



**CONTINUOUS MODE INDUCTIVE
STEP-DOWN LED DRIVER**

GENERAL DESCRIPTION

The M1972 is a high efficiency, constant current and step-down DC/DC converter. It is designed to deliver constant current to light up high power LED. The device operates from an input supply between 6V and 40V and provides an externally adjustable output current of up to 1.0A and LED dimming can be controlled pulse width modulation (PWM) through DIM pin. The device, in conjunction with the coil (L) and current sense resistor (RS), a self-oscillating continuous-mode buck converter. Typical 5% output current accuracy. In addition, the start-up function limits the inrush current while the power is switch on.

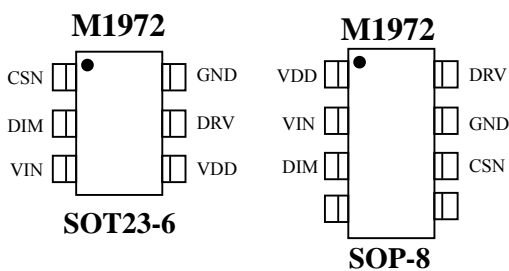
FEATURES

- 6~40V input voltage range
- Programmable output current
- Up to 1MHz switching frequency
- Typical 5% output current accuracy
- SOT23-6、SOP-8 package

APPLICATIONS

- Low voltage halogen replacement LED
- Automotive lighting
- Low voltage industrial lighting
- LED back-up lighting

PIN CONFIGURATION



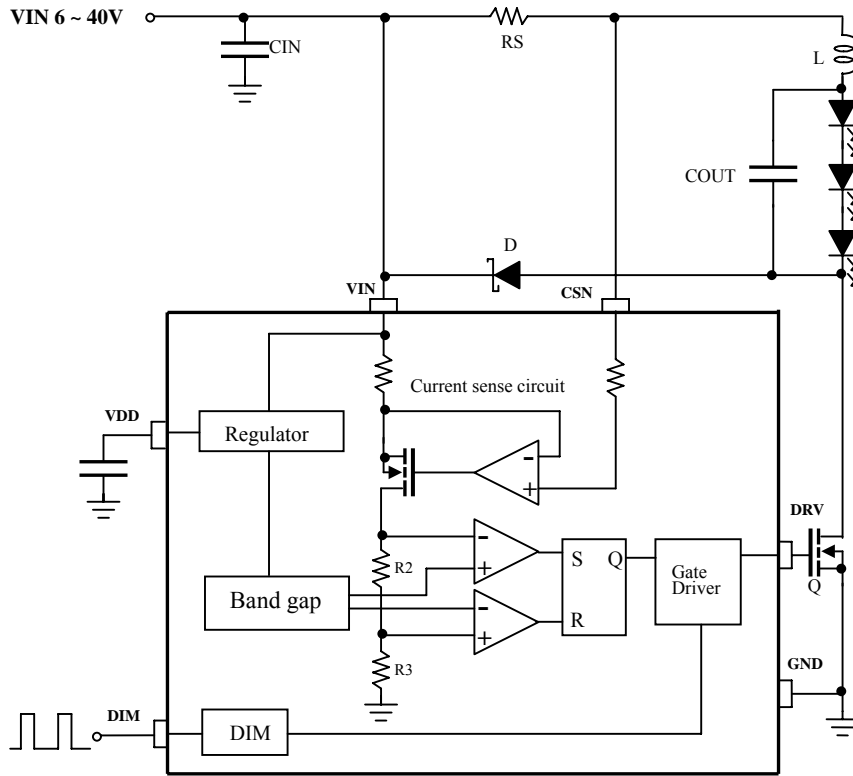
PIN DESCRIPTION

PIN NUMBER		I/O	PIN NAME	FUNCTION
SOT23-6	SOP-8			
1	6	I	CSN	Output current sense terminal
2	3	I	DIM	Dimming control terminal
3	2	I	VIN	Supply voltage terminal , It must be bypassed with a low ESR capacitor to GND
4	1	I	VDD	LDO output terminal
5	8	O	DRV	Drives the gate of the external MOSFET
6	7	I	GND	Device ground



