Adjustable Constant Current LED Driver

General Description

The RP2401 is a constant current regulator for driving LEDs with low quiescent current and low dropout voltage. The current is adjustable from 100mA to 400mA with an external resistor. Soft start, thermal protection and under voltage protection are also provided.

Features

- **Sink Current: 100mA to 400mA adjustable**
- **An external resistor to set current level**
- **Power Supply Voltage: 2.7V to 6V**
- **Low Dropout Voltage: 150mV@350mA (V_{LED} to GND)**
- **Low Quiescent Current: 250μA**
- **Thermal Protection**
- **Soft Start**
- **Low Voltage Protection (UVLO): 2.5V**
- **SOT-89-5 Package**

Ordering Information

RP2401□□

- Package Type
  X5: SOT-89-5
- Operating Temperature Range
  G: Green (Halogen Free with Commercial Standard

Note :

Richpower Green products are :

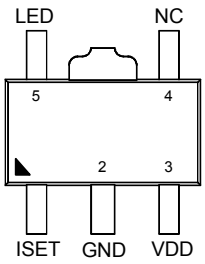
- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

Applications

- Power LED Driver
- Sink Current Regulator

Pin Configurations

(TOP VIEW)



SOT-89-5

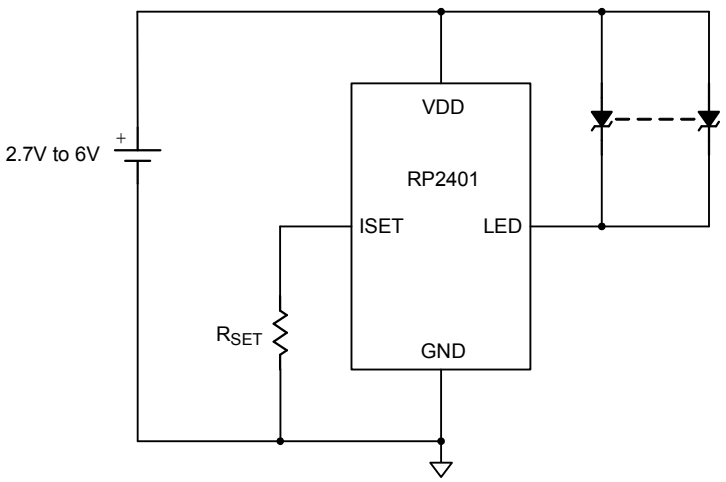
Marking Information

For marking information, contact our sales representative directly or through a Richpower distributor located in your area.

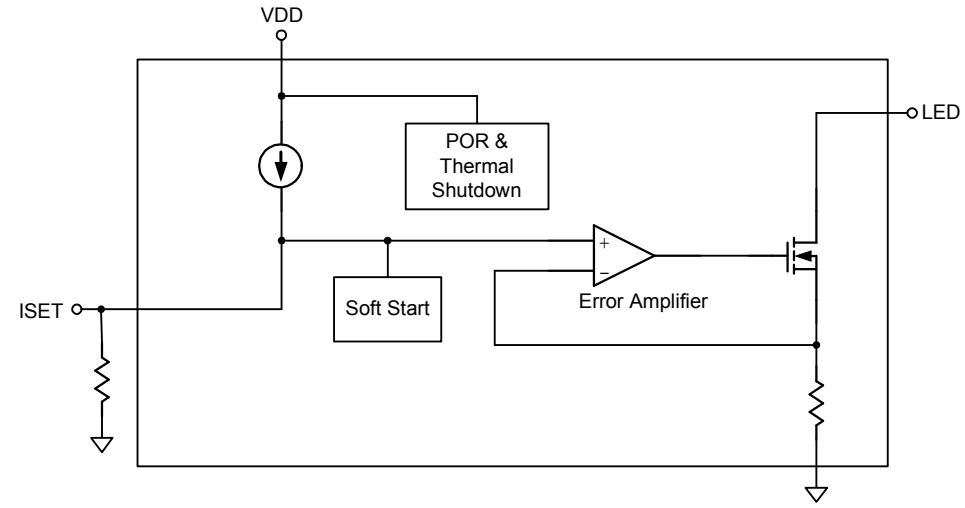
Functional Pin Description

Pin Number	Pin Name	Pin Function
1	ISET	Set current level.
2	GND	Ground.
3	VDD	Power.
4	NC	No connection.
5	LED	Connect to LED.

