Boost-mode LED Driver Specific DC-DC Controller

GENERAL DESCRIPTION

The UCT4395 is a 7.5V DC/DC controller designed specifically for LED Driver in Boost mode. With auxiliary circuitry the operating voltage range can be expanded as high as desired.

The UCT4395 works with an externally connected power N-MOSFET device to construct current mode fixed frequency architecture to regulate the output LED current, which is measured through an external current sense resistor.

The UCT4395 includes under-voltage lockout, soft start and over-temperature protection.

The UCT4395 is available in SOT23-6 package.

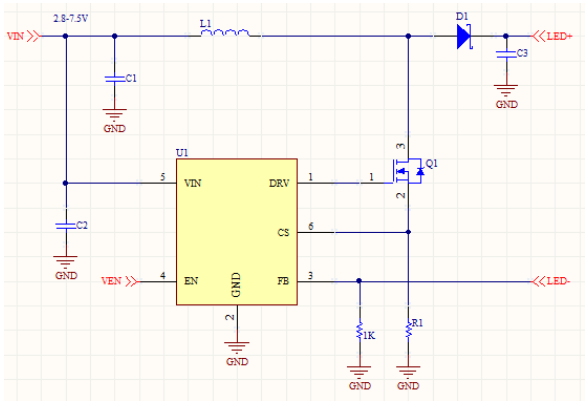
FEATURES

- Wide Operating Voltage: 3.0~7.5V, expandable with auxiliary circuitry
- Up to 90% Efficiency
- 150KHz Fixed Switching Frequency
- 100mV Feedback Voltage
- PWM Dimming
- Peak Current Limit
- UVLO
- SOT23-6 Package

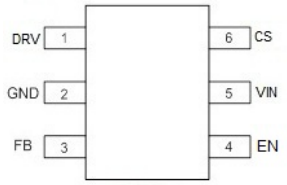
APPLICATIONS

- LED Lighting

TYPICAL APPLICATION CIRCUIT



PIN ASSIGNMENT



PIN DESCRIPTION

PIN NO	SYMBOL	DESCRIPTTION
1	DRV	Drive Output
2	GND	Ground
3	FB	Feedback input
4	EN	Chip Enable Input
5	VIN	Power Supply Input.
6	CS	Current Sense Input

ABSOLUTE MAXIMUM RATINGS (Note 1)

SYMBOL	ITEMS	VALUE	UNIT
V_{IN}	Input Voltage	-0.3～8.0	V
V_{IO}	All Other I/O Pins	GND-0.3 to VDD+0.3	V
P_{DMAX}	Power Dissipation	0.8	W
P_{TR1}	Thermal Resistance， SOP8, Θ_{JA}	150	℃/W
T_J	Junction Temperature	-40~125	℃
Tstg	Storage Temperature	-55 to 150	℃
Tsolder	Package Lead Soldering Temperature	260℃, 10s	

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Recommended Operating Range indicates conditions for which the device is functional, but do not guarantee specific performance limits. Electrical Characteristics state DC and AC electrical specifications under particular test conditions which guarantee specific performance limits. This assumes that the device is within the Operating Range. Specifications are not guaranteed for parameters where no limit is given, however, the typical value is a good indication of device performance.

