2MHz High-Brightness LED Drivers with High-Side Current Sense

General Description

KT1350 is a continuous mode inductive step-down converter, designed for driving single or multiple series connected LEDs efficiently from a voltage source higher than the LED voltage. The device operates from an input supply between 5.5V and 36V. A high-side current-sense resistor adjusts the output current and a dedicated PWM input (DIM) enables a wide range of pulsed dimming. The KT1350 is well suited for applications requiring a wide input voltage range. The high-side current sense minimizes the number of external components while delivering an LED current with ±5% accuracy. A hysteretic control algorithm ensures excellent input-supply rejection and fast response during load transients and PWM dimming. The KT1350 features a 20% inductor current ripple and operates up to 2MHz switching frequency. The KT1350 operates over the -40℃ to+125℃ automotive temperature range and is available in SOT23-6 package.

Applications

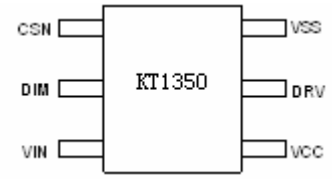
·Architectural, Industrial, and Ambient Lighting

·Automotive RCl, DRL, and Fog Lights

·MR16 and other LED Bulbs

·Indicators and Emergency Lighting

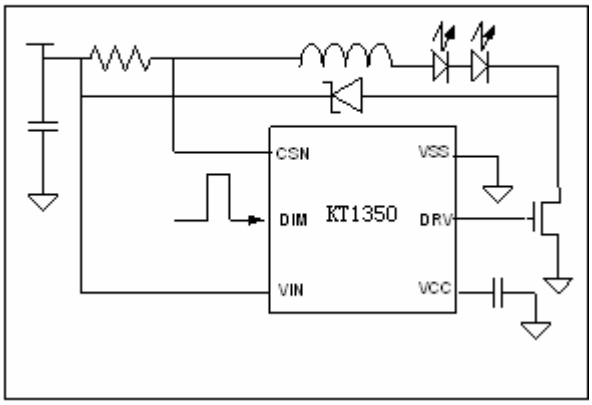
Pin configuration



Features

- High-side current sense
- Dimming control input
- Hysteretic control: No compensation
- Up to 2MHz switching frequency
- ±5% current accuracy
- Adjustable constant output current
- 5.5V to 36V input voltage range
- Over 35W output power
- 5V, 2mA On-board regulator
- -40 to 125℃ Operating Temperature Range
- SOT 23-6 Package

Typical Operating Circuit



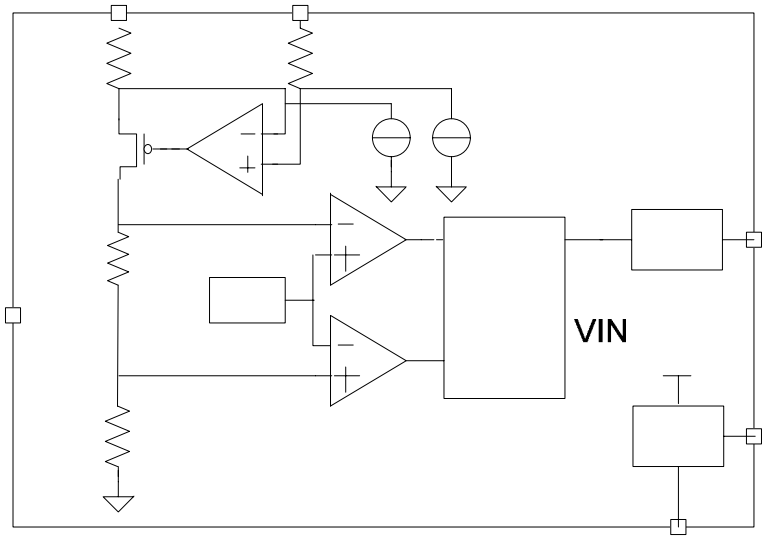
Pin Description

Number	Pin Name	Function Description
1	CSN	current-sensing input
2	DIM	dimming control input
3	VIN	power supply input
4	VCC	LDO output
5	DRV	power MOSFET gate drive
6	VSS	ground

Absolute Maximum Ratings

Symbol	Description	value	unit
VMAX	Maximum voltage on IC pins	40	V
IMAX	Maximum current on IC pins(except VIN，VCC，DRV)	20	mA
T_{OPR}	Operating temperature range	-40 ~ +125	℃
T_{STG}	Storage temperature range	-65 ~ +150	℃
PMAX	Continuous Power Dissipation	1454	mW
V_{ESD}	ESD voltage for human body model	2000	V

