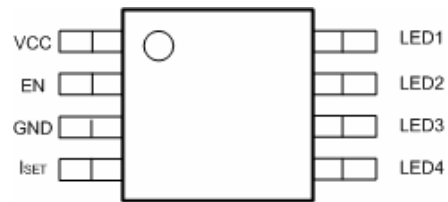


FEATURES

- Cost Effective LED driver
- Constant current output ideal for Driving Led strings
- Four Channel LED Driver provides matched LED current
- Current adjusted via an external resistor
- PWM dimming possible by using either the ENABLE
- Small SOP-8 package
- Outputs can be connected in parallel to increase drive
- Constant current for wide cathode voltage range (4.5V to 18V)
- Highly integrated design, minimal components
- Thermal shutdown protects the driver

Package type SOP-8

**APPLICATIONS**

- Next Generation Mobile Phones
- PDA, DSC, MP3 Players
- Handheld Computers
- LCD Display Modules
- Keyboard Backlight
- LED Displays

DESCRIPTION

The EC4101 is a linear constant current driver designed to drive multiple LEDs in series from a high input voltage rail. The driver acts as a high current matched four channel current source ensuring constant LED current for a range of input voltage. The EC4101 allows implementing the lowest cost LED driver for a variety of applications. Internal circuitry maintains the pre-set constant current output for a wide voltage range at the LED outputs (LED1,2,3,4). LED current can be adjusted up to 125mA per string with an external resistor. The dimming can be achieved by controlling the ISET input or by feeding a PWM signal to the EN pin. Fast EN turn-on and turn-off time allows for very fast PWM dimming frequencies completely eliminating flickering. The built-in thermal protection automatically adjusts LED current to prevent overheating.



ABSOLUTE MAXIMUM RATINGS

V_{CC}, V_{LED1}, V_{LED2}, V_{LED3}, V_{LED4} Voltage to GND 0.3V to 18V

I_{SET} and EN Voltage to GND..... 6V
 Output Current per LED (I_{OUT}) 125mA
 Power Dissipation per Package
 8-pin SOP at TA = 85°C 1.1W
 Junction Temperature+150°C
 Storage Temperature -55°C to +150°C
 ESD Level. 1.5kV HBM

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

ELECTRICAL CHARACTERISTICS

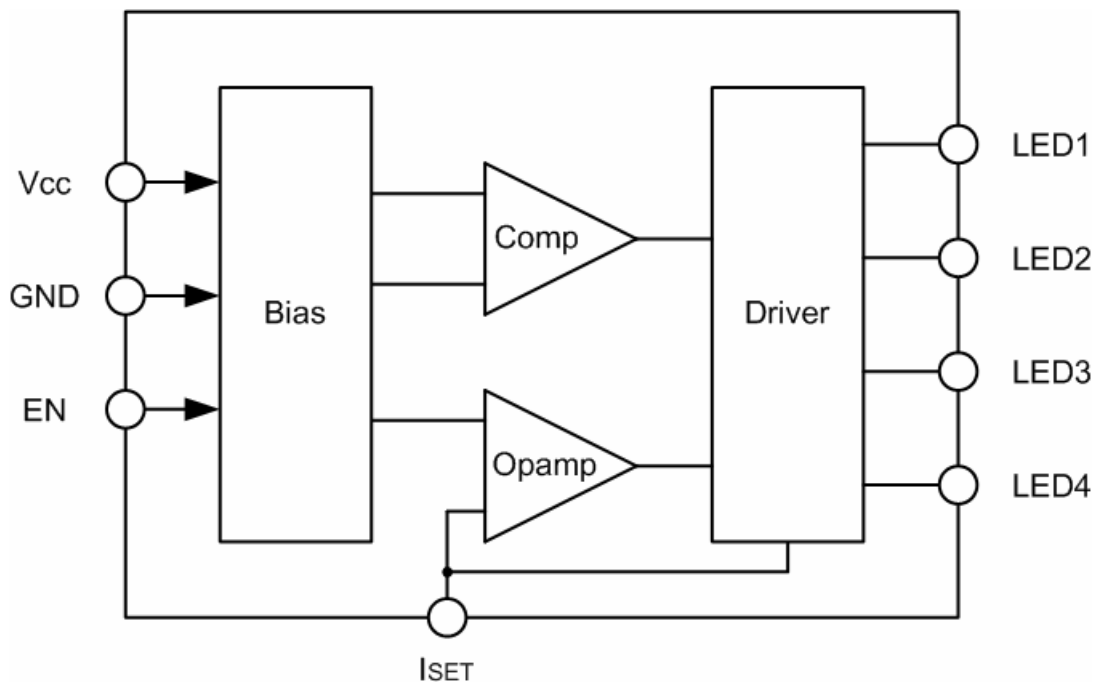
4.5V < V_{CC} < 18V , V_{EN} = 5V, V_{LED1} = V_{LED2} = V_{LED3} = V_{LED4} = 1.0V, R_{SET} = 10k or I_{SET} = 125uA, -40 < TA < 85°C, Unless otherwise noted.

