PMP6306, 40-V, 450-mA, Non-Dimmable, T8 LED Driver Using TPS92210

This reference design, PMP6306, is designed as a 18-W, non-dimmable, T8 LED lighting driver that uses the TPS92210. The driver is used for the off-line, single-stage, corrected power factor which provides a 450-mA constant current to drive 13 high-brightness (HB) LEDs series with a universal input range.

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1 Description

The PMP6306 reference design is a 18-W, ac-to-dc converter that converts 90-Vrms to 265-Vrms ac input to a typical 40-V output voltage and supplies a 450-mA constant current. This end-application is targeted at T8 and T5 lamps with a nominal 450-mA output. The TPS92210, the LED lighting driver, employs constant on-time control to implement better PF performance and includes cascade architecture to reduce switching loss in the primary side. Furthermore, the TPS92210 (SLUS989) provides overcurrent and overvoltage protection, low cost of list of materials, and suitability for use as the replacement for T8 fluorescent tube.

1.1 Typical Applications

- T8/T5 fluorescent tube drivers
- Down and architectural wall sconces
- General LED lighting

1.2 Features

- Single-stage PFC flyback
- 90-Vrms to 265-Vrms off-line operation
- Power factor correction.
- Constant-current control
- Overvoltage protection
- Short-circuit protection
- Isolation design

2 Electrical Performance Specifications

Table 1. PMP6306 Electrical Performance Specifications

Parameter	Test Conditions	Min	Typ	Max	Units
Input Characteristics					
Voltage range		90		265	Vrms
Power Factor (PF)	Output load = 13 LEDs series at 240 Vac	0.902			
Total Harmonic Distortion (THD)				15%	
Output Characteristics					
Output voltage, Vout	Output current = 450 mA		40		V
Output load current, Iout			450		mA
Output current ripple	Co = 680 µF			20%	
Systems characteristics					
Efficiency			85%		

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3 Schematic

The schematic (Figure 1) is for reference only. For purposes of clarity, some of the detailed component parameters are not shown. Consult the bill of materials (Table 2) for additional information.

