**DESCRIPTION**

The LX1971 is a new technology light sensor with spectral response that emulates the human eye; it is pin to pin compatible to Microsemi’s LX1970 visible light sensor however with a wider dynamic range.

This device is ideal for monitoring ambient light for the control of artificial lighting, operation of shades, LED signage and display, street lighting, automotive light sensors and control of backlight dimming. It has a unique photo diode arrangement (patents pending) with a peak response at 520nm while sharply attenuating both ultra violet and infrared wavelengths.

The photo sensor is a PIN diode array with an accurate and very repeatable current output.

**IMPORTANT:** For the most current data, consult MICROSEMI’s website: [http://www.microsemi.com](http://www.microsemi.com)

Protected By U.S. Patents: 6,787,757; Patents Pending

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**KEY FEATURES**

- Approximate Human Eye Spectral Response
- Low IR Sensitivity
- Highly Accurate & Repeatable Output Current vs. Light
- Square root transfer function
- Temperature Stable
- Integrated High Gain Photo Current Amplifiers
- Complementary Current Outputs
- No Optical Filters Needed

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**BENIFITS**

- Requires no wavelength filters
- Insensitive to UV and IR
- More than 4 decades usable light range
- Enables accurate lighting control systems

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**PRODUCT HIGHLIGHT**

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**PACKAGE ORDER INFO**

<table>
<thead>
<tr>
<th>T&lt;sub&gt;A&lt;/sub&gt; (°C)</th>
<th>DU</th>
<th>Plastic MSOP 8-Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40 to 85</td>
<td>LX1971IDU</td>
<td>RoHS Compliant / Pb-free</td>
</tr>
</tbody>
</table>

Note: Available in Tape & Reel. Append the letters "TR" to the part number. (i.e. LX1971IDU-TR)
**LX1971**

**Wide Range Visible Light Sensor**

**PRODUCTION DATA SHEET**

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### ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD (Input Supply Voltage)</td>
<td>-0.3 to 6 V DC</td>
</tr>
<tr>
<td>SNK/SRC (Output Compliance Voltage)</td>
<td>-0.3 to VDD + 0.3V DC</td>
</tr>
<tr>
<td>SNK/SRC (Maximum Output Current)</td>
<td>Internally Limited</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-40 to +85°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-40 to +100°C</td>
</tr>
<tr>
<td>Solder Reflow Peak Temperature (Soldering 10 seconds)</td>
<td>240°C</td>
</tr>
</tbody>
</table>

**Notes:** Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of specified terminal.

Solder reflow to follow: IPC/JEDEC J-STD-020B 7/02 Pb-SN Small Body Profile

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### THERMAL DATA

**DU Plastic MSOP 8-Pin**

<table>
<thead>
<tr>
<th>Thermal Resistance-Junction to Ambient, θJA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DU Package</td>
<td>206°C/W</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Resistance-Junction to Case, θJC</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>DU Package</td>
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### FUNCTIONAL PIN DESCRIPTION

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>VDD</td>
<td>Input Supply Voltage</td>
</tr>
<tr>
<td>VSS</td>
<td>Ground Reference for Power and Signal Output</td>
</tr>
<tr>
<td>SNK</td>
<td>Output Current Sink</td>
</tr>
<tr>
<td>SRC</td>
<td>Output Current Source</td>
</tr>
</tbody>
</table>

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### SIMPLIFIED BLOCK DIAGRAM

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### PACKAGE PIN OUT

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD</td>
</tr>
<tr>
<td>2</td>
<td>NC</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
</tr>
<tr>
<td>4</td>
<td>SRC</td>
</tr>
<tr>
<td>5</td>
<td>SNK</td>
</tr>
<tr>
<td>6</td>
<td>VSS</td>
</tr>
<tr>
<td>7</td>
<td>NC</td>
</tr>
<tr>
<td>8</td>
<td>VSS</td>
</tr>
</tbody>
</table>

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### PACKAGE PHOTO

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APPLICATION EXAMPLES

The following examples present both fully automatic (no user input) and semi-automatic, to fully manual override implementations. These general guidelines are applicable to a wide variety of potential light control applications. The LX1971 can be used for the control of artificial lighting, operation of shades, LED signage and display, street lighting, automotive light sensors and control of backlight dimming.

In each specific application it is important to recognize the need to correlate the sink and source current of the LX1971 for the target environment and its ambient light conditions. The mechanical mounting of the sensor, light aperture hole size, use of a light pipe or bezel are critical in determining the response of the LX1971 for a given exposure of light.

The example in figure one shows a fully automatic lighting control solution with no user interaction. Choose R1 and R2 values for any desired minimum brightness and slope. Choose C1 to adjust response time. As an example, let’s say 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 represent the maximum. The first step would be to determine the ratio of R1 and R2.

\[
R1 = R2 \times \frac{3.0 \text{V}}{0.25 \text{V} - 1} = 11 \times R2
\]

Next the value of R2 can be calculated based on the maximum output source current coming from the LX1971 under the application’s maximum light exposure, lets say this has been determined to be about 50µA. Thus R2 can be calculated first order as follows:

\[
R2 = \frac{1.25 \text{V}}{50 \mu\text{A}} = 25\text{KΩ} \quad \therefore R1 = 11 \times R2 = 275\text{KΩ}
\]

The output node will actually reach 1.25V when the source current from the LX1971 is only about 44µA since about 6µA of current will be contributed from R1.

