LED Lighting Management Solutions

Selection Guide

4Q 2007

National Semiconductor

The Sight & Sound of Information

Environmentally Friendly LED Lighting

Overview

LED lighting has reached luminous efficiencies to compete with common illumination sources such as incandescent and fluorescent bulbs, including Cold Cathode Fluorescent Lamp (CCFL). With higher efficiencies than incandescent bulbs and no hazardous chemicals as in fluorescent bulbs, LED lighting is gaining in popularity as an environmentally friendly lighting solution. The ability to control the color temperature by electronic dimming makes LED lighting appealing to designer interior illumination such as mood lighting. National Semiconductor's LED driver portfolio enables designers to create these environmentally friendly and flexible lighting units.

Regardless of type, color, size, or power, all LEDs work best when driven with a constant current. LED manufacturers specify the characteristics (such as lumens, beam pattern, color) of their devices at a specified forward current (I_F) not at a specific forward voltage (V_F). Most power supply ICs are designed to provide constant voltage outputs over a range of currents (see below), hence it can be difficult to ascertain which parts will work for a given application from the device datasheet alone. With an array of LEDs, the main challenge is to ensure that every LED in the array is driven with the same current. Placing all the LEDs in a series string ensures that exactly the same current flows through each device.

Low-Power LEDs

Low-power LEDs are ideal for lighting portable electronics because they are efficient, easy-to-drive, small, thin, robust, and low noise. When running off a lithium-Ion battery (typically 3.7V output voltage), each low-power LED requires up to 4V at 30 mA. To operate more than one LED for a lighting solution, an LED driver is needed to boost the voltage and regulate the current to optimize LED output.

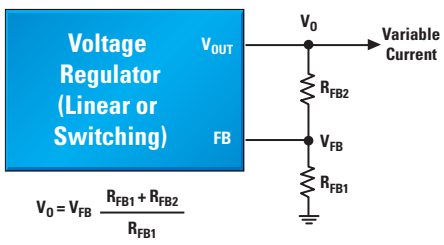
For low-powered LEDs, National offers LED drivers for both parallel and series solutions. Parallel drivers with built-in, actively-matched, high- and low-side current sources, high efficiency, and a low total component count are available with inductive-boost converters, switched-capacitor boost converters, or no boost at all. National's series of LED drivers with inductive-boost converters provide solutions that combine very high efficiency with low noise and a small footprint. All of these solutions are optimized to drive 2 to 10 LEDs, and are available in the industry's smallest packaging: tiny micro-SMD BGA and versatile LLP (Leadless Leadframe Package) and CSP-leadless packages.

High-Brightness LEDs: Input Voltage and Forward Voltage

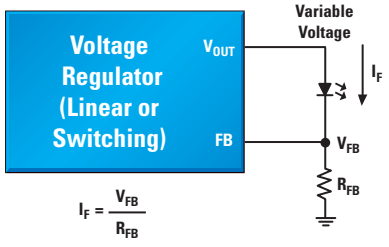
Sources of input voltage for LED arrays come from batteries or power supplies that have a certain tolerance. An automotive battery, for example, may supply 8V to 16V depending on the load and the age of the battery. The 'silver box' power supply inside a desktop CPU may supply 12V ±10%. High-brightness (HB) LEDs also give a range of forward voltage. A typical HB LED might be characterized at a forward current of 350 mA. The forward voltage of the LED when I_F = 350 mA is specified with a range that includes a typical value as well as over-temperature maximum and minimum values. To ensure that a true constant current is delivered to each LED in an array, the power topology must be able to deliver an output voltage equal to the sum of the maximum forward voltages of every device placed in the string.

Manufacturers bin their devices for color, brightness, and forward voltage. Binning for all three characteristics is expensive, and forward voltage is often the specification that is allowed to vary the most. Adding this to the shift in forward voltage as the LED die temperature changes gives rise to the need for constant current regulators that have a wide range of output voltage.

Constant Voltage Regulator



Constant Current Regulator



Inductive-Boost White-LED Drivers (LEDs in Series)

Product ID	Input Voltage Range (V)	Output Voltage (V)	Total LED Current (mA)	Number of LEDs	Switching Frequency (MHz)	Switching Type	Dimming Type	Packaging
LM2707	2.3 to 7.0	18	20	1 to 4	0.8	PFM	PWM	SOT23-8
LM2731/33	2.7 to 14	Adj. up to 20/40	1A/1.5A (switch)	–	600 kHz/1.25 MHz	PWM	–	SOT23-5
NEW LM2735	2.7 to 5.5	Adj. up to 3 to 24	2.1A (switch)	–	520 kHz/1.6 MHz	PWM	–	SOT23-5 , LLP-6, eMSOP-8
LM3500	2.7 to 7	16, 21	30	1 to 5	1	PWM	PWM	micro SMD-8
LM3501	2.7 to 7	16, 21	30	1 to 5	1	PWM	Analog	micro SMD-8
LM3502	2.5 to 5.5	16, 25, 35, 44	30	1 to 10 (2 Banks)	1	PWM	PWM	micro SMD-10, LLP-16
LM3503	2.5 to 5.5	16, 25, 35, 44	30	1 to 10 (2 Banks)	1	PWM	Analog	micro SMD-10, LLP-16
LM3508	2.7 to 5.5	17.5	30	2 to 4	0.85	PWM	PWM	micro SMD-9
NEW LM3509	2.7 to 5.5	21.2	60	2 to 10 (2 Banks)	1.27	PWM	I²C	LLP-10
LM3519	2.7 to 5.5	18	20	1 to 4	2 to 8	PFM	PWM (30 kHz)	SOT23-6
LM3520	2.7 to 5.5	22	30	5, OLED Subdisplay	1.1	PWM	PWM	LLP-14
LM3551/52	2.7 to 5.5	11	700	1 to 4	1.25	PWM	Analog	LLP-14
LM3557	2.7 to 7.5	22	30	1 to 5	1.25	PWM	PWM	LLP-8

