

INK1101

5~120mA Low Saturation Constant Current LED Driver With PWM Dimming

Description

INK1101 is a single channel, linear constant current LED driver, the driving current can be programmed from 5~120mA with an external resistor R_{FB} . The chip operation voltage range is 3.3~5.5V. the as low as 0.3V current programming voltage and 200mV low saturation voltage make INK1101 provide stable current under wide load, maximizing the cascading LED lamps amount. For dimming applications 4 external components are suggested, and for none dimming applications only 3 external components are required. The chip internal includes high precision band gap reference, 5.5V shunt regulator, over temperature protection and low dropout constant current driver.

INK1101 provides users dimming function for dimming applications such as full color driver, stage light and LCD back lighting. INK1101 output current is controlled by the voltage at DIM pin, when DIM voltage is high, the driver is on, when DIM voltage is low, and the driver is off. When no dimming is needed, DIM pin can be left floating or connected to VCC.

INK1101 is built-in over temperature protection function. When the chip junction temperature rise up above 150°C, the output is off, when junction temperature falls below 130°C, the output is on.

INK1101 is available in small size SOT23-5 package, and the operation temperature range is -40~85°C

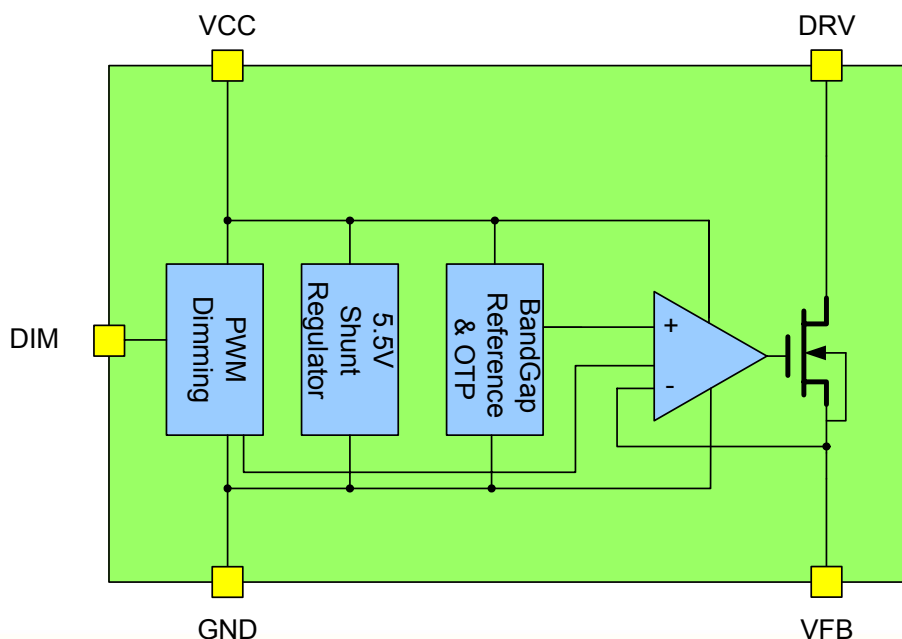
Features & Benefits

- ◆ High load regulation, output current varies little vs. load voltage variation.
- ◆ The Maximum output current can be up to 120mA
- ◆ Output current can be programmed with an external resistor.
- ◆ Chip supply current is low to 300uA, enhances the LED efficacy.
- ◆ Built in Over Temperature Protection (OTP)
- ◆ Output current deviation between chips: $\pm 5\%$

Applications

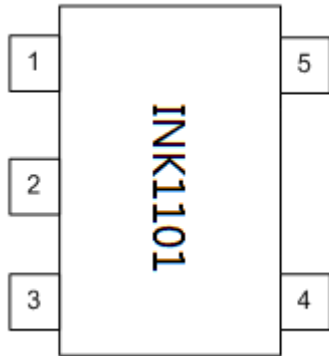
- ◆ Constant Current LED Modules
- ◆ Constant Current LED Strips
- ◆ LED Lighting
- ◆ LED backlighting for LCD
- ◆ LED Stage light

