Low Power Ambient Light-to-Voltage Non-Linear Converter

The ISL29102 is a low cost light-to-voltage silicon optical sensor combining a photodiode array, a non-linear current amplifier and a micro-power op amp on a single monolithic IC. Similar to human eyes, the photodiode array has peak sensitivity at 550nm and spans from 400nm to 600nm, 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 minimizes the effect of temperature dependent leakage currents in the absence of light, improving the light sensity at low lux levels while maintaining excellent sensitivity at low lux levels. The built-in 1µA op amp gives the ISL29102 an output voltage driving advantage for heavier loads.

The ISL29102 is housed in an ultra compact 2mmx2.1mm ODFN plastic case surface mount package. Operation is rated from -40°C to +85°C.

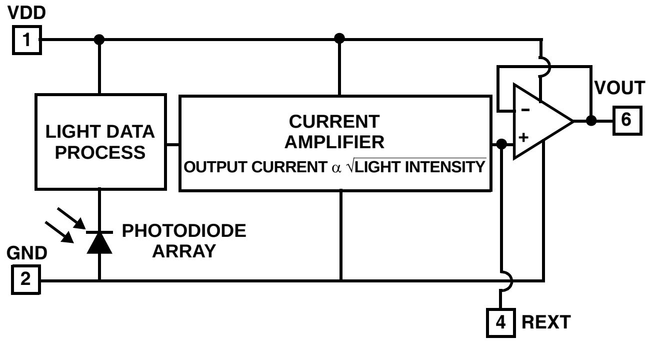
Ordering Information

PART NUMBER (Note 2)	PACKAGE (Pb-Free)	PKG. DWG. #
ISL29102IROZ-T7 (Note 1)	6 Ld ODFN Tape and Reel	L6.2x2.1
ISL29102IROZEVALZ	Evaluation Board	

NOTES:

1. Please refer to TB347 for details on reel specifications.
2. 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.

Simplified Block Diagram



Features

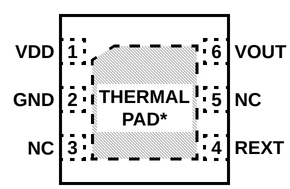
- Square Root Voltage Output
- 0.3 lux to 10,000 lux Range
- 1.8V to 3.3V Supply Range
- Close to Human Eye Spectral Response
- Fast Response Time
- Internal Temperature Compensation
- Good IR Rejection
- Low Supply Current
- Operating Temperature Range -40°C to +85°C
- 6 Ld ODFN: 2mmx2.1mmx0.7mm
- Pb-Free (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

ISL29102
(6 LD ODFN)
TOP VIEW



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

Pin Descriptions

PIN	NAME	DESCRIPTION
1	VDD	Supply (1.8V to 3.3V).
2	GND	Ground
3	NC	No connect
4	REXT	Connected to an external resistor to GND setting the light-to-voltage scaling constant.
5	NC	No connect
6	VOUT	Voltage Output.

Absolute Maximum Ratings (T_A = +25°C)

Supply Voltage Between V_{DD} and GND 3.6V
R_{EXT} . . . . (-0.5V + GND) to (0.5V + V_{DD})
V_{OUT} . . . . (-0.5V + GND) to (0.5V + V_{DD})
V_{OUT} Short Circuit Current . . . . <10mA
ESD Rating
Human Body Model 3kV
Machine Model. 300V

Thermal Information

Thermal Resistance θ_{JA} (°C/W)
6 Lead 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, R_{EXT} = 100kΩ, no load at V_{OUT}, green LED light, unless otherwise specified.

