SP4422A

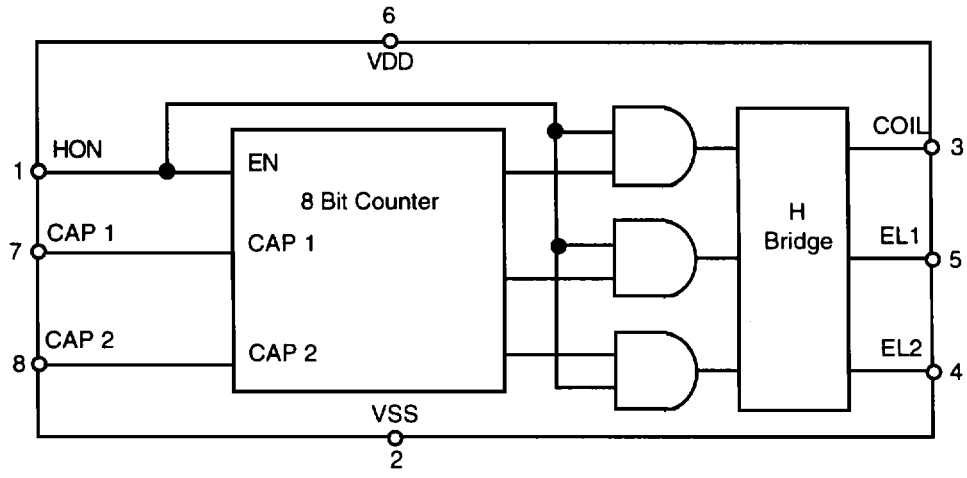
Electroluminescent Lamp Driver

FEATURES

- 1.5V-6.0V Battery Operation
- 50 nA Maximum Standby Current
- High Voltage Output 160 Vpp
- Internal Oscillator

DESCRIPTION...

The SP4422A is a high voltage output DC-AC converter that can operate from a 1.5V-6.0V power supply. The SP4422A is capable of supplying up to 200 Vpp signals, making it ideal for driving electroluminescent lamps. The device features 10 nA (typ) standby current, for use in low power portable products. One external inductor is required to generate the high voltage charge, and one external capacitor is used to select the oscillator frequencey. The SP4422A is offered in an 8 pin narrow SOIC package, for delivery in die form please consult the factory.



SP4422A Block Diagram

ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

V_{dd} 7.0V
Input Voltages/Currents
HON (pin1) ..... -0.5V to (V_{dd}+0.5V)
COIL (pin3) 60mA
Lamp Outputs 250Vpp
Storage Temperature ..... -65°C to +150°C
Power Dissipation 200mW

SPECIFICATIONS

T=25°C; V_{dd}= 3.0V; Lamp Capacitance= 6000pF; Coil= 20 mH at 70 Ohms; Cosc= 150 pF Unless otherwise noted

PARAMETERS	MIN	TYP	MAX	UNITS	CONDITIONS
Input Characteristics					
Supply Voltage	1.5	3.0	6.0	Volts	
Total Supply Current		8	14	mA	Vdd= 3.0V ±5%; Hon= 3.0V
Quiescent Supply Current		10	50	nA	Vdd= 3.0V ±5%; Hon= 0.2V
Clock Frequency	50	64	77	KHz	Cosc=150pF; No load
Hon Voltage On	Vdd-.5	Vdd	Vdd+1	Volts	
Hon Current	1	10	40	µA	Internal pulldown
Hon Voltage Off	Vdd/2	0		Volts	
Hon Current Off			5	nA	
Inductor Drive					
Peak Current		10	60	mA	
Pulse Rate	6.5	8	10	KHz	
Duty Cycle		94		%	
Lamp Output					
Differential Voltage	160	180	220	Vpp	
Frequency	180	256	300	Hz	
Lamp Capacitance		6000		pF	

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 allow the user to vary the oscillator frequency from 32 KHz to 400 KHz. The graphs on page 5 show the relationship between C_{osc} and lamp output voltage. In general, increasing the C_{osc} capacitor will increase the lamp output.

