EV8859-Q-00B

2.8V-22V Vin, 3A Iout, 4-Switch Integrated Buck-Boost Converter with I2C Interface

DESCRIPTION

The EV8859-Q-00B is an evaluation board for MP8859, which is a synchronous 4-switch integrated buck-boost converter. It can regulate the output voltage from 2.8V to 22V wide input voltage range with high efficiency. The integrated output voltage scaling and adjustable output current limit functions fit to the USB Power Delivery (PD) requirement.

MP8859 uses constant-on-time control in buck mode and constant-off-time control in boost mode, providing fast load transient response as well as smooth buck-boost mode transient. MP8859 provides auto PFM/PWM or forced PWM switching modes, programmable output CC(Constant Current) current limit which supports flexible design for different applications.

The MP8859 also features with OCP/OVP/UVP, programmable soft-start and thermal shutdown protection.

The MP8859 is available in a 16-pin QFN(3mmx3mm) package.

ELECTRICAL SPECIFICATION

Parameter	Symbol	Value	Units
Operating Input Voltage	V_{IN}	12	V
Switching Frequency	Fs	500	kHz
Output Voltage	V_{OUT}	5	V
Output Current	I_{OUT}	3	A

FEATURES

- Wide 2.8V to 22V Operating Input-Voltage Range
- 1V* to 20.47V Output Voltage Range(5V Default) with 10mV Resolution through I2C
- 3A Output Current or 4A Input Current
- Adjustable Accurate CC Output-Current Limit with Internal Sensing FET via I2C
- 500kHz Switching Frequency
- Output OVP Hiccup
- Output Short Circuitry Protection with Hiccup
- Over Temperature Warning and Shutdown
- I2C Interface with ALT pin
- 4 Programmable I2C Addresses
- OTP (One-Time-Program) Non-volatile Memory
- I2C Programmable Line Drop Compensation, PFM/PWM Mode, Soft-start, OCP etc.
- EN Shutdown Discharge Programmable

APPLICATIONS

- USB PD Sourcing Port
- Buck-Boost Bus Supply

* For Vout<3V application, the switching frequency will decrease.

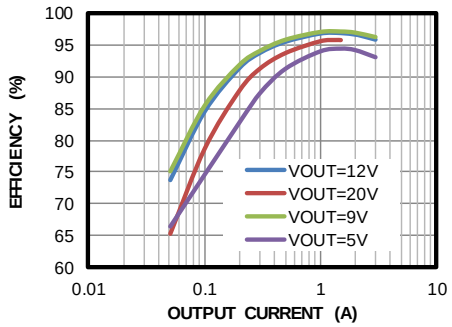
EV8859-Q-00B EVALUATION BOARD

(L x W) 6.35cm x 6.35cm (Four Layer PCB)

Board Number	MPS IC Number
EV8859-Q-00B	MP8859GQ-0000

Efficiency vs. Output Current

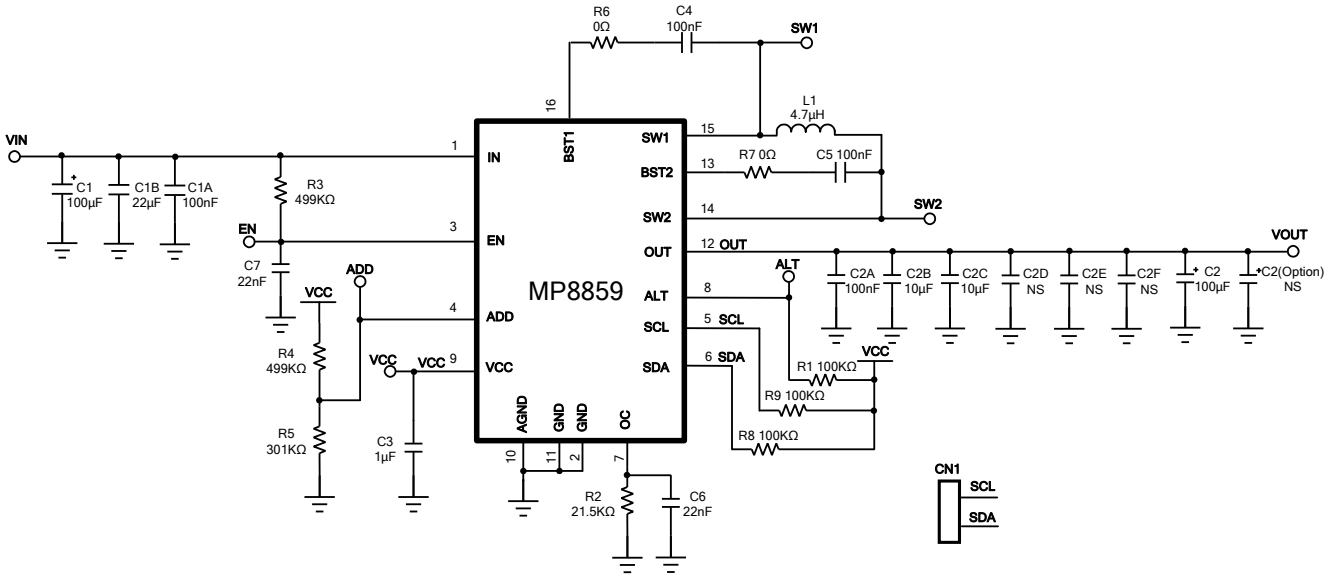
V_{IN}=12V, V_{OUT}=5V-20V, Forced PWM Mode



