



# CAT3647

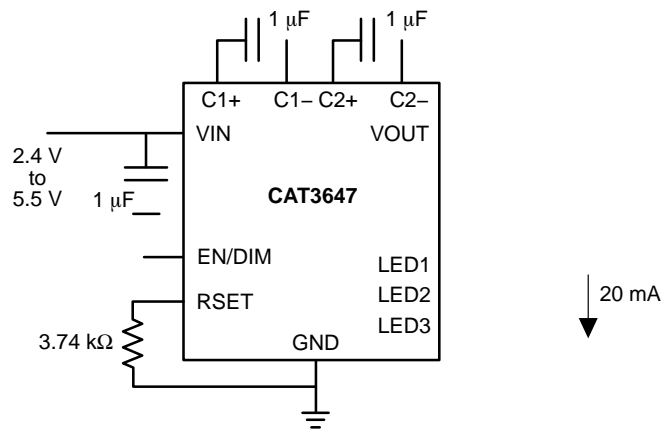


Figure 1. Typical Application Circuit

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**Table 3. ELECTRICAL OPERATING CHARACTERISTICS**

(over recommended operating conditions unless specified otherwise)  $V_{IN} = 3.6\text{ V}$ ,  $EN = \text{High}$ ,  $T_{AMB} = 25^{\circ}\text{C}$

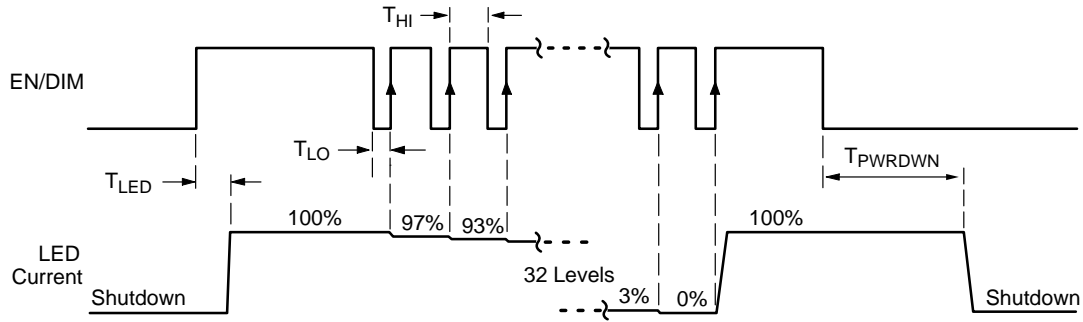
Symbol	Name	Conditions	Min	Typ	Max	Units
$I_Q$	Quiescent Current					

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**Table 4. RECOMMENDED EN/DIM TIMING**

(For  $2.4\text{ V} \leq V_{IN} \leq 5.5\text{ V}$ , over full ambient temperature range  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .)

Symbol	Name	Conditions	Min	Typ	Max	Units
$T_{LO}$	EN/DIM program low time		0.2		100	$\mu\text{s}$
$T_{HI}$	EN/DIM program high time		0.2			$\mu\text{s}$
$T_{PWRDWN}$	EN/DIM low time to shutdown		1.5			ms
$T_{LED}$	LED current settling time			40		$\mu\text{s}$



**Figure 2. EN/DIM Digital Dimming Timing Diagram**

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## TYPICAL PERFORMANCE CHARACTERISTICS

( $V_{IN} = 3.6\text{ V}$ ,  $I_{OUT} = 60\text{ mA}$  (3 LEDs at 20 mA),  $C_{IN} = C_{OUT} = C_1 = C_2 = 1\ \mu\text{F}$ ,  $T_{AMB} = 25^\circ\text{C}$  unless otherwise specified.)

