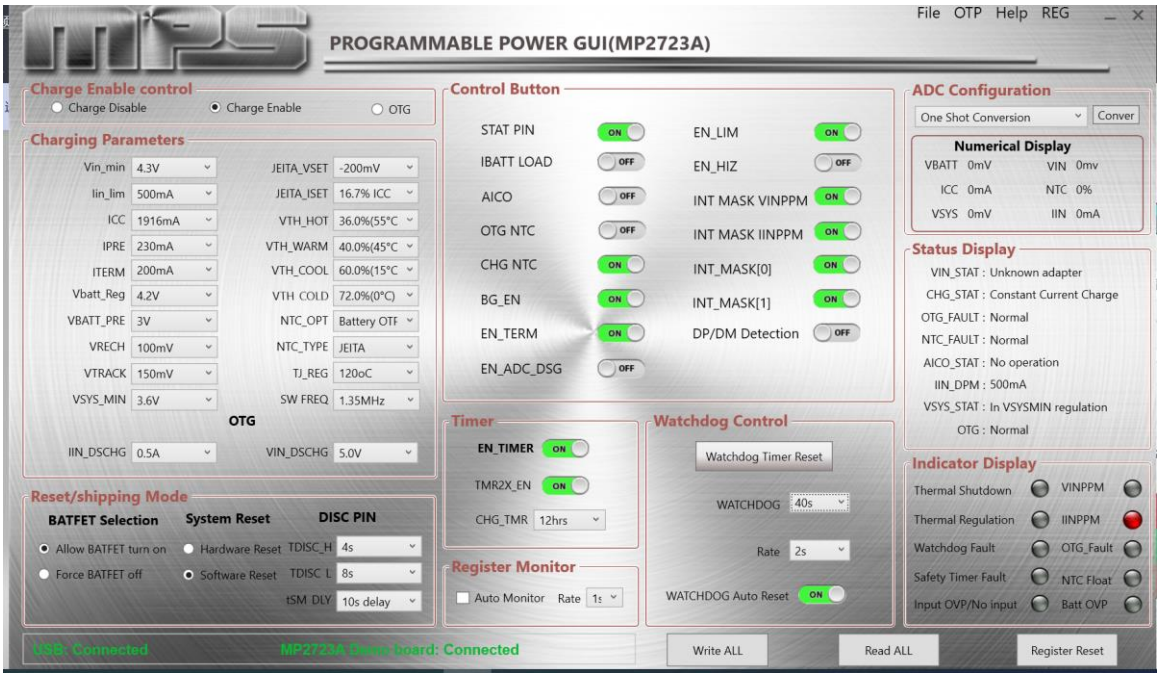

Figure 3: The MP2723A Evaluation Software

Procedures

To set the parameters for the MP2723A, following the steps below:

1. Ensure that the all components are connected before running the program, and the status in the lower-left side of the GUI is indicated in green (see Figure 3).
2. Select the operation mode for the MP2723A (see Figure 4).

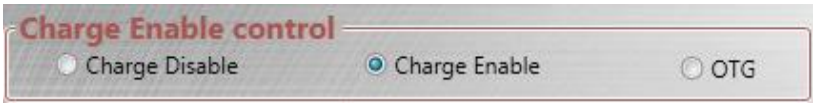

Figure 4: Selecting the Operation Mode

3. Select the charger functions (see Figure 5 on page 5).

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Figure 5: Selecting the Charger Functions

4. Set the input voltage regulation threshold between 3.7V and 5.2V.
   - The default value is 4.3V. Set the voltage regulation threshold according to the V_{BATT_REG} setting. For example, if V_{BATT_REG} is set to 4.35V, the voltage regulation threshold value is recommended to be set to 4.6V or greater (see Figure 6).

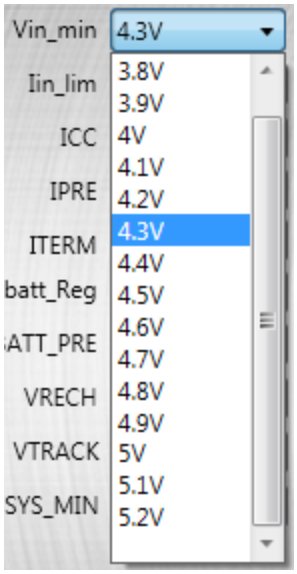

Figure 6: Setting the Input Voltage Regulation Threshold

5. Set the input current limit between 100mA and 3250mA.
   - The default value is 500mA. Set the input current limit so that it meets the input source capacity (see Figure 7 on page 6).

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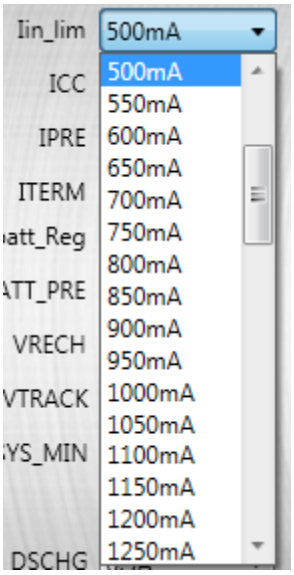

Figure 7: Setting the Input Current Limit

- The input current limit can be set below the maximum current rating of the input source. When the input current reaches the limit, the charge current decreases to keep the input current constant at this limit. This protects the power system.

6. Set the constant charge current between 320mA and 2966mA.
   - The default charge current is set to 1916mA. The actual charge current is limited at the input current limit setting (see Figure 8).

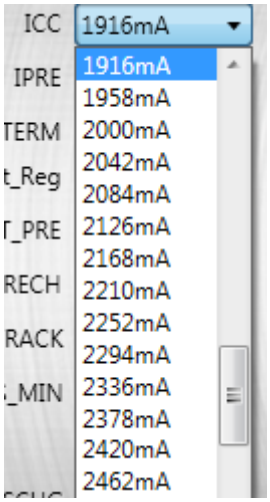

Figure 8: Setting the Constant Charger Current

7. Set the pre-charge current between 150mA and 750mA.
   - The default value is 230mA (see Figure 9 on page 7).

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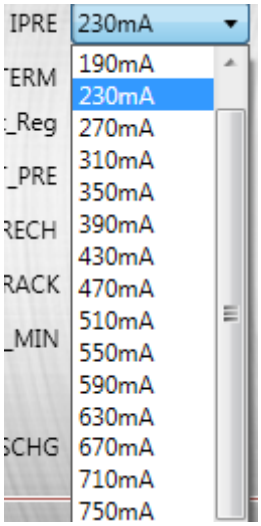

