General Information about Electroluminescent Lamps

Characteristics of EL-Lamps

1. Capacity of an EL-lamp

The EL-lamp is actually a light capacitor. For this reason the term "LEC" (Light-Emitting-Capacitor) would be more suitable analogous to the term "LED" (Light-Emitting-Diode). From the point of view of the supply we are mainly concerned with a capacitive load, precisely with a disk capacitor. The disk capacitor has the following structure:

electrode 1

dielectric ε_r
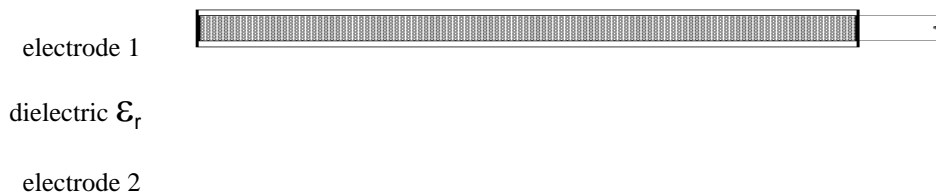
electrode 2

Between the two electrodes 1 and 2 with the distance s there is the so-called dielectric with a permeability number ε_r. The unity for the capacity of the capacitor is Farad. We define the capacitor "C" with the following formula:

$$C = \varepsilon_0 \; x \; \varepsilon_r \; x \; A \, / \, s$$

The units have the following meaning as written below:

ε_0 is the electric field constant with the quantity 8,85 x 10-12As/Vm

ε_r is the permeability number which is determined by the material
between the electrodes

A   is the real capacitor surface

s   is the distance between the two electrodes

How can you influence the capacity when you produce an EL-lamp?

Capacity index of an EL-lamp:

$C_{passive}$ 0,2 - 0,5 nF/cm^2 i.e. measured with a C-measuring instrument
                                                    (approx. 0,5V at approx. 800Hz)
C_{active} 0,3 - 0,6 nF/cm^2 i.e. measured while operating
                                                    (e.g. 110V 400Hz)

2. What's the appearance of the replace control circuit of an EL-lamp?

Apart of the capacity respresenting a dominant quantity, the two resistances Rs and Rp are also important.
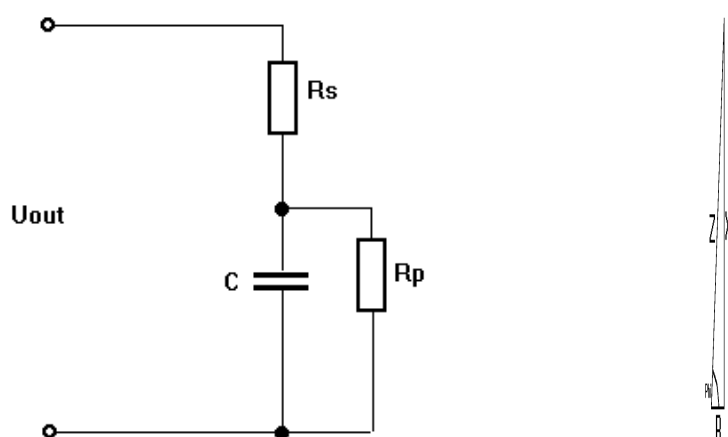
The series resistance Rs is determined by transmission resistance, transition resistance of the connections, electrode resistance and light emission. The values are around 100kOhm x cm^2.

The parallel resistance Rp has in fact more than 100MOhhm which is very much, but is still small enough to enable the capacitor to discharge after switching off.

The capacitive blind resistance depends on the frequency and has the following formula: $X_c = 1/2 \times \pi \times f \times C$.

3. How can the EL-cristals be stimulated?

In principle the EL-lamp emits light in dependance of the electrical current. The current however can only flow by changing the voltage at the electrodes. Therefore an EL-system can only be operated with alternative voltage.

The current is influenced by two parameters. On the one hand by the amplitude of the voltage and on the other hand by the frequency of the change of polarity in function of time, i.e. the frequency of supply voltage.

A big advantage of EL-lamps are the short reaction times. The delay in switching on of the light emission is neglectible with the EL-systems of nowadays and the delay in switching off is about 100µs. Because of that the useful maximum frequency is about 3000Hz. Exceeding this frequency the efficiency decreases extremely due to overstimulation.

The luminousity of EL-lamps is specified in luminous intensity [cd/m^2].

