

# T-1 (3 mm) Diffused LED Lamps

## Technical Data

**HLMP-1301**  
**HLMP-1401**  
**HLMP-1503**  
**HLMP-K401**  
**HLMP-K600**

### Features

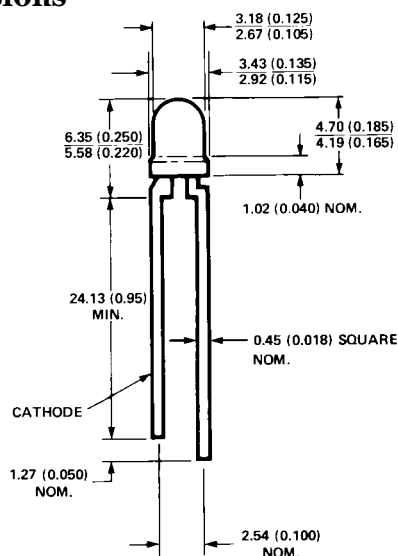
- **High Intensity**
- **Choice of 4 Bright Colors**  
 High Efficiency Red  
 Orange  
 Yellow  
 High Performance Green
- **Popular T-1 Diameter Package**
- **Selected Minimum Intensities**
- **Wide Viewing Angle**
- **General Purpose Leads**
- **Reliable and Rugged**
- **Available on Tape and Reel**

### Description

This family of T-1 lamps is widely used in general purpose indicator applications. Diffusants, tints, and optical design are balanced to yield superior light output and wide viewing angles. Several intensity choices are available in each color for increased design flexibility.



### Package Dimensions



NOTES:  
 1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).  
 2. AN EPOXY MENISCUS MAY EXTEND ABOUT 1mm (0.040") DOWN THE LEADS.

## Selection Guide

| Material     | Color                        | Part Number     | Luminous Intensity $I_v$ (mcd) at 10 mA |      |
|--------------|------------------------------|-----------------|---|------|
|              |                              |                 | Min.                                    | Max. |
| GaAsP on GaP | Red                          | HLMP-1301       | 3.4                                     | –    |
|              |                              | HLMP-1301-E00xx | 3.4                                     | –    |
|              |                              | HLMP-1301-FG0xx | 5.4                                     | 17.2 |
|              |                              | HLMP-1301-G00xx | 8.6                                     | –    |
|              |                              | HLMP-1301-GH0xx | 8.6                                     | 27.6 |
|              | Yellow                       | HLMP-1401       | 2.2                                     | –    |
|              |                              | HLMP-1401-D00xx | 3.6                                     | –    |
|              |                              | HLMP-1401-E00xx | 5.7                                     | –    |
|              |                              | HLMP-1401-EF0xx | 5.7                                     | 18.4 |
|              |                              | HLMP-1401-EFBxx | 5.7                                     | 18.4 |
|              | Orange                       | HLMP-K401       | 2.1                                     | –    |
|              |                              | HLMP-K401-E00xx | 3.4                                     | –    |
|              |                              | HLMP-K401-EF0xx | 3.4                                     | 10.8 |
|              |                              | HLMP-K401-FGDxx | 5.4                                     | 17.2 |
| GaP          | Green                        | HLMP-1503       | 1.0                                     | –    |
|              |                              | HLMP-1503-C00xx | 2.6                                     | –    |
|              |                              | HLMP-1503-D00xx | 4.2                                     | –    |
|              |                              | HLMP-1503-DE0xx | 4.2                                     | 13.4 |
|              |                              | HLMP-1503-DEDxx | 4.2                                     | 13.4 |
|              | Emerald Green <sup>[1]</sup> | HLMP-K600       | 1.0                                     | –    |

**Note:**

1. Please refer to Application Note 1061 for information comparing standard green and emerald green light output degradation.

