

# CAT3603

## 3-Channel LED Driver in 3 x 3 mm Package

### Description

The CAT3603 is a charge pump LED driver operating in either 1x (LDO) mode or 1.5x fractional mode regulating current through each of the 3 LED pins. Operation at a constant switching frequency of 1 MHz allows the use of very small value ceramic capacitors.

The CAT3603 drives 3 white LEDs in parallel and provides tightly matched regulated current to achieve uniform brightness in LCD backlighting applications. An external resistor, RSET, controls the output current level. The device can deliver up to 30 mA over an input voltage supply range from 3 V to 5.5 V, making it ideal for battery-powered applications.

LED dimming can be accomplished using several methods; using a DC voltage to set the RSET pin current, applying a PWM signal on the EN pin, or adding a switched resistor in parallel with RSET. The EN input pin allows the device to be placed in power-down mode with “near-zero” quiescent current.

The device is available in the tiny 12-lead thin DFN 3 mm x 3 mm package with a max height of 0.8 mm.

### Features

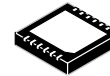
- Drives up to 3 LEDs
- Current Setting Resistor
- Compatible with Supply Voltage of 3 V to 5.5 V
- Power Efficiency up to 91%
- Output Current up to 30 mA per LED
- Fractional Pump 1x/1.5x
- Low Noise Input Ripple
- Fixed High Frequency Operation 1 MHz
- “Zero” Current Shutdown Mode
- Soft Start and Current Limiting
- Short Circuit Protection
- 12-lead TDFN 3 mm x 3 mm Package
- This Device is Pb-Free, Halogen Free/BFR Free and RoHS Compliant

### Applications

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



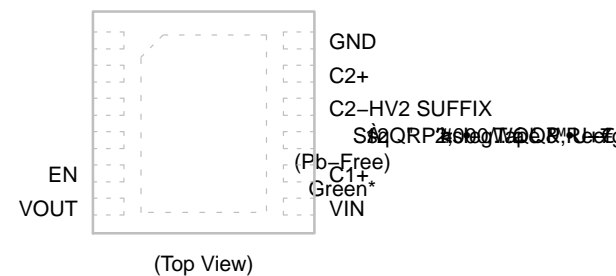
<http://onsemi.com>



TDFN-12  
HV2 SUFFIX  
CASE 511AN

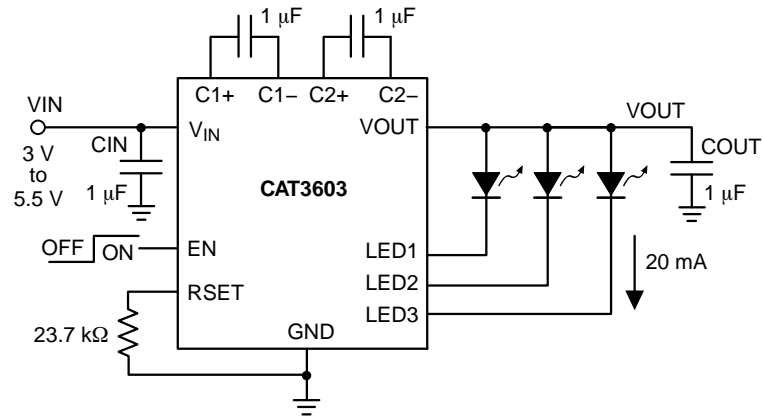
### PIN CONNECTIONS

HABR = CAT3603 Device Code



\* Lead Finish Matte-Tin

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**Note:** Unused LED channels must be connected to VOUT.