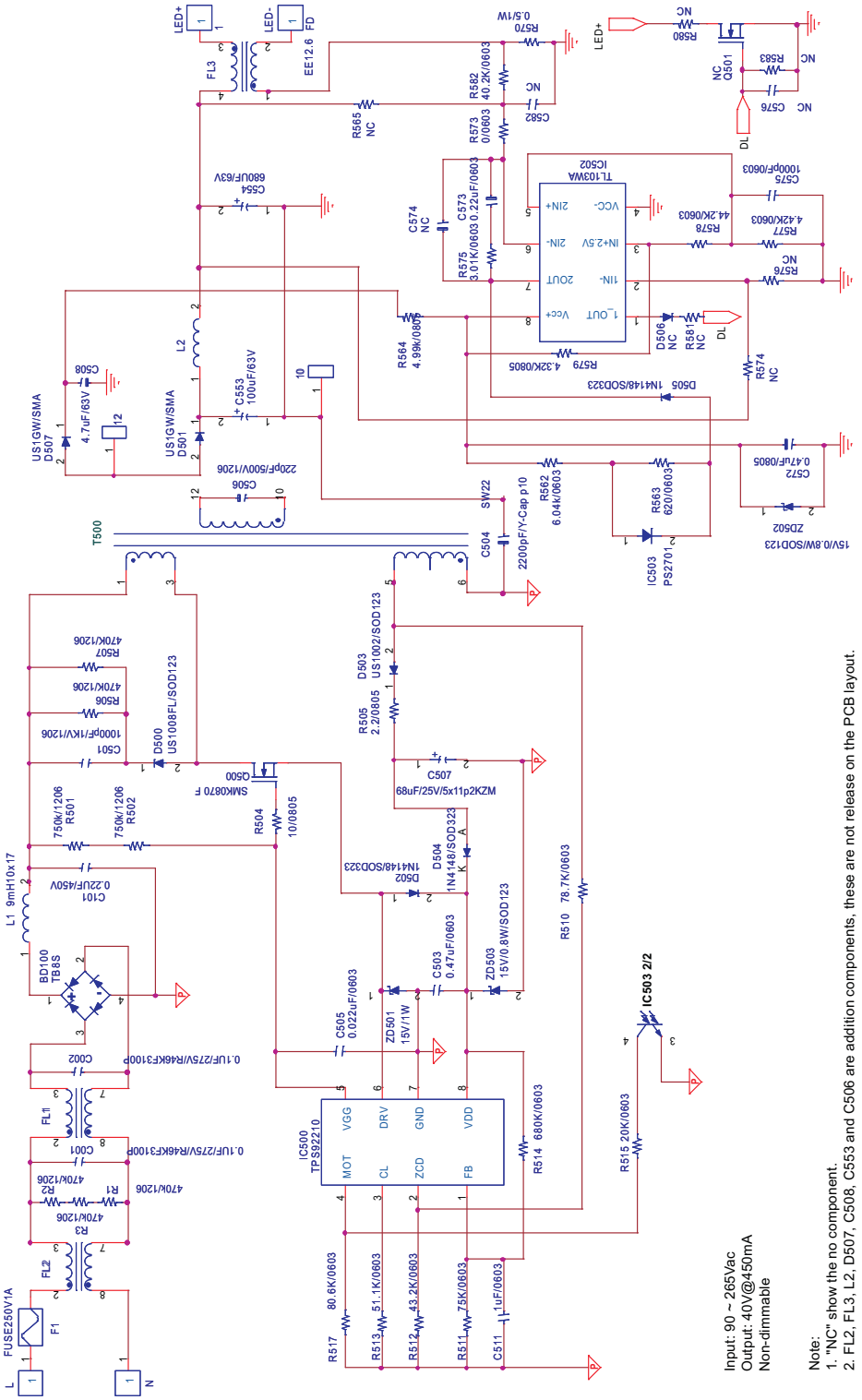

Figure 1. PMP6306 Schematic

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4 Theory of Operation

The data sheet for the TPS92210 controller SLUS989 details its operation and features. In the secondary-side current feedback, the single-stage output on the driver secondary side is a flyback configuration consisting of D501 and π-filter, C553, C554., and L2. Current-sense resistor R570 converts LED load current to a ground-referenced voltage. The voltage of R570 is compared by a reference IC502 from divider R577 and R578. This current amplifier configuration uses closed-loop current regulation for the load LEDs. The collector of the photo-coupler IC503 is connected to OTM pin for constant on-time control.

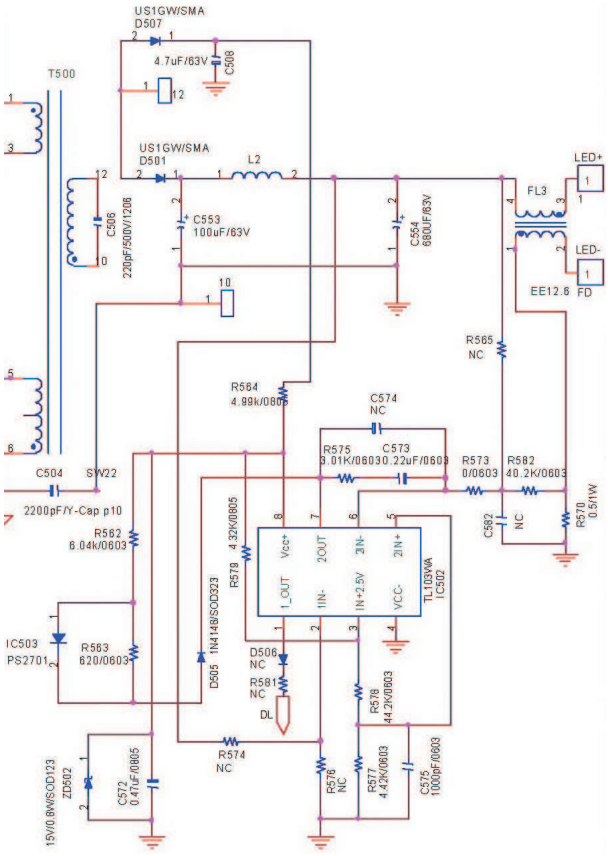

Figure 2. Secondary-Side Load Current Channel

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5 EVM Assembly Drawing and PCB Layout

Figure 3 through Figure 4 shows the design of the T8 EVM printed-circuit board (PCB). The PCB dimensions are 220 mm (L) x 18 mm (W) x 10mm(H); the PCB materials FR406 or compatible, two layers, and 2-oz copper on each layer.

