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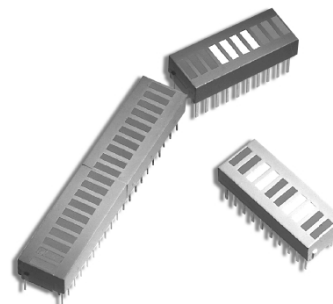
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# HDSP-4830/4840/4850, HDSP-4832/4836 & HLCP-J100

## 10-Element Bar Graph Array



## Data Sheet



### Description

These 10-element LED arrays are designed to display information in easily recognizable bar graph form. The packages are end stackable and therefore capable of displaying long strings of information. Use of these bar graph arrays eliminates the alignment, intensity, and color matching problems associated with discrete LEDs. The HDSP-4830/4840/4850 and HLCPJ100 each contain LEDs of one color. The HDSP-4832/4836 are multicolor arrays with High Efficiency Red, Yellow, and High Performance Green LEDs in a single package.

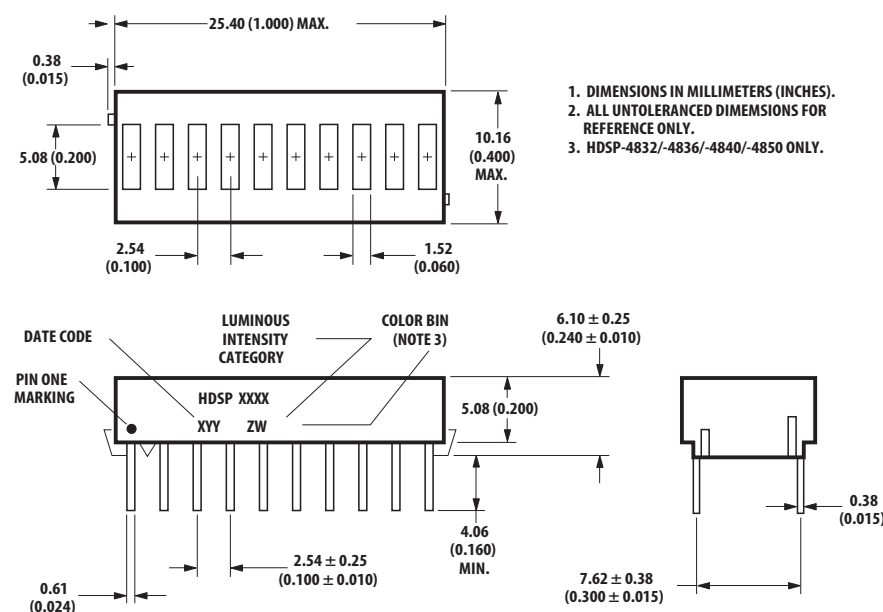
### Applications

- Industrial Controls
- Instrumentation
- Office Equipment
- Computer Peripherals
- Consumer Products

### Features

- Custom Multicolor Array Capability
- Matched LEDs for Uniform Appearance
- End Stackable
- Package Interlock Ensures Correct Alignment
- Low Profile Package
- Rugged Construction
- Large, Easily Recognizable Segments
- High ON-OFF Contrast, Segment to Segment
- Wide Viewing Angle
- Categorized for Luminous Intensity
- HDSP-4832/4836/4840/4850 Categorized for Dominant Wavelength
- HLCP-J100 Operates at Low Current  
Typical Intensity of 1.0 mcd at 1 mA Drive Current

### Package Dimensions



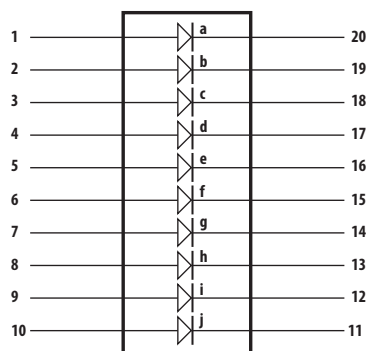
## Absolute Maximum Ratings [1]