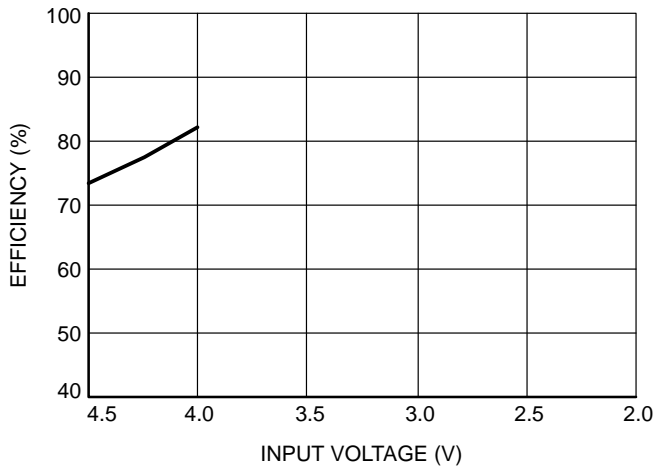


Figure 3. Efficiency vs. Input Voltage

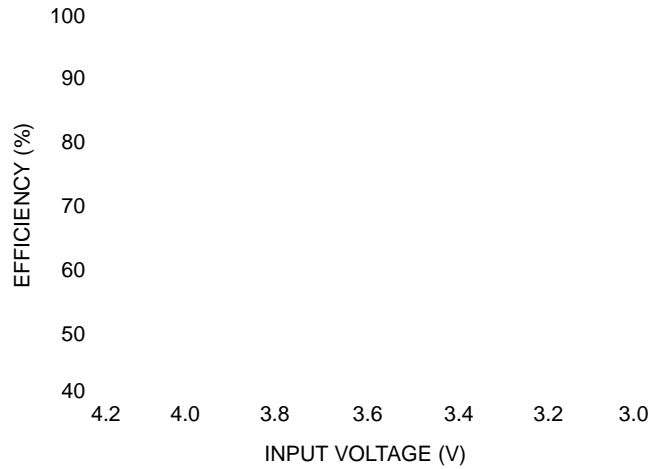


Figure 4. Efficiency vs. Li-Ion Voltage

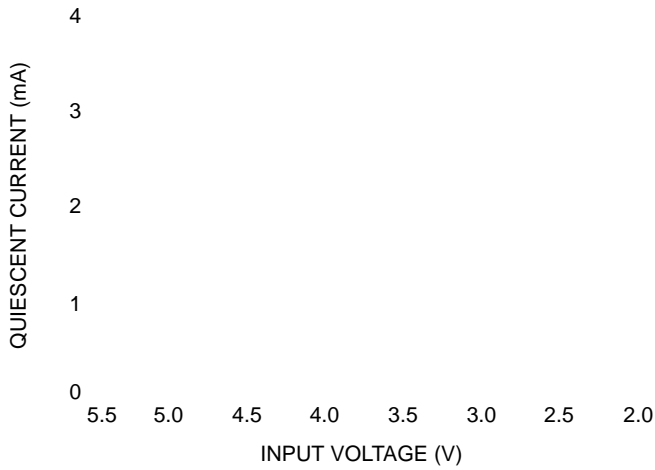


Figure 5. Quiescent Current vs. Input Voltage

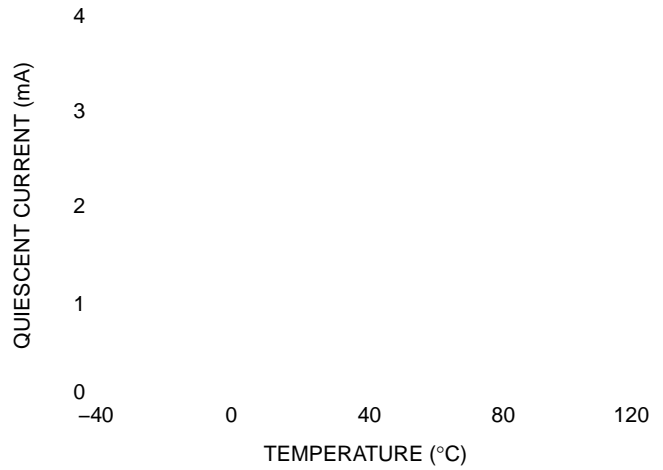


Figure 6. Quiescent Current vs. Temperature

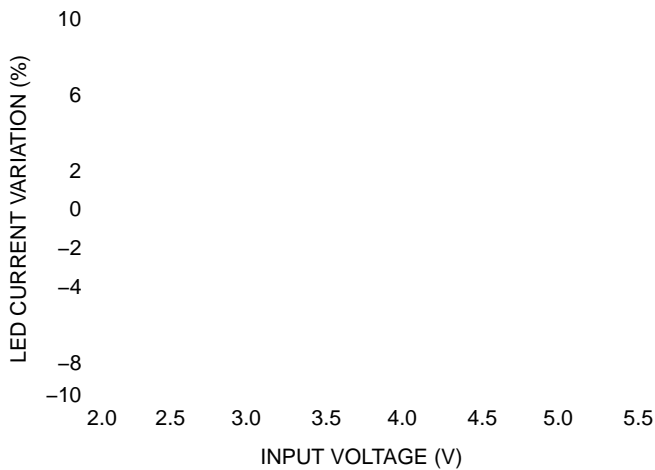


Figure 7. LED Current Change vs. Input Voltage