OTP-EFUSE SELECTED TABLE BY DEFAULT (MP8859GQ-0000)

OTP Items	Default Value
Output Voltage	5V
IOUT_LIMIT	3.5A(For 21.5KΩ OC resistor)
Switching Frequency	500KHz
MODE	Forced PWM mode
Soft Start time	900μs
Line Drop Compensation	Vout compensates 150mV@3A Iout
Output Voltage Discharge mode	Enabled
OCP_OVP protection mode	Hiccup
OTP Configure Code(ID1)	0x00

EVALUATION BOARD SCHEMATIC



EV8859-Q-00B BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Part Number
1	C1	100µF	Electrolytic Cap.,35V	DIP	Chemi-Con	EMZJ350ADA101MF80G
1	C1B	22µF	Ceramic Cap.,25V,X5R	0805	TDK	C2012X5R1E226M
2	C2B,C2C	10µF	Ceramic Cap.,25V,X5R	0805	Murata	GRM21BR61E106MA73L
1	C2	100µF	Electrolytic Cap.,35V	SMD	Chemi-Con	EMZJ350ARA101MHA0G
		100µF	Polymer Cap.,35V	DIP	WE	870055675009
1	C3	1µF	Ceramic Cap.,16V,X5R	0603	WE	885012106017
4	C1A,C2A, C4,C5	100nF	Ceramic Cap.,50V,X7R	0402	SAMSUNG	CL05B104KB5NNNC
2	C6, C7	22nF	Ceramic Cap.,50V, X5R	0603	Murata	GRM188R71H223KA01D
1	L1	4.7µH	Inductor, RDC=19.5mOhm, Isat=7A	SMD	WE	744311470
3	R1,R8,R9	100k	Film Res,1%,0603	0603	YAGEO	RC0603FR-07100KL
1	R2	21.5k	Film Res,1%,0603	0603	YAGEO	RC0603FR-0721K5L
2	R3,R4	499k	Film Res,1%,0603	0603	YAGEO	RC0603FR-07499KL
1	R5	301k	Film Res,1%,0603	0603	YAGEO	RC0603FR-07301KL
2	R6,R7	0	Film Res,1%,0402	0402	YAGEO	RC0402FR-070RL
0	C2D, C2E, C2F	NS				
1	U1	MP8859	4-Switch Integrated Buck-Boost Converter	QFN-16(3mm×3mm)	MPS	MP8859GQ-0000

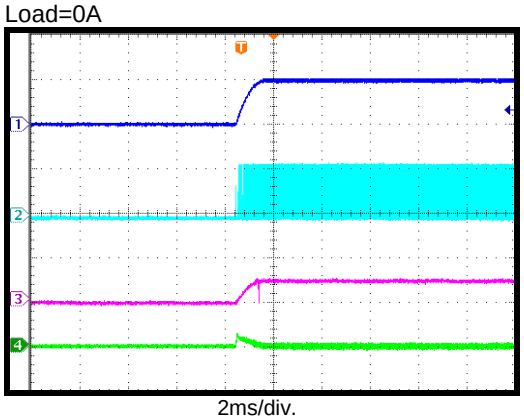
Note: C2 has an option between WE and CHEMICON.

EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.
V_{IN} = 12V, V_{OUT} = 5V, T_A = 25°C, unless otherwise noted.

