

White LED power supply for large display backlight

Introduction

This application note is dedicated to the STLD40D, it's a boost converter that operates from 3.0 V to 5.5 V dc and can provide an output voltage as high as 37 V_{DC} and can drive up to 10 white LEDs in series.

Figure 1. Package

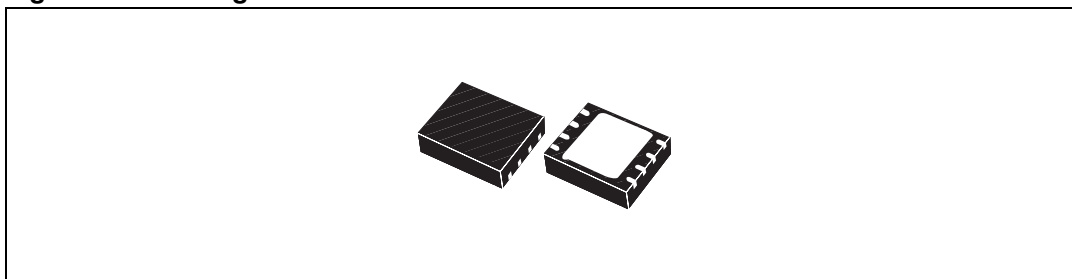
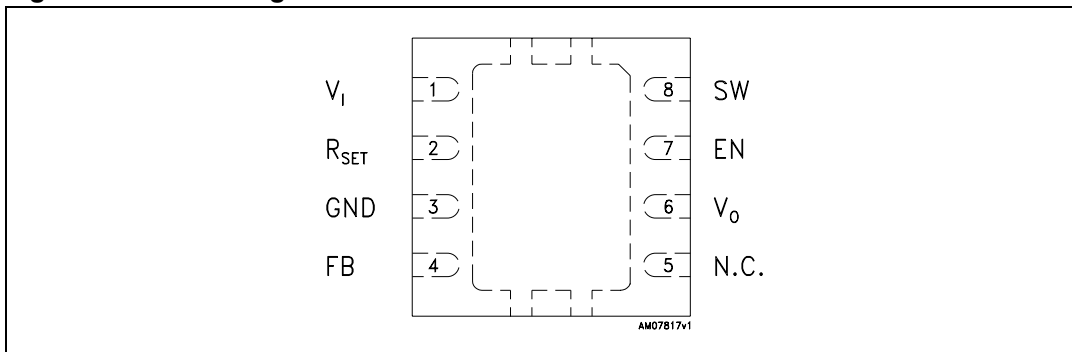


Figure 2. Pin configuration



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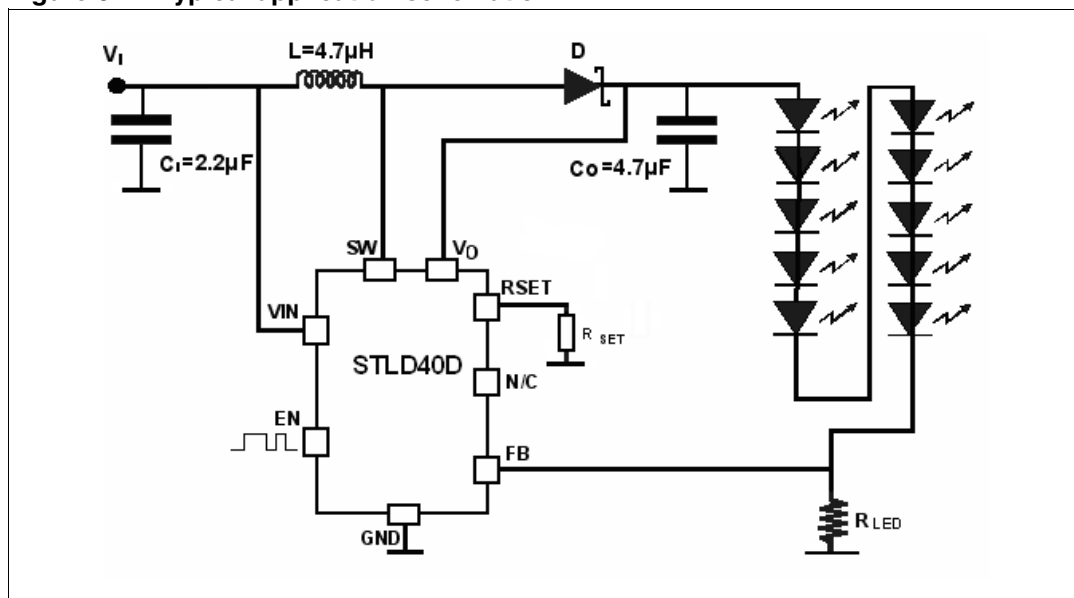
1 Schematic description

The converter is a PFM (pulse frequency modulation) inductor switcher and can work in discontinuous (DCM) as well as continuous (CCM) Mode operation. The output current capability is 20 mA with an output voltage of 37Vdc. The regulation is done by sensing the LED current through resistor R_{LED} . The device can be turned ON/OFF through the logic enable signal pin EN. By applying a low frequency PWM signal the WLEDs can be dimmed.

