EVL28167-N-Q-00A

2.8V to 22V, 3A, 4-Switch, Integrated Buck-Boost Converter with PG Indication Evaluation Board

DESCRIPTION

The EVL28167-N-Q-00A is an evaluation board designed to demonstrate the capabilities of the MP28167-N, a high-efficiency, synchronous buck-boost converter with four integrated power switches and an I^2C interface. The device can regulate output voltages across a wide 2.8V to 22V input voltage (V_{IN}) supply range.

The MP28167-N's integrated output voltage (V_{OUT}) scaling and configurable output current (I_{OUT}) limiting functions are ideal for USB power delivery (PD) applications.

In buck mode, the MP28167-N uses constant on-time (COT) control. In boost mode, it uses constant-off-time control. This provides fast load transient response and a smooth buck-boost mode transient. The MP28167-N features automatic pulse-frequency modulation (PFM) and pulse-width modulation (PWM) modes, forced PWM mode, as well as configurable constant current (CC) limiting and soft start (SS). These features provide flexible design options for different applications.

The MP28167-N requires a minimal number of readily available, standard external components, and is available in a QFN-16 (3mmx3mm) package.

PERFORMANCE SUMMARY (1)

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

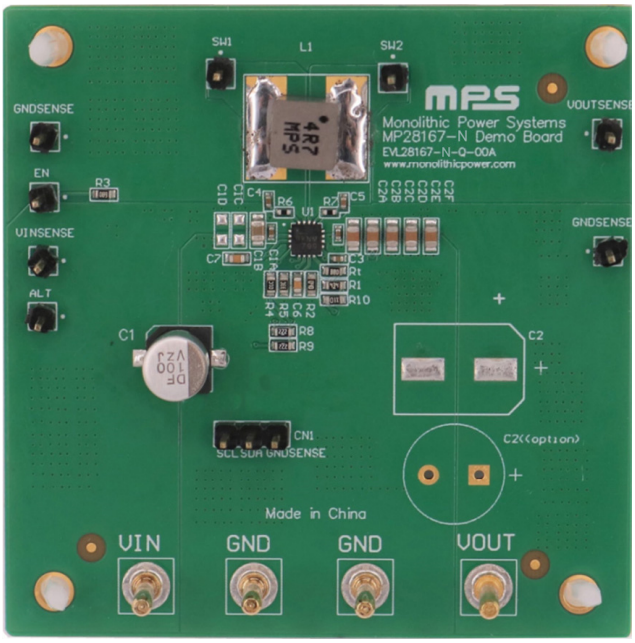
Parameters	Conditions	Value
Operating input voltage (V_{IN})		2.8V to 22V
Switching frequency (f_{SW})	Configured by register 04h, bits[3:2]	500kHz, 750kHz, 1MHz, or 1.25MHz
Output voltage (V_{OUT})	Determined by R1, R2, R_T, and register 00h, bits[2:0] + register 01h, bits[7:0] (1)	1V to 20.47V
Output current (I_{OUT})		3A continuous current or 4A input current

Note:

1) Refer to the MP28167-N datasheet for more details.

MPL Optimized Performance with MPS Inductor MPL5030 Series

EVL28167-N-Q-00A EVALUATION BOARD



LxW (6.35cmx6.35cm)

Board Number	MPS IC Number
EVL28167-N-Q-00A	MP28167GQ-N

QUICK START GUIDE

1. Connect the load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): GND
2. Preset the power supply output to 12V, then turn off the power supply.
3. Connect the power supply output terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
4. After making the connections, turn on the power supply. The board should automatically start up with its default settings. The related parameters can be changed via the I²C. (2)

Note:

2) Refer to the MP28167-N datasheet for more details.

