

Powering Multiple White LEDs, PWM and Digital Dimming Control Using the TPS61060/1/2

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ABSTRACT

The TPS61060/1/2 are inductive, high-frequency, synchronous boost converters with a constant current output to drive up to 5 white LEDs. The reference design and application examples shown in this document implement the TPS6106x devices powering multiple white LEDs, a digital brightness control application, and an example of an efficiency measurement setup.

1 Features

- LED Driver With Integrated Overvoltage and Short-Circuit Protection
- 2.7-V to 6-V Input Voltage Range
- 500-mV/250-mV Feedback Voltage
- TPS61060 Powers Up to 3 LEDs
- TPS61061 Powers Up to 4 LEDs
- TPS61062 Powers Up to 5 LEDs
- PWM Brightness Control on Enable
- Digital Brightness Control on ILED
- 1-MHz Fixed Switching Frequency
- 400-mA Internal Power MOSFET Switch
- LEDs Disconnected During Shutdown
- Operates With Small-Output Capacitors Down to 220 nF
- Up to 80% Efficiency
- 8-Pin NanoFree[®] Package (Chipscale, CSP)
- 3 × 3-mm QFN Package

2 TPS6106x Reference Design

The reference design shown in Figure 1 uses the TPS61061 high-efficiency, small-size boost converter that switches at 1 MHz. The TPS61061 device is part of the TPS6106x family of devices which includes TPS61060, TPS61061, and TPS61062. The schematic contains two independent DC/DC converters. Converter U1 is configured to demonstrate all features of the device, whereas U4 is optimized to demonstrate the small solution size.