PARAMETER	DESCRIPTION	CONDITION	MIN	TYP	MAX	UNIT
E	Range of Input Light Intensity for Square root relationship to be held			0.3 - 10k		Lux
V_{DD}	Operating Supply Voltage		1.8		3.3	V
I_{DD}	Supply Current	E = 0 lux		0.65		µA
		E = 100 lux		3.5		µA
		E = 1,000 lux		10	15	µA
V_{OUT0}	Light-to-Voltage Accuracy	E = 100 lux		0.185		V
V_{OUT1}	Light-to-Voltage Accuracy	E = 1000 lux	0.460	0.580	0.680	V
V_{DARK}	Voltage Output in the absence of light	E = 0 lux, R_{EXT} = 10MΩ		20	50	mV
ΔV_{OUT}	Output Voltage Variation Over Three Light Sources: Fluorescent, Incandescent and Halogen			10		%
PSRR	Power Supply Rejection Ratio	E = 100 lux, V_{DD} = 1.8V to 3.6V		2.5		mV/V
V_{O-MAX}	Maximum Output Compliance voltage at 95% of nominal output			V_{DD} - 0.7V		V
t_R	Rise Time	E = 0 lux to 300 lux		68		µs
		E = 0 lux to 1000 lux		68		µs
t_F	Fall Time	E = 300 lux to 0 lux		1830		µs
		E = 1000 lux to 0 lux		970		us
t_D	Delay Time for Rising Edge	E = 0 lux to 300 lux,		352		µs
		E = 0 lux to 1000 lux		145		µs
t_S	Delay Time for Falling Edge	E = 300 lux to 0 lux		22		µs
		E = 1000 lux to 0 lux		22		µs
ISC	Short Circuit Current of Op Amp			±11		mA
SR	Slew Rate of Op Amp			±10		V/ms
VOS	Offset Voltage of Op Amp			±1.2		mV

