High Precision PSR Constant Current LED Driver

FEATURES

- Built-in 650V power MOSFET
- PSR constant current control without secondary sense and feedback circuit
- No auxiliary winding for sensing and supplying
- Ultra low operating current for high efficiency
- Universal input voltage
- ±3% LED current accuracy
- Choice for maximum duty cycle and OVP voltage
- Precision OVP voltage for best LED open circuit protection
- LED short circuit protection
- CS resistor short circuit protection
- VCC under-voltage protection
- Over temperature compensation
- Available in SOP8 and DIP8 packages

APPLICATIONS

- Isolated solid state lighting
- GU10/E27 LED bulb, spot light
- Other LED lighting

DESCRIPTION

FT833xxx is a high precision primary-side feedback and regulation constant current driver for LED lighting applications. It is designed to work in inductor current discontinuous conduction mode (DCM) and is especially suitable for flyback converter under universal input. Under universal input voltage from 90V to 264V, the system output power for FT833Sxx, FT833Axx, FT833Bxx (SOP8) and FT833BD (DIP8) is recommended to be no more than 3W, 6W, 9W, and 12W, respectively.

The FT833xx integrates a 650V power MOSFET and eliminates secondary sense and feedback circuit. The loop compensation components are also removed while maintaining stability over all operating conditions. It uses a source drive architecture and special demagnetization sensing technology with very low operating current, the auxiliary winding for sensing the output and supplying the chip is therefore eliminated, resulting in low component counts and small system size.

With its highly accurate current sense method, the FT833xxx realizes ±3% accuracy of LED current along with excellent line and load regulation.

The multi-protection function of FT833xxx can greatly enhance the system reliability and safety. The FT833xxx features LED open/short circuit protection, CS resistor short circuit protection, over temperature compensation and VCC UVLO protection. The industry leading OVP voltage accuracy ensures the best LED open circuit protection.

TYPICAL APPLICATION CIRCUIT

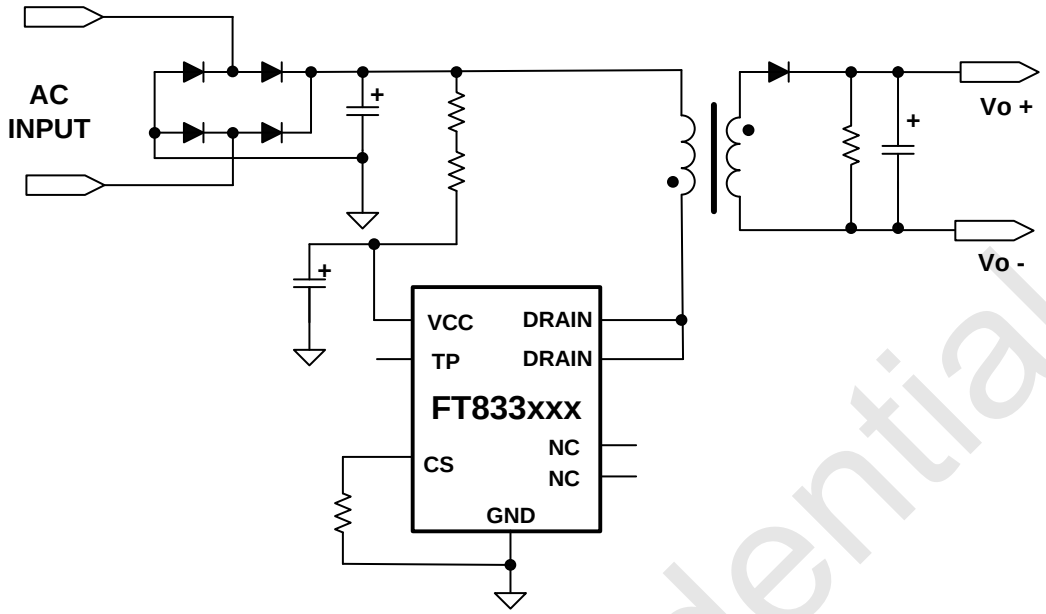


Figure 1. Typical Application Circuit

ABSOLUTE MAXIMUM RATINGS

VCC to GND……-0.3V to 20V
CS Pin Inputs and Outputs……. -0.3V to 6V
DRAIN Pin Inputs and Outputs……-0.3V to 650V
TP Pin Inputs and Outputs……-0.3V to 20V
Operating Temperature Range……-40℃ to +105℃
Junction Temperature……-40℃ to +150℃
Storage Temperature Range ……-60℃ to +150℃
ESD Protection HBM……2000V
ESD Protection MM…… 200V

