

Compact Sequential Mode RGB LED Driver with I²C Control Interface

General Description

The LM3435, a Synchronously Rectified non-isolated Flyback Converter, features all required functions to implement a highly efficient and cost effective RGB LED driver. Different from conventional Flyback converter, LEDs connect across the VOUT pin and the VIN pin through internal passing elements at corresponding LED pins. Thus, voltage across LEDs can be higher than, equal to or lower than the input supply voltage.

Load current to LEDs is up to 2A with voltage across LEDs ranging from 2.0V to 4.5V. Integrated N-Channel main MOSFET, P-Channel synchronous MOSFET and three N-Channel current regulating pass switches allow low component count, thus reducing complexity and minimize board size. The LM3435 is designed to work exceptionally well with ceramic output capacitors with low output ripple voltage. Loop compensation is not required resulting in a fast load transient response. Non-overlapping RGB LEDs are driven sequentially through individual control. Output voltage hence can be optimized for different forward voltage of LEDs during the non-overlapping period. I²C interface eases the programming of the individual RGB LED current up to 1,024 levels per channel.

The LM3435 is available in the thermally enhanced LLP-40 package.

Key Specifications

- Support up to 2A LED current
- Typical $\pm 3\%$ LED current accuracy
- Integrated N-Channel main and P-Channel synchronous MOSFETs
- 3 Integrated N-Channel current regulating pass switches
- LED Currents programmable via I²C bus independently
- Input voltage range 2.7V - 5.5V
- Thermal shutdown
- Thermally enhanced LLP-40 package

