CAT3614

4-C a 1-W LED
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Description

The CAT3614 is a high efficiency 1x/1.5x fractional charge pump with programmable dimming current in four LED channels. To ensure uniform brightness in LCD backlight applications, each LED channel delivers an accurate regulated current.

Low noise and input ripple is achieved by operating at a constant switching frequency of 1 MHz which allows the use of small external ceramic capacitors. The 1x/1.5x fractional charge pump supports a wide range of input voltages from 3 V to 5.5 V with efficiency up to 91%, and is ideal for Li−Ion battery powered devices.

The EN/DIM logic input provides a 1−wire EZDim™ interface for dimming control of the LEDs. When enabled, a series of clock pulses reduces the LED brightness in 1 mA steps on each negative going edge. Currents from 0 mA to 31 mA are supported.

The device is available in the tiny 12−pad TDFN 3 x 3 mm package with a max height of 0.8 mm.

Features

- Drives up to 4 LED Channels
- 1−wire EZDim™ Programmable LED Current

TDFN 12−pad 3 mm x 3 mm 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

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CAT3614/D

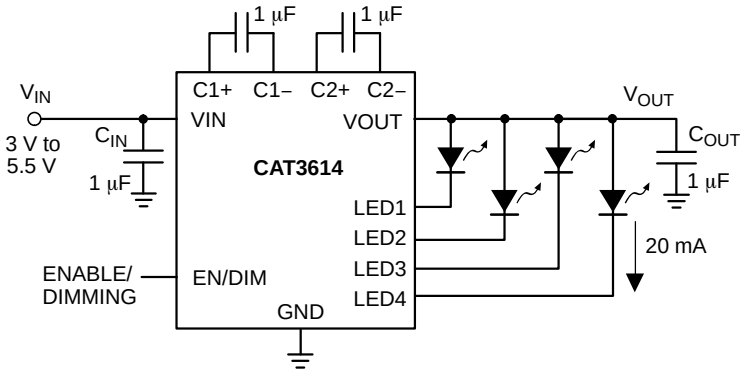

Figure 1. Typical Application Circuit

NOTE: Unused LED channels must be connected to VOUT.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Rating	Unit
VIN, LEDx voltage	6	V
VOUT, C1±, C2± voltage	7	V
EN/DIM voltage	V_{IN} + 0.7 V	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	Range	Unit
VIN	3 to 5.5	V
Ambient Temperature Range	−40 to +85	°C
I_{LED} per LED pin	0 to 31	mA
Total Output Current	0 to 124	mA

NOTE: Typical application circuit with external components is shown above.

Table 3. ELECTRICAL OPERATING CHARACTERISTICS

V_{IN} = 3.6 V, EN = High, ambient temperature of 25°C (over recommended operating conditions unless specified otherwise).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_Q	Quiescent Current	1x mode, no load 1.5x mode, no load	0.3 1	0.5 3	1 8	mA
I_{QSHDN}	Shutdown Current	V_{EN} = 0 V			1	μA
$I_{LED-ACC}$	LED Current Accuracy	1 mA ≤ I_{LED} ≤ 31 mA		±3	±8	%
$I_{LED-DEV}$	LED Channel Matching	(I_{LED} − I_{LEDAVG}) / I_{LEDAVG}		±3	±7	%
R_{OUT}	Output Resistance (open loop)	1x mode, I_{OUT} = 100 mA 1.5x mode, I_{OUT} = 100 mA		0.4 2.6	1 7	Ω
F_{OSC}	Charge Pump Frequency		0.8	1	1.3	MHz
I_{SC_MAX}	Output short2oh2.84 .8ouient					

TYPICAL CHARACTERISTICS

(V_{IN} = 3.6 V, I_{OUT} = 80 mA (4 LEDs at 20 mA), C_1 = C_2 = C_{IN} = C_{OUT} = 1 μF, T_{AMB} = 25°C unless otherwise specified.)