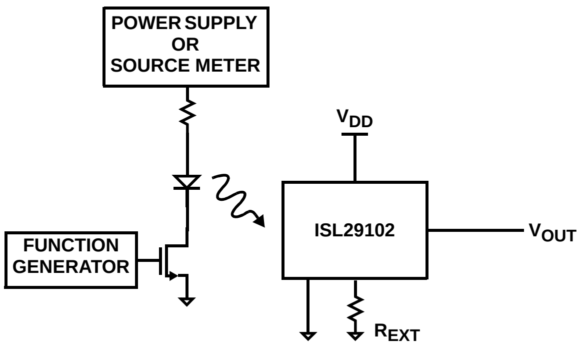


FIGURE 1. TEST CIRCUIT FOR RISE/FALL TIME MEASUREMENT

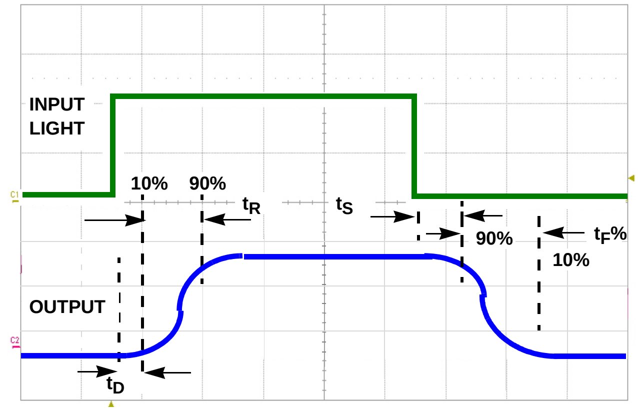


FIGURE 2. TIMING DIAGRAM

Typical Performance Curves

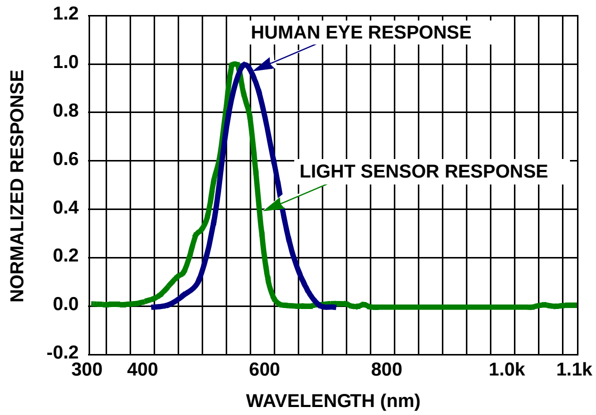


FIGURE 3. SPECTRAL RESPONSE

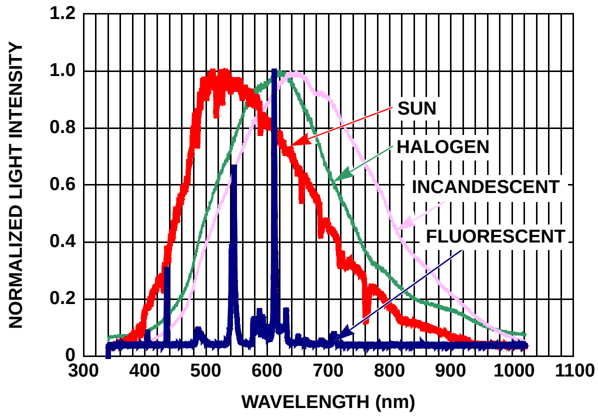


FIGURE 4. SPECTRUM OF LIGHT SOURCES

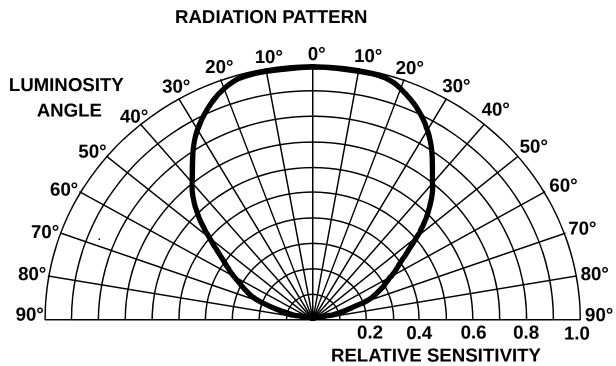


FIGURE 5. RADIATION PATTERN

Typical Performance Curves (Continued)

