A High Precision Primary Side feedback Constant Current Control LED Controller

The Document is Applied to: CS6552AEO,CS6552BEO,CS6552EO,CS6552CEO,CS6552DEO

1、General Description

The CS6552 is a high precision primary-side-feedback LED lighting controller which integrates a 600V high voltage power MOSFET, it achieves 85Vac-265Vac input voltage and accurate LED current for single-power stage, isolated lighting applications. The constant current control method accurately controls the LED current from the primary side, and therefore significantly simplifies the LED lighting system design by eliminating the secondary side feedback components and opto-coupler. It also eliminates the need of loop compensation circuit while maintaining stability，and increase the reliability.

The CS6552 works in discontinuous conduction mode to reduce the MOSFET switching losses. The extremely low start-up current and quiescent current reduces the total power consumption to provide a high efficiency solution for lighting applications.

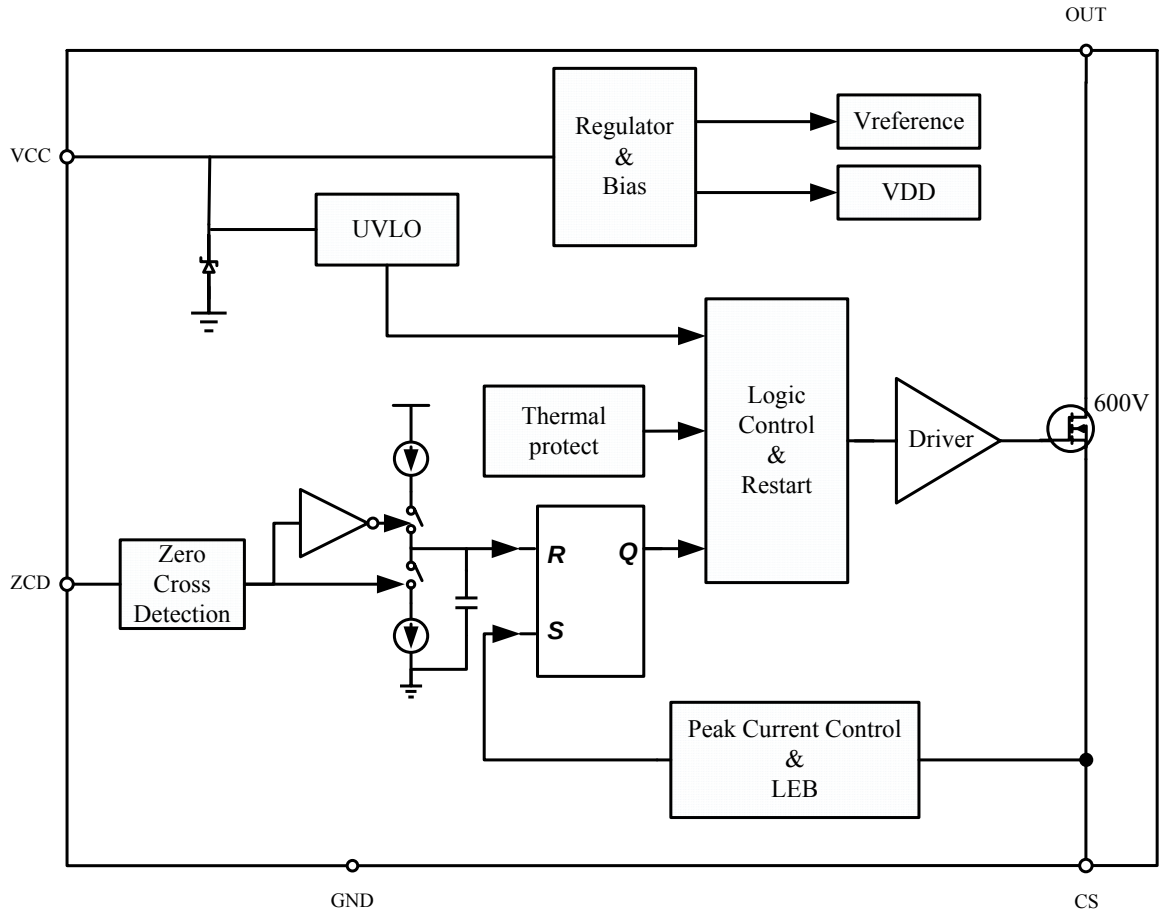
The multi-protection feature of CS6552 significantly improves the system reliability and safety. The CS6552 features over-voltage protection, short-circuit protection, cycle-by-cycle current limit, VCC UVLO and over-temperature protection. The CS6552 will auto-restart when protection happens.