*** Stresses exceed those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Functional operation of the device at conditions beyond those listed in the specification is not guaranteed. Prolonged exposure to extreme conditions may affect device reliability or functionality.**

PIN CONFIGURATION

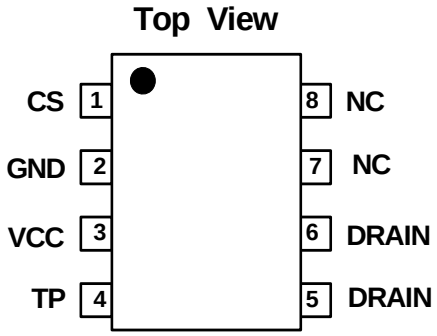


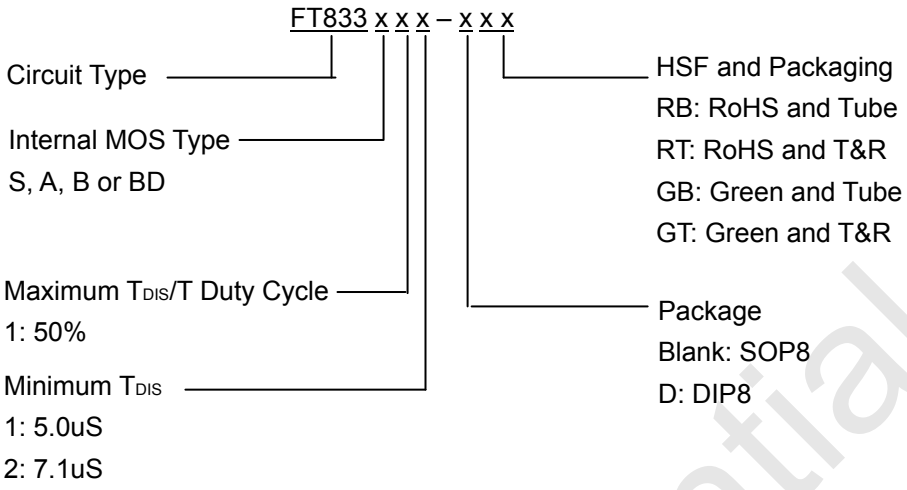
Figure 2. Pin Assignments

TERMINAL DESCRIPTION

No.	PIN	FUNCTION
1	CS	Current sense. This pin connects a current sense resistor to GND to detect the transformer primary current.
2	GND	Ground
3	VCC	Power supply
4	TP	Test point
5,6	DRAIN	Internal high voltage MOSFET Drain
7,8	NC	No connection, must be floating

Table 1

ORDERING INFORMATION



Internal MOS Type	Package	Maximum Output Power		Fovp	HSF	Packaging	Ordering Code
		85V-265V	170V-265V				
S	SOP8	3W	---	100KHz	RoHS	Tube	FT833S11-RB
						T&R	FT833S11-RT
					Green	Tube	FT833S11-GB
						T&R	FT833S11-GT
A	SOP8	6W	7W	100KHz	RoHS	Tube	FT833A11-RB
						T&R	FT833A11-RT
					Green	Tube	FT833A11-GB
						T&R	FT833A11-GT
B	SOP8	9W	10W	70KHz	RoHS	Tube	FT833B12-RB
					Green	T&R	FT833B12-RT
					Green	Tube	FT833B12-GB
					Green	T&R	FT833B12-GT
BD	DIP8	12W	13W	70KHz	RoHS	Tube	FT833BD-DRB
					Green	Tube	FT833BD-DGB
					RoHS	Tube	FT833BD-DRB
					Green	Tube	FT833BD-DGB