Switched-Capacitor Boost White-LED Drivers (LEDs in Parallel)

Product ID	Input Voltage Range (V)	Output Voltage (V)	Current or Voltage Sourced	Total LED Current (mA)	Number of LEDs	Switching Frequency (MHz)	Dimming Type	Packaging
LM2750	2.9 to 5.6	5, Adj (3.8 to 5.2)	Voltage	120	10	1.7	PWM	LLP-10
LM2751	2.8 to 5.5	4.5, 5	Voltage	80 to 150	10	0.0095 to 0.725	PWM	LLP-10
NEW LM2754	2.8 to 5.5	5	Current	800	1 to 4	1	Analog	LLP-24
NEW LM2755	3 to 5.5	5	Current	90	3	1.25	I²C	micro SMD-18
NEW LM2756	2.7 to 5.5	4.6	Current	180	8	1.3	I²C	micro SMD-20
NEW LM2757	2.7 to 5.5	4.1, 4.5, 5	Voltage	100 to 180	10	1.25	No dimming	micro SMD-12
LM27951/52	3 to 5.5	5	Current	120	4	0.75	PWM	LLP-14
LM27964	2.7 to 5.5	5	Current	180	7 (3 Banks)	0.7	I²C	LLP-24
LM27965	2.7 to 5.6	5	Current	180	9 (3 Banks)	1.27	I²C	LLP-24
LM27966	2.7 to 5.7	5	Current	180	5 to 6 (2 Banks)	1.27	I²C	LLP-24

High-Brightness LED Drivers

Product ID	Input Voltage Range (V)	Output Voltage (V)	Total LED Current (mA)	Number of LEDs in Series	Switching Frequency (MHz)	Topology	PWM Dimming	Key Features	Packaging
LM2700	2.2 to 12	Max 17.5V	2500	1 to 4	600 kHz, 1.25 MHz	Boost	No	3.6A switch Input undervoltage and output overvoltage protection	TSSOP-14, LLP-14
LM3402/02HV	6 to 42 / 6 to 75	Adjustable	525	1 to 9/15	Adjustable up to 1 MHz	Buck	Yes	200 mV feedback voltage. Fast PWM dimming	MSOP-8
NEW LM3401	4.5 to 35	Adjustable	3000	1 to 9	1.5	Buck	Yes	Adjustable hysteresis, 200 mV reference	MSOP-8
NEW LM3404/04HV	6 to 42 / 6 to 75	Adjustable	1000	1 to 9/15	Adjustable up to 1 MHz	Buck	Yes	200 mV feedback voltage. Fast PWM dimming	SOIC-8
LM3405/05A	3 to 15 / 3 to 22	Adjustable	1000	1 to 4	1.6	Buck	Yes	205 mV feedback voltage, PWM dimming	TSOT-6
NEW LM3430/32	6 to 40	Adjustable	1000	4 to 100+	Adjustable up to 2 MHz	Boost, SEPIC	Yes	Dynamic Headroom Control	LLP-12, eTSSOP-28, LLP-24
LM5000	3.1 to 40	Adjustable	2000	1 to 20	300 kHz/700 kHz/ 600 kHz/1.2 MHz	Boost, Flyback	No	Internal FET capable of providing up to 2A in a Boost/Flyback configuration to drive LEDs	TSSOP-16, LLP-16
NEW LM5022	13 to 100	Adjustable	1000	1 to 20	Programmable	Buck, Boost, Flyback	Yes	External FET capable of driving LEDs up to 1A	MSOP-10, LLP-10

Low-Voltage LED Lighting

Inductive-Boost Solutions

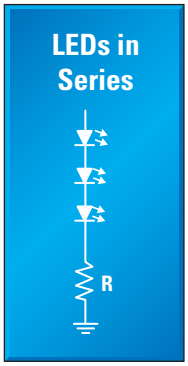
Inductive LED drivers are the best solution for currents greater than a few hundred milliamps. The major advantage to inductive-boost drivers is their ability to drive significantly higher current, which is especially good for applications that need many LEDs or are using an LED flash. Another advantage is that these drivers can continuously adjust their gain (PWM or PFM) to change LED brightness.

- Inductive-boost LED driver
  - – Lower LED voltage = less power consumed
  - – Lower LED voltage = no change in efficiency value

Series Topologies

LEDs in series: When all LEDs are connected off one wire in a column, one after another; positive (+) to negative (-).

Advantages: Single output pin, guaranteed current matching.



LM3509 High Efficiency Boost for White LED's and/or OLED Displays

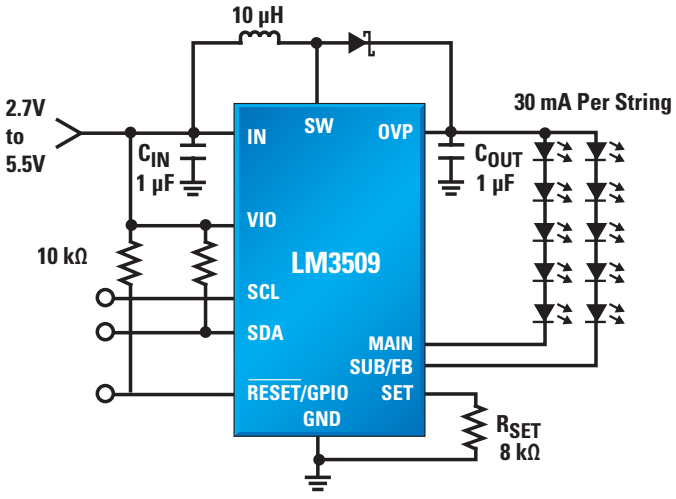
Theory of Operation

The LM3509 current mode boost converter offers two separate outputs. The first output (MAIN) is a constant current sink for driving series white LEDs. The second output (SUB/FB) is configurable as a constant current sink for series white LED bias, or as a feedback pin to set a constant output voltage for powering OLED panels.

