

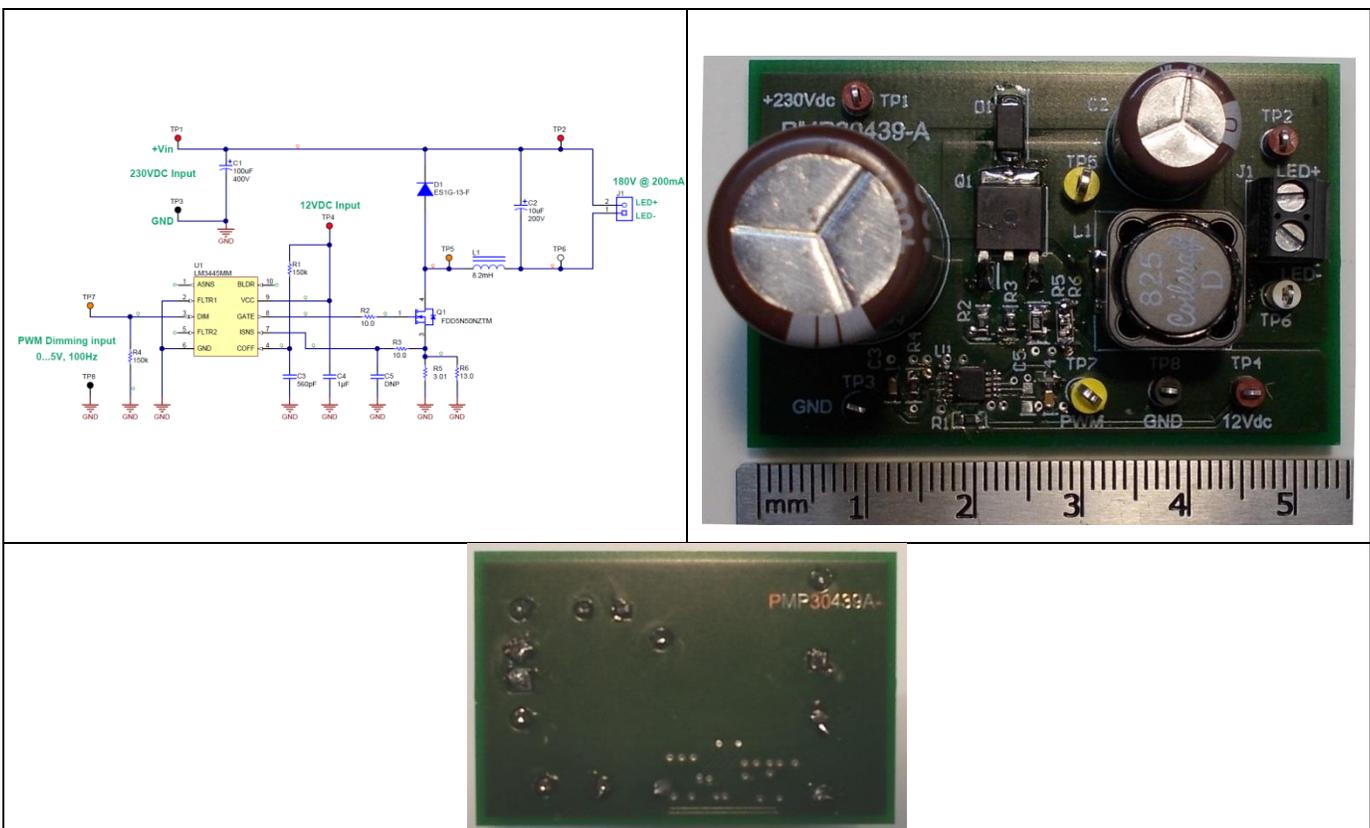
# Test Report: PMP30439

## 230 V in to 180 V out at 200 mA Constant-Current LED Driver Reference Design



### Description

This reference design is a low-side Buck (the output voltage is referenced to the positive DC input (+Vin node), not to the GND node). The controller drives a LED string up to 180V with 200mA constant current. The low-side Buck topology simplifies the schematic thanks to direct-driving of the FET, without the need of high-side driver. [The reference design PMP30439 Rev\\_B has been built on PMP30439 Rev\\_A PCB.](#)



An IMPORTANT NOTICE at the end of this TI reference design addresses authorized use, intellectual property matters and other important disclaimers and information.