## Part Numbering System

HLMP - x x xx - x x x xx

### Mechanical Option

00: Bulk  
 01: Tape & Reel, Crimped Leads  
 02, Bx: Tape & Reel, Straight Leads  
 A1: Right Angle Housing, Uneven Leads  
 A2: Right Angle Housing, Even Leads  
 Dx, EE: Ammo Pack, Straight Leads  
 R4: Tape & Reel, Counter Clockwise  
 Vx: Ammo Pack, Horizontal Leads  
 FG: Products need inventory control for Customer IDI

### Color Bin Options

0: Full Color Bin Distribution  
 B: Color Bins 2 & 3 only  
 D: Color Bins 4 & 5 only

### Maximum Iv Bin Options

0: Open (no max. limit)  
 Others: Please refer to the Iv Bin Table

### Minimum Iv Bin Options

Please refer to the Iv Bin Table

### Color Options

3: GaP HER  
 4: GaP Yellow (except K4xx Series)  
 5: GaP Green  
 6: GaP Emerald Green

### Package Options

1: T-1 (3 mm)  
 K: T-1 (3 mm) Orange (K4xx) or Emerald Green (K6xx)

### Absolute Maximum Ratings at $T_A = 25^\circ\text{C}$

| Parameter  | HER/Orange                         | Yellow      | Green       | Units            |
|--|------------------------------------|-------------|-------------|------------------|
| Peak Forward Current   | 90                                 | 60          | 90          | mA               |
| Average Forward Current <sup>[1]</sup>                                 | 25                                 | 20          | 25          | mA               |
| DC Current <sup>[2]</sup>  | 30                                 | 20          | 30          | mA               |
| Reverse Voltage ( $I_R = 100 \mu\text{A}$ )                            | 5                                  | 5           | 5           | V                |
| Transient Forward Current <sup>[4]</sup><br>(10 $\mu\text{sec}$ Pulse) | 500                                | 500         | 500         | mA               |
| LED Junction Temperature   | 110                                | 110         | 110         | $^\circ\text{C}$ |
| Operating Temperature Range  | -55 to +100                        | -55 to +100 | -20 to +100 | $^\circ\text{C}$ |
| Storage Temperature Range  |                                    |             | -55 to +100 |                  |
| Lead Soldering Temperature<br>[1.6 mm (0.063 in.) from body]           | 260 $^\circ\text{C}$ for 5 seconds |             |             |                  |

**Notes:**

1. See Figure 5 (HER/Orange), 10 (Yellow), or 15 (Green/Emerald Green) to establish pulsed operating conditions.
2. For Red, Orange, and Green series derate linearly from 50 $^\circ\text{C}$  at 0.5 mA/ $^\circ\text{C}$ . For Yellow series derate linearly from 50 $^\circ\text{C}$  at 0.2 mA/ $^\circ\text{C}$ .
3. For Red, Orange, and Green series derate power linearly from 25 $^\circ\text{C}$  at 1.8 mW/ $^\circ\text{C}$ . For Yellow series derate power linearly from 50 $^\circ\text{C}$  at 1.6 mW/ $^\circ\text{C}$ .
4. The transient peak current is the maximum non-recurring peak current that can be applied to the device without damaging the LED die and wirebond. It is not recommended that the device be operated at peak currents beyond the peak forward current listed in the Absolute Maximum Ratings.

### Electrical Characteristics at $T_A = 25^\circ\text{C}$

| Symbol                   | Description   | Device HLMP-  | Min.              | Typ.                            | Max.                     | Units                               | Test Conditions                    |
|--------------------------|---|---|-------------------|---------------------------------|--------------------------|-------------------------------------|------------------------------------|
| $2\theta^{1/2}$          | Included Angle Between Half Luminous Intensity Points | All   |                   | 60                              |                          | Deg.                                | $I_F = 10\text{ mA}$<br>See Note 1 |
| $\lambda_{\text{PEAK}}$  | Peak Wavelength                                       | High Efficiency Red<br>Orange<br>Yellow<br>Green<br>Emerald Green |                   | 635<br>600<br>583<br>565<br>558 |                          | nm                                  | Measurement at Peak                |
| $\lambda_d$              | Dominant Wavelength                                   | High Efficiency Red<br>Orange<br>Yellow<br>Green<br>Emerald Green |                   | 626<br>602<br>585<br>569<br>560 |                          | nm                                  | See Note 2                         |
| $\Delta\lambda_{1/2}$    | Spectral Line Halfwidth                               | High Efficiency Red<br>Yellow<br>Green<br>Emerald Green           |                   | 40<br>36<br>28<br>24            |                          | nm                                  |                                    |
| $\tau_s$                 | Speed of Response                                     | High Efficiency Red<br>Orange<br>Yellow<br>Green<br>Emerald Green |                   | 90<br>280<br>90<br>500<br>3100  |                          | ns                                  |                                    |
| C                        | Capacitance   | High Efficiency Red<br>Orange<br>Yellow<br>Green<br>Emerald Green |                   | 11<br>4<br>15<br>18<br>35       |                          | pF                                  | $V_F = 0;$<br>$f = 1\text{ MHz}$   |
| $R\theta_{\text{J-PIN}}$ | Thermal Resistance                                    | All   |                   | 290                             |                          | $^\circ\text{C/W}$                  | Junction to Cathode Lead           |
| $V_F$                    | Forward Voltage                                       | HER/Orange<br>Yellow<br>Green<br>Emerald Green                    | 1.5<br>1.5<br>1.5 | 1.9<br>2.0<br>2.1               | 2.4<br>2.4<br>2.7<br>2.7 | V                                   | $I_F = 10\text{ mA}$               |
| $V_R$                    | Reverse Breakdown Voltage                             | All   | 5.0               |                                 |                          | V                                   | $I_R = 100\text{ }\mu\text{A}$     |
| $\eta_V$                 | Luminous Efficacy                                     | High Efficiency Red<br>Orange<br>Yellow<br>Green<br>Emerald Green |                   | 145<br>380<br>500<br>595<br>655 |                          | $\frac{\text{lumens}}{\text{Watt}}$ | See Note 3                         |