Figure 9: Setting the Pre-Charge Current

8. Set the termination charge current between 100mA and 700mA.
   - The default value is 180mA (see Figure 10).

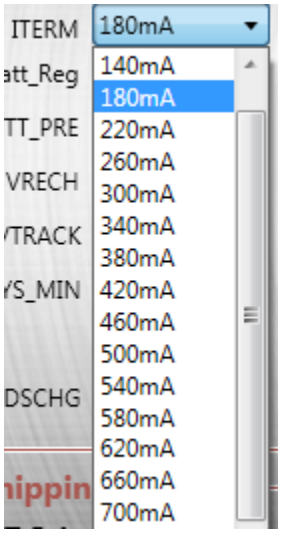

Figure 10: Setting the Termination Charge Current

9. Set the charge full voltage between 3.4V and 4.67V.
   - The default value is 4.2V (see Figure 11 on page 8).

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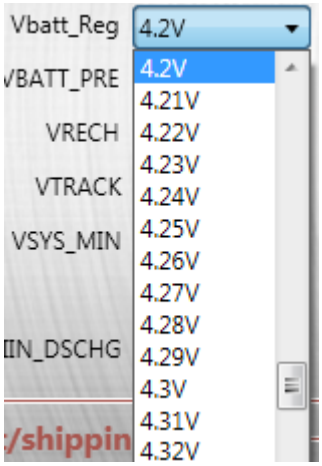

Figure 11: Setting the Charge Full Voltage

10. Set the pre-charge to constant current charge threshold voltage between 2.8V and 3.0V.
    - The default value is 3V (see Figure 12).

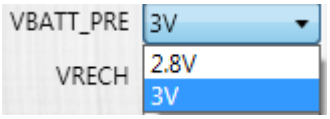

Figure 12: Setting Threshold Voltages

11. Set the battery's automatic recharge voltage to V_{BATT_REG} minus the set value. This range is between 100mV and 200mV.
    - The default value is 100mV (see Figure 13).

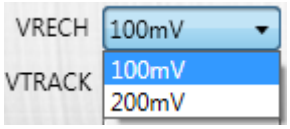

Figure 13: Setting the Automatic Recharge Voltage

12. Set the voltage variation between the SYS regulation voltage and V_{SYS_MIN}, ranging between 100mV and 150mV.
    - The default value is 150mV (see Figure 14).

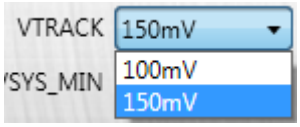

Figure 14: Setting Voltage Variation

13. Set the V_{SYS_MIN} voltage threshold between 3V and 3.75V.
    - The default value is 3.6V (see Figure 15 on page 9).

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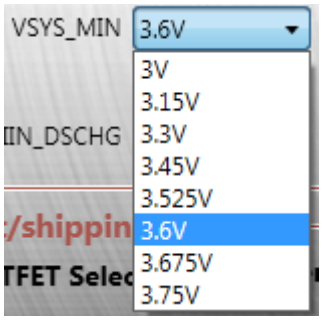

Figure 15: Setting the V_{SYS_MIN} Threshold

14. Set the NTC function according to the selected NTC thermistor and its requirements.
    - If this function is not required during the evaluation, leave it at the default setting (see Figure 16).

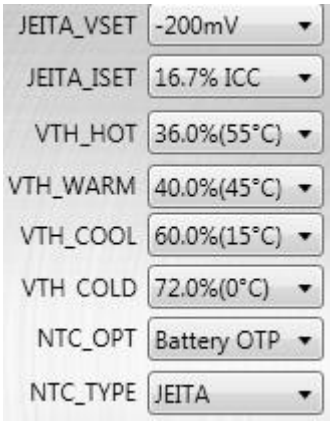

Figure 16: Setting the NTC Function

15. Set the thermal regulation threshold between 60°C and 120°C.
    - The default value is 120°C (see Figure 17).

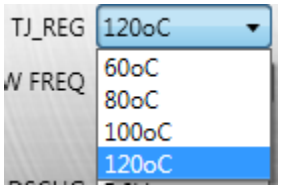

Figure 17: Setting the Thermal Regulation Threshold

16. Set the switching (SW) frequency between 1.35MHz and 1MHz.
    - The default value is 1.35MHz (see Figure 18).

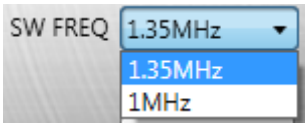

Figure 18: Setting the SW Frequency

17. Set the charge timer between 5hrs and 20hrs.
    - The default value is 12hrs (see Figure 19 on page 10).

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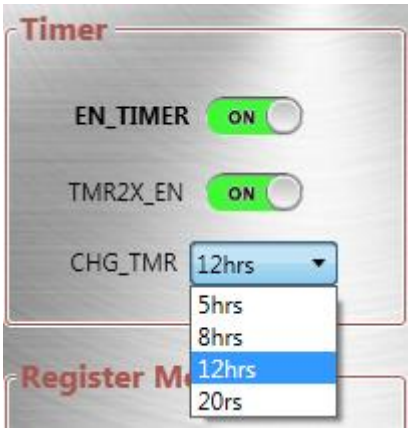

Figure 19: Setting the Charge Timer

- The integrated charge timer provides backup protection to prevent a damaged battery from being charged after a certain time. The timer function can be disabled.

Boost Mode

When the MP2723A is programmed to On-the-Go (OTG) mode, the output voltage and current limit can be controlled via the I²C. For this scenario, follow the steps below:

1. Turn off and disconnect the power from VIN to PGND.
2. If the constant voltage load connected from BATT+ to GND is not a four-quadrant supply (meaning it sources current), remove the load. Use the power source that was disconnected in step 1, set it to 4.0V with a 3.5A current limit, then connect the power source between BATT+ and PGND.
3. Apply a resistor (for applications that are 5W or greater, R should be between 4Ω and 10Ω) from VIN (+) to PGND (-).
4. Pull JP3 high, and select OTG in the menu (see Figure 20).

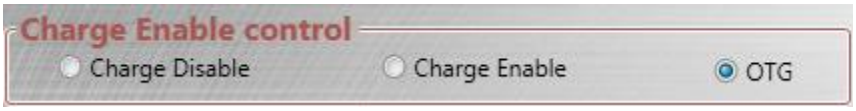

Figure 20: Selecting On-the-Go (OTG) Mode

5. Set the OTG output voltage regulation threshold between 4.8V and 5.5V.
   - The default value is 5V (see Figure 21).

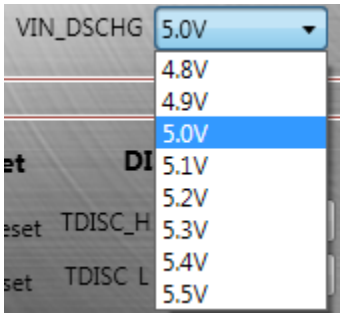

Figure 21: Setting the OTG Output Voltage Regulation

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6. Set the OTG current limit between 0.5A and 1.5A.
   - The default value is 0.5A (see Figure 22).

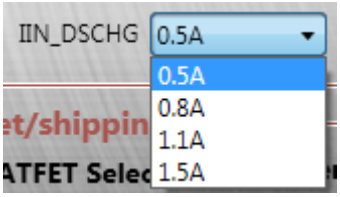

Figure 22: Setting the OTG Current Limit

Other Modes

Figure 23 shows shipping mode control.

