KEC

SEMICONDUCTOR
TECHNICAL DATA

KAB3405T
BICD LINEAR INTEGRATED CIRCUIT

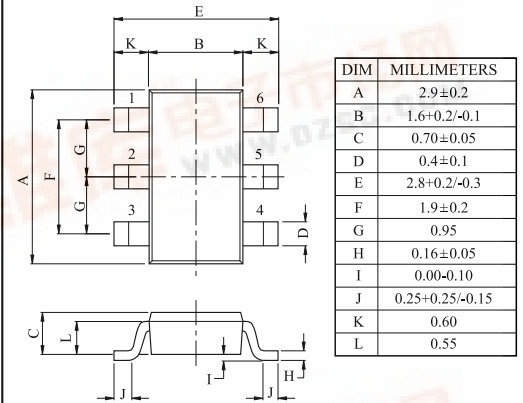## Step Up Type DC/DC Converter for White LED

KAB3405T is a high efficient Step-Up Type DC/DC Converter specially designed for constant current drive of White LED. This IC can drive 2-10 white LEDs connected series using a Li-ion Battery. This IC contains N-ch MOS-FET Transistor for Coil-Switching, and LED Current (I_F) is set with an external resistor.

Features

· Variable LED Current I_F is set with a external resistor
  : 20 mA (Typ.) @ $R_{SENS} = 15\,\Omega$
· High Efficiency
· Output Over Voltage Shutdown
· Built in output over voltage protect circuit.
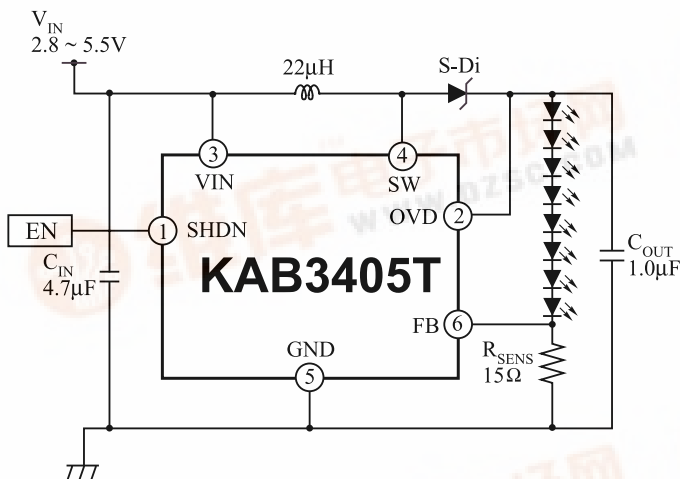· Switching Frequency : 1.0 MHz (Typ.)

Applications

· Back light white LEDs in LCD of PDA, Cellular Phone
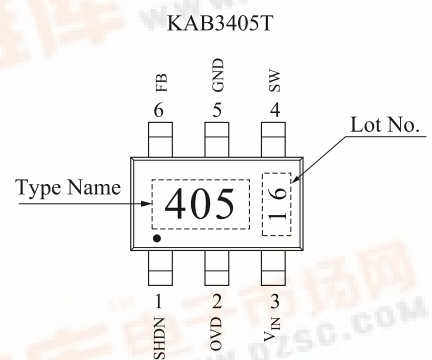· Handy Terminal Equipment.

DIM	MILLIMETERS
A	2.9±0.2
B	1.6+0.2/-0.1
C	0.70±0.05
D	0.4±0.1
E	2.8+0.2/-0.3
F	1.9±0.2
G	0.95
H	0.16±0.05
I	0.00-0.10
J	0.25+0.25/-0.15
K	0.60
L	0.55

