

1A High Brightness LED Driver IC

CN5710

General Description

The CN5710 is a current regulation integrated circuit operating from an input voltage of 2.8V to 6V, the constant output current can be set up to 1A with an external resistor. The CN5710 is ideal for driving LED. The on-chip power MOSFET and current sense block greatly reduce the number of external component count. The CN5710 adopts the temperature regulation instead of temperature protection function, the temperature regulation can make the LED being turned on continuously in case of high ambient temperature or high voltage drop. Other features include chip enable, etc. CN5710 is available in 5pin SOT89 package.

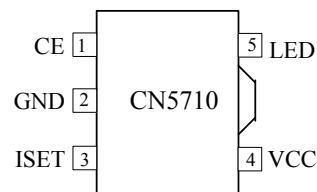
Features

- Operating Voltage Range: 2.8V to 6V
- On-chip Power MOSFET
- Low Dropout Voltage: 0.25V @ 800mA
- LED Current up to 1A
- Output Current Accuracy: $\pm 5\%$
- Chip Temperature Regulation
- Over LED Current Protection
- Operating Temperature Range:
-40 °C to +85 °C
- Available in SOP8 Package
- Pb-free, Rohs Compliant, Halogen Free

Applications

- Flashlight
- High-brightness LED driver
- LED headlights
- Emergency lights and lighting

Pin Assignment



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Typical Application Circuit

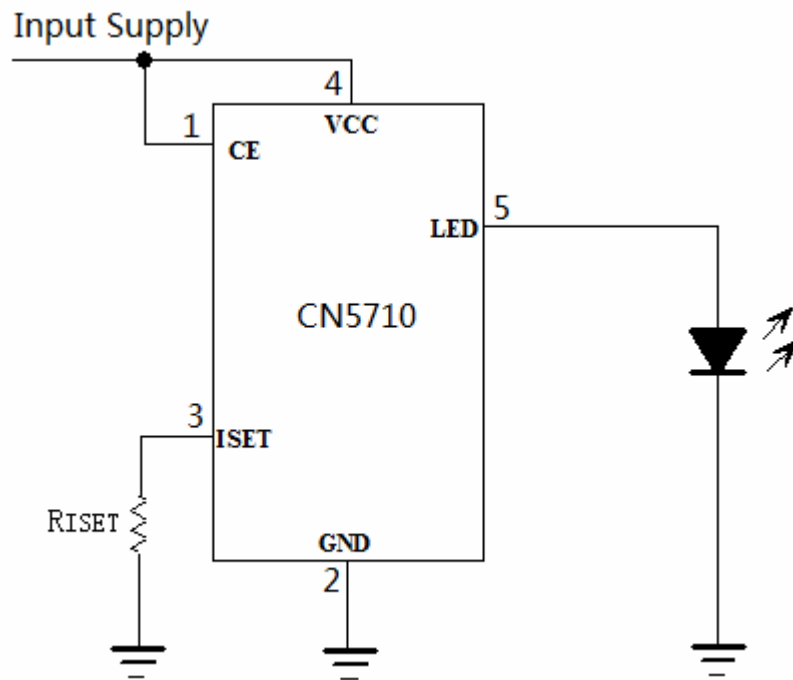


Figure 1 Typical Application Circuit

Ordering Information

Part No.	Package	Shipping	Operating Temperature
CN5710	SOT89-5	Tape and reel, 1000/Reel	-40°C to 85°C

