

SP4422A

Electroluminescent Lamp Driver

DESCRIPTION

The **SP4422A** is a high voltage output DC-AC converter that can operate from a 2.2V-5.0V power supply. The **SP4422A** is capable of supplying up to more than 110 V_{pp} signals, making it ideal for driving electroluminescent lamps. The device could be used in low power portable products. One external inductor is required to generate the high voltage, and one external capacitor is used to select the oscillator frequency. The **SP4422A** is offered in die form and 8-pin SOP packages.

FEATURES

- 2.2V-5.0V Battery Operation
- High Voltage Output
- Internal Oscillator
- Pin-Pin replacement of Sipex SP4422A, SP4423, Functional replacement of : SP4403, IMP803, D340B, D355B

APPLICATIONS

- PDA
- Cellular Phones
- Remote Controls
- Handheld Computers
- LCD Module

Ordering Information

PART NO.	TEMP. RANGE (°C)	PACKAGE
SP4422ACM	-40 – 85 °C	8-Pin SOP
SP4422ACU	-40 – 85 °C	8-Pin MSOP
SP4422ACX	-40 – 85 °C	Dice



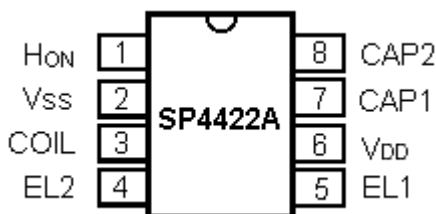
SPECIFICATIONS

(T = 25°C; V_{DD} = 3.0V, Lamp Capacitance = 3000pF, Coil = 9mH (R = 40Ω), C_{OSC} = 180pF unless otherwise noted)

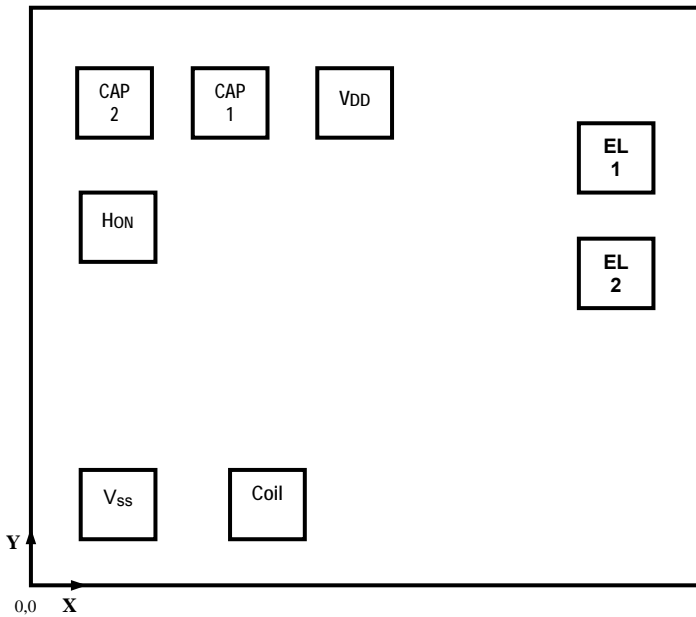
PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS
Supply Voltage, V _{DD}	2.2	3.0	5.0	V	
Supply Current		20	30	mA	V _{DD} = 3.0V, H _{ON} = 3.0V
Coil Voltage, V _{COIL}	V _{DD}		5.0	V	
H _{ON} Input Voltage, V _{HON} LOW: EL off HIGH: EL on	V _{DD} - 0.5	0 V _{DD}	V _{DD} - 2 V _{DD} + 0.25	V	V _{DD} = 3.0V
H _{ON} Current, EL On		25	60	µA	
Shutdown Current, I _{SD} = I _{COIL} + I _{DD}		10	300	nA	V _{DD} = 3.0V, H _{ON} = 0V
INDUCTOR DRIVE					
Coil Frequency, f _{COIL} = f _{LAMP} × 32		9.6		kHz	
Peak Coil Current, I _{PK-COIL}			60	mA	Guaranteed by design
EL LAMP OUTPUT					
EL Lamp Frequency, f _{LAMP}	200	600	1000	Hz	V _{DD} = 3.0V
Peak to Peak Output Voltage	110	140		V _{pp}	V _{DD} = 3.0V

*This data sheet specifies environmental parameters, final test conditions and limits as well suggested operating conditions.

