

# 8 mm (0.31 inch) Ultra Mini Seven Segment Displays

## Technical Data

**HDSP-U1xx Series**  
**HDSP-U2xx Series**  
**HDSP-U3xx Series**  
**HDSP-U4xx Series**  
**HDSP-U5xx Series**

### Features

- **Compact Package**
- **8 mm (0.31 inch) Character Height**
- **Choice of Colors**  
Wide Range of Colors
- **Excellent Appearance**  
Evenly Lighted Segments  
Mitered Corners on Segments  
Gray/Black Surface Gives Optimum Contrast  
 $\pm 50^\circ$  Viewing Angle
- **Design Flexibility**  
Common Anode or Common Cathode  
Right Hand Decimal Point
- **Categorized for Luminous Intensity**  
Yellow and Green also 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**

### Description

The 8 mm (0.31 inch) LED seven segment displays are Agilent's most space-efficient character size. They are designed for viewing distances up to 3 metres (10 feet). The numeric devices feature a right hand decimal point. All devices are available as either common anode or common cathode.

Typical applications include appliances, temperature controllers, and digital panel meters.



### Devices

| AlGaAs Red<br>HDSP- | HER<br>HDSP- | Orange<br>HDSP- | Yellow<br>HDSP- | Green<br>HDSP- | Description                                       | Circuit<br>Diagram |
|---------------------|--------------|-----------------|-----------------|----------------|---------------------------------------------------|--------------------|
| U101                | U201         | U401            | U301            | U501           | Common Anode, Right Hand Decimal, Gray Surface    | A                  |
| U103                | U203         | U403            | U303            | U503           | Common Cathode, Right Hand Decimal, Gray Surface  | B                  |
| U111                | U211         | U411            | U311            | U511           | Common Anode, Right Hand Decimal, Black Surface   | A                  |
| U113                | U213         | U413            | U313            | U513           | Common Cathode, Right Hand Decimal, Black Surface | B                  |

## Part Numbering System

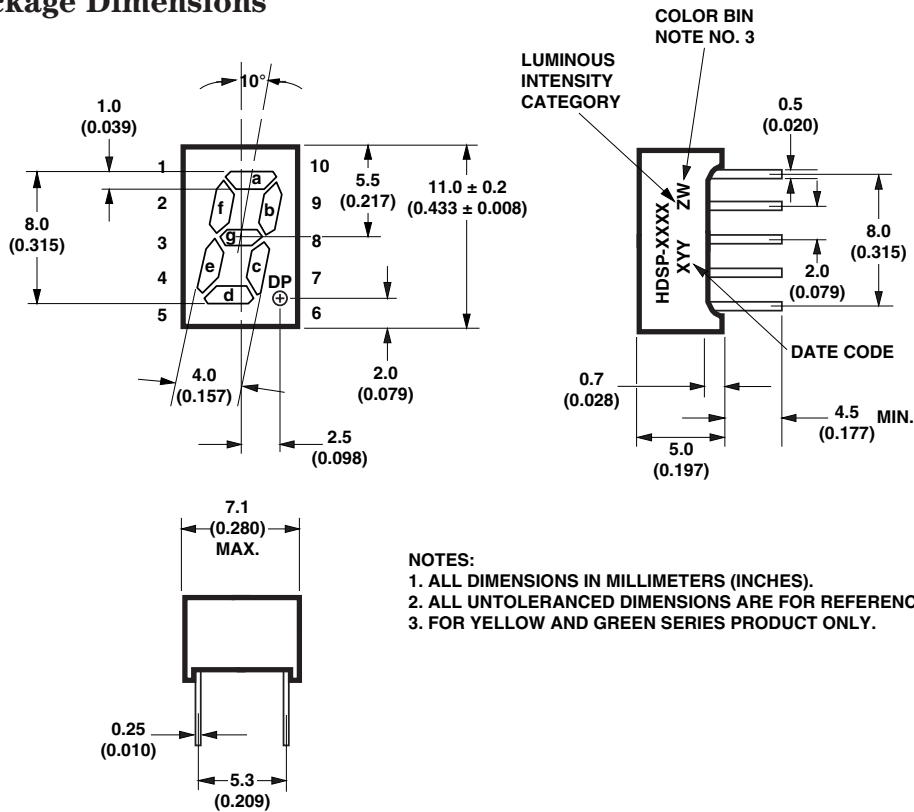
5082 - x xx x - x x x xx  
 HDSP - x xx x - x x x xx



