

FL7760LED1GEVK

3W SPI Controllable LED Driver Evaluation Board User's Manual

OVERVIEW

This manual covers the specification, theory of operation, testing and construction of the FL7760LED1GEVK demonstration kit. The FL7760 kit demonstrates a 1 A buck LED driver intended for a single high-power LED. The SPI (Serial Peripheral Interface) bus does both analog and PWM dimming. The kit includes a load/SPI interface board to facilitate operation of the driver. The driver can be driven independently from any SPI controller. The nominal input voltage is 12 V.

Table 1. SPECIFICATIONS

| | | |
|---------------------|-----------------------|------|
| Input Voltage | 10.8 V dc – 13.2 V dc | |
| Output Voltage | 2.5 V dc – 5.0 V dc | |
| Output Current | 1 A | Max |
| Output Ripple | 40 mA | P–P |
| Efficiency | 85% | Typ. |
| Switching Frequency | 200 kHz | |
| Rise/Fall Time | < 20 μ s | |
| Dimming Interface | SPI | |
| Dimming Resolution | 8 bits | |
| PCB Size | 30 mm \times 30 mm | |

The key features of this demo kit include:

- Low Parts Count
- Single Sided Assembly
- Small Footprint
- Very Fast Rise/Fall Times
- SPI Dimming Control for Analog and PWM Dimming
- 12 V Operation
- Integrated Thermal Shutdown and UVLO

THEORY OF OPERATION

Power Stage

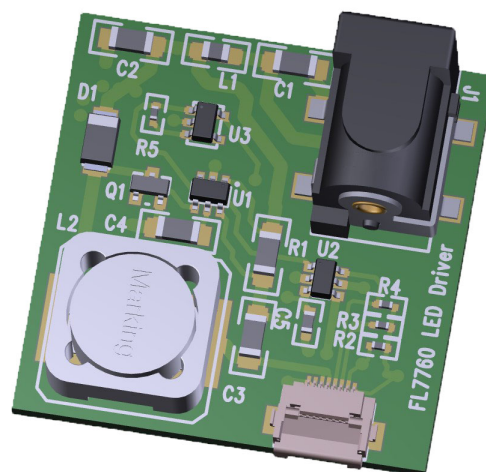
The power stage is a CCM inverted buck converter. The output inductor sets the switching frequency because the control operates in hysteretic control mode. The peak and valley current are fixed percentages of the current reference. This fixes the inductor ripple current and eliminates the need for closed loop compensation. A novel high side current sense enables direct accurate control of the output current.



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**FL7760LED1GEVK
Evaluation Board**

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HV Start

The FL7760 supplies its own Vcc power greatly simplifying implementation. The input voltage range is 8 V – 70V. The internal Vcc regulates to 5 V ± 10%. The internal Vcc supplies a 3.3 V LDO for powering the DAC. The regulator and DAC draw less than 1mA combined.

Dimming

The FL7760 dim input controls both amplitude and on/off control. This makes the dim interface controllable by analog, PWM, or both at the same time. The DAC has an output range of 0 V – 3.3 V for 8 bits of resolution. A dim signal below 0.5 V turns off the output and a dim signal above 3 V is 100% output.

Protection

Thermal Protection

The thermal protection is built into the FL7760 and shuts down the FL7760 when the die temperature exceeds 150°C.

OVP

The output voltage is inherently limited to be less than or equal to Vin. As such, no OVP is required due this inherent limitation.

Load Board Operation

The load board connects to the LED driver via an 8 conductor FPC cable. The FPC cable makes a simple and convenient interconnection. The load board serves 2 major functions: 1) provide an easy connection to an LED load 2) provide a USB–SPI bridge for computer control of the LED driver.

The daughter card on the load has a mini USB–A connection for attachment to your computer. See the test procedure for details of the setup of the SPI terminal application.