MARKING RULE

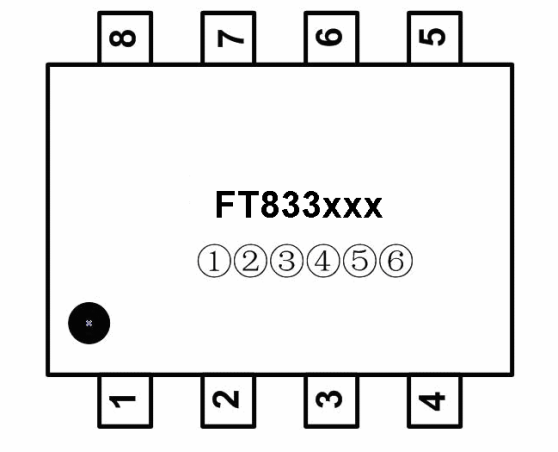


Figure 3. Marking Rule

①②③④⑤⑥ for internal reference

BLOCK DIAGRAM

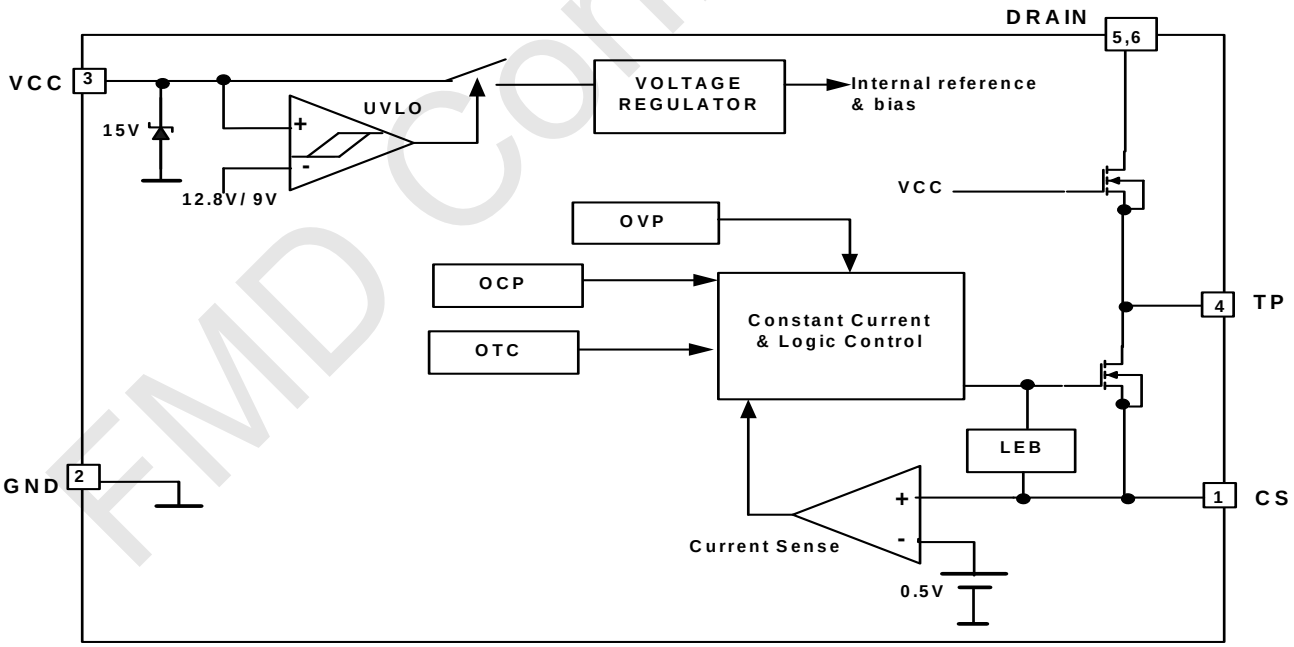


Figure 4. Block Diagram

ELECTRICAL CHARACTERISTICS

(Tj = 25°C, VCC = 14V, unless otherwise specified)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
SUPPLY VOLTAGE						
VCC_{ON}	Turn-on threshold	VCC rising		12.8		V
VCC_{OFF}	Turn-off threshold	VCC falling		9		V
VCC_{CLAMP}	VCC clamp voltage	Clamp current = 1mA		15.4		V
SUPPLY CURRENT						
Istart-up	Start-up current	Before turn-on, VCC= VCCon -1V		26		uA
Iq	Quiescent Current			110		uA
CURRENT SENSE						
V_{CS_TH}	Threshold voltage for peak current limit		485	500	515	mV
T_{LEB}	Leading edge blanking time for current sense			500		ns
T_{DELAY}	Switch off delay time			200		ns
SWITCH FREQUENCY						
F_{MIN}	Minimum working frequency			5		kHz
MAXIMUM DUTY CYCLE						
D_{MAX}	Maximum duty cycle			50		%
MOSFET (FT833Sxx)						
R_{DS_ON}	Static drain-source on-resistance	V_{GS}=10V,I_{DS}=0.5A		38		Ω
BV_{DSS}	Drain-source breakdown voltage	V_{GS}=0V,I_{DS}=250uA	650			V
I_{DSS}	Drain-source leakage current	V_{GS}=0V,V_{DS}=650V			10	uA
I_{DMAX}	Maximum Drain Current	Vd=6V	0.12	0.15		A
MOSFET (FT833Axx)						
R_{DS_ON}	Static drain-source on-resistance	V_{GS}=10V,I_{DS}=0.5A		15		Ω
BV_{DSS}	Drain-source breakdown voltage	V_{GS}=0V,I_{DS}=250uA	650			V
I_{DSS}	Drain-source leakage current	V_{GS}=0V,V_{DS}=650V			10	uA
I_{DMAX}	Maximum Drain Current	Vd=6V	0.35	0.42		A

