Data Sheet | July 1, 2008 | FN6484.0

## Non-Linear Output Current, Low Power Ambient Light Photo Detect IC

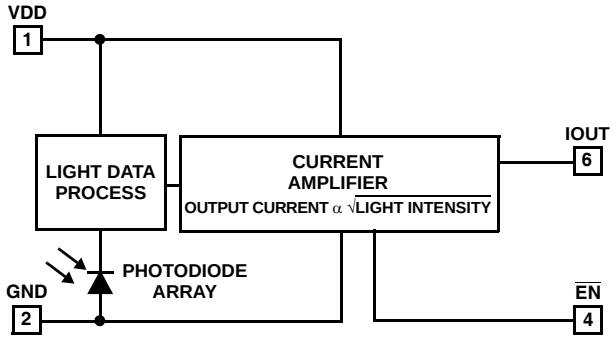
The ISL29009 is a light-to-current silicon optical sensor combining a photodiode and current amplifiers on a single monolithic IC. Similar to human eyes, the photodiode has peak sensitivity at 550nm and spans from 400nm to 700nm, rejecting UV light and IR light. The input luminance range is from 0.3 lux to 10,000 lux.

The integrated non-linear current amplifier boosts and converts the photodiode signal in a square root fashion, extending the light input dynamic range while maintaining excellent sensitivity at dim conditions with low lux levels. The device consumes minimal power over a wide range of ambient lux levels because the current consumption ramps at a square root fashion. A dark current compensation circuit aids the photodiode to minimize temperature dependent leakage currents in the absence of light, improving the light sensitivity at low lux levels.

In addition, the ISL29009 has an $\overline{EN}$ pin that can be used for a polling scheme extending portables' battery life.

The ISL29009 is housed in an ultra compact 2mmx2.1mm ODFN plastic case surface mount package. Operation is rated from -40°C to +85°C.

## Simplified Block Diagram




## Ordering Information

| PART NUMBER (Note) | TEMP. RANGE (°C) | PACKAGE (Pb-free) | PKG. DWG. # |
|---|---|---|---|
| ISL29009IROZ-T7* | -40 to +85 | 6 Ld ODFN | L6.2x2.1 |

*Please refer to TB347 for details on reel specifications.

NOTE: These Intersil Pb-free plastic packaged products employ special Pb-free material sets; molding compounds/die attach materials and NiPdAu plate - e4 termination finish, which is 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.

## Features

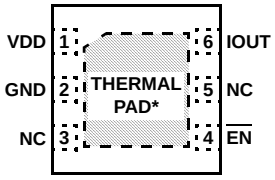
- Non-linear current output
- 0.3 lux to 10,000 lux range
- Dark current compensation
- Temperature compensated
- Human eye response
- 1.8V to 3.3V supply range
- Low supply current
- Fast response time
- 6 Ld ODFN: 2mmx2.1mmx0.7mm
- Pb-free (RoHS compliant)

## Applications

- Display and keypad dimming for:
  - Mobile devices: smart phone, PDA, GPS
  - Computing devices: notebook PC, webpod
  - Consumer devices: LCD-TV, digital picture frame, digital camera
- Industrial and medical light sensing

## Pinout

**ISL29009**
**(6 LD ODFN)**
TOP VIEW




***THERMAL PAD CAN BE CONNECTED TO GND OR ELECTRICALLY ISOLATED**

## Pin Descriptions

| PIN NUMBER | PIN NAME | DESCRIPTION |
|---|---|---|
| 1 | VDD | Supply, 1.8V to 3.3V |
| 2 | GND | Ground |
| 3 | NC | No connect |
| 4 | $\overline{EN}$ | Active LO enable |
| 5 | NC | No connect |
| 6 | IOUT | Current output |



CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.
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## Absolute Maximum Ratings ($T_A$ = +25°C)

Supply Voltage between VDD and GND . . . . . 3.6V
Pin Voltage (IOUT and $\overline{EN}$) . . . . . -0.2V to $V_{DD}$
Maximum Continuous Output Current . . . . . 6mA
Operating Temperature . . . . . -40°C to +85°C
ESD Rating
Human Body Model . . . . . 2kV
Machine Model . . . . . 200V

