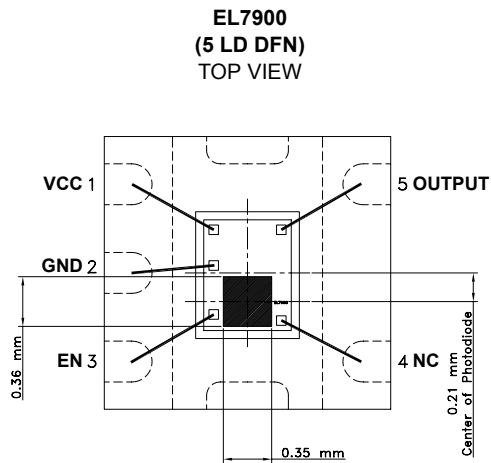


Ambient Light Photo Detect IC

The EL7900 is a light-to-current optical sensor combining a photodiode and a current amplifier on a single monolithic IC. Output current is directly proportionate to the light intensity on the photodiode. Its sensitivity is superior to that of a phototransistor and exhibits little variation. Its spectral sensitivity matches closely to the luminous efficiency and linearity.

Housed in an ultra-compact surface mount clear plastic package, this device is excellent for power saving control function in cell phones, PDAs, and other handheld applications.

Pinout



Features

- Monolithic IC containing photodiode and amplifier
- 1 Lux to 10,000 Lux range
- Converts light intensity to current
- 2.5V to 5.5V supply range
- Low supply current - 1 μ A
- Fast response time - <200 μ s
- Excellent output linearity of luminance
- Ultra-compact and light surface mount package
- Pb-free plus anneal available (RoHS compliant)

Applications

- Mobile phones
- Notebook PCs
- PDAs
- Video cameras
- Digital cameras

Ordering Information

PART NUMBER	TAPE & REEL	PACKAGE	PKG. DWG. #
EL7900ILCZ (Note)	-	5 Ld ODFN (Pb-free)	MDP0052
EL7900ILCZ-13 (Note)	13"	5 Ld ODFN (Pb-free)	MDP0052

NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$)

Supply Voltage between V_{SD} and GND6V
 Maximum Continuous Output Current6mA
 Operating Temperature -40°C to +85°C
 ESD Voltage2kV

Maximum Die Temperature +125°C
 Storage Temperature -45°C to +100°C

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

IMPORTANT NOTE: All parameters having Min/Max specifications are guaranteed. Typical values are for information purposes only. Unless otherwise noted, all tests are at the specified temperature and are pulsed tests, therefore: $T_J = T_C = T_A$

Electrical Specifications $V_{CC} = 3\text{V}$, $T_A = 25^\circ\text{C}$, fluorescent light, unless otherwise specified.

PARAMETER	DESCRIPTION	CONDITION	MIN	TYP	MAX	UNIT
I_{CC1}	Supply Current	$R_L = 1\text{k}\Omega$, EV = 100lx		62		μA
		EV = 0lx		1		μA
I_{CC2}	Supply Current When Disabled	EN = V_{HI}		1.2		μA
I_{L1}	Light Current	EV = 100lx	39	60.5	82	μA
I_{L2}	Light Current	EV = 10lx		6.2		μA
I_{LEAK}	Dark Current	EV = 0lx		0.15		μA
V_{O-MAX}	Maximum Output Compliance Voltage	at 95% of nominal output current, EV = 100lx		2.7		V
T_R	Rise Time (See Note)	$R_L = 5\text{k}\Omega$, EV = 300lx		105	125	μs
		$R_L = 1\text{k}\Omega$, EV = 1000lx		64		μs
T_F	Fall Time (See Note)	$R_L = 5\text{k}\Omega$, EV = 300lx		170	225	μs
		$R_L = 1\text{k}\Omega$, EV = 1000lx		77		μs
T_D	Delay Time for Rising Edge (See Note)	$R_L = 5\text{k}\Omega$, EV = 300lx		165	200	μs
		$R_L = 1\text{k}\Omega$, EV = 1000lx		112		μs
T_S	Delay Time for Falling Edge (See Note)	$R_L = 5\text{k}\Omega$, EV = 300lx		65	85	μs
		$R_L = 1\text{k}\Omega$, EV = 1000lx		33		μs
V_{LO}	Maximum Voltage at EN Pin to Enable				0.6	V
V_{HI}	Minimum Voltage at EN Pin to Disable		1.8			V
I_{LO}	Input Current at EN Pin	$V_{EN} = 0\text{V}$		0.01		μA
I_{HI}	Input Current at EN Pin	$V_{EN} = 3\text{V}$		2		μA
T_{EN}	Enable Time	EV = 200lx		140		μs
T_{DIS}	Disable Time	EV = 200lx		2		μs

