AN-2182 LM3466 Demonstration Board Reference Design

1 Introduction

The LM3466 integrates a linear LED driver for lighting systems that consist of multiple LED strings powered by a constant current power supply. The LM3466 equalizes the current provided by the supply in a pre-set ratio for each active LED string, where an active string is a fully turned on LED string, regardless of the number of strings connected to the supply or the forward voltage of each LED string. If any LED string opens during operation, the LM3466 automatically equalizes the supply current through all of the remaining active LED strings. As a result, the overall brightness of the lighting system is maintained even if some LED strings open during operation. The LM3466 consists of only linear circuitry so that the EMI of the application circuit is not deteriorated.

This application report details the design of an LM3466 evaluation board that drives five LED strings, each of which consists of 14 LEDs. The input current I_S (of the constant current power supply) is 1.75A such that the LED current is 0.35A per string. The evaluation board schematic, PCB layout, Bill of Materials, and circuit design procedures are shown. Typical performance and operating waveforms are also provided for reference.

2 Demonstration Board Schematic and PCB

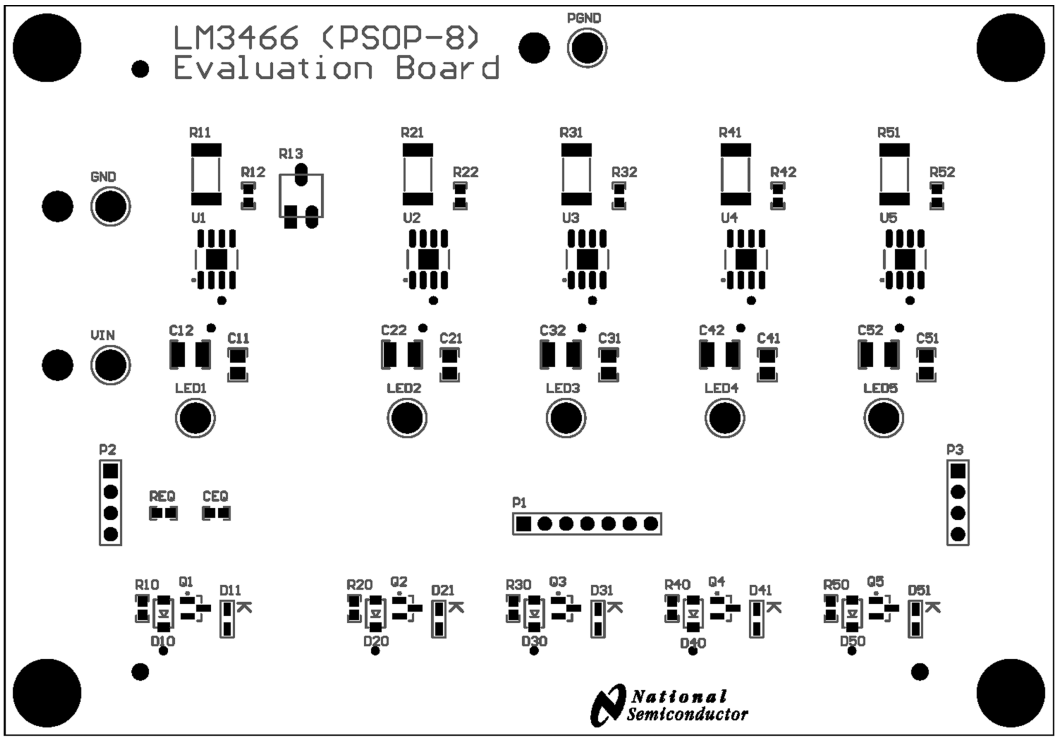

Figure 1. LM3466 Evaluation Board PCB Top Overlay

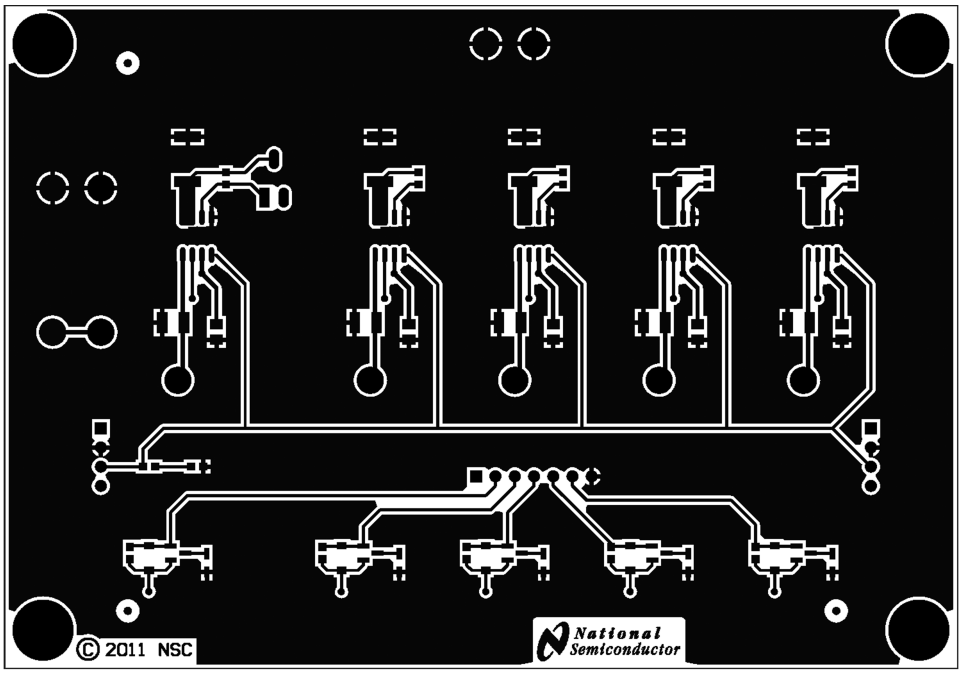

Figure 2. LM3466 Evaluation Board Top View

