

# T-1 3/4 (5 mm) Oval Precision Optical Performance LED Lamps

## Technical Data

### Sun Power Series

|                  |                  |
|------------------|------------------|
| <b>HLMP-ABxx</b> | <b>HLMP-BBxx</b> |
| <b>HLMP-ADxx</b> | <b>HLMD-BDxx</b> |
| <b>HLMP-AGxx</b> | <b>HLMP-BGxx</b> |
| <b>HLMP-ALxx</b> | <b>HLMP-BLxx</b> |
| <b>HLMP-AMxx</b> | <b>HLMP-BMxx</b> |

### Features

- **Smooth, Consistent Spatial Radiation Patterns**
- **Wide Viewing Angle**  
Major Axis 70°  
Minor Axis 35°
- **High Luminous Output**
- **Two Red and Amber Intensity Levels Available:**  
AlInGaP (bright) and  
AlInGaP II (brightest)
- **Colors:**  
472 nm Blue  
526 nm Green  
590/592 nm Amber  
626/630 nm Red
- **Superior Resistance to Moisture**
- **UV Resistant Epoxy**
- **Choice of Package Options**

### Applications

- **Full Color/Video Signs**
- **Variable Message Signs**  
Passenger Information  
Advertising  
Time/Temperature

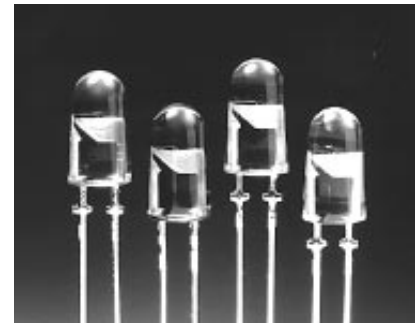
### Benefits

- **Viewing Angle Designed for Wide Field of View Applications**
- **Red, Green, and Blue Radiation Patterns Matched for Full Color Signs**
- **Superior Outdoor Environmental Performance**

### Description

These Precision Optical Performance oval LEDs are specifically designed for Full Color/Video and Passenger Information signs. The oval shaped radiation pattern (35° x 70°) and high luminous intensity ensure that these devices are excellent for wide field of view outdoor applications where a wide viewing angle and readability in sunlight are essential. These lamps have very smooth, matched radiation patterns ensuring consistent color mixing in full color applications, and message uniformity across the viewing angle of the sign.

High efficiency LED materials are used in these lamps: Aluminum Indium Gallium Phosphide (AlInGaP) for amber and red, and Indium Gallium Nitride (InGaN)

