

## LED Light Bars

HLCP-A100/-B100/-C100/D100/-E100/-F100/-G100/-H100

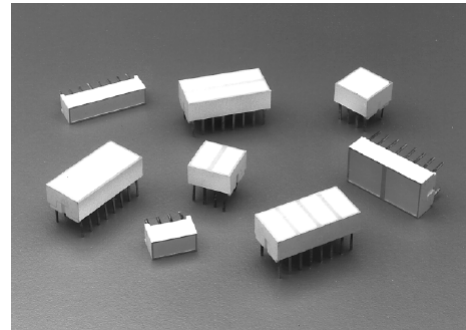
HLMP-2300/-2350/-2400/-2450/-2500/-2550

HLMP-2600/-2620/-2635/-2655/-2670/-2685

HLMP-2700/-2720/-2735/-2755/-2770/-2785

HLMP-2800/-2820/-2835/-2855/-2870/-2885

HLMP-2950/-2965



## Data Sheet

### Description

The HLCP-X100 and HLMP-2XXX series light bars are rectangular light sources designed for a variety of applications where a large bright source of light is required. These light bars are configured in single-in-line and dual-in-line packages that contain either single or segmented light emitting areas. The AlGaAs Red HLCP-X100 series LEDs use double hetero-junction AlGaAs on a GaAs substrate. The HER HLMP-2300/2600 and Yellow HLMP-2400/2700 series LEDs have their p-n junctions diffused into a GaAsP epitaxial layer on a GaP substrate. The Green HLMP-2500/2800 series LEDs use a liquid phase GaP epitaxial layer on a GaP substrate. The bicolor HLMP-2900 series use a combination of HER/Yellow or HER/Green LEDs.

### Features

- Large bright, uniform light emitting areas
- Choice of colors
- Categorized for light output
- Yellow and Green categorized for dominant wavelength
- Excellent ON-OFF contrast
- X-Y stackable
- Flush mountable
- Can be used with panel and legend mounts
- Light emitting surface suitable for legend attachment per Application Note 1012
- HLCP-X100 Series designed for low current operation
- Bicolor devices available

### Applications

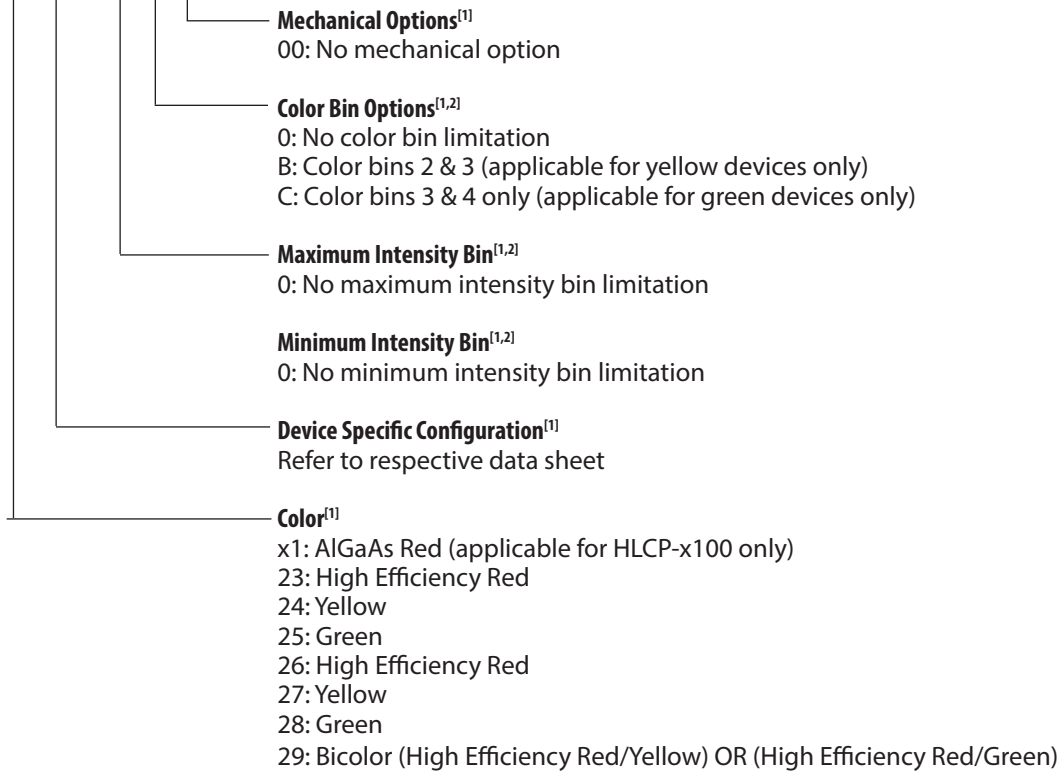
- Business machine message annunciators
- Telecommunications indicators
- Front panel process status indicators
- PC board identifiers
- Bar graphs

## Selection Guide

| Light Bar Part Number |      |                 |       | Size of Light<br>Emitting Areas             | Number of Light<br>Emitting Areas | Package Outline                                                                       |
|-----------------------|------|-----------------|-------|---------------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------|
| HLCP-<br>AlGaAs       | HER  | HLMP-<br>Yellow | Green |                                             |                                   |                                                                                       |
| A100                  | 2300 | 2400            | 2500  | 8.89 mm x 3.81 mm<br>(.350 in. x .150 in.)  | 1                                 | A  |
| B100                  | 2350 | 2450            | 2550  | 19.05 mm x 3.81 mm<br>(.750 in. x .150 in.) | 1                                 | B  |
| D100                  | 2600 | 2700            | 2800  | 8.89 mm x 3.81 mm<br>(.350 in. x .150 in.)  | 2                                 | D  |
| E100                  | 2620 | 2720            | 2820  | 8.89 mm x 3.81 mm<br>(.350 in. x .150 in.)  | 4                                 | E  |
| F100                  | 2635 | 2735            | 2835  | 3.81 mm x 19.05 mm<br>(.150 in. x .750 in.) | 2                                 | F  |
| C100                  | 2655 | 2755            | 2855  | 8.89 mm x 8.89 mm<br>(.350 in. x .350 in.)  | 1                                 | C  |
| G100                  | 2670 | 2770            | 2870  | 8.89 mm x 8.89 mm<br>(.350 in. x .350 in.)  | 2                                 | G  |
| H100                  | 2685 | 2785            | 2885  | 8.89 mm x 19.05 mm<br>(.350 in. x .750 in.) | 1                                 | H  |
|                       | 2950 | 2950            |       | 8.89 mm x 8.89 mm<br>(.350 in. x .350 in.)  | Bicolor                           | I  |
|                       | 2965 |                 | 2965  | 8.89 mm x 8.89 mm<br>(.350 in. x .350 in.)  | Bicolor                           | I  |