## 1 Test Prerequisites

### 1.1 Voltage and Current Requirements

**Table 1. Voltage and Current Requirements**

PARAMETER	SPECIFICATIONS
Input Voltage	230VDC
Output Voltage	180VDC
Output Current	200mA

### 1.2 Required Equipment

- 0...300VDC, (min. 300mA), constant voltage source (VS1)
- 0...15VDC, (min. 50mA), constant voltage source (VS2)
- LED string, 180V (nominal), 200mA
- Oscilloscope (min. 100 MHz bandwidth)
- Current probe (min. 100 KHz bandwidth)
- Function generator (FG): providing 0.1%...99.9% duty cycle, 0..5Vpk, 100Hz, PWM signal for dimming
- Optional: infrared camera

### 1.3 Considerations

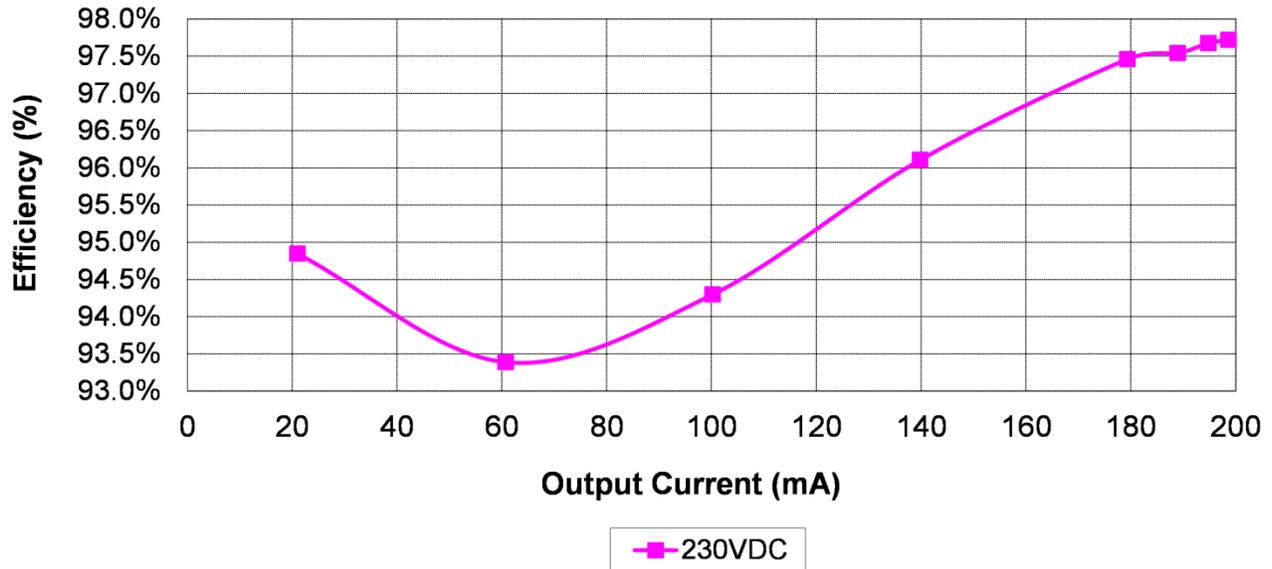
- a) Connect the source VS1 to TP1 and TP3.
- b) Connect the source VS2 to TP4 and TP3.
- c) Connect the function generator FG to TP7 and TP8.
- d) Connect the LED string to TP2 and TP6, with the positive to TP2
- e) Set the function generator to supply a PWM signal, with low level = 0V and high level = 5V, frequency = 100 Hz, and duty cycle = 0.1%.
- f) Turn VS2 on.
- g) Enable the FG output.
- h) Turn VS1 on.
- i) Adjust the duty cycle of FG from 0.1% to 99.9% to vary LED current
- j) Turn off the board by reverse sequencing (h-g-f)
- k) Wait until both output and input capacitors are completely discharged (warning: HIGH VOLTAGE)

## 2 Testing and Results

### 2.1 Efficiency Graphs:

The efficiency graph, versus output LED current, is shown below. The output current has been varied by adjusting the PWM dimming duty cycle, from 99.9% to 0.1%.