SCHEMATIC

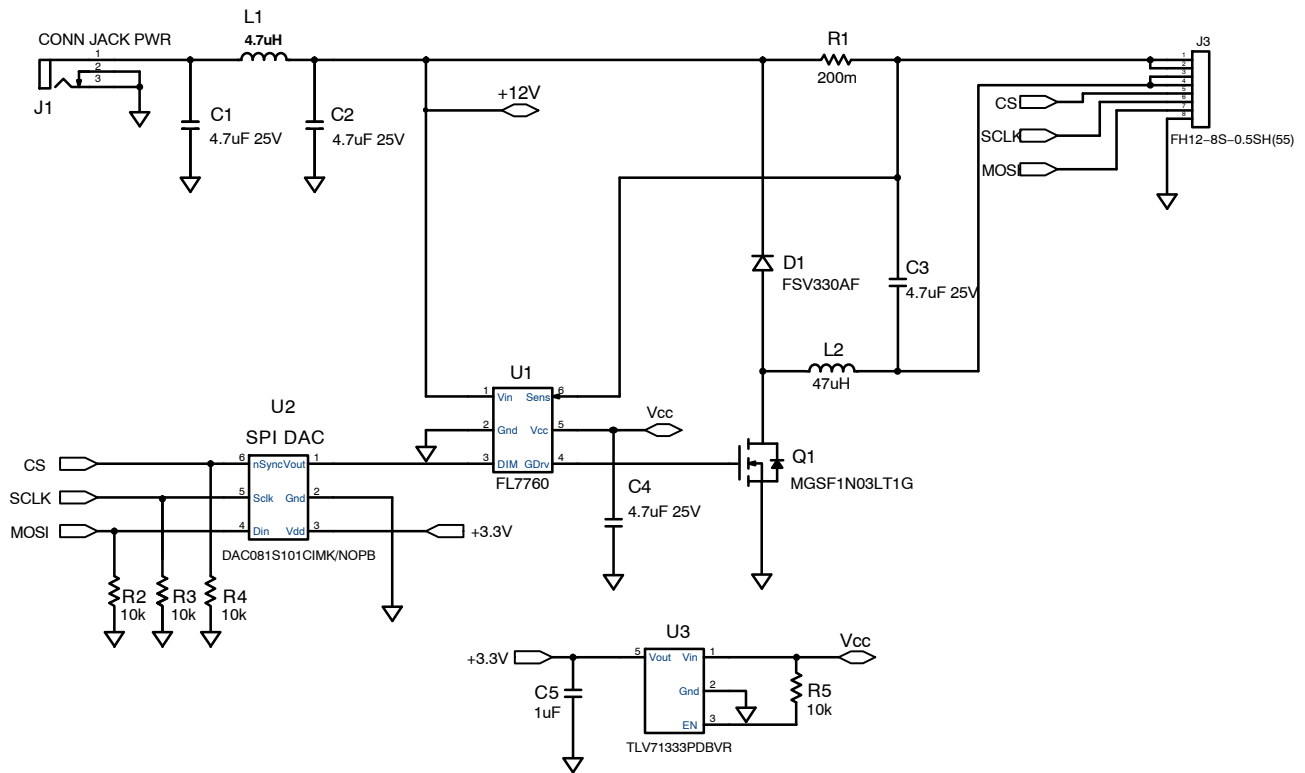


Figure 1. LED Driver Circuit

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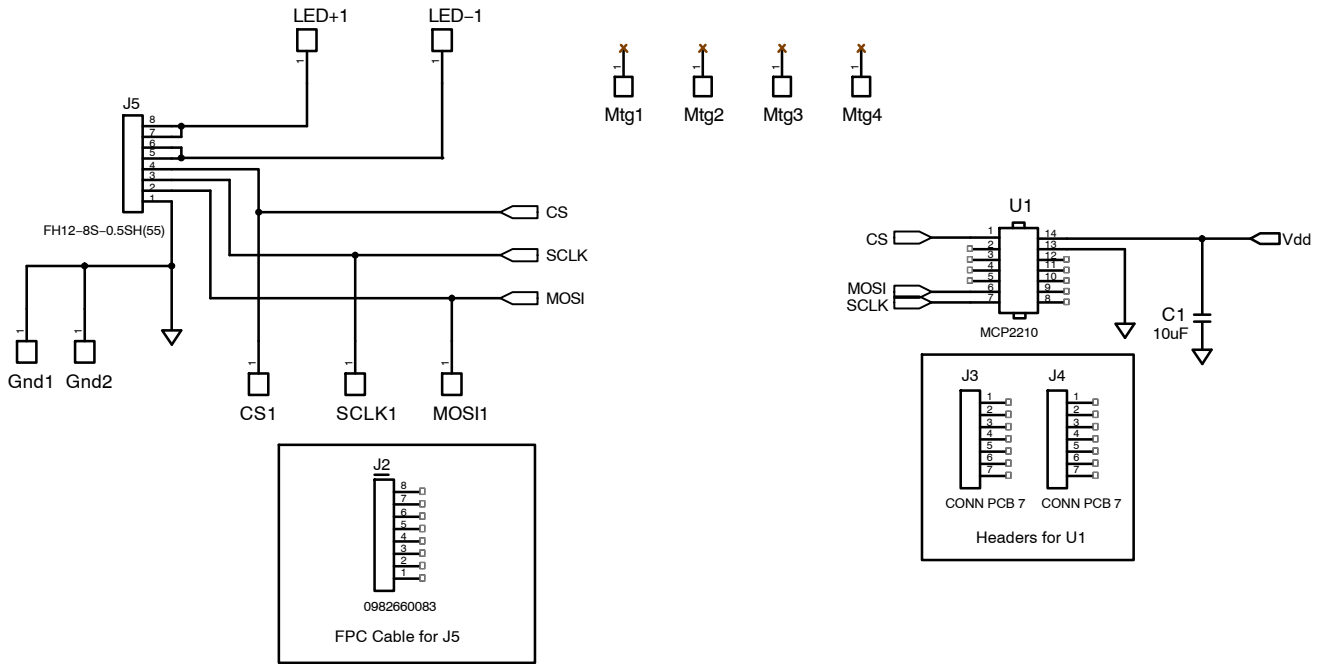


Figure 2. LED Driver Circuit

Table 2. BILL OF MATERIAL

| Qty | Reference | Part | Distributor | Dist. P/N | Manufacturer | Mfr_PN |
|-----|-------------------------------|---------------------|------------------|--------------------------|------------------|---------------------|
| 4 | C1, C2, C3, C4 | 4.7 uF 25 V | Digikey | 1276-3178-1-ND | Samsung | CL31B475KAHNNWE |
| 1 | C5 | 1 uF | Digikey | 587-3247-1-ND | Taiyo Yuden | UMK107AB7105KA-T |
| 1 | D1 | FSV330AF | ON Semiconductor | FSV330AFCT-ND | ON Semiconductor | FSV330AF |
| 1 | J1 | CONN JACK PWR | Digikey | 732-5929-1-ND | Würth | 694106106102 |
| 1 | J3 | FH12-8S-0.5SH(55) | Digikey | H124618CT-ND | Hirose | FH12-8S-0.5SH(55) |
| 1 | L1 | 4.7 uH | Digikey | 445-6760-1-ND | TDK | MLZ2012N4R7LT000 |
| 1 | L2 | 4.7 uH | Digikey | 732-2197-1-ND | Würth | 7447715470 |