## Part Numbering System

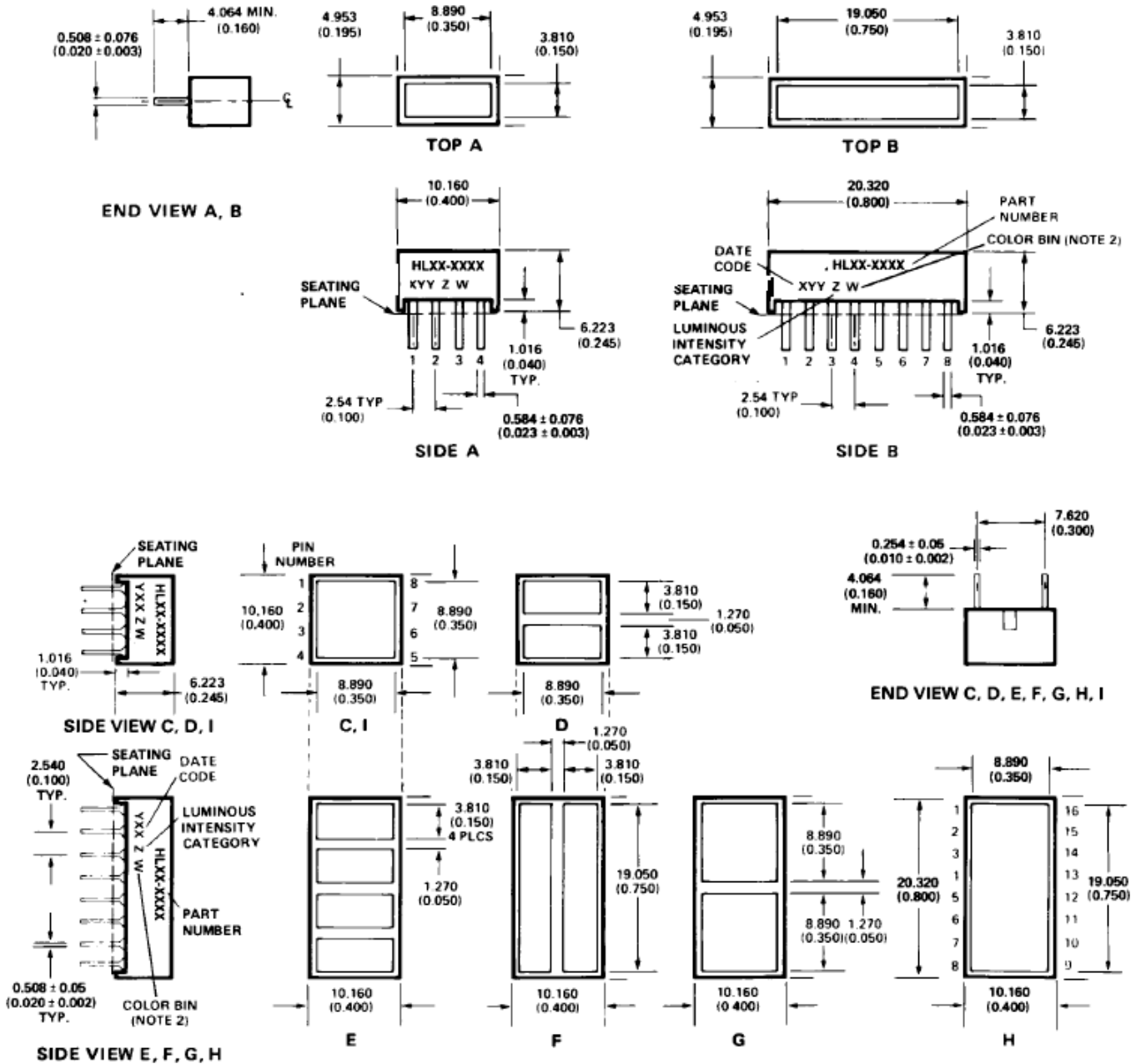
HLCP - xx xx - xx x xx  
 HLMP - xx xx - xx x xx



### Notes:

1. For codes not listed in the figure above, please refer to the respective data sheet or contact your nearest Avago representative for details.
2. Bin options refer to shippable bins for a part-number. Color and Intensity Bins are typically restricted to 1 bin per tube (exceptions may apply). Please refer to respective data sheet for specific bin limit information.

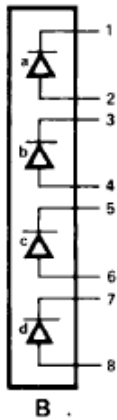
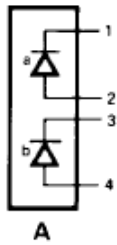
## Package Dimensions



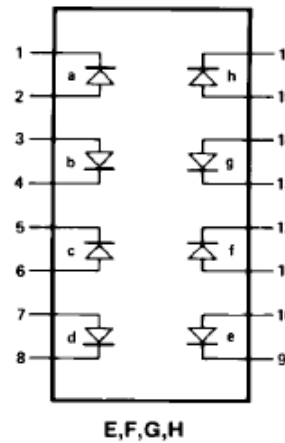
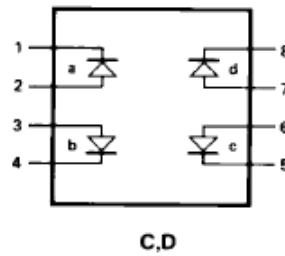
### NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES). TOLERANCES ±0.25 mm (±0.010 IN.) UNLESS OTHERWISE INDICATED.
2. FOR YELLOW AND GREEN DEVICES ONLY.

