# Plastic Infrared Emitting Diode OP290 Series 



## Features:

- Choice of narrow or wide irradiance pattern
- Choice of power ranges
- Choice of T-13/4, TO-18 or T-46 package
- Higher power output than GaAs at equivalent LEDs


## Description:

Each device in this series, is a gallium aluminum arsenide infrared Light Emitting Diode (LED) that is molded in an IRtransmissive package with a wavelength centered at 890 nm , which closely matches the spectral response of silicon phototransistors, except for OP298 (AA, AB, AC, AD), which has either an 850 nm or 875 nm center wavelength. For identification purposes, each LED anode lead is longer than the cathode lead. Package T-13/4 devices include: OP290, OP291, OP292, OP294, OP295, OP296, OP297, OP299 (A, B, C) and OP297FAB, Plastic Package TO-18 or TO-46 devices include: OP293 and OP298 (A, B, C, AA, AB, AC, AD).

Each OP290, OP291 and OP292 series come in three electrical parameters options A, B and C. The OP290 series forward current is specified under pulse conditions up to 1.5 amps , the OP291 series forward current is specified under pulse conditions up to 100 milliamps and the OP292 series forward current is specified under pulse conditions up to 1 amp. The Cathode Lead length is $0.06^{\prime \prime}$ ( 1.52 mm ) shorter than the Anode Lead. The silver-copper lead frame offers excellent thermal characteristics.

Each OP293 and OP298 series come in three electrical parameter options A, B and C. The OP293 series has an included emission angle of $60^{\circ}$ while the OP298 series has an included emission angle of $25^{\circ}$. The Cathode Lead length is $0.06^{\prime \prime}(1.52$ mm ) shorter than the Anode Lead. These devices, which come in a variety of power ranges offering a low cost replacement for TO-18 or TO-46 hermetic packages.

Each OP298 series come with a high irradiance output versions with four electrical parameter options AA, AB, AC and AD. These power options are in the range of $\mathbf{5 X}$ greater than the $\mathrm{A}, \mathrm{B}$ or C options. The OP298 series has an included emission angle of $25^{\circ}$. The Cathode Lead length is $0.06^{\prime \prime}(1.52 \mathrm{~mm})$ shorter than the Anode Lead. These devices, which come in a variety of power ranges offering a low cost replacement for TO-18 or TO-46 hermetic packages.

OP294 and OP299 are designed for low-current or power-limited applications, such as battery supplies. They are similar to the OP290 and OP295, but use a smaller chip that increases output efficiency at low current levels by increasing current density. Light output can be maximized with continuous (D.C.) forward current up to 100 mA or with pulsed forward current up to 750 mA . The Cathode Lead length is 0.06 " ( 1.52 mm ) shorter than the Anode Lead.

Each OP295, OP296 and OP297 series come in three electrical parameters options A, B and C. The OP295 series forward current is specified under pulse conditions up to 5 amps, the OP296 series forward current is specified under pulse conditions up to 2 amps and the OP297 series forward current is specified under pulse conditions up to 1 amp . The Cathode Lead length is $0.06^{\prime \prime}$ ( 1.52 mm ) shorter than the Anode Lead. The OP297FAB has a reversed polarity from the OP297A, B or C. The silver-copper lead frame offers excellent thermal characteristics.

All of these devices are spectrally and mechanically matched to the OP593 and OP598 series phototransistors.

## Please refer to Application Bulletins 208 and 210 for additional design information and reliability (degradation) data.

## Applications:

| - Non-contact reflective object sensor | - Machine automation | - Door sensor |
| :--- | :--- | :--- |
| - Assembly line automation | - Machine safety | - Battery-operated applications |

## Plastic Infrared Emitting Diode

OP290 Series

## Tr Electronics



TO-18, TO-46 Package
OP293 \& OP298


Electrical Connection
$A, B, C, A A, A B, A C, A D$

| Pin \# | $\mathrm{X}=0.060$ " $(1.52 \mathrm{~mm})$ |
| :---: | :---: |
| 1 | Anode |
| 2 | Cathode |



INCHES


Electrical Specifications

| Absolute Maximum Ratings ( $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ unless |  |
| :---: | :---: |
| Storage and Operating Temperature Range | $-40^{\circ} \mathrm{C}$ to $+100^{\circ} \mathrm{C}$ |
| Reverse Voltage OP290, OP292, OP294, OP295, OP297, OP299 OP291, OP293, OP296, OP298 | $\begin{aligned} & 5.0 \mathrm{~V} \\ & 2.0 \mathrm{~V} \end{aligned}$ |
| Continuous Forward Current OP290, OP291, OP292 OP294, OP295, OP299 OP295, OP296, OP297 |  |
| Continuous Forward Current, OP293, OP298 <br> Free Air <br> Board Mounted <br> Full Heat Sink | 100 mA 133 mA 200 mA |
| Peak Forward Current OP290, OP295 ( $25 \mu \mathrm{~s}$ pulse width) OP291, OP296 ( $100 \mu \mathrm{~s}$ pulse width) OP292, OP297 ( $100 \mu \mathrm{~s}$ pulse width) OP293, OP298 ( $25 \mu$ s pulse width) OP294, OP299 | $\begin{array}{r} 5.0 \mathrm{~A} \\ 2.0 \mathrm{~A} \\ 1.00 \mathrm{~A} \\ 2.0 \mathrm{~A} \\ 750 \mathrm{~mA} \end{array}$ |

