# EVQ4425A-QB-00A

**High Efficiency 1.5A, 36V, 2.2MHz Synchronous Step-Down LED Driver Evaluation Board**

## DESCRIPTION

The EVQ4425A-QB-00A is an evaluation board for the MPQ4425A-AEC1 and MPQ4425A.

MPQ4425A-AEC1/MPQ4425A is a high-efficiency, synchronous, rectified, step-down, switch-mode white LED driver with built-in power MOSFETs. It offers a very compact solution to achieve a 1.5A continuous output current with excellent load and line regulation over a wide input supply range. The MPQ4425A has synchronous mode operation to get high efficiency.

The EVQ4425A-QB-00A is a fully assembled and tested evaluation board, which generates load current up to 1.5A from a 4V to 36V input range.

## ELECTRICAL SPECIFICATION

| Parameter | Symbol | Value | Units |
|---|---|---|---|
| Input Voltage | $V_{EMI}$ | 4 - 36 | V |
| Output Current | $I_{LED}$ | 1.5 | A |

## FEATURES

- Wide 4V to 36V Operating Input Range 85mΩ High-Side, 50mΩ Low-Side Internal Power MOSFETs
- High-Efficiency Synchronous Mode Operation
- Default 2.2MHz Switching Frequency
- PWM Dimming (Min 100Hz Dimming Frequency)
- Force CCM Mode
- 0.2V Reference Voltage
- Internal Soft-Start
- Fault Indication for LED Short, Open and Thermal Shutdown
- Over-Current Protection (OCP) with Valley-Current Detection
- Proprietary Switching-Loss-Reduction Technology
- Thermal Shutdown
- Available in a QFN-13 (2.5mmx3mm) Package
- CISPR25 Class5 Compliant
- AEC-Q100 Grade-1

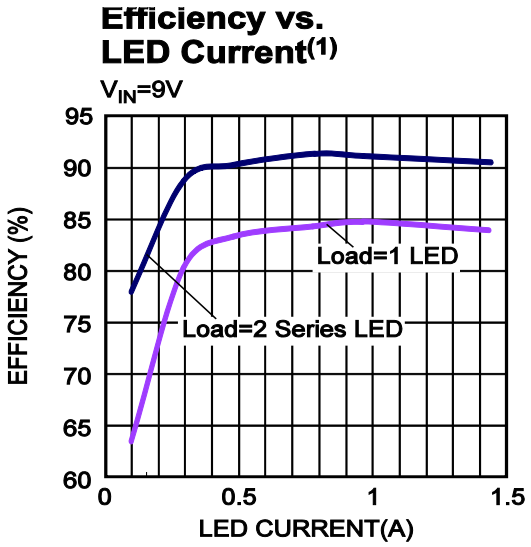
## APPLICATIONS

- Automotive LED Lighting

# EVQ4425A-QB-00A EVALUATION BOARD


**(L × W × H) 6.35cm x 6.35cm x 1.3cm**

| Board Number | MPS IC Number |
|---|---|
| EVQ4425A-QB-00A | MPQ4425AGQB-AEC1 |



## QUICK START GUIDE

1. Connect the positive and negative terminals of the LED to the LED+ and LED- pins, respectively.
2. Preset the power supply output to between 4 and 36V, and then turn it off.

   If longer cables are used between the source and the EVB (>0.5m total), a damping capacitor should be installed at the input terminals. Especially when Vin is ≥ 24V.
3. Connect the positive and negative terminals of the power supply output to the VIN and GND pins, respectively. To get better EMI performance, connect the input power between VEMI and GND.
4. Turn the power supply on. The MPQ4425AGQB will automatically startup.
5. To use the Enable function, apply a digital input to the EN pin. Drive EN higher than 1.45V to turn on the regulator, drive EN less than 1V to turn it off.
6. To use the Dimming function, apply a 100Hz to 2kHz external clock to the EN/DIM pin for the PWM dimming.
7. The output current is set by the external resistor $R_{FB}$, Feedback reference voltage is 0.2V, $I_{LED}$ is then given by below equation:

$$I_{LED} = \frac{0.2V}{R_{FB}}$$

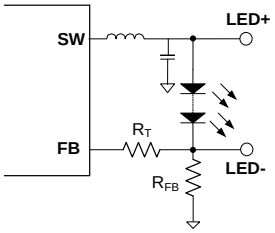
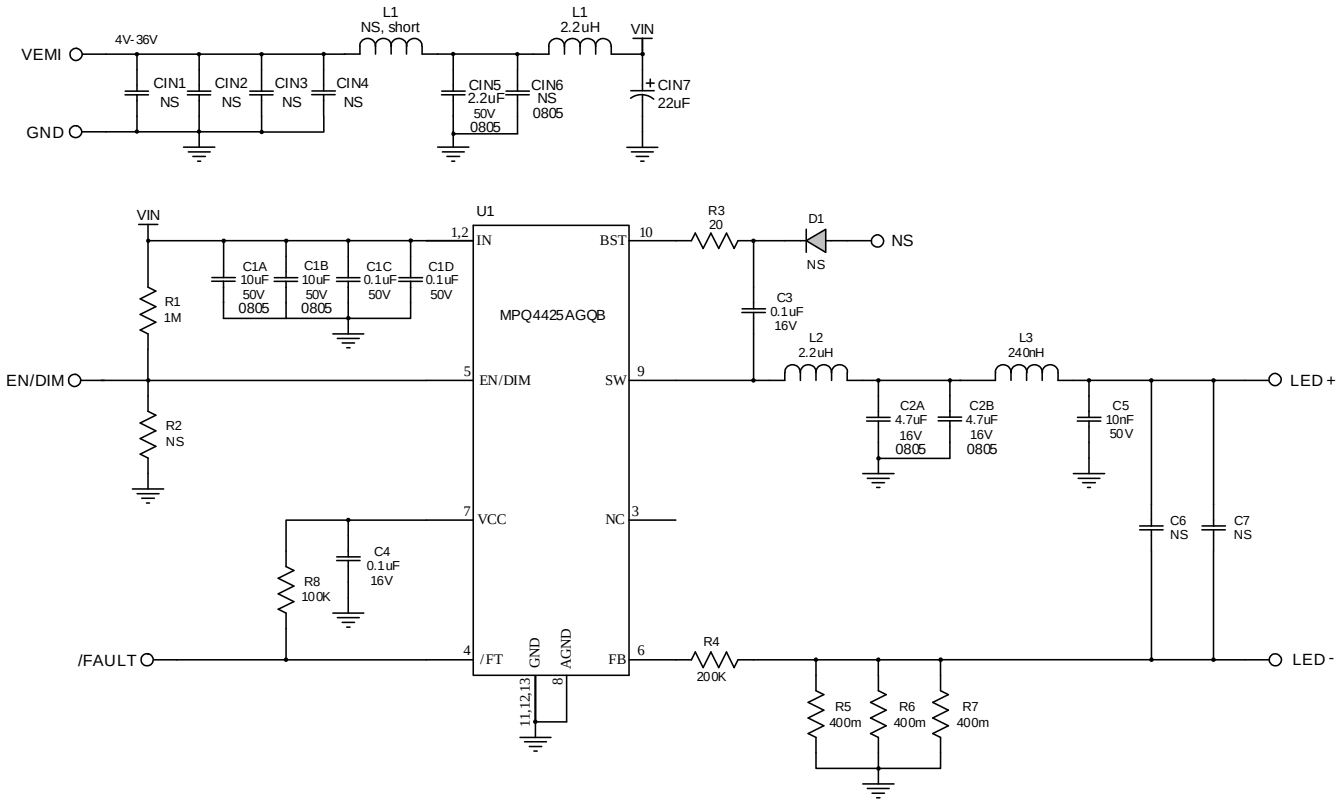



**Figure 1: Feedback Network**

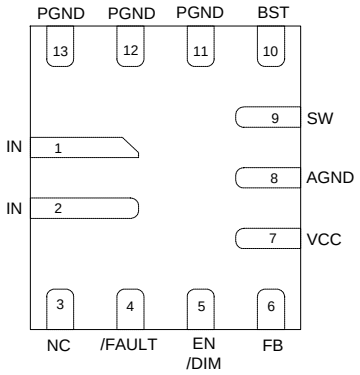
8. $R_T$ is used to set the loop bandwidth. Basically, lower $R_T$, higher bandwidth. But high bandwidth may cause insufficient phase margin, resulting in loop unstable. So a proper value of $R_T$ is needed to make a trade-off between bandwidth and phase margin. Below table lists the recommended feedback resistor and $R_T$ values for common output with 1 or 2 series LED.

| $I_{LED}$ (A) | $R_{FB}$ (mΩ) | $R_T$ (kΩ) |
|---|---|---|
| 0.5 | 400(1%) | 200 (1%) |
| 1 | 200(1%) | 150 (1%) |
| 1.5 | 133(1%) | 100 (1%) |

