1A 60W Common Anode Capable Constant Current Buck LED Driver Requires No External Current Sensing Resistor

Check for Samples: LM3414, LM3414HV

FEATURES

- **Support LED Power up to 60W (see Note under Description): 18x 3W HBLEDs**
- **Requires NO External Current Sensing Resistor**
- **±3% LED Current Accuracy**
- **Up to 96% Efficiency**
- **High Contrast Ratio (Minimum Dimming Current Pulse Width <10 µS)**
- **Integrated Low-Side N-Channel MOSFET**
- **Adjustable Constant LED Current From 350mA to 1000mA**
- **Support Analog Dimming and Thermal Fold-Back**
- **Wide Input Voltage Range:**
  – **4.5V to 42V (LM3414)**
  – **4.5V to 65V (LM3414HV)**
- **Constant Switching Frequency Adjustable from 250 kHz to 1000 kHz**
- **Thermal Shutdown Protection**
- **Power Enhanced SOIC-8 or 3mm x 3mm WSON-8 Package**

APPLICATIONS

- **High Power LED Driver**
- **Architectural Lighting, Office Troffer**
- **Automotive Lighting**
- **MR-16 LED Lamp**

DESCRIPTION

The LM3414 and LM3414HV are 1A 60W (see Note below) common anode capable constant current buck LED drivers. They are exceptionally suitable to drive single string of 3W HBLED with up to 96% efficiency. They accept input voltages from 4.5VDC to 65VDC and deliver up to 1A average LED current with ±3% accuracy. The integrated low-side N-channel power MOSFET and current sensing element realize simple and low component count circuitry as no bootstrapping capacitor and external current sensing resistor are required. An external small-signal resistor to ground provides very fine LED current adjustment, analog dimming as well as thermal fold-back functions.

Constant switching frequency operation eases EMI. No external loop compensation network is needed. The proprietary Pulse-Level-Modulation (PLM) control method benefits in high conversion efficiency and true average LED current regulation. Fast response time realizes fine LED current pulse fulfilling the 240 Hz 256-step dimming resolution requirement for general lighting.

The LM3414 and LM3414HV are available in SOIC-8 and 3mm x 3mm WSON-8 packages.

Note: Thermal de-rating applies according to actual operation conditions
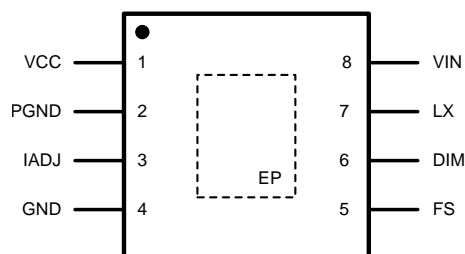
Simplified Application Schematic
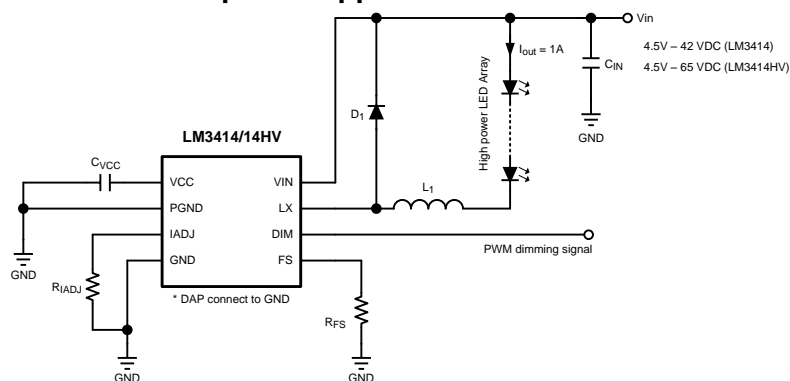
LM3414, LM3414HV

Connection Diagram

Top View
8-Lead Plastic SOIC-8
Package Number DDA
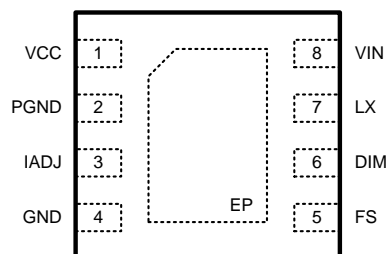
Top View
8-Lead Plastic WSON-8
Package Number NGQ

PIN DESCRIPTIONS

Pin	Name	Description	Application Information
1	VCC	Internal Regulator Output Pin	This pin should be bypassed to ground by a ceramic capacitor with a minimum value of 1µF.
2	PGND	Power Ground Pin	Ground for power circuitry. Reference point for all stated voltages. Must be externally connected to EP and GND.
3	IADJ	Average Output Current Adjustment Pin	Connect resistor R_{IADJ} from this pin to ground to adjust the average output current.
4	GND	Analog Ground Pin	Analog ground connection for internal circuitry, must be connected to PGND external to the package.
5	FS	Switching Frequency Setting Pin	Connect resistor R_{FS} from this pin to ground to set the switching frequency.
6	DIM	PWM Dimming Control Pin	Apply logic level PWM signal to this pin controls the intend brightness of the LED string.
7	LX	Drain of N-MOSFET Switch	Connect this pin to the output inductor and anode of the schottky diode.
8	VIN	Input Voltage Pin	The input voltage should be in the range of 4.5V to 42V (LM3414) or 4.5V to 65V (LM3414HV).
EP	EP	Thermal Pad (Power Ground)	Used to dissipate heat from the package during operation. Must be electrically connected to PGND external to the package.

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings (LM3414) [1]

VIN to GND	-0.3V to 42V
VIN to GND (Transient)	45V (500 ms)
LX to PGND	-0.3V to 42V
LX to PGND (Transient)	-3V(2 ns) to 45V (500 ms)
FS, IADJ to GND	-0.3V to 5V
DIM to GND	-0.3V to 6V
ESD Rating. Human Body Model [2]	2kV
Storage Temp. Range	-65°C to 125°C
Soldering Information	
Lead Temperature (Soldering 10s)	260°C
Infrared/Convection Reflow (20sec)	235°C

(1) Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Ratings are conditions under which operation of the device is intended to be functional. For ensured specifications and test conditions, see the Electrical Characteristics.

(2) The human body model is a 100pF capacitor discharged through a 1.5 kΩ resistor into each pin.

Product Folder Links: *LM3414 LM3414HV*

Operating Ratings (LM3414)

V_{IN}		4.5V to 42V
Junction Temperature Range		−40°C to +125°C
Thermal Resistance θ_{JA}	SOIC-8 Package	45°C/W
	WSON-8 Package	54°C/W

Absolute Maximum Ratings (LM3414HV) [1][2]

VIN to GND	-0.3V to 65V
VIN to GND (Transient)	67V (500 ms)
LX to PGND	-0.3V to 65V
LX to PGND (Transient)	-3V(2 ns) to 67V (500 ms)
FS, IADJ to GND	-0.3V to 5V
DIM to GND	-0.3V to 6V
ESD Rating, Human Body Model [3]	2kV
Storage Temp. Range	-65°C to 125°C
Soldering Information	
Lead Temperature (Soldering 10s)	260°C
Infrared/Convection Reflow (20sec)	235°C

(1) Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Ratings are conditions under which operation of the device is intended to be functional. For ensured specifications and test conditions, see the Electrical Characteristics.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
(3) The human body model is a 100pF capacitor discharged through a 1.5 kΩ resistor into each pin.