When configured as a dual output white LED bias supply, the LM3509 adaptively regulates the supply voltage of the LED strings to maximize efficiency and insure the current sinks remain in regulation. The maximum current per output is set via a single external low power resistor. An I²C-compatible interface allows for independent adjustment of the LED current in either output from 0 to max current in 32 exponential steps.

When configured as a white LED + OLED bias supply the LM3509 can independently and simultaneously drive a string of up to 5 white LED's and deliver a constant output voltage of up to 21V for OLED panels.

LM3509 Typical Application Circuit



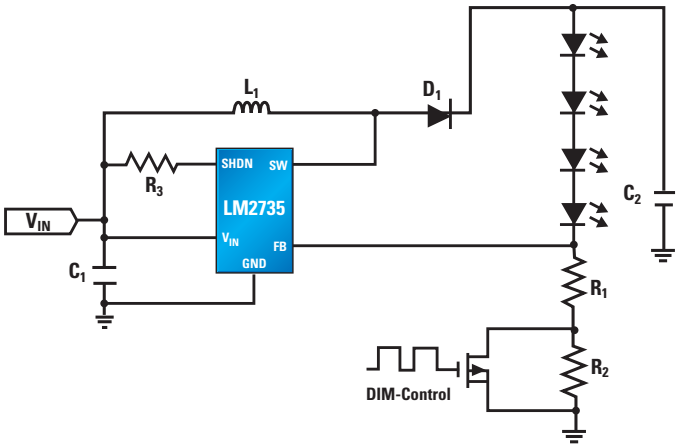
Dual White LED Bias Supply

LM2735 Space-Efficient Boost and SEPIC DC-DC Regulator

Theory of Operation

The LM2735 is an easy-to-use, space-efficient 2.1A low-side switch regulator ideal for Boost and SEPIC DC-DC regulation. It provides all the active functions to provide local DC-DC conversion with fast-transient response and accurate regulation in the smallest PCB area. Switching frequency is internally set to either 520 kHz or 1.6 MHz, allowing the use of extremely small surface mount inductor and chip capacitors while providing efficiencies up to 90%. Current-mode control and internal compensation provide ease-of-use, minimal component count, and high-performance regulation over a wide range of operating conditions.

LM2735 Typical Application Circuit

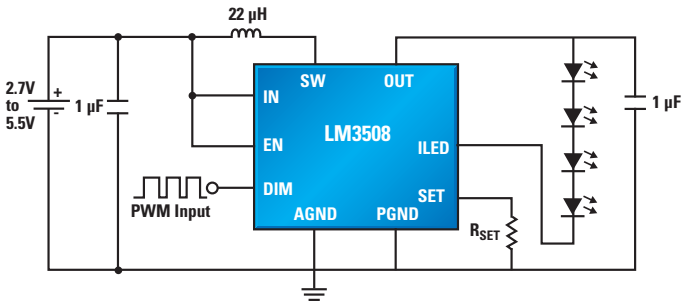


LM3508 Synchronous Magnetic Constant Current White LED Driver

Theory of Operation

The LM3508 is a synchronous boost converter (no external Schottky diode required) that provides a constant current output. It is designed to drive up to 4 series white LEDs at 30 mA from a single-cell Li-Ion battery. A single low power external resistor is used to set the maximum LED current. The LED current can be adjusted by applying a PWM signal of up to 100 kHz to the DIM pin. Internal soft-start circuitry is designed to eliminate high in-rush current at start-up. For maximum safety, the device features an advanced short-circuit protection when the output is shorted to ground.

LM3508 Typical Application Circuit



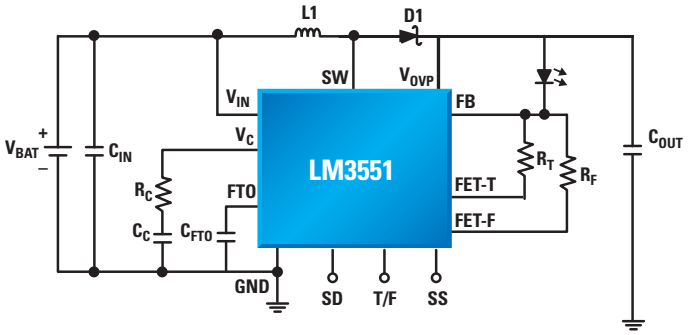
Low-Voltage LED Lighting

LM3551 High-Current Inductive DC-DC Converter for Flash-LED Applications

Theory of Operation

The LM3551 is a fixed-frequency 1.25 MHz step-up DC-DC converter with up to 700 mA flash-driving capability. The LM3551 can drive a high-power flash LED either in a high-power flash mode and a lower-power torch mode using the TORCH/FLASH pin. An external SD pin is available to put the device into low power shutdown mode.

LM3551 Typical Application Circuit



LM2731 0.6/1.6 MHz Boost Converter with 22V Internal FET Switch

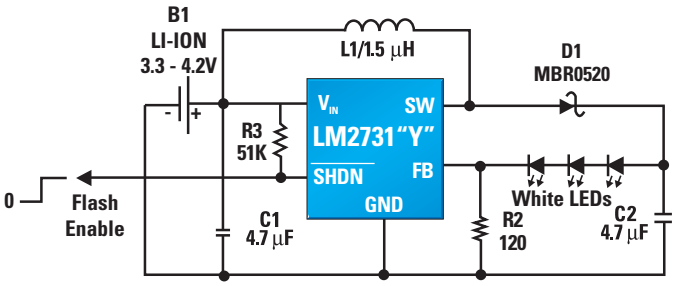
Theory of Operation

The LM2731 switching regulators are current-mode boost converters operating at fixed frequencies of 1.6 MHz ("X" option) and 600 kHz ("Y" option).

The SOT-23 packaging and use of small inductors and capacitors result in the industry's highest power density. The 22V internal switch makes these devices perfect for boosting to voltages up to 20V.

Protection is provided through cycle-by-cycle current limiting and thermal shutdown. Internal compensation simplifies design and reduces component count.