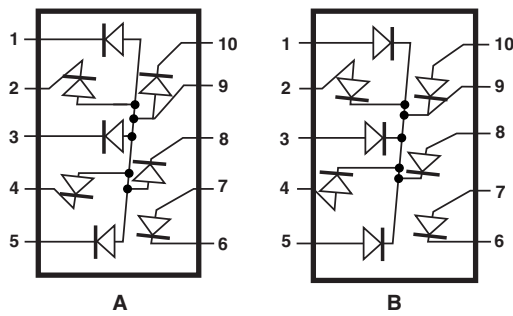
### Notes:

1. For codes not listed in the figure above, please refer to the respective data sheet or contact your nearest Agilent 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



## Internal Circuit Diagram



| PIN | FUNCTION   |            |
|-----|------------|------------|
|     | A          | B          |
| 1   | CATHODE a  | ANODE a    |
| 2   | CATHODE f  | ANODE f    |
| 3   | CATHODE g  | ANODE g    |
| 4   | CATHODE e  | ANODE e    |
| 5   | CATHODE d  | ANODE d    |
| 6   | CATHODE DP | CATHODE DP |
| 7   | ANODE DP   | ANODE DP   |
| 8   | CATHODE c  | ANODE c    |
| 9   | ANODE      | CATHODE    |
| 10  | CATHODE b  | ANODE b    |

HDSP-UXXX CIRCUIT

## Absolute Maximum Ratings

| Description                                                              | AlGaAs Red<br>HDSP-<br>U1xx<br>Series | HER/Orange<br>HDSP-<br>U2xx/-4xx<br>Series | Yellow<br>HDSP-<br>U3xx<br>Series | Green<br>HDSP-<br>U5xx<br>Series | Units |
|--------------------------------------------------------------------------|---------------------------------------|--------------------------------------------|-----------------------------------|----------------------------------|-------|
| Average Power per Segment or DP                                          | 37                                    | 105                                        | 80                                | 105                              | mW    |
| Peak Forward Current per Segment or DP                                   | 45 <sup>[1]</sup>                     | 90 <sup>[3]</sup>                          | 60 <sup>[5]</sup>                 | 90 <sup>[7]</sup>                | mA    |
| DC Forward Current per Segment or DP                                     | 15 <sup>[2]</sup>                     | 30 <sup>[4]</sup>                          | 20 <sup>[6]</sup>                 | 30 <sup>[8]</sup>                | mA    |
| Operating Temperature Range                                              | -20 to +90                            | -25 to +90                                 |                                   |                                  | °C    |
| Storage Temperature Range                                                | -30 to +90                            |                                            |                                   |                                  | °C    |
| Reverse Voltage per Segment or DP                                        | 3.0                                   |                                            |                                   |                                  | V     |
| Wavesoldering Temperature for 3 Seconds (1.60 mm [0.063 in.] below body) | 250                                   |                                            |                                   |                                  | °C    |

### Notes:

1. See Figure 1 to establish pulsed conditions.
2. No derating over specified temperature range.
3. See Figure 5 to establish pulsed conditions.
4. Derate above 53°C at 0.45 mA/°C (see Figure 8).
5. See Figure 6 to establish pulsed conditions.
6. Derate above 81°C at 0.52 mA/°C (see Figure 8).
7. See Figure 7 to establish pulsed conditions.
8. Derate above 39°C at 0.37 mA/°C (see Figure 8).