We are assuming a high impedance input to the LED driver. In Figure 2 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 limited range. The PWM input source could of course be replaced with an equivalent DC voltage.

The preceding examples represent just a few of the many ways the sensor can be used. For example since there is also a complimentary sink output a resistor from VDD to SNK could develop a voltage that could be compared (with some hysteresis) to a fixed (or adjustable) reference voltage and develop a logic signal. In the case of street lighting or operation of shades such a signal would engage the function when reaching the correct ambient light level.

Figure 3 shows how a fully manual override can be quickly added to the example in figure 2. In addition to the gate to turn on and off the LX1971, a diode has been inserted to isolate the LX1971 when it is shut down.

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**RESPONSE VS WAVELENGTH**

- **Human Eye**
- **LX1971 Range**

**I_{SRC} STEP RESPONSE**

- $V_{DD} = 3.0V$; $R_{SRC} = 25K & 4.7uF$

**LINE REGULATION**

- $V_{DD} = 3.5V$; $R_{SRC} = 25K & 4.7uF$

**DARK CURRENT VS TEMP**

- $R_{SRC} = 25K & 4.7uF$

**SNK OUTPUT PSRR**

- $V_{DD} = 3.0V$; $R_{SNK} = 25K & 4.7uF$

**GAIN VS TEMP**

- $y = 1.35E-03x + 9.64E-01$
- $V_{DD} = 3.0V$ Direct Light Input of 13.14µW/cm²
**LX1971**

**Wide Range Visible Light Sensor**

**PRODUCTION DATA SHEET**

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### SNK COMPLIANCE VS CURRENT

![SNK Compliance Graph](image1)

- **SNK compliance Voltage (V):** 0.1 to 0.5 V
- **Output Current (µA):** 20 to 120 µA

\[ V_{DD} = 3.0\, \text{V}; R_{SNK} = 25\, \text{K} & 4.7\, \mu\text{F} \]

### SRC COMPLIANCE VS CURRENT

![SRC Compliance Graph](image2)

- **Source Compliance Voltage (VDD-SRC):** 0.1 to 0.8 V
- **Output Current (µA):** 20 to 100 µA

\[ V_{DD} = 3.0\, \text{V}; R_{SRC} = 25\, \text{K} & 4.7\, \mu\text{F} \]

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### SRC OUTPUT VS LUMINANCE (LUX)

**Incandescent**

![SRC Output Graph](image3)

- **Luminance (lux):** 0 to 18000 lux
- **SRC (µA):** 0 to 160 µA

\[ V_{DD} = 4.0\, \text{V}; R_{SNK} = 10\, \text{K} & 4.7\, \mu\text{F} \]

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### SRC OUTPUT VS LUMINANCE (LUX)

![SRC Output Graph](image4)

- **Luminance (lux):** 0 to 2500 lux
- **SRC (µA):** 0 to 50 µA

\[ V_{DD} = 4.0\, \text{V}; R_{SNK} = 10\, \text{K} & 4.7\, \mu\text{F} \]
**PACKAGE DIMENSIONS**

**DU** 8-Pin Miniature Shrink Outline Package (MSOP)

<table>
<thead>
<tr>
<th>Dim</th>
<th>MILLIMETERS</th>
<th>INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.10</td>
<td>0.043</td>
</tr>
<tr>
<td>A1</td>
<td>0.05 0.15</td>
<td>0.002 0.006</td>
</tr>
<tr>
<td>b</td>
<td>0.26 0.41</td>
<td>0.010 0.016</td>
</tr>
<tr>
<td>c</td>
<td>0.13 0.23</td>
<td>0.005 0.009</td>
</tr>
<tr>
<td>D</td>
<td>2.90 3.10</td>
<td>0.114 0.122</td>
</tr>
<tr>
<td>e</td>
<td>0.65 BSC</td>
<td>0.025 BSC</td>
</tr>
<tr>
<td>E</td>
<td>4.75 5.05</td>
<td>0.187 0.198</td>
</tr>
<tr>
<td>E1</td>
<td>2.90 3.10</td>
<td>0.114 0.122</td>
</tr>
<tr>
<td>L</td>
<td>0.41 0.71</td>
<td>0.016 0.028</td>
</tr>
<tr>
<td>L1</td>
<td>0.95 BSC</td>
<td>0.037 BSC</td>
</tr>
<tr>
<td>S</td>
<td>0.525 BSC</td>
<td>0.021 BSC</td>
</tr>
<tr>
<td>Θ</td>
<td>3°</td>
<td>3°</td>
</tr>
</tbody>
</table>

**Recommended light footprint pattern**

Note:

P1 represents a possible light footprint and its dimensions are not subject to strict tolerances. Only the active area of the device is required to be covered with light. This larger footprint is designed to ensure coverage of the device’s active area.