# EV4034-S-00D

**85VAC~265VAC/50Hz, 10V/350mA**
**Non-Isolation Off-line LED Driver Evaluation Board**

The Future of Analog IC Technology

## DESCRIPTION

The EV4034-S-00D Evaluation Board is designed to demonstrate the capabilities of MP4034. The MP4034 can be used for non-isolated LED lighting controller.

The EV4034-S-00D typically drives a 3.5W LED string with a $10V_{TYP}$, 350mA LED load from 85VAC to 265VAC, at 50Hz.

The EV4034-S-00D has excellent efficiency and meets IEC61547 surge immunity and EN55015 conducted EMI requirements. It has multiple protections, including lamp open protection, short-circuit protection, a cycle-by-cycle current limit, and over-temperature protection.

## ELECTRICAL SPECIFICATION

| Parameter | Symbol | Value | Units |
|---|---|---|---|
| Input Voltage | $V_{IN}$ | 85 to 265 | VAC |
| Output Voltage | $V_{OUT}$ | 10 | V |
| LED Current | $I_{LED}$ | 350 | mA |
| Output Power | $P_{OUT}$ | 3.5 | W |
| Average Efficiency (full load) | η | >80 | % |

## FEATURES

- No External Compensation Components
- Precise Constant Current (CC)
- Integrated 700V MOSFET with Minimal External Components
- Variable Off-Time Peak-Current Control
- 600μA High-Voltage Current Source
- Up to 3.5W Output Power
- Over-Voltage Protection (OVP)
- Over-Temperature Protecction (OTP)
- Lamp Open Protection
- Natural Frequency Dithering for Improved EMI Signature
- Low Cost and Simple External circuit
- Fits GU10 LED

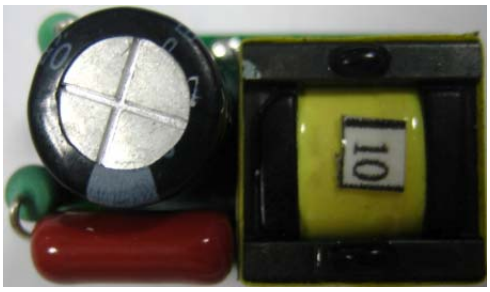
## APPLICATIONS

- Solid State Lighting
- Industrial & Commercial Lighting
- Residential Lighting

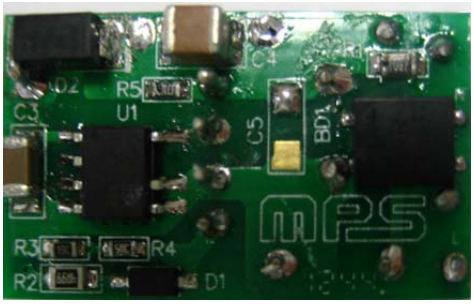



**Warning:** Although this board is designed to satisfy safety requirements, the engineering prototype has not been agency approved. Therefore, all testing should be performed using an isolation transformer to provide the AC input to the prototype board.

