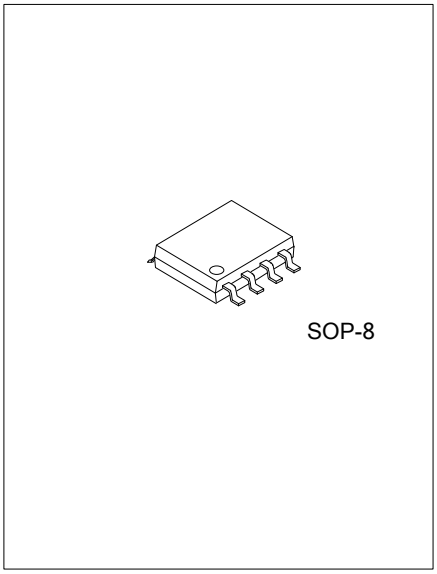
PSR & PFC LED DRIVER CONTROLLER



■ DESCRIPTION

The UTC **UCL5811** is a single-power stage, isolated and primary side offline LED lighting regulator which achieves high power factor.

The proprietary real-current control method can control the LED current accurately from the primary side information. It can significantly simplify the LED lighting system design by eliminating the feedback components and the opto-coupler.

The UTC **UCL5811** integrates active power factor correction and works in Quasi Resonance mode (QRM) in order to reduce the MOSFET switching losses. With a building in 700V start-up MOSFET, IC can eliminate the power loss caused by start-up resistors to provide a high efficiency solution for lighting applications. The external programmable line voltage compensation provides a more precise output current throughout the universal AC input voltage range. The leading edge blanking circuit on the CS/FB input removes the signal glitch and results in reduced external components and system cost. The multi-protection features of UTC **UCL5811** greatly enhance the system reliability and safety.

The UTC **UCL5811** V_{DD} and output over voltage protection; output short circuit protection, cycle-by-cycle current limit and secondary peak current protection on CS pin, V_{DD} UVLO andauto-restart and over-temperature protection.The driver output voltage is clamped at 18V to protect the external power MOSFET.

■ FEATURES

* Single stage PFC
* Primary side regulation without Secondary Feedback
* Quasi Resonance (QR) mode with Fly-back topology
* Real-Current control to meet accurate output current
* Very less components
* Programmable input AC compensation
* Leading Edge Blanking on CS/FB pin
* Building in hysteresis OTP
* V_{DD} over voltage protection
* Cycle by cycle current limiting on CS pin
* Secondary peak current protection on CS pin
* Output short to GND protection
* Output programmable over voltage protection
* FB and CS pins default protection