# EVALUATION BOARD SCHEMATIC




## Package Reference



## EVQ4425A-QB-00A BILL OF MATERIALS

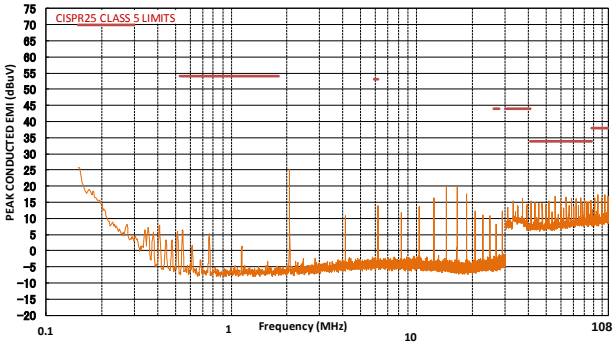
| Qty | Designator | Value | Description | Package | Manufacture | Manufacturer_PN |
|---|---|---|---|---|---|---|
| 1 | CIN5 | 2.2uF | Ceramic Capacitor, 50V, X7R | 0805 | TDK | C2012X7R1H225K |
| 1 | CIN7 | 22uF | Electrolytic Capacitor, 50V | SMD | Cotronic | UT1H220M0605VG |
| 2 | C1A, C1B | 4.7uF | Ceramic Capacitor, 50V, X7S | 0805 | Murata | GRM21BC71H475KE11L |
| 2 | C1C, C1D | 0.1uF | Ceramic Capacitor, 50V, X7R | 0603 | Murata | GRM188R71H104KA93D |
| 2 | C2A, C2B | 4.7uF | Ceramic Capacitor, 16V, X7R | 0805 | Murata | GCM21BR71C475KA73L |
| 2 | C3, C4 | 0.1uF | Ceramic Capacitor, 25V, X7R | 0603 | Murata | GCJ188R71E104KA12D |
| 1 | C5 | 10nF | Ceramic Capacitor, 25V, X7R | 0603 | Wurth | 885012206065 |
| 7 | CIN1, CIN2, CIN3, CIN4, CIN6, C6, C7 | NS | | | | |
| 1 | D1 | NS | | | | |
| 1 | L1 | Short | | | | |
| 2 | L2, L3 | 2.2uH | Inductor, 70mOhm DCR, 2.6A | SMD | Cyntec | VCUW25201B-2R2MS5 |
| 1 | L4 | 240nH | Inductor, 27mOhm DCR, 6.5A | SMD | Cyntec | VCUW20161B-R24MS5 |
| 1 | R1 | 1M | Film Resistor, 5% | 0603 | Yageo | RC0603JR-071ML |
| 1 | R3 | 20 | Film Resistor, 1% | 0603 | Yageo | RC0603FR-0720RL |
| 1 | R4 | 200K | Film Resistor, 1% | 0603 | Yageo | RC0603FR-07200KL |
| 3 | R5, R6, R7 | 400m | Film Resistor, 1% | 1206 | Yageo | RL1206FR-070R4L |
| 1 | R8 | 100K | Film Resistor, 1% | 0603 | Yageo | RC0603FR-07100KL |
| 1 | R2 | NS | | | | |
| 1 | U1 | | Step-Down Regulator | QFN13 (2mmX3mm) | MPS | MPQ4425AGQB-AEC1 |
| 4 | VEMI, GND, LED+, LED- | | 2.0mm Golden Pin | | HZ | |
| 3 | EN/DIM, GND, /FAULT | | 2.54mm Test Pin | | HZ | |

# EVB TEST RESULTS

**Performance waveforms are tested on the evaluation board.**
**$V_{IN}$ = 12V, LOAD=2 series LED, L=2.2µH, $F_{SW}$=2.2MHz, $T_A$ = +25°C, unless otherwise noted.**

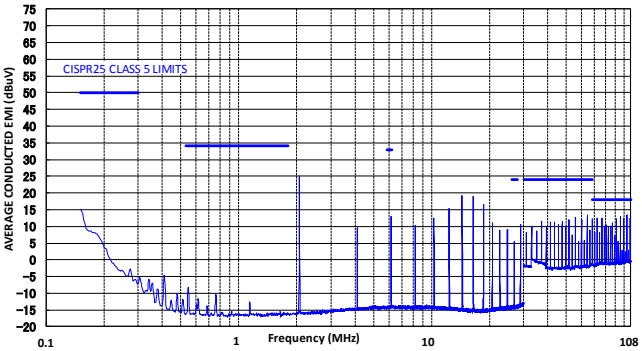
## CISPR25 CLASS 5 PEAK CONDUCTED EMISSIONS