PIN DESCRIPTION



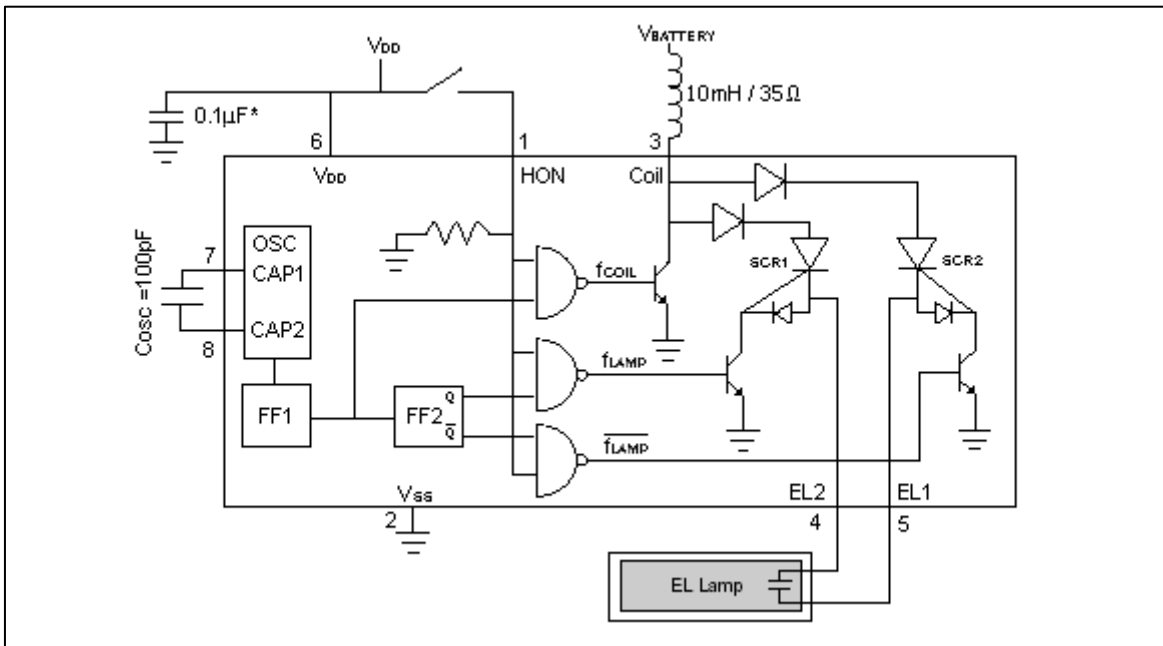
- Pin 1 – HoN- Enable for driver operation, high = active; low = inactive.
- Pin 2 – V_{SS}- Power supply common, connect to ground.
- Pin 3 – Coil- Coil input, connect coil from V_{DD} to pin 3.
- Pin 4 – Lamp- Lamp driver output 2, connect to EL lamp.
- Pin 5 – Lamp- Lamp driver output 1, connect to EL lamp.
- Pin 6 – V_{DD}- Power supply for driver, connect to system V_{DD}.
- Pin 7 – Cap1- Capacitor input 1, connect to C_{osc}.
- Pin 8 – Cap2- Capacitor input 2, connect to C_{osc}.

BOUNDING DIAGRAM


Pad Name	X(μm)	Y(μm)
VDD	765.5	1521.5
CAP1	341.5	1520.5
CAP2	44.5	1512.5
HON	62.5	978.5
VSS	67.5	181.5
COIL	548.5	181.5
EL2	1643.5	948.5
EL1	1643.5	1161.5

NOTES:

1. Dimensions are in Microns unless otherwise noted.
2. Bonding pads are 125x125 typical
3. Outside dimensions are maximum, including scribe area.
4. Die size 1.96 x 1.72mm.
5. Die thickness is 400±30 microns.
6. Substrate must be connect to Vss.

