NCP5030EVB/D

NCP5030 High Power Lighting Evaluation Board

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EVALUATION BOARD MANUAL

Overview

The NCP5030 is a fixed frequency PWM buck−boost converter optimized for constant current applications such as driving high−powered white LED. The buck−boost is implemented in an H−bridge topology and has an adaptive architecture where it operates in one of three modes: boost, buck−boost, or buck depending on the input and load condition. This device has been designed with high−efficiency for use in portable applications and is capable of driving up to 1.2 A pulse current and 900 mA continuous current into a high power LED for camera flash, flashlight, torch and similar applications. To protect the device cycle by cycle current limiting and a thermal shutdown circuit have been incorporated as well as output OVP (Over−Voltage Protection). The high switching frequency allows the use of a low value 4.7 μH inductor and ceramic capacitors. The NCP5030 is in a low profile and efficient thermally enhanced 3 x 4 mm DFN package.

NCP5030 High Power Lighting Evaluation Board

This evaluation board demonstrates the overall NCP5030 capabilities and offers very easy current programming. The output current is fully configurable via the usage of 4 external resistors and corresponding jumper headers. The NCP5030 lighting demo board schematic is depicted in Figure 1:

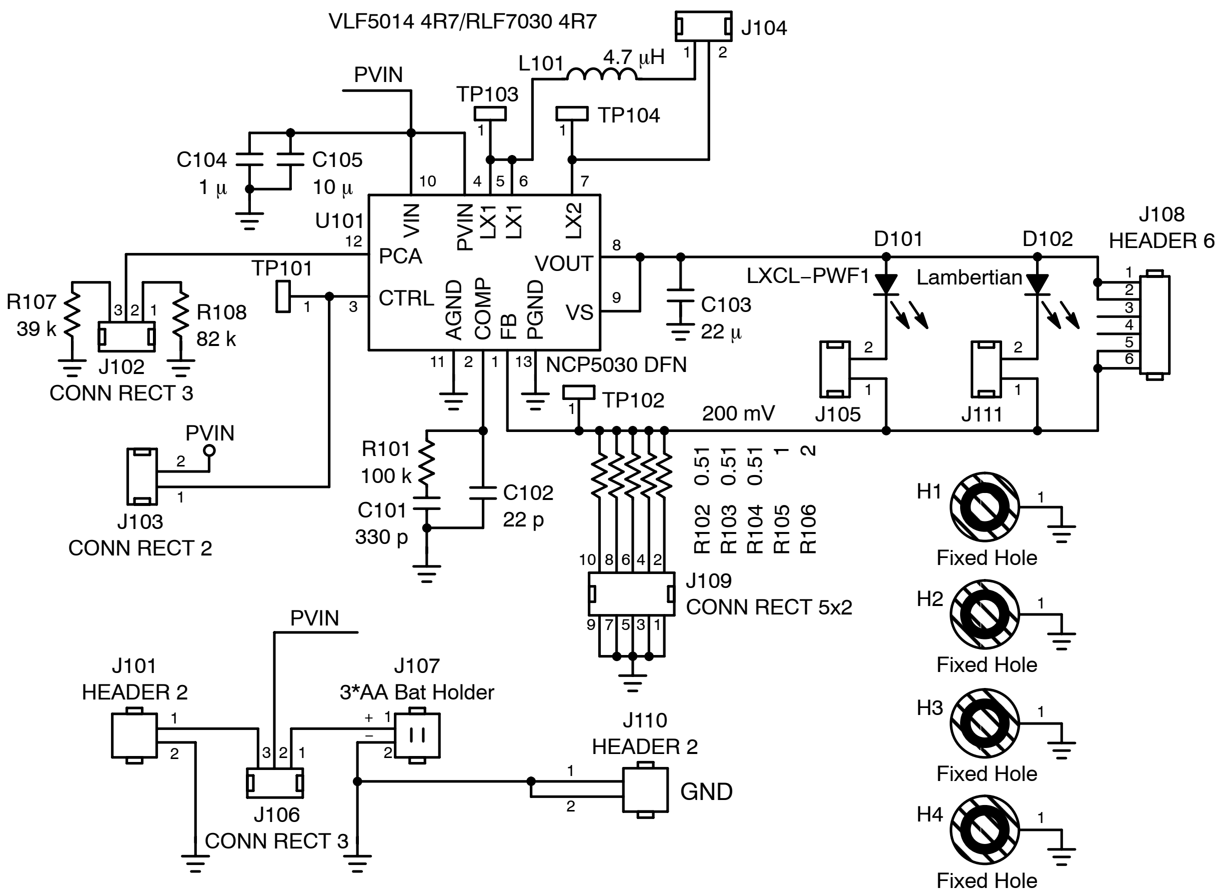

Figure 1. NCP5030 High Power Lighting Evaluation Board Schematic

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Operation

L101 selection depends on the output current, VLF5014A4R7M1R1 is recommended at output current under 500 mA, and RLF7030T4R7M3R4 is recommended when output current is larger than 700 mA.

The power supply of NCP5030 should be from 2.7 V to 5.5 V. Maximum input voltage is 7.0 V and maximum continuous output current is 900 mA.

CAUTION:

1. **Exceeding the maximum input voltage may damage NCP5030 permanently!**