Features

- Integrate 600V high voltage power MOSFET
- Primary-side-control Without Secondary-feedback Circuit
- High Precision LED Output current for 85Vac-265Vac Input Voltage
- Ultra-low(23μA) Start Up Current
- Discontinuous Conduction Mode Improves Efficiency
- Low(<1.5mA) Quiescent Current
- Leading Edge Blanking Function
- Output Open/Short Circuit Protection
- Current Detect Resistor Open Circuit Protection
- Cycle-by-cycle Current Limit Protection
- VCC UVLO Protection
- VCC Over Voltage Protection
- Over-temperature Protection
- Available in SOP8 Package

2、Function Diagram and Pin Description

2. 1、Function Diagram



2. 2、Function Description

The CS6552 is a high precision primary-side-feedback LED lighting controller that achieves 85Vac-265Vac input voltage，It integrated 600V high voltage power MOSFET. The LED current can be accurately controlled with Primary-side-control method.

2.2.1、Start UP and UVLO

Initially, the capacitor beside VCC pin is charged through the start up resistor from the AC line. When VCC voltage reaches the VCC on threshold voltage of IC, the control logic works, VCC power supply is taken over by the auxiliary winding.

The UVLO of CS6552 will shutdown as soon as VCC pin is lower than VCC off voltage, and another start up cycle starts.

2.2.2、Constant Current Control

The constant current control method allows the CS6552 controlling the secondary side LED current from the primary side information. The output LED mean current can be calculated approximately as:

$$Io = \frac{N \times V_{REF}}{4 \times R_{CS}}$$

N—Turn ratio of primary side to secondary side

V_{REF}—The CS detect threshold voltage (typical 0.48V)

R_{CS}—The sensing resistor connected between CS pin and GND

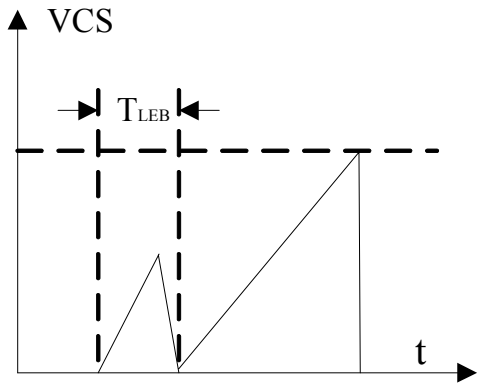
2.2.3、System Frequency

The CS6552 works in discontinuous conduction mode, the recommended frequency is 40kHz~48kHz. The maximal and minimal frequency is limited by CS6552. The system frequency expression is:

$$f = \frac{V_{LED}}{8 * I_{LED} * L_P} * \frac{N_P^2}{N_S^2}$$

2.2.3、Leading Edge Blanking

In order to avoid the premature termination of the switching pulse due to the parasitic capacitance discharging at MOSFET turning on, an internal leading edge blanking(LEB) unit is employed between the CS pin and the current comparator input. During the blanking time, the path from CS pin to the current comparator input is blocked.



2.2.4、LED open Protection

When the LED open circuit happens, VCC voltage will raise up to higher than VCC on voltage, the Vcc capacitance will discharge through the interior circuit. The Vcc will be clamped at about 14.5V and the output voltage is proportional to Vcc, the output voltage is given by the following equation:

$$Vout = (Vcc + VDa) \times N - VDo$$

N is the turn ratio of the output winding to the auxiliary winding

VDa is the auxiliary rectifier diode forward drop voltage

VD is the output rectifier diode forward drop voltage

If the Vcc voltage raises to higher than VCC overvoltage protection threshold, the output power MOSFET will be turned of and be locked. The system will restart again until the error condition is removed.

2.2.5、LED short Protection

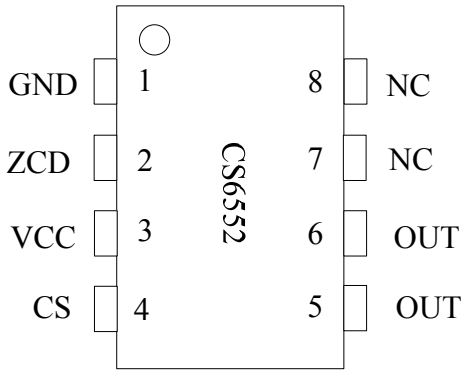
When the LED is shorted to ground, the output voltage is clamped to zero. The auxiliary

winding can't supply current for Vcc, so Vcc will drop down. Since the Vcc is below VCC off voltage, the system will restart and operate in hiccup mode until the shorted condition is removed.