Typical Application Circuit



Function Block Diagram



Absolute Maximum Ratings (Note 1)

- Supply Voltage (V_{IN}) ---------- 6V
- Control Voltage ---------- 6V
- Output Voltage ---------- 6V
- Power Dissipation, P_D @ T_A = 25°C
  SOT-89-5 ---------- 0.833W
- Package Thermal Resistance (Note 4)
  SOT-89-5, θ_{JA} ---------- 120°C/W
- Junction Temperature ---------- 150°C
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Storage Temperature Range ---------- –65°C to 150°C
- ESD Susceptibility (Note 2)
  HBM (Human Body Mode) ---------- 2kV
  MM (Machine Mode) ---------- 200V

Recommended Operating Conditions (Note 3)

- Ambient Temperature Range ---------- –40°C to 85°C
- Supply Voltage, VDD ---------- 2.7V to 5.5V

Electrical Characteristics

Parameter	Test Conditions	Min	Typ	Max	Units
Sink Current Range	V_{DD}= 3.6V	100	--	400	mA
Sink Current Accuracy		-5	--	+5	%
VDD under Voltage Lockout	I_{LED}= 100mA	--	2.5	2.7	V
Load Regulation	V_{LED}= 0.4V to 2V, V_{DD}= 3.6V	--	--	2	%
Line Regulation	V_{DD}= 3V to 5.5V	--	--	2	%
Resistance of Current Sink	V_{LED}= 0.1V, V_{DD}= 3.6V, R_{SET}= 100kΩ	--	--	0.5	ohm
Supply Current	V_{DD}= 3.6V, R_{SET}= 100kΩ	--	250	--	μA
Over Temperature Protection		--	150	--	°C
Over Temperature Hysteresis		--	30	--	°C
Soft-start Time	I_{LED}= 400mA	--	50	--	μs

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. 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 remain possibility to affect device reliability.

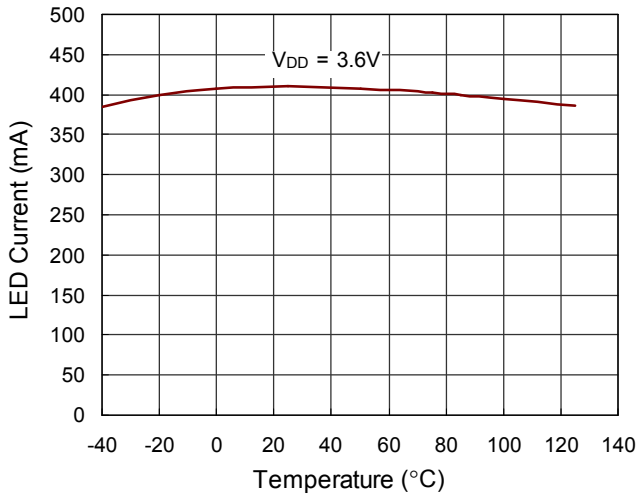
Note 2. Devices are ESD sensitive. Handling precaution recommended.

Note 3. The device is not guaranteed to function outside its operating conditions.