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

### AlGaAs Red

| Device Series | Parameter                                                      | Symbol              | Min. | Typ. | Max. | Units        | Test Conditions         |
|---------------|----------------------------------------------------------------|---------------------|------|------|------|--------------|-------------------------|
| HDSP-U1xx     | Luminous Intensity/Segment <sup>[1,2]</sup><br>(Digit Average) | I <sub>V</sub>      | 315  | 600  |      | μcd          | I <sub>F</sub> = 1 mA   |
|               |                                                                |                     |      | 3600 |      |              | I <sub>F</sub> = 5 mA   |
|               | Forward Voltage/Segment or DP                                  | V <sub>F</sub>      |      | 1.6  |      | V            | I <sub>F</sub> = 1 mA   |
|               |                                                                |                     |      | 1.7  |      |              | I <sub>F</sub> = 5 mA   |
|               |                                                                |                     |      | 1.8  | 2.2  |              | I <sub>F</sub> = 20 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> |      | 255  |      | °C/W/<br>Seg |                         |

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

### High Efficiency Red

| Device Series | Parameter                                                      | Symbol                      | Min. | Typ. | Max. | Units                  | Test Conditions                |
|---------------|----------------------------------------------------------------|-----------------------------|------|------|------|------------------------|--------------------------------|
| HDSP-U2xx     | Luminous Intensity/Segment <sup>[1,2]</sup><br>(Digit Average) | $I_V$                       | 360  | 980  |      | $\mu\text{cd}$         | $I_F = 5\text{ mA}$            |
|               |                                                                |                             |      | 5390 |      |                        | $I_F = 20\text{ mA}$           |
|               | Forward Voltage/Segment or DP                                  | $V_F$                       |      | 2.0  | 2.5  | V                      | $I_F = 20\text{ mA}$           |
|               | 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  | 30   |      | V                      | $I_R = 100\text{ }\mu\text{A}$ |
|               | 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                         | $R\theta_{\text{J-Pin}}$    |      | 200  |      | $^\circ\text{C/W/Seg}$ |                                |

### Orange

| Device Series | Parameter                                                      | Symbol                      | Min. | Typ. | Max. | Units                  | Test Conditions                |
|---------------|----------------------------------------------------------------|-----------------------------|------|------|------|------------------------|--------------------------------|
| HDSP-U4xx     | Luminous Intensity/Segment <sup>[1,2]</sup><br>(Digit Average) | $I_V$                       | 360  | 980  |      | $\mu\text{cd}$         | $I_F = 5\text{ mA}$            |
|               |                                                                |                             |      | 5390 |      |                        | $I_F = 20\text{ mA}$           |
|               | Forward Voltage/Segment or DP                                  | $V_F$                       |      | 2.0  | 2.5  | V                      | $I_F = 20\text{ mA}$           |
|               | Peak Wavelength                                                | $\lambda_{\text{PEAK}}$     |      | 600  |      | nm                     |                                |
|               | Dominant Wavelength <sup>[3]</sup>                             | $\lambda_d$                 |      | 603  |      | nm                     |                                |
|               | Reverse Voltage/Segment or DP <sup>[4]</sup>                   | $V_R$                       | 3.0  | 30   |      | V                      | $I_R = 100\text{ }\mu\text{A}$ |
|               | 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                         | $R\theta_{\text{J-Pin}}$    |      | 200  |      | $^\circ\text{C/W/Seg}$ |                                |

**Yellow**

| Device Series | Parameter                                                      | Symbol                      | Min.  | Typ. | Max.  | Units          | Test Conditions         |
|---------------|----------------------------------------------------------------|-----------------------------|-------|------|-------|----------------|-------------------------|
| HDSP-U3xx     | Luminous Intensity/Segment <sup>[1,2]</sup><br>(Digit Average) | $I_V$                       | 225   | 480  |       | $\mu\text{cd}$ | $I_F = 5 \text{ mA}$    |
|               |                                                                |                             |       | 2740 |       |                | $I_F = 20 \text{ mA}$   |
|               | Forward Voltage/Segment or DP                                  | $V_F$                       |       | 2.2  | 2.5   | V              | $I_F = 20 \text{ mA}$   |
|               | Peak Wavelength                                                | $\lambda_{\text{PEAK}}$     |       | 583  |       | nm             |                         |
|               | Dominant Wavelength <sup>[3,5]</sup>                           | $\lambda_d$                 | 581.5 | 586  | 592.5 | 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/°C          |                         |
|               | Thermal Resistance LED Junction-to-Pin                         | $R\theta_{\text{J-Pin}}$    |       | 200  |       | °C/W/<br>Seg   |                         |