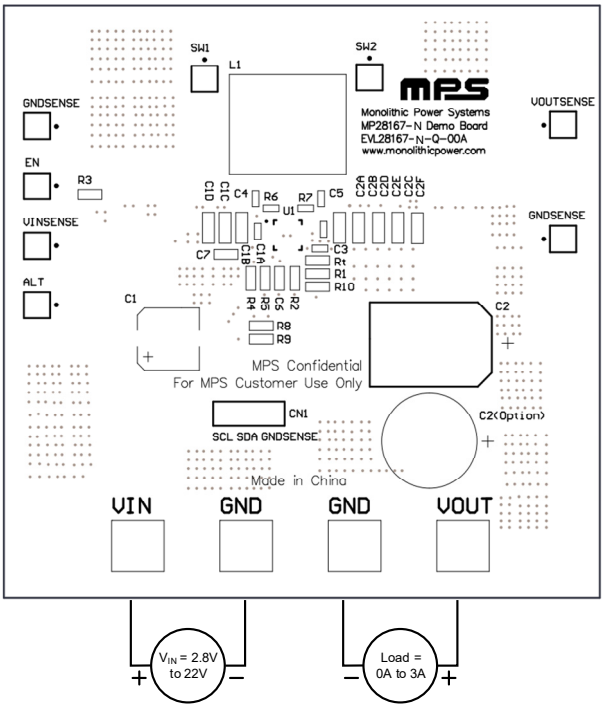


Figure 1: Measurement Equipment Set-Up

EVALUATION BOARD SCHEMATIC

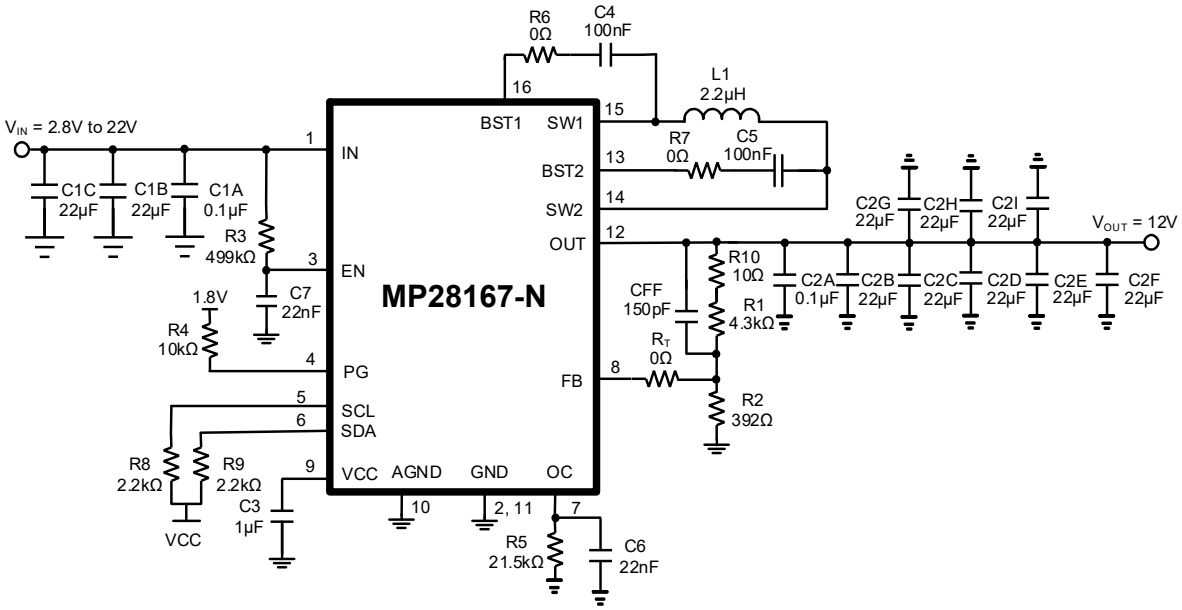


Figure 2: Evaluation Board Schematic

EV28167-N-Q-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
10	C2A, C1B, C2B, C1C, C2C, C2D, C2E, C2F, C2G, C2H	22µF	Ceramic capacitor, 25V, X5R	0805	TDK	C2012X5R1E226M
1	C3	1µF	Ceramic capacitor, 16V, X6S	0402	Murata	GRM155C81C105KE11D
4	C1A, C2A, C4, C5	100nF	Ceramic capacitor, 50V, X7R	0402	Samsung	CL05B104KB5NNNC
2	C6, C7	22nF	Ceramic capacitor, 50V, X5R	0603	Murata	GRM188R71H223KA01D
1	CFF	150pF	Ceramic capacitor, 50V, X5R	0603	Murata	GRM1885C1H151JA01D
1	R3	499kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07499KL
1	R5	21.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0721K5RL
1	R4	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	R1	4.3kΩ	Film resistor, 1%	603	Yageo	RC0603FR-07430KL
2	R8, R9	2.2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-072K2L
1	R2	392Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07107KL
1	R10	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
2	R6, R7	0Ω	Film resistor, 1%	0402	Yageo	RC0402FR-070RL
1	R_T	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07806KL
1	CN1	2.54mm	Test pin, 1x3-pin	DIP	Wurth	61300311121
1	L1' (3)	2.2µH	Inductor, R_{DC} = 12mΩ, I_{SAT} = 14A	SMD	Wurth	74437349022
1	L1	2.2µH	Inductor, R_{DC} = 12.3mΩ, I_{SAT} = 11A	SMD	MPS	MPL-AL5030-2R2
1	U1	MP28167-N	22V, 3A, 4-switch, integrated buck-boost converter with PG indication	QFN-16 (3mmx 3mm)	MPS	MP28167GQ-N

Note:

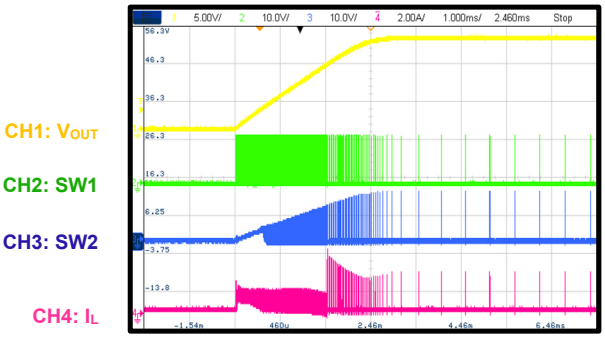
3) L1' indicates the backup inductor for L1. L1 is recommended for most applications.

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 12V, L = 2.2µH, f_{SW} = 1MHz, T_A = 25°C, unless otherwise noted.

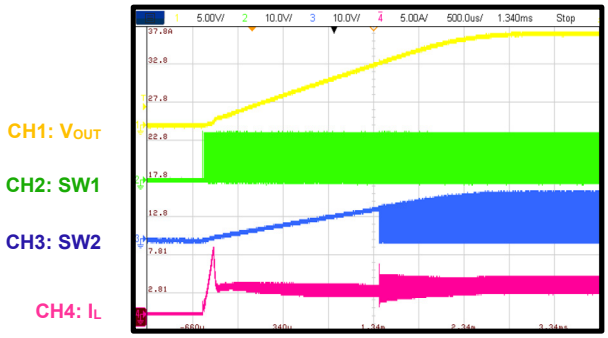
Start-Up through EN via I²C Command

Load = 0A



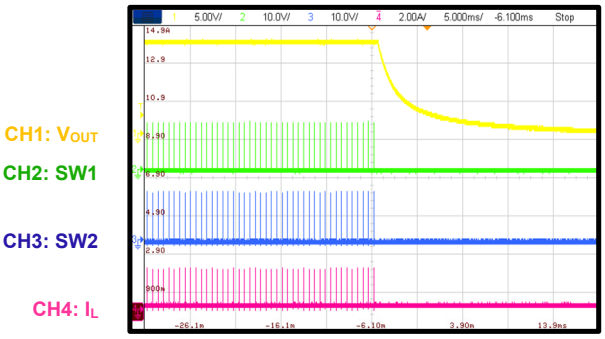
Start-Up through EN via I²C Command

Load = 3A



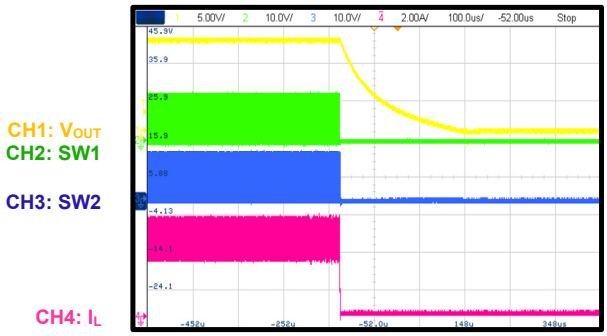
Shutdown through EN via I²C Command

Load = 0A



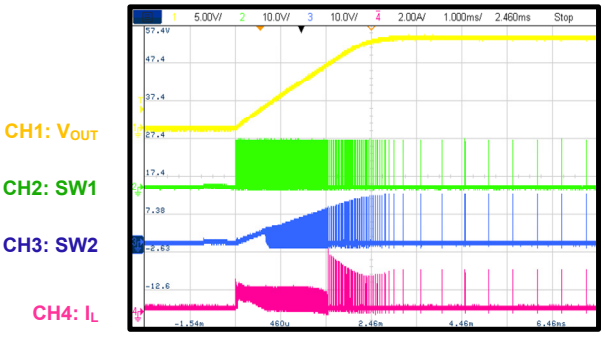
Shutdown through EN via I²C Command

Load = 3A



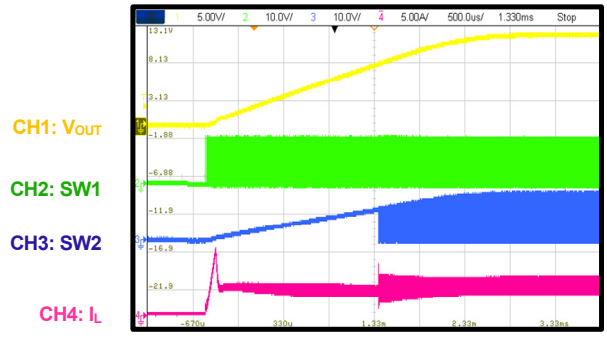
Start-Up through EN

Load = 0A



Start-Up through EN

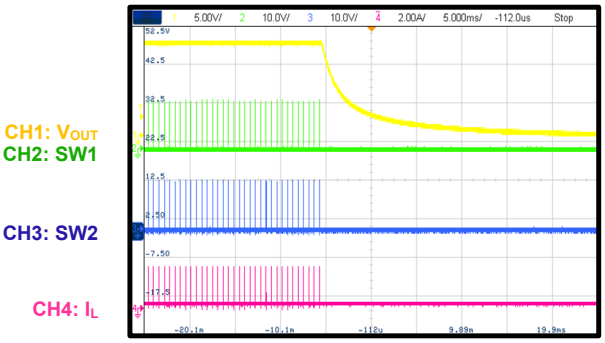
Load = 3A



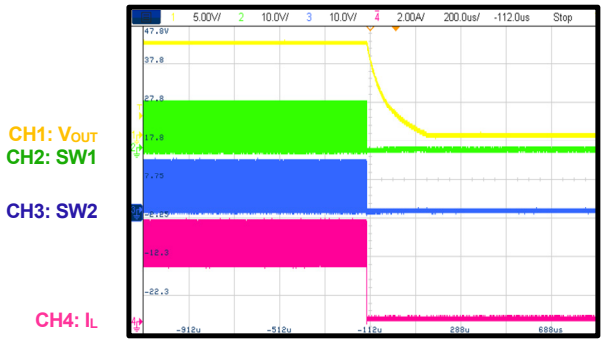
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 12V, L = 2.2µH, f_{SW} = 1MHz, T_A = 25°C, unless otherwise noted.