NOTE: Switching time measurement is based on Figures 1 and 2.

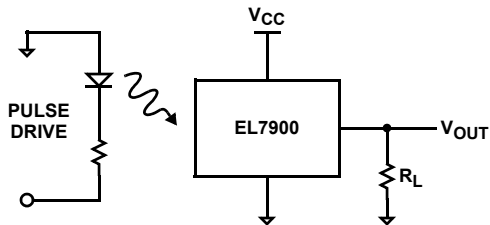


FIGURE 1. RISE/FALL TIME MEASUREMENT

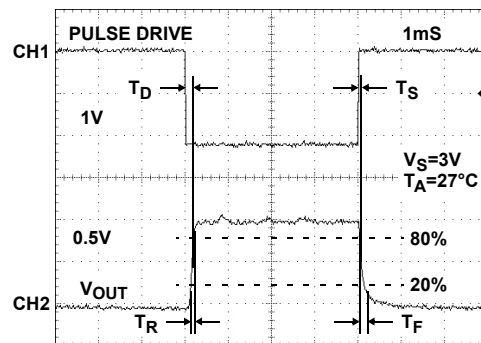


FIGURE 2.

Typical Performance Curves

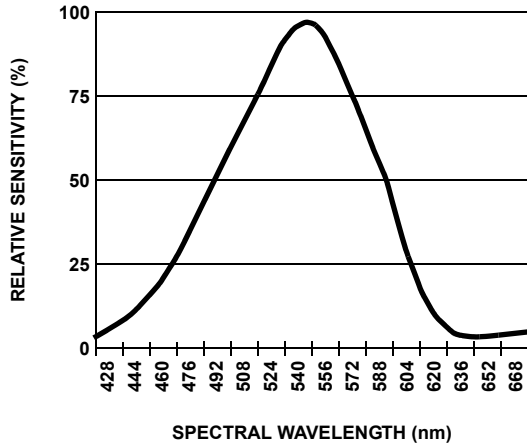


FIGURE 3. RELATIVE SENSITIVITY

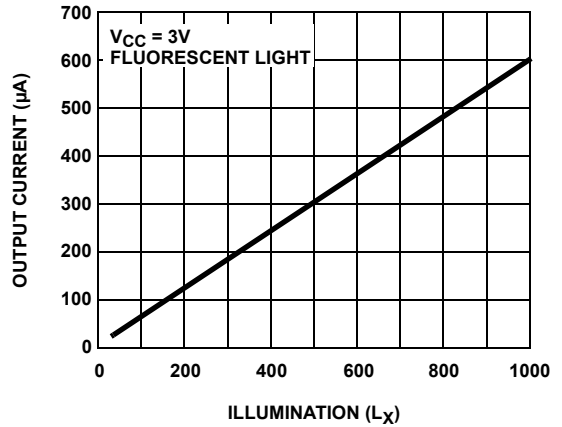


FIGURE 4. SENSITIVITY

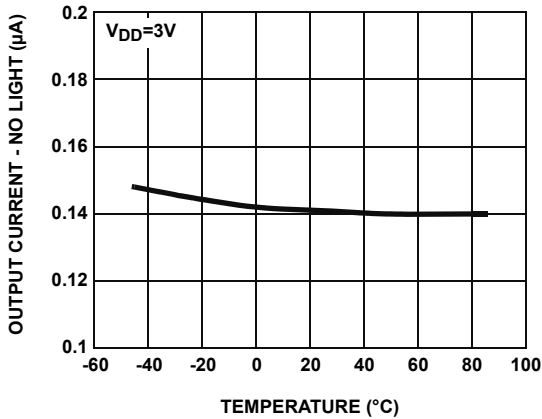


FIGURE 5. DARK CURRENT vs TEMPERATURE

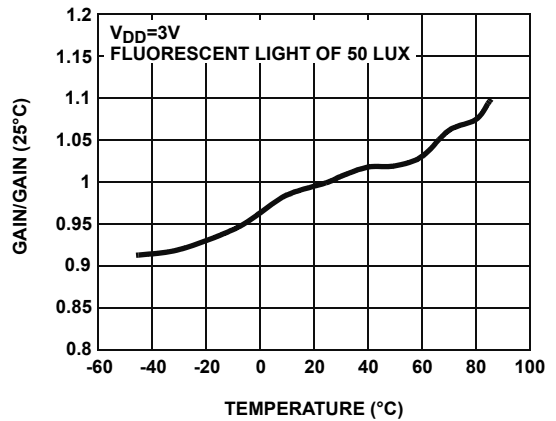


FIGURE 6. GAIN vs TEMPERATURE

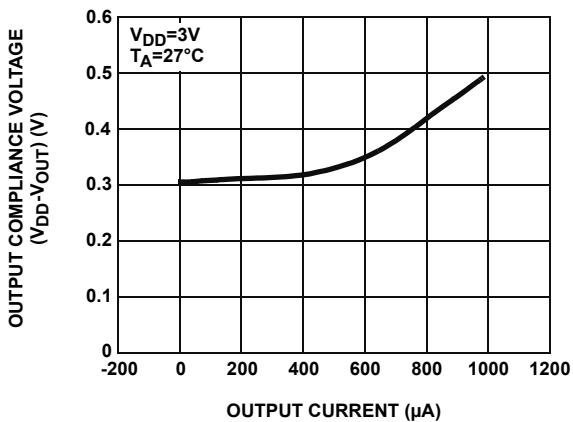


FIGURE 7. OUTPUT COMPLIANCE VOLTAGE vs CURRENT

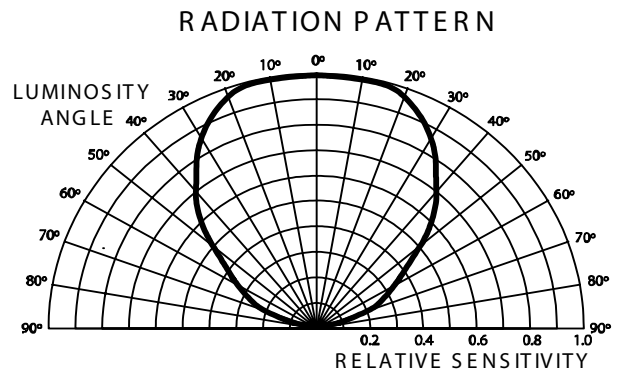