**High Performance Green**

| Device Series | Parameter                                                      | Symbol                      | Min. | Typ. | Max. | Units          | Test Conditions         |
|---------------|----------------------------------------------------------------|-----------------------------|------|------|------|----------------|-------------------------|
| HDSP-U5xx     | Luminous Intensity/Segment <sup>[1,2]</sup><br>(Digit Average) | $I_V$                       | 860  | 3000 |      | $\mu\text{cd}$ | $I_F = 10 \text{ mA}$   |
|               |                                                                |                             |      | 6800 |      |                | $I_F = 20 \text{ mA}$   |
|               | 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>[3,5]</sup>                           | $\lambda_d$                 |      | 571  |      | 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/°C          |                         |
|               | Thermal Resistance LED Junction-to-Pin                         | $R\theta_{\text{J-Pin}}$    |      | 200  |      | °C/W/<br>Seg   |                         |

**Notes:**

1. Case temperature of 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. The Yellow (HDSP-U3XX) series and Green (HDSP-U5XX) series displays are categorized for dominant wavelength. The category is designated by a number adjacent to the luminous intensity category letter.

## AlGaAs Red

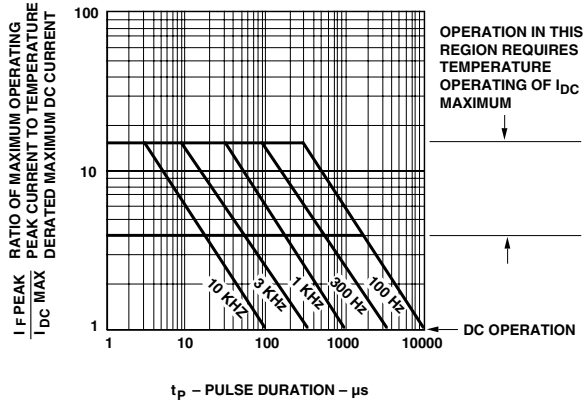


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration – AlGaAs Red.

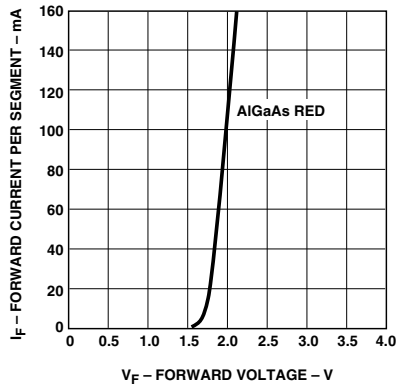


Figure 2. Forward Current vs. Forward Voltage.

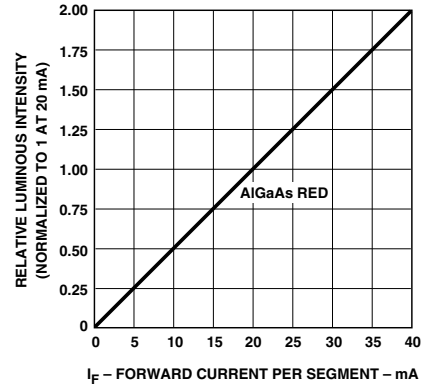


Figure 3. Relative Luminous Intensity vs. DC Forward Current.

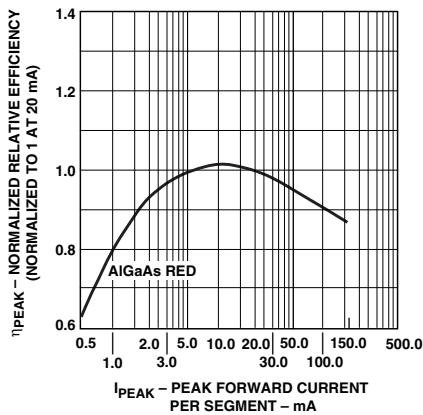


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

## HER, Orange, Yellow, Green

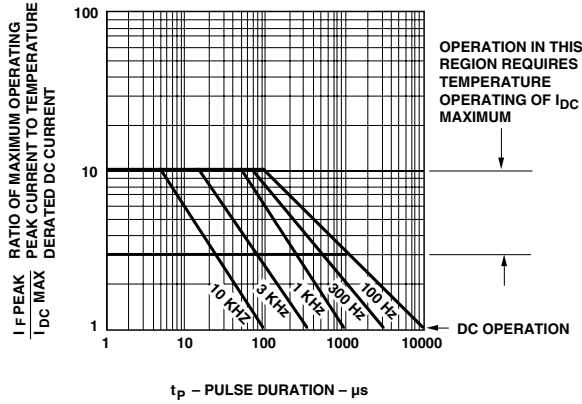


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration – HER, Orange.