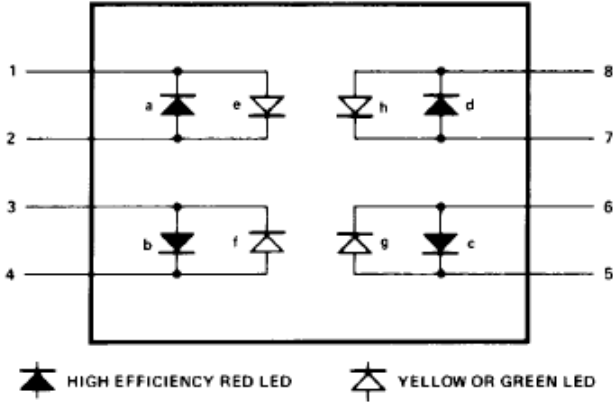
## Internal Circuit Diagrams



| PIN FUNCTION |                                |                                |
|--------------|--------------------------------|--------------------------------|
| PIN          | A<br>-2300/-2400<br>-2500/A100 | B<br>-2350/-2450<br>-2550/B100 |
| 1            | CATHODE a                      | CATHODE a                      |
| 2            | ANODE a                        | ANODE a                        |
| 3            | CATHODE b                      | CATHODE b                      |
| 4            | ANODE b                        | ANODE b                        |
| 5            |                                | CATHODE c                      |
| 6            |                                | ANODE c                        |
| 7            |                                | CATHODE d                      |
| 8            |                                | ANODE d                        |



| PIN | PIN FUNCTION |            |
|-----|--------------|------------|
|     | C, D         | E, F, G, H |
| 1   | CATHODE a    | CATHODE a  |
| 2   | ANODE a      | ANODE a    |
| 3   | ANODE b      | ANODE b    |
| 4   | CATHODE b    | CATHODE b  |
| 5   | CATHODE c    | CATHODE c  |
| 6   | ANODE c      | ANODE c    |
| 7   | ANODE d      | ANODE d    |
| 8   | CATHODE d    | CATHODE d  |
| 9   |              | CATHODE e  |
| 10  |              | ANODE e    |
| 11  |              | ANODE f    |
| 12  |              | CATHODE f  |
| 13  |              | CATHODE g  |
| 14  |              | ANODE g    |
| 15  |              | ANODE h    |
| 16  |              | CATHODE h  |



| PIN | PIN FUNCTION |                  |
|-----|--------------|------------------|
|     | HER          | YELLOW/<br>GREEN |
| 1   | CATHODE a    | ANODE e          |
| 2   | ANODE a      | CATHODE e        |
| 3   | ANODE b      | CATHODE f        |
| 4   | CATHODE b    | ANODE f          |
| 5   | CATHODE c    | ANODE g          |
| 6   | ANODE c      | CATHODE g        |
| 7   | ANODE d      | CATHODE h        |
| 8   | CATHODE d    | ANODE h          |

## Absolute Maximum Ratings

| Parameter                                                   | AlGaAs Red<br>HLCP-X100<br>Series | HER<br>HLMP-2300/<br>2600/29XX<br>Series | Yellow<br>HLMP-2400/<br>2700/2950<br>Series | Green<br>HLMP-2500/<br>2800/2965<br>Series |
|-------------------------------------------------------------|-----------------------------------|------------------------------------------|---------------------------------------------|--------------------------------------------|
| Average Power Dissipated per LED Chip                       | 37 mW <sup>[1]</sup>              | 135 mW <sup>[2]</sup>                    | 85 mW <sup>[3]</sup>                        | 135 mW <sup>[2]</sup>                      |
| Peak Forward Current per LED Chip                           | 45 mA <sup>[4]</sup>              | 90 mA <sup>[5]</sup>                     | 60 mA <sup>[5]</sup>                        | 90 mA <sup>[5]</sup>                       |
| Average Forward Current per LED Chip                        | 15 mA                             | 25 mA                                    | 20 mA                                       | 25 mA                                      |
| DC Forward Current per LED Chip                             | 15 mA <sup>[1]</sup>              | 30 mA <sup>[2]</sup>                     | 25 mA <sup>[3]</sup>                        | 30 mA <sup>[2]</sup>                       |
| Reverse Voltage* per LED Chip                               | 5 V                               |                                          | 6 V <sup>[6]</sup>                          |                                            |
| Operating Temperature Range                                 | –20°C to +100°C <sup>[7]</sup>    | –40°C to +85°C                           |                                             | –20°C to +85°C                             |
| Storage Temperature Range                                   | –40°C to +85°C                    |                                          |                                             |                                            |
| Wave Soldering Temperature<br>1.6 mm (1/16 inch) below Body | 250°C for 3 seconds               |                                          |                                             |                                            |

\* Reverse Voltage is for LED testing purpose and not recommended to be used as application condition.

### Notes:

1. Derate above 87°C at 1.7 mW/°C per LED chip. For DC operation, derate above 91°C at 0.8 mA/°C.
2. Derate above 25°C at 1.8 mW/°C per LED chip. For DC operation, derate above 50°C at 0.5 mA/°C.
3. Derate above 50°C at 1.8 mW/°C per LED chip. For DC operation, derate above 60°C at 0.5 mA/°C.
4. See Figure 1 to establish pulsed operation. Maximum pulse width is 1.5 mS.
5. See Figure 6 to establish pulsed operation. Maximum pulse width is 2 mS.
6. Does not apply to bicolor parts.
7. For operation below –20°C, contact your local Avago sales representative.