2. **Too long time duration at over output current may decrease LED life time or even damage LED!**

Table 1. Input Power Connector

Symbol	Descriptions
J101−1	Positive terminal of external power supply
J101−2	GND of external power supply
J107−1	Positive terminal of 3*AA batteries in serial
J107−2	GND of 3*AA batteries in serial

Table 2. Output Power Connector

J108−1/2	VOUT of NCP5030
J108−5/6	FB of NCP5030

Table 3. Jumper Setup

J102−1/2	Peak current set to about 3 A, peak current and setting resistor selection can reference the datasheet of NCP5030
J102−2/3	Peak current set to about 1.5 A, peak current and setting resistor selection can reference the datasheet of NCP5030
J103	Short will connect CTRL to PVIN and enable NCP5030
J110	GND test jumper
J104	Must be connected to ensure NCP5030 work properly, can measure inductor current here, such as peak current of inductor
J105	Select D101 as load of NCP5030, be careful if J111 or J108 is connected
J111	Select D102 as load of NCP5030, be careful if J105 or J108 is connected
J109	Output current setting, reference to table 5(Output current setting table)

Table 4. Test Points

TP101	CTRL and enable of NCP5030.
TP102	FB, feedback, reference voltage is 200 mV.
TP103	Switch LX1
TP104	Switch LX2

Current Setting Selection

The output is determined by the resistor or resistors connected between FB pin and GND. R102 to R106 and J109 are used for output current setting according to eq. 1:

$$I_{out}(A) = \frac{0.2}{R(\Omega)} \qquad \text{(eq. 1)}$$

Where R is the total resistance between FB and GND, J109 allows parallel connections of several resistors to select output current.

Following is the output current setting table of J109 (1 = short connected; 0 = left open)

Table 5. Output Current Setting Table

PIN9−10	PIN7−8	PIN5−6	PIN3−4	PIN1−2	Output Current (mA)
0	0	0	0	1	100
0	0	0	1	0	200
0	0	0	1	1	300
0	0	1	0	0	400
0	0	1	0	1	500
0	0	1	1	0	600
0	0	1	1	1	700
0	1	1	0	0	800
0	1	1	0	1	900

Efficiency Test

Figure 2 and Figure 3 describe efficiency results in different conditions.

