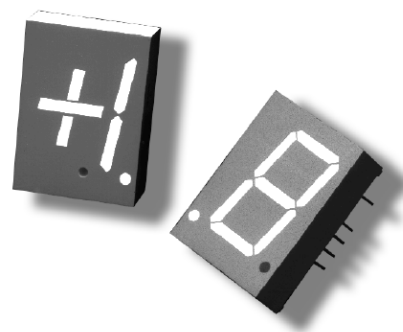


# HDSP-390x Series, HDSP-420x Series HDSP-860x Series, HDSP-N15x Series

## 20 mm (0.8 inch) Seven Segment Displays



## Data Sheet



### Description

The 20 mm (0.8 inch) LED seven segment displays are designed for viewing distances up to 10 metres (33 feet). These devices use an industry standard size package and pinout. All devices are available as either common anode or common cathode.

### Applications

These displays are ideal for most applications. Pin for pin equivalent displays are also available in a low current design. The low current displays are ideal for portable applications. For additional information see the Low Current Seven Segment Displays data sheet.

### Features

- Industry standard size
- Industry standard pinout  
15.24 mm (0.6 in.) DIP leads on 2.54 mm (0.1 in.) centers
- Choice of Colors  
AlGaAs Red, High Efficiency Red, Yellow, Green
- Excellent appearance  
Evenly lighted segments  
Mitered corners on segments  
Gray package gives optimum contrast  
 $\pm 50^\circ$  viewing angle
- Design flexibility  
Common anode or common cathode  
Left and right hand decimal points
- Categorized for luminous intensity  
Yellow and green categorized for color  
Use of like categories yields a uniform display
- High light output
- High peak current
- Excellent for long digit string multiplexing intensity and color selection option  
See Intensity and Color Selected Displays Data Sheet
- Sunlight viewable AlGaAs

### Devices

| AlGaAs <sup>[1]</sup> | HER       | Yellow    | Green     | Description                       | Package Drawing |
|-----------------------|-----------|-----------|-----------|-----------------------------------|-----------------|
| HDSP-N150             | HDSP-3900 |           |           | Common Anode Left Hand Decimal    | A               |
| HDSP-N151             | HDSP-3901 | HDSP-4201 | HDSP-8601 | Common Anode Right Hand Decimal   | B               |
| HDSP-N153             | HDSP-3903 | HDSP-4203 | HDSP-8603 | Common Cathode Right Hand Decimal | C               |
|                       | HDSP-3905 |           |           | Common Cathode Left Hand Decimal  | D               |

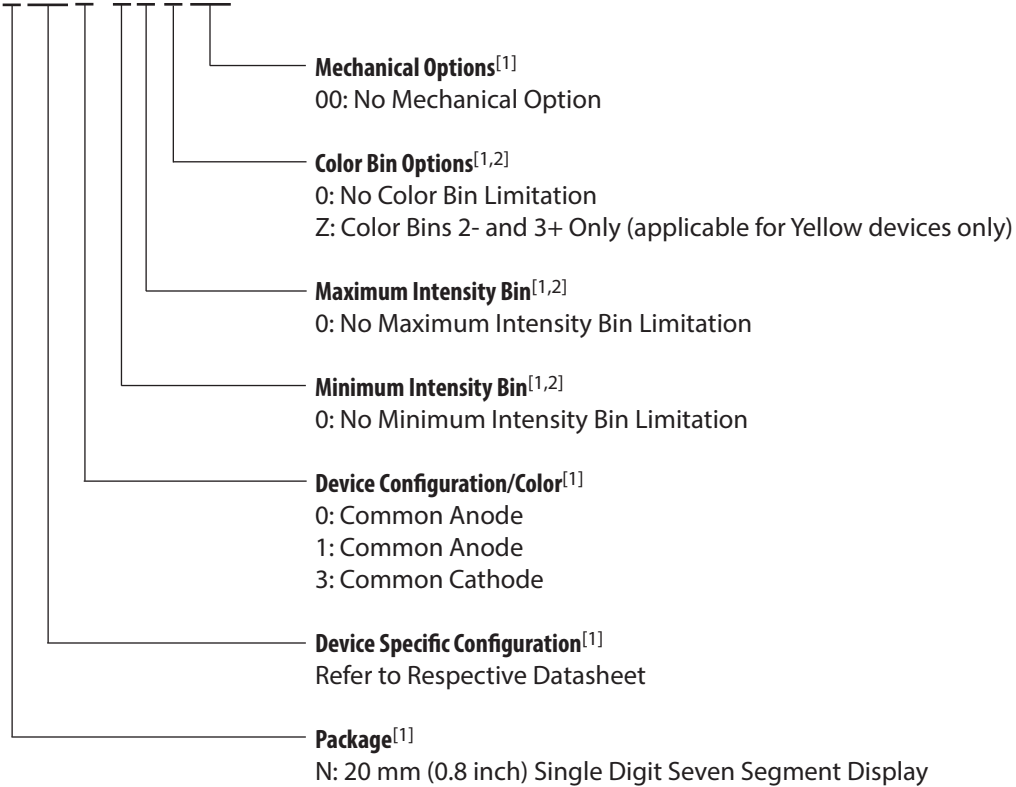
#### Notes:

1. These displays are recommended for high ambient light operation. Please refer to the HDSP-N10x AlGaAs data sheet for low current operation.

## Part Numbering System

5082 - X X X X - X X X X X

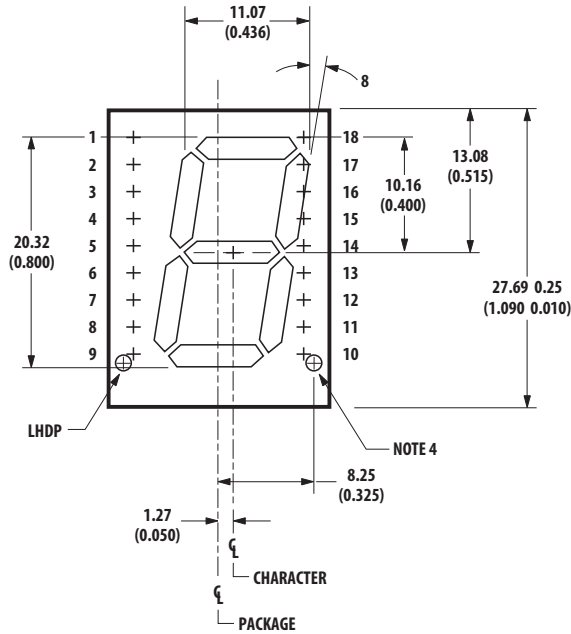
HDSP- X X X X - X X X X X



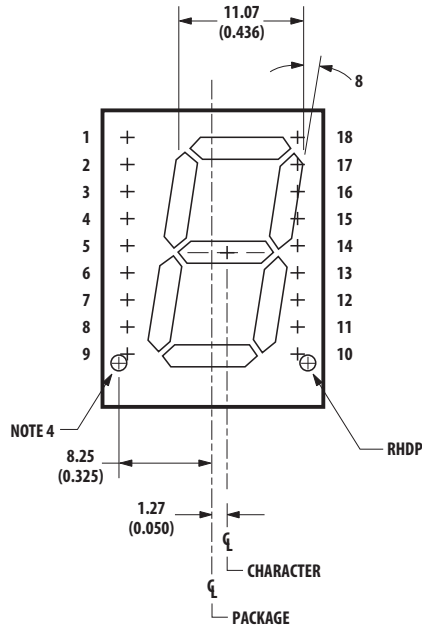
### Notes:

1. For codes not listed in the figure above, please refer to the respective datasheet 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 datasheet for specific bin limit information.

