

# Photologic Hermetic Sensors

OPL800, OPL800-OC, OPL801, OPL801-OC, OPL810, OPL810-OC, OPL811, OPL811-OC, OPL812-OC, OPL813-OC, OPL820, OPL820-OC, OPL821-OC



## Features:

- Four output options available
- High noise immunity
- Direct TTL/LSTTL interface
- TO-18 hermetically sealed package
- Sensors mechanically and spectrally matched to other Optek devices (see device descriptions detailed below)

## Description:

All **OPL800**, **OPL801**, **OPL820** and **OPL821** sensors consist of a photodiode, a linear amplifier and a Schmitt trigger on a single silicon chip (monolithic chip for **OPL820** and **OPL821**). **OPL810**, **OPL811**, **OPL812** and **OPL813** sensors also have a voltage regulator added to their photologic chips. Each device's photologic chip is mounted onto a standard TO-18 header and hermetically sealed in a lensed metal can.

All devices in the series feature TTL/LSTTL compatible logic level output, which can drive up to 8 TTL loads (**OPL800**, **OPL801**) or up to 10 TTL loads (**OPL810**, **OPL811**, **OPL812**, **OPL813**, **OPL820** and **OPL821**) without additional circuitry. On all these devices, the Schmitt trigger's hysteresis characteristics provide high immunity to noise on input and  $V_{CC}$ .

**OPL800** series devices feature medium-speed data rates to 250 kBaud, with typical rise and fall times of 25 nanoseconds.

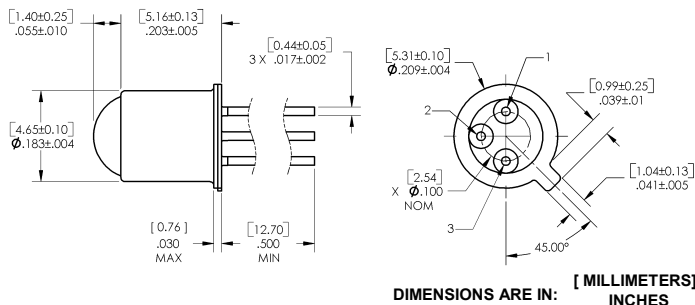
*OPL800 and OPL801 devices are mechanically and spectrally matched to OP130 and OP231 series LEDs. OPL810, OPL811, OPL812 and OPL813 devices are mechanically and spectrally matched to OP130 and OP230 series devices. OPL820 and OPL821 devices are mechanically and spectrally matched to OP130 and OP231 series LEDs.*

## Applications:

- Non-contact reflective object sensor
- Assembly line automation
- Machine automation
- Machine safety
- End of travel sensor
- Door sensor

| Pin # | OPL80_ or OPL81_ | OPL82_   | Transistor |
|-------|------------------|----------|------------|
| 1     | Ground           | Ground   | Collector  |
| 2     | $V_{CC}$         | Output   | Base       |
| 3     | Output           | $V_{CC}$ | Emitter    |

## Mounted to TO-18 Base



RoHS

## General Note

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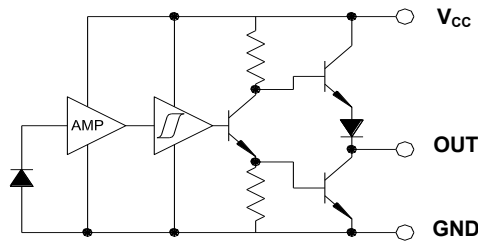
OPL800, OPL800-OC, OPL801, OPL801-OC, OPL810,  
 OPL810-OC, OPL811, OPL811-OC, OPL812-OC, OPL813-  
 OC, OPL820, OPL820-OC, OPL821-OC