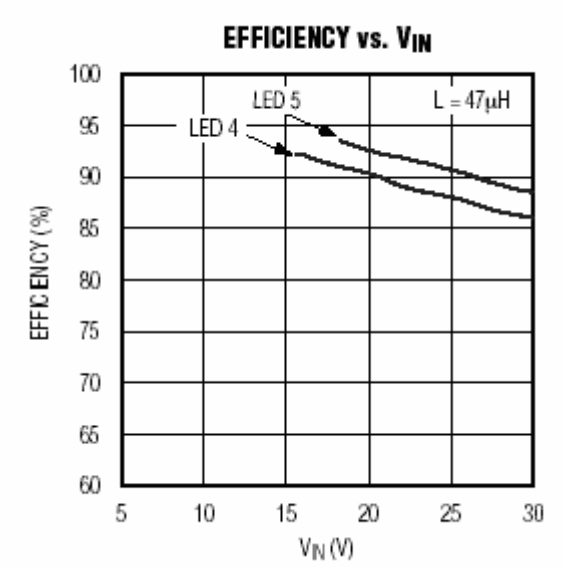
Block Diagram



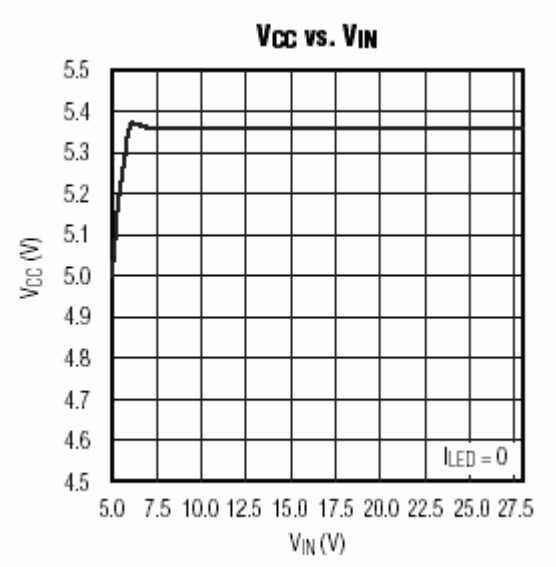
Electronic Characteristics

Symbol	Parameter	Test condition	Min	Typ	Max	Unit
VIN	Input voltage range		5.5		36	V
fsw	Switching frequency				2	MHz
IGND	Ground current	DRV open			5	mA
IIN	Supply current	VDIM < 0.6V			400	uA
UVLO	Under-voltage lockout	VIN = VCSN = VDIM, VIN falling from 6V, VDRV < 0.5V		4.5	5.0	V
HYSUV	Under-voltage lockout hysteresis			0.5		V
Sense Comparator						
VSNSHI	Sense voltage threshold high	(VIN - VCSN) rising from 0V until VDRV <0.5V		220		mV
VSNLO	Sense voltage threshold low	(VIN - VCSN) falling from 0.26V until VDRV >(VCC - 0.5V)		180		mV
tDPDH	Propagation delay to output high			80		ns
tDPDL	Propagation delay to output low			80		ns
ICSN	Current sense input current			5		uA
CS-HYS	Current sense threshold hysteresis			40		mV
Dimming control						
fDIM	Maximum DIM frequency				20	KHz
VIH	DIM input-voltage high	VCSN = VIN, increase DIM until VDRV > (VCC - 0.5V)	2.8			V
VIL	DIM input-voltage low	VCSN = VIN, decrease DIM until VDRV < 0.5V			0.6	V
DIM-HYS	DIM hysteresis			200		mV
tDIMON	DIM turn-on time	DIM rising edge to VDRV = 0.5 x VCC, CDRV = 1nF		100		ns
tDIMOFF	DIM turn-off time	DIM falling edge to VDRV = 0.5 x VCC, CDRV = 1nF		100		ns
	DIM input leakage high	VDIM = VIN			10	uA
	DIM input leakage low	VDIM = 0			1	uA
LDO						
VCC	LDO output voltage	IVCC = 0.1mA to 5mA, VIN = 5.5V to 36V	4.5		5.5	V
	Load regulation	IVCC = 0.1mA to 5mA, VIN = 12V		4		Ohm
	Line regulation	VIN = 6V to 36V, IVCC = 5mA		11		mV
PSRR	Power supply rejection ratio	VIN = 12V, IVCC = 2mA, fIN = 10kHz		-35		dB
tSTRAT	Regulator startup time	VCC = 0 to 4.5V		350		us

