AT7650A,AT7650B

Phase Dimmable, 6 Pin Primary-side current control IC for LED Lighting

Immense Advance Tech.

FEATURES

- Built-in phase angle decode
- TRIAC hold current management Technique
- Primary-side Fly-back control without the photo-coupler
- Universal Input Voltage Range
  AT7650A 90VAC~135VAC
  AT7650B 180VAC~264VAC
- Transition-mode PFC operating
- Active Power Factor Correction Technique
- Constant Output Current Control LED driver
- 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
- Gate Driving Voltage Clamping
- SOT26 Package Available

APPLICATION

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

DESCRIPTION

AT7650A,AT7650B is a primary-side control IC with phase angle decode circuit and adjustable hold current function for TRIAC dimming LED lighting.
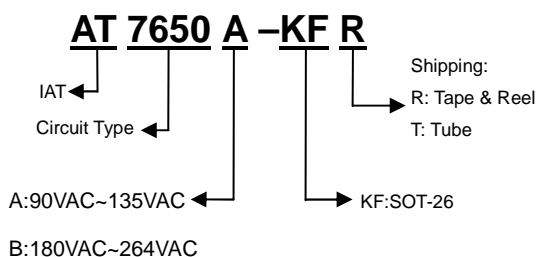
The IC achieves high power factor and low THD operation by BCM mode. The line and load regulation of LED current is about ±3% because of particular control method.

AT7650A,AT7650B also provides gate driving voltage clamping, VCC over voltage protection and system output open/short circuit protection to increase IC performance.
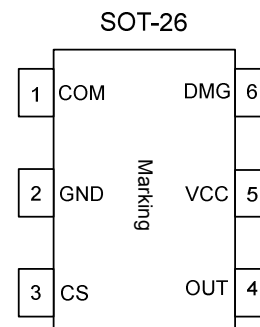
ORDER INFORMATION

AT 7650 A −KF R

IAT
Circuit Type

A:90VAC~135VAC
B:180VAC~264VAC

KF:SOT-26

Shipping:
R: Tape & Reel
T: Tube

PIN CONFIGURATIONS (TOP VIEW)

SOT-26

1	COM	DMG	6
2	GND	VCC	5
3	CS	OUT	4

Marking

PIN DESCRIPTIONS

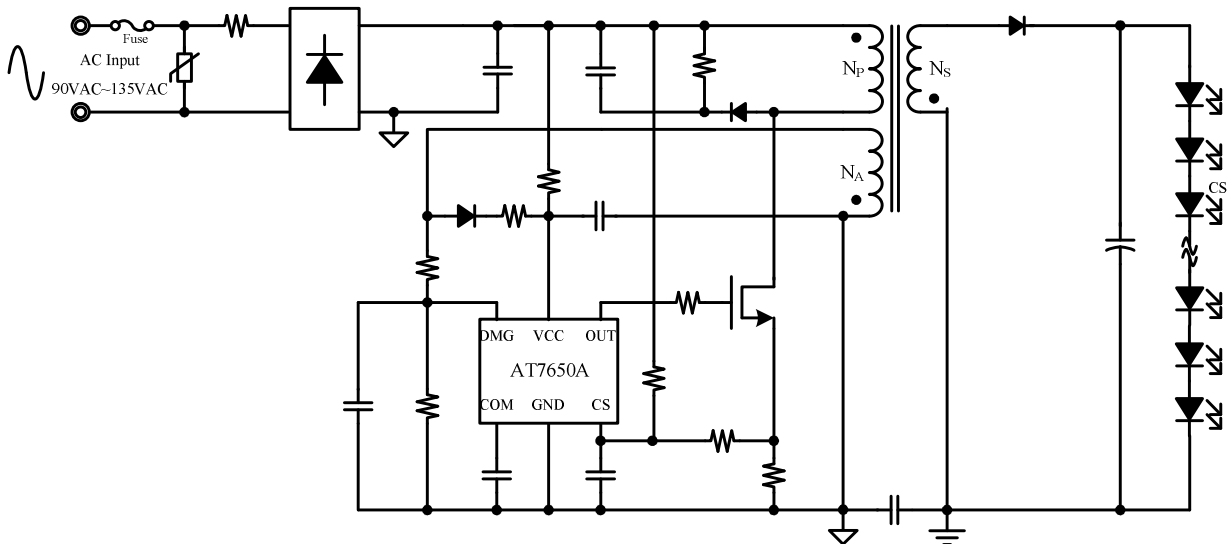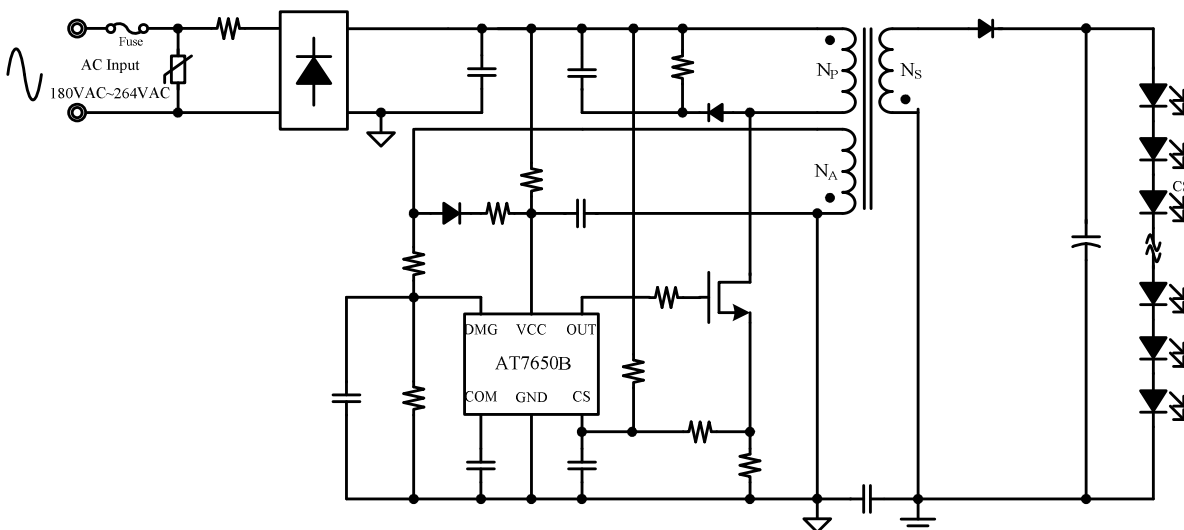| Pin Name	Pin Description
COM	Output pin of error amplifier.
GND	Ground return for all internal circuit.
CS	Input current sense pin.
OUT	Gate driver output.
VCC	Power supply pin for all internal circuit.
DMG	Zero current demagnetization sensing.

