



6-Channel Charge Pump LED Driver with EZDim™



FEATURES

- › 6 LED channels with tight matching
- › Independent Main and Sub channels
- › 1-wire EZDim™ Programmable LED Current
- › Accurate 1mA Dimming Level
- › Power efficiency up to 91%
- › Fractional pump 1x/1.5x
- › Low noise input ripple
- › Fixed High Frequency Operation 1MHz
- › “Zero” Current Shutdown Mode
- › Soft start and current limiting
- › Short circuit protection
- › Thermal shutdown protection
- › RoHS-compliant 16-pad TQFN 4mm x 4mm package

APPLICATION

- › Main and sub-display backlight
- › Color LCD and keypad Backlighting
- › Cellular Phones
- › Handheld Devices
- › Digital Cameras

ORDERING INFORMATION

Part Number	Package	Quantity per Reel	Package Marking
CAT3616HV4-T2	TQFN-16 ⁽¹⁾	2000	G616
CAT3616HV4-GT2	TQFN-16 ⁽²⁾	2000	CDAH

Notes: (1) Matte-Tin Plated Finish (RoHS-compliant).
 (2) NiPdAu Plated Finish (RoHS-compliant).

DESCRIPTION

The CAT3616 is a high efficiency 1x/1.5x fractional charge pump with programmable dimming current in six 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 1MHz which allows the use of small external ceramic capacitors. The 1x/1.5x fractional charge pump supports a wide range of input voltages from 3V to 5.5V with efficiency up to 91%, and is ideal for Li-Ion battery powered devices.

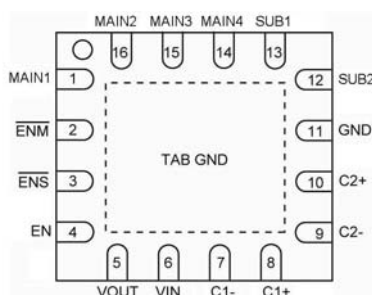
Two groups of LEDs, main (MAIN1 to MAIN4) and sub (SUB1 and SUB2) are programmable through the $\overline{\text{ENM}}$ (active low) and $\overline{\text{ENS}}$ inputs. Independent current from 1mA to 31mA with a 1mA step are set by toggling the $\overline{\text{ENM}}$ and $\overline{\text{ENS}}$ inputs. The enable EN input pin allows to shutdown the device with zero quiescent current.

The device is available in a 16-pad TQFN package with a max height of 0.8mm.

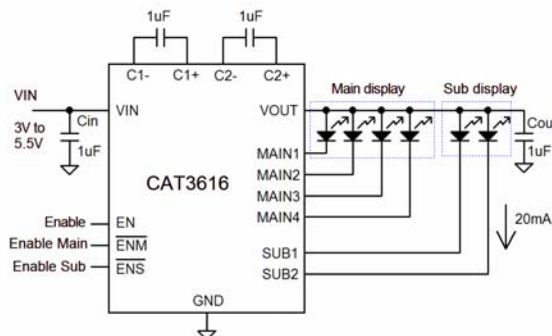
For Ordering Information details, see page 13.

PIN CONFIGURATION

TQFN 16-pad 4 x 4mm (Top view)



TYPICAL APPLICATION CIRCUIT



Note: Unused LED channels must be connected to VOUT.

ABSOLUTE MAXIMUM RATINGS

Parameter	Rating	Unit
V _{IN} , LED _{xx} voltage	6	V
V _{OUT} , C1 _± , C2 _± voltage	7	V
EN, $\bar{E}N\bar{M}$, $\bar{E}N\bar{S}$ voltage	V _{IN} + 0.7V	V
Storage Temperature Range	-65 to +160	°C
Junction Temperature Range	-40 to +150	°C
Lead Temperature	300	°C

RECOMMENDED OPERATING CONDITIONS

Parameter	Range	Unit
V _{IN}	3 to 5.5	V
Ambient Temperature Range	-40 to +85	°C
I _{LED} per LED pin	0 to 31	mA
I _{OUT} Total Output Current	0 to 150	mA