## EV4034-S-00D EVALUATION BOARD



**TOP VIEW**




**BOTTOM VIEW**

**(L x W x H) 27mm x 16mm x 16mm**

| Board Number | MPS IC Number |
|---|---|
| EV4034-S-00D | MP4034GS |

## EVALUATION BOARD SCHEMATIC

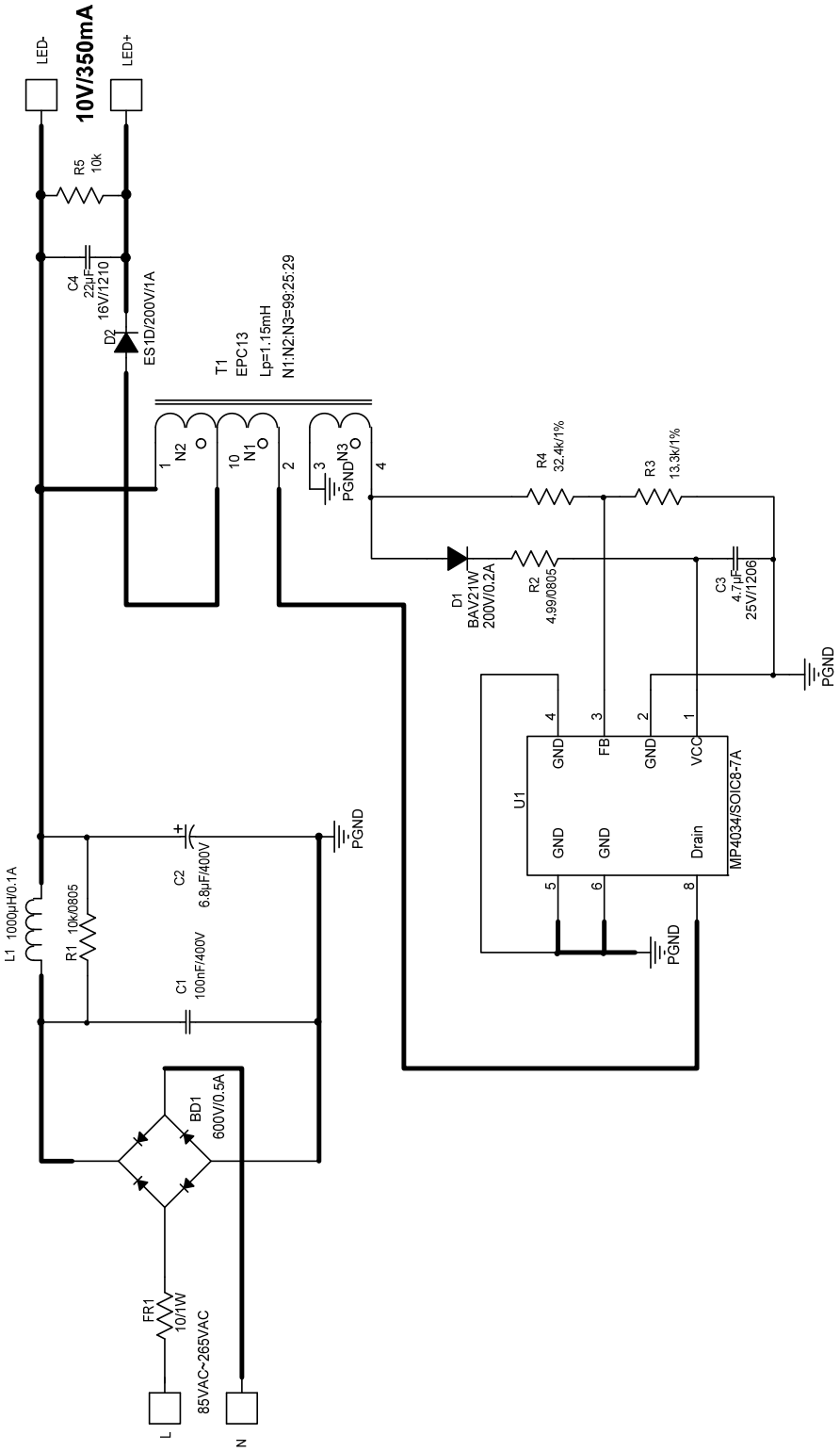



**Figure 1—Schematic**

## PCB LAYOUT (SINGLE-SIDED)

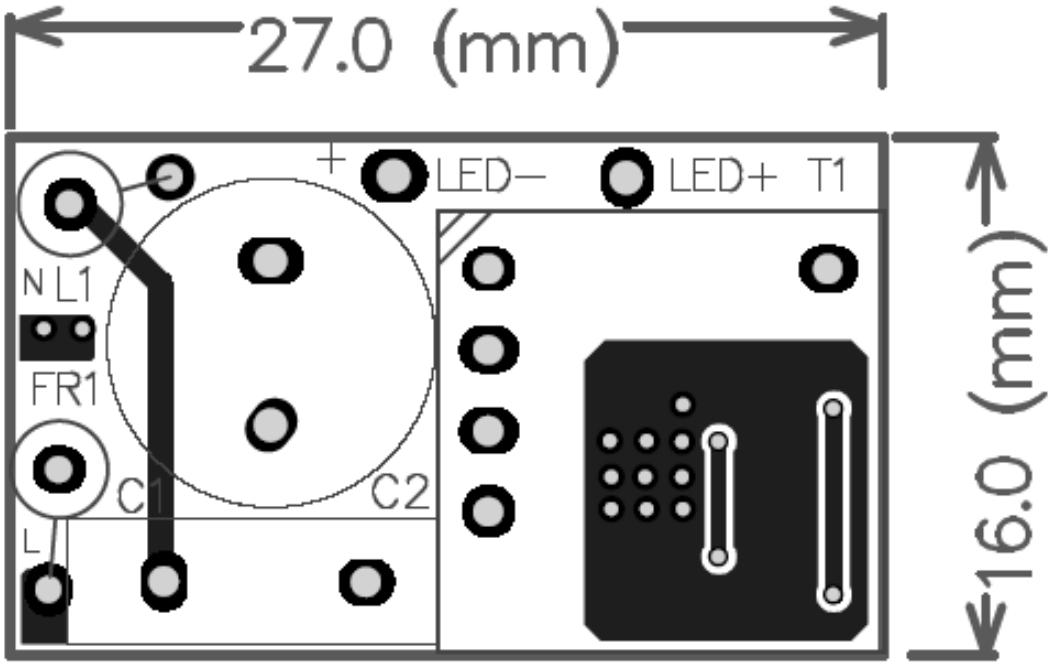



**Figure 2—Top Layer**

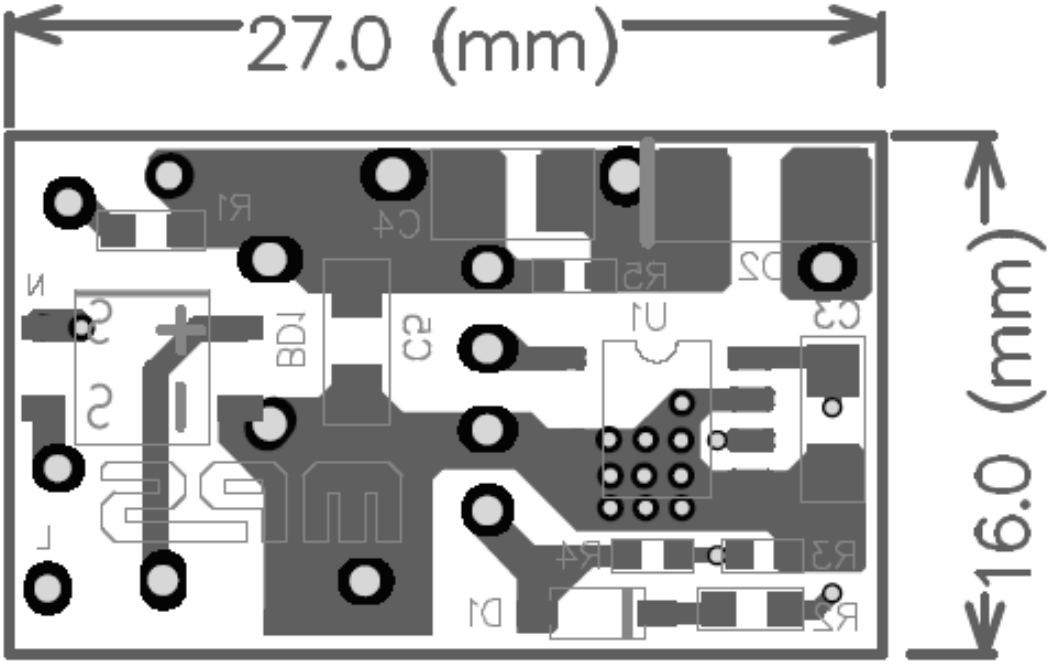



**Figure 3—Bottom Layer**

## CIRCUIT DESCRIPTION

The EV4034-S-00D is configured for non-isolation control topology, It can simplify the schematic and reduce BOM costs. It can also achieve an accurate LED current.

The input stage consists of FR1 and BD1. FR1 is protects against component failure or some excessive short events, and can restrain the inrush current.

The $\pi$ filter (C1, L1 and C2) guarantees that the conducted EMI meets the EN55015 standard.

R2, C3 and D1 provide the VCC power supply.

The resistor divider (R3 and R4) provides lamp open protection by sampling the voltage on the auxiliary winding. When an open circuit occurs, the output voltage remains constant.

T1 is the power transformer, the structure of which is also very important to pass EMI test.

D2, C4 and R5 compose output circuit. D2 is a schottky diode for better efficiency. C4 is a ceramic capacitor for lower output voltage ripple and R5 is the dummy load for lamp open protection..