Table 1. Device and Package Configurations

Converter	IC	Package
U1	TPS61061DRB	QFN-8
U4	TPS61061YZF	CSP-8 chipscale

2.1 Schematic and Bill of Materials

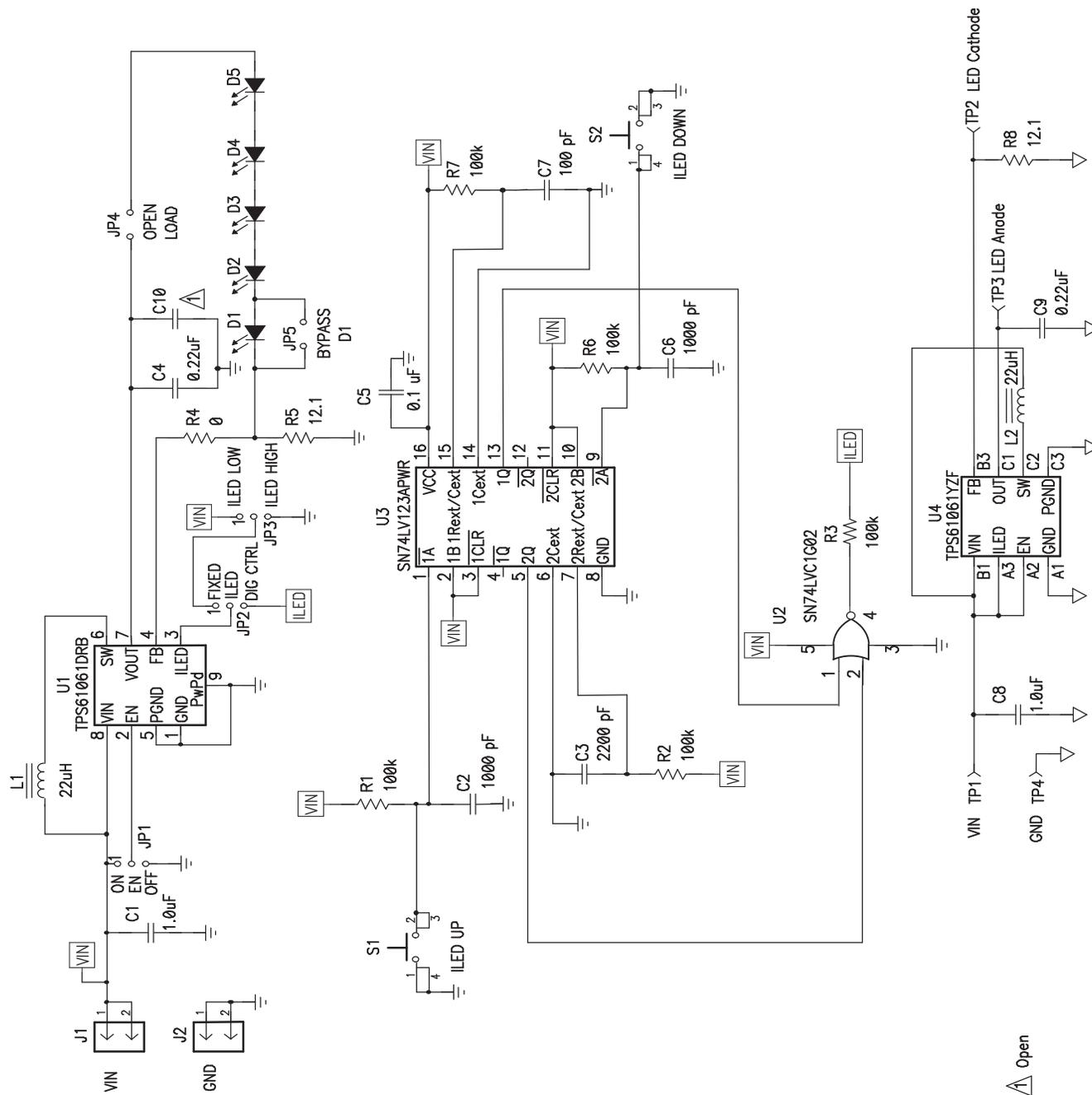


Figure 1. TPS6106xEVM Schematic

Table 2.2. TPS6106xEVM Bill of Materials

COUNT	Ref Des	DESCRIPTION	SIZE	MFR	PART NUMBER
2	C1, C8	Capacitor, ceramic, 1-µF, 16-V, X7R, 10%	603	TDK	C1608X7R1C105KT
0	C10	Capacitor, ceramic, xxx-µF, vv-V	1206		

Table 2.2. TPS6106xEVM Bill of Materials (continued)

2	C2, C6	Capacitor, ceramic, 1000-pF, 50-V, X7R, 10%	603	TDK	C1608X7R1H102K
1	C3	Capacitor, ceramic, 2200-pF, 50-V, X7R, 10%	603	TDK	C1608X7R1H222K
2	C4, C9	Capacitor, ceramic, 0.22- μ F, 10-V, X5R, 10%	603	TDK	C1608X5R1A224K
1	C5	Capacitor, ceramic, 0.1- μ F, 16-V, X7R, 10%	603	TDK	C1608X7R1C104K
1	C7	Capacitor, ceramic, 100-pF, 50-V, C0G, 5%	603	TDK	C1608C0G1H101J
5	D1–D5	Diode, LED, White, 30 mA	1210	Lumex	SML-LX2832UWC-TR
				Chicago Miniature	CMD67-21UWC
2	J1, J2	Header, 2-pin, 100-mil spacing, (36-pin strip)	0.100 X 2	Sullins	PTC36SAAN
3	JP1, JP2, JP3	Header, 3-pin, 100-mil spacing, (36-pin strip)	0.100 X 3	Sullins	PTC36SAAN
2	JP4, JP5	Header, 2-pin, 100-mil spacing, (36-pin strip)	0.100 X 2	Sullins	PTC36SAAN
1	L1	Inductor, SMT, 22- μ H, 580-mA, 160-m Ω	1210	Coilcraft	ME3220-223KX
1	L2	Inductor, SMT, 22- μ H, 580-mA, 800-m Ω	0.102 X 0.110	TDK	VLF3012AT-220MR33
5	R1, R2, R3, R6, R7	Resistor, chip, 100-k Ω , 1/16-W, 1%	603	Std	Std
1	R4	Resistor, chip, 0- Ω , 1/16 W, 5%	603	Std	Std
2	R5, R8	Resistor, chip, 12.1- Ω , 1/16 W, 1%	603	Std	Std
2	S1, S2	Switch, SPST, PB-Momentary, Sealed, Washable	0.245 X 0.251	C&K	KT11P2JM
2	TP1, TP3	Test point, red, 1-mm	0.038	Farnell	240-345
2	TP2, TP4	Test point, black, 1-mm	0.038	Farnell	240-333
1	U1	IC, constant current LED driver with digital brightness control	QFN-8P	TI	TPS61061DRB
1	U2	IC, single 2-input positive-NOR gate	SOT23-5	TI	SN74LVC1G02DBVR
1	U3	IC, dual retriggerable Monostable multivibrators with Schmitt-Trigger inputs	PW16	TI	SN74LV123APWR
1	U4	IC, constant current LED driver with digital brightness control	WCSP-9	TI	TPS6106YZF
1	--	PCB, 2.6-inch x 1.95-inch x 0.062-inch		Any	HPA091
5	--	Shunt, 100-mil, black	0.100	3M	929950-00