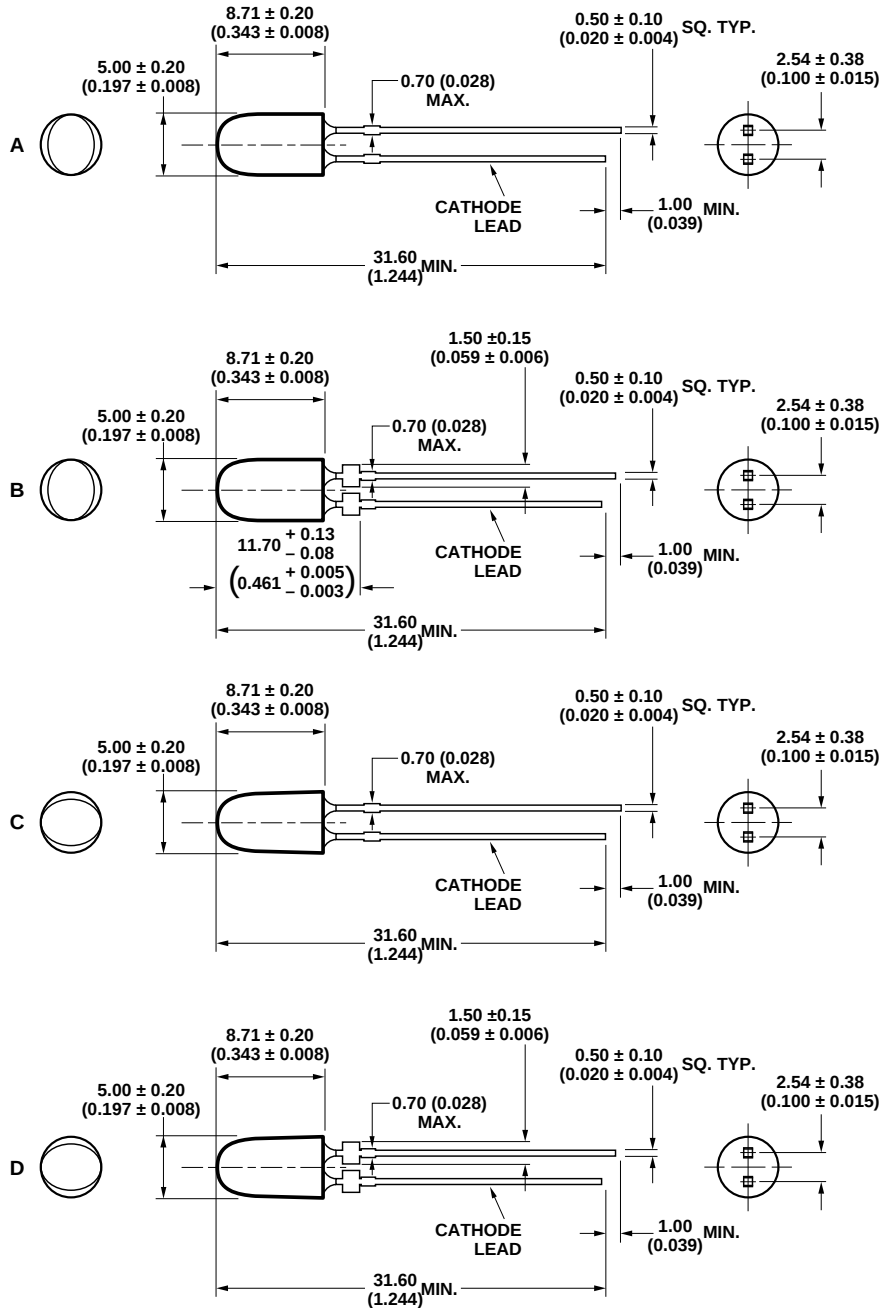


for blue and green. There are two families of red and amber lamps, AlInGaP and the higher performance AlInGaP II. Each lamp is made with an advanced optical grade epoxy offering superior high temperature and high moisture resistance in outdoor applications. The package epoxy contains both UV-a and UV-b inhibitors to reduce the effects of long term exposure to direct sunlight.

Designers can select parallel (where the axis of the leads is parallel to the wide axis of the oval radiation pattern) or perpendicular orientation. Designers can also choose between lamps with or without standoffs. The red and amber lamps are available in tinted versions.

*CAUTION: The Blue and Green LEDs are Class 1 ESD sensitive. Please observe appropriate precautions during handling and processing. Refer to Agilent Application Note AN-1142 for additional details.*

## Package Dimensions



### NOTES:

- ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).
- LEADS ARE MILD STEEL, SOLDER DIPPED.
- TAPERS SHOWN AT TOP OF LEADS (BOTTOM OF LAMP PACKAGE) INDICATE AN EPOXY MENISCUS THAT MAY EXTEND ABOUT 1 mm (0.040 IN.) DOWN THE LEADS.
- RECOMMENDED PC BOARD HOLE DIAMETERS:
  - LAMP PACKAGES A AND C WITHOUT STAND-OFFS: FLUSH MOUNTING AT BASE OF LAMP PACKAGE =  $1.143/1.067 \text{ mm (0.044/0.042 IN.)}$ .
  - LAMP PACKAGES B AND D WITH STAND-OFFS: MOUNTING AT LEAD STAND-OFFS.