4. Requirements of operation voltages

EL-lamps being produced with the paste of Du Pont, so-called EL-thick-coat-systems start emitting the cristals at about 20VAC. Not until this voltage, a field power is reached which stimulates the electrons enough and therefore releases a light emission.

The maximum voltage depends on the construction of the EL-lamp. At high-voltage systems up to 200Veff can be set up.

5. The mentioned characteristics of the EL-lamp lead to following conclusions for EL-drivers:

1. At a defined EL-system the quantity of the capacity depends on the illumination surface. With it the driver load is proportionally to the illumination surface.

2. Several lamps can be connected at the same supply. The entire capacity is the total sum of all single capacities.

3. At a serial circuit a voltage distribution occurs in opposite proportion to single capacities. Normally this kind of operation is only used for special cases.

4. A phase angle between 80° and 87° results from the dominant   influence of the capacity in proportion to the resistances Rs and Rp. Because of that there flows practically only reactive current and there is no heat in the EL-lamp.

5. Efficient operating frequences are between 200 and 3000Hz.

6. The sector of operation voltage of an EL-lamp extends to 20 up to

150VAC.

Definitions for EL-Lamps

Nominal Supply Conditions
All the values of the parameters of the current supply, from which the nominal characteristics are derived and where the lamp produces the nominal output.

The parameters, where the values are specified in the product norm, are as follows:

- Nominal voltage [V eff]
- Nominal frequency [Hz]
- Form of signals

Nominal Current Intensity [A]
Effective alternative current, which is absorbed from the lamp under nominal supply conditions.

Nominal Current Intensity related to Surfaces [A/m^2]
Effective alternative current which is absorbed from the surface unity of the lamp under nominal supply conditions.

Power Factor
Cosine of the angle of phase displacement at sine wave supply between the absorbed current and the regulated tension under nominal supply conditions.

Apparent Nominal Power [VA]
Product from nominal tension and nominal current intensity.

Apparent Nominal Power related to Surfaces [VA/m^2]

Product from nominal tension and nominal current intensity relating to the surface.

Nominal Luminance [cd/m^2]

Luminance of the electroluminescent lamp under nominal supply conditions.

Useful Luminance [cd/m^2]

Value of the luminance according to the specific application conditions.

Half-Life [h]

Number of operation hours under nominal supply conditions to reach half of the value of nominal luminance.

Useful Life [h]

Number of operation hours during which the electroluminescent lamp at nominal frequency supplied with nominal tension (not exceeding nominal tension) can be hold on the value of useful luminance.

Emission Spectrum

Representation of the energetic allocation as function of the wavelength which has been emitted by the electroluminescent lamp under nominal supply conditions.

Luminance-Constancy [%]

Luminance fluctuations related to the nominal value of the illuminated surface of the electroluminescent lamp under nominal supply conditions.

Lead Wavelength [nm]

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Wavelength of the energetic emission-maximum of the electroluminescent lamp under nominal supply conditions.

Leading Wavelength [nm]

Wavelength of the monochromatic radiation of the same colour as the illuminated surface of the electroluminescent lamp under nominal supply conditions.

Chromatic Coordinates

Chromatic coordinates (x, y or u`, v`), fixed in the chromatic spectrogramme C.I.E. 1931 (standard observer 2^0 or C.I.E. 1976), of the electroluminescent lamp under nominal supply conditions.

Energetic Luminance [W/m^2/sr]

Energy which is radiated from the electroluminescent lamp under nominal supply conditions.

Luminous Power [lm/W]

Light flow emitted by the electroluminescent lamp under nominal supply conditions related to the active absorbed efficient power.

Efficiency [cd/VA]

Quotient of the luminance under effective illumination surface divided by the apparent power.

Capacity [F]

Capacity of the electroluminescent lamp under nominal supply conditions.

Capacity related to Surfaces [F/m^2]

Capacity per unit of illumination surface of the electroluminescent lamp under nominal supply conditions.

Width of Margins [mm]

Dimensions of the non-luminous external limits of the electroluminescent lamp.

Minimal Curve Radius [mm]

Smallest radius which can be accepted by a flexible electroluminescent lamp without deterioration of its power.

Looks

The way of presentation of an electroluminescentlamp at visual inspection.

Visible Faults

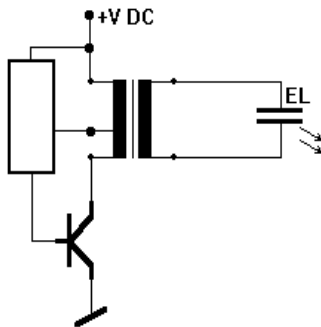Visible defects, especially in the luminous surface which can affect the performance.