Operating Ratings (LM3414HV)

V_{IN}		4.5V to 65V
Junction Temperature Range		−40°C to +125°C
Thermal Resistance θ_{JA}	SOIC-8 Package	45°C/W
	WSON-8 Package	54°C/W

Electrical Characteristics (LM3414)

V_{IN} = 24V unless otherwise indicated. Typical and limits appearing in plain type apply for $T_A=T_J$= +25°C[1]. Limits appearing in boldface type apply over full Operating Temperature Range. Datasheet min/max specification limits are obtained under device test mode and specified by design, test, or statistical analysis.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
SYSTEM PARAMETERS						
$I_{IN-DIM-HIGH}$	Operating Current	4.5V ≤ Vin ≤ 42V R_{IADJ} = 3.125 kΩ V_{DIM} = High	**2.2**	3.2	**3.5**	mA
$I_{IN-DIM-LOW}$	Standby Current	4.5V ≤ Vin ≤ 42V R_{IADJ} = 3.125 kΩ V_{DIM} = Low	**0.8**	1.15	**1.4**	mA
I_{LX-OFF}	LX Pin Current	Main Switch Turned OFF $V_{LX} = V_{IN}$ = 42V		6		µA

(1) Typical specification represent the most likely parametric norm at 25°C operation.

Electrical Characteristics (LM3414HV)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
SYSTEM PARAMETERS						
$I_{IN-DIM-HIGH}$	Operating Current	4.5V ≤ Vin ≤ 65V R_{IADJ} = 3.125 kΩ V_{DIM} = High	**2.2**	3.3	**3.6**	mA

LM3414, LM3414HV

Electrical Characteristics (LM3414HV) (continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$I_{IN-DIM-LOW}$	Standby Current	$4.5V \leq V_{in} \leq 65V$ $R_{IADJ} = 3.125\ k\Omega$ $V_{DIM} = Low$	**0.8**	1.2	**1.45**	mA
I_{LX-OFF}	LX Pin Current	Main Switch Turned OFF $V_{LX} = V_{IN} = 65V$		6.5		µA

Electrical Characteristics (LM3414/LM3414HV)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
SYSTEM PARAMETERS						
I_{LED}	Average LED Current	$R_{IADJ} = 3.125\ k\Omega$ $T_A = 25°C$	0.97	1	1.03	A
		$R_{IADJ} = 3.125\ k\Omega$ $T_A = -40°C$ to $125°C$	**0.95**	1	**1.05**	A
$V_{CC-UVLO}$	Vcc UVLO Threshold	V_{CC} Decreasing	3.60	3.75	3.90	V
$V_{CC-UVLO-HYS}$	Vcc UVLO Hysteresis			300		mV
V_{IADJ}	IADJ Pin voltage		**1.230**	1.255	**1.280**	V
V_{DIM}	DIM Pin Threshold	V_{DIM} Increasing		1.0	**1.2**	V
$V_{DIM-HYS}$	DIM Pin Hysteresis			100		mV
f_{SW}	Switching Frequency Range		**250**	500	**1000**	kHz
f_{SW-TOL}	Switching Frequency Tolerance	$R_{FS} = 40\ k\Omega$	**420**	500	**580**	kHz
t_{ON-MIN}	Minimum On-time				**400**	ns
INTERNAL VOLTAGE REGULATOR						
V_{CC}	V_{CC} Regulator Output Voltage[1]	$C_{VCC} = 1µF$, No Load to $I_{VCC} = 2mA$	**4.7**	5.4	**6.0**	V
		Vin = 4.5V, 2 mA Load	**3.8**	4.2		V
MAIN SWITCH						
R_{LX}	Resistance Across LX and GND	Main Switch Turned ON			**1.8**	Ω
THERMAL PROTECTION						
T_{SD}	Thermal Shutdown Temperature	T_J Rising		170		°C
T_{SD-HYS}	Thermal Shutdown Temperature Hysteresis	T_J Falling		10		°C
THERMAL RESISTANCE						
θ_{JA}	Junction to Ambient, 0 LFPM Air Flow[2]	SOIC-8 package		45		°C/W
		WSON-8 package		54		°C/W

(1) VCC provides self bias for the internal gate drive and control circuits. Device thermal limitations limit external loading to the pin.
(2) Tested on a 4 layer JEDEC board. Four vias provided under the exposed pad. See JESD51-5 and JESD51-7. The value of the θ_{JA} for the WSON package is specifically dependent on the PCB trace area, trace material, and the number of layers and thermal vias. For improved thermal resistance and power dissipation for the WSON package, refer to Application Note AN-1187 (SNOA401).

Product Folder Links: *LM3414 LM3414HV*

Typical Performance Characteristics

All curves taken at V_{IN} = 48V with configuration in typical application for driving twelve power LEDs with I_{LED} = 1A shown in this datasheet. T_A = 25°C, unless otherwise specified.
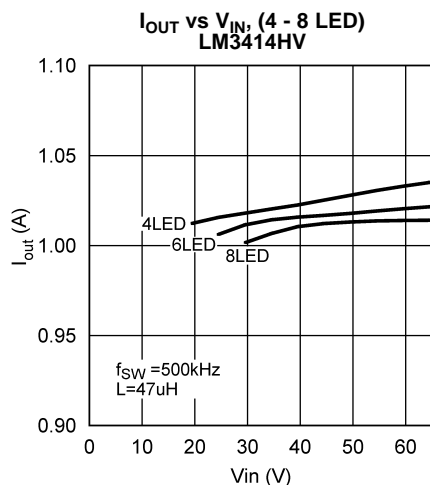
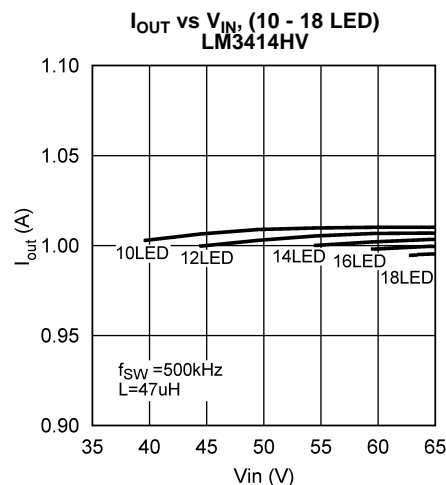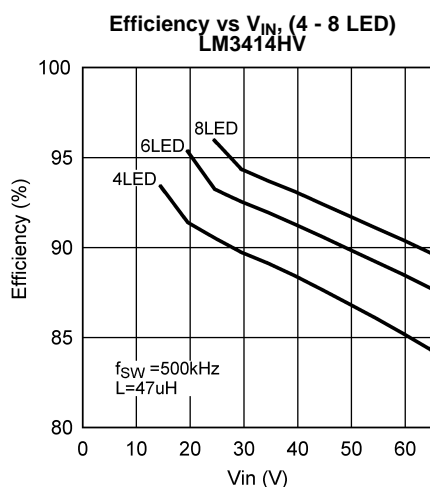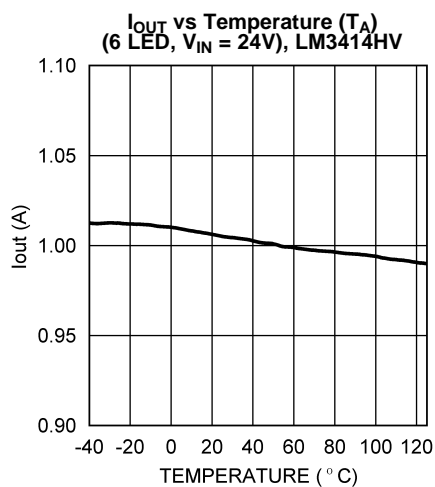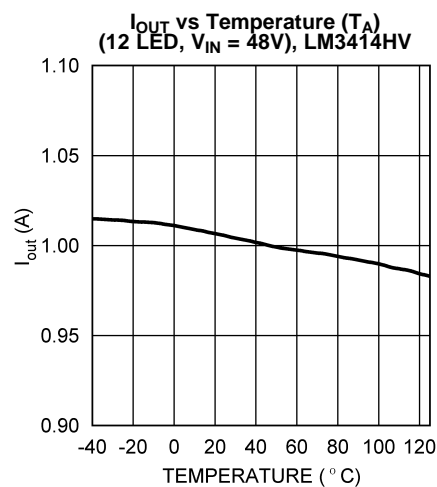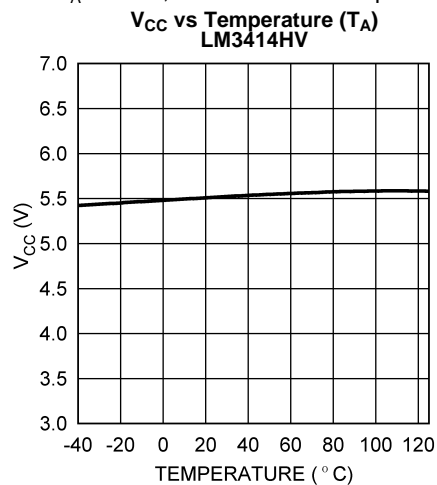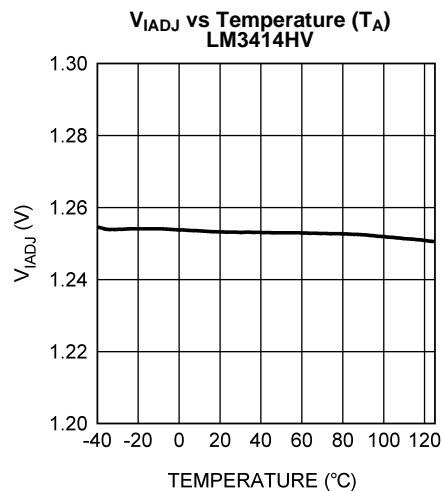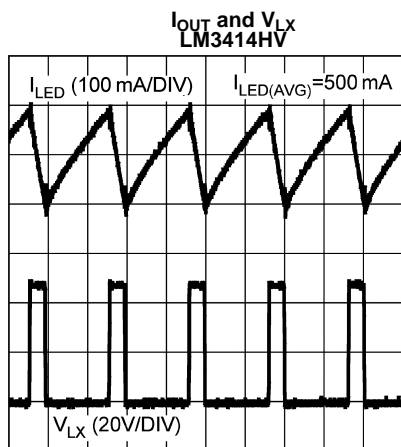**I_{OUT} vs V_{IN}, (4 - 8 LED)**
LM3414HV