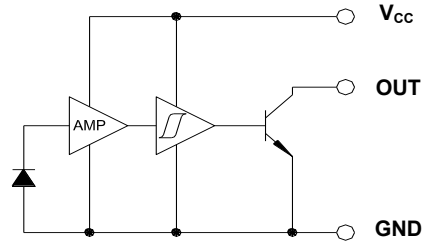
| Ordering Information |                     |  |                           |                   |             |
|----------------------|---------------------|--|---------------------------|-------------------|-------------|
| Part Number          | Photologic®         | Input Power $E_E$<br>( $\mu\text{W}/\text{cm}^2$ ) Min / Max | $V_{CC}$ (V)<br>Min / Max | $I_{OH} / I_{OL}$ | Lead Length |
| OPL800               | Totem-Pole          | 50 / 600   | 4.5 / 16.0                | 0.10 / 12.8       | 0.50"       |
| OPL800-OC            | Open-Collector      |  |                           |                   |             |
| OPL801               | Inv-Totem-Pole      |  |                           |                   |             |
| OPL801-OC            | Inv-Open-Collector  |  |                           |                   |             |
| OPL810               | Totem-Pole          | 5 / 100  | 4.5 / 16.0                | 0.10 / 16.0       |             |
| OPL810-OC            | Open-Collector      |  |                           |                   |             |
| OPL811               | Inv-Totem-Pole      |  |                           |                   |             |
| OPL811-OC            | Inv-Open-Collector  |  |                           |                   |             |
| OPL812-OC            | Open-Collector      |  |                           |                   |             |
| OPL813-OC            | Inv-Open-Collector  | 2 / 35   |                           |                   |             |
| OPL820               | 10K Pull-Up         |  |                           |                   |             |
| OPL820-OC            | Open Collector      |  |                           |                   |             |
| OPL821-OC            | Inv. Open Collector |  |                           |                   |             |

**OPL800, OPL800OC, OPL801, OPL801-OC, OPL810, OPL810-OC,  
 OPL811, OPL811-OC, OPL812-OC, OPL813-OC, OPL820-OC, OPL821-OC**

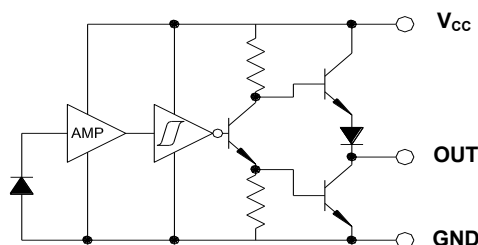
**OPL800/800B/810 Buffered Totem-Pole**



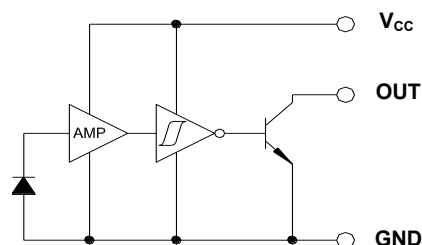
**OPL800-OC/810-OC/812-OC/820/OC Open-Collector**



**OPL801/811 Inverted Totem-Pole**



**OPL801-OC/811-OC/813-OC/821-OC Inverted Open-Collector**



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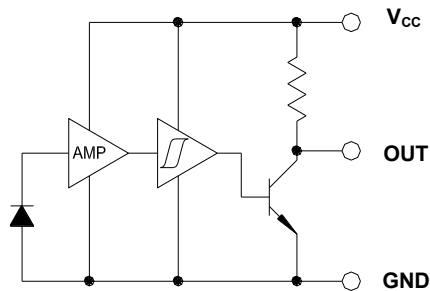
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## OPL820

### OPL820 10K Pull-Up



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 OC, OPL820, OPL820-OC, OPL821-OC



## Electrical Specifications

**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)  
**OPB800/801/810/811 and OPB800-OC Series**

| Input Diode  |  |
|--|--|
| Operating Temperature Range<br>OPL800, OPL801<br>OPL810, OPL811<br>OPL820                                    | -55° C to +110° C<br>-55° C to +105° C<br>-40° C to +100° C          |
| Storage Temperature Range<br>OPL800, OPL801<br>OPL810, OPL811<br>OPL820                                      | -65° C to +150° C<br>-65° C to +125° C<br>-55° C to +125° C          |
| Lead Soldering Temperature [1/16 inch (1.6mm) from the case for 5 sec. with soldering iron]                  | 260°C <sup>(1)</sup>   |
| Input Infrared LED   |  |
| Supply Voltage, $V_{CC}$ (not to exceed 3 seconds)<br>OPL800, OPL801<br>OPL810, OPL811, OPL820               | 10 V<br>18 V   |
| Sourcing Current<br>OPL810, OPL811   | 10 mA  |
| Output Voltage (high state)<br>OPL800, OPL801, OPL810, OPL811<br>OPL820                                      | 35 V<br>30 V   |
| Output Current Sink (low state)<br>OPL810, OPL811<br>OPL820  | 50 mA<br>16 mA   |
| Irradiance<br>OPL800, OPL801<br>OPL810, OPL810-OC, OPL811, OPL811-OC<br>OPL812, OPL812-OC, OPL813, OPL813-OC | 3 mW/cm <sup>2</sup><br>2 mW/cm <sup>2</sup><br>1 mW/cm <sup>2</sup> |