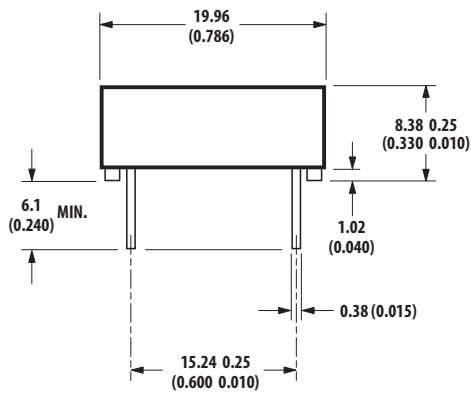
## Package Dimensions



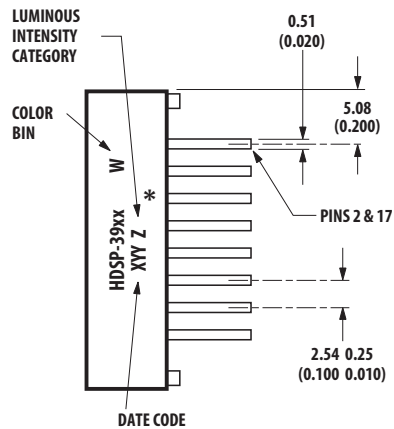
FRONT VIEW A, D



FRONT VIEW B, C



END VIEW



SIDE VIEW

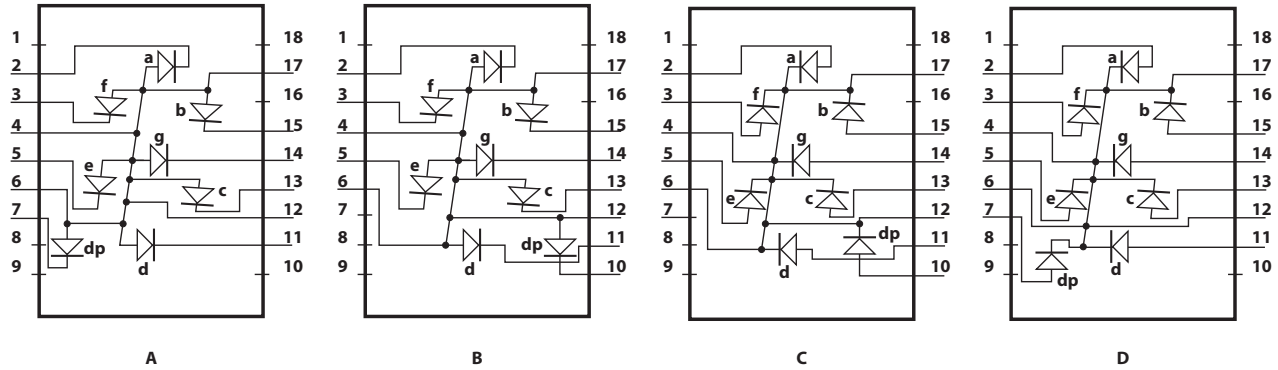
\* THE SIDE VIEW OF PACKAGE INDICATES COUNTRY OF ORIGIN.

| FUNCTION |                      |                      |                        |                        |
|----------|----------------------|----------------------|------------------------|------------------------|
| PIN      | A                    | B                    | C                      | D                      |
| 1        | NO PIN               | NO PIN               | NO PIN                 | NO PIN                 |
| 2        | CATHODE a            | CATHODE a            | ANODE a                | ANODE a                |
| 3        | CATHODE f            | CATHODE f            | ANODE f                | ANODE f                |
| 4        | ANODE <sup>[3]</sup> | ANODE <sup>[3]</sup> | CATHODE <sup>[6]</sup> | CATHODE <sup>[6]</sup> |
| 5        | CATHODE e            | CATHODE e            | ANODE e                | ANODE e                |
| 6        | ANODE <sup>[3]</sup> | ANODE <sup>[3]</sup> | CATHODE <sup>[6]</sup> | CATHODE <sup>[6]</sup> |
| 7        | CATHODE dp           | NO CONNec.           | NO CONNec.             | ANODE dp               |
| 8        | NO PIN               | NO PIN               | NO PIN                 | NO PIN                 |
| 9        | NO PIN               | NO PIN               | NO PIN                 | NO PIN                 |
| 10       | NO PIN               | CATHODE dp           | ANODE dp               | NO PIN                 |
| 11       | CATHODE d            | CATHODE d            | ANODE d                | ANODE d                |
| 12       | ANODE <sup>[3]</sup> | ANODE <sup>[3]</sup> | CATHODE <sup>[6]</sup> | CATHODE <sup>[6]</sup> |
| 13       | CATHODE c            | CATHODE c            | ANODE c                | ANODE c                |
| 14       | CATHODE g            | CATHODE g            | ANODE g                | ANODE g                |
| 15       | CATHODE b            | CATHODE b            | ANODE b                | ANODE b                |
| 16       | NO PIN               | NO PIN               | NO PIN                 | NO PIN                 |
| 17       | ANODE <sup>[3]</sup> | ANODE <sup>[3]</sup> | CATHODE <sup>[6]</sup> | CATHODE <sup>[6]</sup> |
| 18       | NO PIN               | NO PIN               | NO PIN                 | NO PIN                 |

