

PMP6009
TPS92075
230Vac Triac Dimmable 10W LED Driver
Reference Design



June, 2013

230Vac Triac Dimmable 10W LED Driver Reference Design

1 Introduction

This TPS92075 reference design presents the TPS92075 AC-DC controller driving an 80V string of LEDs at 100mA in a buck configuration. It is compatible with most 230Vac triac dimmers. The TPS92075 is designed for non-isolated, phase dimmable, buck PFC LED drivers and features constant off-time control, digital phase angle decoder and digital reference control. Additional features include cycle-by cycle switch current limit, VCC under-voltage lockout, and output over-voltage protection.

2 Description

This reference design provides a high-brightness LED driver based on the TPS92690Q1 configured as a power factor corrected buck regulator that is triac dimmable. It is designed to operate with an input voltage in the range of 198VAC to 264VAC with a 230-VAC nominal input voltage. This design is set up for an 8W output power with an output voltage range of 70 V to 90 V.

2.1 Typical Applications

This converter design describes an application of the TPS92075 as an LED driver with the specifications listed below. For applications with a different output voltage or current range refer to the TPS92075 datasheet.

2.2 Features

2.2.1 Connector Description

This section describes the connectors of the reference design board.

2.2.1.1 J8

This connector is for the AC input to the board. Use the screw down terminal to connect Line and Neutral to the circuit.

2.2.1.2 J5

This connector is for the LED load. Use the screw down terminal to connect the LED anode to the pin marked LED+ and connect the LED cathode to the pin marked LED-.

3 Electrical Performance Specifications

Table 1: TPS92075 230Vac Triac Dimmable Buck Electrical Performance Specifications

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Characteristics					
Voltage range	Normal operation	198	230	264	VAC
Maximum input current	At 230VAC 50Hz input voltage		0.05		A
Output Characteristics					
Output voltage, VOUT		75	80	85	V
Output load current, IOUT	Input voltage = 230V 50Hz, Load = 80V LED	90	105	120	mA
Output current regulation	Input voltage = 230V 50Hz, Load = 80V LED		< ±5		%
Output current ripple	Input voltage = 230V 50Hz, Load = 80V LED		<40		mApp
Systems Characteristics					
Switching frequency	Input voltage = 230V 50Hz, Load = 80V LED		65		kHz
Power Factor	Input voltage = 230V 50Hz, Load = 80V LED		0.95		
Efficiency	Input voltage = 230V 50Hz, Load = 80V LED		85		%