EL-Driver Technologies for EL-Lamps

1. Self swinger

At an adapted EL-lamp the self swinger has got a similar current to sine, preceding the voltage by almost 90°. EL-drivers ELD-40 are based on this circuit technique.
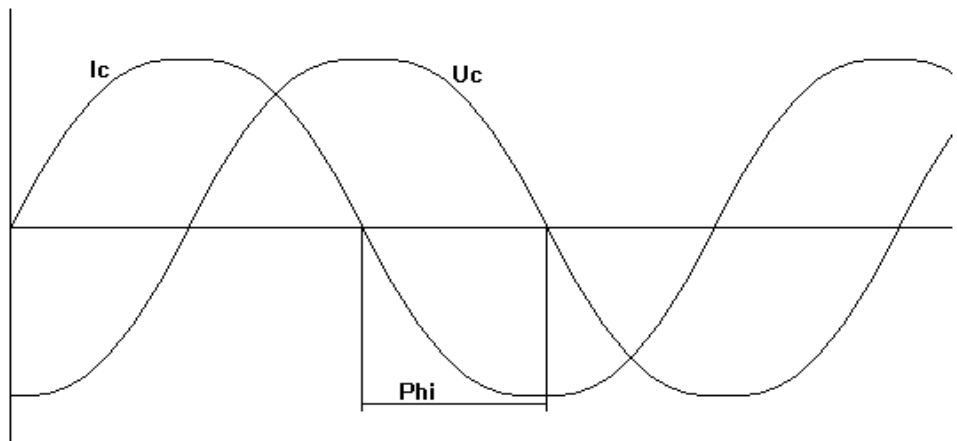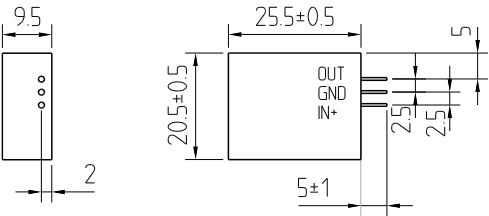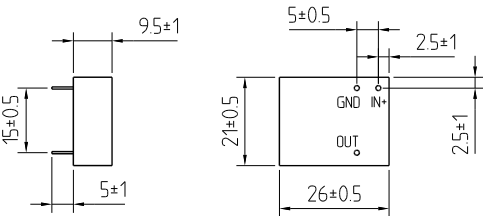

1.1.   Self swinger circuit

- Efficiency on average
- Cost-effective
- EMC good
- Frequency and voltage are fix, not dimmable and extremely dependent on load.
- Parallel operation for increasing power is possible.[1]
- Redundant operation to increase the failure safety is possible.
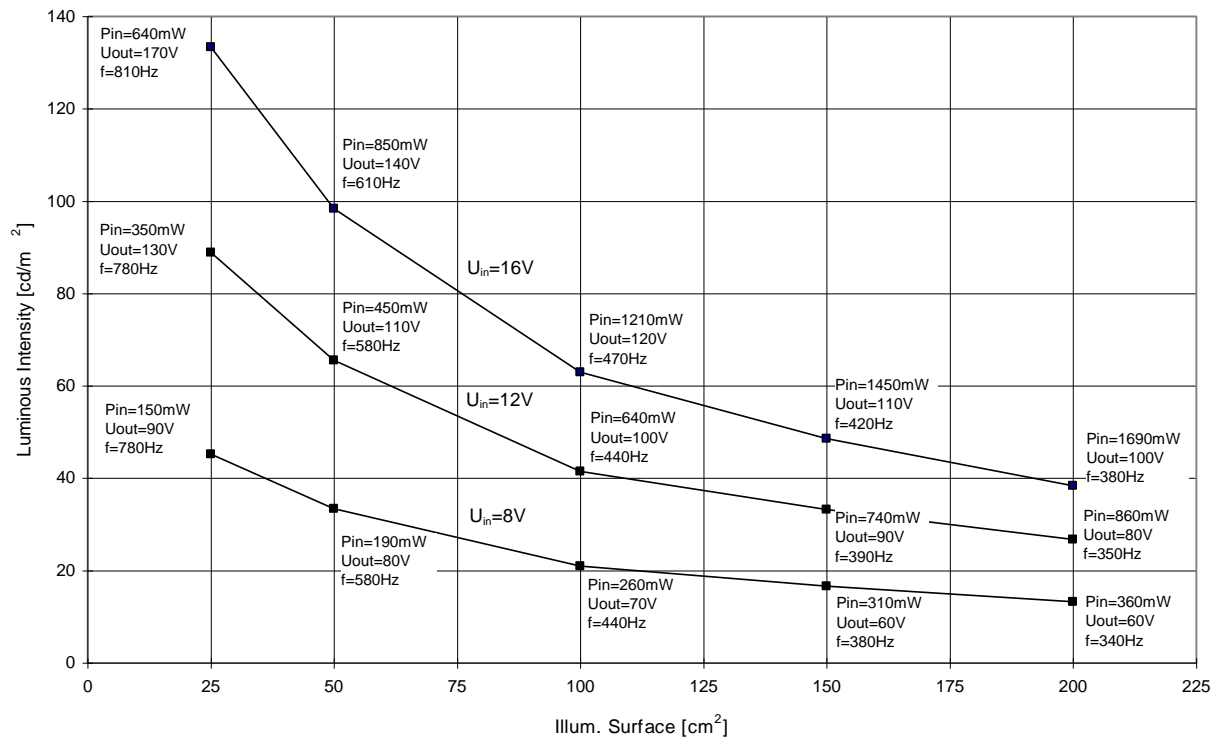
1.2. Specifications E040 601X