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OC, OPL820, OPL820-OC, OPL821-OC



## Electrical Specifications

### Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ unless otherwise noted) OPB800/801/810/811/812/813 and OPB800-OC Series

| Output Photologic®   |   |
|--|---|
| Voltage at Output Lead<br>OPL800, OPL801, OPL810, OPL811<br>OPL820 | 35 V<br>30 V  |
| Duration of Output Short to $V_{CC}$                               | 1 second  |
| Power Dissipation<br>OPL800, OPL801<br>OPL810, OPL811<br>OPL820    | 120 mW <sup>(2)</sup><br>250 mW <sup>(2)</sup><br>200 mW <sup>(2)</sup> |

#### Notes:

- (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering. For OPB820, a maximum of 20 grams force may be applied to leads while at soldering temperatures.
- (2) Derate linearly 2.5 mW/°C above 25° C for OPL800, OPL801, OPL810, OPL811. Derate linearly 5.7 mW/°C above 90° C for OPL820.
- (3) For OPL800, OPL801, OPL810, OPL811, light measurements are made with  $\lambda_i = 935\text{ nm}$ . For OPB820, light measurements are made with an LED source having a wavelength of 935 nm.

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OPL810-OC, OPL811, OPL811-OC, OPL812-OC, OPL813-  
OC, OPL820, OPL820-OC, OPL821-OC



## Electrical Specifications

| Electrical Characteristics (T <sub>A</sub> = 25° C unless otherwise noted) |   |       |       |       |                          |  |
|--|---|-------|-------|-------|--------------------------|--|
| SYMBOL   | PARAMETER   | MIN   | TYP   | MAX   | UNITS                    | TEST CONDITIONS                            |
| V <sub>CC</sub>  | Operating Supply Voltage  |       |       |       |                          |  |
|  | OPL800/801  | 4.5   | -     | 5.5   | V                        | -  |
|  | OPL810/811  | 4.5   | -     | 16    | V                        | -  |
|  | OP820   | 4.5   | -     | 16    | V                        | -  |
| V <sub>CC</sub>  | Peak-to-Peak V <sub>CC</sub> Ripple Necessary to Cause False Triggering of Output |       |       |       |                          |  |
|  | OPL800/801  | -     | 2     | -     | V                        | f = DC to 50 MHz                           |
|  | OPL810/811  | -     | -     | 1     | V                        | f = DC to 50 MHz                           |
| I <sub>CC</sub>  | Supply Current  | -     | -     | 15    | mA                       | E <sub>e</sub> = 0 or 1 mW/cm <sup>2</sup> |
| E <sub>eT</sub> <sup>(+)</sup>   | Positive-Going Threshold Irradiance <sup>(3)</sup>                                |       |       |       |                          |  |
|  | OPL800/801  | 0.050 | 0.180 | 0.600 | mW/cm <sup>2</sup>       | T <sub>A</sub> = 25°C                      |
|  | OPL810/811  | 0.015 | 0.060 | 0.200 | mW/cm <sup>2</sup>       | T <sub>A</sub> = 25°C                      |
|  | OPL820  | 0.002 | 0.015 | 0.035 | mW/cm <sup>2</sup>       | See below <sup>(3)</sup>                   |
| E <sub>eT</sub> <sup>(+)</sup> /E <sub>eT</sub> <sup>(-)</sup>             | Hysteresis Ratio  |       |       |       |                          |  |
|  | OPL800/801  | 1.5   | 2.0   | 2.5   | -                        | -  |
|  | OPL810/811  | 1.2   | 1.5   | 2.0   | -                        | -  |
| E <sub>e</sub> <sup>(+)</sup> /E <sub>e</sub> <sup>(-)</sup>               | Hysteresis Ratio  |       |       |       |                          |  |
| OPL820   | 1.05  | 1.20  | 1.90  | -     | See below <sup>(3)</sup> |  |
| I <sub>CCH</sub>   | High State Supply Current   |       |       |       |                          |  |
| OPL820   | -   | 5     | 12    | mA    | See below <sup>(4)</sup> |  |
| I <sub>CCL</sub>   | Low State Supply Current  |       |       |       |                          |  |
| OPL820   | -   | 4     | 12    | mA    | See below <sup>(5)</sup> |  |