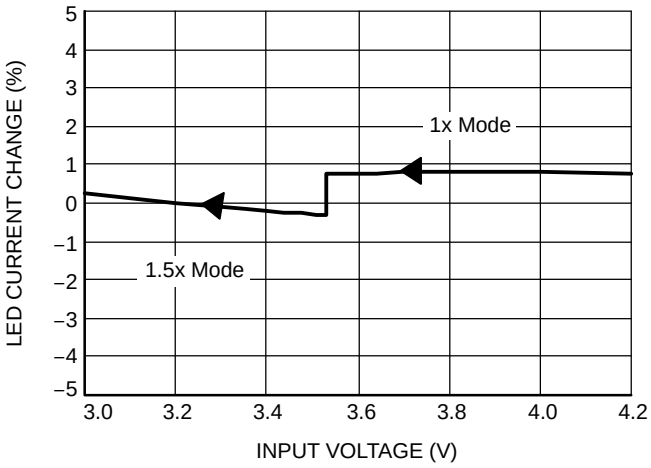

Figure 9. LED Current Change vs. Input Voltage

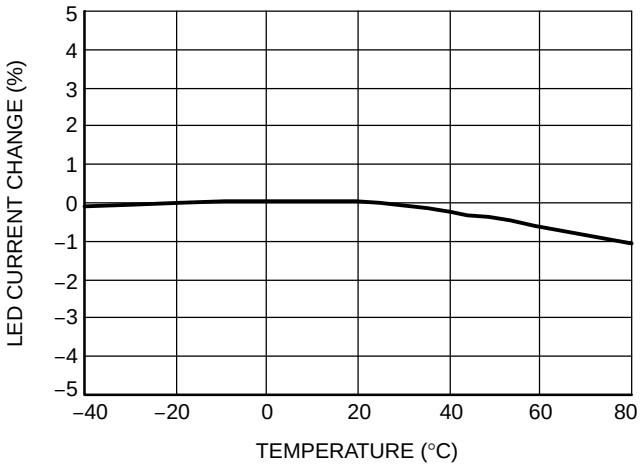

Figure 10. LED Current Change vs. Temperature

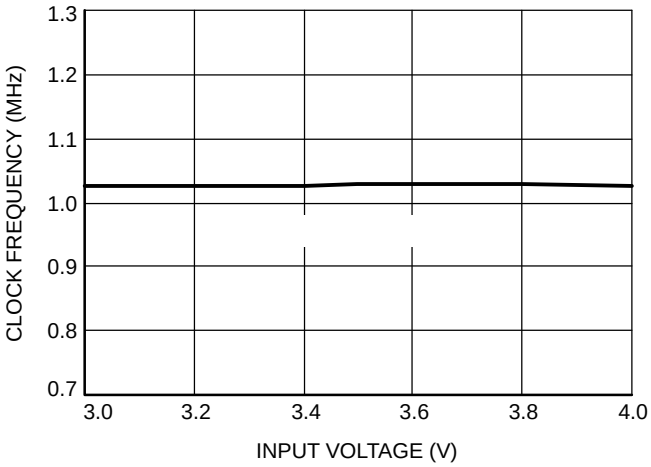

Figure 11. Oscillator Frequency vs. Input Voltage

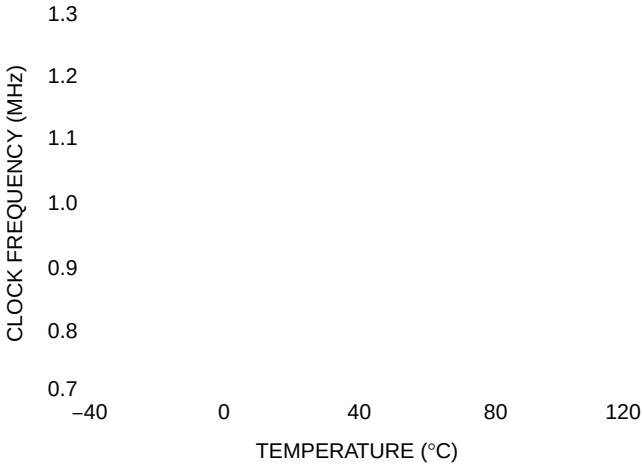

Figure 12. Oscillator Frequency vs. Temperature

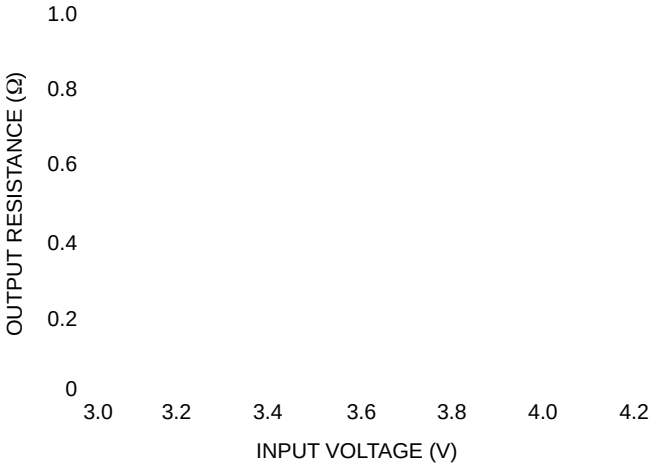

Figure 13. Output Resistance vs. Input Voltage (1x Mode)

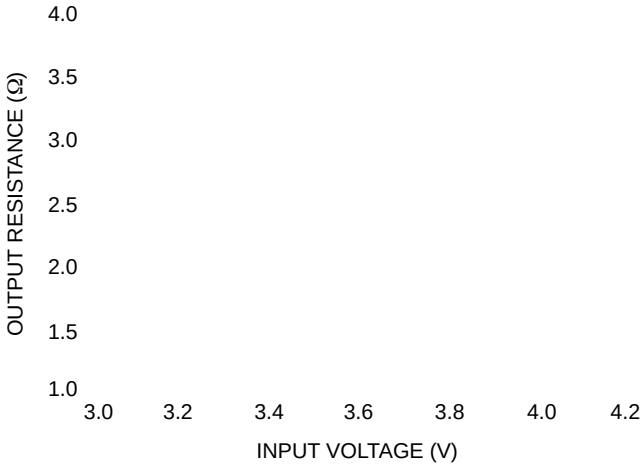

Figure 14. Output Resistance vs. Input Voltage (1.5x Mode)

TYPICAL CHARACTERISTICS

(V_{IN} = 3.6 V, I_{OUT} = 80 mA (4 LEDs at 20 mA), $C_1 = C_2 = C_{IN} = C_{OUT}$ = 1

Table 5. PIN DESCRIPTIONS

Pin #	Name	Function
1	VIN	Supply voltage.
2	C1+	Bucket capacitor 1 terminal
3	C1–	Bucket capacitor 1 terminal
4	C2–	Bucket capacitor 2 terminal
5	C2+	Bucket capacitor 2 terminal
6	GND	Ground reference
7	LED1	LED1 cathode terminal (if not used, connect to VOUT) (Note 3)
8	LED2	LED2 cathode terminal (if not used, connect to VOUT) (Note 3)
9	LED3	LED3 cathode terminal (if not used, connect to VOUT) (Note 3)
10	LED4	LED4 cathode terminal (if not used, connect to VOUT) (Note 3)
11	EN/DIM	Device enable (active high) and dimming control input
12	VOUT	Charge pump output connected to the LED anodes
TAB	TAB	Connect to GND on the PCB

3. LED1, LED2, LED3, LED4 pins should not be left floating. They should be connected to the LED cathode, or tied to VOUT pin if not used.

Pin Function

VIN is the supply pin for the charge pump. 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 2.2 V to 5.5 V. Whenever the input supply falls below the undervoltage threshold (2 V) all LEDs channels will be automatically disabled.

