DESCRIPTION

The MT7932 is a single-stage, primary side control AC-DC LED driver with active power factor correction. The MT7932 integrates on-chip PFC circuit operates in discontinuous conduction mode (DCM) to achieve high power factor and low harmonic distortion (THD). With MAXIC Proprietary control technique, precision LED current is achieved without secondary side sense and feedback circuit including opto-coupler.

The MT7932 provides various protections, such as over current protection (OCP), over voltage protection (OVP), short circuit protection (SCP) and over temperature protection (OTP), etc, to improve system reliability.

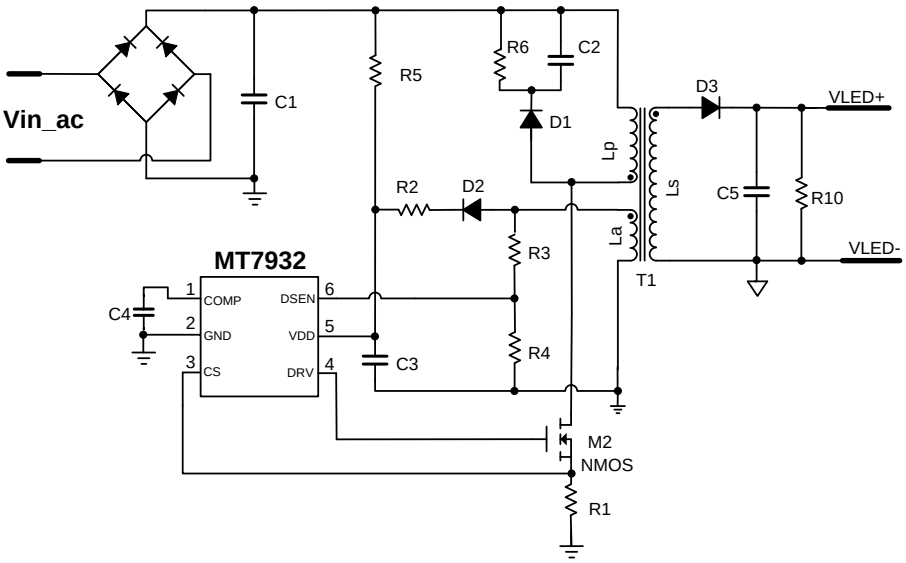
FEATURES

- Single-stage Active PFC for high power factor and low THD (<8%)
- Primary side control eliminates opto-coupler
- High precision LED current (±3%)
- Up to 60W driving capability.
- Cycle-by-cycle current limiting
- Under-voltage lockout (UVLO) protection
- VDD and output over voltage protection
- Adjustable constant current and output power setting
- Power on soft-start
- Available in SOT23-6 package

APPLICATIONS

- AC/DC LED driver applications
- Signal and decorative LED lighting
- E27/PAR30/PAR38/GU10 LED lamp
- T8/T10 LED String

Typical Application Circuit



ABSOLUTE MAXIMUM RATINGS

VDD Voltage	-0.3V to VDD Clamp
DRV Pin Voltage	-0.3V to 25V
COMP/CS/DSEN Pins Voltage	-0.3V to 5V
Power Dissipation (TA=25°C, SOT23-6)	0.6W
Lead Temperature (soldering, 10 sec.)	260°C
Storage Temperature	-55°C to 150°C
Junction Temperature Tj	150°C

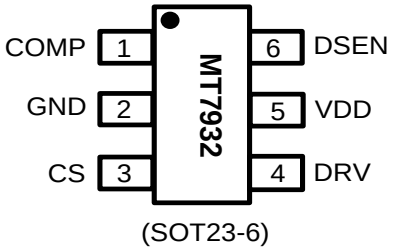
Recommended operating conditions

Supply voltage	7.2V to 22V
Operating Temperature	-40°C to 105°C

Thermal resistance

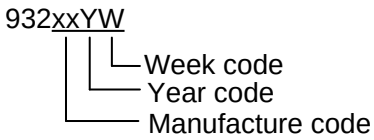
Junction to ambient ($R_{\theta JA}$)	170°C/W
Junction to Case ($R_{\theta JC}$)	130°C/W

PIN CONFIGURATIONS



(SOT23-6)

Chip Mark



PIN DESCRIPTION

Name	Pin No.	Description
COMP	1	Internal EA's output. Connect a capacitor to ground for frequency compensation.
GND	2	Ground.
CS	3	Current Sense Pin.
DRV	4	Gate drive output for primary MOSFET.
VDD	5	Power Supply.
DSEN	6	The voltage feedback from auxiliary winding. Connected to a resistor divider from auxiliary winding to sense output voltage.