#### Notes:

- $\theta^{1/2}$  is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
- The dominant wavelength,  $\lambda_d$ , is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
- Radiant intensity,  $I_e$ , in watts/steradian, may be found from the equation  $I_e = I_v/\eta_v$ , where  $I_v$  is the luminous intensity in candelas and  $\eta_v$  is the luminous efficacy in lumens/watt.

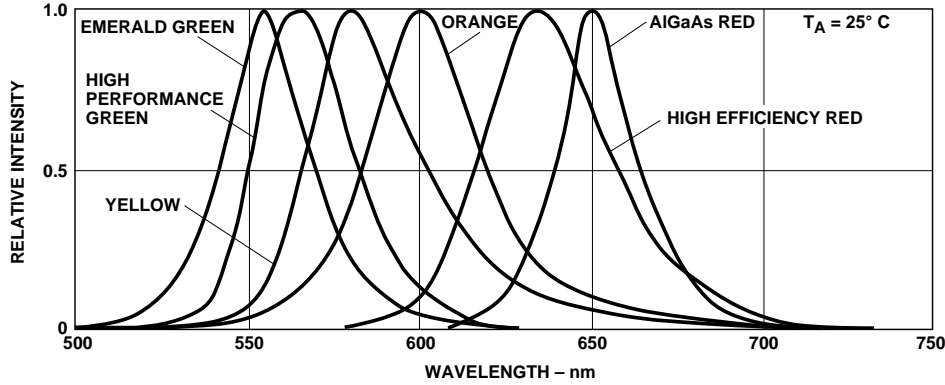


Figure 1. Relative Intensity vs. Wavelength.

### T-1 High Efficiency Red, Orange Diffused Lamps

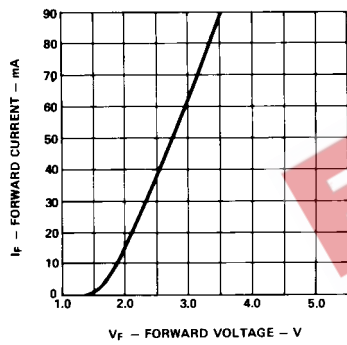


Figure 2. Forward Current vs. Forward Voltage Characteristics.

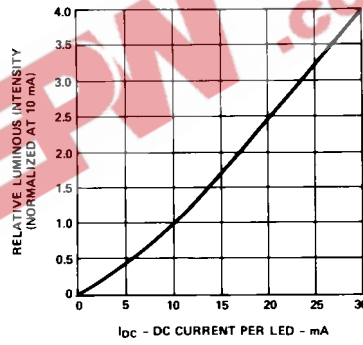


Figure 3. Relative Luminous Intensity vs. DC Forward Current.

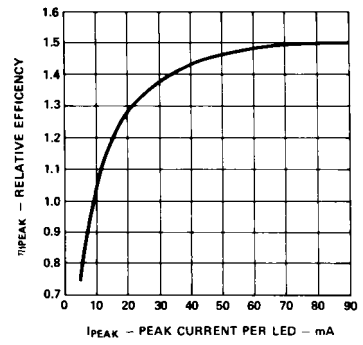


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak LED Current.

