



MT7828

High Efficiency Buck Constant Current LED Driver

DESCRIPTION

MT7828 is a high precision LED constant current control chip operating at critical conduction mode (CRM) with zero current switched-on and peak current switched-off. It's mainly targeted for non-isolated buck LED power systems.

Critical conduction mode ensures that the MT7828 turns on the internal power MOSFET when the inductor current reaches zero, reducing the power MOSFET switching loss, and achieving more than 95% efficiency. With critical conduction mode, MT7828 outputs high accuracy LED current, and further achieves excellent line regulation and load regulation. It's insensitive to inductance and the I-shape inductor can be used.

MT7828 is intended for simplified peripheral circuits, low BOM cost application with an internal power MOSFET.

MT7828 has wide working voltage range, which is suitable for full-range AC input or 60V - 400V DC input voltage. MT7828 provides various protection features to enhance the system reliability, including over current protection (OCP), short circuit protection (SCP), and thermal adjustment, etc.

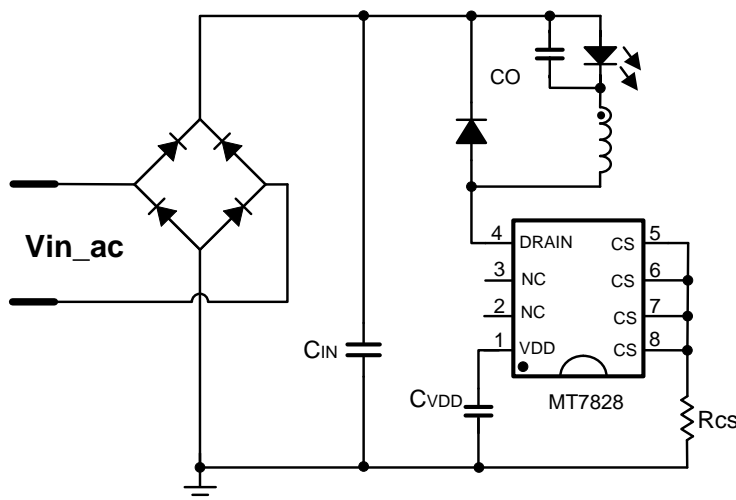
FEATURES

- Critical Conduction Mode, insensitive to the inductance.
- High efficiency (up to 95%)
- Highly accurate constant LED current
- Cycle-by-cycle current limitation
- LED Short Circuit Protection
- Leading edge blanking technique
- Under-voltage lockout (UVLO) protection
- Thermal adjustment
- Available in SOP8 package

APPLICATIONS

- LED bulb, LED tube, LED signal and landscape lamp
- LED stage light, LED candle light, LED corn light, etc.
- General purpose constant current source

Typical Application Circuit



**MT7828****High Efficiency Buck Constant Current LED Driver****ABSOLUTE MAXIMUM RATINGS**

DRAIN (internal high-voltage power MOS drain voltage)	-0.3V ~ 500V
VDD (Internal power supply output voltage)	-0.3 ~10V
P _{DMAX} (maximum power consumption)	0.8W
Storage Temperature range	-55°C ~ 150°C
Junction Temperature (T _j)	150°C

RECOMMENDEDE OPERATING CONDITIONS

Operating Temperature	-40°C ~ 105°C
Output Current	<80mA (Type A)
Input voltage: 176Vac~265Vac	<120mA (Type B)
Output voltage: VLED = 36V	<200mA (Type C)
	<275mA (Type D)
	<350mA (Type E)

ORDERING INFORMATIONS

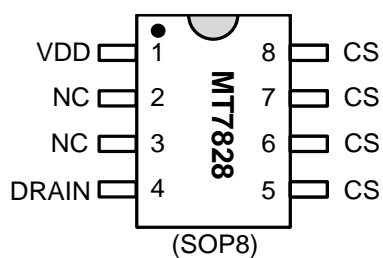
Device	R _{DS(on)}	Mark
MT7828A	30ohm	MT7828A ZYYWWxx
MT7828B	18ohm	MT7828B ZYYWWxx
MT7828C	12ohm	MT7828C ZYYWWxx
MT7828D	8ohm	MT7828D ZYYWWxx
MT7828E	5.1ohm	MT7828E ZYYWWxx



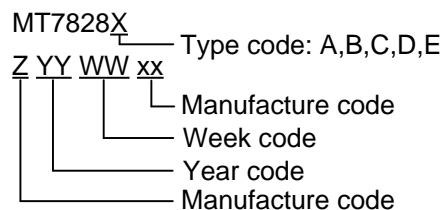
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PIN CONFIGURATIONS



Chip Mark



PIN DESCRIPTION

Name	Pin No.	Description
VDD	1	Power supply pin. Internal clamped at 7.2V
NC	2,3	No connection
DRAIN	4	Drain of internal high-voltage power MOSFET
CS	5,6,7,8	Chip Ground and current sense pin

**MT7828****High Efficiency Buck Constant Current LED Driver****ELECTRICAL CHARACTERISTICS**

(Test condition: VDD=7.2V, TA=25°C unless otherwise stated.)