TS6

Basic Application Circuit

Marking

KAB3405T

Block Diagram
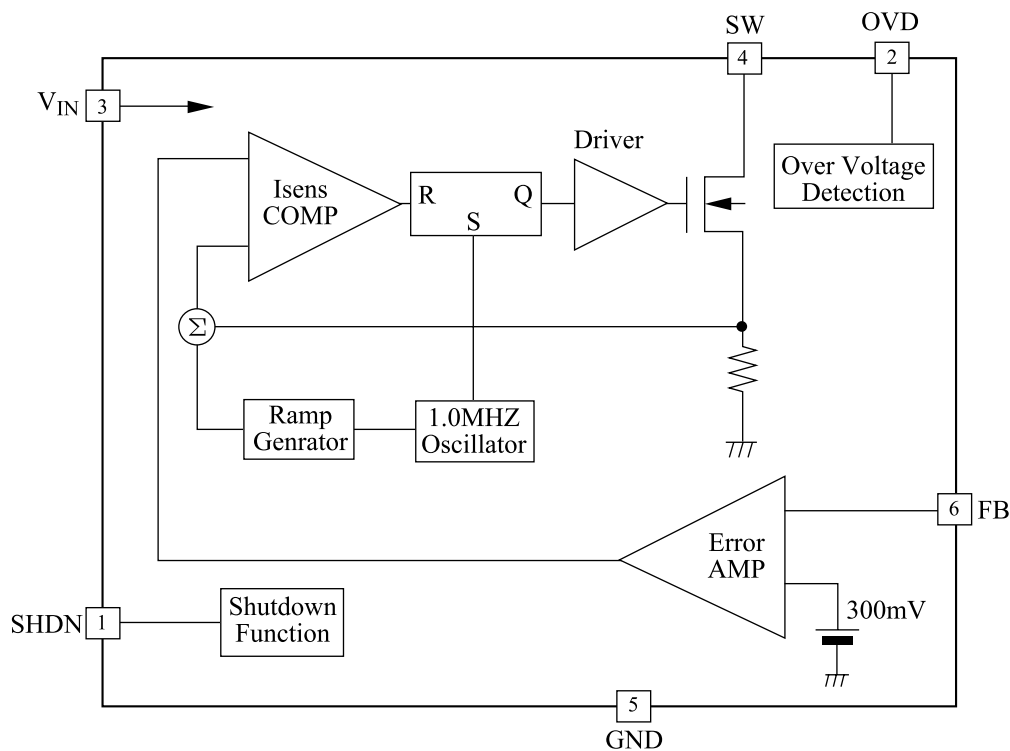
Pin Function

Pin No.	Symbol	Function Description
1	SHDN	Voltage-Input Terminal for IC-Enable / Disable.
2	OVD	Over Voltage Detection Terminal. IC Switching Operation is disabled with detection over voltage. If the voltage returns to detection level or less, Operation is enabled again.
3	V_{IN}	Supply Voltage Input Terminal. (2.8V to 5.5V)
4	SW	Switch Terminal for DC/DC Converter. Nch MOSFET Built-In.
5	GND	Ground Terminal.
6	FB	LED I_F Setting Resister Connecting Terminal.

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MAXIMUM RATINGS (Ta = 25°C if without notice)

Characteristics	Symbol	Ratings	Unit
Power Supply Voltage	V_{IN}	-0.3 to +6.0	V
Input Voltage	$V_{IN(SHDN)}$	-0.3 to $+V_{IN}$ + 0.3	V
Switching Terminal Voltage	$V_{O(SW)}$	-0.3 to 40	V
Switching Terminal Current	$I_{O(SW)}$	1500	mA
Power Dissipation	P_D	0.41 (Device)	W
		0.47(on PCB)Caution 2	
Thermal Resistance	$R_{th(j-a)}$	300(Device)	°C/W
		260(on PCB)	
Operation Temperature Range	T_{opr}	-40 to +85	°C
Storage Temperature Range	T_{stg}	-55 to +150	°C
Maximum Junction Temperature	T_j	150	°C

Caution 2: Power Dissipation must be calculated with subtraction of 3.8 mW/°C from Maximum
Rating with every 1°C if Topr is upper 25°C. (on PCB)

ELECTRICAL CHARACTERISTICS (Ta = 25°C, V_{IN}=2.8V to 5.5V if without notice)

