EVQ5873-RP-00A

36V, 3A, Single-Channel, 60mΩ, Smart High-Side Load Switch Evaluation Board, AEC-Q100 Qualified

DESCRIPTION

The EVQ5873-RP-00A is an evaluation board designed to demonstrate the capabilities of the MPQ5873, a smart high-side power switch for nominal 3A loads. It can support a wide 3.5V to 36V input voltage (V_{IN}) range.

The MPQ5873 supports both an internal and configurable, high-accuracy external current limit. This helps clamp the inrush current under short-circuit conditions, which improves system reliability. An adjustable start-up slew rate also helps to reduce inrush current during start-up.

The FT/CS pin provides high-accuracy current sensing, which achieves accurate real-time diagnostics without additional calibration. The voltage on the FT/CS pin (V_{CS}) represents 1 / K_{CS} of the load current (I_{LOAD}), where K_{CS} is a constant value across the temperature and supply voltage ranges. The FT/CS pin can report faults by pulling up its voltage.

The MPQ5873 provides full diagnostics during both on and off states. By pulling the DIAG_EN pin up or down, off state open-load detection and short to battery detection can enabled or disabled. If off state diagnostics are not required in the system, the function can be disabled to reduce the standby current by connecting the DIAG_EN and GND pins.

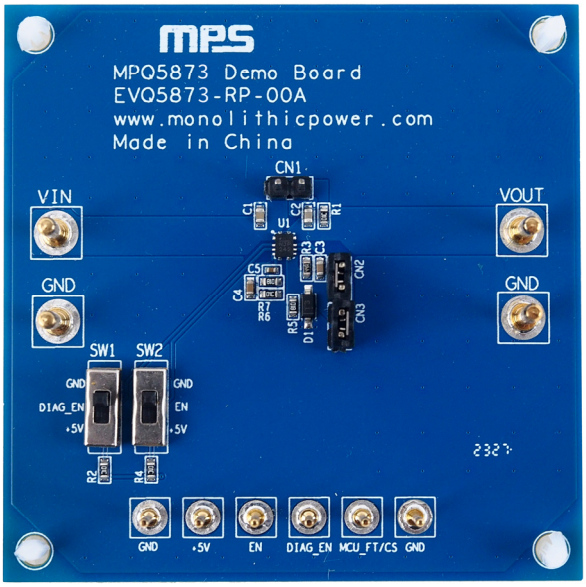
The MPQ5873 is available in a QFN-8 (2mmx2.5mm) package. It is available in AEC-Q100 Grade 1 and is compliant with AEC-Q100-012 Test Grade A.

PERFORMANCE SUMMARY

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

Parameters	Conditions	Value
Recommended continuous supply voltage		5V to 36V
Full input voltage (V_{IN}) range		3.5V to 36V
Maximum V_{IN} range for short-circuit protection (SCP)		24V
Maximum output current (I_{OUT})		3A

EVQ5873-RP-00A EVALUATION BOARD



LxWxH (6.3cmx6.3cmx1cm)

Board Number	MPS IC Number
EVQ5873-RP-00A	MPQ5873GRPE-AEC1

QUICK START GUIDE

1. Preset the power supply (V_{IN}) between 5V and 36V, then turn the power supply off.
2. Electronic loads represent a negative impedance to the regulator, and setting a current too high may trigger over-current protection (OCP).
3. Do not use constant-current (CC) load mode for the electronic load. This may result in excessive heat on the integrated MOSFET, which can damage the IC.
4. Select a proper current limit that can support the load current (I_{LOAD}) during start-up. For more details on setting up the current limit, refer to the Electrical Characteristics as well as the Internal Current Limit and Configurable External Current Limit sections in the MPQ5873 datasheet.

   The current-limit resistance (R_{CL}) can be calculated with Equation (1):

$$R_{CL} = \frac{K_{CL} \times V_{TH\_LIM}}{I_{CL}} \quad (1)$$

   Where R_{CL} is in Ω, V_{TH_LIM} is 0.7V, K_{CL} is 1000, and I_{CL} is the expected current limit (in A). If using the internal current, short ILIM to the IC's GND pin via CN2.

5. To use the configurable soft-start function, select a proper soft-start capacitor (C_{SS}). An internal 10μA CC source (I_{SS}) charges C_{SS} and ramps up the voltage on the SS pin (V_{SS}). V_{OUT} follows (V_{SS} x K_{SS}) during the soft-start time (t_{SS}). Typically, K_{SS} is about 16.7.

   The output voltage (V_{OUT}) rising time (t_{VOUT_RISING}) can be estimated with Equation (2):

$$t_{VOUT\_RISING} = \frac{1}{K_{SS}} \times \frac{V_{OUT}(V) \times C_{SS}(nF)}{I_{SS}(\mu A)} \quad (2)$$

6. For more details on standby mode, diagnostic mode, and normal mode, refer to the MPQ5873 datasheet. Figure 1 shows the operation state machine.