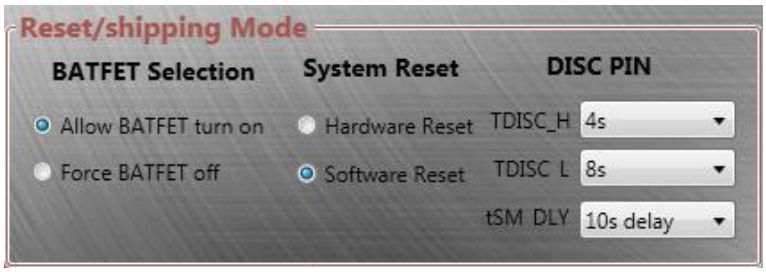

Figure 23: Shipping Mode Control

Figure 24 shows additional adjustable parameters.

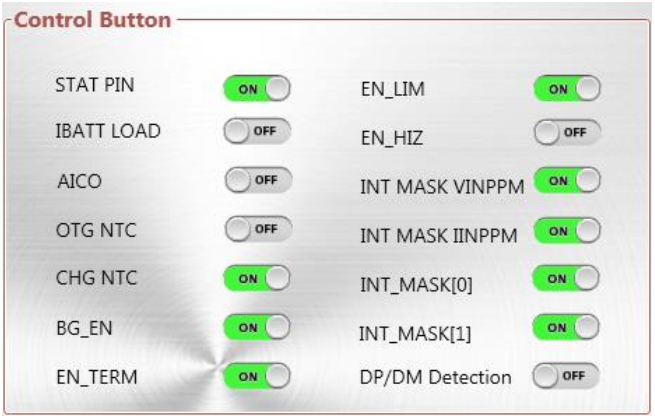

Figure 24: Adjustable Parameters for the MP2723A

Figure 25 shows watchdog control.

Figure 25: Watchdog Control

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Figure 26 shows register auto-monitoring.

Figure 26: Register Auto-Monitoring

Figure 27 shows ADC configuration.

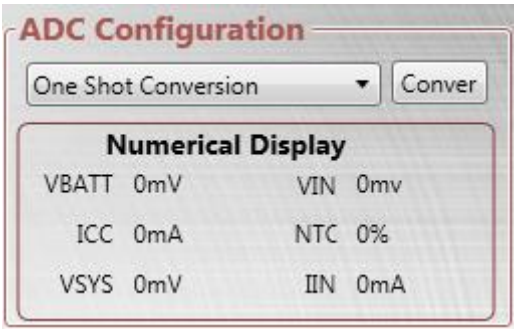

Figure 27: ADC Configuration

Figure 28 shows how to monitor the MP2723A operation status and fault report.