■ ORDERING INFORMATION

Ordering Number	Package	Packing
UCL5811G-S08-R	SOP-8	Tape Reel

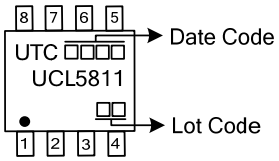
UCL5811G-S08-R

(1)Packing Type — (1) R: Tape Reel

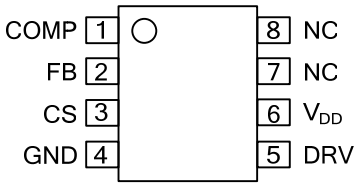
(2)Package Type — (2) S08: SOP-8

(3)Green Package — (3) G: Halogen Free and Lead Free

■ MARKING



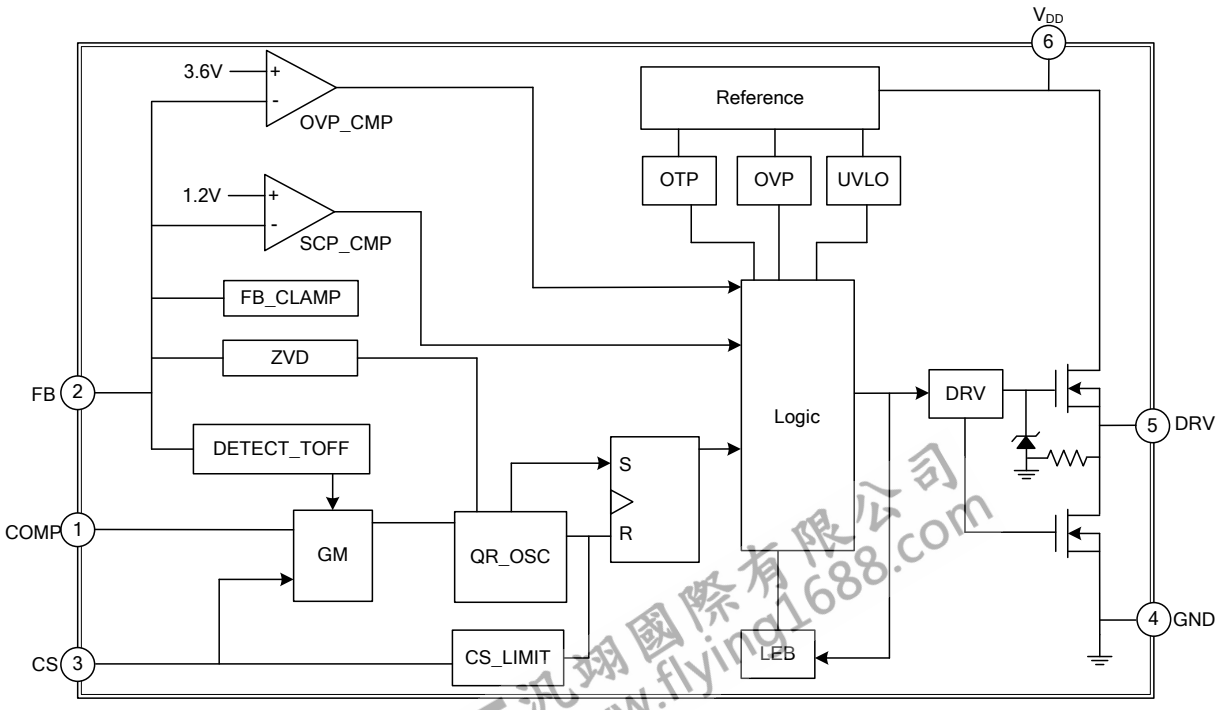
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	COMP	Loop compensation pin. Connect a RC network across this pin and ground to stabilize the control loop.
2	FB	Detect output diode zero current to regulate output current. Connected to a resistor divider for sensing the reflected voltage from auxiliary winding.
3	CS	Current sense pin, a resistor connects to sense the MOSFET current.
4	GND	Power Ground.
5	DRV	Output to drive the external power MOSFET, Maximum Voltage is internally clamped to 18V.
6	V_{DD}	Power Supply pin.
7,8	NC	No connect.

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING

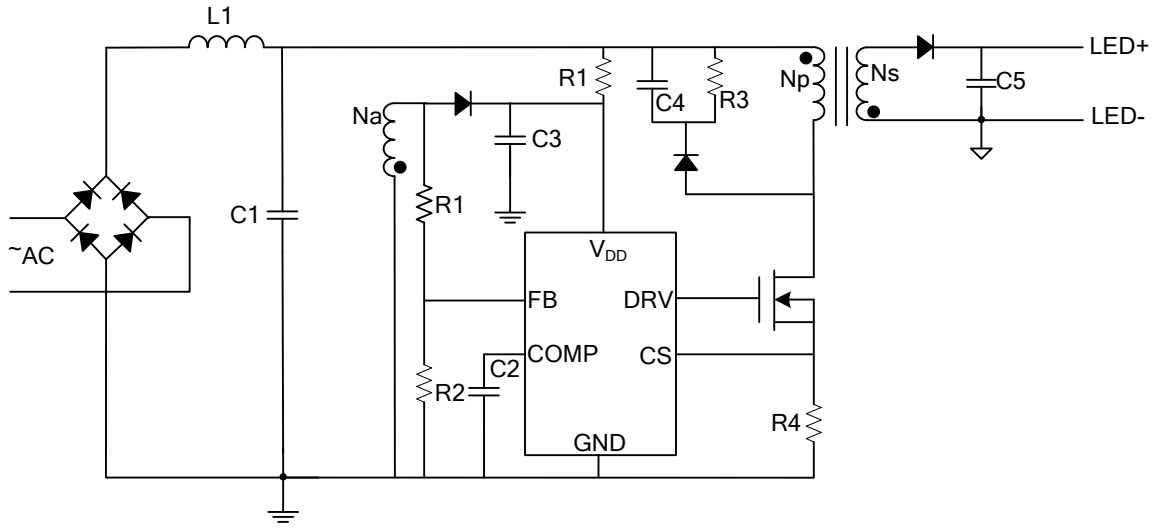
PARAMETER	SYMBOL	RATINGS	UNIT
Maximum supply voltage on V_{DD} pin	V_{DD}	28	V
Input Voltage to FB Pin	V_{FB}	-0.3 ~ 6	V
Input Voltage to CS Pin	V_{CS}	-0.3 ~ 6	V
Input Voltage to CMP Pin	V_{CMP}	-0.3 ~ 6	V
Maximum Operating Junction Temperature	T_J	+125	°C
Storage Temperature	T_{STG}	-55 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ ELECTRICAL CHARACTERISTICS (T_C=25°C and V_{DD}=15V unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{DD} Pin						
Operating Supply Current	I_{OP}	Gate open		1		mA
On Threshold Voltage	V_{DD_ON}			16		V
Off Threshold Voltage	V_{DD_OFF}			9		V
Logic Reset V_{DD} Threshold Voltage	V_{DD_RST}			6		V
V_{DD} Over Voltage Protection Level	V_{DD_OVP}			25		V
FB Pin						
FB Voltage When Sink Current	V_{FB_SINK}	2mA sink current		5		V
FB Voltage When Source Current	V_{FB_SOURCE}	4mA source current	-0.1	GND	+0.1	V
FB Zero Voltage Detect	V_{FB_ZVD}			0.2		V
FB Voltage When Output OVP	V_{FB_OVP}			3.6		V
FB Voltage When Trigger SCP	V_{FB_SCP}			1		V
CS Pin						
Cycle by Cycle Current Limited on CS	V_{CS}	FB=0V		1		V
Inner CS Voltage Vary with FB Source Current	$\Delta V_{CS}/\Delta I_{FB}$			TBD		mV/mA
Leading-Edge Blanking Time	T_{LEB}		300	400	500	ns
COMP Pin						
Reference Voltage for OTA Input	V_{REF}			0.2		V
COMP Maximal Sink Current	I_{COMP_SINK}			50		uA
COMP Maximal Source Current	I_{COMP_SOURCE}			10		uA
COMP Maximal Voltage	V_{COMP_MAX}			4.0		V
Oscillator						
Maximal Frequency	F_{OSC_MAX}			130		kHz
Minimal Frequency	F_{OSC_MIN}			30		kHz
DRV pin						
Rise Time	T_{Rise}	C_L=1nF		200		ns
Fall Time	T_{Fall}	C_L=1nF		100		ns
Over Temperature Drive Protection						
Over Temperature Protection	T_{OTP}			145		°C
OTP Hysteresis	T_{OTP_HYS}			20		°C

