AT7372

Primary-side current control IC with High PFC for LED Lighting

Immense Advance Tech.

FEATURES

- Primary-side feedback control without the opto-coupler
- Universal Input Voltage Range from 90VAC to 264VAC
- Built-in Active Power Factor Correction Technique
- Constant Output Current Control
- DCM Constant On-Time topology
- Good Line and Load Regulation
- Open-LED Protection on DMG pin
- Over-Voltage Protection on VCC pin
- Short-LED Protection
- Cycle by Cycle Over current Protection on CS pin
- Over-Temperature Protection
- Programmable switching frequency by RT Pin
- Gate Driving Voltage Clamping

DESCRIPTION

AT7372 is a primary-side Fly-back control IC with active power factor correction function for LED lighting application.

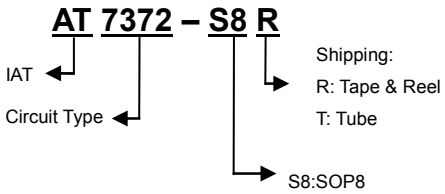
The IC achieves high power factor and low THD operation by DCM mode and constant on time. The line and load regulation of LED current is about ±3% because of particular control method.

AT7372 also provides gate driving voltage clamping, VCC overvoltage protection and system output open/short circuit protection to increase IC performance.

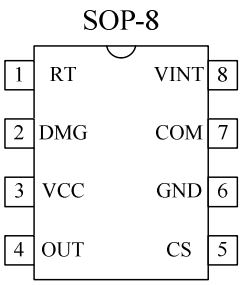
APPLICATIONS

- LED lighting
- Down light
- Tube lamp
- PAR lamp
- Bulb

ORDER INFORMATION



PIN CONFIGURATIONS (TOP VIEW)



PIN DESCRIPTIONS

Pin Name	Pin Description
RT	Frequency setting.
DMG	Zero current demagnetization sensing.
VCC	Power supply pin for all internal circuit.
OUT	Power MOS output pin.
CS	Input current sense pin.
GND	Ground return for all internal circuitry.
COM	Output pin of error amplifier.
VINT	Integration output current signal pin.