Block Diagram

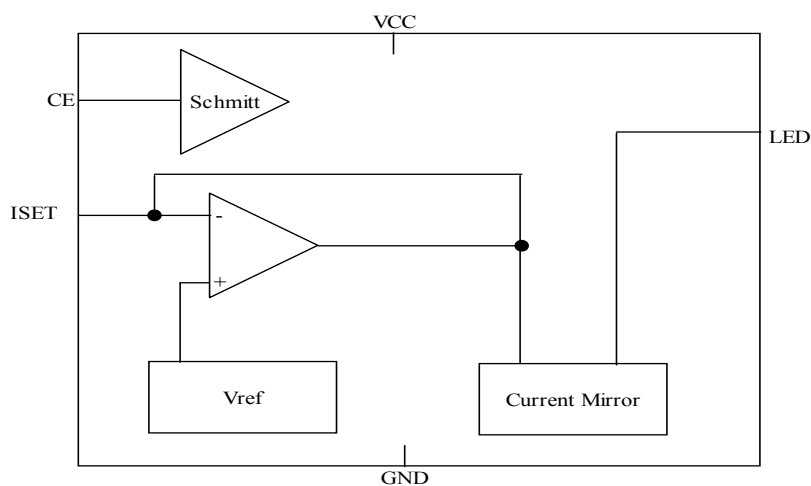


Figure 2 Functional Block Diagram

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Pin Description

Pin No.	Symbol	Description
1	CE	Chip Enable Input. A high input will put the device in the normal operating mode. Pulling the CE pin to low level will put the CN5710 into disable mode. The CE pin can be driven by TTL or CMOS logic level.
2	GND	The Negative Terminal of Power Supply.
3	ISET	LED Current Setting Pin. LED pin current is set by a resistor R_{ISET} which is connected between ISET pin and GND, the current is calculated by: $I_{LED} = 1800V / R_{ISET}$ Where, I_{LED} is LED pin current and is in ampere (A) R_{ISET} is the resistance from ISET pin to GND in ohms. R_{ISET} 's maximum value is 30K ohm.
4	VCC	The Positive Terminal of Power Supply. The internal circuit is powered by VCC.
5	LED	The Anode of LED. LED's anode is connected to this pin, and LED current flows out of this pin.
6	Exposed Pad	Soldered to GND.

ABSOLUTE MAXIMUM RATINGS

Terminal Voltage (With respect to GND)	Thermal Resistanc(Juction to Case).....60°C/W
VCC.....-0.3V to +6.5V	Operating Temperature.....-40 to +85°C
Other terminal voltage.....-0.3V to VCC	Storage Temperature.....-65 to +150°C
Maximum Junction Temperature..... 150°C	Lead Temperature (soldering, 10s)+260°C

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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Electrical Characteristics

(VCC=3.7V, TA= 25°C, unless otherwise noted.)

Parameters	Symbol	Test Conditions	Min	Typ	Max	Unit
Operating Voltage Range	VCC		2.8		6	V
Quiescent current	IVCC1	R _{ISET} =2.4kΩ, I _{LED} =0A	200	260	320	uA
Shutdown state operating current	IVCC2	V _{CE} =0V			1	uA
LED pin current	I _{LED1}	R _{ISET} =2.4k Ω	712	750	788	A
LED pin current accuracy			-5		+5	%
Over Current Protection Level	I _{OC}		1.5	1.9	2.3	A
LED pin voltage drop	V _{DROP}	I _{LED} =100mA×95%		50		mV
		I _{LED} =350mA×95%		110		
		I _{LED} =500mA×95%		150		
		I _{LED} =800mA×95%		250		
CE input low	V _{CEL}	CE voltage falls			0.6	V
CE input high	V _{CEH}	CE voltage rises	2.3			V
CE input current	I _{CEL}	CE=GND, VCC=6V	-1			uA
	I _{CEH}	CE=VCC=6V			1	

Detailed Description

CN5710 is a current regulation integrated circuit operating from an input voltage of 2.8V to 6V, the constant output current can be set up to 1A with an external resistor. The CN5710 consists of high precision reference voltage, amplifier, current mirror, etc. The on-chip power transistor and current sense block greatly reduce the external component count, which makes the CN5710 ideal for LED driver.

When the CE pin is high, the input voltage is greater than 2.8V, and is larger than the LED forward voltage plus the required voltage drop, CN5710 functions normally to deliver constant current from the LED pin.

The CN5710 adopts the temperature regulation instead of temperature protection function, the temperature regulation can make the LED being turned on continuously in case of high ambient temperature or high voltage drop. When the CN5710 junction temperature reaches about 135 ° C, the internal temperature regulation block reduces the LED current so that the junction temperature will not rise any more. This feature allows the users to maximize the use of the power handling capability of the chip, do not worry about the chip overheating and damage to the chip or external components.