White LED Flash Application



Switched-Capacitor Solutions

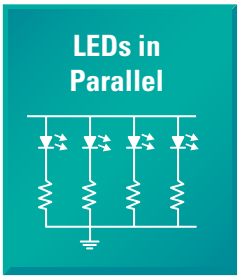
For LED-drive applications, the gain of a switched capacitor converter must be large enough to supply enough boost at minimum V_{IN}, maximum LED voltage, and maximum LED current. This must hold over temperature and process variation. More advanced switched-capacitor techniques can improve overall efficiency, but good inductive solutions will almost always have an efficiency advantage over switched-capacitor solutions.

- Switched-capacitor boost LED driver
  – Lower LED voltage = no change in power consumed
  – Lower LED voltage = increase in efficiency value

Parallel Topologies

LEDs in parallel: When LEDs are connected off one wire, next to each other in a row; positive (+) to separate grounds (GND).

Advantage: Not restricted to one power rail; good for keypad applications.

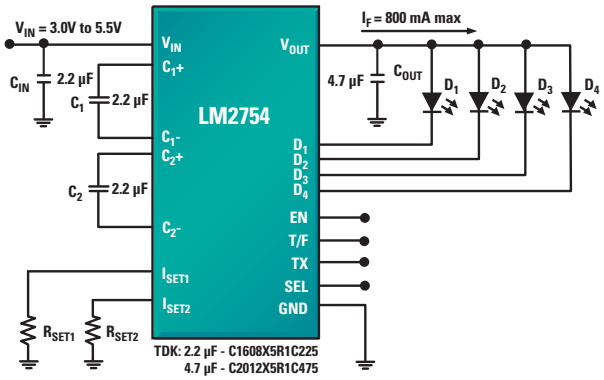


LM2754 800 mA Switched Capacitor Flash LED Driver

Theory of Operation

The LM2754 is an integrated low noise, high current switched capacitor DC-DC converter with four regulated current sinks. The device is optimized for driving 1 to 4 high power white LEDs in parallel with a maximum current of 800 mA. Maximum efficiency is achieved over the input voltage range by actively selecting the proper gain based on the LED forward voltage and current requirements. Two external low power resistors set the desired current for Torch and Flash modes.

LM2754 Typical Application



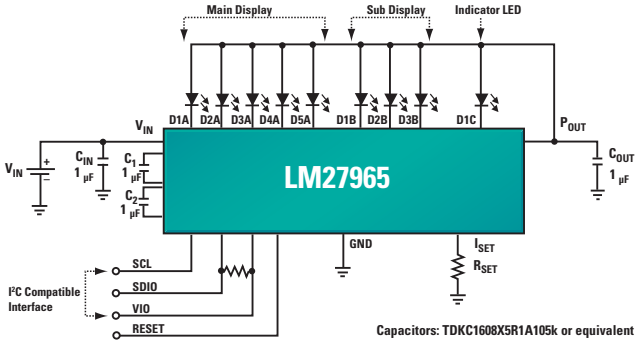
LM27965 Dual Display White LED Driver with I²C Compatible Brightness Control

Theory of Operation

The LM27965 is a highly integrated charge-pump-based dual-display LED driver. The device can drive up to nine LEDs in parallel with a total output current of 180 mA. Regulated internal current sinks deliver excellent current and brightness matching in all LEDs.

The LED driver current sinks are split into three independently controlled groups.

LM27965 Typical Application



When Input Voltage Exceeds LED Voltage

If input voltage always exceeds the sum of the maximum forward voltages of every LED in a string, then two options are possible: linear regulators and buck regulators.

The simplest method is to use a linear regulator. In order to provide constant current, the linear regulator must be an adjustable type that uses a pair of feedback resistors. Replacing the top feedback resistor with the LED string and placing a current-sensing resistor in the bottom position 'tricks' the former constant voltage source into adjusting the output voltage until enough current flows through the current-sensing resistor to equal the feedback voltage of the IC. Linear regulators have the advantages of simplicity and low parts count, and generate no EMI. They can deliver constant current as long as the V_F in the LED string does not exceed their dropout limited output voltage. The disadvantage lies in efficiency and thermal dissipation. Loss in a linear regulator LED driver is approximately equal to $(V_{IN} – n \times V_F) \times I_F$, where 'n' is the number of LEDs in the string. At currents of 350 mA and above, the linear solution may require a heatsink, adding cost and size to the design.

The second possibility when input voltage always exceeds the LED voltage is a step-down or buck regulator. As with linear regulators, this must be an adjustable type, and the same method can be used to turn almost any buck regulator into a constant current source for LEDs. Buck regulators enjoy high efficiency and eliminate the need for a heatsink, at the cost of a more complex circuit and the addition of switching noise. Many recent buck regulators switch at 1 MHz and above, making their external components so small that at currents under 1A they may actually use less space than a linear regulator.

When Input Voltage is Less than LED Voltage

When the minimum forward voltage of all the LEDs in a string will always exceed the maximum input voltage, a step-up regulator is needed.

The inductive-boost converter is the simplest regulator that can deliver currents above 350 mA with a varying output voltage. As with linear and buck regulators, a boost converter with a feedback-divider network can be modified to become a constant current source. One important distinction between the buck regulator and boost regulator must be made when the power switch is internal to the control IC. Such monolithic systems have a fixed current limit. In buck regulators, the internal switch passes the same DC current as the LED. A boost converter differs in that the internal switch sees a higher current that varies with input voltage; the greater the difference between V_{IN} and V_{OUT}, the higher the internal switch current. Care must be taken to evaluate a monolithic boost regulator-based LED drive to make sure that it will not hit the fixed current limit over the range of input voltage.

When Input Voltage Range Overlaps LED Voltage Range

As HB LEDs are adopted into more and more applications as general illumination, situations arise in which the input voltage varies above and below the forward voltage of the LED string.