■ TYPICAL APPLICATION CIRCUIT



■ FUNCTIONAL DESCRIPTION

Operating Description

The UTC **UCL5811** is a primary side control offline LED controller that incorporates all the features for high performance LED lighting. LED current can be accurately controlled with the real current control method form the primary side information. Active Power Factor Correction (PFC) is included to eliminate the unwanted harmonic noise injected onto the AC line.

Startup

During start-up, the current can charge up the V_{DD} hold capacitor. the turn-on and turn on and turn-off thresholds of UTC **UCL5811** are approximately 15V and 9V respectively. The 6V hysteresis voltage is implemented to prevent shutdown from a voltage dip during start-up.

Quasi Resonance mode (QRM)

During the external power MOSFET on time (T_{ON}) the rectified input voltage is applied across the primary side inductor (L_M) and the primary current increases linearly from zero to the peak value (I_{PK}). When the external power MOSFET turns off, the energy stored in the inductor forces the secondary side diode to be turn-on, and the current of the inductor begins to decrease linearly from the peak value to zero. When the current decreases to zero, the parasitic resonant of inductor and all the parasitic capacitance makes the power MOSFET drain-source voltage decrease, this decreasing is also reflected on the auxiliary winding. The zero-current detector in FB pin generates the turn on signal of the external MOSFET when the FB voltage is lower than 0.2V and ensures the MOSFET turn on at a valley voltage.

As a result, there are virtually no primary switch turn-on losses and no secondary diode reverse-recover losses. It ensures high efficiency and low EMI noise.

Active Power Factor Correction (APFC)

UTC **UCL5811** is designed with quasi-resonance and constant on time (T_{ON}) to achieve high power factor under normal operation. The on time of UTC **UCL5811** vary with input AC voltage $V_P\sin\omega t$ and load condition and its value is constant basically because of very large loop compensation capacitance on COMP pin. According to following equations.

$$I_{L-peak}=\frac{Vp\sin\varpi t}{L_m}\times T_{on} I_{L-avg}=\frac{Vp\sin\varpi t}{2*L_m}\times T_{on}{}^{2}\times\frac{1}{T_{OSC}}$$

The peak current I_{L_peak} and average current I_{L_avg} of transformer will be shaped as AC input sinusoid too because (T_{ON}) and f_{OSC} both are constant and then high power factor can be achieved.

Real Current Regulator without Secondary Feedback

The proprietary real current control method allows the UTC **UCL5811** to accurately control the secondary side LED current from the primary side informatio. The output LED mean current can be calculated approximately as:

$$I_{OUT}=\frac{1}{2}\times\frac{1}{5*R_{CS}}\times V_{REF}\times\frac{N_p}{N_s}$$

Where I_{OUT} is the secondary output current of LED, V_{REF} is the inner reference voltage. N_P is number of turns of primary winding and N_S is number of turns of the secondary winding.