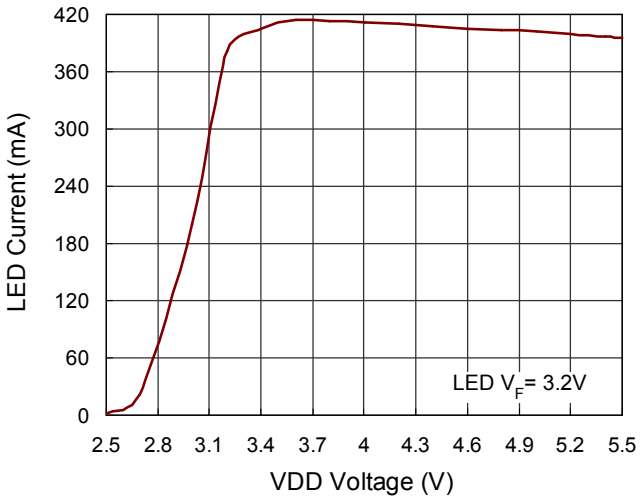
Note 4. θ_{JA} is measured in the natural convection at T_A = 25°C on a high effective thermal conductivity test board (Four Layers, 2S2P) of JEDEC 51-7 thermal measurement standard.

Typical Operating Characteristics

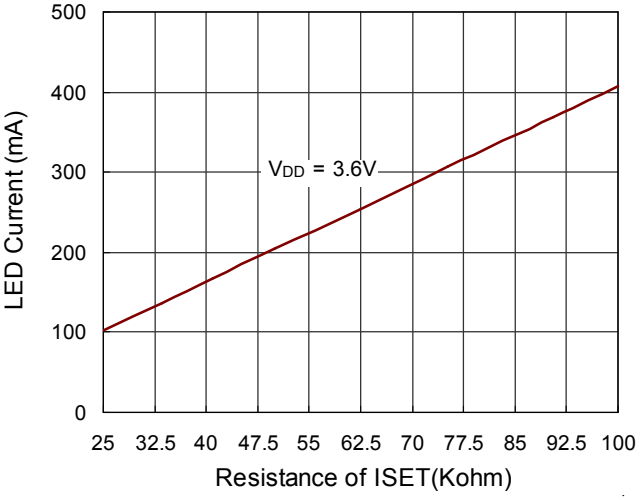
Temperature Stability



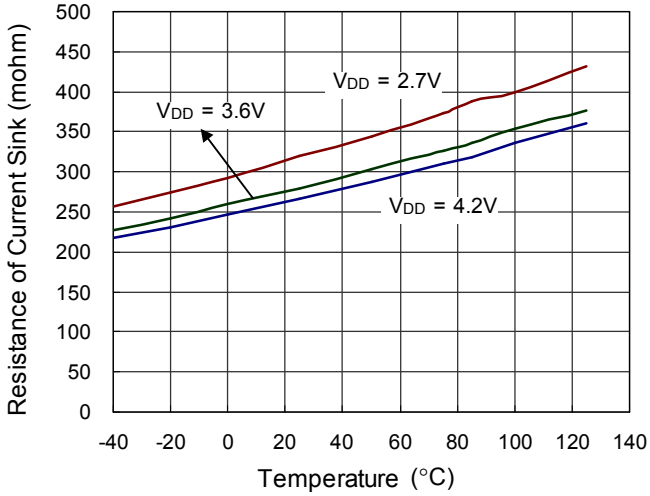
LED Current vs. VDD Voltage



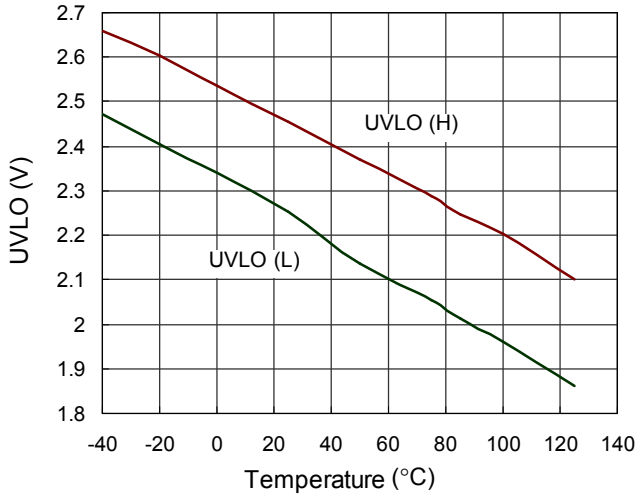
LED Current vs. Resistance of ISET



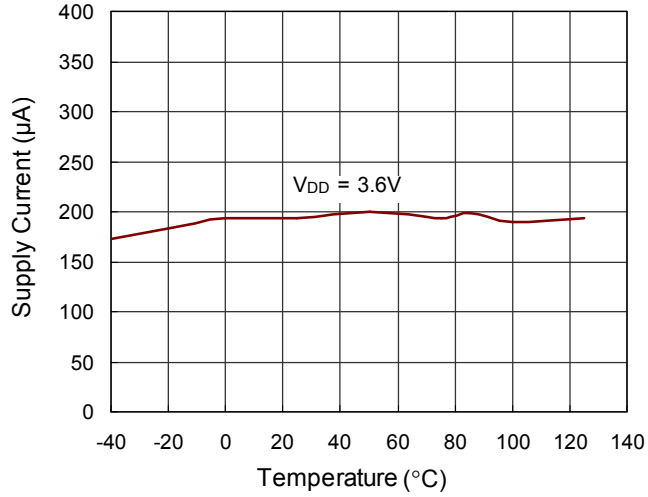
Resistance of Current Sink vs. Temperature



