DESCRIPTION

The A8442 is a high performance white LED driver. It integrates current sources and automatic mode selection charge pump. The part maintains the high efficiency by utilizing an x1/x1.5 fractional charge pump and low dropout current sources. The small equivalent x1 mode open loop resistance and ultra-low dropout voltage of current source extend the operating time of x1 mode and optimize the efficiency of Li-ion battery in white LED applications.

The A8442 supports up to 4 white LEDs and regulates a constant current for uniform intensity. The part implements a 4-bit DAC for brightness control. Users can easily configure the LED current from 1.25mA to 20mA by a serial pulse. The dimming of white LEDs current can be achieved by applying a pulse signal to the EN pin. There are totally 16 steps of current could be set by users. The operating voltage range is 2.7V to 5.5V. Internal soft start circuitry effectively reduces the in-rush current while both start-up and mode transition. The load is disconnected from V_{IN} while shutdown and the shutdown current is less than 1μA.

The A8442 is available in QFN16(3x3) package.

ORDERING INFORMATION

Package Type	Part Number
QFN16(3x3)	A8442Q16R
	A8442Q16VR
Note	R: Tape & Reel V: Green Package
AiT provides all Pb free products Suffix " V " means Green Package	

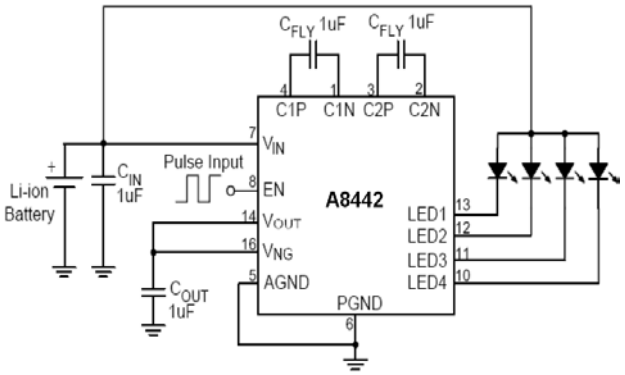
FEATURES

- 90% Average Efficiency Over Battery Life
- Support up to 4 White LEDs
- 80mV Typical Current Source Dropout
- Support up to 80mA Output Current
- 2% Typical LED Current Accuracy
- 1% Typical LED Current Matching
- High Active
- Soft Start Function
- Auto Charge Pump Mode Selection
- 500kHz Fixed Frequency Oscillator
- Output Over Voltage Protection
- 16-Step Brightness Control
- Low Input Noise and EMI
- Low 1μA Shutdown Current
- Available in QFN16(3x3) Package