150kHZ to 108MHz



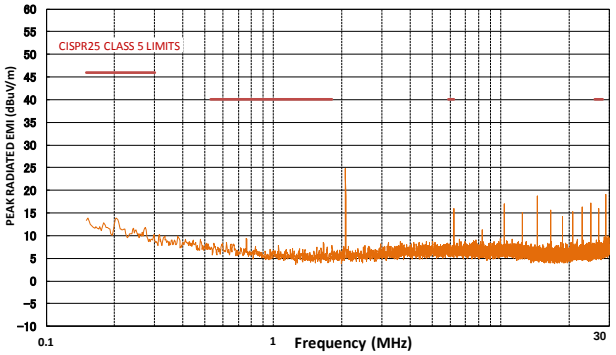

## CISPR25 CLASS 5 AVERAGE CONDUCTED EMISSIONS

150kHZ to 108MHz



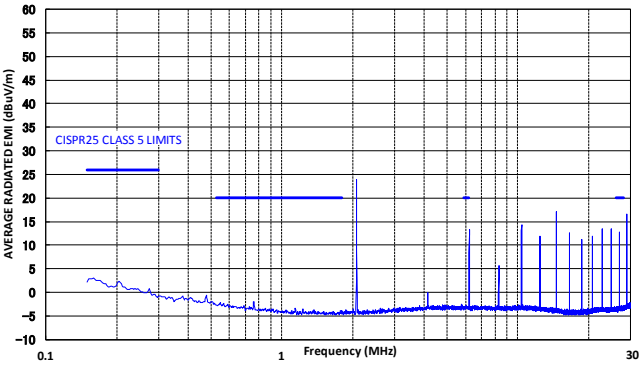

## CISPR25 CLASS 5 PEAK RADIATED EMISSIONS

150kHZ to 30MHz



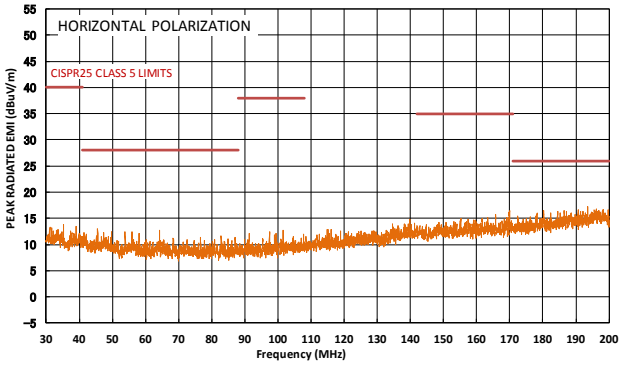

## CISPR25 CLASS 5 AVERAGE RADIATED EMISSIONS

150kHZ to 30MHz



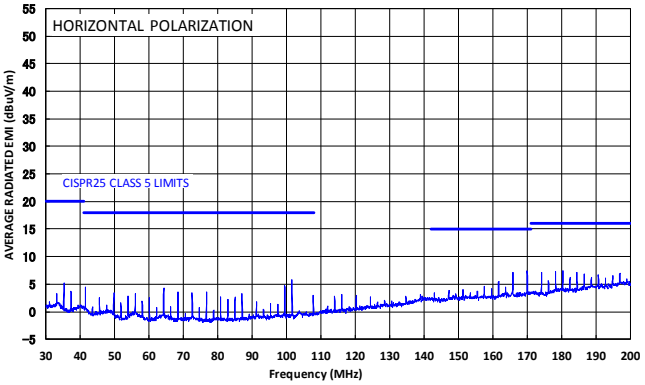

## CISPR25 CLASS 5 PEAK RADIATED EMISSIONS

Horizontal, 30MHz to 200MHz




## CISPR25 CLASS 5 AVERAGE RADIATED EMISSIONS

Horizontal, 30MHz to 200MHz

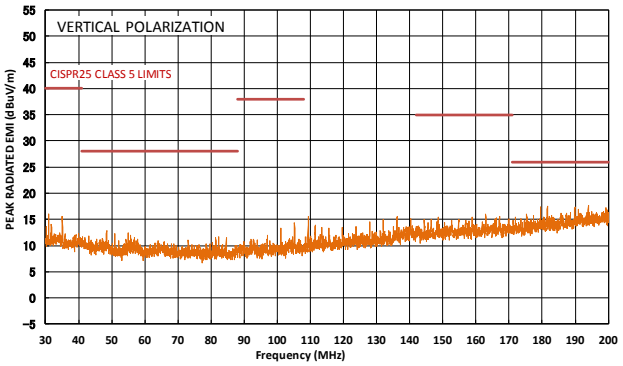


## EVB TEST RESULTS *(continued)*

**Performance waveforms are tested on the evaluation board.**
**$V_{IN}$ = 12V, LOAD=2 series LED, L=2.2µH, $F_{SW}$=2.2MHz, $T_A$ = +25°C, unless otherwise noted.**

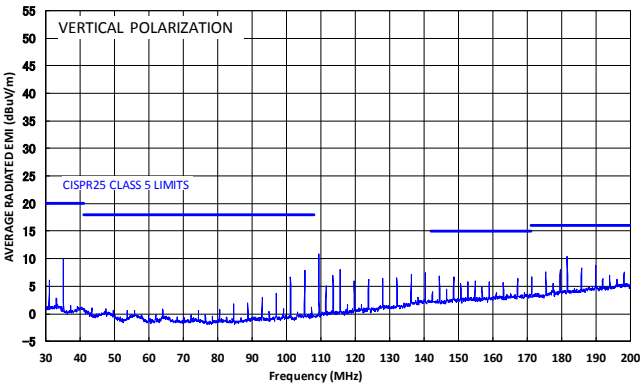
### CISPR25 CLASS 5 PEAK RADIATED EMISSIONS