### NOTES:

1. DIMENSIONS IN MILLIMETERS AND (INCHES).
2. ALL UNTOLERANCED DIMENSIONS ARE FOR REFERENCE ONLY.
3. REDUNDANT ANODES.
4. UNUSED dp POSITION.
5. SEE INTERNAL CIRCUIT DIAGRAM.
6. REDUNDANT CATHODES.
7. FOR HDSP-420x/-860x SERIES PRODUCT ONLY.

## Internal Circuit Diagram



## Absolute Maximum Ratings

| Description                                                      | AlGaAs Red<br>HDSP-N150<br>Series | HER<br>HDSP-3900<br>Series | Yellow<br>HDSP-420x<br>Series | Green<br>HDSP-860x<br>Series | Units |
|------------------------------------------------------------------|-----------------------------------|----------------------------|-------------------------------|------------------------------|-------|
| Average Power per Segment or DP                                  | 96                                | 105                        | 105                           | 105                          | mW    |
| Peak Forward Current per Segment or DP                           | 160 <sup>[1]</sup>                | 135 <sup>[3]</sup>         | 135 <sup>[3]</sup>            | 90 <sup>[5]</sup>            | mA    |
| DC Forward Current per Segment or DP                             | 40 <sup>[2]</sup>                 | 40 <sup>[4]</sup>          | 40 <sup>[4]</sup>             | 30 <sup>[6]</sup>            | mA    |
| Operating Temperature Range                                      | -20 to +100 <sup>[7]</sup>        | -40 to +100                |                               | -40 to +100                  | °C    |
| Storage Temperature Range                                        |                                   | -55 to +100                |                               |                              | °C    |
| Reverse Voltage* per Segment or DP                               |                                   | 3.0                        |                               |                              | V     |
| Wave Soldering Temperature for 3 Seconds<br>(1.60 mm [0.063 in.] |                                   | 250                        |                               |                              | °C    |

\* reverse voltage is for LED testing purposes and is not recommended to be used as an application condition.

Notes:

- See Figure 2 to establish pulsed conditions.
- Derate above 55°C at 0.8 mA/°C.
- See Figure 7 to establish pulsed conditions.
- Derate above 50°C at 0.73 mA/°C.
- See Figure 8 to establish pulsed conditions.
- Derate above 50°C at 0.54 mA/°C.
- For operation below -20°C, contact your local Avago components sales office or an authorized distributor.

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

### AlGaAs Red

#### Device Series - HDSP-N15x

| Parameter                                                        | Symbol              | Min. | Typ. | Max. | Units    | Test Conditions         |
|------------------------------------------------------------------|---------------------|------|------|------|----------|-------------------------|
| Luminous Intensity/Segment <sup>[1,2,5]</sup><br>(Digit Average) | I <sub>V</sub>      | 6.0  | 14.0 |      | mcd      | I <sub>F</sub> = 20 mA  |
| Forward Voltage/Segment or DP                                    | V <sub>F</sub>      |      | 1.8  |      | V        | I <sub>F</sub> = 20 mA  |
|                                                                  |                     |      | 2.0  | 3.0  | V        | I <sub>F</sub> = 100 mA |
| Peak Wavelength                                                  | λ <sub>PEAK</sub>   |      | 645  |      | nm       |                         |
| Dominant Wavelength <sup>[3]</sup>                               | λ <sub>d</sub>      |      | 637  |      | nm       |                         |
| Reverse Voltage/Segment or DP <sup>[4]</sup>                     | V <sub>R</sub>      | 3.0  | 15   |      | V        | I <sub>R</sub> = 100 μA |
| Temperature Coefficient of V <sub>F</sub> /Segment or DP         | ΔV <sub>F</sub> /°C |      | -2   |      | mV/°C    |                         |
| Thermal Resistance LED Junction-to-Pin                           | Rθ <sub>J-PIN</sub> |      | 430  |      | °C/W/Seg |                         |