## Notes:

1. For OP290, OP291, OP292, OP295, OP296 and OP297, derate linearly $1.67 \mathrm{~mA} /{ }^{\circ} \mathrm{C}$ above $25^{\circ} \mathrm{C}$ (free-air). When used with heat sink (see note 5), derate linearly $2.07 \mathrm{~mA} /{ }^{\circ} \mathrm{C}$ above $65^{\circ} \mathrm{C}$ (normal use). For OP293 and OP298, when measured in free-air, derate power dissipation linearly 1.43 $\mathrm{mW} /{ }^{\circ} \mathrm{C}$ above $25^{\circ} \mathrm{C}$. For OP294 and OP299, derate linearly $1.80 \mathrm{~mW} /{ }^{\circ} \mathrm{C}$ above $25^{\circ} \mathrm{C}$.

# Plastic Infrared Emitting Diode <br> OP290 Series 

Electrical Specifications

| Absolute Maximum Ratings ( $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ unless otherwise noted) |  |
| :---: | :---: |
| Maximum Duty Cycle OP290 ( $25 \mu$ s pulse width @ 5 A) | $1.25 \%^{(1)}$ |
| Lead Soldering Temperature [1/16 inch (1.6 mm) from case for 5 seconds with soldering iron] | $260^{\circ} \mathrm{C}^{(2)}$ |
| Power Dissipation, Free Air <br> OP290, OP291, OP292, OP295, OP296, OP297 <br> OP293, OP298 <br> Power Dissipation, Board Mounted <br> OP290, OP291, OP292, op295, OP296, OP297 OP293, OP298 <br> Power Dissipation, Full Heat Sink OP290, OP291, OP292, OP295, OP296, OP297 OP293, OP298 | $\begin{gathered} 333 \mathrm{~mW}^{(3)} \\ 142 \mathrm{~mW}^{(3)} \\ 533 \mathrm{~mW}^{(4)} \\ 200 \mathrm{~mW}^{(4)} \\ \\ 1.11 \mathrm{WW}^{(5)} \\ 400 \mathrm{~mW}^{(5)} \end{gathered}$ |
| Power Dissipation OP294, OP299 | 180 mW |

## Notes:

1. For OP290, OP291, OP292, OP295, OP296 and OP297, refer to graph of Maximum Peak Pulse Current vs Pulse Width.
2. For all OPs in this series, RMA flux is recommended. Duration can be extended to 10 second maximum when soldering. A maximum of 20 grams force may be applied to the leads when flow soldering.
3. For OP290, OP291, OP292, OP295, OP296 and OP297, measured in free-air. Derate linearly $3.33 \mathrm{~mW} /{ }^{\circ} \mathrm{C}$ above $25^{\circ} \mathrm{C}$.
4. For OP290, OP291and OP292, mounted on $1 / 16^{\prime \prime}(1.6 \mathrm{~mm})$ thick PCBoard with each lead soldered through 80 mil square lands $0.250^{\prime \prime}(6.35 \mathrm{~mm})$ below flange of device. Derate linearly $5.33 \mathrm{~mW} /{ }^{\circ} \mathrm{C}$ above $62.5^{\circ}$. For OP293 and OP298, mounted on $1 / 16^{\prime \prime}(1.60 \mathrm{~mm})$ thick PCBoard with each lead soldered through 80 mil square lands $0.250^{\prime \prime}(6.35 \mathrm{~mm})$ below flange of device. Derate power dissipation linearly $2.00 \mathrm{~mW} /{ }^{\circ} \mathrm{C}$ above $25^{\circ} \mathrm{C}$ (normal use). For OP295, OP296 and OP297, mounted on $1 / 16^{\prime \prime}$ ( 1.6 mm ) thick PCBoard with each lead soldered through 80 mil square lands $0.250 \prime$ " 6.35 mm ) below flange of device. Derate linearly $5.33 \mathrm{~mW} /{ }^{\circ} \mathrm{C}$ above $25^{\circ} \mathrm{C}$.
5. Immersed in silicone fluid to simulate infinite heat sink. For OP290, OP291 and OP292, derate linearly $11.1 \mathrm{~mW} /{ }^{\circ} \mathrm{C}$ above $95^{\circ} \mathrm{C}$. For OP293 and OP298, derate power dissipation linearly $2.50 \mathrm{~mW} /{ }^{\circ} \mathrm{C}$ above $25^{\circ} \mathrm{C}$. For OP295, OP296 and OP297, derate linearly $11.1 \mathrm{~mW} /{ }^{\circ} \mathrm{C}$ above $25^{\circ} \mathrm{C}$.