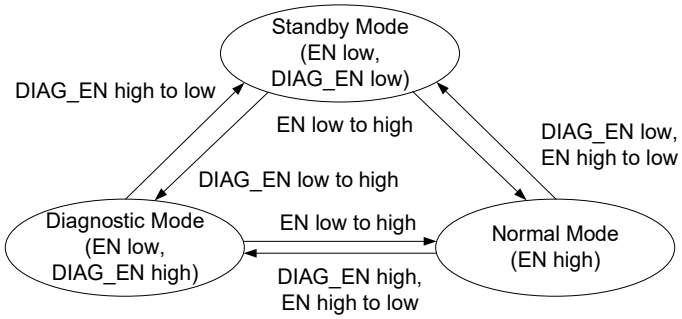


Figure 1: Operation State Machine

7. To use the current-sense (CS) function, select a proper current-sense resistor (R_{CS}) and ensure that the FT/CS pin voltage (V_{CS}) is within a linear range (3V) during normal operation. Remove R_{CS} if the current-sense function is not used.
8. Short CN1 to use off-state open-load detection. For more details, refer to the Open-Load Detection section in the MPQ5873 datasheet.

9. To use the enable function, apply a digital input to the EN pin. Pull EN above the specified threshold (1.2V) to enable the chip. Pull EN below the threshold (1V) to shut down the chip. The EN and DIAG_EN pins can be controlled by SW1 and SW2 if the +5V pin is sourced by a power supply.
10. CN3 is in parallel with a ground network (D1 and R5) to protect the IC from reverse polarity connections or to switch off the inductive load. Short CN3 if the ground network is not needed.
11. Connect the power supply terminals to:
    a. Positive (+): VIN
    b. Negative (-): GND
12. Connect the load terminals to:
    a. Positive (+): VOUT
    b. Negative (-): GND
13. After making the connections, turn the power supply on.
14. Control the device's on/off state using the EN pin.
15. Figure 2 shows the measurement equipment set-up.