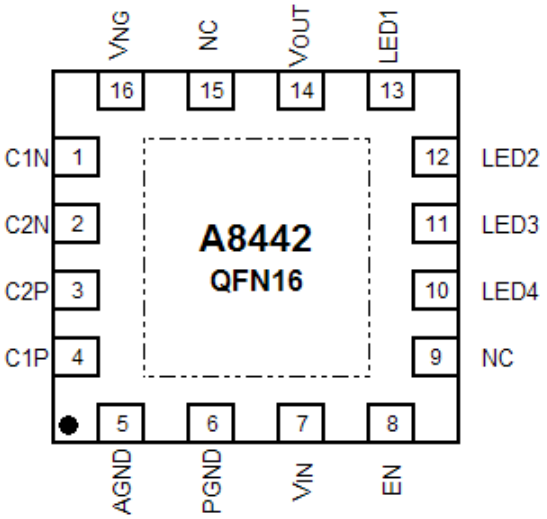
APPLICATION

- Mobile Phone, DSC, MP3
- White LED Backlighting
- LCD Display Supply

TYPICAL APPLICATION



PIN DESCRIPTION



Top View

Pin #	Symbol	Function
1	C1N	Negative Terminal of Bucket Capacitor 1
2	C2N	Negative Terminal of Bucket Capacitor 2
3	C2P	Positive Terminal of Bucket Capacitor 2
4	C1P	Positive Terminal of Bucket Capacitor 1
5	AGND	Analog Ground
6	PGND	Power Ground
7	V_{IN}	Power Input Voltage
8	EN	Chip Enable (Active High), and connects to GPIO pin of MCU
9,15	NC	No Internal Connection
10	LED4	Current Sink For Led4. (If Not In Use ,Pin Should Be Connected To GND)
11	LED3	Current Sink For Led3. (If Not In Use ,Pin Should Be Connected To V_{IN})
12	LED2	Current Sink For Led2. (If Not In Use ,Pin Should Be Connected To V_{IN})
13	LED1	Current Sink For Led1. (If Not In Use ,Pin Should Be Connected To V_{IN})
14	V_{OUT}	Output Voltage Source for LED1 to LED4
16	V_{NG}	charge pump output
Exposed Pad	GND	exposed pad should be soldered to PCB board and connected to GND

ABSOLUTE MAXIMUM RATINGS

Input Voltage		−0.3V to 6V
Output Voltage		−0.3V to 6V
EN Voltage		−0.3V to 6V
Power Dissipation, P_D @ T_A = 25°C	QFN−16(3X3)	1.47W
Package Thermal Resistance	QFN−16(3x3), θ_{JA}	68°C/W
Junction Temperature		150°C
Lead Temperature (Soldering, 10 sec.)		260°C
Junction Temperature Range		−40°C to 125°C
Storage Temperature Range		−65°C to 150°C
ESD Susceptibility		
HBM (Human Body Mode)		3kV
MM (Machine Mode)		200V

Stresses above may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

T_A = 25°C, Otherwise specified

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Supply Voltage	V_{IN}		2.7	-	5.5	V
Undervoltage Lockout Threshold	V_{UVLO}	V_{IN} rising or falling	1.8	2.0	2.4	V
Undervoltage Lockout Hysterresis			-	100	-	mV
Shutdown Current	I_{SHDN}	V_{IN} = 4.2V, EN = LOW	-	1	10	uA
Quiescent of x1 Mode	I_Q×1	x1 Mode, V_{IN} = 5.5V, LED off	-	1	-	mA
I_{LED} Accuracy	$I_{LED-ERR}$	2mA < I_{LED} < 20mA	-	2	8	%
Current Matching	$I_{LED-LED-ERR}$	2mA < I_{LED} < 30mA	-	1	5	
×1 mode to ×1.5 mode Transition voltage(V_{IN} falling)	V_{TRANS}	V_{LED} = 3.4V, I_{LED1}=I_{LED2}=I_{LED3}=I_{LED4}=15mA	-	3.5	-	V
Oscillator Frequency	F_{OSC}	V_{IN}-V_{OUT}	-	500K	-	HZ
Output Over Voltage Protection	V_{OVP}		-	5.5	6	V
Thermal Shutdown Threshold			-	150	-	℃
Thermal Shutdown Hysteresis			-	10	-	℃
EN Low Time for Shut Down	T_{SHDN}		2	-	-	mS
EN Low Time for Dimming	T_{LO}		0.5	-	500	uS
EN High Time for Dimming	T_{HI}		0.5	-	-	uS
EN Threshold Logic-High Voltage	V_{IH}		1.5	-	-	V
EN Threshold Logic-Low Voltage	V_{IL}		-	-	0.4	V