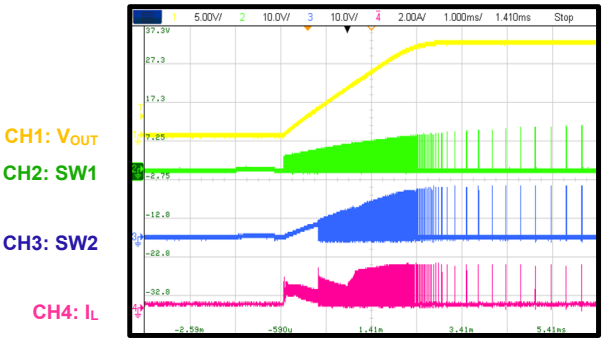
Shutdown through EN
Load = 0A



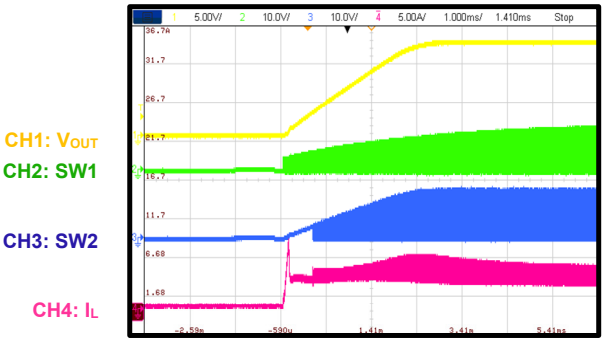
Shutdown through EN
Load = 3A



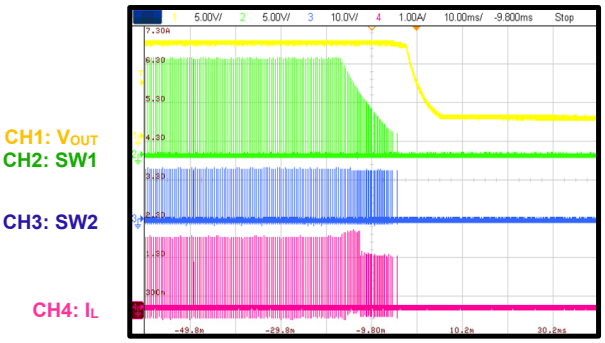
Start-Up through VIN
Load = 0A



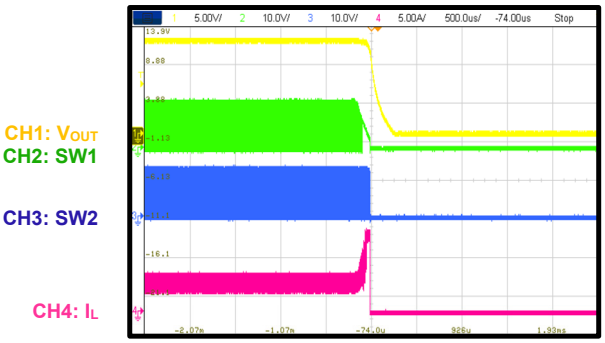
Start-Up through VIN
Load = 3A



Shutdown through VIN
Load = 0A



Shutdown through VIN
Load = 3A

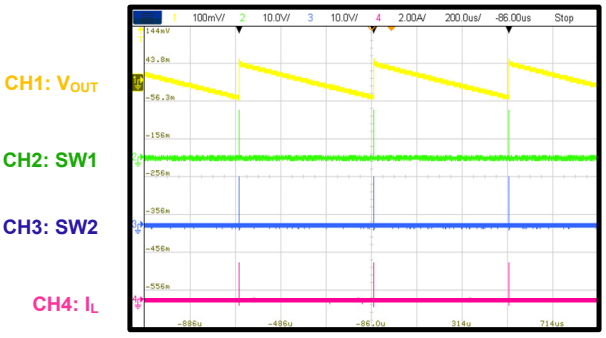


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 12V, L = 2.2µH, f_{SW} = 1MHz, T_A = 25°C, unless otherwise noted.

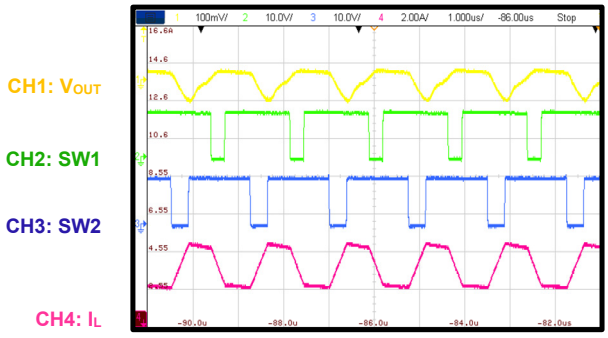
Steady State (Automatic PFM/PWM Mode)

V_{OUT} = 12V, load = 0A, f_{SW} = 1MHz



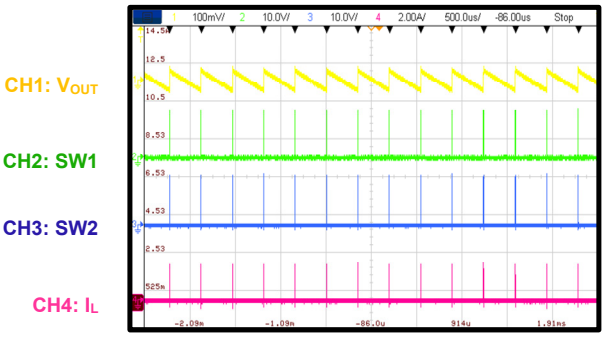
Steady State (Automatic PFM/PWM Mode

V_{OUT} = 12V, load = 3A, f_{SW} = 1MHz



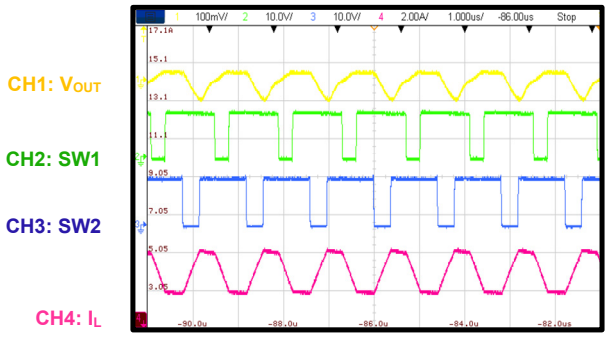
Steady State (Automatic PFM/PWM Mode)

V_{OUT} = 12V, load = 0A, f_{SW} = 1.25MHz



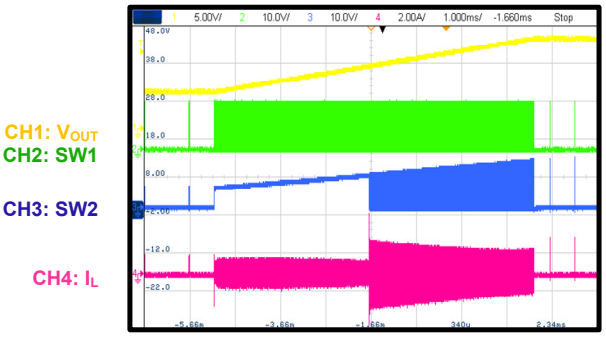
Steady State (Automatic PFM/PWM Mode)

V_{OUT} = 12V, load = 3A, f_{SW} = 1.25MHz



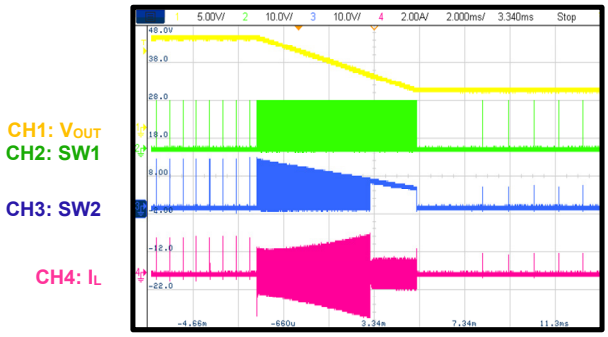
I²C VID

V_{OUT} = 5V to 12V, I_{OUT} = 0A, R1 = 4.3kΩ, R2 = 392kΩ



I²C VID

V_{OUT} = 12V to 5V, I_{OUT} = 3A, R1 = 4.3kΩ, R2 = 392kΩ

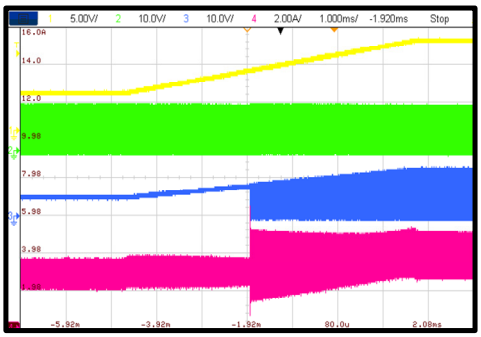


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 12V, L = 2.2µH, f_{SW} = 1MHz, T_A = 25°C, unless otherwise noted.