Blocks

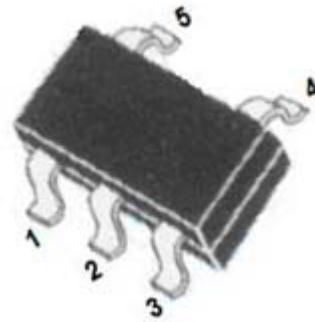


Ordering Information

Part No.	Package	Remarks
INK1101ST	SOT23-5	SOT23-5 (3000pcs/reel)

PIN Assignment


SOT23-5



SOT23-5

PIN Name	PIN No.	Functions
VFB	1	LED current programming PIN, reference voltage is 0.3V
GND	2	Ground
DIM	3	PWM dimming control
VCC	4	IC power supply
DRV	5	LED current sink

Maximum Ratings

Parameter	Symbol	Ref.	Unit
VCC	VCC	-0.3~5.8	V
DIM Voltage	V_{DIM}	-0.3~VCC+0.3	V
VFB Voltage	V_{FB}	-0.3~6	V
DRV Voltage	$V_{DRV, I_{LED}=0}$	-0.3~32	V
Continuous Output Current	$V_{DRV}=1V, I_{OUTC}$	120	mA
Thermal Resistance (SOT89-5)	$R_{th(j-a)2}$	187.5	°C/W
Operation Ambient Temperature	TA	-40~85	°C
Operation Junction Temperature	TJ	125	°C
Storage Temperature.	TS	-55~150	°C
ESD (HBM)	ESD(HBM)	6000	V

Note: Operating Conditions exceed the maximum ratings may cause the device permanent damaged. Long time exposing the device in the ambient exceed the maximum conditions may degrade the chip reliability.

Electrical Parameters (VIN=12V @ 25°C unless specified otherwise)

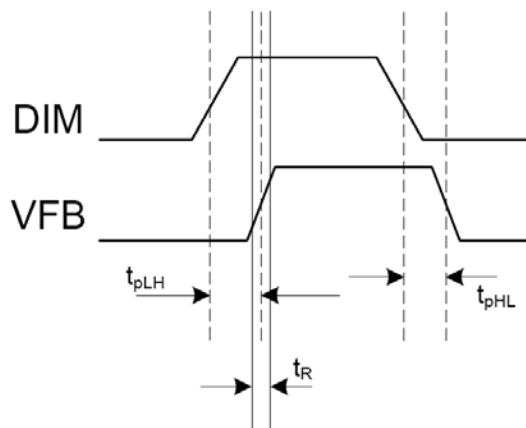
Parameters	Symbol	Condition	Min	Typ.	Max.	Unit
Chip power supply	V_{CC}	Without current limiting resistor	3.3	-	5.7	V
Shunt Regulator	V_{CC}	R1=5K	5.3	5.5	5.7	V
Chip Current	I_{CC}	DIM none connection, $V_{CC}=5V$, $R_{FB}=5\Omega$, $V_{DRV}=2V$	-	300	600	μA
DIM logic level	V_{DIMH}		$0.7V_{CC}$	-	-	V
	V_{DIML}		-	-	$0.3V_{CC}$	V
	V_{DIMH}		-	$0.1V_{CC}$	-	V
Output current	I_{OUTH}	$R_{FB}=5\Omega$, DIM floating, $V_{DRV}=6V$	57	60	63	mA
	I_{OUTL}	$R_{FB}=5\Omega$, DIM grounded, $V_{DRV}=6V$	-	-	0.1	μA
Output Saturation voltage	V_{SAT}	$I_{OUT}=120mA$	-	0.1	0.3	V
Current Set Voltage	V_{FB}	$V_{DRV}=2V$, $R_{FB}=5\Omega$	285	300	315	mV
Line Regulation	$\%/dV_{CC}$	$R_{FB}=5\Omega$, $V_{DRV}=2V$, $V_{CC}=3.3\sim 5.5V$	-	0.1	0.3	%
Load Regulation	$\%/dV_{DRV}$	$R_{FB}=5\Omega$, DIM 悬空, $V_{DRV}=0.4\sim 5V$	-	0.1	0.3	%
OTP temperature ^①	T_{OTP}		-	150	-	$^{\circ}C$
OTP release temp. ^①	T_{OTPR}		-	125	-	$^{\circ}C$

Note:

① , Guaranteed by design, not tested data.