| 1 | Q1 | MGSF1N03LT1G | ON Semiconductor | MGSF1N03LT1GOSCT-ND | ON Semiconductor | MGSF1N03LT1G |
| 1 | R1 | 200 m | Digikey | CSR1206FKR200CT-ND | Stackpole | CSR1206FKR200 |
| 4 | R2, R3, R4, R5 | 10 k | Digikey | 311-10.0KLRCT-ND | Yageo | RC0402FR-0710KL |
| 1 | U1 | FL7760 | ON Semiconductor | FL7760 | ON Semiconductor | FL7760 |
| 1 | U2 | DAC081S101CIMK/NOPB | Digikey | DAC081S101CIMK/NOPBCT-ND | TI | DAC081S101CIMK/NOPB |
| 1 | U3 | TLV71333PDBVR | Digikey | 296-35591-1-ND | TI | TLV71333PDBVR |
| 5 | SCLK1, MOSI1, Gnd1, CS1, Gnd2 | Test Point | Digikey | 952-2264-1-ND | Harwin | S2751-46R |
| 1 | C1 | 10 uF | Digikey | 1276-6641-1-ND | Samsung | CL31B106MOHNNNE |
| 1 | J2 | 982660083 | Digikey | WM14102-ND | Molex | 982660083 |
| 2 | J3, J4 | CONN PCB 7 | Digikey | S7040-ND | Sullins | PPPC071LFBN-RC |
| 1 | J5 | FH12-8S-0.5SH(55) | Digikey | H124618CT-ND | Hirose | FH12-8S-0.5SH(55) |
| 2 | LED-1, LED+1 | MTG_Hole | Digikey | 3267 | Pomona | 3267 |
| 1 | U1 | MCP2210 | Digikey | ADM00419-ND | Microchip | ADM00419 |