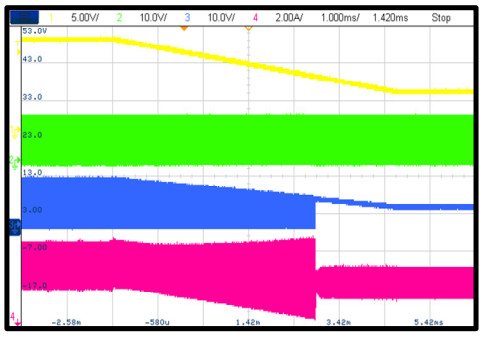
I²C VID

V_{OUT} = 5V to 12V, I_{OUT} = 0A, R1 = 4.3kΩ, R2 = 392kΩ



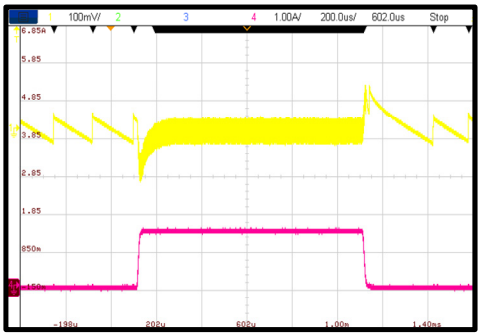
I²C VID

V_{OUT} = 12V to 5V, I_{OUT} = 3A, R1 = 4.3kΩ, R2 = 392kΩ



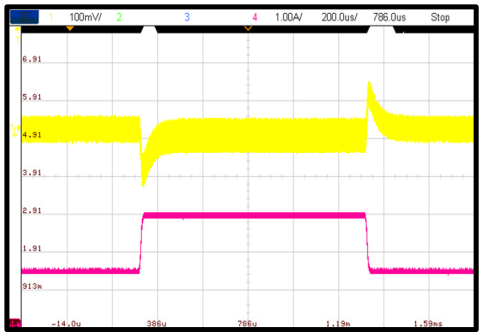
Load Transient

V_{IN} = 12V, V_{OUT} = 12V, no line drop compensation, 0A to 1.5A, 150mA/µs

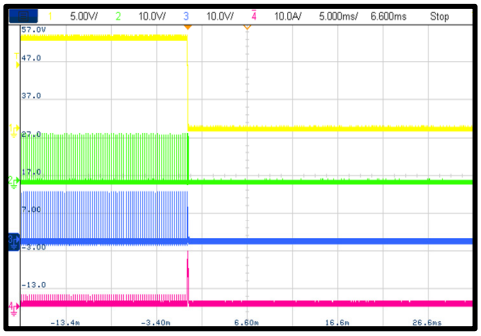


Load Transient

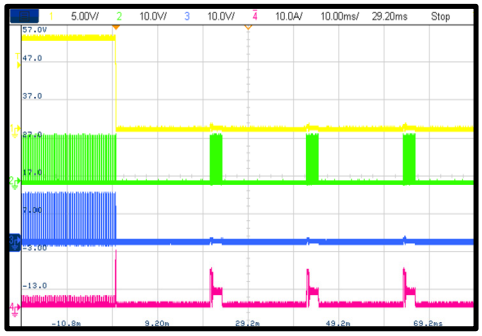
V_{IN} = 12V, V_{OUT} = 12V, no line drop compensation, 1.5A to 3A, 150mA/µs



SCP Entry in Latch-Off Mode



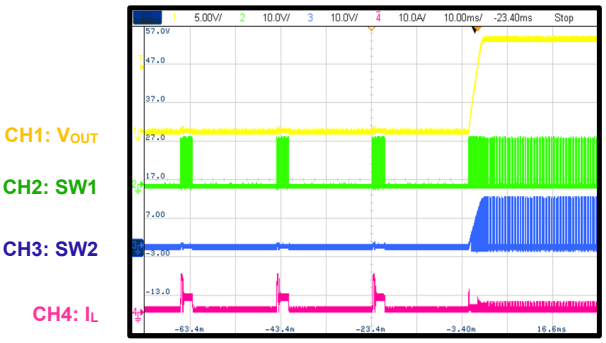
SCP Entry in Hiccup Mode



EVB TEST RESULTS *(continued)*

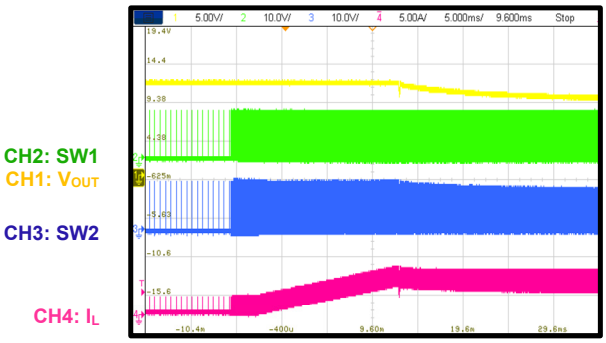
Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 12V, L = 2.2µH, f_{SW} = 1MHz, T_A = 25°C, unless otherwise noted.

SCP Recovery in Hiccup Mode

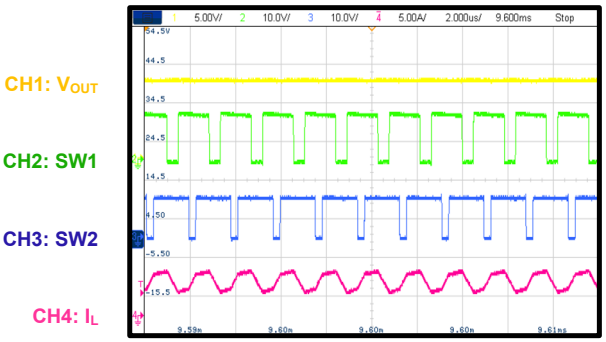


CC Limit Entry

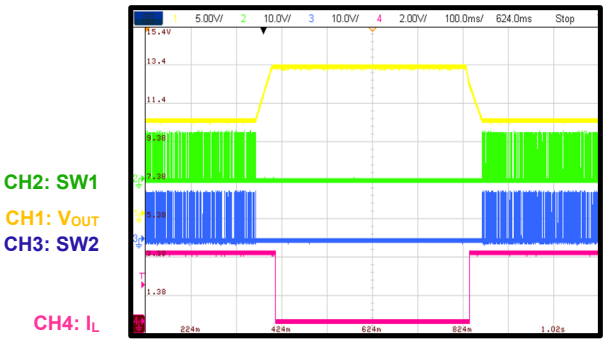
Tested in constant voltage (CV) mode on an electronic load



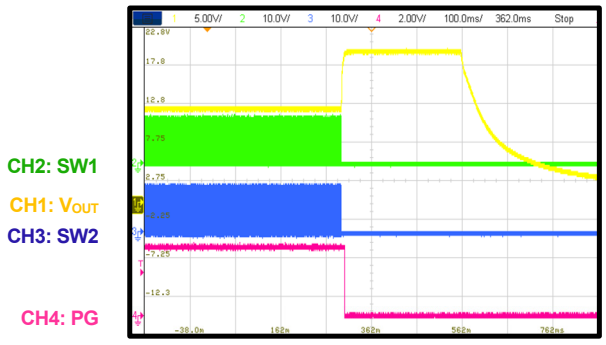
CC Limit Steady State



VOUT OVP in Hiccup Mode



VOUT OVP in Latch-Off Mode

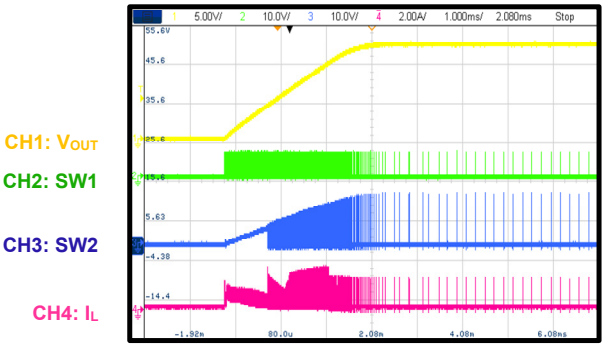


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 6V, V_{OUT} = 12V, L = 2.2µH, f_{SW} = 1MHz, T_A = 25°C, unless otherwise noted.

