

DESCRIPTION

MT7604 is a high voltage linear constant-current LED driver. It's designed to drive LED string directly from 110VAC/220VAC mains.

MT7604 integrates 500V power MOSFET so that the peripheral circuit is simplified. It can easily pass EMI without inductor, transformer or other magnetic components, low BOM cost is achieved.

The whole driver system can be integrated into the LED lighting module, as an integrated lighting engine, which can be driven by AC line directly.

MT7604 can drive precision constant output current by option of an external resistor. The LED current setting range is 5mA~60mA. More than one MT7604 can be used in parallel when the LED current exceeds 60mA.

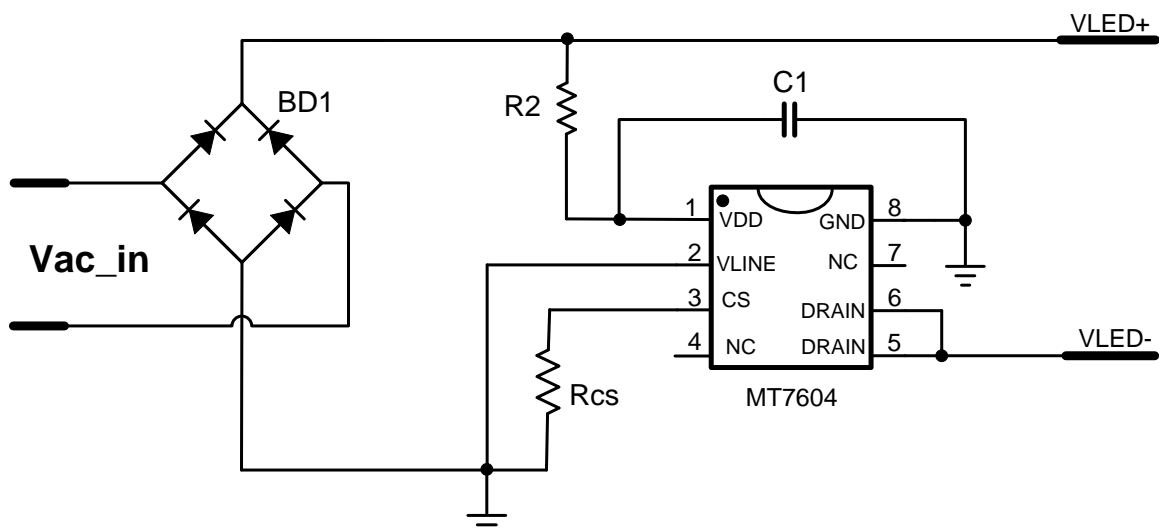
FEATURES

- High accurate constant current
- Internal 500V power MOSFET
- High integration, few external components
- Supports linear voltage compensation
- No E-caps and magnetic components
- Extended IC lifetime
- High power factor application
- Low EMI interference
- Available in SOP8 package

APPLICATION

- Alternative RC step-down LED lamp
- LED fluorescent, candle lamp
- LED bulb, decorative lamp
- Other compact LED lightings

Typical Application Circuit



ABSOLUTE MAXIMUM RATINGS

VDD pin voltage	-0.3V ~ 20V
CS, VLINE pin voltage	-0.3V ~ 6V
DRAIN pin voltage	-0.3V ~ 500V
Storage Temperature	-55°C~150°C
Junction Temperature (Tj)	150°C

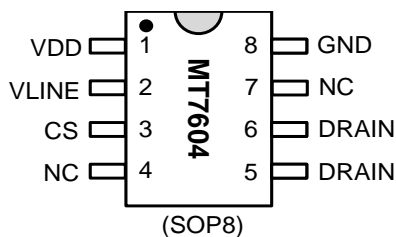
RECOMMENDED OPERATING CONDITIONS

Supply voltage VDD	15V
Operating Temperature	-40°C~105°C

THERMAL RESISTANCE

Junction to ambient (R θ JA)	128°C/W
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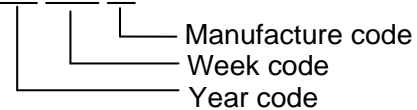
PIN CONFIGURATIONS



