

### 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     | $F_s$     | 500   | kHz   |
| Output Voltage          | $V_{OUT}$ | 5     | V     |
| Output Current          | $I_{OUT}$ | 3     | A     |

### 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 |

### 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

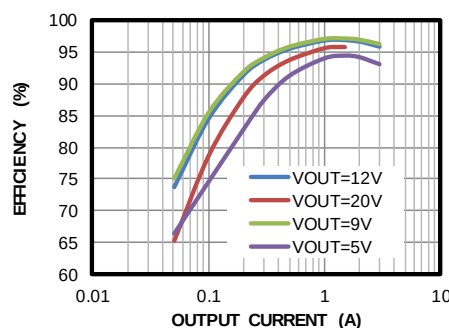
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\* For  $V_{OUT} < 3V$  application, the switching frequency will decrease.

#### Efficiency vs. Output Current

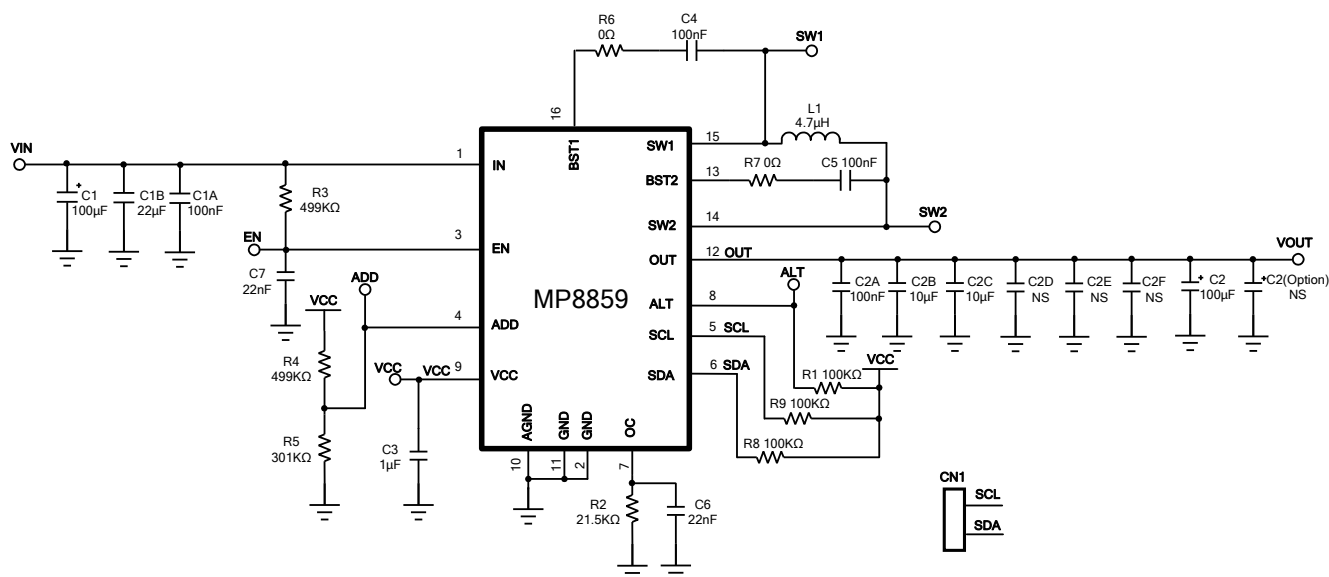
$V_{IN}=12V$ ,  $V_{OUT}=5V-20V$ , Forced PWM Mode



