

POWER MANAGEMENT

Power Efficient EL Lamp Driver

The IMP560 is an Electroluminescent (EL) lamp driver designed for systems with low EL lamp drive voltage requirements. It is ideal for low ambient light applications or where small lamps are used. With just one-half the inductor current of the IMP803, the IMP560 reduces system power consumption and extends battery life. Input supply voltage range is 2.0V to 6.0V and quiescent current is a low 420 μ A. Typical EL lamp drive voltage is \pm 60V.

All four EL lamp-driving functions are on-chip. These are the switch-mode power supply, its high-frequency oscillator, the high-voltage H-bridge lamp driver and its low-frequency oscillator. EL lamps of up to 6nF capacitance can be driven to high brightness.

The circuit requires few external components; a single inductor, single diode, two capacitors and three resistors. Two of these resistors set the frequency for two internal oscillators. An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 120V peak-to-peak. This conserves power and extends battery life.

A disable mode puts the chip into a low current drain mode. With a 3.0V supply, quiescent current drops to 200nA maximum, 50nA typical. The chip is disabled by connecting the oscillator frequency setting resistor R_{SW} to ground.

The IMP560 is available in MicroSO and SO-8 packages and in die or wafer form.

Key Features

- ◆ 120V peak-to-peak typical AC output voltage
- ◆ Low input current (w/inductor current).....12mA
- ◆ Low disabled input current.....50nA
- ◆ Wide operating voltage range - from 2.0V to 6.0V
- ◆ Simple design requires few passive components
- ◆ Adjustable output lamp frequency controls lamp color and power consumption
- ◆ Adjustable converter frequency for minimum power consumption
- ◆ IMP803 and HV803 pin compatible
- ◆ MicroSO package option

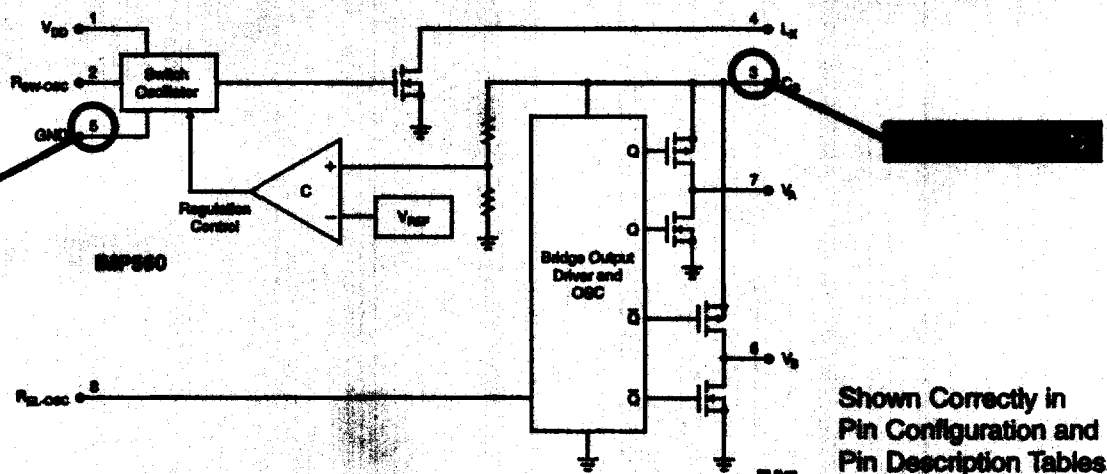
Applications

- ◆ Night lights
- ◆ Automotive displays
- ◆ Cellular phones
- ◆ Pagers
- ◆ Clocks and radios
- ◆ Portable GPS receivers
- ◆ LCD module backlights

Data Sheet Correction

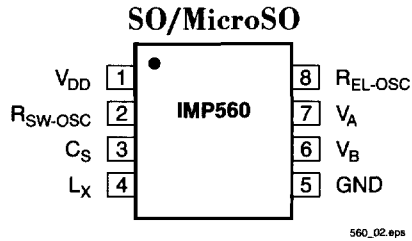
IMP560

Block Diagram - Page 1



Shown Correctly in
Pin Configuration and
Pin Description Tables.