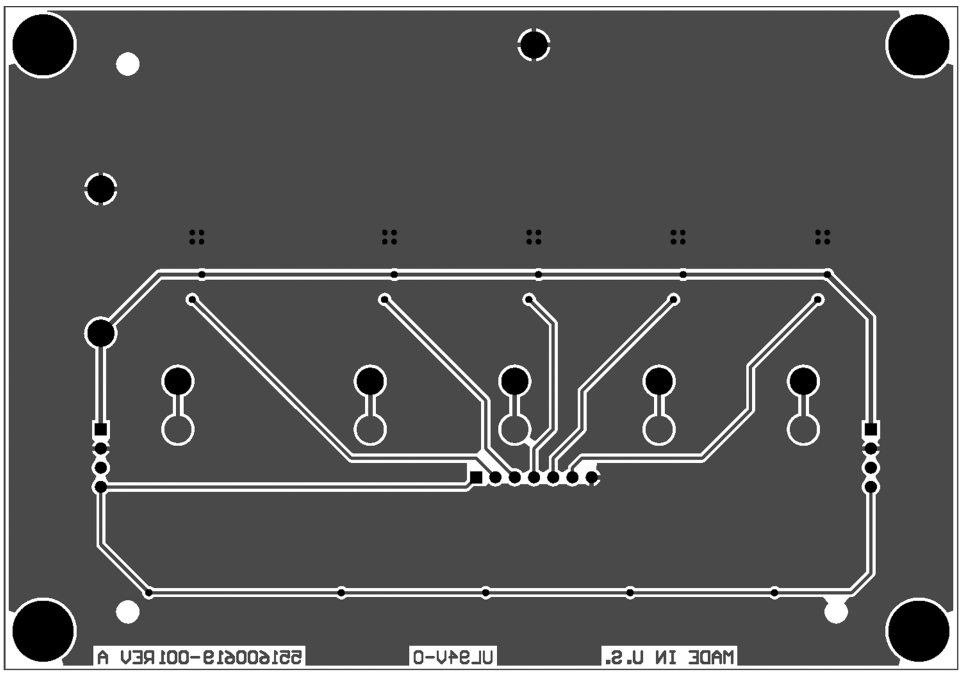

Figure 3. LM3466 Evaluation Board Bottom View

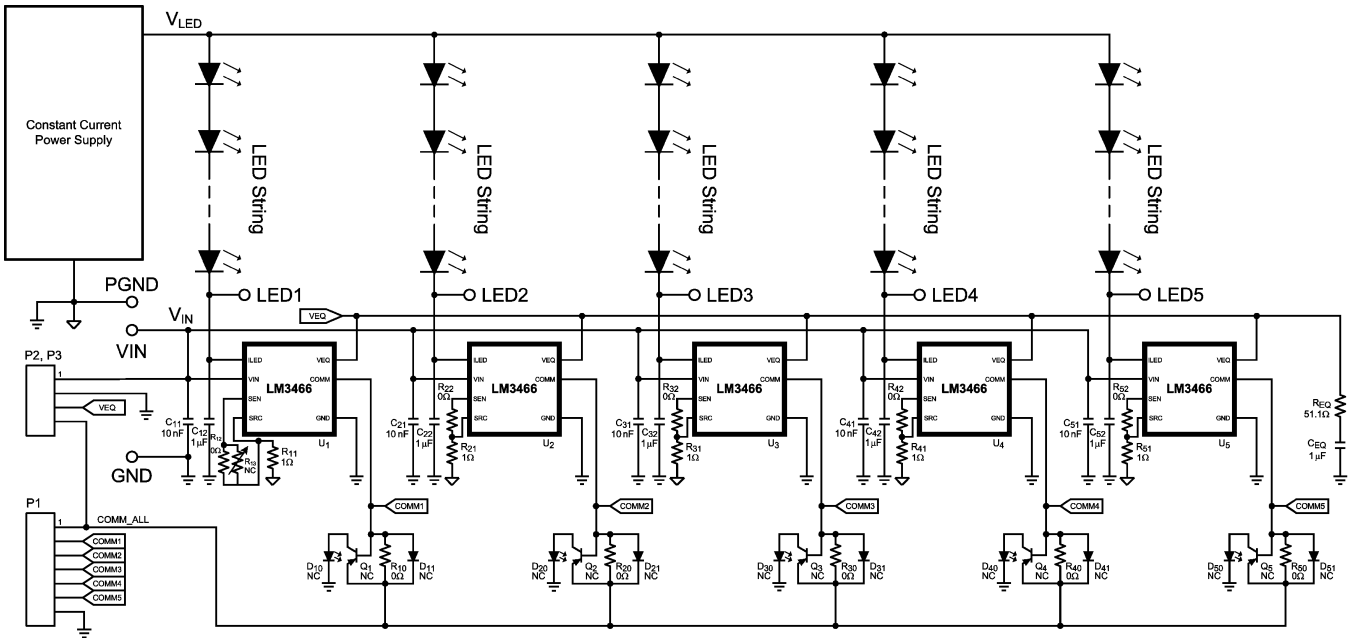

Figure 4. LM3466 Evaluation Board Schematic

Table 1. Evaluation Board Quick Setup Procedures

Step	Description	Notes
1	Connect a constant current power supply to VLED and PGND. The VIN terminal can be connected to VLED, or another voltage source ranged from 6 V to 70 V.	The supply current I_S is set to 1.75A, with a maximum output voltage of 48 V.
2	Connect five LED strings from VLED to LED1 to LED5 terminals.	Each LED string consists of 14 LEDs with a forward string voltage of lower than 48 V at 0.35A.
3	Turn on the power supply. The five LED strings are turned on and the current is 0.35A each.	The voltage on R11-R51 is 0.35 V.