ELECTRICAL CHARACTERISTICS

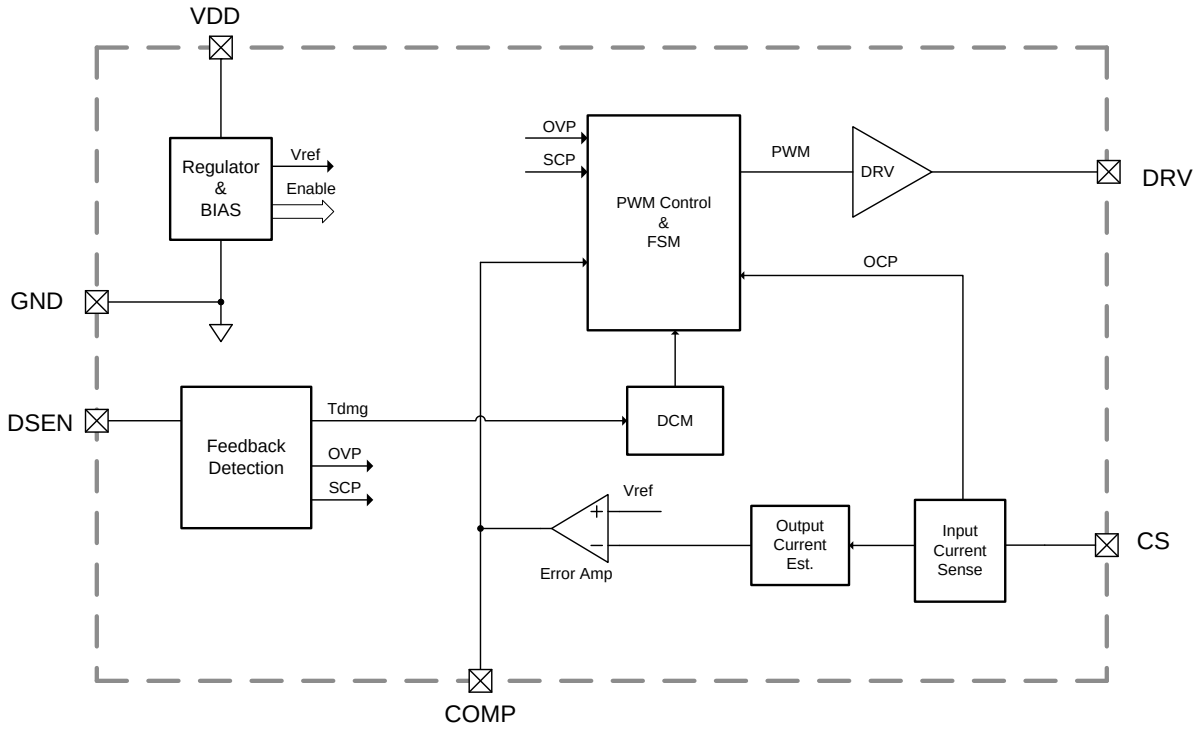
(Test conditions: V_{DD}=12V, T_A=25°C unless otherwise stated.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Start-up (VDD pin)						
I_{START}	Start up Current			25	50	μA
UVLO	Lower Threshold Voltage of V_{DD}	V_{DD} Pin ramp down		7.2		V
V_{START}	Start-up Voltage	V_{DD} Pin ramp up		18		V
Supply Current						
I_q	Quiescent Current	No switching		1.2		mA
Control Loop						
V_{FB}	Primary Current Sense Voltage		392	400	408	mV
V_{COMPH}	Upper Limit of COMP			2.0		V
SCP	Short Circuit Protection Threshold at DSEN pin			400		mV
OVP1	Over Voltage Protection Threshold at VDD pin			24		V
OVP2	Over Voltage Protection Threshold at DSEN			3.2		V
MinOFF	Minimum OFF time		8			μs
Current Sense (CS pin)						
LEB	Leading Edge Blanking of CS			240		ns
OCP	Over Current Protection at CS pin			2.0		V
Thermal Protection						
OTP	Over temperature protection			150		℃
	Over temperature release hysteresis			20		℃
Drive Stage (DRV pin)						
T_R	Rising Time	CL=1nF, DRV Pin Falls from V_{DD} to 0V		50①		ns
T_F	Falling Time	CL=1nF, DRV Pin Rises from 0V to V_{DD}		30①		ns

