

**DESCRIPTION**

The MT79328 is a single-stage, primary side control AC-DC LED driver with active power factor correction. The MT79328 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.

Embedded with 700V power MOSFET, the peripheral circuit is simplified.

The MT79328 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.

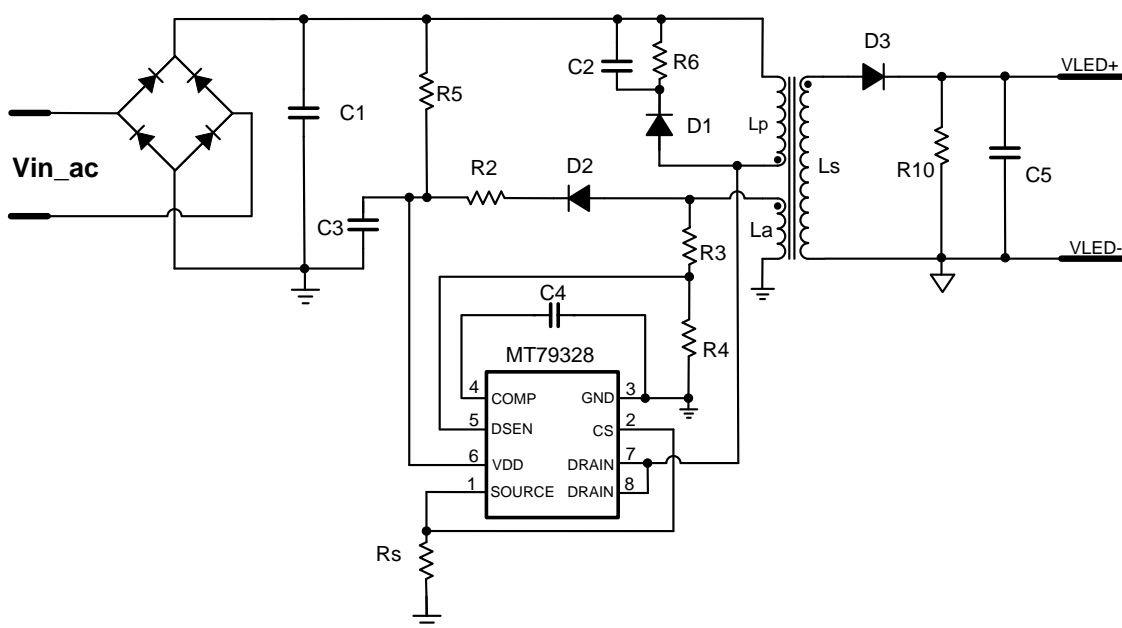
**FEATURES**

- Single-stage Active PFC for high power factor and low THD (<8%)
- Primary side control eliminates opto-coupler
- High precision LED current ( $\pm 3\%$ )
- 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
- Embedded with 700V power MOSFET
- Available in DIP8 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
DRAIN Pin Voltage	-0.3V to 700V
COMP/CS/DSEN Pins Voltage	-0.3V to 5V
Power Dissipation ( TA=25°C)	1.5W
Lead Temperature (soldering, 10 sec.)	260°C
Storage Temperature	-55°C to 150°C
Junction Temperature Tj	150°C

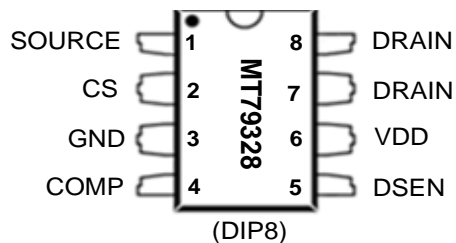
### Recommended operating conditions

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

### Thermal resistance

Junction to ambient (R <sub>θJA</sub> )	70°C/W
Junction to Case (R <sub>θJC</sub> )	47°C/W