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FUNCTIONAL BLOCK DIAGRAM





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ABSOLUTE MAXIMUM RATING

(TA=25°C)

Parameter	Rating	Unit	Parameter
VIN to GND	VIN	-0.3~40	V
CSN to VIN	SW	+0.3~(-6.0)	V
GATE to GND	DIM	-0.3~6	V
Operating temperature range	TOPT	-40 to +85	°C
Storage temperature range	TSTG	-65 to 150	°C

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Units	Conditions
Input DC supply voltage range	VIN	6		40	V	
Max Operating frequency	fsw	23		426	KHz	L=470uH RCSN=0.22
Input current	IIN		70		uA	VDIM < 0.6V
UVLO Voltage	UVLO		5		V	VIN = VCSN, VDIM=VDD, VIN falling from 6V, VDRV < 0.5V
UVLO Hysteresis	HYSUV		0.5		V	
Current Sense						
Current sense high	Vsnhi		250		mV	(VIN - VCSN) rising from 0V until VDRV < 0.5V
Current sense low	Vsnlow		212		mV	(VIN - VCSN) falling from 0.26V until VDRV > (VDD - 0.5V)
Vcsn Propagation Delay time	TPDH		0.8		us	VCSN from low to high (rising time)
	TPDL		4.7		us	VCSN from high to low (falling time)
Current sense comparator current	ICSN		20.1		uA	
Current sense Hysteresis	CSN-HYS		38		mV	Vsnhi- Vsnlow
PWM Dimming						
Max DIM frequency	fdim			20	KHz	
DIM input High voltage	VIH	3.1			V	VCSN = VIN, increase DIM until VDRV > (VDD - 0.5V)
DIM input low voltage	VIL			0.5	V	VCSN = VIN, decrease DIM until VDRV < 0.5V
DIM ON time	Tdimon		26		ns	DIM rising edge to VDRV = 0.5 x VDD, CDRV = 1nF
DIMOFF time	Tdimoff		23		ns	DIM falling edge to VDRV = 0.5 x VDD, CDRV = 1nF
DIM input High current				+10	uA	VDIM = VDD
DIM input low current				-1	uA	VDIM = 0
LDO						
LDO output voltage	Vdd		5.5	5.9	V	IVDD = 0.1mA to 5mA, VIN = 6V to 40
Start up	Tstart		53.7		us	VDD = 1 to 5.5V CVDD= 2.2uF



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DEVICE DESCRIPTION

The device, in conjunction with the coil (L) and current sense resistor (RS), forms a self-oscillating continuous-mode buck converter.

APPLICATION NOTE

1. Setting Output Current

The nominal average output current in the LED(s) is determined by the value of the external Current sense resistor (RS) connected between VIN and ISENSE and is given by:

$$I_{LED} = \frac{0.066}{R_s}$$

2. Inductor Selection

Recommended inductor values for the M1972 are in the range 47uH to 470uH. The chosen coil should have a saturation current higher than the peak output current 30%~50%. The inductance is determined by two factors: the switching frequency and the inductor ripple current. f_{SW} is the switching frequency of the M1972 can be described as

$$f_{sw} = \frac{(VIN - n \times V_{LED} \times RS)}{VIN \times \Delta V \times L}$$

Where:

L is the coil inductance (H) , RS is the current sense resistance (Ω)

VLED is the total LED forward voltage (V) , n is LED amount , $\Delta V = (V_{SNSHI} - V_{SNSLO})$.

When selecting an inductor, not only the inductance but also the saturation current that should be considered as the factors to affect the performance of module. In general, it is recommended to choose an inductor with 1.5 times of LED current as the saturation current.

3. PWM Dimming

M1972 provides a low-frequency Pulse Width Modulated (PWM) dimming input that can accept an external control signal with a duty ratio of 0-100% and a frequency of up to 20kHz(Max). To disable PWM dimming and enable the M1972 permanently, connect the DIM pin to VDD.