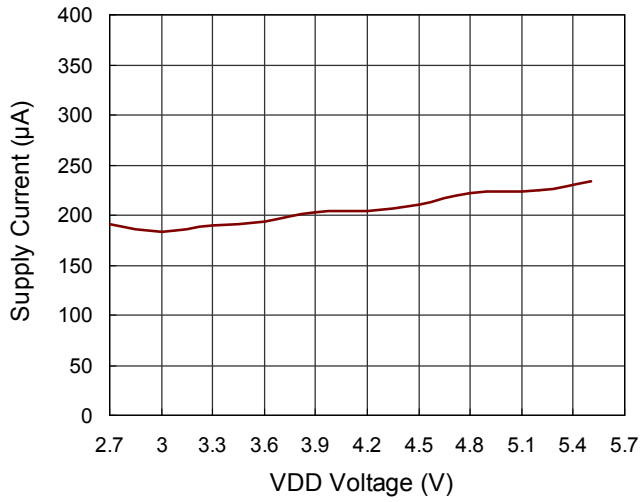
UVLO vs. Temperature



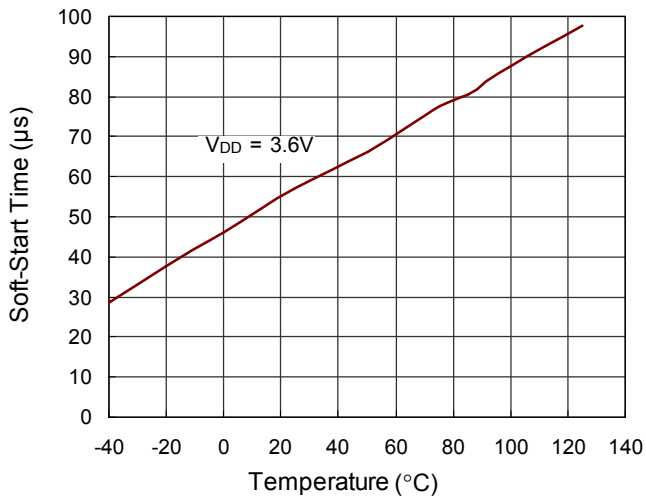
Supply Current vs. Temperature



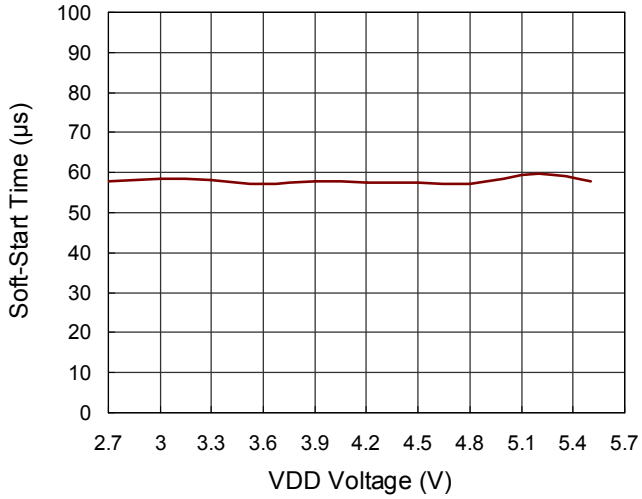
Supply Current vs. VDD Voltage



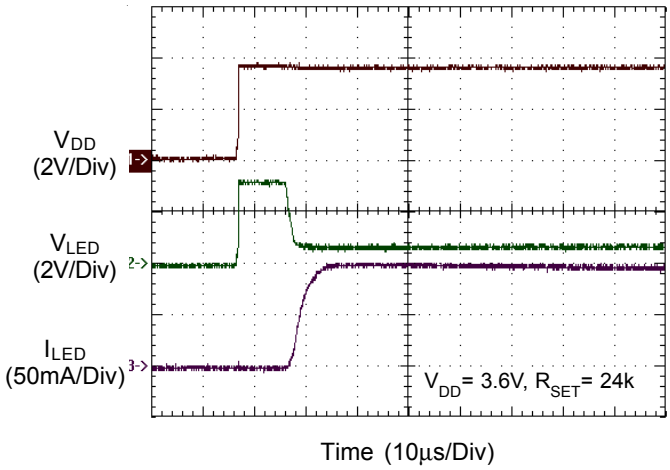
Soft-Start Time vs. Temperature



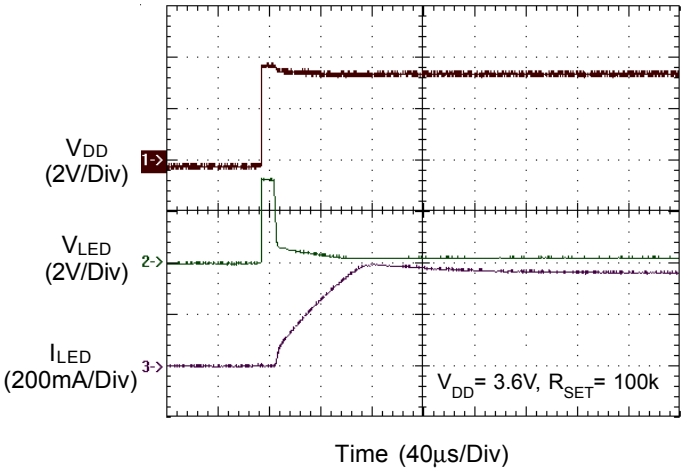
Soft-Start Time vs. VDD Voltage



Switch on Response



Switch on Response



Application Information

The RP2401 is an adjustable constant current sink for LEDs driving.

Input Capacitor

Generally, the RP2401 is able to work without an input capacitor. However, to get better performance, paralleling an input capacitor typically 10μF between the anode of LED and ground is recommended. RP2401 provides an under voltage lockout (UVLO) function to prevent it from unstable during IC startup. The UVLO threshold of V_{DD} falling is set at 2.5V typically.

Setting the LED Current

The RP2401 can provide a fixed LED current by connecting a resistor R_{SET} from I_{SET} to GND. R_{SET} establishes the reference current and don't take the trace of R_{SET} as power traces. The approximate setting formula of the LED current is given as follows:

$$I_{LED} = 4 \times R_{SET}(k\Omega)\,mA$$

Figure 1 shows the typical value of I_{LED} versus R_{SET} and Table 1 shows the values of R_{SET} for a fixed I_{LED}.