RECOMMANDED OPERATING RANGE

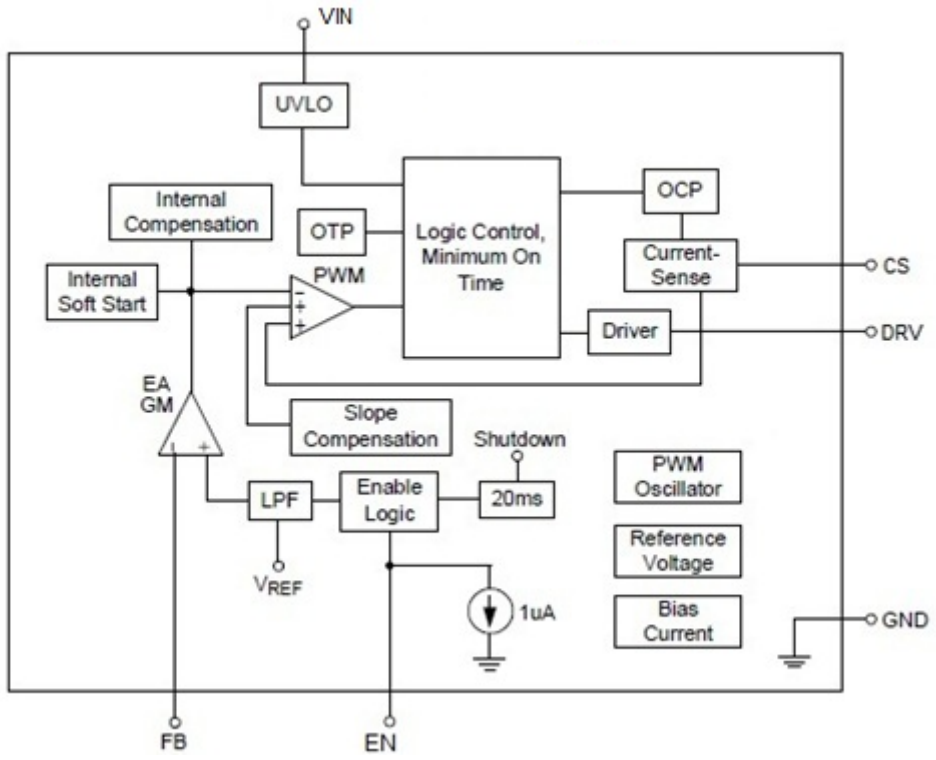
SYMBOL	ITEMS	VALUE	UNIT
V_{IN}	VIN Supply Voltage	3.0 to 7.5	V
T_{OPT}	Operating Temperature	-40 to +85	℃

ELECTRICAL CHARACTERISTICS

The following specifications apply for V_{IN}= V_{EN} =3.6V T_A=25 °C, unless specified otherwise.

SYMBOL	ITEMS	CONDITIONS	MIN	TYP	MAX	UNIT
V_{IN}	Input Voltage		3.0		7.5	V
VULVO	UVLO Voltage			2.9		V
UVHYS	UVLO Hysterisis			250		mV
V_{FB}	FB Pin Voltage		95	100	105	mV
I_{SHDN}	Shutdown Current			0.1	1	μA
I_Q	Quiescent Current	V_{FB}=0.4V		200	500	μA
F_{SW}	Switching Frequency			150		KHz
D_{MAX}	Maximum Duty Cycle	V_{FB}=0V	95	97		%
VCS	CS Threshold Voltage			200		mV
V_{EN_H}	EN Minimum High Level		1.5			V
V_{EN_L}	EN Maximum Low Level				0.4	V
I_{EN}	EN Input Bias Current			0.1	1	μA
fDIM	Dimming frequency		100		2K	Hz
R_{DRV}	DRV On Resistance			1		Ω
T_{SS}	Soft Start Time	V_{IN} Power On		5		mS

SIMPLIFIED BLOCK DIAGRAM



OPERATION DESCRIPTIONS

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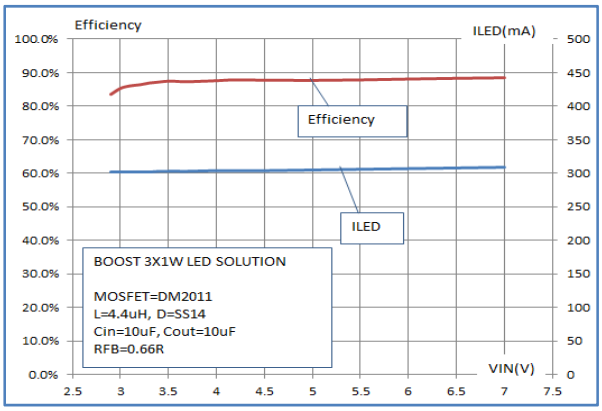
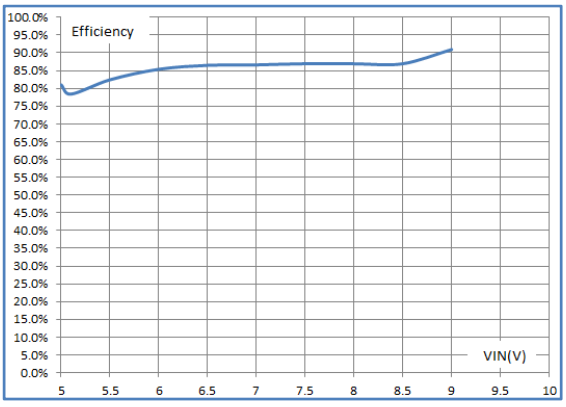
TYPICAL OPERATING CHARACTERISTICS