TYPICAL PERFORMANCE CHARACTERISTICS

Figure 1. For 4-WLEDs Application Circuit

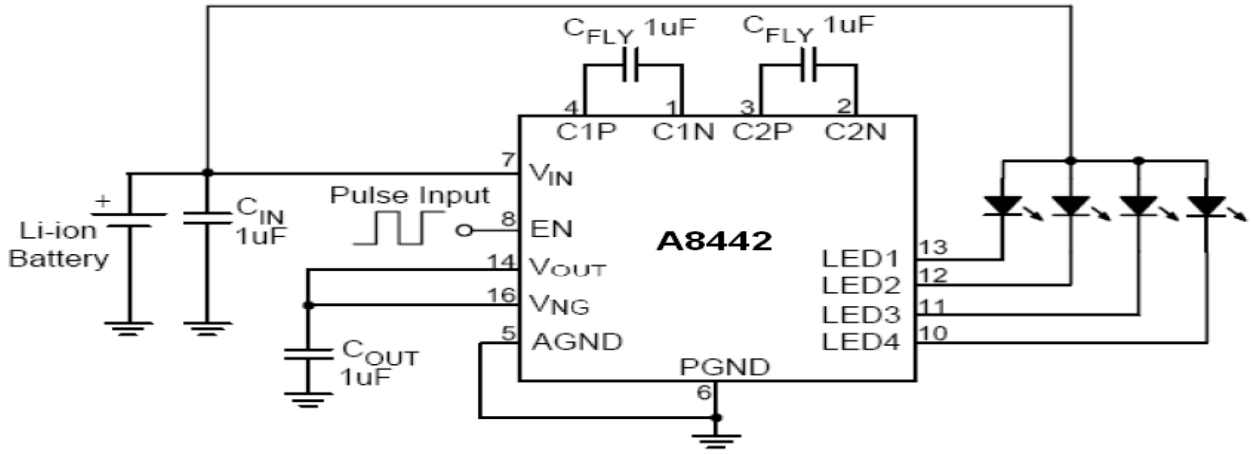


Figure 2. For 3-WLEDs Application Circuit