Figure 1.

I_{OUT} vs V_{IN}, (10 - 18 LED)
LM3414HV

Figure 2.

Efficiency vs V_{IN}, (4 - 8 LED)
LM3414HV

Figure 3.

Efficiency vs V_{IN}, (10 - 18 LED)
LM3414HV

Figure 4.

I_{OUT} vs Temperature (T_A)
(6 LED, V_{IN} = 24V), LM3414HV

Figure 5.

I_{OUT} vs Temperature (T_A)
(12 LED, V_{IN} = 48V), LM3414HV
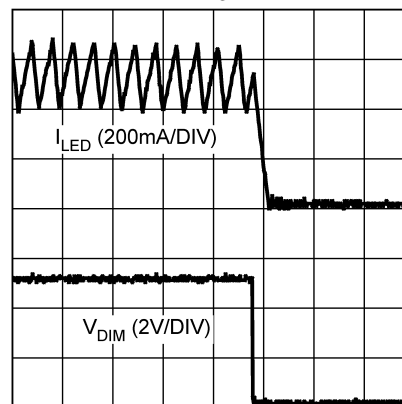

Figure 6.

Product Folder Links: *LM3414 LM3414HV*

Typical Performance Characteristics (continued)

All curves taken at V_{IN} = 48V with configuration in typical application for driving twelve power LEDs with I_{LED} = 1A shown in this datasheet. T_A = 25°C, unless otherwise specified.

V_{CC} vs Temperature (T_A)
LM3414HV

Figure 7.

V_{IADJ} vs Temperature (T_A)
LM3414HV

Figure 8.

I_{OUT} and V_{LX}
LM3414HV

1 µs/DIV

Figure 9.

I_{LX} and V_{DIM}
LM3414HV

2.5 ms/DIV
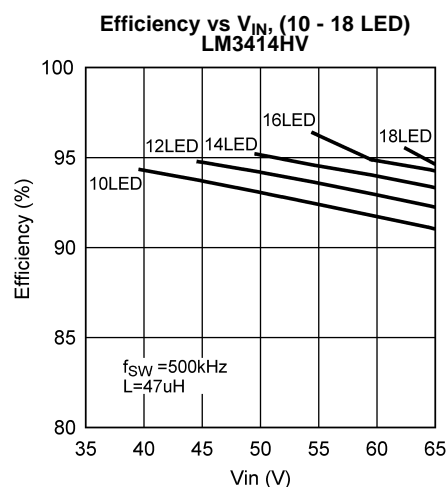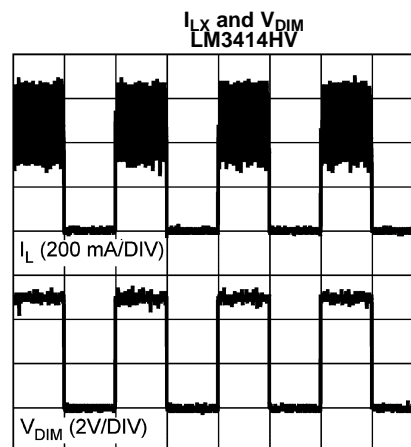
Figure 10.

LED Current with PWM Dimming (V_{DIM} Rising)
LM3414HV

5 µs/DIV
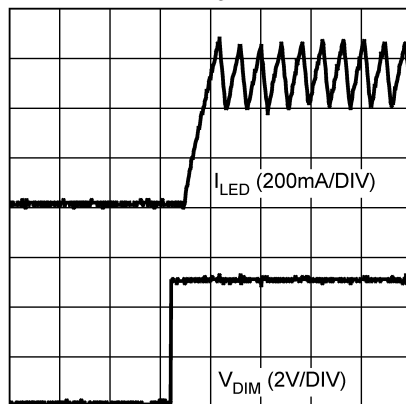
Figure 11.

LED Current with PWM Dimming (V_{DIM} Falling)
LM3414HV

5 µs/DIV

Figure 12.

Product Folder Links: *LM3414 LM3414HV*

Typical Performance Characteristics (continued)

All curves taken at V_{IN} = 48V with configuration in typical application for driving twelve power LEDs with I_{LED} = 1A shown in this datasheet. T_A = 25°C, unless otherwise specified.

**LED Current with PWM Dimming
(9μs dimming pulse), LM3414HV**

I_{LED} (200mA/DIV)

V_{DIM} (2V/DIV)

5 μs/DIV
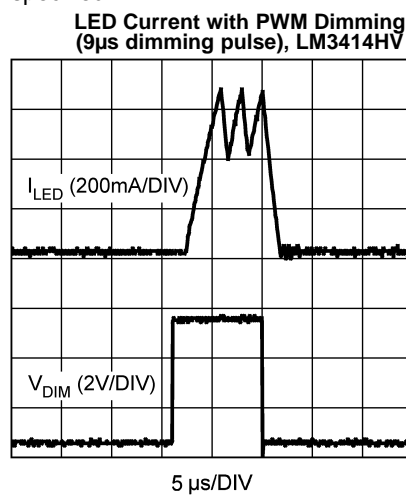
Figure 13.