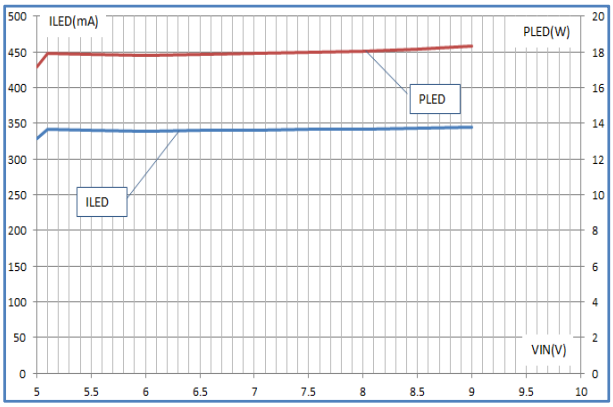
Tested under TA=25°C, unless otherwise specified

1. Efficiency and ILED for Boost Driving 3x1W LED Solution

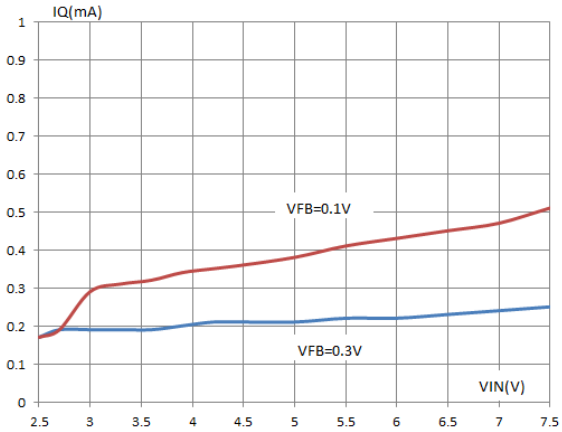


2. Efficiency and ILED for Boost Driving 18x1W LED Solution

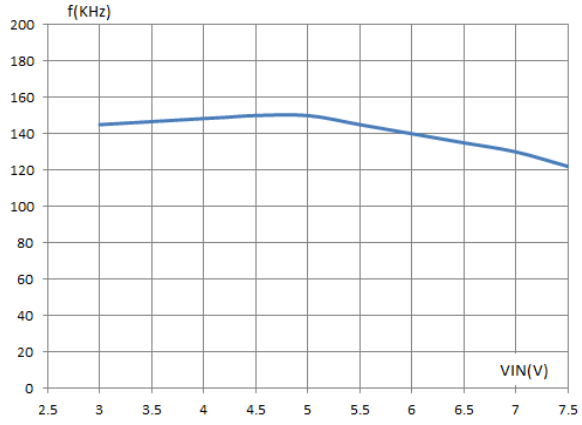




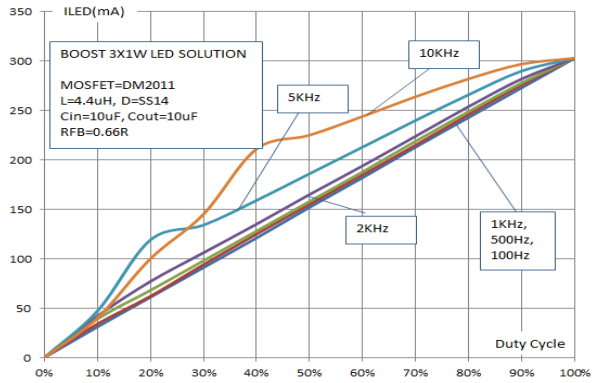
3. IQ



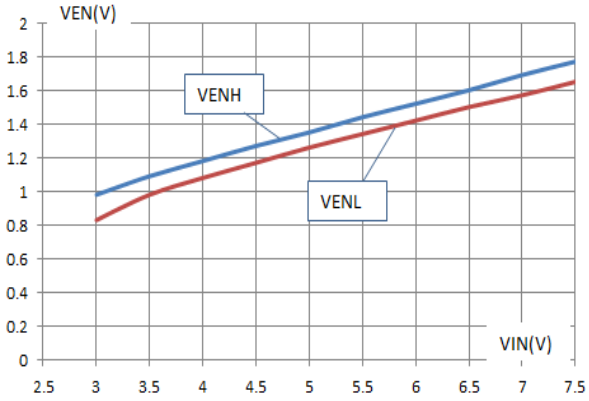
4. Frequency



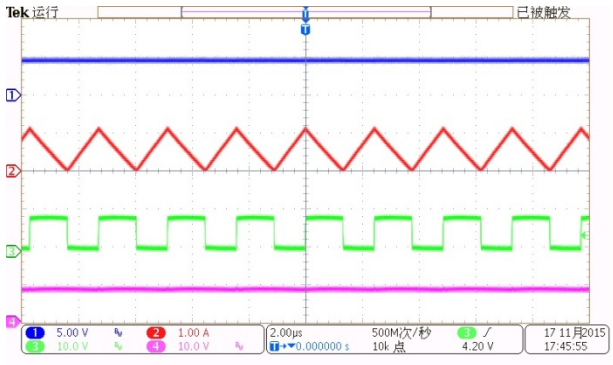
5. PWM Dimming Effect



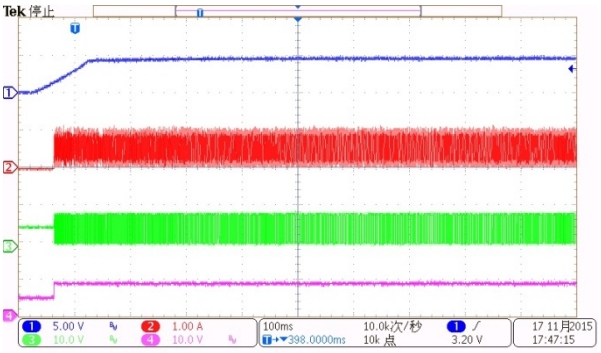
6. VEN vs VIN



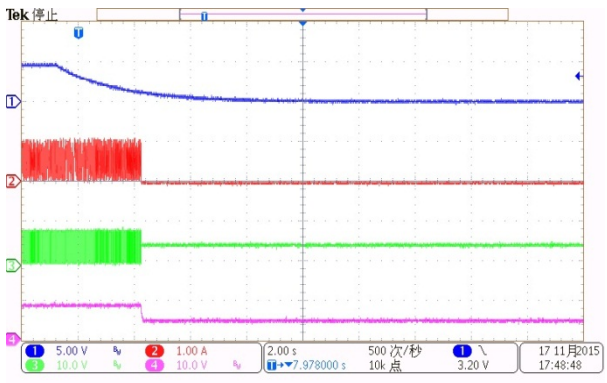
7. DRV and SW Waveform



8. Stat-up



9. Shutdown



Note: (1)Channel(BLUE) is VEN, Channel2(RED) is I of Inductor, Channel3(GREEN) is VSW, Channel4(PINK) is VLED+ (2)For guaranteed effects the DIMMING frequency is suggested within 2KHz.

APPLICATION INFORMATION

- **MOSFET Selection**

The MOSFET is very important to the entire system regarding output power, efficiency and start-up voltage. Normally, the parameters such as VDS, RDSON and VTH are the most considered ones:

- VDS must exceed the output Voltage.
- RDSON affects both the efficiency and the maximum Inductor current.
- VTH affects the start-up voltage. For single-cell Li-ion Supplied systems, VTH shall not be over 3V.

- **Inductor Selection**

A 4.7~10μH inductor is recommended for most applications. If high efficiency is a critical requirement, a low DCR inductor should be selected. The inductor's saturation current rating should also exceed the peak input current, especially for high load current application.

