DESCRIPTION

MT7963 is a PWM controller for AC-DC LED lighting. With primary side sensing and regulation technology, no secondary side feedback circuit is needed. Further, the loop compensation components are also eliminated while maintaining system stability. Integrated with 650V power switch simplifies the system design and improves the reliablity.

With Maxic's proprietary current regulation technique, the MT7963 achieves ±5% accuracy of LED current along with excellent line regulation and load regulation.

MT7963 provides plenty of protections, such as such as over current protection(OCP), short circuit protection (SCP), over voltage protection (OVP) and over temperature protection(OTP),etc, to ensure system reliability.

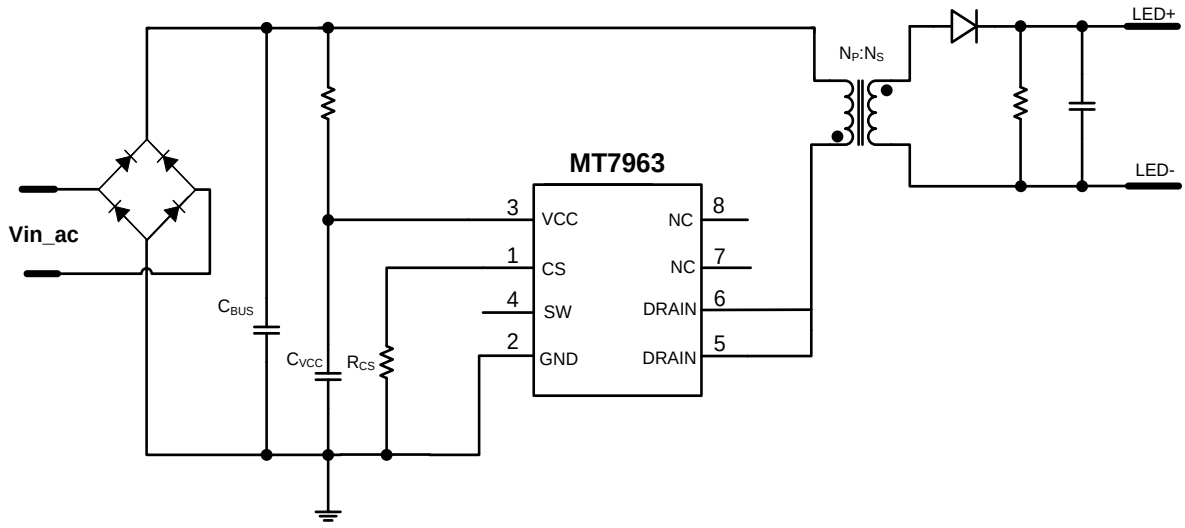
FEATURES

- Build in 650V power MOSFET
- No auxiliary winding needed
- Supporting 85V to 265V AC line voltage range
- Primary side sensing and regulation, no need of secondary side feedback
- High precision constant LED current (+/-5%)
- Cycle-by-cycle peak current control
- LED short-circuit protection
- VDD under voltage lock-out protection
- Over temperature protection
- Available in SOP8 package

APPLICATION

- LED bulb, Spotlight
- LED lighting application
- General purpose constant current source

Typical Application Circuit



ABSOLUTE MAXIMUM RATINGS

DRAIN	-0.3V to 650V
VCC	-0.3V to 40V
VCC maximum sink current	5mA
CS	-0.3V to 6V
P_{DMAX}（Maximum Power）	0.45W
Storage Temperature	-55°C to 150°C
Junction Temperature (Tj)	150°C