## High Efficiency Red

### Device Series - HDSP-390x

| Parameter                                                      | Symbol                      | Min. | Typ. | Max. | Units                  | Test Conditions                           |
|----------------------------------------------------------------|-----------------------------|------|------|------|------------------------|-------------------------------------------|
| Luminous Intensity/Segment <sup>[1,2]</sup><br>(Digit Average) | $I_V$                       | 3350 | 7000 |      | $\mu\text{cd}$         | $I_F = 100 \text{ mA}$ Peak:<br>1 of 5 df |
|                                                                |                             |      | 4800 |      | $\mu\text{cd}$         | $I_F = 20 \text{ mA}$                     |
| Forward Voltage/Segment or DP                                  | $V_F$                       |      | 2.6  | 3.5  | V                      | $I_F = 100 \text{ mA}$                    |
| Peak Wavelength                                                | $\lambda_{\text{PEAK}}$     |      | 635  |      | nm                     |                                           |
| Dominant Wavelength <sup>[3]</sup>                             | $\lambda_d$                 |      | 626  |      | nm                     |                                           |
| Reverse Voltage/Segment or DP <sup>[4]</sup>                   | $V_R$                       | 3.0  | 25   |      | V                      | $I_R = 100 \mu\text{A}$                   |
| Temperature Coefficient of $V_F$ /Segment or DP                | $\Delta V_F/^\circ\text{C}$ |      | -2   |      | mV/ $^\circ\text{C}$   |                                           |
| Thermal Resistance LED Junction-to-Pin                         | $R\theta_{J-PIN}$           |      | 375  |      | $^\circ\text{C/W/Seg}$ |                                           |

## Yellow

### Device Series - HDSP-420x

| Parameter                                                      | Symbol                      | Min.  | Typ. | Max.  | Units                  | Test Conditions                           |
|----------------------------------------------------------------|-----------------------------|-------|------|-------|------------------------|-------------------------------------------|
| Luminous Intensity/Segment <sup>[1,2]</sup><br>(Digit Average) | $I_V$                       |       | 2200 | 7000  | $\mu\text{cd}$         | $I_F = 100 \text{ mA}$ Peak:<br>1 of 5 df |
|                                                                |                             |       | 3400 |       | $\mu\text{cd}$         | $I_F = 20 \text{ mA}$                     |
| Forward Voltage/Segment or DP                                  | $V_F$                       |       | 2.6  | 3.5   | V                      | $I_F = 100 \text{ mA}$                    |
| Peak Wavelength                                                | $\lambda_{\text{PEAK}}$     |       | 583  |       | nm                     |                                           |
| Dominant Wavelength <sup>[3,6]</sup>                           | $\lambda_d$                 | 581.5 | 586  | 592.5 | nm                     |                                           |
| Reverse Voltage/Segment or DP <sup>[4]</sup>                   | $V_R$                       | 3.0   | 25.0 |       | V                      | $I_R = 100 \mu\text{A}$                   |
| Temperature Coefficient of $V_F$ /Segment or DP                | $\Delta V_F/^\circ\text{C}$ |       | -2   |       | mV/ $^\circ\text{C}$   |                                           |
| Thermal Resistance LED Junction-to-Pin                         | $R\theta_{J-PIN}$           |       | 375  |       | $^\circ\text{C/W/Seg}$ |                                           |