## Thermal Information

| Thermal Resistance | $\theta_{JA}$ (°C/W) |
|---|---|
| 6 Ld ODFN | 90 |

Maximum Die Temperature . . . . . +90°C
Storage Temperature . . . . . -40°C to +100°C
Operating Temperature . . . . . -40°C to +85°C
Pb-free reflow profile . . . . . .see link below
http://www.intersil.com/data/tb/TB477.pdf

*CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.*

*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

$V_{DD}$ = 3V, $T_A$ = +25°C, $\overline{EN}$ = 0, $R_L$ = 100kΩ at IOUT pin, green LED light, unless otherwise specified.

| PARAMETER | DESCRIPTION | CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| E | Range of Input Light Intensity | | | 0.3 to 10k | | lux |
| VDD | Power Supply Range | | 1.8 | | 3.3 | V |
| $I_{DD}$ | Supply Current | E = 1000 lux | | 9 | 14 | µA |
| | | E = 100 lux | | 3 | | µA |
| | | E = 0 lux | | 0.25 | | µA |
| $I_{SD}$ | Supply Current when Shut Down | $\overline{EN} = V_{DD}$ | | 250 | 350 | nA |
| $I_{OUT1}$ | Light-to-Current Accuracy | E = 100 lux | | 1.8 | | µA |
| $I_{OUT2}$ | Light-to-Current Accuracy | E = 1000 lux | 4.6 | 5.7 | 6.8 | µA |
| $I_{DARK}$ | Dark Current Output in the Absence of Light | E = 0 lux, $R_L$ = 10MΩ | | 2 | 5 | nA |
| $\Delta I_{OUT}$ | Output Current Variation Over Three Light Sources: Fluorescent, Incandescent and Halogen | | | 10 | | % |
| $V_{O-MAX}$ | IOUT Max Output Compliance Voltage at 95% of Nominal Output | E = 1000 lux | | $V_{DD}$ - 0.2 | | V |
| $t_R$ | IOUT Rise Time (Note 1) | $R_L$ = 100kΩ, E = 300 lux from 0 Lux | | 70 | | µs |
| | | $R_L$ = 100kΩ, E = 1000 lux from 0 Lux | | 20 | | µs |
| $t_F$ | IOUT Fall Time (Note 1) | $R_L$ = 100kΩ, E = 300 lux to 0 Lux | | 2410 | | µs |
| | | $R_L$ = 100kΩ, E = 1000 lux to 0 Lux | | 1290 | | µs |
| $t_D$ | IOUT Delay Time for Rising Edge (Note 1) | $R_L$ = 100kΩ, E = 300 lux from 0 Lux | | 600 | | µs |
| | | $R_L$ = 100kΩ, E = 1000 lux from 0 Lux | | 280 | | µs |
| $t_S$ | IOUT Delay Time for Falling Edge (Note 1) | $R_L$ = 100kΩ, E = 300 lux to 0 Lux | | 75 | | µs |
| | | $R_L$ = 100kΩ, E = 1000 lux to 0 Lux | | 5 | | µs |
| $V_{LO}$ | Maximum Voltage at $\overline{EN}$ pin to Enable | | | 0.5 | | V |
| $V_{HI}$ | Minimum Voltage at $\overline{EN}$ pin to Disable | | | $V_{DD}$ - 0.5 | | V |
| $I_{LO}$ | Input Current at $\overline{EN}$ pin | $V_{\overline{EN}}$ = 0V | | 1 | | nA |
| $I_{HI}$ | Input Current at $\overline{EN}$ pin | $V_{\overline{EN}}$ = 3V | | 1 | | nA |

## Electrical Specifications

$V_{DD}$ = 3V, $T_A$ = +25°C, $\overline{EN}$ = 0, $R_L$ = 100kΩ at IOUT pin, green LED light, unless otherwise specified. **(Continued)**

| PARAMETER | DESCRIPTION | CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $t_{EN}$ | Enable Time | $R_L$ = 100kΩ, E = 100 lux | | 20 | | µs |
| $t_{DIS}$ | Disable Time | $R_L$ = 100kΩ, E = 100 lux | | 200 | | µs |

NOTE:

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

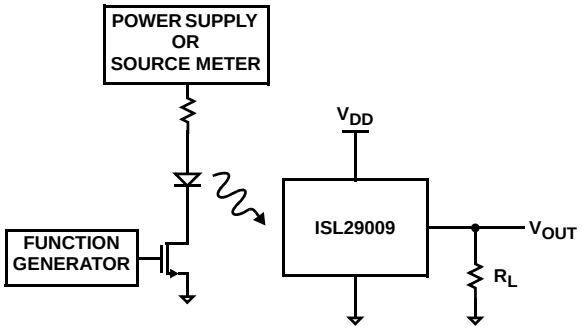



FIGURE 1. TEST CIRCUIT FOR RISE/FALL TIME MEASUREMENT

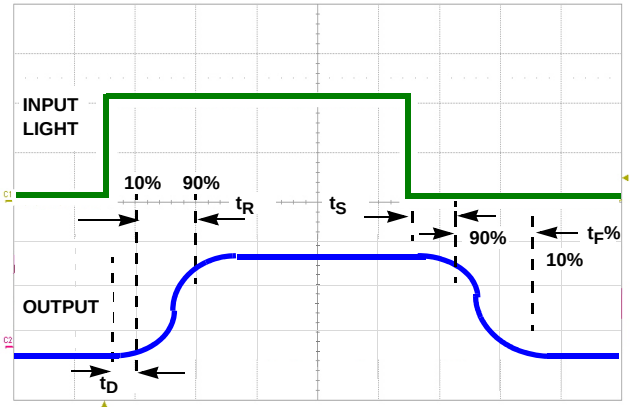



FIGURE 2. TIMING DIAGRAM

## Typical Performance Curves

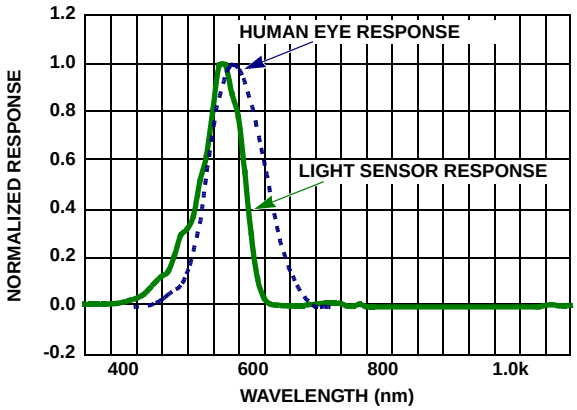



FIGURE 3. SPECTRAL RESPONSE

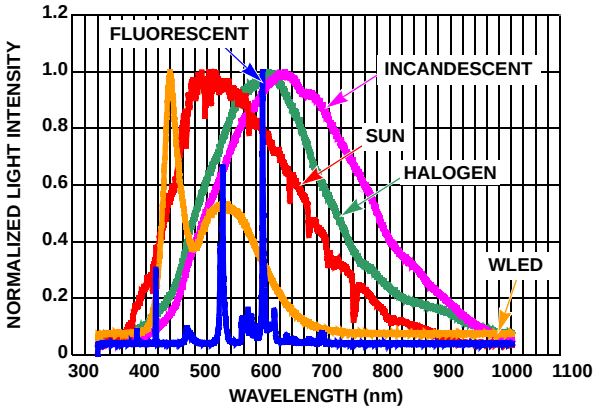



FIGURE 4. SPECTRUM OF LIGHT SOURCES

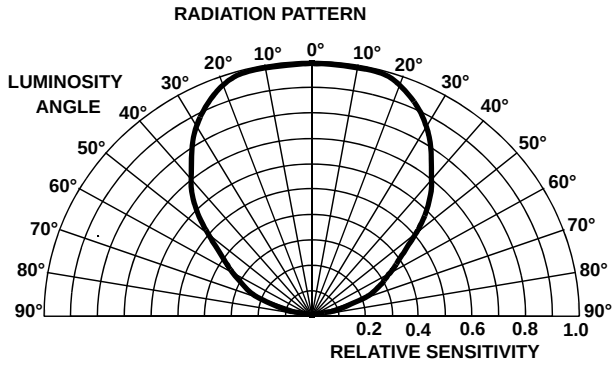



FIGURE 5. RADIATION PATTERN

## Typical Performance Curves (Continued)

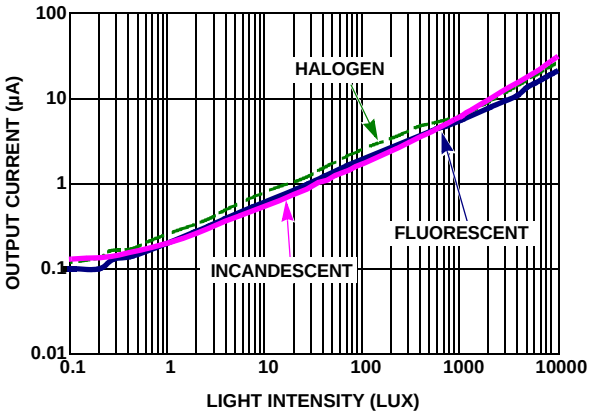



FIGURE 6. OUTPUT CURRENT vs LIGHT INTENSITY

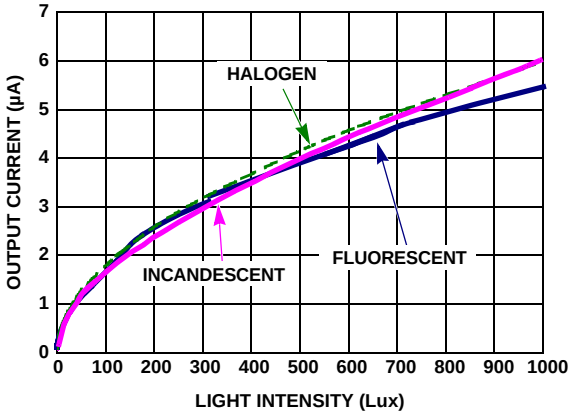



FIGURE 7. OUTPUT CURRENT vs LIGHT INTENSITY

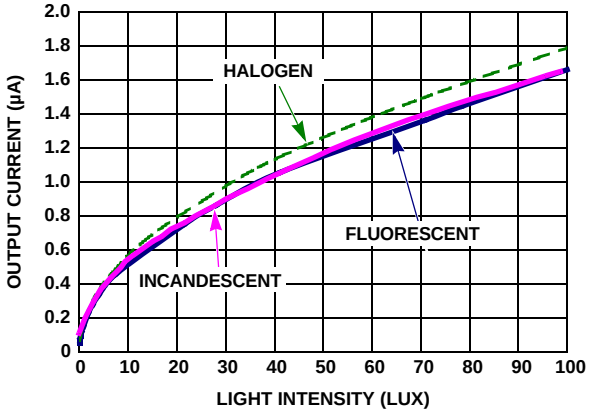



FIGURE 8. OUTPUT CURRENT vs LIGHT INTENSITY

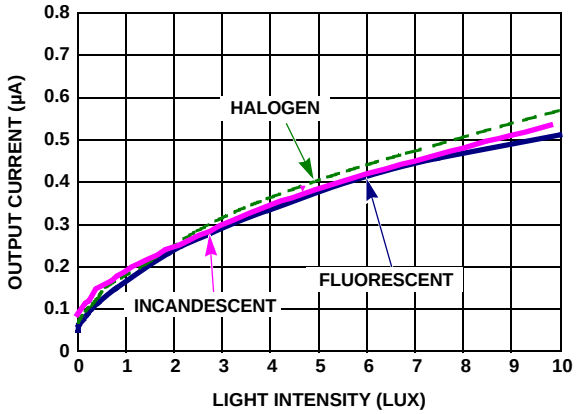