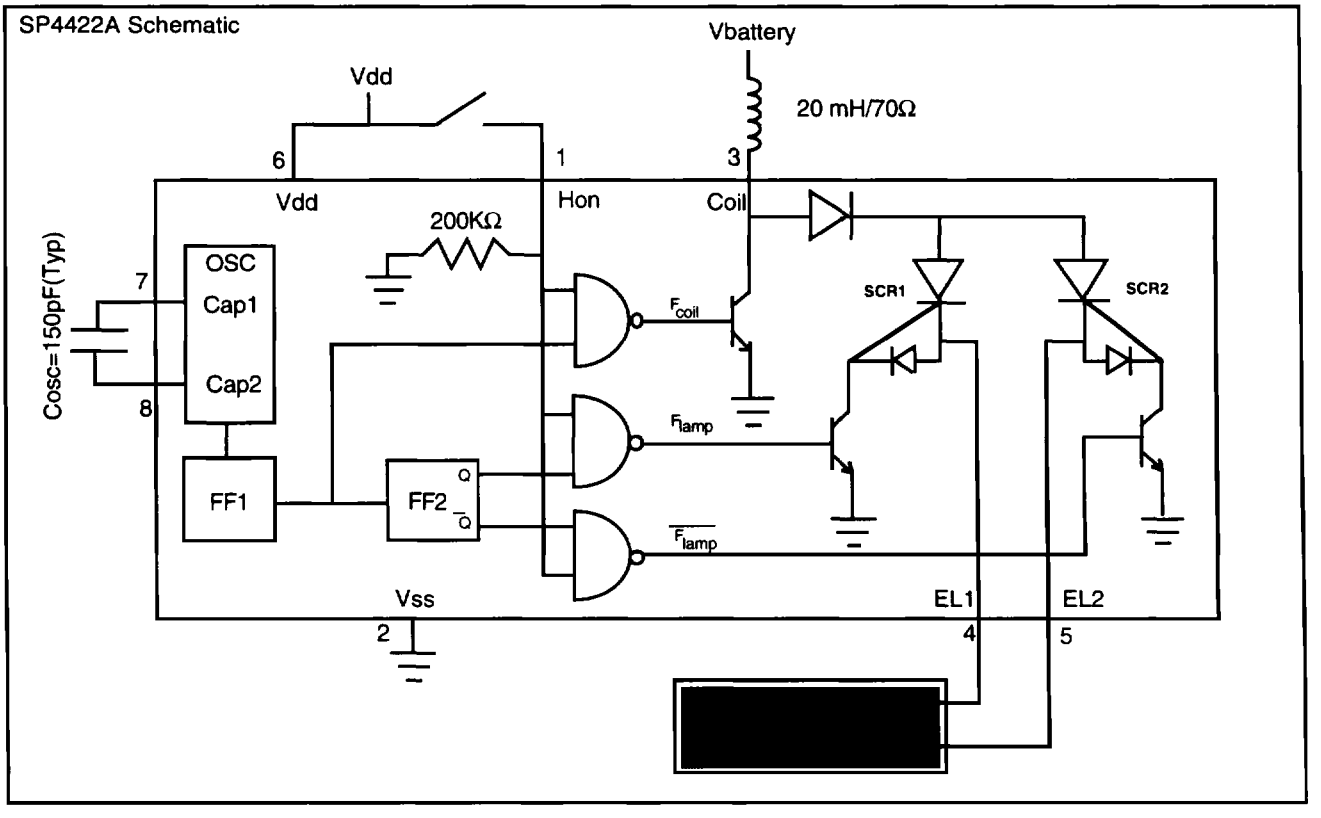
The suggested oscillator frequency is 64KHz (C_{osc}=150pF). The oscillator output is internally divided to create two internal control signals, F_{coil} and F_{lamp}. The oscillator output is internally divided down by 8 flip flops, a 64KHz signal will be divided into 8 frequency levels; 32KHz, 16KHz, 8KHz, 4KHz, 2KHz, 1KHz, .5KHz, .25KHz. The third flip flop output (8KHz) is used to drive the coil (figure 2) and the eighth flip flop output (256Hz) 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 fromVdd-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 speed that can be externally supplied is 400KHz.