Chip Mark

MT7604

YY WW xx



Pin description

Name	Pin No	Description
VDD	1	Power supply pin
VLINE	2	Linear compensation pin. If this pin connects to ground directly, the linear voltage compensation is unavailable
CS	3	Current sense pin
NC	4	No connection
DRAIN	5,6	Drain of the internal MOSFET
NC	7	No connection
GND	8	Chip ground

ELECTRICAL CHARACTERISTICS

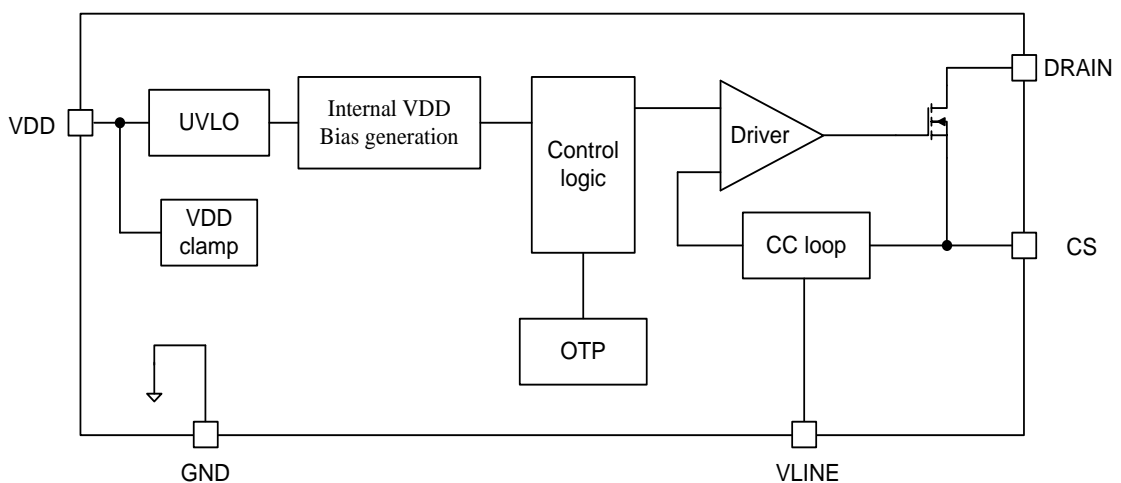
(Test conditions: VDD=15V, TA=25°C unless otherwise stated)

Symbol	Parameter		Min	Typ	Max	Unit
Start-up and power supply voltage (VDD Pin)						
V _{START}	Start-up voltage	VDD voltage ramp up		12		V
UVLO	Under voltage lockout threshold voltage	VDD voltage ramp down		9		V
V _{CLAMP}	VDD clamp voltage			15		V
Supply current						
I _{START}	Start-up current			100		uA
I _{VDD}	Operating current			200		uA
Current sense (CS Pin)						
V _{REF}	Peak current detection threshold			500		mV
Over Temperature Protection						
T _{fold}	Over temperature protection			140		°C
I _{slope}	Slope of output current decrease			4		%/°C

MT7604 TYPICAL APPLICATION (220VAC)

Input Power	PF	LED Output Voltage (V)	Average Output Current (mA)	Typical Efficiency
5W	0.9	250V	18mA	85%

BLOCK DIAGRAM



APPLICATION INFORMATION

MT7604 is a linear constant-current LED driver. It Integrates power MOSFET with less peripheral components to achieve accurate constant current at specific operating voltage range.

Start Up

During start-up, VDD is charged through a start-up resistor. As VDD reaches 12V, the control logic starts to work. As the VDD continues rising up to 15V, it will be clamped. When the VDD voltage drops to below 9V, the system shuts down, and the UVLO function is triggered. As shown in Fig.1.