Figure 28: Monitoring the MP2723A Status and Faults

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EVALUATION BOARD SCHEMATIC

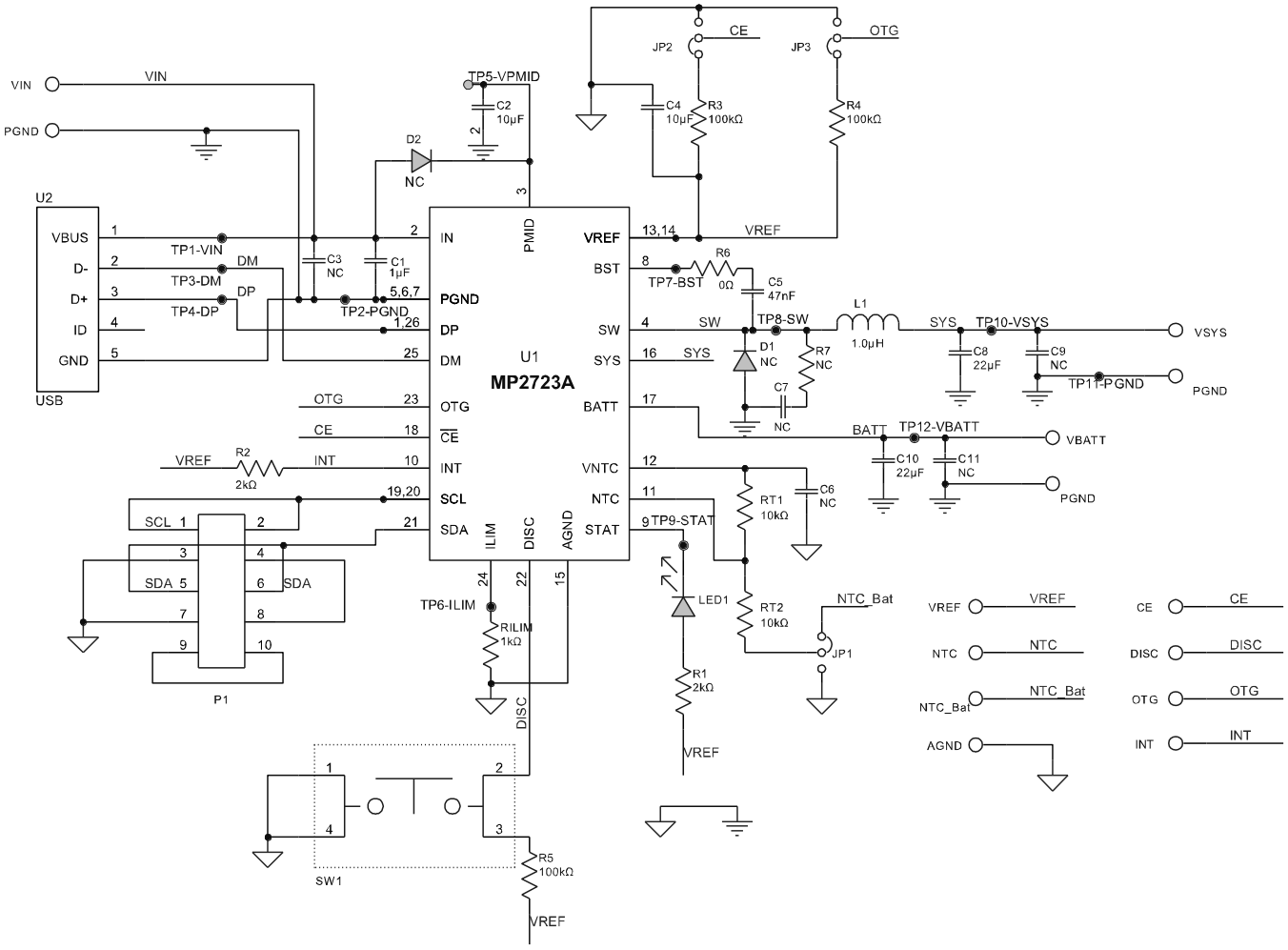

Figure 29: Evaluation Board Schematic

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EV2723A-QC-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	C1	1µF	Ceramic capacitor, 25V, X7R, 0603	0603	Murata	GRM188R71E105KA12D
1	C2	10µF	Ceramic capacitor, 50V, X5R, 1206	1206	Murata	GRM31CR61H106KA12L
1	C3	NC	Ceramic capacitor, 50V, X5R, 1206	1206	Murata	
1	C4	10µF	Ceramic capacitor, 16V, X5R, 0603	0603	Murata	GRM188R61C106KAALD
1	C5	47nF	Ceramic capacitor, 50V, X7R, 0603	0603	Murata	GRM188R71H473KA61D
2	C6, C7	NC	Ceramic capacitor, 16V, X5R, 0603	0603	Murata	
2	C8, C10	22µF	Ceramic capacitor, 16V, X5R, 0805	0805	Murata	GRM21BR61C226ME44L
2	C9, C11	NC	Ceramic capacitor, 16V, X5R, 0805	0805	Murata	
2	D1, D2	NC	Diode, 50V, 3A	SMA	HQ	
1	L1	1.0µH	Inductor, 1.0µH	SMD	Cyntec	HTEP32251B-1R0MIR-89
1	LED1	RED	BL-HUF35A-TRB	0805	Bright LED	BL-HUF35A-TRB
2	R1, R2	2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-072KL
3	R3, R4, R5	100kΩ	Film resistor, 5%	0603	Yageo	RC0603JR-07100KL
1	R6	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-070RL
1	R7	NC	Film resistor, 1%	0603	Yageo	
1	RILIM	1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
2	RT1, RT2	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	SW1	10mmx 1.5mm	Button	SM, 4mmx 10mmx 1.5mm	Any	
3	JP1, JP2, JP3	2.54mm	2.54mm connector	DIP	Any	
1	P1	5-pin	Header, 5-pin, dual row	DIP	Any	
8	DISC, VREF, AGND, OTG, CE, INT, NTC, NTC_Bat,	2.54mm	2.54mm connector	DIP	Any	

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EV2723A-QC-00A BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
12	DM, DP, VBATT, GND, VSYS, BST, STAT, SW, VPMID, GND, VIN, ILIM	Yellow	Test point (yellow)	DIP	Any	
6	VIN, PGND, VBATT, PGND, PGND, VSYS	2mm	2mm connector	DIP	Any	
1	U1	MP2723A	3A, I²C-controlled SW charger	QFN-26 (3.5mmx3.5mm)	MPS	MP2723AGQC-0000
1	U2	Micro-USB	Micro-USB	DIP	Wurth	629105150521

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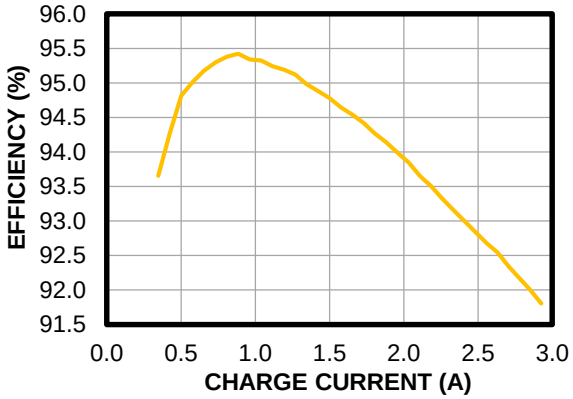
EVB TEST RESULTS

V_{IN} = 5.0V, V_{BATT} = full range, I²C-controlled, I_{CC} = 1.916A, I_{IN_LIM} = 3250mA, V_{IN_MIN} = 4.3V, T_A = 25°C, L1 = 1.0µH, C_{BATT} = 22µF, C_{SYS} = 22µF, C_{IN} = 1µF, C_{PMID} = 10µF, unless otherwise noted.

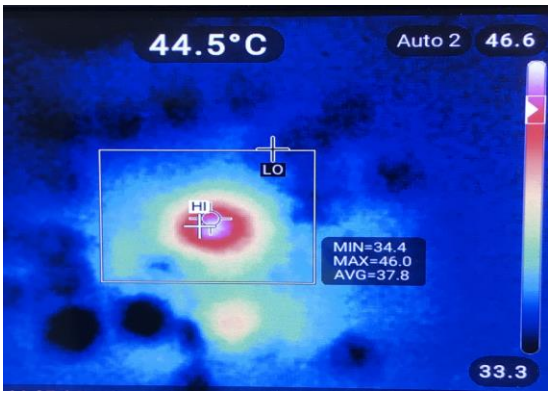
Efficiency vs. Charge Current

V_{IN} = 5V, V_{BATT} = 3.8V, R_{L_DCR} = 21mΩ



Thermal Rise

V_{IN} = 5V, V_{BATT} = 3.8V, I_{CC} = 2A, no forced airflow, T_{CASE} = 45°C



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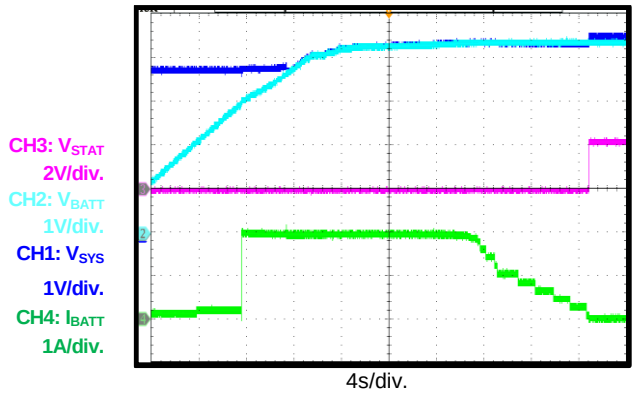
EVB TEST RESULTS

V_{IN} = 5.0V, V_{BATT} = full range, I²C-controlled, I_{CC} = 1.916A, I_{IN_LIM} = 3250mA, V_{IN_MIN} = 4.3V, T_A = 25°C, L1 = 1.0µH, C_{BATT} = 22µF, C_{SYS} = 22µF, C_{IN} = 1µF, C_{PMID} = 10µF, unless otherwise noted.

