SP4403
Electroluminescent Lamp Driver

DESCRIPTION

The **SP4403** is a high voltage output DC-AC inverter specifically designed to drive electroluminescent lamps to backlight liquid crystal displays, keypads, and backlit readouts used in battery operated portable equipment. The **SP4403** will operate from a 1.8V-6.0V power supply. The **SP4403** is capable of supplying up to more than 160 V_{pp} signals, making it ideal for driving electroluminescent lamps. One external inductor is required to generate the high voltage, and one external capacitor is used to select the oscillator frequency. The device could be used in low power portable products, such as PDA's, pagers, cellular phones, and other portable applications using LCDs in dim or low light environments. The **SP4403** is offered in die form and 8-pin SOP packages.

FEATURES

- 1.8V-6.0V Battery Operation
- High Voltage Output, Low power consumption
- Internal Oscillator
- Uses Small 680µH or 1mH Coil
- Pin-Pin replacement of Sipex SP4422A, SP4423, Functional replacement of : SP4403, IMP803, D340B, D355B

APPLICATIONS

- PDA
- Pagers
- Cellular Phones
- Remote Controls
- Handheld Computers
- Handheld GPS Units
- LCD Module

Ordering Information

PART NO.	TEMP. RANGE (°C)	PACKAGE
SP4403EM	-40 – 85 °C	8-Pin SOP
SP4403EMT	-40 – 85 °C	8-Pin TSSOP
SP4403EU	-40 – 85 °C	8-Pin MSOP
SP4403EX	-40 – 85 °C	Dice

ABSOLUTE MAXIMUM RATING

V_{DD}: 6.5V
COIL (pin3) Current: 280mA
Power Dissipation 500mW

HON (pin1): -0.3V to V_{DD}+0.3V
Lamp Output (V_{pp}): 250V

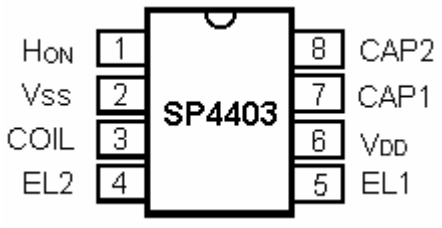
ELECTRICAL SPECIFICATIONS

(T= 25°C; V_{DD} = 3.0V, Lamp Capacitance = 10nF, Coil = 2.2mH (R = 11Ω), C_{OSC} = 270pF unless otherwise noted)

PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS
Supply Voltage, V_{DD}	1.8	3.0	6.0	V	
Supply Current, I_{COIL}+I_{DD}		20 45	30 60	mA	V_{DD} = 3.0V, V_{HON} = 3.0V V_{DD} = 6.0V, V_{HON} = 6.0V
Coil Voltage, V_{COIL}	V_{DD}		6.0	V	
HON Input Voltage, V_{HON} LOW: EL off HIGH: EL on	 -0.25 V_{DD} - 0.25	 0 V_{DD}	 0.25 V_{DD} +0.25	V	V_{DD} = 3.0V
HON Current, EL On		8	40	µA	V_{HON} =V_{DD} = 3.0V
Shutdown Current, I_{SD} =I_{COIL}+I_{DD}		0.03	1	µA	V_{DD} = 3.0V, V_{HON} = 0V
INDUCTOR DRIVE					
Coil Frequency, f_{COIL} =f_{LAMP} ×32		9.6		kHz	
Coil Duty Cycle		85		%	
EL LAMP OUTPUT					
EL Lamp Frequency, f_{LAMP}	200	350	600	Hz	V_{DD} = 3.0V
Peak to Peak	160	180		V_{pp}	V_{DD} = 3.0V