IMP1500037



Pin Compatible With IMP803 and HV803

Ordering Information

Part Number	Input Voltage	Regulated Output Voltage	Temperature Range	Pins-Package
IMP560EMA	2.0V to 6.0V	YES	-40°C to +85°C	8-MicroSO
IMP560ESA	2.0V to 6.0V	YES	-40°C to +85°C	8-SO
IMP560IMA	2.0V to 6.0V	YES	-25°C to +85°C	8-MicroSO
IMP560ISA	2.0V to 6.0V	YES	-25°C to +85°C	8-SO
IMP560/D	2.0V to 6.0V	YES	25°C	Dice

Ordering Information

Part Number	Input Voltage	Regulated Output Voltage	MOS Switch Maximum ON Resistance
IMP803	2.0V to 6.0V	180V	8Ω
IMP525	1.0V to 5.5V	112V	15Ω
IMP560	2.0V to 6.0V	120V	8Ω

Absolute Maximum Ratings

Supply Voltage, V_{DD} , $V_{RSW-OSC}$ and $V_{REL-OSC}$. . . -0.5V to +6.5V
 Output Voltage, V_{CS} -0.5V to +120V
 Storage Temperature Range -65°C to +150°C
 Power Dissipation (SO) 400mW
 Power Dissipation (MicroSO) 300mW

Note: All voltages are referenced to GND.