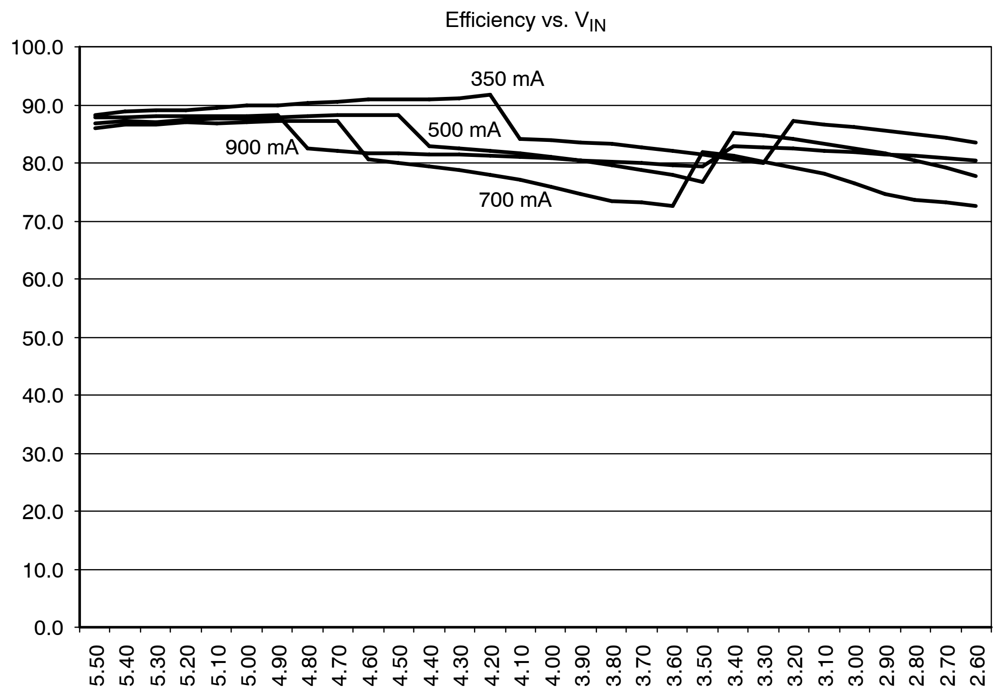

Figure 2. Efficiency vs. Input Voltage, R_{pca} = 82 KΩ, load = LXHL − PW09, Inductor = VLF5014A4R7M1R1 for I_{out} = 350 mA, 500 mA and 700 mA, RLF7030T4R7M3R4 for I_{out} = 900 mA

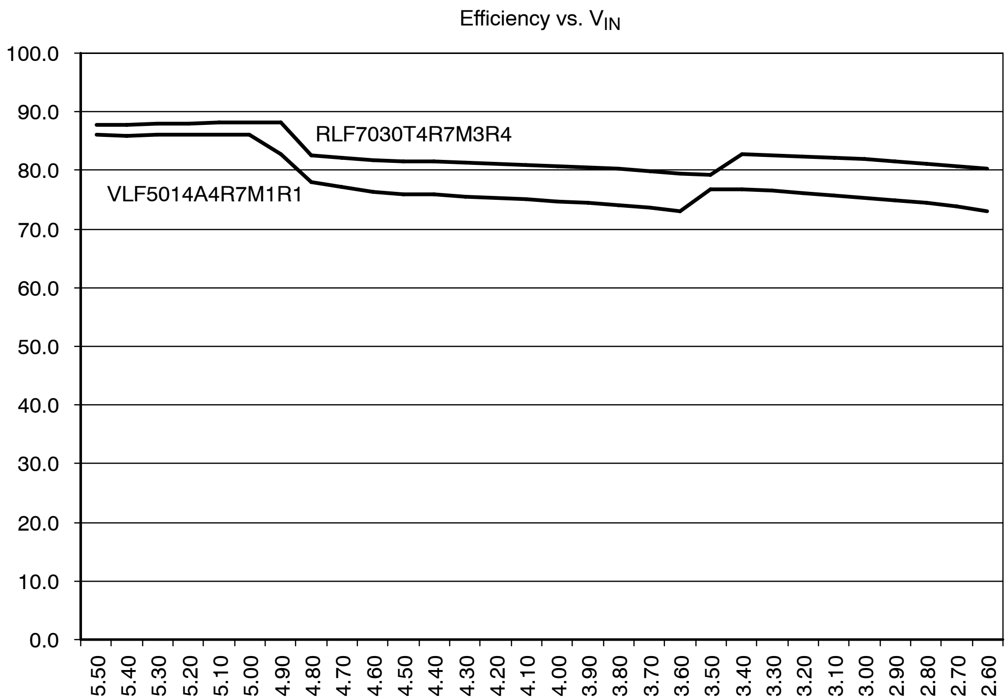

Figure 3. Efficiency vs. Input Voltage @ Inductor, I_{out} = 900 mA, R_{pca} = 82 KΩ, load = LXHL − PW09, V_f = 3.9 V

Output Current Regulation

Figure 4 shows the relationship between output current regulation R_{pca} and input voltage. There may be a tradeoff between output current and input current limit.