The input voltage has been set to 230 VDC, and the bias voltage to 12VDC.



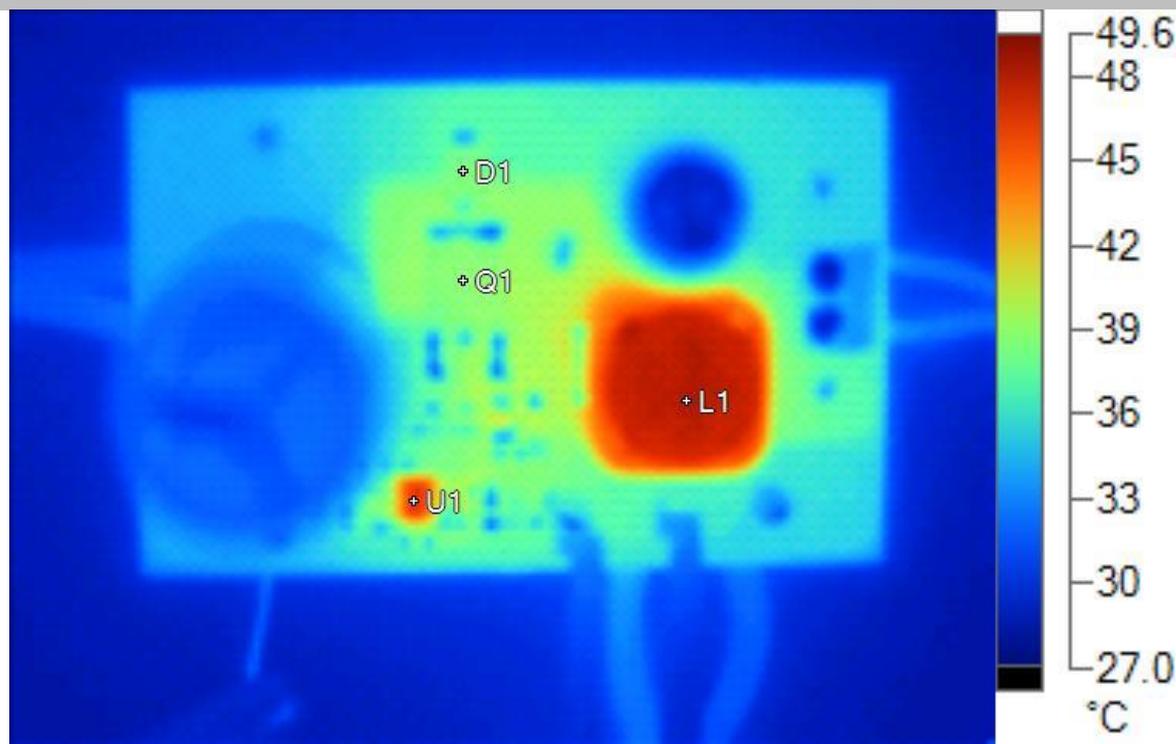
### 2.2 Efficiency Data:

The efficiency graph reports the data from the table shown below:

Vin(V)	Vbias(V)	Iin(mA)	Ibias(mA)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)	PWM(%)
230	12	0	3.65	0.044	0	0	0	0.0%	99.9
230	12	15.3	4.19	3.569	161.2	21.0	3.39	94.84%	90.0
230	12	46.5	6.83	10.777	165.8	60.7	10.06	93.38%	70.0
230	12	77.9	8.75	18.022	169.6	100.2	16.99	94.30%	50.0
230	12	109.0	9.20	25.180	173.1	139.8	24.20	96.10%	30.0
230	12	140.2	11.21	32.381	176.0	179.3	31.56	97.46%	10.0
230	12	148.0	11.93	34.183	176.5	188.9	33.34	97.54%	5.0
230	12	152.6	11.96	35.242	176.7	194.8	34.42	97.67%	2.0
230	12	155.6	12.15	35.934	176.8	198.6	35.11	97.71%	0.1

### 2.3 Thermal Image

The graph and table below show the thermal picture of the converter supplied at 230VDC and loaded with a LED string. The output voltage was ~ 180V and the current 200mA. The image has been taken after the board was running for 20 minutes, placed horizontal on the bench, at full load, with ambient temperature of 25C and in still air condition.



**Main Image Markers**

Name	Temperature	Emissivity	Background
L1	48.5°C	0.95	25.0°C
U1	46.5°C	0.95	25.0°C
Q1	38.7°C	0.95	25.0°C
D1	38.4°C	0.95	25.0°C

### 2.4 Dimensions

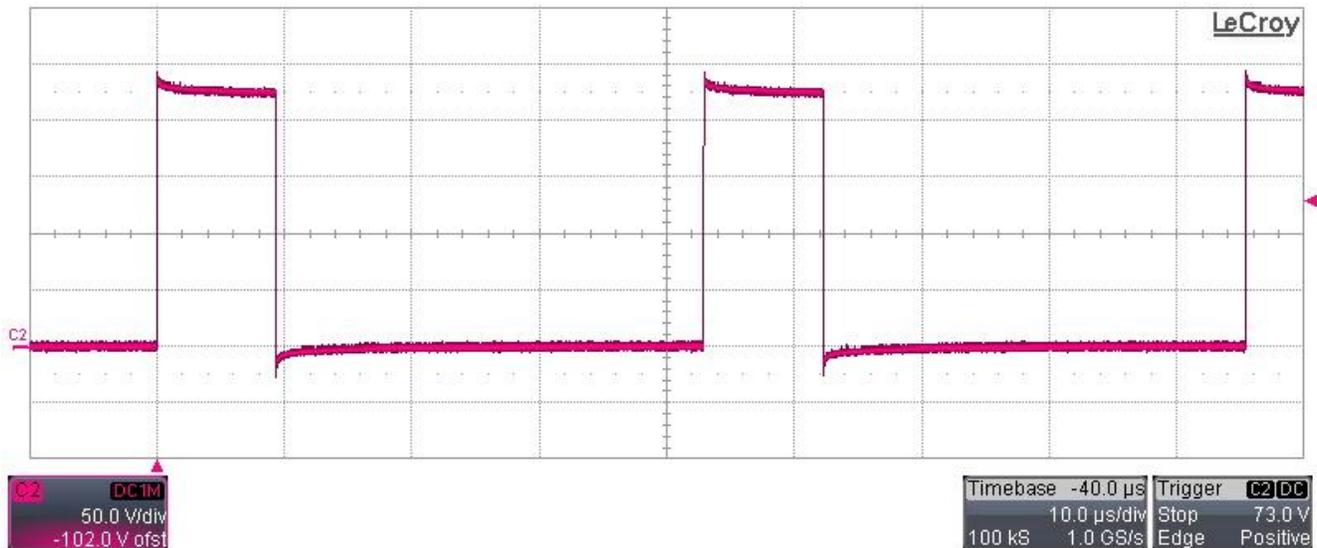
The board dimensions are 54.61 mm x 35.56 mm, height 40 mm.

### 3 Waveforms

#### 3.1 Switching

The switching waveforms have been measured by supplying the converter at 230VDC in full load condition.