2.3 TPS6106x Designs Powering 2+ White LEDs

Make note of the features for the EN and ILED pins. The EN pin is the PWM dimming, turning on and off the converter to change the duty cycle. The ILED pin is the analog dimming where the LED current is reduced. With ILED, the internal D to A is stepped up or down to change the FB voltage set point.

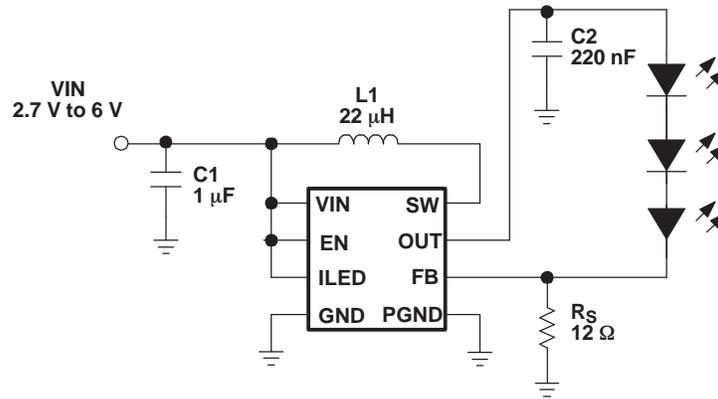


Figure 2. TPS61060 Powering Three White LEDs

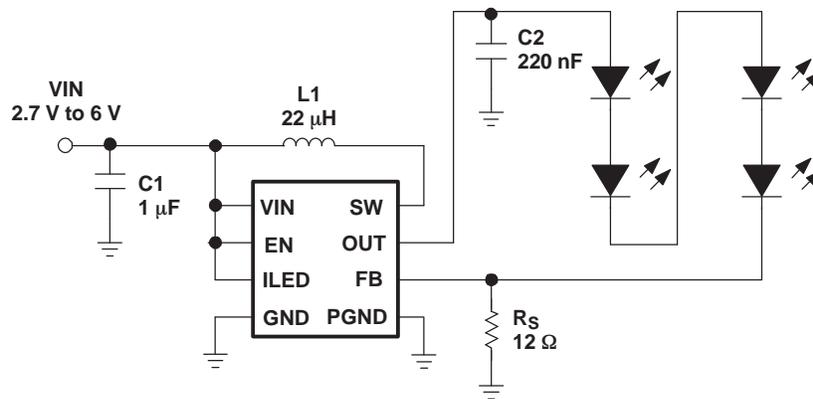


Figure 3. TPS61061 Powering Four White LEDs

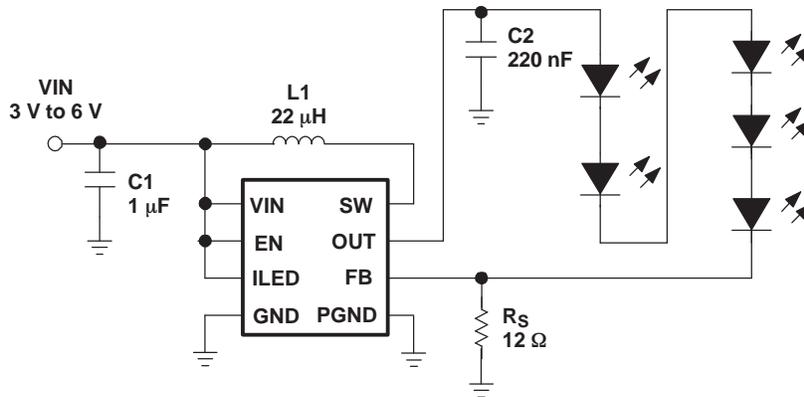