The CN5710 also has the chip enable function, which can shutdown the whole chip to limit the current consumption within 1uA.

The CN5710 also adopts the over current protection block. When LED current approaches 1.9A(Typical), the over current protection block begins to function to prevent the LED current from increasing further.

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Applications Information

Set the LED current

The CN5710 uses a resistor between ISET pin and GND to set the LED current, which is calculated as follows:

$$I_{LED} = 1800V / R_{ISET}$$

Where: I_{LED} is the LED current in amperes (A);

R_{ISET} is the resistance between ISET pin and GND in ohm, R_{ISET} 's maximum value is 30K ohm.

For example, if 750mA LED current is required:

$$R_{ISET} = 1800V / 0.75A = 2.4k\Omega$$

In order to ensure good stability and temperature characteristics, it is recommended to use a 1%, metal film resistor for R_{ISET} .

Chip power consumption considerations

CN5710's maximum allowable power dissipation is:

$$P_{Dmax} = (T_J - T_A) / \theta_{JA}$$

Where, P_{Dmax} is the CN5710's maximum allowable power dissipation

T_J is the CN5710's maximum junction temperature, which is 135 °C

T_A is the CN5710's operating environment temperature

θ_{JA} is the thermal resistance of the package

CN5710's actual power consumption is calculated with the following formula:

$$P_{Dact} = (V_{CC} - V_{LED}) \times I_{LED}$$

Where, P_{Dact} is CN5710's actual power consumption

V_{LED} is the voltage at LED pin

I_{LED} is the current flowing out of LED pin

For normal operation, P_{Dact} should be less than P_{Dmax} .

LEDs in parallel

The CN5710 can drive more than one LEDs in parallel, as shown in Figure 3.

In order to make sure the current is evenly distributed among the LEDs, a robust resistor in series with each LED is recommended.

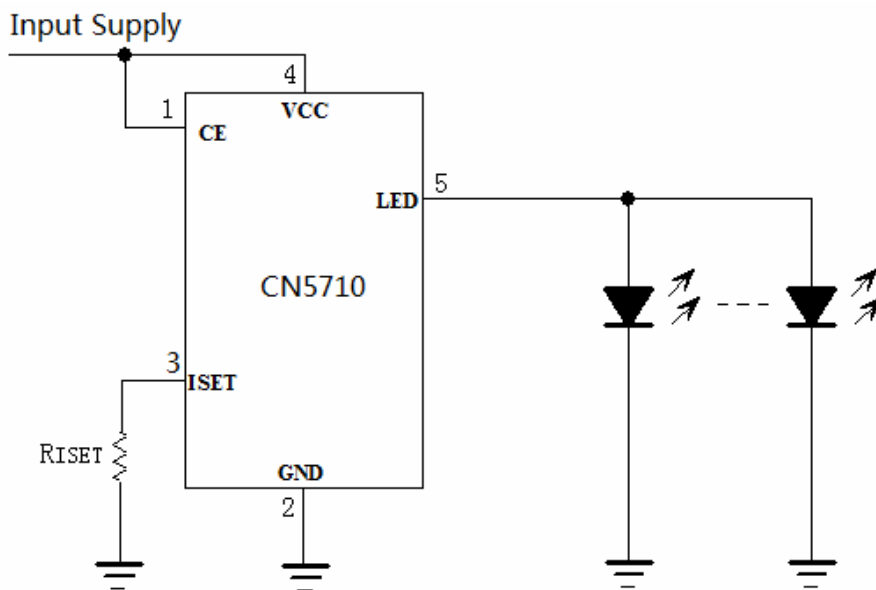


Figure 3 CN5710 drives LEDs in Parallel

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LED Dimming

There are three methods to dim the LED:

Method 1: The PWM signal is directly applied to the chip enable pin(CE), the frequency of the PWM signal should be less than 2KHz.

Method 2: A logic signal is applied to the gate of an NMOS as shown in Figure 4.