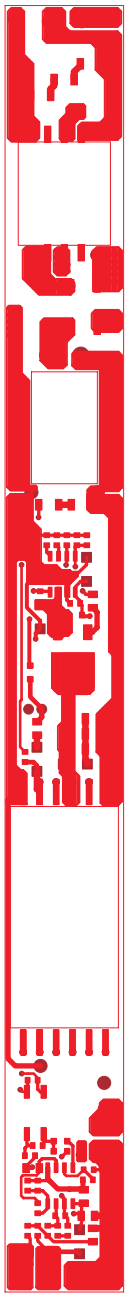

Figure 3. Top Copper

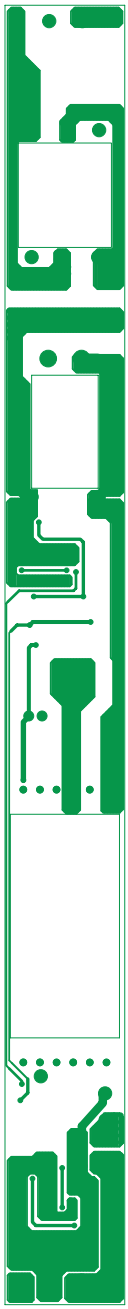

Figure 4. Bottom Copper

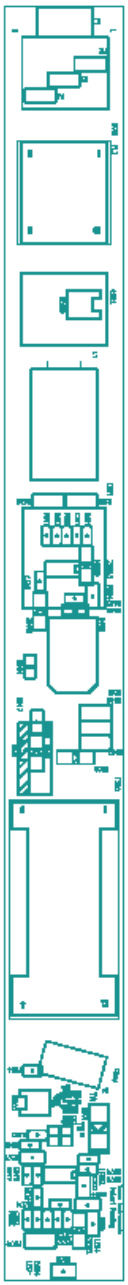

Figure 5. Bottom Assembly Drawing

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6 Performance Data and Typical Characteristic Curves

Figure 7 to Figure 12 present typical performance curves for PMP6306, 40-V at 450-mA non-dimmable T8 LED driver. The test equipment and flowchart are shown in Figure 6.