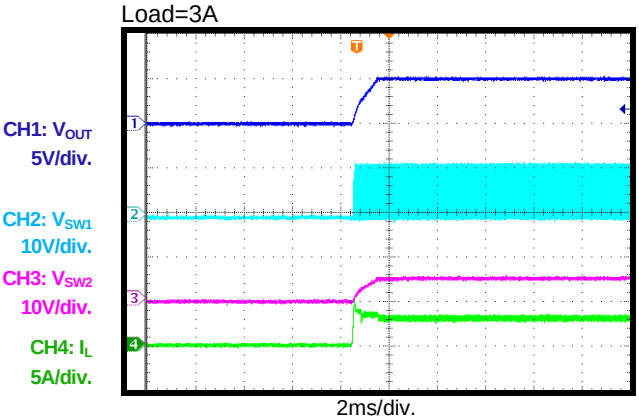
EN Bit Enable through I²C Command

Load=0A



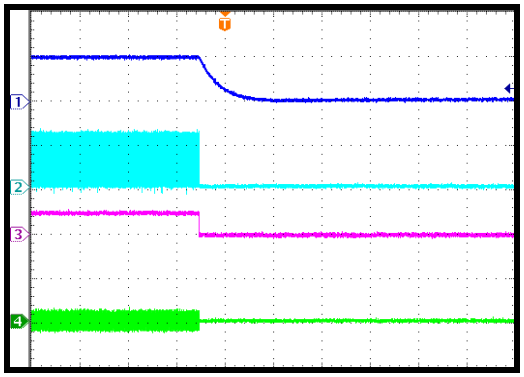
EN Bit Enable through I²C Command

Load=3A



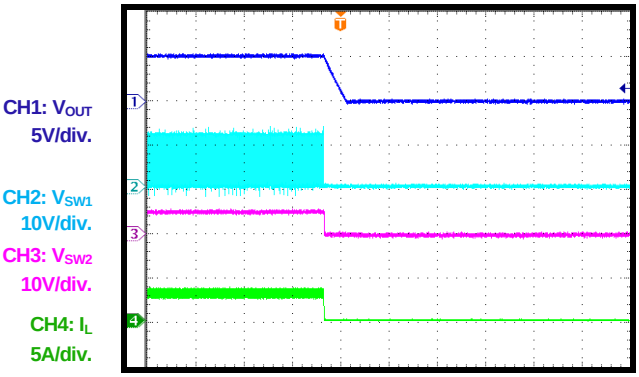
EN Bit Disable through I²C Command

Load=0A



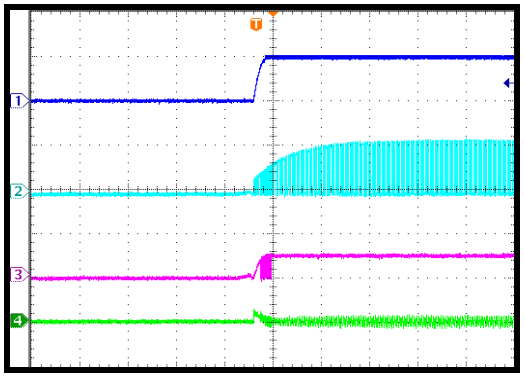
EN Bit Disable through I²C Command

Load=3A



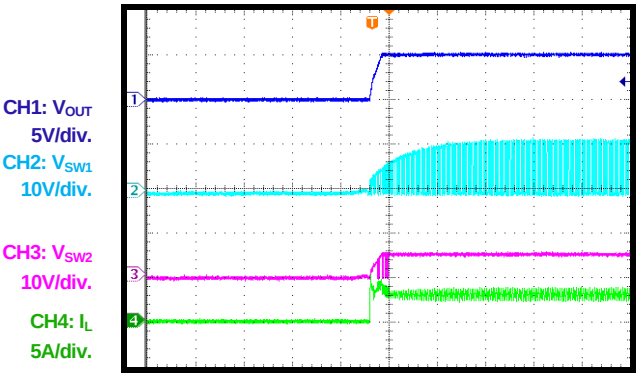
VIN Start-Up

Load=0A



VIN Start-Up

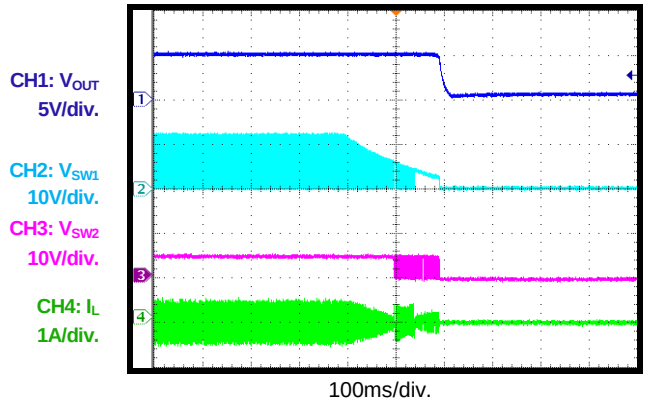
Load=3A



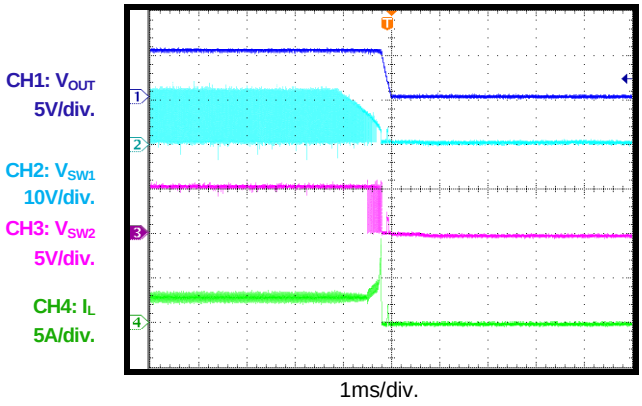
EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.
V_{IN} = 12V, V_{OUT} = 5V, T_A = 25°C, unless otherwise noted.