Characteristics	Symbol	Test Condition	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}	-	2.8	-	5.5	V
Operating Consumption Current	$I_{N(ON)}$	V_{IN}=3.6V, R_{SENS}=15Ω	-	0.6	0.9	mA
Quiescent Consumption Current	$I_{N(Off)}$	V_{IN}=3.6V,V_{SHDN}=0V	-	0.5	1.0	μA
SHDNTerminal 'H' Level Input Voltage	V_{SHDNH}	-	1.3	-	V_{IN}	V
SHDN Terminal 'L' Level Input Voltage	V_{SHDNL}	-	0	-	0.4	V
SHDN Terminal Current	I_{SHDN}	V_{IN}=3.6V,V_{SHDN}=3.6V or 0V	-	0	1.0	μA
Integrated MOS-Tr Switching requency	f_{OSC}	V_{IN}=3.6V,V_{SHDN}=3.6V	0.77	1.0	1.43	MHz
Switching Terminal Leak Current	$I_{OZ(SW)}$	-	-	0.5	1	μA
FB Terminal Feedback Voltage (V_{FB})	V_{FB}	V_{IN}=3.6V, R_{SENS}=15Ω, Ta=25°C, L=22μH	285	300	315	mV
		V_{IN}=4.2V, R_{SENS}=15Ω, Ta=25°C, L=22μH	285	300	315	mV
FB Terminal Line Regulation	V_{FB}	V_{IN}=3.6V center V_{IN}=3.0 to 5.0V	-5	-	5	%
FB Terminal Current	I_{FB}	V_{IN}=3.6V, V_{SHDN}=3.6V, V_{FB}=300mV	-	0.02	-	μA
OVD terminal Voltage	V_{OVD}	-	35	38	39.5	V
OVD Terminal Leakage Current	I_{OVD}	V_{OVD}=30V	-	0.5	1	μA

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Protection in LED opened condition

  The operation with OVD terminal is available for the protection in case LED Circuit opened.

When the voltage of OVD terminal is over 38V (typ.), Nch MOS switching operation is disabled in the IC. When the voltage of OVD terminal drops below 38V (typ.), Nch MOS switching operation becomes available again.

  If load of LED is detached, Nch MOS switching operation is disabled with detection of boost circuit voltage and the IC is protected from unexpected over voltage.

Setting of external Capacitor

  recommended values are
  $$C_{IN} = \text{Over } 2.2 \ (\mu F), \ C_{OUT} = \text{Over } 1.0 \ (\mu F)$$

The recommended values of the capacitors depend on the control of brightness. For details, please see the item "Control of brightness" from the next page.)

These recommended values reduce fluctuation of input current to up accuracy of brightness.

  <Please see after page-6>
  The capacitor value must be considered for gain enough accuracy of brightness with reduction of noise from
  Input current changing.

Setting of External Inductor Size

  Please select the inductor size with referring this table corresponding to each number of LEDs.

  Recommendation for the case that LED current I_F = 20 mA

LEDs	Inductor Size	Note
2 - 5	$10 \mu H$	LED current I_F = 20 mA
Over 6	$22 \mu H$	

Setting of I_F

  Resistance connects between R_{SENS} pin and GND.
  The average current is set by this R_{SENS} value and average current are obtained by the following equation.

  $$I_F[mA] = \frac{300[mV]}{R_{SENS}[\Omega]}$$

Current Value error is within $\pm 5\%$.

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Current Dimming Control

Recommended Brightness Control Circuits are 3 types.
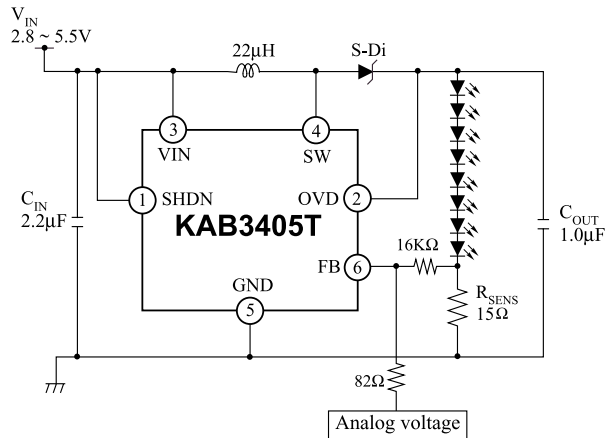
1) Input analog voltage to FB terminal

I_F can be adjusted with Analog voltage input to FB terminal.

This method is without repeating IC ON/OFF, and no consider holding rash current.