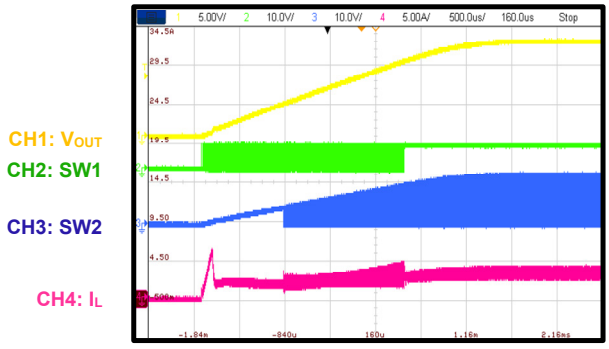
Start-Up through EN via I²C Command

Load = 0A



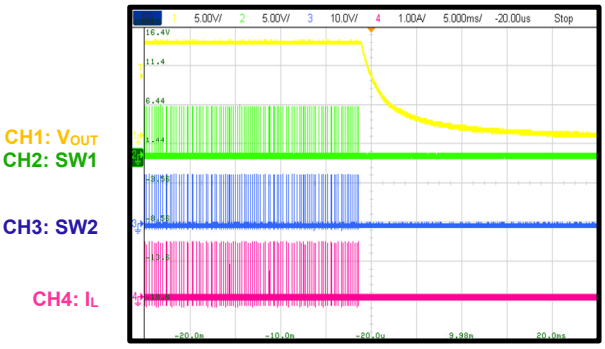
Start-Up through EN via I²C Command

Load = 1.4A



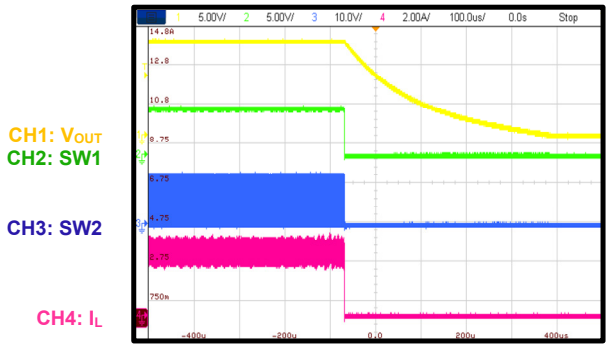
Shutdown through EN via I²C Command

Load = 0A



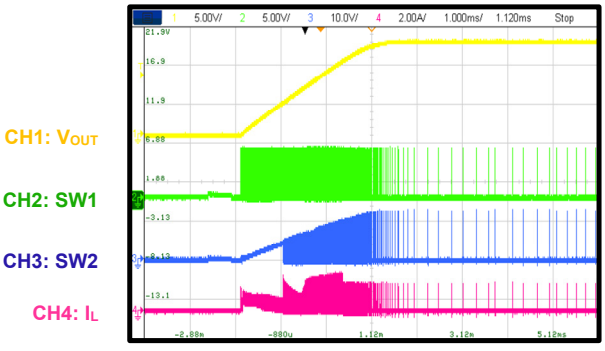
Shutdown through EN via I²C Command

Load = 1.4A



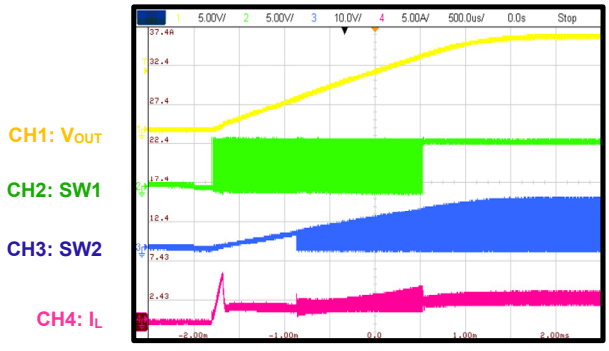
Start-Up through EN

Load = 0A



Start-Up through EN

Load = 1.4A

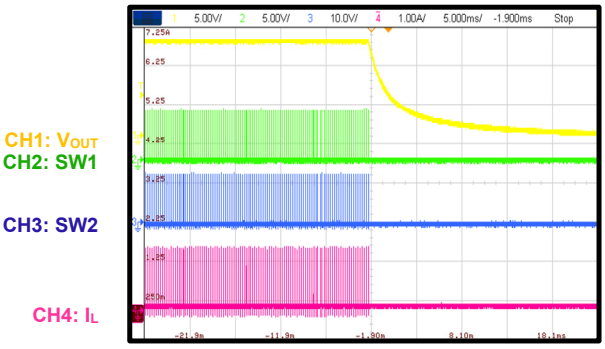


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 6V, V_{OUT} = 12V, L = 2.2µH, f_{SW} = 1MHz, T_A = 25°C, unless otherwise noted.