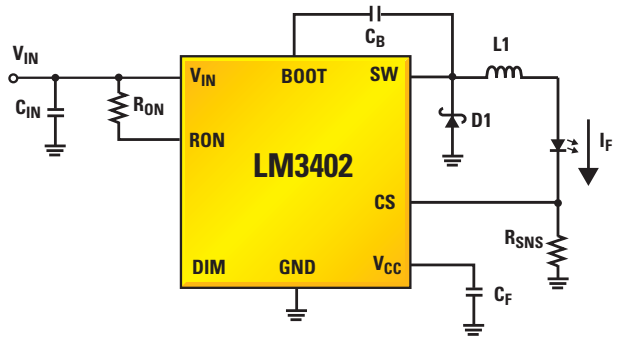
For these cases, a regulator is needed that can both buck and boost the output as needed. Possible topologies include the buck-boost regulator, the SEPIC regulator, the Cuk regulator, and the flyback regulator. In all of these topologies the power-switch current exceeds the LED current and varies as input voltage varies. The same attention to peak switch current must be made over the full range of input voltage, especially if a regulator with an internal power switch and fixed current limit is to be used.

LM3402 0.5A LED Driver with 200 mV Feedback Voltage and V_{IN} up to 75V

Theory of Operation

The LM3402/02HV is a compact, efficient constant current step-down (Buck) monolithic switching regulator designed to drive high power LEDs. Ideal for automotive, industrial, and general lighting applications, it contains a high-side N-MOSFET switch capable of driving up to 500 mA and a low 200 mV feedback voltage. The wide input voltage range of 6V to 42V for the LM3402 and 6V to 75V for the LM3402HV, makes this an ideal LED driver for a wide range of applications.

Typical Application Circuit

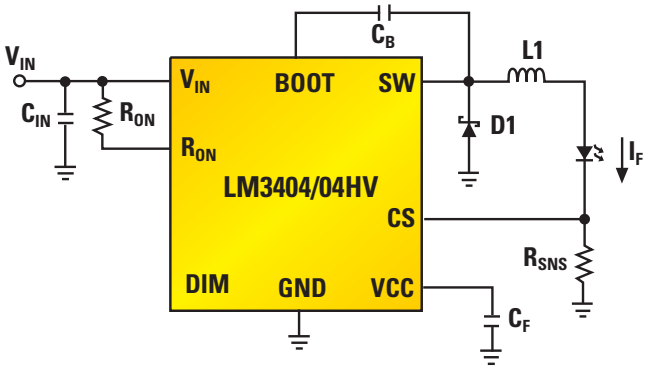


LM3404 1.0A Constant Current Buck Regulator for Driving High-Power LEDs

Theory of Operation

The LM3404/04HV are monolithic switching regulators designed to deliver constant currents to high-power LEDs. Ideal for automotive, industrial, and general lighting applications, they contain a high-side N-MOSFET switch with a current limit of 1.2A (typical) for step-down (Buck) regulators. Hysteretic control with controlled on-time, coupled with an external resistor allow the converter output voltage to adjust as needed. Output current dimming via PWM, broken/open LED protection, low-power shutdown and thermal shutdown complete the feature set.

Typical Application Circuit



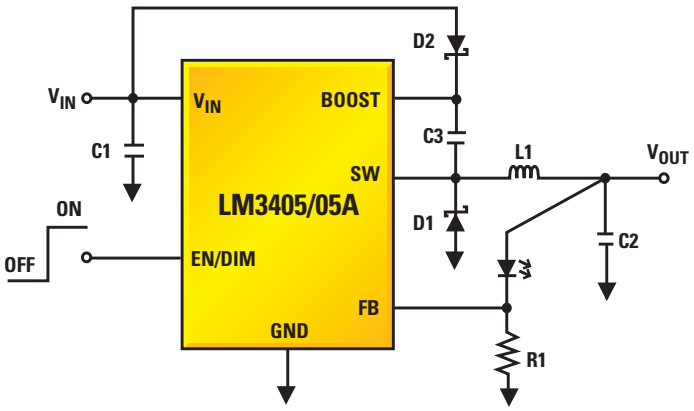
High-Brightness LED Lighting

LM3405/05A LED Driver 1A Constant-Current Buck Regulator

Theory of Operation

The LM3405/05A is a current-mode buck regulator with integrated 1A power switch. With a 0.2V feedback reference voltage to minimize power dissipation and 1.6 MHz switching frequency, the LM3405/05A regulator offers an efficient and small LED driver solution. The current mode control and internal compensation offer ease-of-use and predictable performance over a wide range of operating conditions. PWM dimming of LEDs is possible through the enable/dim pin. The LM3405/05A also contains protection features such as thermal shutdown, current limit, input under voltage lockout, and output over voltage protection.

Typical Application Circuit

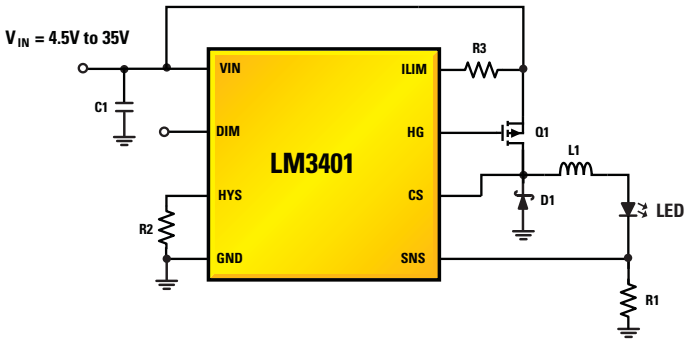


LM3401 Hysteretic PFET Controller

Theory of Operation

The LM3401 is a step-down (buck) switching controller designed to provide constant current for high brightness LEDs. An external P-MOSFET switch enables the device to run at 100% duty cycle and continue to drive LEDs when V_{IN} is equal to the feed-forward voltage (V_f) drop across the LEDs. Adjustable, dual side hysteresis allows very flexible inductor selection, switching frequency customization, and reduced propagation delay error. The LM3401 only requires a minimum of 7 external components and no output capacitor, saving solution cost and board space. Other features include low V_{REF} for highest efficiency and current accuracy (±6%) as well as PWM dimming capability.