## Electrical/Optical Characteristics at T<sub>A</sub> = 25°C

### AlGaAs Red HLCP-X100 Series

| Parameter                                                          | HLCP-               | Symbol              | Min. | Typ. | Max. | Units        | Test Conditions         |
|--------------------------------------------------------------------|---------------------|---------------------|------|------|------|--------------|-------------------------|
| Luminous Intensity<br>per Lighting Emitting<br>Area <sup>[1]</sup> | A100/D100/E100      | I <sub>V</sub>      | 3    | 7.5  |      | mcd          | I <sub>F</sub> = 3 mA   |
|                                                                    | B100/C100/F100/G100 |                     | 6    | 15   |      | mcd          |                         |
|                                                                    | H100                |                     | 12   | 30   |      | mcd          |                         |
| Peak Wavelength                                                    |                     | λ <sub>PEAK</sub>   |      | 645  |      | nm           |                         |
| Dominant Wavelength <sup>[2]</sup>                                 |                     | λ <sub>d</sub>      |      | 637  |      | nm           |                         |
| Forward Voltage per LED                                            |                     | V <sub>F</sub>      |      | 1.8  | 2.2  | V            | I <sub>F</sub> = 20 mA  |
| Reverse Breakdown Voltage per LED                                  |                     | V <sub>R</sub>      | 5    | 15   |      | V            | I <sub>R</sub> = 100 μA |
| Thermal Resistance LED Junction-to-Pin                             |                     | Rθ <sub>J-PIN</sub> |      | 250  |      | °C/W/<br>LED |                         |

### High Efficiency Red HLMP-2300/2600/2900 Series

| Parameter                                                    | HLMP-                                   | Symbol            | Min. | Typ. | Max. | Units        | Test Conditions         |
|--------------------------------------------------------------|-----------------------------------------|-------------------|------|------|------|--------------|-------------------------|
| Luminous Intensity per Lighting Emitting Area <sup>[1]</sup> | 2300/2600/2620                          | $I_V$             | 6    | 23   |      | mcd          | $I_F = 20 \text{ mA}$   |
|                                                              | 2350/2635/2655/2670/2950 <sup>[3]</sup> |                   | 13   | 45   |      | mcd          |                         |
|                                                              | 2965 <sup>[4]</sup>                     |                   | 19   | 45   |      | mcd          |                         |
|                                                              | 2685                                    |                   | 22   | 80   |      | mcd          |                         |
| Peak Wavelength                                              |                                         | $\lambda_{PEAK}$  |      | 635  |      | nm           |                         |
| Dominant Wavelength <sup>[2]</sup>                           |                                         | $\lambda_d$       |      | 626  |      | nm           |                         |
| Forward Voltage per LED                                      |                                         | $V_F$             |      | 2.0  | 2.6  | V            | $I_F = 20 \text{ mA}$   |
| Reverse Breakdown Voltage per LED <sup>[5]</sup>             |                                         | $V_R$             | 6    | 15   |      | V            | $I_R = 100 \mu\text{A}$ |
| Thermal Resistance LED Junction-to-Pin                       |                                         | $R\theta_{J-PIN}$ |      | 150  |      | °C/W/<br>LED |                         |

### Yellow HLMP-2400/2700/2950 Series

| Parameter                                                    | HLMP-                                   | Symbol            | Min. | Typ. | Max. | Units        | Test Conditions         |
|--------------------------------------------------------------|-----------------------------------------|-------------------|------|------|------|--------------|-------------------------|
| Luminous Intensity per Lighting Emitting Area <sup>[1]</sup> | 2400/2700/2720                          | $I_V$             | 6    | 20   |      | mcd          | $I_F = 20 \text{ mA}$   |
|                                                              | 2450/2735/2755/2770/2950 <sup>[3]</sup> |                   | 13   | 38   |      | mcd          |                         |
|                                                              | 2785                                    |                   | 26   | 70   |      | mcd          |                         |
| Peak Wavelength                                              |                                         | $\lambda_{PEAK}$  |      | 583  |      | nm           |                         |
| Dominant Wavelength <sup>[2]</sup>                           |                                         | $\lambda_d$       |      | 585  |      | nm           |                         |
| Forward Voltage per LED                                      |                                         | $V_F$             |      | 2.1  | 2.6  | V            | $I_F = 20 \text{ mA}$   |
| Reverse Breakdown Voltage per LED <sup>[5]</sup>             |                                         | $V_R$             | 6    | 15   |      | V            | $I_R = 100 \mu\text{A}$ |
| Thermal Resistance LED Junction-to-Pin                       |                                         | $R\theta_{J-PIN}$ |      | 150  |      | °C/W/<br>LED |                         |

### High Performance Green HLMP-2500/2800/2965 Series

| Parameter                                                    | HLMP-               | Symbol            | Min. | Typ. | Max. | Units        | Test Conditions         |
|--------------------------------------------------------------|---------------------|-------------------|------|------|------|--------------|-------------------------|
| Luminous Intensity per Lighting Emitting Area <sup>[1]</sup> | 2500/2800/2820      | $I_V$             | 5    | 25   |      | mcd          | $I_F = 20 \text{ mA}$   |
|                                                              | 2550/2835/2855/2870 |                   | 11   | 50   |      | mcd          |                         |
|                                                              | 2965 <sup>[4]</sup> |                   | 25   | 50   |      | mcd          |                         |
|                                                              | 2885                |                   | 22   | 100  |      | mcd          |                         |
| Peak Wavelength                                              |                     | $\lambda_{PEAK}$  |      | 565  |      | nm           |                         |
| Dominant Wavelength <sup>[2]</sup>                           |                     | $\lambda_d$       |      | 572  |      | nm           |                         |
| Forward Voltage per LED                                      |                     | $V_F$             |      | 2.2  | 2.6  | V            | $I_F = 20 \text{ mA}$   |
| Reverse Breakdown Voltage per LED <sup>[5]</sup>             |                     | $V_R$             | 6    | 15   |      | V            | $I_R = 100 \mu\text{A}$ |
| Thermal Resistance LED Junction-to-Pin                       |                     | $R\theta_{J-PIN}$ |      | 150  |      | °C/W/<br>LED |                         |

