LM5020 Design Document

National Semiconductor
LM5020
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1.0 Design Specifications

Inputs	Outputs #1
VinMin=20	Vout1=3
VinMax=28	Iout1=0.9

2.0 Design Description

This design document describes a circuit for driving very bright high current LEDs, such as Luxeon LEDs, using a peak current control scheme. A PWM control input is included, with fast turn ON and turn OFF times so that the LED light output can be synchronized to a system timing control function.

U1, LM5020, is a 100V Current Mode PWM Controller. The oscillator frequency is set by resistor R3.

At the beginning of each oscillator cycle, FET M1 will be driven on. This is because Vfb, the voltage feedback pin, is grounded. Note that the COMP pin is left open, since the voltage control loop is not used for this design. With M1 ON, L1 inductor current increases. The inductor current is conducted directly through the LED, so the LED current is likewise increasing.

The LED current is sensed by the parallel combination of R5 and R11, and this signal is filtered to remove high frequency switching noise by the low pass filter consisting of R6 and C4. Current increases until the current sense input, CS, reaches its threshold of 0.5V. At this time, M1 is turned off.

With M1 OFF, the inductor current must decay. When the inductor voltage reverses, the catch diode, D1, turns ON. The current decays in the loop consisting of LED, L1, and D1 until the next oscillator cycle begins, at which time M1 turns ON and the operating cycle repeats. The operation is at a fixed frequency, and the peak current through the LED is controlled.

The LM5020 includes an under voltage lockout (UVLO) feature, so that a circuit implemented with this controller will be held in the off state until Vin reaches an acceptable voltage. This value is determined by the R1 and R2 voltage divider.

In addition, a PWM control input is coupled into the UVLO function by R4. The designer can select R1, R2, and R4 values so that a PWM logic level signal will gate the converter's operation. This can be accomplished with very little phase delay, since the propagation delays are quite fast, and the control loop decisions are driven by voltage levels with no loop filter delay. Also, because the LED current is controlled, and there is no directly controlled output voltage, which one would usually find in a voltage converter, no output capacitor is used. Therefore, there is no capacitive discharge delay when the converter is turned off by the PWM signal.