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

ELECTRICAL OPERATING CHARACTERISTICS

V_{IN} = 3.6V, 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, all LEDs Off 1x mode, all LEDs On 1.5x mode, all LEDs Off		0.5 2.2 3.5		mA mA mA
I _{QSHDN}	Shutdown Current	V _{EN} = 0V		0	1	µA
I _{LED}	LED Current Range with 6 LEDs		0		31	mA
I _{LED-ACC}	LED Current Accuracy	1mA ≤ I _{LED} ≤ 31mA		±3		%
I _{LED-DEV}	LED Channel Matching	(I _{LED} - I _{LEDAVG}) / I _{LEDAVG}		±3		%
R _{OUT}	Output Resistance (open loop)	1x mode, I _{OUT} = 120mA 1.5x mode, I _{OUT} = 120mA		0.5 2.2		Ω Ω
F _{OSC}	Charge Pump Frequency		0.8	1	1.3	MHz
I _{SC_MAX}	Output short circuit Current Limit	V _{OUT} < 0.5V		60		mA
I _{IN_MAX}	Input Current Limit	1x mode, V _{OUT} > 1V		300		mA
I _{EN/DIM} V _{HI} V _{LO}	EN/DIM Pin • Input Leakage • Logic High Level • Logic Low Level		-1 1.3		1 0.4	µA V V
T _{SD}	Thermal Shutdown			165		°C
T _{HYS}	Thermal Hysteresis			20		°C
V _{UVLO}	Undervoltage lock out (UVLO) threshold			2		V

RECOMMENDED EN, ENM AND ENS TIMING

For 3V VIN 5.5V, over full ambient temperature range -40 to +125°C.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{SETP}	EN setup from shutdown		10			μs
T_{LO}	\overline{ENM} , \overline{ENS} program low time		0.3		200	μs
T_{HI}	\overline{ENM} , \overline{ENS} program high time		0.3			μs
T_{OFF}	EN low time to shutdown		1.5			ms
T_D	LED current enable			40		μs
T_{DEC}	LED current decrement			0.1		μs

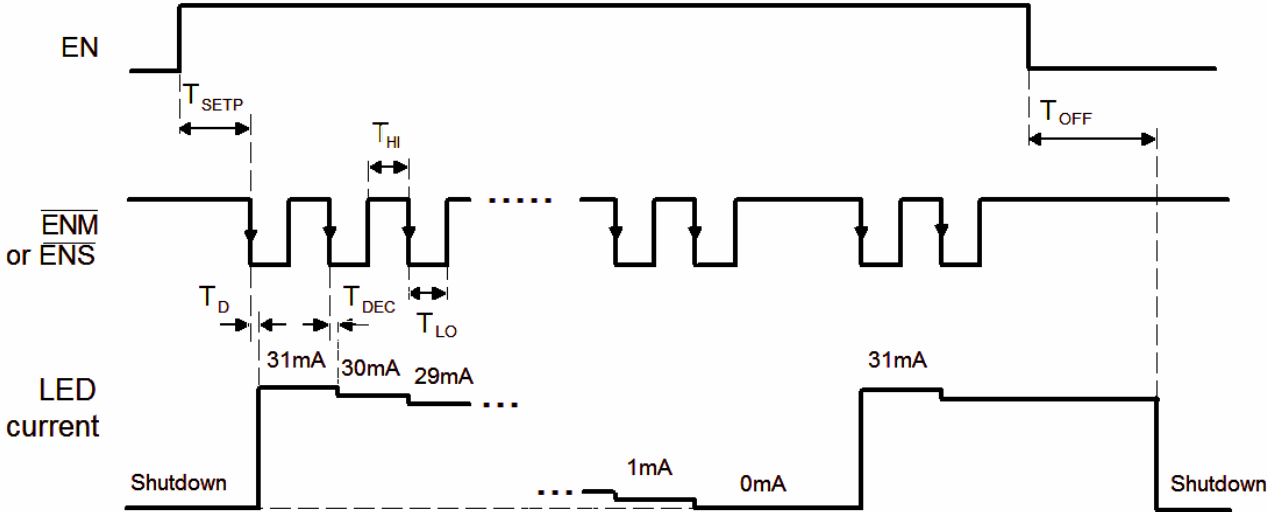
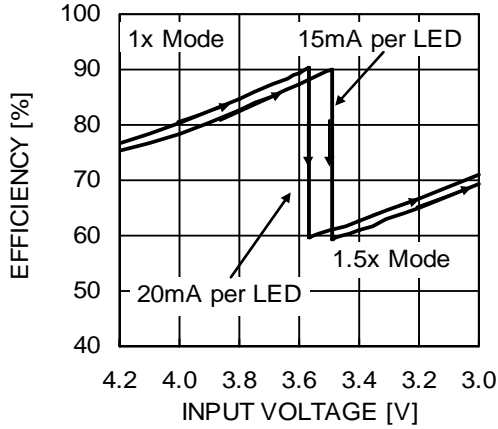