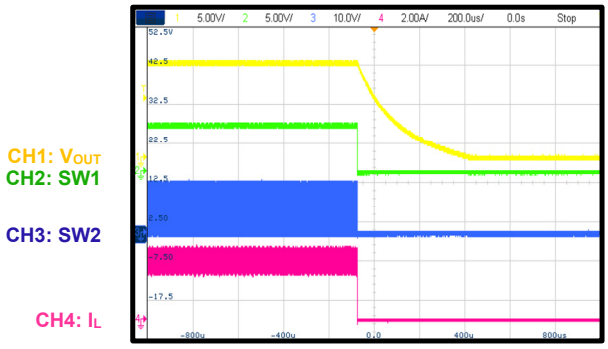
Shutdown through EN

Load = 0A



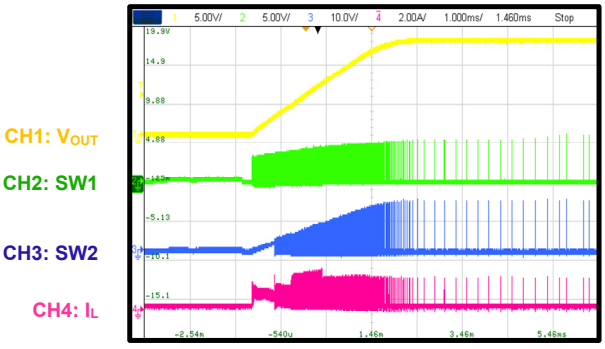
Shutdown through EN

Load = 1.4A



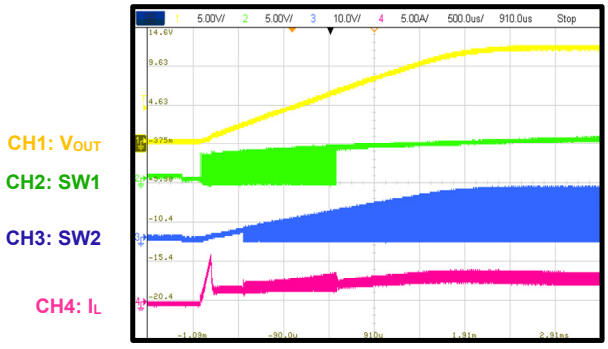
Start-Up through VIN

Load = 0A



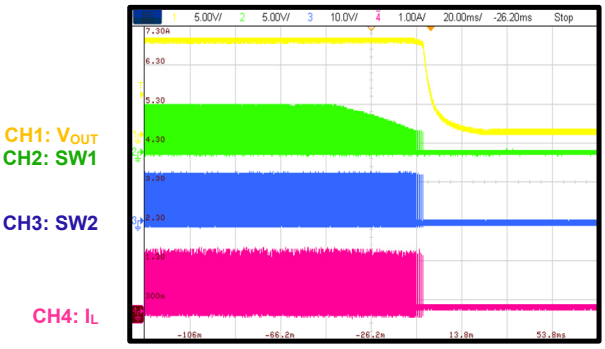
Start-Up through VIN

Load = 1.4A



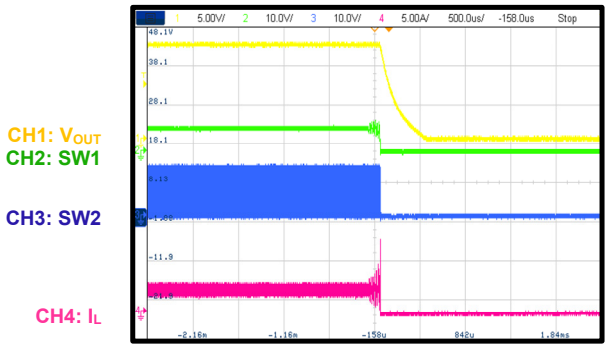
Shutdown through VIN

Load = 0A



Shutdown through VIN

Load = 1.4A

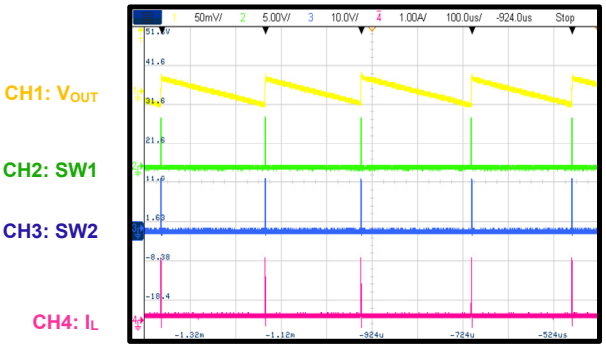


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 6V, V_{OUT} = 12V, L = 2.2µH, f_{SW} = 1MHz, T_A = 25°C, unless otherwise noted.

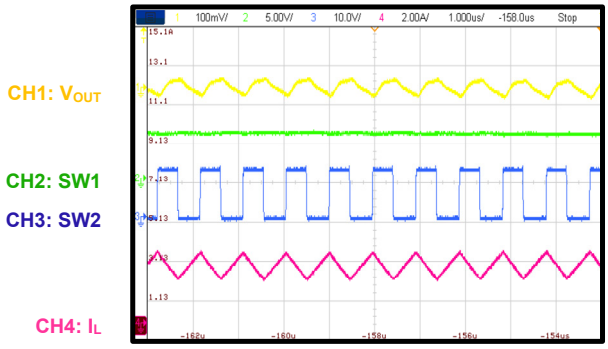
Steady State (Automatic PFM/PWM Mode)

V_{OUT} = 12V, load = 0A, f_{SW} = 1MHz



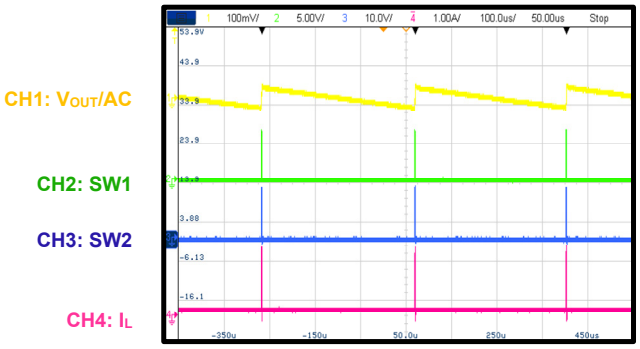
Steady State (Automatic PFM/PWM Mode)

V_{OUT} = 12V, load = 1.4A, f_{SW} = 1MHz



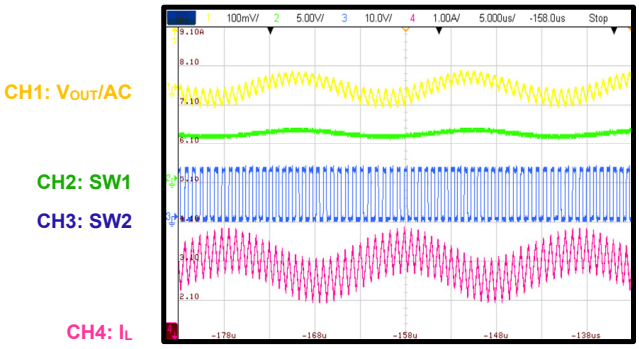
Steady State (Automatic PFM/PWM Mode)

V_{OUT} = 12V, load = 0A, f_{SW} = 1.25MHz



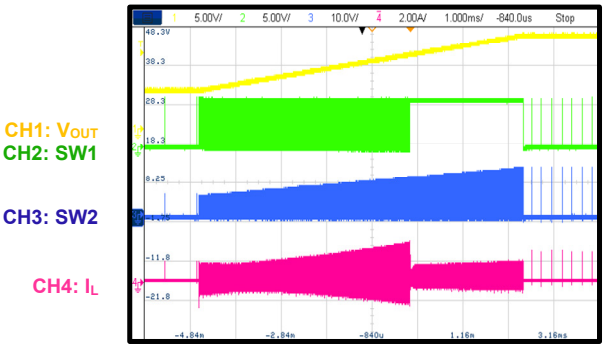
Steady State (Automatic PFM/PWM Mode)

V_{OUT} = 12V, load = 1.4A, f_{SW} = 1.25MHz



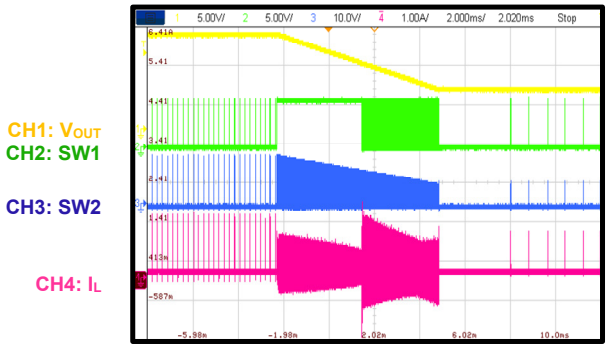
I²C VID

V_{OUT} = 5V to 12V, I_{OUT} = 0A, R1 = 4.3kΩ, R2 = 392kΩ



I²C VID

V_{OUT} = 12V to 5V, I_{OUT} = 0A, R1 = 4.3kΩ, R2 = 392kΩ

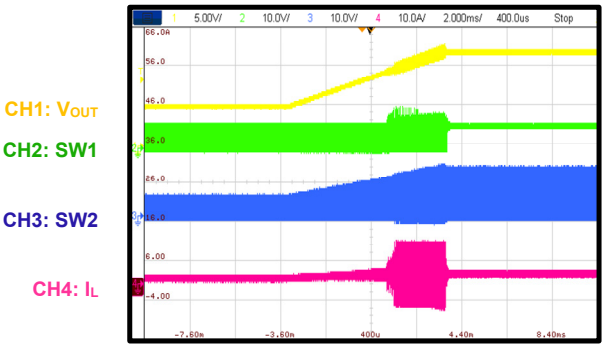


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 6V, V_{OUT} = 12V, L = 2.2µH, f_{SW} = 1MHz, T_A = 25°C, unless otherwise noted.