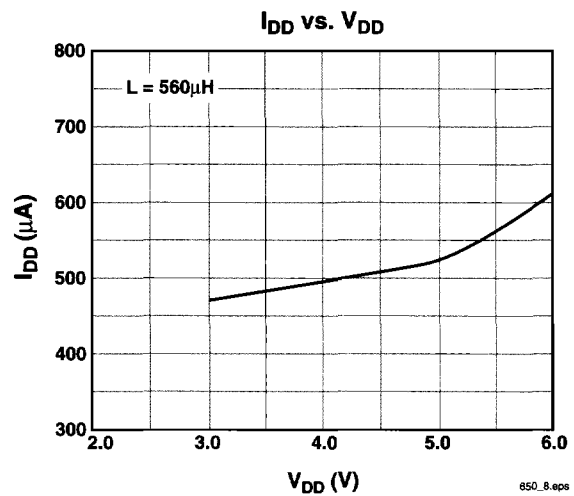
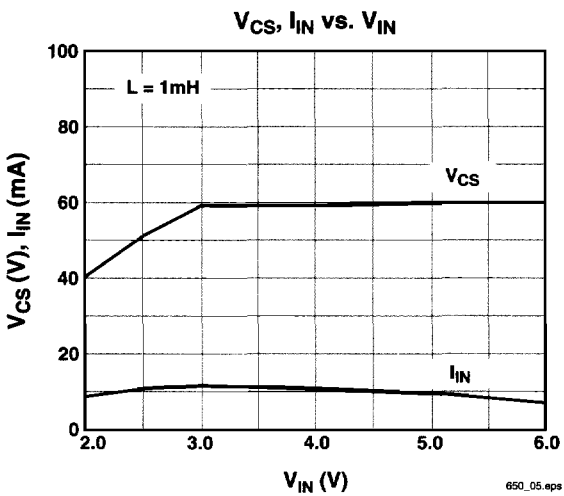
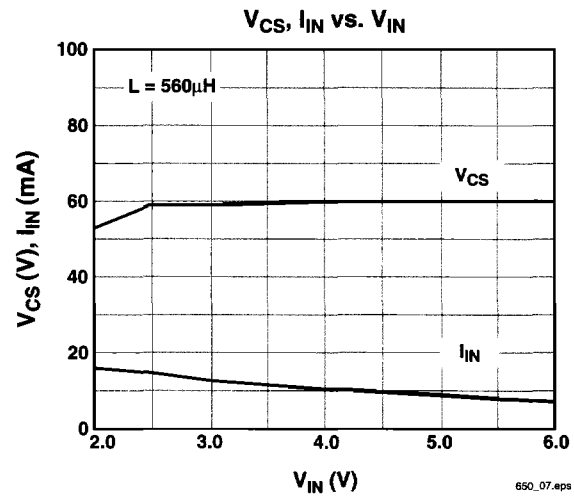
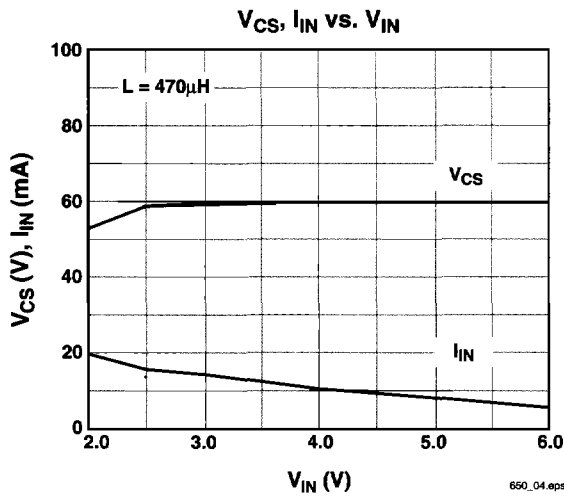
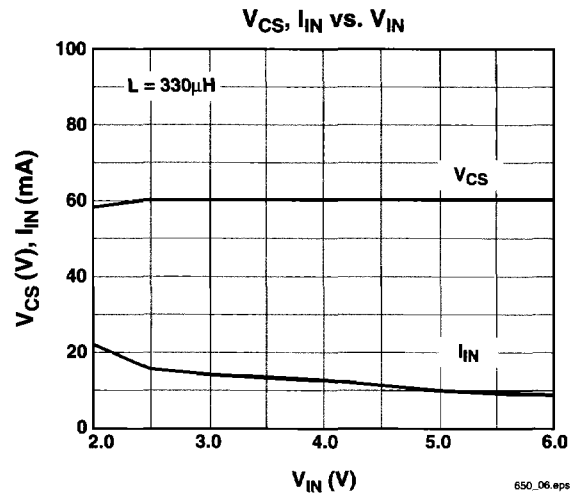
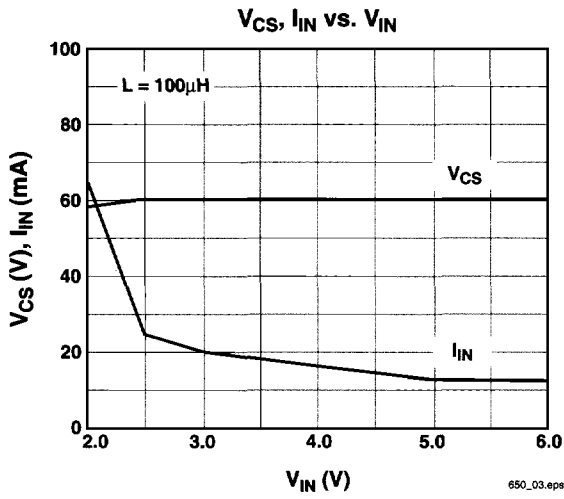
These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

Electrical Characteristics

Unless otherwise noted, $V_{DD} = 3.0V$, $R_{SW} = 750k\Omega$, $R_{EL} = 2.0M\Omega$, and $T_A = 25^\circ C$.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
ON-resistance of MOS Switch	$R_{DS(ON)}$	$I = 100mA$		3.5	8	Ω
Output Voltage Regulation	V_{CS}	$V_{DD} = 2.0$ to $6.0V$	55	60	65	V
Output Voltage Peak-to-peak (in regulation)	$V_A - V_B$	$V_{DD} = 2.0$ to $6.0V$	110	120	130	V
Quiescent V_{DD} Supply Current, Disabled	I_{DDIS}	$V_{RSW-OSC} < 100mV$		50	200	nA
Input Current at V_{DD} Pin	I_{DD}	$V_{DD} = 3.0V$, See Figure 1		470	700	μA
Input Current at V_{DD} Pin	I_{DD}	$V_{DD} = 5.0V$, See Figure 2		500	750	μA
Input Current: I_{DD} Plus Inductor Current	I_{IN}	$V_{DD} = 3.0V$, See Figure 1		12		mA
V_{A-B} Output Drive Frequency	f_{EL}	$V_{DD} = 3.0V$, See Figure 1	300	370	430	Hz
Switching Frequency	f_{SW}	$V_{DD} = 3.0V$, See Figure 1	50	70	90	kHz
Switching Duty Cycle	D_{SW}	$V_{DD} = 3.0V$, See Figure 1		88		%