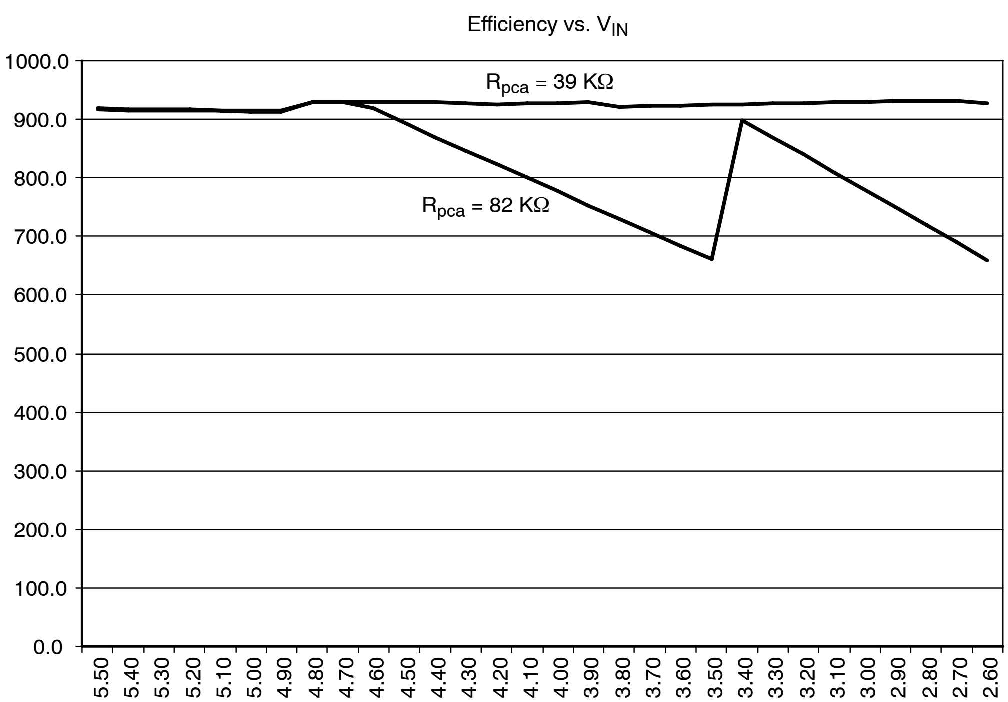

Figure 4. Output Current Regulation vs. Input Voltage @ R_{pca}, I_{out} = 900 mA Inductor = RLF7030T4R7M3R4; Load = LXHL − PW09, V_f = 3.9 V