BLOCK DIAGRAM AND TYPICAL APPLICATION

SP4422A Schematic

THEORY OF OPERATION

The **SP4422A** is made up of three basic circuit elements, an oscillator, coil, and switched H-bridge network. The oscillator provides the device with an on-chip clock source used to control the charge and discharge phases for the coil and lamp. An external capacitor connected between pins 7 and 8 allows the user to vary the oscillator frequency from 32kHz to 400kHz. In general, increasing the C_{osc} capacitor will increase the lamp output.

The suggested oscillator frequency is 64kHz. The oscillator output is internally divided to create two internal control signals, f_{COIL} and f_{LAMP} . The oscillator output is internally divided down by 8 flip flops, a 64kHz signal will be divided into 8 frequencies; 32kHz, 16kHz, 8kHz, 4kHz, 2kHz, 1kHz, 500Hz, and 250Hz. The 3rd flip flop output (8kHz) is used to drive the coil and the 8th flip flop output (250Hz) is used to drive the lamp. Although the oscillator frequency can be varied to optimize the lamp output, the ratio of f_{COIL}/f_{LAMP} will always equal 32.

The on-chip oscillator of the **SP4422A** can be overdriven with an external clock source by removing the C_{osc} capacitor and connecting a clock source to pin 8. The clock should have a 50% duty cycle and range from $V_{DD}-1V$ to ground. An external clock signal may be desirable in order to synchronize any parasitic switching noise with the system clock. The maximum external clock frequency that can be supplied is 400kHz.

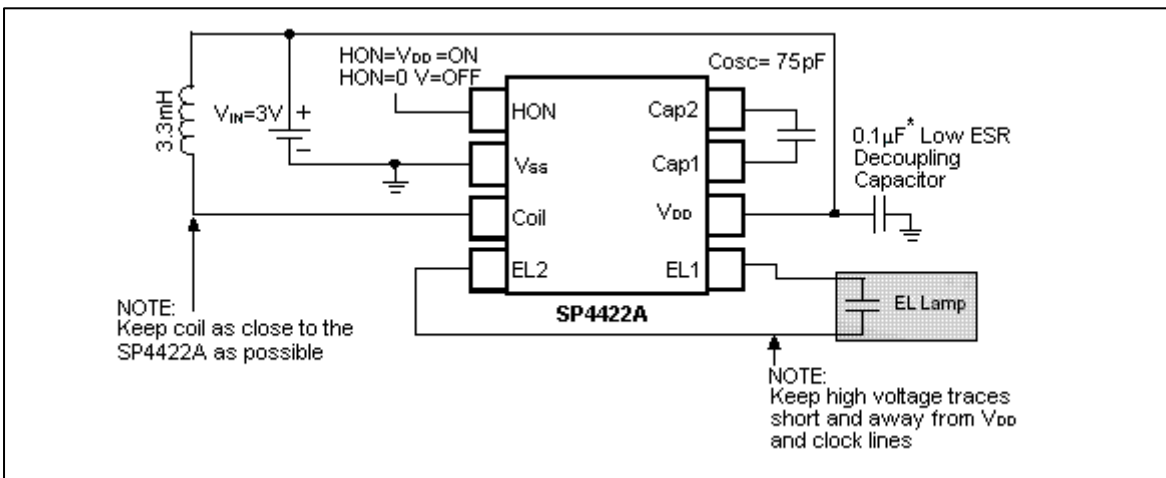
ELECTROLUMINESCENT TECHNOLOGY

What is electroluminescence?

An EL lamp is basically a strip of plastic that is coated with a phosphorous material which emits light (fluoresces) when a high voltage (>40V) which was first applied across it, is removed or reversed. Long periods of DC voltages applied to the material tend to breakdown the material and reduce its lifetime. With these considerations in mind, the ideal signal to drive an EL lamp is a high voltage sine wave. Traditional approaches to achieving this type of waveform included discrete circuits incorporating a transformer, transistors, and several resistors and capacitors. This approach is large and bulky, and cannot be implemented in most hand held equipment. **SP4422A** now offers low power single chip driver circuits specifically designed to drive small to medium sized electroluminescent panels. All that is required is one external inductor and capacitor.