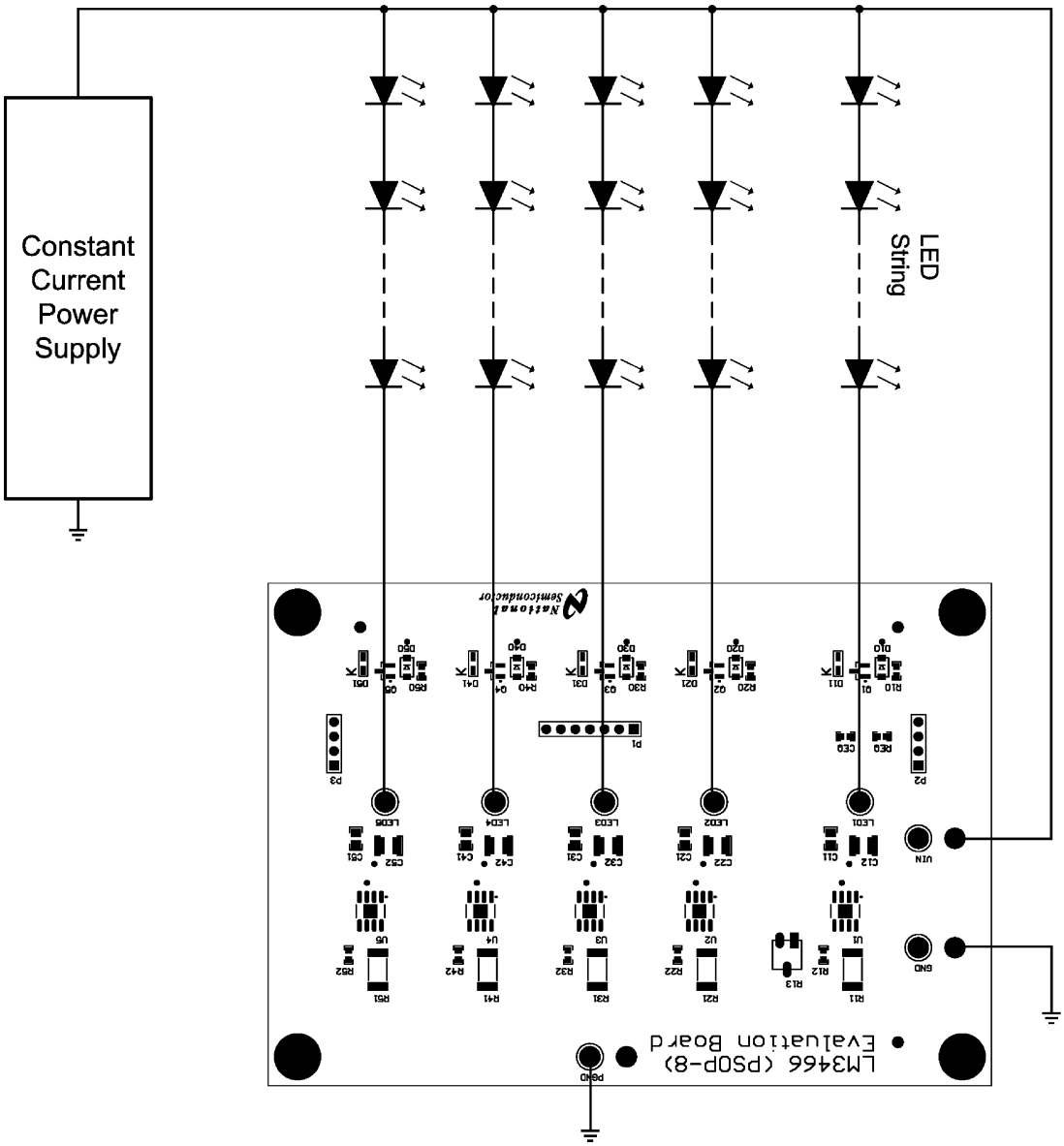

Figure 5. LM3466 Evaluation Board Connection Diagram

3 Design Procedure

The LM3466 evaluation board has 5 channels driving five LED strings powered by a constant current power supply (I_S = 1.75A). It is expected that the current of every LED string is 0.35A. From the schematic (see Figure 4), each channel consists of an LM3466 (U_i), a sense resistor (R_{i1}), and two capacitors (C_{i1} and C_{i2}), where i = 1 to 5. An RC circuit connecting the VEQ pin to ground is required for the whole circuit. The above components are determined as follows.