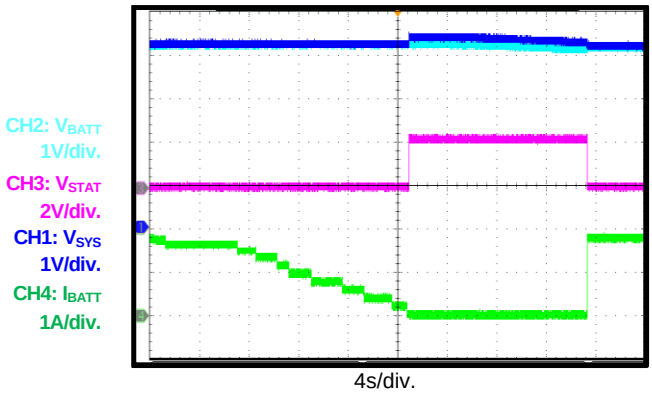
Battery Charge Curve

V_{IN} = 5V, V_{BATT_REG} = 4.35V, I_{SYS} = 0A



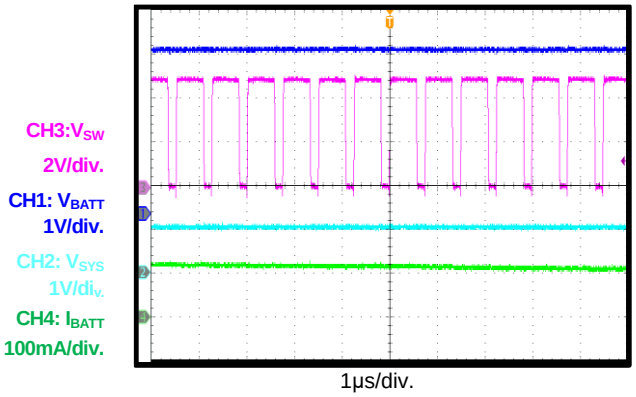
Auto-Recharge

V_{IN} = 5V, V_{BATT_REG} = 4.2V, I_{SYS} = 0A



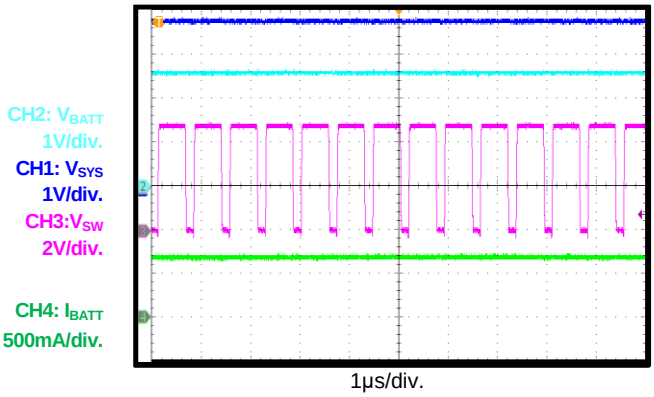
Trickle Charge

V_{IN} = 5V, V_{BATT} = 1.0V, I_{TC} = 145mA



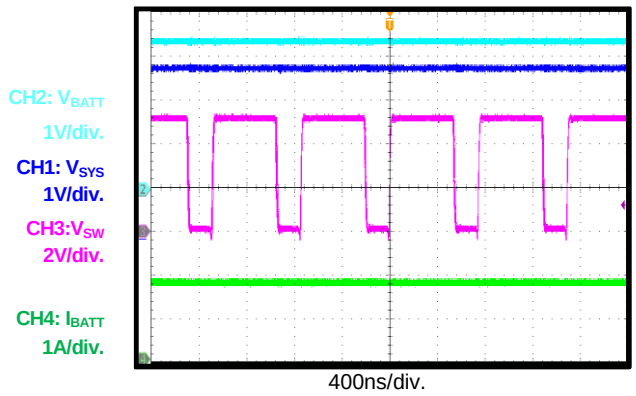
Pre-Charge

V_{IN} = 5V, V_{BATT} = 2.5V, I_{PRE} = 680mA



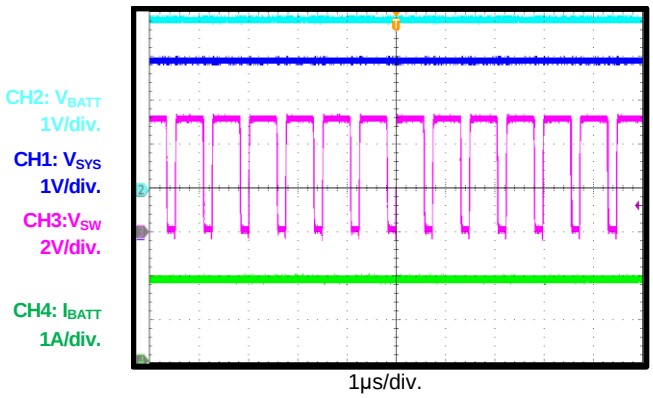
Constant Current Charge

V_{IN} = 5V, V_{BATT} = 3.3V, I_{CC} = 1840mA



Constant Current Charge

V_{IN} = 5V, V_{BATT} = 3.8V, I_{CC} = 1840mA



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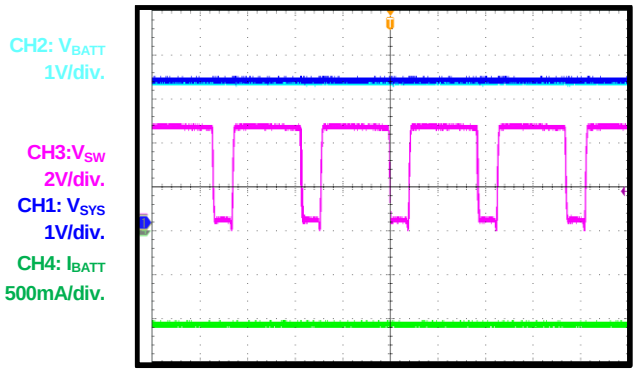
EVB TEST RESULTS *(continued)*

V_{IN} = 5.0V, V_{BATT} = full range, I²C-controlled, I_{CC} = 1.916A, I_{IN_LIM} = 3250mA, V_{IN_MIN} = 4.3V, T_A = 25°C, L1 = 1.0µH, C_{BATT} = 22µF, C_{SYS} = 22µF, C_{IN} = 1µF, C_{PMID} = 10µF, unless otherwise noted.