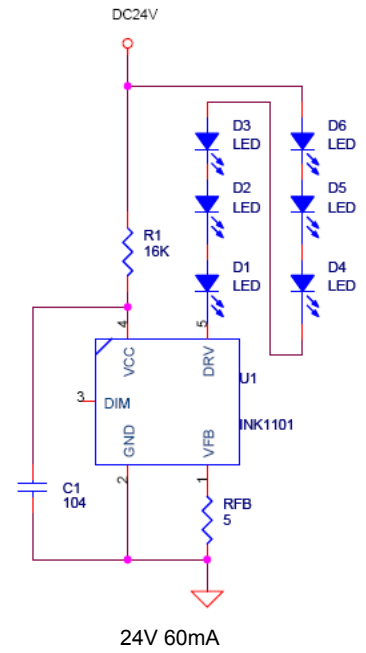
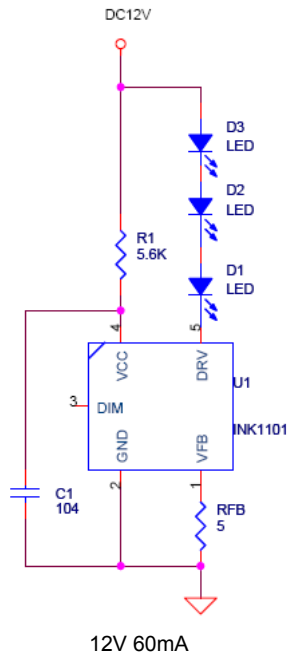
Switching Characteristics ($V_{CC}=5V$ @ $25^{\circ}C$ unless specified otherwise)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	
Delay time (low to high)	DIM-VFB	$V_{CC}=5V$; $V_{DRV}=2V$; $R_{FB}=5\Omega$	0.2	0.5	1	μS	
Delay time (high to low)	DIM-VFB		0.05	0.1	0.2	μS	
DIM pulse width	DIM		t_W (OE)	1.5	-	-	μS
Output current raising time			t_R	0.1	0.2	0.4	μS
Output current falling time			t_F	0.1	0.2	0.4	μS