Figure 1. Enable LED Timing Diagram

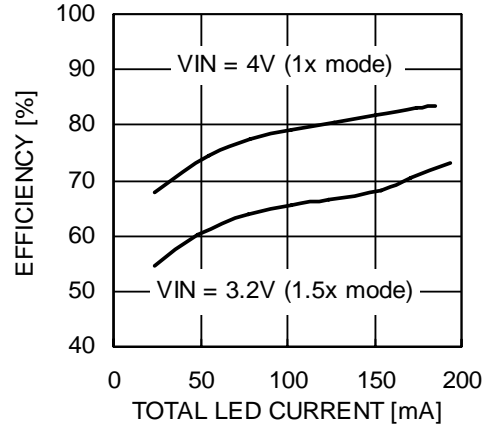
TYPICAL CHARACTERISTICS

$V_{IN} = 3.6V$, $I_{OUT} = 90mA$ (6 LEDs at 15mA), $EN = V_{IN}$, $\overline{ENM} = \overline{ENS} = GND$, $C_{IN} = C1 = C2 = C_{OUT} = 1\mu F$, $T_{AMB} = 25^{\circ}C$, unless otherwise specified.

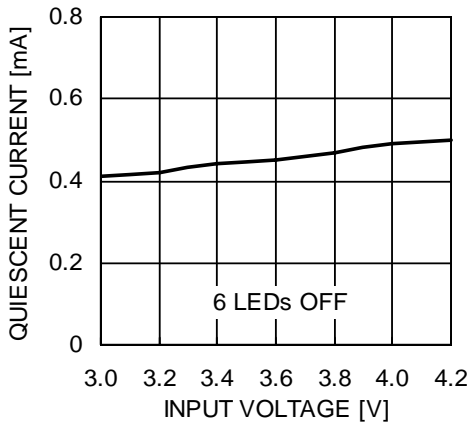
Efficiency vs. Input Voltage (6 LEDs on)



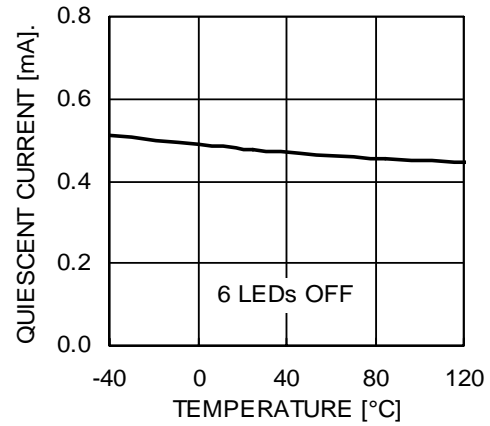
Efficiency vs. Total LED Current (6 LEDs)



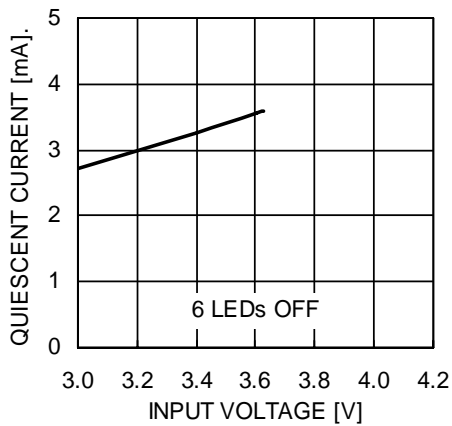
Quiescent Current vs. Input Voltage (1x Mode)



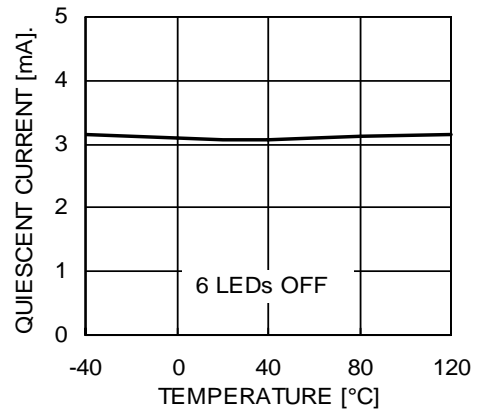
Quiescent Current vs. Temperature (1x Mode)