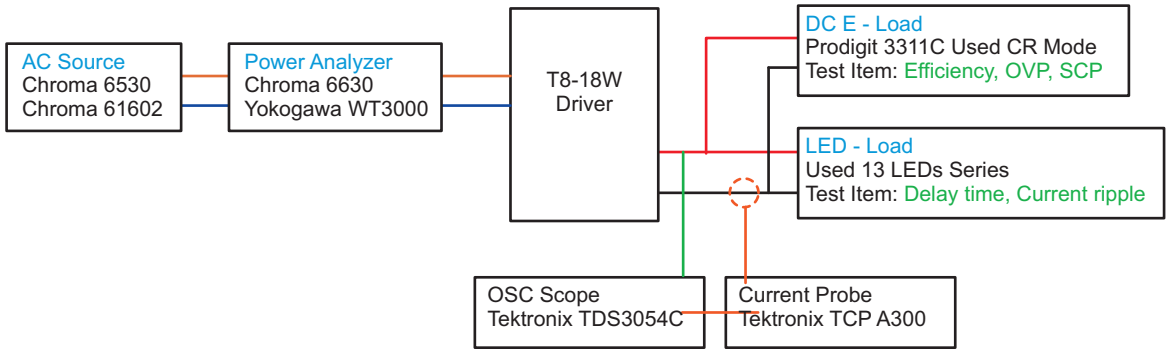

Figure 6. Test Equipment and Flow Chart

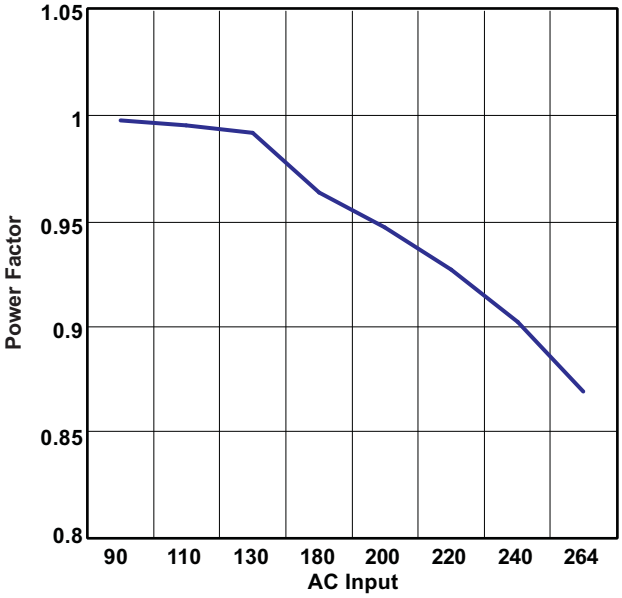

Figure 7. Power Factor

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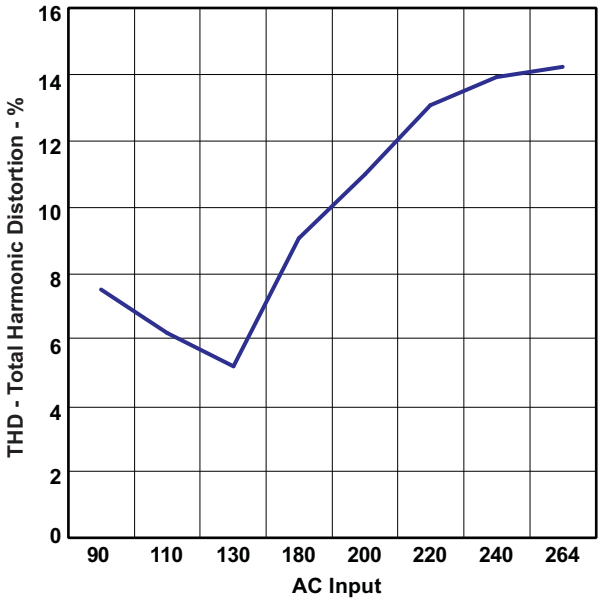

Figure 8. Total Harmonic Distortion

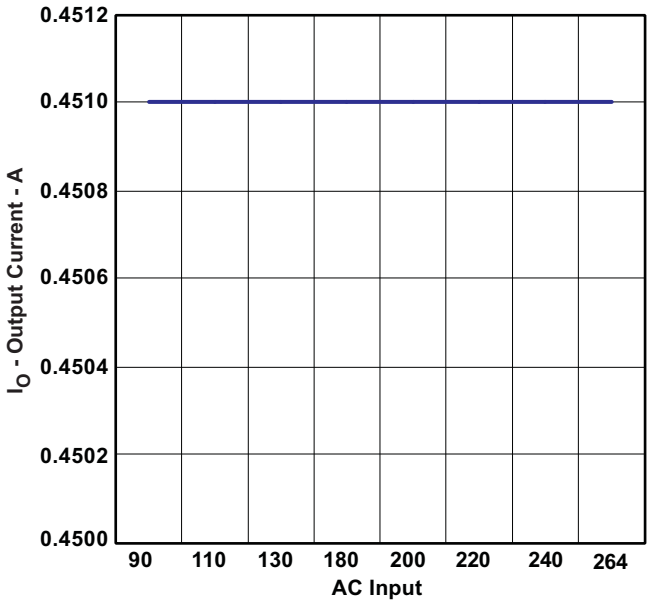

Figure 9. Output Current

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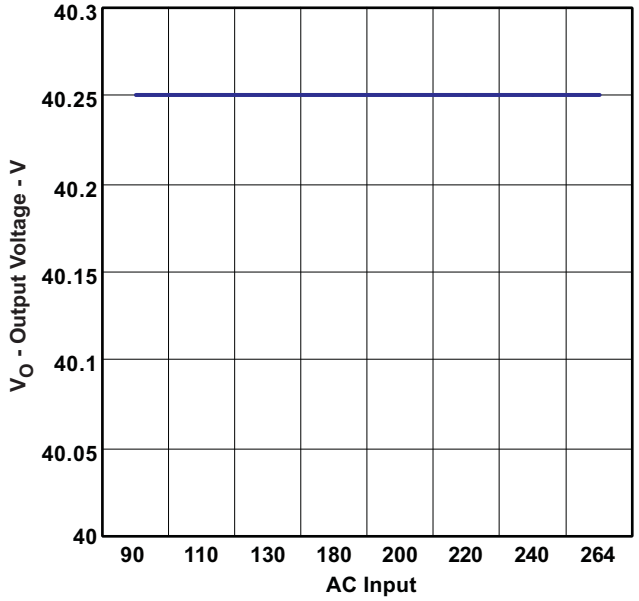