## Green

### Device Series - HDSP-860x

| Parameter                                                      | Symbol                      | Min. | Typ. | Max. | Units                  | Test Conditions                          |
|----------------------------------------------------------------|-----------------------------|------|------|------|------------------------|------------------------------------------|
| Luminous Intensity/Segment <sup>[1,2]</sup><br>(Digit Average) | $I_V$                       | 680  | 1500 |      | $\mu\text{cd}$         | $I_F = 10 \text{ mA}$                    |
|                                                                |                             |      | 1960 |      | $\mu\text{cd}$         | $I_F = 50 \text{ mA}$ Peak:<br>1 of 5 df |
| Forward Voltage/Segment or DP                                  | $V_F$                       |      | 2.1  | 2.5  | V                      | $I_F = 10 \text{ mA}$                    |
| Peak Wavelength                                                | $\lambda_{\text{PEAK}}$     |      | 566  |      | nm                     |                                          |
| Dominant Wavelength <sup>[3,6]</sup>                           | $\lambda_d$                 |      | 571  | 577  | nm                     |                                          |
| Reverse Voltage/Segment or DP <sup>[4]</sup>                   | $V_R$                       | 3.0  | 50.0 |      | V                      | $I_R = 100 \mu\text{A}$                  |
| Temperature Coefficient of $V_F$ /Segment or DP                | $\Delta V_F/^\circ\text{C}$ |      | -2   |      | mV/ $^\circ\text{C}$   |                                          |
| Thermal Resistance LED Junction-to-Pin                         | $R\theta_{J-PIN}$           |      | 375  |      | $^\circ\text{C/W/Seg}$ |                                          |

#### Notes:

1. Case temperature of the device immediately prior to the intensity measurement is 25°C.
2. The digits are categorized for luminous intensity. The intensity category is designated by a letter on the side of the package.
3. The dominant wavelength,  $\lambda_d$ , is derived from the CIE chromaticity diagram and is that single wavelength which defines the color of the device.
4. Typical specification for reference only. Do not exceed absolute maximum ratings.
5. For low current operation, the AlGaAs Red HDSP-N100 series displays are recommended. They are tested at 1 mA dc/segment and are pin for pin compatible with the HDSP-N150 series.
6. The Yellow (HDSP-420x) and Green (HDSP-860x) displays are categorized for dominant wavelength. The category is designated by a number adjacent to the luminous intensity category letter.

## AlGaAs Red

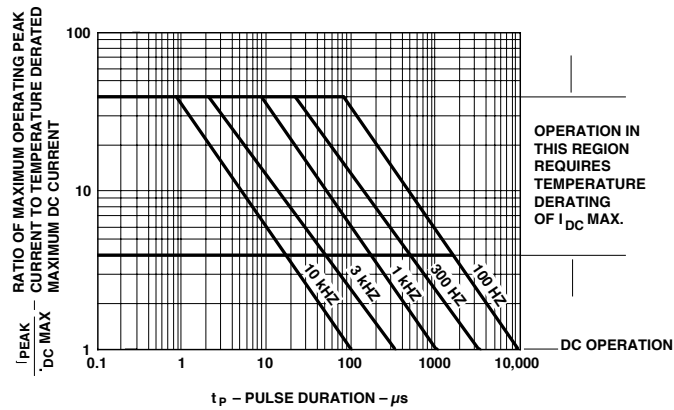


Figure 1. Maximum allowed peak current vs. pulse duration – AlGaAs Red.

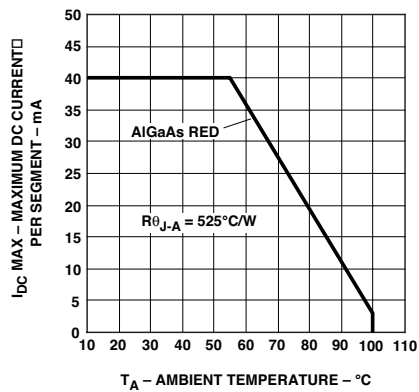


Figure 2. Maximum allowable DC current vs. ambient temperature.

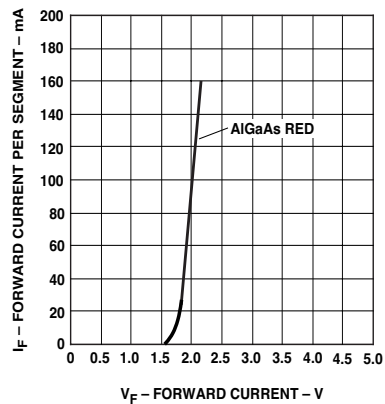


Figure 3. Forward current vs. forward voltage.

