

#### Features:

- 1.1V to 5.5V Input Range
- 2 Amp Peak Switch Current
- High Efficiency > 80%
- 20V Maximum Output with Over-Voltage Protection
- LED Intensity Control
- 1.0 MHz Fixed Frequency Switching
- 8 Lead SOIC Package

#### Applications:

- White LED Display Backlighting
  - Low Voltage: Mobile Phones, PDA's, MP3 Players, Digital Cameras
  - High Drive Current: Vehicle Instrumentation Panels

#### General Description

The MX841 is a fixed frequency, constant current source step-up DC/DC converter. The output current is directly regulated making the MX841 ideal for driving series connected white light emitting diodes (LED's) in backlight applications. The MX841 powers up to 3 series white LED's at 1.1V, and 20 series/parallel white LED's at 5.0V.

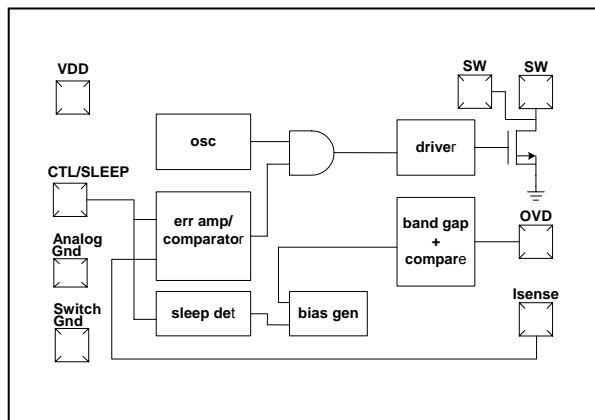
The MX841 features a 1.0MHz switching frequency to accommodate the use of small capacitors and a small inductor necessary in size sensitive portable applications. Light intensity and shutdown are conveniently controlled by a single analog voltage. Power efficiency and battery life are extended through the use of a high voltage, low  $R_{DS(ON)}$  N-channel MOSFET switch.

The MX841 is designed to operate over a temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , and is available in an SOIC-8 Package, with or without an Exposed Pad in Tube or on Tape and Reel. (Alternate package types available upon request).

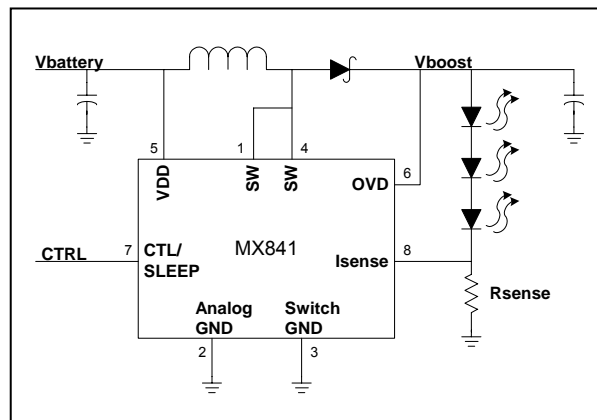
#### Ordering Information

Part No.	Description	Qty
17000-00TU	SOIC-8 Standard Tube	100
17000-00TR	SOIC-8 Standard T&R	2500
17043-00TU	SOIC-8 Exposed Pad Tube	100
17043-00TR	SOIC-8 Exposed Pad T&R	2500

#### Functional Block Diagram



#### Typical Application



## Absolute Maximum Ratings (Voltages with respect to GND=0V)

Parameter	Min	Max	Unit
V <sub>DD</sub> Supply Voltage	-0.4	+6.5	V
CTRL Voltage	G <sub>ND</sub> -0.4	V <sub>DD</sub> +0.4	V
I <sub>SENSE</sub> Voltage	G <sub>ND</sub> -0.4	V <sub>DD</sub> +0.4	V
SW Voltage	-0.4	+24.0	V
OVD Voltage	-0.4	+24.0	V
Operating Ambient Temperature Range	-40	+85	C°
Storage Temperature Range	-55	+150	C°
Operating Junction Temperature Range	-40	+125	C°
Power Dissipation T <sub>A</sub> = 27°C	Standard SOIC θ <sub>JA</sub> = 114°C/W	775	mW
	Exposed Pad SOIC θ <sub>JA</sub> = 50°C/W	1.75	W

Absolute Maximum Ratings are stress ratings. Stresses in excess of these ratings can cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this data sheet is not implied. Exposure of the device to the absolute maximum ratings for an extended period may degrade the device and affect its reliability.