#### Notes:

1. These devices are categorized for luminous intensity. The intensity category is designated by a letter code on the side of the package.
2. The dominant wavelength,  $\lambda_d$ , is derived from the CIE chromaticity diagram and is the single wavelength which defines the color of the device. Yellow and Green devices are categorized for dominant wavelength with the color bin designated by a number code on the side of the package.
3. This is an HER/Yellow bicolor light bar. HER electrical/optical characteristics are shown in the HER table. Yellow electrical/optical characteristics are shown in the Yellow table.
4. This is an HER/Green bicolor light bar. HER electrical/optical characteristics are shown in the HER table. Green electrical/optical characteristics are shown in the Green table.
5. Does not apply to HLMP-2950 or HLMP-2965.

## AlGaAs Red

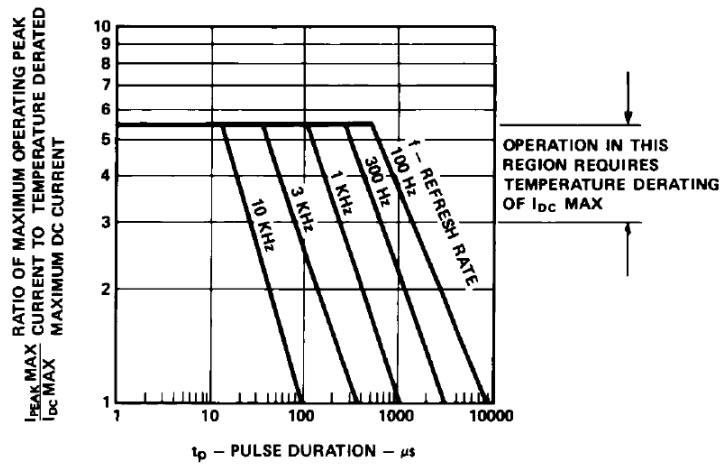


Figure 1. Maximum Allowable Peak Current vs. Pulse Duration.

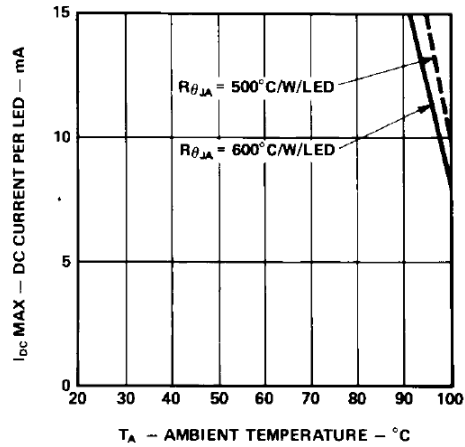


Figure 2. Maximum Allowed DC Current per LED vs. Ambient Temperature,  $T_J MAX = 110^\circ\text{C}$ .

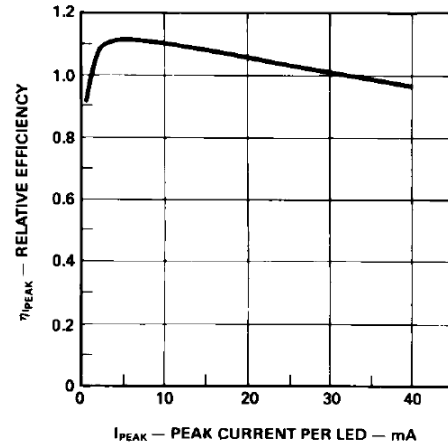


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak LED Current.

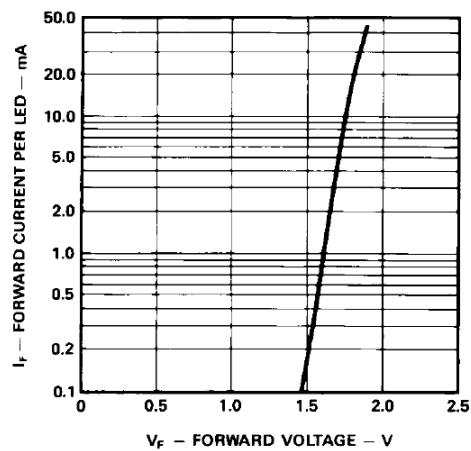


Figure 4. Forward Current vs. Forward Voltage.

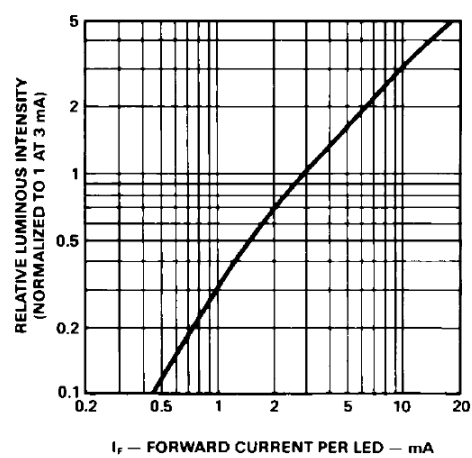


Figure 5. Relative Luminous Intensity vs. DC Forward Current.