| Parameter                                                                           | AlGaAs Red<br>HLCP-J100 | HER<br>HDSP-4830        | Yellow<br>HDSP-4840  | Green<br>HDSP-4850   |
|-------------------------------------------------------------------------------------|-------------------------|-------------------------|----------------------|----------------------|
| Average Power Dissipation per LED<br>( $T_A = 25^\circ\text{C}$ )                   | 37 mW                   | 87 mW                   | 50 mW                | 105 mW               |
| Peak Forward Current per LED                                                        | 45 mA <sup>[3]</sup>    | 90 mA <sup>[4]</sup>    | 60 mA <sup>[4]</sup> | 90 mA <sup>[4]</sup> |
| DC Forward Current per LED                                                          | 15 mA <sup>[5]</sup>    | 30 mA <sup>[6]</sup>    | 20 mA <sup>[6]</sup> | 30 mA <sup>[6]</sup> |
| Operating Temperature Range                                                         | -20°C to +100°C         | -40°C to +85°C          |                      | -20°C to +85°C       |
| Storage Temperature Range                                                           | -55°C to +100°C         |                         | -40°C to +85°C       |                      |
| Reverse Voltage per LED                                                             | 5.0 V                   |                         | 3.0 V                |                      |
| Lead Solder Dipping Temperature<br>(1.59 mm (1/16 inch)<br>below seating plane) [7] |                         | 260°C for 5 seconds [8] |                      |                      |
| Wave Soldering Temperature<br>(at 2 mm distance from the body)                      |                         | 250°C for 3 seconds     |                      |                      |

### Notes:

1. Absolute maximum ratings for HER, Yellow, and Green elements of the multicolor arrays are identical to the HDSP-4830/4840/4850 maximum ratings.
2. See Figure 1 to establish pulsed operating conditions. Maximum pulse width is 1.5 ms.
3. See Figure 2 to establish pulsed operating conditions. Maximum pulse width is 1.5 ms.
4. See Figure 8 to establish pulsed operating conditions. Maximum pulse width is 2 ms.
5. Derate maximum DC current for Red above  $T_A = 62^\circ\text{C}$  at 0.79 mA/°C, and AlGaAs Red above  $T_A = 91^\circ\text{C}$  at 0.8 mA/°C. See Figure 3.
6. Derate maximum DC current for HER above  $T_A = 48^\circ\text{C}$  at 0.58 mA/°C, Yellow above  $T_A = 70^\circ\text{C}$  at 0.66 mA/°C, and Green above  $T_A = 37^\circ\text{C}$  at 0.48 mA/°C. See Figure 9.
7. Clean only in water, isopropanol, ethanol, Freon TF or TE (or equivalent), or Genesolve DI-15 (or equivalent).
8. Maximum tolerable component side temperature is 134°C during solder process.

## Internal Circuit Diagram



| Pin | Function | Pin | Function  |
|-----|----------|-----|-----------|
| 1   | Anode a  | 11  | Cathode j |
| 2   | Anode b  | 12  | Cathode i |
| 3   | Anode c  | 13  | Cathode h |
| 4   | Anode d  | 14  | Cathode g |
| 5   | Anode e  | 15  | Cathode f |
| 6   | Anode f  | 16  | Cathode e |
| 7   | Anode g  | 17  | Cathode d |
| 8   | Anode h  | 18  | Cathode c |
| 9   | Anode i  | 19  | Cathode b |
| 10  | Anode j  | 20  | Cathode a |

## Multicolor Array Segment Colors

| Segment | HDSP-4832<br>Segment Color | HDSP-4836<br>Segment Color |
|---------|----------------------------|----------------------------|
| a       | HER                        | HER                        |
| b       | HER                        | HER                        |
| c       | HER                        | Yellow                     |
| d       | Yellow                     | Yellow                     |
| e       | Yellow                     | Green                      |
| f       | Yellow                     | Green                      |
| g       | Yellow                     | Yellow                     |
| h       | Green                      | Yellow                     |
| i       | Green                      | HER                        |
| j       | Green                      | HER                        |

## Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}^{[4]}$

### AlGaAs Red HLCP-J100

| Parameter                                                   | Symbol                        | Min. | Typ. | Max. | Units                  | Test Conditions                                 |
|-------------------------------------------------------------|-------------------------------|------|------|------|------------------------|-------------------------------------------------|
| Luminous Intensity per LED<br>(Unit Average) <sup>[1]</sup> | $I_V$                         | 600  | 1000 |      | $\mu\text{cd}$         | $I_F = 1 \text{ mA}$                            |
|                                                             |                               |      | 5200 |      |                        | $I_F = 20 \text{ mA Pk};$<br>1 of 4 Duty Factor |
| Peak Wavelength                                             | $\lambda_{\text{PEAK}}$       |      | 645  |      | nm                     |                                                 |
| Dominant Wavelength <sup>[2]</sup>                          | $\lambda_d$                   |      | 637  |      | nm                     |                                                 |
| Forward Voltage per LED                                     | $V_F$                         |      | 1.6  |      | V                      | $I_F = 1 \text{ mA}$                            |
|                                                             |                               |      | 1.8  | 2.2  |                        | $I_F = 20 \text{ mA}$                           |
| Reverse Voltage per LED <sup>[5]</sup>                      | $V_R$                         | 5    | 1.5  |      | V                      | $I_R = 100 \mu\text{A}$                         |
| Temperature Coefficient $V_F$ per LED                       | $\Delta V_F / ^\circ\text{C}$ |      | -2.0 |      | mV/ $^\circ\text{C}$   |                                                 |
| Thermal Resistance LED Junction-to-Pin                      | $R\theta_{J-PIN}$             |      | 300  |      | $^\circ\text{C/W/LED}$ |                                                 |

### High Efficiency Red HDSP-4830

| Parameter                                                  | Symbol                        | Min. | Typ. | Max. | Units                  | Test Conditions         |
|------------------------------------------------------------|-------------------------------|------|------|------|------------------------|-------------------------|
| Luminous Intensity per LED (Unit Average) <sup>[1,4]</sup> | $I_V$                         | 900  | 3500 |      | $\mu\text{cd}$         | $I_F = 10 \text{ mA}$   |
| Peak Wavelength                                            | $\lambda_{\text{PEAK}}$       |      | 635  |      | nm                     |                         |
| Dominant Wavelength <sup>[2]</sup>                         | $\lambda_d$                   |      | 626  |      | nm                     |                         |
| Forward Voltage per LED                                    | $V_F$                         |      | 2.1  | 2.5  | V                      | $I_F = 20 \text{ mA}$   |
| Reverse Voltage per LED <sup>[5]</sup>                     | $V_R$                         | 3    | 30   |      | V                      | $I_R = 100 \mu\text{A}$ |
| Temperature Coefficient $V_F$ per LED                      | $\Delta V_F / ^\circ\text{C}$ |      | -2.0 |      | mV/ $^\circ\text{C}$   |                         |
| Thermal Resistance LED Junction-to-Pin                     | $R\theta_{J-PIN}$             |      | 300  |      | $^\circ\text{C/W/LED}$ |                         |

### Yellow HDSP-4840

| Parameter                                                  | Symbol                        | Min. | Typ. | Max. | Units                  | Test Conditions         |
|------------------------------------------------------------|-------------------------------|------|------|------|------------------------|-------------------------|
| Luminous Intensity per LED (Unit Average) <sup>[1,4]</sup> | $I_V$                         | 600  | 1900 |      | $\mu\text{cd}$         | $I_F = 10 \text{ mA}$   |
| Peak Wavelength                                            | $\lambda_{\text{PEAK}}$       |      | 583  |      | nm                     |                         |
| Dominant Wavelength <sup>[2,3]</sup>                       | $\lambda_d$                   | 581  | 585  | 592  | nm                     |                         |
| Forward Voltage per LED                                    | $V_F$                         |      | 2.2  | 2.5  | V                      | $I_F = 20 \text{ mA}$   |
| Reverse Voltage per LED <sup>[5]</sup>                     | $V_R$                         | 3    | 40   |      | V                      | $I_R = 100 \mu\text{A}$ |
| Temperature Coefficient $V_F$ per LED                      | $\Delta V_F / ^\circ\text{C}$ |      | -2.0 |      | mV/ $^\circ\text{C}$   |                         |
| Thermal Resistance LED Junction-to-Pin                     | $R\theta_{J-PIN}$             |      | 300  |      | $^\circ\text{C/W/LED}$ |                         |