FIGURE 9. OUTPUT CURRENT vs LIGHT INTENSITY

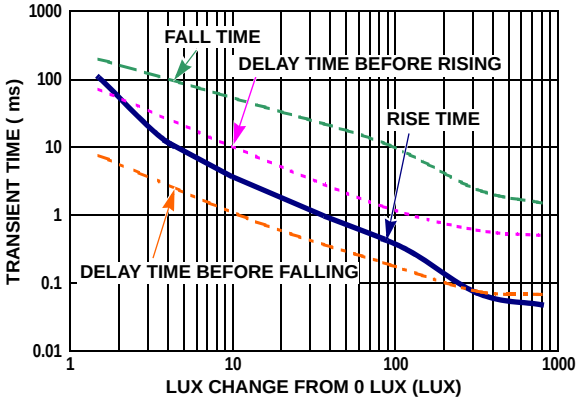



FIGURE 10. TRANSIENT TIME vs LUX CHANGE FROM 0 LUX

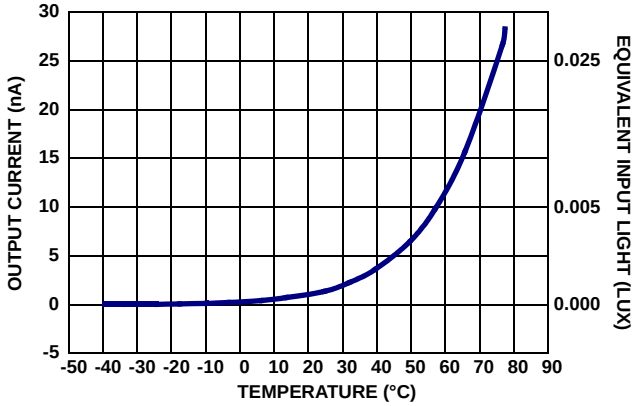



FIGURE 11. OUTPUT CURRENT vs TEMPERATURE AT 0 LUX

## Typical Performance Curves (Continued)

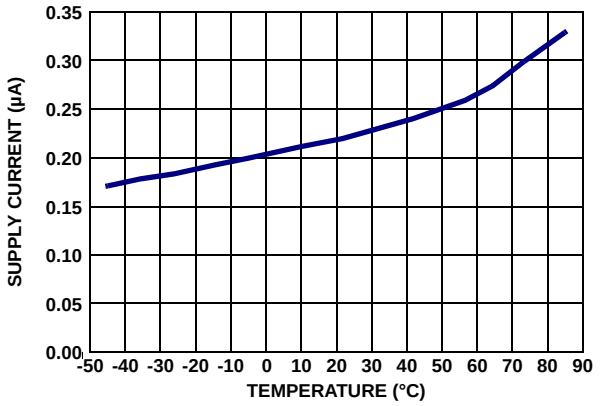



FIGURE 12. SUPPLY CURRENT vs TEMPERATURE AT 0 LUX

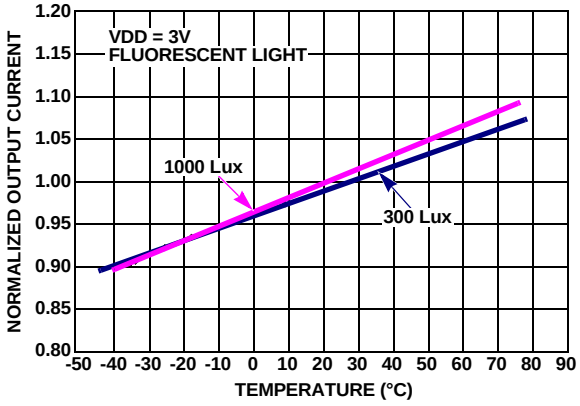



FIGURE 13. NORMALIZED OUTPUT CURRENT vs TEMPERATURE

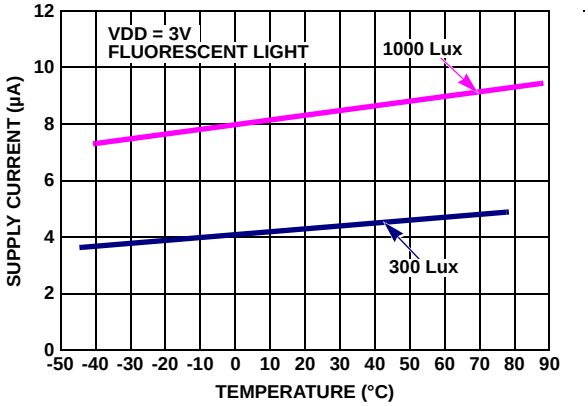



FIGURE 14. SUPPLY CURRENT vs TEMPERATURE

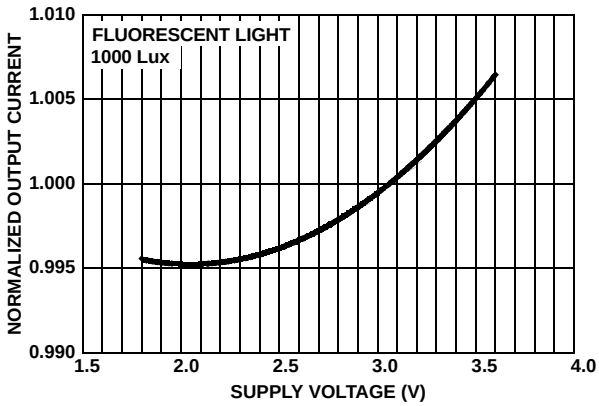



FIGURE 15. NORMALIZED OUTPUT CURRENT vs SUPPLY VOLTAGE

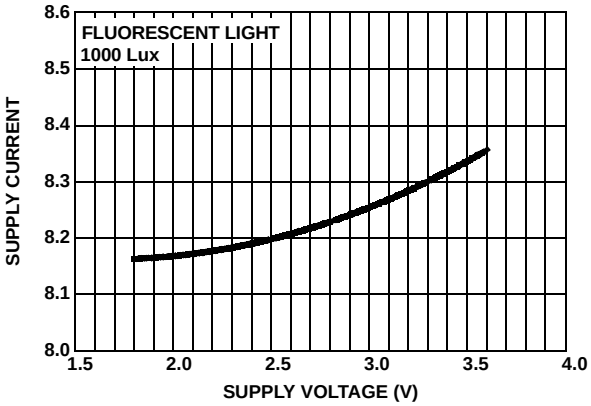



FIGURE 16. SUPPLY CURRENT vs SUPPLY VOLTAGE

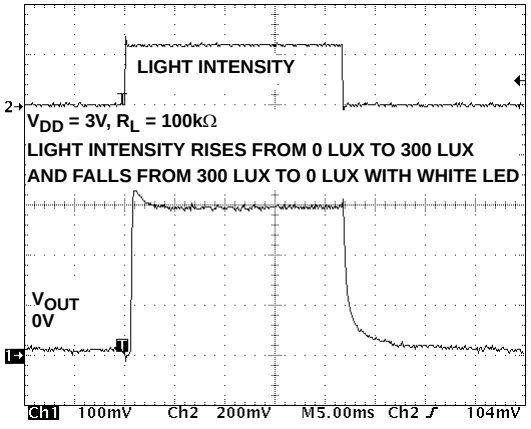