## HER, Yellow, Green

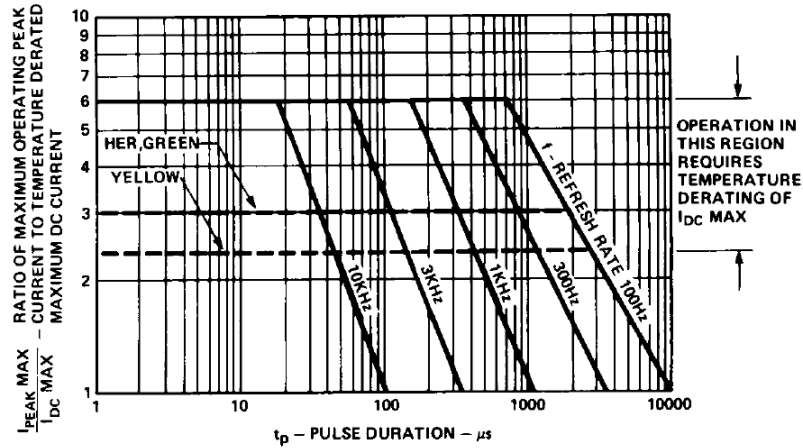


Figure 6. Maximum Allowed Peak Current vs. Pulse Duration.

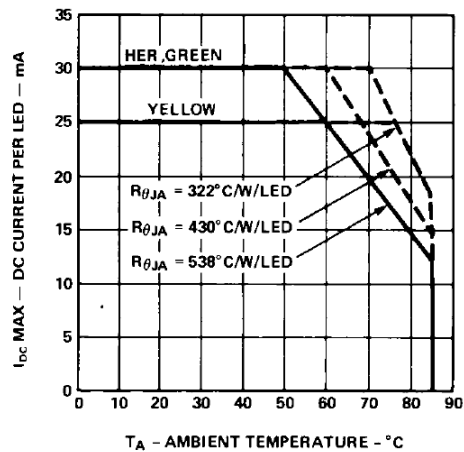


Figure 7. Maximum Allowable DC Current per LED vs. Ambient Temperature,  $T_J$  MAX = 100°C.

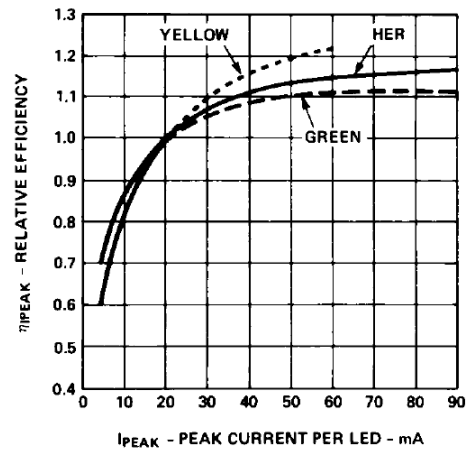


Figure 8. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak LED Current.

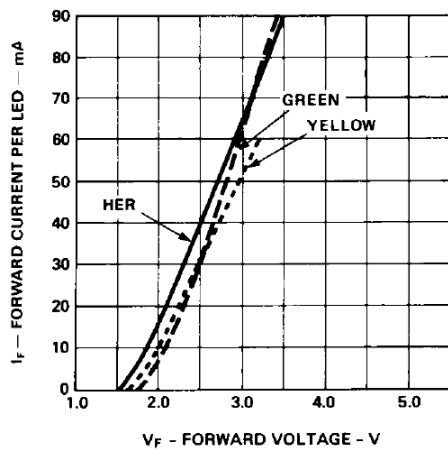


Figure 9. Forward Current vs. Forward Voltage Characteristics.

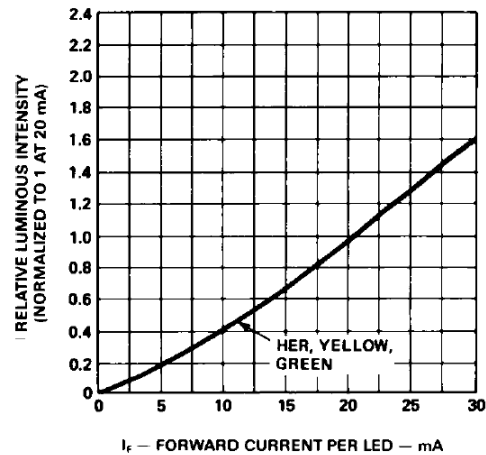


Figure 10. Relative Luminous Intensity vs. DC Forward Current.

For a detailed explanation on the use of data sheet information and recommended soldering procedures, see Application Notes 1005, 1027, and 1031.

## Intensity Bin Limits (mcd)

### HLMP-2300/2600/2620 Annunciators (.2 x .4 HER/AlGaAs), HLCP-A100/D100/E100

| IV Bin Category | Min.  | Max.  |
|-----------------|-------|-------|
| A               | 3.00  | 5.60  |
| B               | 4.50  | 8.20  |
| C               | 6.80  | 12.10 |
| D               | 10.10 | 18.50 |
| E               | 15.30 | 27.80 |
| F               | 22.80 | 45.50 |
| G               | 36.90 | 73.80 |

Notes:

1. Minimum category A for Red L/C AlGaAs (-A100/-D100/-E100).
2. Minimum category C for HER (-2300/-2600/-2620).

### HLMP-2350/2635/2655/2670 Annunciators (.2 x .8 HER/AlGaAs), HLCP-B100/C100/F100/G100 (.4 x .4 HER/AlGaAs)

| IV Bin Category | Min.  | Max.   |
|-----------------|-------|--------|
| A               | 5.40  | 10.90  |
| B               | 9.00  | 16.00  |
| C               | 13.10 | 24.00  |
| D               | 19.70 | 36.10  |
| E               | 29.60 | 54.20  |
| F               | 44.90 | 88.80  |
| G               | 71.90 | 143.80 |

Notes:

1. Minimum category A for Red L/C AlGaAs (-B100/-C100/-F100/-G100).
2. Minimum category C for HER (-2350/-2635/-2670).

### HLMP-2685/HLCP-H100 Annunciators (.4 x .8 HER/AlGaAs)

| IV Bin Category | Min.   | Max.   |
|-----------------|--------|--------|
| A               | 10.80  | 22.00  |
| B               | 18.00  | 27.10  |
| C               | 22.00  | 40.80  |
| D               | 33.30  | 61.10  |
| E               | 50.00  | 91.80  |
| F               | 75.10  | 150.00 |
| G               | 121.70 | 243.40 |