### Green HDSP-4850

| Parameter                                                  | Symbol                        | Min. | Typ. | Max. | Units                  | Test Conditions         |
|------------------------------------------------------------|-------------------------------|------|------|------|------------------------|-------------------------|
| Luminous Intensity per LED (Unit Average) <sup>[1,4]</sup> | $I_V$                         | 600  | 1900 |      | $\mu\text{cd}$         | $I_F = 10 \text{ mA}$   |
| Peak Wavelength                                            | $\lambda_{\text{PEAK}}$       |      | 566  |      | nm                     |                         |
| Dominant Wavelength <sup>[2,3]</sup>                       | $\lambda_d$                   |      | 571  | 577  | nm                     |                         |
| Forward Voltage per LED                                    | $V_F$                         |      | 2.1  | 2.5  | V                      | $I_F = 20 \text{ mA}$   |
| Reverse Voltage per LED <sup>[5]</sup>                     | $V_R$                         | 3    | 50   |      | V                      | $I_R = 100 \mu\text{A}$ |
| Temperature Coefficient $V_F$ per LED                      | $\Delta V_F / ^\circ\text{C}$ |      | -2.0 |      | mV/ $^\circ\text{C}$   |                         |
| Thermal Resistance LED Junction-to-Pin                     | $R\theta_{J-PIN}$             |      | 300  |      | $^\circ\text{C/W/LED}$ |                         |

Notes:

1. The bar graph arrays are categorized for luminous intensity. The category is designated by a letter located on the side of the package.
2. The dominant wavelength,  $\lambda_d$ , is derived from the CIE chromaticity diagram and is that single wavelength which defines the color of the device.
3. The HDSP-4832/-4836/-4840/-4850 bar graph arrays are categorized by dominant wavelength with the category designated by a number adjacent to the intensity category letter. Only the yellow elements of the HDSP-4832/-4836 are categorized for color.
4. Electrical/optical characteristics of the High-Efficiency Red elements of the HDSP-4832/-4836 are identical to the HDSP-4830 characteristics. Characteristics of Yellow elements of the HDSP-4832/-4836 are identical to the HDSP-4840. Characteristics of Green elements of the HDSP-4832/-4836 are identical to the HDSP-4850.
5. Reverse voltage per LED should be limited to 3.0 V max. for the HDSP-4830/-4840/-4850/-4832/-4836 and 5.0 V max. for the HLCP-J100.

## Red, AlGaAs Red

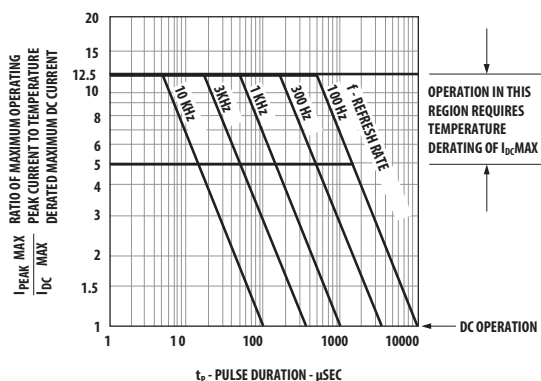


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration – Red.

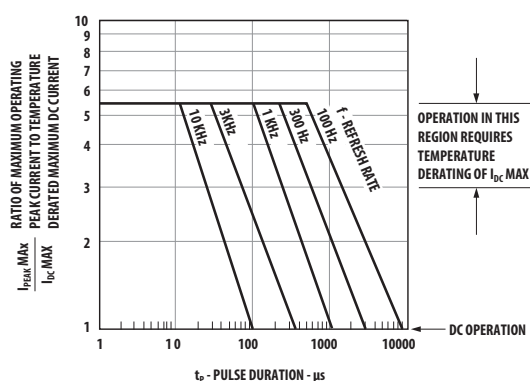


Figure 2. Maximum Tolerable Peak Current vs. Pulse Duration – AlGaAs Red.

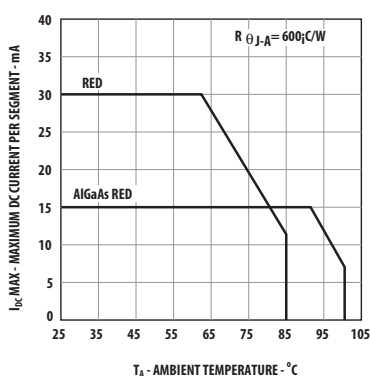


Figure 3. Maximum Allowable DC Current vs. Ambient Temperature.  
 $T_{JMAX} = 100^{\circ}\text{C}$  for Red and  $T_{JMAX} = 110^{\circ}\text{C}$  for AlGaAs Red.