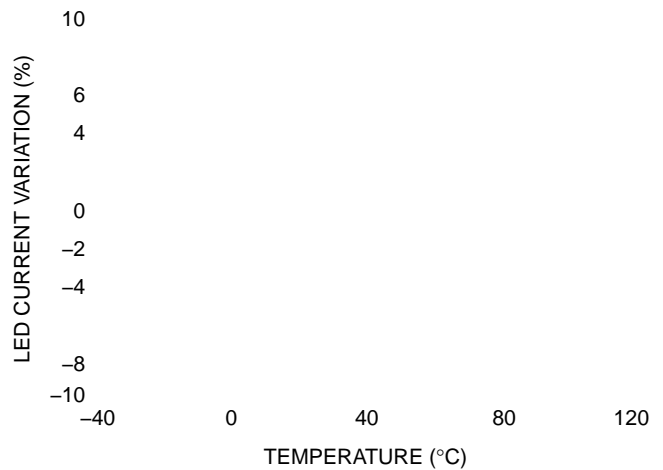


Figure 8. LED Current Change vs. Temperature

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## TYPICAL PERFORMANCE CHARACTERISTICS

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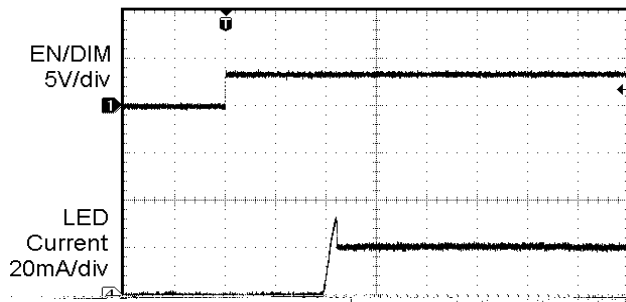


Figure 15. Power Up Delay (1x Mode)

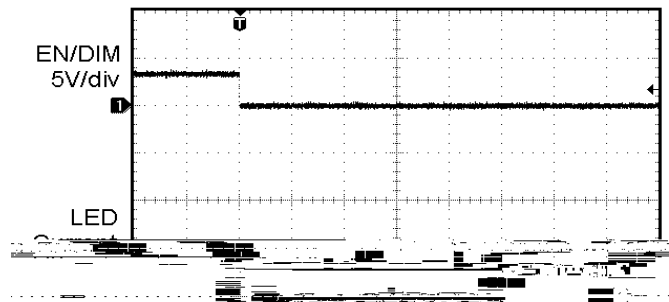


Figure 16. Power Down Delay (1x Mode)

