Design Solution#66

SP6133 : 15V Input, 10Amp nominal 20A peak LED driver with PWM Dimming

Designed by: Tim Sullivan

Part Number: SP6133

Application Description: The SP6133

Electrical Requirements:

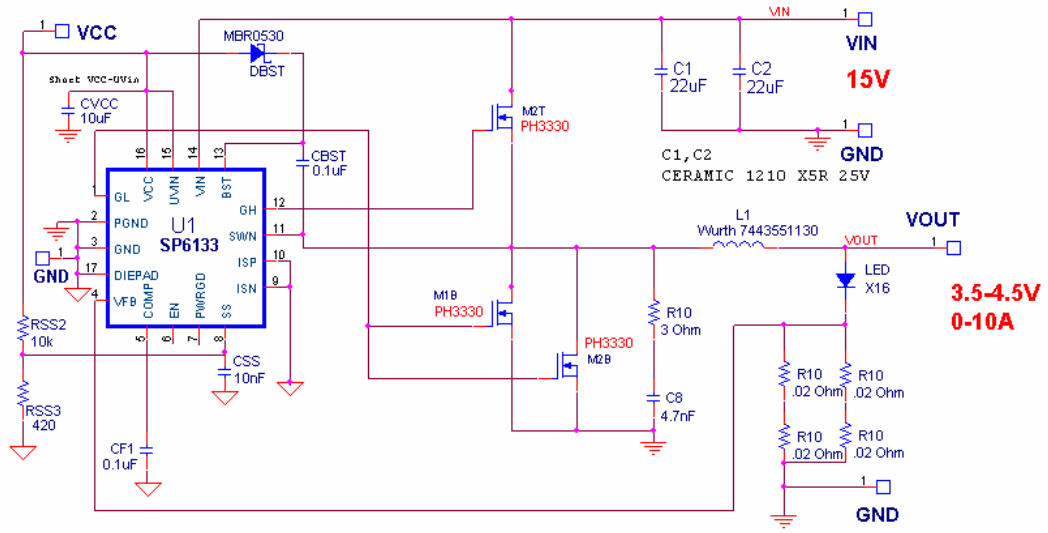
Input Voltage:	15V nominal (9 – 20VIN)
Output Voltage:	3.5-4.5
Output Current:	10A nominal – 25A peak capable LED Driver

Circuit Description:

The SP6133 was configured as a 10 Amp constant current LED driver. A bank of 16 Luxeon 1 LEDs (P#:LXH LMW1D) was utilized. The design was completed using two low-side and one high-side FET and which allowed the design to work up to 10 Amps continuous and 25 Amps peak current.

By setting the reference of the supply to 200mV, low Ohm sense resistors could be used in series with the LED to create a current-controlled converter. (see schematic) The converter will adjust the duty cycle to increase or decrease the output voltage to maintain the 200mV across the sense resistors. The output current will be set by: $I\_out = Vref/R\_sense$

Simplified Design Solution Schematic



Note: ISP and ISN are shorted to ground. When using the SP6133 with output voltages above 3.3Volts the overcurrent feature of the part cannot be used and these pins should be shorted to ground.

Application Details:

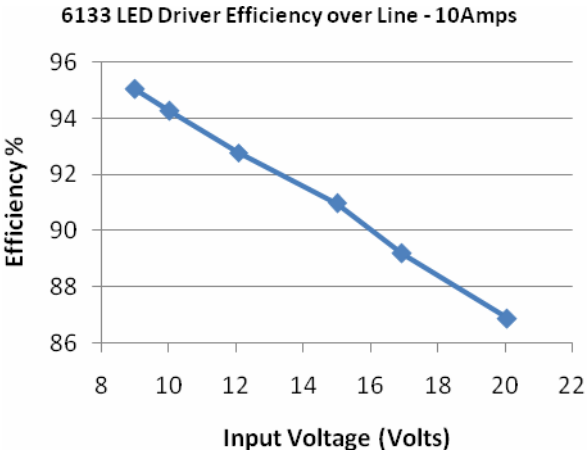
In this example RSENSE is set to 20mΩ, giving the nominal 10 Amps output current. To obtain 25 Amps, V_{ref} would need to be increased to 500mV. This could be done by externally adjusting the voltage to the Soft Start pin. Note that only voltages less than or equal to 0.8 volts can be used. The Soft Start pin has been configured so that voltages above 0.8 volts will not increase the internal reference voltage, it can only be lowered. Voltages below 200mV are not recommended. If a lower voltage is required to reduce power dissipation in the sense resistors, a scaling circuit can be used as was done in Design Solution #33.
http://www.sipex.com/files/DesignSolutions/Design%20Solution%2033%20SP7652LED%20driver%20w%20dimmer.pdf