Notes:

1. Minimum category A for Red L/C AlGaAs (-H100).
2. Minimum category C for HER (-2685).

### HLMP-2400/2700/2720 Annunciators (.2 x .4 Yellow)

| IV Bin Category | Min.  | Max.  |
|-----------------|-------|-------|
| C               | 6.10  | 11.20 |
| D               | 9.20  | 16.80 |
| E               | 13.80 | 25.30 |
| F               | 20.70 | 41.40 |
| G               | 33.60 | 67.20 |

### HLMP-2450/2735/2755/2770 Annunciators (.2 x .8 Yellow & .4 x .4 Yellow)

| IV Bin Category | Min.  | Max.   |
|-----------------|-------|--------|
| C               | 13.00 | 22.00  |
| D               | 18.00 | 33.00  |
| E               | 27.00 | 50.00  |
| F               | 40.50 | 81.00  |
| G               | 65.60 | 131.20 |

### HLMP-2785 Annunciators (.4 x .8 Yellow)

| IV Bin Category | Min.   | Max.   |
|-----------------|--------|--------|
| C               | 26.00  | 44.40  |
| D               | 36.00  | 66.00  |
| E               | 54.00  | 99.00  |
| F               | 81.00  | 162.00 |
| G               | 131.40 | 262.80 |

### HLMP-2500/2800/2820 Annunciators (.2 x .4 Yellow)

| IV Bin Category | Min.  | Max.   |
|-----------------|-------|--------|
| C               | 5.60  | 10.20  |
| D               | 8.40  | 15.30  |
| E               | 12.60 | 23.10  |
| F               | 18.90 | 37.80  |
| G               | 30.60 | 61.20  |
| H               | 49.50 | 97.90  |
| I               | 80.10 | 158.40 |

### HLMP-2550/2835/2855/2870 Annunciators (.2 x .8/.4 x .4 Green)

| IV Bin Category | Min.   | Max.   |
|-----------------|--------|--------|
| C               | 11.30  | 20.60  |
| D               | 17.00  | 31.00  |
| E               | 25.40  | 46.50  |
| F               | 38.10  | 76.20  |
| G               | 61.60  | 123.20 |
| H               | 99.81  | 197.67 |
| I               | 161.73 | 320.21 |

**HLMP-2885 Annunciators (.4 x .8 Green)**

| IV Bin Category | Min.   | Max.   |
|-----------------|--------|--------|
| C               | 22.20  | 40.80  |
| D               | 33.40  | 61.20  |
| E               | 50.10  | 91.90  |
| F               | 75.10  | 150.30 |
| G               | 121.10 | 242.20 |
| H               | 196.10 | 383.50 |
| I               | 313.70 | 613.60 |

**HLMP-2950 Bi-Color Annunciators (.4 x .4 HER/Yellow)****Red Iv Categories**

| IV Bin Category | Min.  | Max.   |
|-----------------|-------|--------|
| C               | 11.30 | 20.60  |
| D               | 17.00 | 31.00  |
| E               | 25.40 | 46.50  |
| F               | 38.10 | 76.20  |
| G               | 61.60 | 123.20 |

**Yellow Iv Categories**

| IV Bin Category | Min.  | Max.   |
|-----------------|-------|--------|
| C               | 13.00 | 22.00  |
| D               | 18.00 | 33.00  |
| E               | 27.00 | 50.00  |
| F               | 40.50 | 81.00  |
| G               | 65.60 | 131.20 |

**HLMP-2965 Bi-Color Annunciators (.4 x .4/.2 x .8 HER/Green)****Red Iv Categories**

| IV Bin Category | Min.  | Max.   |
|-----------------|-------|--------|
| D               | 19.70 | 36.10  |
| E               | 29.60 | 54.20  |
| F               | 44.90 | 88.80  |
| G               | 71.90 | 143.80 |

**Green Iv Categories**

| IV Bin Category | Min.   | Max.   |
|-----------------|--------|--------|
| B               | 7.50   | 13.90  |
| C               | 11.30  | 20.60  |
| D               | 17.00  | 31.00  |
| E               | 25.40  | 46.50  |
| F               | 38.10  | 76.20  |
| G               | 61.60  | 123.20 |
| H               | 100.00 | 200.00 |

## Notes:

1. Minimum category D for LPE Green (-2965).
2. In green mode, the devices are to be color binned into standard color bins, per Table 2. (-2685).

**Color Categories****Dominant Wavelength (nm)**

| Color  | Bin | Min.   | Max.   |
|--------|-----|--------|--------|
| Yellow | 0   | 579.0  | 582.5  |
|        | 1   | 581.5  | 585.0  |
|        | 3   | 584.0  | 587.5  |
|        | 2   | 586.5  | 590.0  |
|        | 4   | 589.0  | 592.5  |
| Green  | 5   | 591.5  | 595.0  |
|        | 2   | 573.00 | 577.00 |
|        | 3   | 570.00 | 574.00 |
|        | 4   | 567.00 | 571.00 |
|        | 5   | 564.00 | 568.00 |

## Notes:

All categories are established for classification of products. Products may not be available in all categories. Please contact your local Avago representatives for further clarification/information.

## Electrical

These light bars are composed of two, four, or eight light emitting diodes, with the light from each LED optically scattered to form an evenly illuminated light emitting surface.

