LM3405A Reference Design for MR16 LED Bulb, 600mA

National Semiconductor
LM3405A
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1.0 Design Specifications

Inputs	Output #1
VinMin=10.8ACV	Vout1=3.8V
VinMax=13.2ACV	Iout1=0.6A

2.0 Design Description

The LM3405A LED driver has been used for this design. It is a current mode control buck switching regulator designed to provide a simple, high efficiency solution for driving high power LEDs (Typical Vf = 3.8V) . With a 0.205V reference voltage feedback control to minimize power dissipation, an external resistor sets the current as needed for driving various types of LEDs. The LM3405A uses internal compensation offering ease of use and predictable, high performance regulation over a wide range of operating conditions. Additional features include user accessible EN/DIM pin for enabling and PWM dimming of LEDs, thermal shutdown, cycle-by-cycle current limit and over-current protection.

With the advancement of high brightness LED technology, LEDs are rapidly evolving to become a common light source for general illumination. LEDs are regarded as a longer life, lower energy consumption light source without the toxic material in CFLs. This design is an example of an MR16 form factor LED bulb to replace a halogen light bulb. It is capable of providing 600mA constant current to drive high brightness LEDs from a 12V AC source. Thanks to the wide operating voltage range of the LM3405A (from 3VDC to 20VDC), a very small input capacitor can maintain continuous operation. Switching frequency is internally set to 1.6MHz, allowing the use of extremely small surface mount inductors and chip capacitors. All these factors help to squeeze the overall dimensions of the PCB to fit the stringent space constraints of the MR16 form factor and this makes LM3405A the best LED driver for this application.

3.0 Features

- VIN range: 12VAC ±10%
- 0.6A output current
- Small PCB size
- Can drive a 1W LED
- Single LED application
- Over-current protection
- Thermal shutdown
- Integrated 1.0A NFET