The circuit was also configured to allow dimming of the LED by pulse width modulating the UVIN pin or the VFB pin. By modulating the UVIN pin, slightly better efficiencies are seen at low duty cycles. This is due to the different way each configuration operates. When using the VFB pin, the output is pulled to ground during each cycle. When using the UVIN pin, the converter is simply shut off during each cycle -- this causes the output voltage to drop only to below the LED forward voltage. The next time the converter turns on the output does not have need to rise the full voltage range. Waveforms have been included to illustrate this effect.

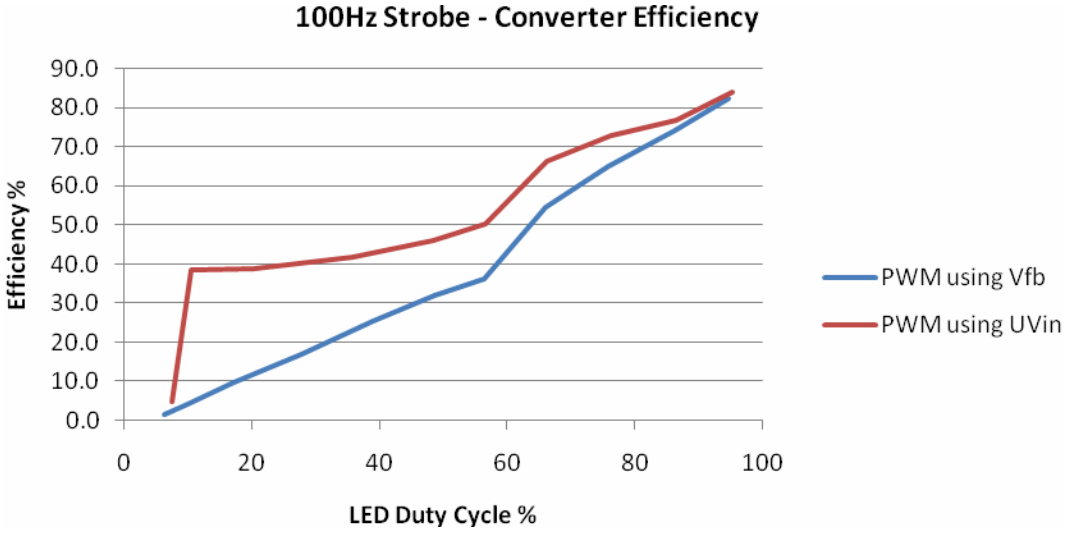
Bill of Materials

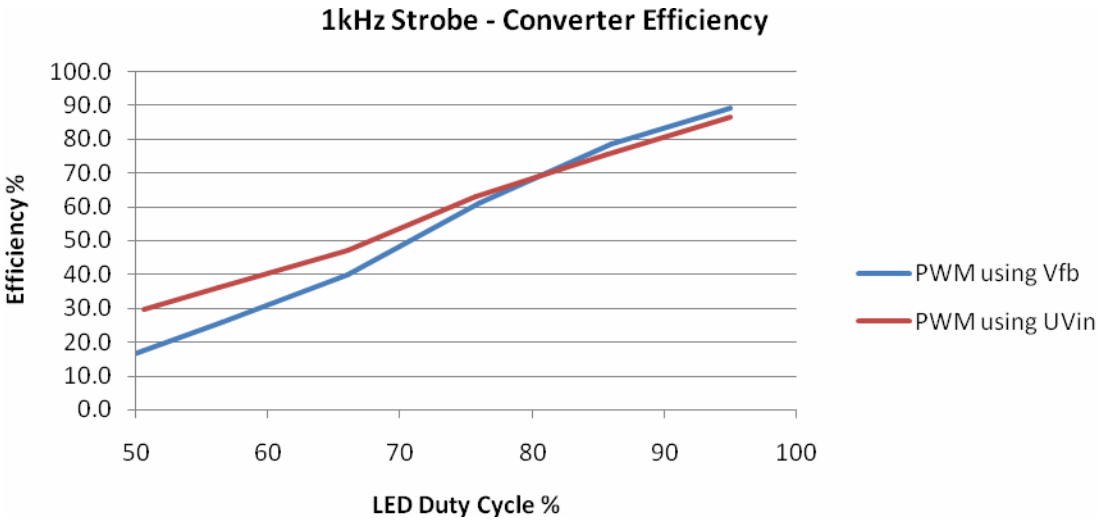
Line	Qty	Reference	Manufacturer	Part Description
1	1	U1	Sipex	SP6133
2	3	C1,C2	Murata	22uF, 25V, X5R, 1210
3	1	DBST	Vishay	MBR0530
4	16	LED	Luxeon	Luxeon: LXH LMW1D
5	1	L1	Wurth	7443551130
6	3	M1B,M2T,M2B	NXP (Phillips)	30V, 2.3mΩ, PH3330L
7	4	Ra,b,c,d	Panasonic	20mW, 2512, 1W, 1%, ERJ-M1WSF20MU
8	2	CBST,CF1	Murata	0.1uF
9	1	CSS	Murata	10nF
10	1	CVCC	Murata	10uF
11	1	RSS2	Panasonic	10k
12	1	RSS3	Panasonic	420
13	1	R10	Panasonic	3 Ohm