Step 1: Determine the sense resistor

The current provided by the constant current power supply is equalized through each channel in a pre-set ratio determined by the sense resistor R_{i1}. This LM3466 evaluation board is designed so that the current of each channel is the same, the sense resistor of each channel is designed to be the same. It is recommended that the nominal voltage of the SEN pin V_{SEN} should be around 0.3 V. Therefore, R_{i1} is selected to be 1 Ω. As a result, V_{SEN} should be 0.35 V if the LED current is 0.35A.

Step 2: Determine the capacitors

C_{i1}: A high quality ceramic capacitor for decoupling should be connected from the VIN pin to ground. In this LM3466 evaluation board, a 100 V, 0.01 µF ceramic capacitor is used.

C_{i2}: If the cable connecting the LED string and the evaluation board is long, the parasitic inductance of the cable may generate noise. If this happens, a high quality ceramic capacitor should be connected between the ILED pin and ground. In this LM3466 evaluation board, a 100V, 1 µF ceramic capacitor is used.

Step 3: Determine other components

R_{EQ} and C_{EQ}: The VEQ pins of all LM3466 are shorted together and then connected to ground through R_{EQ} and C_{EQ} for normal operation. Only one R_{EQ} and one C_{EQ} are required for one lighting system. It is recommended that R_{EQ} be 51.1Ω and C_{EQ} be 1 µF.

Step 4: Optional circuit for fault reporting

For simplicity, the COMM pins of all LM3466 can be shorted directly to a common bus COMM_ALL for normal operation (R_{i0} = 0 Ω). If fault reporting upon LED string open of a corresponding channel is required, an optional circuit can be used to connect the COMM pin of each LM3466 to COMM_ALL. Since the COMM pin pulls low during LED string open, the small signal LED in the optional circuit shown in Figure 6 will light during a fault.

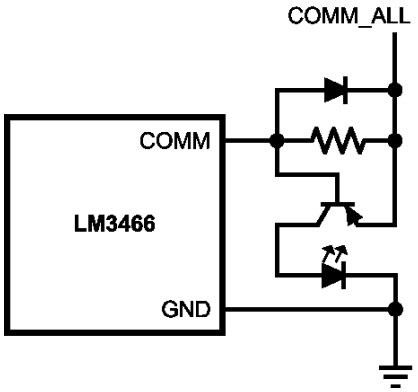

Figure 6. Optional COMM Circuit

4 PC Board Layout

To minimize the effect of noise, the ground connections of the LM3466 and the sense resistor R_{i1} should be closed. Good heat dissipation helps optimize the performance of the LM3466. The ground plane should be used to connect the exposed pad of the LM3466, which is internally connected to the LM3466 die substrate. The area of the ground plane should be extended as much as possible on the same copper layer above and below the LM3466. Using numerous vias beneath the exposed pad to dissipate heat of the LM3466 to another copper layer is also a good practice.