Figure 10. Output Voltage

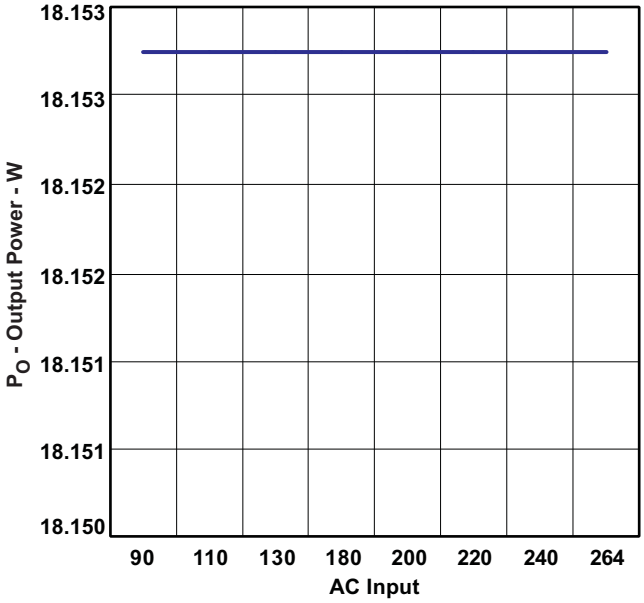

Figure 11. Output Power

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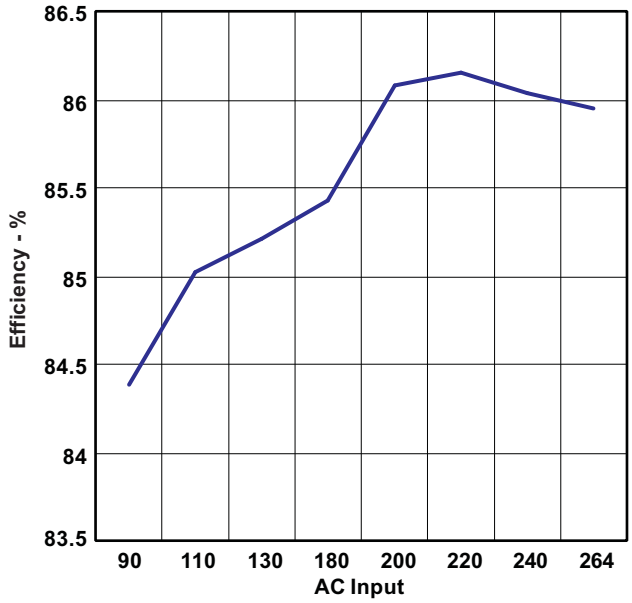

Figure 12. Efficiency

AC Input	Ip-p	Imean	Current Rate	Current Rate
90	156mA	454mA	+/ - 18%	AC Source: Chroma 6530 Power Analyzer: Chroma 6630 Ou tput Load: LED Load used 13 LEDs series.
265	156mA	454mA	+/ - 18%	

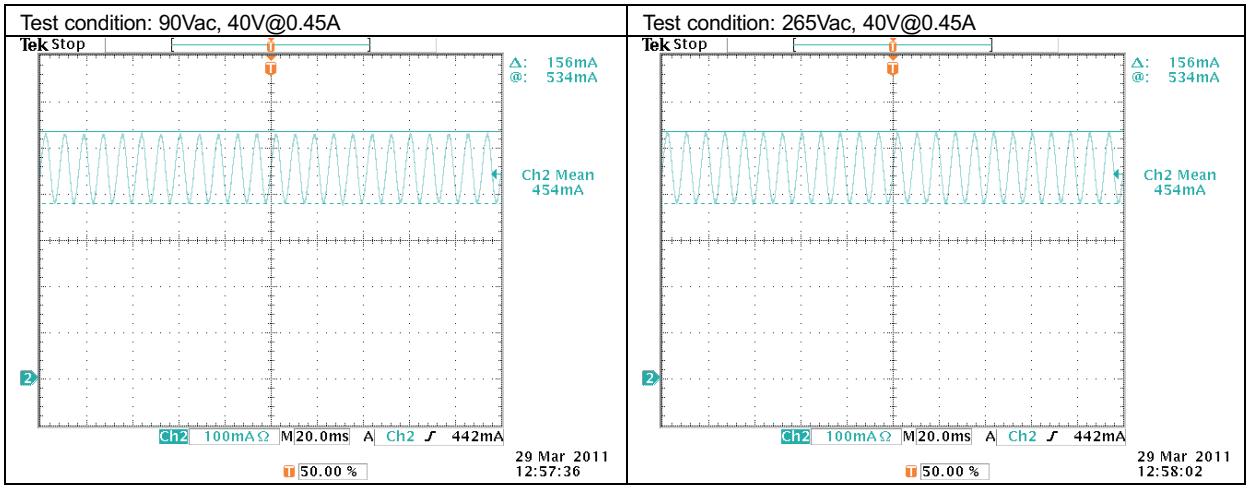

Figure 13. Output Ripple Current

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AC Input	Delay Time	Current Rate
90	460ms	AC Source: Chroma 6530 Power Analyzer: Chroma 6630 Output Load: LED Load used 13 LEDs series.
265	260ms	