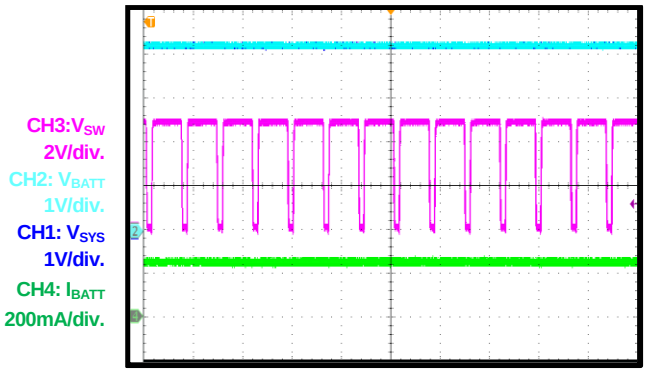
Battery Supplement Mode

V_{IN} = 5V, V_{BATT} = 3.8V, I_{SYS} = 4.5A



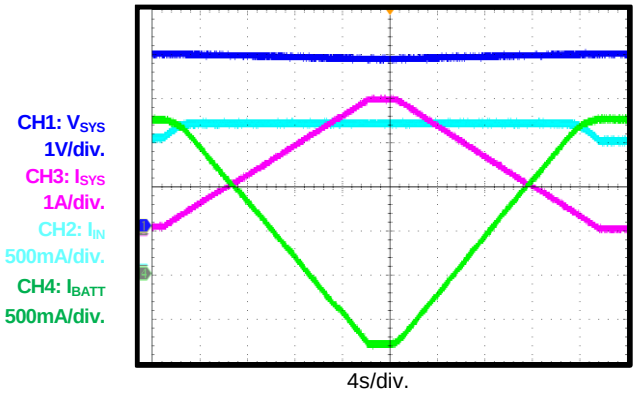
Constant Voltage Charge

V_{IN} = 5V, V_{BATT} = 4.2V, I_{SYS} = 0A



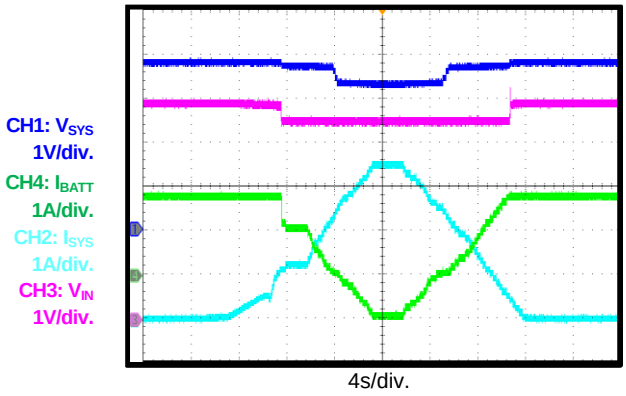
Input Current Limit

V_{IN} = 5V, V_{BATT} = 3.8V, I_{IN_LIM} = 1800mA



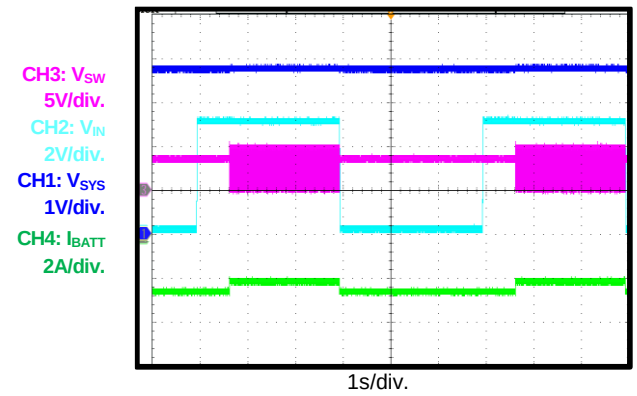
Input Voltage Limit

V_{IN} = 5V (2A), V_{BATT} = 3.3V, V_{IN_MIN} = 4.6V



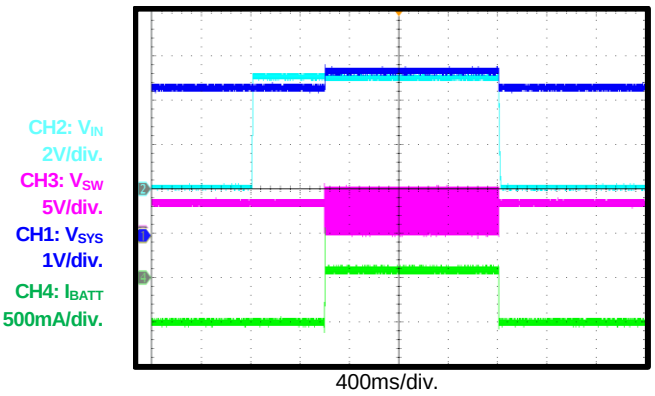
Power-On/Off Waveform

V_{IN} = 5V, V_{BATT} = 3.8V, I_{SYS} = 2.5A, default mode



Power-On/Off Waveform

V_{IN} = 5V, V_{BATT} = 3.3, I_{SYS} = 0.5A, default mode



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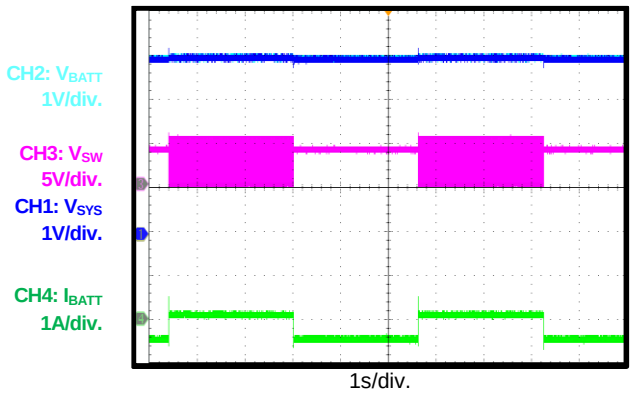
EVB TEST RESULTS *(continued)*

V_{IN} = 5.0V, V_{BATT} = full range, I²C-controlled, I_{CC} = 1.916A, I_{IN_LIM} = 3250mA, V_{IN_MIN} = 4.3V, T_A = 25°C, L1 = 1.0µH, C_{BATT} = 22µF, C_{SYS} = 22µF, C_{IN} = 1µF, C_{PMID} = 10µF, unless otherwise noted.