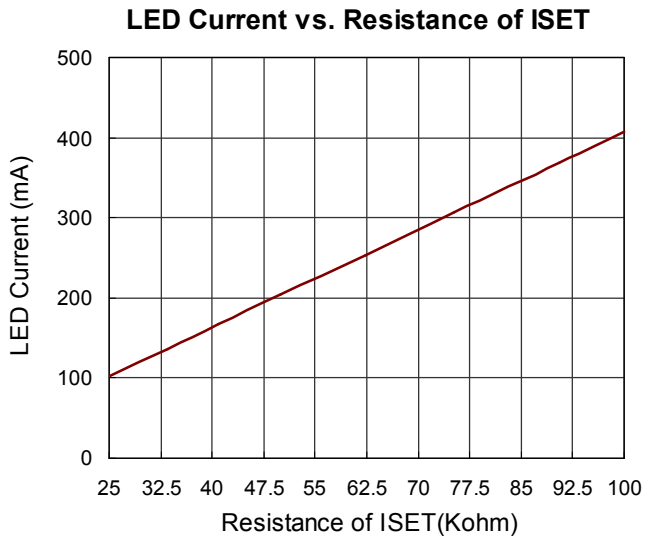


Figure 1. The typical curve of I_{LED} vs. R_{SET}

Table 1. R_{SET} Value Selection

I_{LED} (mA)	R_{SET}(kΩ)
100	25
200	50
350	87.5
400	100

If maximum accuracy is required, a precision resister is needed. Over 400mA LED current may cause permanent damages.

Soft-Start and Over-Voltage Protection

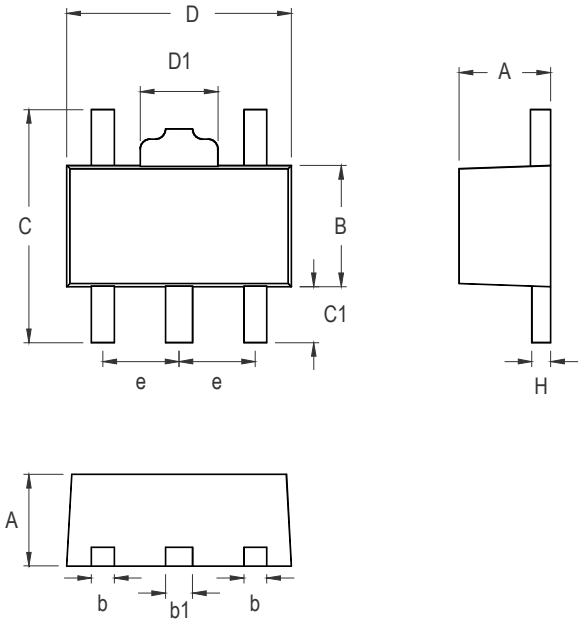
The RP2401 equips a soft-start circuit to limit the inrush current during power on. The typically soft-start time is 50μs while I_{LED} =400mA. If the voltage of LED pin is higher than (V_{DD} -1.5) volts, the over voltage protection function will work to reduce LED current.

Over Temperature Protection

The RP2401 has an over-temperature protection function to limit the maximum power dissipation. When the operation junction temperature exceeds 150°C, the OTP circuit will turn off the pass element. The pass element turns on again after the junction temperature cools below 120°C. For continuous operation, the junction temperature should not exceed absolute maximum operation junction temperature 85°C. The power dissipation definition in device is:

$$P_D = V_{LED} \times I_{LED} + V_{DD} \times I_Q$$

Outline Dimension



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
B	2.300	2.600	0.091	0.102
C	3.937	4.250	0.155	0.167
C1	0.800	1.194	0.031	0.047
D	4.400	4.600	0.173	0.181
D1	1.397	1.800	0.055	0.071
e	1.400	1.600	0.055	0.063
H	0.356	0.440	0.014	0.017

5-Lead SOT-89 Surface Mount Package

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