EN/DIM is the enable and dimming control logic input for all LED channels. Guaranteed 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 remain at 0 mA. The falling edge of the first pulse applied to EN/DIM sets all LED currents to their full scale of 31 mA.

On each consecutive falling edge of the pulse applied to EN/DIM, the LED current is decreased by 1 mA step. On the 32nd pulse, the LED current is set to zero. The next pulse on EN/DIM resets the current back to their full scale of 31 mA.

To place the device into zero current shutdown mode, the EN/DIM pin must be held low for 1.5 ms or more.

VOUT

Block Diagram

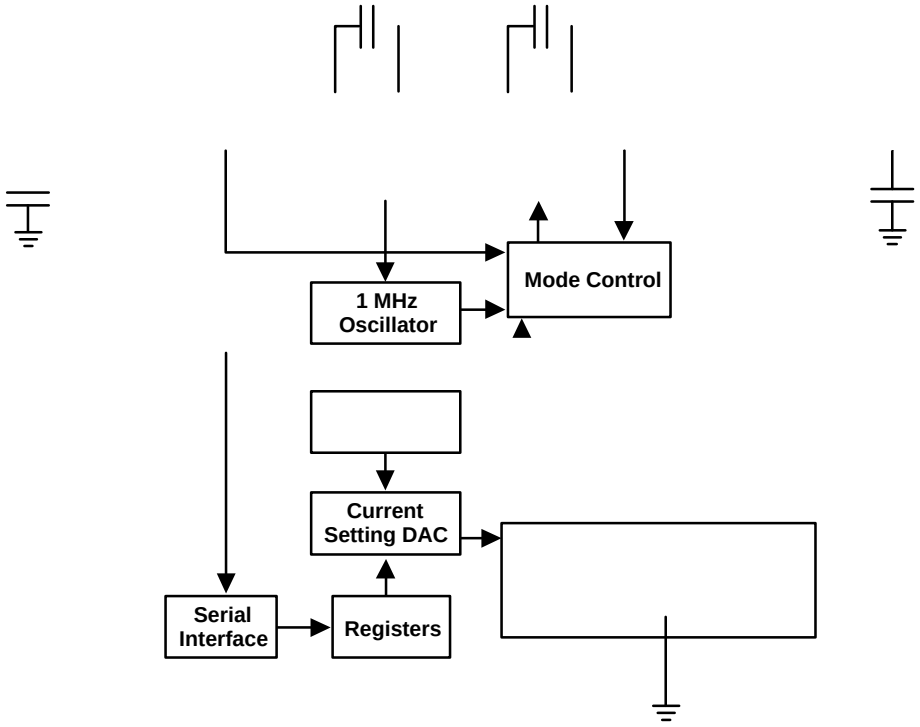

Figure 27. CAT3614 Functional Block Diagram

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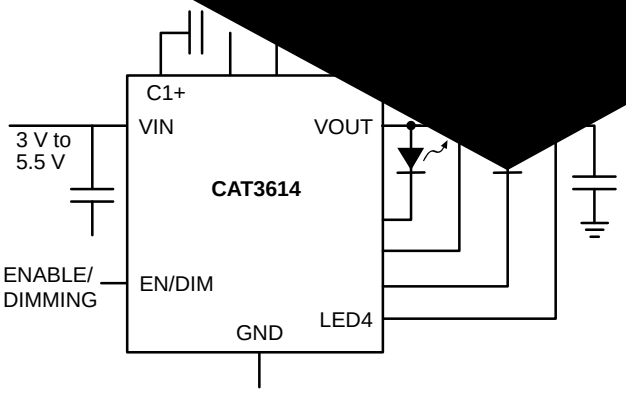