FIGURE 17. TRANSIENT RESPONSE OF ISL29009 TO CHANGE IN LIGHT INTENSITY

## Application Information

### Light-to-Current and Voltage Conversion

The ISL29009 has responsiveness that is a square-root function of the light intensity intercepted by the photodiode in lux. Because the photodiode has a responsivity that resembles the human eye, conversion rate is independent of the light source (fluorescent light, incandescent light or direct sunlight).

$$I_{OUT} = \frac{1.8\mu A}{\sqrt{100lux}}\sqrt{E} \quad \text{(EQ. 1)}$$

Here, $I_{OUT}$ is the output current in µA, and E is the input light in lux.

A load resistor $R_L$ is added to convert $I_{OUT}$ into $V_{OUT}$. The output voltage can be expressed in Equation 2:

$$V_{OUT} = I_{OUT} \times R_L = \frac{1.8\mu A}{\sqrt{100lux}}\sqrt{E} \times R_L \quad \text{(EQ. 2)}$$

Here, $V_{OUT}$ is the output voltage and $R_L$ is the value of the load resistor added. The compliance of the ISL29009's output circuit may result in premature saturation of the output current and voltage when an excessively large $R_L$ is used. The output compliance voltage is 200mV below the supply voltage as listed in $V_{O-MAX}$ of the “Electrical Specifications” table on page 2.

### Optical Sensor Location Outline

The green area in Figure 18 shows the optical sensor location outline of ISL29009. Along the pin-out direction, the center line (CL) of the sensor coincides with that of the packaging. The sensor width in this direction is 0.39mm. Perpendicular to the pin-out direction, the CL of the sensor has an 0.19mm offset from the CL of packaging away from pin-1. The sensor width in this direction is 0.46mm.