The coil is an external component connected from $V_{battery}$ to pin 3 of the SP4422A. Energy is developed in the coil according to the equation $E_L=1/2LI^2$ where the current I is defined as $I=(V_{battery}-IR-V_{OL})/R_T$. In order to maximize the energy produced by the coil $V_{battery}$ should represent the largest voltage in the system (up to a maximum of 6V) and the coil should have low resistance and high inductance; $V_{battery}$= 3.0 VDC with a 20mH/70Ω coil are typical. It is not necessary that Vdd=$V_{battery}$. Coils are also a function of the core material and winding used, performance variences may be noticeable from different coil suppliers. The Sipex SP4422A is final tested using a 20mH/70Ω coil from CTC. For suggested coil sources see page 7.

The F_{coil} signal controls a switch that connects the end of the coil at pin 3 to ground or to open circuit. The F_{coil} signal is a 94% duty cycle signal switching at 1/8 the oscillator frequency, for a 64KHz oscillator F_{coil} is 8KHz. During the time when the F_{coil} signal is high, the coil is connected from $V_{battery}$ to ground and a charged magnetic field is created in the coil. During the low part of F_{coil} , the ground connection is switched open, the field collapses and the energy in the inductor is forced to flow toward the high voltage H-bridge switches. F_{coil} will send 16 of these charge pulses to the lamp, each pulse increaes the voltage drop across the lamp in discrete steps. As the voltage potential approaches its maximum, the steps become smaller see figure 1 page 6.

The H-bridge consists of two SCR structures that act as high



voltage switches. These two switches control the polarity of how the lamp is charged. The SCR switches are controlled by the F_{lamp} signal which is the oscillator frequency divided by 256, for a 64KHz oscillator, F_{lamp}=256Hz.

When the energy from the coil is released, a high voltage spike is created triggering the SCR switches. The direction of current flow is determined by which SCR is enabled. One full cycle of the H-bridge will create 16 voltage steps from ground to 80V (typ) on pins 4 and 5 which are 180 degrees out of phase with each other see figure 2. A differential view of the outputs is shown in figure 4 on page 6.

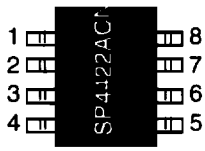
Electroluminescent Technology

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. Sipex 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.

Electroluminescenct backlighting is ideal when used with LCD displays, key pads, 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.

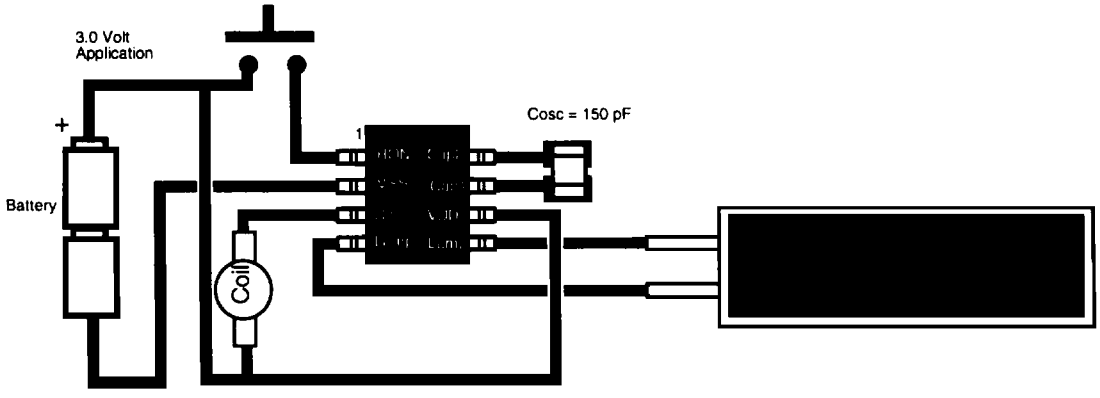
The amount of light emitted is a function of the voltage applied to the lamp, the frequency at which it is applied, the lamp material used and its size, and lastly the inductor used. There are many variables which can be optimized for specific applications. Sipex supplies characterization charts to aid the designer in selecting the optimum circuit configuration (see page 5.)