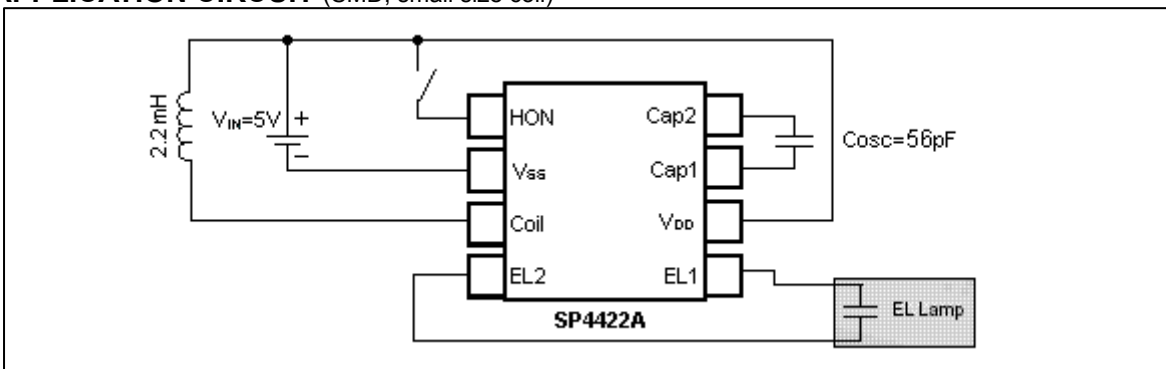
Electroluminescent backlighting is ideal when used with LCD displays, keypads, or other backlit readouts. Its main use is to illuminate displays in dim to dark conditions for momentary periods of time. EL lamps typically consume less than LEDs or bulbs making them ideal for battery powered products. Also, EL lamps are able to evenly light an area without creating "hot spots" in the display.

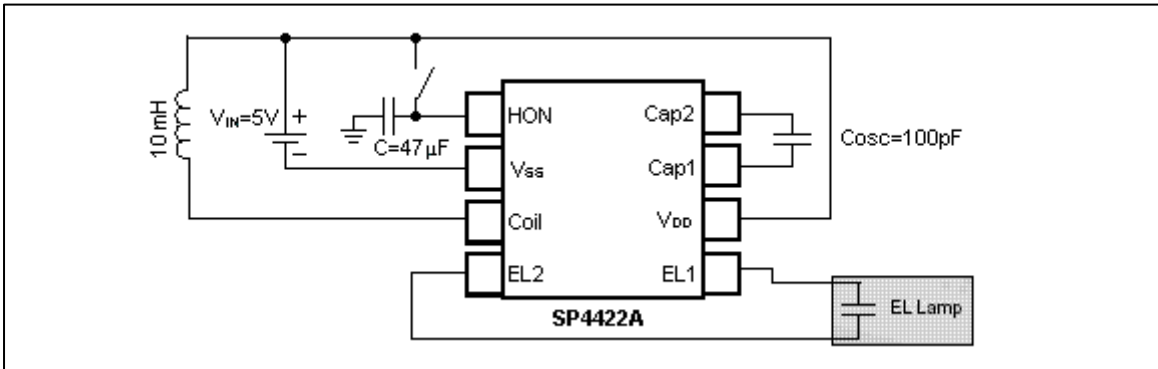
TYPICAL APPLICATION CIRCUIT (good result, high brightness, low current)



Typical SP4422A Application Circuit

APPLICATION CIRCUIT (SMD, small size coil)



APPLICATION CIRCUIT (Hold delay, very low current circuit, normal light)

LAYOUT CONSIDERATIONS

The **SP4422A** circuit board layout must observe careful analog precautions. For applications with noisy voltage power supplies a 0.1µF low ESR decoupling capacitor must be connected from VDD to ground. Any high voltage traces should be isolated from any digital clock traces or enable lines. A solid ground plane connection is strongly recommended. All traces to the coil or to the high voltage outputs should be kept as short as possible to minimize capacitive coupling to digital clock lines and to reduce EMI emissions.