Vertical, 30MHz to 200MHz



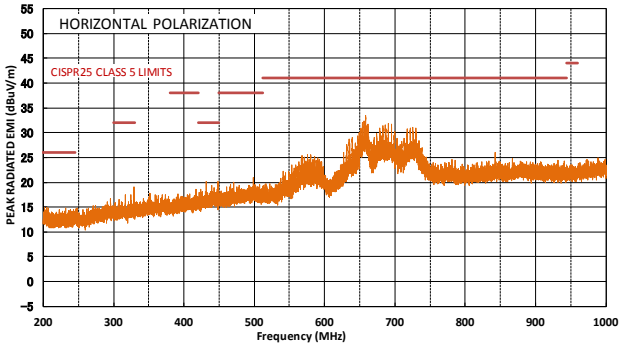

### CISPR25 CLASS 5 AVERAGE RADIATED EMISSIONS

Vertical, 30MHz to 200MHz



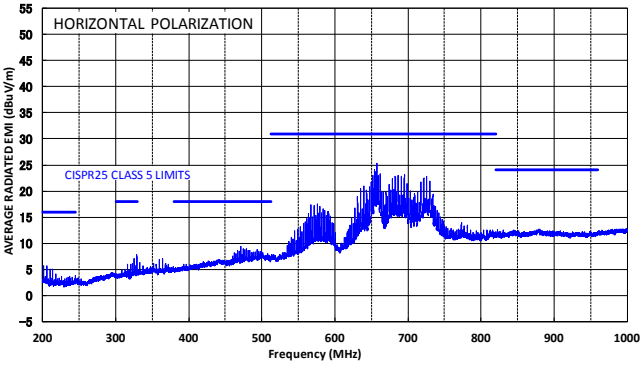

### CISPR25 CLASS 5 PEAK RADIATED EMISSIONS

Horizontal, 200MHz to 1GHz



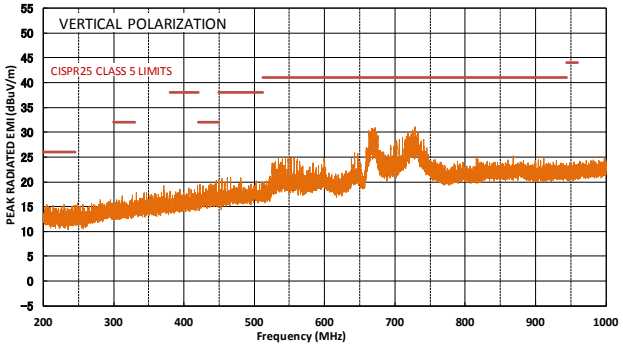

### CISPR25 CLASS 5 AVERAGE RADIATED EMISSIONS

Horizontal, 200MHz to 1GHz



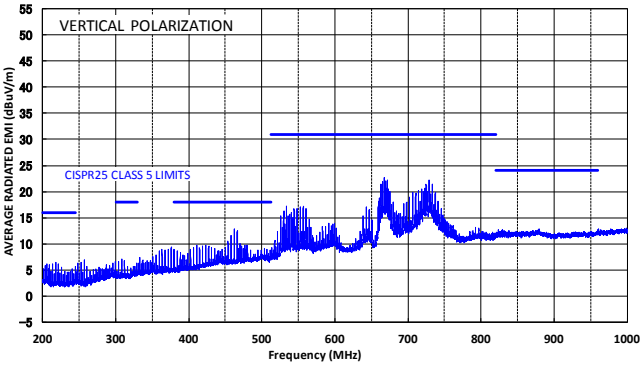

### CISPR25 CLASS 5 PEAK RADIATED EMISSIONS

Vertical, 200MHz to 1GHz




### CISPR25 CLASS 5 AVERAGE RADIATED EMISSIONS

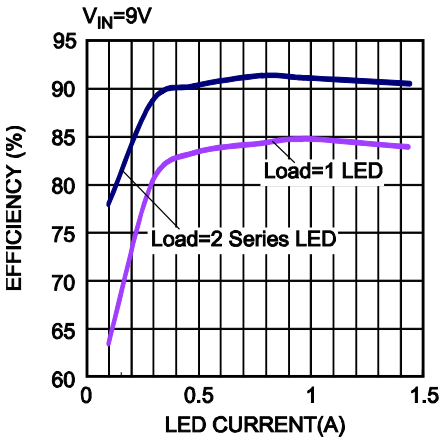
Vertical, 200MHz to 1GHz



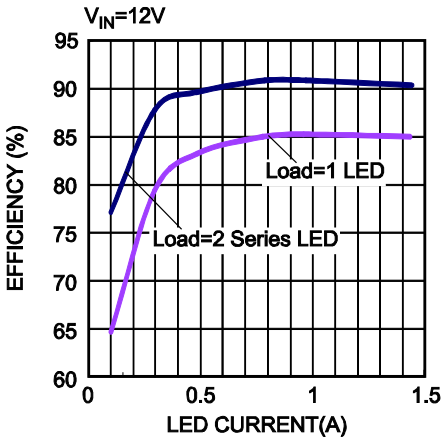
## EVB TEST RESULTS *(continued)*

**Performance waveforms are tested on the evaluation board.**
**$V_{IN}$ = 12V, LOAD=2 series LED, L=2.2μH, $F_{SW}$=2.2MHz, $T_A$ = +25°C, unless otherwise noted.(1)**

