A 4004

, Constant Current, 4-Channel ™

Description

The CAT4004 provides four matched low dropout current sources to drive LEDs. An external resistor on RSET sets the current in the LED channels. Each LED channel includes an individual control loop allowing the device to handle a wide range of LED forward voltages while still maintaining tight current matching.

The EN/DIM logic inputs supports device enable and a digital dimming interface for current setting of all LEDs. Six different current dimming ratios are available.

The device is aimed at “direct drive” battery applications. It is required that the battery or voltage source have enough headroom to drive the LED forward voltage and current sink (>150 mV).

The device is available in a tiny 8−lead TDFN 2 mm x 3 mm package with a max height of 0.8 mm.

Features

- Four LED Current Sinks with Tight Matching
- Low Dropout Driver 130 mV at 30 mA
- No Switching Noise
- Shutdown Current < 1 μA
- LED Current set by External Resistor
- Dimming via 1−wire EZDim™ Interface
- Thermal Shutdown Protection
- 8−lead 2 mm x 3 mm TDFN Package
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- LCD Display Backlight
- Cellular Phones
- Digital Still Cameras
- Handheld Devices

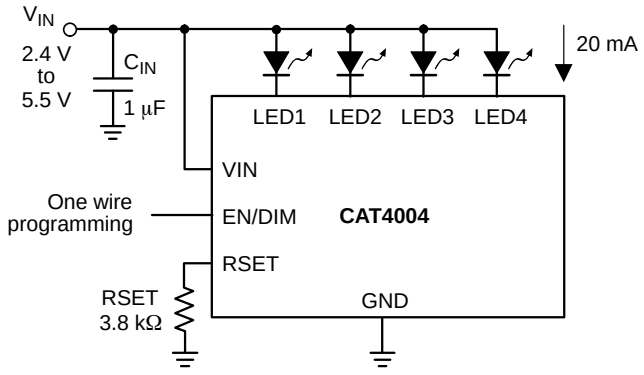
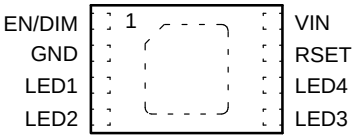


Figure 1. Typical Application Circuit

http://onsemi.com

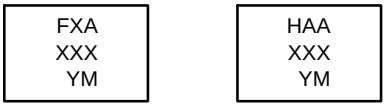
TDFN−8
VP2 SUFFIX
CASE 511AK

PIN CONNECTIONS



(Top View)

MARKING DIAGRAMS



FX = CAT4004VP2−T3
HA = CAT4004VP2−GT3
A = Assembly Location
XXX = Last Three Digits of Assembly Lot Number
Y = Production Year (Last Digit)
M = Production Month (1−9, A, B, C)

ORDERING INFORMATION

Device	Package	Shipping
CAT4004VP2−T3 (Note 1)	TDFN−8 (Pb−Free)	3,000/ Tape & Reel
CAT4004VP2−GT3 (Note 2)	TDFN−8 (Pb−Free)	3,000/ Tape & Reel

1. Matte−Tin Plated Finish (RoHS−compliant).
2. NiPdAu Plated Finish (RoHS−compliant).

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Rating	Unit
VIN, LEDx, RSET	6	V
EN/DIM Voltage	V_{IN} + 0.7	V
Storage Temperature Range	−65 to +160	°C
Junction Temperature Range	−40 to +150	°C
Lead Temperature	300	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Table 2. RECOMMENDED OPERATING CONDITIONS

Parameter	Rating	Unit
V_{IN}	2.4 to 5.5	V
Ambient Temperature Range	−40 to +85	°C
I_{LED} per LED pin	0 to 40	mA

NOTE: Typical application circuit with external components is shown on page 1.