## 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**

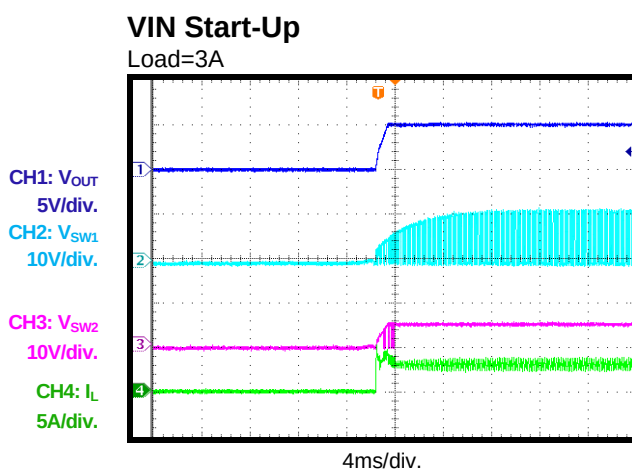
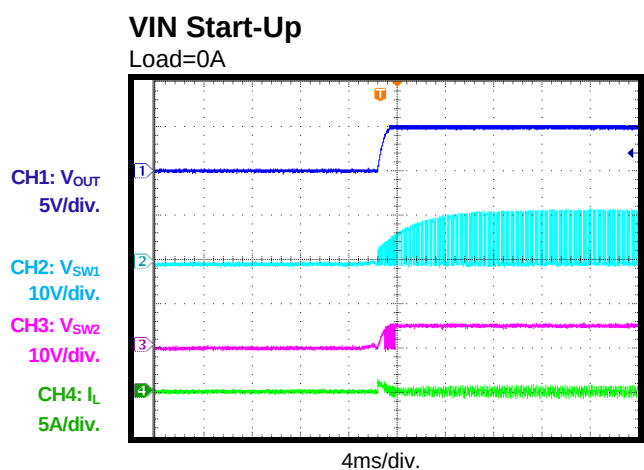
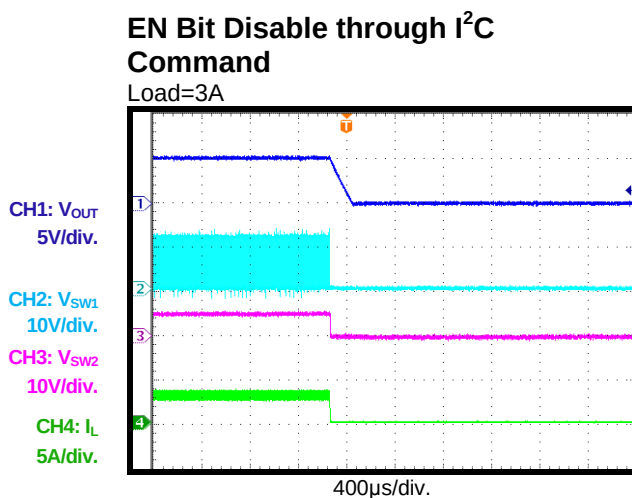
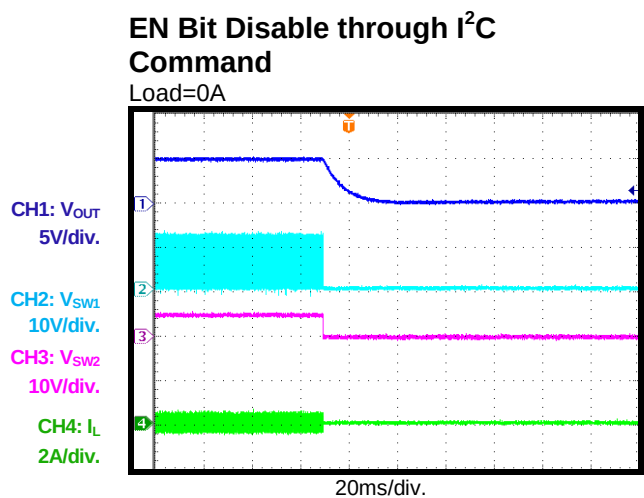
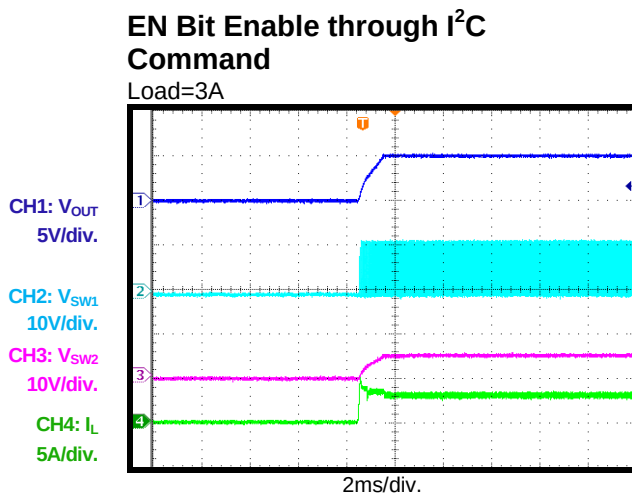
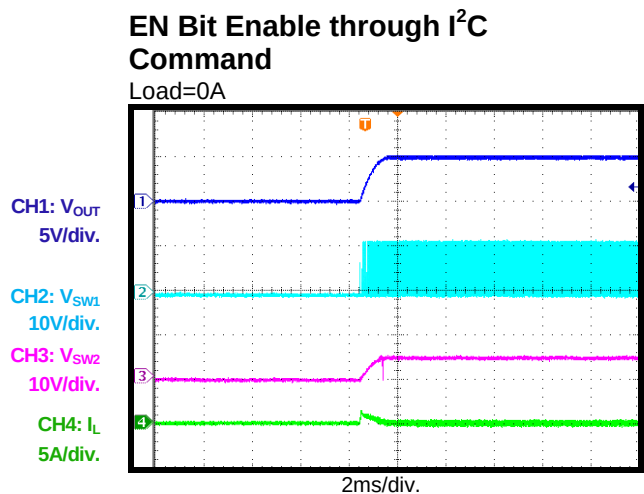
| Qty | Ref               | Value       | Description                                 | Package                      | Manufacturer | Part Number        |
|-----|-------------------|-------------|---------------------------------------------|------------------------------|--------------|--------------------|
| 1   | C1                | 100 $\mu$ F | Electrolytic Cap.,35V                       | DIP                          | Chemi-Con    | EMZJ350ADA101MF80G |
| 1   | C1B               | 22 $\mu$ F  | Ceramic Cap.,25V,X5R                        | 0805                         | TDK          | C2012X5R1E226M     |
| 2   | C2B,C2C           | 10 $\mu$ F  | Ceramic Cap.,25V,X5R                        | 0805                         | Murata       | GRM21BR61E106MA73L |
| 1   | C2                | 100 $\mu$ F | Electrolytic Cap.,35V                       | SMD                          | Chemi-Con    | EMZJ350ARA101MHA0G |
|     |                   | 100 $\mu$ F | Polymer Cap.,35V                            | DIP                          | WE           | 870055675009       |
| 1   | C3                | 1 $\mu$ F   | Ceramic Cap.,16V,X5R                        | 0603                         | WE           | 885012106017       |
| 4   | C1A,C2A,<br>C4,C5 | 100nF       | Ceramic Cap.,50V,X7R                        | 0402                         | SAMSUNG      | CL05B104KB5NNNC    |
| 2   | C6, C7            | 22nF        | Ceramic Cap.,50V, X5R                       | 0603                         | Murata       | GRM188R71H223KA01D |
| 1   | L1                | 4.7 $\mu$ H | Inductor,<br>RDC=19.5mOhm,<br>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,<br>C2E, C2F  | NS          |                                             |                              |              |                    |
| 1   | U1                | MP8859      | 4-Switch Integrated<br>Buck-Boost Converter | QFN-<br>16(3mm $\times$ 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.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $T_A = 25^{\circ}C$ , unless otherwise noted.



