Single Cell Battery Powered Electroluminescent Lamp Driver/Inverter

The IMP525 is an Electroluminescent (EL) lamp driver designed for systems that must operate down to 1 volt and below. The input supply voltage range is 0.9V to 2.5V. Typical output lamp drive voltage is 112V. 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; one inductor, one diode, one capacitor and two resistors. The resistors set the frequency for the two oscillators.

A disable mode puts the chip into a low current-drain state. When disabled, quiescent current drops to 1µA typical with a V_{DD} of 1.5V. The chip can be disabled by connecting R_{SW}, the oscillator frequency setting resistor, to ground. A disable pad (active low), accessible only on the die, can also be used to disable the driver.

An internal circuit shuts down the switching regulator when the lamp drive voltage exceeds 112V peak-to-peak. This conserves power and extends battery life.

The IMP525 is available in MicroSO and SO-8 packages and in die form.

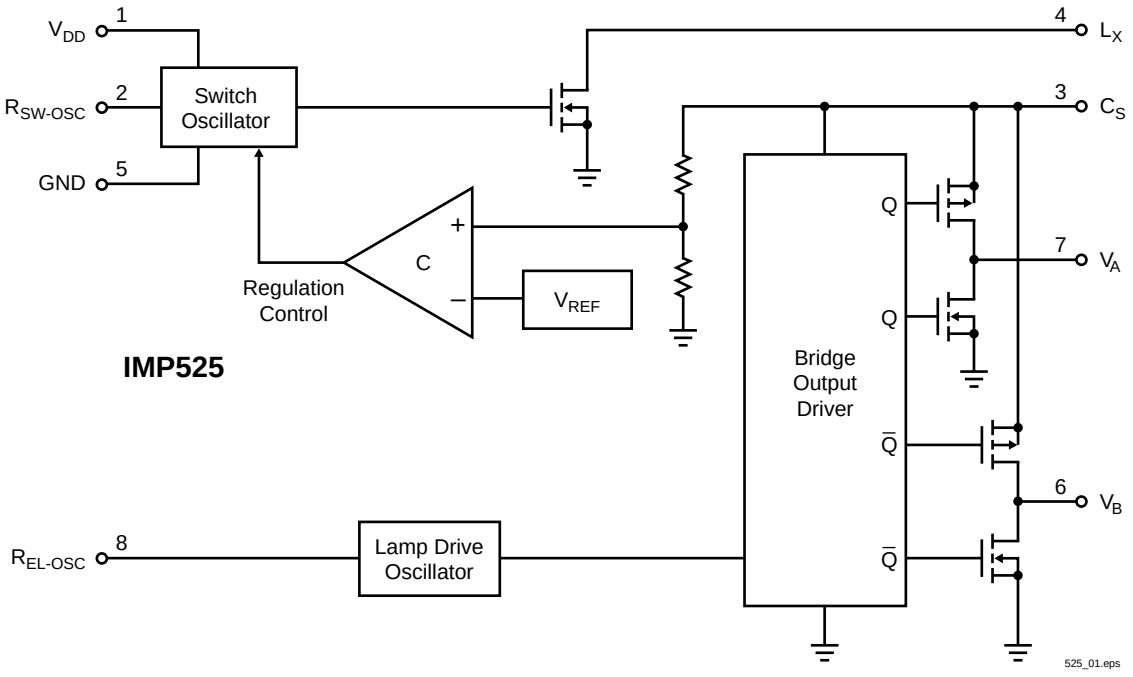
Key Features

- Wide operating voltage range - from 0.9V to 2.5V
- Simple design requires few passive components
- 112V peak-to-peak typical AC output voltage
- Adjustable output frequency controls lamp color and power consumption
- Adjustable converter frequency minimizes circuit power consumption
- Disable mode extends battery life
- Disable current 1µA typical
- Compact MicroSO package option

Applications

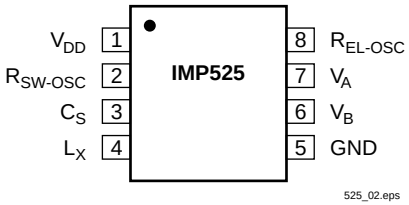
- Audio/TV remote control units
- Pagers/Cellular phones
- PDAs
- Clocks and radios
- Portable GPS receivers
- LCD modules
- Toys

Block Diagram



Pin Configuration

SO/MicroSO



Ordering Information

Part Number	Input Voltage	Regulated Output Voltage	Temperature Range	Pins-Package
IMP525EMA	0.9V to 2.5V	YES	–40°C to +85°C	8-MicroSO
IMP525ESA	0.9V to 2.5V	YES	–40°C to +85°C	8-SO
IMP525/D	0.9V to 2.5V	YES	25°C	Dice

Add /T to ordering part number for Tape and Reel.