Selection of the optimum circuit configuration (the testing data comes from following curves. EL lamp: 10cm², VDD=5V)

Result	Coil	Capacitor	Brightness (Lux)	Current (mA)	EL frequency	Efficiency (brightness/Current)
Good (high brightness, low current)	3.3mH	75pF	69	31	~800Hz	2.2
	4.7mH	82pF	65	26	~750Hz	2.5
Very low current (normal brightness)	10mH	100pF	56	21	~600Hz	2.7
	6.8mH	82pF	53	22	~750Hz	2.4
Very high light	3.3mH	82pF	71	32	~750Hz	2.2
Small coil (SMD, small size)	2.2mH	56pF	65	38	~1000Hz	1.7

As for special requirement, the selection of coil (inductor) and capacitor please refer to the following performance curves. The guide line: the brightness high enough to meet the requirement, to reduce the supply current (lower power consumption). The EL brightness is depending on both EL lamp frequency and IC output voltage. If frequency of white EL lamp is much high, the light will move to slight blue color.

The amount of light emitted is a function of the voltage applied to the lamp, the frequency at which it is applied, the lamp material used and its size, and lastly, the coil (inductor) used. There are many variables which can be optimized for specific applications. SP4422A supplies characterization charts to aid the designer in selecting the optimum circuit configuration.

EL lamp: There are two kinds of EL lamp material: normal light and high light, it's better to use high light EL lamp.

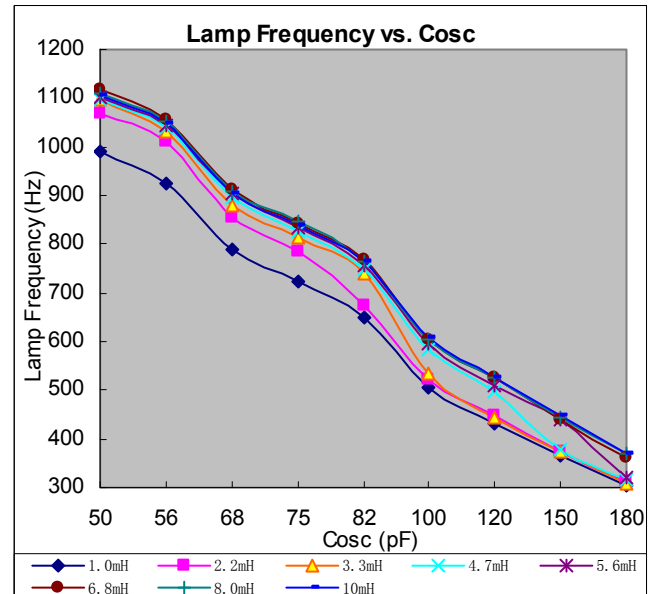
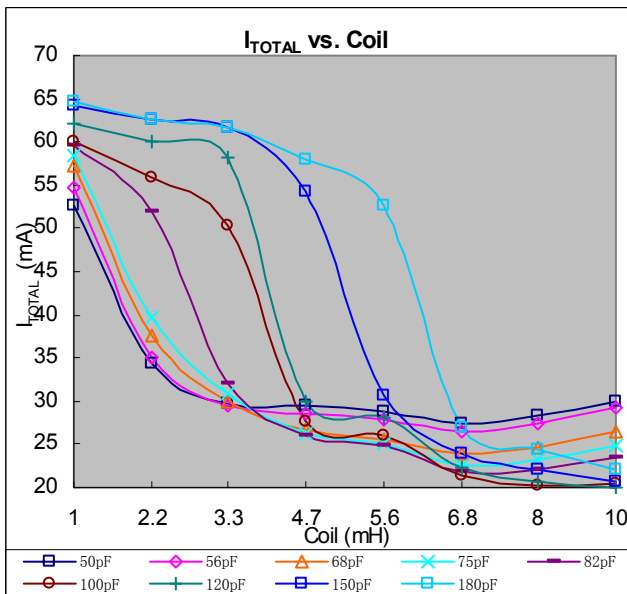
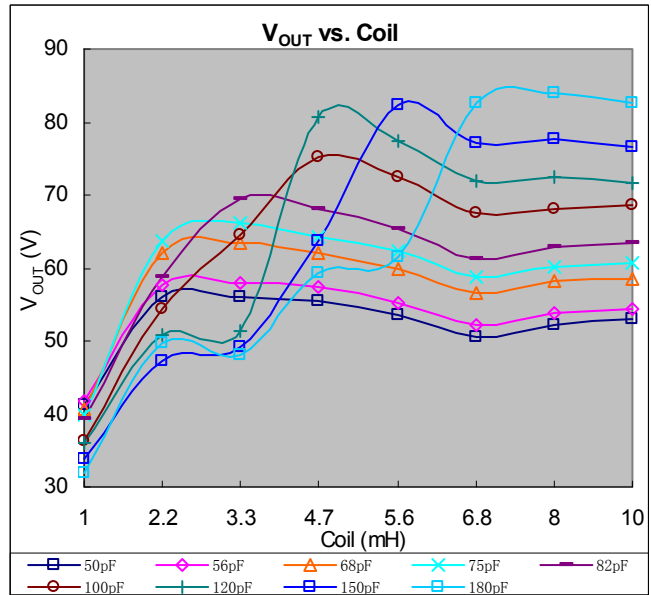
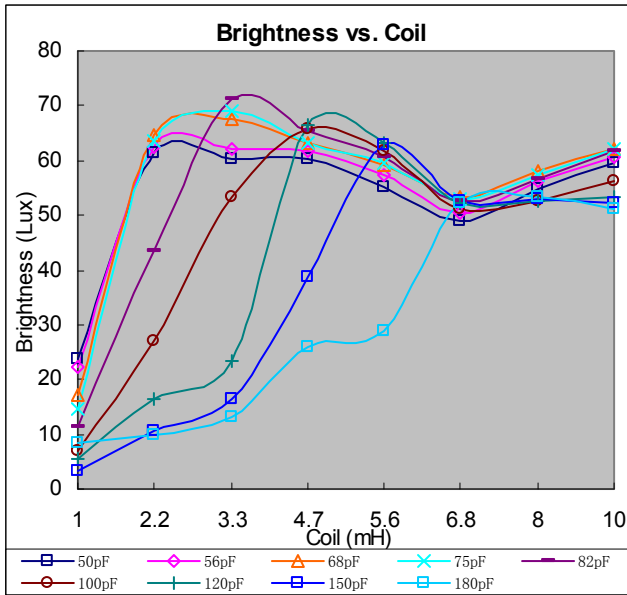
Capacitor (C_{osc}): The smaller the C_{osc} value, the higher EL lamp frequency. Suggest value: 50 – 200pF.