The maximum peak inductor current can be programmed by connecting a resistor R_{SET} to pin R_{SET} .

1.1 Application schematic

Figure 3. Typical application schematic



2 Selection of external components

2.1 Input and output capacitor selection

For input and output capacitor it is recommended to use a ceramic capacitor with low ESR. For good stability of the device supplied by a low input voltage of 3.0 V at maximum ratings of output power, it is recommended to use 2.2 μF / 6.3 V as a minimum value of input capacitor and 4.7 μF / 40 V as a minimum value of output capacitor.

2.2 Inductor selection

Shielded thick inductor with low DC series resistance of wiring is recommended for this application. For good efficiency it is recommended to use inductor with series DC resistance $R_{\text{DCL}} = R_{\text{D}}/10$, [Ω ; 1, Ω] where R_{D} is the dynamic resistance of the LED [Ω ; 1, Ω]. For nominal operation, the peak inductor current can be calculated by this formula:

Equation 1

$$\frac{\frac{I_{\text{OUT}}}{n} + (V_{\text{OUT}} - V_{\text{IN}})^2}{(2 \cdot L \cdot F \cdot V_{\text{OUT}}^2)} \cdot V_{\text{IN}}$$

Where:

- I_{PEAK} Peak inductor current
- I_{OUT} Current sourced at the V_{OUT} pin
- n Efficiency of the STLD40D
- V_{OUT} Output voltage at pin V_{OUT}
- V_{IN} Input voltage at pin V_{IN}
- L Inductance value of the inductor
- F Switching frequency

2.3 LED selection

All LEDs with forward voltage from 2.7 V to 5 V are feasible for use with device STLD40D. The LED forward voltage must include the voltage spread of this value. The current in the LED can be set through the sensing resistor value.

Table 1. Recommended components

Symbol	Description	Parameter	Value			Unit
			Min.	Typ.	Max	
D	Boost schottky diode	VRRM	40			V
		V_F at $I_F = 300\text{ mA}$, $T_J = 25\text{ °C}$			0.5	V
		I_R at $V_R = 10\text{ V}$, $T_J = 25\text{ °C}$			30	μA
	STPS1L40M	VRRM	40			V
		V_F at $I_F = 1\text{ A}$, $T_J = 25\text{ °C}$			0.46	V
		I_R at $V_R = 20\text{ V}$, $T_J = 25\text{ °C}$			21	μA
R_{LED}	Feedback LED current regulation resistor	$I_{LED}=20\text{mA}$		8		W
C_{in}	Input ceramic capacitor, low ESR	Ceramic type		2.2		μF
C_{out}	Output ceramic capacitor, low ESR	Capacitance	4.7			μF
		Voltage	40			V
		ESR			1.6	W
L	Boost inductor (height<2mm)	Inductance			4.7	μF
		DCR			1	W
		$I_{satRSET=GND}$			1	A