Ch.2: Switch-node (Drain of Q1) (50V/div, 10usec/div, no BWL)

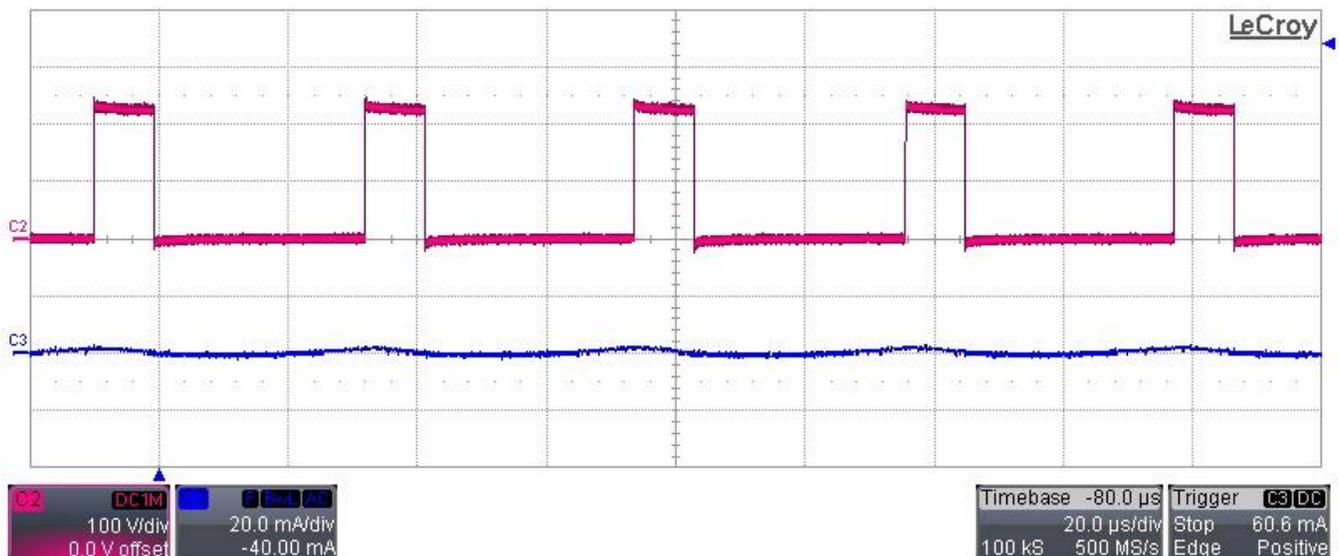


#### 3.2 Output Current Ripple

The output current ripple has been measured by supplying the converter at the same conditions of point 3.1.

Ch.2: Switch-node (Drain of Q1) (100V/div, 20usec/div, no BWL)

Ch.3: Output current ripple (LED current) (20mA/div, AC coupling, 20 MHz BWL)