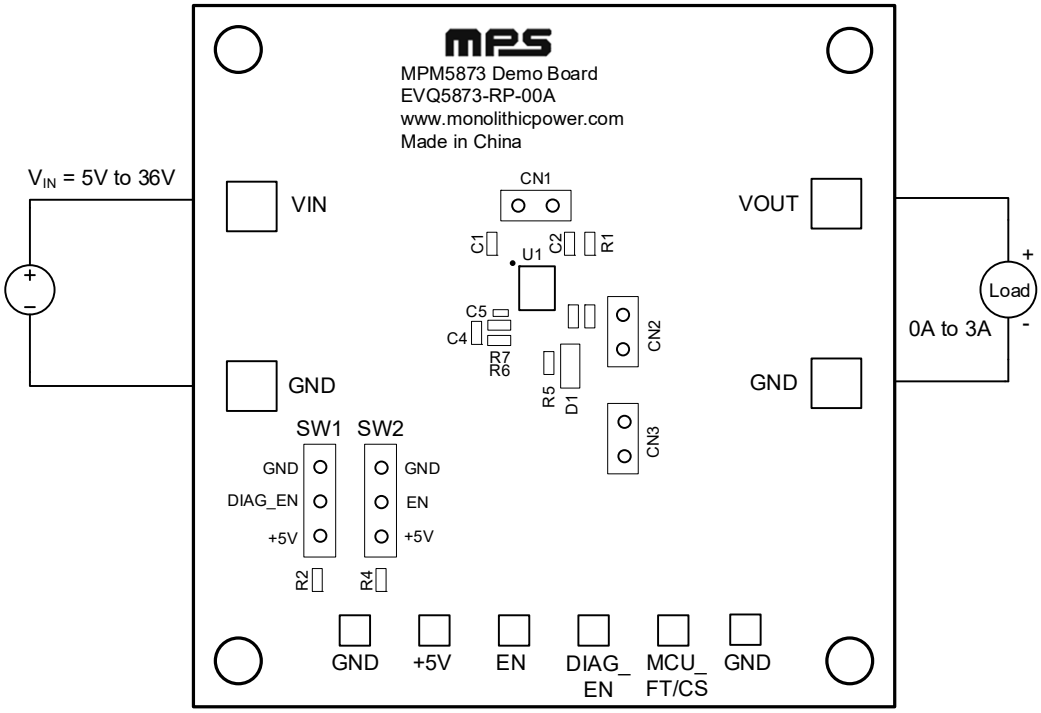


Figure 2: Measurement Equipment Set-Up

EVALUATION BOARD SCHEMATIC

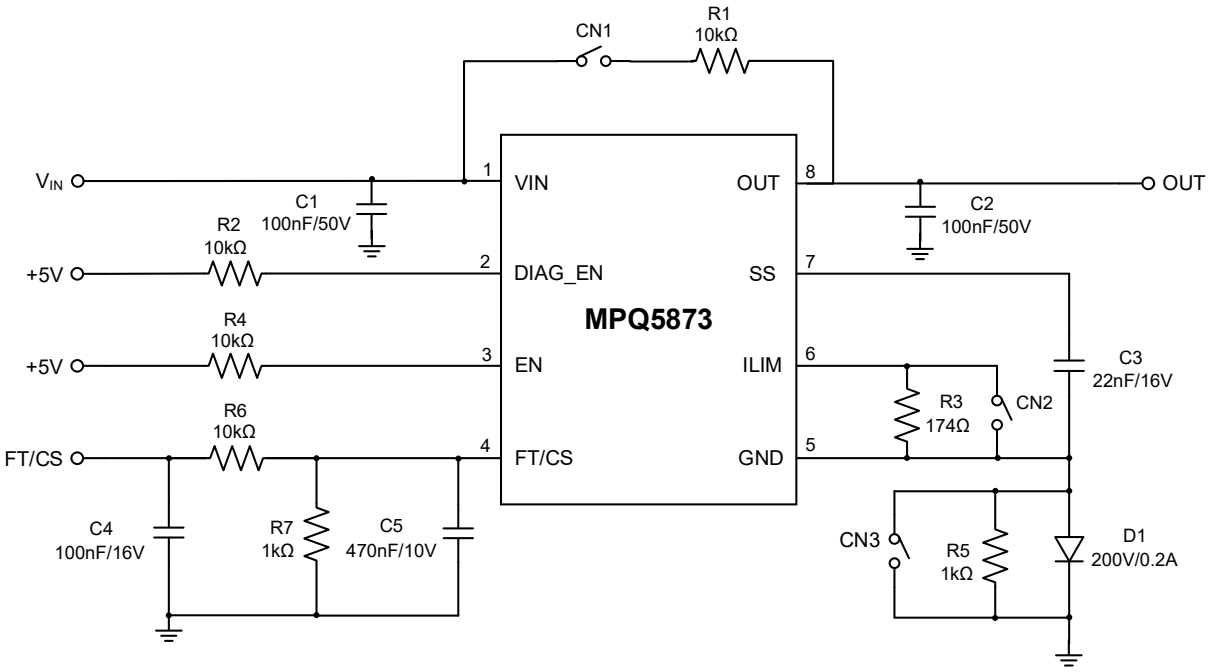
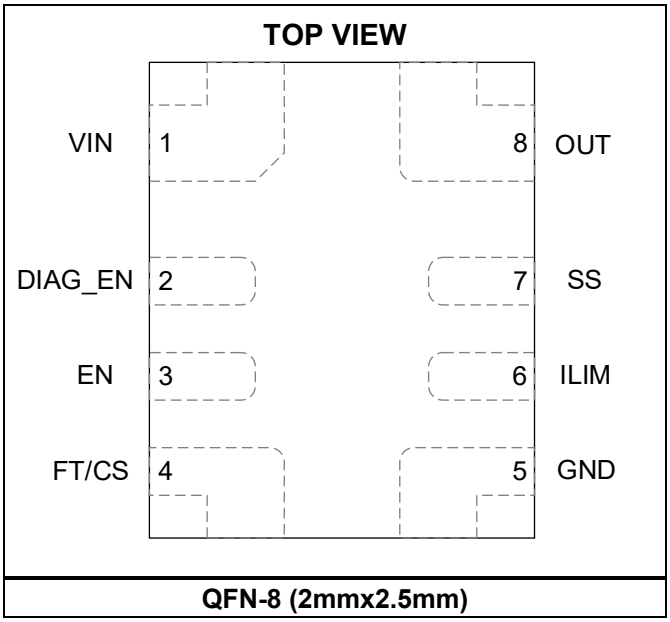


Figure 3: Evaluation Board Schematic

PACKAGE REFERENCE



QFN-8 (2mmx2.5mm)

EVQ5873-RP-00A BILL OF MATERIALS

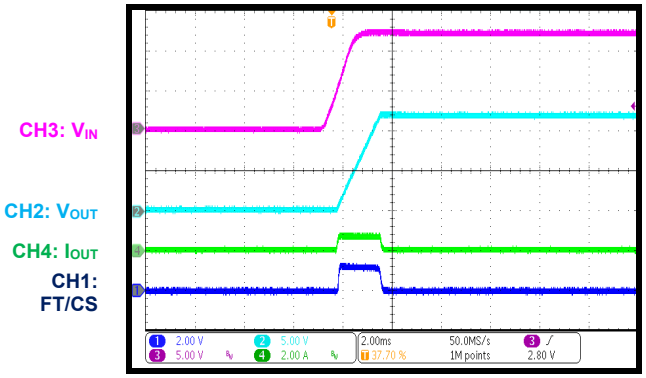
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
2	C1, C2	100nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
1	C3	22nF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C223KA01D
1	C4	100nF	Ceramic capacitor, 16V, X7R	0603	Murata	GRM188R71C104KA01D
1	C5	470nF	Ceramic capacitor, 10V, X7R	0402	Murata	GRM155R71A474KE01D
4	R1, R2, R4, R6	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	R3	174Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07174RL
2	R5, R7	1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
1	D1	200V	Diode, 0.2A	SOD-123	Diodes, Inc.	BAV21W
1	U1	MPQ5873	36V, 3A, 60mΩ, smart high-side load switch, AEC-Q100 qualified	QFN-8 (2mmx 2.5mm)	MPS	MPQ5873GRPE-AEC1

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 12V, C_{LOAD} = 100µF, T_A = 25°C, unless otherwise noted.