Electrical Specifications
Electrical Characteristics ( $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ unless otherwise noted)

| SYMBOL | PARAMETER | MIN | TYP | MAX | UNITS | TEST CONDITIONS |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Input Diode |  |  |  |  |  |  |
| $\mathrm{E}_{\mathrm{E}(\text { APT })^{(2)}}$ | Apertured Radiant Incidence <br> OP290A <br> OP290B <br> OP290C | $\begin{aligned} & 210 \\ & 180 \\ & 150 \end{aligned}$ | - | $300$ | $\mathrm{mW} / \mathrm{cm}^{2}$ | $\mathrm{I}_{\mathrm{F}}=1.50 \mathrm{~A}^{(1)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture $0.2^{\prime \prime}(5.08 \mathrm{~mm})$ from the tip of the lens. |
|  | OP291A OP291B OP291C | $\begin{aligned} & 16 \\ & 13 \\ & 10 \end{aligned}$ |  | $26$ |  | $I_{\mathrm{F}}=100 \mathrm{~mA}^{(11)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture <br> $0.2^{\prime \prime}(5.08 \mathrm{~mm})$ from the tip of the lens. |
|  | OP292A OP292B OP292C | $\begin{aligned} & 2.7 \\ & 2.2 \\ & 1.7 \end{aligned}$ | $3.6$ | $4.4$ |  | $I_{F}=20 m A^{(1)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture <br> $0.2^{\prime \prime}(5.08 \mathrm{~mm})$ from the tip of the lens. |
|  | OP293A OP293B OP293C | $\begin{aligned} & 16 \\ & 13 \\ & 10 \end{aligned}$ | $22$ | $26$ |  | $I_{\mathrm{F}}=100 \mathrm{~mA}^{(1)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture $0.2^{\prime \prime}(5.08 \mathrm{~mm})$ from the tip of the lens. |
|  | OP294 | 0.50 | - | 1.50 |  | $I_{\mathrm{F}}=5 \mathrm{~mA}^{(1)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture $0.200^{\prime \prime}(5.08 \mathrm{~mm})$ from the tip of the lens. |
|  | OP295A OP295B OP295C | $\begin{aligned} & 44 \\ & 33 \\ & 22 \end{aligned}$ |  | $77$ |  | $I_{F}=1.50 A^{(1)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture <br> $1.129^{\prime \prime}(28.7 \mathrm{~mm})$ from the tip of the lens. |
|  | OP296A OP296B OP296C | $\begin{aligned} & 3.6 \\ & 2.6 \\ & 1.6 \end{aligned}$ |  | $6.6$ |  | $I_{\mathrm{F}}=100 \mathrm{~mA}^{(1)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture <br> $1.129^{\prime \prime}(28.7 \mathrm{~mm})$ from the tip of the lens. |
|  | OP297FAB <br> OP297A <br> OP297B <br> OP297C | $\begin{aligned} & 2.4 \\ & 0.7 \\ & 0.5 \\ & 0.3 \end{aligned}$ | $1.0$ | $1.3$ |  | $I_{F}=20 \mathrm{~mA}^{(1)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture $1.129^{\prime \prime}(28.7 \mathrm{~mm})$ from the tip of the lens. |
|  | OP298A OP298B OP298C | $\begin{aligned} & 3.0 \\ & 2.4 \\ & 1.8 \end{aligned}$ |  | $4.8$ |  | $I_{\mathrm{F}}=100 \mathrm{~mA}^{(1)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture <br> $0.2^{\prime \prime}(5.08 \mathrm{~mm})$ from the tip of the lens. |
|  | OP298AA <br> OP298AB <br> OP298AC <br> OP298AD | $\begin{aligned} & 3.5 \\ & 3.5 \\ & 6.5 \\ & 8.5 \end{aligned}$ |  | $\begin{gathered} 8.5 \\ 11.5 \end{gathered}$ |  | $I_{\mathrm{F}}=100 \mathrm{~mA}^{(1)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture $1.129^{\prime \prime}(28.7 \mathrm{~mm})$ from the tip of the lens. |
|  | OP299 | 0.15 | - | 0.45 |  | $I_{\mathrm{F}}=100 \mathrm{~mA}^{(1)(2)}$ <br> Measured into a $0.250^{\prime \prime}$ [ 6.35 mm ] aperture $1.129^{\prime \prime}(28.7 \mathrm{~mm})$ from the tip of the lens. |