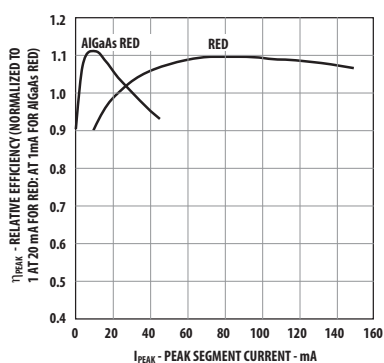


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

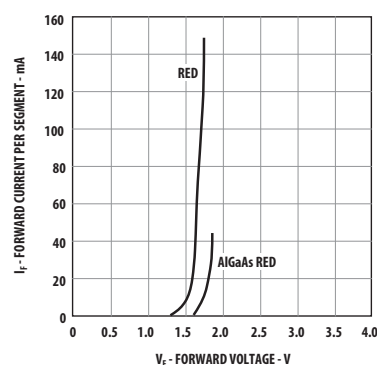


Figure 5. Forward Current vs. Forward Voltage.

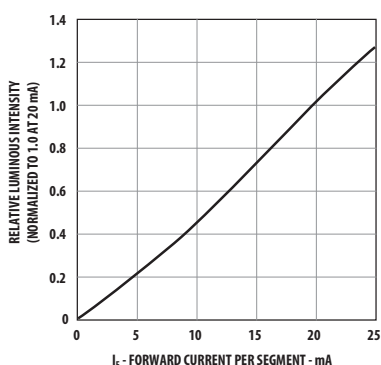


Figure 6. Relative Luminous Intensity vs. DC Forward Current – Red.

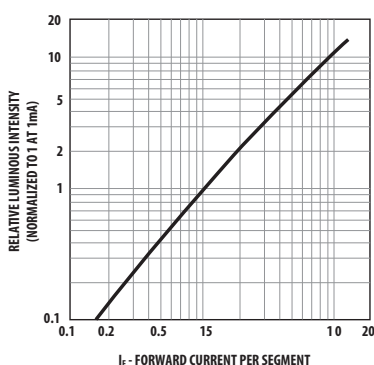


Figure 7. Relative Luminous Intensity vs. DC Forward Current – AlGaAs.

For a Detailed Explanation on the Use of Data Sheet Information and Recommended Soldering Procedures, See Application Note 1005.

## HER, Yellow, Green

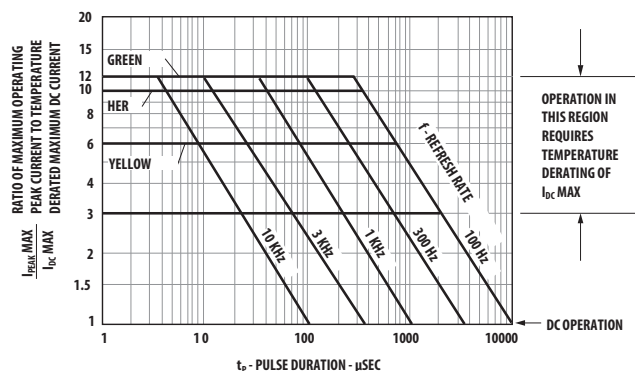


Figure 8. Maximum Tolerable Peak Current vs. Pulse Duration –

## HER/Yellow/Green.

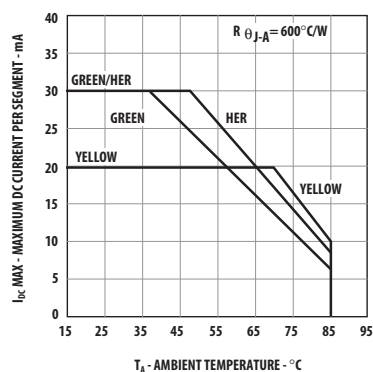


Figure 9. Maximum Allowable DC Current vs. Ambient Temperature.  $T_{JMAX} = 100^{\circ}\text{C}$ .