The anode and cathode of each LED is brought out by separate pins. This universal pinout arrangement allows the LEDs to be connected in three possible configurations: parallel, series, or series parallel. The typical forward voltage values can be scaled from Figures 4 and 9. These values should be used to calculate the current limiting resistor value and typical power consumption. Expected maximum  $V_F$  values for driver circuit design and maximum power dissipation, may be calculated using the following  $V_F$  MAX models:

AlGaAs Red HLCP-X100 series

$$V_{F\text{MAX}} = 1.8 \text{ V} + I_{\text{Peak}} (20 \Omega)$$

$$\text{For: } I_{\text{Peak}} \leq 20 \text{ mA}$$

$$V_{F\text{MAX}} = 2.0 \text{ V} + I_{\text{Peak}} (10 \Omega)$$

$$\text{For: } 20 \text{ mA} \leq I_{\text{Peak}} \leq 45 \text{ mA}$$

HER (HLMP-2300/2600/2900), Yellow (HLMP-2400/2700/2900) and Green (HLMP-2500/2800/2900) series

$$V_{F\text{MAX}} = 1.6 + I_{\text{Peak}} (50 \Omega)$$

$$\text{For: } 5 \text{ mA} \leq I_{\text{Peak}} \leq 20 \text{ mA}$$

$$V_{F\text{MAX}} = 1.8 + I_{\text{Peak}} (40 \Omega)$$

$$\text{For: } I_{\text{Peak}} \geq 20 \text{ mA}$$

The maximum power dissipation can be calculated for any pulsed or DC drive condition. For DC operation, the maximum power dissipation is the product of the maximum forward voltage and the maximum forward current. For pulsed operation, the maximum power dissipation is the product of the maximum forward voltage at the peak forward current times the maximum average forward current. Maximum allowable power dissipation for any given ambient temperature and thermal resistance ( $R_{\theta J-A}$ ) can be determined by using Figure 2 or 7. The solid line in Figure 2 or 7 ( $R_{\theta J-A}$  of 600/538 C/W) represents a typical thermal resistance of a device socketed in a printed circuit board. The dashed lines represent achievable thermal resistances that can be obtained through improved thermal design. Once the maximum allowable power dissipation is determined, the maximum pulsed or DC forward current can be calculated.

## Optical

| Size of Light Emitting Area | Surface Area              |                            |
|-----------------------------|---------------------------|----------------------------|
|                             | Sq. Metres                | Sq. Feet                   |
| 8.89 mm x 8.89 mm           | 67.74 x 10 <sup>-6</sup>  | 729.16 x 10 <sup>-6</sup>  |
| 8.89 mm x 3.81 mm           | 33.87 x 10 <sup>-6</sup>  | 364.58 x 10 <sup>-6</sup>  |
| 8.89 mm x 19.05 mm          | 135.48 x 10 <sup>-6</sup> | 1458.32 x 10 <sup>-6</sup> |
| 3.81 mm x 19.05 mm          | 72.85 x 10 <sup>-6</sup>  | 781.25 x 10 <sup>-6</sup>  |

The radiation pattern for these light bar devices is approximately Lambertian. The luminous sterance may be calculated using one of the two following formulas:

$$L_v (\text{cd/m}^2) = \frac{I_v (\text{cd})}{A (\text{m}^2)}$$

$$L_v (\text{footlamberts}) = \frac{\pi I_v (\text{cd})}{A (\text{ft}^2)}$$

Refresh rates of 1 kHz or faster provide the most efficient operation resulting in the maximum possible time average luminous intensity.

The time average luminous intensity may be calculated using the relative efficiency characteristic of Figure 3 or 8,  $\eta I_{\text{PEAK}}$  and adjusted for operating ambient temperature. The time average luminous intensity at  $T_A = 25^\circ\text{C}$  is calculated as follows:

$$I_{v\text{ TIME AVG}} = \left[ \frac{I_{\text{AVG}}}{I_{\text{TEST}}} \right] (\eta I_{\text{PEAK}}) (I_v \text{ Data Sheet})$$

where:

$$I_{\text{TEST}} = 3 \text{ mA}$$

for AlGaAs Red (HLMP-X000 series) 20 mA  
for HER, Yellow and Green (HLMP-2XXX series)

Example:

For HLMP-2735 series

$$\eta I_{\text{PEAK}} = 1.18 \text{ at } I_{\text{PEAK}} = 48 \text{ mA}$$

$$I_{v\text{ TIME AVG}} = \left[ \frac{12 \text{ mA}}{20 \text{ mA}} \right] (1.18) (35 \text{ mcd})$$

$$= 25 \text{ mcd}$$

The time average luminous intensity may be adjusted for operating ambient temperature by the following exponential equation:

$$I_v(T_A) = I_v(25^\circ\text{C})e^{[K(T - 25^\circ\text{C})]}$$

| Color      | K          |
|------------|------------|
| AlGaAs Red | -0.0095/°C |
| HER        | -0.0131/°C |
| Yellow     | -0.0112/°C |
| Green      | -0.0104/°C |

Example:

$$I_v(80^\circ\text{C}) = (25 \text{ mcd})e^{[-0.0112(80-25)]}$$

$$= 14 \text{ mcd.}$$

## Mechanical

These light bar devices may be operated in ambient temperatures above +60°C without derating when installed in a PC board configuration that provides a thermal resistance pin to ambient value less than 280°C/W/LED. See Figure 2 or 7 to determine the maximum allowed thermal resistance for the PC board,  $R_{\theta_{PC-A}}$ , which will permit nonderated operation in a given ambient temperature.

To optimize device optical performance, specially developed plastics are used which restrict the solvents that may be used for cleaning. It is recommended that only mixtures of Freon (F113) and alcohol be used for vapor cleaning processes, with an immersion time in the vapors of less than two (2) minutes maximum. Some suggested vapor cleaning solvents are Freon TE, Genesolv DES, Arklone A or K. A 60°C (140°F) water cleaning process may also be used, which includes a neutralizer rinse (3% ammonia solution or equivalent), a surfactant rinse (1% detergent solution or equivalent), a hot water rinse and a thorough air dry. Room temperature cleaning may be accomplished with Freon T-E35 or T-P35, Ethanol, Iso-propanol or water with a mild detergent.

For further information on soldering LEDs please refer to Application Note 1027.

For product information and a complete list of distributors, please go to our web site: [www.avagotech.com](http://www.avagotech.com)

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