Pin Description

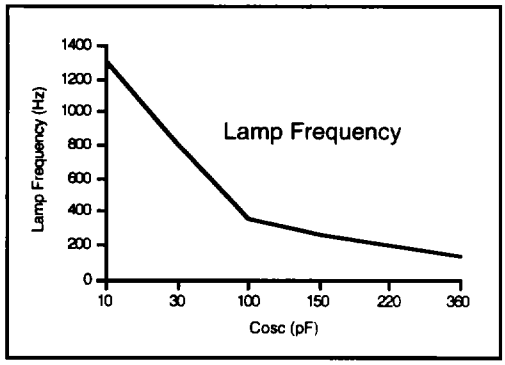


Pin 1	HON- Enable for driver operation, high=active; low=inactive.
Pin 2	Vss- Power supply common, connect to ground.
Pin 3	Coil- Coil input, connect coil from Vdd to pin3.
Pin 4	Lamp- Lamp driver output1, connect to EL lamp.
Pin 5	Lamp- Lamp driver output2, connect to EL lamp.
Pin 6	Vdd- Power supply for driver, connect to system Vdd.
Pin 7	Cap1- Capacitor input 1, connect to Cosc.
Pin 8	Cap2- Capacitor input 2, connect to Cosc.

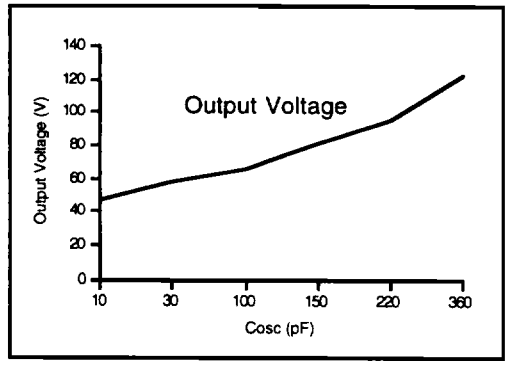
Typical SP4422ACN Application Circuit



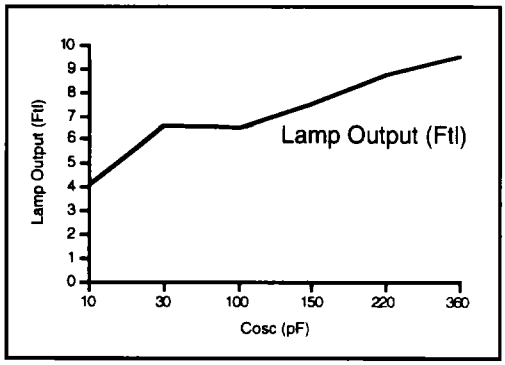
The following performance curves are intended to give the designer a relative scale from which to optimize specific applications. Absolute measurements may vary depending upon the brand of components chosen.



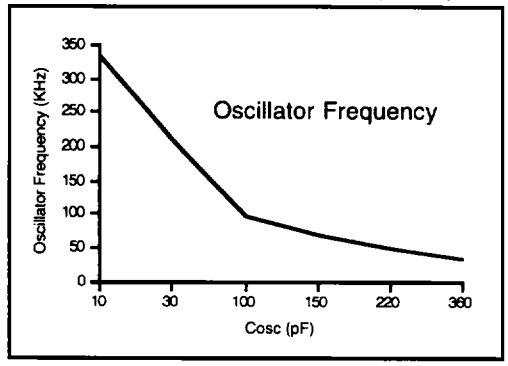
Lamp Frequency vs Cosc.
Vdd= 3.0V; Coil= 20mH, 70Ω; Lamp=1 sq. in.



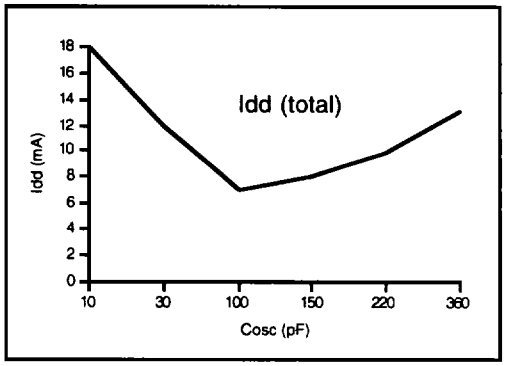
Output Voltage vs Cosc.
Vdd= 3.0V; Coil= 20mH, 70Ω; Lamp=1 sq. in.