Absolute Maximum Ratings

Supply Voltage, V_{DD}, $V_{RSW-OSC}$ and $V_{REL-OSC}$ . . –0.5V to +3.5V
Storage Temperature Range . . . . . –65°C to +150°C
Power Dissipation (SO package) 400mW
Power Dissipation (MicroSO package) 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.

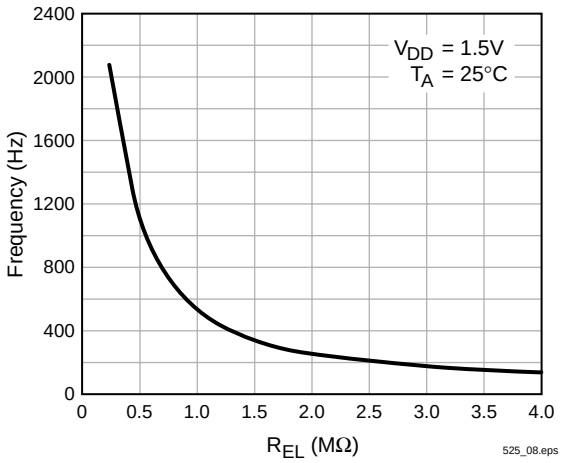
Electrical Characteristics

Unless otherwise noted, V_{DD} = 1.5V, R_{SW} = 1MΩ, R_{EL} = 1.0MΩ, and T_A = 25°C.

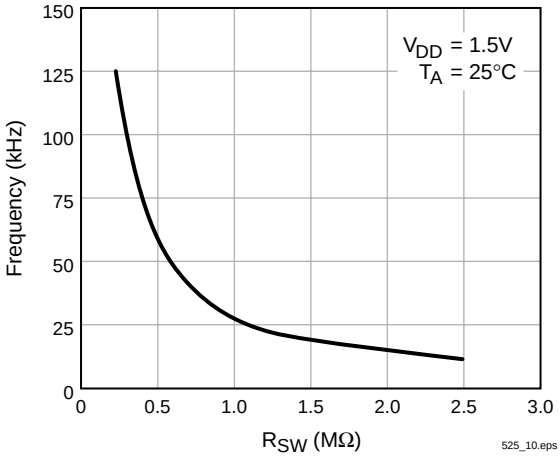
Parameter	Symbol	Conditions	Min	Typ	Max	Units
ON-resistance of MOS Switch	$R_{DS(ON)}$	I = 50mA			15	Ω
Operating Voltage			0.9		2.5	V
Output Voltage at C_S	V_{CS}	V_{DD} = 1.5V, See Figure 1, Table 1	52	58	65	V
Output Voltage at C_S	V_{CS}	V_{DD} = 0.9V, See Figure 1, Table 2		50		V
Output Voltage Peak-to-Peak	V_A-V_B	V_{DD} = 1.5V, See Figure 1	104	112	124	V_{P-P}
Quiescent V_{DD} Supply Current, Disabled (Disable pin available on die only)	I_{QDIS}	Disable = HIGH		70		nA
Quiescent V_{DD} Supply Current, Disabled	I_{QDIS}	R_{SW-OSC} = GND V_{DD} = 1.5V		1.0	2.0	µA
Input Current at V_{DD} Pin	I_{DD}	V_{DD} = 0.9V to 1.5V			1.5	mA
Input Current: I_{DD} Plus Inductor Current	I_{IN}	V_{DD} = 1.5V		23	32	mA
V_{A-B} Output Drive Frequency	f_{EL}	V_{DD} = 1.5V, See Figure 1, Table 1		500		Hz
Boost Converter Switching Frequency	f_{SW}	V_{DD} = 1.5V, See Figure 1, Table 1		26		kHz
Switching Duty Cycle	D_{SW}	V_{DD} = 1.5V, See Figure 1		87.5		%
Disable Input LOW Voltage (Disable pin available on die only)	V_{DISL}		GND		0.2	V
Disable Input HIGH Voltage (Disable pin available on die only)	V_{DISH}		V_{DD}-0.5V		V_{DD}	V