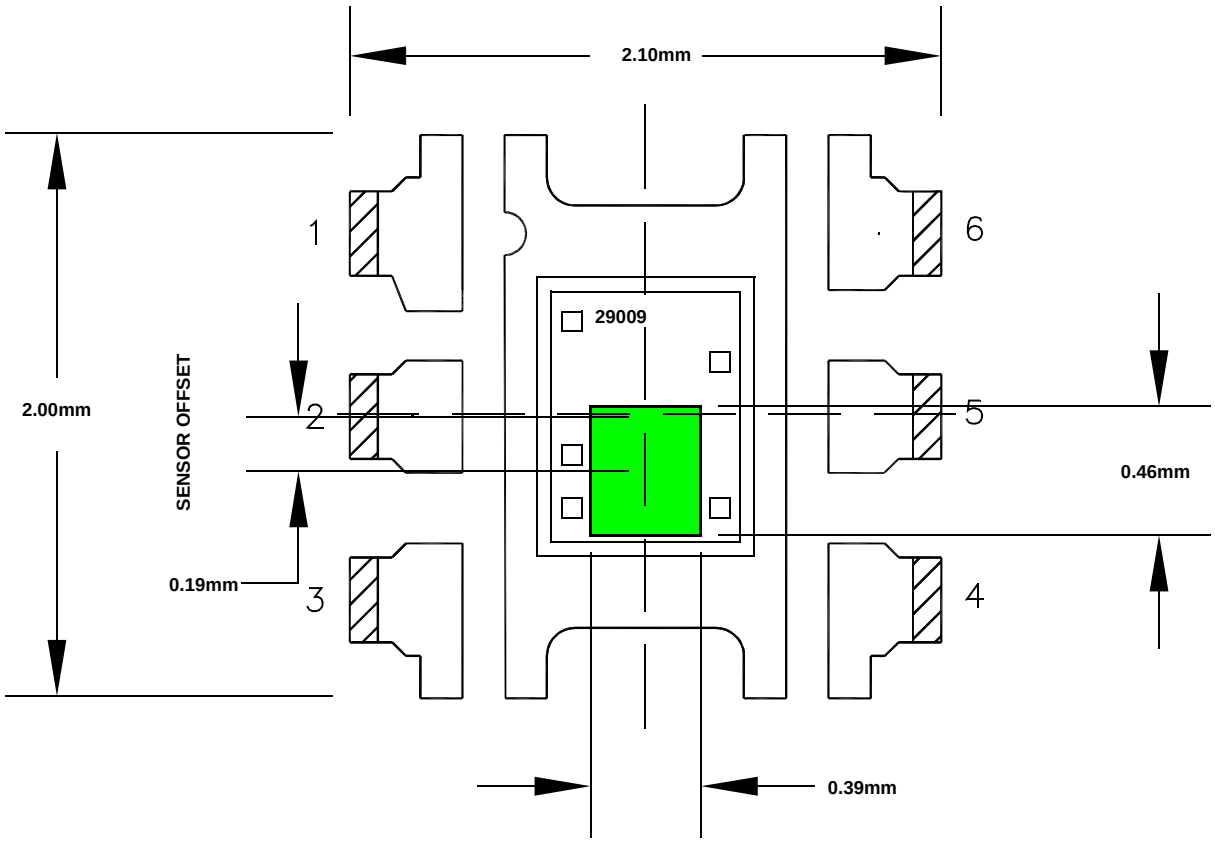



**FIGURE 18. 6 LD ODFN SENSOR LOCATION OUTLINE**

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Intersil Corporation’s quality certifications can be viewed at www.intersil.com/design/quality