4.0 Schematic

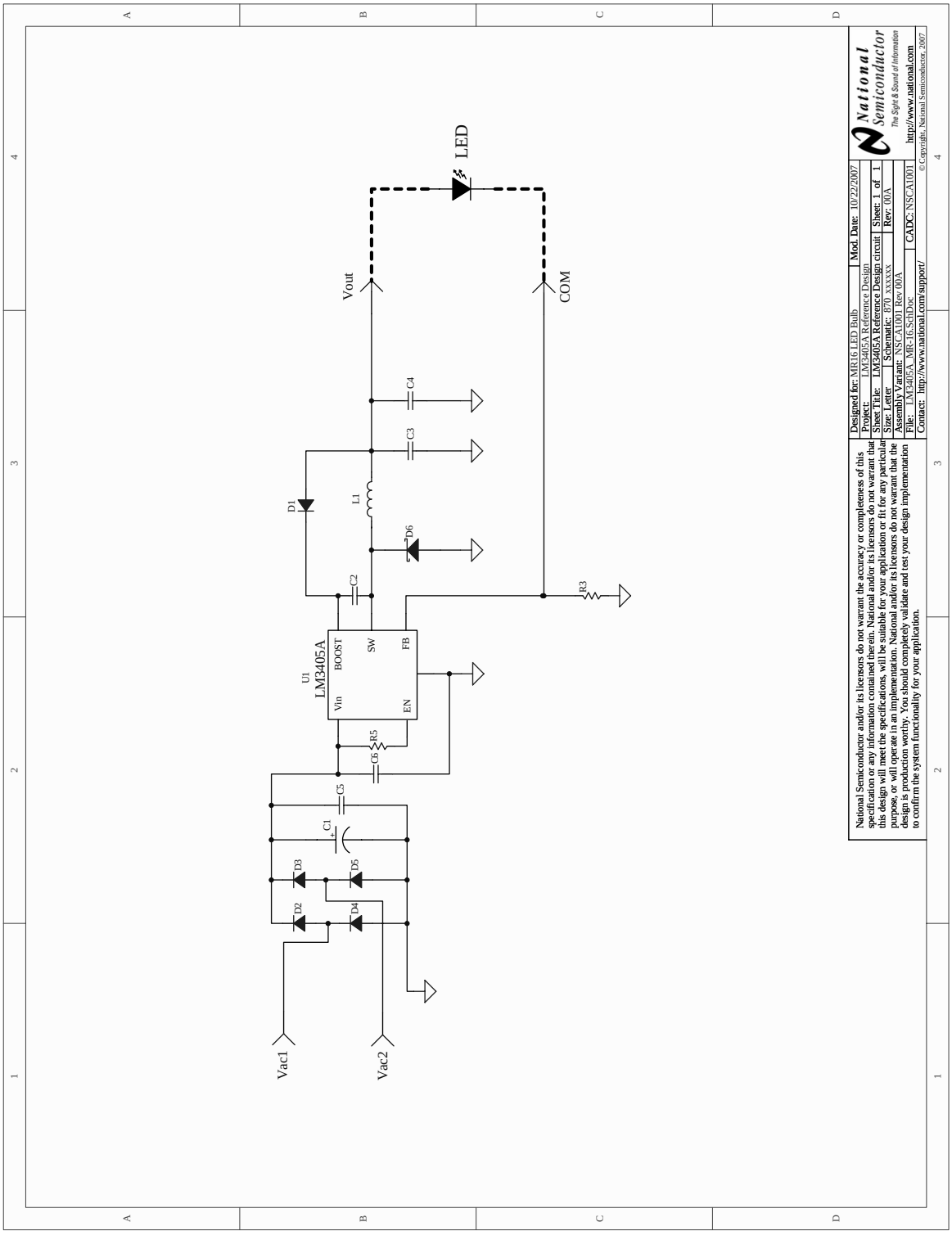


FIGURE 1. Schematic

5.0 Bill of Materials

Item	Part	Manufacturer	Part #	Attribute
1	C1	Lelon or Rabycon	SG or YK, 220uF, 16V	16V, 220uF, 8mm * 7mm
2	C2	Murata	GRM188R71C474KA88	CAP0805, 0.47 uF
3	C3	Murata	GRM188R71C474KA88	CAP0805, 0.47 uF
4	C4	Murata	GRM40X7R103K50	CAP0805, 10nF
5	C5	Murata	GRM219R71C154KA73	CAP0805, 0.15 uF
6	C6	Murata	GRM219R71C154KA73	CAP0805, 0.15 uF
7	D1	Vishay	1N4148W	75V, 200mA, Diode
8	D2	IR	10MQ040N	40V, 1A, Diode
9	D3	IR	10MQ040N	40V, 1A, Diode
10	D4	IR	10MQ040N	40V, 1A, Diode
11	D5	IR	10MQ040N	40V, 1A, Diode
12	D6	IR	10MQ040N	40V, 1A, Diode
13	L1	Sumida	CDH3D13SHPNP-6R8MC	inductor 6.8uH
14	R3	Vishay	CRCW08050R33F	RES0805, 0.33 ohm
15	R5	Vishay	CRCW06031023F	RES0603, 102K ohm
16	U1	National Semiconductor	LM3405A	LM3405A