Typical Application Circuit



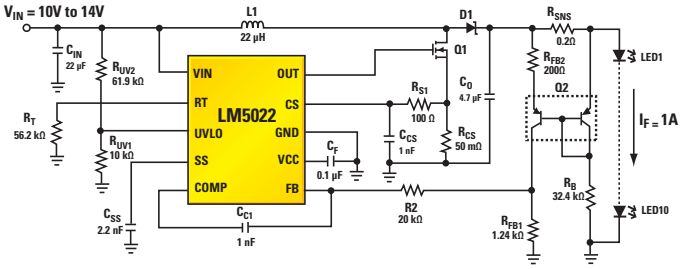
LM5022 60V Low Side Controller for Boost and SEPIC

Theory of Operation

The LM5022 is a high voltage low-side N-channel MOSFET controller ideal for use in boost and SEPIC regulators. It contains all of the features needed to implement single ended primary topologies. Output voltage regulation is based on current-mode control, which eases the design of loop compensation while providing inherent input voltage feed-forward.

The LM5022 includes a start-up regulator that operates over a wide input range of 6V to 60V. The PWM controller is designed for high speed capability including an oscillator frequency range up to 2 MHz and total propagation delays less than 100 ns.

Typical Application Circuit

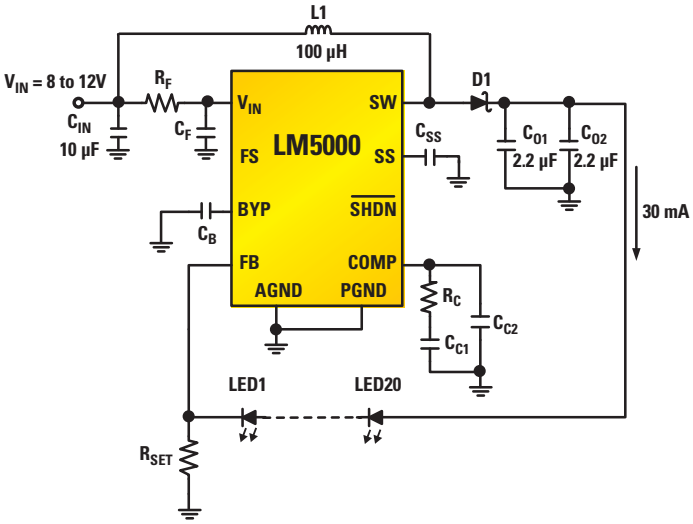


LM5000 High-Voltage Boost Regulator

Theory of Operation

This circuit boosts the input voltage in order to keep 20 LEDs in a single-series string, ensuring that the same current flows through each device. The high voltage capability of the LM5000 makes it simple to power long strings with no external power switches required.

Vanity Mirror LED Backlight



LM3430 and LM3432 Boost Controller and 6-Channel Current Regulator for LED Backlighting

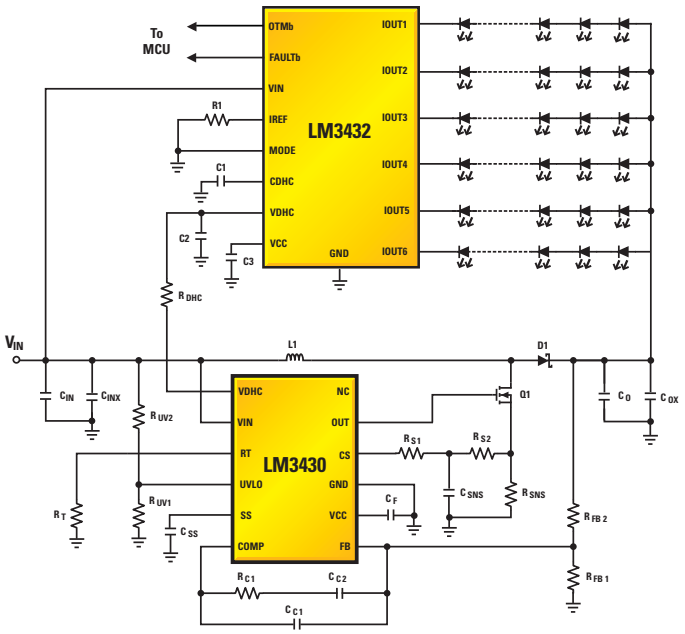
Theory of Operation

The LM3430 is a robust boost controller capable of very high duty cycles (>90%). The device is optimized for high speed capability and can achieve a switching frequency up to 2 MHz, enabling the use of tiny inductors and capacitors.

The LM3432 is a 6-Channel LED backlight driver that incorporates individual channel current regulation to provide accurate and balanced driving currents for each LED channel. This device features very flexible configuration, allowing the user to choose digital (PWM) or analog dimming control, set a dimming ratio of up to 4000:1, and drive 4 to 6 channels with over 100 total LEDs. The LM3432 also has open circuit and short circuit protection for each channel.

A feedback pin on the LM3430 allows maximum system efficiency to be achieved when used with the LM3432. This configuration also enables the LM3432 to achieve optimal power dissipation and thermal performance.

Typical Application Circuit



High Integration and Color LED Drivers

With the ever-increasing demand for LED functions, higher integration and space constraints drive the adoption of integrated lighting management units. These single-chip Lighting Management Unit (LMU) ICs, are optimized for powering multiple lighting applications including LED drivers for displays, indicators, RGB, keypad, and flash.

These devices also include an interface for control such as I^2C or SPI which is used to manage the brightness, sequence, and/or to synchronize the LEDs with an Audio input. The advantage of LMUs is their very small solution size, while incorporating the highest efficiency, flexibility, ease of control and, most of all, ease of design.