Typical Characteristics



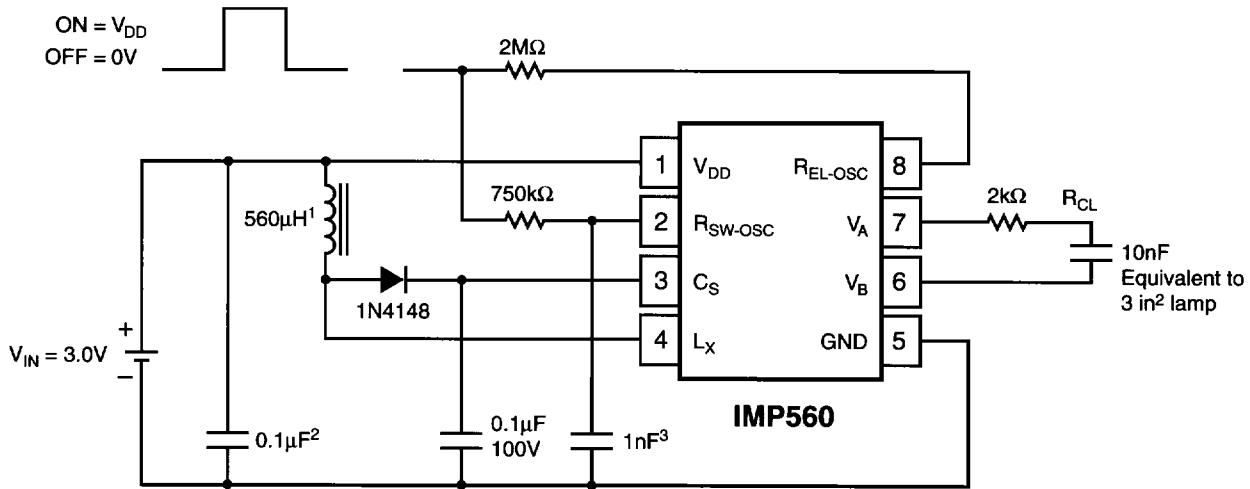
Pin Number	Name	Function
1	V _{DD}	Positive voltage supply for the IMP560. Inductor L may be connected here or to a separate unregulated supply.
2	R _{SW-OSC}	Switch-mode resistor pin. Switching frequency is determined by an external resistor, R _{SW} .
3	C _S	Boost converter storage capacitor. The voltage across the EL lamp is equal to twice the voltage at C _S .
4	L _X	Connection to flyback inductance, L.
5	GND	Ground pin.
6	V _B	EL lamp drive. The lamp is connected in a high-voltage bridge circuit with V _B providing the complementary connection to V _A . The peak-to-peak AC voltage across the EL lamp is thus two times V _{CS} .
7	V _A	EL lamp drive. (See above)
8	R _{EL-OSC}	The EL lamp oscillator frequency setting pin. The oscillator frequency is controlled by external resistor R _{EL} .

External Components

External Component	Description and Selection Guide
Diode	A fast reverse recovery diode, with BV > 100, such as a 1N4148.
Capacitor C _S	This is the high voltage capacitor that stores the inductive energy transferred through the diode. A 100 volt capacitor between 10nF and 100nF is recommended.
Resistor R _{EL}	The EL lamp oscillator frequency setting resistor. This resistor, connected between the R _{EL-OSC} pin and ground, provides an oscillator frequency inversely proportional to R _{EL} ; as R _{EL} increases, the EL lamp frequency decreases along with the current drawn by the lamp. Lamp color is also determined by this frequency. A 2MΩ resistor between the R _{EL-OSC} pin and the V _{DD} supply results in a lamp frequency around 350Hz; a 1MΩ resistor will give ≈700Hz.
Resistor R _{SW}	Switching Oscillator frequency setting resistor. The switching oscillator resistor is connected between the R _{SW-OSC} pin and the V _{DD} supply. The switching frequency is inversely proportional to the resistor value, dropping as the resistance increases.
Capacitor C _{SW}	This is an optional noise-suppression capacitor connected from ground to the R _{SW-OSC} pin. A 1nF capacitor is recommended.
Inductor L _X	The inductor provides the voltage boost needed by means of inductive “flyback”. The internal MOSFET switch alternately opens and closes the ground connection for the inductor at the L _X pin. When this internal switch opens, the inductor potential will forward-bias the diode and the current will pass through the storage capacitor C _S , charging it to a high voltage. Smaller inductors are preferred to prevent saturation. As the value of the inductor increases (and the series DC resistance of the inductor decreases), the switching frequency set by R _{SW} should be increased to prevent saturation. In general, smaller value inductors that can handle more current are more desirable when larger area EL lamps must be driven.
Lamp, R _{CL}	An external resistor in series with the lamp (R _{CL}) will protect the output drivers from high transient currents during lamp commutation.