## EV4034-S-00D BILL OF MATERIALS

| Qty | RefDes | Value | Description | Package | Manufacturer | Manufacturer_PN |
|---|---|---|---|---|---|---|
| 1 | BD1 | MB6F | Diode;600V;0.5A | SOP-4 | Bangdayuan | MB6F |
| 1 | C1 | 100nF | Capacitor;400V;CBB | DIP | Panasonic | ECQE4104KF |
| 1 | C2 | 6.8μF | Electrolytic Capacitor; 400V | DIP | LTEC | TY 6.8μF/400V |
| 1 | C3 | 4.7μF | Ceramic Capacitor; 25V;X7R | 1206 | TDK | C3216X7R1E475K |
| 1 | C4 | 22μF | Ceramic Capacitor; 16V;X7R | 1210 | muRata | GRM32ER71C226KEA8L |
| 1 | D1 | BAV21W | Diode;200V;0.2A | SOD-123 | Diodes | BAV21W-7-F |
| 1 | D2 | ES1D | Diode;200V;1A | SMA | Taiwan Semiconductor | ES1D |
| 1 | FR1 | 10 | Resistor;5%;1W | DIP | Yageo | FKN1WSJT-52-10R |
| 1 | L1 | 1000μH | Inductor; 17.4Ω;0.1A | DIP | Bangdayuan | CKL0410-102 |
| 1 | R1 | 10kΩ | Film Resistor; 1%;1/8W | 0805 | Yageo | RC0805FR-0710KL |
| 1 | R2 | 4.99Ω | Film Resistor; 5%;1/8W | 0805 | Yageo | RC0805FR-074R99L |
| 1 | R3 | 13.3kΩ | Film Resistor;1% | 0603 | Yageo | RC0603FR-0713K3L |
| 1 | R4 | 32.4kΩ | Film Resistor;1% | 0603 | Yageo | RC0603FR-0732K4L |
| 1 | R5 | 10kΩ | Film Resistor;5% | 0603 | Yageo | RC0603JR-0710K |
| 1 | T1 | 1.15mH | EPC13; N1:N2:N3=99:25:29 | DIP | Emei | FX0279 |
| 1 | U1 | MP4034 | Primary-Side Regulator | SOIC8-7A | MPS | MP4034GS |