Block Diagram
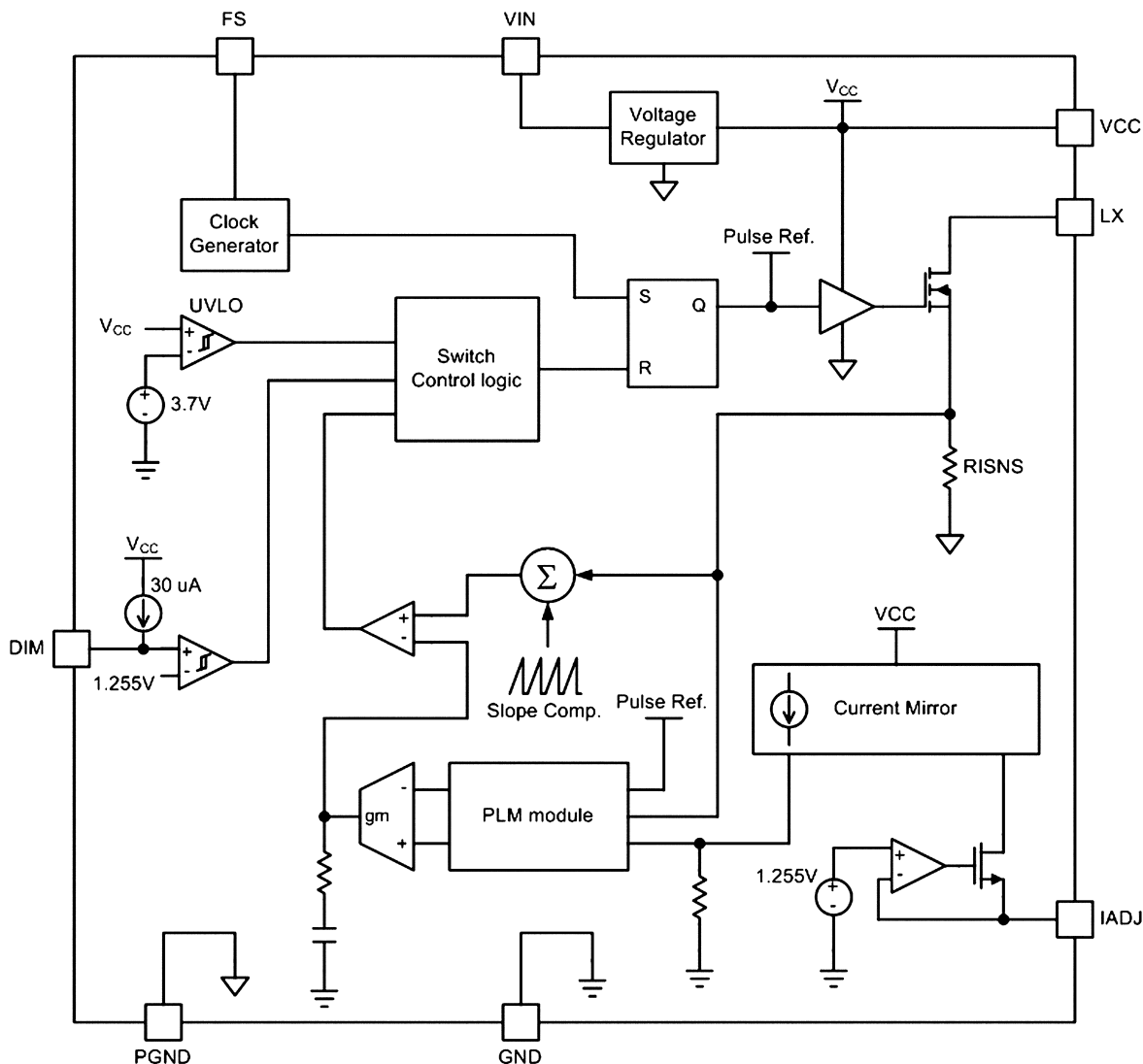
Operation Description

OVERVIEW

The LM3414/14HV is a high power floating buck LED driver with wide input voltage ranges. It requires no external current sensing elements and loop compensation networks. The integrated power N-MOSFET enables high output power with up to 1000 mA output current. The combination of Pulse Width Modulation (PWM) control architecture and the proprietary Pulse Level Modulation (PLM) ensures accurate current regulation, good EMI performance and provides high flexibility on inductor selection. High speed dimming control input allows precision and high resolution brightness control for applications require fine brightness adjustment.

APPLICATION INFORMATION

SETTING THE SWITCHING FREQUENCY

Both the LM3414 and LM3414HV are PWM LED drivers that contain a clock generator to generate constant switching frequency for the device. The switching frequency is determined by the resistance of an external resistor R_{FS} in the range of 250 kHz to 1 MHz. Lower resistance of R_{FS} results in higher switching frequency. The switching frequency of the LM3414/14HV is governed by the following equation:

$$f_{SW} = \frac{20 \times 10^6}{R_{FS}} \text{ kHz}$$

(1)
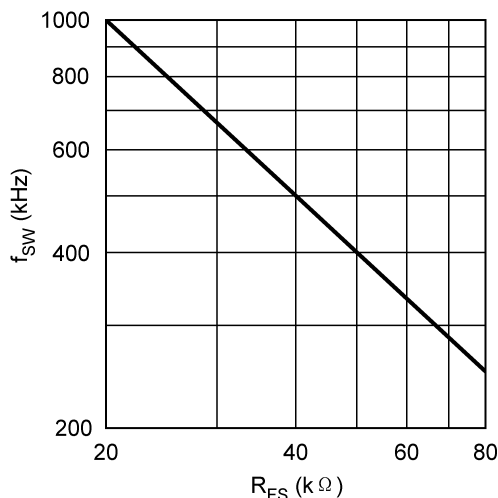
Figure 14. Switching Frequency vs R_{FS}

Table 1. Examples for f_{SW} Settings

f_{SW} (kHz)	R_{FS} (kΩ)
250	80
500	40
1000	20

To ensure accurate current regulation, the LM3414/14HV should be operated in continuous conduction mode (CCM) and the on time should not be shorter than 400 ns under all operation condition.

SETTING LED CURRENT

The LM3414/14HV requires no external current sensing resistor for LED current regulation. The average output current of the LM3414/14HV is adjustable by varying the resistance of the resistor, R_{IADJ} that connects across the IADJ and GND pins. The IADJ pin is internally biased to 1.255V. The LED current is then governed by the following equation:

$$I_{LED} = \frac{3125 \times 10^3}{R_{IADJ}} \text{ mA}$$

where

- 350 mA < I_{LED} < 1A

(2)
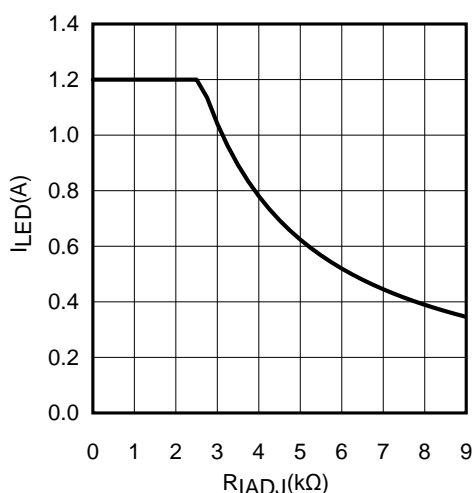
Figure 15. LED Current vs R_{IADJ}

Table 2. Examples for I_{OUT} Settings

I$_{OUT}$ (mA)	R$_{IADJ}$ (kΩ)
350	8.93
500	6.25
700	4.46
1000	3.13

The LED current can be set to any level in the range from 350 mA to 1A. In order to provide accurate LED current, R_{IADJ} should be a resistor with no more than 0.5% tolerance. If the IADJ pin is accidentally shorted to GND (R_{IADJ} = 0), the output current will be limited to avoid damaging the circuit. When the over current protection is activated, current regulation cannot be maintained until the over-current condition is cleared.