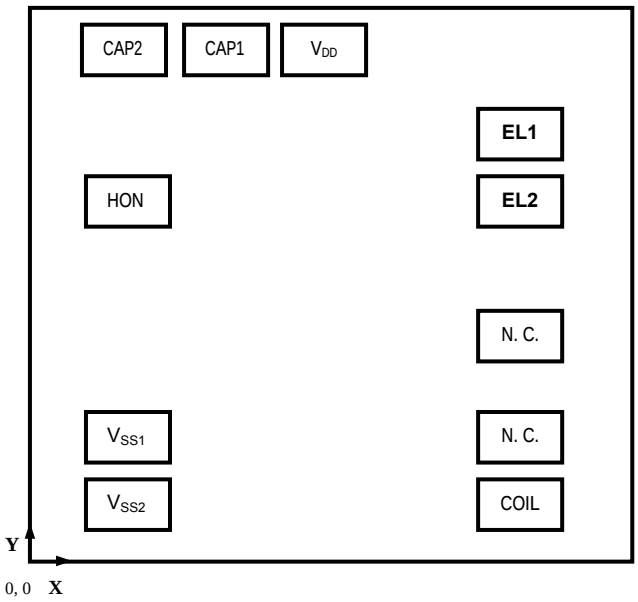
*This data sheet specifies environmental parameters, final test conditions and limits as well suggested operating conditions.

PIN DESCRIPTION



Pin 1 – HON- Enable for driver operation, high = active; low = inactive.
Pin 2 – VSS- Power supply common, connect to ground.
Pin 3 – Coil- Coil input, connect coil from VDD 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 – VDD- Power supply for driver, connect to system VDD.
Pin 7 – Cap1- Capacitor input 1, connect to COSC.
Pin 8 – Cap2- Capacitor input 2, connect to COSC.

BOUNDING DIAGRAM

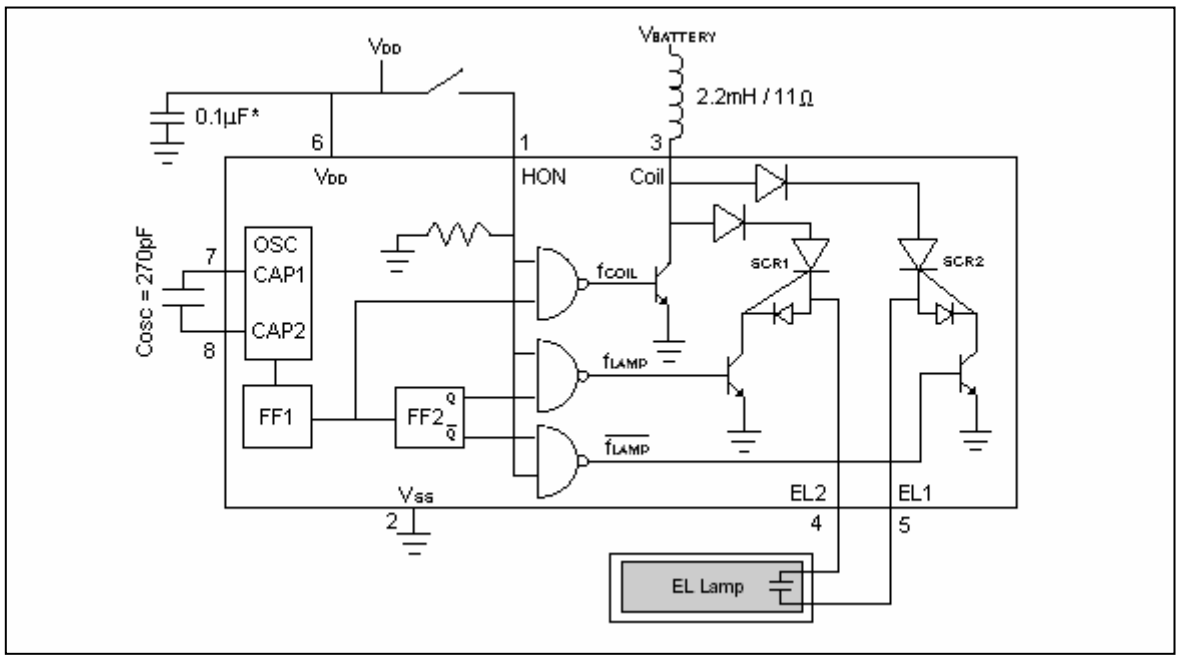


PAD LOCATION COORDINATES

Pad Name	X(µm)	Y(µm)
V_{DD}	900.5	1998.5
CAP1	476.5	1998.5
CAP2	177.5	1989.5
HON	187.5	1455.5
V_{SS1}	187.5	423.5
V_{SS2}	187.5	248.5
COIL	1778.5	248.5
N. C.		
N. C.		
EL2	1778.5	1447.5
EL1	1778.5	1638.5

NOTES:
1. Dimensions are in Microns unless otherwise noted.
2. Bonding pads are 125x125 typical
3. Outside dimensions are maximum, including scribe area.
4. Pad center coordinates are relative to die center.
5. Die size 1980 x 2160.
6. V_{SS1} and V_{SS2} are connected to V_{SS} supply on PCB.
7. N.C. -no connection.