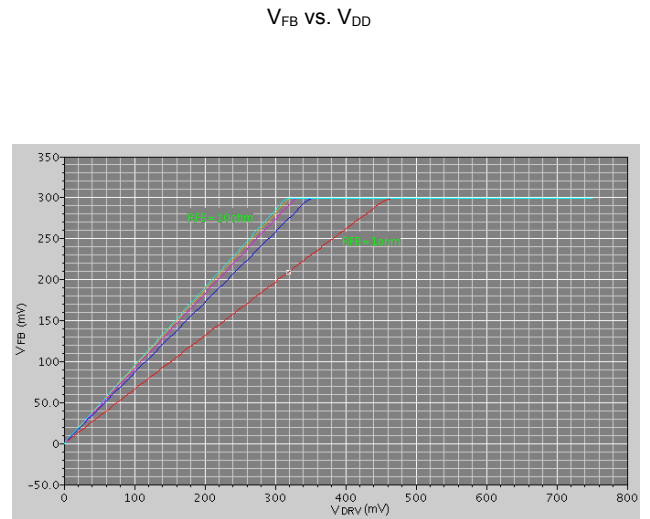
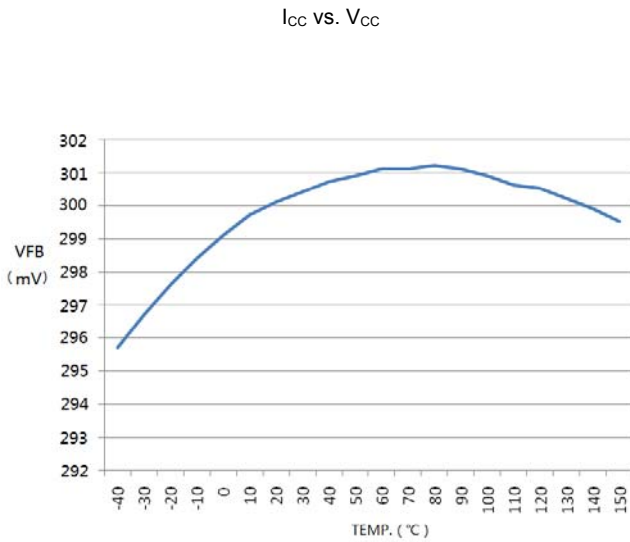
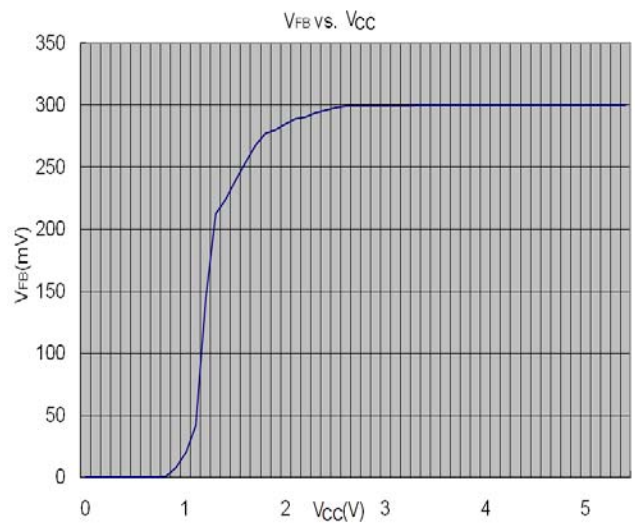
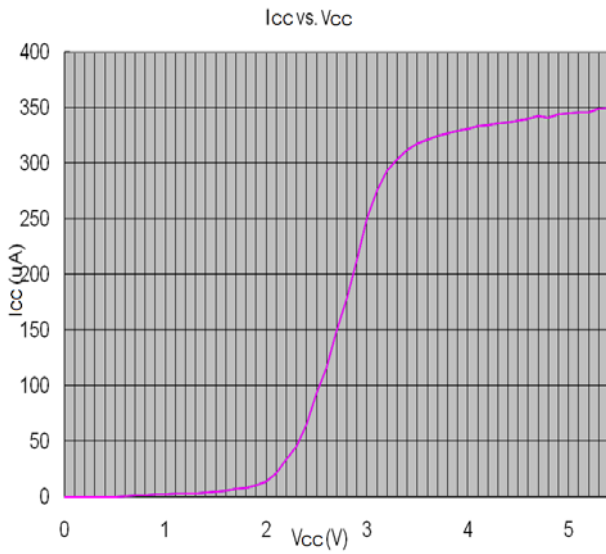


Switching Characteristics

Typical Applications Circuit

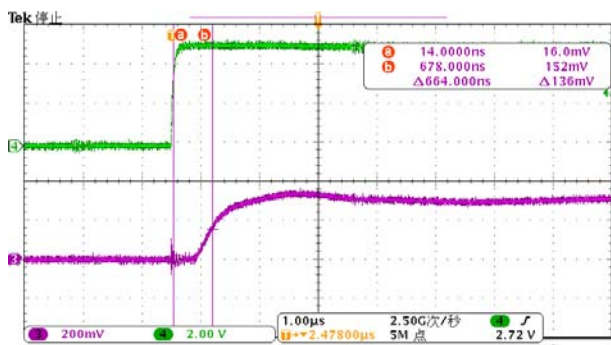


Curves & Waveforms

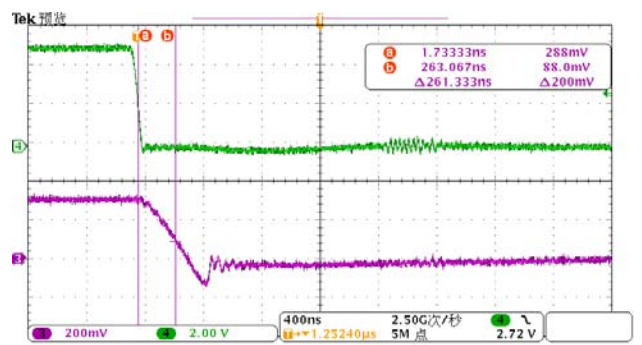


V_{FB} vs temp.