E040 6010 (standing)	E040 6011 (laying)

Nominal input	12VDC	Max.illum. surface	200 cm2
Typ. output	140VAC	Storage temperature	-30°C - +80°C
Typ. frequency	400Hz	Operating temperature	-10°C - +70°C

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[1] Dependent on manufacturer

The values on the above diagram are based on the following EL-datas:

ELF 2006

Colour	green-blue
Emission max.	500nm
$C_{passive}$	0.25 nF/cm^2
C_{active}	0.39 nF/cm^2 @ 100V 400Hz

Attention: Running on the spot or short circuit can damage the EL-Driver!
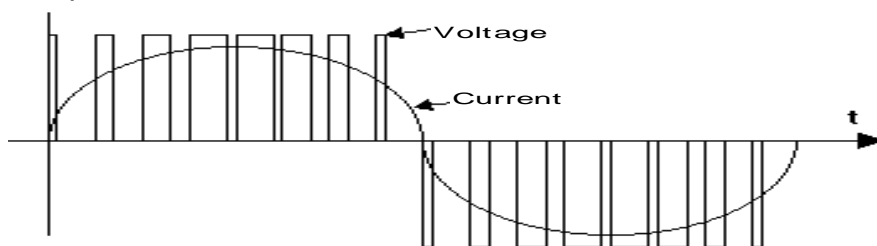
2. PWM - Inverter

The meaning of PWM is **P**ulse-**W**ide-**M**odulation. With this way of circuit any EL-lamp can be driven with an accurately definite frequency. An ideal harmonic current curve is caused for the EL-lamp. The Full Costum ASIC ELD-
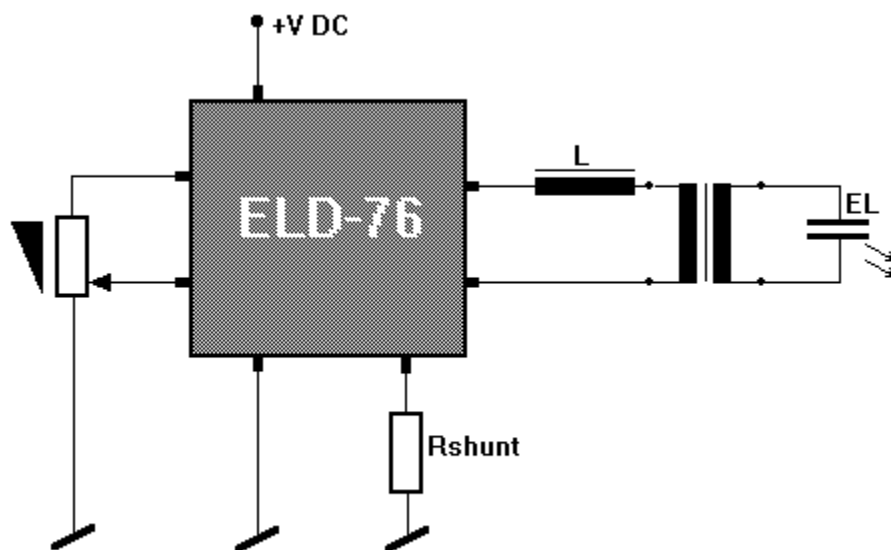
76 which has been developped by ENZ-Electronic AG offers an optimum main component for all these circuits.