BLOCK DIAGRAM AND TYPICAL APPLICATION



SP4403 Schematic

THEORY OF OPERATION

The **SP4403** 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, and reduce the lamp frequency.

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 **SP4403** 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.

Layout Considerations

The **SP4403** circuit board layout must observe careful analog precautions. For applications with noisy voltage power supplies a 1.1µF low ESR decoupling capacitor must be connected from V_{DD} 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.

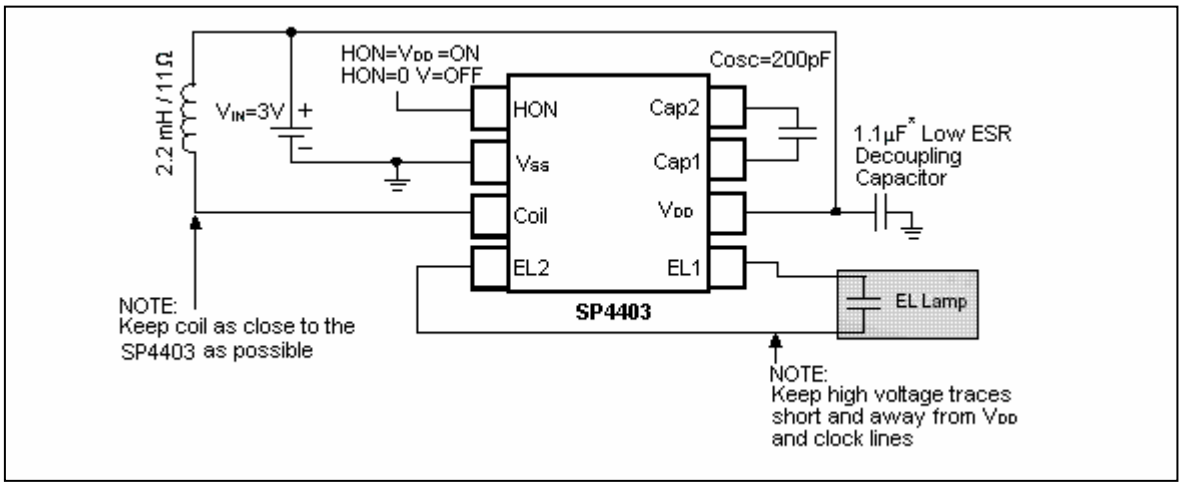
The brightness of lamp could be influenced by EL lamp material, space, capacitor Cosc, inductor Coil, and the voltage of input power, the result could be big different.

Conductor Cosc: Increase Cosc, the EL lamp frequency will decrease, the power supply and output voltage will increase, the brightness will go up, but after touch the maxim value the brightness will go down. Suggest the value range, Capacitor Cosc: 150—800pF. First try the value: 270, 390, 560pF, etc, then make the choice.

Inductor Coil: It has a big influence to IC output property. It is used for the power reserve. Basically, reduce the value of inductor, the EL lamp brightness will increase, and power current also increased. When big EL lamp area needed, inductor value should be some big, together with capacitor. Please find the balance of supply current and output property. The resistor of inductor smaller, IC transfer higher, EL lamp brightness is high. Suggest the value range: 680µH-3.3mH. First try the value: 1, 2.2mH, etc., then make the choice.

Normally, inductor 1-2.2mH, capactor 390-560pF (only for the reference)