## ESD Warning

ESD (electrostatic discharge) sensitive device. Although the MX841 features proprietary ESD protection circuitry, permanent damage may be sustained if subjected to high energy electrostatic discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

## DC Electrical Characteristics

V<sub>DD</sub>=3.0V, R<sub>SENSE</sub>=5Ω, V<sub>CTRL</sub>=1.0V, L=6.8μH, C<sub>BYP</sub>=1μF, T<sub>A</sub> = -40°C to +85°C, Typical Values at +25°C  
Unless otherwise specified

Parameter	Condition	Min	Typ	Max	Unit
Supply Voltage	T <sub>A</sub> = 25°C	1.1		5.5	V
Supply Current Overtolerance	Not Switching: V <sub>CTRL</sub> = 260mV V <sub>RSENSE</sub> > 13 X V <sub>CTRL</sub>		0.5	0.8	mA
Supply Current Operating	Switching: V <sub>CTRL</sub> = V <sub>DD</sub> , V <sub>RSENSE</sub> = GND			2	
Sleep Current	V <sub>CTRL</sub> < 100mV	T <sub>A</sub> = +25°C		6	μA
		T <sub>A</sub> = +85°C		7	μA
CTRL Bias Current		-10			μA
I <sub>SENSE</sub> Bias Current			-7		μA
OVD Bias Current	OVD = 18V	V <sub>CTRL</sub> > 260mV		20	μA
		V <sub>CTRL</sub> = GND		0	
Over Voltage Threshold	OVD Rising			22	V
	OVD Falling	18.5			V
CTRL / V <sub>RSENSE</sub>			13		V/V
V <sub>CTRL</sub> Sleep Mode	V <sub>CTRL</sub> Rising		260		mV
	V <sub>CTRL</sub> Falling		100		mV
SW On Resistance	V <sub>SW</sub> = 0.1V		1.9		Ω
	V <sub>SW</sub> = 0.5V		2.2		Ω
Switch Current	V <sub>DD</sub> =1.2V, L=33μH		30		mA
	V <sub>DD</sub> =5.5V, L=2.5μH		2		A
SW Voltage Range		V <sub>DD</sub> - V <sub>SCHOTTKY</sub>		20	V
SW Leakage Current	OVD = V <sub>SW</sub> = 18V	T <sub>A</sub> = +25°C		0.1	μA
		T <sub>A</sub> = +85°C		0.3	μA
V <sub>CTRL</sub>		0		V <sub>DD</sub>	V

**AC Electrical Characteristics**

$V_{DD}=3.0V$ ,  $R_{SENSE}=5\Omega$ ;  $V_{CTRL}=1.0V$ ,  $L=6.8\mu H$ ;  $C_{BYP}=1\mu F$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ , Typical Values at  $+25^{\circ}C$   
 Unless otherwise specified

Parameter	Condition	Min	Typ	Max	Unit
Oscillator Frequency		0.6	1.0	1.3	MHz
Duty Cycle			72.5		%

**Pin Description**

Pin No.	Pin Name	Description
1, 4	SW	Power Switch. Connects the drain of the internal high voltage N-channel MOSFET to the Inductor and Schottky Diode to generate the LED boost voltage. This voltage is determined by the total forward bias voltage of the LED series string and the Isense resistor value. (Note: Both pins must be connected.)
2	Analog GND	Analog Ground (Note: Must be connected to a low noise ground source.)
3	Switch GND	Switch Ground (Note: Must be connected to a high current ground source.)
5	VDD	Input supply pin. Input range from 1.1 to 5.5 volts. Must be bypassed with a low ESR capacitor to GND.
6	OVD	Over Voltage Detect input. Compares the LED boots voltage to the internal voltage reference. If the boost voltage rises above 22V the OVD circuit disables the oscillator and N-channel MOSFET until the boost voltage falls below 18.5V. Must be bypassed with a low ESR capacitor to GND.
7	CTRL	Shutdown and Intensity Control Input. A control voltage above 260mV enables device operation. A control voltage below 100mV disables device operation. LED intensity is linearly adjusted with voltages between 260mV and $V_{DD}$ .
8	Isense	Current Sense Input. The LED bias current is set by connecting a carbon composite or monolithic resistor from this input to Ground. $I_{SENSE}$ regulates this current to 1/13 of the CTRL input voltage.

## Functional Description

The MX841 is specifically designed to be operated from a single cell battery source. The step-up voltage necessary for the constant current source to drive up to 5 white LED's in series, or multiple strings of white LED's, is achieved with minimal external components. (See Application Schematics on pages 1&4).

### Setting the LED Current

The regulated output current is determined by the selection of the sense Resistor connected from the  $I_{SENSE}$  input to ground, and the maximum user defined voltage of the CTRL input. The desired output current, (typically 15mA to 20mA for white LEDs), is derived using the following formula for the  $R_{SENSE}$  value:  $R_{SENSE} \Omega = (V_{CTRL} \times 1/13) / I_{LED}$ .

### Current Regulation / Light Intensity Control

The  $I_{SENSE}$  voltage is fed into an ErrorAmp/Comparator. The user defined Control Voltage applied at the CTRL input is scaled by a gain factor of 1/13 and compared to the  $I_{SENSE}$  voltage. If the scaled control voltage is greater than the  $I_{SENSE}$  voltage, the 1.0MHz oscillator signal driving the N-Channel MOSFET will be enabled. Once the  $I_{SENSE}$  voltage reaches the scaled CTRL voltage the oscillator signal is modulated on and off by the ErrorAmp/Comparator to maintain the desired regulated output current.