TYPICAL APPLICATION CIRCUITS

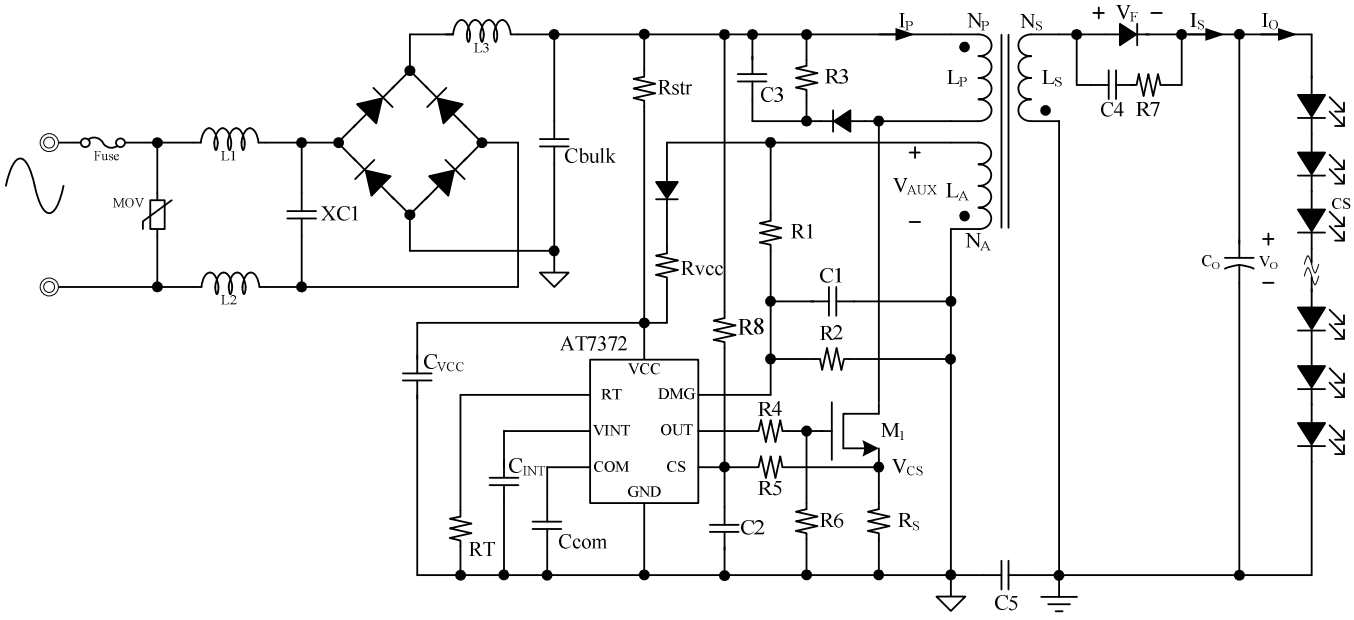


Figure 1

ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Symbol	Range	Unit
Power supply pin	V_{DD}	40	V
DMG voltage to GND	V_{DMG}	-0.3 to 40	V
OUT voltage to GND	V_{OUT}	-0.3 to 40	V
RT voltage to GND	V_{RT}	-0.3 to 5.5	V
CS voltage to GND	V_{CS}	-0.3 to 5.5	V
COM voltage to GND	V_{COM}	-0.3 to 5.5	V
VINT voltage to GND	V_{VINT}	-0.3 to 5.5	V
Operating junction temperature rang	T_J	-40 to + 125	°C
Operating ambient temperature rang	T_{OPA}	-40 to +85	°C
Storage temperature rang	T_{STG}	-65 to +150	°C
Lead temperature (Soldering 5 sec)	T_{LEAD}	260	°C
Power dissipation @T_A=25 °C	P_D	0.4	W
Thermal resistance junction to ambient	θ_{JA}	160	°C/W
ESD rating (Human body mode) (Note 2)	V_{ESD}	2	kV

RECOMMENDED OPERATING CONDITIONS (Note 3)

Parameter	Symbol	Operation Conditions	Unit
Power supply pin	V_{DD}	32	V
DMG voltage to GND	V_{DMG}	-0.3 to 32	V
OUT voltage to GND	V_{OUT}	-0.3 to 20	V
Other Pins	-	5.0	V
Operating Junction Temperature Range	T_J	-40 to +125	°C
Operating Ambient Temperature Range	T_{OPA}	-40 to +85	°C

Note 1: Stresses listed as the above “Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2: Devices are ESD sensitive. Handing precaution recommended.

Note 3: The device is not guaranteed to function outside its operating conditions.