MINIMUM SWITCH ON-TIME

As the LM3414 features a 400 ns minimum ON time, it is essential to make sure the ON time of the internal switch is not shorter than 400 ns when setting the LED driving current. If the switching ON time is shorter than 400 ns, the accuracy of the LED current may not maintain and exceed the rated current of the LEDs. The ratio of the LED forward voltage to input voltage is restricted by the following restriction:

$$\frac{V_{LED}}{V_{IN}} \geq 400 \text{ nS x } f_{SW}$$

(3)

PEAK SWITCH CURRENT LIMIT

The LM3414/14HV features an integrated switch current limiting mechanism that protects the LEDs from being overdriven. The switch current limiter will be triggered when the switch current is three times exceeding the current level set by R_{IADJ}. Once the current limiter is triggered, the internal power switch turns OFF for 3.6 µs to allow the inductor to discharge and cycles repetitively until the over current condition is removed. The current limiting feature is exceptionally important to avoid permanent damage of the LM3414/14HV application circuit due to short circuit of LED string.
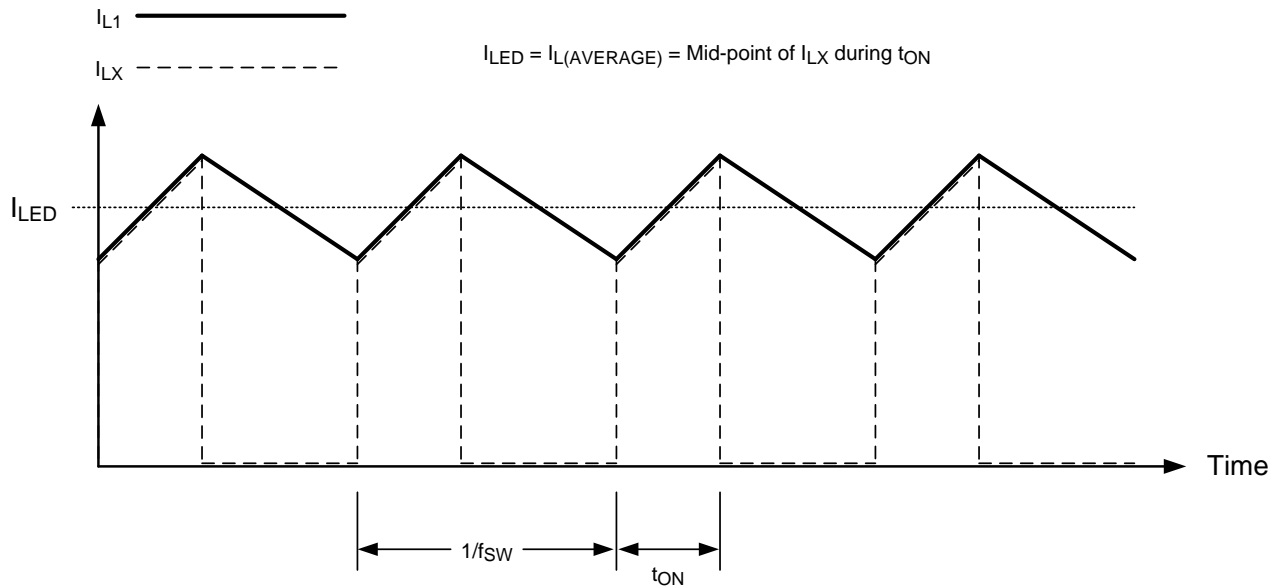
Product Folder Links: *LM3414 LM3414HV*

I_{L1} ———

I_{LX} - - - - - - - -

$I_{LED} = I_{L(AVERAGE)}$ = Mid-point of I_{LX} during t_{ON}

Figure 16. Waveforms of a Floating Buck LED Driver with PLM

INDUCTOR SELECTION

To ensure proper output current regulation, the LM3414/14HV must operate in Continuous Conduction Mode (CCM). With the incorporation of PLM, the peak-to-peak inductor current ripple can be set as high as ±60% of the defined average output current. The minimum inductance of the inductor is decided by the defined average LED current and allowable inductor current ripple. The minimum inductance can be found by the equations shown below:

Since:

$$\Delta I_L = \frac{V_{IN} - V_{LED}}{L} \times D \times T$$

(4)

Thus:

$$L_{MIN} = \frac{V_{IN} - V_{LED}}{1.2 \times I_{LED}} \times \frac{V_{LED}}{V_{IN}} \times \frac{1}{f_{SW}}$$

(5)

The LM3414/14HV can maintain LED current regulation without output filter capacitor. This is because the inductor of the floating buck structure provides continuous current to the LED throughout the entire switching cycle. When LEDs are driven without filter capacitor, the LED peak current must not set exceeding the rated current of the LED. The peak LED current is governed by the following equation:

$$\Delta I_L = \left[\frac{(V_{IN} - V_{LED}) V_{LED}}{2L \times V_{IN} \times f_{SW}} \right] + I_{LED(AVG)}$$

(6)

INTERNAL N_MOS POWER SWITCH

The LM3414/14HV features an integrated N-channel power MOSFET that connects between the LX and GND pins for power switching. With the switch turned ON, the resistance across the LX and GND pins is 1.8Ω maximum.

INTERNAL VCC REGULATOR

The LM3414/14HV features a 5.4V internal voltage regulator that connects between the VIN and VCC pins for powering internal circuitry and provide biases to external components. The VCC pin must be bypassed to the GND pin with a 1μF ceramic capacitor, C_{VCC} that connected to the pins as close as possible. When the input voltage falls below 6V, the VCC voltage will drop below 5.4V and decrease proportionally as Vin decreases. The device will shutdown as the VCC voltage falls below 3.9V. When the internal regulator is used to provide bias to external circuitry, it is essential to ensure the current sinks from VCC pin does not exceed 2mA to maintain correct voltage regulation.

CONTROL SCHEME

The main control circuitry of the LM3414/14HV is generally a Pulse-Width-Modulated (PWM) controller with the incorporation of the Pulse-Level-Modulation (PLM) technology. PLM is a technology that facilitates true output average current control without the need to sense the output current directly. In the LM3414/LM3414HV, the PLM circuit senses the current of the internal switch through an integrated current sensing circuitry to realize average output current control. The use of PLM reduces the power losses on current sensor as it needs current information only when the switch is turned ON.

In general, the LED drivers with current sensing resistor at the output, the power dissipation on the current sensing resistor is I_{LED}^2 x R_{ISNS}, where I_{LED} is the average output current and R_{ISNS} is the resistance of the current sensing resistor. In the LM3414/LM3414HV, because of the incorporation of PLM, power dissipates on the R_{ISNS} only in ON period of the internal power switch. The power loss on R_{ISNS} becomes I_{LED}^2 x R_{ISNS} x D, where D is the switching duty cycle. For example, when the switching duty cycle, D of a converter is 0.5, the power loss on R_{ISNS} with PLM is half of those with conventional output current sensing.