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OC, OPL820, OPL820-OC, OPL821-OC



## Electrical Specifications

| Electrical Characteristics ( $T_A = 25^\circ\text{C}$ unless otherwise noted) |                           |              |          |     |                                    |   |
|---|---------------------------|--------------|----------|-----|------------------------------------|---|
| SYMBOL  | PARAMETER                 | MIN          | TYP      | MAX | UNITS                              | TEST CONDITIONS   |
| $V_{OH}$  | High Level Output Voltage |              |          |     |                                    |   |
|   | OPL800                    | 2.4          | -        | -   | V                                  | $I_{OH} = -800\ \mu\text{A}$ , $E_e = 1\ \text{mW}/\text{cm}^2$ |
|   | OPL801                    | 2.4          | -        | -   | V                                  | $I_{OH} = -800\ \mu\text{A}$ , $E_e = 0$                        |
|   | OPL810                    | $V_{CC}-2.1$ | -        | -   | V                                  | $I_{OH} = -1\text{mA}$ , $E_e = 0.4\ \text{mW}/\text{cm}^2$     |
|   | OPL811                    | $V_{CC}-2.1$ | -        | -   | V                                  | $I_{OH} = -1\text{mA}$ , $E_e = 0$                              |
| OPL820-OC/821-OC  | $V_{CC}-1.5$              | -            | $V_{CC}$ | V   | $I_{OH} = -100\ \mu\text{A}^{(4)}$ |   |

### Notes:

- (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering. For OPL820, a maximum of 20 grams force may be applied to leads while at soldering temperatures.
- (2) Derate linearly  $2.5\ \text{mW}/^\circ\text{C}$  above  $25^\circ\text{C}$  for OPL800, OPL801, OPL810, OPL811. Derate linearly  $5.7\ \text{mW}/^\circ\text{C}$  above  $90^\circ\text{C}$  for OPL820.
- (3) For OPL800, OPL801, OPL810, OPL811, light measurements are made with  $\lambda_i = 935\ \text{nm}$ . For OPL820, light measurements are made with an LED source having a wavelength of  $935\ \text{nm}$ .
- (4) High output state limits are valid for  $4.5\ \text{V} < V_{CC} < 16\ \text{V}$  and  $E_e > 0.035\ \text{mW}/\text{cm}^2$  (OPL820, OPL820-OC),  $E_e < 0.001\ \text{mW}/\text{cm}^2$  (OPL821-OC).
- (5) Low output state limits are valid for  $4.5\ \text{V} < V_{CC} < 16\ \text{V}$  and  $E_e > 0.035\ \text{mW}/\text{cm}^2$  (OPL821-OC),  $E_e < 0.001\ \text{mW}/\text{cm}^2$  (OPL820, OPL820-OC).

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OC, OPL820, OPL820-OC, OPL821-OC