6.0 Other Operating Values

Operating Values

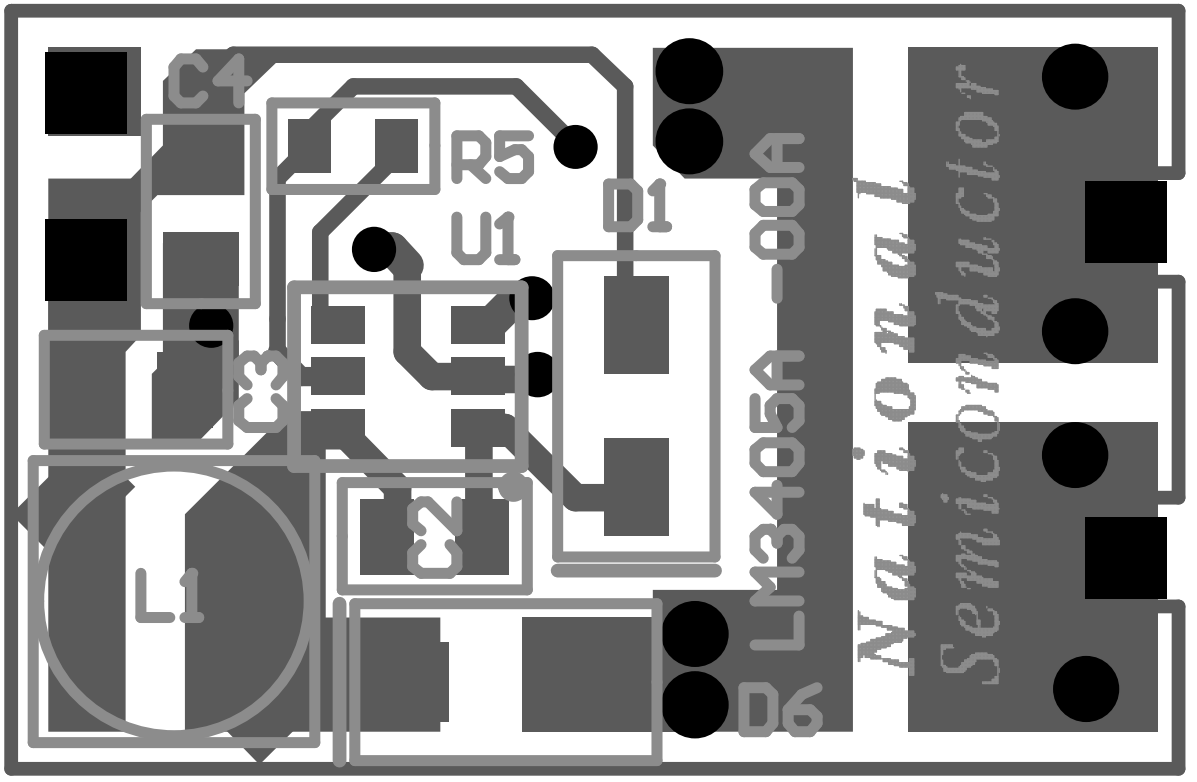
Description	Parameter	Value	Unit
Modulation Frequency	Frequency	1600	KHz
Total output power	Pout	1	W
Input Voltage	Vin	12	Vac
Output Current (LED current)	Iout	600	mA