**Figure 1. Typical Application Circuit**

**Table 1. ABSOLUTE MAXIMUM RATINGS**

Parameter	Rating	Unit
VIN, VOUT, LEDx voltage	-0.3 to 7.0	V
EN voltage	-0.3 to VIN	V
RSET voltage	-0.3 to VIN	V
Junction Temperature Range	-40 to +150	°C
Storage Temperature Range	-65 to +160	°C
Lead Temperature	300	°C
ESD Rating HBM (Human Body Model)	2,000	V
ESD Rating MM (Machine Model)	200	V

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	Range	Unit
VIN	3 to 5.5	V
Ambient Temperature Range	-40 to +85	°C
Input, Output, Bucket Capacitors	1 ±20% typical	µF
I <sub>LED</sub> per LED pin	0 to 30	mA

1. Typical application circuit with external components is shown above.

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**Table 3. ELECTRICAL OPERATING CHARACTERISTICS**

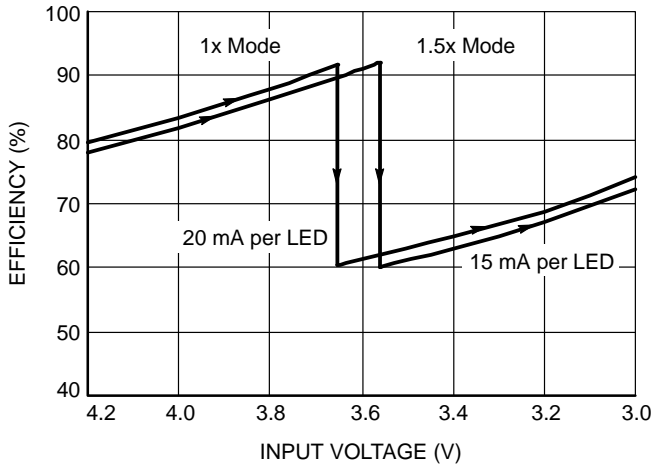
(VIN = 3.6 V, EN = High, TAMB = 25°C over recommended operating conditions unless otherwise stated.)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
IQ	Quiescent Current	V <sub>EN</sub> = 0 V, shutdown mode		0.1	1	μA
		1x Mode, No Load		0.4	1	mA
		1.5x Mode, No Load		2.7	5	mA
V <sub>RSET</sub>	RSET Regulated Voltage		1.17	1.2	1.23	V
I <sub>LED</sub>	Programmed LED Current	I <sub>RSET</sub> = 5 μA		2.4		mA
		I <sub>RSET</sub> = 37 μA		15.0		
		I <sub>RSET</sub> = 78 μA		30.0		
I <sub>LED-ACC</sub>	LED Current Accuracy	0.5 mA ≤ I <sub>LED</sub> ≤ 3 mA		±15		%
		3 mA ≤ I <sub>LED</sub> ≤ 30 mA		±5		
I <sub>LED-DEV</sub>	LED Channel Matching	(I <sub>LED</sub> - I <sub>LEDAVG</sub> ) / I <sub>LEDAVG</sub>		±3		%
R <sub>OUT</sub>	Output Resistance (Open Loop)	1x Mode				
		1.5x Mode, I <sub>OUT</sub>				

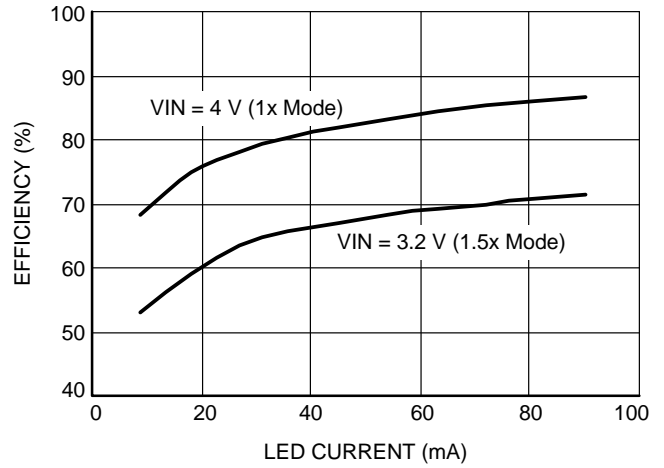
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## TYPICAL CHARACTERISTICS