Table 3. ELECTRICAL OPERATING CHARACTERISTICS
(over recommended operating conditions unless specified otherwise) V_{IN} = 4.0 V, EN = High, T_{AMB} = 25°C

Symbol	Name	Conditions	Min	Typ	Max	Units
I_Q	Quiescent Current	No load, RSET = Float No load, RSET = 4.8 kΩ		0.6 1.0		mA
I_{QSHDN}	Shutdown Current	V_{EN} = 0 V			1	μA
$I_{LED-ACC}$	LED Current Accuracy	1 mA ≤ I_{LED} ≤ 40 mA		±1		%
$I_{LED-DEV}$	LED Channel Matching	I_{LED} − I				

Table 4. RECOMMENDED EN/DIM TIMING
(For $2.4 \le V_{IN} \le 5.5$ V, over full ambient temperature range −40°C to +85°C.)

Symbol	Name	Conditions	Min	Typ	Max	Units
T_{SETUP}	EN/DIM setup from shutdown		10			μs
T_{LO}	EN/DIM program low time		0.2		100	μs
T_{HI}	EN/DIM program high time		0.2			μs
T_{PWRDWN}	EN/DIM low time to shutdown					

TYPICAL PERFORMANCE CHARACTERISTICS

(V_{IN} = 4 V, V_F = 3.3 V, I_{OUT} = 80 mA (4 LEDs at 20 mA), C_{IN} = 1 μF, T_{AMB} = 25°C unless otherwise specified.)