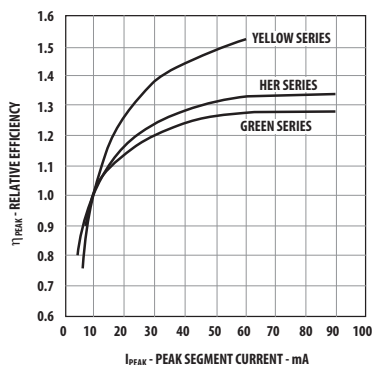


Figure 10. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

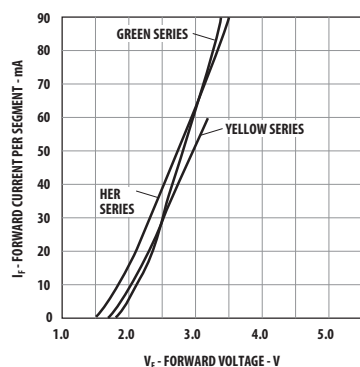


Figure 11. Forward Current vs. Forward Voltage.

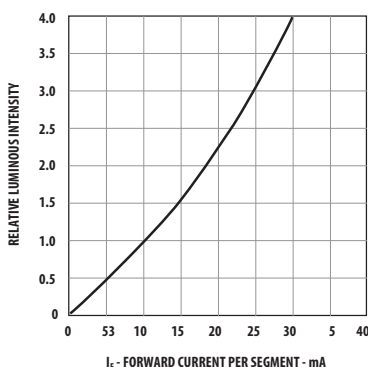


Figure 12. Relative Luminous Intensity vs. DC Forward Current.

For a Detailed Explanation on the Use of Data Sheet Information and Recommended Soldering Procedures, See Application Note 1005.

## Electrical/Optical

These versatile bar graph arrays are composed of ten light emitting diodes. The light from each LED is optically stretched to form individual elements. The AlGaAs Red (HLCP-J100) bar graph array LEDs use double heterojunction AlGaAs on a GaAs substrate. HER (HDSP-4830) and Yellow (HDSP-4840) bar graph array LEDs use a GaAsP epitaxial layer on a GaP substrate. Green (HDSP-4850) bar graph array LEDs use liquid phase GaP epitaxial layer on a GaP substrate. The multicolor bar graph arrays (HDSP-4832/4836) have HER, Yellow, and Green LEDs in one package. These displays are designed for strobed operation. The typical forward voltage values can be scaled from Figures 5 and 11. 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  $V_{FMAX}$  models:

AlGaAs Red HLCP-J100 series

$$V_{FMAX} = 1.8 V + I_{Peak} (20 \Omega)$$

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

$$V_{FMAX} = 2.0 V + I_{Peak} (10 \Omega)$$

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

HER (HDSP-4830) and Yellow (HDSP-4840) series

$$V_{FMAX} = 1.6 + I_{Peak} (45 \Omega)$$

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

$$V_{FMAX} = 1.75 + I_{Peak} (38 \Omega)$$

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

Green (HDSP-4850) series

$$V_{FMAX} = 2.0 + I_{Peak} (50 \Omega)$$

For:  $I_{Peak} > 5 \text{ mA}$

Figures 4 and 10 allow the designer to calculate the luminous intensity at different peak and average currents. The following equation calculates intensity at different peak and average currents:

$$I_V \text{ AVG} = (I_F \text{ AVG} / I_F \text{ AVG DATA SHEET}) \eta_{\text{peak}} (I_V \text{ DATA SHEET})$$

Where:

$I_V \text{ AVG}$  is the calculated time averaged luminous intensity resulting from  $I_F \text{ AVG}$ .

$I_F \text{ AVG}$  is the desired time averaged LED current.

$I_F \text{ AVG DATA SHEET}$  is the data sheet test current for  $I_V \text{ DATA SHEET}$ .

$\eta_{\text{peak}}$  is the relative efficiency at the peak current, scaled from Figure 4 or 10.

$I_V \text{ DATA SHEET}$  is the data sheet luminous intensity, resulting from  $I_F \text{ AVG DATA SHEET}$ .

For example, what is the luminous intensity of an HDSP-4830 driven at 50 mA peak 1/5 duty factor?

$$I_F \text{ AVG} = (50 \text{ mA}) (0.2) = 10 \text{ mA}$$

$$I_F \text{ AVG DATA SHEET} = 10 \text{ mA}$$

$$\eta_{\text{peak}} = 1.3$$

$$I_V \text{ DATA SHEET} = 3500 \mu\text{cd}$$

Therefore

$$I_V \text{ AVG} = (10 \text{ mA} / 10 \text{ mA}) (1.3) (3500 \text{ mcd}) = 4550 \text{ mcd}$$

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