PULSE-LEVEL-MODULATION (PLM) OPERATION PRINCIPLES

The Pulse-Level-Modulation is a patented method to ensure accurate average output current regulation without the need of direct output current sensing. Figure 16 shows the current waveforms of a typical buck converter under steady state, where, I_{L1} is the inductor current and I_{LX} is the main switch current flowing into the LX pin. For a buck converter operating in steady state, the mid-point of the RAMP section of the main switch current is equal to the average level of the inductor current hence the average output current. In short, by regulating the mid-point of the RAMP section of the main switch current with respect to a precise reference level, PLM achieves output current regulation by sensing the main switch current solely.

PWM DIMMING CONTROL

The DIM pin of the LM3414/14HV is an input with internal pull-up that accepts logic signals for average LED current control. Applying a logic high (above 1.2V) signal to the DIM pin or leaving the DIM pin open will enable the device. Applying a logic low signal (below 0.9V) to the DIM pin will disable the switching activity of the device but maintain VCC regulator active. The LM3414/14HV allows the inductor current to slew up to the preset regulated level at full speed instead of charging the inductor with multiple restrained switching duty cycles. This enables the LM3414/14HV to achieve high speed dimming and very fine dimming control as shown in Figure 17 and Figure 18:

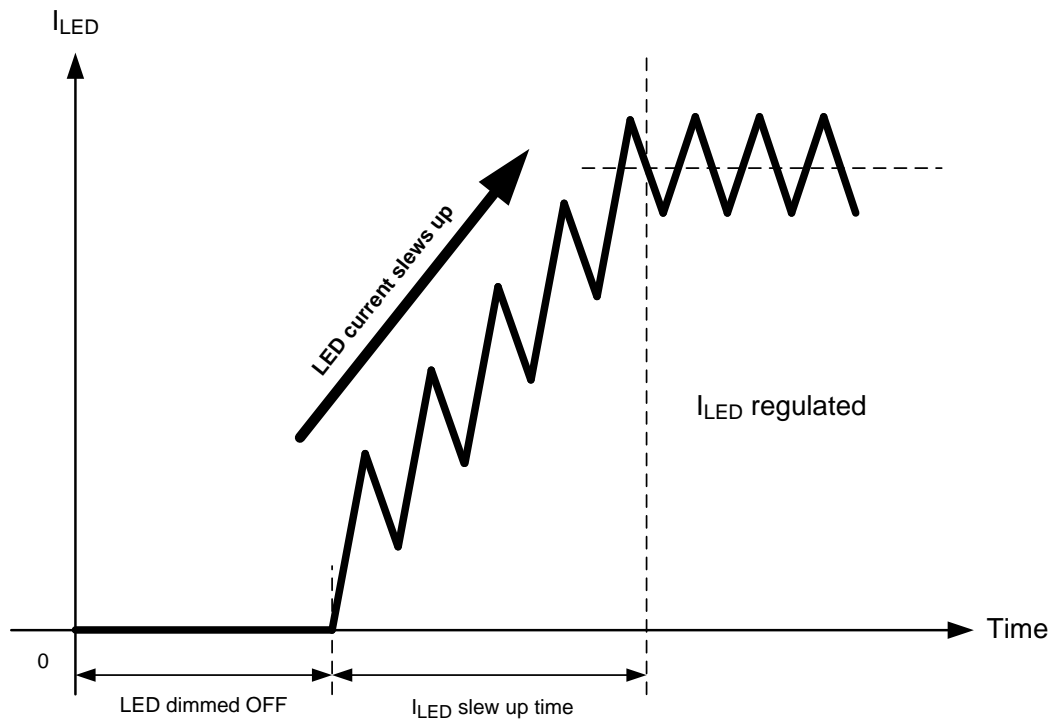Product Folder Links: *LM3414 LM3414HV*

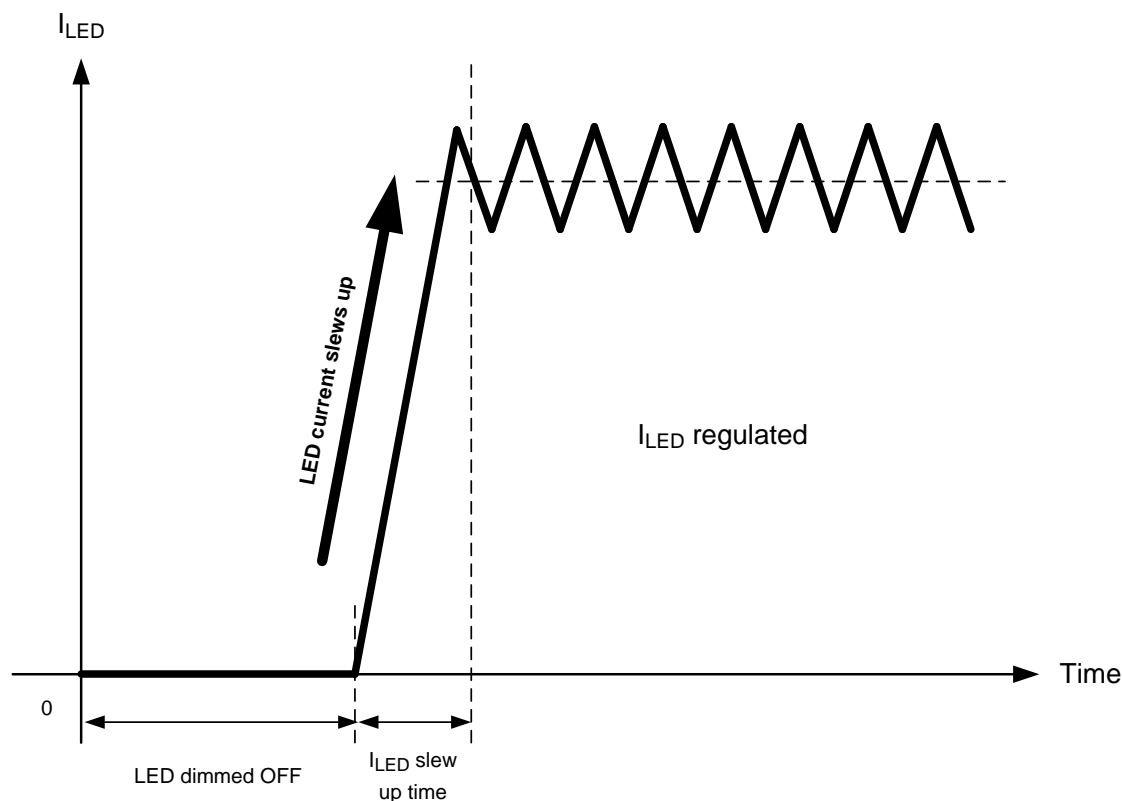**Figure 17. LED Current Slews up with Multiple Switching Cycle**

Figure 18. Shortened Current Slew up Time of the LM3414/14HV

To ensure normal operation of the LM3414/14HV, it is recommended to set the dimming frequency not higher than 1/10 of the switching frequency. The minimum dimming duty cycle is limited by the 400 ns minimum ON time. In applications that require high dimming contrast ratio, low dimming frequency should be used.

ANALOG DIMMING CONTROL

The IADJ pin can be used as an analog dimming signal input. As the average output current of the LM3414 depends on the current being drawn from the IADJ pin, thus the LED current can be increased or decreased by applying external bias current to the IADJ pin. The simplified circuit diagram for facilitating analog dimming is as shown in Figure 19.