## Part Numbering Scheme

**HLMP-(1)(2)(3)(4)**

*where (1) = Leadframe*

*Orientation*

“A” = Parallel

“B” = Perpendicular

*where (2) = Color Option*

“L” = 590/592 nm Amber

“G” = 626 nm Red

“D” = 630 nm Red

“M” = 525 nm Green

“B” = 472 nm Blue

*where (3) = Standoff Option*

“0” = Without

“1” = With

*where (4) = Tint Option*

“1” or “6” = Matching Color  
Tints

**Refer to selection guides for  
available combinations.**

## AlInGaP Device Selection Guide (Amber, Red)

| Part Number | Color and<br>Typical<br>Dominant<br>Wavelength<br>$\lambda_d$ (nm) | Luminous<br>Intensity<br>$I_V$ (mcd) at<br>20 mA<br>Min. | Luminous<br>Intensity<br>$I_V$ (mcd) at<br>20 mA<br>Typ. | Tinting<br>Type | Leads<br>with<br>Stand-Offs | Lead<br>Frame<br>Orientation | Package<br>Drawing |
|-------------|--------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|-----------------|-----------------------------|------------------------------|--------------------|
| HLMP-AL01   | Amber 590                                                          | 270                                                      | 600                                                      | Amber           | No                          | Parallel                     | A                  |
| HLMP-AL11   | Amber 590                                                          | 270                                                      | 600                                                      | Amber           | Yes                         | Parallel                     | B                  |
| HLMP-BL01   | Amber 590                                                          | 270                                                      | 600                                                      | Amber           | No                          | Perpendicular                | C                  |
| HLMP-BL11   | Amber 590                                                          | 270                                                      | 600                                                      | Amber           | Yes                         | Perpendicular                | D                  |
| HLMP-AG01   | Red 626                                                            | 270                                                      | 600                                                      | Red             | No                          | Parallel                     | A                  |
| HLMP-AG11   | Red 626                                                            | 270                                                      | 600                                                      | Red             | Yes                         | Parallel                     | B                  |
| HLMP-BG01   | Red 626                                                            | 270                                                      | 600                                                      | Red             | No                          | Perpendicular                | C                  |
| HLMP-BG11   | Red 626                                                            | 270                                                      | 600                                                      | Red             | Yes                         | Perpendicular                | D                  |

### Notes:

1. The luminous intensity is measured on the mechanical axis of the lamp package.
2. The optical axis is closely aligned with the package mechanical axis.
3. The dominant wavelength  $\lambda_d$ , is derived from the CIE Chromaticity Diagram and represents the color of the lamp.

### AlInGaP2 Device Selection Guide (Amber, Red)

| Part Number | Color and Typical Dominant Wavelength $\lambda_d$ (nm) | Luminous Intensity $I_V$ (mcd) at 20 mA Min. | Luminous Intensity $I_V$ (mcd) at 20 mA Typ. | Tinting Type | Leads with Stand-Offs | Lead Frame Orientation | Package Drawing |
|-------------|--------------------------------------------------------|----------------------------------------------|----------------------------------------------|--------------|-----------------------|------------------------|-----------------|
| HLMP-AL06   | Amber 592                                              | 590                                          | 1300                                         | Amber        | No                    | Parallel               | A               |
| HLMP-AL16   | Amber 592                                              | 590                                          | 1300                                         | Amber        | Yes                   | Parallel               | B               |
| HLMP-BL06   | Amber 592                                              | 590                                          | 1300                                         | Amber        | No                    | Perpendicular          | C               |
| HLMP-BL16   | Amber 592                                              | 590                                          | 1300                                         | Amber        | Yes                   | Perpendicular          | D               |
| HLMP-AD06   | Red 630                                                | 590                                          | 1300                                         | Red          | No                    | Parallel               | A               |
| HLMP-AD16   | Red 630                                                | 590                                          | 1300                                         | Red          | Yes                   | Parallel               | B               |
| HLMP-BD06   | Red 630                                                | 590                                          | 1300                                         | Red          | No                    | Perpendicular          | C               |
| HLMP-BD16   | Red 630                                                | 590                                          | 1300                                         | Red          | Yes                   | Perpendicular          | D               |