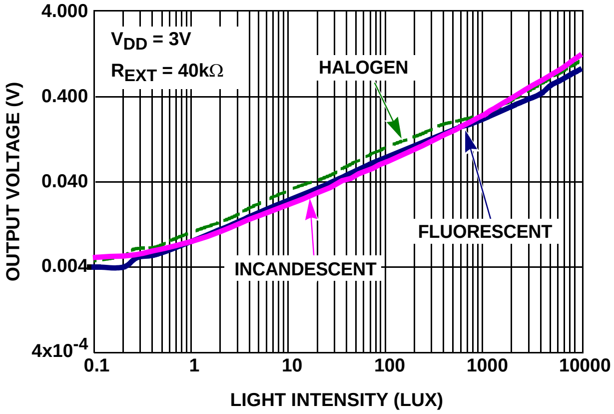


FIGURE 6. OUTPUT VOLTAGE vs LIGHT INTENSITY

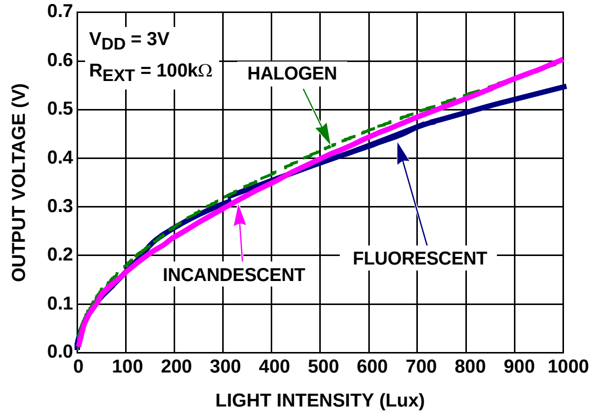


FIGURE 7. OUTPUT VOLTAGE vs LIGHT INTENSITY

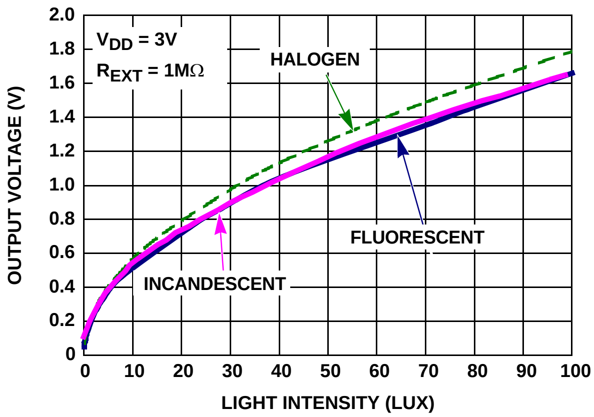


FIGURE 8. OUTPUT VOLTAGE vs LIGHT INTENSITY

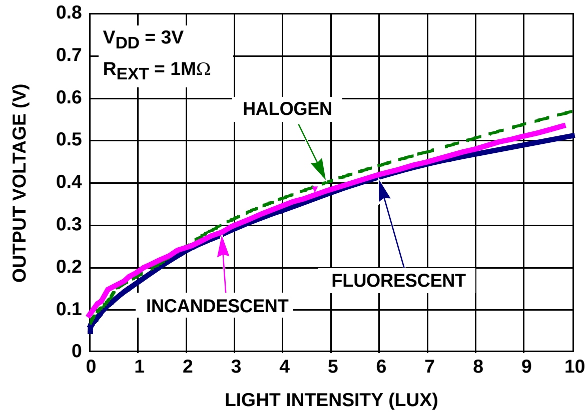


FIGURE 9. OUTPUT VOLTAGE vs LIGHT INTENSITY

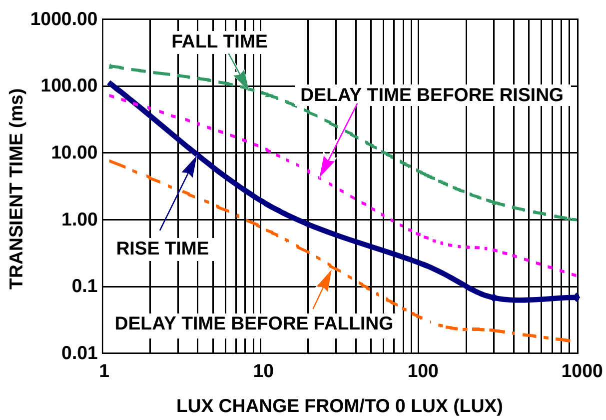


FIGURE 10. TRANSIENT TIME vs LUX CHANGE FROM/TO 0 LUX

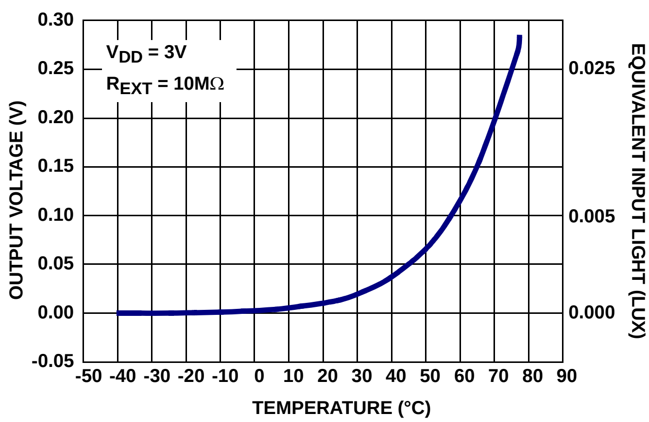


FIGURE 11. OUTPUT VOLTAGE vs TEMPERATURE AT 0 LUX

Typical Performance Curves (Continued)