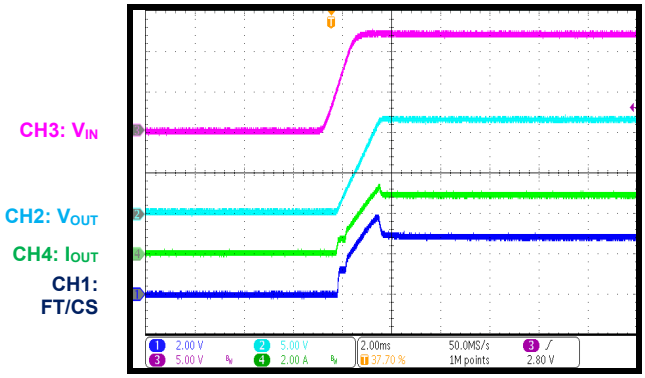
Start-Up through VIN

I_{OUT} = 0A



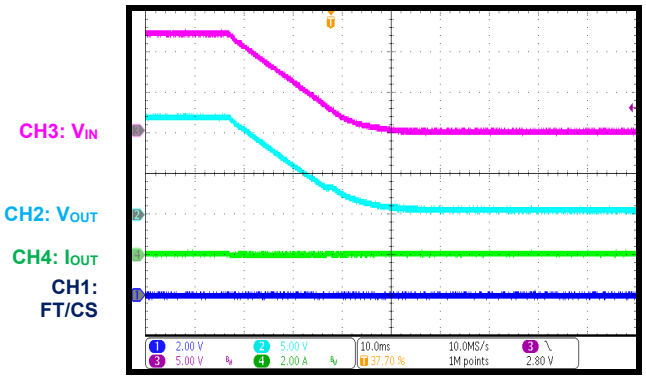
Start-Up through VIN

I_{OUT} = 3A



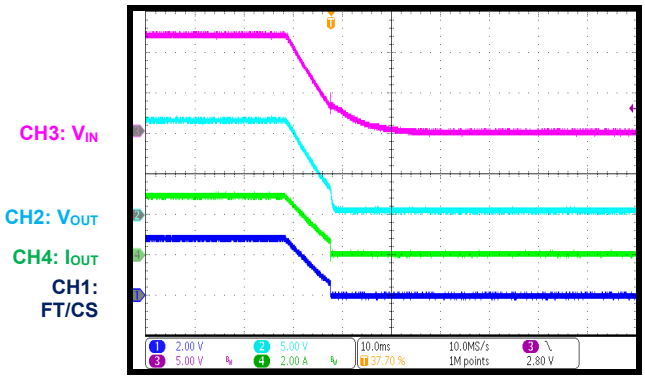
Shutdown through VIN

I_{OUT} = 0A



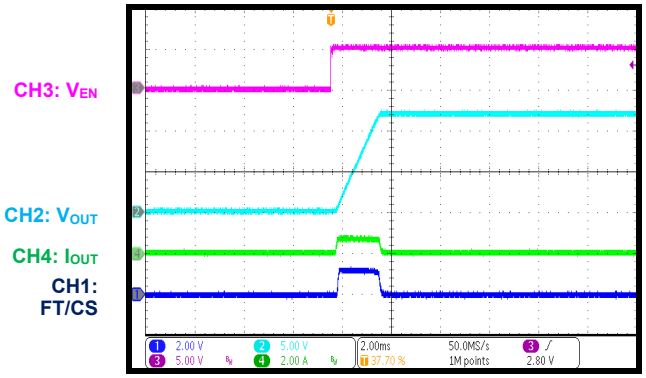
Shutdown through VIN

I_{OUT} = 3A



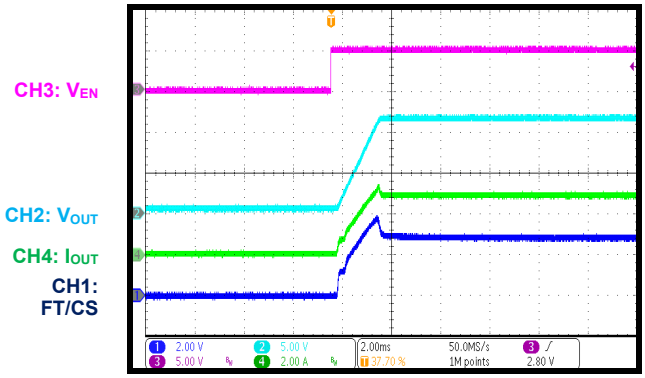
Start-Up through EN

I_{OUT} = 0A



Start-Up through EN

I_{OUT} = 3A

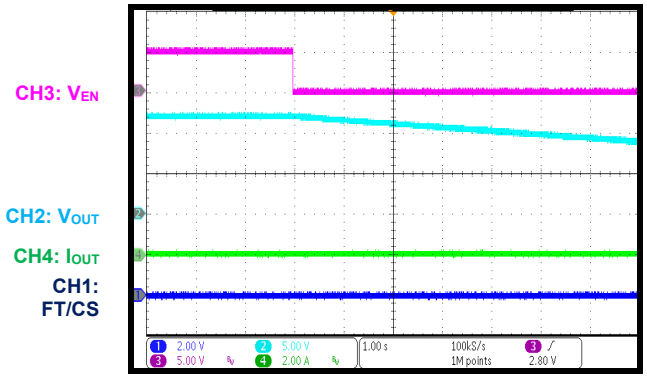


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 12V, C_{LOAD} = 100µF, T_A = 25°C, unless otherwise noted.