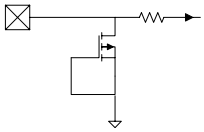
2.2.6、Over Temperature Protection

To prevent from any lethal thermal damage, when the inner temperature exceeds 160℃, the CS6552 shuts down switching cycle and latched until VCC voltage drop below VCC off voltage and restart again.

2. 3、Pin Configuration



2. 4、Pin Description and Structure Scheme

Pin	Symbol	Function	Attribute	Structure Scheme
1	GND	Ground pin.	P	
2	ZCD	The demagnetization-time detect.	I	
3	VCC	Supply voltage pin. This pin supplies the power for control signal. Connect this pin to an external capacitor.	P	
4	CS	Current sense pin. The MOSFET current is sensed via a resistor.	I	
5、6	OUT	The Drain of the integrated 600V high voltage power MOSFET	I	
7、8	NC			

3、Electrical Characteristics

3. 1、Absolute Maximum Ratings

Unless otherwise specified，T_{amb}= 25℃

Parameter	Symbol	Value	Units
Supply Voltage	VCC	-0.3~21	V
Power MOS output	V_{OUT}	-0.3~600	V
Analog inputs and outputs（CS，ZCD）		-0.3~7	V
Continuous Power Dissipation	P_{DMAX}	0.45	W
Thermal resistance	θ_{JA}	145	℃/W
Junction Temperature	T_J	-45~150	℃
Storage Temperature	T_{STG}	-65~150	℃
ESD（HBM）		4	kV

3. 2、Electrical Characteristics

Unless otherwise specified, T_{amb}= 25℃, V_{CC}=12V

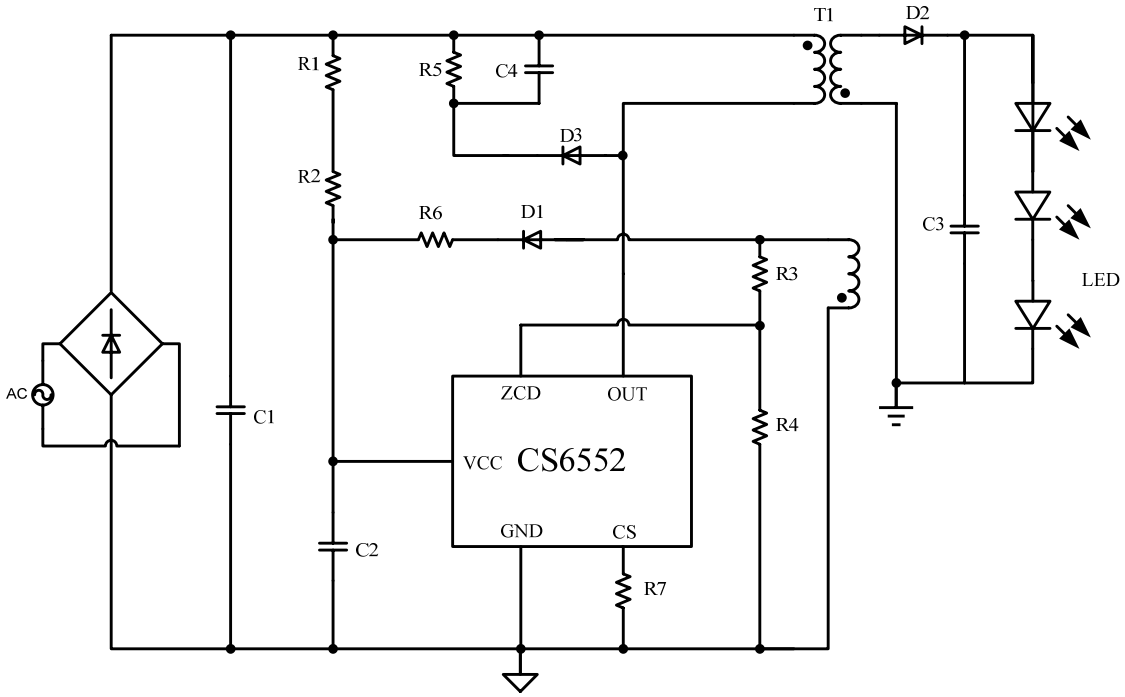
Symbol	Parameter	Condition	Min	Typ	Max	Units
Supply Voltage						
V_{OP}	Input voltage		6.5		16	V
V_{ON}	VCC start up threshold	VCC rising	13	13.9	15	V
V_{OFF}	VCC under voltage threshold	VCC falling		6.4		V
V_{OVP}	VCC over voltage threshold			16.1		V
V_{CLAMP}	VCC clamping voltage			19.1		V
Operation Current						
I_{ST}	Start up time	V_{CC}=12V		23	45	μA
I_{SUPPLY}	Typical operation current	F_{op}=40kHz		0.7	1.5	mA
Current Detector						
$V_{CS—TH}$	current detect threshold		470	480	490	mV
T_{LEB}	leading edge blanking time			500		ns
T_{DELAY}	Turn off delay time			190		ns
ZCD Feedback						
V_{ZCD}	ZCD feedback voltage threshld			1		V
V_{ZCD_CLAMP}	ZCD Clamping voltage	I_{ZCD}=5μA		1.6		V
T_{OFF_MIN}	Minimal turn off time			4.1		μs