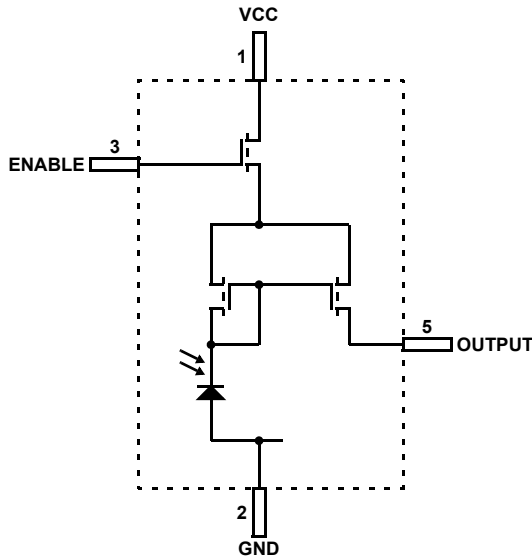


FIGURE 8. RADIATION PATTERN

Pin Descriptions

PIN	NAME	DESCRIPTION
1	VCC	Supply, 2.5V to 5.5V
2	GND	Ground
3	EN	Enable
4	NC	No connect
5	Output	Current output pin

Block Diagram



Application Information

Product Description

The EL7900 is a light-to-current optical sensor combining photodiodes and current amplifiers on a single monolithic IC. The photodiodes are temperature-compensated and their spectrum resembles the human eye response. The output current is directly proportional to the intensity of light falling on the photodiodes. For 100Lux of input fluorescent light, the EL7900 has an output current of 60µA.