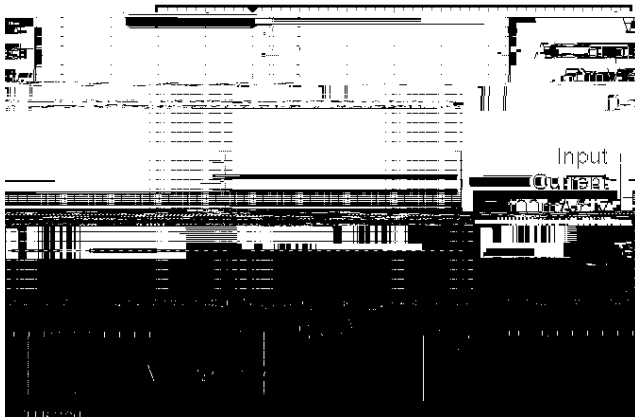


Figure 17. Operating Waveforms in 1x Mode

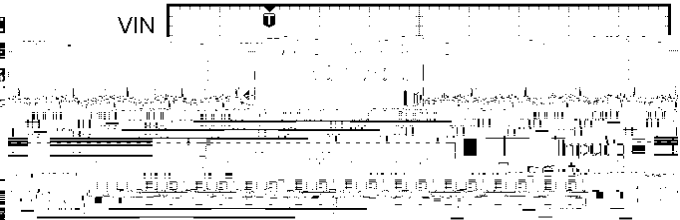


Figure 18. Switching Waveforms in 1.33x Mode

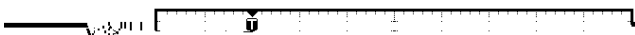


Figure 19. Switching Waveforms in 1.5x Mode

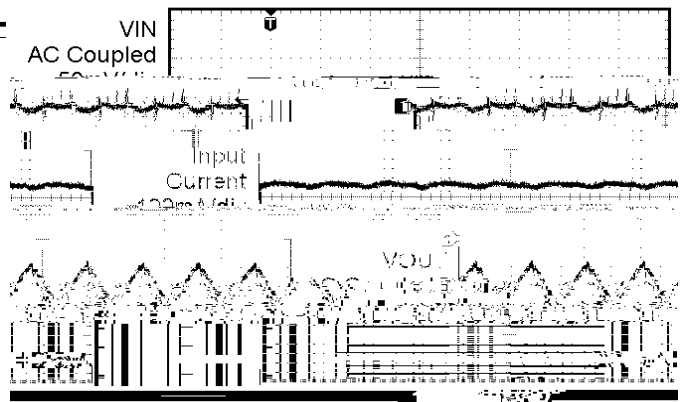
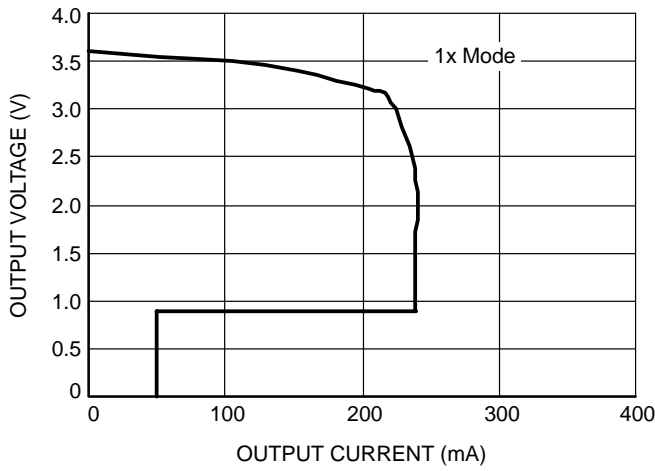


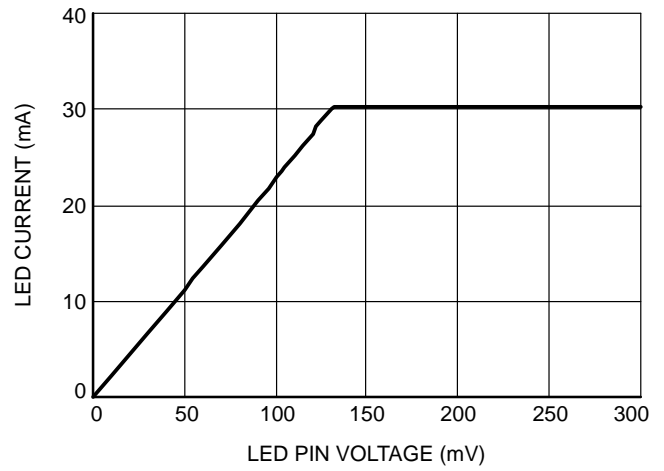
Figure 20. Switching Waveforms in 2x Mode

**TYPICAL PERFORMANCE CHARACTERISTICS**

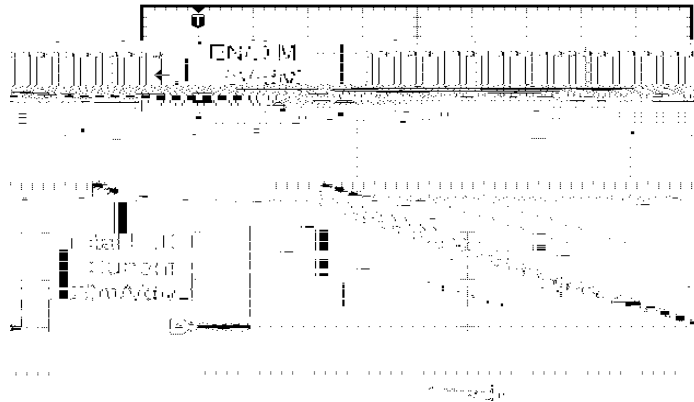
( $V_{IN} = 3.6\text{ V}$ ,  $I_{OUT} = 60\text{ mA}$  (3 LEDs at 20 mA),  $C_{IN} = C_{OUT} = C_1 = C_2 = 1\ \mu\text{F}$ ,  $T_{AMB} = 25^\circ\text{C}$  unless otherwise specified.)