4. VDD (Voltage Regulator)

The VDD pin must be bypassed by a low ESR capacitor ($\geq 0.1\mu F$) to provide a low impedance path for the high frequency current of the output gate driver.

5. Schottky Diode Selection

For maximum efficiency and performance, the rectifier (D1) should be a fast low capacitance Schottky diode with low reverse leakage at the maximum operating voltage and temperature. They also provide better efficiency than silicon diodes, due to a combination of lower forward voltage and reduced recovery time.



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It is important to select parts with a peak current rating above the peak coil current and a continuous current rating higher than the maximum output load current. It is very important to consider the reverse leakage of the diode when operating above 85°C. Excess leakage will increase the power dissipation in the device and if close to the load may create a thermal runaway condition.

6. Capacitor Selection

A low ESR capacitor should be used for input decoupling, as the ESR of this capacitor appears in series with the supply source impedance and lowers overall efficiency. This capacitor has to supply the relatively high peak current to the coil and smooth the current ripple on the input supply. A minimum value of 4.7uF is acceptable if the input source is close to the device, but higher values will improve performance at lower input voltages, especially when the source impedance is high. The input capacitor should be placed as close as possible to the IC.

7. Reducing Output Ripple

Peak to peak ripple current in the LED(s) can be reduced, if required, by shunting a capacitor C3 across the LED(s) as shown figure 2. A value of 1uF will reduce the supply ripple current by a factor three (approx.). Proportionally lower ripple can be achieved with higher capacitor values. Note that the capacitor will not affect operating frequency or efficiency, but it will increase start-up delay, by reducing the rate of rise of LED voltage.

8. Thermal Compensation Of Output Current

High luminance LEDs often need to be supplied with a temperature compensated current in order to maintain stable and reliable operation at all drive levels. M1972 possible to use an external Negative Temperature Coefficient (NTC) thermistors and/or diodes, mounted very close to the LED(s). The output of the sensing network can be used to drive the DIM pin in order to reduce output current with increasing temperature

Typical Application Circuit

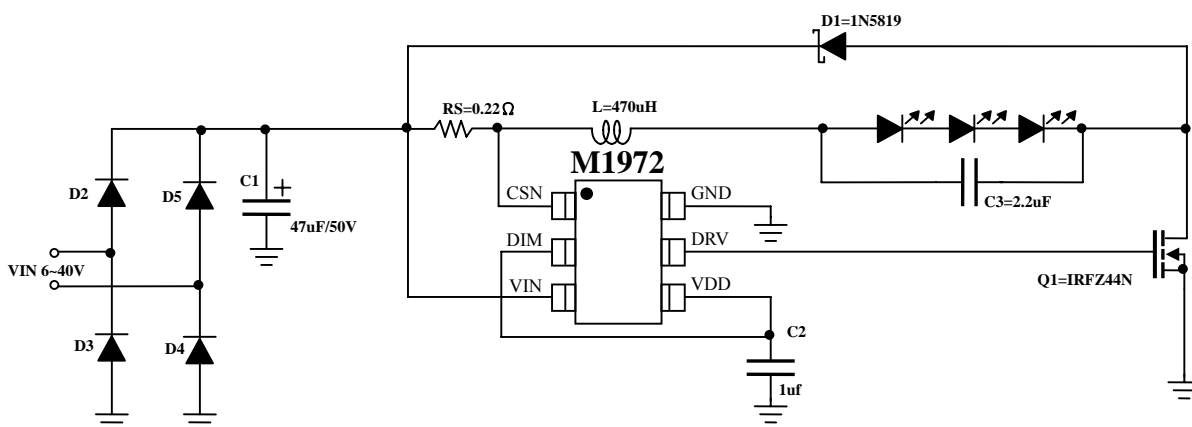


Figure 2 MR16 1*3W

* All specs and applications shown above subject to change without prior notice.
(以上電路及規格僅供參考,本公司得逕行修正)



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PACKAGE OUTLINE