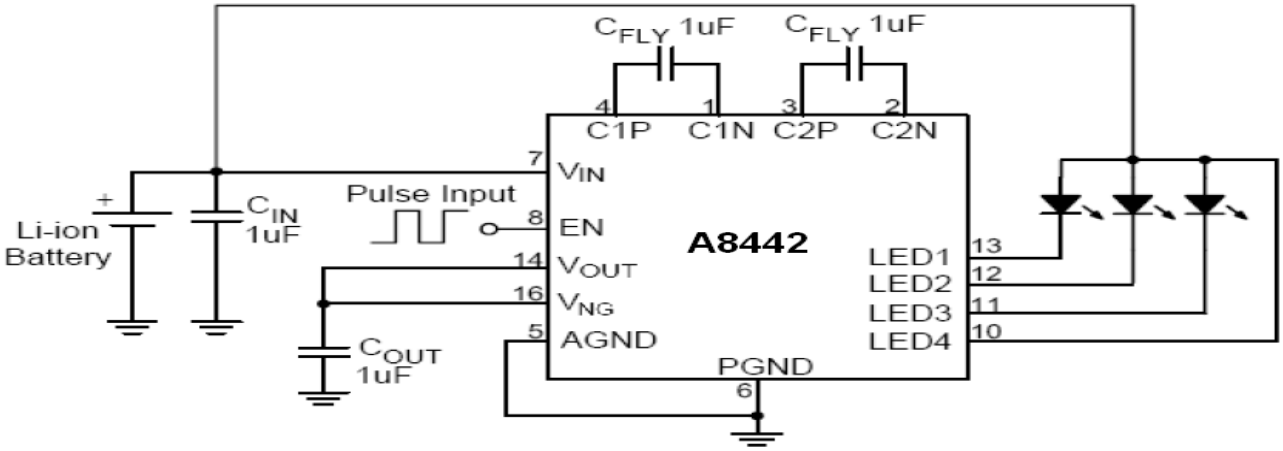
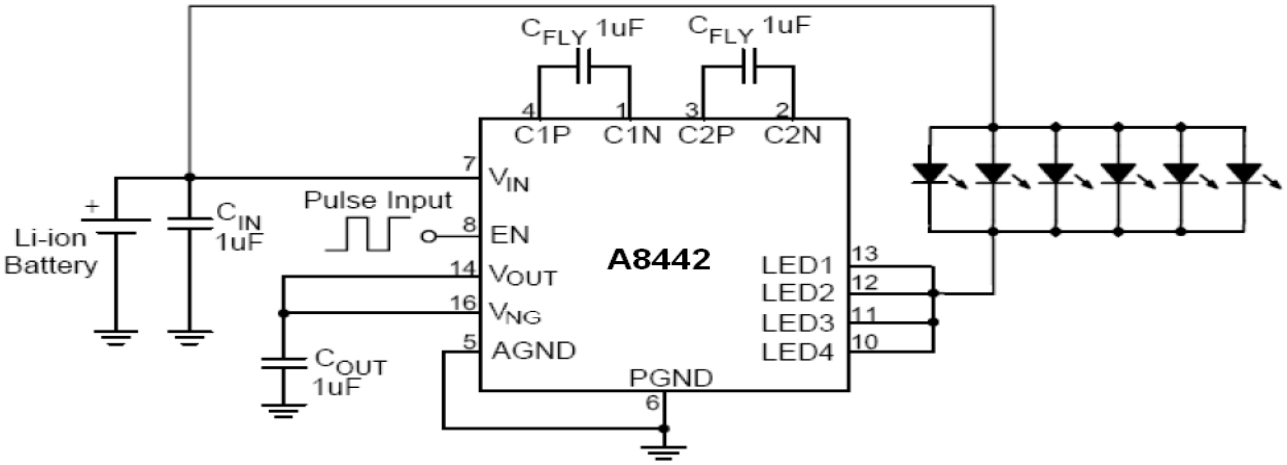
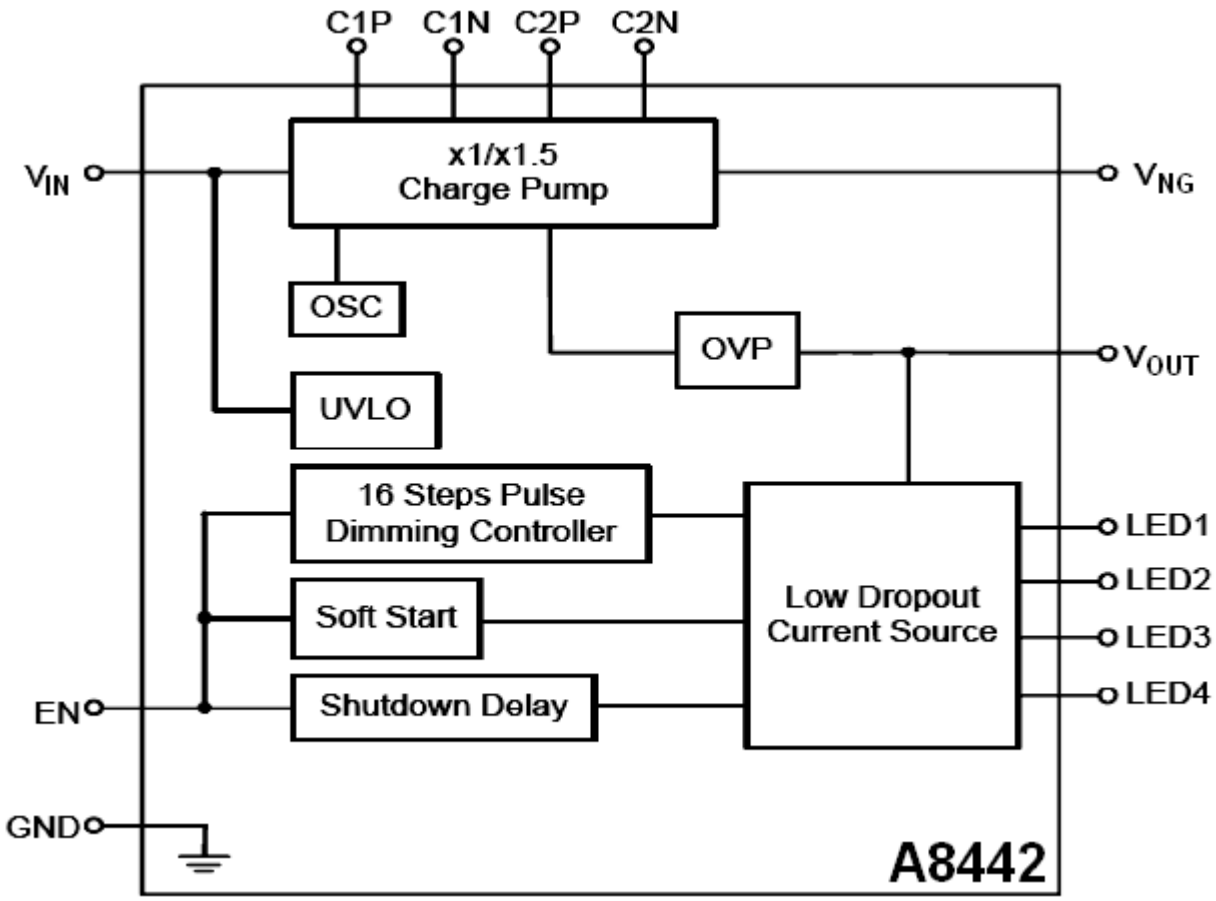