BLOCK DIAGRAM

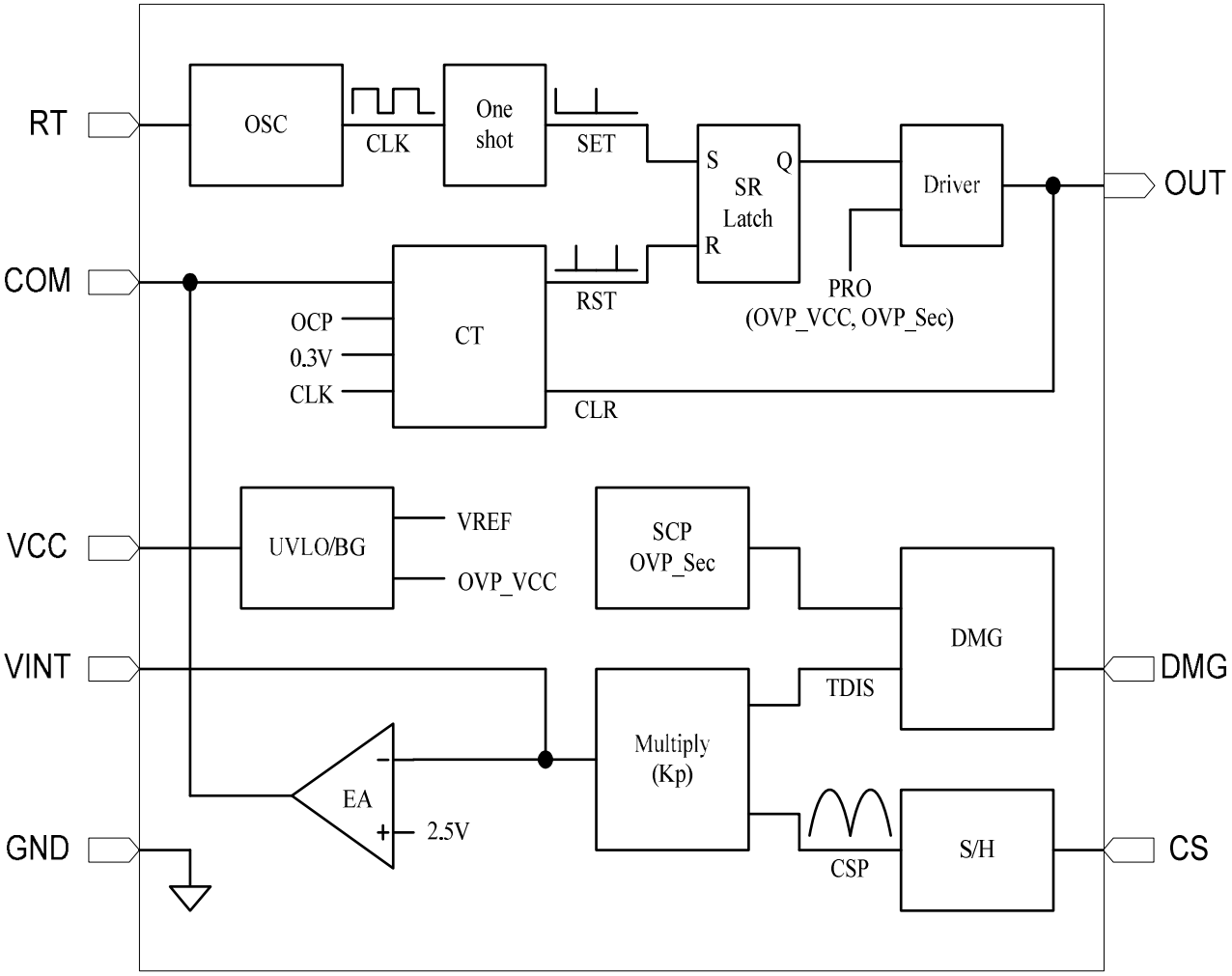


Figure 2

ELECTRICAL CHARACTERISTICS

T_A= 25°C, unless otherwise specified.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Turn-on voltage	V_{CC_ON}		17.2	18.2	19.2	V
Turn-off voltage	V_{CC_OFF}		9.5	10	10.5	V
Quiescent current	I_Q		--	25	35	uA
Normal current consumption	I_{CC}		--	1	2	mA
PROTECTION						
VCC voltage protection	V_{OVPA}		31	32	33	V
Output voltage protection	V_{OVPS}		10	10.5	11	V
CS limit voltage	V_{OCPH}		1.2	1.25	1.3	V
CS limit voltage(Short Circuit)	V_{OCPL}		0.30	0.33	0.36	V
OSCILLATOR						
Start up timer	T_{STR}	R_{RT}=50Kohm		240		us
Switch timer	T_S	R_{RT}=50Kohm		24.0		us
MULTIPLY						
Multiply gain	K_P		--	12.5	--	V
ERROR AMPLIFIER						
Transconductance	G_M		84	120	156	umho
Reference voltage	V_{REF}		2.475	2.5	2.525	V
Maximum sink current	I_{COM_SINK}		--	55	--	uA
Maximum source current	I_{COM_SOUR}		--	55	--	uA
DRIVER						
Rising time(Note 4)	T_{RISE}	V_{CC}=20V, C_O =1nF	--	100	--	ns
Falling time(Note 4)	T_{FALL}	V_{CC}=20V, C_O =1nF	--	40	--	ns
Output clamp voltage	V_{O_CLAMP}		--	--	16.5	V

Note 4: T_{RISE} and T_{FAIL} are guarantee by design.

Note 5: The products may be covered by one or more R.O.C. and foreign patents, or potentially by pending R.O.C. and foreign patent applications assigned to IAT.

APPLICATION INFORMATION

1. Function Description

The AT7372 is a constant current Flyback controller with primary side control and PFC function for LED lighting applications.

Which controller is DCM operation with constant on time based regulator design. In other to achieve high power factor and good EMI performance. This control algorithm fix I_{CS_PK} in wide range variation of Line voltage. We can design transformer critically by $I_{CS(Limit)}$ function.

The AT7372 are built-in functions of VCC over voltage protection, open LED protection, short LED protection, over temperature protection, and primary side current limit, and gate clamp within.