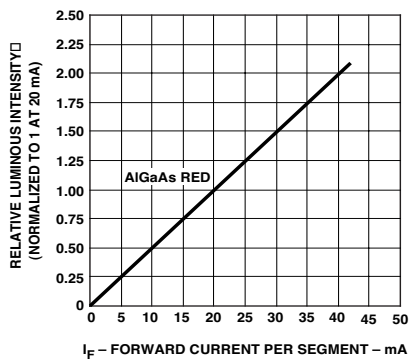


Figure 5.

Figure 4. Relative luminous intensity vs. DC forward current.

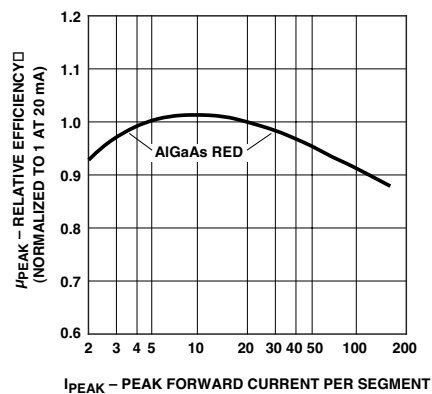


Figure 5. Relative efficiency (luminous intensity per unit current) vs. peak current.

## HER, Yellow, Green

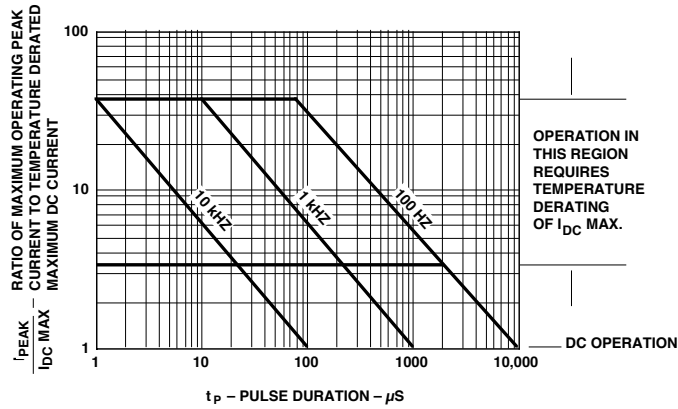


Figure 6. Maximum allowed peak current vs. pulse duration – HER, Yellow.

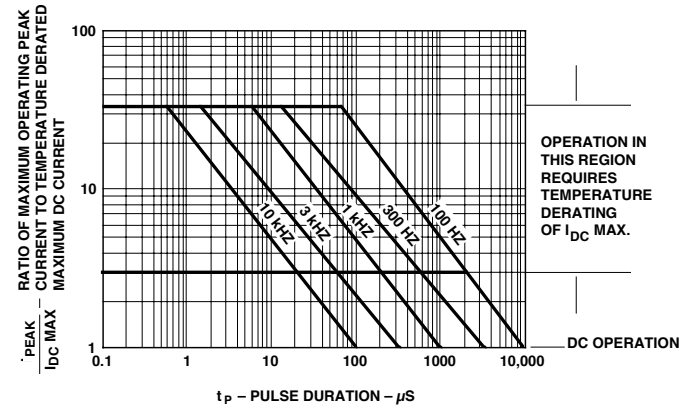


Figure 7. Maximum allowed peak current vs. pulse duration – Green.

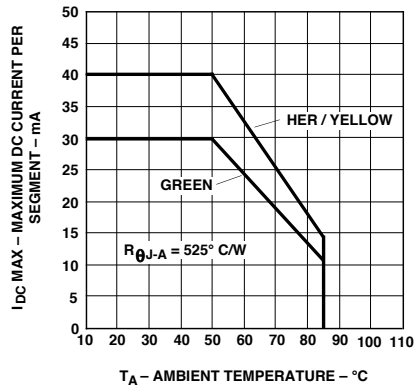


Figure 8. Maximum allowable DC current vs. ambient temperature.

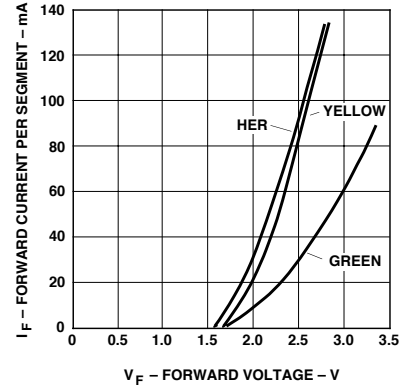


Figure 9. Forward current vs. forward voltage.