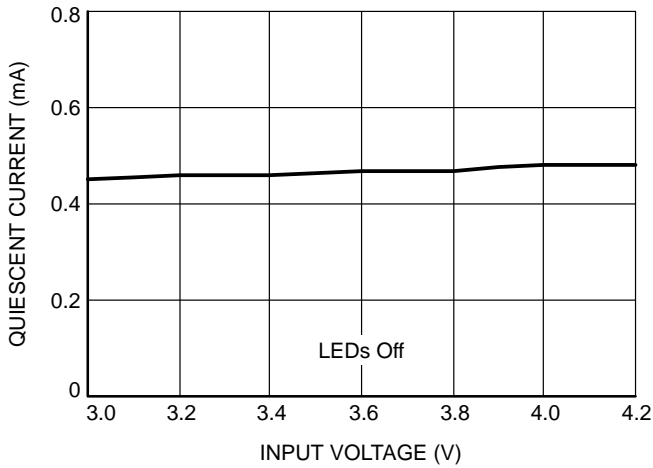
(VIN = 3.6 V, IOUT = 60 mA (3 LEDs at 20 mA), C1 = C2 = CIN = COUT = 1 μF, TAMB = 25°C unless otherwise specified.)



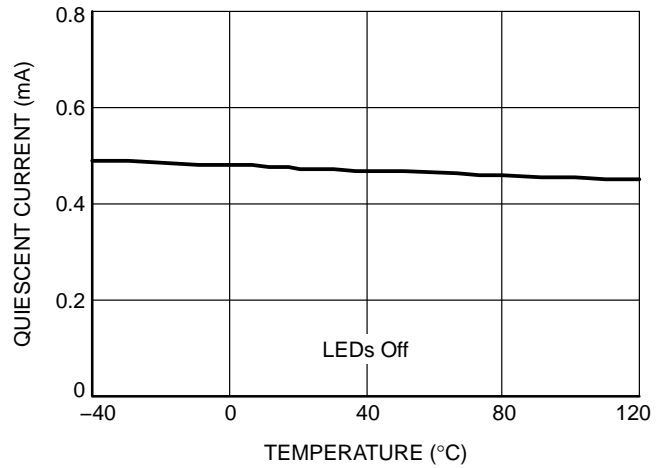
**Figure 2. Efficiency vs. Input Voltage (3 LEDs on)**



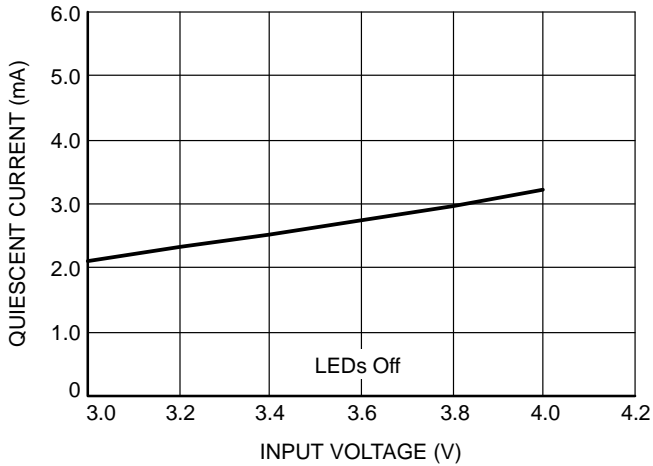
**Figure 3. Efficiency vs. Total LED Current (3 LEDs)**



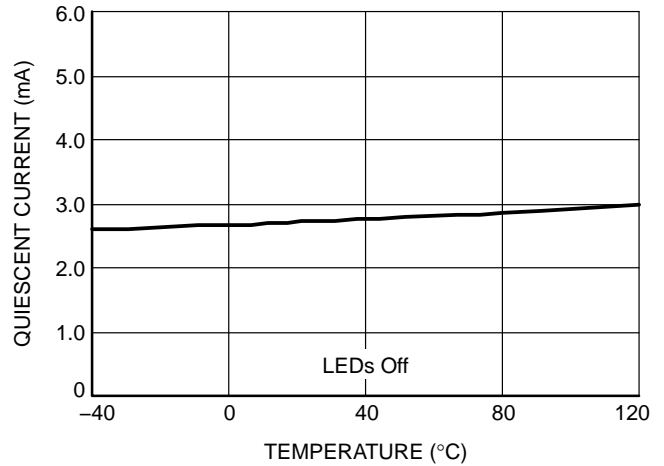
**Figure 4. Quiescent Current vs. Input Voltage (1x Mode)**