MOSFET (FT833Bxx)						
R_{DS_ON}	Static drain-source on-resistance	V_{GS}=10V,I_{DS}=0.5A		6		Ω
BV_{DSS}	Drain-source breakdown voltage	V_{GS}=0V,I_{DS}=250uA	650			V
I_{DSS}	Drain-source leakage current	V_{GS}=0V,V_{DS}=650V			10	uA
I_{DMAX}	Maximum Drain Current	Vd=6V	0.73	0.83		A

Output Over Voltage Protection (FT833xx1)						
T_{DIS_MIN}	Minimum discharge time			5.0		uS
Fovp	OVP system frequency			100		KHz
Output Over Voltage Protection (FT833Bxx)						
T_{DIS_MIN}	Minimum discharge time			7.1		uS
Fovp	OVP system frequency			70		KHz
Over Temperature Compensation						
T_{TC}	Thermal compensation threshold			150		℃
T_{TC_HYS}	Thermal compensation hysteresis			25		℃

Table2

FUNCTIONAL DESCRIPTION

Startup Control

The start-up current in FT833xxx is designed to be as low as 26uA. The VCC capacitor is charged through the start-up resistor when the system is powered on. Once the VCC voltage reaches the start-up threshold, the FT833xxx starts to switch. The VCC voltage of FT833xxx is clamped at 15.4V, Due to the ultra-low operating current, the auxiliary winding is not needed to supply the IC.

Constant Current Control

Cycle-by-cycle current sense is adopted in FT833xxx, and the voltage on CS is compared with the internal 500mV reference voltage through the current sense comparator, the MOSFET is switched off when the voltage on CS reaches the threshold.

The primary peak current is given by: $I_{P\_PK} = \frac{500}{Rcs}(mA)$

The current in LED can be calculated by the equation: $I_{LED} = \frac{I_{P\_PK}}{2} * \frac{N_P}{N_S} * \frac{T_{DIS}}{T}$

Where,

N_P: primary winding turns of transformer,

N_S: secondary winding turns of transformer

I_{P_PK}: peak current in MOSFET

T_{DIS}/T: ratio of secondary discharge time and switching period, or duty cycle.

Leading Edge Blanking (LEB)

A turn on spike on CS pin will inevitably appear when the power MOSFET is switched on. At the beginning of each switching pulse, the current sense comparator is disabled for around 500ns to avoid premature termination. The power MOSFET cannot be switched off during the blanking period.

Operating Switching Frequency

The FT833xxx is designed to work in discontinuous conduction mode and no external loop compensation component is required while maintaining stability. The maximum switching frequency for normal operation is suggested to be set around 65KHz ~ 70KHz for FT833xx1 and around 52KHz for FT833Bxx. If the maximum frequency is set too high, it will limit the number of maximum series LED lamps. If set too low, the LED open circuit voltage will be too high.

The maximum and minimum switching frequency is limited in FT833xxx to ensure the stability of system.

The switching frequency can be set by the formula:

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

Where, L_P is the primary winding inductance of transformer.

Over Voltage Protection (OVP)

FT833xxx features the industry leading output OVP accuracy. Output LED open circuit will trigger the over-voltage protection logic and latch, the system stops switching immediately. VCC will be pulled down

and charged up again, the system works in a hiccup mode.

LED Short Circuit Protection

When LED short circuit is detected, the system works at minimum frequency (Fop=5KHz), so the power consumption is low.