Test and Application Circuit, 3.0V

Figure 1 shows the IMP560 configured to drive a 3-square-inch EL lamp, represented as a 10nF capacitor.



Note:

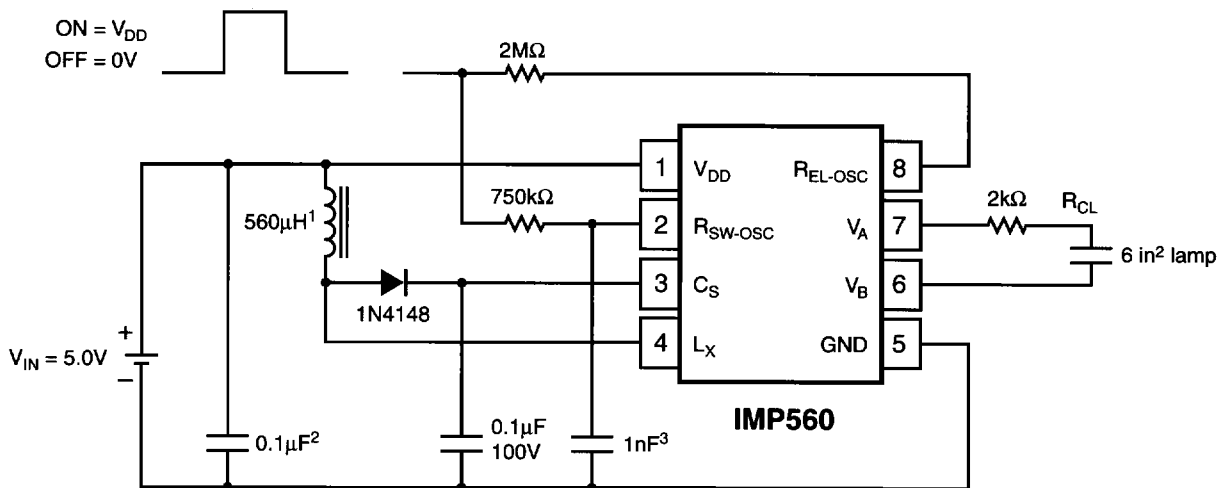
1. Murata part # LQH4N561K04 (DC resistance <math><14.5 \Omega</math>)
2. Larger values may be required depending upon supply impedance.
3. Optional noise-suppression capacitor.

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Figure 1. 3.0V Application

Test and Application Circuit, 5.0V

Figure 2 shows a 5.0V input application driving a 6-square-inch EL lamp.



Note:

1. Murata part # LQH4N561K04 (DC resistance <math><14.5 \Omega</math>)
2. Larger values may be required depending upon supply impedance.
3. Optional noise-suppression capacitor.