### InGaN Device Selection Guide (Blue, Green)

| Part Number | Color and Typical Dominant Wavelength $\lambda_d$ (nm) | Luminous Intensity $I_V$ (mcd) at 20 mA Min. | Luminous Intensity $I_V$ (mcd) at 20 mA Typ. | Tinting Type | Leads with Stand-Offs | Lead Frame Orientation | Package Drawing |
|-------------|--------------------------------------------------------|----------------------------------------------|----------------------------------------------|--------------|-----------------------|------------------------|-----------------|
| HLMP-AM01   | Green 526                                              | 590                                          | 1300                                         | Green        | No                    | Parallel               | A               |
| HLMP-AM11   | Green 526                                              | 590                                          | 1300                                         | Green        | Yes                   | Parallel               | B               |
| HLMP-BM01   | Green 526                                              | 590                                          | 1300                                         | Green        | No                    | Perpendicular          | C               |
| HLMP-BM11   | Green 526                                              | 590                                          | 1300                                         | Green        | Yes                   | Perpendicular          | D               |
| HLMP-AB01   | Blue 472                                               | 205                                          | 400                                          | Blue         | No                    | Parallel               | A               |
| HLMP-AB11   | Blue 472                                               | 205                                          | 400                                          | Blue         | Yes                   | Parallel               | B               |
| HLMP-BB01   | Blue 472                                               | 205                                          | 400                                          | Blue         | No                    | Perpendicular          | C               |
| HLMP-BB11   | Blue 472                                               | 205                                          | 400                                          | Blue         | Yes                   | Perpendicular          | D               |

**Notes:**

1. The luminous intensity is measured on the mechanical axis of the lamp package.
2. The optical axis is closely aligned with the package mechanical axis.
3. The dominant wavelength  $\lambda_d$ , is derived from the CIE Chromaticity Diagram and represents the color of the lamp.

### Absolute Maximum Ratings at 25°C

|                                             | Amber and Red        | Blue and Green   |
|---------------------------------------------|----------------------|------------------|
| DC Forward Current                          | 50 mA                | 30 mA            |
| Peak Pulsed Forward Current                 | 70 mA                | 100 mA           |
| Average Forward Current (Pulsed Operation)  | 30 mA <sup>[1]</sup> | 30 mA            |
| Reverse Voltage ( $I_R = 100 \mu\text{A}$ ) | 5 V                  |                  |
| Reverse Voltage ( $I_R = 10 \mu\text{A}$ )  |                      | 5 V              |
| Power Dissipation                           | 120 mW               | 120 mW           |
| LED Junction Temperature                    | 130°C                | 100°C            |
| Operating Temperature Range                 | -40°C to +100°C      | -40°C to +80°C   |
| Storage Temperature Range                   | -40°C to +120°C      | -40°C to +100°C  |
| Soldering Temperature                       | 260°C for 5 sec.     | 260°C for 5 sec. |

**Note:**

- Higher pulsed average currents can be used under certain conditions. Refer to Agilent Application Brief I-024.

### Intensity Bin Limits (mcd at 20 mA)

| Bin Name | Min. | Max. |
|----------|------|------|
| G        | 140  | 180  |
| H        | 180  | 240  |
| J        | 240  | 310  |
| K        | 310  | 400  |
| L        | 400  | 520  |
| M        | 520  | 680  |
| N        | 680  | 880  |
| P        | 880  | 1150 |
| Q        | 1150 | 1500 |
| R        | 1500 | 1900 |
| S        | 1900 | 2500 |

Tolerance for each bin limit is  
± 15%.