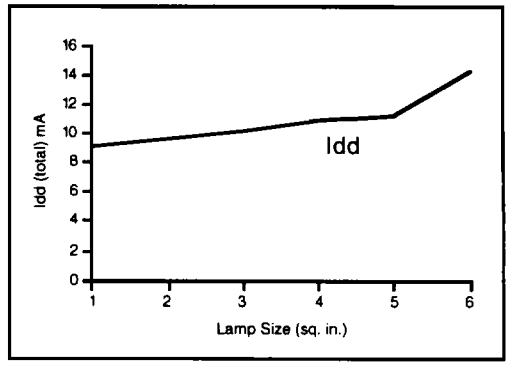
Lamp Output vs Cosc.
Vdd= 3.0V; Coil= 20mH, 70Ω; Lamp=1 sq. in.



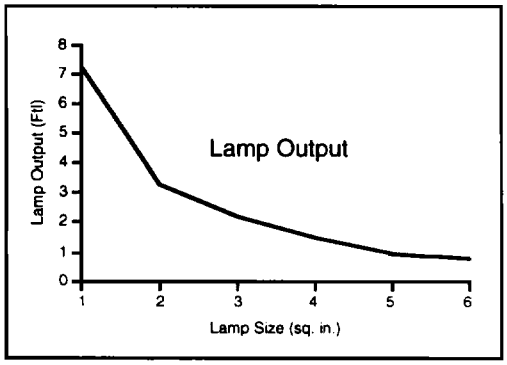
Oscillator Frequency vs Cosc.
Vdd= 3.0V; Coil= 20mH, 70Ω; Lamp=1 sq. in.



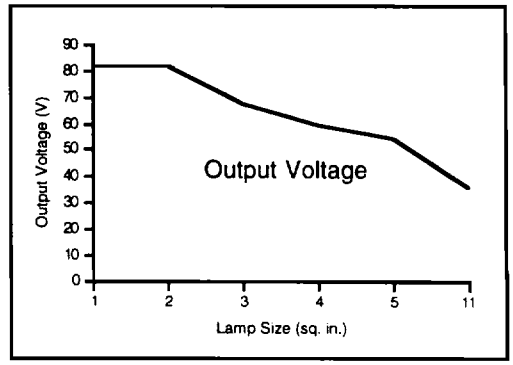
Idd vs Cosc.
Vdd= 3.0V; Coil= 20mH, 70Ω; Lamp=1 sq. in.



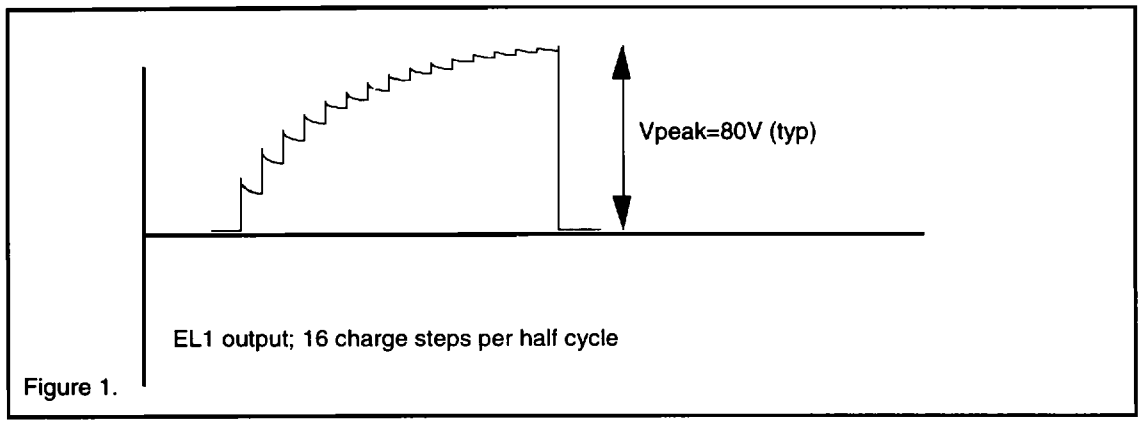
Idd vs Lamp Size.
Vdd= 3.0V; Coil= 20mH, 70Ω; Cosc= 180pF