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TEST PROCEDURE

Equipment Needed

- DC Source – 12 V ± 5% @ 1 A
- 2 – DC Voltmeter – 300 V dc minimum 0.1% accuracy or better
- 2 – DC Ammeter – 1 A dc minimum 0.1% accuracy or better
- LED Load – 2.5 V – 5.0 V @ 1.0 A

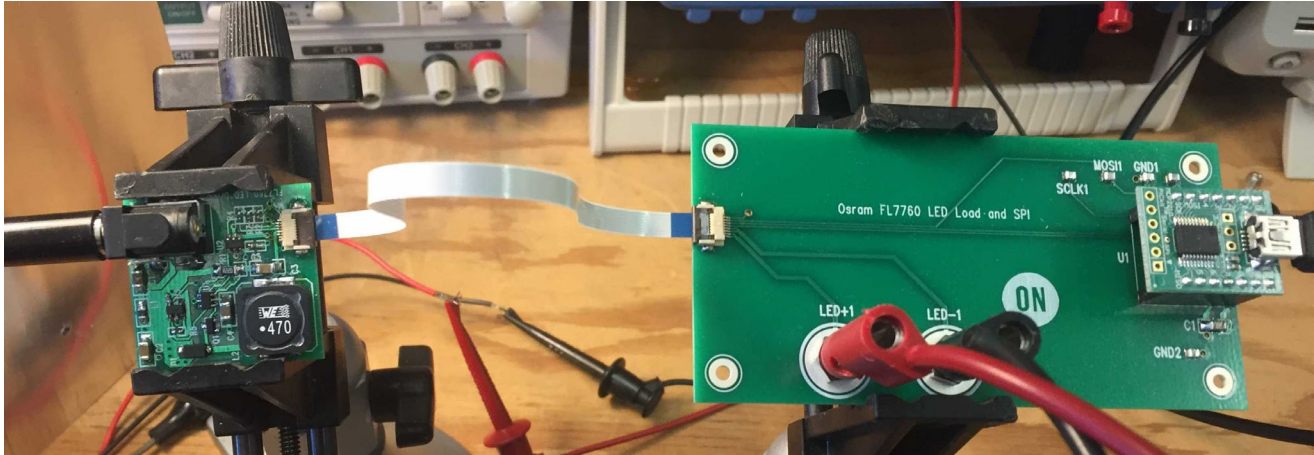


Figure 3. Test Set Up

The Connections

1. Connect the LED load board to the LED driver using the FPC cable provided in the kit.
2. Connect red (+) and black (-) leads through the ammeter to the LED load.
3. Connect a 12 V dc source to the input power connector.

NOTE: Unless otherwise specified, all voltage measurements are taken at the terminals of the UUT.