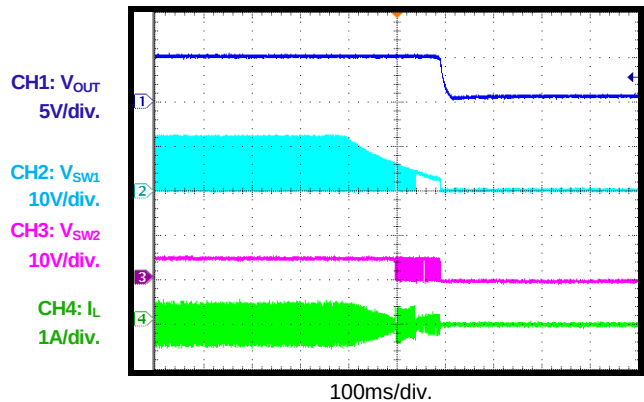
## EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $T_A = 25^{\circ}C$ , unless otherwise noted.

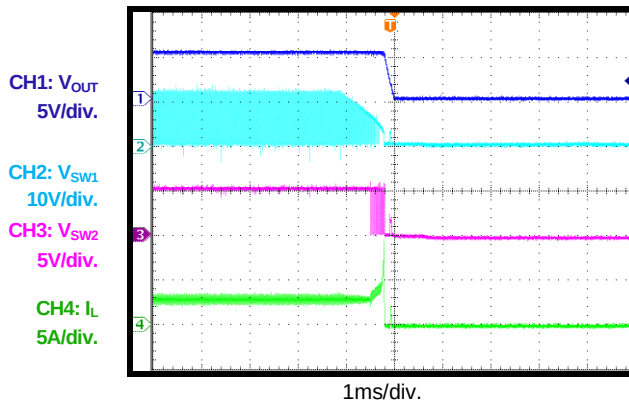
### VIN Power Off

Load=0A



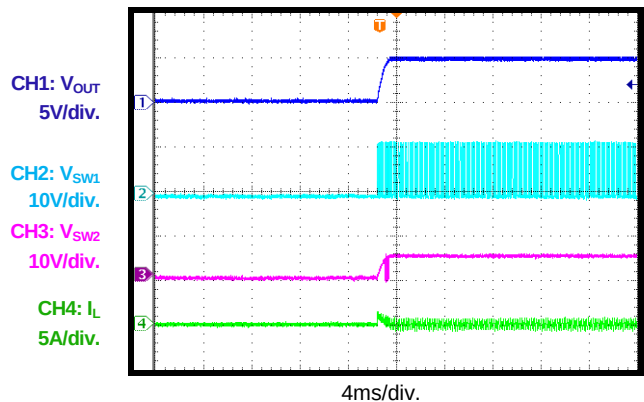
### VIN Power Off

Load=3A



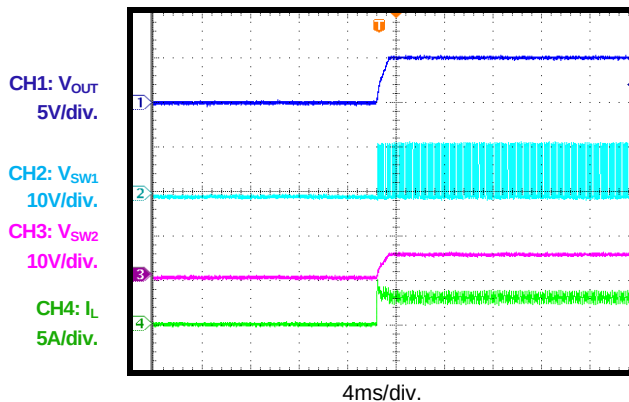
### EN Pin Enable

Load=0A



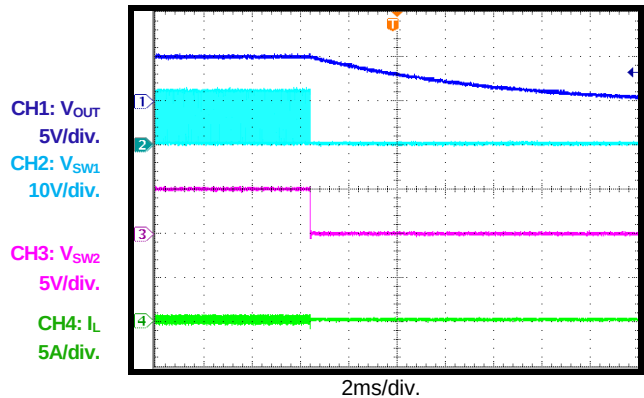
### EN Pin Enable

Load=3A



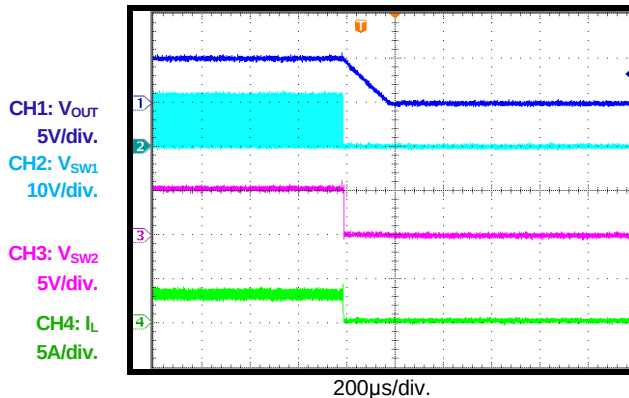
### EN Pin Disable

Load=0A



### EN Pin Disable

Load=3A



## EVB TEST RESULTS *(continued)*

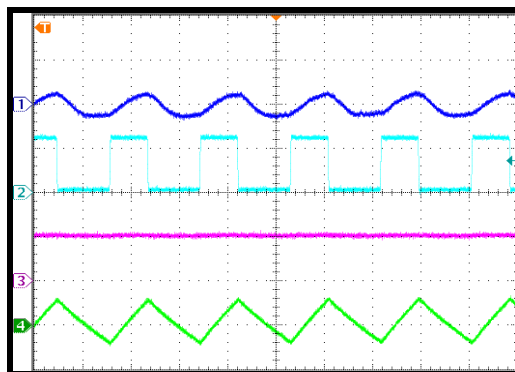
Performance waveforms are tested on the evaluation board.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

### Steady State

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

CH1:  
 $V_{OUT}/AC$   
50mV/div.  
CH2:  $V_{SW1}$   
10V/div.  
CH3:  $V_{SW2}$   
5V/div.  
CH4:  $I_L$   
1A/div.