3.0 Schematic

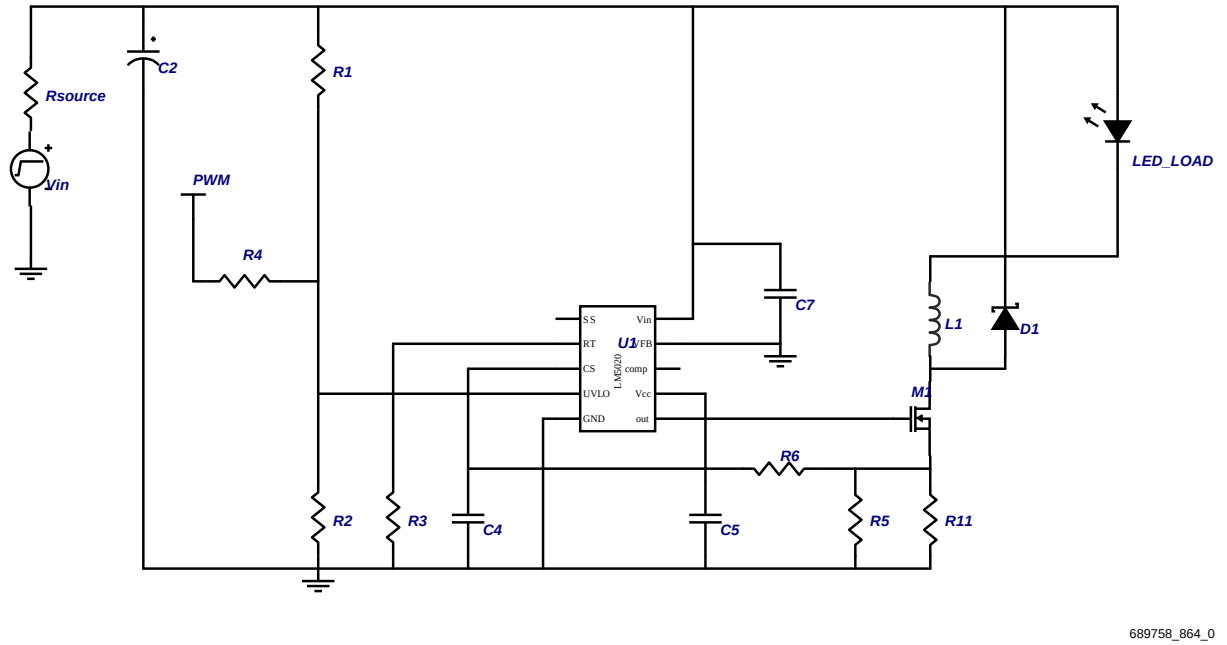
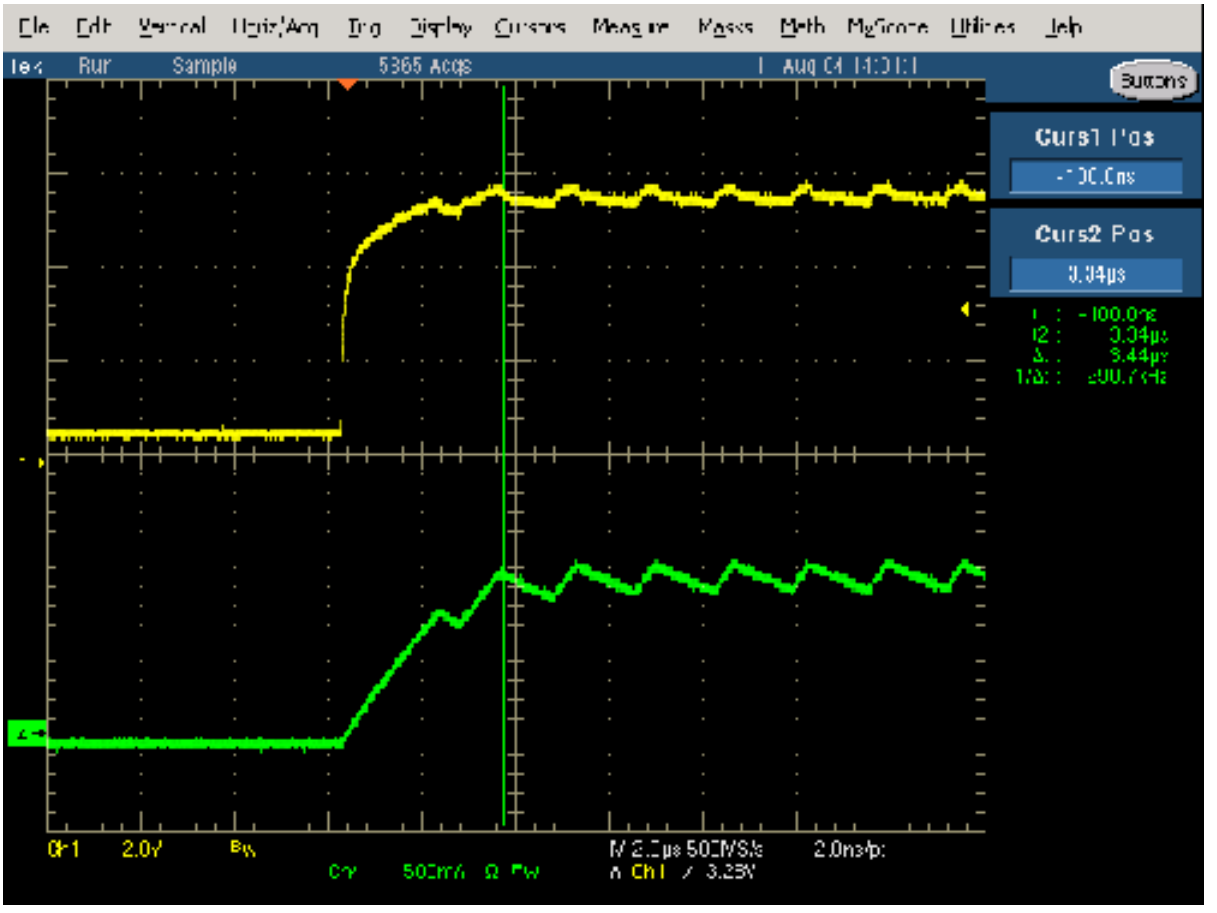


FIGURE 1. Example Schematic Showing Connection for all Components.