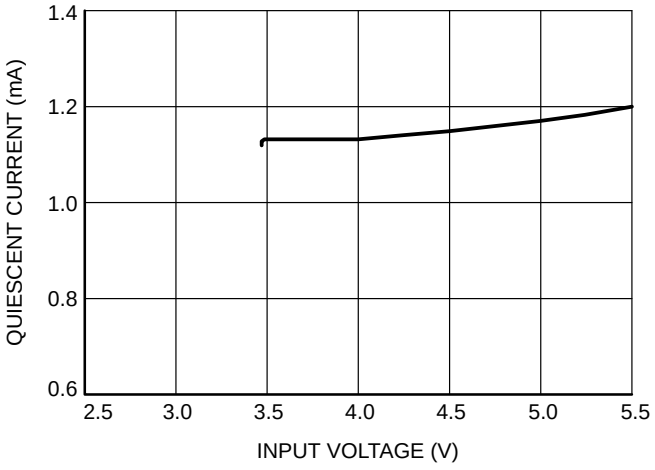


Figure 3. Quiescent Current vs. Input Voltage

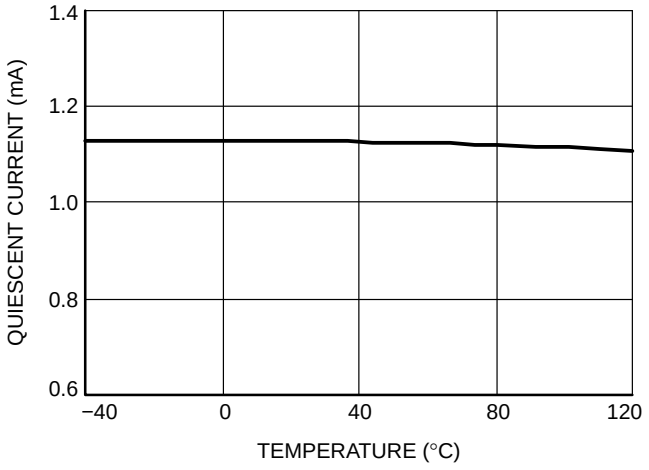


Figure 4. Quiescent Current vs. Temperature

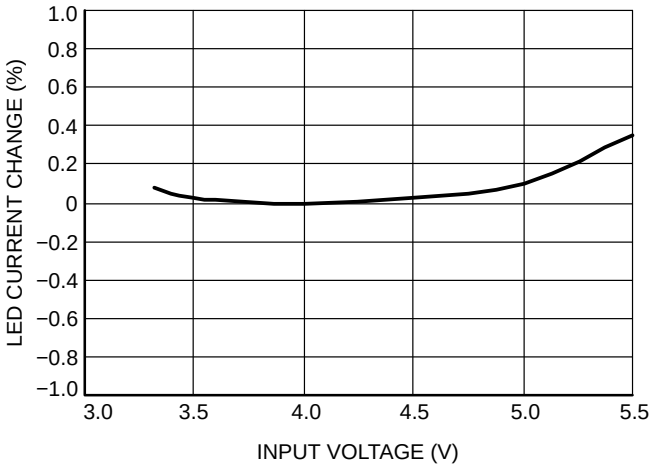


Figure 5. LED Current Change vs. Input Voltage

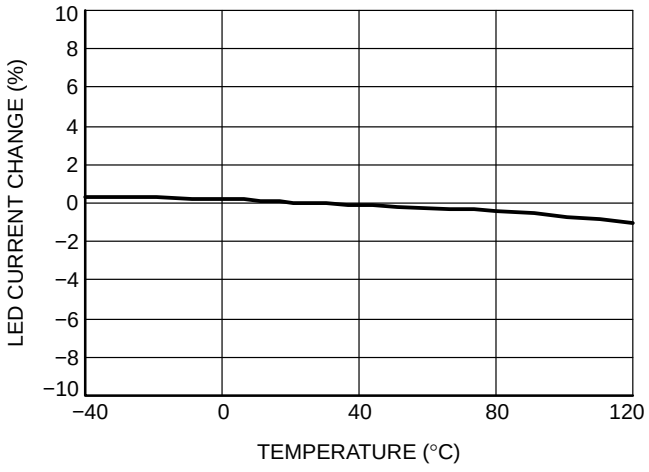


Figure 6. LED Current Change vs. Temperature

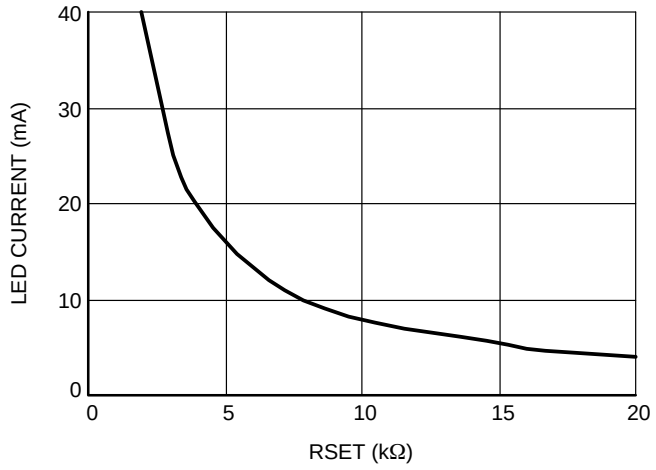


Figure 7. LED Current vs. RSET Resistor

TYPICAL PERFORMANCE CHARACTERISTICS

(V_{IN} = 4 V, V_F = 3.3 V, I_{OUT} = 80 mA (4 LEDs at 20 mA), C_{IN} = 1 μF, T_{AMB} = 25°C unless otherwise specified.)