## Electrical Specifications

| Electrical Characteristics (T <sub>A</sub> = 25° C unless otherwise noted) |                              |                      |     |                 |       |  |
|--|------------------------------|----------------------|-----|-----------------|-------|--|
| SYMBOL   | PARAMETER                    | MIN                  | TYP | MAX             | UNITS | TEST CONDITIONS  |
| V <sub>OH</sub>  | High Level Output Voltage    |                      |     |                 |       |  |
|  | OPL800                       | 2.4                  | -   | -               | V     | I <sub>OH</sub> = -800 μA, E <sub>e</sub> = 1 mW/cm <sup>2</sup> |
|  | OPL801                       | 2.4                  | -   | -               | V     | I <sub>OH</sub> = -800 μA, E <sub>e</sub> = 0                    |
|  | OPL810                       | V <sub>CC</sub> -2.1 | -   | -               | V     | I <sub>OH</sub> = -1mA, E <sub>e</sub> = 0.4 mW/cm <sup>2</sup>  |
|  | OPL811                       | V <sub>CC</sub> -2.1 | -   | -               | V     | I <sub>OH</sub> = -1mA, E <sub>e</sub> = 0                       |
|  | OPL820-OC/821-OC             | V <sub>CC</sub> -1.5 | -   | V <sub>CC</sub> | V     | I <sub>OH</sub> = -100 μA <sup>(4)</sup>                         |
| V <sub>OL</sub>  | Low Level Output Voltage     |                      |     |                 |       |  |
|  | OPL800/800-OC                | -                    | -   | 0.4             | V     | I <sub>OL</sub> = 12.8 mA, E <sub>e</sub> = 0                    |
|  | OPL801/801-OC                | -                    | -   | 0.4             | V     | I <sub>OL</sub> = 12.8 mA, E <sub>e</sub> = 1 mW/cm <sup>2</sup> |
|  | OPL810/810-OC                | -                    | -   | 0.4             | V     | I <sub>OL</sub> = 16 mA, E <sub>e</sub> = 0                      |
|  | OPL811/811-OC                | -                    | -   | 0.4             | V     | I <sub>OL</sub> = 16 mA, E <sub>e</sub> = 0.4 mW/cm <sup>2</sup> |
|  | OPL812-OC                    | -                    | -   | 0.4             | V     | I <sub>OL</sub> = 16 mA, E <sub>e</sub> = 0                      |
|  | OPL813-OC                    | -                    | -   | 0.4             | V     | I <sub>OL</sub> = 16 mA, E <sub>e</sub> = 0.2 mW/cm <sup>2</sup> |
|  | OPL820                       | -                    | -   | 0.4             | V     | I <sub>OL</sub> = 16 mA <sup>(5)</sup>                           |
| I <sub>OH</sub>  | High Level Output Current    |                      |     |                 |       |  |
|  | OPL800-OC                    | -                    | -   | 100             | μA    | V <sub>OH</sub> = 30 V, E <sub>e</sub> = 2 mW/cm <sup>2</sup>    |
|  | OPL801-OC                    | -                    | -   | 100             | μA    | V <sub>OH</sub> = 30 V, E <sub>e</sub> = 0                       |
|  | OPL810-OC                    | -                    | -   | 100             | μA    | V <sub>OH</sub> = 30 V, E <sub>e</sub> = 0.4 mW/cm <sup>2</sup>  |
|  | OPL811-OC                    | -                    | -   | 100             | μA    | V <sub>OH</sub> = 30 V, E <sub>e</sub> = 0                       |
|  | OPL812-OC                    | -                    | -   | 100             | μA    | V <sub>OH</sub> = 30 V, E <sub>e</sub> = 0.2 mW/cm <sup>2</sup>  |
|  | OPL813-OC                    | -                    | -   | 100             | μA    | V <sub>OH</sub> = 30 V, E <sub>e</sub> = 0                       |
| I <sub>OS</sub>  | Short Circuit Output Current |                      |     |                 |       |  |
|  | OPL800                       | -20                  |     |                 | mA    | E <sub>e</sub> = 1 mW/cm <sup>2</sup> , Output = GND             |
|  | OPL801                       | -                    |     | -100            | mA    | E <sub>e</sub> = 0, Output = GND                                 |

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## Electrical Specifications