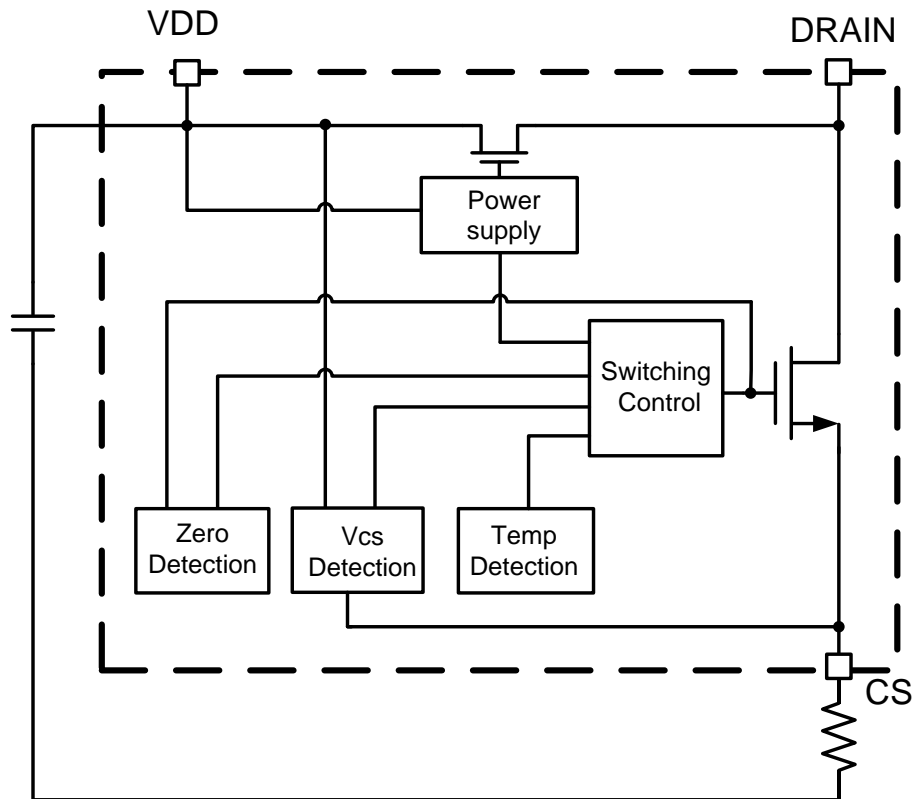
Symbol	Parameter		Min	Typ	Max	Unit
Start-up and supply voltage (VDD Pin)						
I _{START}	VDD start up current	V _{DD} =7V		1.0	1.8	mA
VDD	Operating voltage	normal operation		7.2		V
V _{DD_UV}	Under voltage lockout threshold Voltage	V _{DD} Pin ramp down		5.8		V
Supply current						
I _{op}	Operating current			150		uA
Current sense (CS Pin)						
V _{REF}	Peak current detection threshold		582	600	618	mV
LEB	Leading edge blanking time at CS pin			500		nS
Thermal Adjustment						
Tfold	Thermal adjustment temperature			150		°C
	Slope of output current decrease after the temperature exceeding the threshold Tfold			4		%/°C
Driver Circuit						
T _{OFF_MIN}	Minimum OFF time			1.2		uS
T _{OFF_MAX}	Maximum OFF time			420		uS
T _{ON_MAX}	Maximum ON time			45		uS
High-voltage Power MOSFET (DRAIN)						
R _{DSON}	MT7828A	Static drain-source on-resistance	I _{DS} =50mA		30	Ω
R _{DSON}	MT7828B	Static drain-source on-resistance	I _{DS} =100mA		18	Ω
R _{DSON}	MT7828C	Static drain-source on-resistance	I _{DS} =150mA		12	Ω
R _{DSON}	MT7828D	Static drain-source on-resistance	I _{DS} =240mA		8	Ω
R _{DSON}	MT7828E	Static drain-source on-resistance	I _{DS} =240mA		5.1	Ω
BV _{DSS}		Drain-source breakdown voltage	VGS=0V/I _{DS} =250uA	500		V



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BLOCK DIAGRAM



APPLICATION INFORMATION

MT7828 is a constant current driver with high -voltage power MOSFET. It works under critical conduction mode, and switches on the power MOSFET at zero inductor current, which improves efficiency and reduces the power MOSFET switching loss. MT7828 is specially designed for LED lighting applications, simplified peripheral circuits and low BOM cost is achieved.

Start up

VDD is charged by the internal JFET once the system is powered on. As the VDD reaches 7.2V, the control logic starts to work, the internal switch starts toggling, and the VDD is stabilized. MT7828 will be shut down as the VDD falls to below 5.8V.

CRM and Output Current Setup

The peak current of internal power MOSFET is cycle-by-cycle detected by monitoring the CS pin voltage. When the voltage on CS pin reaches 600mV (internal reference voltage), the internal power MOSFET is turned off, it will be turned on again, when the inductor current drops to zero.