Functional Test Procedure

1. Set the LED Load for 3.5 V output.
2. Set the input voltage to 12 V.
3. Measure input voltage and current.
4. Measure output voltage and current.

Regulation

See Table 3.

Table 3. REGULATION

| DAC Data | I _{out} Target | Output Current | Output Voltage | Input Voltage | Input Current |
|----------|-------------------------|----------------|----------------|---------------|---------------|
| 00 00 | 0 A | | | | |
| 0F F0 | 1 A ± 5% | | | | |
| 07 00 | 0.5 A ± 5% | | | | |

$$\text{Efficiency} = \frac{V_{\text{out}} \times I_{\text{out}}}{V_{\text{in}} \times I_{\text{in}}} \times 100\%$$

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TEST DATA

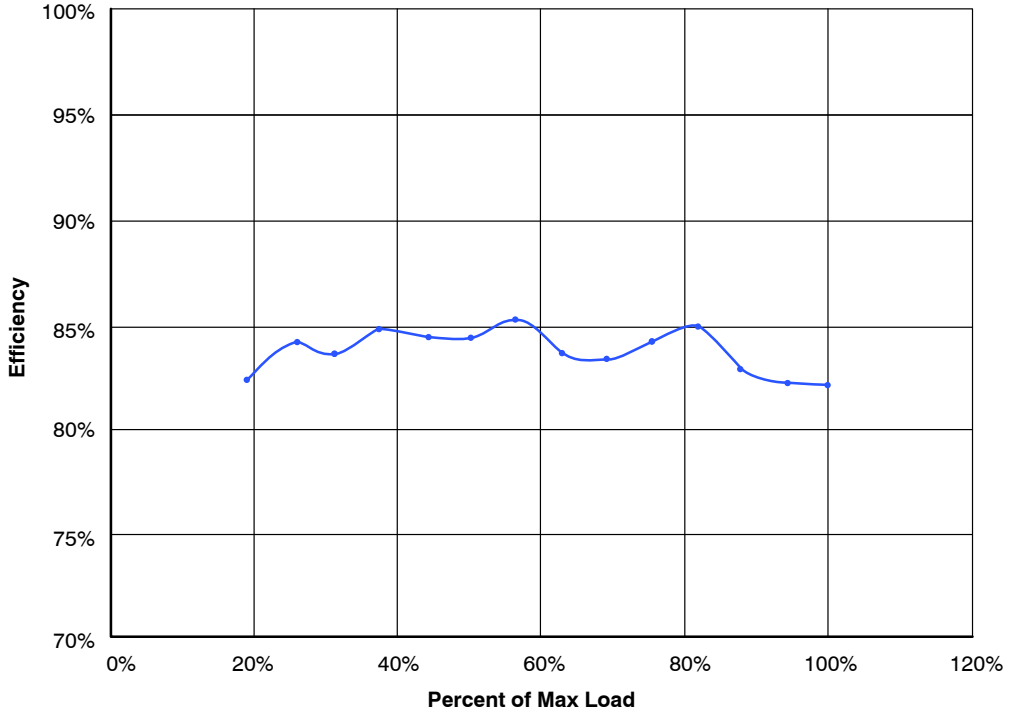


Figure 4. Efficiency

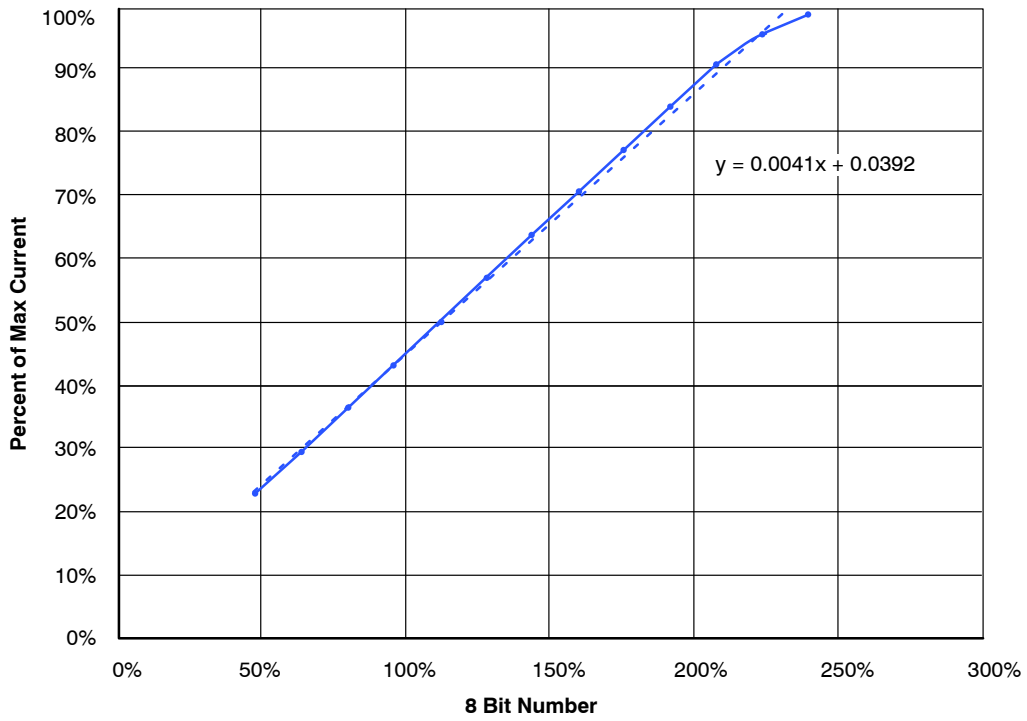


Figure 5. Dim Curve

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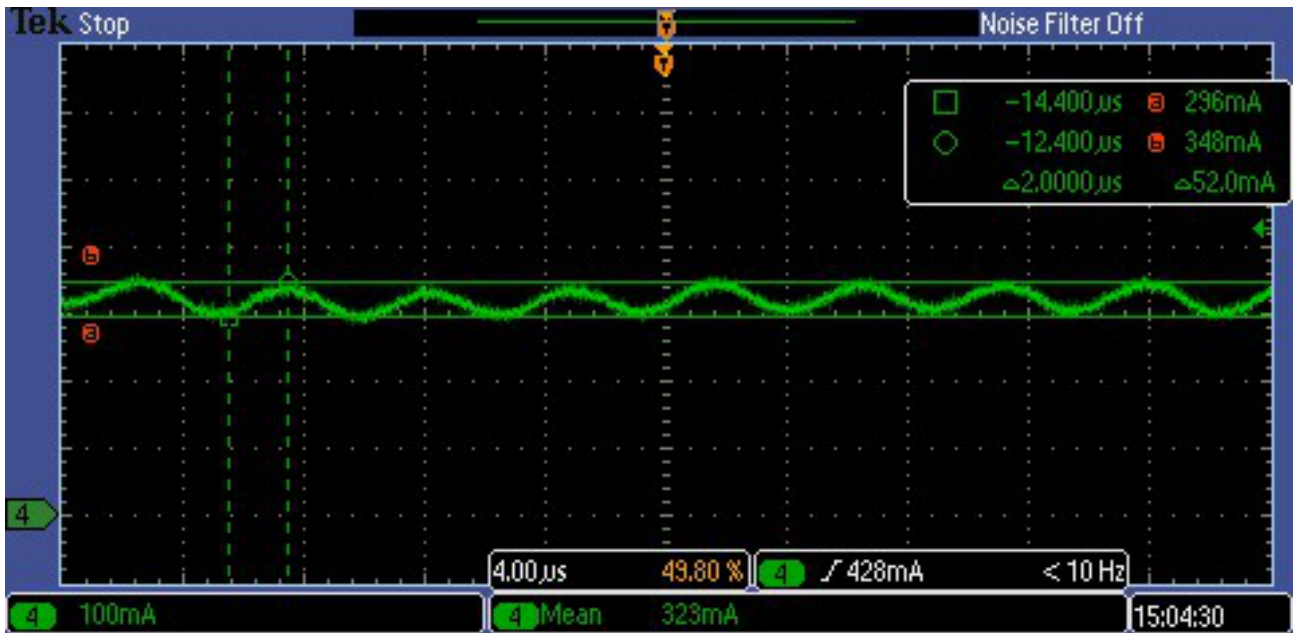