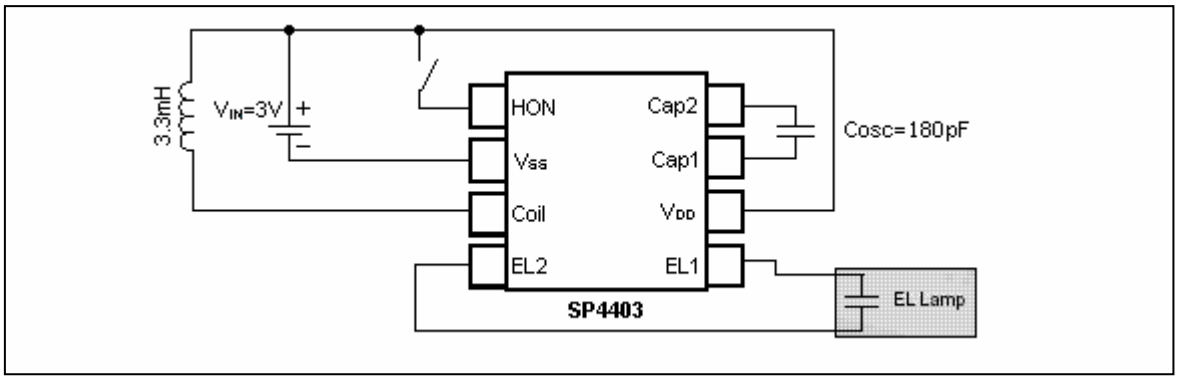
TYPICAL APPLICATION CIRCUIT



Typical SP4403 Application Circuit

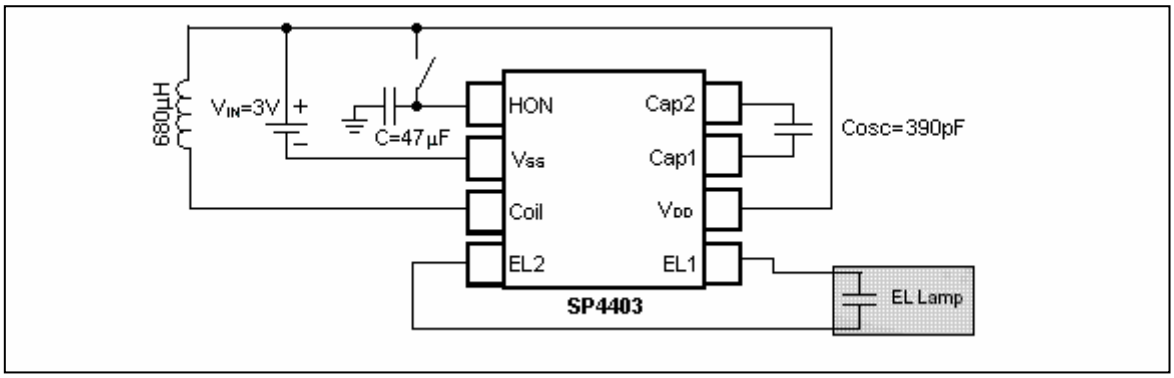
APPLICATION CIRCUIT – HOLD RELEASE

(very low power consumption when inductor and capacitor selected as indicated)

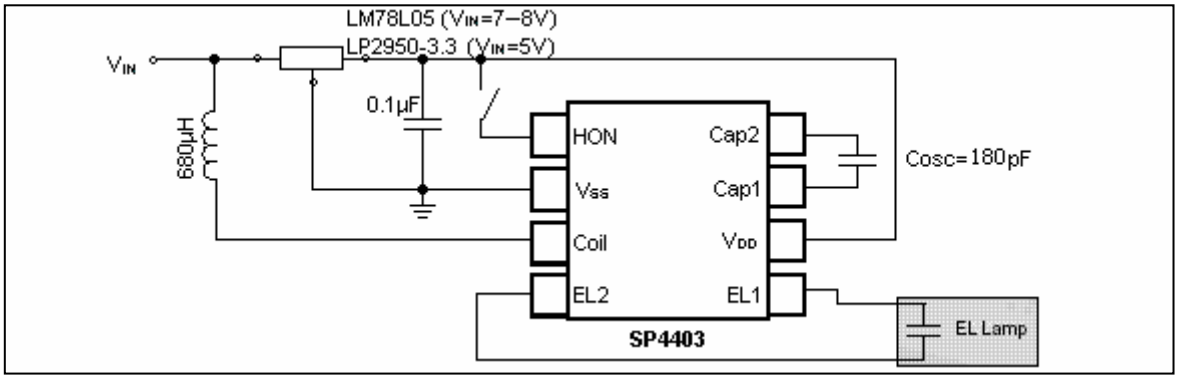


APPLICATION CIRCUIT – HOLD DELAY

(high brightness lamp when inductor and capacitor selected as indicated)