4 Schematic

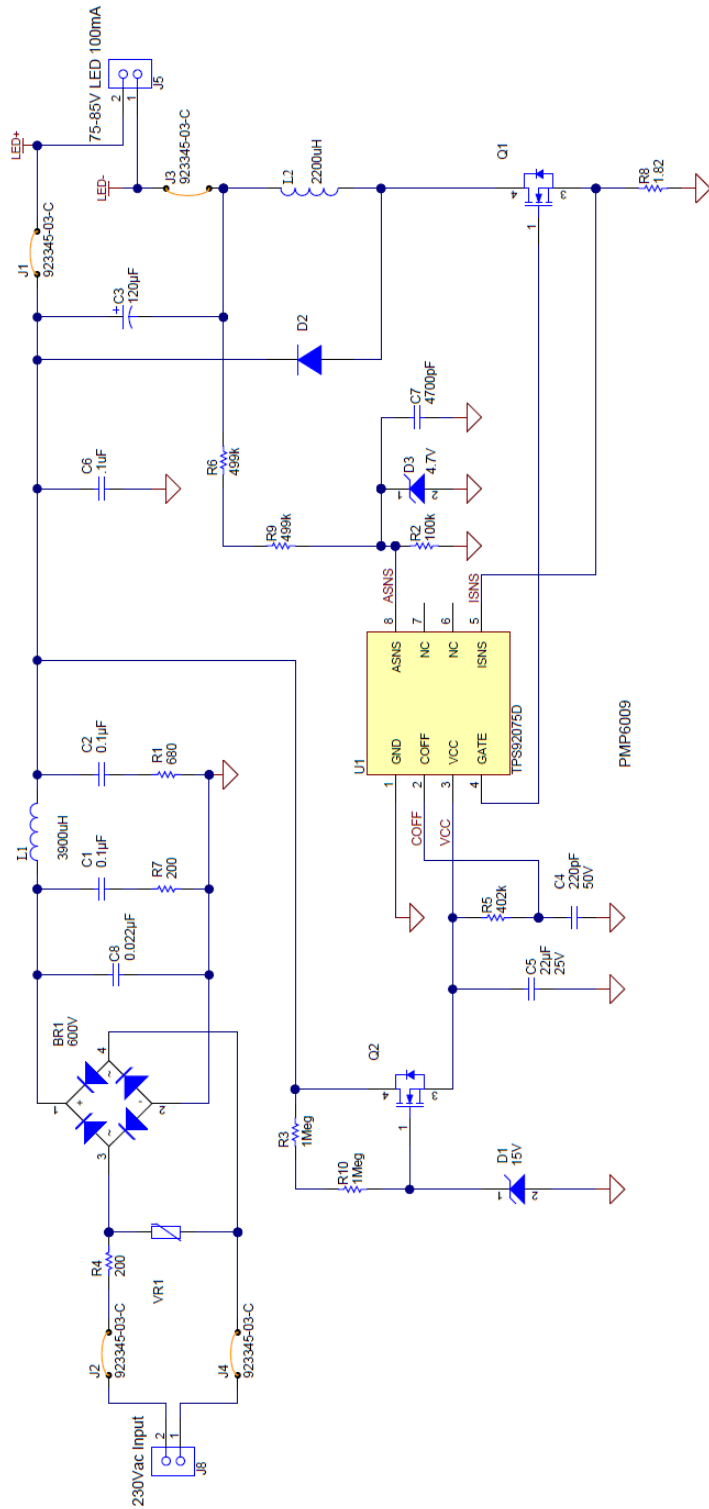


Figure 1: TPS92075 230Vac Triac Dimmable 10W LED Driver Schematic

5 Performance Data and Typical Characteristic Curves

Figures 2 through 9 present typical performance curves for TPS92075 230Vac Triac Dimmable 10W LED Driver