Figure 6. Input Current Ripple



Figure 7. Output Current Ripple

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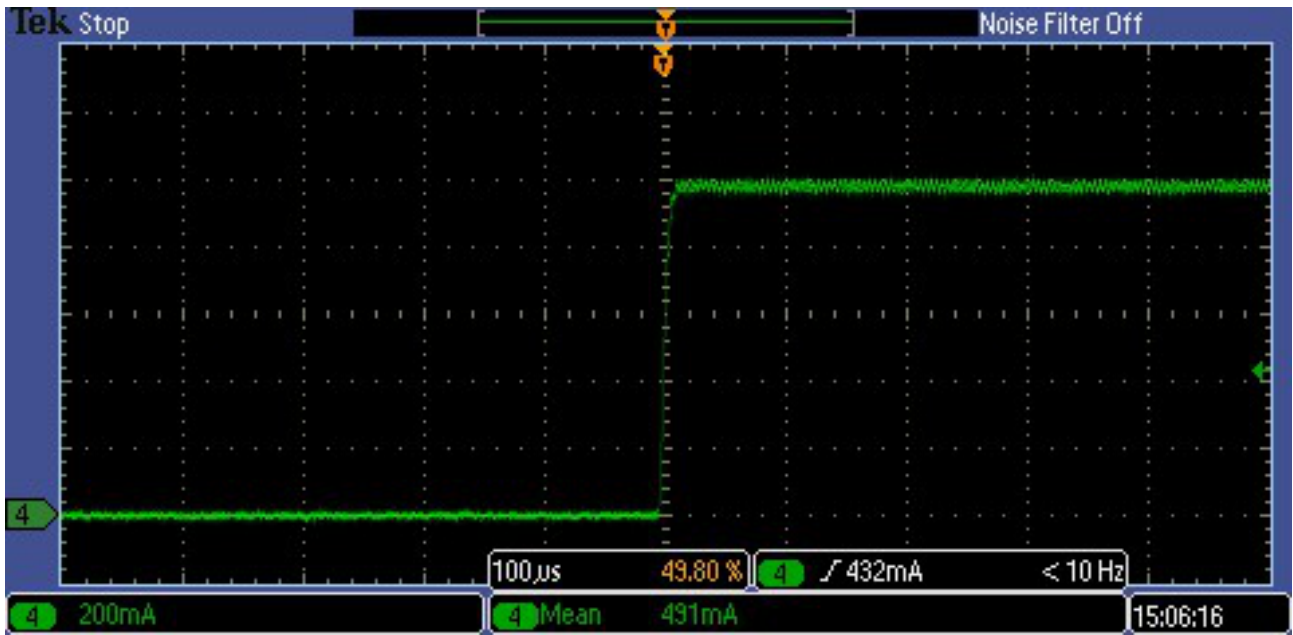