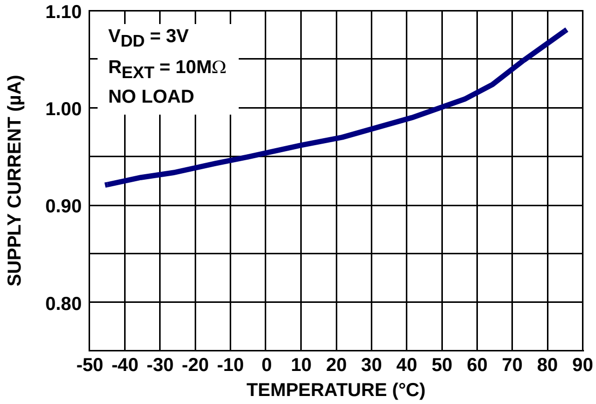


FIGURE 12. SUPPLY CURRENT vs TEMPERATURE AT 0 LUX

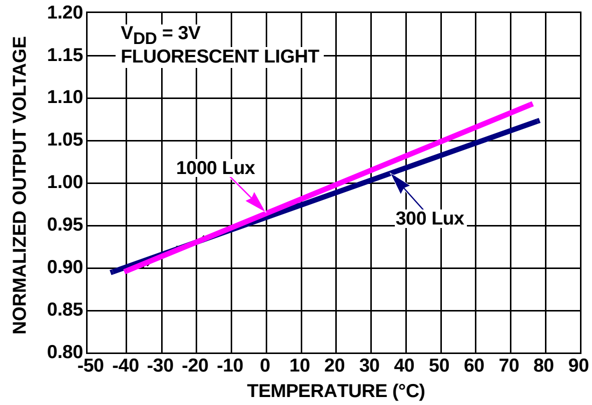


FIGURE 13. NORMALIZED OUTPUT VOLTAGE vs TEMPERATURE

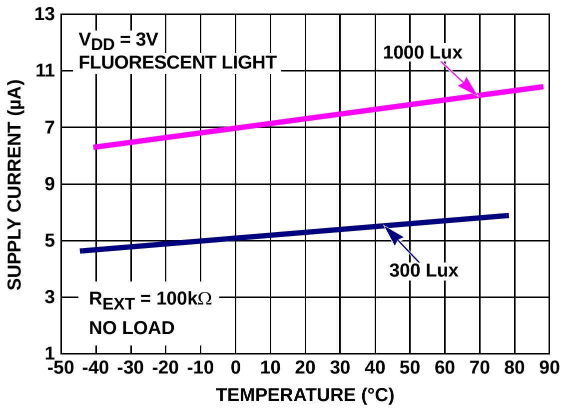


FIGURE 14. SUPPLY CURRENT vs TEMPERATURE

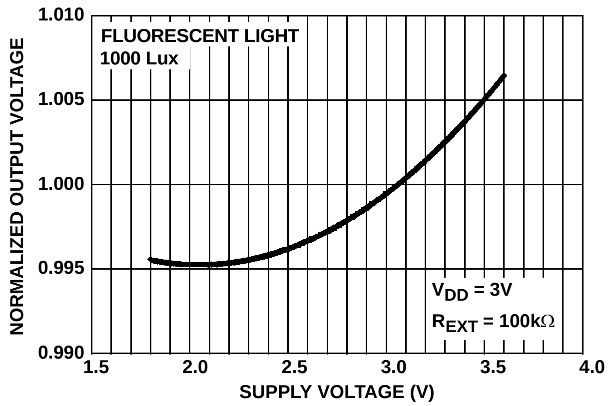


FIGURE 15. NORMALIZED OUTPUT VOLTAGE vs SUPPLY VOLTAGE

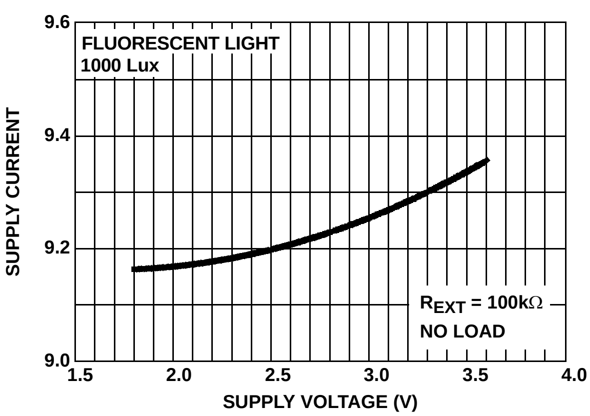


FIGURE 16. SUPPLY CURRENT vs SUPPLY VOLTAGE

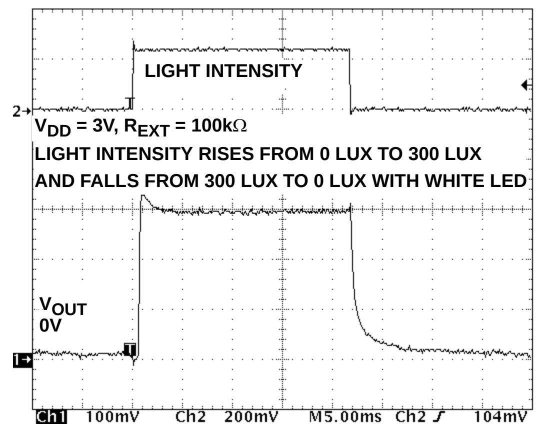


FIGURE 17. TRANSIENT RESPONSE OF ISL29102 TO CHANGE IN LIGHT INTENSITY

Application Information

Light-to-Voltage Conversion

The ISL29102 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).