The peak inductor current is given by:

$$I_{LPK} = \frac{600}{R_{CS}} (mA) \quad (1)$$

Where, R_{CS} is the current sense resistor in ohm. The CS comparator also includes a 500nS leading edge blanking time to block the transient noise as the power switch just turned on.

The LED current can be calculated as:



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$$I_{LED} = \frac{I_{LPK}}{2} = \frac{600mV}{2 \times R_{CS}} (mA) \quad (2)$$

Where, I_{LPK} is the peak current of the inductor. Shown in the above equation, the output current is determined by the R_{CS} and the V_{REF} (internal reference voltage), insensitive to the inductance.

Switching Frequency

MT7828 operates at critical conduction mode. When the inductor current is zero, the system turns on the internal power MOSFET, the inductor current rises up from the ground.

The on time of the power MOSFET is:

$$T_{ON} = \frac{L \times I_{LPK}}{V_{IN} - V_{LED}} \quad (3)$$

Where, L is the inductance of the inductor; I_{LPK} is the peak current through the inductor; V_{IN} is the DC voltage of the rectified input voltage; V_{LED} is the forward voltage dropped on the LED. When the CS voltage increases to V_{REF} , the internal power MOSFET is switched off. The inductor current will discharge the LED through the free-wheeling diode. The internal power MOSFET won't be turned on until the current in the inductor drops to zero. The off time of the power MOSFET is:

$$T_{OFF} = \frac{L \times I_{LPK}}{V_{LED}} \quad (4)$$

Operating frequency of the system is:

$$f = \frac{1}{T_{ON} + T_{OFF}} = \frac{V_{LED} \times (1 - \frac{V_{LED}}{V_{IN}})}{L \times I_{LPK}} \quad (5)$$

From the above equation, it's showing that MT7828 operating frequency is determined by the input voltage V_{IN} , the LED forward voltage V_{LED} and the inductance L. The higher input voltage V_{IN} makes operating frequency higher. For both EMI and efficiency consideration, the operating frequency located between 30kHz~80kHz is recommended. To meet this

requirement, appropriate inductance value should be determined at minimum input voltage condition.

MT7828 sets the maximum off-time $T_{OFF_MAX}=420\mu S$, the minimum off-time $T_{OFF_MIN}=1.2\mu S$. Shown in T_{OFF} equation, if the inductance is large, T_{OFF} maybe longer than T_{OFF_MAX} , the system will turn on the switch before the inductor current falls to zero. On the contrary, if inductance is small, T_{OFF} may be shorter than T_{OFF_MIN} , then the inductor current has already been reduced to zero before the next cycle starts, the system enters into discontinuous mode. The actual LED current will be smaller than the target value. It's important to choose the proper inductance and operating frequency.

Over-current Protection

MT7828 immediately turns off the internal power MOSFET once the voltage on CS pin reaches 600mV. This cycle-by-cycle current limitation scheme prevents the relevant components, such as power MOSFET, transformer, etc. suffers from damage.

Other Protection Features

MT7828 provides various protections, such as LED short-circuit protection, over temperature protection, etc.

When the LED short-circuit is detected, MT7828 immediately enters short-circuit protection status, the system works at MAXOFF status. So the system power consumption is very low. Once the short-circuit condition is removed, the system automatically resumes to normal working status. The MT7828 integrates a thermal protection function to monitors the IC junction temperature. When the IC junction temperature exceeds T_{fold} , the LED output current is gradually reduced. Thus, the output power and thermal dissipation are also reduced. In this way, the system



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temperature is limited and system reliability is also enhanced.

PCB Layout Consideration

The VDD (Pin1) de-coupling capacitor (typically 1uF ~ 4.7uF ceramic capacitor) must close to the pin (Pin1) as much as possible. Better not exceed 5mm. This can greatly improve the system noise immunity.

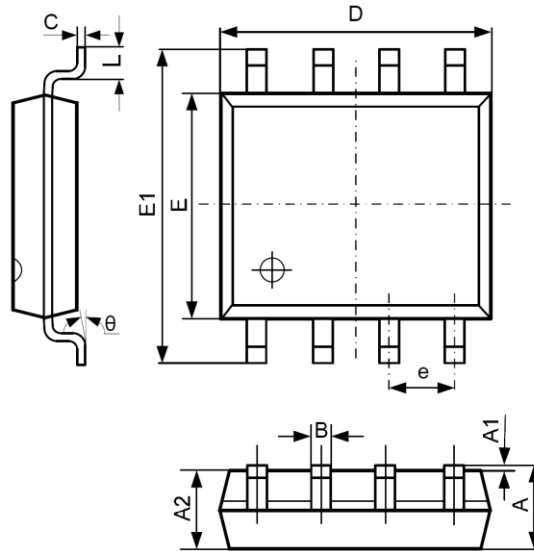


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PACKAGE INFORMATION

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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