Note:

① Guaranteed by design.

BLOCK DIAGRAM



APPLICATION INFORMATION

The MT7932 is a primary-side controller for AC-DC LED driver. The LED current can be accurately regulated through sensing the primary side information to realize real current control. The MT7932 integrates power factor correction function to eliminate pollution to the AC line and works in Discontinuous Conduction Mode (DCM).

Real Current Control

The MT7932 accurately regulates LED current through sensing the primary side information. The LED current can be easily set as following (refer to the application circuit in page 1):

$$I_{LED} = \frac{1}{2} \frac{N_P}{N_S} \frac{V_{FB}}{R_S}$$

Where, N_P is primary winding; N_S is secondary winding; V_{FB} (=400mV) is the internal voltage reference and R_S is an external current sensing resistor.

Start Up

During start-up process, VDD is charged through a start-up resistor. As VDD reaches 18V, COMP is pre-charged by internal circuit. After COMP reaches 0.8V, the internal control loop is well settled, which is considered as “LoopOK”. Then PWM signal is send to DRV Pin to power up the convertor.

The power supply is taken over by the auxiliary winding once the voltage of this winding is high enough.

The PWM signal is shut down after VDD goes below 7.2V (UVLO threshold voltage). Meanwhile, COMP is discharged to ground. The whole start-up procedure is shown in Fig.1.

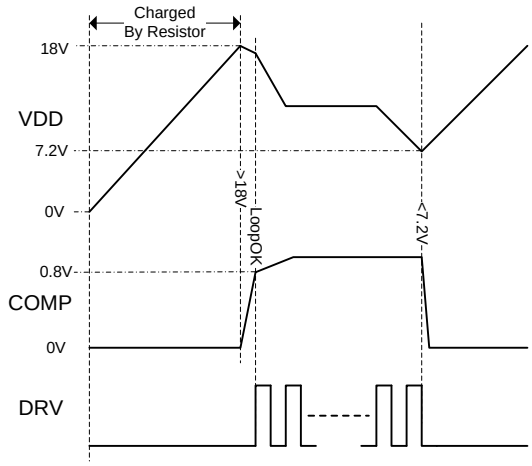


Fig.1 Start up sequence

Power Factor Correction

The primary side current increases linearly from zero to peak value, as sensed by the current sensing pin CS, during the power MOSFET on-time. When the primary current reaches the threshold, The MT7932 turns off the power MOSFET immediately. The MT7932 turns on the power MOSFET again after a fixed Off-time. The peak current threshold is regulated by MAXIC proprietary technique and follows the rectified sinusoidal-shape of main line voltage. As a result, the envelope of the inductor current is sinusoidal-shaped, high power factor and low THD is therefore achieved in this way.

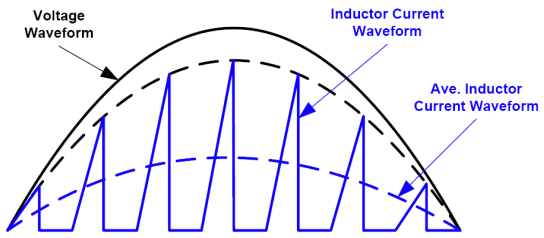


Fig.2 Power Factor Correction

Auxiliary Sensing

The turning-on of power MOSFET is controlled by sensing DSEN's waveform, which is sampled from Auxiliary windings by the resistor-divider. If any falling edge of DSEN's waveform is detected within MinOFF time, the MT7932 will turn on the power MOSFET right after MinOFF time. If the falling edge is detected after MinOFF time, the MT7932 will turn on the power MOSFET immediately. It's highly recommended that a proper primary-inductance should be designed so that the MT7932 works in DCM to achieve low THD. Besides, maximum OFF time control scheme prevents the convertor from stopping switching.