2.2.1. EL-driver from DC-supply, with output power of about 10VA with transformer or transferrable at the output

Characteristics: high efficiency, galvanic separation, dimmable, 200 - 2800Hz
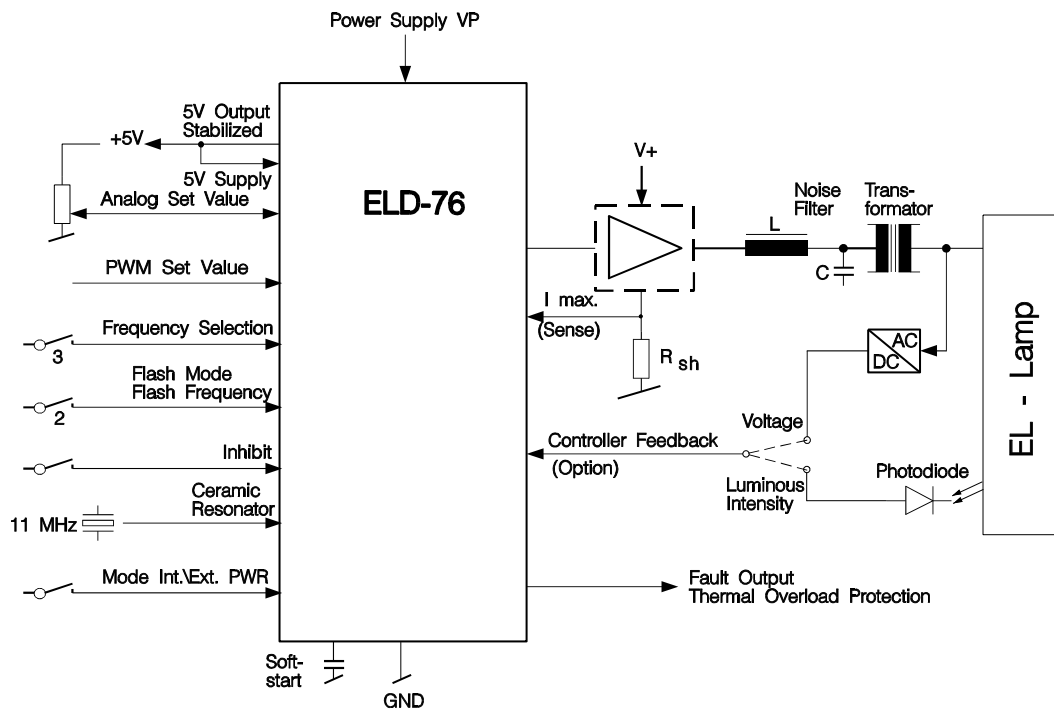
2.2. EL-Driver ELD-76

The driver ELD-76 is a **full custom ASIC** for controlling thickfilm electroluminescent lamps via transformator. The ASIC is available in DIE form and with PLCC44 case.

Main Characteristics
- High current driver up to 0.5A
- Wide supply voltage range from 4.5V to 35V
- Overload protection
- High efficiency through PWM
- Integrated 5V - Low Drop voltage regulator
- Thermal overload protection, fault output
- Eight output frequencies digitally selectable from 200 Hz to 2800 Hz
- Flash mode with three flash intervalls from 1.4 Hz to 5.5 Hz
- Output voltage adjustable by means analog and digital (PWM)
- Softstart
- Appropriate for control of output voltage or luminous intensity
- Mode selectable for external high current driver
- Noise filter guarantees high quality sine wave
- Input/output isolation through transformator

Block Diagram

Power Supply VP

ELD-76

5V Output
Stabilized
+5V
5V Supply
Analog Set Value
PWM Set Value
Frequency Selection
3
Flash Mode
Flash Frequency
2
Inhibit
Ceramic
Resonator
11 MHz
Mode Int.\Ext. PWR

Soft-
start
GND

V+

I max.
(Sense)
R sh

Noise
Filter
L
C

Trans-
formator

AC
DC

Controller Feedback
(Option)

Voltage

Luminous
Intensity

Photodiode

EL - Lamp

Fault Output
Thermal Overload Protection

Subject to change