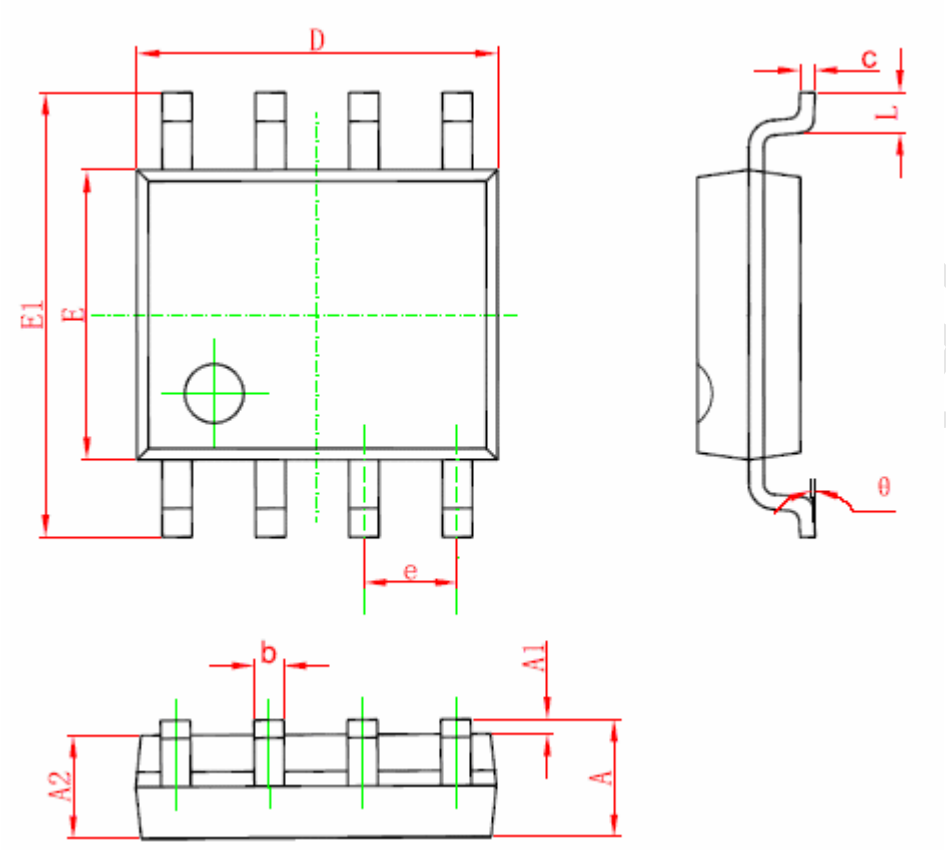
CS Resistor Short or Transformer Saturation

In these catastrophic fault conditions, the internal fast fault detection circuit will trigger and latch, the system stops switching immediately. VCC will be pulled down and charged up again, the system works in a hiccup mode.

Over Temperature Compensation

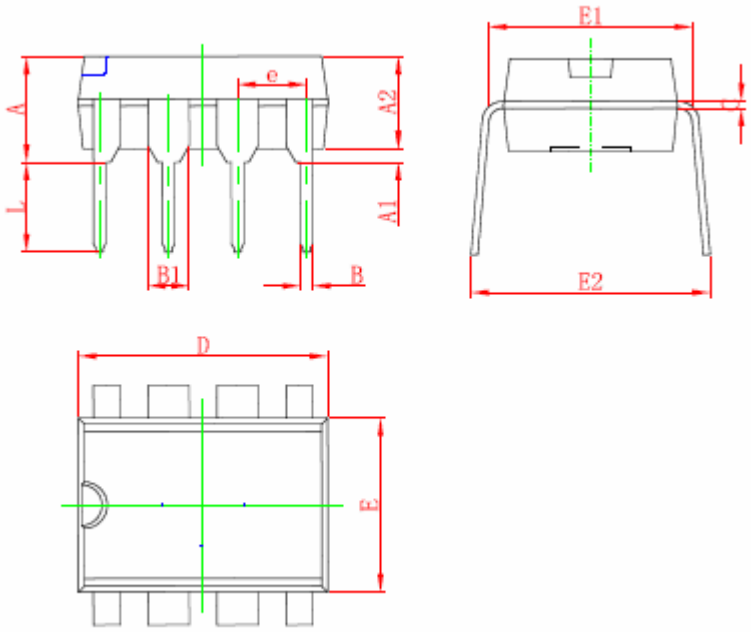
FT833xxx senses the die temperature after start up, and the thermal compensation threshold is set to 150℃ with a 25℃ hysteresis. When FT833xxx temperature rises and reaches the threshold, the output current will be reduced by half until the IC temperature falls 25℃ below the thermal compensation trigger point, at which point the output current will recover to 100% of its designed target.

SOP8 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions 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	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

DIP8 PACKAGE OUTLINE 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

Fremont Micro Devices (SZ) Limited

#5-8, 10/F, Changhong Building, Ke-Ji Nan 12 Road, Nanshan District, Shenzhen, Guangdong 518057
Tel: (86 755) 86117811
Fax: (86 755) 86117810

Fremont Micro Devices (Hong Kong) Limited

#16, 16/F, Blk B, Veristrong Industrial Centre, 34-36 Au Pui Wan Street, Fotan, Shatin, Hong Kong
Tel: (852) 27811186
Fax: (852) 27811144

Fremont Micro Devices (USA), Inc.

42982 Osgood Road Fremont, CA 94539
Tel: (1-510) 668-1321
Fax: (1-510) 226-9918

Web Site: http://www.fremontmicro.com/