Lamp Output vs Lamp Size.
Vdd= 3.0V; Coil= 20mH, 70Ω; Cosc= 180pF

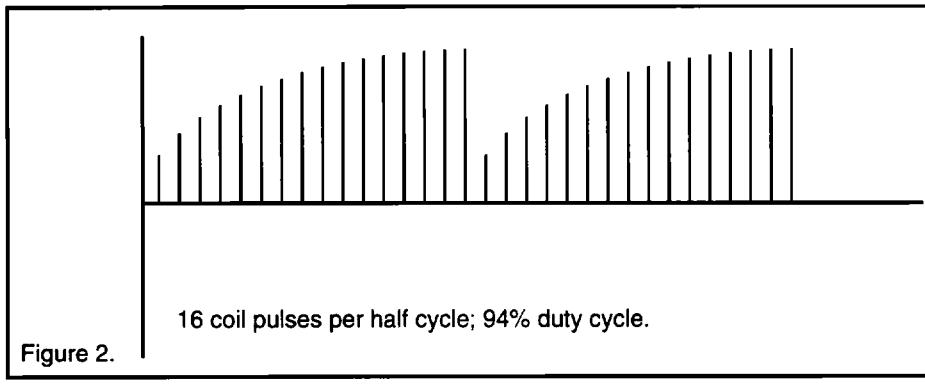


Output Voltage vs Lamp Size.
Vdd= 3.0V; Coil= 20mH, 70Ω; Cosc= 180pF



EL1 output; 16 charge steps per half cycle

Figure 1.



16 coil pulses per half cycle; 94% duty cycle.

Figure 2.

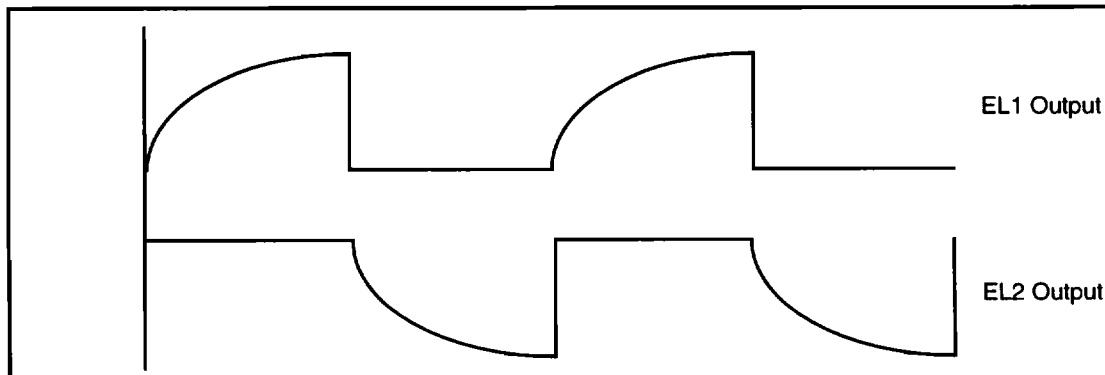
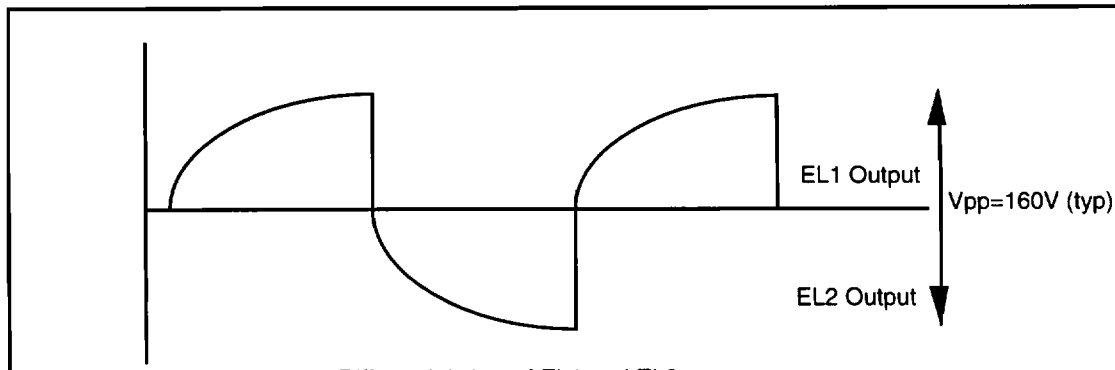


Figure 3.