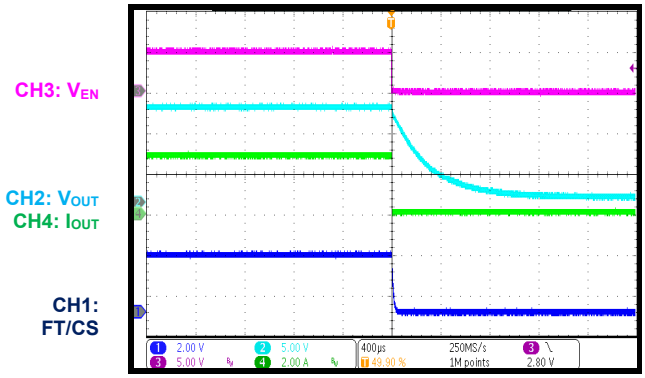
Shutdown through EN

I_{OUT} = 0A



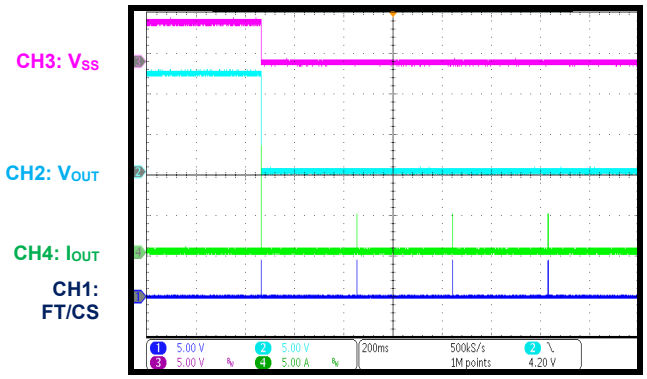
Shutdown through EN

I_{OUT} = 3A



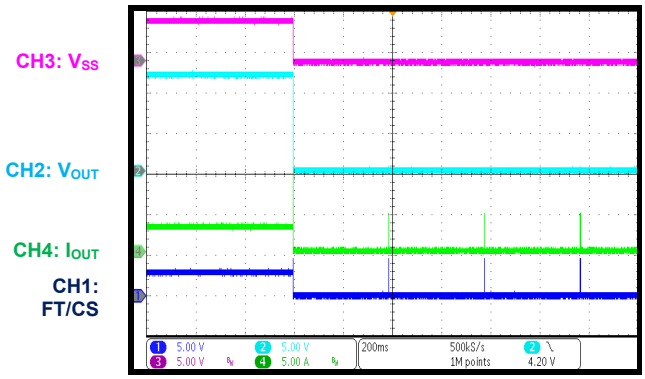
SCP Entry

I_{OUT} = 0A

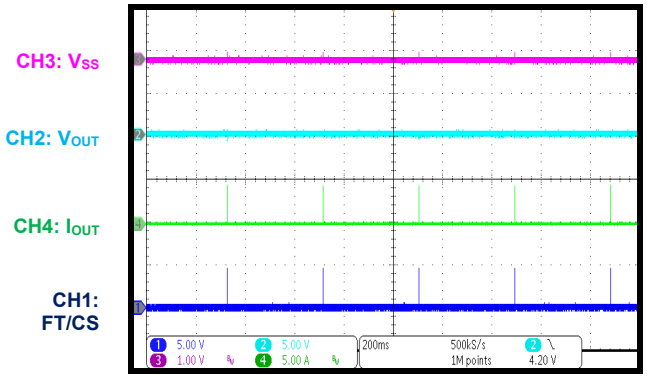


SCP Entry

I_{OUT} = 3A

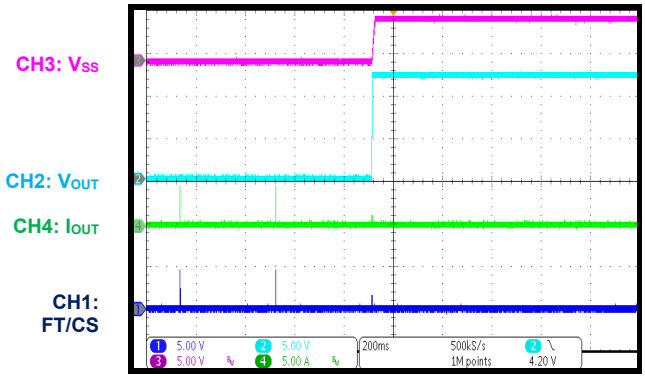


SCP Steady State



SCP Recovery

I_{OUT} = 0A

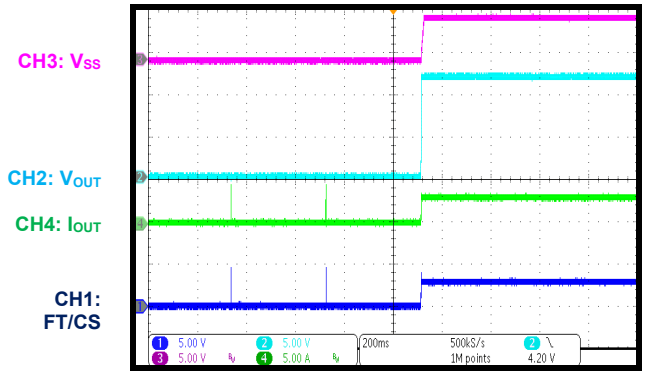


EVB TEST RESULTS *(continued)*

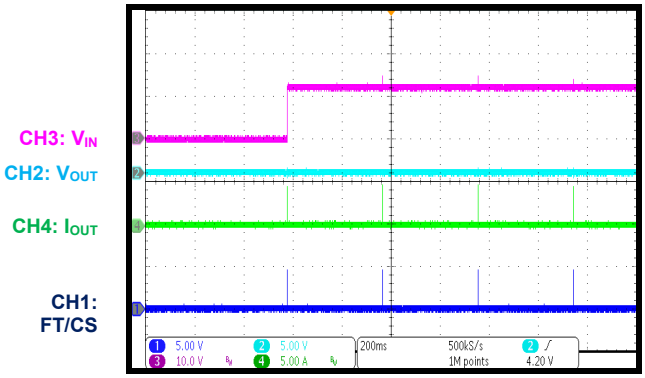
Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 12V, C_{LOAD} = 100µF, T_A = 25°C, unless otherwise noted.