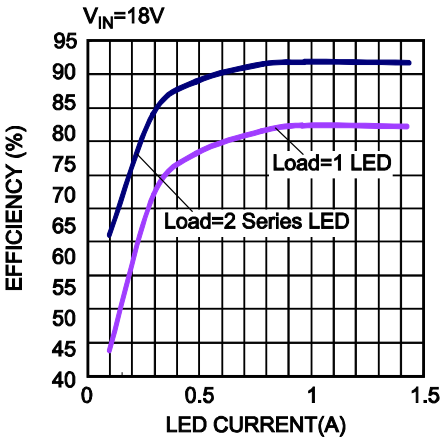
**Efficiency vs. LED Current**



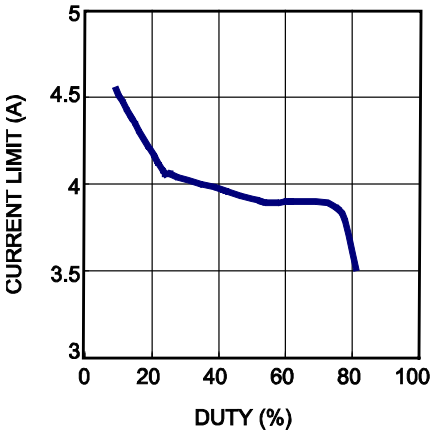

**Efficiency vs. LED Current**



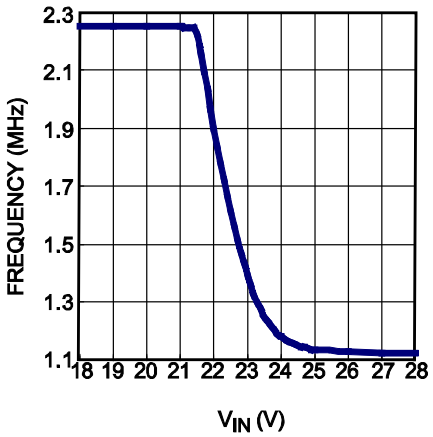

**Efficiency vs. LED Current**




**Current Limit vs.Duty**




**Frequency vs. $V_{IN}$**

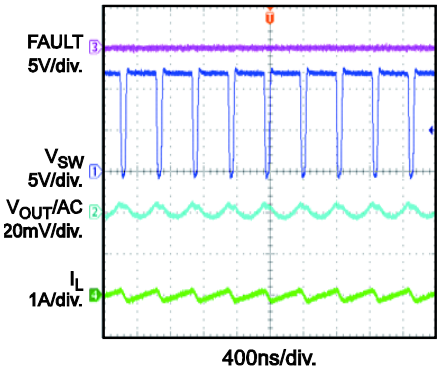



**Note:**
1). All the efficiency curves are tested on EVB without input and output filters.

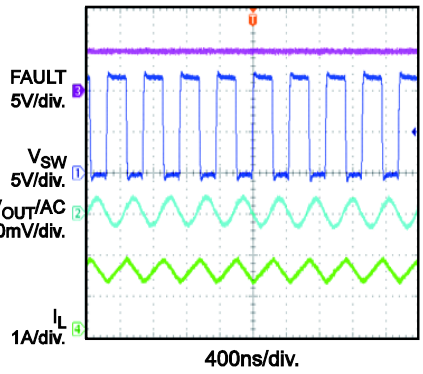
## EVB TEST RESULTS *(continued)*

**Performance waveforms are tested on the evaluation board.**
**$V_{IN}$ = 12V, LOAD=2 series LED, L=2.2µH, $F_{SW}$=2.2MHz, $T_A$ = +25°C, unless otherwise noted.**