### HLMP-xLxx Color Bin Limits (nm at 20 mA)

| Bin Name | Min.  | Max.  |
|----------|-------|-------|
| 1        | 584.5 | 587.0 |
| 2        | 587.0 | 589.5 |
| 4        | 589.5 | 592.0 |
| 6        | 592.0 | 594.5 |

Tolerance for each bin limit is  
± 0.5 nm.

**Note:**

- Bin categories are established for classification of products. Products may not be available in all bin categories. Please contact your Agilent representative for information on currently available bins.

**Electrical/Optical Characteristics at  $T_A = 25^\circ\text{C}$** 

| Parameter                                                                                                                                                                                                                                                          | Symbol                  | Min.   | Typ.                                       | Max.                                   | Units              | Test Conditions                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------|--------------------------------------------|----------------------------------------|--------------------|--------------------------------------------------------------------------------------------------|
| Typical Viewing Angle<br>Major<br>Minor                                                                                                                                                                                                                            | $2\theta_{1/2}$         |        | 70<br>35                                   |                                        | $^\circ\text{C}$   |                                                                                                  |
| Forward Voltage<br>Amber ( $\lambda_d = 590\text{ nm}$ )<br>Amber ( $\lambda_d = 592\text{ nm}$ )<br>Red ( $\lambda_d = 626\text{ nm}$ )<br>Red ( $\lambda_d = 630\text{ nm}$ )<br>Blue ( $\lambda_d = 472\text{ nm}$ )<br>Green ( $\lambda_d = 526\text{ nm}$ )   | $V_F$                   |        | 2.02<br>2.15<br>1.90<br>2.00<br>3.5<br>3.5 | 2.4<br>2.4<br>2.4<br>2.4<br>4.0<br>4.0 | V                  | $I_F = 20\text{ mA}$                                                                             |
| Reverse Voltage<br>Amber, Red<br>Blue, Green                                                                                                                                                                                                                       | $V_R$                   | 5<br>5 | 20<br>–                                    |                                        | V                  | $I_F = 100\text{ }\mu\text{A}$<br>$I_F = 10\text{ }\mu\text{A}$                                  |
| Peak Wavelength<br>Amber ( $\lambda_d = 590\text{ nm}$ )<br>Amber ( $\lambda_d = 592\text{ nm}$ )<br>Red ( $\lambda_d = 626\text{ nm}$ )<br>Red ( $\lambda_d = 630\text{ nm}$ )<br>Blue ( $\lambda_d = 472\text{ nm}$ )<br>Green ( $\lambda_d = 526\text{ nm}$ )   | $\lambda_{\text{peak}}$ |        | 592<br>594<br>635<br>639<br>470<br>524     |                                        | nm                 | Peak of<br>Wavelength of<br>Spectral<br>Distribution at<br>$I_F = 20\text{ mA}$                  |
| Spectral Halfwidth<br>Amber ( $\lambda_d = 590/592\text{ nm}$ )<br>Red ( $\lambda_d = 626/630\text{ nm}$ )<br>Blue ( $\lambda_d = 472\text{ nm}$ )<br>Green ( $\lambda_d = 526\text{ nm}$ )                                                                        | $\Delta\lambda_{1/2}$   |        | 17<br>17<br>35<br>47                       |                                        | nm                 | Wavelength<br>Width at<br>Spectral<br>Distribution<br>1/2 Power Point<br>at $I_F = 20\text{ mA}$ |
| Capacitance<br>Amber, Red<br>Blue, Green                                                                                                                                                                                                                           | C                       |        | 40<br>43                                   |                                        | pF                 | $V_F = 0, F = 1\text{ MHz}$                                                                      |
| Thermal Resistance<br>Amber, Red<br>Blue, Green                                                                                                                                                                                                                    | $R\theta_{J-PIN}$       |        | 240<br>240                                 |                                        | $^\circ\text{C/W}$ | LED Junction-<br>to-Cathode Lead                                                                 |
| Luminous Efficacy<br>Amber ( $\lambda_d = 590\text{ nm}$ )<br>Amber ( $\lambda_d = 592\text{ nm}$ )<br>Red ( $\lambda_d = 626\text{ nm}$ )<br>Red ( $\lambda_d = 630\text{ nm}$ )<br>Blue ( $\lambda_d = 472\text{ nm}$ )<br>Green ( $\lambda_d = 526\text{ nm}$ ) | $\eta_V$                |        | 480<br>500<br>150<br>155<br>75<br>520      |                                        | lm/W               | Emitted<br>Luminous<br>Power/Emitted<br>Radiant Power                                            |