The EL7900 is housed in an ultra-compact surface mount clear plastic package.

Light-to-Current and Voltage Conversion

The EL7900 has a responsiveness that is directly proportional to the intensity of light intercepted by the photodiodes. Although the conversion rate varies depending on the light sources (fluorescent light, incandescent light or direct sunlight), in general for a fluorescent light, the light-to-current conversion is:

$$I_{OUT} = \left(\frac{60\mu A}{100\text{Lux}} \right) \times L_{INPUT}$$

Here, I_{OUT} is the output current in µA, and L_{INPUT} is the input light in Lux.

For some applications, a load resistor is added between the output and the ground as shown in Figure 1. The output voltage can be expressed in the following equation:

$$V_{OUT} = I_{OUT} \times R_{LOAD} = \left(\frac{60\mu A}{100\text{Lux}} \right) \times L_{INPUT} \times R_{LOAD}$$

Here, V_{OUT} is the output voltage and R_{LOAD} is the value of the load resistor added. The compliance of the EL7900's output circuit may result in premature saturation of the output current and voltage when an excessively large R_{LOAD} is used. The output compliance voltage is 300mV below the supply voltage as listed in V_{O-max} of Electrical Specifications.

In order to have the linear relationship between the input light and the output current and voltage, a proper resistor value (i.e., gain) should be picked for a specific input light range. The resistor value can be picked according to the following equation:

$$R_{LOAD} = \frac{(V_{SUP} - 0.3V)}{60\mu A} \times \frac{100\text{Lux}}{L_{RANGE}}$$

Here, V_{SUP} is the supply voltage, and L_{RANGE} is the specific input light range for an application. For example, an indoor light ranges typically from 0 to 1,000Lux. A resistor value of 4.5kΩ for 3V supply voltage can be used. For a small light range, a large resistor value should be used to achieve better sensitivity; for a large light range, a small resistor value should be used to prevent non-linear output current and voltage.

Application Examples

The following examples present from fully automatic to fully manual override implementations. These guidelines are applicable to a wide variety of potential light control applications. The EL7900 can be used to control the brightness input of CCFL inverters. Likewise it can interface well with LED drivers. In each specific application, it is important to recognize the target environment and its ambient light conditions. The mechanical mounting of the sensor, light aperture hole size and use of a light pipe or bezel are critical in determining the response of the EL7900 for a given exposure of light.

The example in Figure 9 shows a fully automatic dimming solution with no user interaction. Choose R_1 and R_2 values for any desired minimum brightness and slope. Choose C_1 to adjust response time and to filter 50/60Hz room lighting. For example, suppose you wish to generate an output voltage from 0.25V to 1.25V to drive the input of an LED driver controller. The 0.25V represents the minimum LED brightness and 1.25V represents the maximum. The 1st step would be to determine the ratio of R_1 and R_2 :

$$R_1 = R_2 \times \left(\frac{3.0V}{0.25V} - 1 \right) = 11 \times R_2$$

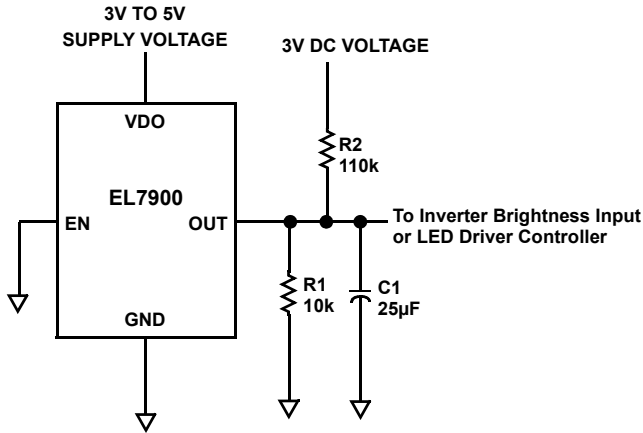


FIGURE 9.