Furthermore, the MT7932 features over-voltage protection (OVP), short-circuit protection (SCP), and over-current protection (OCP) functions. Those protections are triggered by sensing the auxiliary winding waveform information, as the auxiliary winding voltage is proportional to the output voltage (secondary winding voltage) during the OFF time period. The auxiliary winding voltage is sampled by DSEN pin, one LEB (Leading Edge Blanking) time right after DRV signal is turned off.

Auxiliary sensing function is shown in Fig.3.

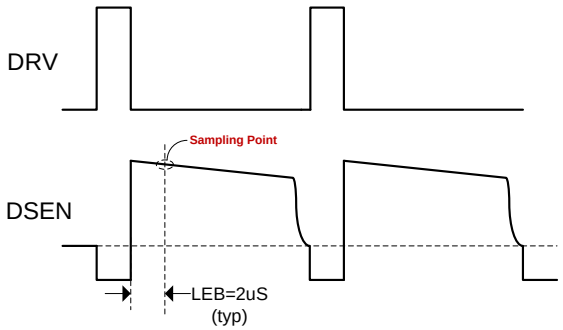


Fig.3 Auxiliary Signal Sensing

Over-voltage Protection

The MT7932 is implemented with two over-voltage protection schemes:

(1) If DSEN pin's voltage is detected above 3.2V for three times, (refer to **Auxiliary Sensing** section), the MT7932 turns off the PWM switching signal, and VDD voltage gradually drops to UVLO threshold, and the system will be re-started. The threshold voltage of

over-voltage protection V_{OUT_OV}, can be easily defined as (refer to the application circuit in page 1):

$$V_{OUT\_OV} = 3.2 * (1 + \frac{R3}{R4}) * \frac{N_s}{N_a} + V_{D3}$$

Where, N_s is the secondary winding; N_a is auxiliary winding; V_{D3} is the forward bias of the secondary side rectifier diode.

(2) If VDD pin's voltage exceeds 24V three times, the MT7932 turns off the PWM switching signal, and VDD gradually drops to UVLO threshold, and then the system will be re-started. It is highly recommended to set up the VDD voltage between 12V and 22V by designed a proper N_a to N_s ratio of the transformer.

Short-circuit Protection

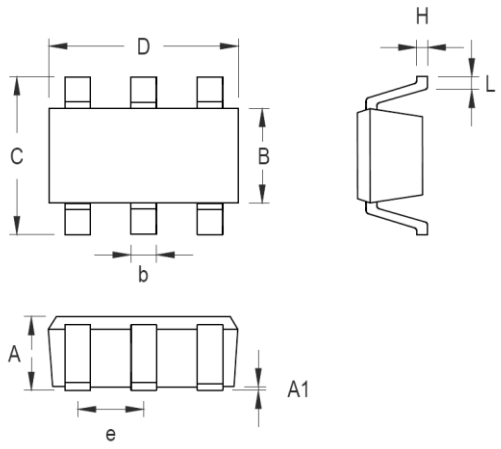
The short-circuit protection is triggered if the DSEN pin voltage is detected below 400mV at OFF period for a continuous time of 5 to 10ms. The gate drive switching will be turned off, and a restart process will be kicked off when the VDD voltage drops below the UVLO threshold.
This re-start process will repeat if the short-circuit condition continues to exist.

Over-current Protection

The MT7932 immediately turns off the power MOSFET once the voltage at CS pin exceeds 2.0V. This cycle by cycle current limitation scheme prevents the relevant components, such as power MOSFET, transformer, etc. from damage.

PACKAGE INFORMATION

SOT23-6 PACKAGE OUTLINE AND DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.035	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.250	0.559	0.010	0.022
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

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