# TRANSFORMER SPECIFICATION

## Electrical Diagram

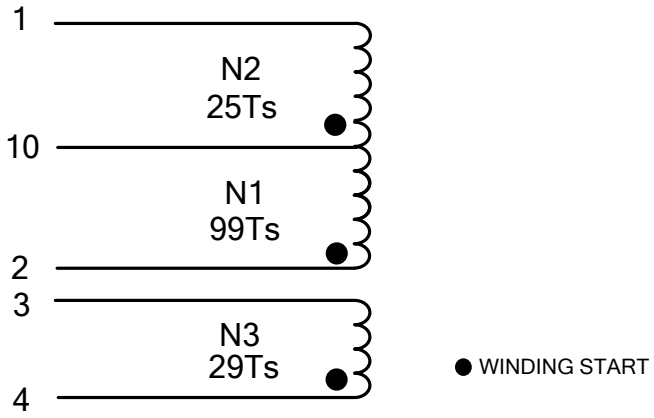



**Figure 4—Transformer Electrical Diagram**

## Winding Diagram

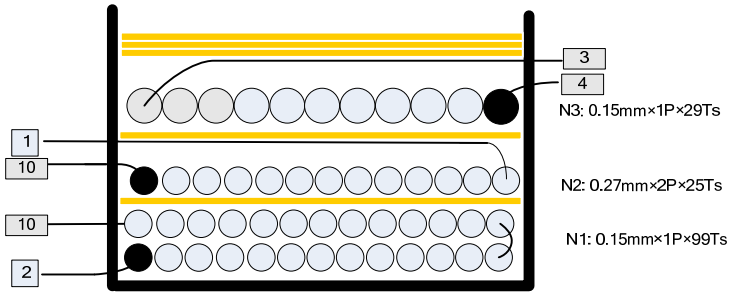



**Figure 5—Winding Diagram**

## Winding Order

| Winding No. | Tape Layer Number | Start & End | Magnet WireΦ(mm) | Turns |
|---|---|---|---|---|
| N1 | 1 | 2→10 | 0.15mm * 1 | 99 |
| N2 | 1 | 10→1 | 0.27mm * 2 | 25 |
| N3 | 3 | 4→3 | 0.15mm * 1 | 29 |

## Materials

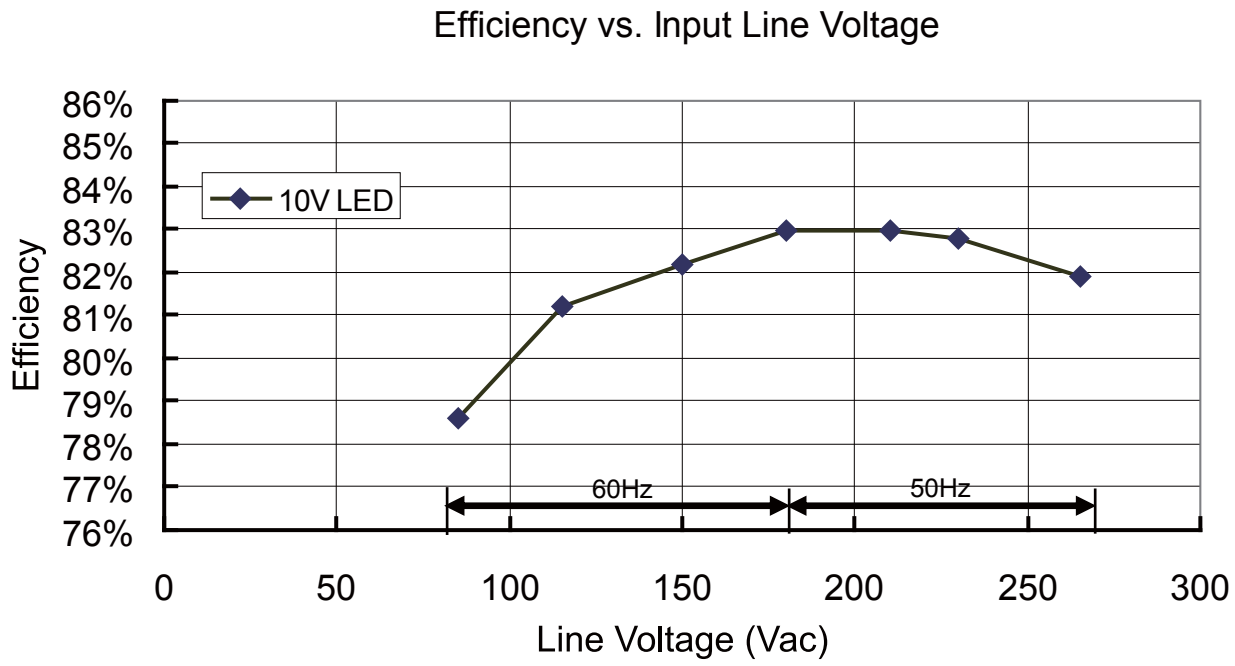
| Item | Description |
|---|---|
| 1 | Core: EE13, UI=2500±25%, AL=74.8nH/$N^2$±3% GAPPED, ACME P4 or equivalent |
| 2 | Bobbin: EPC13, 5+5PIN 1 SECT TH, UL94V-0 |
| 3 | Wire:Φ0.15mm, 2UEW, Class B |
| 4 | Wire: Φ0.27mm ,2UEW, Class B |
| 5 | Tape: 4.0mm(W)×0.06mm(TH) |
| 6 | Tape: 7.5mm(W)×0.06mm(TH) |
| 7 | Varnish: JOHN C. DOLPH CO, BC-346A or equivalent |
| 8 | Solder Bar: CHEN NAN: SN99.5/Cu0.5 or equivalent |