The AT7372 sense switch current from CS voltage Multiplier by TDIS to provide the integral result(VINT). The avarge VINT is finally 2.5V(Vref) by the system close loop feedback. The avarge output current can express as below.

$$I_{O\_avg} = \frac{N_P}{N_S} \times \frac{2.5}{2 \times K_P \times R_S}$$

2. Pin Detail

2-1. RT

Switch timer(Ts) and Start up timer(Tstr) setup Tstr = 10Ts:

$$T_{S(\mu S)} = \frac{R_T}{2250}$$

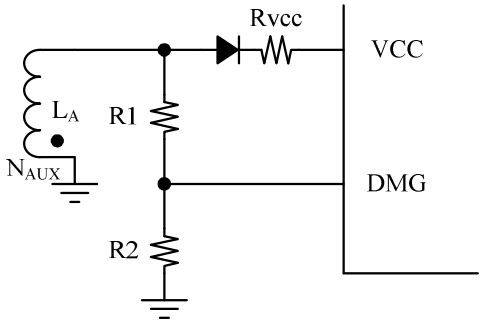
$$T_{STR(\mu S)} = \frac{R_T}{225}$$

2-2. DMG

The Output voltage is reflected by the auxiliary winding(N_{AUX}) voltage of Flyback transformer, the DMG pin can sense output information to depart from start up voltage(V_{O_STR}) and protection voltage(V_{O_OVP}).

When DMG sense voltage under V_{O_STR}, the circuit will work on short circuit protection, F_{STR}=1/Tstr, V_{CS_PK}=0.33V,

When DMG sense voltage over V_{O_OVP}, the circuit will latch out off until VCC under V_{CC_OFF}.



$$V_{O\_STR} = \frac{N_S}{N_A} \times 3 \times \frac{R_1 + R_2}{R_2}$$

$$V_{O\_OVP} = \frac{N_S}{N_A} \times V_{OVPS} \times \frac{R_1 + R_2}{R_2}$$

2-3. VCC

Power supply for the controller during normal operation. The controller will start up when VCC reaches 18.2V (typical) and will shut-down when VCC voltage is below 10V (typical). A decoupling capacitor should be connected between the VCC and GND pin as close as possible.

The AT7372 perform VCC over voltage protection though VCC pin.Once VCC pin exceed in 32V, AT7372 turns off and latch out the MOSFET switcher until VCC under V_{CC_OFF}.

2-4. OUT

Gate drive for external MOSFET switch. Gate clamp function within.

2-5. CS

MOSFET current signal sensing for Multiply(K_P)

$$I_{CS(Limit)} = \frac{1.25}{R_S}$$

2-6. GND

GND is the reference node of internal circuit.

2.7. COM

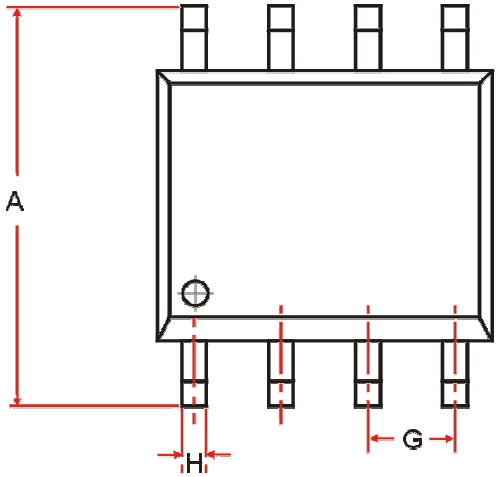
This is the output of the Gm amplifier. Connect with a suitable RC network to ground.

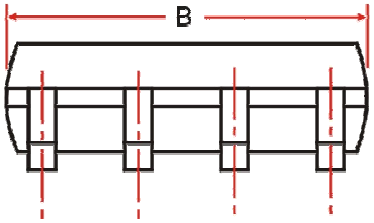
2.8. VINT

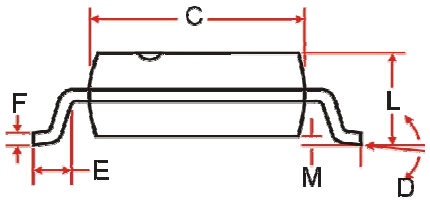
The VINT pin connect with a suitable Capacitor to ground. It saved the integral result of the VCS Multiplier by TDIS.

PACKAGE OUTLINE DIMENSIONS

SOP-8 PACKAGE OUTLINE DIMENSIONS







REF.	DIMENSIONS Millimeters	
	Min.	Min.
A	5.80	6.20
B	4.80	5.00
C	3.80	4.00
D	0°	8°
E	0.40	0.90
F	0.15	0.26
M	0	0.25
H	0.31	0.51
L	1.35	1.75
G	1.27 TYP.	

Note:

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