Typical Characteristics

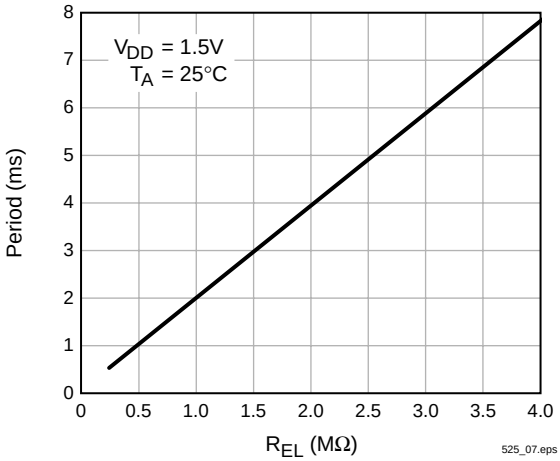
EL Lamp Drive Frequency



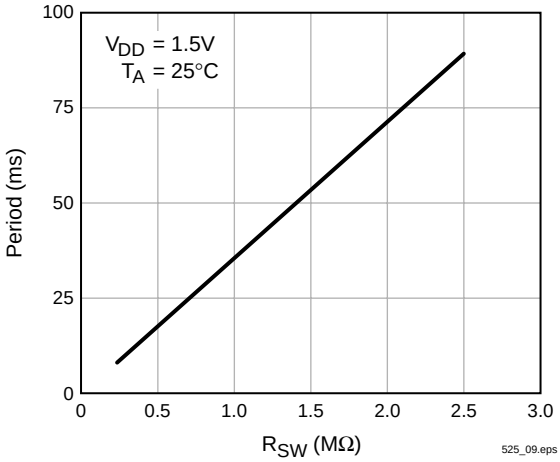
Boost Converter Switching Frequency



EL Lamp Drive Period



Boost Converter Switching Period



Pin Descriptions

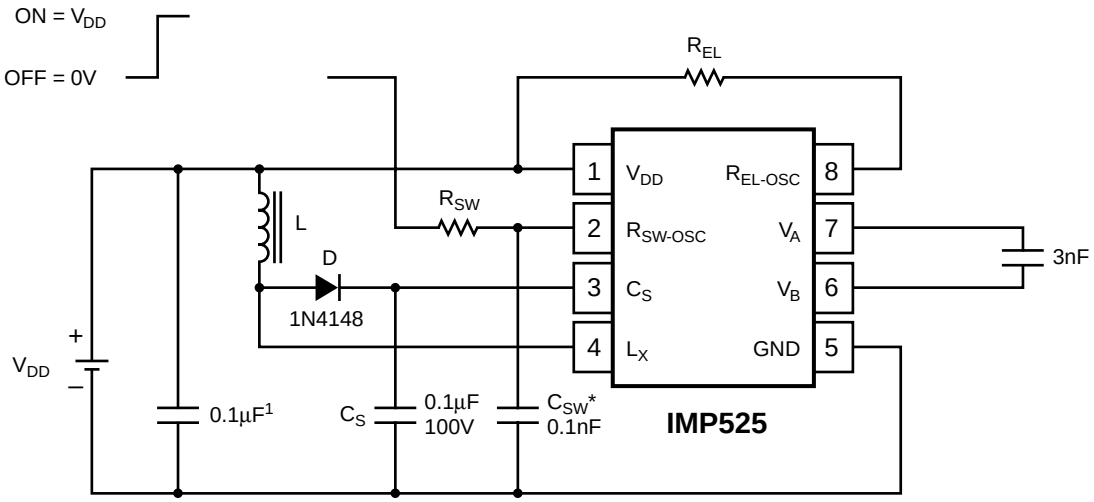
Pin Number	Name	Function
1	V_{DD}	Positive voltage supply for the IMP525. Inductor L may be connected here or to a separate supply.
2	R_{SW-OSC}	Switch-mode resistor pin. Switching frequency is determined by external resistor R_{SW}, connected between pin 2 and V_{DD}.
3	C_S	Boost converter storage capacitor. 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 to a high-voltage bridge circuit with V_B providing the complementary connection to V_A.
7	V_A	EL lamp drive. (See above)
8	R_{EL-OSC}	The EL lamp oscillator frequency-setting pin. The frequency is controlled by resistor R_{EL}, connected from pin 8 to V_{DD}.
Disable Pad	DIS	Available only in die form. Setting DIS HIGH disables the chip.