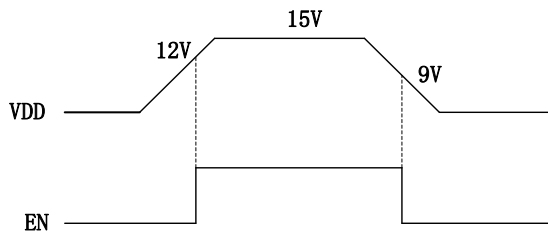


Fig.1 Start up and close sequence

Output Current and Voltage Determination

It is important to determine the LED voltage and current, As MT7604 is a linear buck LED driver IC, the peak value of the rectified input voltage must be greater than the output LED voltage.

Refer to Fig.2, MT7604 automatically turns on the LED string following the input sine wave. When the input voltage rises and reaches to the LED conducting voltage V_{LED} , The LED string is turned on. Since then, the input voltage continues rising, the LED string voltage keeps stable, the internal MOSFET bears the superfluous voltage drop. If the input voltage drops, the procedure is reversed. So high LED voltage makes the LED availability to be low, and low LED voltage will reduce the system efficiency. It is recommended to choose about 120V high-voltage LED string in 120VAC applications; And to choose about 250V high-voltage LED

string in 220VAC applications. It can be adjusted according to actual application.

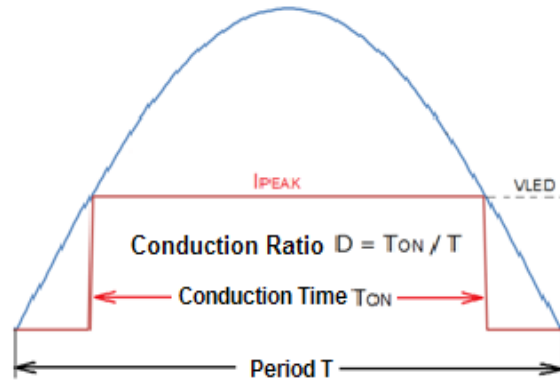


Fig.2 LED conduction procedure

Sense Resistor Settings

The output current be set by the sense resistor R_{CS} . MT7604 generates a control signal by comparing the voltage on sense resistor R_{CS} and internal reference voltage V_{REF} (500mV) to achieve LED constant current output.

The peak current of LED light string:

$$I_{PEAK} = \frac{V_{REF}}{R_{CS}} = \frac{500mV}{R_{CS}} \quad (1)$$

Fig.2 shows the LED conduction procedure, MT7604 actually controls the LED peak current during the conduction-time.

There are two cases in real application:

- 1) No large electrolytic capacitor is needed after the rectifier bridge, as shown in Fig.2. At the valley, the input voltage is lower than LED string forward voltage, the output current is zero. When the input voltage is higher than the LED string forward voltage, the output current is I_{PEAK} . So, in the real application, the LED string current is discontinuous, and the I_{LED} is the average LED string current.

$$I_{LED} = I_{PEAK} \times D \quad (2)$$

Where, D is the LED string conduction ratio.

Linear Constant – Current LED Driver

In general, $D \approx 0.5$, so $I_{LED} \approx 0.5 \times I_{PEAK}$.

The final average LED current needs to be fine tuned/trimmed according to the measured results. In this case, the system power factor (PF) can reach more than 0.9. But the LED output current will increase with the input voltage.

- 1) There is an electrolytic capacitor after the rectifier bridge. After rectifying, the input voltage substantially closes to DC voltage. So, the LED output current equals to the peak current, $I_{LED} = I_{PEAK}$, as calculated in

Equation (1). In this case, the output current is stable. But power factor is relatively lower.