Product Folder Links: *LM3414 LM3414HV*
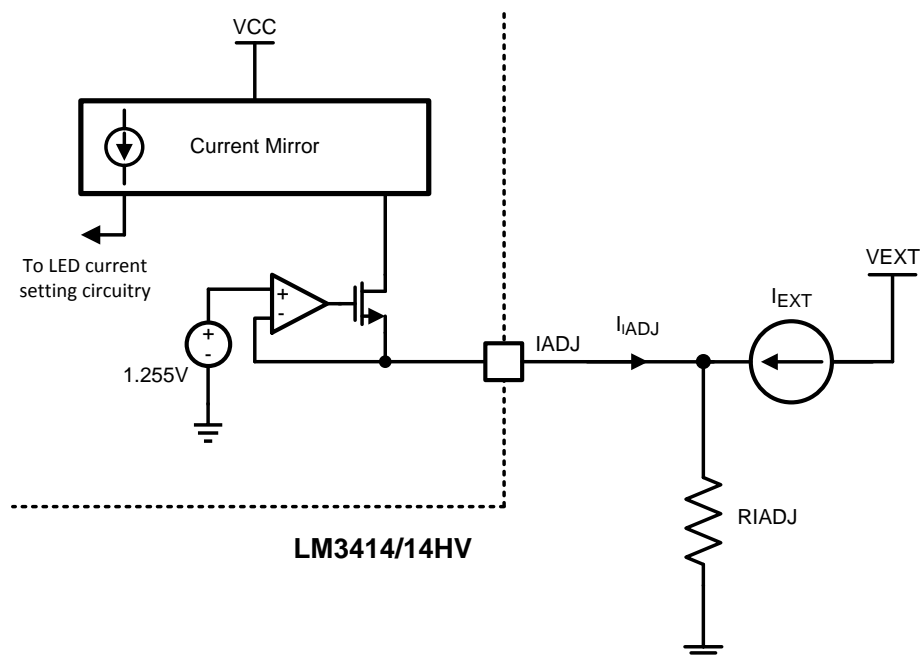
Figure 19. Analog LED Current Control Circuit

When external bias current I_{EXT} is applied to the IADJ pin, the reduction of LED current follows the equations:

$$I_{LED} = \left[\left(\frac{1.255}{R_{IADJ}} - I_{EXT} \right) \times 2490 \times 10^3 \right] mA$$

(7)

Provided that

$$I_{EXT} < \frac{1.255}{R_{IADJ}}$$

(8)

I_{LED} decreases linearly as I_{EXT} increases.

This feature is exceptionally useful for the applications with analog dimming control signals such as those from analog temperature sensors and ambient light sensors.

DESIGN EXAMPLE

Figure 20 shows an example circuit for analog dimming control using simple external biasing circuitry with a variable resistor.
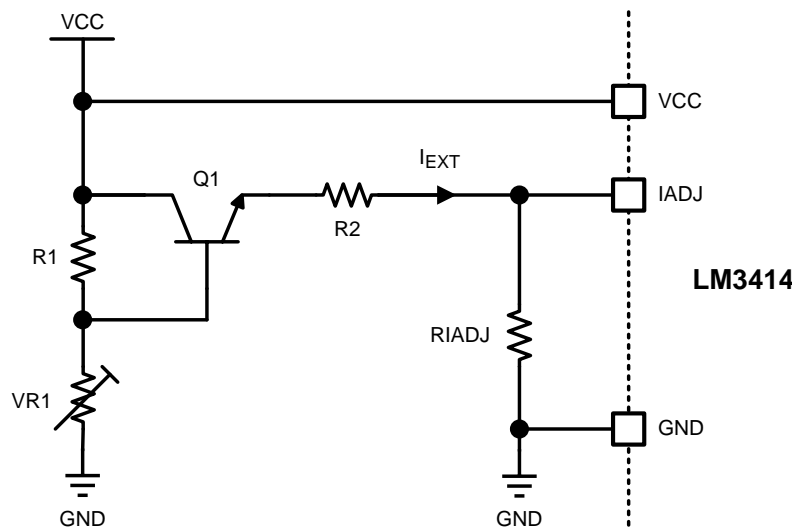
Figure 20. Example Analog Dimming Control Circuit

In the figure, the variable resistor VR1 controls the base voltage of Q1 and eventually adjusts the bias voltage of current to the IADJ pin (I_{EXT}). As the resistance of VR1 increases and the voltage across VR1 exceeds 1.255V + 0.7V, the LED current starts to decrease as I_{EXT} increases.

where

$$I_{EXT} = \left[\frac{VCC - 1.955 \left(\dfrac{R1}{VR1} + 1 \right)}{R_2 \left(\dfrac{R1}{VR1} + 1 \right)} \right] mA$$

(9)

The analog dimming begins only when $I_{EXT} > 0$.

DESIGN CONSIDERATIONS

The overall performance of the LED driver is highly depends on the PCB layout and component selection. To minimize connection losses and parasitic inductance of the traces, the best practice is to keep the copper traces connecting the inductor, power switch and rectifier short and thick . Long traces on critical power paths will introduce voltage and current spikes to the LM3414/LM3414HV. If the voltage spike level exceeds the absolute maximum pin voltage of the LM3414, it could damage the device and LEDs. To avoid physical damage of the circuit, a Transient Voltage Suppressor (TVS) can be added across VIN and GND pins to suppress the spike voltage. This also helps in absorbing the input voltage spike when the circuit is powered through physical switch upon power up.

Additional Application Circuit
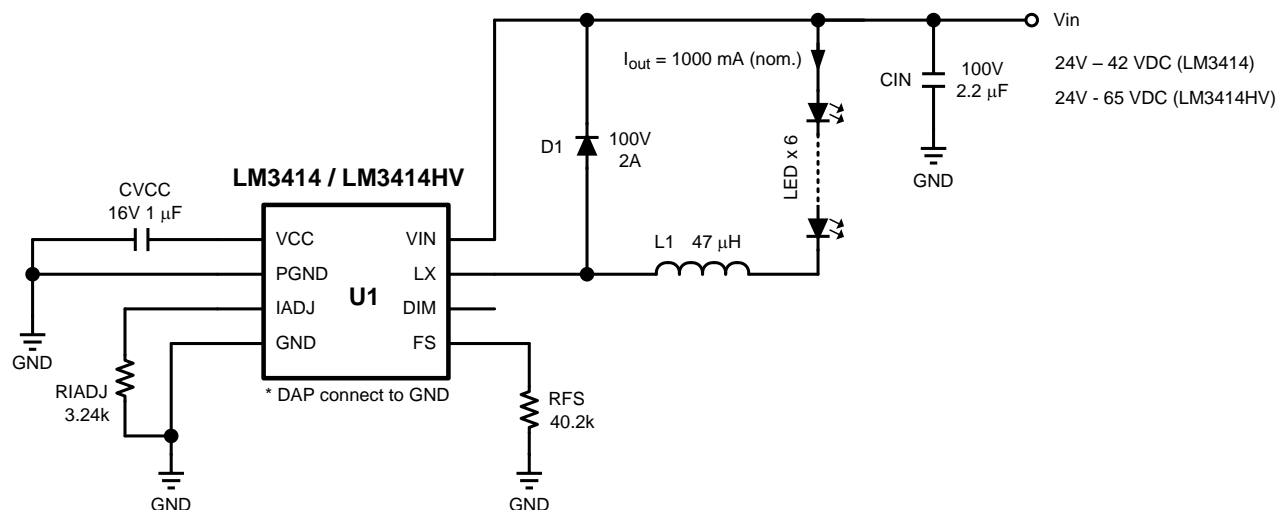
Figure 21. LM3414/14HV Design Example (I_OUT = 500 mA)