5.1 Efficiency

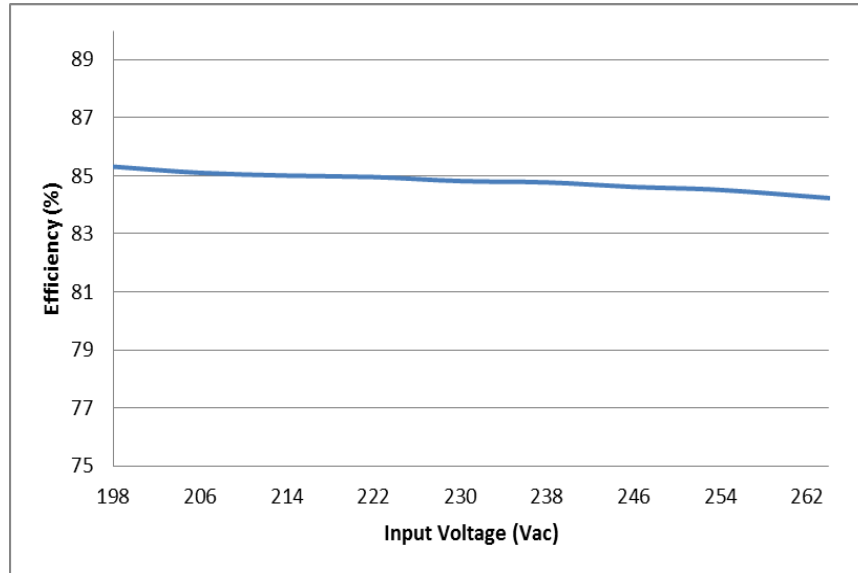


Figure 2: Efficiency

5.2 Line Regulation

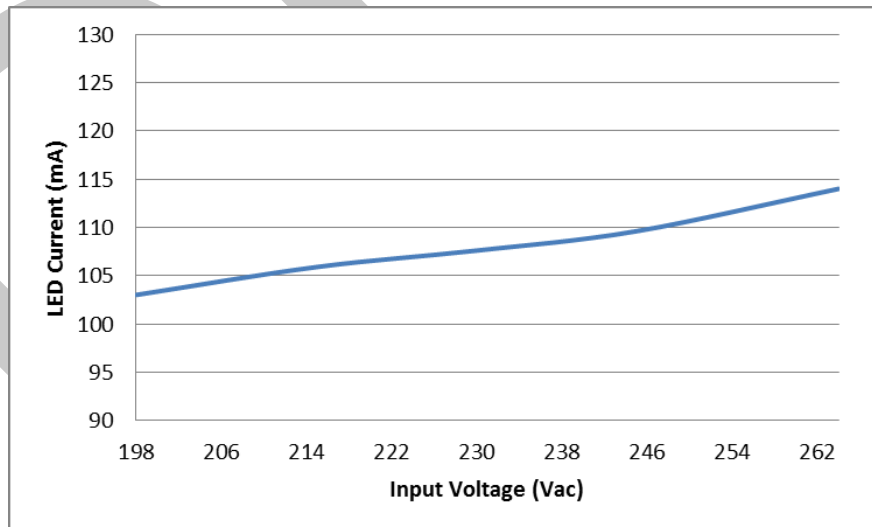


Figure 3: Line Regulation

5.3 Triac Dimmer Response

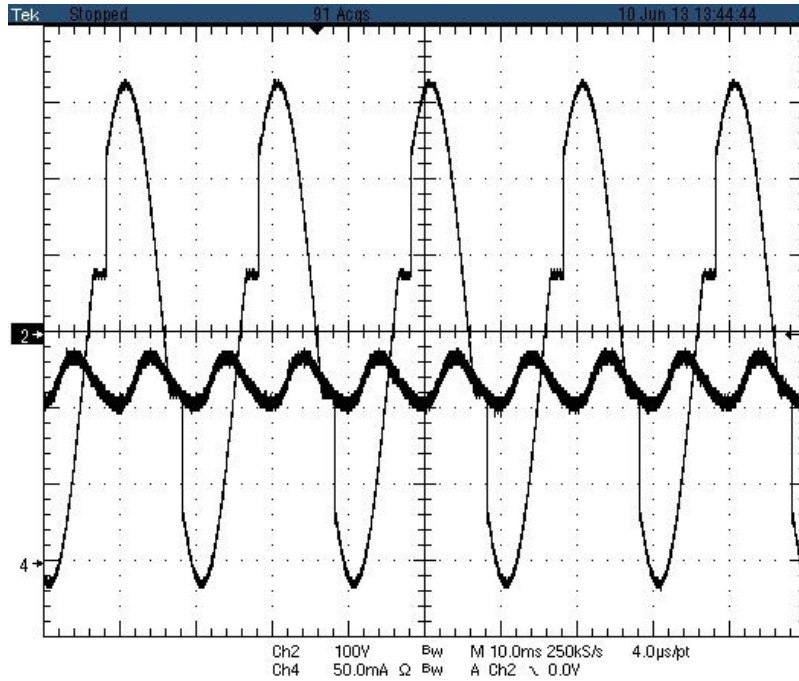