[Notice]

· LED current value goes ever 100% of current set with R_{SENS}, if the input voltage is between 0 V to 300 mV(typ)

<<Recommended application>>



2) Input PWM signal with filtering to FB terminal

I_F can be adjusted with filtering PWM signal using RC filter indicated in recommended circuit, because the PWM signal can be regard as analog voltage after filtering.

This method is without repeating IC ON/OFF, and no need to consider holding rash current.

[Notice]

· LED current value goes over 100% of the current set with R_{SENS}, if the input voltage after filtering is between 0 V to 300 mV (typ).

<<Recommended application>>
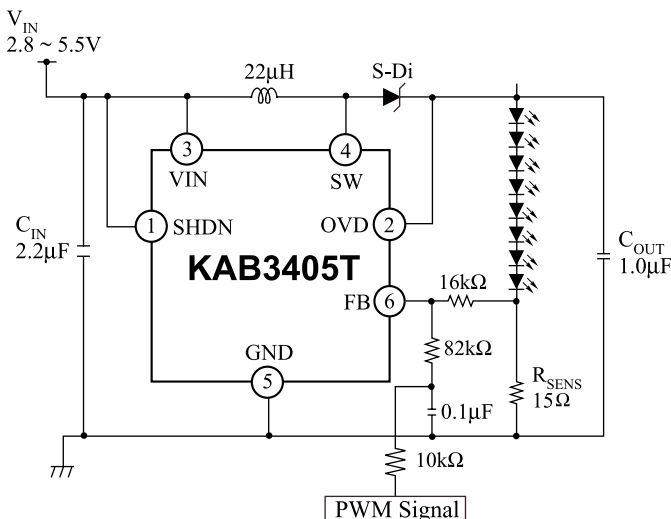
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3) Input Logic signal

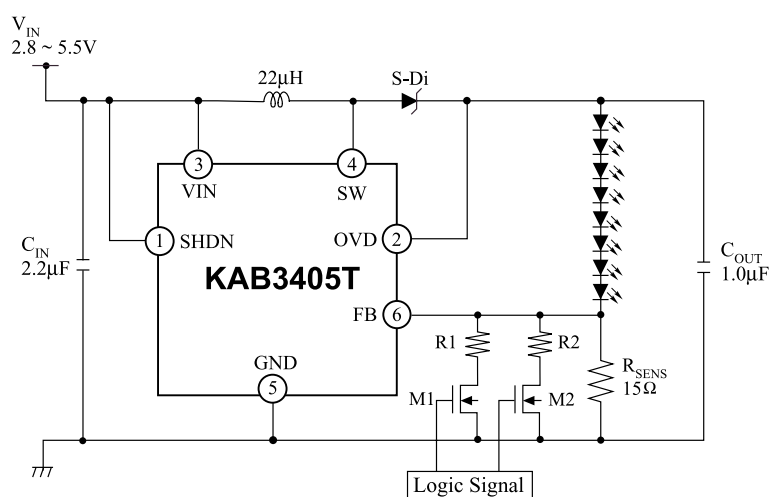I_F can be adjusted with Logic signal input as indicated in recommended circuit.

The resistor connected the ON-state Nch MOS Drain and R_{SENS} determines I_F.

Average of setting current Io (mA) is next, approximately.

I_F=(300 [mV]/Sum of resistor value [Ω])

$$I_F \, [mA] = \frac{300[mV]}{\text{Sum of resistor value } [\Omega]}$$

<<Recommended application>>

M1	M2	LED Current
OFF	OFF	$\dfrac{300[mV]}{R_{SENS}[\Omega]}$
ON	OFF	$300[mV] \times \dfrac{R_{SENS}[\Omega] \; R1[\Omega]}{R_{SENS}[\Omega]+ R1[\Omega]}$
OFF	ON	$300[mV] \times \dfrac{R_{SENS}[\Omega] \; R2[\Omega]}{R_{SENS}[\Omega]+ R2[\Omega]}$
ON	ON	$300[mV] \times \dfrac{R_{SENS}[\Omega] \; R1[\Omega] \; R2[\Omega]}{R_{SENS}[\Omega] R1[\Omega] + R_{SENS}[\Omega] R2[\Omega] + R1[\Omega] R2[\Omega]}$