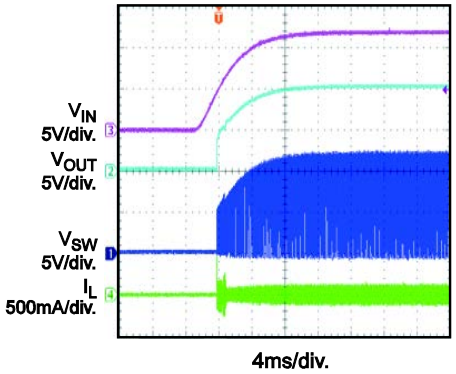
### Steady State
$I_{LED}$ = 0A



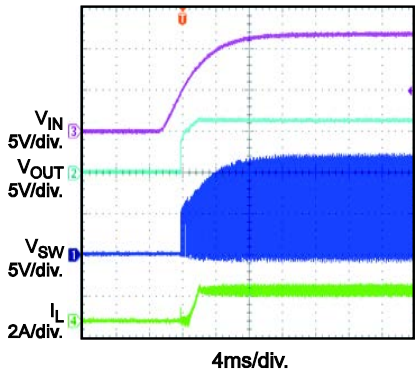

### Steady State
$I_{LED}$ = 1.5A



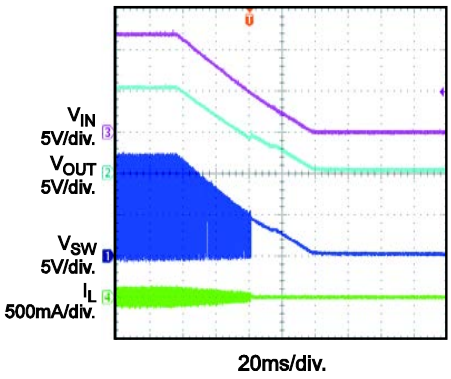

### Start-Up through $V_{IN}$
$I_{LED}$ = 0A



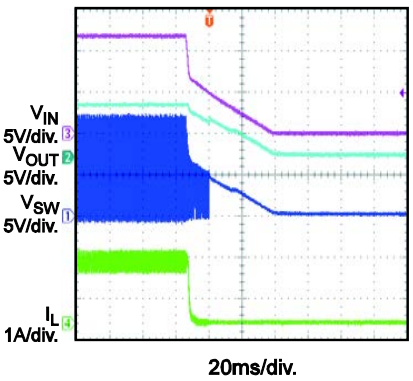

### Start-Up through $V_{IN}$
$I_{LED}$ = 1.5A



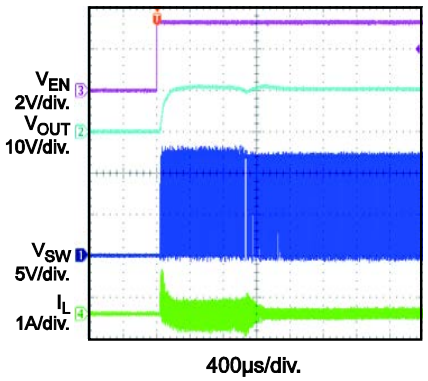

### Shutdown through $V_{IN}$
$I_{LED}$ = 0A



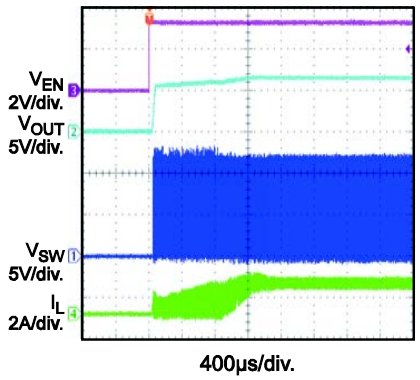

### Shutdown through $V_{IN}$
$I_{LED}$ = 1.5A



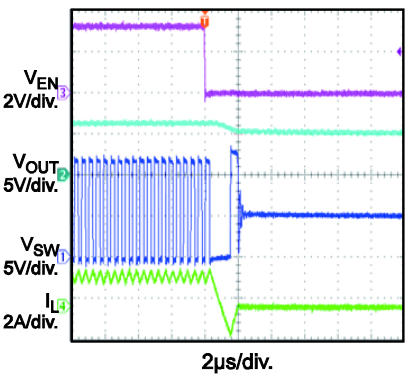

### Start-Up through EN
$I_{LED}$ = 0A




### Start-Up through EN
$I_{LED}$ = 1.5A



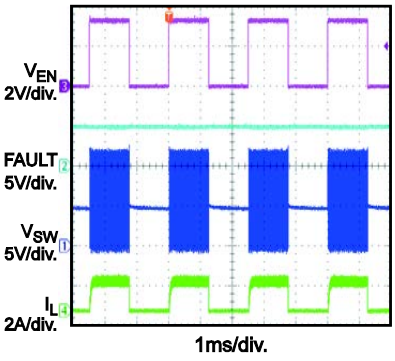

### Shutdown through EN
$I_{LED}$ = 1.5A



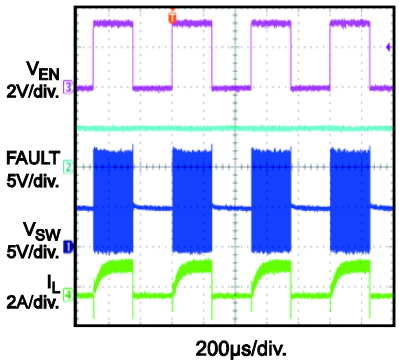
## EVB TEST RESULTS *(continued)*

**Performance waveforms are tested on the evaluation board.**
**$V_{IN}$ = 12V, LOAD=2 series LED, L=2.2µH, $F_{SW}$=2.2MHz, $T_A$ = +25°C, unless otherwise noted.**