Figure 4: Triac Maximum Level Waveform Ch2: AC Input Ch4 LED current

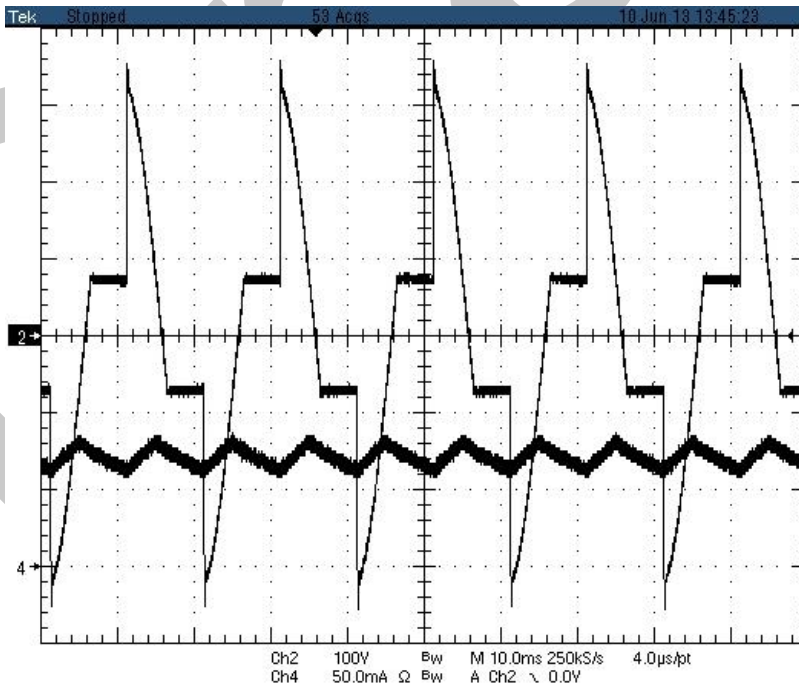


Figure 6: Triac 90 Degree Conduction Angle Waveform Ch2: AC Input Ch4 LED current

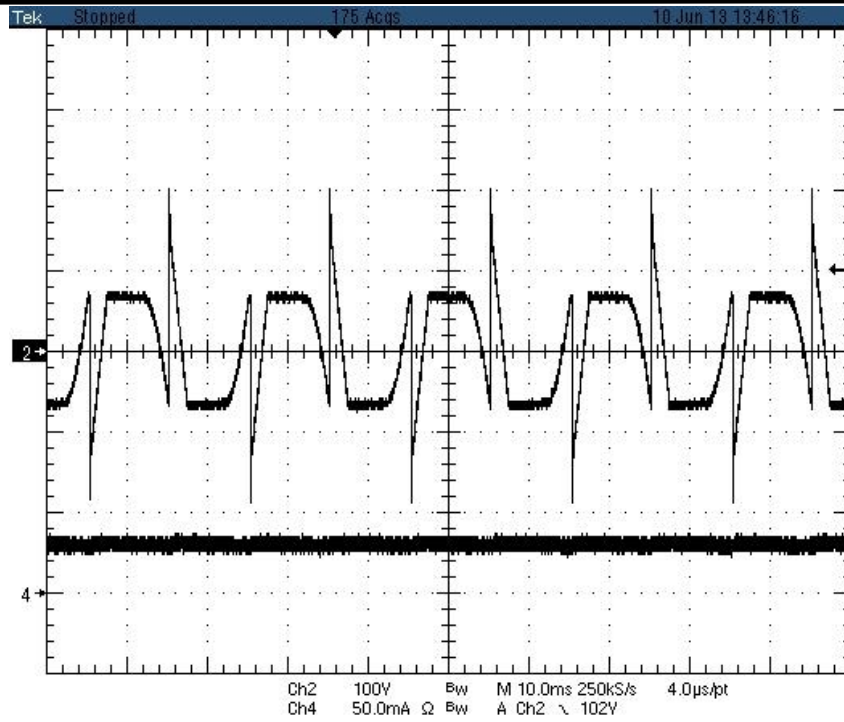
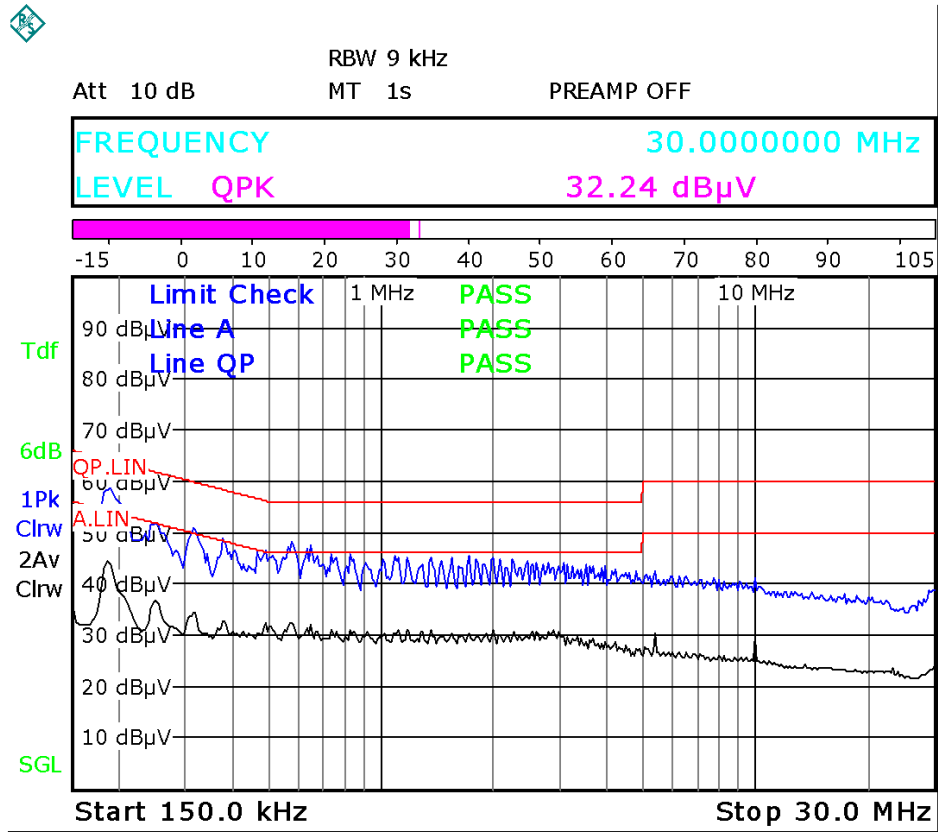