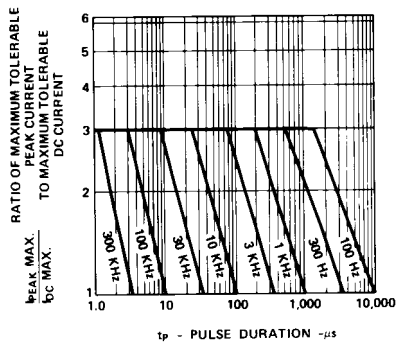


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. ( $I_{DC}$  MAX as per MAX Ratings).

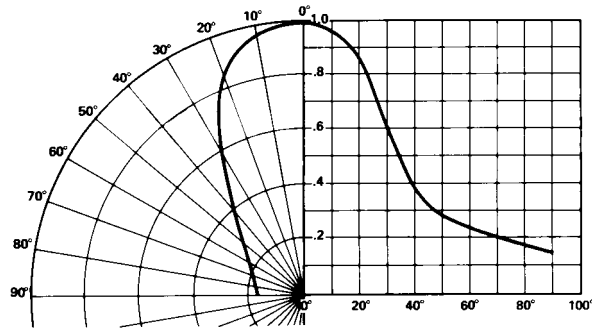


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

### T-1 Yellow Diffused Lamps

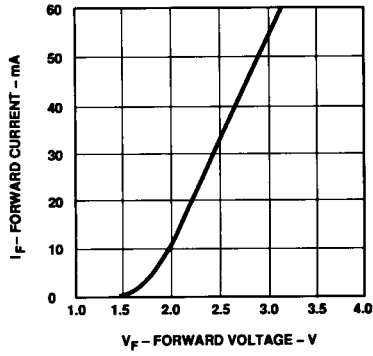


Figure 7. Forward Current vs. Forward Voltage Characteristics.

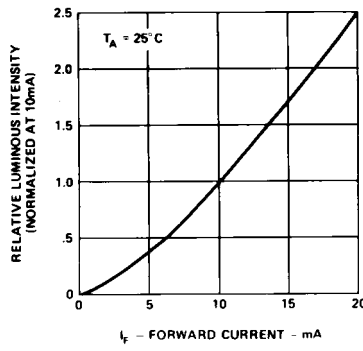


Figure 8. Relative Luminous Intensity vs. Forward Current.

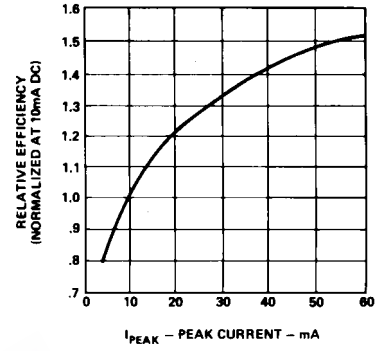


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

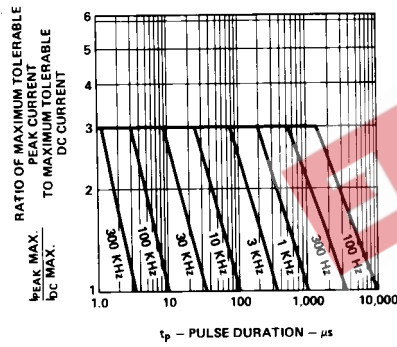


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. ( $I_{DC}$  MAX as per MAX Ratings).

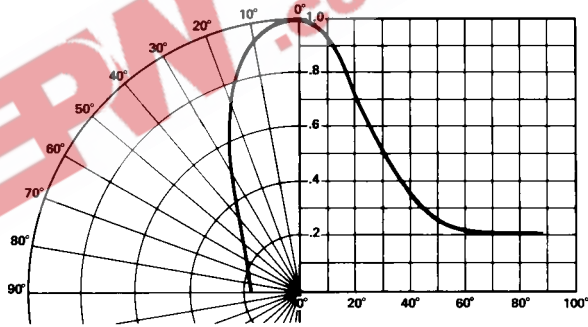


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

## T-1 Green/Emerald Green Diffused Lamps

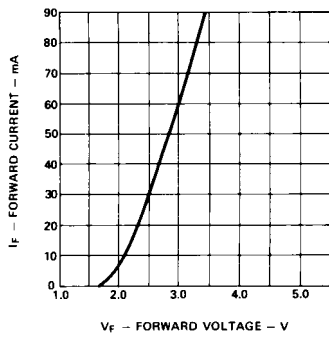


Figure 12. Forward Current vs. Forward Voltage Characteristics.