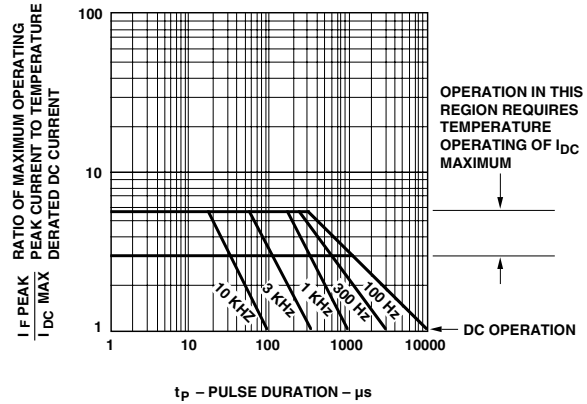


Figure 6. Maximum Tolerable Peak Current vs. Pulse Duration – Yellow.

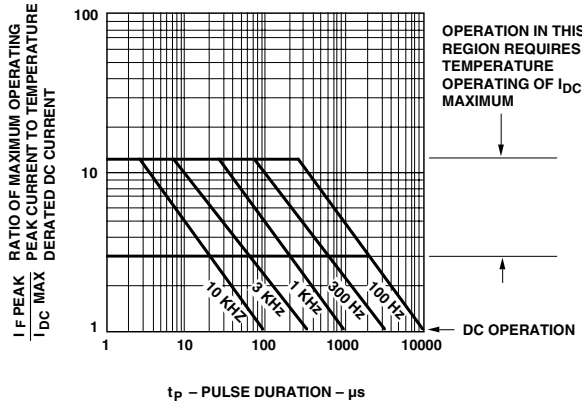


Figure 7. Maximum Tolerable Peak Current vs. Pulse Duration – Green.

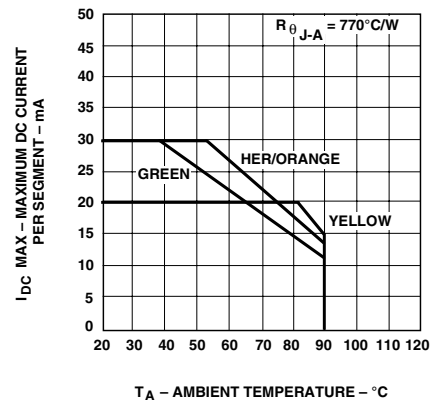


Figure 8. Maximum Allowable DC Current vs. Ambient Temperature.

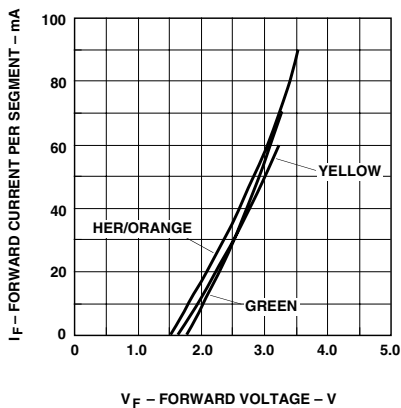


Figure 9. Forward Current vs. Forward Voltage Characteristics.

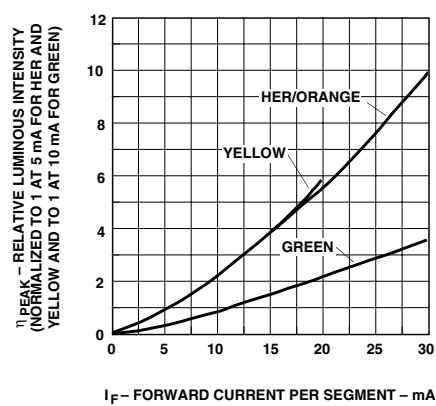


Figure 10. Relative Luminous Intensity vs. DC Forward Current.