- **Capacitor Selection**

Small size ceramic capacitors are ideal for UCT4395 application. A 47uFx2 input capacitor and a 1uF output capacitor are suggested for most applications. For better voltage filtering, ceramic capacitors with low ESR are recommended.

- **Diode Selection**

Using a Schottky diode is recommended in UCT4395 applications because of its low forward voltage drop and fast reverse-recovery time. The current rating of the Schottky diode should exceed the peak current of the boost converter. The voltage rating should also exceed the target output voltage.

- **LED Current Setting**

LED Current is determined by the feedback resistor. The feedback voltage is internally set at 100mV. For accurate LED Current settings, precision 1% resistors are recommended. The formula is shown below:

ILED = VFB/RFB

For ILED=350mA, RFB is 0285Ω.

- **Current Limiting**

The current flow through inductor as charging period is detected by a current sensing circuit through the CS pin. As the value comes across the current limiting threshold, the external N-MOSFET will be turned off so that the inductor will be forced to leave charging stage and enter discharging stage. Therefore, the inductor current will not increase over the current limiting threshold. The threshold voltage VCS is 200mV, thus the Peak Current is:

Ipk = VCS/RCS

- **PWM Dimming**

The UCT4395 is PWM Dimmable by simply applying a PWM signal to the EN pin. The suggested PWM frequency is within 2KHz.

- **Power Sequence**

In order to assure the normal soft start function for suppressing the inrush current the input voltage should be ready before EN pulls high.

- **Soft-Start**

The function of soft-start is made for suppressing the inrush current to an acceptable value at the beginning of power on. The UCT4395 provides a built-in soft-start function by clamping the output voltage of error amplifier so that the duty cycle of the PWM will be increased gradually in the soft-start period.

- **UVLO**

The Under-Voltage Lock Out function disables the UCT4395 from malfunctioning when the power supply is too low, and recovers when the power supply goes high.

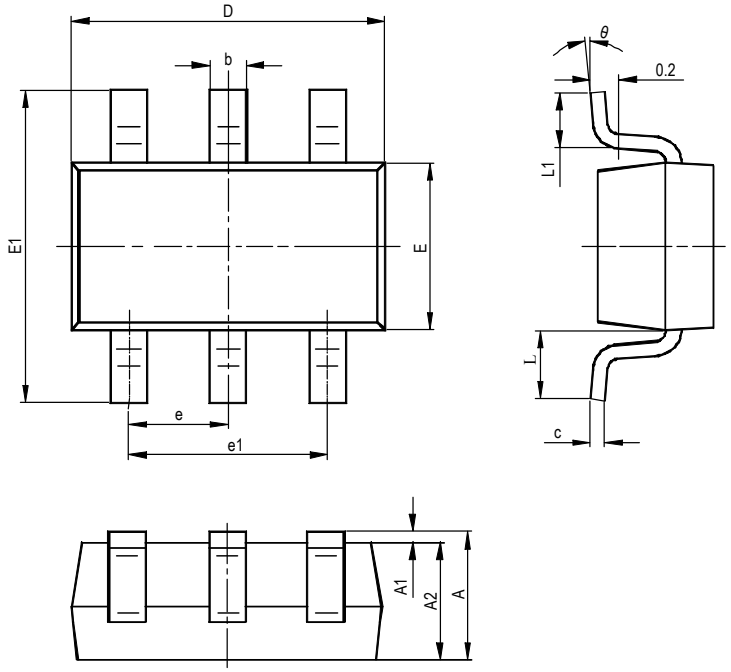
- **Layout Considerations**

PCB layout is very important for high frequency switching regulators in order to keep the loop stable and minimize noise. For best performance of the UCT4395, the following guidelines must be strictly followed.

- Input and Output capacitors should be placed close to the IC and connected to ground plane to reduce noise coupling.
- The GND pin should be connected to a strong ground plane for heat sinking and noise protection.
- Keep the main current traces as possible as short and wide.
- The DRV node is with high frequency voltage swing. It should be kept in a smallest area.
- Place the CS (on CS pin) and feedback components (on FB pin) as close as possible to the IC and keep away from the noisy devices.

PACKAGE OUTLINE

SOT23-6



SYMBOL	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°