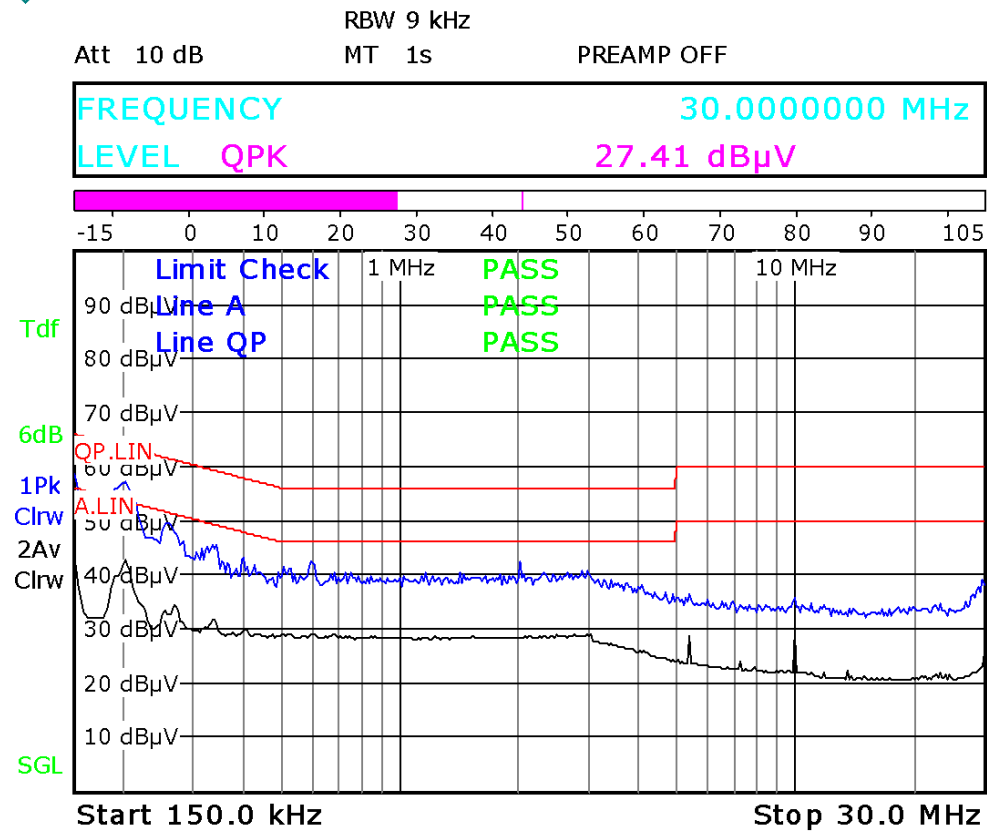
Figure 7: Triac Minimum Level Waveform Ch2: AC Input Ch4 LED current