External Components

External Component	Description and Selection Guide
Diode	A fast reverse recovery diode, with BV > 100, such as a 1N4148.
Capacitor C_S	The high voltage capacitor that stores the inductive energy transferred through the catch diode. A 100 volt capacitor between 10nF and 100nF is recommended.
Resistor R_{EL}	The EL lamp oscillator frequency-setting resistor. R_{EL} is connected between pin 8 and V_{DD}, providing a 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 1MΩ resistor between the R_{EL-OSC} pin and the V_{DD} supply results in a lamp frequency around 500Hz.
Resistor R_{SW}	Switching Oscillator frequency-setting resistor. R_{SW} 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 100pF capacitor is recommended.
Inductor L	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 the switch opens, the inductor potential will forward-bias the diode and the current will pass through to the storage capacitor C_S, charging it to a high voltage. As the value of the inductor is increased, the switching frequency set by R_{SW} should also 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. A small electrolytic capacitor (10µF, 16V), normally present across the inductor supply V_{IN}, will likely eliminate the need for C_{SW}.

Test Circuit

Figure 1 shows the IMP525 configured to drive an EL lamp, represented as a 3nF capacitor.



Note:
1. Larger values may be required depending upon supply impedance.

** Optional*

Figure 1. Test Circuit

Table 1. V_{IN} = 1.5V

Component	Connections	Value	Description
R_{SW}	V_{DD}, R_{SW-OSC}	1MΩ	Boost converter oscillator bias resistor
R_{EL}	V_{DD}, R_{EL-OSC}	1MΩ	EL lamp driver oscillator bias resistor
L	V_{DD}, L_X[2]	330µH[2]	Boost converter inductor
C_S	C_S, GND	0.1µF/100V	Boost converter storage capacitor
D	L_X, C_S	1N4148	Switching diode
C_{SW}	R_{SW-OSC}, GND	0.1nF	Noise-suppression capacitor

Notes. 2. Murata LQH4N331K04 (8.2Ω max. DCR)

Table 2. V_{IN} = 0.9V

Component	Connections	Value	Description
R_{SW}	V_{DD}, R_{SW-OSC}	1.0MΩ	Boost converter oscillator bias resistor
R_{EL}	V_{DD}, R_{EL-OSC}	2.62MΩ	EL lamp driver oscillator bias resistor
L	V_{DD}, L_X[3]	680µH[3]	Boost converter inductor
C_S	C_S, GND	0.1µF/100V	Boost converter storage capacitor
D	L_X, C_S	1N4148	Switching diode
C_{SW}	R_{SW-OSC}, GND	0.1nF	Noise-suppression capacitor

Notes. 3. Coilcraft DS1608C-684 (2.2Ω max. DCR)