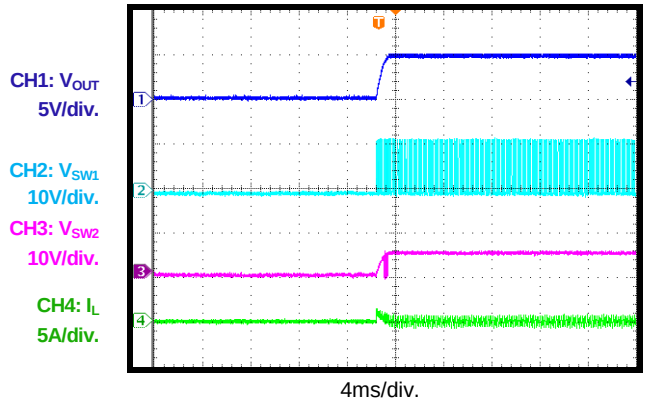
VIN Power Off
Load=0A



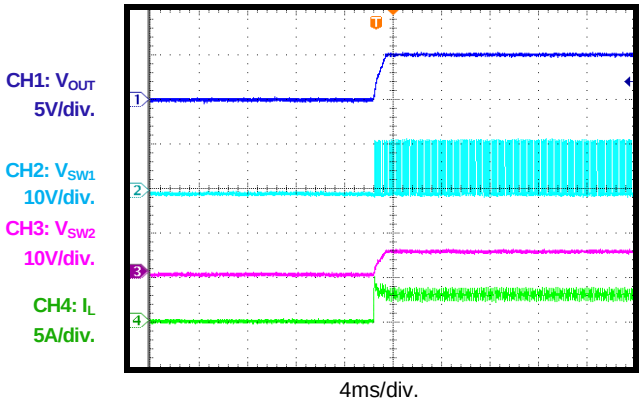
VIN Power Off
Load=3A



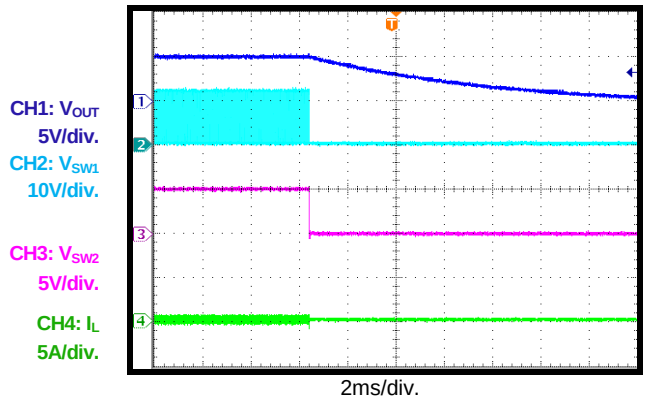
EN Pin Enable
Load=0A



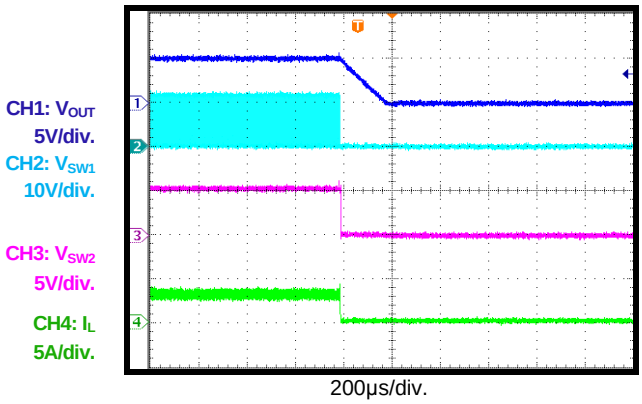
EN Pin Enable
Load=3A



EN Pin Disable
Load=0A



EN Pin Disable
Load=3A

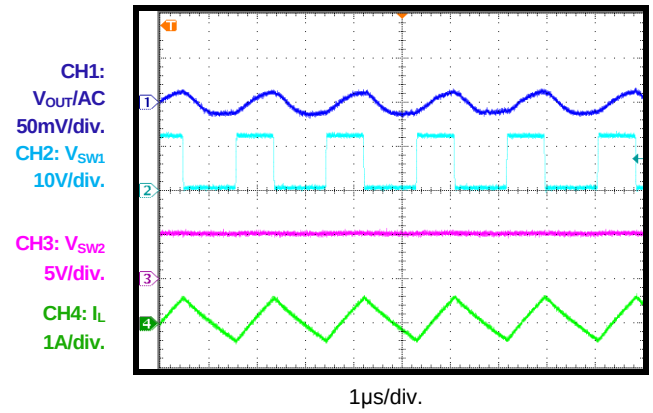


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.
V_{IN} = 12V, V_{OUT} = 5V, T_A = 25°C, unless otherwise noted.