| PARAMETER | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|--|------|------|------|-------|--|
| Supply Voltage | 4.5 | 5 | 18 | V | |
| Quiescent Supply Current | | 0.4 | 0.5 | mA | I _{LED1} =I _{LED2} =I _{LED3} =I _{LED4} |
| Output/I _{SET} Current Multiplication Ratio | 1000 | 1200 | 1400 | | V _{CH} = 1V |
| LED Current (per diode) | | 125 | | mA | |
| CH to CH Current Matching | -5% | | +5% | % | |
| LED Current Line Voltage Regulation | | 0.15 | 0.6 | %/V | I _{OUT} change per volt V _{CC} change |
| LED Current Load Voltage Regulation | | 9 | | %/V | 1.0V < V _{LED} < 5V, I _{LED} = 125mA |
| LED Current Thermal Regulation | | 0.1 | | %/°C | I _{LED} = 125mA |
| I _{SET} Pin Voltage | 1.4 | 1.5 | 1.6 | V | |
| Thermal Shutdown Threshold | | 130 | | °C | |
| Thermal Shutdown Hysteresis | | 20 | | °C | |
| Current OFF Mode | | | 0.5 | mA | V _{EN} = 0V |
| Min. ENABLE " ON Voltage " (Note1) | | | 1.6 | V | |
| Max. ENABLE " OFF Voltage " (Note2) | 0.4 | | | V | |

Note 1. ENABLE "ON" is V_{EN} for which I_{LED} > 80mA

Note 2. ENABLE "OFF" is V_{EN} for which I_{LED} < 1uA @ V_{LED1} > 1.0V

BLOCK DIAGRAM



THEORY OF OPERATION

Introduction

The EC4101 is a four channel constant current source LED driver with programmable output current level. The design consists of a regulator bandgap, voltage to current converter, and output mirror drivers. The bandgap ensures good performance over voltage and temperature. The four outputs are tightly coupled allowing for excellent channel matching.

Thermal Shutdown

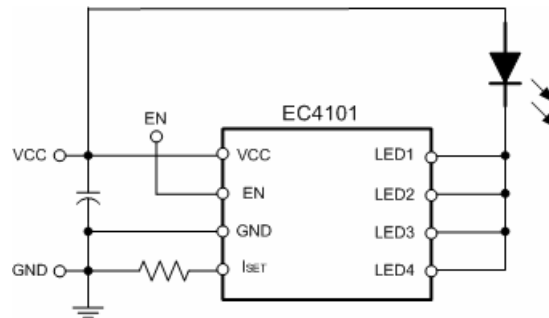
The EC4101 uses a thermal comparator to monitor the system temperature shutting the device down if the internal temperature reaches 150°C. The device will remain off until the internal temperature drops below 130°C.

Enable

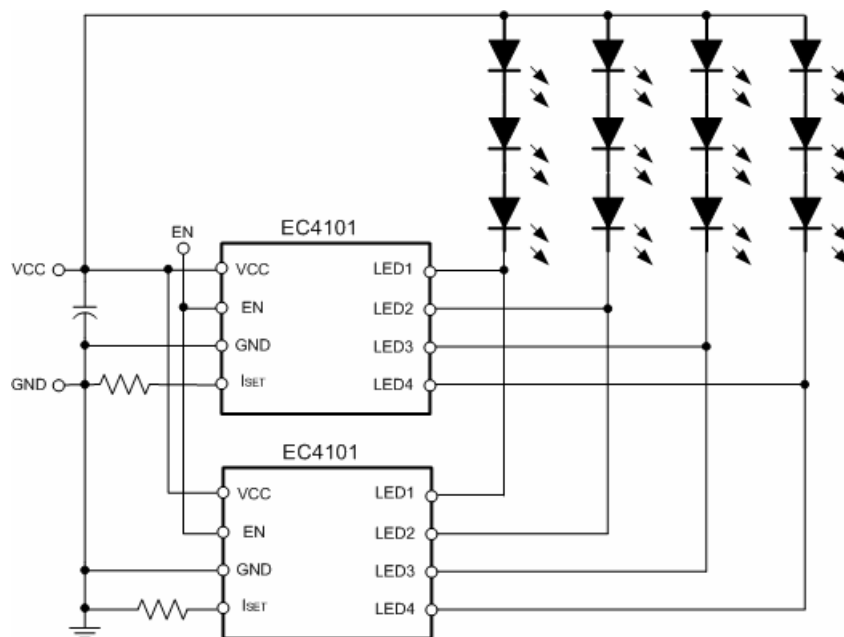
The device has an enable function that is designed for TTL level inputs. This input will also track the VCC pin so levels up to VCC are acceptable. The enable pin can also be used to control the LED brightness with a pulse width modulated control signal. Duty Cycle or PWM control of the LED current maintains constant LED color while brightness is changing. The EC4101 responds in less than 10us to PWM signals applied to this pin.