V_{FB} vs. V_{DRV}



t_{PLH} Test



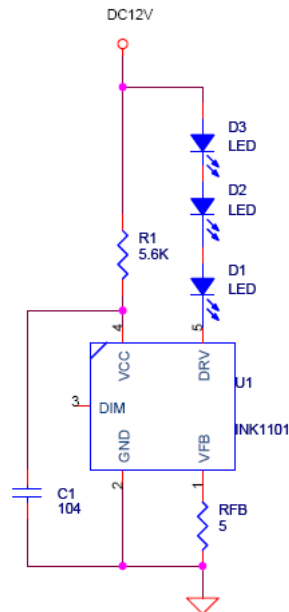
t_{PHL} Test

Applications

Typical Application

When INK1101 is used for constant current LED modules and strips, only 3 external components are needed: 2 resistors and one ceramic capacitor. One resistor R_{FB} for LED current programming, the other one resistor R1 for INK1101 shunt regulator current, and one capacitor for regulator stabilization. Resistor R1 enhances the lamp reliability when lamp hot-swap, or reverse battery connected.

The LED current programming voltage is low to 0.3V, and the saturation voltage of the high voltage pass MOSFET is only 0.1 V when the LED current is set to 120mA, thus 0.4V voltage on DRV pin is enough for this application. This feature makes INK1101 suitable for LED modules and LED strips.



Constant LED Light Source with PWM Dimming

LED Current Programming

LED current is set by an external resistor connected between VFB pin and GND. The reference voltage is 0.3V, the maximum LED current can be up to 120mA, LED current is derived by the following equation:

$$I_{LED} = V_{FB} / R_{FB}$$

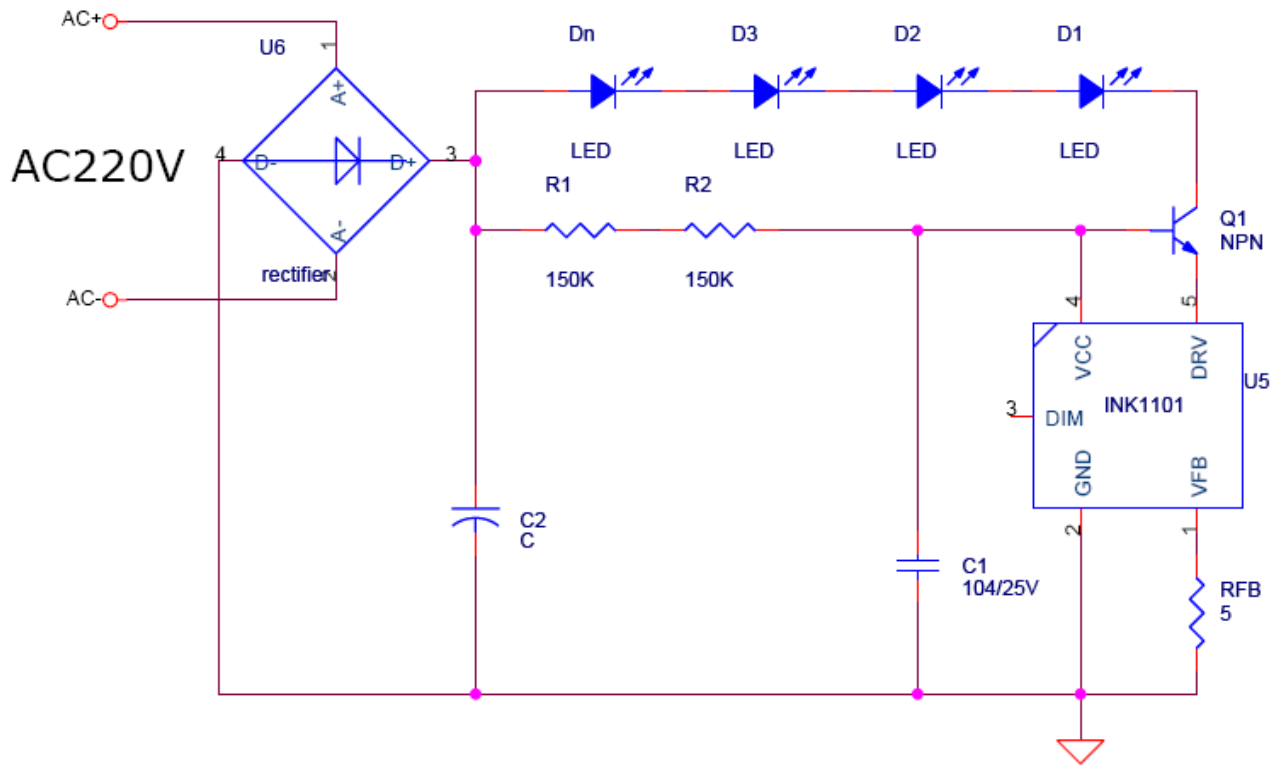
VFB is current set reference voltage, typical value is 300mV, RFB is the current programming resistor connected between VFB pin and GND. When the LED current is 60mA, RFB is 5Ω with 1% accuracy.