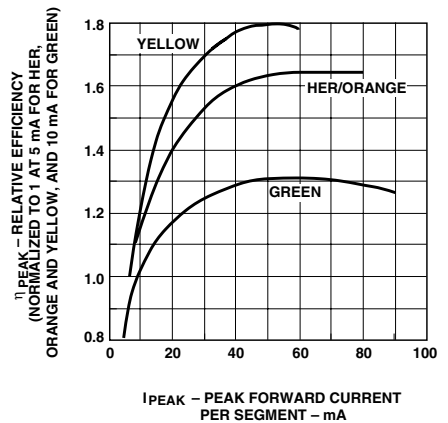


Figure 11. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

## Intensity Bin Limits (mcd)

### AlGaAs Red

| HDSP-U1xx       |       |       |
|-----------------|-------|-------|
| IV Bin Category | Min.  | Max.  |
| E               | 0.315 | 0.520 |
| F               | 0.428 | 0.759 |
| G               | 0.621 | 1.16  |
| H               | 0.945 | 1.71  |
| I               | 1.40  | 2.56  |
| J               | 2.10  | 3.84  |
| K               | 3.14  | 5.75  |
| L               | 4.70  | 8.55  |

### HER

| HDSP-U2xx       |       |       |
|-----------------|-------|-------|
| IV Bin Category | Min.  | Max.  |
| B               | 0.342 | 0.630 |
| C               | 0.516 | 0.946 |
| D               | 0.774 | 1.418 |
| E               | 1.160 | 2.127 |
| F               | 1.740 | 3.190 |
| G               | 2.610 | 4.785 |
| H               | 3.915 | 7.177 |

### Orange

| HDSP-U4xx       |       |       |
|-----------------|-------|-------|
| IV Bin Category | Min.  | Max.  |
| C               | 0.443 | 0.677 |
| D               | 0.554 | 0.846 |
| E               | 0.692 | 1.057 |
| F               | 0.856 | 1.322 |
| G               | 1.082 | 1.652 |
| H               | 1.352 | 2.066 |
| I               | 1.692 | 2.581 |
| J               | 2.114 | 3.227 |
| K               | 2.641 | 4.034 |
| L               | 3.300 | 5.042 |
| M               | 4.127 | 6.303 |
| N               | 5.157 | 7.878 |

## Yellow

| HDSP-U3xx       |       |       |
|-----------------|-------|-------|
| IV Bin Category | Min.  | Max.  |
| B               | 0.229 | 0.387 |
| C               | 0.317 | 0.582 |
| D               | 0.476 | 0.872 |
| E               | 0.714 | 1.311 |
| F               | 1.073 | 1.967 |
| G               | 1.609 | 2.950 |
| H               | 2.413 | 4.425 |

## Green

| HDSP-U5xx       |      |      |
|-----------------|------|------|
| IV Bin Category | Min. | Max. |
| H               | 0.86 | 1.58 |
| I               | 1.29 | 2.37 |
| J               | 1.94 | 3.55 |
| K               | 2.90 | 5.33 |
| L               | 4.37 | 8.01 |

## 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 local Agilent representatives for further clarification/information.

## Electrical/Optical

For more information on electrical/optical characteristics, please see Application Note 1005.

## 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, trichloroethylene, carbon tetrachloride, etc.) are not recommended for cleaning LED parts. All of these various solvents attack or dissolve the encapsulating materials used to form the package of plastic LED parts.

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

**[www.agilent.com/semiconductors](http://www.agilent.com/semiconductors)**

For product information and a complete list of distributors, please go to our web site.

For technical assistance call:

Americas/Canada: +1 (800) 235-0312 or  
(916) 788-6763

Europe: +49 (0) 6441 92460

China: 10800 650 0017

Hong Kong: (+65) 6756 2394

India, Australia, New Zealand: (+65) 6755 1939

Japan: (+81 3) 3335-8152(Domestic/International), or 0120-61-1280(Domestic Only)

Korea: (+65) 6755 1989

Singapore, Malaysia, Vietnam, Thailand,  
Philippines, Indonesia: (+65) 6755 2044

Taiwan: (+65) 6755 1843

Data subject to change.

Copyright © 2004 Agilent Technologies, Inc.

Obsoletes 5964-6424E

July 12, 2004

5988-2220EN