Results: Converter Efficiency

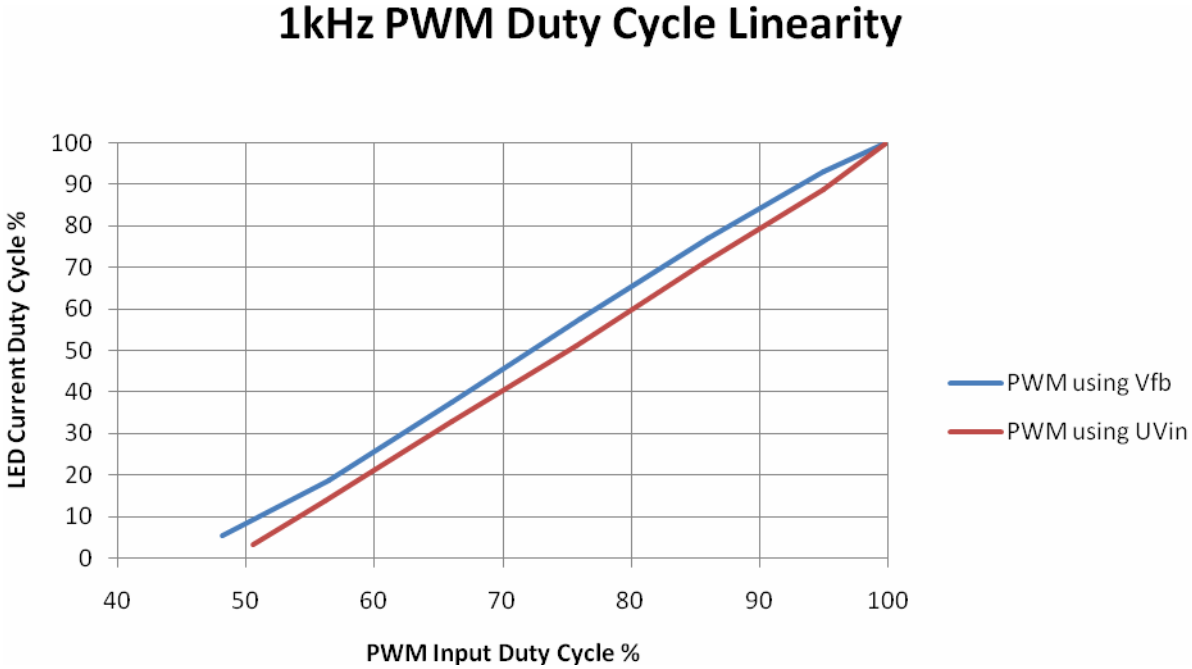


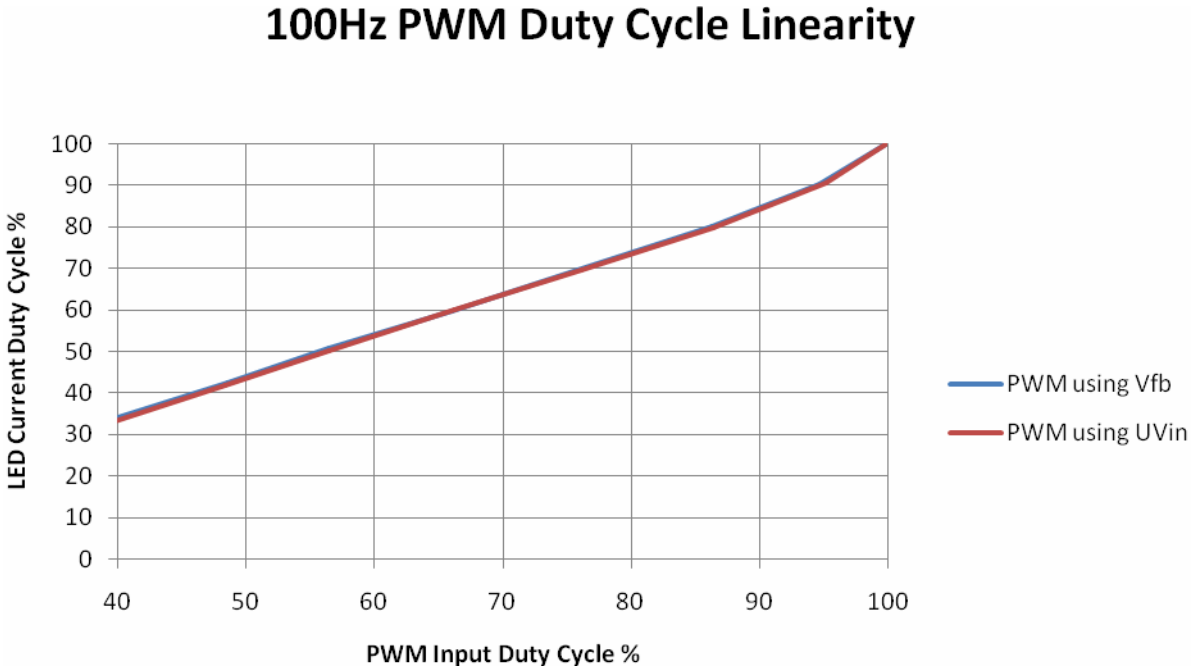
V_{IN}	Efficiency