**Figure 21. Foldback Current Limit**



**Figure 22. LED Current vs. LED Pin Voltage**



**Figure 23. Dimming Waveform**



Table 6. PIN DESCRIPTION

Name	Function
LED1	LED1 cathode terminal.
LED2	LED2 cathode terminal.
LED3	LED3 cathode terminal.
RSET	Connect resistor RSET to set the LED current.
EN/DIM	Device enable (active high) and Dimming Control.
VOUT	Charge pump output connected to the LED anodes.
VIN	Charge pump input, connect to battery or supply.
C1+	Bucket capacitor 1 Positive terminal
C1-	Bucket capacitor 1 Negative terminal
C2+	Bucket capacitor 2 Positive terminal
C2-	Bucket capacitor 2 Negative terminal
GND	Ground Reference
NC	Not connected inside package.
GND	Connect to GND on the PCB.

**Pin Function**

**VIN** is the supply pin for the charge pump. A small 1  $\mu$ F 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 device enters shutdown mode.

**EN/DIM** is the enable and one wire dimming input for all LED channels. Levels of logic high and logic low are set at 1.3 V and 0.4 V respectively. When EN/DIM is initially taken high, the device becomes enabled and all LED currents are set to the full scale according to the resistor  $R_{SET}$ . To place the device into “zero current” shutdown mode, the EN/DIM pin must be held low for at least 1.5 ms.

**VOUT** is the charge pump output that is connected to the LED anodes. A small 1  $\mu$ F ceramic bypass capacitor is required between the VOUT pin and ground near the device.

**GND** is the ground reference for the charge pump. The pin must be connected to the ground plane on the PCB.

**C1+, C1-** are connected to each side of the ceramic bucket capacitor  $C_1$ .

**C2+, C2-** are connected to each side of the ceramic bucket capacitor  $C_2$ .

**LED1, LED2, LED3** provide the internal regulated current sources for each of the LED cathodes. These pins enter high-impedance zero current state whenever the device is placed in shutdown mode.

**TAB** is the exposed pad underneath the package. For best thermal performance, the tab should be soldered to the PCB and connected to the ground plane.

**RSET** is connected to the resistor ( $R_{SET}$ ) to set the full scale current for the LEDs. The voltage at this pin regulated to

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## Block Diagram

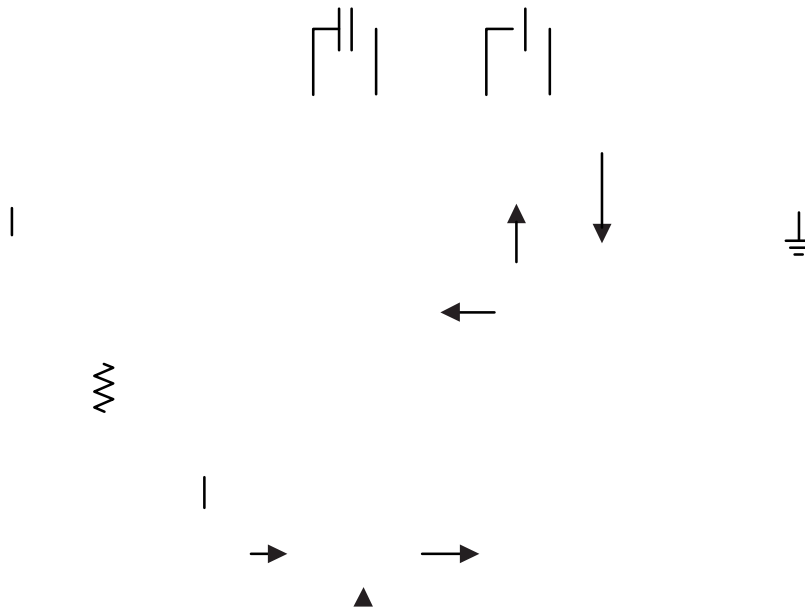


Figure 24. CAT3647 Functional Block Diagram

**LED Current Selection**

After power-up, the LED current is set by the external resistor ( $R_{SET}$ ) value and the number of pulses (n) on the EN/DIM input as follows:

$$\text{LED current} = 125 \times \frac{0.6 \text{ V}}{R_{SET}} \times \left( \frac{31 - n}{31} \right)$$

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## Unused LED Channels

For applications not requiring all the channels, it is recommended the unused LED pins be tied directly to VOUT (see Figure 26).