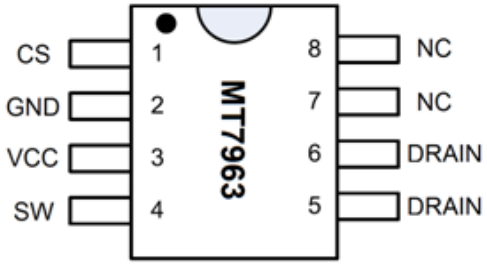
Recommended operating conditions

Supply voltage	8V to 15V
Operating Temperature	-40°C to 105°C

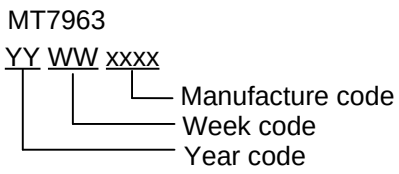
Thermal resistance

Junction to ambient ($R_{\theta JA}$)	128°C/W

PIN CONFIGURATIONS



Chip Mark



PIN DESCRIPTION

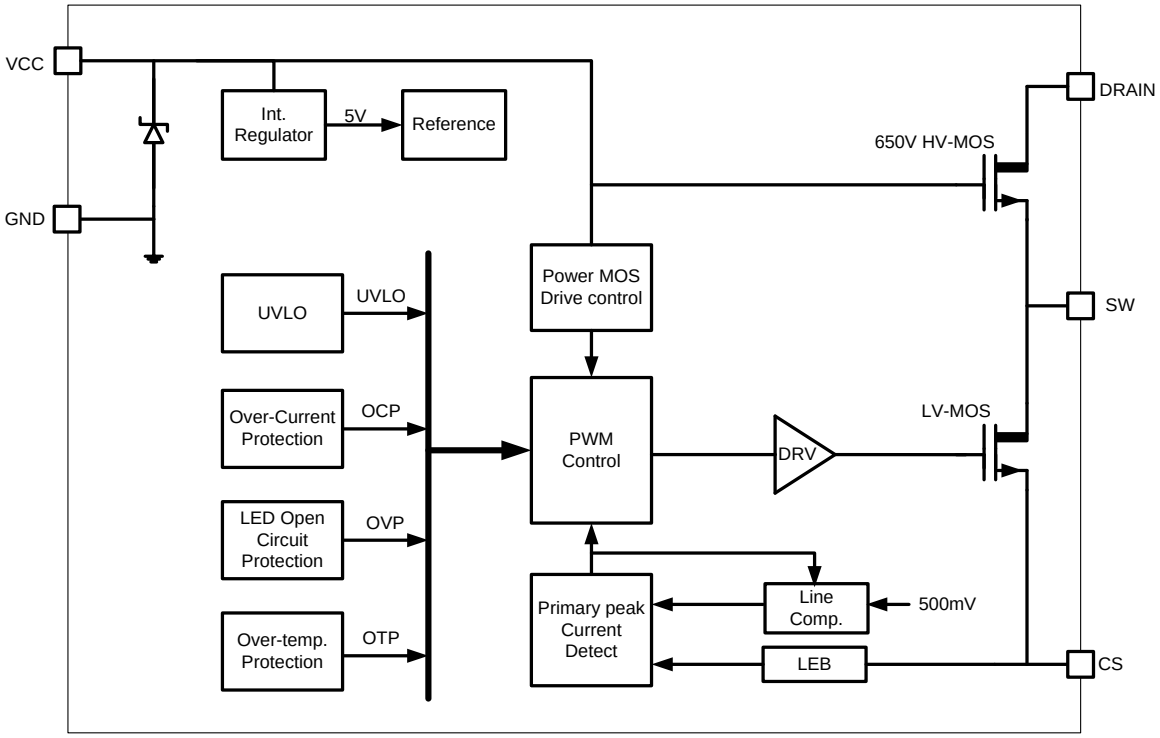
Name	Pin No.	Description
CS	1	Current sense input, sense resistor connected between CS and GND
GND	2	Ground
VCC	3	Power supply
SW	4	Internal power MOS source
DRAIN	5	Internal power MOS drain
	6	
NC	7	No connection. This pin must be floating.
	8	

ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Start-up & Power supply(VCC Pin)						
I_{START}	Start-up Current			35	60	μA
UVLO	Lower Threshold Voltage of V_{CC}	V_{CC} Pin ramp down		8		V
V_{START}	Start-up Voltage	V_{CC} Pin ramp up		13		V
$V_{CC-CLAMP}$	VCC clamp voltage	I_{DD}=5mA		15		V
Operation Current						
I_Q	Operation current			0.3		mA
Current Sense(CS Pin)						
V_{CS-TH}	Threshold Voltage of Peak Current Protection		485	500	515	mV
LEB1	Leading Edge Blanking at CS Pin			500		nS
Driver Circuit						
T_{OFF_MIN}	Minimum OFF time			2		us
T_{OFF_MAX}	Maximum OFF time			200		us
T_{ON_MAX}	Maximum ON time			24		us
D_{UTY_MAX}	Maximum Duty cycle			42		%
Over Temperature Protection						
OTP	Over temperature protection threshold			155		℃
	Over temperature protection release thysteresis			20		℃
Power MOSFET(DRAIN Pin)						
R_{DSON}	Static drain-source on-resistance	VGS=10V/I_{DS}=0.4A		13		Ω
BV_{DSS}	Drain-source breakdown voltage	VGS=0V/I_{DS}=250uA	650			V
I_{DSS}	Drain-source leakage current	VGS=0V/V_{DS}=650V			10	uA

BLOCK DIAGRAM



APPLICATION INFORMATION

MT7963 is a high performance power switch specially designed for LED lighting. MT7963 works in Discontinuous Conduction Mode (DCM). With Maxic's proprietary constant current regulation and compensation technique, MT7963 achieves accurate LED current output without auxiliary winding and secondary side feedback circuit. It integrates 650V power MOSFET, minimizes the external component count, lower the total BOM cost.

Start Up

During start-up, VCC is charged through a start-up resistor. As VCC reaches 13V, the control logic starts to work, and the power MOSFET begins to switch, as show in Fig.1.

MT7963 will shut down if VCC goes below 8V (UVLO threshold voltage).