5 Bill of Materials

Item	Part Number	Mfg name	Part Description	Qty	Ref Designator(s)	Size
1	GRM21BR72A103KA01L	MuRata	CAP, CERM, 0.01 µF, 100V, ±10%, X7R, 0805	5	C11, C21, C31, C41, C51	0805
2	GRM32ER72A105KA01L	MuRata	CAP, CERM, 1 µF, 100V, ±10%, X7R, 1210	5	C12, C22, C32, C42, C52	1210
3	GRM188R71A105KA61D	MuRata	CAP, CERM, 1 µF, 10V, ±10%, X7R, 0603	1	CEQ	0603
4	1502-2	Keystone Electronics	Terminal, Turret, TH, Double	8	GND, LED1, LED2, LED3, LED4, LED5, PGND, VIN	
5	CRCW06030000Z0EA	Vishay-Dale	RES, 0 Ω, 5%, 0.1W, 0603	10	R10, R12, R20, R22, R30, R32, R40, R42, R50, R52	0603
6	CRCW25121R00FKEG	Vishay	RES, 1.00 Ω 1W 1% 2512	5	R11, R21, R31, R41, R51	2512
7	CRCW060351R1FKEA	Vishay-Dale	RES, 51.1 Ω, 1%, 0.1W, 0603	1	REQ	0603
8	LM3466/NOPB	Texas Instruments	Simple Linear LED driver for Multi-Channel LED Systems	5	U1, U2, U3, U4, U5	SO PowerPAD -8

6 Typical Performance and Waveforms

All curves and waveforms are taken at I_S = 1.75A with the evaluation board and T_A = 25°C, unless otherwise specified.