**Notes:**

1.  $2\theta_{1/2}$  is the off-axis angle where the luminous intensity is 1/2 the on-axis intensity.
2. The radiant intensity,  $I_e$  in watts per steradian, may be found from the equation  $I_e = I_v/\eta_v$  where  $I_v$  is the luminous intensity in candelas and  $\eta_v$  is the luminous efficacy in lumens/watt.

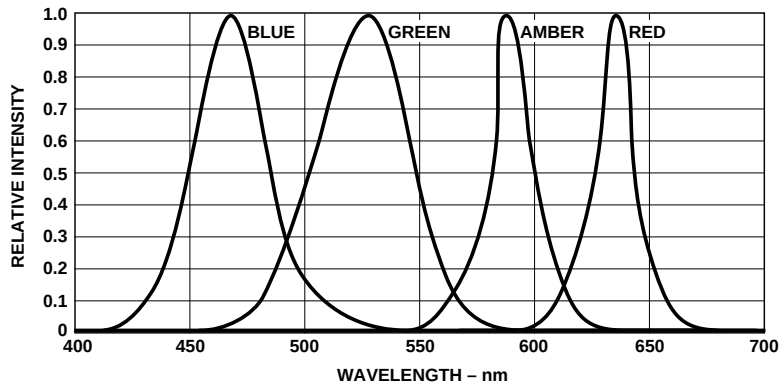


Figure 1. Relative Intensity vs. Wavelength.

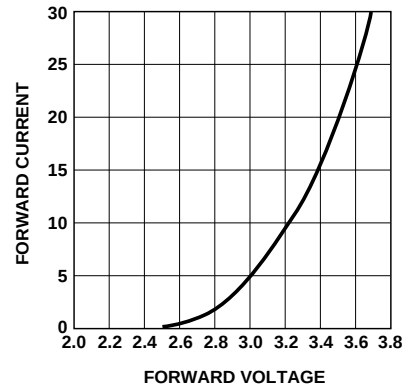


Figure 2. Blue, Green Forward Current vs. Forward Voltage.

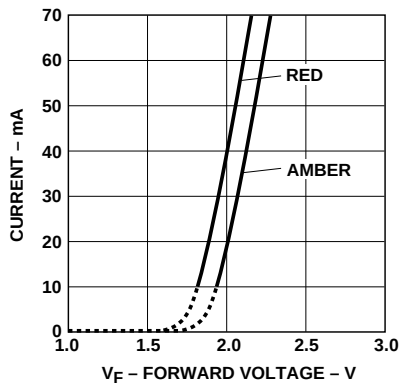


Figure 3. Amber, Red Forward Current vs. Forward Voltage.

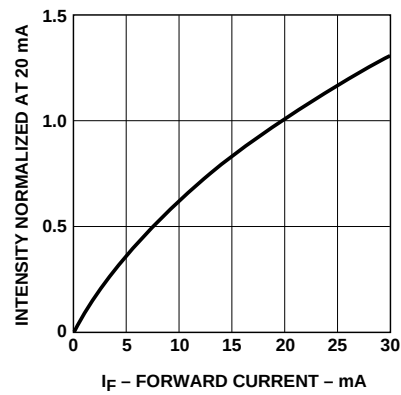


Figure 4. Blue, Green Relative Luminous Intensity vs. Forward Current.