Quiescent Current vs. Input Voltage (1.5x Mode)



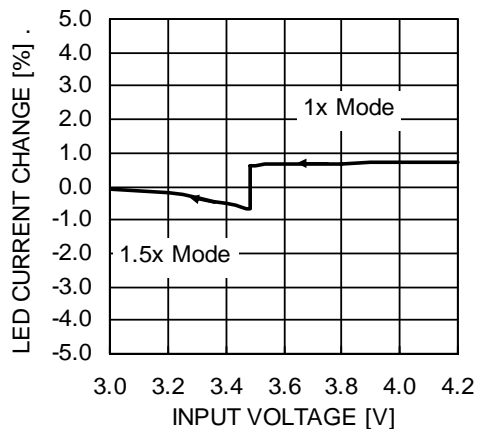
Quiescent Current vs. Temperature (1.5x Mode)



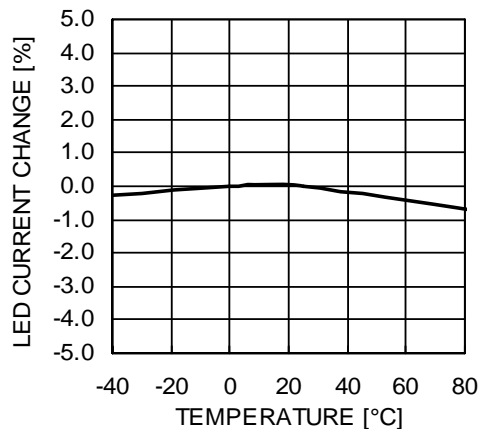
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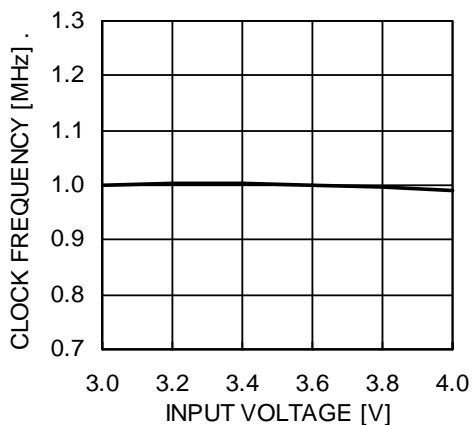
LED Current Change vs. Input Voltage



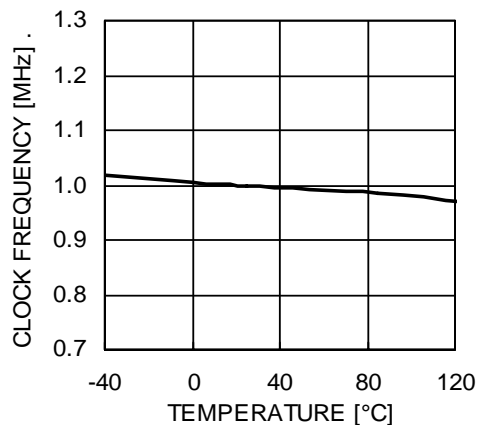
LED Current Change vs. Temperature



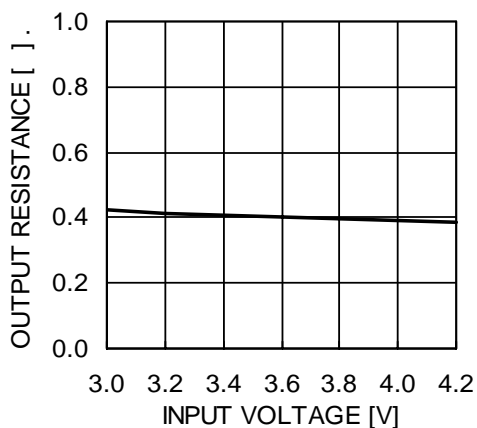
Oscillator Frequency vs. Input Voltage



Oscillator Frequency vs. Temperature



Output Resistance vs. Input Voltage (1x Mode)



Output Resistance vs. Input Voltage(1.5x Mode)