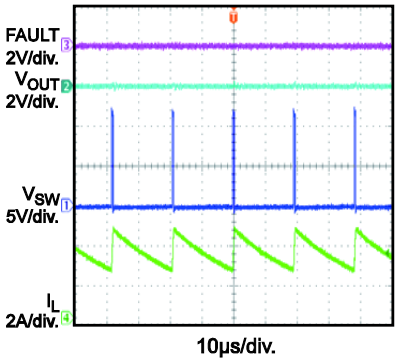
**PWM Dimming**
400Hz



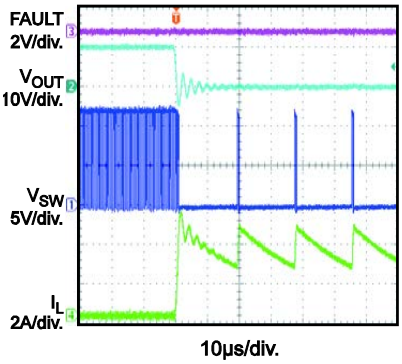

**PWM Dimming**
2kHz



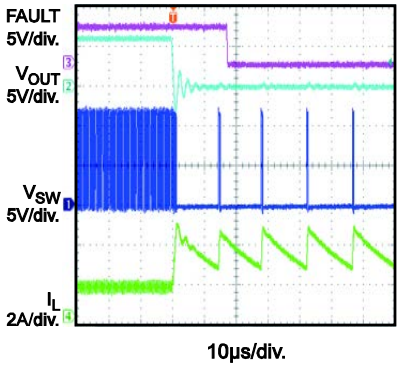

**LED+ Short to GND**
**Steady State**



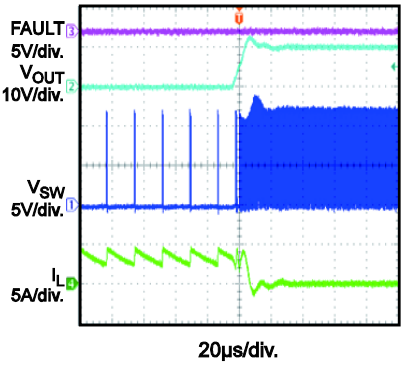

**LED+ Short to GND Entry**
$I_{LED}$ = 0A



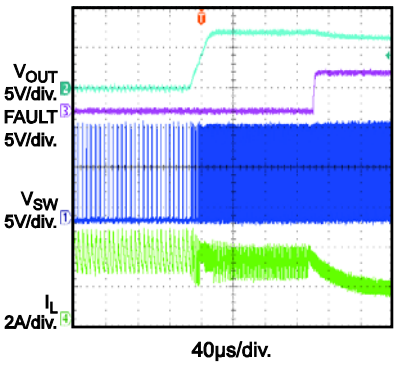

**LED+ Short to GND Entry**
$I_{LED}$ = 1.5A



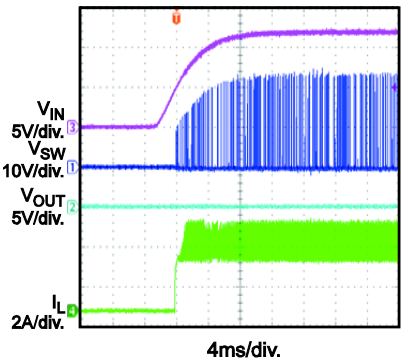

**LED+ Short to GND Recovery**
$I_{LED}$ = 0A



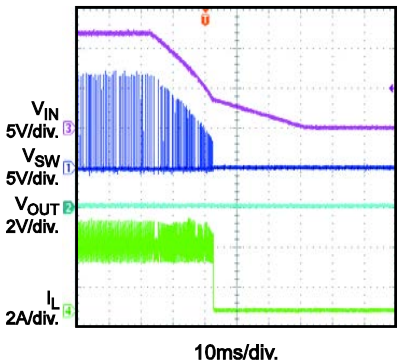

**LED+ Short to GND Recovery**
$I_{LED}$ = 1.5A




**LED+ Short to GND**
**Input Power On**



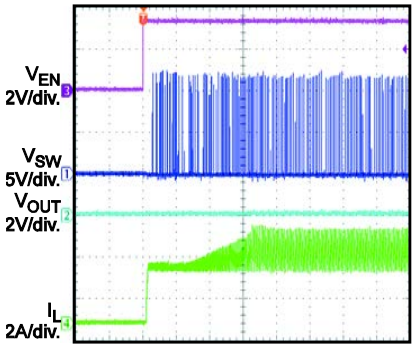

**LED+ Short to GND**
**Input Power Off**



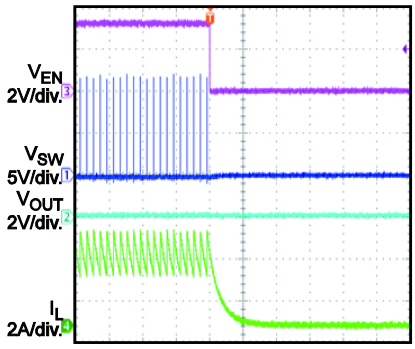
## EVB TEST RESULTS *(continued)*

**Performance waveforms are tested on the evaluation board.**
**$V_{IN}$ = 12V, LOAD=2 series LED, L=2.2µH, $F_{SW}$=2.2MHz, $T_A$ = +25°C, unless otherwise noted.**

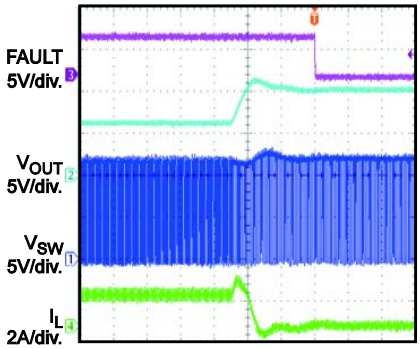
**LED+ Short to GND EN On**



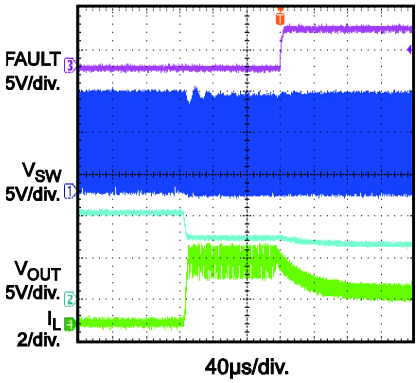

**LED+ Short to GND EN Off**



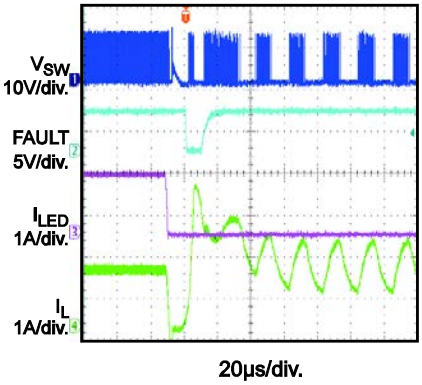

**LED Open Entry**




**LED Open Recovery**




**LED+ and LED- Short Entry**




**LED+ and LED- Short Recovery**