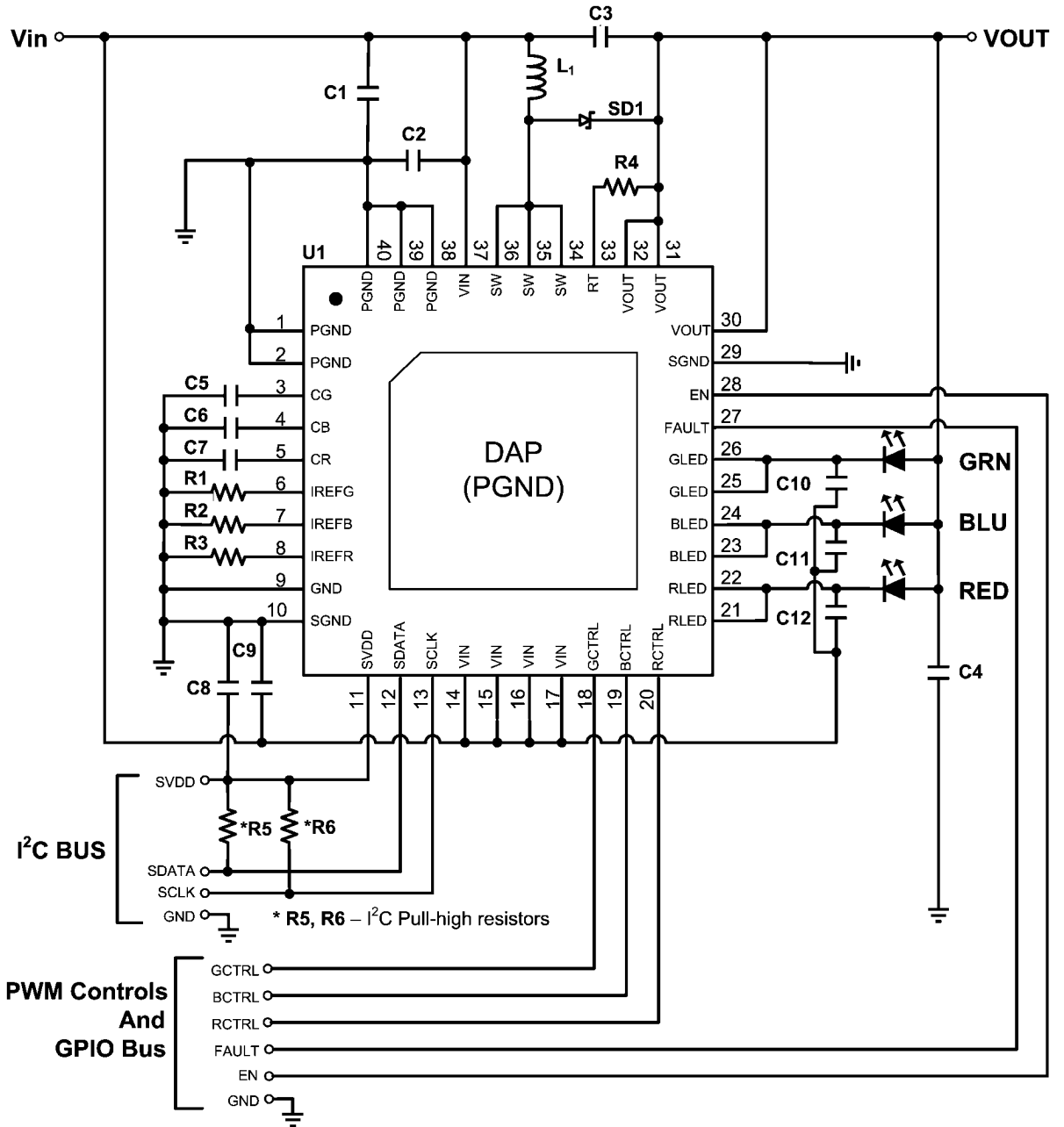
Features

- Sequential RGB driving mode
- Low component count and small solution size
- Stable with ceramic and other low ESR capacitors, no loop compensation required
- Fast transient response
- Programmable converter switching frequency up to 1 MHz
- MCU interface ready with I²C bus
- Peak current limit protection for the switcher
- LED fault detection and reporting via I²C bus

Applications

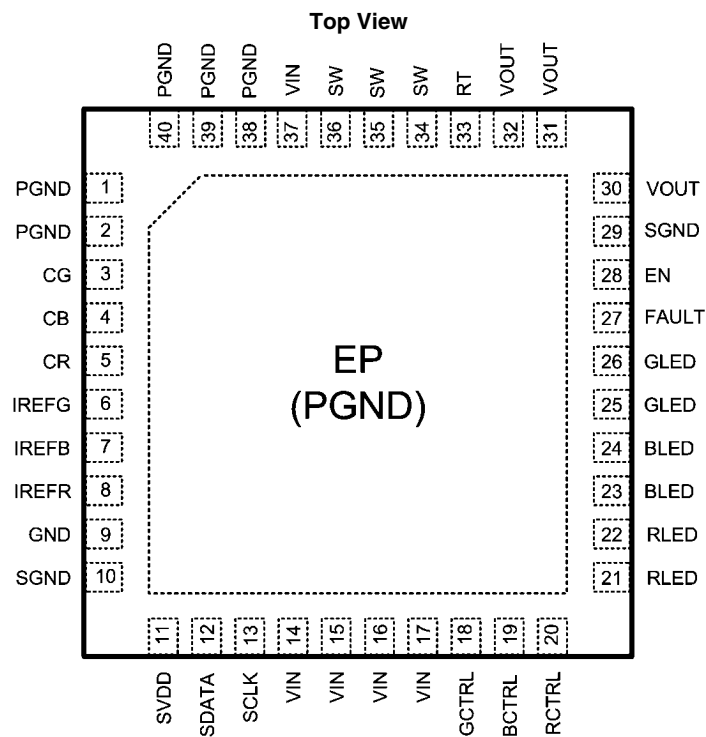
- Li-ion batteries / USB Powered RGB LED driver
- Pico / Pocket RGB LED Projector

Typical Application Circuit



30162501

Connection Diagram



30162502

40-pin Leadless Leadframe Package (LLP)
5.0 x 5.0 x 0.8mm, 0.4mm pitch
NS Package Number SQF40A