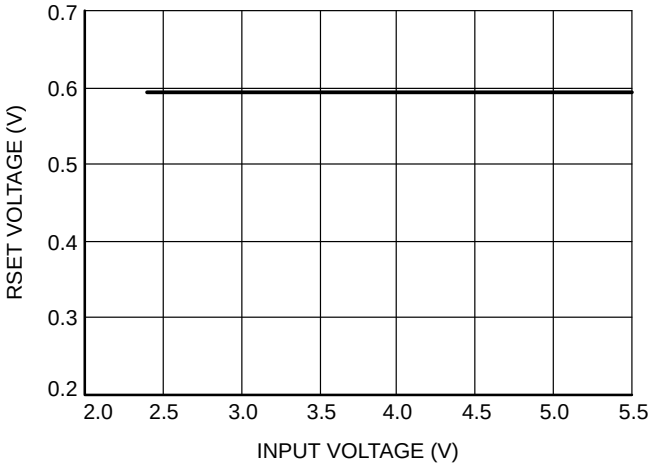


Figure 8. RSET Pin Voltage vs. Input Voltage

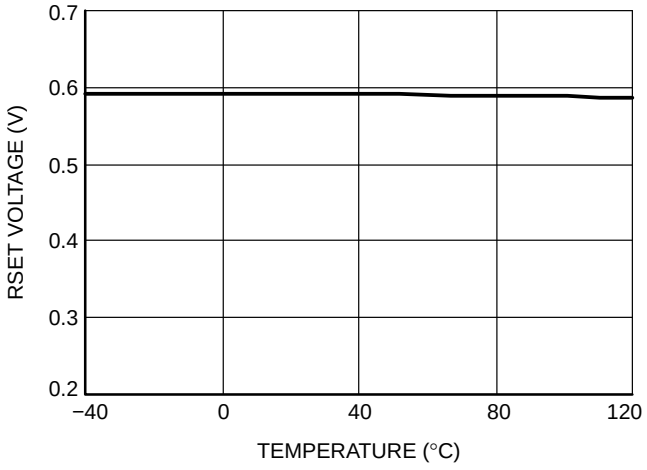


Figure 9. RSET Pin Voltage vs. Temperature

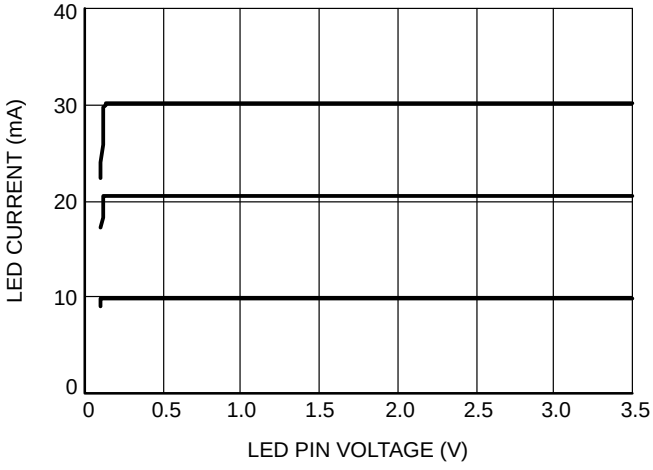


Figure 10. LED Current vs. LED Pin Voltage

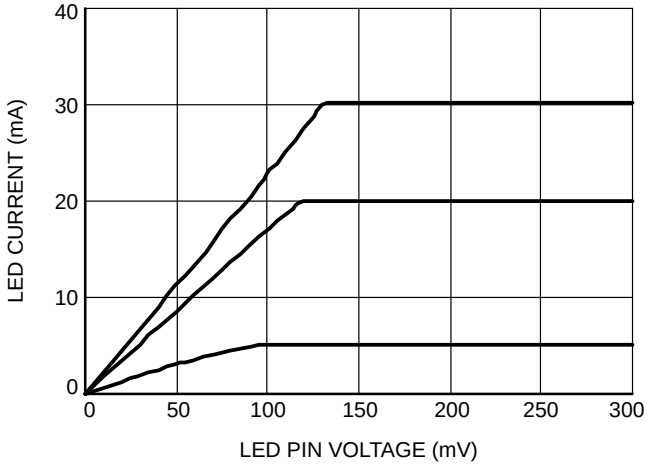


Figure 11. Dropout Characteristics

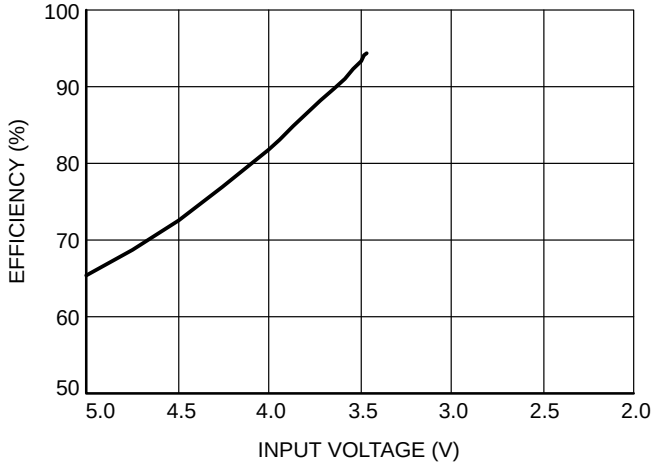


Figure 12. Efficiency vs. Input Voltage

TYPICAL PERFORMANCE CHARACTERISTICS

(V

Table 5. PIN DESCRIPTIONS

Pin #	Name	Function
1	EN/DIM	Device enable (active high) and dimming control
2	GND	Ground reference
3	LED1	LED1 cathode terminal