4.0 Bill Of Materials

Part	Manufacturer	Part#	Attributes
C2	Sanyo	50CV150AX	150u F, 0.21 Ohms
C4	Vishay	VJ0805A101KXAAT	100p F
C5	TDK	C2012X7R1H105K	1u F
C7	Vishay	VJ0805Y103KXAC	0.1u F
D1	Diodes	B240	0.5 V
L1	Coilcraft	DO3316P-683	68u H, 0.2 Ohms
M1	Vishay	SI3458DV	
R1	Dale	CRCW08051503FRT6	150k Ohms
R11	Dale	CRCW08051000FRT6	1 Ohms
R2	Dale	CRCW08051002FRT6	10k Ohms
R3	Dale	CRCW08051002FRT6	10k Ohms
R4	Dale	CRCW08051002FRT6	10k Ohms
R5	Dale	CRCW08051000FRT6	1 Ohms
R6	Dale	CRCW08051001FRT6	100 Ohms
U1	National Semiconductor	LM5020	

5.0 Waveforms



PADC_NSC0361_wf_1

FIGURE 2. LED current rise time detail at Vin=26V and ILED=0.88A ch1=LED voltage ch4=LED current

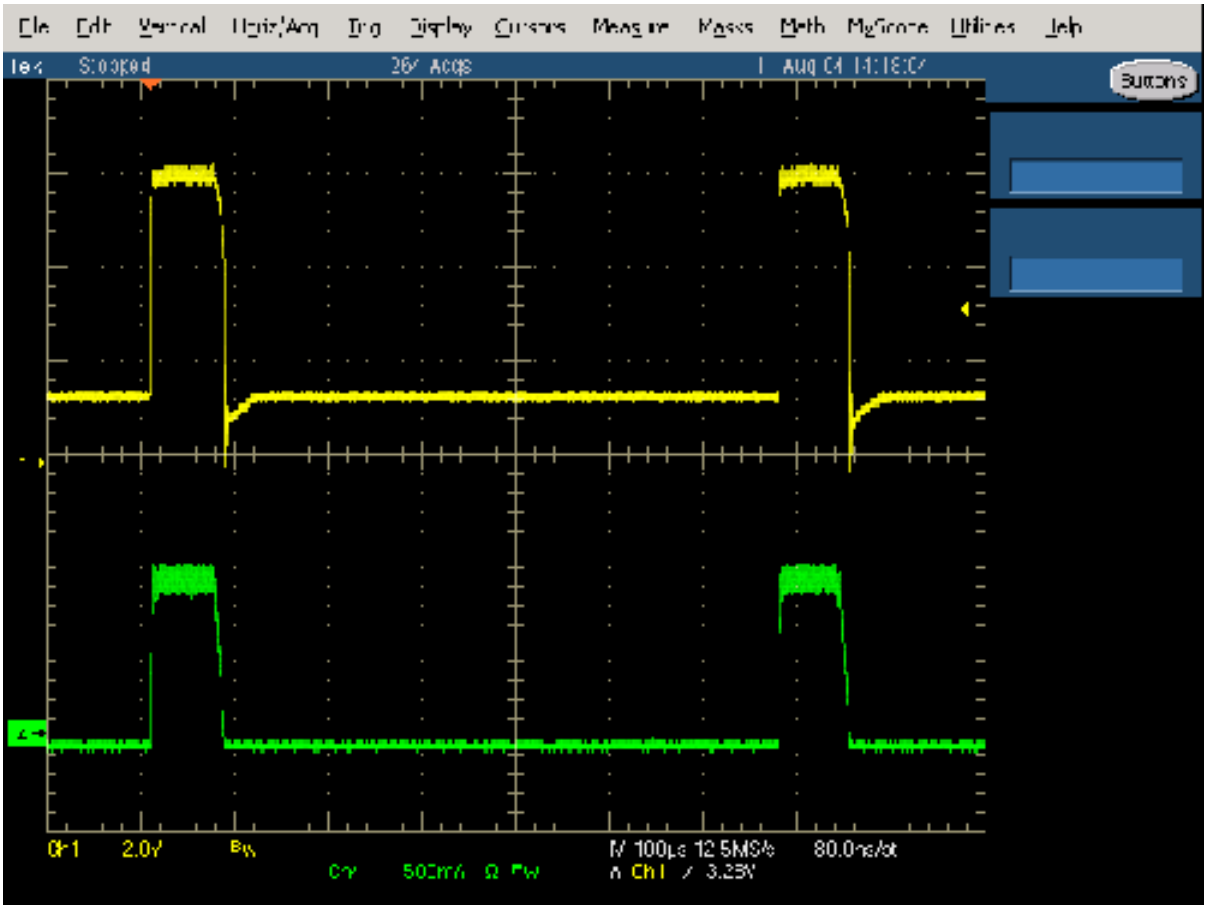


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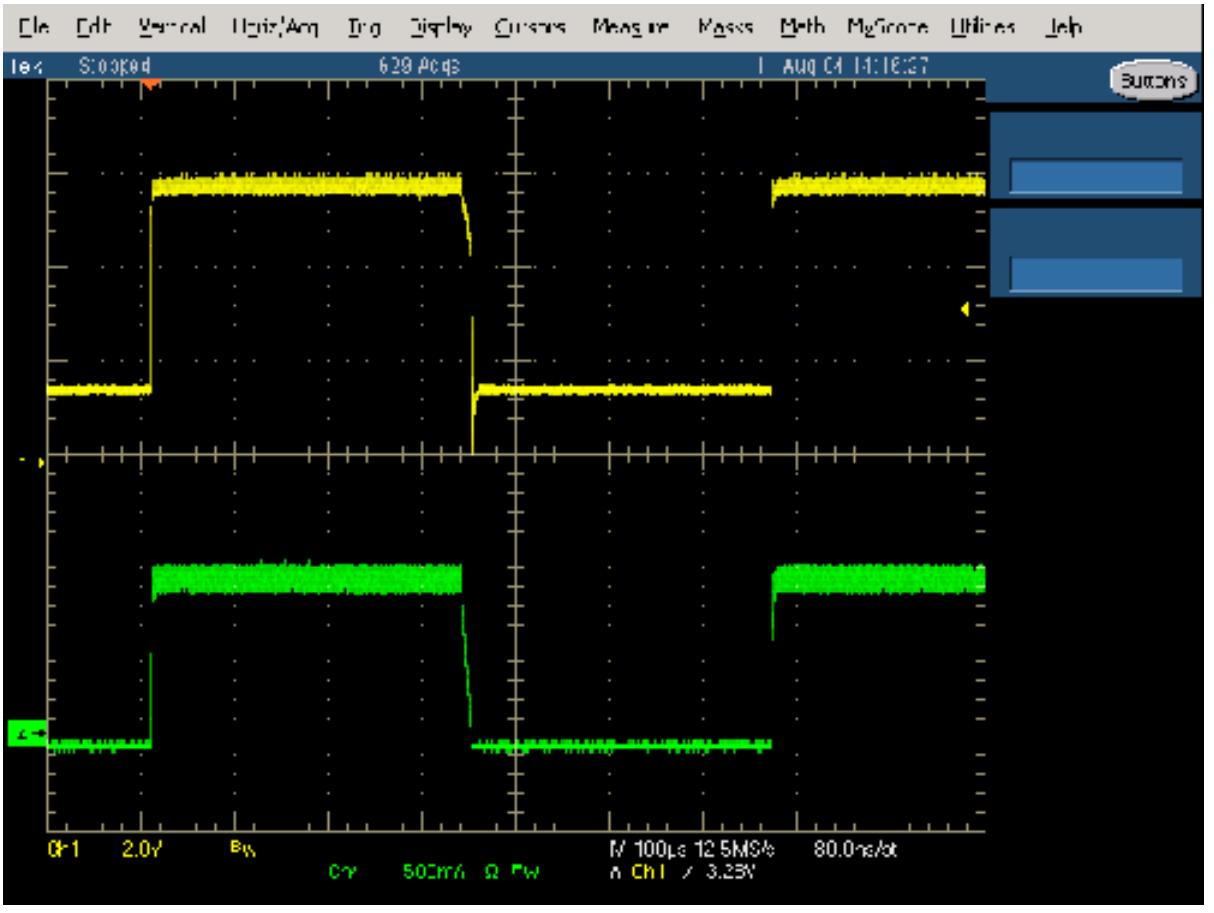
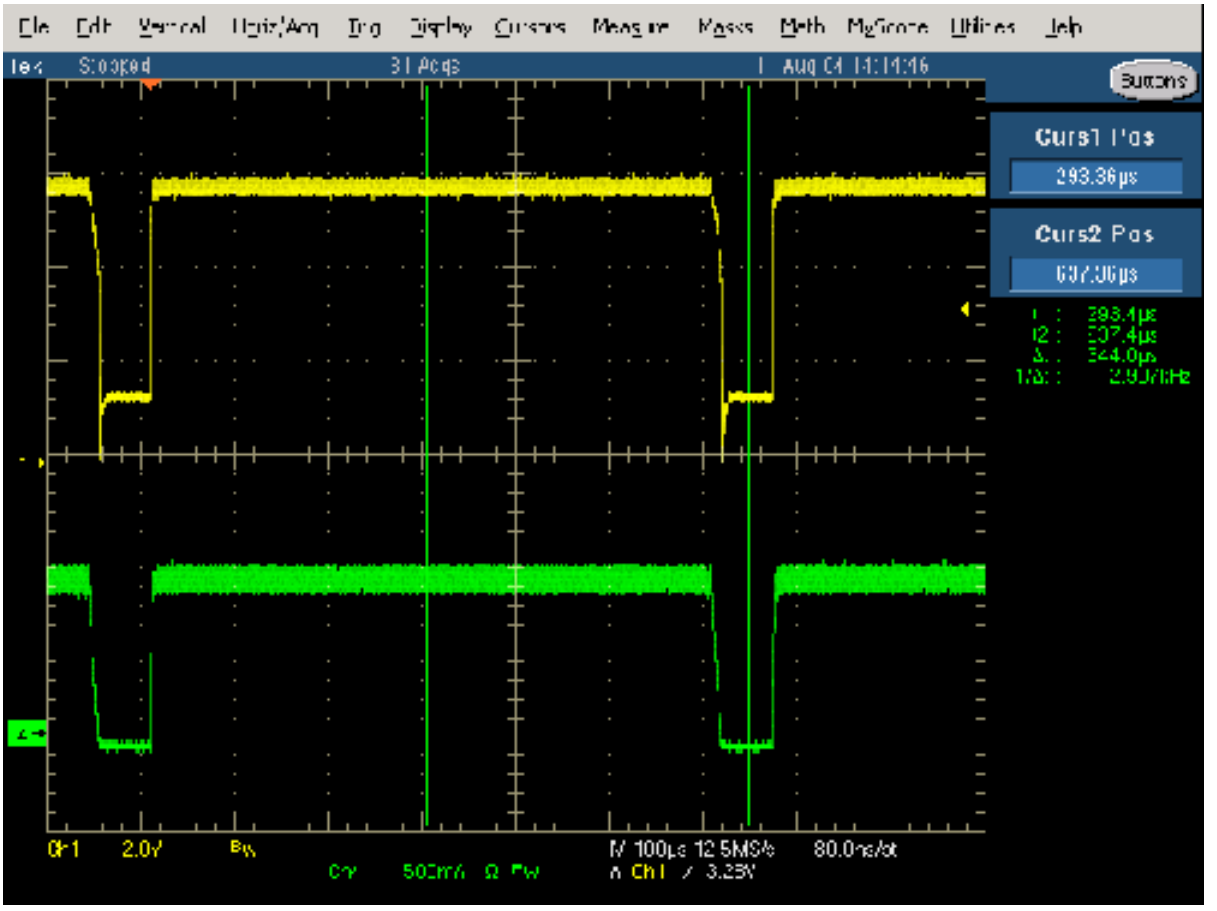
FIGURE 3. LED current for Vin=26V, ILED=0.88A, fpwm=1.5kHz and D=0.1 ch1=LED voltage ch4=LED current



PADC_NSC0361_wf_3

FIGURE 4. LED current for Vin=26V, ILED=0.88A, fpwm=1.5kHz and D=0.5 ch1=LED voltage ch4=LED current



PADC_NSC0361_wf_4

FIGURE 5. LED current for Vin=26V, ILED=0.88A, fpwm=1.5kHz and D=0.9 ch1=LED voltage ch4=LED current

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