| Electrical Characteristics ( $T_A = 25^\circ\text{C}$ unless otherwise noted) |  |     |     |     |               |   |
|---|--|-----|-----|-----|---------------|---|
| SYMBOL  | PARAMETER  | MIN | TYP | MAX | UNITS         | TEST CONDITIONS   |
| $t_r, t_f$  | Output Rise Time, Fall Time<br>OPL800/801              | -   | 70  | -   | ns            | $T_A = 25^\circ\text{C}$ , $E_e = 0$ or $1\text{ mW/cm}^2$ , $R_L = 8$ TTL loads, $f = 10\text{ kHz}$ , D.C. = 50%    |
|   | OPL800-OC/801-OC                                       | -   | 70  | -   | ns            | $T_A = 25^\circ\text{C}$ , $E_e = 0$ or $1\text{ mW/cm}^2$ , $R_L = 360\ \Omega$ , $f = 10\text{ kHz}$ , D.C. = 50%   |
|   | OPL810/811   | -   | 70  | -   | ns            | $T_A = 25^\circ\text{C}$ , $E_e = 0$ or $0.4\text{ mW/cm}^2$ , $R_L = 10$ TTL loads, $f = 10\text{ kHz}$ , D.C. = 50% |
|   | OPL810-OC/811-OC/812-OC/<br>813-OC                     | -   | 100 | -   | ns            | $T_A = 25^\circ\text{C}$ , $E_e = 0$ or $1\text{ mW/cm}^2$ , $R_L = 300\ \Omega$ , $f = 10\text{ kHz}$ , D.C. = 50%   |
|   | OPL820   | -   | 60  | -   | ns            | $R_L = 390\ \Omega$   |
| $t_{PLH}, t_{PHL}$  | Propagation Delay<br>Low/High - High/Low<br>OPL800/801 | -   | 5   | -   | $\mu\text{s}$ | $T_A = 25^\circ\text{C}$ , $E_e = 0$ or $1\text{ mW/cm}^2$ , $R_L = 8$ TTL loads, $f = 10\text{ kHz}$ , D.C. = 50%    |
|   | OPL800-OC/801-OC                                       | -   | 5   | -   | $\mu\text{s}$ | $T_A = 25^\circ\text{C}$ , $E_e = 0$ or $1\text{ mW/cm}^2$ , $R_L = 8$ TTL loads, $f = 10\text{ kHz}$ , D.C. = 50%    |
|   | OPL810/811   | -   | 5   | -   | $\mu\text{s}$ | $T_A = 25^\circ\text{C}$ , $E_e = 0$ or $0.4\text{ mW/cm}^2$ , $R_L = 10$ TTL loads, $f = 10\text{ kHz}$ , D.C. = 50% |
|   | OPL810-OC/811-OC/812-OC/<br>813-OC                     | -   | 5   | -   | $\mu\text{s}$ | $T_A = 25^\circ\text{C}$ , $E_e = 0$ or $1\text{ mW/cm}^2$ , $R_L = 300\ \Omega$ , $f = 10\text{ kHz}$ , D.C. = 50%   |
|   | OPL820 (to high state)                                 | -   | 1   | -   | $\mu\text{s}$ | $E_e = 0.1\text{ mW/cm}^2$ , $R_L = 390\ \Omega$  |
|   | OPL820 (to low state)                                  | -   | 2.1 | -   | $\mu\text{s}$ | $E_e = 0.1\text{ mW/cm}^2$ , $R_L = 390\ \Omega$  |
| Data Rate   | Data Rate Using NRZ Format                             | -   | 100 | -   | kHz           | $E_e = 0.1\text{ mW/cm}^2$ , $R_L = 390\ \Omega$  |

### Notes:

- (1) RMA flux is recommended. Duration can be extended to 10 sec. max. when flow soldering. For OPB820, a maximum of 20 grams force may be applied to leads while at soldering temperatures.
- (2) Derate linearly  $2.5\text{ mW/}^\circ\text{C}$  above  $25^\circ\text{C}$  for OPL800, OPL801, OPL810, OPL811. Derate linearly  $5.7\text{ mW/}^\circ\text{C}$  above  $90^\circ\text{C}$  for OPL820.
- (3) For OPL800, OPL801, OPL810, OPL811, light measurements are made with  $\lambda_i = 935\text{ nm}$ . For OPB820, light measurements are made with an LED source having a wavelength of  $935\text{ nm}$ .
- (4) High output state limits are valid for  $4.5\text{ V} < V_{CC} < 16\text{ V}$  and  $E_e > 0.035\text{ mW/cm}^2$  (OPL820, OPL820-OC),  $E_e < 0.001\text{ mW/cm}^2$  (OPL821-OC).
- (5) Low output state limits are valid for  $4.5\text{ V} < V_{CC} < 16\text{ V}$  and  $E_e > 0.035\text{ mW/cm}^2$  (OPL821-OC),  $E_e < 0.001\text{ mW/cm}^2$  (OPL820, OPL820-OC).