**Figure 5. Quiescent Current vs. Temperature (1x Mode)**



**Figure 6. Quiescent Current vs. Input Voltage (1.5x Mode)**



**Figure 7. Quiescent Current vs. Temperature (1.5x Mode)**

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## TYPICAL CHARACTERISTICS

(VIN = 3.6 V, IOUT = 60 mA (3 LEDs at 20 mA), C1 = C2 = CIN = COUT = 1 μF, TAMB = 25°)

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## TYPICAL CHARACTERISTICS

(VIN = 3.6 V, IOUT = 60 mA (3 LEDs at 20 mA), C1 = C2 = CIN = COUT = 1 μF, TAMB = 25°C unless otherwise specified.)

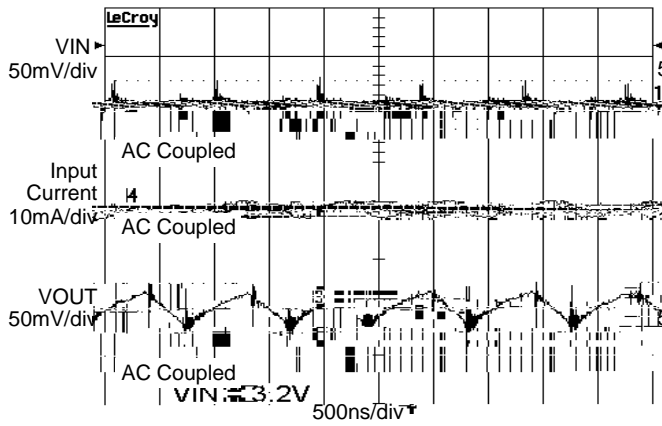


Figure 14. Switching Waveforms in 1.5x Mode

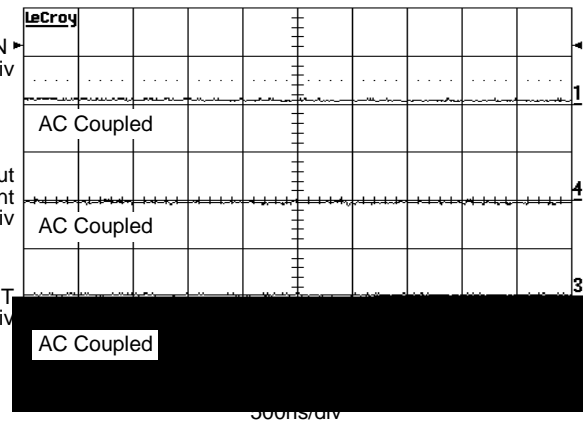


Figure 15. Operating Waveforms in 1x Mode

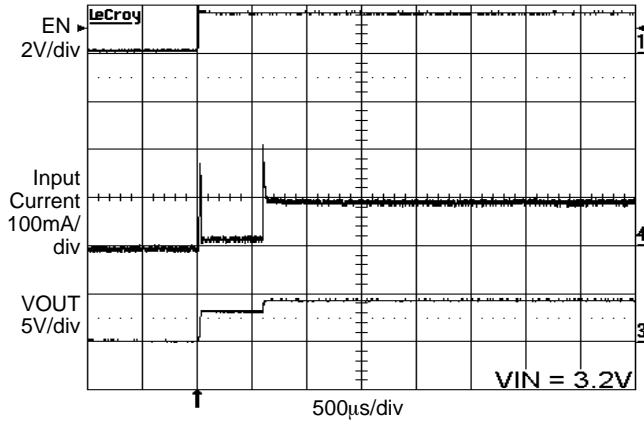


Figure 16. Power Up 3 LEDs at 20 mA, VIN = 3.2 V (1.5x Mode)