5.4 EMI Performance



Date: 6.JUN.2013 23:47:34

Figure 8: 230VAC Line-Conducted EMI Scan



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Figure 9: 230VAC Neutral-Conducted EMI Scan

6 TPS92075 230Vac Triac Dimmable 10W LED Driver Reference Design PCB layout

The following figures (Figure 13 through Figure 14) show the design of the printed circuit board.

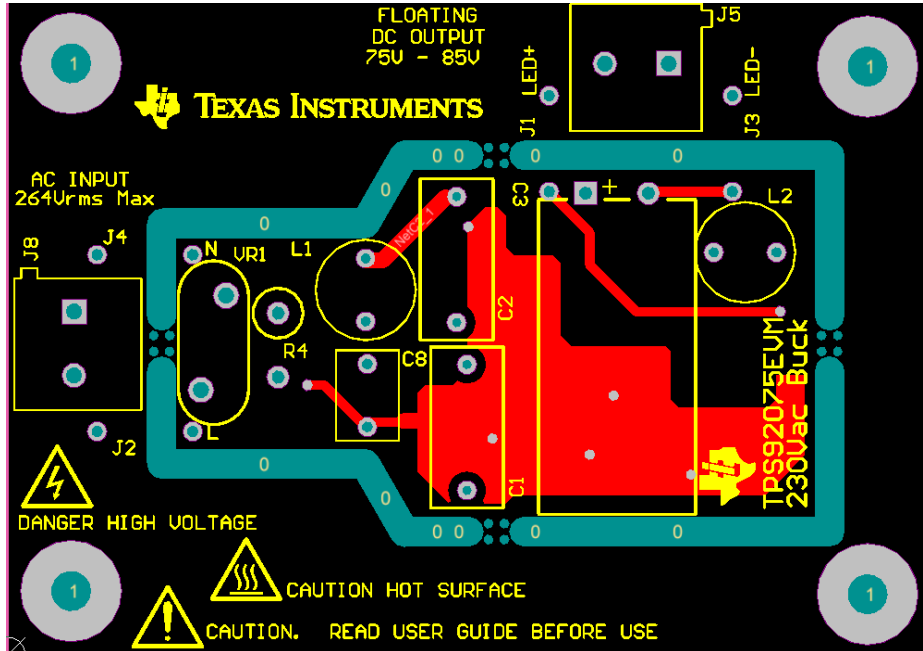


Figure 10: Top Layer and Top Overlay (Top view)