SCP Recovery

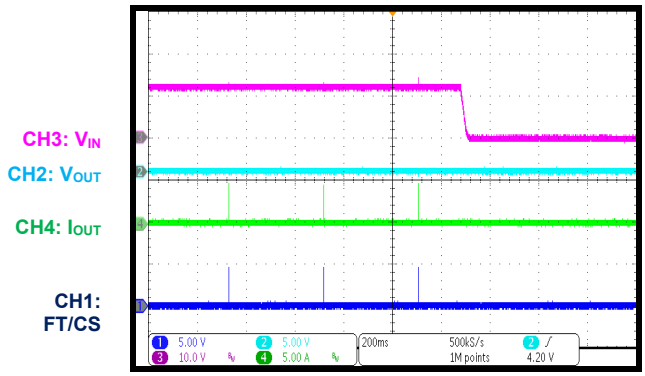
I_{OUT} = 3A



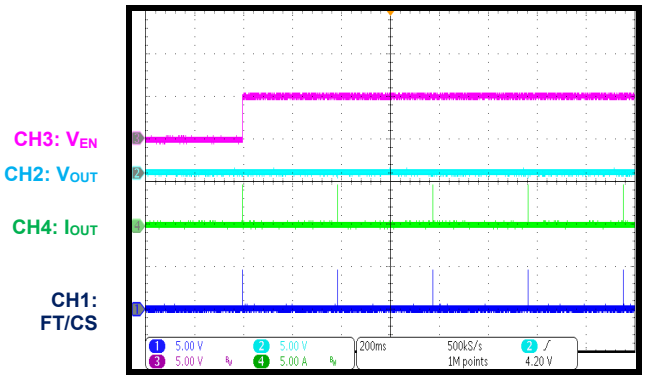
SCP Start-Up



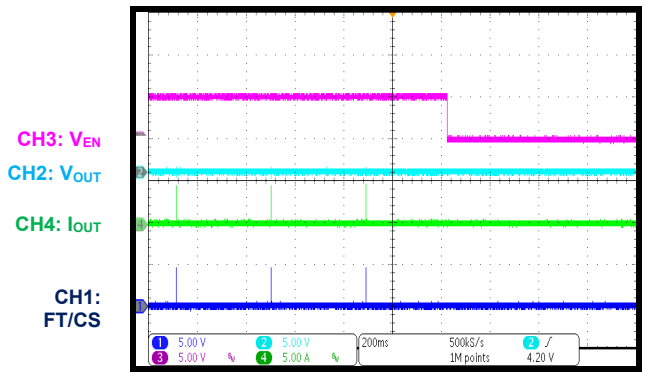
SCP Shutdown



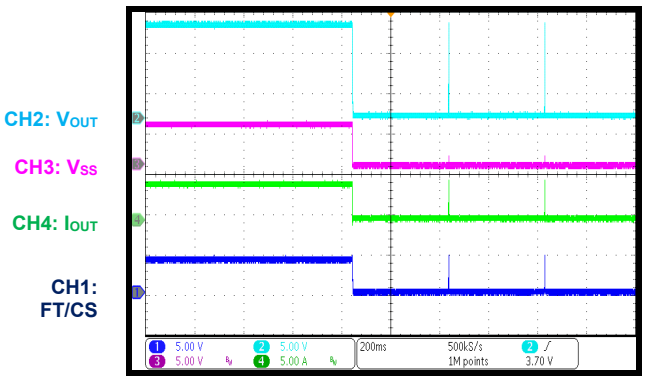
SCP Start-Up through EN



SCP Shutdown through EN



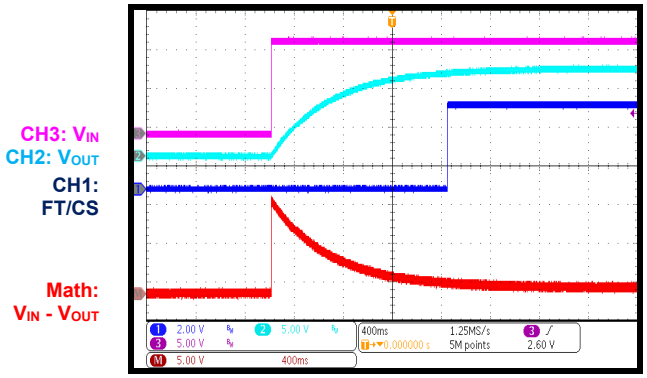
Over-Current Protection



EVB TEST RESULTS *(continued)*

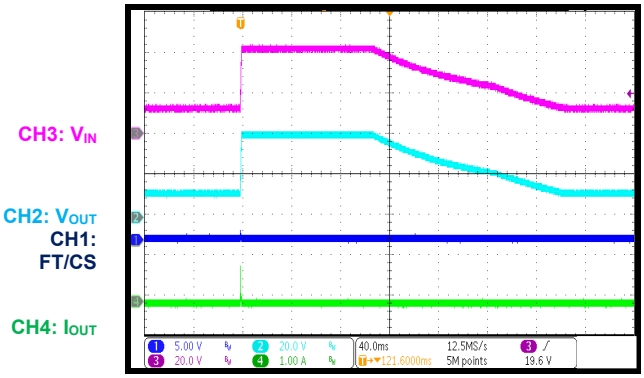
Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 12V, C_{LOAD} = 100µF, T_A = 25°C, unless otherwise noted.

Open-Load Detection



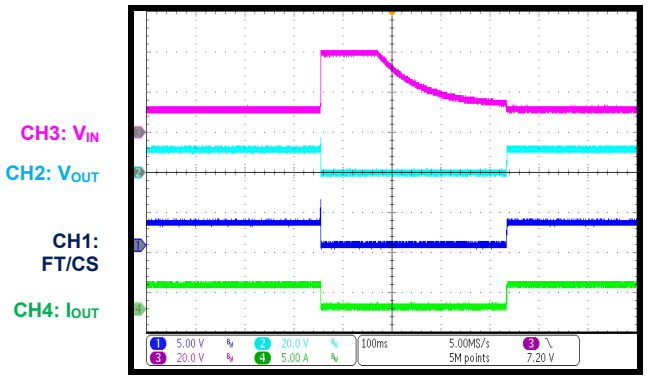
Load Dump

I_{OUT} = 0A



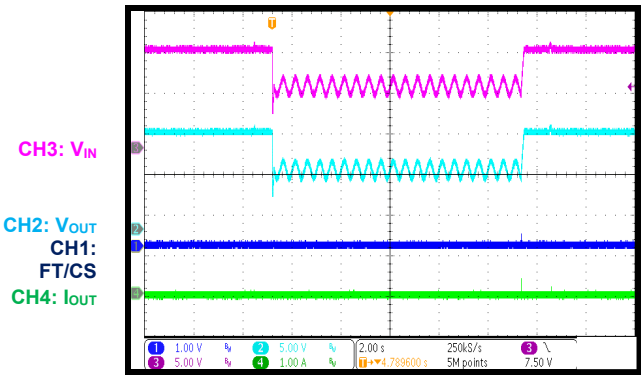
Load Dump

I_{OUT} = 3A



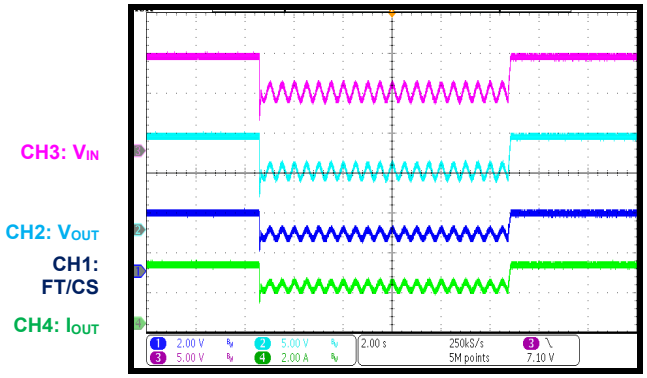
Cold Crank

I_{OUT} = 0A



Cold Crank

I_{OUT} = 3A



PCB LAYOUT (1)