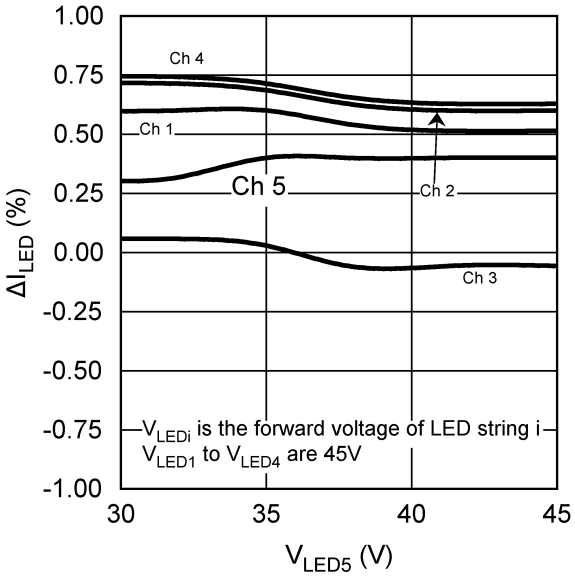

Figure 7. Current Regulation vs V_{LED}

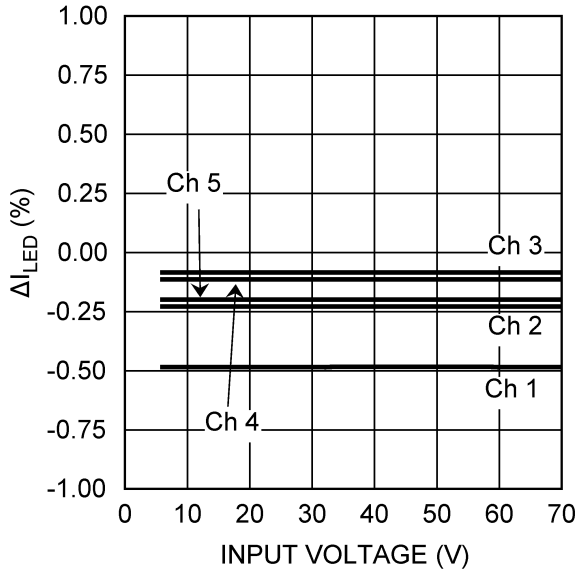

Figure 8. Current Regulation vs Input Voltage

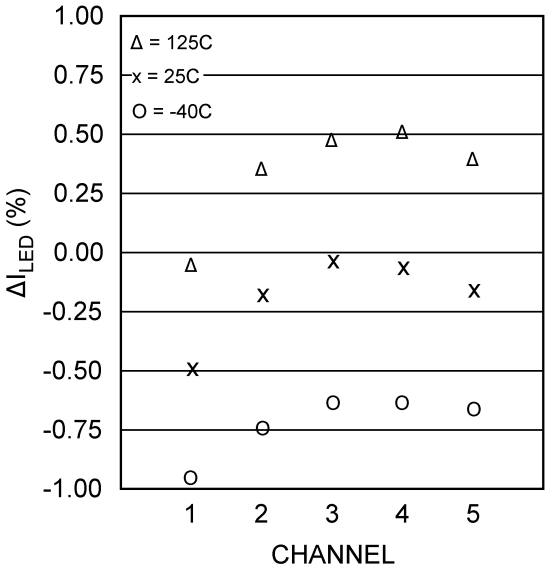

Figure 9. Current Regulation (Channel to Channel) vs Temperature

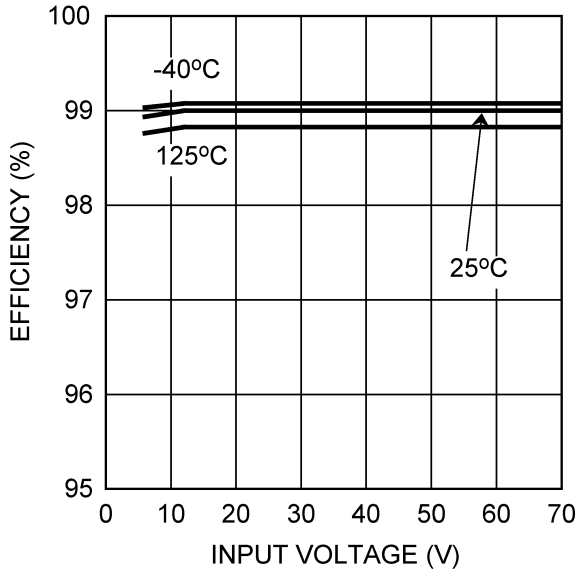

Figure 10. Efficiency vs Input Voltage

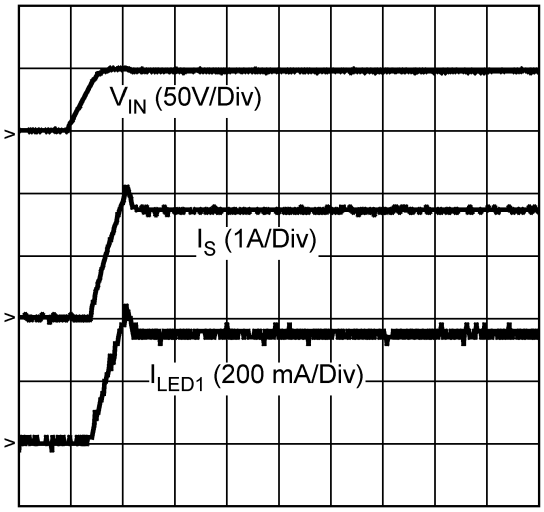

Figure 11. Power Up

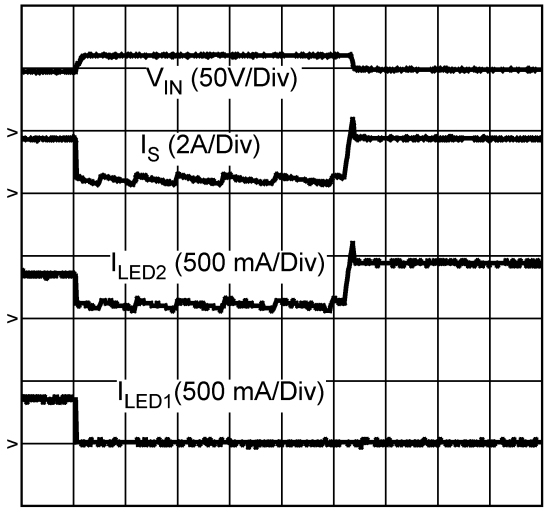

Figure 12. LED String Disconnect

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