TYPICAL APPLICATION CIRCUITS

Figure 1

Figure 2

BLOCK DIAGRAM

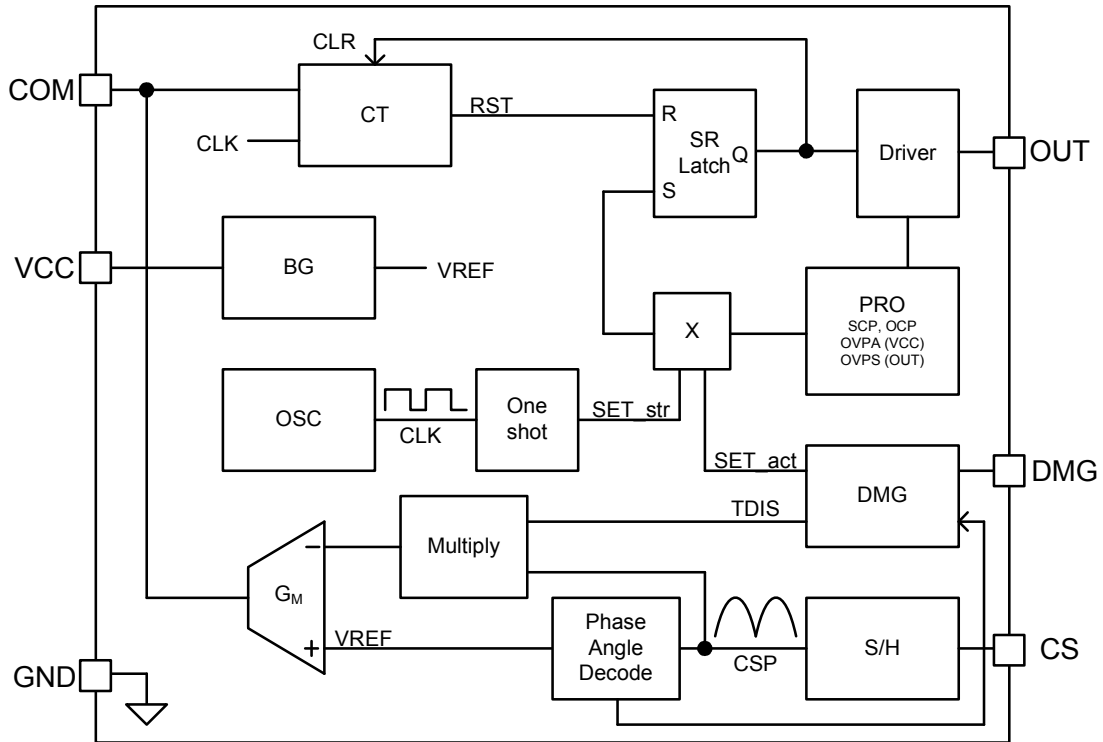Figure 3

AT7650A,AT7650B

Phase Dimmable, 6 Pin Primary-side current control IC for LED Lighting

ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Symbol	Range	Unit
Power supply pin	V_{CC}	40	V
DMG voltage to GND	V_{DMG}	-0.3 to 40	V
OUT voltage to GND	V_{OUT}	-0.3 to 40	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
Junction Temperature Range	T_J	-40 to +150	℃
Storage Temperature Range	T_{STG}	-65 to +150	℃
Lead Temperature (Soldering 10 sec)	T_{LEAD}	260	℃
Power Dissipation @T_A=25 ℃	P_D	0.3	W
Thermal Resistance Junction to Ambient (Note 2)	θ_{JA}	220	℃/W
Thermal Resistance Junction to Case	θ_{JC}	106.6	℃/W
ESD Rating (Human body mode) (Note 3)	V_{ESD}	2	kV

RECOMMENDED OPERATING CONDITIONS (Note 4)

Parameter	Symbol	Operation Conditions	Unit
Power supply pin	V_{CC}	34.5	V
DMG voltage to GND	V_{DMG}	-0.3 to 11.2	V
OUT voltage to GND	V_{OUT}	-0.3 to 19	V
CS voltage to GND	V_{CS}	-0.3 to 5	V
COM voltage to GND	V_{COM}	-0.3 to 5	V
Operating Junction Temperature Range	T_J	-40 to +125	℃
Operating Ambient Temperature Range	T_{OPA}	-40 to +85	℃

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: Thermal Resistance is specified with the component mounted on a low effective thermal conductivity test board in free air at T_A=25℃ .

Note 3: Devices are ESD sensitive. Handing precaution recommended.

Note 4: The device is not guaranteed to function outside its operating conditions.

ELECTRICAL CHARACTERISTICS

T_A= 25℃, unless otherwise specified.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Turn-on voltage	V_{CC_ON}		17	18	19	V
Turn-off voltage	V_{CC_OFF}		8.5	9.5	10	V
Quiescent current 1	I_{Q1}	Vcc=17V, at Vcc off	—	30	50	uA
Quiescent current 2	I_{Q2}	Start up at 4.5 KHz	—	600	800	uA