# EVB TEST RESULTS

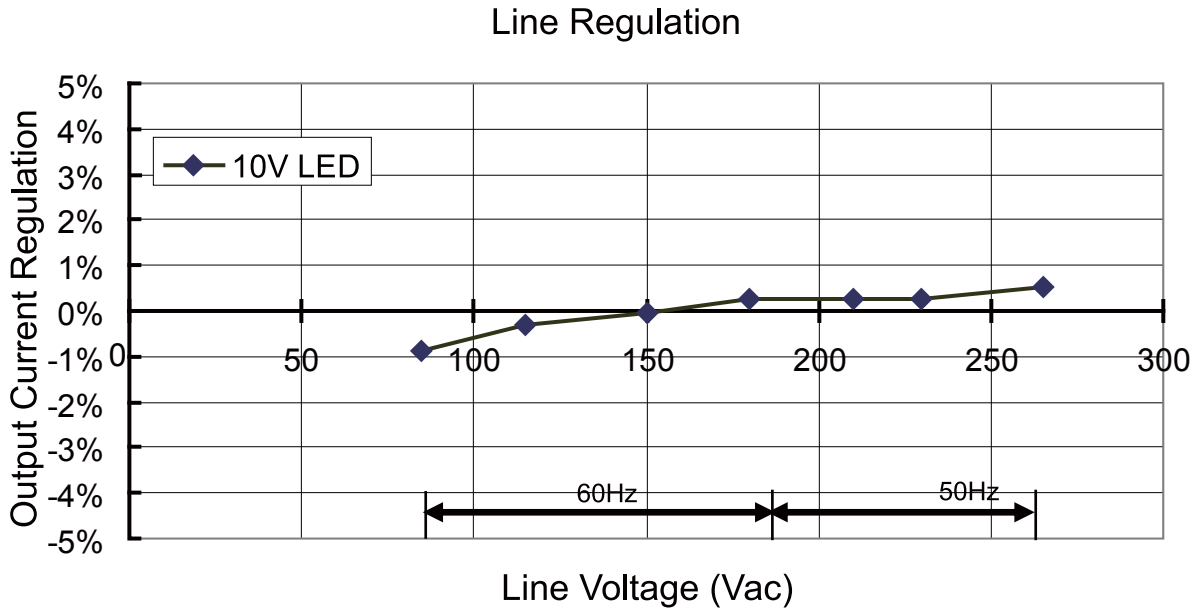
## Performance Data

### Efficiency

| *f* (Hz) | Vin (VAC) | Pin (W) | Vout (V) | Iout (mA) | Pout (W) | Efficiency (%) |
|---|---|---|---|---|---|---|
| 60 | 85 | 4.55 | 10.22 | 350 | 3.58 | 78.61 |
| | 115 | 4.43 | 10.22 | 352 | 3.60 | 81.21 |
| | 150 | 4.39 | 10.22 | 353 | 3.61 | 82.18 |
| 50 | 180 | 4.36 | 10.22 | 354 | 3.62 | 82.98 |
| | 210 | 4.36 | 10.22 | 354 | 3.62 | 82.98 |
| | 230 | 4.37 | 10.22 | 354 | 3.62 | 82.79 |
| | 265 | 4.43 | 10.22 | 355 | 3.63 | 81.90 |



**Line Regulation**



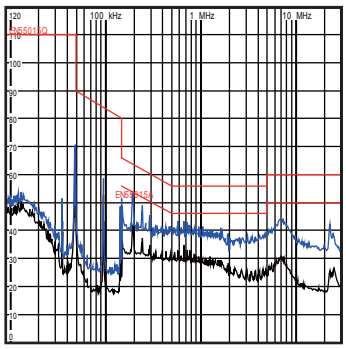

**Surge Test**

Line to Line 500V surge testing was completed according to IEC61547.
Input voltage was set at 230VAC/50Hz. Output was loaded at full load and operation was verified following each surge event.

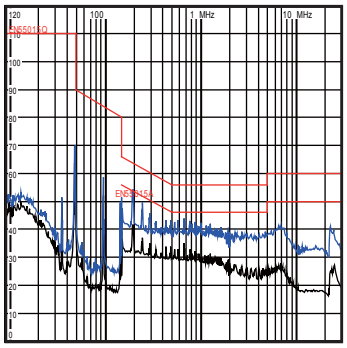
| Surge Level (V) | Input Voltage (VAC) | Injection Location | Injection Phase (°) | Test Result (Pass/Fail) |
|---|---|---|---|---|
| +/-500 | 230 | L to N | 0 | Pass |
| +/-500 | 230 | L to N | 90 | Pass |
| +/-500 | 230 | L to N | 180 | Pass |
| +/-500 | 230 | L to N | 270 | Pass |

## Conducted EMI Test

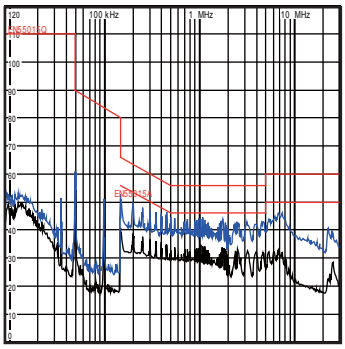
### Conducted EMI Test
110Vac, 60Hz, Maximum Load,
L Line, EN55015 Limits