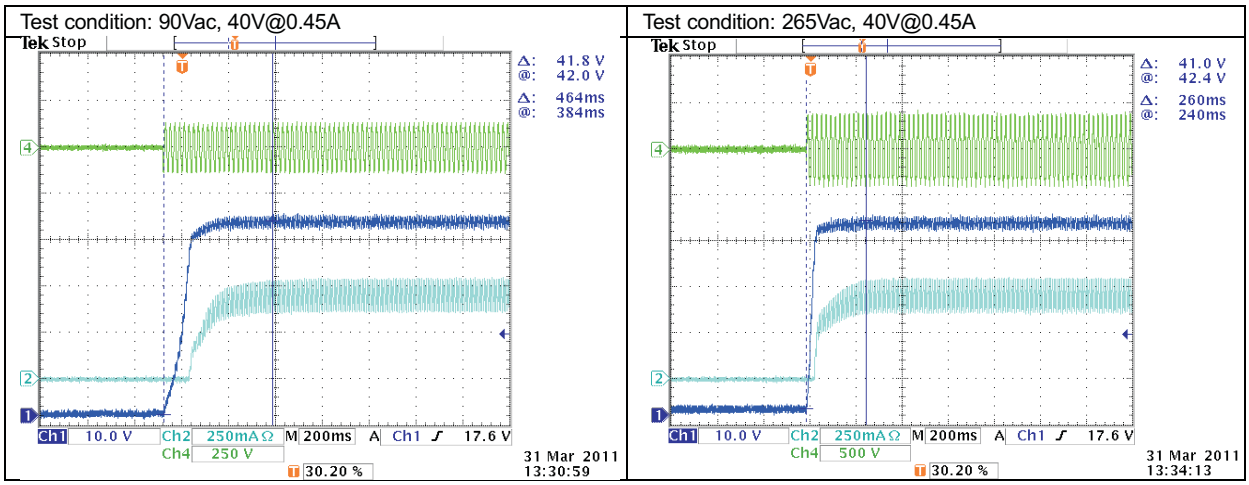

Figure 14. Turnon Delay Time

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AC Input	OVP		Current Rate
	After	Before	
90	51V	51V	AC Source: Chroma 6530 Power Analyzer: Chroma 6630 DC E -Load: Prodigit 3311C used CR mode (setting 87.2 ohm)
265	51.8V	51.4V	