PWM LED Dimming Control

INK1101 can be used for dimming LED applications, such as stage light and LCD back lighting. The DIM pin is built in a 20KΩ pull up resistor, very easy for connection with PWM generator. When DIM voltage is high LED driver is on, and when DIM voltage is low, LED driver is off. The minimum pulse width is 1μS.

When no Dimming function is needed, the DIM pin can be left floating or connected to VCC. If the PWM generator is not on board, an 100Ω current limit resistor is suggested to be connected between INK1101 chips and PWM generator.

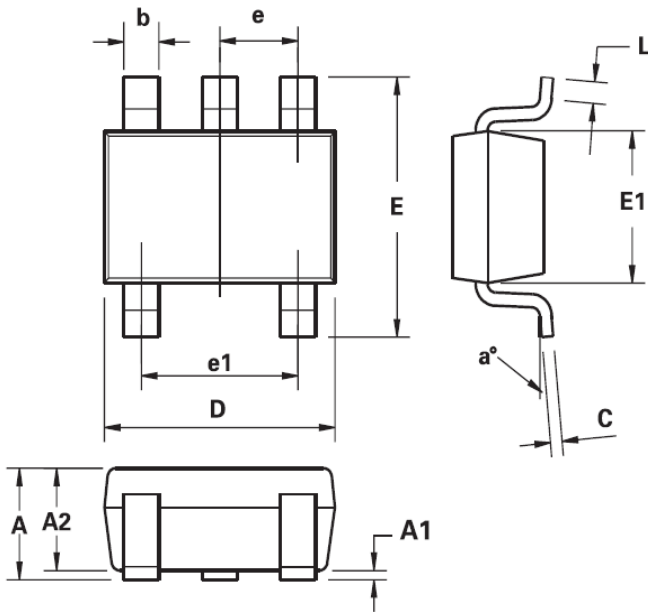
Expanded INK1101 Applications



INK1101 is utilized to set the constant current of LED series. Q1 is a power NPN transistor, a TO252 packaged 13001 is recommended here. This application is advantaged of high voltage case when current more than 60mA.

Package Information (Unit: millimeter)

SOT-23-5



Symbol	Millimeter	
	Min.	Max.
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.20	0.50
C	0.09	0.26
D	2.70	3.10
E	2.20	3.20
E1	1.30	1.80
e	0.95REF	
e1	1.90REF	
L	0.10	0.60
a°	0°	30°