Figure 3. For more than 4-WLEDs Application Circuit



BLOCK DIAGRAM



DETAILED INFORMATION

The A8442 uses a fractional switched capacitor charge pump to power up to four white LEDs with a programmable current for uniform intensity. The part integrates current sources and automatic mode selection charge pump. It maintains the high efficiency by utilizing an x1/x1.5 fractional charge pump and current sources. The small equivalent x1 mode open loop resistance and ultra-low dropout voltage of current source extend the operating time of x1 mode and optimize the efficiency in white LED applications.

Brightness Control

The A8442 implements a pulse dimming method to control the brightness of white LEDs. Users can easily configure the LED current from 1.25mA to 20mA by a serial pulse. The dimming of white LEDs' current can be achieved by applying a pulse signal to the EN pin. There are totally 16 steps of current could be set by users.

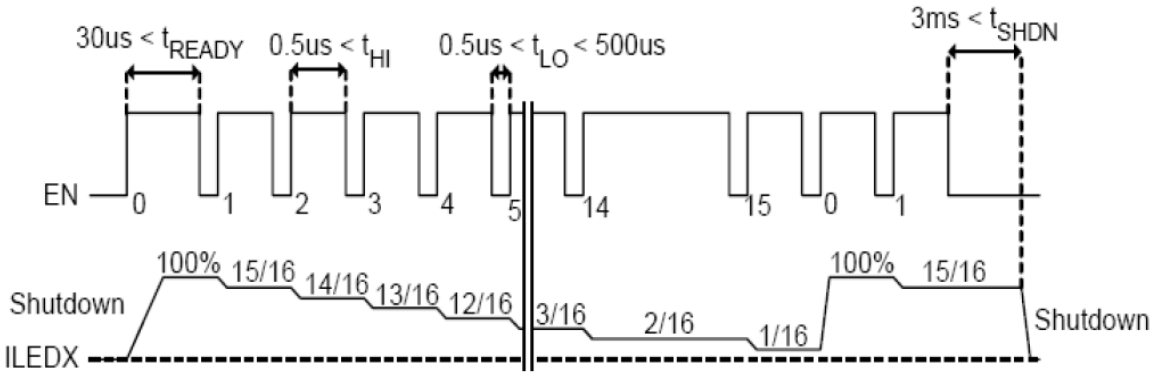


Figure 4. Brightness control by pulse dimming

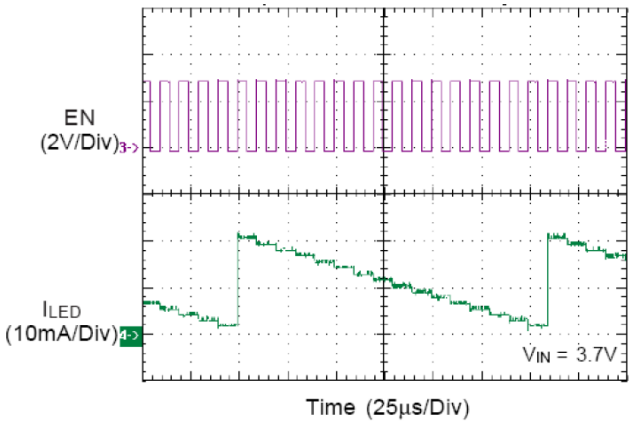


Figure 5. Examples of pulse adjust brightness

Mode Decision

The A8442 uses a smart mode selection method to decide the working mode for optimizing the efficiency. Mode decision circuit senses the output and LED voltage for up/down selection. The A8442 automatically switches to x1.5 mode whenever the dropout condition is detected from the current source and returns to x1 mode whenever the dropout condition releases.