Lighting Management Unit Solutions

Product ID	Description	V_{IN} Range	Drive Current for All	Current for Flash Mode	Current Matching	Temp Range (°C)	Packaging
LP3943	LED controller for RGB/white/blue LEDs	2.3 to 5.5	25 mA/LED	—	—	-40 to 125	LLP-24
LP3944	LED controller for RGB/white/blue LEDs	2.3 to 5.5	25 mA/LED	—	—	-40 to 125	LLP-24
LP3950	Color-LED driver with audio sync	3 to 7.2	300 mA	—	3%	-40 to 125	Laminate TCSP-32
NEW **LP3952**	6-Channel color LED driver with audio synchronization	3 to 5.5	240 mA	—	5%	-30 to 85	micro SMD-36 or micro SMDxt-36
NEW **LP39542**	Lighting management unit for 4+2 white LEDs, 2 sets RGB LEDs with audio sync and pattern control, and a flash LED driver	3 to 5.5	400 mA	400 mA	White LED 0.2%, RGB 5%	-30 to 85	micro SMD-36 or micro SMDxt-36
LP3958	Lighting management unit for controlling 4+2 white LEDs for main and sub display and 3 sets of white LEDs for keypad	3 to 5.5	70 mA total	—	—	-30 to 85	micro SMD-25
LP5526	Lighting management unit with high-voltage boost converter with up to 150 mA serial flash LED driver	3. to 5.5	150 mA total	150 mA	—	-30 to 85	micro SMD-25
NEW **LP55271**	LED driver for camera flash and 4 LEDs with I^2C programmability, connectivity test, and audio synchronization	3 to 5.5	1 A total	400 mA	1%	-30 to 85	micro SMD-30
LM4970	LED controller with LED lighting effects synchronized to audio	2.7 to 5.5	42 mA	—	—	-40 to 85	LLP-14
NEW **LP5520**	RGB backlight driver with white balance compensation	2.9 to 5.5	180 mA	—	0.2%	-30 to 85	micro SMD-25
NEW **LP5521**	Fully programmable 3-channel color LED driver with advanced power save features	2.7 to 5.5	75 mA	—	1%	-30 to 85	micro SMD-20
NEW **LP5522**	Autonomous single LED controller with one wire interface	2.7 to 5.5	20 mA	—	—	-30 to 85	micro SMD-6
NEW **LP5524**	Parallel LED Driver with PWM brightness control	2.7 to 5.5	100 mA	—	1%	-40 to 85	micro SMD-9
NEW **LP55281**	Quad RGB LED driver with boost converter and LED connectivity test	3 to 5.5	400 mA	—	5%	-30 to 85	micro SMD-36 or micro SMDxt-36

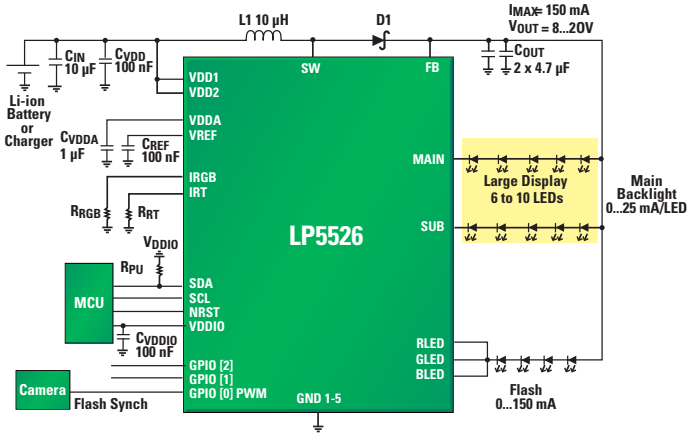
High Integration and Color LED Drivers

LP5526 Lighting Management Unit with High Voltage Boost Converter

Theory of Operation

LP5526 is a lighting management unit for camera phones. It drives 2 display backlights and camera flash LEDs from high voltage boost converter. The backlight drivers (MAIN and SUB pins) are both high resolution constant current mode drivers. The flash outputs can drive series connected FLASH LED with up to 150 mA of current. External PWM pin can be used for triggering the flash mode which has also a 1s safety timer. This is all controlled through 2-wire low voltage I²C-compatible interface.

LP5526 Typical Application

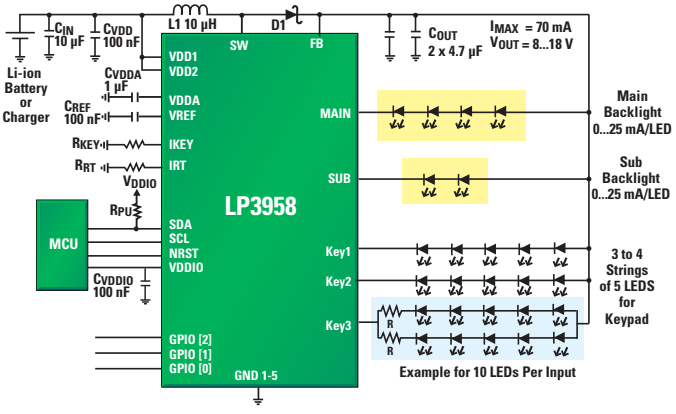


LP3958 Lighting Management Unit with High Voltage Boost Converter

Theory of Operation

LP3958 is a lighting management unit for portable applications. It is used to drive display backlight and keypad LEDs. The device can drive 5 separately connected strings of LEDs with high voltage boost converter. The keypad LED driver allows driving LEDs from high voltage boost converter or separate supply voltage. The "Main" and "Sub" outputs are high resolution current mode drivers. Keypad LED outputs can be used in switch mode and current mode. External PWM control can be used for any selected outputs. They are all controlled with a low voltage, 2-wire, I²C-compatible interface.