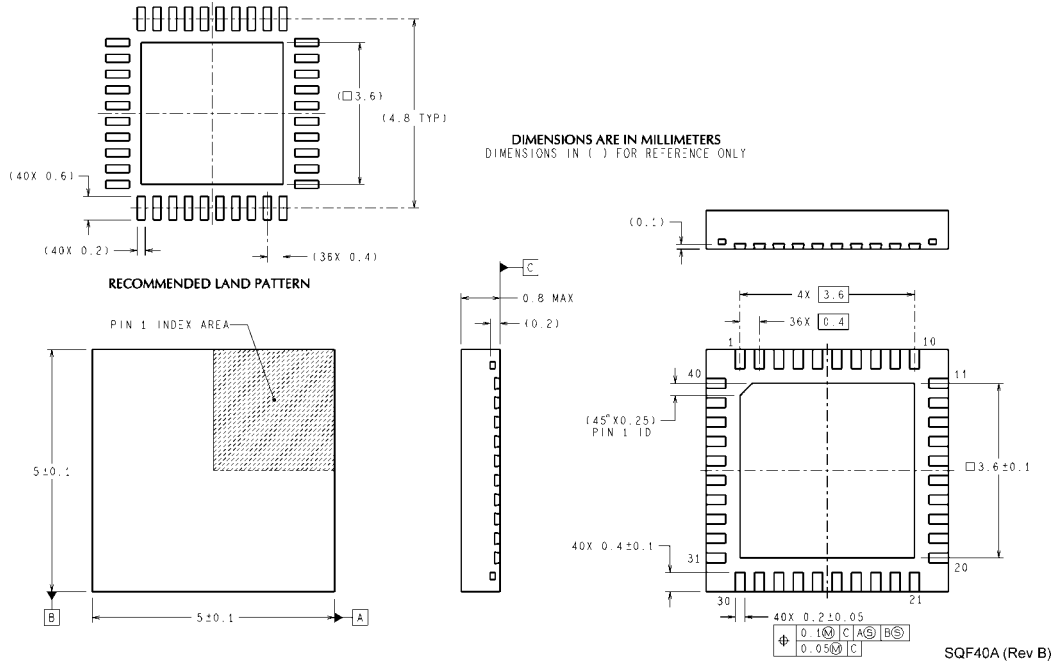
Ordering Information

Order Number	Spec.	Package Type	NSC Package Drawing	Supplied As
LM3435SQ	NOPB	LLP-40	SQF40A	1000 Units, Tape and Reel
LM3435SQX	NOPB	LLP-40	SQF40A	4500 Units, Tape and Reel

Pin Descriptions

Pin	Name	Type	Description	Application Information
1, 2, 38, 39, 40	PGND	Ground	Power Ground	Ground for power devices, connect to GND.
3	CG	Output	GREEN LED capacitor	Connect a capacitor to Ground for GREEN LED. Minimum 1nF.
4	CB	Output	BLUE LED capacitor	Connect a capacitor to Ground for BLUE LED. Minimum 1nF.
5	CR	Output	RED LED capacitor	Connect a capacitor to Ground for RED LED. Minimum 1nF.
6	IREFG	Output	Current Reference for GREEN LED	Connect a resistor to Ground for GREEN LED current reference generation.
7	IREFB	Output	Current Reference for BLUE LED	Connect a resistor to Ground for BLUE LED current reference generation.
8	IREFR	Output	Current Reference for RED LED	Connect a resistor to Ground for RED LED current reference generation.
9	GND	Ground	Ground	
10, 29	SGND	Ground	I ² C Ground	Ground for I ² C control, connect to GND.
11	SVDD	Power	I ² C VDD	VDD for I ² C control.
12	SDATA	Input / Output	DATA bus	Data bus for I ² C control.
13	SCLK	Input	CLOCK bus	Clock bus for I ² C control.
14, 15, 16, 17, 37	VIN	Power	Input supply voltage	Supply pin to the device. Nominal input range is 2.7V to 5.5V.
18	GCTRL	Input	GREEN LED control	On/Off control signal for GREEN LED.
19	BCTRL	Input	BLUE LED control	On/Off control signal for BLUE LED.
20	RCTRL	Input	RED LED control	On/Off control signal for RED LED.
21, 22	RLED	Output	RED LED cathode	Connect RED LED cathode to this pin.
23, 24	BLED	Output	BLUE LED cathode	Connect BLUE LED cathode to this pin.
25, 26	GLED	Output	GREEN LED cathode	Connect GREEN LED cathode to this pin.
27	FAULT	Output	Fault indicator	Pull-up when LED open or short is being detected.
28	EN	Input	Enable pin	Internally pull-up. Connect to a voltage lower than 0.2 x VIN to disable the device.
30, 31, 32	VOUT	Input / Output	Output voltage	Connect anodes of LEDs to this pin.
33	RT	Input	ON-time control	An external resistor connected from VOUT to this pin sets the main MOSFET on-time, hence determine the switching frequency.
34, 35, 36	SW	Output	Switch node	Internally connected to the source of the main N-channel MOSFET and the drain of the P-channel synchronous MOSFET. Connect to the output inductor.
EP	EP	Ground	Exposed Pad	Thermal connection pad, connect to the GND pin.