### General Note

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# Photologic Hermetic Sensors

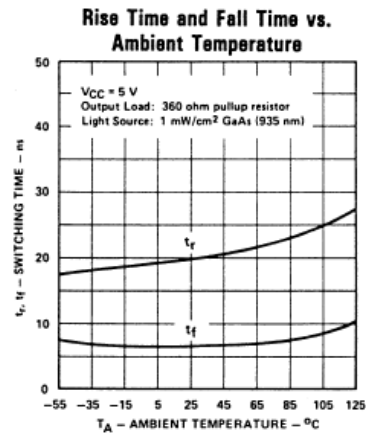
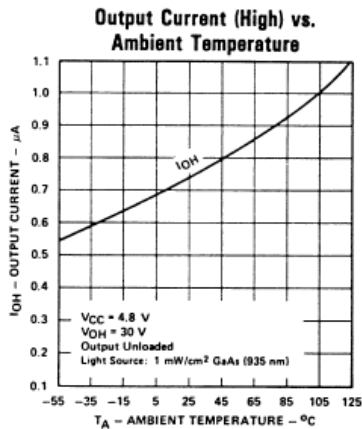
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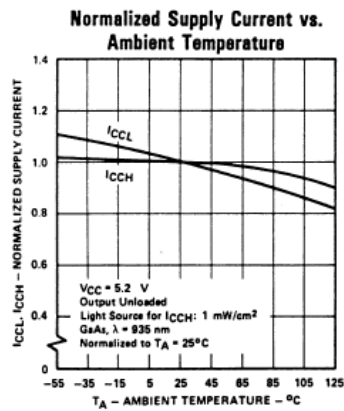
## Performance OPL800, OPL801



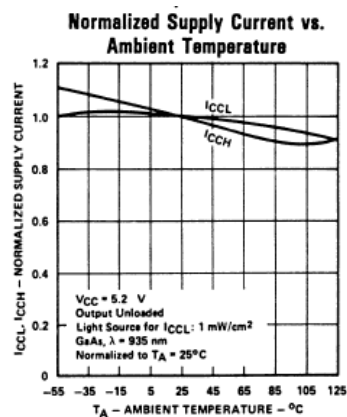
## OPL800-OC, OPL801-OC



## OPL800, OPL800-OC



## OPL801, OPL801-OC



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# Photologic Hermetic Sensors

OPL800, OPL800-OC, OPL801, OPL801-OC, OPL810, OPL810-OC, OPL811, OPL811-OC, OPL812-OC, OPL813-OC, OPL820, OPL820-OC, OPL821-OC



## Performance

OPL800, OPL801 Series



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# Photologic Hermetic Sensors

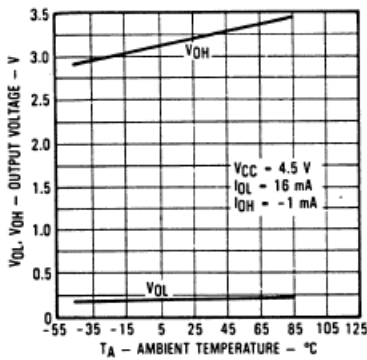
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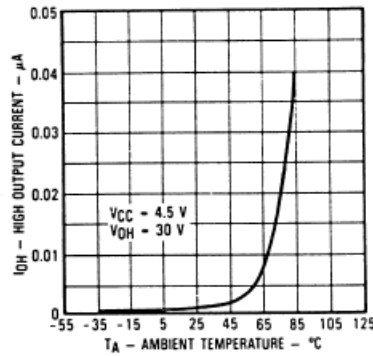
## Performance

### OPL810, OPL811 Series

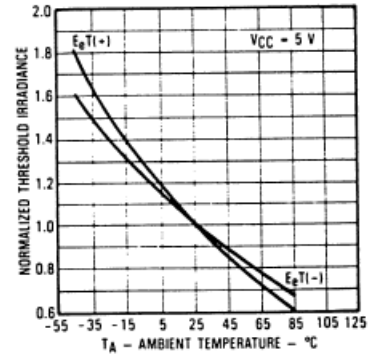
Output Voltage vs. Ambient Temp.



High Output Current vs. Ambient Temp.

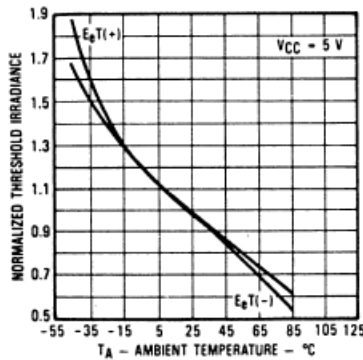


Normalized Threshold Irradiance vs. T<sub>A</sub>



### OPL812, OPL813 Series

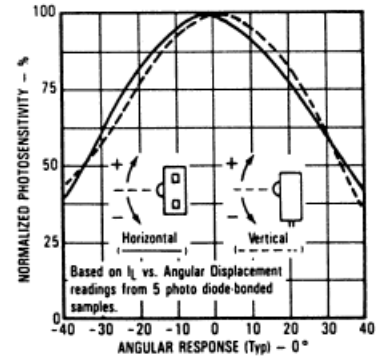
Normalized Threshold Irradiance vs. Amb. Temp.