9	95
10	94
12	93
15	91
17	89
20	87



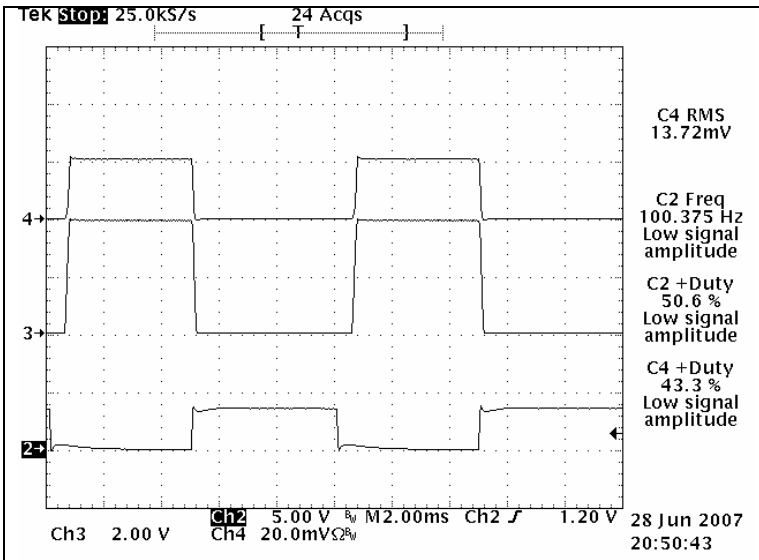
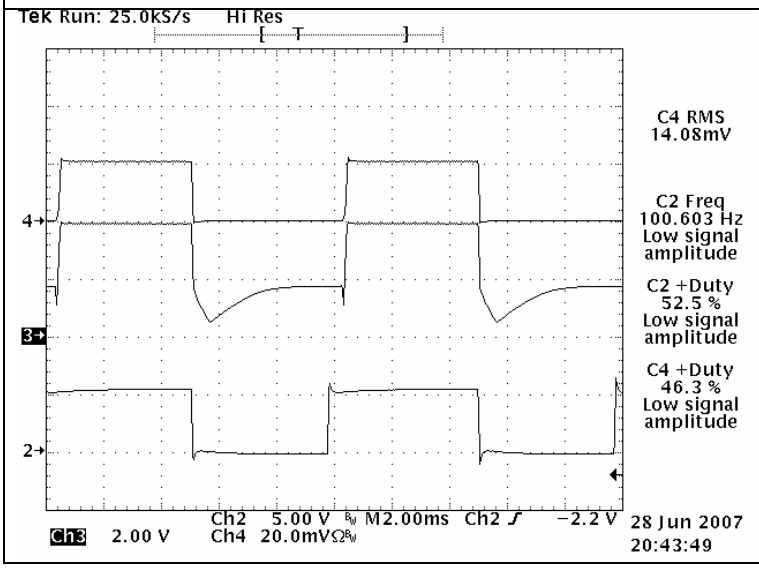