7.0 Board Photos

boardphoto2

FIGURE 3. Board photo

8.0 Layouts



layout6

FIGURE 4. LM3405A - PCB bottom side

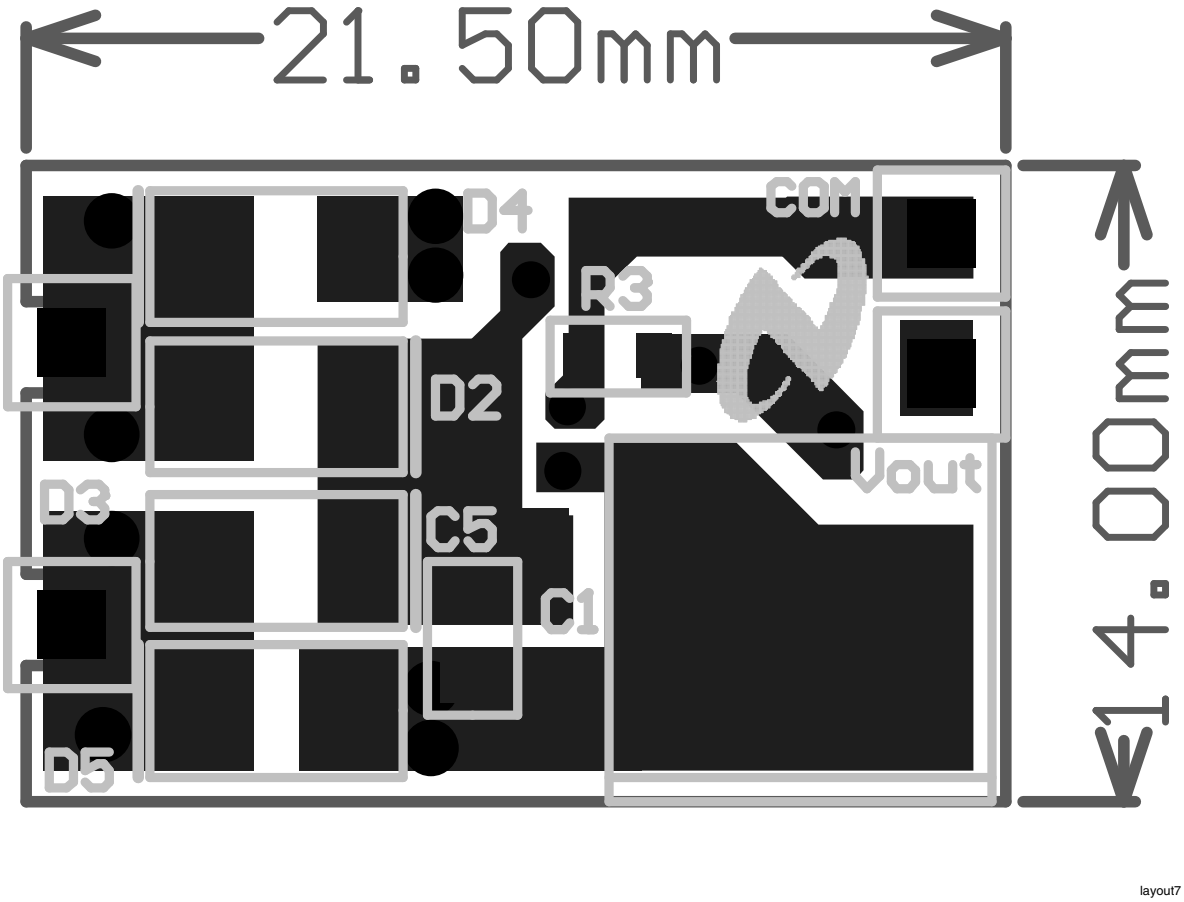
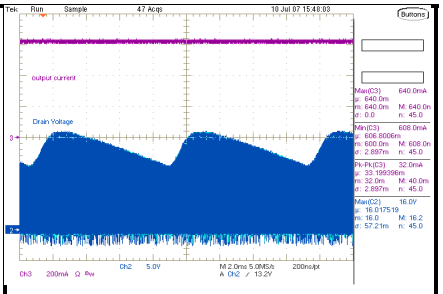


FIGURE 5. LM3405A - PCB top side

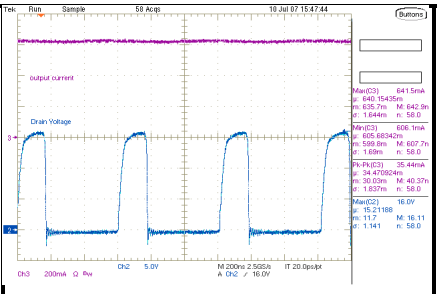
9.0 Waveforms

Main Switch (Vds)



Testing Condition	Fig 1
Vin	12VAC
I out	0.608
Output loading	LED

Main Switch (Vds) & o/p Ripple Current



Testing Condition	Fig 2
Vin	12VAC
I out	0.608
Output loading	LED

waveform1

FIGURE 6. LM3405A - Waveform

10.0 Appendix

1 Output Voltage & Current

Parameter		Reading	
Vin	Loading	Vo	Io
12.00VAC	LED = 1 pcs	**3.34V**	**0.61A**

2 Efficiency

	Reading					
Input voltage	Vin	PF	P in	Vo	Io	Efficiency
12.00VAC	12VAC / 50Hz	0.59	3.60W	3.34V	0.61A	**56.41%**

Remark : The output loading is LED (Luxeon III LXHL-LM3C green)

image

FIGURE 7. LM3405A - Test data

Notes

Notes

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