Power Consumption and Heat Dissipation

The voltage difference between input voltage and output LED voltage can generate power consumption, which is all undertaken by the internal power MOSFET. Hence the LED string voltage and input voltage should be properly configured to guarantee the power consumption less than 1W, or carry on other effective thermal design solutions, Aluminum PCB is recommended for better heat dissipation.

Over Temperature Protection

When the junction temperature exceeds T_{fold} (typically $140^{\circ}C$), the LED output current is gradually reduced. Thus, the output power and thermal dissipation are also reduced, so as to protect the LED lamps, and be able to extend the system life. When the temperature is higher than T_{fold} , the drop slope for the output current with the temperature is about $4\%/^{\circ}C$.

Linear Compensation

MT7604 integrates Maxim proprietary linear compensation technique. The input voltage is

detected by the VLINE pin through a resistor divider R1, R3, R4. The output current is compensated when the input voltage varies, so that the input power keeps stable. As shown in Fig3.

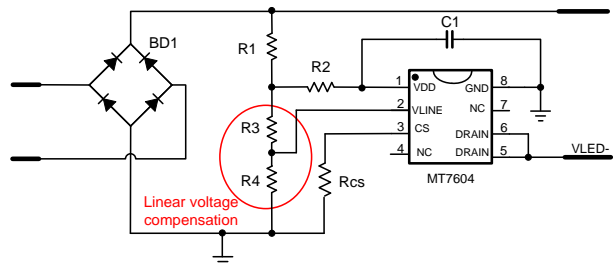


Fig.3 Linear compensation application circuit

Methods to Increase the Output Current

MT7604 integrates a temperature compensation scheme. In order to increase the output current, the system must have good heat dissipation to reduce the temperature of MT7604 chip.

- 1) To increase the copper area and bonding pad of DRAIN pin;
- 2) Use aluminum PCB for better thermal dissipation;
- 3) To increase the heat dissipation base of the whole lamp.

If the output LED current is greater than the peak current (typically 60mA) which MT7604 can support, more than one MT7604 can be used in parallel. Refer to Fig.4.

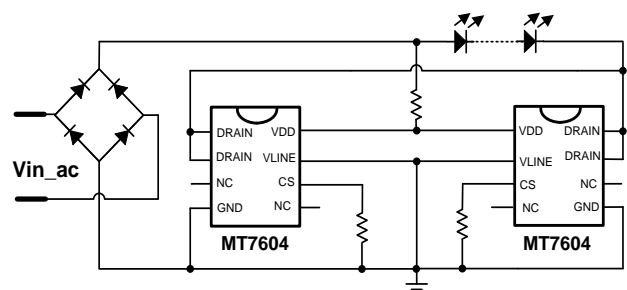
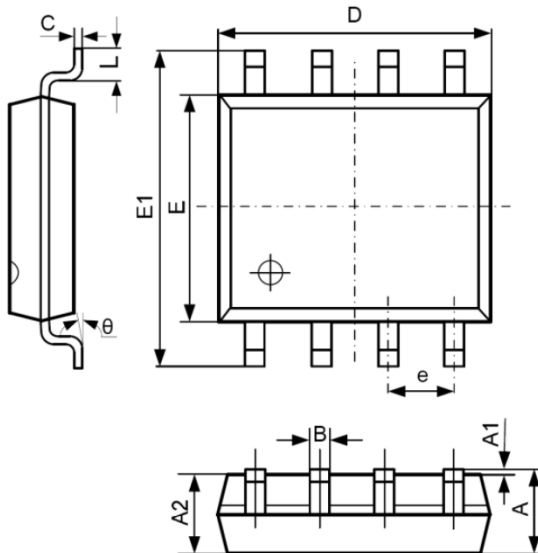


Fig.4 Double MT7604 are in parallel to increase output current

PACKAGE INFORMATION

SOP-8 PACKAGE OUTLINE AND DIMENSIONS



SYMBOL	DIMENSION IN MILLIMETERS		DIMENSION IN INCHES	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270 TYP		0.050 TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

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