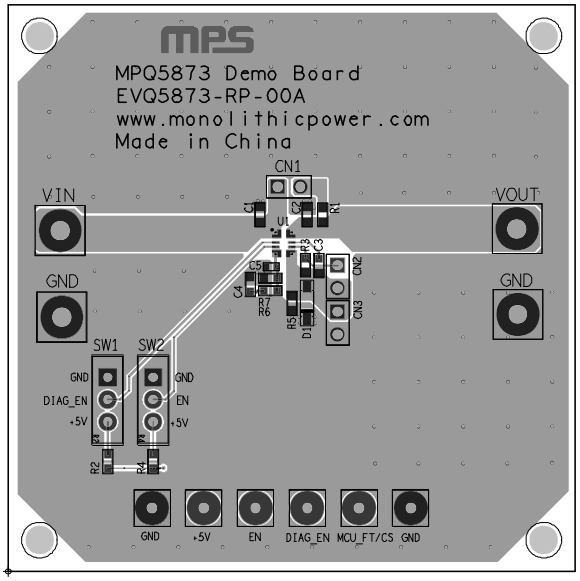


Figure 4: Top Silk and Top Layer

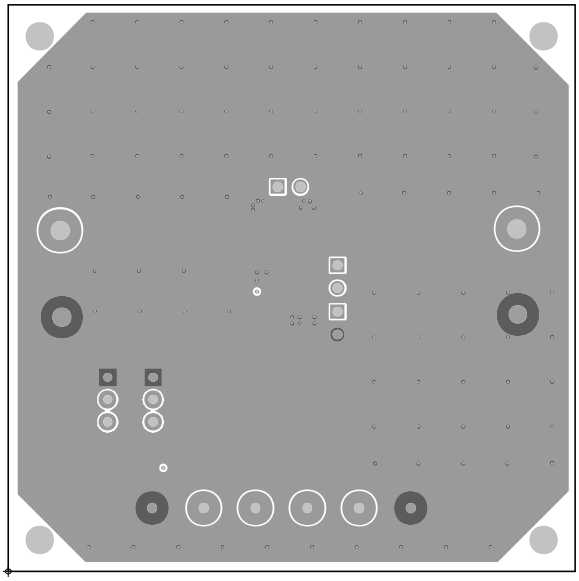


Figure 5: Mid-Layer 1

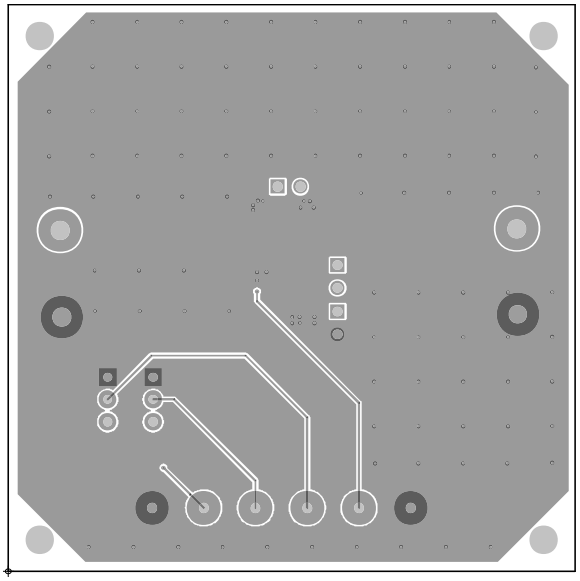


Figure 6: Mid-Layer 2

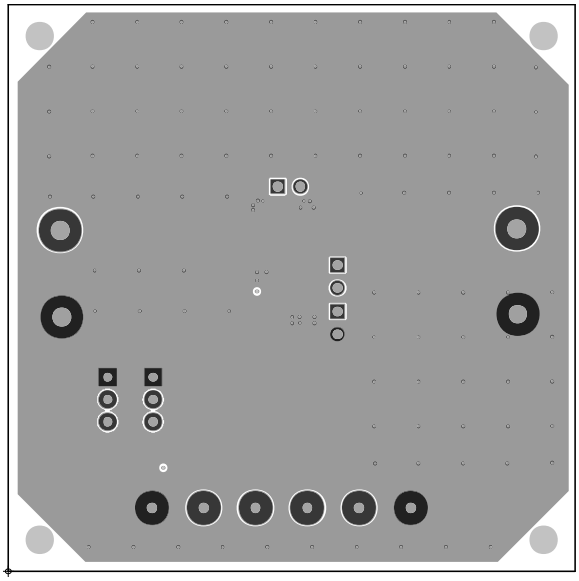


Figure 7: Bottom Layer and Bottom Silk

Note:

1) The copper thickness is 2oz.

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	5/17/2024	Initial Release	-