Physical Dimensions inches (millimeters) unless otherwise noted



Notes

For more National Semiconductor product information and proven design tools, visit the following Web sites at:
www.national.com

Products		Design Support	
Amplifiers	www.national.com/amplifiers	WEBENCH® Tools	www.national.com/webench
Audio	www.national.com/audio	App Notes	www.national.com/appnotes
Clock and Timing	www.national.com/timing	Reference Designs	www.national.com/refdesigns
Data Converters	www.national.com/adc	Samples	www.national.com/samples
Interface	www.national.com/interface	Eval Boards	www.national.com/evalboards
LVDS	www.national.com/lvds	Packaging	www.national.com/packaging
Power Management	www.national.com/power	Green Compliance	www.national.com/quality/green
Switching Regulators	www.national.com/switchers	Distributors	www.national.com/contacts
LDOs	www.national.com/ldo	Quality and Reliability	www.national.com/quality
LED Lighting	www.national.com/led	Feedback/Support	www.national.com/feedback
Voltage References	www.national.com/vref	Design Made Easy	www.national.com/easy
PowerWise® Solutions	www.national.com/powerwise	Applications & Markets	www.national.com/solutions
Serial Digital Interface (SDI)	www.national.com/sdi	Mil/Aero	www.national.com/milaero
Temperature Sensors	www.national.com/tempensors	SolarMagic™	www.national.com/solarmagic
PLL/VCO	www.national.com/wireless	PowerWise® Design University	www.national.com/training

THE CONTENTS OF THIS DOCUMENT ARE PROVIDED IN CONNECTION WITH NATIONAL SEMICONDUCTOR CORPORATION ("NATIONAL") PRODUCTS. NATIONAL MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS PUBLICATION AND RESERVES THE RIGHT TO MAKE CHANGES TO SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. NO LICENSE, WHETHER EXPRESS, IMPLIED, ARISING BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT.

TESTING AND OTHER QUALITY CONTROLS ARE USED TO THE EXTENT NATIONAL DEEMS NECESSARY TO SUPPORT NATIONAL'S PRODUCT WARRANTY. EXCEPT WHERE MANDATED BY GOVERNMENT REQUIREMENTS, TESTING OF ALL PARAMETERS OF EACH PRODUCT IS NOT NECESSARILY PERFORMED. NATIONAL ASSUMES NO LIABILITY FOR APPLICATIONS ASSISTANCE OR BUYER PRODUCT DESIGN. BUYERS ARE RESPONSIBLE FOR THEIR PRODUCTS AND APPLICATIONS USING NATIONAL COMPONENTS. PRIOR TO USING OR DISTRIBUTING ANY PRODUCTS THAT INCLUDE NATIONAL COMPONENTS, BUYERS SHOULD PROVIDE ADEQUATE DESIGN, TESTING AND OPERATING SAFEGUARDS.

EXCEPT AS PROVIDED IN NATIONAL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, NATIONAL ASSUMES NO LIABILITY WHATSOEVER, AND NATIONAL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE SALE AND/OR USE OF NATIONAL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE CHIEF EXECUTIVE OFFICER AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

Life support devices or systems are devices which (a) are intended for surgical implant into the body, or (b) support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in a significant injury to the user. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness.

National Semiconductor and the National Semiconductor logo are registered trademarks of National Semiconductor Corporation. All other brand or product names may be trademarks or registered trademarks of their respective holders.

Copyright© 2011 National Semiconductor Corporation

For the most current product information visit us at www.national.com



**National Semiconductor
Americas Technical
Support Center**
Email: support@nsc.com
Tel: 1-800-272-9959

**National Semiconductor Europe
Technical Support Center**
Email: europe.support@nsc.com

**National Semiconductor Asia
Pacific Technical Support Center**
Email: ap.support@nsc.com

**National Semiconductor Japan
Technical Support Center**
Email: jpn.feedback@nsc.com