Figure 4. I_{LED} vs. R_{LED}

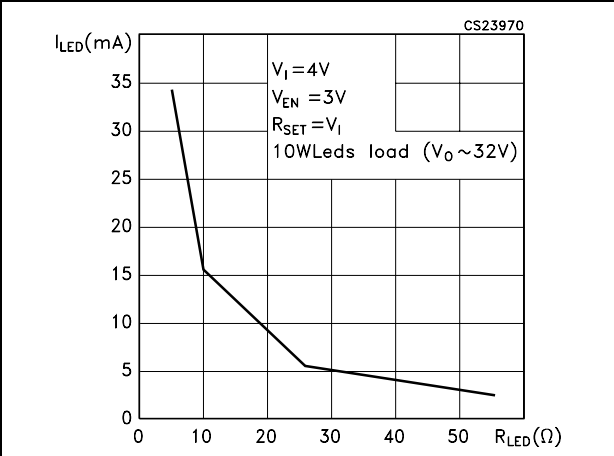


Figure 5. I_{LIMIT} vs. R_{SET}

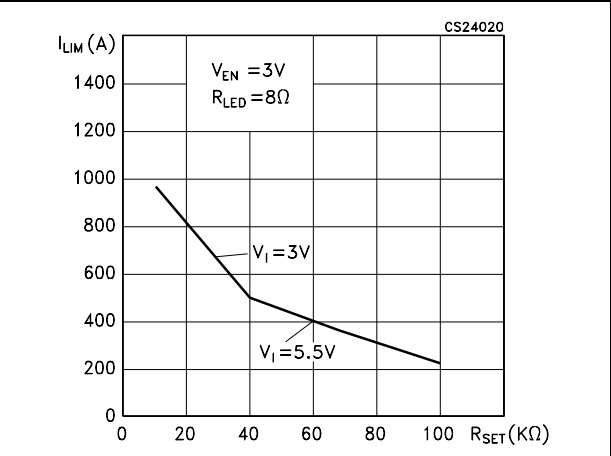


Figure 6. γ vs. V_I

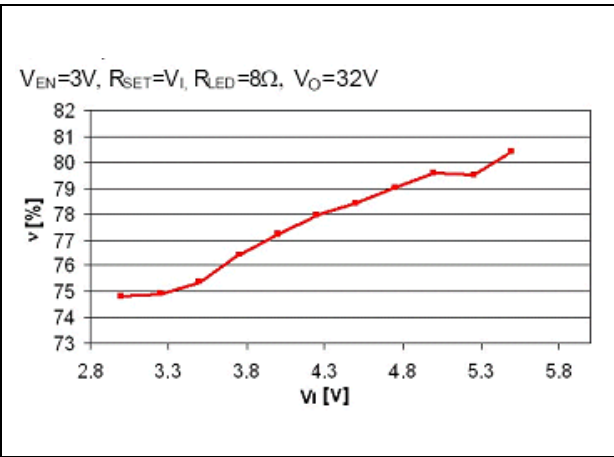
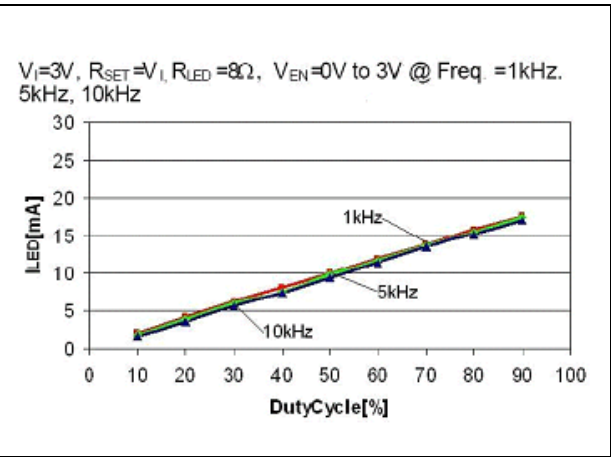


Figure 7. I_{LED} vs. duty cycle EN pin (dimming)

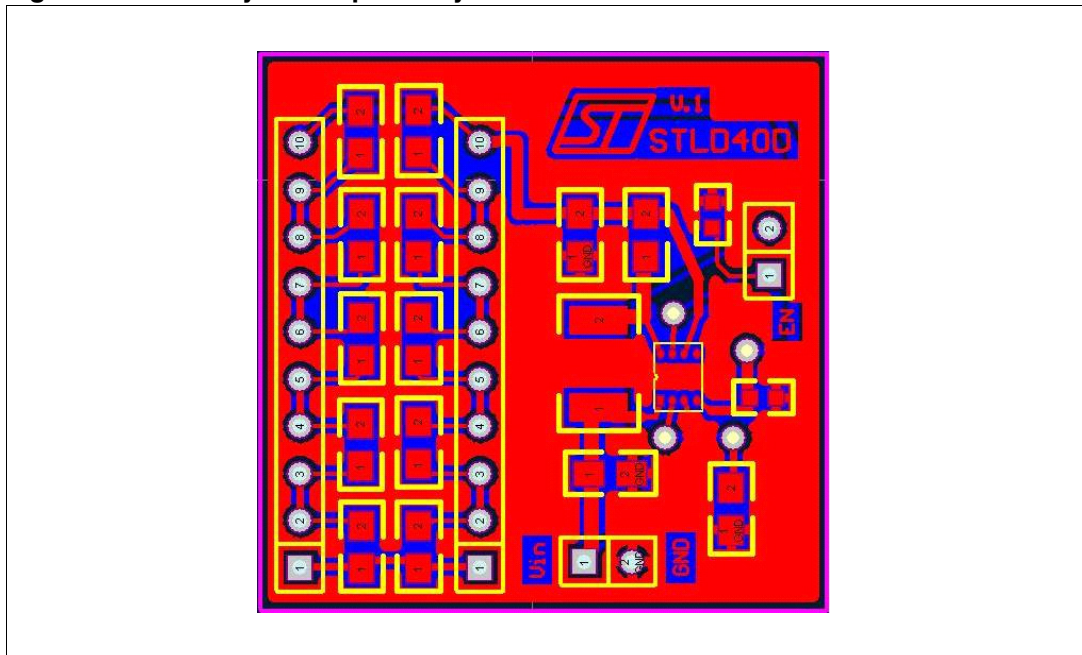


3 PCB design

3.1 PCB design rules

STLD40D is a powerful switched device. The PCB must be designed in line with the rules for designing switched supplies. The power windings must be as short as possible and wide, because of large current. It is recommended to use a dual layer PCB minimal. Place all external components close to the STLD40D. Also switched high-energy loops should be as small as possible to reduce EMI.

Figure 8. PCB layout - Top overlay view



4 Revision history

Table 2. Document revision history

Date	Revision	Changes
20-Mar-2006	1	Initial release
19-May-2006	2	Minor text changes
01-Jun-2011	3	Modified: Table 1 on page 5

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