LED connection

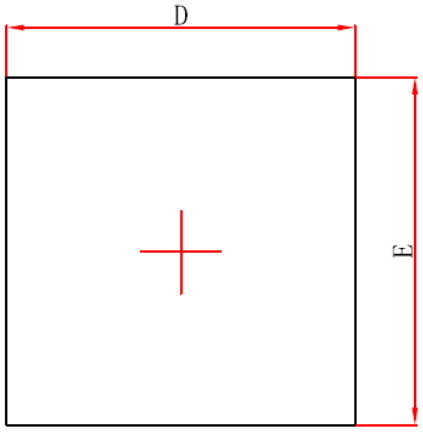
The A8442 supports up to 4 white LEDs. The four LEDs are connected from V_{IN} to pin 10, 11, 12 and 13 respectively. If the LED is not used, the LED pin should be connected to VIN directly.

Selecting Capacitors

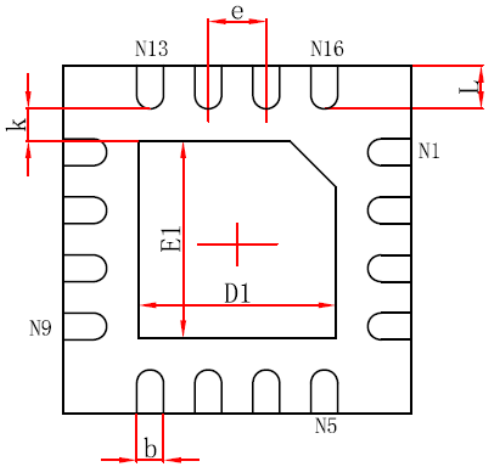
To get the better performance of A8442, the selection of peripherally appropriate capacitor and value is very important. These capacitors determine some parameters such as input/output ripple voltage, power efficiency, maximum supply current by charge pump, To reduce the input and output ripple effectively, the low ESR ceramic capacitors are recommended. For LED driver applications, the input voltage ripple is more important than output ripple. Input ripple is controlled by input capacitor C_{IN}, increasing the value of input capacitance can further reduce the ripple. Practically, the input voltage ripple depends on the power supply impedance. The flying capacitor C1 and C2 determine the supply current capability of the charge pump and to influence the overall efficiency of system. The lower value will improve efficiency, but it will limit the LED's current at low input voltage.

PACKAGE INFORMATION

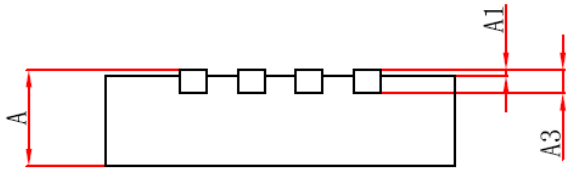
Dimension in QFN16 (Unit: mm)



Top View



Bottom View



Side View

Symbol	Min	Max
A	0.700/0.800	0.800/0.900
A1	0.000	0.050
A3	0.203REF	
D	2.900	3.100
E	2.900	3.100
D1	1.600	1.800
E1	1.600	1.800
k	0.200MIN	
b	0.180	0.300
e	0.500TYP	
L	0.300	0.500

IMPORTANT NOTICE

AiT Semiconductor Inc. (AiT) reserves the right to make changes to any its product, specifications, to discontinue any integrated circuit product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

AiT Semiconductor Inc.'s integrated circuit products are not designed, intended, authorized, or warranted to be suitable for use in life support applications, devices or systems or other critical applications. Use of AiT products in such applications is understood to be fully at the risk of the customer. As used herein may involve potential risks of death, personal injury, or servere property, or environmental damage. In order to minimize risks associated with the customer's applications, the customer should provide adequate design and operating safeguards.

AiT Semiconductor Inc. assumes to no liability to customer product design or application support. AiT warrants the performance of its products of the specifications applicable at the time of sale.