Steady State

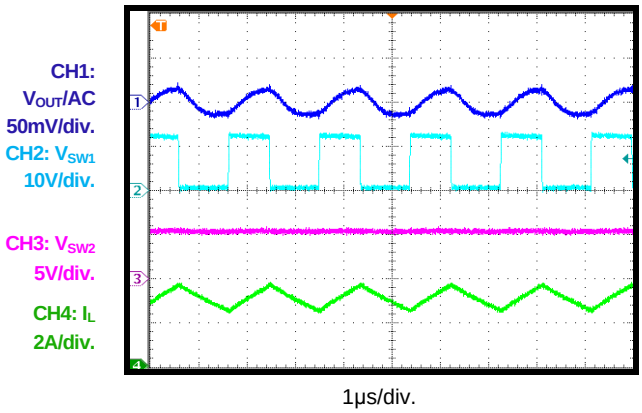
V_{OUT}=5V, Load=0A



1µs/div.

Steady State

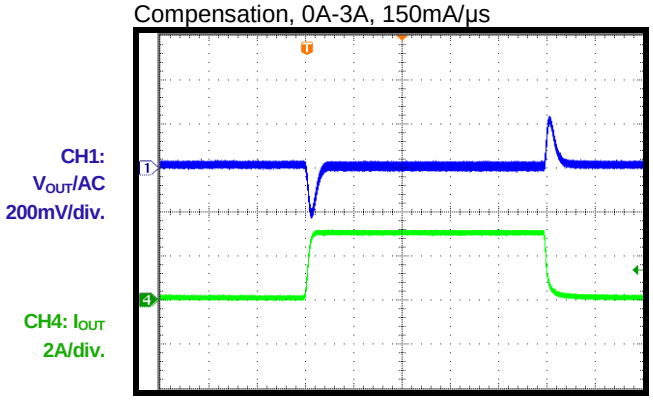
V_{OUT}=5V, Load=3A



1µs/div.

Load Transient

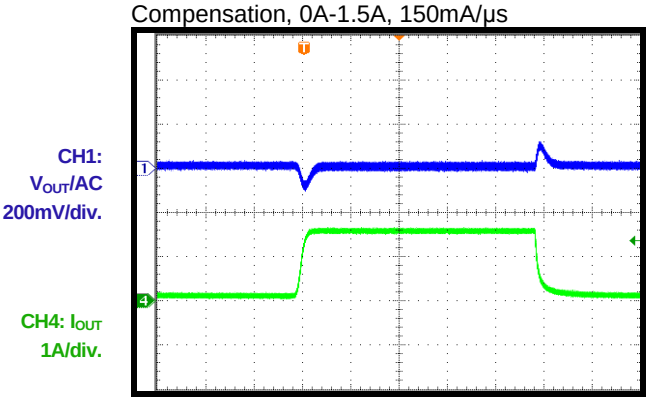
V_{IN}=12V, V_{OUT}=5V, No Line Drop Compensation, 0A-3A, 150mA/µs



400µs/div.

Load Transient

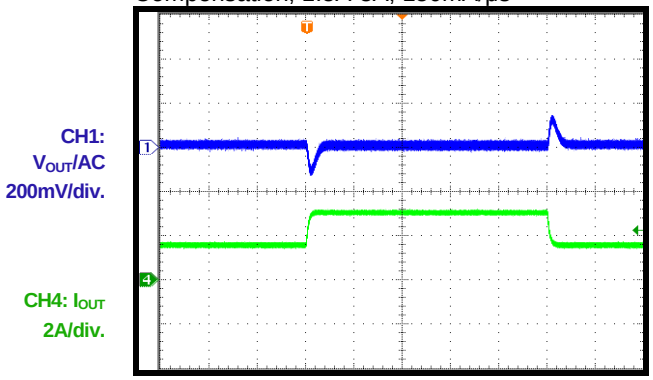
V_{IN}=12V, V_{OUT}=5V, No Line Drop Compensation, 0A-1.5A, 150mA/µs



400µs/div.