PCB LAYOUT

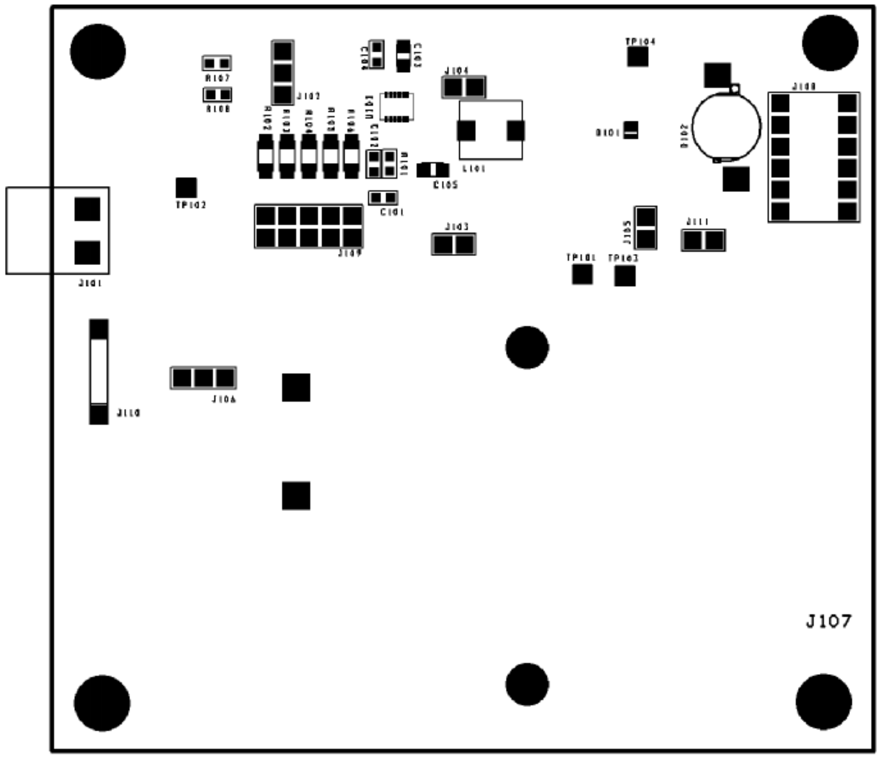

Figure 5. Assembly Layer

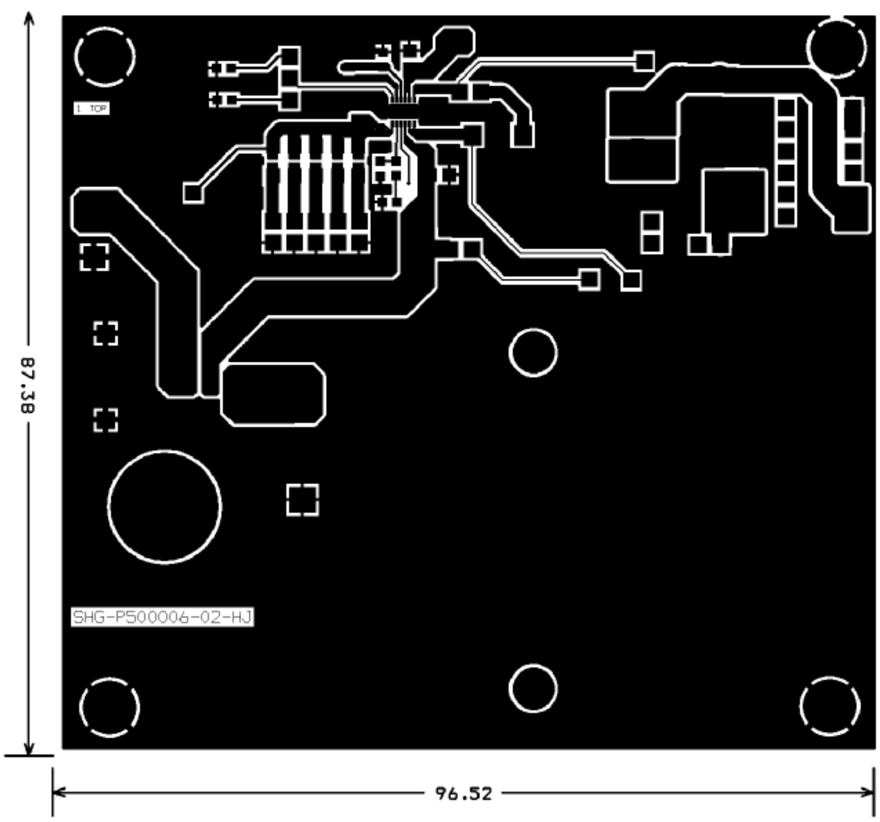

Figure 6. Top Layer Routing

Bill of Materials for the NCP5030 High Power Lighting Evaluation Board

Designator	Qty	Description	Value	Tolerance	Footprint	MFG	MFG Part Number	Substitution Allowed	ROHS Compliant
C101	1	Ceramic chip capacitor	330 pF	5%	0603	TDK	C1608C0G1H331J	Yes	Yes
C102	1	Ceramic chip capacitor	22 pF	5%	0603	TDK	C1608C0G1H220J	Yes	Yes
C103	1	Ceramic chip capacitor	22 μF	20%	0805	TDK	C2012X5R0J226M	Yes	Yes
C104	1	Ceramic chip capacitor	1 μF	20%	0603	TDK	C1608X5R0J105M	Yes	Yes
C105	1	Ceramic chip capacitor	10 μF	20%	0805	TDK	C2012X5R0J106M	Yes	Yes
L101	1	Chip winding magnetic shielded inductor	4.7 μH	20%	4.5*4.7 mm 6.8*7.3 mm	TDK	VLF5014AT−4R7M1R1 RLF7030T−4R7M3R4	Yes	Yes
R101	1	Chip resistor	100 KΩ	5%	0603	Std.	Std.	Yes	Yes
R102	1	Chip resistor	TBD (not mounted)	NA	0805/1206	Std.	NA	NA	NA
R103, R104	2	Chip resistor	0.51 Ω	1%,1/4 W	0805/1206	Std.	Std.	Yes	Yes
R105	1	Chip resistor	1 Ω	1%,1/8 W	0805/1206	Std.	Std.	Yes	Yes
R106	1	Chip resistor	2.2 Ω	1%,1/8 W	0805/1206	Std.	Std.	Yes	Yes
R107	1	Chip resistor	39 KΩ	5%	0603	Std.	Std.	Yes	Yes
R108	1	Chip resistor	82 KΩ	5%	0603	Std.	Std.	Yes	Yes
TP101− TP104	4	PCB terminal 1 mm	NA	NA	Standard 1 mm	Std.	Std.	Yes	Yes
U101	1	Buck−Boost driver for high power flash LED	NA	NA	WDFN12, 3*4 mm	ON Semiconductor	NCP5030MTTXG	No	Yes
J101	1	Header X 2	NA	NA	SL5.08/2/90	SL5.08/2/90B	Weidmüller	Yes	Yes
J102, J106	2	Header 3 pin, 0.1 inch spacing	NA	NA	0.100*3	Std.	Std.	Yes	Yes
J103, J104, J105, J111	4	Header 2 pin, 0.1 inch spacing	NA	NA	0.100*2	Std.	Std.	Yes	Yes
J107	1	3*AA Battery holder	NA	NA	1.84*2.25 mm	MPD	BH3AA−PC	No	Yes
J108	1	Header 6	NA	NA	0.100*6	AMP	535676	No	Yes
J109	1	Header 2*5,0.1 inch spacing	NA	NA	0.100*2*5	Std.	Std.	Yes	Yes
J110	1	GND jumper 400 mil spacing	NA	NA	0.400 spacing	D3082−B01	Harwin	Yes	Yes