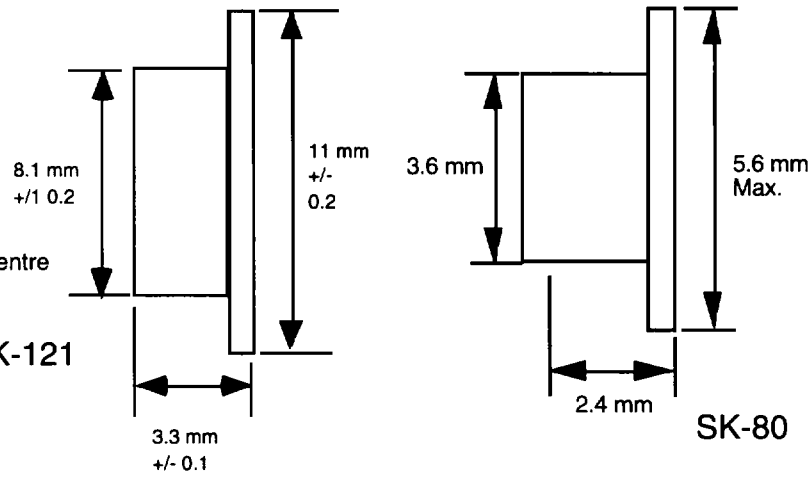


Differential view of EL1 and EL2.

Figure 4.

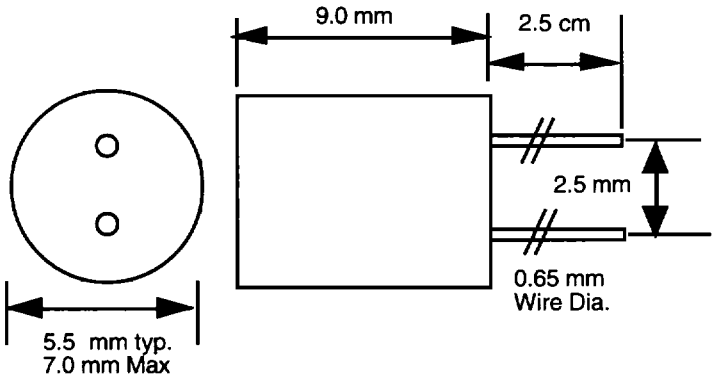
Surface Mount Inductors

NOTE:	Specification per part number SK-80
Inductance:	65mH ±15mH
Resistance:	270 Ohms ±15% @ 25°C
Part Number	SK-121
Inductance:	29mH ±20 %
Resistance:	62 Ohms ±10% @ 25°C
Vendor:	Sankyo Shoji Co. (HK) RM 28, 9/il Thriving Ind. Centre Tsuen Wan, N.T. Hong Kong
Phone:	8522 414 9268
Fax:	852-2-695-1842
Contact:	Mr. K.M. Chang



Through Hole Inductors

NOTE:	Specification per part number CH5070AS-203K-006 Sipex No. S50926-M-1075-Sipex
Inductance:	20 mH ±10%
Resistance:	75 Ohms Max
Vendor:	CTC Coils LTD (HK) Flat L-M 14 Fl, Haribest Ind'l Bldg. 45-47 Au Pul Wan Street Fo Tan Shatin. N.T., Hong Kong
Phone:	85 2695 4889
Fax:	652695 1842
Contact:	Alfred Won cc Marine Au