LP3958 Typical Application

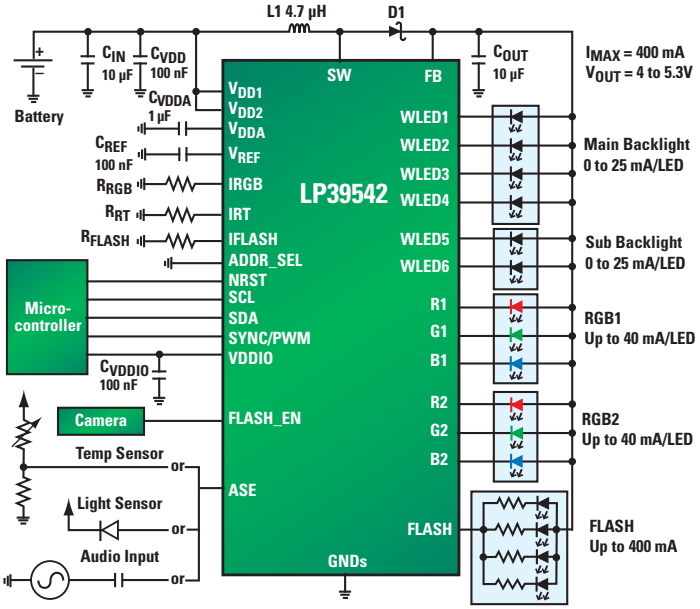


LP39542 Advanced Lighting Management Unit

Theory of Operation

LP39542 is an advanced LMU for handheld devices. The boost DC-DC drives high-current loads with high efficiency. Backlight drivers and the stand-alone command-based RGB controller are feature rich and easy to configure. The built-in audio synchronization feature allows users to synchronize the color LEDs to audio inputs. The integrated single driver can drive a high-current camera flash LED or motor/vibra. The internal ADC can be also used for ambient light or temperature sensing. The I²C compatible interface allows the easy control of LP39542. The small micro SMD package together with minimum external components is an ideal fit for handheld devices.

LP39542 Typical Application

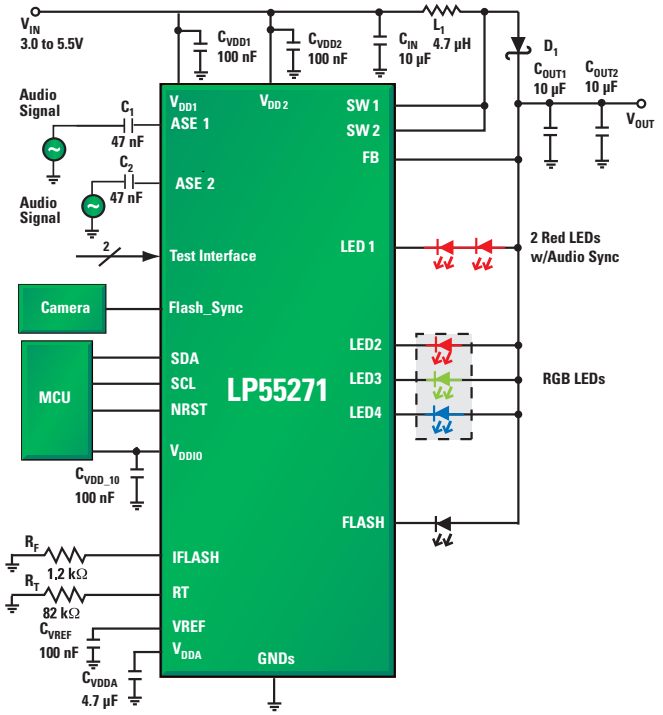


LP55271 Tiny LED Driver for Camera Flash

Theory of Operation

The LP55271 is a lighting management unit for handheld devices with I²C-compatible control interface. The LP55271 has a step-up DC-DC converter with high current output and it drives display and keypad backlights and powers the camera flash LED. In addition, the DC-DC converter has the output current to power an audio amplifier simultaneously. The chip has five LED drivers, which are high-efficiency, constant-current devices. The built-in audio synchronization feature allows the user to synchronize one of the LEDs to an audio input. Also included is a 400 mA flash driver with a safety stop feature and 50 mA torch mode. An external enable pin is provided for synchronizing the flash with the camera action.

LP55271 Typical Application



Design Tools

LED WEBENCH® Online Design Environment

Build an LED array of up to 20 X 3 in minutes! Use this online design and prototyping environment to accelerate your design process in just four simple steps:

1. Choose a part
2. Create a design and optimize for your system
3. Analyze it using electrical simulation
4. Build it with your custom kit that is delivered 24 hours later

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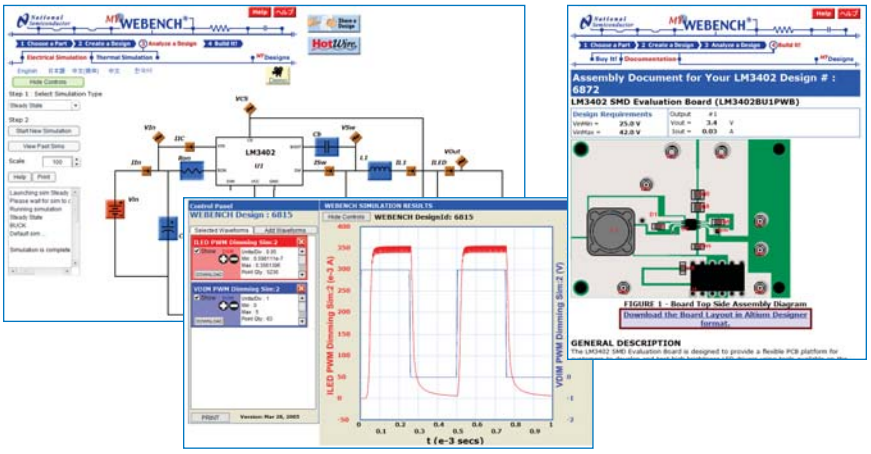

For More Information

National Semiconductor provides a comprehensive set of support services. Product information, including sales literature and technical assistance, is available through National's Customer Support Centers.

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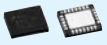
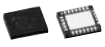


Leadless Leadframe Package (LLP®)

National's LLP® package provides excellent power dissipation capability in a very small footprint.

Packaging Solutions

AVAILABLE LEAD-FREE



LLP® (Leadless leadframe package)

SOIC

SOT-23

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