Operation supply current	I_{CC}		—	2.5	3.0	mA
PROTECTION						
VCC voltage protection	V_{OVPA}		31	32	34	V
Output voltage protection	V_{OVPS}		10	10.5	11	V
CS limit voltage	V_{OCP}		1.15	1.25	1.35	V
Short circuit protection(Note5)	V_{O_STR}		—	3	—	V
OSCILLATOR						
Start up timer	T_{STR}		—	222	—	us
GM AMPLIFIER						
Transconductance	G_M		—	60	—	uA /V
Source current	I_{COMP_SOU}		—	20	—	uA
DRIVER						
Dropout voltage	V_{OH}	V_{CC}=33V, I_O = 10mA	—	1.2	1.5	V
	V_{OL}	V_{CC}=33V, I_O = -10mA	—	0.12	—	V
Rising time	T_{RISE}	V_{CC}=20V, C_O =1nF	—	40	—	ns
Falling time	T_{FAIL}	V_{CC}=20V, C_O =1nF	—	80	—	ns
Output clamp voltage	V_{O_CLAMP}		—	—	19	V
Leading edge blanking time	LEB_T		—	0.5	—	ns
OTP(Note 6)						
OTP Trip Point			—	150	—	℃
OTP Release Point			—	115	—	℃
OTP Threshold Hysteresis			—	35	—	℃

Note 5: Guaranteed by design.

Note 6: Auto Recovery Type.

APPLICATION INFORMATION

1. Function Description

The AT7650A,AT7650B is a primary-side control IC with phase angle decode circuit and adjustable hold current function for TRIAC dimming LED lighting..

The controller is BCM operation with constant on time based regulator design to achieve high power factor performance.

The AT7650A,AT7650B is built-in functions of phase dimmable, VCC over voltage protection, open LED protection, short LED protection, over temperature protection, primary side current limit, and gate clamp within.

The AT7650A,AT7650B sense switch current from CS voltage Multiplier by TDIS to get the output current information. By the system close loop feedback. The avarge output current can express as below.

$$I_{OUT} = \frac{N_P}{N_S} \times \frac{0.333 * \eta}{2 \times R_S}$$

2. Pin Detail

2-1. COM

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

2-2. GND

GND is the reference node of internal circuit.