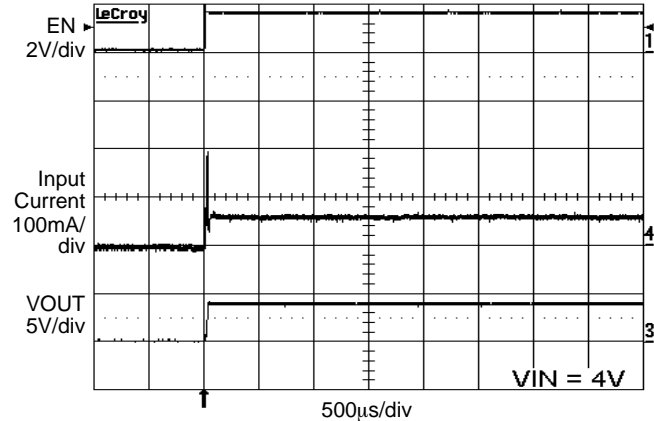


Figure 17. Power Up 3 LEDs at 20 mA, VIN = 4 V (1x Mode)

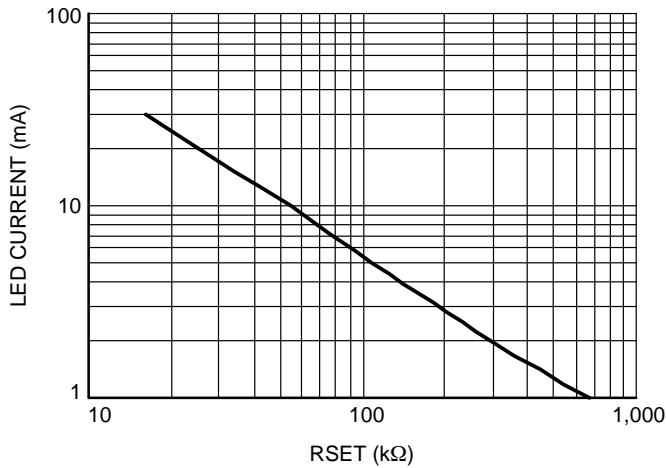


Figure 18. LED Current vs. RSET

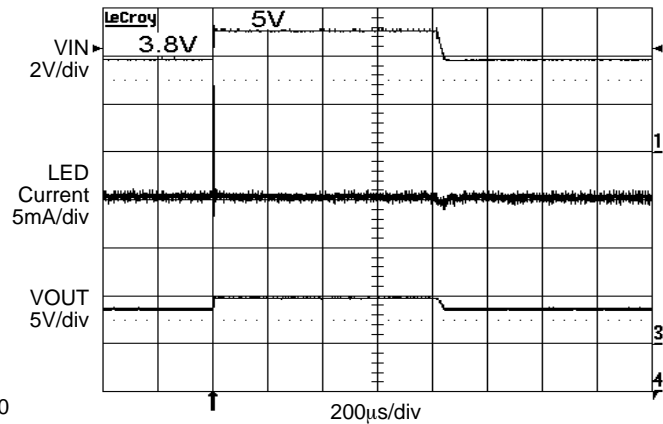


Figure 19. Line Transient Response in 1x Mode



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## Block Diagram