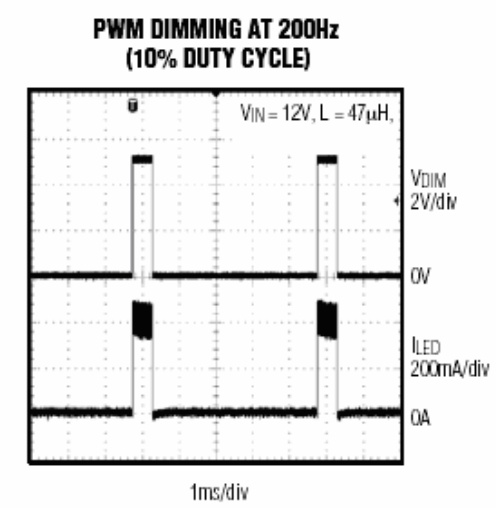
Typical efficiency

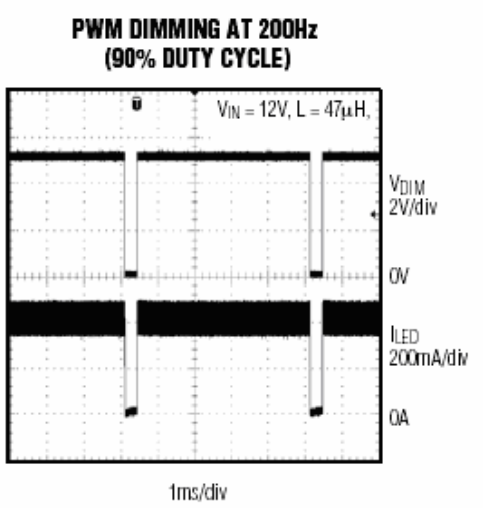


LDO output



PWM dimming control





Application Information

1. **Set Output Current**

The KT1350 features a programmable LED current using a resistor connected between VIN and CSN. Use the following equation to calculate output current:

$$ILED = \frac{0.2}{RSENSE}$$

2. **Inductor Value Selection**

The value of inductor effects switching frequency. Smaller inductor value leads to a higher switching frequency. Use the following equation to determine the operating frequency:

$$f_{SW} = \frac{(VIN - n \times VLED) \times n \times VLED \times RSENSE}{VIN \times \Delta V \times L}$$

Where n=number of LEDs, VLED=forward voltage drop of one LED, and $\Delta V = (VSNSHI - VSNSLO)$.

3. **Dimming Control**

The KT1350 allow dimming with a PWM signal at the DIM pin. A logic level below 0.6V at DIM forces the KT1350 DRV output low, turning off the LED current. To turn the LED current on, the logic level at DIM must be at least 2.8V. If dimming function is not wanted, then connect DIM to VCC.

4. **MOSFET Selection**

The breakdown voltage of MOSFET should be higher than the maximum input power supply voltage. Selecting smaller RON makes higher efficiency.

5. **LDO Output**

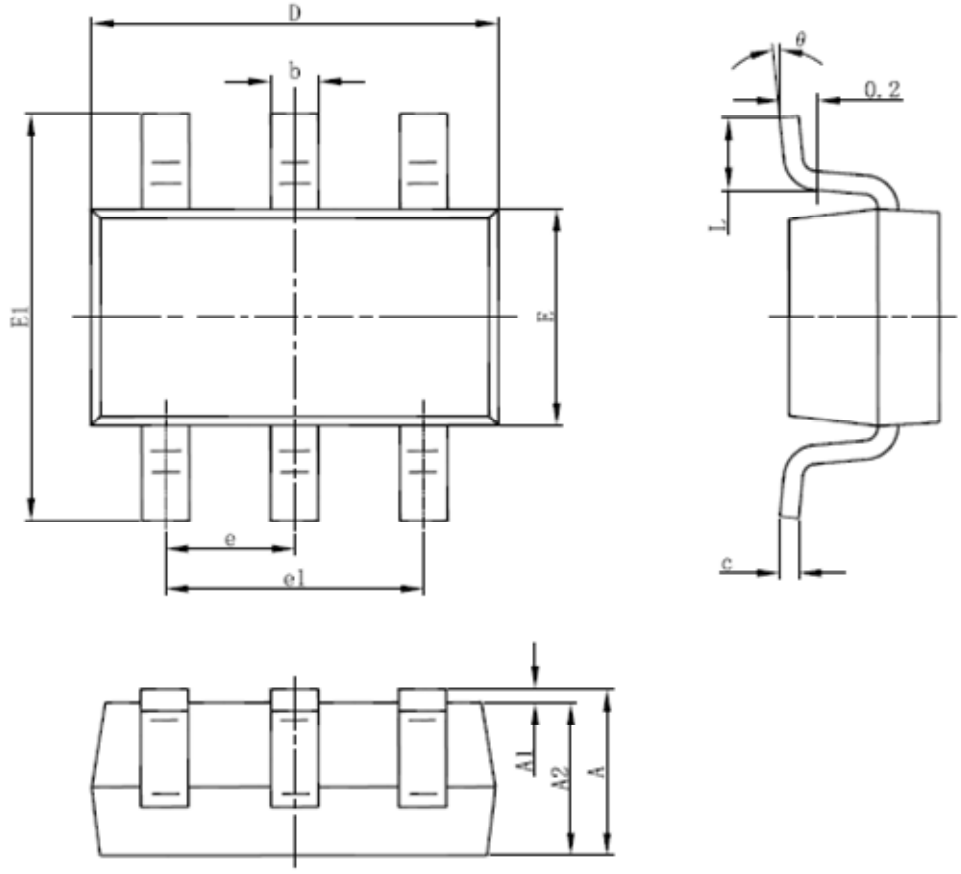
VCC is the output of a 5V regulator of sourcing 5mA. Bypass VCC to GND with a 1uF capacitor.

6. **Input Capacitor Filter**

Bypass VIN to GND with a 47uF capacitor. The voltage range of capacitor should be higher than the maximum input power supply voltage.

Package Information

SOT-23-6L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In 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	0.500	0.012	0.020
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	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°