EL polarizers/transflector manufacturers

Yoshi Shinozuka
Polarizers
Nitto Denko
56 Nicholson Lane
San Jose, CA. 432-5480

Top Polarizer- NPF F1205DU
Bottom - NPF F4225 or (F4205) P3 w/transflector

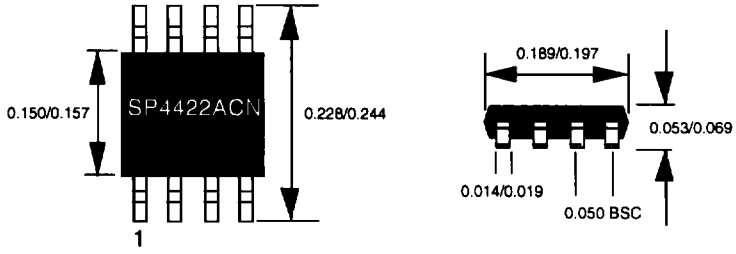
Transflector Material
Astra Products
Mark Bogin
P.O. Box 479
Baldwin, NJ 11510
Phone (516)-223-7500
Fax (516)-868-2371

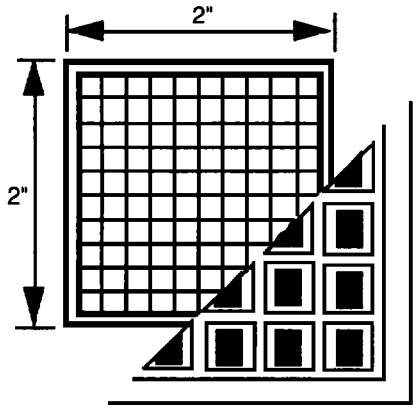
EL Lamp manufacturers

Leading Edge Ind. Inc.
11578 Encore Circle
Minnetonka, MN 55343
Phone 1-800-845-6992

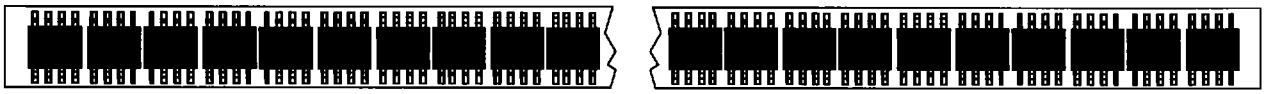
Elform (MKS) (EL Lamps)
Bob Short
1025 Ridgeview Suite 200
Reno, NV. 89510
Phone: (702) 829-1905
Fax: (702) 829-1693

Luminescent Systems inc. (LSI)
101 Etna Road
Lebanon, NH. 03766-9004
Phone: (603) 448-3444
Fax: (603) 448-33452

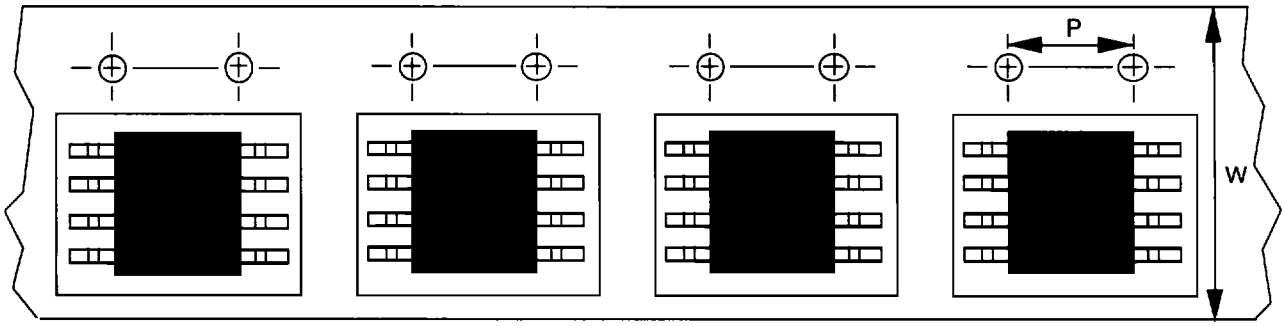




100 SP4422A die per waffle pack



95 SP4422ACN per tube



NSOIC-8 13" reels: P=8mm, W=12mm		
Minimum qty per reel	Standard qty per reel	Maximum qty per reel
500	1500	2500

ORDERING INFORMATION

Model	Temperature Range	Package Type
SP4422ACN	0°C to +70°C	8-Pin NSOIC
SP4422ACN/TR	0°C to +70°C	8-Pin NSOIC
SP4422ACX	0°C to +70°C	Die