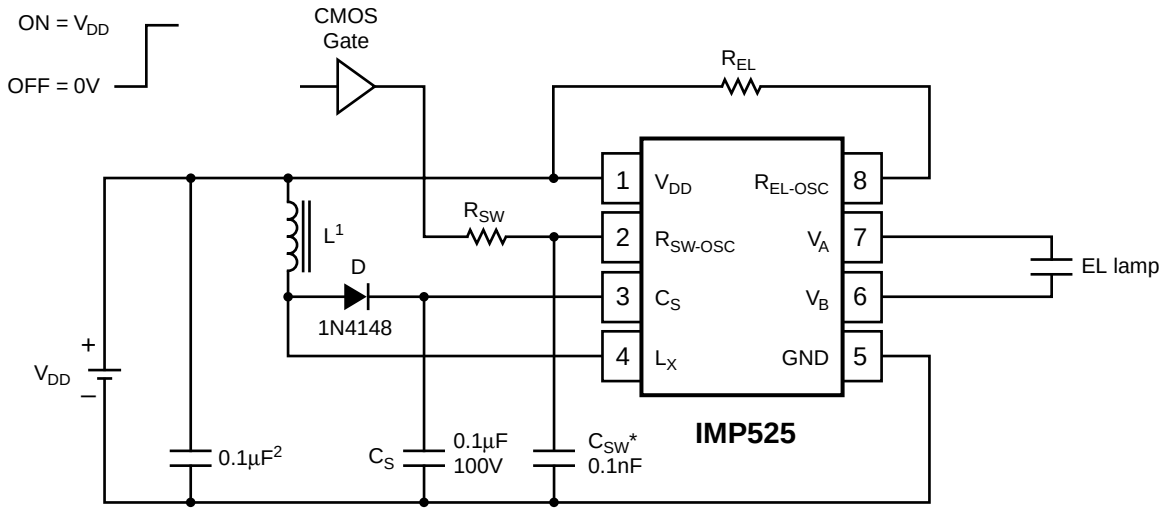
Enable / Disable Operation

Figure 2 shows how the IMP525 can be enabled via a logic gate that connects R_{SW} to V_{DD}, and disabled by connecting it to ground.

The IMP525 can also be disabled using a pad on the die. The Disable function pin is not available in packaged parts.

Enable/Disable Table	
R_{SW} Connection	IMP525 State
V_{DD}	Enabled
Ground	Disabled

Disable PAD Connection (Available only with dice)	IMP525 State
HIGH (V_{DD})	Disabled
LOW (Ground)	Enabled



Note:
1. Murata part # LQH4N331K04 (DC resistance < 8.2 Ω)
2. Larger values may be required depending upon supply impedance.

** Optional*

525_04.eps

Figure 2. Enable/Disable Operation

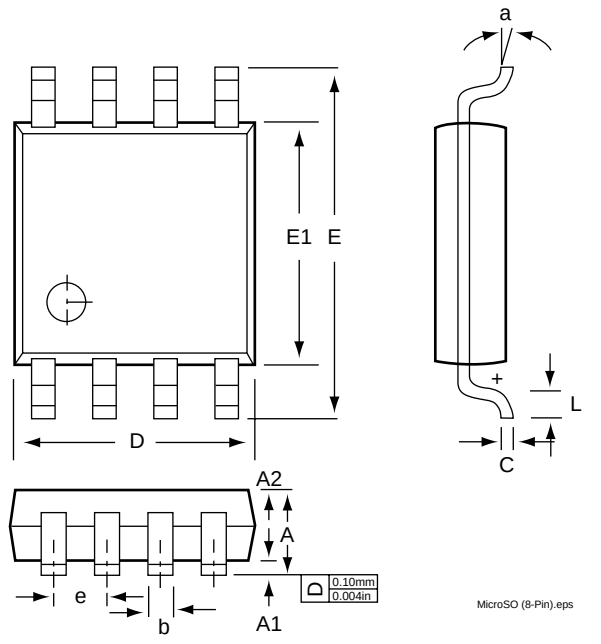
High Voltages Present

The IMP525 generates high voltages and caution should be exercised.

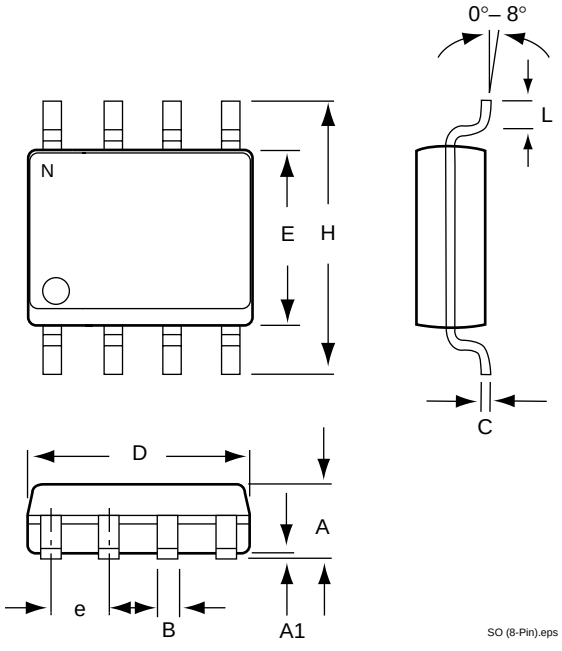
Inductor Manufacturers

Manufacturer	Series	USA Phone Number
Toko	D52FU	(847) 297-0070
Coilcraft	DS1608, DO1608, DT1608	(847) 639-6400
River Electronics	FLC32	(310) 320-7488
Murata	LQH4N	(800) 831-9172

MicroSO (8-Pin)



SO (8-Pin)



Package Dimensions

	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

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Printed in USA
Publication #: 2002
Revision: A
Issue Date: 04/21/99
Type: Product