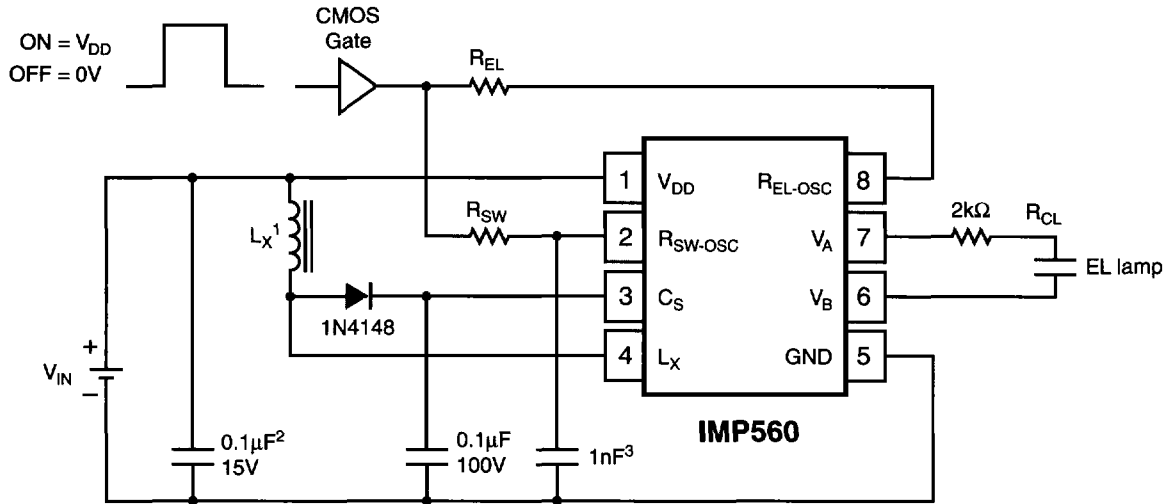
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Figure 2. 5.0V Application

Enable/Disable Operation

Figure 3 shows the IMP560 can be enabled via a logic gate that connects R_{SW} to V_{DD} , and disabled by connecting it to ground. R_{EL} may be connected either to V_{DD} or to the gate.

Enable/Disable Table	
R_{SW} Connection	IMP560 State
V_{DD}	Enabled
Ground	Disabled



Note:

1. Murata part # LQH4N561K04 (DC resistance <math>< 14.5 \Omega</math>)
2. Larger values may be required depending upon supply impedance.
3. Optional noise-suppression capacitor.

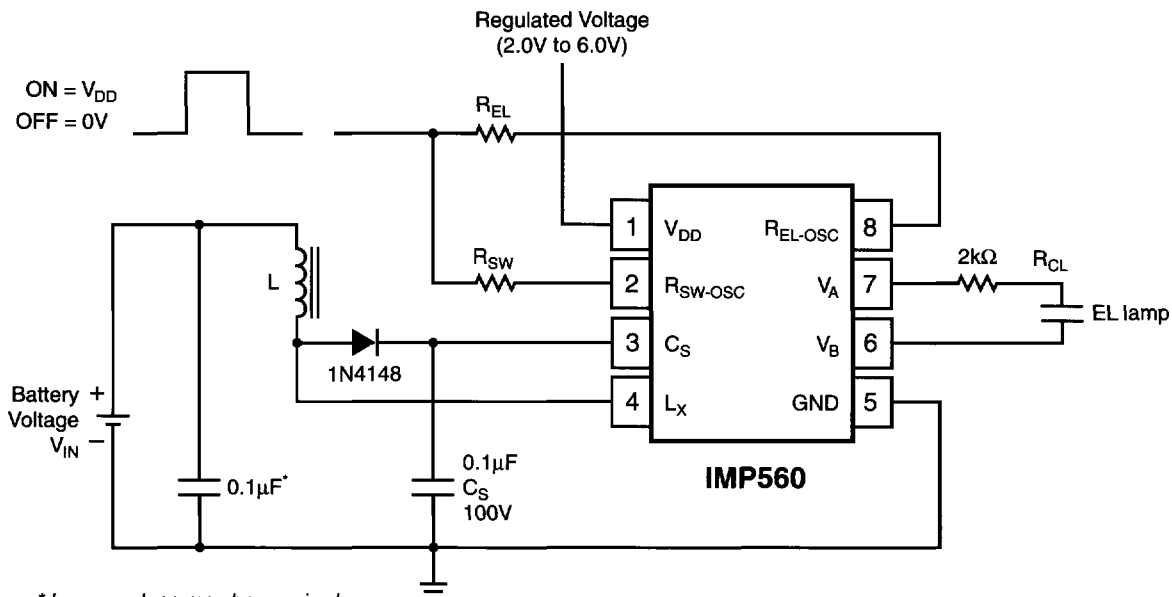
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Figure 3. Enable/Disable Operation

Dual Supply Operation with 1.5V Battery

The IMP560 can also be operate from a single battery cell when a regulated voltage higher than 2.0V is also available. The dual supply configuration, shown in Figure 4, uses the regulated voltage to operate the IMP560 while the energy for the high-voltage boost circuit comes from the battery. The current to run the internal logic is typically 420µA.