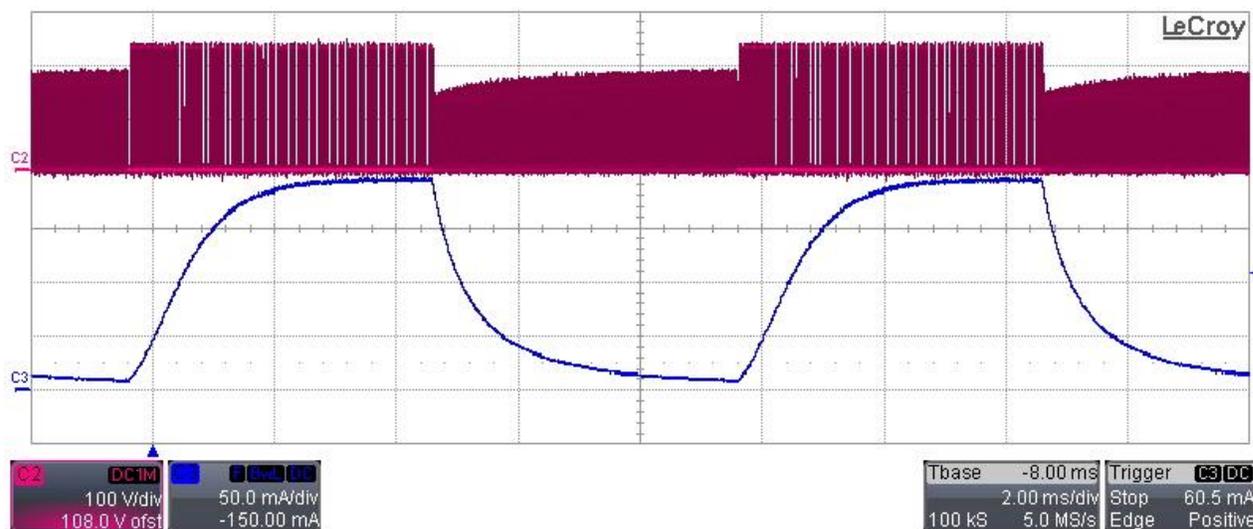


### 3.3 Output Current Variation during PWM Dimming

The output current variation has been measured by supplying the converter at the same conditions of point 3.1 and by applying 50% duty cycle @ 100Hz to dimming input (TP7).

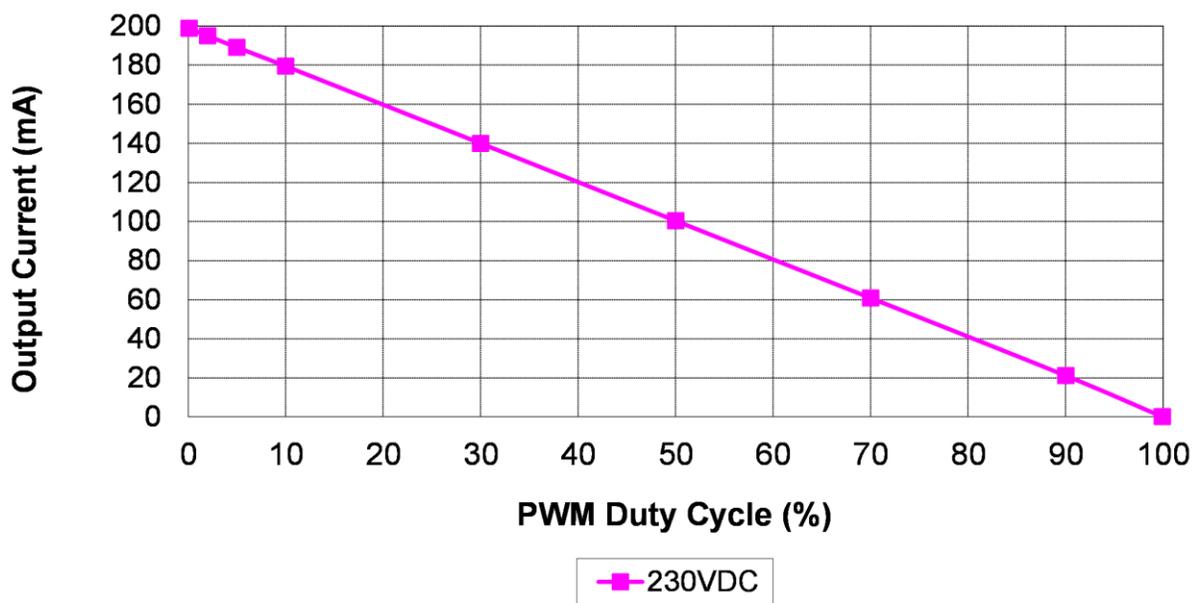
Ch.2: Switch-node (Drain of Q1) (100V/div, 2msec/div, no BWL)

Ch.3: Output current ripple (LED current) (50mA/div, 20 MHz BWL)



### 3.4 PWM Dimming Linearity

The output current variation versus PWM duty cycle is shown in the table below. Test conditions: same as point 3.1. The PWM dimming duty cycle has been varied between 99.9% (no LED current) to 0.1% (almost full current).



## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (<https://www.ti.com/legal/termsofsale.html>) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2021, Texas Instruments Incorporated