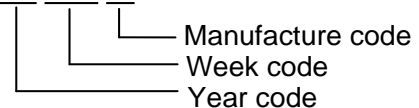
### PIN CONFIGURATIONS



### Chip Mark

MT79328

YY WW xx



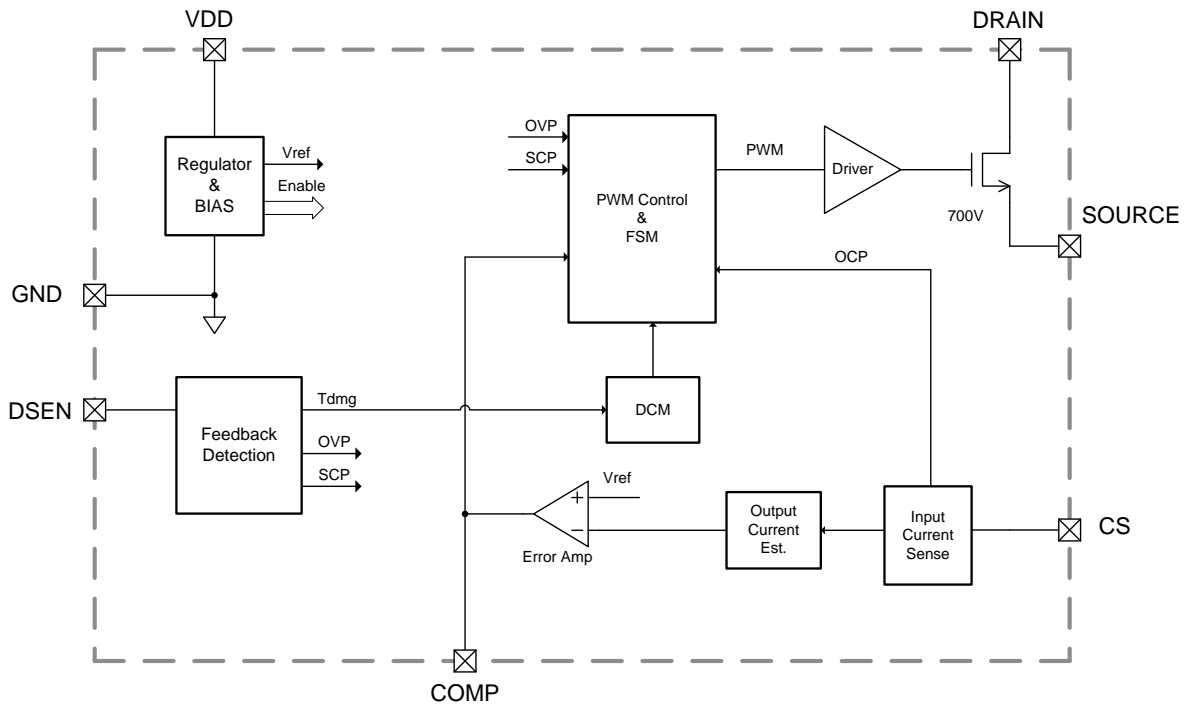
### PIN DESCRIPTION

Name	Pin No.	Description
SOURCE	1	Source of the power MOS
CS	2	Current sense pin
GND	3	Ground
COMP	4	Internal EA's output. Connect a capacitor to ground for frequency compensation
DSEN	5	The voltage feedback from auxiliary winding. Connected to a resistor divider from auxiliary winding to sense output voltage
VDD	6	Power supply
DRAIN	7,8	Drain of the power MOS drain

**ELECTRICAL CHARACTERISTICS**
(Test conditions:  $V_{DD}=12V$ ,  $T_A=25^{\circ}C$  unless otherwise stated.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Start-up (VDD pin)</b>						
$I_{START}$	Start up Current			25	50	$\mu A$
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
<b>Supply Current</b>						
$I_q$	Quiescent Current	No switching		1.2		mA
<b>Control Loop</b>						
$V_{FB}$	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			$\mu s$
<b>Current Sense (CS pin)</b>						
LEB	Leading Edge Blanking of CS			240		ns
OCP	Over Current Protection at CS pin			2.0		V
<b>Thermal Protection</b>						
OTP	Over temperature protection			150		$^{\circ}C$
	Over temperature release hysteresis			20		$^{\circ}C$
<b>POWER MOSFET (DRAIN/SOURCE)</b>						
$BV_{DSS}$	Drain-Source Breakdown voltage		700			V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS}=10V/I_{DS}=2.0A$		2.5		$\Omega$

**BLOCK DIAGRAM**



**APPLICATION INFORMATION**

The MT79328 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 MT79328 integrates power factor correction function to eliminate pollution to the AC line and works in Discontinuous Conduction Mode (DCM). Embedded with 700V power MOSFET, the peripheral circuit is simplified and low BOM cost is achieved.

**Real Current Control**

The MT79328 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):

$$I_{LED} = \frac{1}{2} \frac{N_p V_{FB}}{N_s R_s}$$

Where,  $N_p$  is primary winding;  $N_s$  is secondary

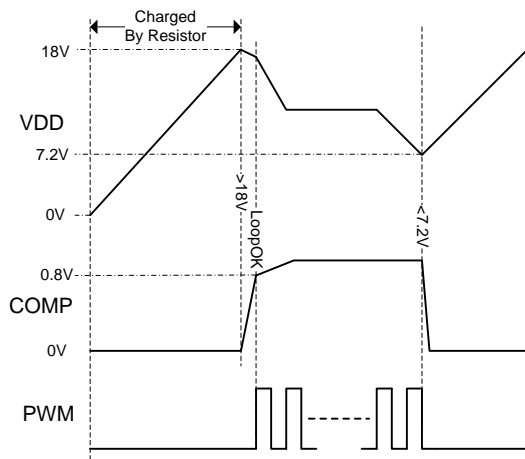
winding;  $V_{FB}$  (=400mV) is the internal voltage reference and  $R_s$  is an external current sensing resistor.