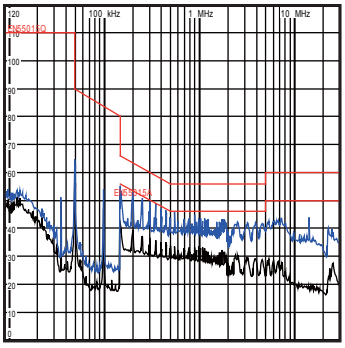

### Conducted EMI Test
110Vac, 60Hz, Maximum Load,
N Line, EN55015 Limits




### Conducted EMI Test
220Vac, 50Hz, Maximum Load,
L Line, EN55015 Limits

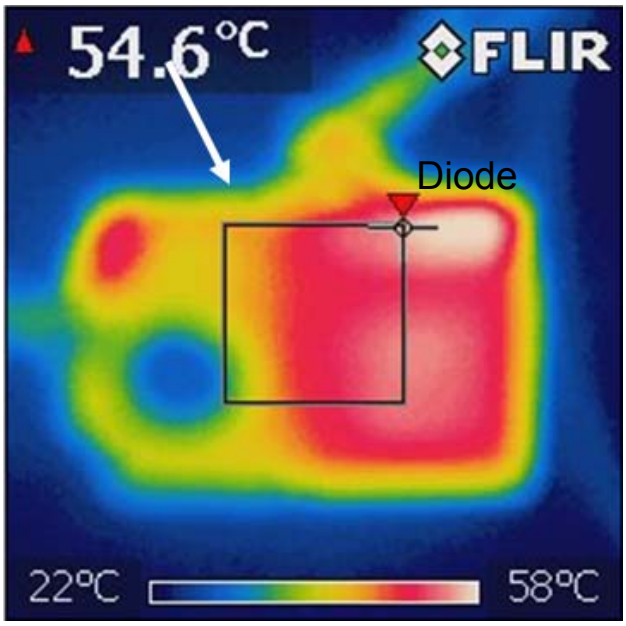



### Conducted EMI Test
220Vac, 50Hz, Maximum Load,
N Line, EN55015 Limits

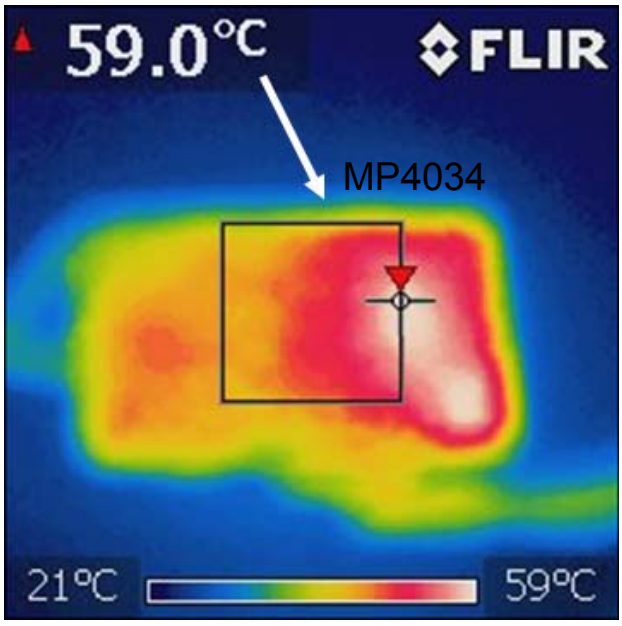


**Thermal Test**

Test with 85Vac input and full load condition ($T_A$=25°C)




**Top Layer**

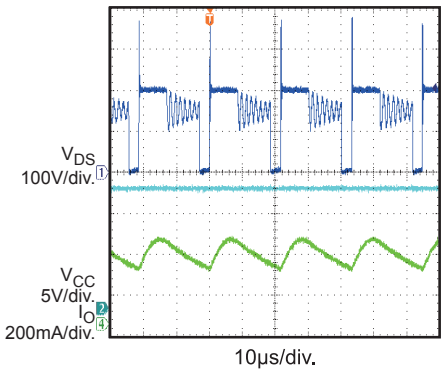



**Bottom Layer**

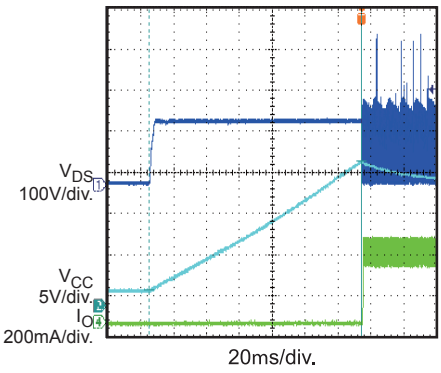
# EVB TEST RESULTS

**Performance waveforms are tested on the evaluation board.**
**$V_{IN}$=110VAC/60Hz, 3 LEDs in series, $I_{LED}$=350mA, $V_{OUT}$=10V, $L_P$=1.15mH, $N_1$:$N_2$:$N_3$=99:25:29**