Next the value of R_2 can be calculated based on the maximum output current coming from the EL7900 under the application's maximum light exposure. Suppose the current has been determined to be about $125\mu\text{A}$. Thus R_2 can be calculated approximately as follows:

$$R_2 = \left(\frac{1.25\text{V}}{125\mu\text{A}} \right) = 10\text{k}\Omega$$

and

$$R_1 = 11 \times R_2 = 110\text{k}\Omega$$

In Figure 10, user adjustable bias control has been added to allow control over the minimum and maximum output voltage. This allows the user to adjust the output brightness to personal preference over a limit range.

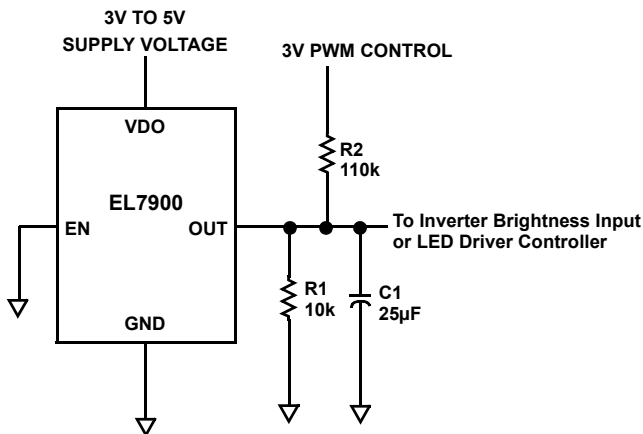


FIGURE 10.

Figure 11 shows how a fully manual override can be quickly added by using the EN pin.

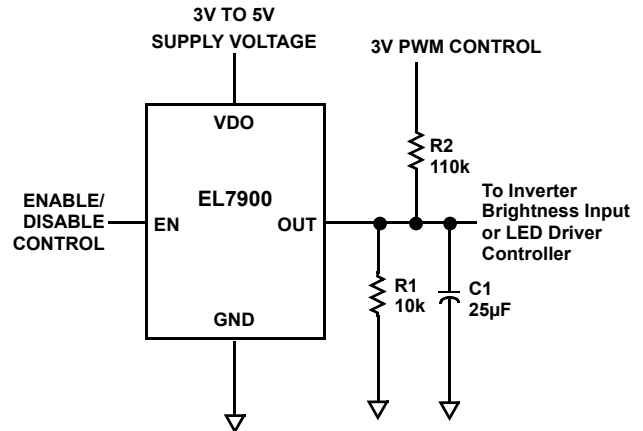


FIGURE 11.

Short Circuit Current Limit

The EL7900 does not limit the output short circuit current. If the output is directly shorted to the ground continuously, the output current could easily increase for a strong input light such that the device may be damaged. Maximum reliability is maintained if the output continuous current never exceeds 6mA by adding a load resistor at the output. This limit is set by the design of the internal metal interconnects.