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

In Equation 1, V_{OUT} is the output voltage, E is the light intensity and R_{EXT} is the value of the external resistor. The R_{EXT} is used to set the light-to-voltage scaling constant. The compliance of the ISL29102's output circuit may result in premature saturation when an excessively large R_{EXT} is used. The output compliance voltage is 700mV 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 ISL29102. 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.

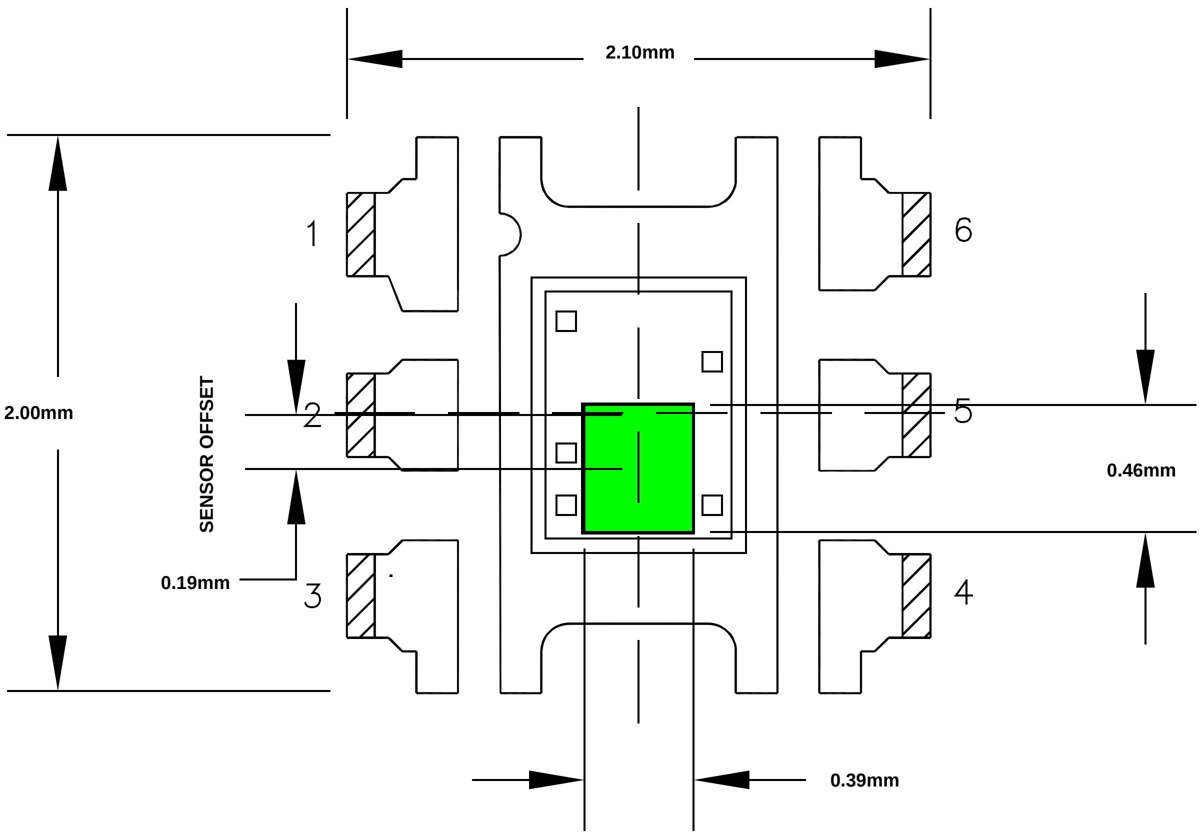


FIGURE 18. 6 LD ODFN SENSOR LOCATION OUTLINE

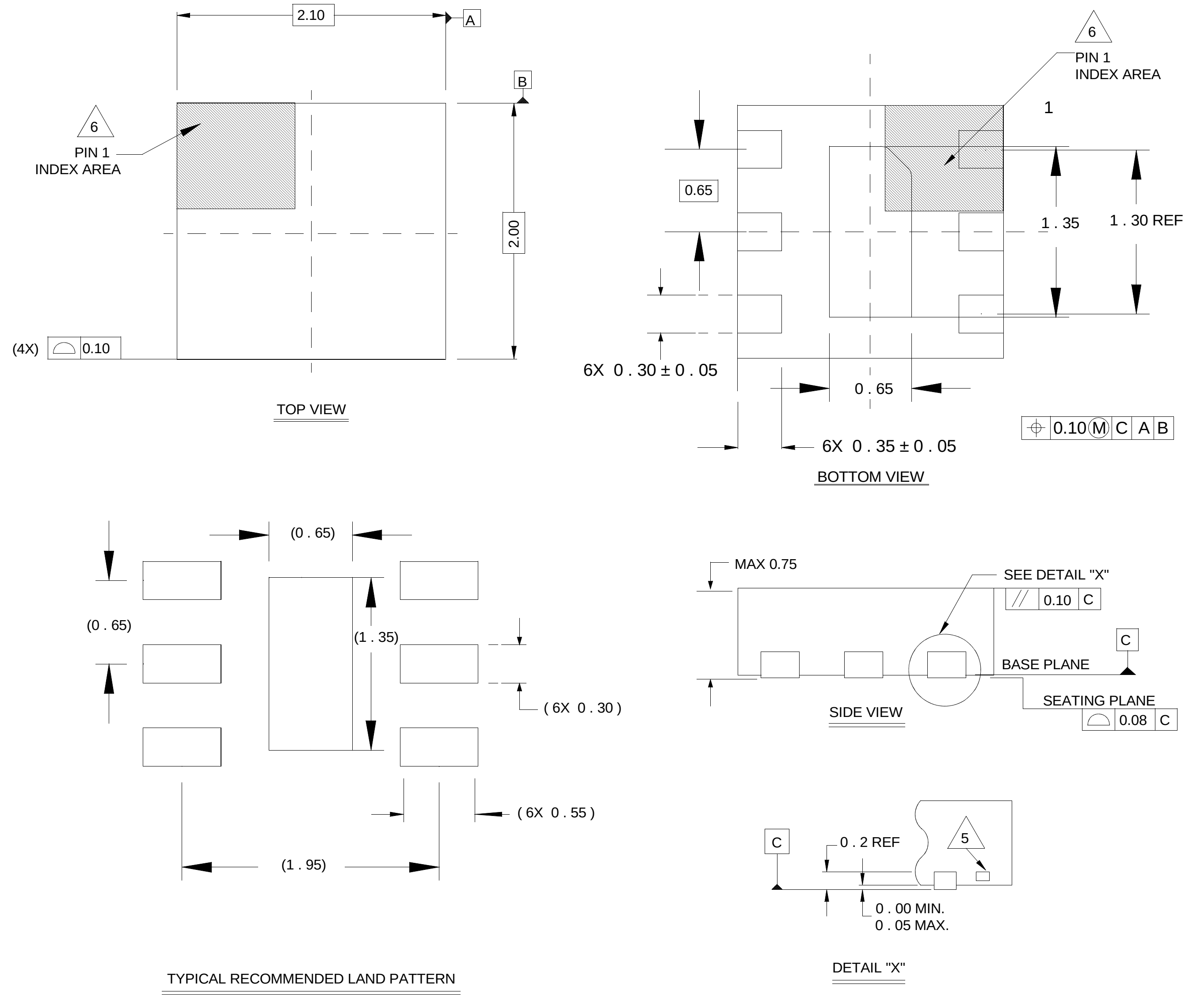
All Intersil U.S. products are manufactured, assembled and tested utilizing ISO9000 quality systems.
Intersil Corporation’s quality certifications can be viewed at www.intersil.com/design/quality

For information regarding Intersil Corporation and its products, see www.intersil.com

Package Outline Drawing

L6.2x2.1

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



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.