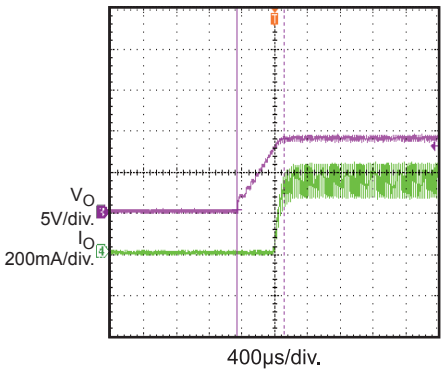
### Steady State



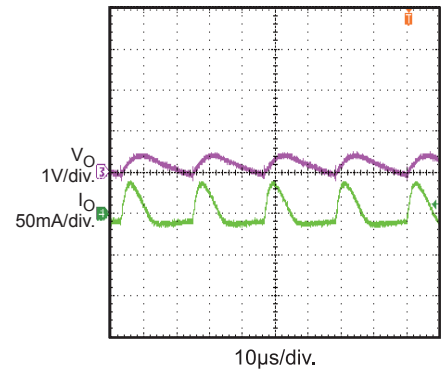

### Turn On Delay



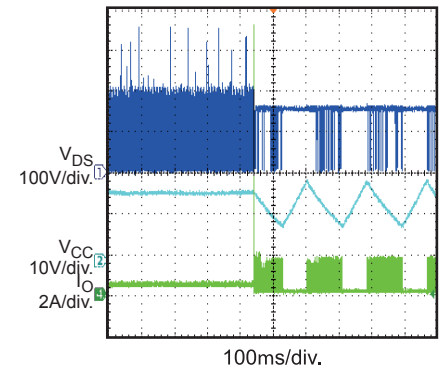

### Output Rise Time



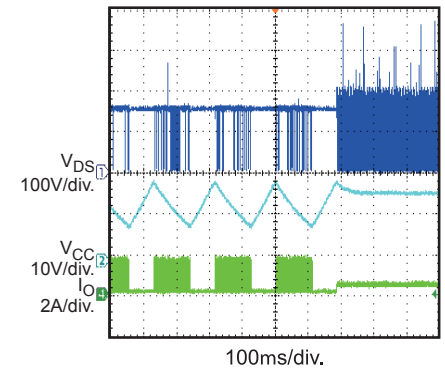

### Output Ripple



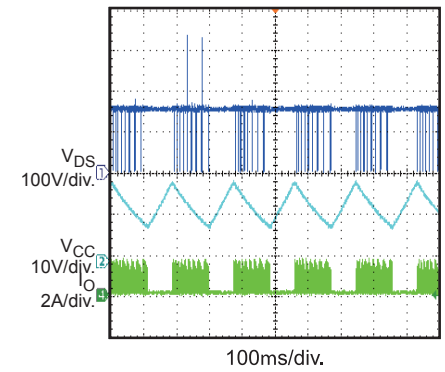

### SCP Enter



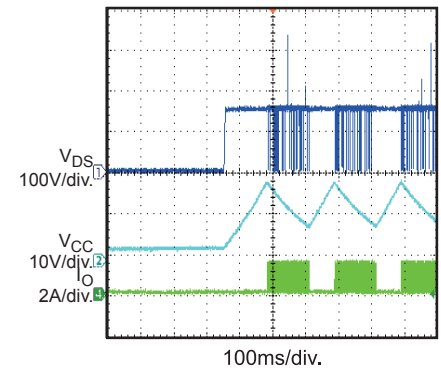

### SCP Recovery



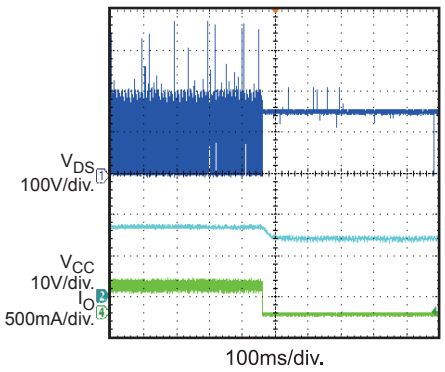

### SCP Steady State




### SCP Start Up



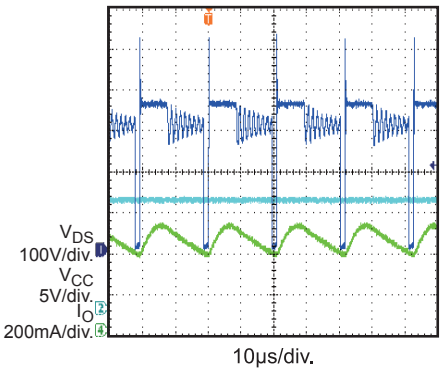

### Lamp Open Protection



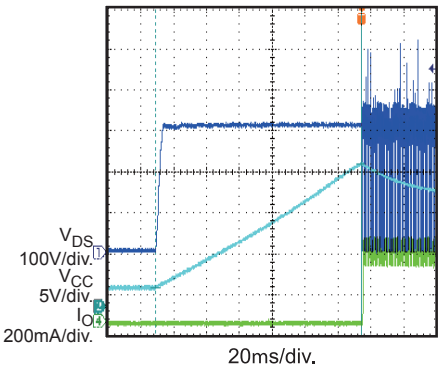
## EVB TEST RESULTS *(continued)*

**Performance waveforms are tested on the evaluation board.**
**$V_{IN}$=220VAC/50Hz, 3 LEDs in series, $I_{LED}$=350mA, $V_{OUT}$=10V, $L_P$=1.15mH, $N_1$:$N_2$:$N_3$=99:25:29**