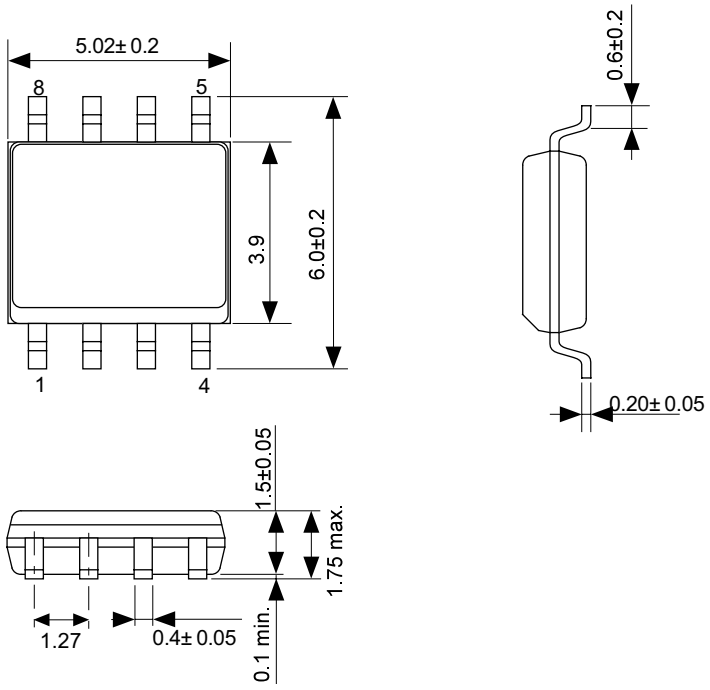


APPLICATION CIRCUIT – LARGE EL LAMP (10 IN² EL LAMP)



PACKAGE

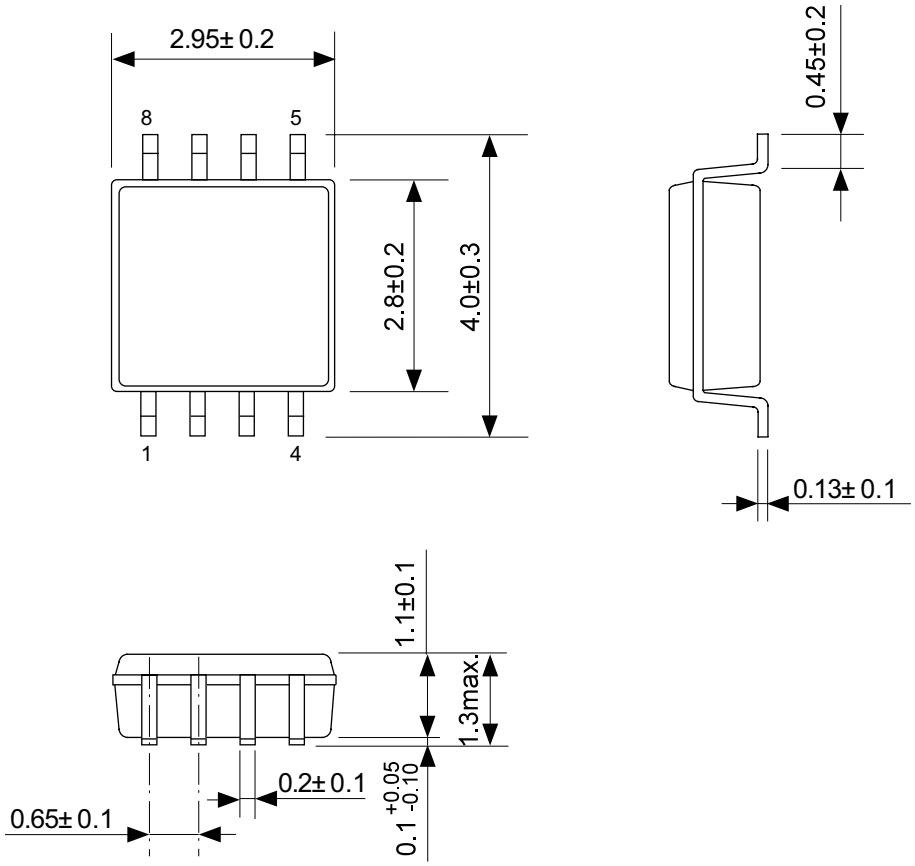
8-Pin SOP **Unit: mm**



PACKAGE (continued)

8-Pin MSOP

Unit: mm



8-Pin TSSOP

Unit: mm