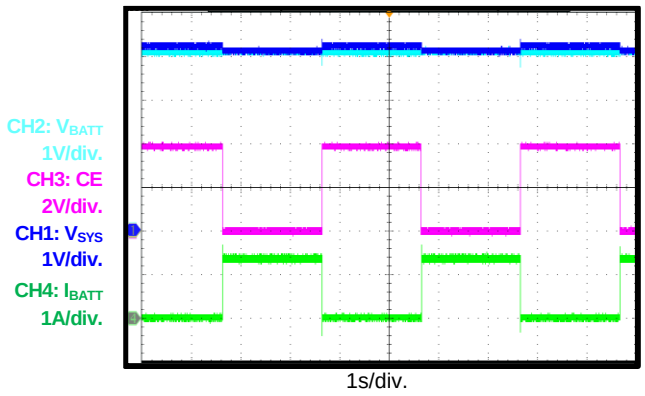
Suspend Mode On/Off

V_{IN} = 5V, V_{BATT} = 4.0V, I_{SYS} = 0.5A, default mode



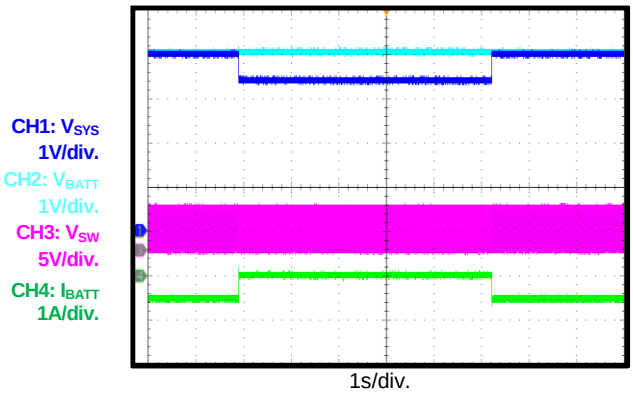
Charge On/Off

V_{IN} = 5V, V_{BATT} = 4.0V, I_{SYS} = 0A



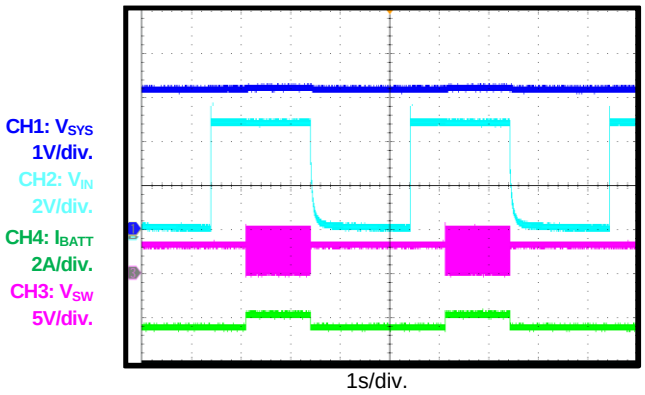
BATTFET On/Off

V_{IN} = 5V, V_{BATT} = 4.0V, I_{SYS} = 4A



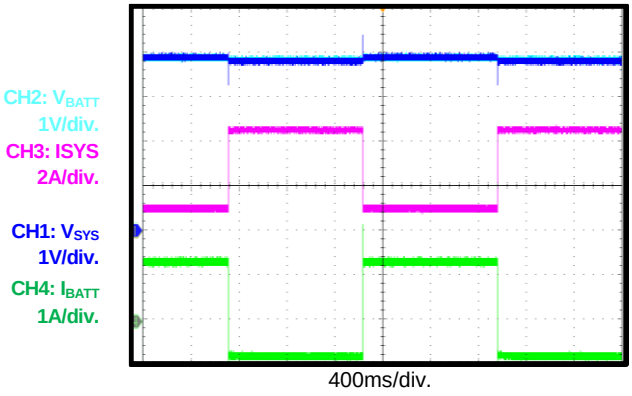
VIN Hot Insertion/Removal

V_{IN} = 5V, V_{BATT} = 3.3V, I_{SYS} = 4.5A, default mode



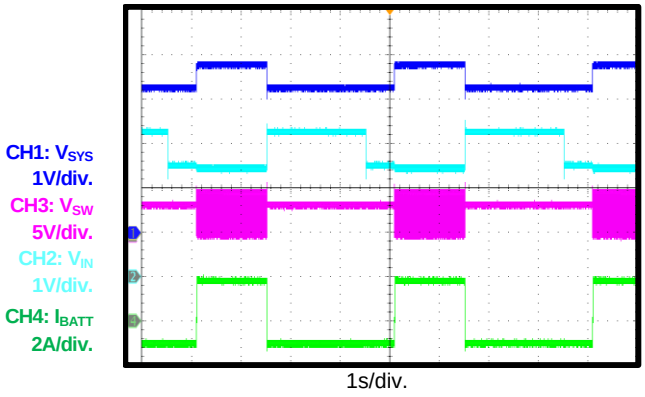
SYS Load Transient

V_{IN} = 5V, V_{BATT} = 3.8V, I_{SYS} = 1A to 4.5A, transient



VIN OVP Test

V_{IN} = 5V to 6.5V transient, V_{BATT} = 3.3V, I_{SYS} = 1A



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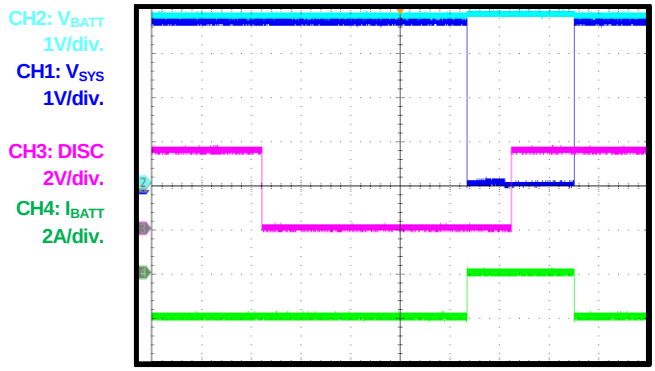
EVB TEST RESULTS *(continued)*

V_{IN} = 5.0V, V_{BATT} = full range, I²C-controlled, I_{CC} = 1.916A, I_{IN_LIM} = 3250mA, V_{IN_MIN} = 4.3V, T_A = 25°C, L1 = 1.0µH, C_{BATT} = 22µF, C_{SYS} = 22µF, C_{IN} = 1µF, C_{PMID} = 10µF, unless otherwise noted.