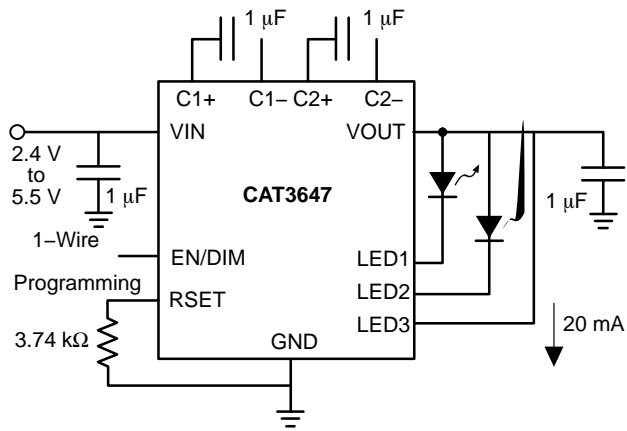
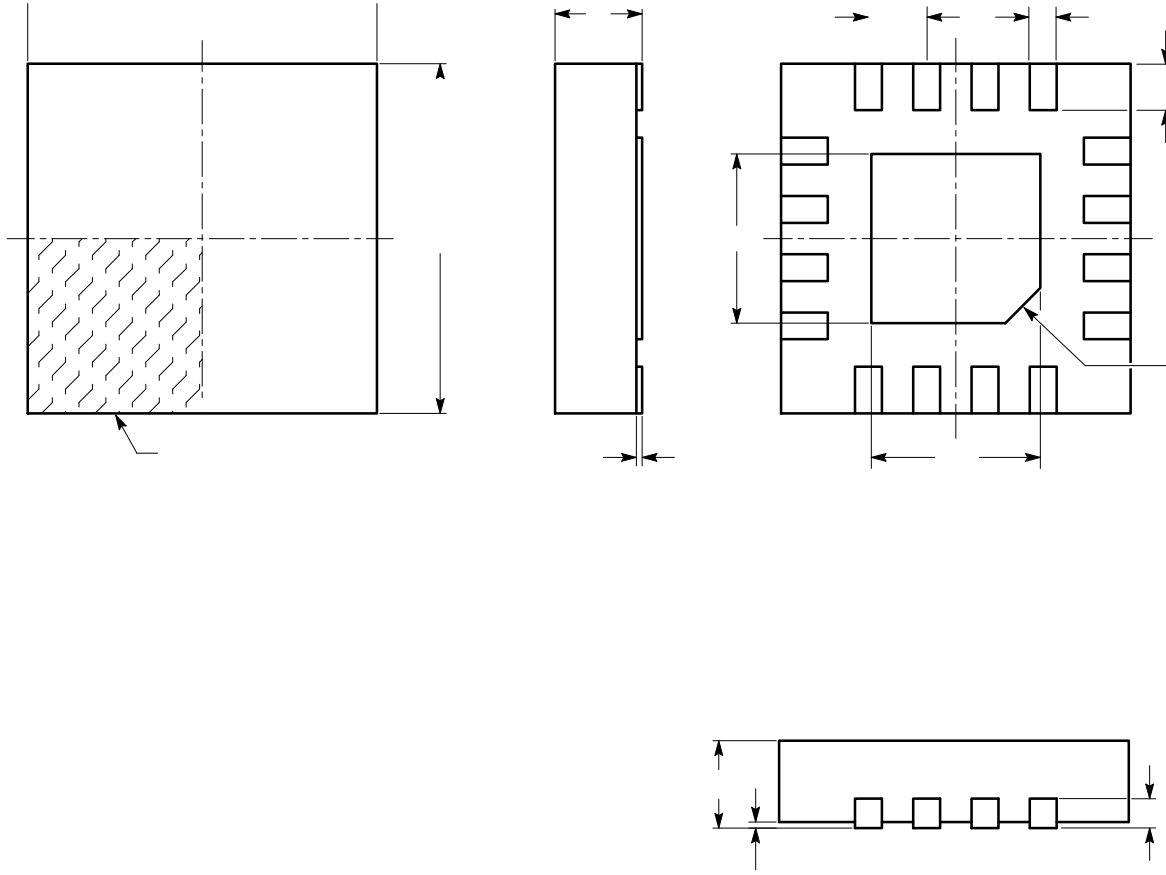


Figure 26. Application with 2 LEDs

TQFN16, 3x3



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