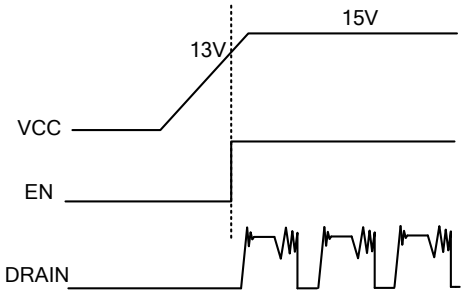


Fig.1 Start up sequence

Constant Current Control and Output Current Setup

Cycle-by-cycle current sense is offered in MT7963, the CS pin is connected to the current sense comparator, and the voltage on CS pin is compared with the internal 500mV reference voltage, the MOSFET is turned off when the voltage on the CS pin reaches the threshold. The comparator also includes a 500nS leading edge blanking time to block the transient noise as the power switch just turned on.

The primary side peak current is given by:

$$I_{P\_PK} = \frac{500}{R_{CS}}(mA)$$

where R_{CS} is the peak current sensing resistor (refer to the *Typical Application Circuit*)

The LED current can be calculated by the following equation:

$$I_{LED} = \frac{I_{P\_PK}}{4} \times \frac{N_P}{N_S} = \frac{500}{4 \times R_{CS}} \times \frac{N_P}{N_S}(mA)$$

where N_P is the turns of the primary winding, N_S is the turns of the secondary winding, I_{P_PK} is the primary side peak current. Shown in the above equation, the output current is determined by the turns ratio of the transformer and the current sense resistor value, insensitive to the inductance of the transformer.

Switching Frequency

MT7963 is designed to operating in discontinuous conduction mode and no external loop compensation is needed for stability. The maximum duty cycle is limited to 42%. It's highly recommended to limit the maximum switching frequency less than 75kHz and the minimum switching frequency more than 20kHz.

The switching frequency can be set by formula:

$$f_{SW} = \frac{N_P^2 \times V_{LED}}{8 \times N_S^2 \times L_p \times I_{LED}}$$

where, N_P is the turns of the primary winding, N_S is the turns of the secondary winding, Lp is the transformer primary winding inductance. Designing the switching frequency between 60kHz to 70kHz by properly set the transformer parameters.

Protection Features

MT7963 provides various protections, such as LED short / open-circuit protection, CS resistor short-circuit protection, VCC under-voltage protection and over temperature protection, etc.

When the LED is open-circuited, MT7963 immediately triggers over voltage protection logic, ceasing switch toggling, the VCC voltage gradually drops and reaches to the under-voltage protection threshold, the system will be re-started.

When the LED is short-circuited, the switching frequency is only 5kHz, achieves low power consumption.

Over-Current Protection

MT7963 immediately turns off the power MOSFET once the voltage at CS pin exceeds 500mV. This cycle by cycle current limitation scheme prevents the relevant components, such as power MOSFET, transformer, etc. from damage.

PCB Layout

The following rules should be followed in MT7963 PCB layout:

Bypass Capacitor

The bypass capacitor on VCC pin should be as close as possible to the pin.

Ground Path

The ground path for capacitor C_{VCC} must connect to the chip ground directly, without any noise ground between them, such as SW capacitor ground, the power ground path for R_{CS}, etc.

Other small signal ground path also should connect to the chip ground pin. The chip ground and the SW capacitor ground should separately connect to the power ground path for current sense resistor R_{CS}. Keep the power ground path short and thick. Finally, all ground path connect to the bulk capacitor C_{BUS} ground terminal.

The Area of Power Loop

The area of main current loop should be as small as possible to reduce EMI radiation, such as the primary current loop, the snubber circuit and the secondary rectifying loop.

DRAIN pin

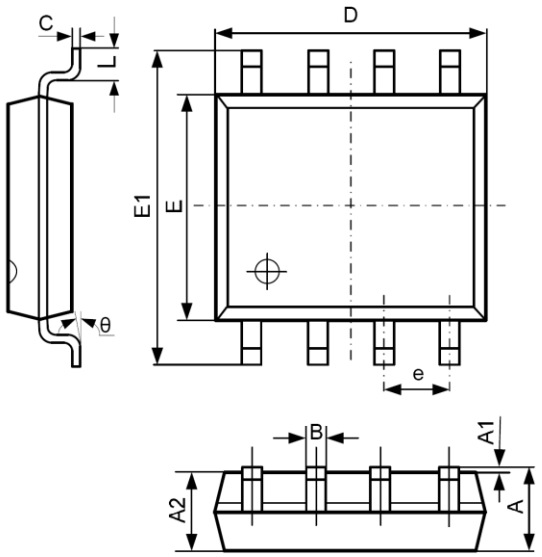
Increase the copper area of the drain terminal for thermal consideration. But Drain terminal is the major noise source of the system. Should be trade-off with thermal dissipation and noise reduction.

NC pin

NC pin must left floating to reserve enough space for creepage distance.

PACKAGE INFORMATION

SOP-8 PACKAGE OUTLINE AND DIMENSIONS



SYMBOL	DIMENSION IN MILLIMETERS		DIMENSION IN INCHES	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270 TYP		0.050 TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

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