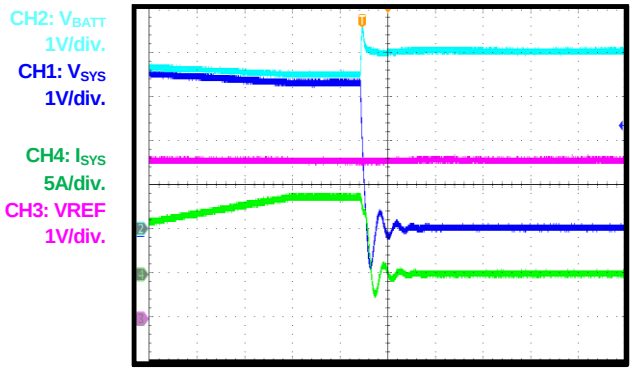
System Reset Mode

V_{IN} = float, V_{BATT} = 3.8V, I_{SYS} = 2A



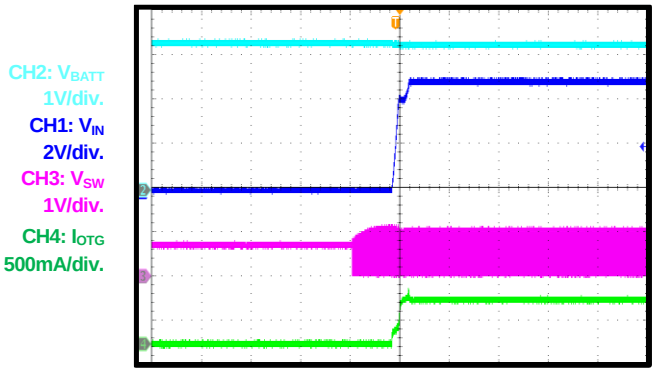
Battery Discharge Current

V_{IN} = float, V_{BATT} = 4.0V, I_{SYS} = up to 9A



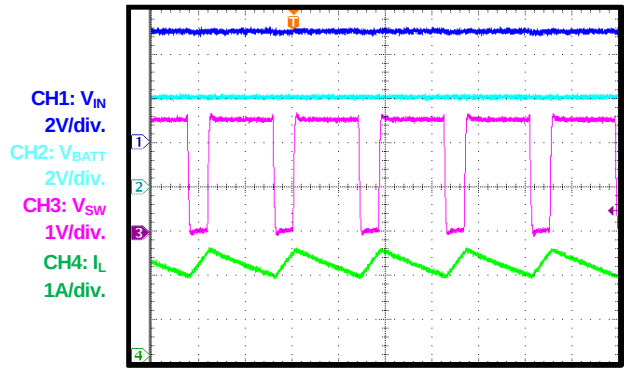
OTG Mode Start-Up

V_{IN} = float, OTG mode, V_{BATT} = 3.3V,
I_{IN_DSCHG} = 0.5A, I_{OTG} = 0.5A



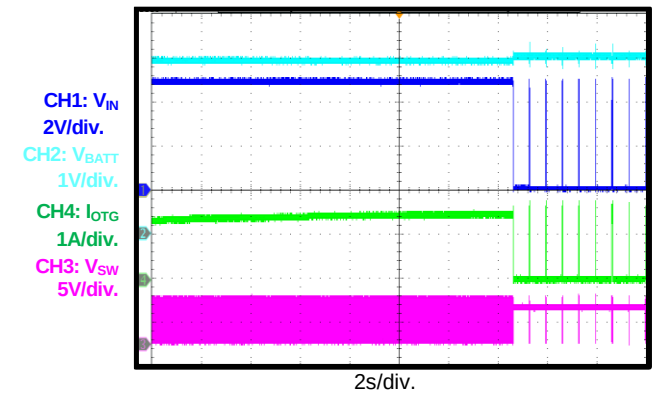
OTG Steady State Operation

V_{IN} = float, OTG mode, V_{BATT} = 4.0V,
I_{IN_DSCHG} = 1.5A, I_{OTG} = 1.5A



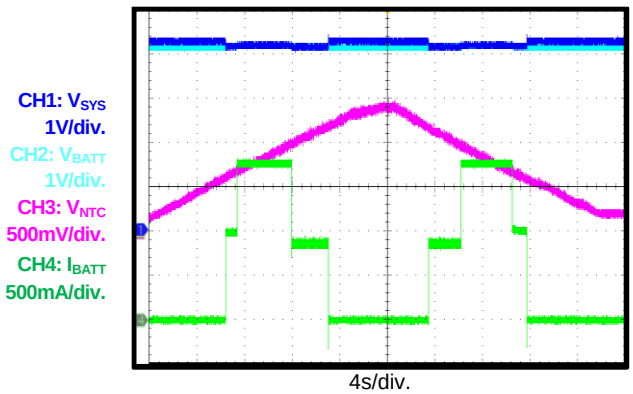
OTG Voltage Regulation

V_{IN} = float, OTG mode, V_{BATT} = 4.0V,
I_{IN_DSCHG} = 1.5A, I_{OTG} = 0A to 1.5A



NTC JIETA Operation

V_{IN} = 5V, V_{BATT} = 4.1V, I_{SYS} = 0A,
J_{EITA_VSET} = -100mV, J_{EITA_ISET} = 50%



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PCB LAYOUT

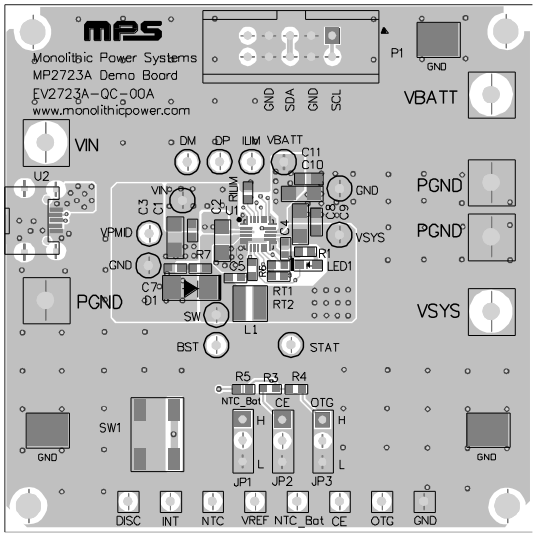

Figure 30: Top Layer

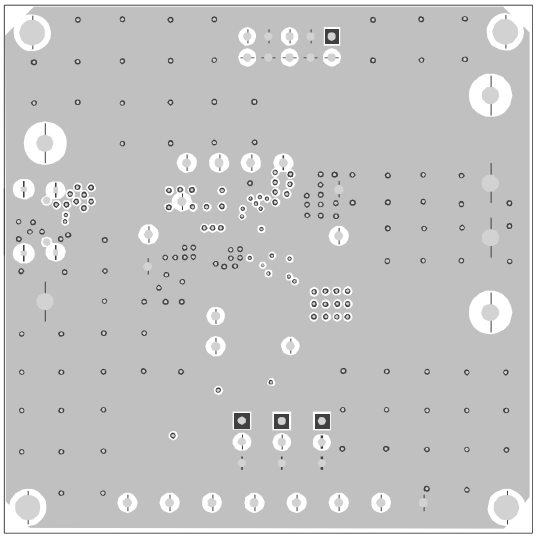

Figure 31: Middle Layer 1

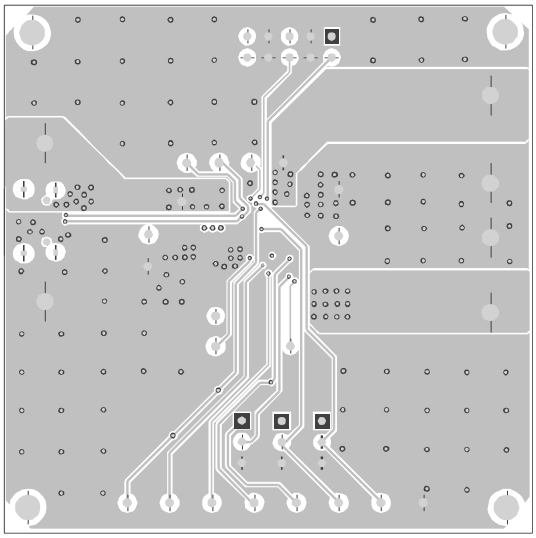

Figure 32: Middle Layer 2

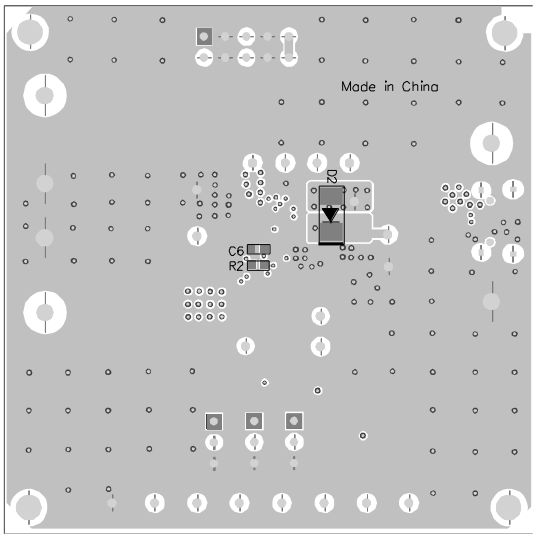

Figure 33: Bottom Layer

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REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	10/20/2021	Initial Release	-

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