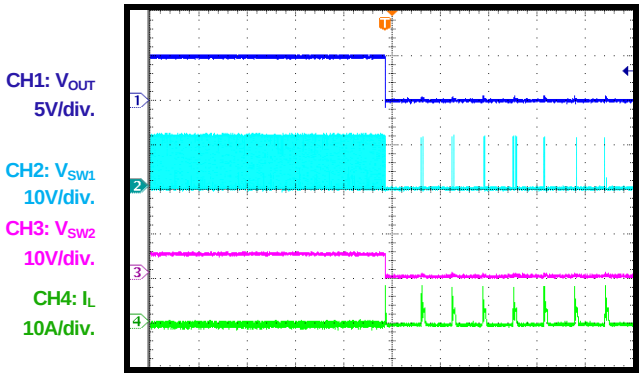
Load Transient

V_{IN}=12V, V_{OUT}=5V, No Line Drop Compensation, 1.5A-3A, 150mA/µs



400µs/div.

SCP Entry with Hiccup Mode

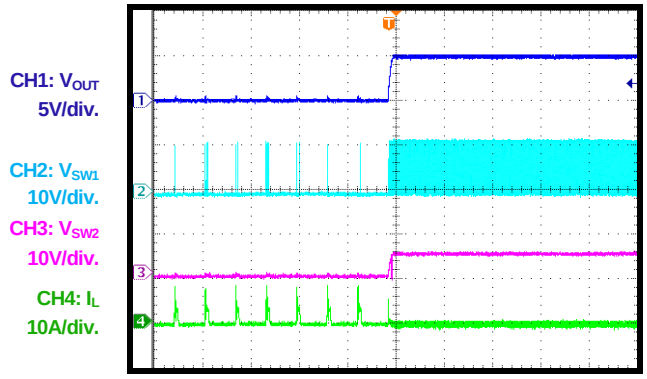


10ms/div.

EVB TEST RESULTS *(continued)*

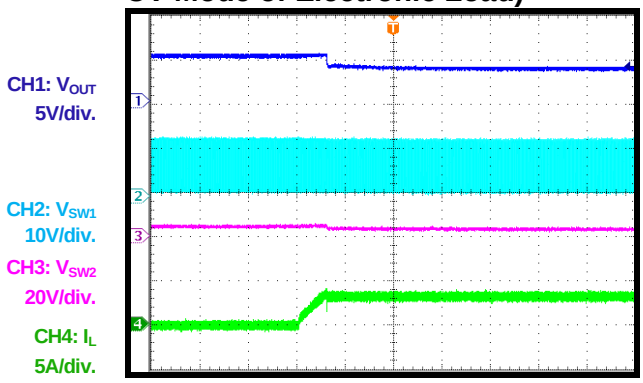
Performance waveforms are tested on the evaluation board.
V_{IN} = 12V, V_{OUT} = 5V, T_A = 25°C, unless otherwise noted.

SCP Recovery with Hiccup Mode



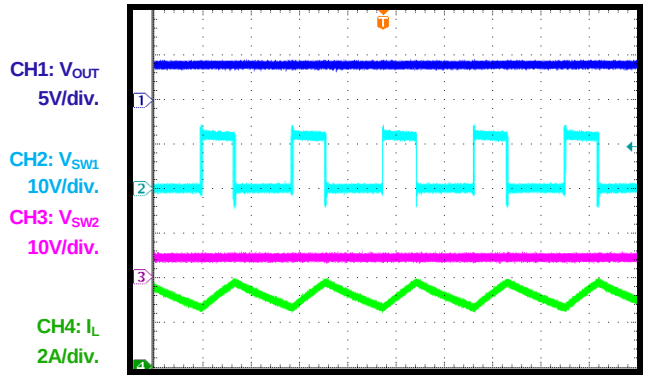
10ms/div.

CC Current Limit Entry (Test with CV Mode of Electronic Load)



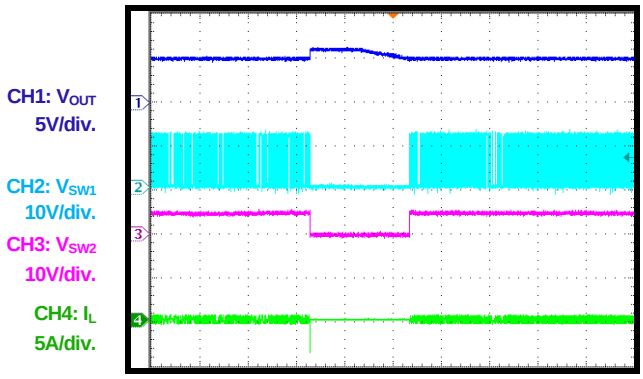
10ms/div.