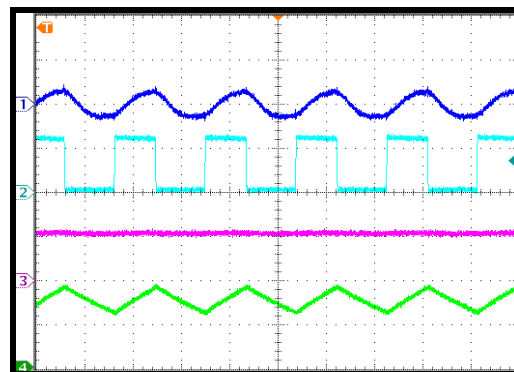


1µs/div.

### Steady State

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

CH1:  
 $V_{OUT}/AC$   
50mV/div.  
CH2:  $V_{SW1}$   
10V/div.  
CH3:  $V_{SW2}$   
5V/div.  
CH4:  $I_L$   
2A/div.

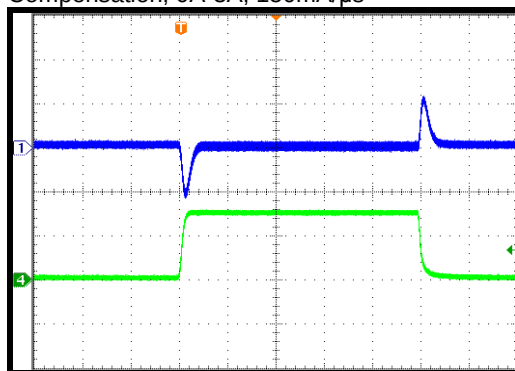


1µs/div.

### Load Transient

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

CH1:  
 $V_{OUT}/AC$   
200mV/div.  
CH4:  $I_{OUT}$   
2A/div.

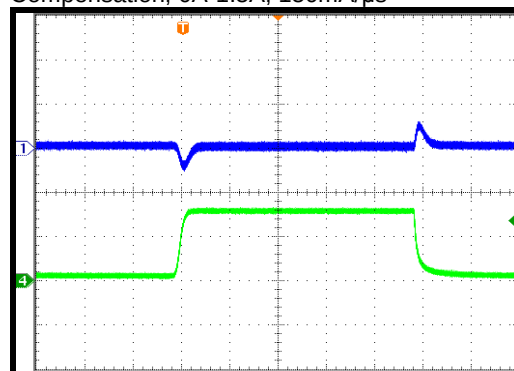


400µs/div.

### Load Transient

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

CH1:  
 $V_{OUT}/AC$   
200mV/div.  
CH4:  $I_{OUT}$   
1A/div.

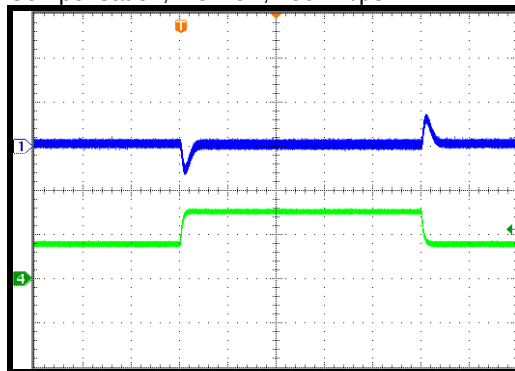


400µs/div.

### Load Transient

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

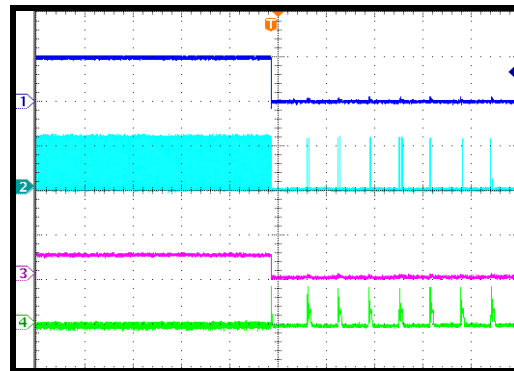
CH1:  
 $V_{OUT}/AC$   
200mV/div.  
CH4:  $I_{OUT}$   
2A/div.