Results: PWM Strobe Linearity

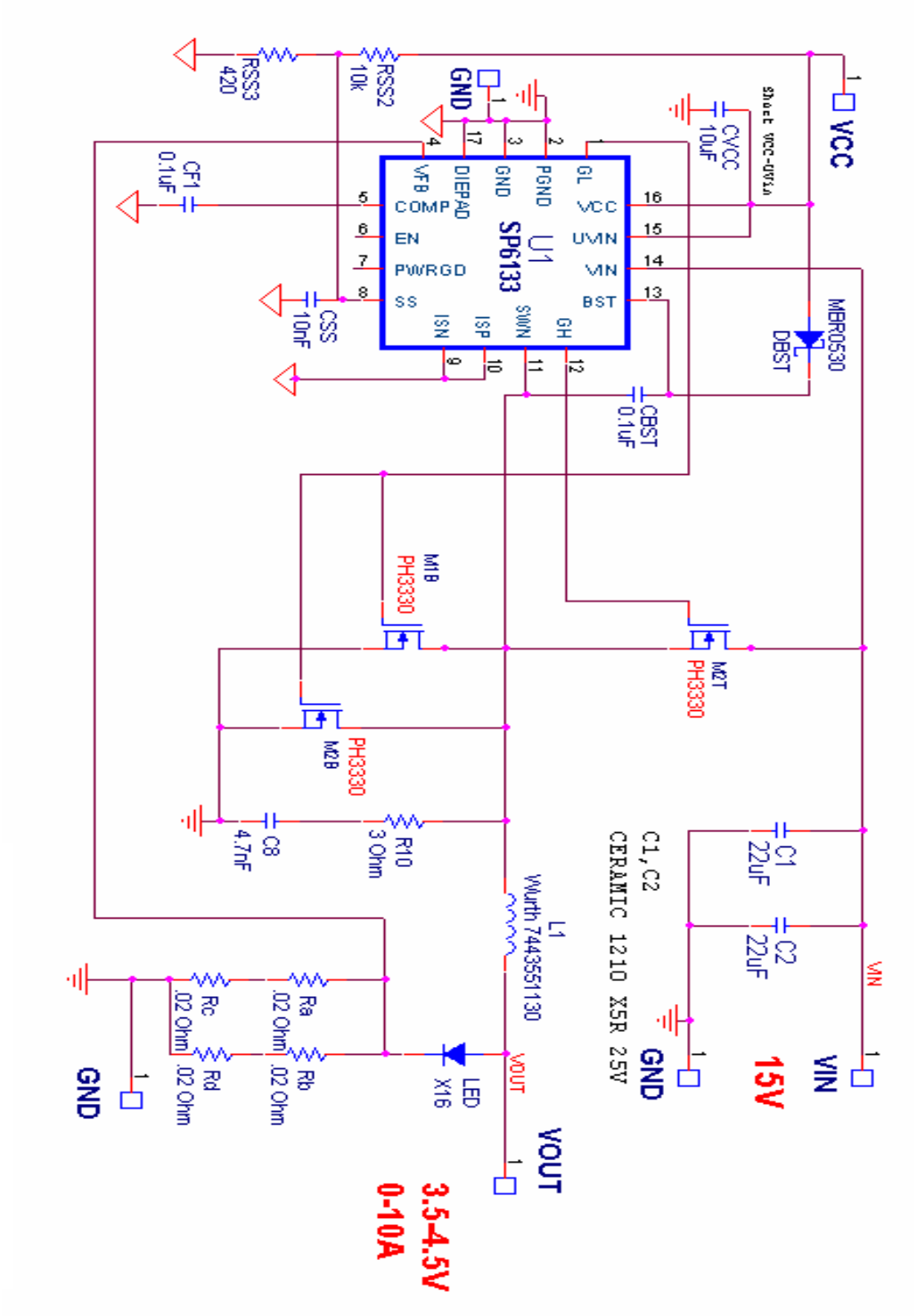




Waveforms:

	Waveform 1 CH4: I_{LED} 10A/div CH3: VOUT CH2: VFB
	Waveform 2 CH4: I_{LED} 10A/div CH3: VOUT CH2: UVIN Note the difference in output voltage. When using UVIN the output voltage is not pulled to ground.

Circuit Schematic



All resistance values are in Ohms.

For further assistance:

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Live Technical Chat:	http://www.geolink-group.com/sipex/
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