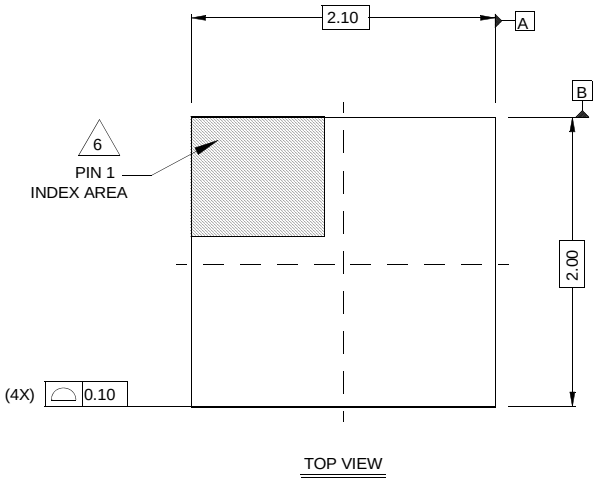
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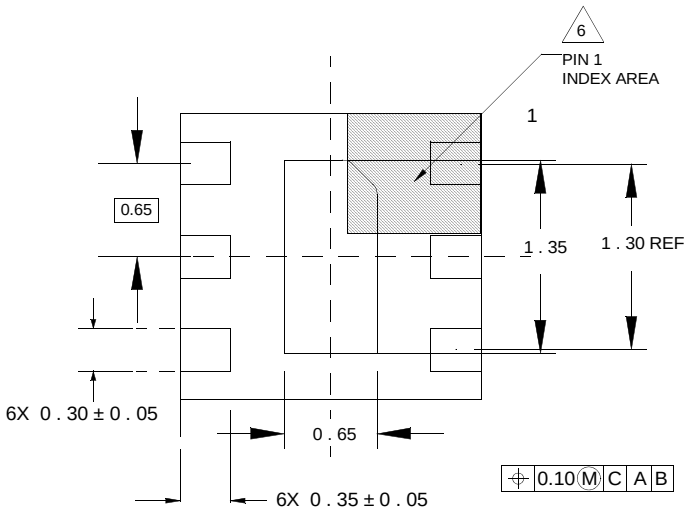
# Package Outline Drawing

## L6.2x2.1

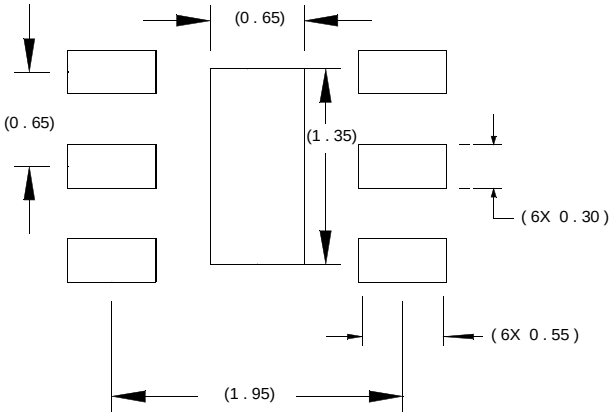
**6 LEAD OPTICAL DUAL FLAT NO-LEAD PLASTIC PACKAGE (ODFN)**
**Rev 0, 9/06**



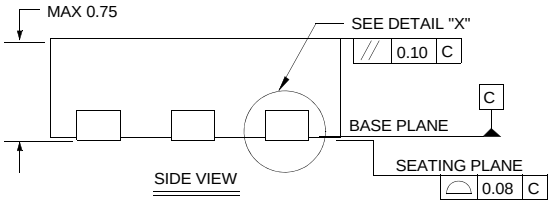

TOP VIEW



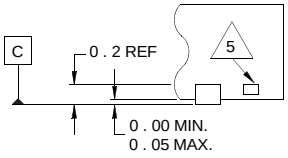

BOTTOM VIEW




TYPICAL RECOMMENDED LAND PATTERN




SIDE VIEW




DETAIL "X"

NOTES:

1. Dimensions are in millimeters.
   Dimensions in ( ) for Reference Only.
2. Dimensioning and tolerancing conform to AMSE Y14.5m-1994.
3. Unless otherwise specified, tolerance : Decimal ± 0.05
4. Dimension b applies to the metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip.
5. Tiebar shown (if present) is a non-functional feature.
6. The configuration of the pin #1 identifier is optional, but must be located within the zone indicated. The pin #1 identifier may be either a mold or mark feature.

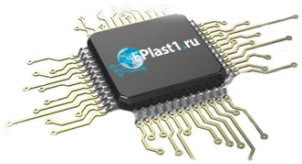
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Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
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- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.




**Как с нами связаться**

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