Coil (inductor): The selection of coil is very important for EL driver. Energy is stored in the coil. It's not the same coil for different size EL lamp. Generally speaking, if coil is bigger value, the total working current is lower. The resistance of coil is lower, the EL driver can get better result, brightness is higher. Suggest value: 2.2mH – 10mH.

Voltage Vin: High input voltage will result high brightness of EL lamp.

TYPICAL PERFORMANCE CURVES

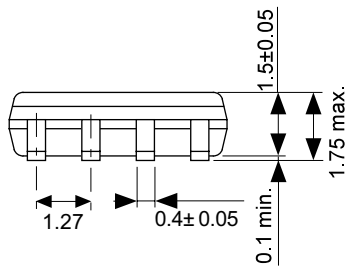
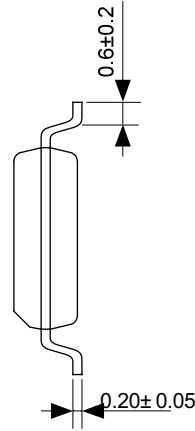
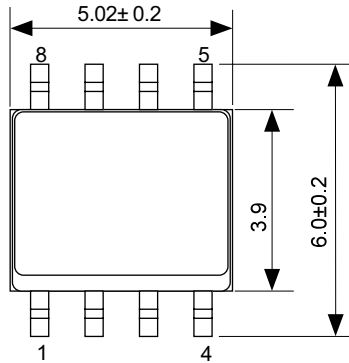
The following performance curves are intended to give the designer a relative scale from which to optimize specific applications. Absolute measurements may vary depending upon the brand of components chosen (the size of EL lamp: 10cm², input voltage: V_{DD}=5V).



PACKAGE

8-Pin SOP

Unit: mm



8-Pin MSOP