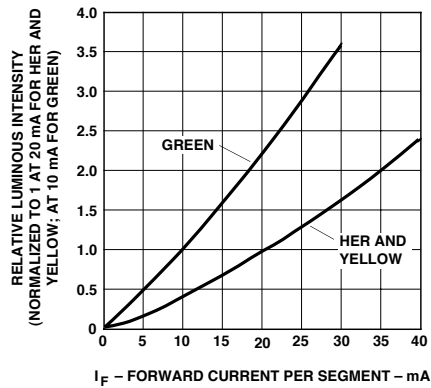


Figure 10. Relative luminous intensity vs. DC forward current.

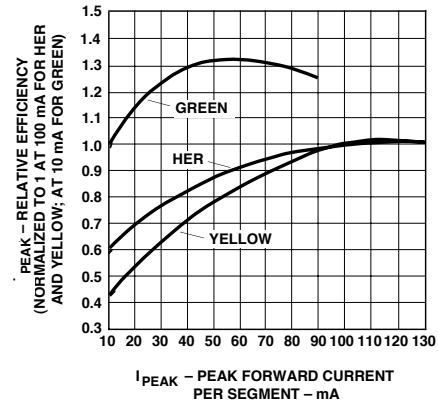


Figure 11. Relative efficiency (luminous intensity per unit current) vs. peak current.

## Intensity Bin Limits (mcd)

### AlGaAs Red - HDSP-N15x

| IV Bin Category | Min.  | Max.  |
|-----------------|-------|-------|
| J               | 6.14  | 11.20 |
| K               | 9.20  | 16.90 |
| L               | 13.80 | 25.30 |
| M               | 20.70 | 38.00 |
| N               | 31.10 | 56.90 |
| O               | 46.60 | 85.40 |

### Yellow - HDSP-420x

| IV Bin Category | Min.  | Max.  |
|-----------------|-------|-------|
| C               | 2.23  | 4.09  |
| D               | 3.35  | 6.14  |
| E               | 5.02  | 9.21  |
| F               | 7.53  | 13.82 |
| G               | 11.30 | 20.72 |
| H               | 16.95 | 31.08 |
| I               | 25.43 | 46.62 |

### Green - HDSP-860x

| IV Bin Category | Min. | Max. |
|-----------------|------|------|
| D               | 1.03 | 1.88 |
| E               | 1.54 | 2.82 |
| F               | 2.31 | 4.25 |
| G               | 3.47 | 6.37 |
| H               | 5.21 | 9.55 |

### HER - HDSP-390x

| IV Bin Category | Min.  | Max.  |
|-----------------|-------|-------|
| D               | 3.35  | 6.14  |
| E               | 5.02  | 9.21  |
| F               | 7.53  | 13.82 |
| G               | 11.30 | 20.72 |
| H               | 16.95 | 31.08 |
| I               | 25.43 | 46.62 |

## Color Categories

| Color  | Bin | Dominant Wavelength (nm) |        |
|--------|-----|--------------------------|--------|
|        |     | Min.                     | Max.   |
| Yellow | 1   | 581.50                   | 585.00 |
|        | 3   | 584.00                   | 587.50 |
|        | 2   | 586.50                   | 590.00 |
|        | 4   | 589.00                   | 592.50 |
| Green  | 2   | 573.00                   | 577.00 |
|        | 3   | 570.00                   | 574.00 |
|        | 4   | 567.00                   | 571.00 |
|        | 5   | 564.00                   | 568.00 |

#### Note:

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

## Contrast Enhancement

For information on contrast enhancement, please see Application Note 1015.

## Soldering/Cleaning

Cleaning agents from the ketone family (acetone, methyl ethyl ketone, etc.) and from the chlorinated hydrocarbon family (methylene chloride, trichloro-ethylene, carbon tetrachloride, etc.) are not recommended for cleaning LED parts. All of these various solvents attack or dissolve the encapsulating epoxies used to form the package of plastic LED parts.

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

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

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AV02-2551EN - October 9, 2015

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