4	LED2	LED2 cathode terminal
5	LED3	LED3 cathode terminal
6	LED4	LED4 cathode terminal
7	RSET	RSET external LED mirror gain 128
8	VIN	Device supply input, connect to battery or supply
TAB	TAB	Connect to GND on the PCB

Pin Function

VIN is the supply pin for the device logic. A small 1 μF ceramic bypass capacitor is required between the VIN pin and ground near the device. The operating input voltage range is from 2.5 V to 5.5 V. Whenever the input supply falls below the under−voltage threshold (1.8 V), all the LED channels are disabled and the

Block Diagram

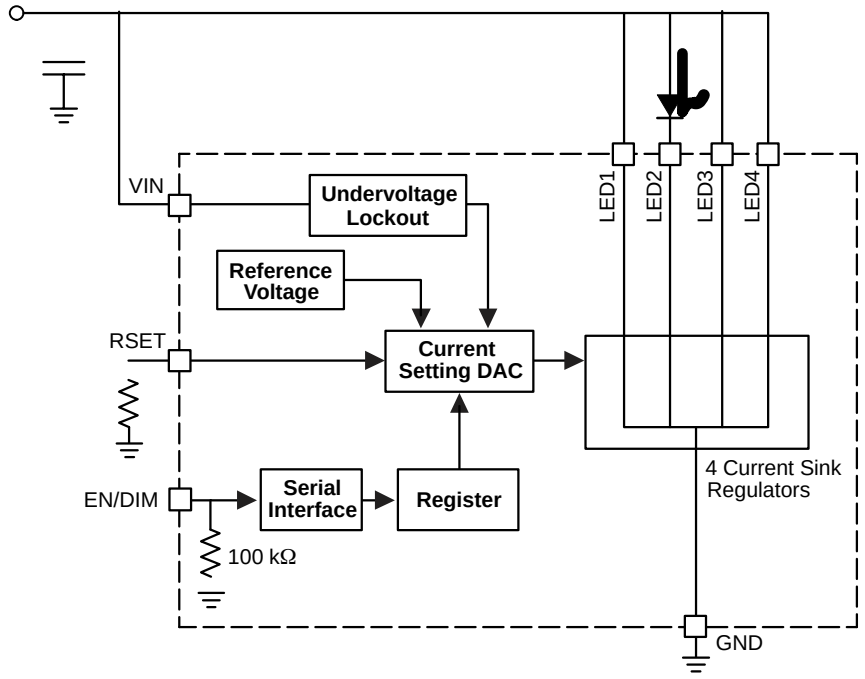
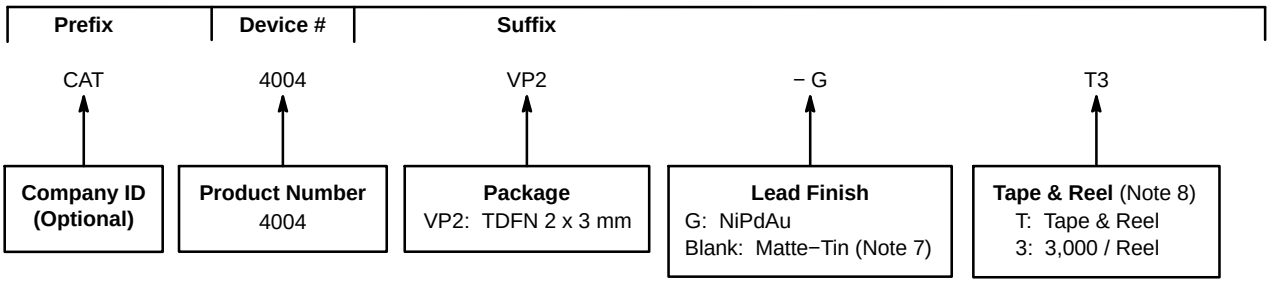