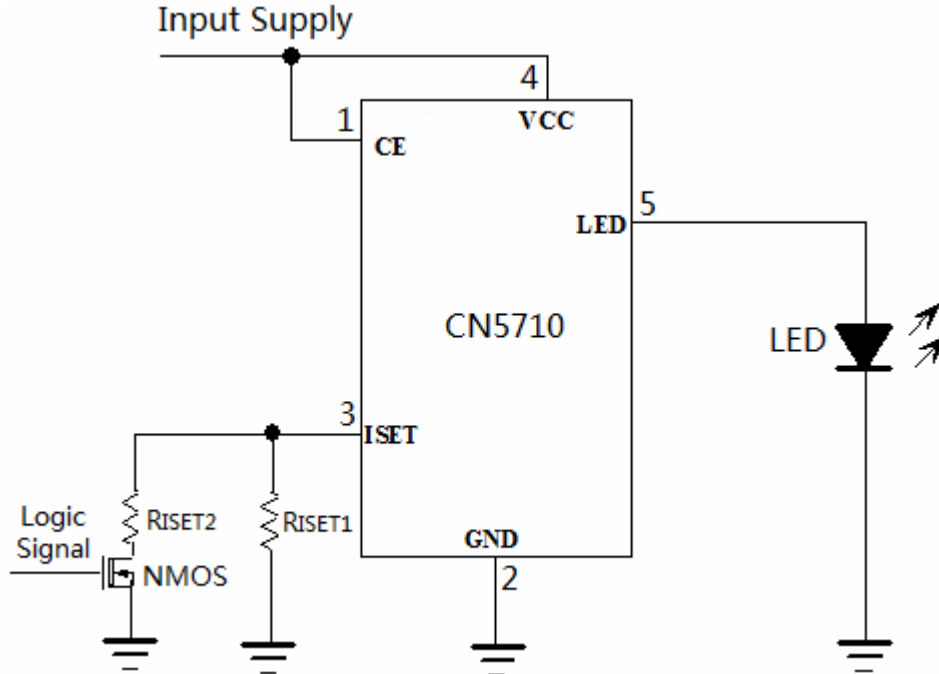


Figure 4 A logic signal to Dim LED

Method 3: A potentiometer is used to dim the LED as shown in Figure 5.