CC Current Limit Steady State



1µs/div.

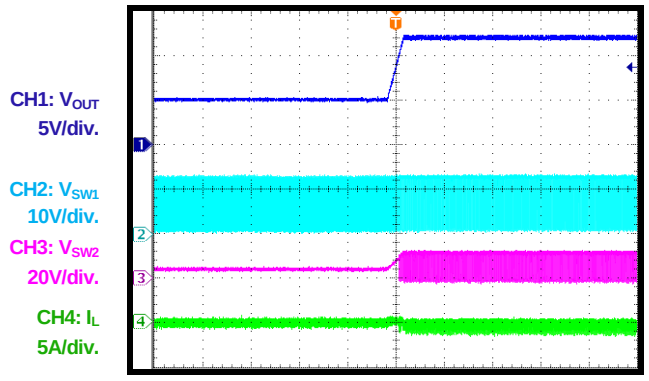
VOUT OVP with Hiccup Mode



1s/div.

I2C VID

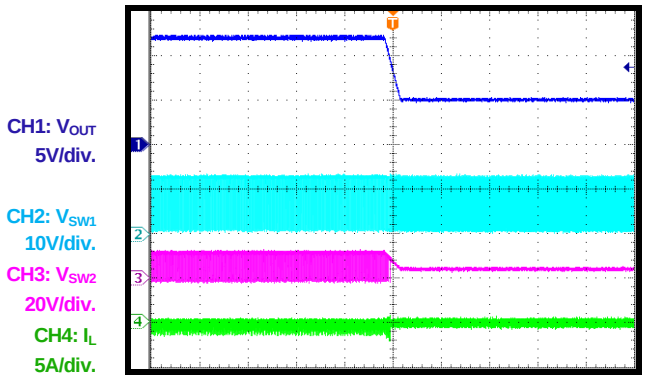
V_{OUT}=5V to 12V, I_{OUT}=0A



20ms/div.

I2C VID

V_{OUT}=12V to 5V, I_{OUT}=0A



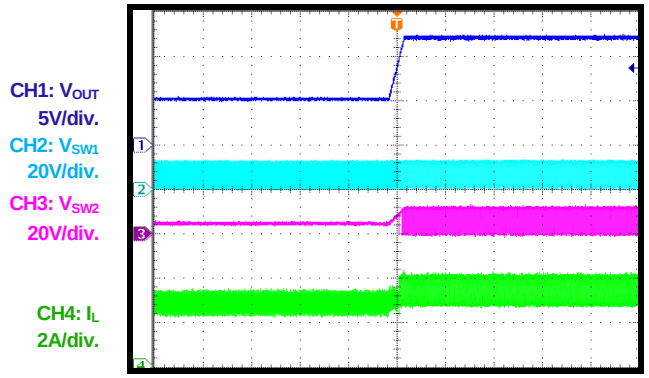
20ms/div.

EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.
V_{IN} = 12V, V_{OUT} = 5V, T_A = 25°C, unless otherwise noted.