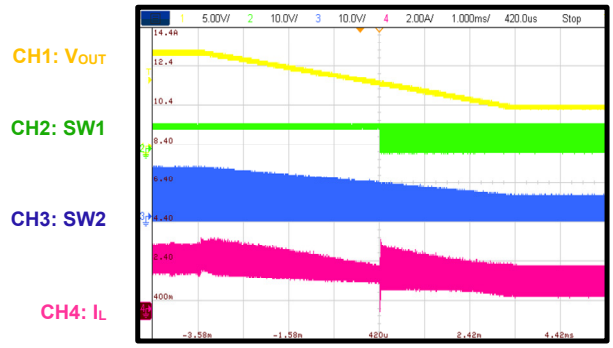
I²C VID

V_{OUT} = 5V to 12V, I_{OUT} = 1.2A, R1 = 4.3kΩ, R2 = 392kΩ



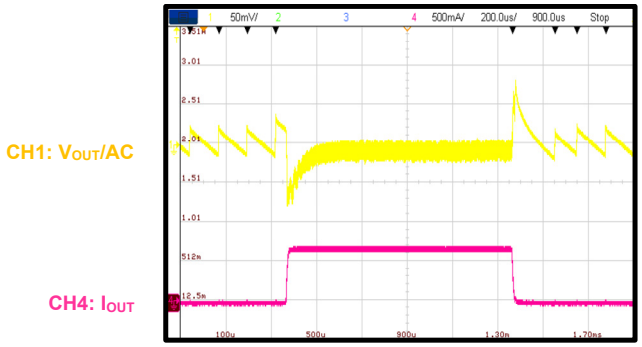
I²C VID

V_{OUT} = 12V to 5V, I_{OUT} = 1.2A, R1 = 4.3kΩ, R2 = 392kΩ



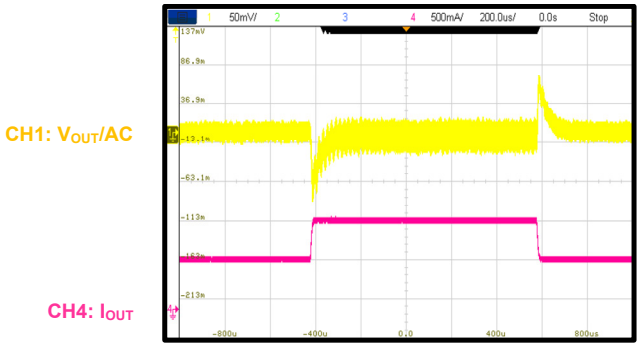
Load Transient

V_{IN} = 12V, V_{OUT} = 12V, no line drop compensation, 0A to 0.7A, 150mA/µs

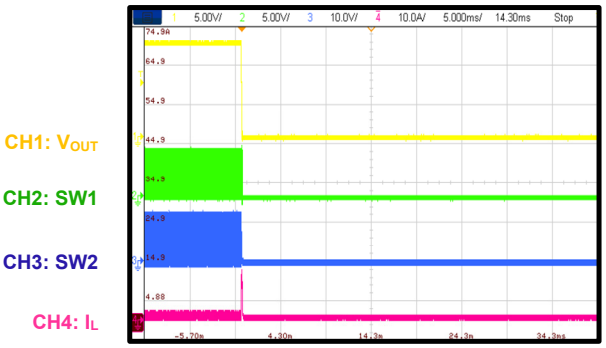


Load Transient

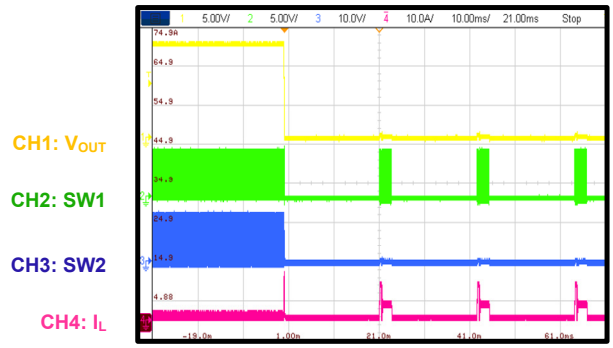
V_{IN} = 12V, V_{OUT} = 12V, no line drop compensation, 0.7A to 1.4A, 150mA/µs



SCP Entry in Latch-Off Mode



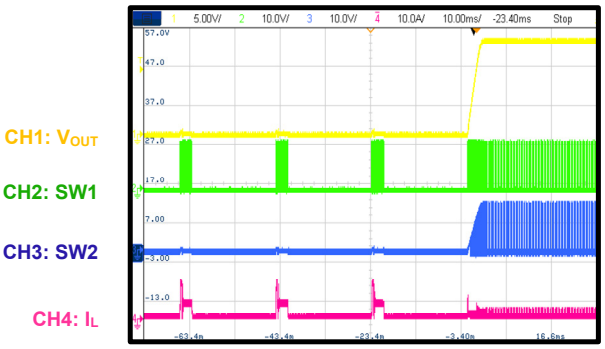
SCP Entry in Hiccup Mode



EVB TEST RESULTS *(continued)*

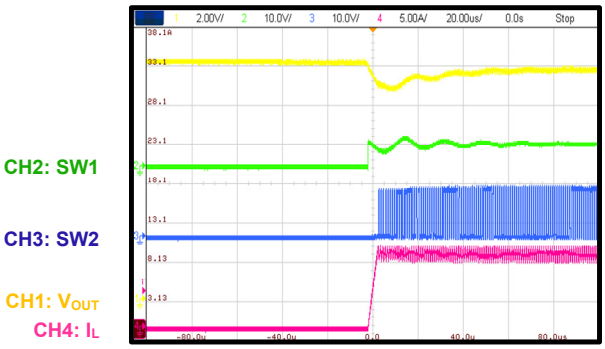
Performance curves and waveforms are tested on the evaluation board. V_{IN} = 6V, V_{OUT} = 12V, L = 2.2µH, f_{SW} = 1MHz, T_A = 25°C, unless otherwise noted.

SCP Recovery in Hiccup Mode

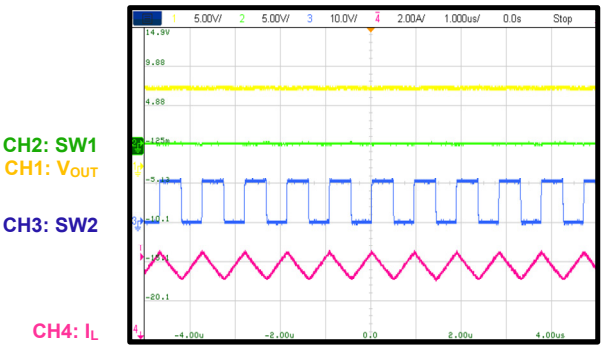


CC Limit Entry

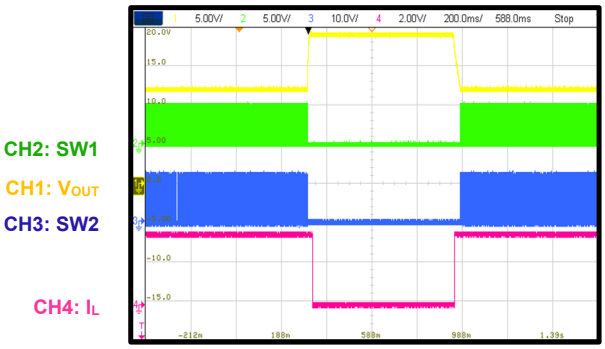
Tested in constant resistance (CR) mode on an electronic load