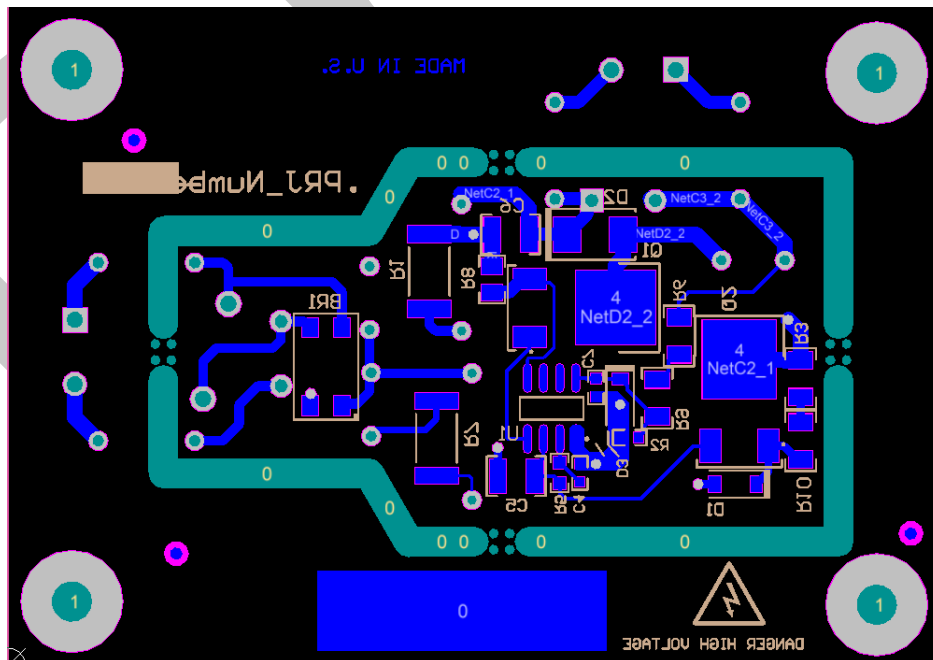


Figure 11: Bottom Layer and Bottom Overlay (Bottom view)

Table 2: The TPS92075 230Vac Dimmable components list according to the schematic shown in Figure 1

REFERENCE DESIGNATOR	QTY	VALUE	DESCRIPTION	SIZE	MFR	PART NUMBER
U1	1		Non-isolated Phase Dimmable Buck PFC LED Driver with Adaptive Reference Control	M08A	TI	TPS92075D
C1,C2	2	0.1 μ F	CAP FILM 0.1UF 630VDC RADIAL	13mmx6mm	EPCOS	B32921C3104
C3	1	120 μ F	Capacitor, Aluminum, 100V	12.5mmx20mm	Nichicon	UHE2A121MHD6
C4	1	220 pF	CAP, CERM, 220pF, 50V, 5%,NP0	0603	MuRata	GRM1885C1H221JA01D
C5	1	22 μ F	CAP CER 22UF 25V 20% X7R	1210	Taiyo Yuden	TMK325B7226MM-TR
C6	1	0.1 μ F	CAP CER 0.1UF 630V 10% X7T	1210	TDK	C3225X7T2J104K160AC
C7	1	4700 pF	CAP, CERM, 4700pF, 50V, +/-10%, X7R	0603	MuRata	GRM188R71H472KA01D
C8	1	0.022 μ F	CAP FILM 0.022UF 400VDC RADIAL	7.2mmx4.5mm	Kemet	R82MC2200
D1	1	15V	Diode, Zener, 15V, 500mW	SOD-123	On Semi	MMSZ4702T1G
D2	1	600V	DIODE ULT FAST 600V 1A SMB	SMB	MCC	ER1J-LTP
D3	1	4.7V	DIODE ZENER 4.7V 500MW	SOD-123	Diodes Inc	BZT52C4V7-13-F
L1	1	3.9 mH	INDUCTOR 3900UH 0.18A	7.8mmx7.5mm	Wurth	744 730 392
L2	1	2.2 mH	INDUCTOR 2200UH 0.36A	9mmx12mm	Bourns	RLB9012-222KL
Q1, Q2	2	600V	MOSFET N-CH 600V 3.9A	DPAK	Fairchild	FCD4N60TM
R1	1	680 Ω	RES, 680 ohm, 5%, 1W	2512	std	
R2	1	100 k Ω	Resistor, Chip, 1/10W, 1%	0603	Std	
R3, R10	2	1.0 M Ω	Resistor, Chip, 1/8W, 1%	0805	Std	
R4	1	200 Ω	Resistor, 2W, 5%, Axial	5mmx15mm	Yageo	FRM200JR-73-200R
R5	1	402 k Ω	Resistor, Chip, 1/10W, 1%	0603	Std	
R6, R9	1	499 k Ω	Resistor, Chip, 1/8W, 1%	0805	std	
R7	1	200 Ω	RES, 200 ohm, 5%, 1W	2512	std	
R8	1	1.82 Ω	Resistor, Chip, 1/8W, 1%	0805	Std	
VR1	0					

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