The circuit of Figure 4 can also be used with batteries that exceed 6.5V as long as V_{DD} does not exceed 6.0V.

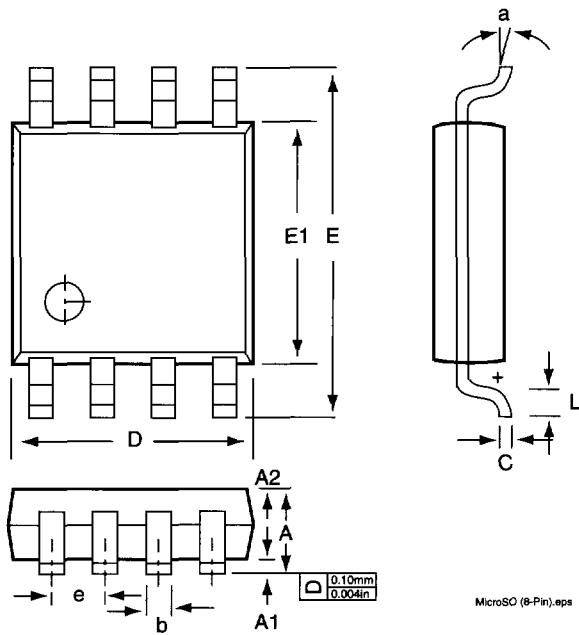


* Larger values may be required depending upon supply impedance

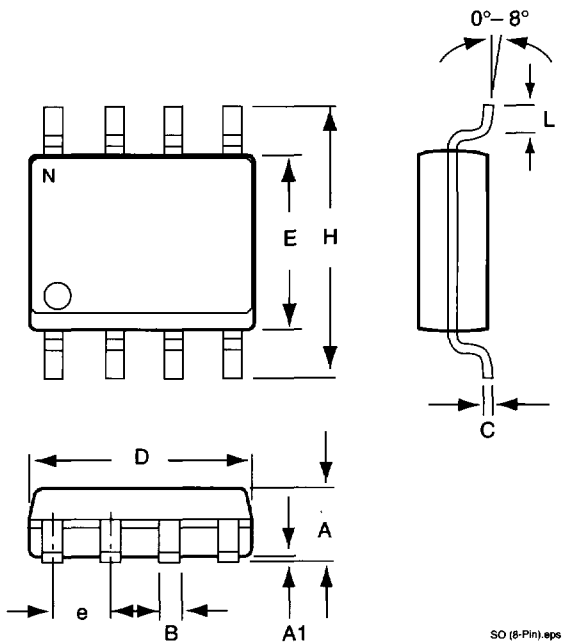
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Figure 4. Dual Supply Operation with High Battery Voltages

MicroSO (8-Pin)



SO (8-Pin)



	Inches		Millimeters	
	Min	Max	Min	Max
MicroSO (8-Pin)				
A	—	0.0433	—	1.10
A1	0.0020	0.0059	0.050	0.15
A2	0.0295	0.0374	0.75	0.95
b	0.0098	0.0157	0.25	0.40
C	0.0051	0.0091	0.13	0.23
D	0.1142	0.1220	2.90	3.10
e	0.0256 BSC		0.65 BSC	
E	0.193 BSC		4.90 BSC	
E1	0.1142	0.1220	2.90	3.10
L	0.0157	0.0276	0.40	0.70
a	0°	6°	0°	6°
SO (8-Pin)				
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.013	0.020	0.33	0.51
C	0.007	0.010	0.19	0.25
e	0.050		1.27	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27
D	0.189	0.197	4.80	5.00

High-Voltages Present

The IMP560 generates high voltages and caution should be exercised.



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