## Notes:

1. Measurement is taken at the end of a single $100 \mu \mathrm{~s}$ pulse. Heating due to increased pulse rate or pulse width will cause a decrease in reading.
2. Measurement of the average apertured radiant energy incident upon a sensing area 0.250 " ( 6.35 mm ) in diameter perpendicular to and centered on the mechanical axis of the lens and the specified distance from the end of the device. On all models in this series, $\mathrm{E}_{\mathrm{E}(\mathrm{APT})}$ is not necessarily uniform within the measured area.
3. Measurement is taken at the end of a single 10 ms pulse. Heating due to increased pulse rate or pulse width will cause a decrease in reading.

## Plastic Infrared Emitting Diode

OP290 Series

## T Electronics

## Electrical Specifications

| Electrical Characteristics ( $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ unless otherwise noted) |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SYMBOL | PARAMETER | MIN | TYP | MAX | UNITS | TEST CONDITIONS |
| Input Diode |  |  |  |  |  |  |
| $V_{\text {F }}$ | ```Forward Voltage }\mp@subsup{}{}{(3) OP290, OP295 OP291, OP296 OP292, OP297, OP297FAB OP293, OP298 (A, B, C) OP298 (AA, AB, AC, AD) OP294, OP299``` |  |  | $\begin{aligned} & 4.00 \\ & 2.00 \\ & 1.75 \\ & 2.00 \\ & 2.00 \\ & 1.50 \end{aligned}$ | V | $\begin{aligned} & \mathrm{I}_{\mathrm{F}}=1.50 \mathrm{~A} \\ & \mathrm{I}_{\mathrm{F}}=100 \mathrm{~mA} \\ & \mathrm{I}_{\mathrm{F}}=20 \mathrm{~mA} \\ & \mathrm{I}_{\mathrm{F}}=1.50 \mathrm{~A} \\ & \mathrm{I}_{\mathrm{F}}=100 \mathrm{~mA} \\ & \mathrm{I}_{\mathrm{F}}=5 \mathrm{~mA} \end{aligned}$ |
| $I_{R}$ | ```Reverse Current \({ }^{(3)}\) OP290, OP292 OP291, OP293, OP298 (A, B, C), OP296 OP298 (AA, AB, AC, AD) OP294, OP299 OP295, OP297 OP297FAB``` |  |  | $\begin{gathered} 10 \\ 100 \\ 100 \\ 10 \\ 10 \\ 15 \end{gathered}$ | $\mu \mathrm{A}$ | $\begin{aligned} & \mathrm{V}_{\mathrm{R}}=5 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{R}}=2 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{R}}=2 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{R}}=2 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{R}}=5 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{R}}=5 \mathrm{~V} \end{aligned}$ |
| $\lambda_{P}$ | ```Wavelength at Peak Emission OP290, OP291, OP292, OP293, OP294, OP295, OP296, OP297, OP298 (A, B, C), OP299 OP297FAB, OP298 (AA, AB, AC, AD)``` |  | 890 $875$ |  | nm | $\mathrm{I}_{\mathrm{F}}=10 \mathrm{~mA}$ |
| B | Spectral Bandwidth between Half Power Points | - | 80 | - | nm | $\mathrm{I}_{\mathrm{F}}=10 \mathrm{~mA}$ |
| $\Delta \lambda_{P} / \Delta T$ | Spectral Shift with Temperature | - | +0.18 | - | $n \mathrm{~m} /{ }^{\circ} \mathrm{C}$ | $\mathrm{I}_{\mathrm{F}}=$ Constant |
| $\theta_{\text {HP }}$ | Emission Angle at Half Power Points OP290, OP291, OP292, OP294 OP293 OP295, OP296, OP297, OP299 OP298 |  | $\begin{aligned} & 50 \\ & 60 \\ & 20 \\ & 25 \end{aligned}$ |  | Degree | $\mathrm{I}_{\mathrm{F}}=20 \mathrm{~mA}$ |
| $\mathrm{t}_{\mathrm{r}}$ | Output Rise Time | - | 500 | - | ns | $\mathrm{I}_{\mathrm{F}(\mathrm{PK})}=100 \mathrm{~mA}, \mathrm{PW}=10 \mu \mathrm{~s}$, and |
| $\mathrm{t}_{\mathrm{f}}$ | Output Fall Time | - | 250 | - | ns | D.C. $=10.0 \%$ |

## Plastic Infrared Emitting Diode <br> OP290 Series

## TT Electronics



## Plastic Infrared Emitting Diode

## OP290 Series



## Plastic Infrared Emitting Diode

OP290 Series

## Performance <br> OP290A/OP593 and OP295/OP598 - Coupling Characteristics



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