**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 drives the internal power MOSFET to power up the convertor.

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

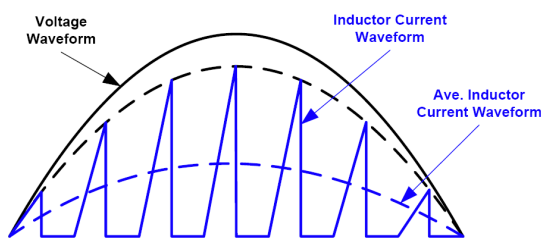
The PWM signal is shut down after VDD goes below 7.2V (UVLO threshold voltage). Meanwhile, COMP is discharged to ground. The whole start-up procedure is shown in Fig.1.



**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 MT79328 turns off the power MOSFET immediately. The MT79328 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**

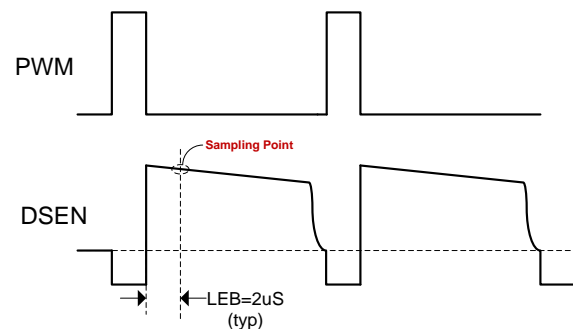
**Auxiliary Sensing**

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 MT79328 will turn on the power MOSFET right after MinOFF time. If the falling edge is detected after MinOFF time, the MT79328 will turn on the power MOSFET immediately. It's highly recommended that a proper primary-inductance should be designed so that the MT79328 works in DCM to achieve low THD. Besides, maximum OFF time control scheme prevents the convertor from stopping switching.

Furthermore, the MT79328 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 PWM signal is turned off.

Auxiliary sensing function is shown in Fig.3.



**Fig.3 Auxiliary Signal Sensing**

**Over-voltage Protection**

The MT79328 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 MT79328 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



**Maximizing IC Performance**

**MT79328**

**Single Stage, Low THD, AC-DC LED Driver**

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

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

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 MT79328 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.

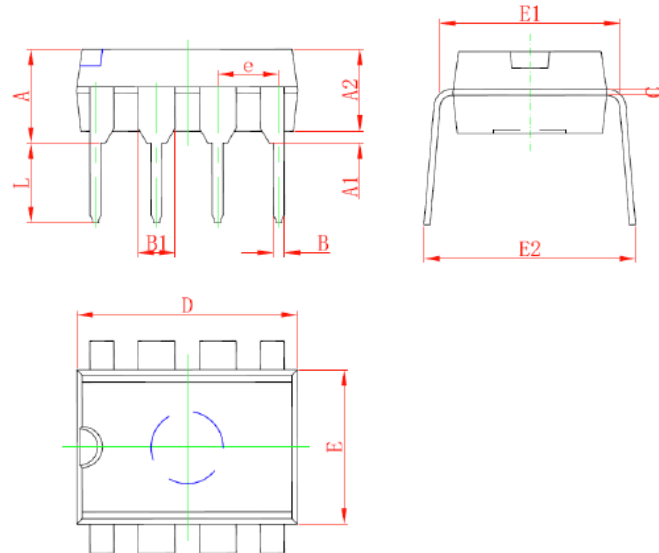
This re-start process will repeat if the short-circuit condition continues to exist.

### Over-current Protection

The MT79328 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**

**DIP8 PACKAGE OUTLINE AND DIMENSIONS**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	4.310	0.146	0.170
A1	0.510		0.020	
A2	3.200	3.600	0.126	0.142
B	0.380	0.570	0.015	0.022
B1	1.524 (BSC)		0.060 (BSC)	
C	0.204	0.360	0.008	0.014
D	9.000	9.400	0.354	0.370
E	6.200	6.600	0.244	0.260
E1	7.320	7.920	0.288	0.312
e	2.540 (BSC)		0.100 (BSC)	
L	3.000	3.600	0.118	0.142
E2	8.400	9.000	0.331	0.354

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