2-3. CS

MOSFET current signal sensing for Multiply, Phase angle decode and current limit setting function

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

2-4.OUT

Gate drive for external MOSFET switch and is built-in Gate clamp function.

2-5VCC

Power supply for the controller during normal operation. The controller will start up when VCC reaches 18V (typical) and will shut-down when VCC voltage is below 9.5V (typical). A decoupling capacitor should be connected between the VCC and GND pin as close as possible.

The AT7650A,AT7650B perform VCC over voltage protection though VCC pin. Once VCC pin exceed in 32V, AT7560 turns off and latch out the MOSFET switcher until VCC under V_{CC_OFF}.

2-6DMG

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, and the system switching frequency $F_{STR}=1/Tstr$.

When DMG sense voltage over V_{O_OVP}, the circuit will work on over voltage protection, it will latch out off until VCC under V_{CC_OFF}.
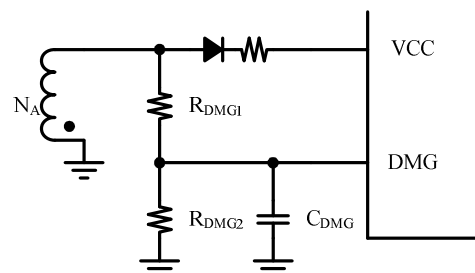
APPLICATION INFORMATION(CONTINUED)

OVP Protection (By DMG)

$$V_{DMG\_OVP} = \frac{N_S}{N_A} \times V_{OVPS} \times \frac{R_{DGM1} + R_{DGM2}}{R_{DMG2}}$$

OVP Protection (By VCC)

$$V_{VCC\_OVP} = \frac{N_S}{N_A} \times V_{OVPA}$$

Short Circuit Protection

$$V_{O\_Short} = \frac{N_S}{N_A} \times V_{O\_STR} \times \frac{R_{DMG1} + R_{DMG2}}{R_{DMG2}}$$
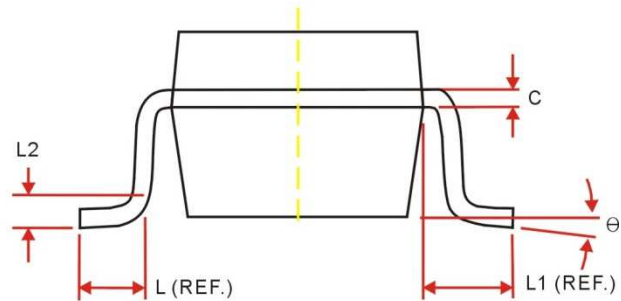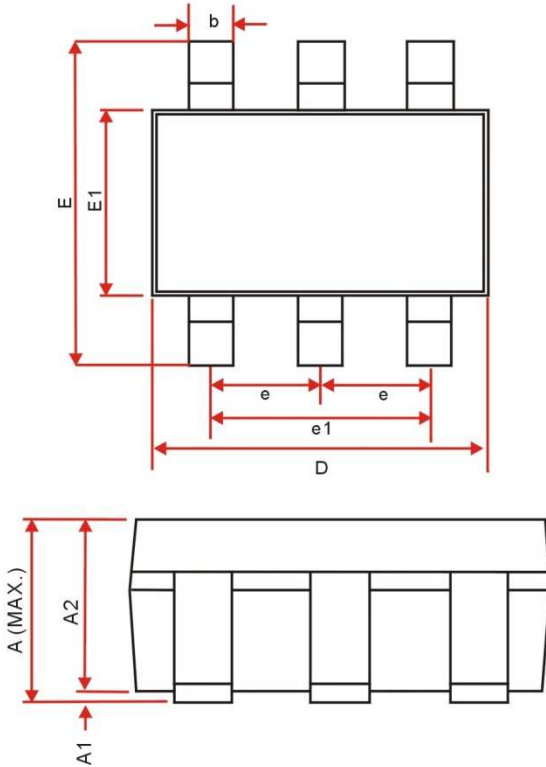
PACKAGE OUTLINE DIMENSIONS
SOT-26 PACKAGE OUTLINE DIMENSIONS

Symbol	Dimensions In Millimeters	
	Min	**Max**
A	1.45 MAX.	
A1	0	0.15
A2	0.90	1.30
C	0.08	0.22
D	2.90 REF.	
E	2.80 REF.	
E1	1.60 REF.	
L	0.30	0.60
L1	0.60 REF.	
L2	0.25 REF.	
Θ	0°	10°
b	0.30	0.50
e	0.95REF.	
e1	1.90REF.	

Note :

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