To be continued

Continued

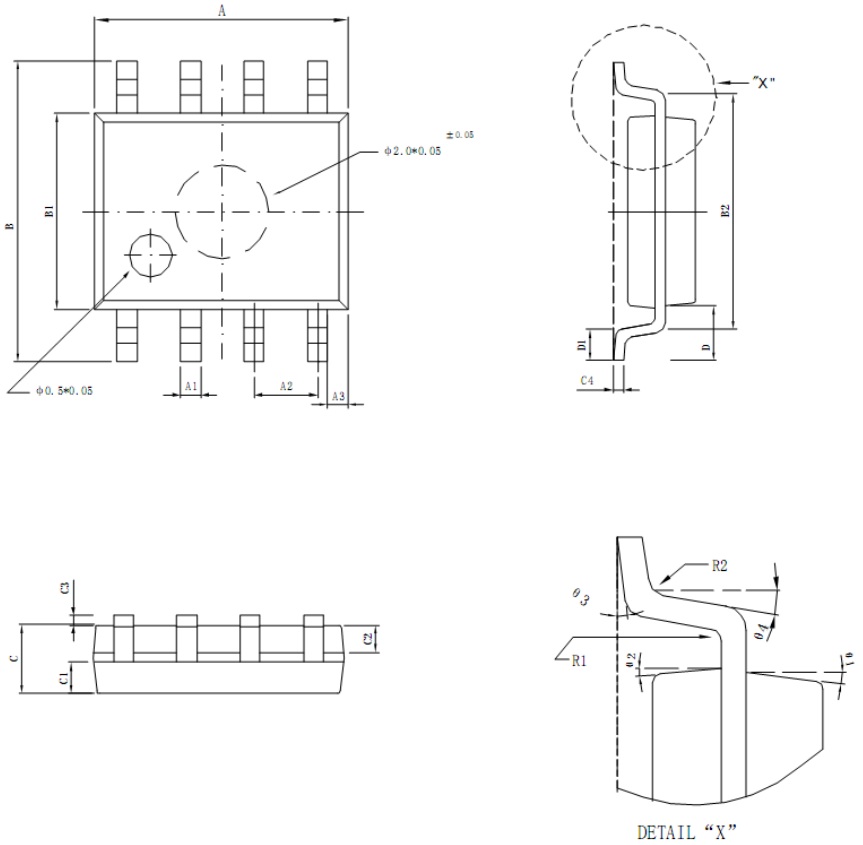
Symbol	Parameter	Condition		Min	Typ	Max	Units
Power MOS							
R_{ON}	The turn-on resistor of integrated high voltage power MOSFET	CS6552AEO	V_{CC}=10V I_{OUT}=0.25A		24	30	Ω
		CS6552BEO	V_{CC}=10V I_{OUT}=0.4A		11	15	Ω
		CS6552EO	V_{CC}=10V I_{OUT}=0.5A		9	10.5	Ω
		CS6552CEO	V_{CC}=10V I_{OUT}=0.75A		8.5	10	Ω
		CS6552DEO	V_{CC}=10V I_{OUT}=1A		6	7	Ω
Over Temperature Protection							
T_{SD}	Over temperature protection threshold				160		℃
T_{SD_HYS}	Temperature hysteresis				30		℃

4、Typical Application Circuit and Information



5、Package Dimensions

5. 1、Package Outline



5. 2、Mechanical Data

Symbol	Min.	Max.	Symbol	Min.	Max.
A	4.95	5.15	C3	0.10	0.20
A1	0.37	0.47	C4	0.20TYP	
A2	1.27TYP		D	1.05TYP	
A3	0.41TYP		D1	0.50TYP	
B	5.80	6.20	R1	0.07TYP	
B1	3.80	4.00	R2	0.07TYP	
B2	5.0TYP		θ1	17°TYP	
C	1.30	1.50	θ2	13°TYP	
C1	0.55	0.65	θ3	4°TYP	
C2	0.55	0.65	θ4	12°TYP	

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