Light intensity is controlled by reducing the voltage at the CTRL input. As the CTRL input voltage is reduced below the user defined maximum value, the oscillator signal driving the N-Channel MOSFET is interrupted by the ErrorAmp/Comparator. The pulse skip modulating of the N-Channel MOSFET causes a reduction in the regulated current equal to the ratio of the reduced CTRL voltage to the maximum CTRL voltage.

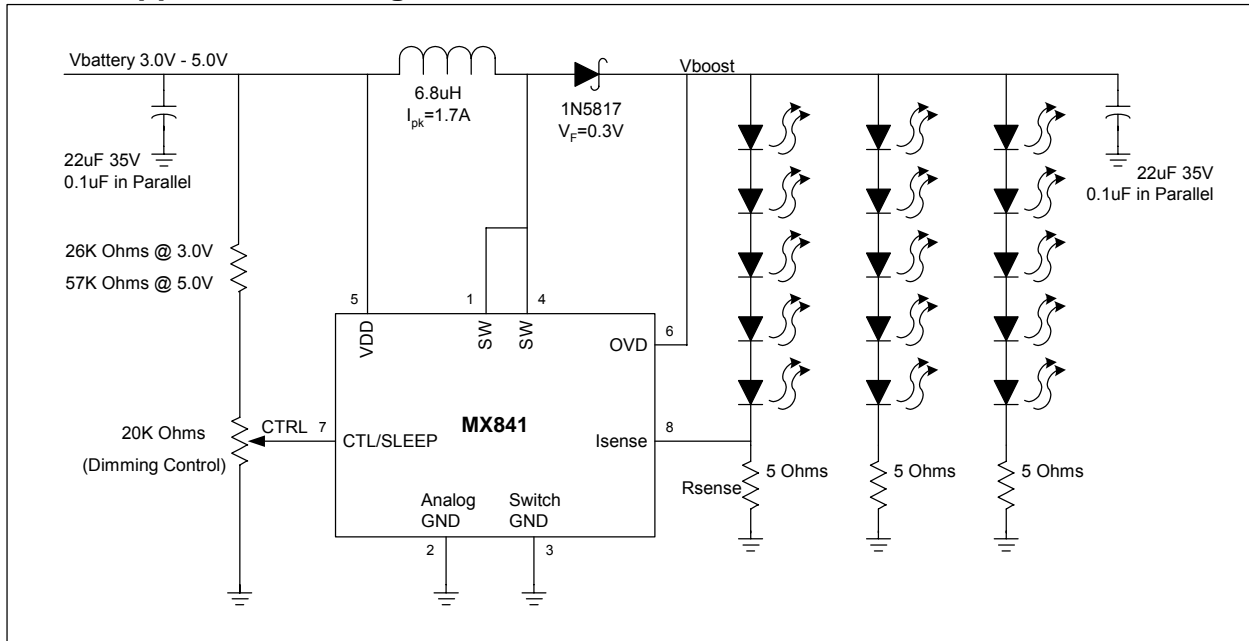
### Sleep Mode

The MX841 goes into sleep mode when the  $V_{CTRL}$  input is less than 100mV. All circuits except  $V_{CTRL}$  detection are shutdown and the supply current falls to 6uA. Once the  $V_{CTRL}$  input rises above 260mV the MX841 resumes normal operation.

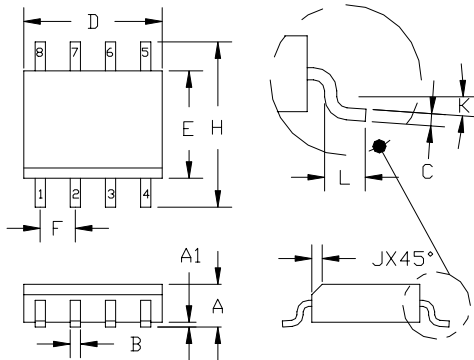
### Over Voltage Detection

The MX841 will go into a shutdown state to avoid an over voltage condition if the current path between the SW output and the  $R_{SENSE}$  input is interrupted. A voltage reference and comparator circuit evaluates the voltage potential at the OVD input and shuts down the oscillator and N-Channel MOSFET if an over voltage condition is detected. Normal operation is resumed once the OVD input voltage falls below the reference voltage, (20V typical).

Circuit Application Driving 15 White LED's



8-LEAD SOI



DIM.	INCH		MM.		NOTE
	MIN.	MAX.	MIN.	MAX.	
A	.0532	.0688	1.35	1.75	----
A1	.0040	.0098	.10	.25	----
B	.013	.020	.33	.51	----
C	.0075	.0098	.19	.25	----
D	.1890	.1968	4.80	5.00	②
E	.1497	.1574	3.80	4.00	②
F	.050	BSC	1.27	BSC	----
H	.2284	.2440	5.80	6.20	----
J	.0099	.0196	.25	.50	----
K	0°	8°	0°	8°	----
L	.016	.050	.40	1.27	----

- 3. MOLDED PACKAGE SHALL CONFORM TO JEDEC STANDARD CONFIGURATION MS-012 VARIATION AA.
- ② DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
- ① CONTROLLING DIMENSIONS: MILLIMETERS.
- NOTES: (UNLESS OTHERWISE SPECIFIED)

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