Figure 8. Input Current Rise

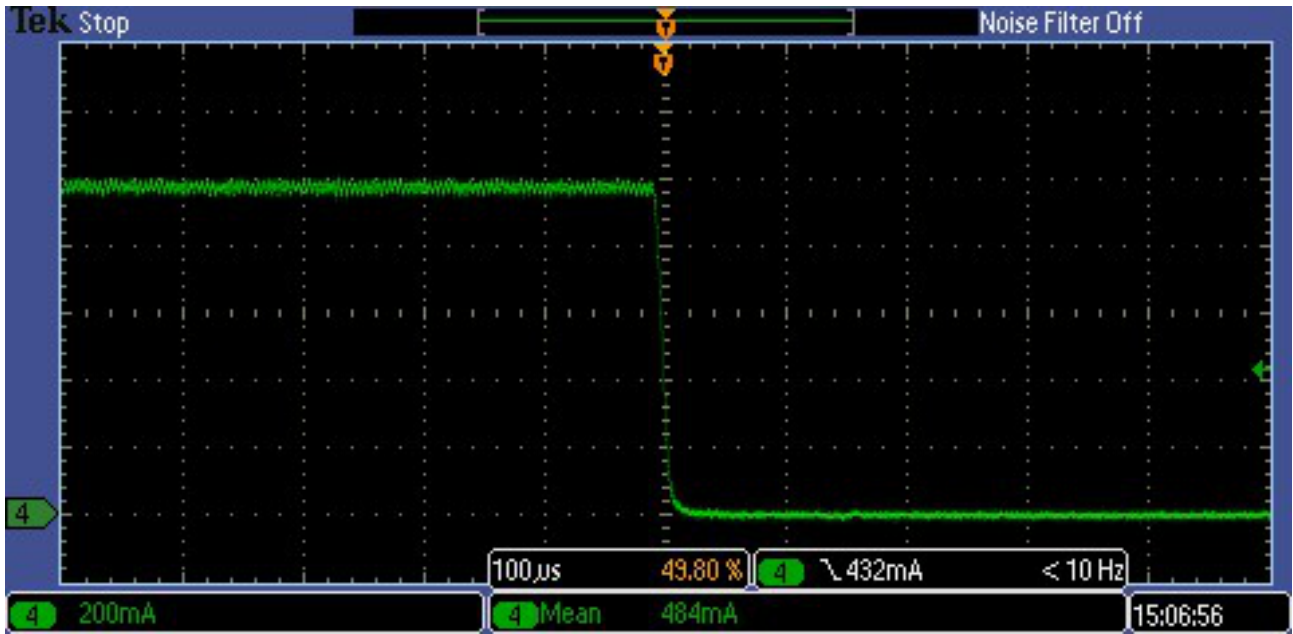


Figure 9. Output Current Fall

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THERMAL IMAGE

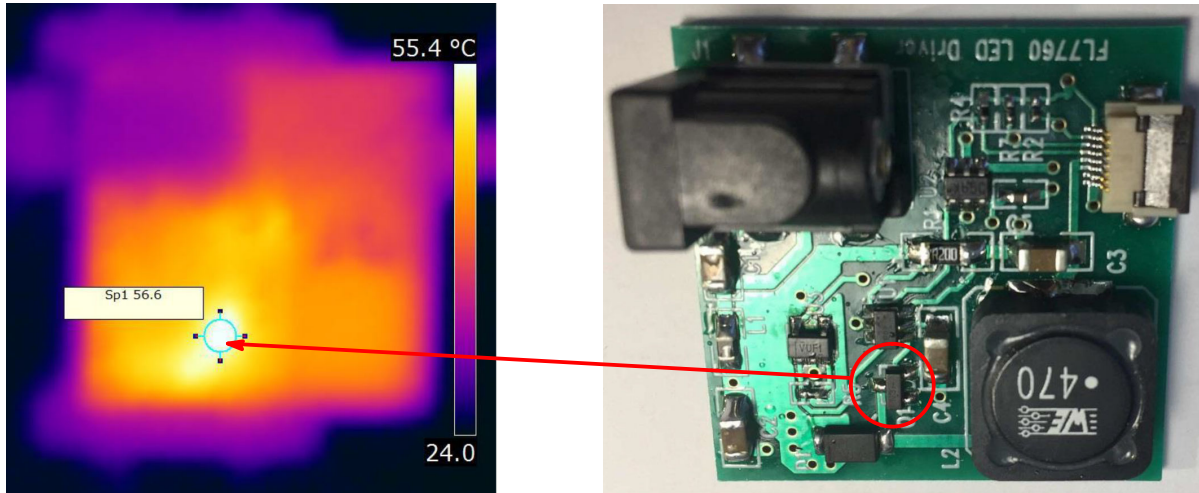


Figure 10.

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