Table 3. Bill of Materials

Designation	Description	Package	Manufacture Part #	Vendor
U1	LED Driver IC LM3414 / LM3414HV	SOIC-8	LM3414 / LM3414HV	TI
L₁	Inductor 47 µH	8 x 8 x 4.9 (mm)	MMD-08EZ-470M-SI	Mag.Layers
D₁	Schottky Diode 100V 2.0A	SMP	SS2PH10-M3	Vishay
C_IN	Cap MLCC 100V 2.2 µF X7R	1210	GRM32ER72A225KA35L	Murata
C_VCC	Cap MLCC 16V 1.0 µF X5R	603	GRM39X5R105K16D52K	Murata
R_IADJ	Chip Resistor 3.24 kΩ 1%	603	CRCW06033241F	Vishay
R_FS	Chip Resistor 40.2 kΩ 1%	603	CRCW06034022F	Vishay
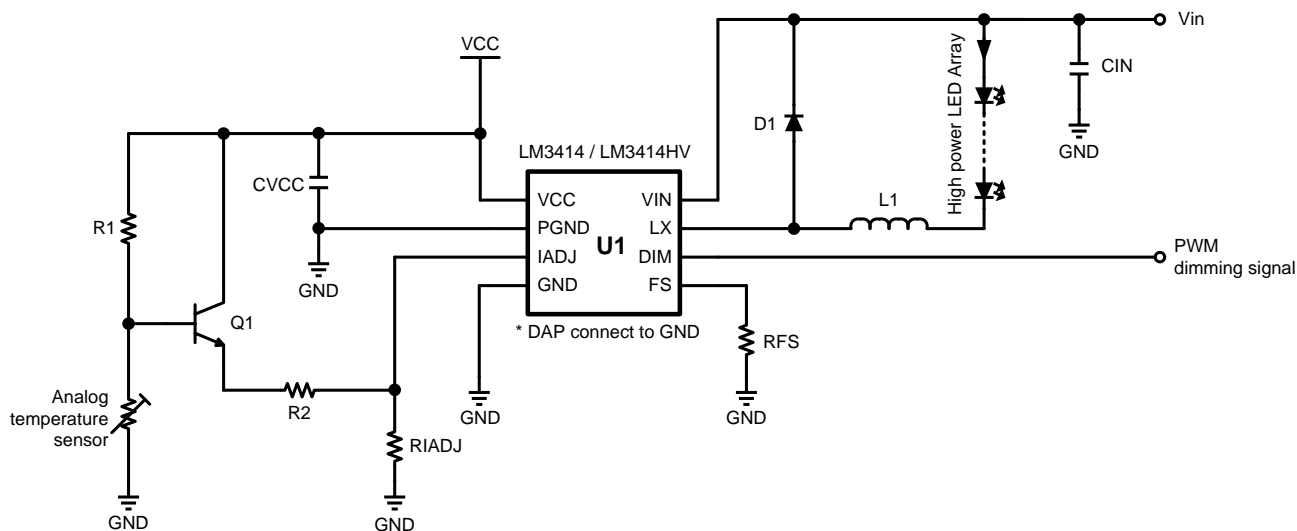
Figure 22. Application Circuit of LM3414/14HV with Temperature Fold-Back Circuitry and PWM Dimming

REVISION HISTORY

Product Folder Links: *LM3414 LM3414HV*

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM3414HVMR/NOPB	ACTIVE	SO PowerPAD	DDA	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 125	L3414 HVMR	Samples
LM3414HVMRX/NOPB	ACTIVE	SO PowerPAD	DDA	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 125	L3414 HVMR	Samples
LM3414HVSD/NOPB	ACTIVE	WSON	NGQ	8	1000	Green (RoHS & no Sb/Br)	Call TI	Level-1-260C-UNLIM	-40 to 125	L249B	Samples
LM3414HVSDX/NOPB	ACTIVE	WSON	NGQ	8	4500	Green (RoHS & no Sb/Br)	Call TI	Level-1-260C-UNLIM	-40 to 125	L249B	Samples
LM3414MR/NOPB	ACTIVE	SO PowerPAD	DDA	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 125	L3414 MR	Samples
LM3414MRX/NOPB	ACTIVE	SO PowerPAD	DDA	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 125	L3414 MR	Samples
LM3414SD/NOPB	ACTIVE	WSON	NGQ	8	1000	Green (RoHS & no Sb/Br)	Call TI	Level-1-260C-UNLIM	-40 to 125	L248B	Samples
LM3414SDX/NOPB	ACTIVE	WSON	NGQ	8	4500	Green (RoHS & no Sb/Br)	Call TI	Level-1-260C-UNLIM	-40 to 125	L248B	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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PACKAGE MATERIALS INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSIONS

A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM3414HVMRX/NOPB	SO Power PAD	DDA	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM3414HVSD/NOPB	WSON	NGQ	8	1000	178.0	12.4	3.3	3.3	1.0	8.0	12.0	Q1
LM3414HVSDX/NOPB	WSON	NGQ	8	4500	330.0	12.4	3.3	3.3	1.0	8.0	12.0	Q1
LM3414MRX/NOPB	SO Power PAD	DDA	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM3414SD/NOPB	WSON	NGQ	8	1000	178.0	12.4	3.3	3.3	1.0	8.0	12.0	Q1
LM3414SDX/NOPB	WSON	NGQ	8	4500	330.0	12.4	3.3	3.3	1.0	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM3414HVMRX/NOPB	SO PowerPAD	DDA	8	2500	367.0	367.0	35.0
LM3414HVSD/NOPB	WSON	NGQ	8	1000	210.0	185.0	35.0
LM3414HVSDX/NOPB	WSON	NGQ	8	4500	367.0	367.0	35.0
LM3414MRX/NOPB	SO PowerPAD	DDA	8	2500	367.0	367.0	35.0
LM3414SD/NOPB	WSON	NGQ	8	1000	210.0	185.0	35.0
LM3414SDX/NOPB	WSON	NGQ	8	4500	367.0	367.0	35.0

DDA0008A

.193±.004
[4.9±0.1]

B

8   5

EXPOSED PAD
AT BOTTOM

C

.230-.244
[5.84-6.20]

.154±.004
[3.9±0.1]

PIN 1 ID

1   4

(□ .090)
[2.29]

6X .050
[1.27]

.056-.066
[1.42-1.68]

(.058)
[1.47]

A

.004 [0.1] A

8X .0138-.0192
[0.35-0.49]

.001-.005
[0.025-0.127]
TYP

⊕ .010 [0.25]Ⓜ A BⓈ CⓈ

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS
DIMENSIONS IN ( ) FOR REFERENCE ONLY

(□ .090)
[2.29]

SYMM ₡

SYMM ₡

(.219)
[5.56]

(8X .075)
[1.91]

(8X .024)
[0.61]

(6X .050)
[1.27]

RECOMMENDED LAND PATTERN

45° X .013
[0.33]

0° - 8°

.016-.035
[0.42-0.89]

(.040)
[1.01]

8X
.0075-.0098
[0.19-0.25]

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NGQ0008A

(2)

(1.6)

(2.8)

(8X 0.6)

(8X 0.25)

(6X 0.5)

RECOMMENDED LAND PATTERN

DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS IN ( ) FOR REFERENCE ONLY

(0.1)

3±0.1

3±0.1

PIN 1 INDEX
AREA

C

0.8 MAX

2±0.1

(45°X0.25)

PIN 1 ID

1   4

1.6±0.1

8X 0.4±0.1

8   5

8X 0.25±0.05

6X 0.5

⊕ 0.1Ⓜ C AⓈ BⓈ

2X 1.5

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