Figure 4. TPS61062 Powering Five White LEDs

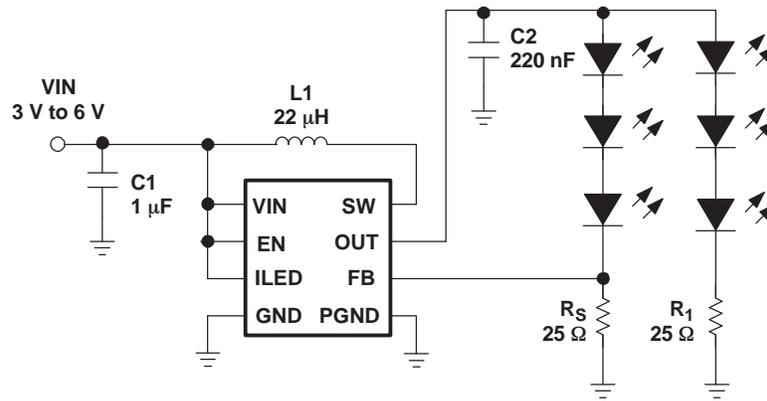


Figure 5. TPS61060 Powering Six White LEDs

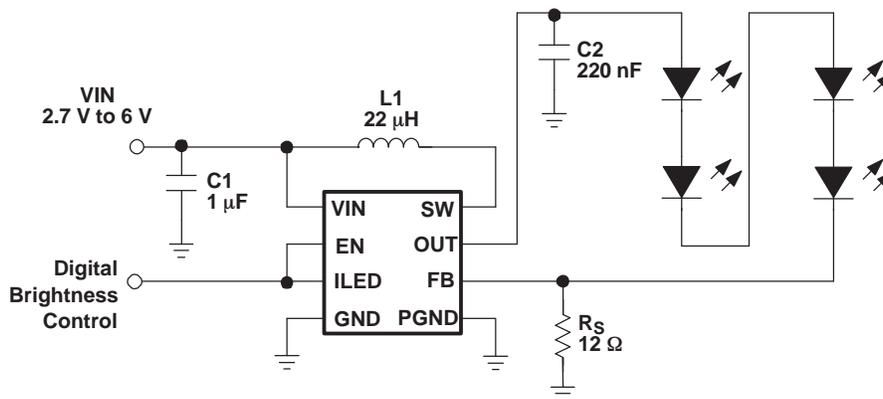


Figure 6. TPS61061 Digital Brightness Control ⁽¹⁾

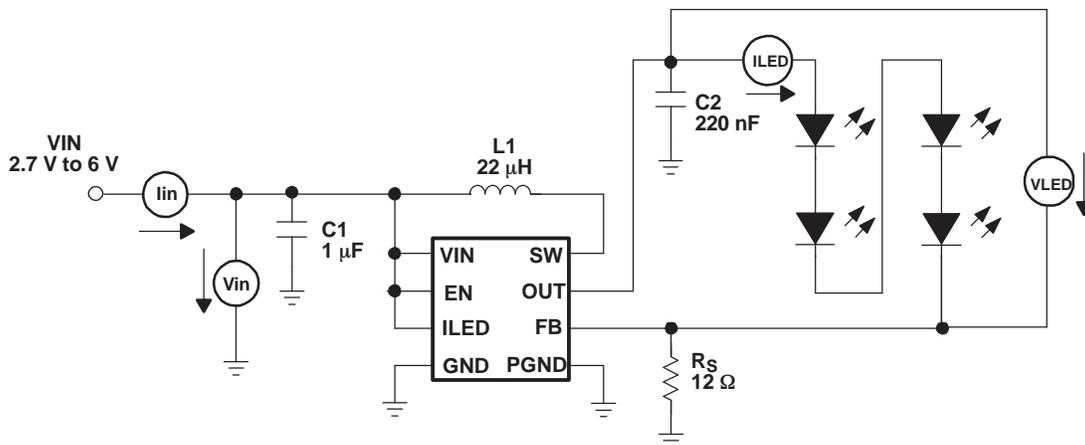


Figure 7. Efficiency Measurement Setup

⁽¹⁾ This circuit combines the enable with the digital brightness control pin, allowing the digital signal applied to ILED to also enable and disable the device.

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