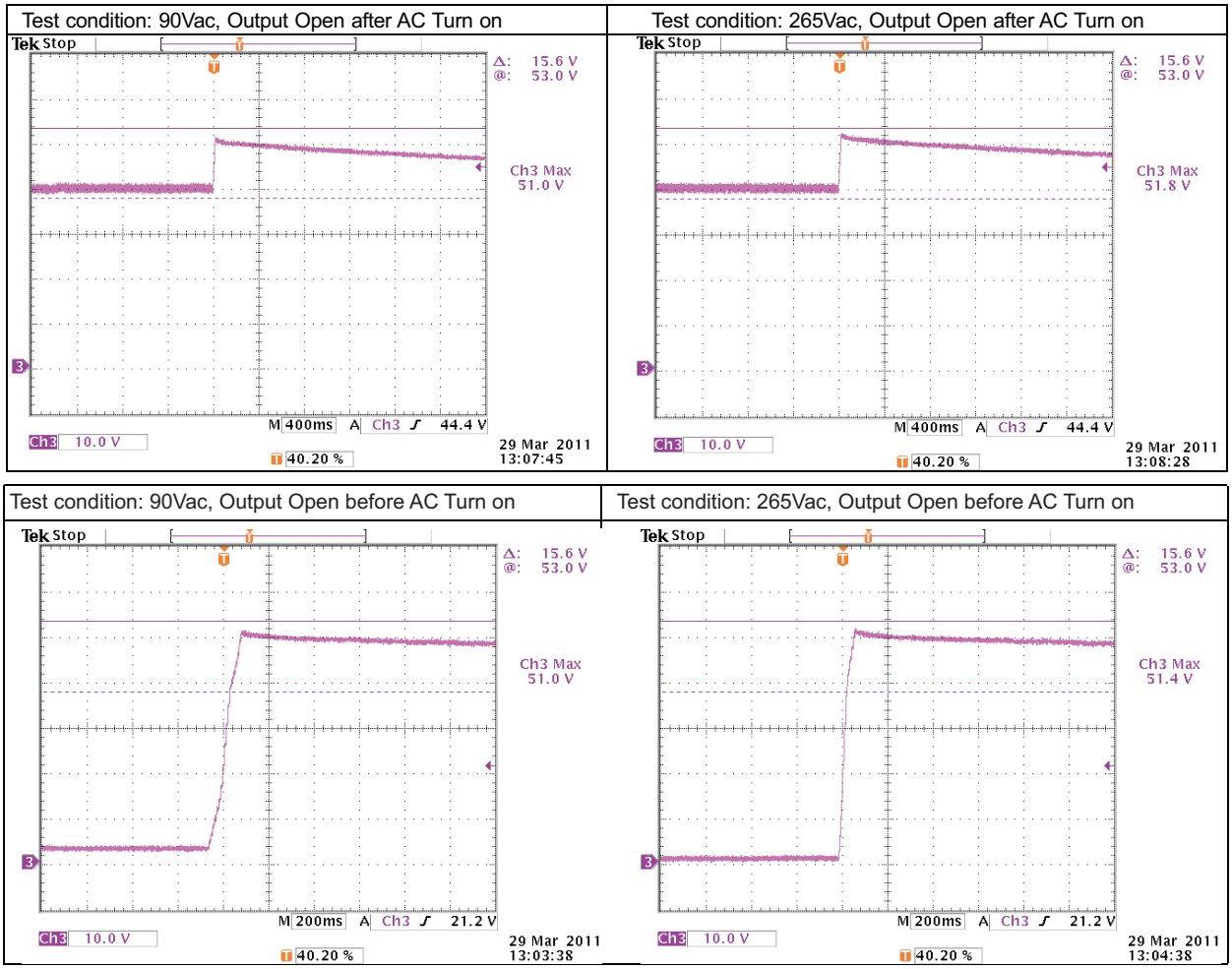

Figure 15. Overvoltage Protection

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AC Input	SCP		Current Rate
	Imax	Irms	
90	792mA	238mA	AC Source: Chroma 6530 Power Analyzer: Chroma 6630 DC E -Load: Prodigit 3311C used CR mode (used SHORT function)
265	968mA	564mA	