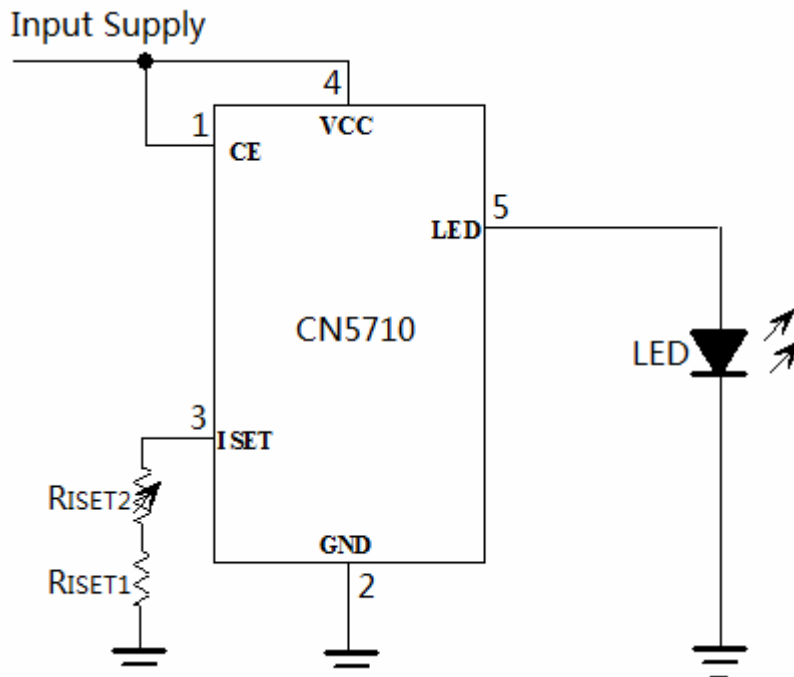


Figure 5 A Potentiometer to Dim the LED

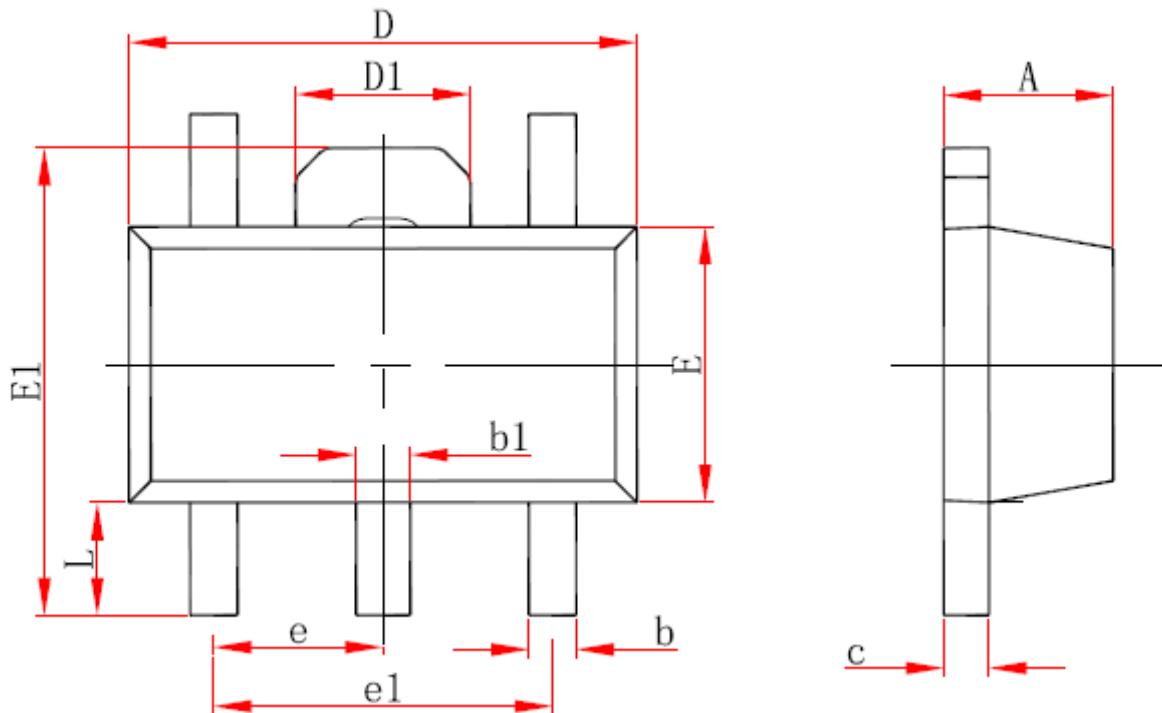
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PCB Design Considerations

1. R_{ISET} at ISET pin should be as close to the CN5710 as possible, also the parasitic capacitance at ISET pin should be kept as small as possible.
2. It is very important to use a good thermal PC board layout to maximize LED current. The thermal path for the heat generated by the IC is from the die to the copper lead frame through the package lead (especially the ground lead) to the PC board copper, the PC board copper is the heat sink. The footprint copper pads should be as wide as possible and expand out to larger copper areas to spread and dissipate the heat to the surrounding ambient. Feedthrough vias to inner or backside copper layers are also useful in improving the overall thermal performance. Other heat sources on the board, not related to the CN5710, must also be considered when designing a PC board layout because they will affect overall temperature rise and the maximum LED current.
3. The ability to deliver maximum LED current under all conditions require that the exposed metal pad on the back side of the CN5710 package be soldered to the PC board ground. Failure to make the thermal contact between the exposed pad on the backside of the package and the copper board will result in larger thermal resistance.

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Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.380	0.580	0.015	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF.		0.061 REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP.		0.060 TYP.	
e1	3.000 TYP.		0.118 TYP.	
L	0.900	1.200	0.035	0.047

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