400µs/div.

### SCP Entry with Hiccup Mode

CH1:  $V_{OUT}$   
5V/div.  
CH2:  $V_{SW1}$   
10V/div.  
CH3:  $V_{SW2}$   
10V/div.  
CH4:  $I_L$   
10A/div.



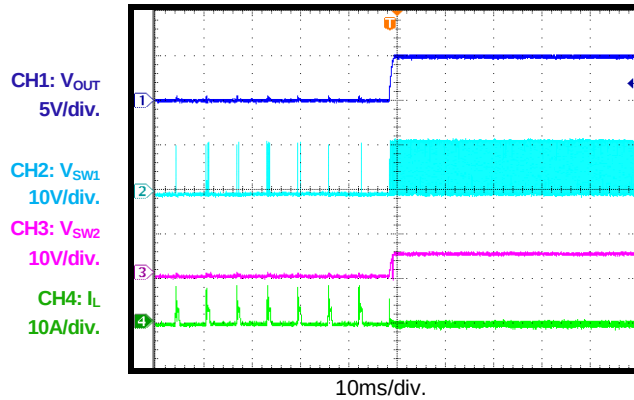
10ms/div.

## EVB TEST RESULTS *(continued)*

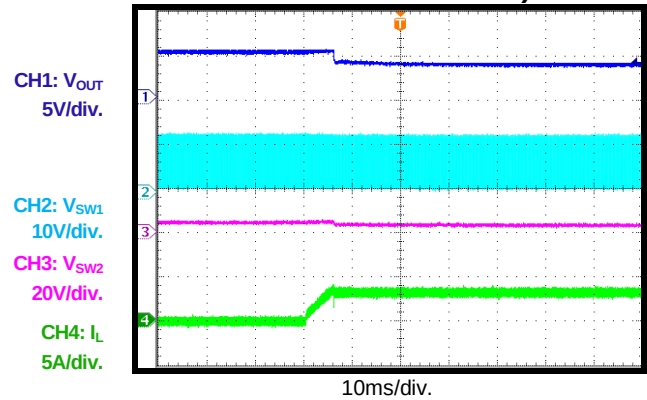
Performance waveforms are tested on the evaluation board.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $T_A = 25^{\circ}C$ , unless otherwise noted.

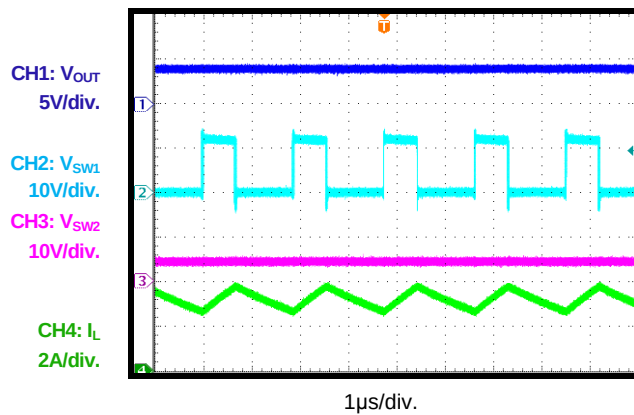
### SCP Recovery with Hiccup Mode



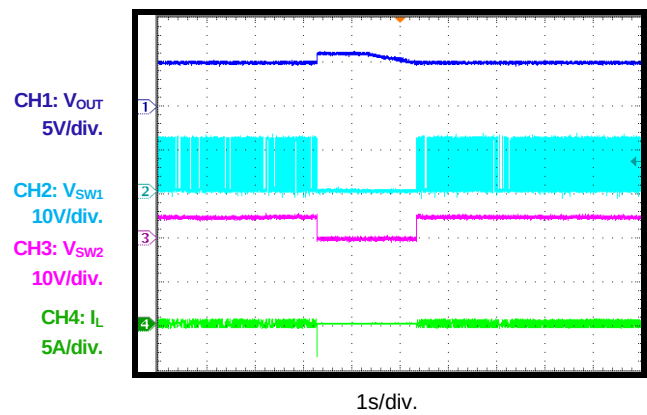
### CC Current Limit Entry (Test with CV Mode of Electronic Load)