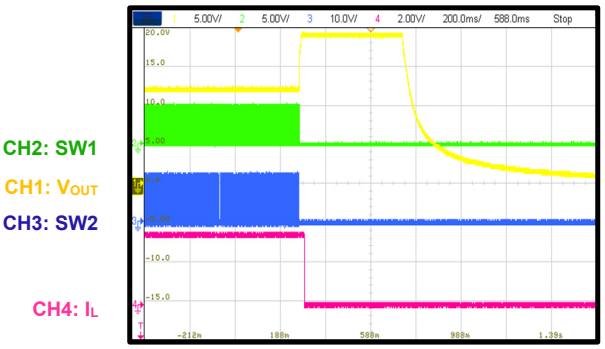
CC Limit Steady State



V_{OUT} OVP in Hiccup Mode



V_{OUT} OVP in Latch-Off Mode



PCB LAYOUT

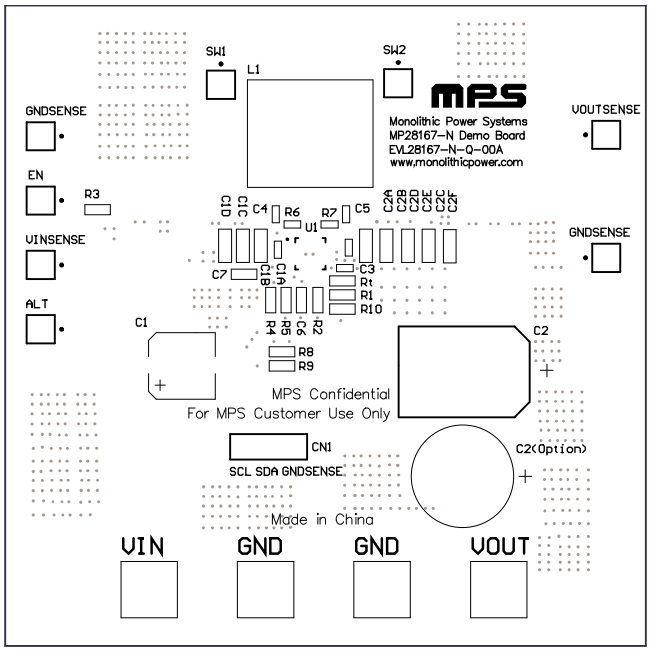


Figure 3: Top Silk

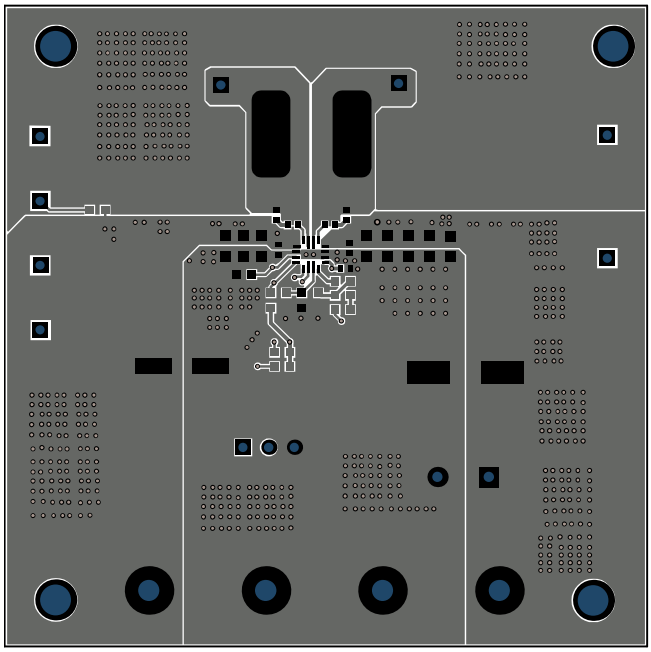


Figure 4: Top Layer

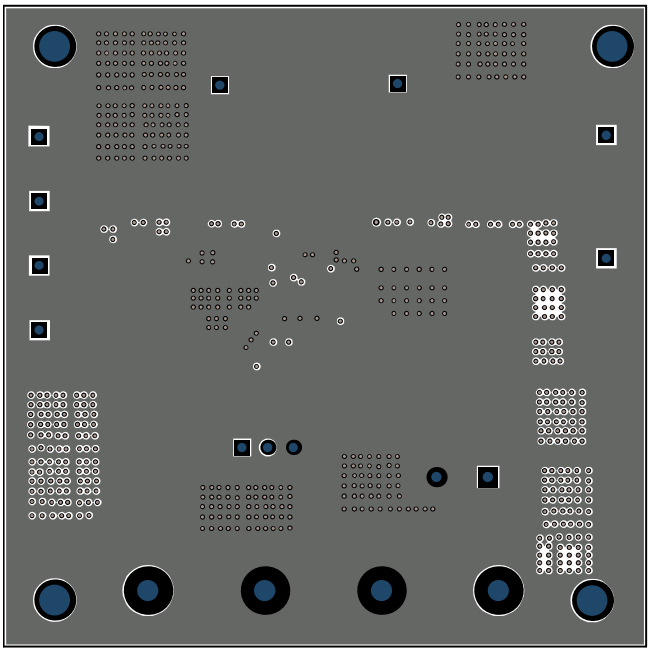


Figure 5: Mid-Layer 1

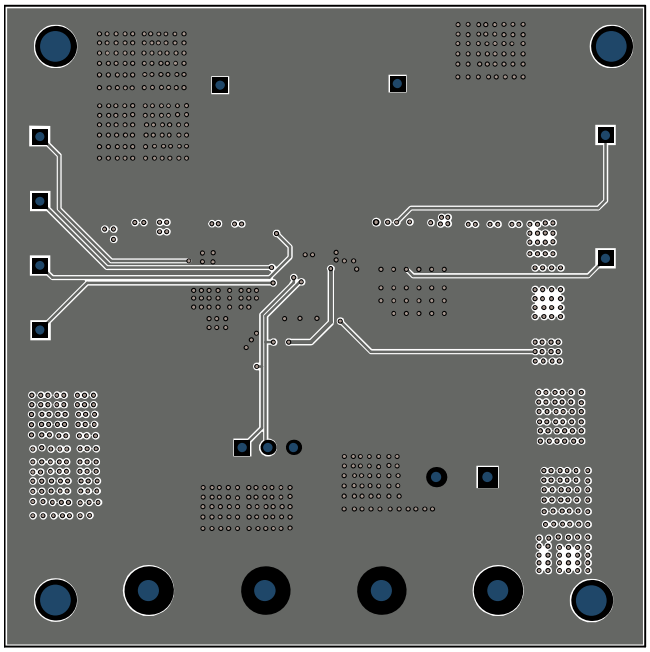


Figure 6: Mid-Layer 2

PCB LAYOUT *(continued)*

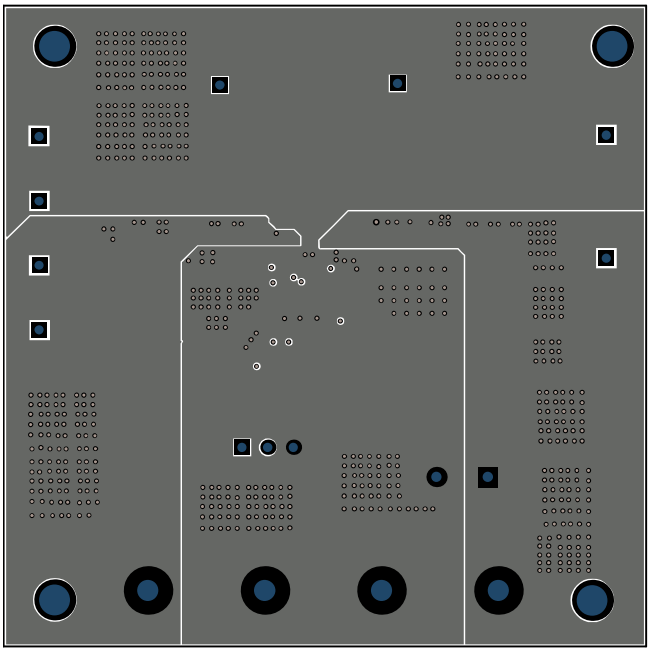


Figure 7: Bottom Layer

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	5/8/2023	Initial Release	-