I_{SET} Pin

The I_{SET} pin is the servo point of an amplifier configured as a voltage to current converter. The voltage at this pins servos to the internal bandgap potential. A set resistor can be connected from the Iset pin to ground to generate a reference current for the following current gain stages. A current could alternately be applied to this pin in the form of a current source or current output DAC. This pin can also have a PWM signal applied to control the LED brightness.



The R_{SET} value may be determined as $R_{SET} = 1.5 * 1200/I_{OUT}, k\Omega$ where 1.5 is a typical I_{SET} pin voltage, 1200 is a typical current multiplication ratio, and I_{OUT} is a required LED current in mA.



Cathode Voltage, Supply Voltage and Power Dissipation

The voltage applied to the cathode of each LED determines the overall efficiency of the EC4101 circuit. The EC4101 is designed to be able to sink 125mA at each of its four outputs; LED1 - 4. The EC4101 is also designed to be able to handle up to 18V on these pins. This voltage handling capability assumes the total power can be dissipated by the EC4101. The power dissipation inside the EC4101 will be directly related to the voltage and current applied to these pins. For example, the typical operating cathode voltage is 500mV. At maximum current the power dissipated by one LED driver output is 125mA * 500mV = 62.5mW. The following charts show the power dissipation of the EC4101 under various conditions. The power dissipation should be kept below 1.3W for safe operation and long term reliability at room



Four Channel Constant Current LED Driver

EC4101

temperature and derate to 530mW at 85°C. While the above operating conditions are recommended, the part cannot be damaged due to internal temperature control as described above in the thermal shutdown section.

■ ORDERING INFORMATION

| PART NUMBER | TOP MARK | PACKAGE |
|-------------|----------|----------------------|
| EC4101N-F | EC4101-F | Lead free 8-pin SOP |
| EC4101N-G | EC4101-G | Green Mode 8-pin SOP |

PACKAGE TYPE SOP8 :

NOTE

1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS
2. DIMENSION L IS MEASURED IN GAGE PLANE
3. TOLERANCE 0.10 mm UNLESS OTHERWISE SPECIFIED
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
5. DIE PAD EXPOSURE SIZE IS ACCORDING TO LEAD FRAME DESIGN.
6. FOLLOWED FROM JEDEC MS-012

| SYMBOLS | DIMENSIONS IN MILLIMETERS | | | DIMENSIONS IN INCHES | | |
|---------|---------------------------|------|------|----------------------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 1.40 | 1.50 | 1.60 | 0.055 | 0.059 | 0.063 |
| A1 | 0.00 | 0.10 | 0.10 | 0.000 | 0.004 | 0.004 |
| A2 | --- | 1.45 | --- | --- | 0.057 | --- |
| B | 0.33 | --- | 0.51 | 0.013 | --- | 0.020 |
| C | 0.19 | --- | 0.25 | 0.007 | --- | 0.010 |
| D | 4.80 | --- | 5.00 | 0.189 | --- | 0.197 |
| E | 3.80 | --- | 4.00 | 0.150 | --- | 0.157 |
| e | --- | 1.27 | --- | --- | 0.050 | --- |
| H | 5.80 | --- | 6.20 | 0.228 | --- | 0.244 |
| L | 0.40 | --- | 1.27 | 0.016 | --- | 0.050 |
| y | --- | --- | 0.10 | --- | --- | 0.004 |
| θ | 0° | --- | 8° | 0° | --- | 8° |

| Rev # | 修改區域 Location | 原尺寸 Original dimension | 新尺寸 New dimension | 日期 Date | 修改者 Corrector | 承認 Approval |
|-------|---------------|------------------------|-------------------|---------|---------------|-------------|
| | | | | | | |
| | | | | | | |

| | | | | |
|-------------|------------------------------------|----------|------|-------------|
| 單位 Unit | mm | 比例 Scale | N.A. | 承認 Approval |
| 版別 Revision | 1 | 頁次 Page | 1/1 | 校核 Check |
| 圖號 Dwg No. | PD2600800 | | | 設計 Design |
| 圖名 Title | SOP8L (FD) PACKAGE OUTLINE DRAWING | | | 繪圖 Draw |