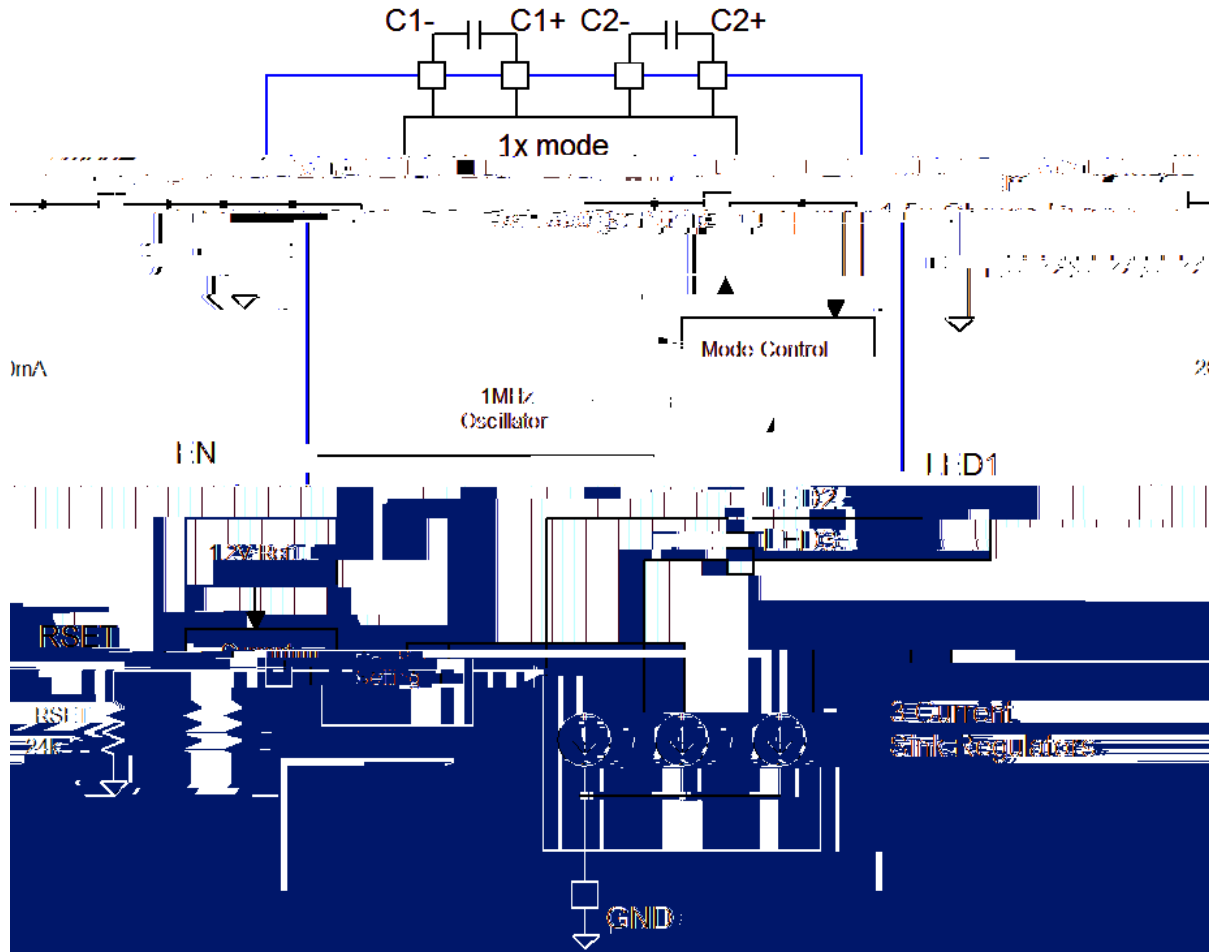


Figure 21. CAT3603 Functional Block Diagram

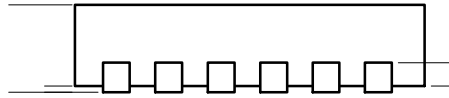
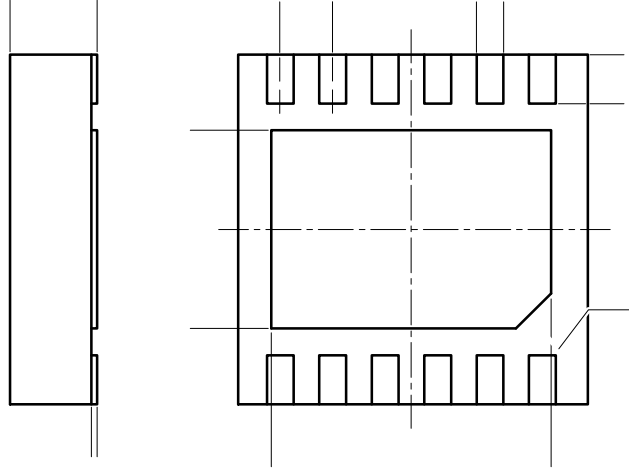


Basic Operation

**CAT3603**

**TDFN12, 3x3**  
CASE 511AN  
ISSUE A

DATE 18 MAR 2009



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