Figure 28. Three LED Application

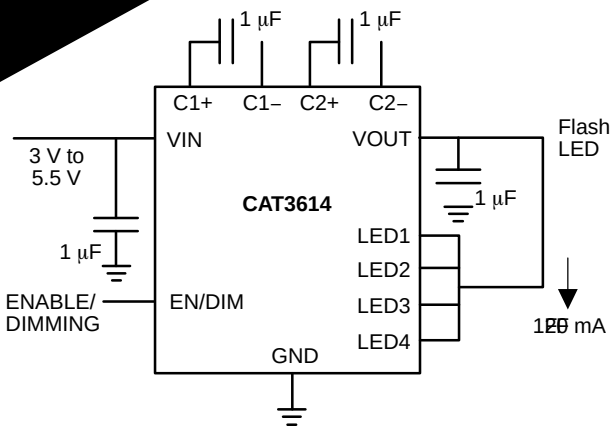

Figure 29. Single Flash LED Application

TDFN12, 3x3
CASE 511AN−01
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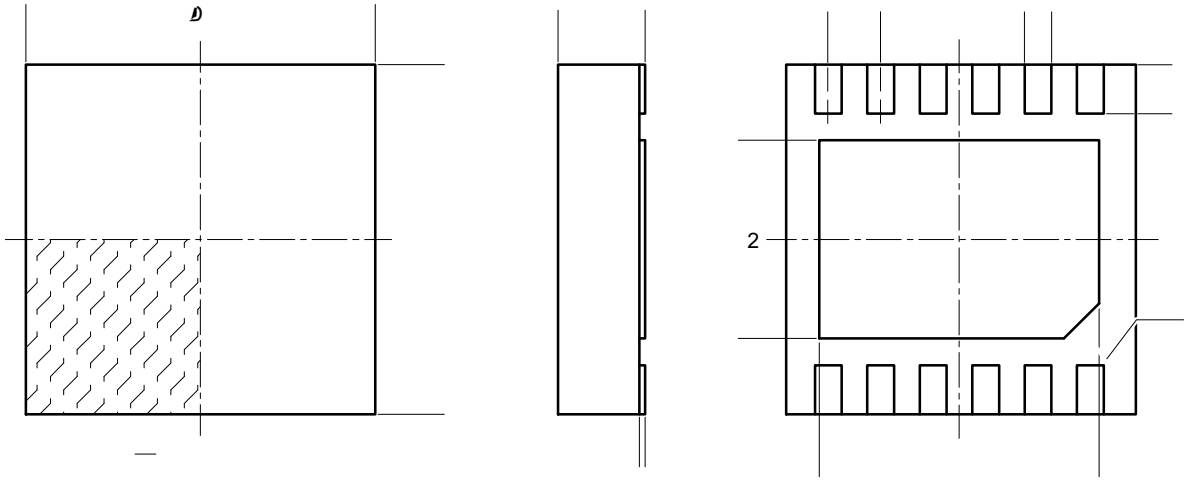
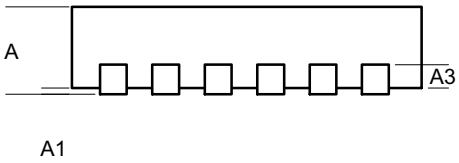
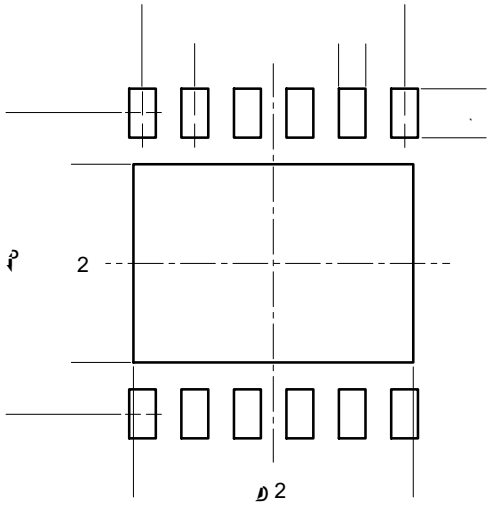


TOP VIEW **SIDE VIEW** **BOTTOM VIEW**





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