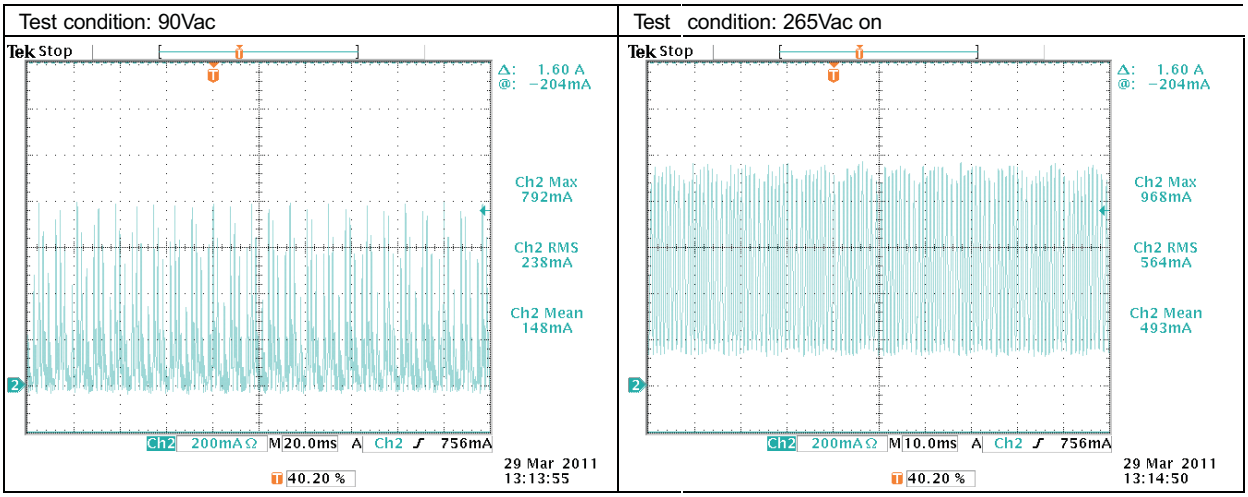

Figure 16. Short-Circuit Protection

7 Bill of Materials

Table 2. PMP6306 Bill of Materials

Part Reference	Part No	Description	MFR
BD100	TB8S	BD 800V 1A	PANJIT
C001	R46KF3100P	CAP 0.1 µF 275V	PAC
C002	R46KF3100P	CAP 0.1 µF 276V	PAC
C101	MMX 630 104	CAP 0.22 µF 450V	PAC
C501		CAP 470 pF 1kV 1206	Holy Stone
C503		CAP 0.47 µF 25V X7R 0603	Holy Stone
C504		CAP Y2 2200 pF P10	PAC
C505		CAP 0.022 µF 25V X7R 0603	Holy Stone
C506		CAP 220 pF 500V 1206	Holy Stone
C507		CAP 68 µF 25V KZM 5x11 p2	NCC
C508		CAP 4.7 µF 63V 1206	Holy Stone
C553		CAP 100 µF 63V 5x11 p5	NCC
C554		CAP 680 µF 63V 10x40 p5	LTEC
C572		CAP 0.47 µF 25V X7R 0805	Holy Stone
C573		CAP 0.22 µF 25V X7R 0603	Holy Stone
C575		CAP 1000 pF 25V X7R 0603	Holy Stone
D500	US1008FL/SOD123	DIO 800V 1A SOD-123	PANJIT
D501	US1GW/SMA	DIO 400V 1A SMA	PANJIT
D502	1N4148/SOD323	DIO 100V 0.2A 0.2W SOD-323	PANJIT
D503	US1002/SOD123	DIO 200V 1A SOD-123	PANJIT
D504	1N4148/SOD323	DIO 100V 0.2A 0.2W SOD-323	PANJIT
D505	1N4148/SOD323	DIO 100V 0.2A 0.2W SOD-323	PANJIT

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Table 2. PMP6306 Bill of Materials (continued)

Part Reference	Part No	Description	MFR
D507	US1GW/SMA	DIO 400V 1A SMA	PANJIT
F1	FUSE250V1A	FUSE 250V 1A	PAC
FL1	TME100423T	CM Choke	TRANSFORMER
FL2	TME110057L	CM Choke	TRANSFORMER
FL3	TME110056L	CM Choke	TRANSFORMER
IC500	TPS92210	IC Green-Mode Flyback Controller	TI
IC502	TL103WA	IC Dual Operational Amplifiers with Internal Reference	TI
IC503	PS2701	IC Photo High Isolation Voltage	NEC
Q500	SMK0870F	MOSFET 700V 8A TO-220F	AUK
L1	TME100230L	9mH10x17	TRANSFORMER
L2	TME110058L	150µH10x17	TRANSFORMER
R1		RES 470k 1206	YAGEO
R2		RES 470k 1206	YAGEO
R3		RES 470k 1206	YAGEO
R501		RES 750k 1206	YAGEO
R502		RES 750k 1206	YAGEO
R504		RES 10R 0805	YAGEO
R505		RES 2R2 0805	YAGEO
R506		RES 470k HV 1206	YAGEO
R507		RES 470k HV 1206	YAGEO
R510		RES 78.7k 0603	YAGEO
R511		RES 75k 0603	YAGEO
R512		RES 43.2k 0603	YAGEO
R513		RES 51.1k 0603	YAGEO
R514		RES 680k 0603	YAGEO
R515		RES 20k 0603	YAGEO
R517		RES 80.6k 0603	YAGEO
R562		RES 6.04k 0603	YAGEO
R563		RES 620 ohm 0603	YAGEO
R564		RES 4.99k 0805	YAGEO
R570		RES 0.5 ohm 1W	YAGEO
R573		RES 0 ohm 0603	YAGEO
R575		RES 3.01k 0603	YAGEO
R576		RES 6.65k 0603	YAGEO
R577		RES 4.42k 0603	YAGEO
R578		RES 44.2k 0603	YAGEO
R579		RES 4.32k 0805	YAGEO
R582		RES 40.2k 0603	YAGEO
R584		RES 910 1206 1W	YAGEO
T500	TME100414T	EW15 250 µH	TRANSFORMER
ZD501		ZENER 15V 1W	PANJIT
ZD502		ZENER 15V 0.8W SOD-124	PANJIT
ZD503		ZENER 15V 0.8W SOD-125	PANJIT

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