D101	1	LXCL−PWT1	NA	NA	2.0*1.6 mm	Lumileds	LXCL−PWT1	No	Yes
D102	1	Lambertian LED modules	LUXEON I LUXEON III	NA	Lambertian	Lumileds	LXHL−PW01 LXHL−PW09	Yes	Yes

Test Procedure

1. Visual inspection the board after solder, there should be no short, redundant solder ball.
2. Measure the resistance of each pin of NCP5030 to GND, there should be no short to GND (except pin GND) or each other. Measure the forward and backward resistance of D101/D102. Ensure solder is good.
3. Short J104;
4. Short J103;
5. Short J106 2−3(power supply from J101);
6. Configure J102 in 2−3 position;
7. Short J105, open J111, J108;
8. Configure J109 in 100 mA position (pin1−2 shorted);
9. Configure power supply output voltage to 3.7 V.
10. Power off and connect power supply to J101;
11. Power on, check D101 is lighting;
12. Power off and Configure J109 in 200 mA position (pin3−4 shorted);
13. Power on, check D101 is lighting;
14. Power off and Configure J109 in 400 mA position (pin5−6 shorted);
15. Power on, check D101 is lighting;
16. Power off and Configure J109 in 400 mA position (pin7−8 shorted);
17. Power on, check D101 is lighting;
18. Power off and configure J102 at 1−2 position;
19. Configure J109 in 100 mA position (pin1−2 shorted);
20. Power on, check D101 is lighting;
21. Power off, open J105, short J111 (if D102 mounted);
22. Power on, check D102 is lighting (if D102 mounted);
23. Power off, open J105, J111, connect J108 to external LED or LED module (if there is);
24. Power on, check external LED or LED module is lighting (if there is);
25. Power off;
26. Configure board default and connect jumpers accordingly
    - Place board in 300 mA output current configuration:
    - Place jumpers on J109 1−2(100 mA), 3−4(200 mA), 9−10(0 mA);
    - Place a jumper on J102 2−3;
    - Place jumpers on J103/J104;
    - Place a jumper on J105 and make sure J111 is open;
    - Place a jumper on J106 2−3;

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