Normalized Spectral Response



Angular Displacement from Package Mechanical Axis



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# Photologic Hermetic Sensors

OPL800, OPL800-OC, OPL801, OPL801-OC, OPL810, OPL810-OC, OPL811, OPL811-OC, OPL812-OC, OPL813-OC, OPL820, OPL820-OC, OPL821-OC



## Performance

OPL812, OPL813 Series

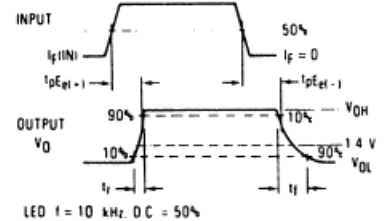


### Switching Test Curves

#### Switching Test Curve for Inverters



#### Switching Test Curve for Buffers



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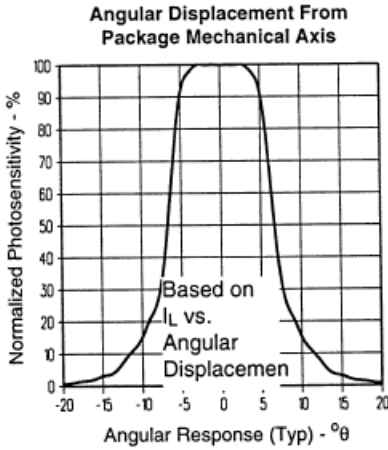
# Photologic Hermetic Sensors

OPL800, OPL800-OC, OPL801, OPL801-OC, OPL810, OPL810-OC, OPL811, OPL811-OC, OPL812-OC, OPL813-OC, OPL820, OPL820-OC, OPL821-OC



## Performance

### OPL820, OPL821 Series



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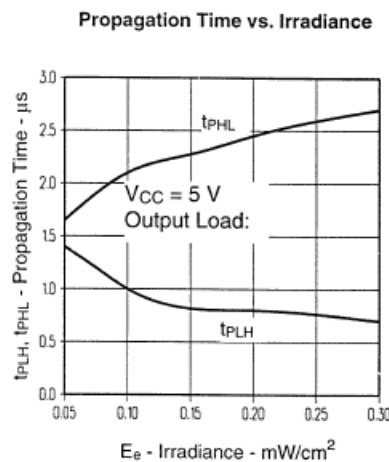
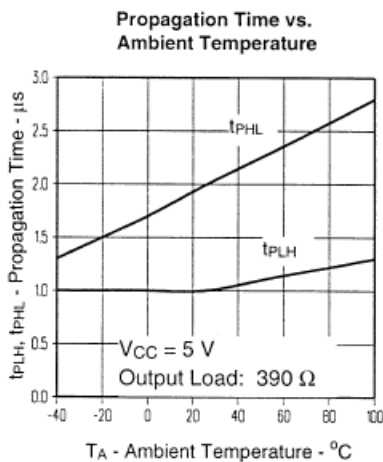
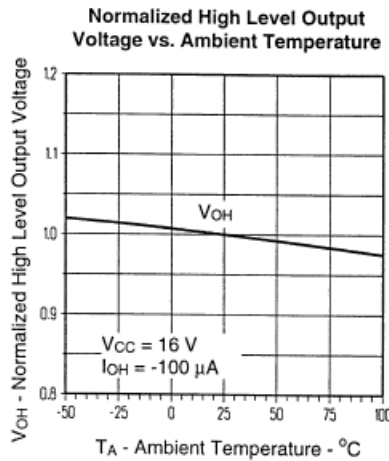
# Photologic Hermetic Sensors

OPL800, OPL800-OC, OPL801, OPL801-OC, OPL810, OPL810-OC, OPL811, OPL811-OC, OPL812-OC, OPL813-OC, OPL820, OPL820-OC, OPL821-OC



## Performance

### OPL820, OPL821 Series



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