### CC Current Limit Steady State

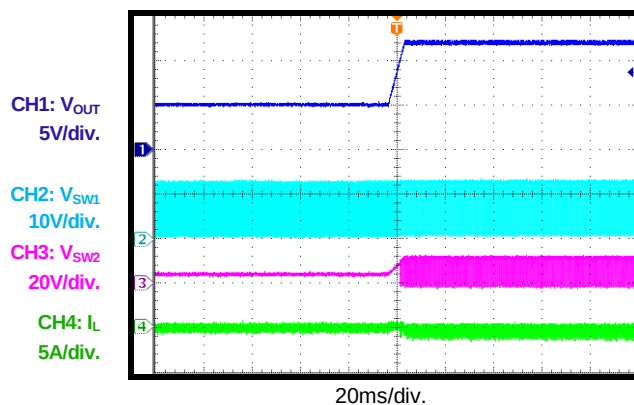


### VOUT OVP with Hiccup Mode



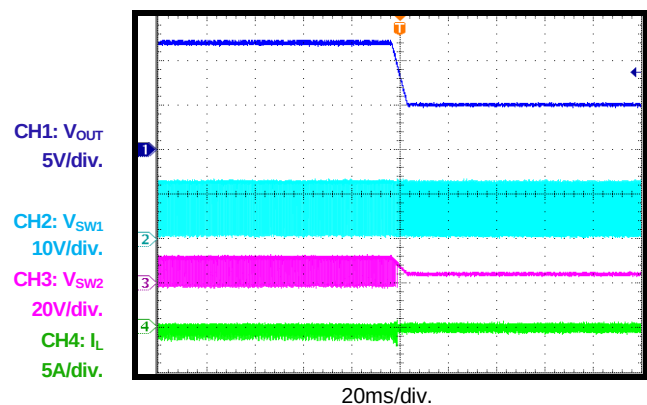
### I2C VID

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



### I2C VID

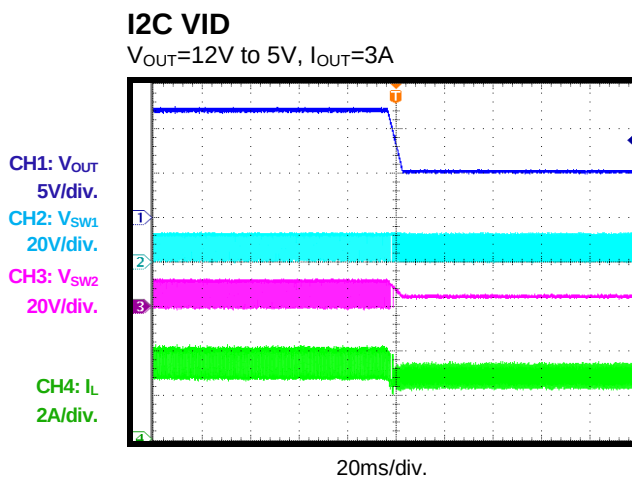
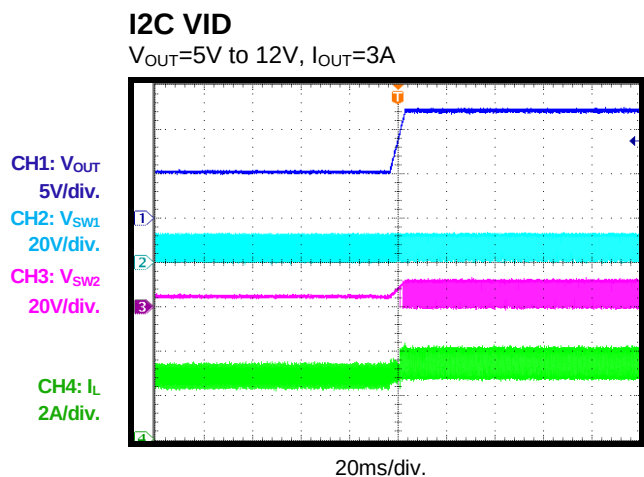
$V_{OUT}=12V$  to  $5V$ ,  $I_{OUT}=0A$



## EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $T_A = 25^\circ C$ , unless otherwise noted.





# PRINTED CIRCUIT BOARD LAYOUT

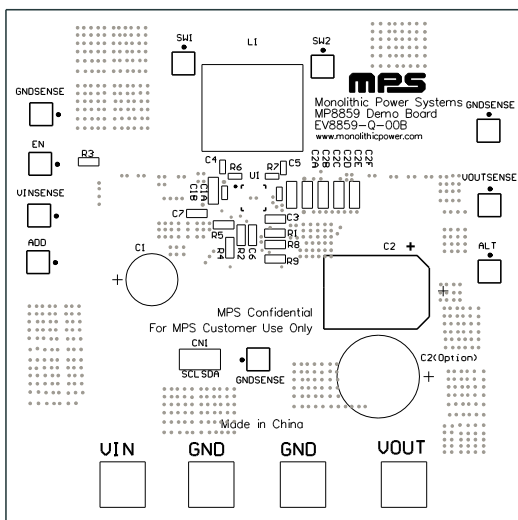


Figure 1—Top Silk Layer

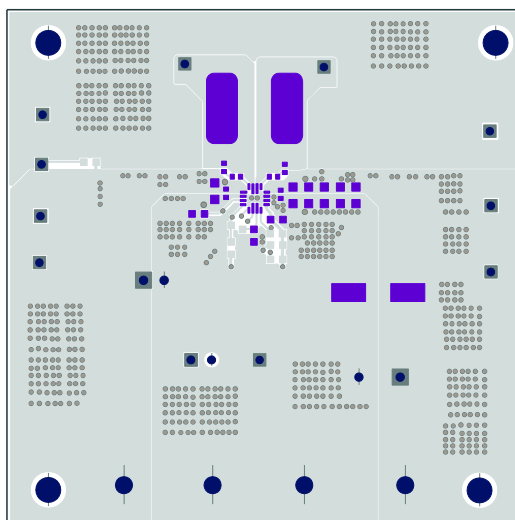


Figure 2—Top Layer

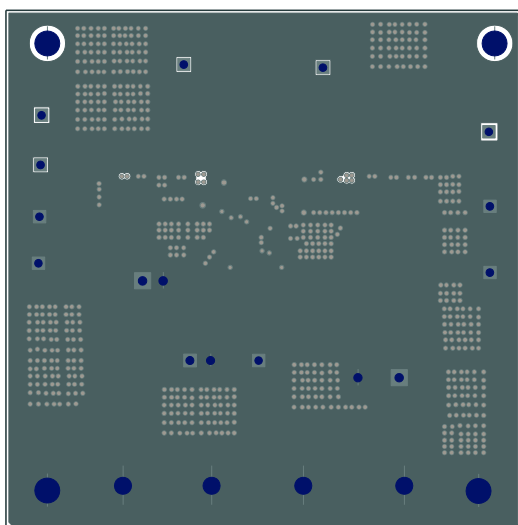


Figure 3—Mid 1 Layer

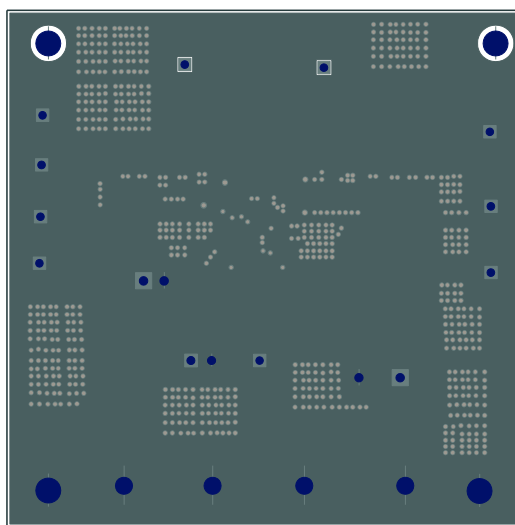


Figure 4—Mid 2 Layer

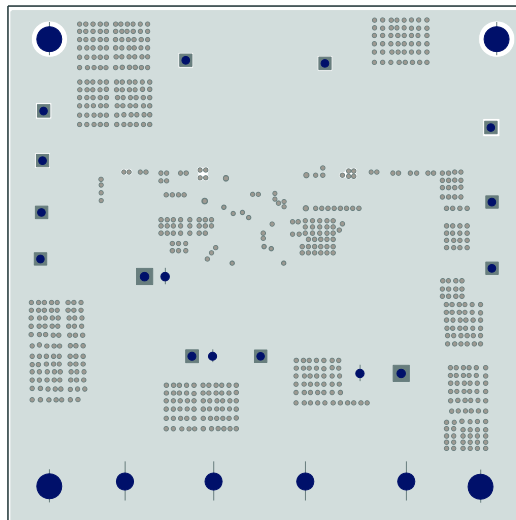


Figure 5—Bottom Layer

## 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.

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