Figure 17. CAT4004 Functional Block Diagram

Example of Ordering Information (Note 6)

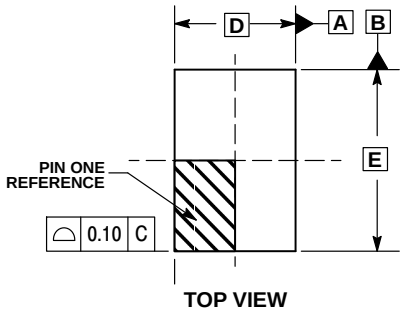


4. All packages are RoHS−compliant (Lead−free, Halogen−free).
5. The standard lead finish is NiPdAu.
6. The device used in the above example is a CAT4004VP2−GT3 (TDFN, NiPdAu Plated Finish, Tape & Reel, 3,000/Reel).
7. For Matte−Tin package option, please contact your nearest ON Semiconductor Sales office.
8. For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

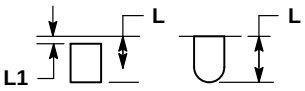
TDFN8, 2x3, 0.5P
CASE 511AK
ISSUE B

SCALE 2:1

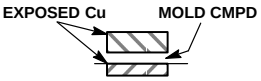
DATE 18 MAR 2015



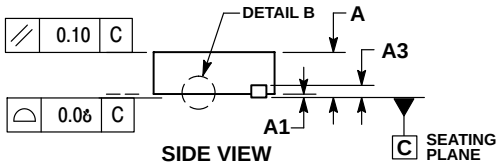
TOP VIEW



DETAIL A
ALTERNATE CONSTRUCTIONS



DETAIL B
ALTERNATE CONSTRUCTION

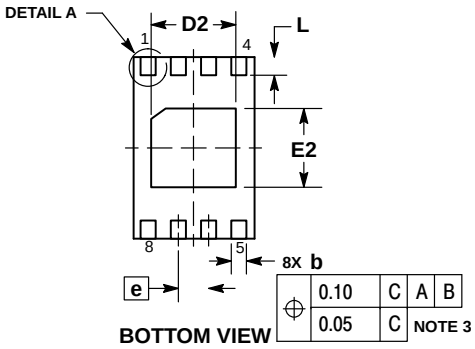


SIDE VIEW

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.25MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS	
DIM	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A3	0.20 REF	
b	0.20	0.30
D	2.00 BSC	
D2	1.30	1.50
E	3.00 BSC	
E2	1.20	1.40
e	0.50 BSC	
L	0.20	0.40
L1	–––	0.15

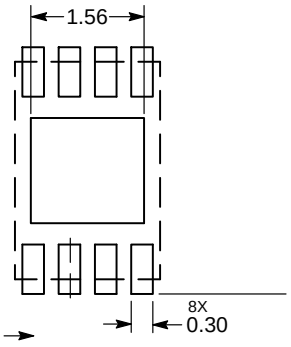
GENERIC MARKING DIAGRAM*



BOTTOM VIEW

XXXXX = Specific Device Code

RECOMMENDED SOLDERING FOOTPRINT*



*For additional information on our Pb−Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.