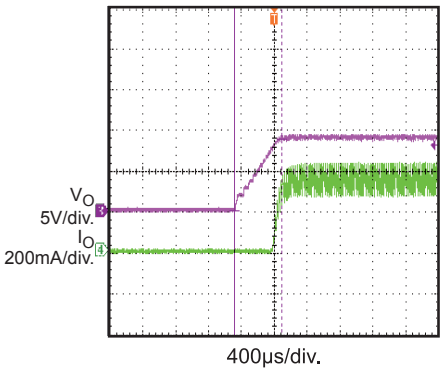
### Steady State



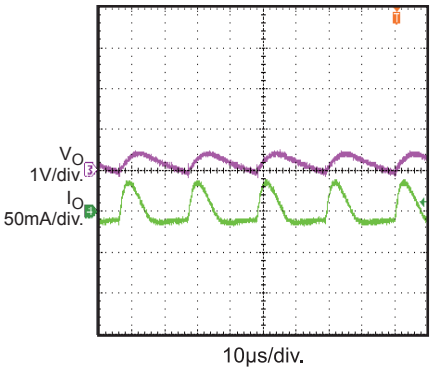

### Turn On Delay



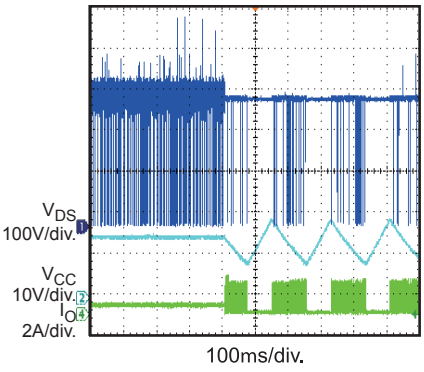

### Output Rise Time



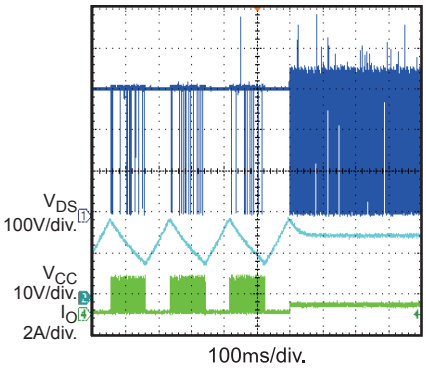

### Output Ripple



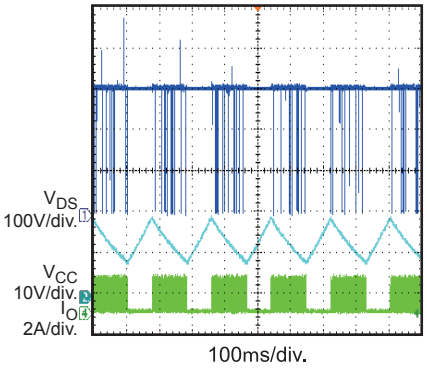

### SCP Enter



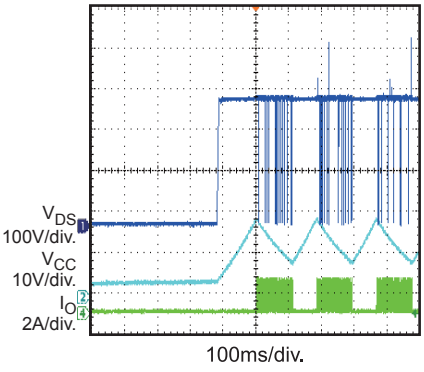

### SCP Recovery



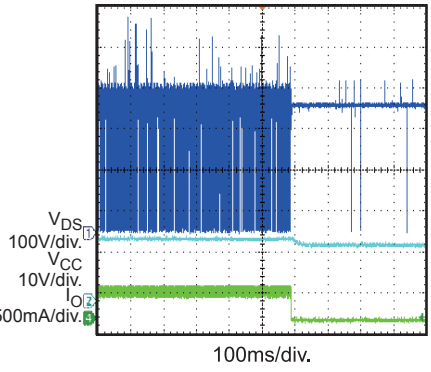

### SCP Steady State




### SCP Start Up




### Lamp Open Protection



## QUICK START GUIDE

1. Preset AC Power Supply to 85VAC ≤ $V_{IN}$ ≤265VAC.
2. Turn Power Supply off.
3. Connect the LED string between “LED+” (anode of LED string) and “LED-” (cathode of LED string).
4. Connect Power Supply terminals to AC $V_{IN}$ terminals as shown on the board.
5. Turn AC Power Supply on after making connections.