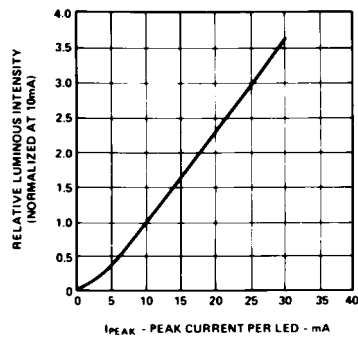


Figure 13. Relative Luminous Intensity vs. Forward Current.

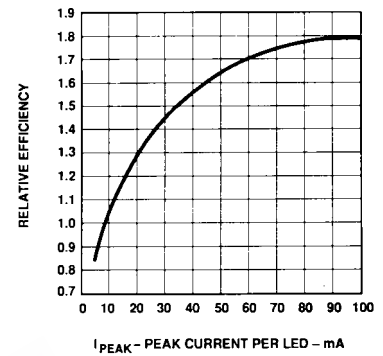


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak LED Current.

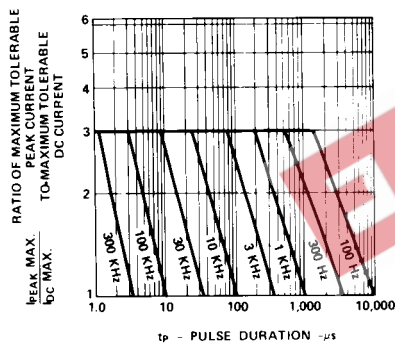


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. ( $I_{DC}$  MAX as per MAX Ratings).

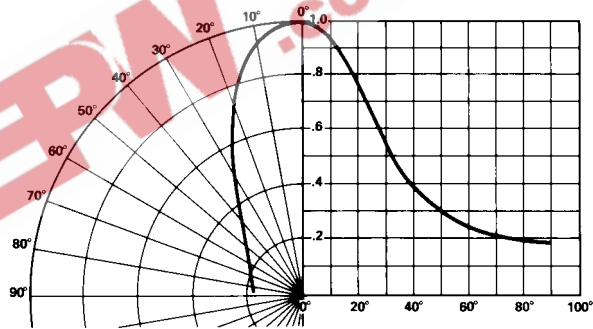


Figure 16. Relative Luminous Intensity vs. Angular Displacement.



**Intensity Bin Limits**

| Color      | Bin     | Intensity Range (mcd) |         |
|------------|---------|-----------------------|---------|
|            |         | Min.                  | Max.    |
| Red/Orange | D       | 2.4                   | 3.8     |
|            | E       | 3.8                   | 6.1     |
|            | F       | 6.1                   | 9.7     |
|            | G       | 9.7                   | 15.5    |
|            | H       | 15.5                  | 24.8    |
|            | I       | 24.8                  | 39.6    |
|            | J       | 39.6                  | 63.4    |
|            | K       | 63.4                  | 101.5   |
|            | L       | 101.5                 | 162.4   |
|            | M       | 162.4                 | 234.6   |
|            | N       | 234.6                 | 340.0   |
|            | O       | 340.0                 | 540.0   |
|            | P       | 540.0                 | 850.0   |
|            | Q       | 850.0                 | 1200.0  |
|            | R       | 1200.0                | 1700.0  |
|            | S       | 1700.0                | 2400.0  |
|            | T       | 2400.0                | 3400.0  |
|            | U       | 3400.0                | 4900.0  |
|            | V       | 4900.0                | 7100.0  |
|            | W       | 7100.0                | 10200.0 |
| X          | 10200.0 | 14800.0               |         |
| Y          | 14800.0 | 21400.0               |         |
| Z          | 21400.0 | 30900.0               |         |
| Yellow     | C       | 2.5                   | 4.0     |
|            | D       | 4.0                   | 6.5     |
|            | E       | 6.5                   | 10.3    |
|            | F       | 10.3                  | 16.6    |
|            | G       | 16.6                  | 26.5    |
|            | H       | 26.5                  | 42.3    |
|            | I       | 42.3                  | 67.7    |
|            | J       | 67.7                  | 108.2   |
|            | K       | 108.2                 | 173.2   |
|            | L       | 173.2                 | 250.0   |
|            | M       | 250.0                 | 360.0   |
|            | N       | 360.0                 | 510.0   |
|            | O       | 510.0                 | 800.0   |
|            | P       | 800.0                 | 1250.0  |
|            | Q       | 1250.0                | 1800.0  |
|            | R       | 1800.0                | 2900.0  |
|            | S       | 2900.0                | 4700.0  |
| T          | 4700.0  | 7200.0                |         |
| U          | 7200.0  | 11700.0               |         |
| V          | 11700.0 | 18000.0               |         |
| W          | 18000.0 | 27000.0               |         |