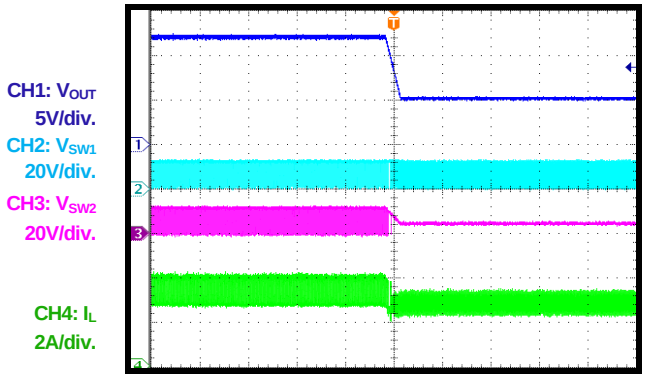
I2C VID

V_{OUT}=5V to 12V, I_{OUT}=3A



I2C VID

V_{OUT}=12V to 5V, I_{OUT}=3A



PRINTED CIRCUIT BOARD LAYOUT

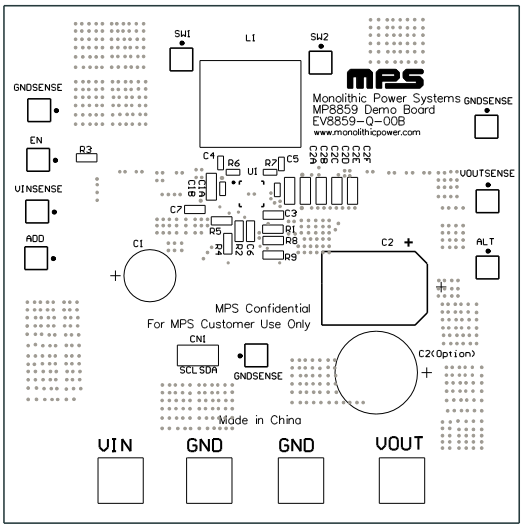


Figure 1—Top Silk Layer

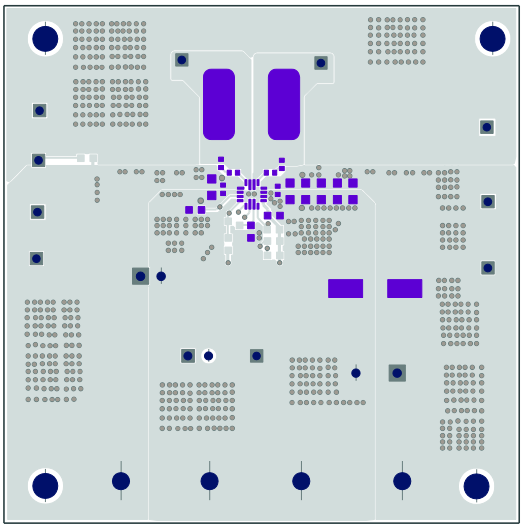


Figure 2—Top Layer

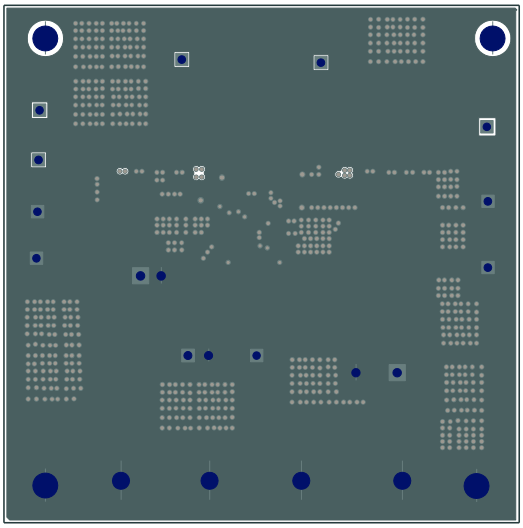


Figure 3—Mid 1 Layer

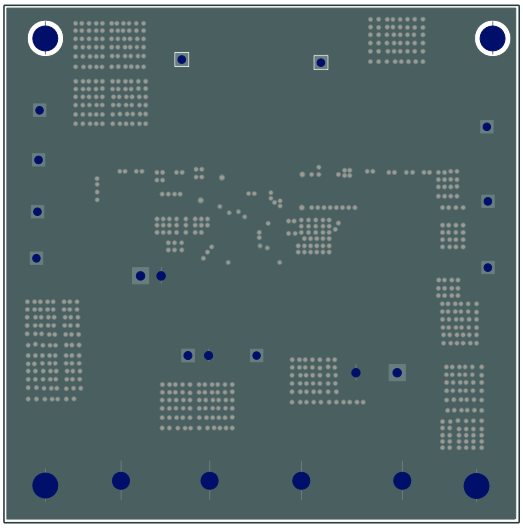


Figure 4—Mid 2 Layer

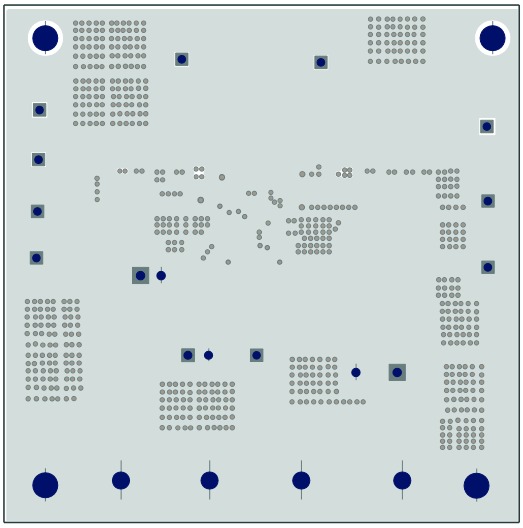


Figure 5—Bottom Layer

QUICK START GUIDE

1. Connect the positive and negative terminals of the load to the Vout and GND pins, respectively.
2. Preset the power supply output 12V, and then turn off the power supply.
3. Connect the positive and negative terminals of the power supply output to the VIN and GND pins, respectively.
4. Turn the power supply on, the board will automatically start up with default settings. The related parameters (refer to datasheet) can be changed by I2C connection.