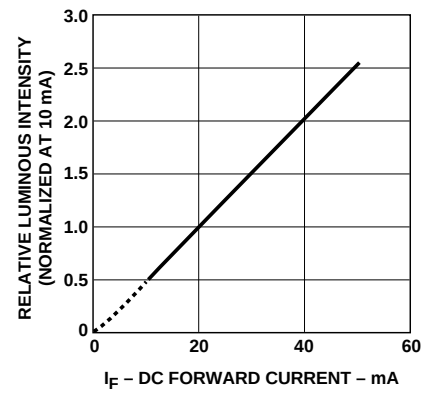


Figure 5. Amber, Red Relative Luminous Intensity vs. Forward Current.

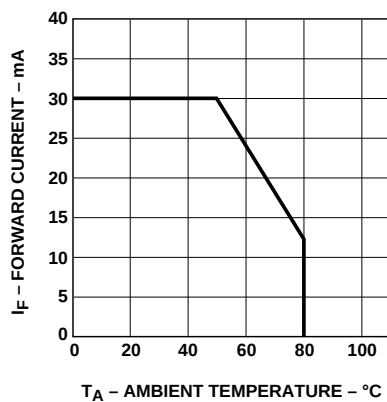


Figure 6. Blue, Green Maximum Forward Current vs. Ambient Temperature.

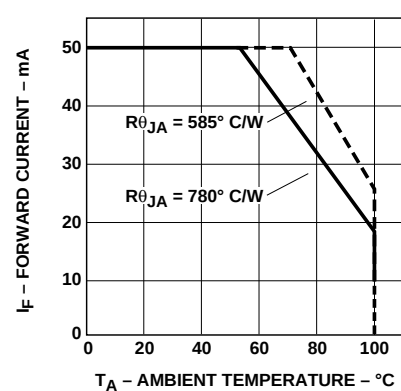
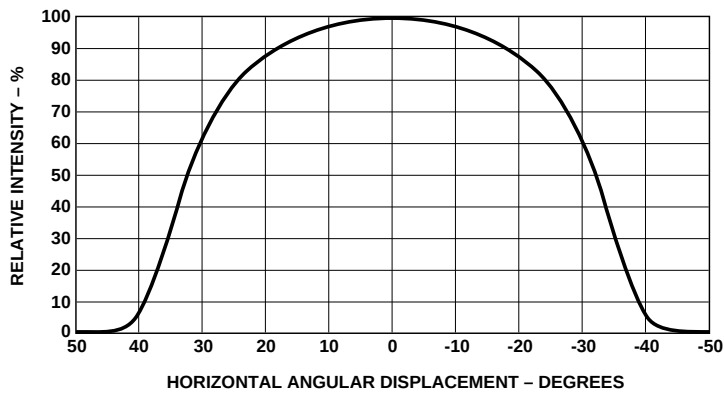
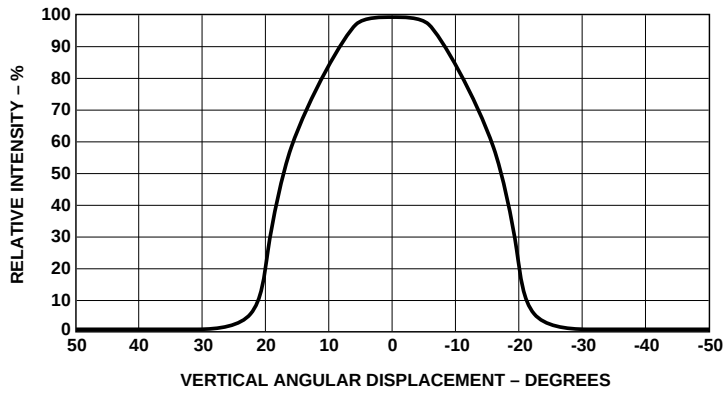


Figure 7. Amber, Red Maximum Forward Current vs. Ambient Temperature.



**Figure 8. Spatial Radiation Pattern – 35 x 70 Degree Lamps.**