**Intensity Bin Limits, continued**

| Color                   | Bin     | Intensity Range (mcd) |        |
|-------------------------|---------|-----------------------|--------|
|                         |         | Min.                  | Max.   |
| Green/<br>Emerald Green | A       | 1.1                   | 1.8    |
|                         | B       | 1.8                   | 2.9    |
|                         | C       | 2.9                   | 4.7    |
|                         | D       | 4.7                   | 7.6    |
|                         | E       | 7.6                   | 12.0   |
|                         | F       | 12.0                  | 19.1   |
|                         | G       | 19.1                  | 30.7   |
|                         | H       | 30.7                  | 49.1   |
|                         | I       | 49.1                  | 78.5   |
|                         | J       | 78.5                  | 125.7  |
|                         | K       | 125.7                 | 201.1  |
|                         | L       | 201.1                 | 289.0  |
|                         | M       | 289.0                 | 417.0  |
|                         | N       | 417.0                 | 680.0  |
|                         | O       | 680.0                 | 1100.0 |
|                         | P       | 1100.0                | 1800.0 |
|                         | Q       | 1800.0                | 2700.0 |
|                         | R       | 2700.0                | 4300.0 |
| S                       | 4300.0  | 6800.0                |        |
| T                       | 6800.0  | 10800.0               |        |
| U                       | 10800.0 | 16000.0               |        |
| V                       | 16000.0 | 25000.0               |        |
| W                       | 25000.0 | 40000.0               |        |

Maximum tolerance for each bin limit is  $\pm 18\%$ .

### Color Categories

| Color         | Category # | Lambda (nm) |       |
|---------------|------------|-------------|-------|
|               |            | Min.        | Max.  |
| Emerald Green | 9          | 522.5       | 555.5 |
|               | 8          | 555.5       | 558.5 |
|               | 7          | 558.5       | 561.5 |
|               | 6          | 561.5       | 564.5 |
| Green         | 6          | 561.5       | 564.5 |
|               | 5          | 564.5       | 567.5 |
|               | 4          | 567.5       | 570.5 |
|               | 3          | 570.5       | 573.5 |
|               | 2          | 573.5       | 576.5 |
| Yellow        | 1          | 582.0       | 584.5 |
|               | 3          | 584.5       | 587.0 |
|               | 2          | 587.0       | 589.5 |
|               | 4          | 589.5       | 592.0 |
|               | 5          | 592.0       | 593.0 |
| Orange        | 1          | 597.0       | 599.5 |
|               | 2          | 599.5       | 602.0 |
|               | 3          | 602.0       | 604.5 |
|               | 4          | 604.5       | 607.5 |
|               | 5          | 607.5       | 610.5 |
|               | 6          | 610.5       | 613.5 |
|               | 7          | 613.5       | 616.5 |
|               | 8          | 616.5       | 619.5 |

Tolerance for each bin limit is  $\pm 0.5$  nm.

## Mechanical Option Matrix

| Mechanical Option Code | Definition  |
|------------------------|---|
| 00                     | Bulk Packaging, minimum increment 500 pcs/bag                                     |
| 01                     | Tape & Reel, crimped leads, minimum increment 1800 pcs/bag                        |
| 02                     | Tape & Reel, straight leads, minimum increment 1800 pcs/bag                       |
| A1                     | Right Angle Housing, uneven leads, minimum increment 500 pcs/bag                  |
| A2                     | Right Angle Housing, even leads, minimum increment 500 pcs/bag                    |
| BG                     | Tape & Reel, straight leads in 2K increment                                       |
| BJ                     | Tape & Reel, straight leads in 2K increment                                       |
| DD                     | Ammo Pack, straight leads in 2K increment   |
| DJ                     | Ammo Pack, straight leads in 2K increment   |
| EE                     | Ammo Pack, straight leads in 5K increment   |
| R4                     | Tape & Reel, straight leads, counter clockwise, anode lead leaving the reel first |
| VA                     | Ammo Pack, horizontal leads in 2K increment                                       |
| VB                     | Ammo Pack, horizontal leads in 2K increment                                       |
| FG                     | Inventory Control for Customer IDI  |

**Note:**

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