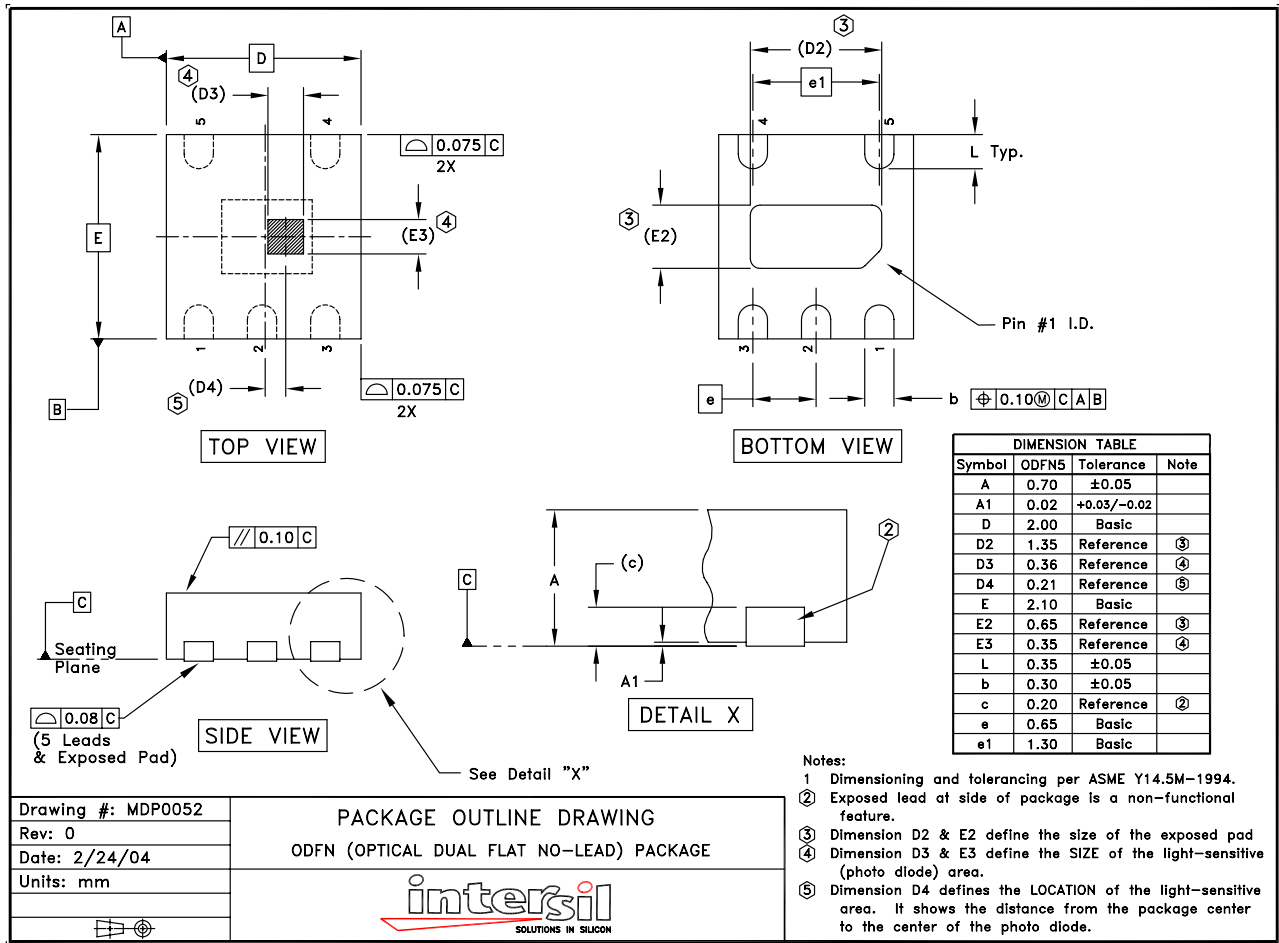
Suggested PCB Footprint

Footprint pads should be a nominal 1-to-1 correspondence with package pads. The large, exposed central die-mounting paddle in the center of the package requires neither thermal nor electrical connections to PCB, and such connections should be avoided.

Power Supply Bypassing and Printed Circuit Board Layout

The EL7900 is relatively insensitive to the printed circuit board layout due to its low speed operation. Nevertheless, good printed circuit board layout is necessary for optimum performance. Ground plane construction is highly recommended, lead length should be as short as possible and the power supply pins must be well bypassed to reduce the risk of oscillation. For normal single supply operation, where the GND pin is connected to ground, a $0.1\mu\text{F}$ ceramic capacitor should be placed from V_{CC} pin to GND pin. A $4.7\mu\text{F}$ tantalum capacitor should then be connected in parallel, placed close to the device.

Package Outline Drawing



NOTE: The package drawing shown here may not be the latest version. To check the latest revision, please refer to the Intersil website at <http://www.intersil.com/design/packages/index.asp>

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